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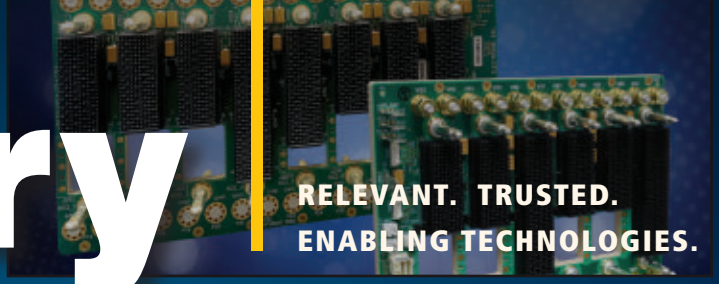

Electronics and sensors for hypersonic flight

Hypersonic weapons require resistance to heat and vibration, as well as small size, weight, and power consumption. **PAGE 14**

RF and microwave equipment

Latest SWaP-C and design trends in communications, electronic warfare (EW), and advanced test instruments under pressure to reduce size, weight, power consumption, and cost. **PAGE 22**

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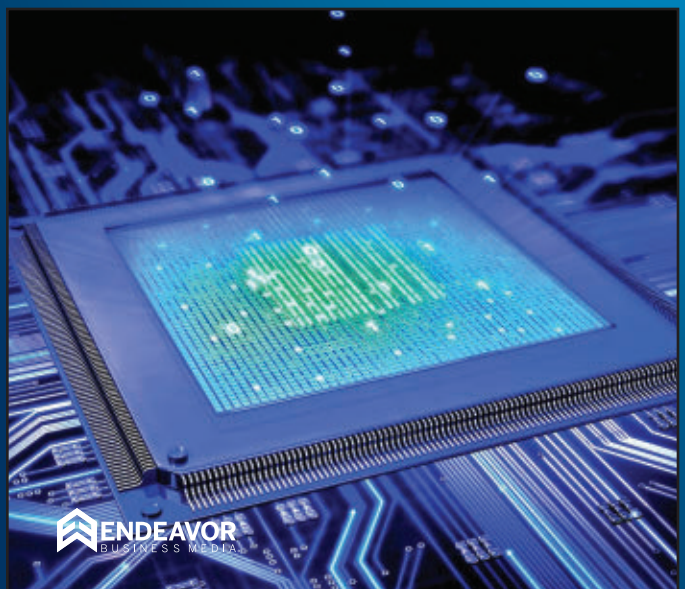

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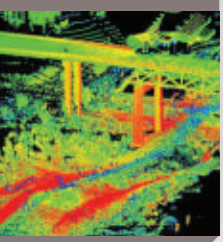

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BY **JOHN KELLER**, EDITOR IN CHIEF

The coming revolution in space-based sensors and fast 5G networking

Imagine a world surrounded by orbiting satellites equipped with fast communications payloads, multispectral surveillance sensors, and laser cross-links able to network information overhead and to any points on the Earth at the speed of light.

A 5G-like surveillance network like this could track hypersonic munitions and aircraft, detect and target relocatable military targets, warn of imminent improvised explosive device (IED) attacks, and, eventually perhaps, even track enemy submarines — all in real time.

Earlier this year the U.S. Space Force Space and Missile Systems Center at Los Angeles Air Force Base in El Segundo, Calif., sent out feelers to industry in a request for information for the 5G for Space Data Transport (SDT) project, which seeks to adapt 5G networking, RF and microwave access, mobility support, and related big-data functions to U.S. space systems.

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

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

Then last January the U.S. Missile Defense Agency (MDA) at Schriever Air Force Base, Colo., announced a $155 million contract to the Northrop Grumman Aeronautics Systems segment in Redondo Beach, Calif., for the Hypersonic and Ballistic Tracking Space Sensor (HBTSS) Phase IIA effort to develop a prototype satellite sensor to detect and track inbound enemy ballistic and hypersonic missiles.

HBTSS seeks to develop satellites for low-Earth orbit to provide global sensor coverage to detect, track, and target ballistic and hypersonic missiles. The system is to detect, track, and discriminate among missile targets, and ultimately fold into the planned sensor infrastructure of the Space Development Agency's (SDA) missile tracking layer, which will consist of hundreds of satellites in low Earth orbit that communicate with each other and work together to detect and track enemy weapons.

HBTSS satellites will have wide-field-of-view sensors networked together with optical inter-satellite cross-links to detect and track targets on land, at sea, in the air, and in space. The HBTSS will be one of dozens of satellites with medium-field-of-view sensors that will provide fire-control data to missile defense systems.

Combining wide- and medium-field-of-view sensors is necessary to track hypersonic missiles like the Russian Avangard and Chinese Starry Sky-2 hypersonic glide vehicles (HGVs).

Today's missile-defense systems are not able to track and kill hypersonic weapons, which are designed to outmaneuver contemporary detection systems through speed and hyper-maneuverability. In October 2019 MDA chose Northrop Grumman, Raytheon, Leidos, and L3Harris, each to design a prototype sensor payload. U.S. military commanders expect to launch the first HBTSS satellites in 2023.

Meanwhile, the Blackjack program of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., is continuing technology demonstrations and prototyping in an effort to orbit a constellation of small, secure, and affordable military satellites that capitalize on modern commercial satellite technologies with similar capabilities to today's military communications that operate at geosynchronous orbit (GEO), but at a fraction of the cost.

It won't be long before the vision of a space-based reconnaissance and networking system to provide persistent surveillance of the Earth's oceans, land masses, and surrounding airspace becomes a reality.

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Military researchers are investigating ways to improve atomic vapors for electric field sensing in airborne electronic warfare (EW) to naval anti-submarine warfare (ASW).

ColdQuanta eyes quantum applications in electronic warfare (EW), sensors, and ASW

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers needed enabling technologies to advance the performance of atomic vapors for electric field sensing in applications ranging from airborne electronic warfare (EW) to naval anti-submarine warfare (ASW). They found their solution from ColdQuanta Inc. in Boulder, Colo.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have announced a $3.6 million contract to ColdQuanta for the Science of Atomic Vapors for New Technologies (SAVaNT) project.

DARPA researchers are asking ColdQuanta scientists to develop high-performance atomic vapors for electric field sensing and imaging, magnetic field sensing, and quantum information science (QIS).

ColdQuanta specializes in commercializing quantum technology, and in developing technology for quantum applications, which rely on quantum physics for next-generation computing, sensors, cryptography, simulation, metrology, and imaging.

Atoms are constants of nature; they are not subject to manufacturing variabilities, defects, impurities, or aging, which makes them suitable for precision measurements, DARPA researchers explain.

One example involves atomic clocks, which are accurate to a fraction of a second over the age of the universe. Still, such high-precision quantum devices typically require laser-cooled and trapped atoms kept at microKelvin temperatures to mitigate thermal noise effects. This means laboratory-scale expansive setups.

Yet vapor-based technologies operate at or near room temperature without complex laser cooling and trapping, but still offer the advantages of the pristine nature of atoms.

The ability to manipulate atoms with light has advanced tremendously over the past couple of decades, and includes powerful quantum methods like electromagnetically induced transparency and spin exchange relaxation-free (SERF) magnetometry.

Scientists have used atomic vapors like Rydberg electrometry and SERF magnetometry for quantum information systems, and it may be possible to

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achieve additional significant breakthroughs in vapor-based devices.

For the DARPA SAVaNT program, ColdQuanta experts will investigate techniques to mitigate main decoherence mechanisms to realize the full potential of atomic vapor-based technologies. The program has three technical areas based on applications where atomic vapors should have the biggest benefit: Rydberg electrometry; vector magnetometry; and vapor quantum electrodynamics (VQED).

ColdQuanta will pursue new technologies for important military needs like low size, weight and power (SWaP); high-sensitivity electric and magnetic field measurements; and application that require scalable room-temperature quantum memories and interfaces. One challenge is to improve atomic coherence in vapors, and will depend on dominant decoherence mechanisms.

SAVaNT is a four-year program in two phases and three technical areas. The first phase focuses on demonstrating the physics of Rydberg electrometry; vector magnetometry; and vapor quantum electrodynamics.

The second phase will demonstrate an integrated benchtop physics package, and characterize technology tradeoffs of Rydberg electrometry; vector magnetometry; and vapor quantum electrodynamics.

Rydberg electrometry uses atoms to sense electric fields, and has notable advantages over antennas, such as extremely large operational bandwidth accessible with one device; potential for high sensitivity; and self-calibration. The focus is on improving sensitivity and instantaneous bandwidth.

Vapor magnetometers demonstrate one of the highest scalar magnetic field sensitivities of any device, yet it requires expansive magnetic shielding and complex active cancellation of ambient magnetic fields. The focus is on achieving vapor-based vector magnetometry of quasi-DC fields ranging from 100 Hz to 1 MHz with high sensitivity and accuracy.

Vapor quantum electrodynamics, meanwhile, seeks to demonstrate a room-temperature, vapor-based quantum electrodynamics platform in the strong-coupling regime. For more information contact ColdQuanta online at https://coldquanta.com, or DARPA at www.darpa.mil.

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Raytheon to build high-performance radar for THAAD missile-defense battery

Engineers at Raytheon Technologies Corp. will build an additional high-performance missile-defense radar system for the newest Terminal High Altitude Area Defense (THAAD) ballistic missile defense battery under terms of a $243.2 million order. Officials of the U.S. Missile Defense Agency at Redstone Arsenal in Huntsville, Ala., are asking the Raytheon Missiles & Defense segment in Woburn, Mass., to provide one Army/Navy Transportable Surveillance and Control Model 2 radars, better-known as the AN/TPY-2. The AN/TPY-2 radar is designed to detect, acquire, and track incoming ballistic missiles, and uses its powerful radar and complex computer algorithms to discriminate between incoming armed missiles and decoys. The radar will be for the eighth transportable THAAD missile battery, which could be moved quickly to global hot spots to defend against enemy ballistic missile threats. The AN/TPY-2 radar can be deployed in two different modes. In forward-based mode, the radar is based near hostile territory, and acquires ballistic missiles in boost phase, and then tracks and discriminates the threat. For more information contact Raytheon Missiles & Defense online at www.rtx.com/our-company/our-businesses/rmd, or the Missile Defense Agency at www.mda.mil.

Progeny Systems to upgrade submarine combat system for fast-attack boats

Undersea warfare experts at Progeny Systems Corp. in Manassas, Va. will continue building and upgrading an integrated system to help submarine crew members control submarine combat weapons such as torpedoes, missiles, mines, and unmanned underwater vehicles (UUVs). Officials of the Naval Sea Systems Command in Washington announced an $8.7 million order to Progeny for options to the Payload Control System (PCS) for technical insertion advanced processing builds. PCS is the software portion of the AN/BYG-1 submarine combat control system for all Navy submarines. The AN/BYG-1 is installed on the U.S. Navy Los Angeles-, Seawolf-, and Virginia-class fast-attack submarines, as

well as on Ohio-class cruise missile submarines and on Australian Collins-class attack submarines.

FCC prohibits high-power microwave weapons for counter-UAV uses because of RF interference or jamming

When Hawthorne, Calif.-based startup Epirus Inc. asked to test a new electronic weapon last winter to shoot down unmanned aerial vehicles (UAVs), the U.S. Federal Communications Commission (FCC) in Washington said no. Epirus officials filed an application with the FCC to test a high-power microwave device in the California desert east of Palm Springs, about three miles from a small airport and the busy I-10 interstate. The counter-UAV prototype would be operated intermittently with an effective radiated power of 270 megawatts — thousands of times higher than the strongest FM radio stations, and in the same ballpark as controversial experiments that produce artificial aurorae — and have a range of 300 meters. The FCC, however, did not let the experiment proceed.

Three companies to design space nuclear propulsion systems for space missions

The Pentagon's research and development arm awarded a trio of companies with contracts to build and demonstrate a nuclear-powered propulsion system on a spacecraft in orbit by 2025. General Atomics, Lockheed Martin, and Jeff Bezos's space venture Blue Origin won the Defense Advanced Research Projects Agency or DARPA awards, under the agency's Demonstration Rocket for Agile Cislunar Operations program, or DRACO. The goal of the program is to use a nuclear thermal propulsion system to power a spacecraft beyond low-Earth orbit. DARPA officials say a nuclear-powered spacecraft could achieve the high power of chemical propulsion system and the high efficiency of electric power. The contracts awarded to the companies are for the first 18-month phase of the program, with two tracks. In Track A, General Atomics will design a nuclear thermal reactor and propulsion subsystem concept. In Track B, Blue Origin and Lockheed Martin will develop spacecraft concept designs.

news

Air Force asks industry for next-generation cyber security

BY **John Keller**

ROME, N.Y. — U.S. Air Force researchers are asking industry to develop next-generation cyber security enabling technologies to safeguard warfighting capabilities in the air, in space, and in military computers and networking.

Officials of the Air Force Research Laboratory Information Directorate in Rome, N.Y., issued a broad agency announcement in late March (FA8750-21-S-7001) for the potential $975 million five-year Capabilities for Cyber Advancement project.

This project not only aims at developing next-generation offensive and defensive cyber warfare capabilities, but also to integrate technologies into military programs that involve air and space superiority; intelligence, surveillance, and reconnaissance; rapid global mobility; global strike; and command and control.

Trusted computers for warfighting that are secure against cyber-attacks are necessary for complex, high-level military operations that achieve global situational awareness, Air Force researchers explain. Cyber security technologies must be immune to threats and have an autonomous ability to modify themselves to avoid unforeseen attacks and emerging threats.

Researchers are interested in cyber technologies that meet attacks by enabling critical technologies to survive the attack by re-provisioning resources as necessary. These cyber defenses should be able to respond to cyber-attacks automatically by restoring, repairing, or re-provisioning critical computing and networking resources.

Air Force researchers are most interested in:

- cloud architectures;
- code analysis and evaluation;
- cyber modeling and simulation;
- decision support for cyber missions;
- design frameworks;
- evaluation and measurement techniques;
- formal methods;
- mobile and embedded device security;
- means for recovery from attack;

- methods for non-traditional cyber security;
- methods for data security in untrusted environments;
- protocol development and analysis;
- risk management approaches;
- secure processors;
- secure development tools and techniques;
- standards for information exchange;
- trusted hardware and software;
- virtualization; and
- zero trust computing.

These cyber security technologies should apply to military programs of record with cyber components or dependence; shared, commercial, private, and government computer clouds; embedded devices and firmware; mobile and Bring-Your-Own devices; automation systems; tactical systems; and wired and wireless networks at the enterprise and tactical levels.

Air Force researchers also are interested in defensive cyber technologies to strengthen military computers and networking, and that defend against enemy cyber-attack technologies.

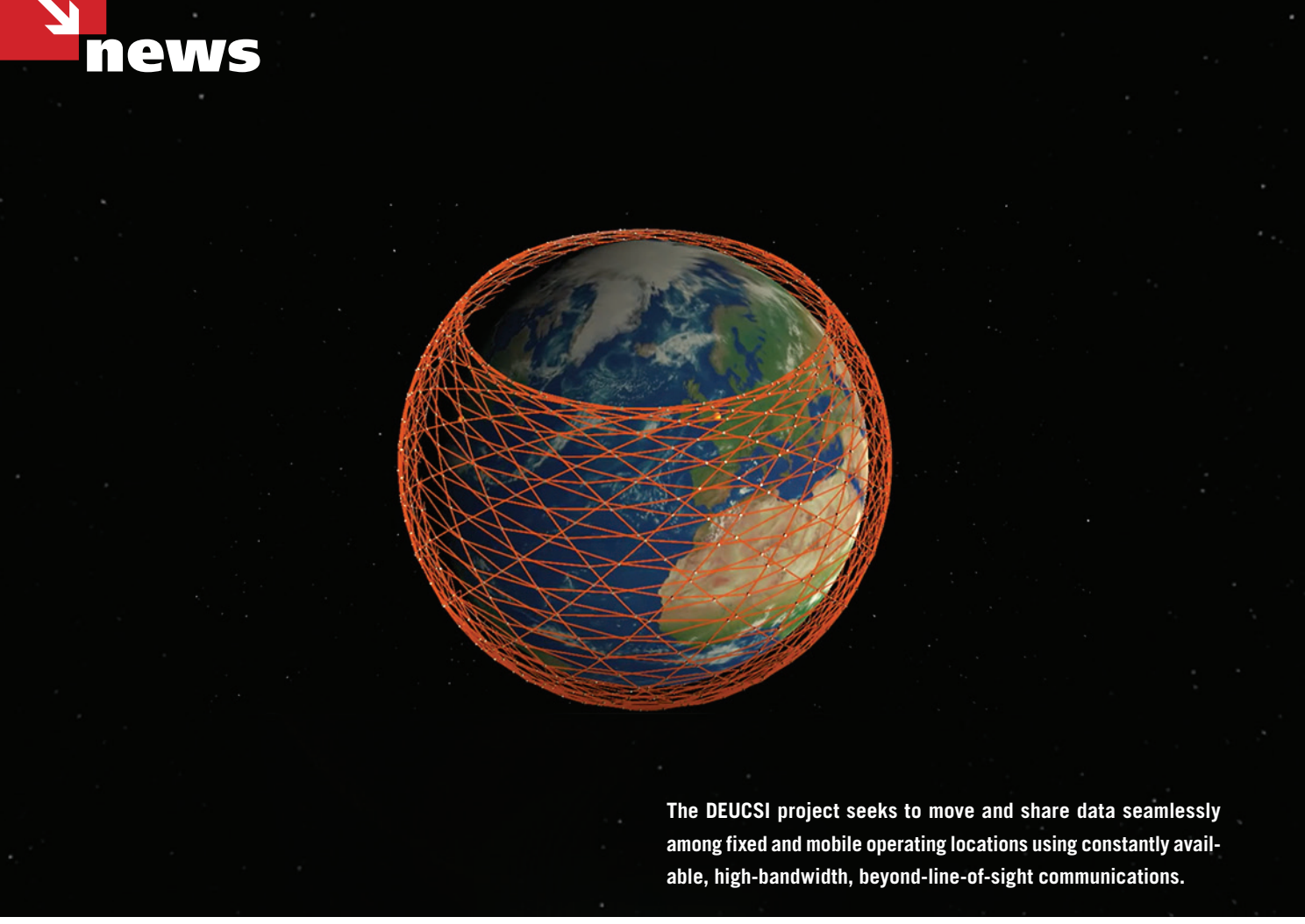
Several contractors most likely will be involved in this project, and Individual awards will last for five years and range in value from $100,000 to $99 million.

For now, Air Force researchers are asking industry for four-to-five-page white papers. Those submitting promising papers may be invited to submit full proposals. No foreign entities are allowed to participate.

Companies interested should email questions and four-to-five-page white papers to the Air Force's Walter Karas at afrl.riga.baa@us.af.mil. Bidding will close on 30 Sept. 2025.

U.S. Air Force trusted computing experts are asking industry to develop the next generation of cyber security tools and software.

Email contracting questions to the Air Force's Amber Buckley at Amber.Buckley@us.af.mil. More information is online at https://beta.sam.gov/opp/8c7a6a1136ac435b-983929b56a2929cb/view.



The DEUCSI project seeks to move and share data seamlessly among fixed and mobile operating locations using constantly available, high-bandwidth, beyond-line-of-sight communications.

Lockheed Martin joins military internet space project to speed communications

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — Space communications experts at Lockheed Martin Corp. are joining a U.S. Air Force research project to find new ways to distribute information among land, sea, and air forces quickly to support high-speed decision-making.

Officials of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, have announced a $12.8 million order to the Lockheed Martin Aeronautics segment in Fort Worth, Texas, for the Defense Experimentation Using the Commercial Space Internet (DEUCSI) program.

Lockheed Martin joins Ball Aerospace & Technologies Corp. in Boulder, Colo.; L3Harris Technologies Communication Systems-West in Salt Lake City; the Raytheon Technologies Corp. Intelligence & Space segment in McKinney, Texas; and the Northrop Grumman Information Technology Enterprise Solutions — 3 Services (ITES-3S) segment in Herndon, Va., for the DEUCSI Call 002 effort. Raytheon won its DEUCSI contract in September 2020, and L3Harris and Northrop Grumman won their contracts in December 2019.

This project seeks the ability to move and share data seamlessly among a wide variety of fixed and mobile operating locations using constantly available, high-bandwidth, beyond-line-of-sight communications.

Lockheed Martin will integrate hardware and software, conduct additional test flights, and identifies the F-35 joint strike fighter aircraft as the required aircraft for the first flight test.

DEUCSI space-based capability will be called path-agnostic communications because its users will be able to

communicate reliably to any location in the world without explicitly specifying which nodes of a communication network to use.

Lockheed Martin, Ball Aerospace, L3Harris, Raytheon, and Northrop Grumman will seek to establish the ability to communicate with Air Force and other military platforms via several different commercial space internet constellations using common user terminal hardware elements.

The vision for path-agnostic communications is becoming possible due to the burgeoning commercial space internet, Air Force officials say. Several commercial companies plan to establish space internet constellations consisting of hundreds to thousands of satellites, each to create global internet services.

The DEUCSI program seeks to establish resilient, high-bandwidth, high-availability Air Force communications and data sharing capabilities by leveraging developing commercial space internet networks. This approach differs radically from traditional military satellite communications programs in which the government typically specifies and funds every aspect of the program, Air Force researchers point out.

Instead, taking advantage of the commercial space internet will concentrate government efforts on the few areas that are unique to Air Force applications.

The project has three phases: establish connectivity between several Air Force sites using commercial demonstration satellites and terminals; expand connectivity to many Air Force assets by proliferating user terminals to several locations and vehicle types; and special experiments to address military-unique requirements not otherwise met by commercial space internet vendors.

For more information contact Lockheed Martin Aeronautics online at www.lockheedmartin.com; Raytheon Intelligence & Space at www.rtx.com; Ball Aerospace at www.ball.com/aerospace; L3Harris Communications Systems-West online at www.l3harris.com; Northrop Grumman ITES-3S at www.northropgrumman.com/information-technology-enterprise-solutions-3-services-ites-3s; or the Air Force Research Laboratory at www.afrl.af.mil.

An Air Force technician uses a Ludwieg tube wind tunnel to measure the pressures, temperatures and flow fields of basic geometric and hypersonic research vehicles. Air Force photo.

Meeting SWaP needs for electronics and sensors for hypersonic flight

Providing electronic components for hypersonic weapons requires resistance to heat and vibration, as well as small size, weight, and power consumption.

BY **Megan Crouse**

It's hard to stop something moving at Mach 5, to say the least. Electronics packages for hypersonic vehicles need to stand up to extraordinary speed, temperature, and pressure. With today's hypersonic weapons engineered with throttleable rocket engines for mid-range attack or defense against other missiles or the ships that carry them, even more challenges come along for the flight. The story behind making reliable electronics for these conditions stretches from the 1940s to today's defense projects.

Hypersonic flight technically occurs between Mach 5 and Mach 10 — greater than the speed of sound. At these speeds the molecular bonds of the air must be considered in engineering, as they can change the magnitude of the forces the air exerts on the vehicle. At higher speeds, an electronically charged plasma forms around the vehicle. Manned vehicles also have traveled at these speeds: experimental aircraft such as NASA's X-43 in the 2000s or the Lockheed X-17, as well as the Space Shuttle orbiter.

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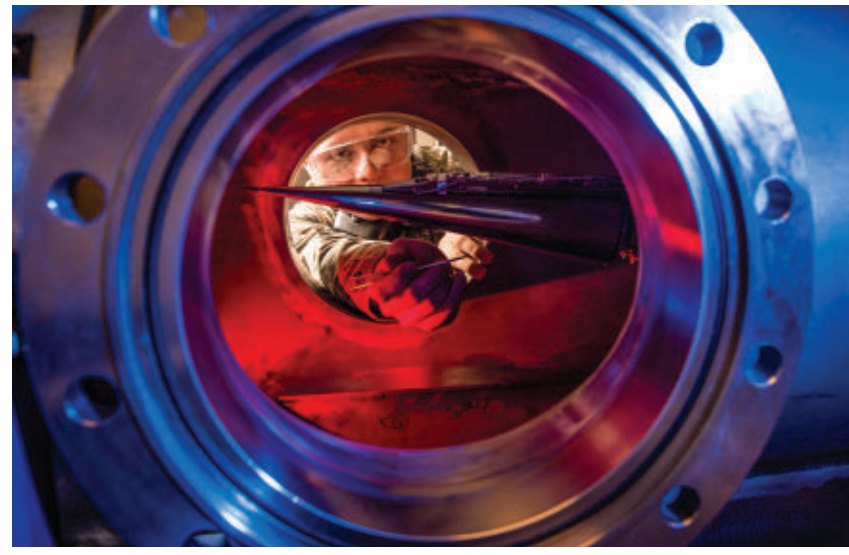
Occasionally you might see a report of a proposed hypersonic passenger flight that could bring people from Los Angeles to Tokyo in two hours. For now, the most urgent area of development for this technology has been defense, specifically missiles and warheads. But NASA researchers also are working on commercial aircraft at these speeds, as they have off and on since the X-15 in 1967.

"High-speed flight represents the next frontier in commercial passenger travel and has the potential to radically impact how people interact," Chuck Leonard, project manager of NASA's Hypersonic Technology Project, said in March 2021 in reference to a collaboration on hypersonic plane concepts with aerospace company Hermeus.



This illustration represents the extremes in heat, shock, and vibration of low-orbit hypersonic flight. Lockheed Martin Photo

Today's defense applications

Today's global powers continue their race to the fastest-responding missiles. In 2019, Popular Mechanics predicted that Russia would be the first global power with hypersonic weapons. Designed to attack ocean or land targets, hypersonic missiles would make payloads — including nuclear weapons — very difficult to intercept. The Russian navy tested the 3M22 Zircon — a scramjet cruise missile which can travel at Mach 8 or 9 — starting in 2020 and reported a successful launch in the White Sea and Barents Sea in October.

The DARPA Falcon Hypersonic Test Vehicle emerges from its rocket nose cone and prepares to re-enter the Earth's atmosphere.

This is another weapon in Russia's suite of hypersonic missiles, after the Kinzhal and Avangard glide vehicle, which can reach speeds as fast as Mach 27. Like other hypersonic weapons, the main tactical advantage to deploying or countering these is their ability to maneuver in low altitudes at very high speeds.

China allegedly has two hypersonic-capable missiles: the medium-range DF-17 hypersonic glide vehicle, which debuted in a military parade in Beijing in 2019, and the experimental Starry Sky-2 aircraft. The DF-17 appears to be road-mobile, which presents a problem for targeting these systems prior to launch.

A March 2020 Beijing Institute of Technology paper proposed that the next escalation in this area might be "hypersonic swarms," or drone vehicles that fly in hypersonic packs. This runs into the problems of enabling hypersonic to communicate, so the paper focuses on getting the proposed drones to talk to each other over a novel mobile wireless network. While this seems to

be confined to academic halls for now, the idea of many small vehicles instead of one large one may be an area to watch for.

To reply to a threat like that, the opposition needs equally fast technology, as well as hair-trigger, high-altitude radar. For example, L3Harris is working on a $121 million U.S. Missile Defense Agency contract for hypersonic and ballistic tracking from space. It will demonstrate the company's solution for the Hypersonic and Ballistic Tracking Space Sensor (HBTSS) program, which provides eyes in the sky — specifically, infrared sensors and advanced processing capability for low-Earth orbit space architecture for missile warning and defense.

Throttleable rockets also come into play here, as they enable greater maneuverability when it comes to responding to variable-range threats like other highly-maneuverable hypersonic missiles and the ships that launch them. In particular, the U.S. Navy is calling for missiles that can launch attacks around the world in less than an hour, including other hypersonic weapons and the ships from which they would be launched. The Navy issued a sources-sought notice for the Navy Conventional Prompt Strike Weapon System Platform-Specific Development and Production project in March 2021 to integrate hypersonic weapons on three stealthy Zumwalt-class destroyer surface warships.

In addition, in June 2019, the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a solicitation for the Operational Fires (OpFires) Integrated Weapon System project. The finished product would need to "penetrate modern enemy air defenses and rapidly engage time-sensitive targets," including incoming missiles. This gives them the ability to defend quickly in a rapidly changing mission, such as an incoming strike from a mobile nuclear missile. The contract was offered to Lockheed Martin, which began work on it in early 2020.

This is just one of a suite of hypersonic weapons the U.S. is working on for different capabilities and use cases. The U.S. Air Force is working with DARPA on a Hypersonic Air-breathing Weapon Concept

The Lockheed Martin AGM-183 Air-Launched Rapid Response Weapon (ARRW) is an experimental U.S. Air Force hypersonic weapon that uses a boost glide vehicle propelled to a maximum speed of Mach 20.

hypersonic missile, or HAWC — although this may be too large to mount on an aircraft carrier elevator. Another hypersonic project called Screaming Arrow called for a scramjet vehicle launched with a rocket engine first before the scramjet takes over at hypersonic speeds.

At the same time, Lockheed Martin is working on the AGM-183A Advanced Rapid Response Weapon (ARRW), designed to travel at speeds to Mach 20, truly competitive among today's designs, and a Hypersonic Conventional Strike Weapon (HCSW). At time of writing the AGM-183A appeared to be gearing up for its first test flight on the West Coast, according to Federal Aviation Administration alerts reported by The Drive.

The rise and fall of Screaming Arrow

In the U.S., the most recent high-profile project in this area is the Office of Naval Research's Screaming Arrow. A hypersonic anti-ship missile, a solicitation notice in March 2020 called for an air-breathing scramjet-powered, weapon to mount aboard a F/A 18 E/F Super Hornet multirole fighter jet. Documentation from the Department for Aviation, Force Projection and Integrated Defense asked for proposals, but as of March 5, 2021 the solicitation was cancelled.

That doesn't mean the entire project was cancelled — it also might have been moved to a higher classification. The project covered the gamut of the weapon's capabilities, from launch to impact.

As defense technology filters down into industry, so too does industry work on finding the answer to military size, weight, and power (SWaP) needs.

SWaP considerations

At hypersonic speeds, systems designers must consider vibration, pressure, and temperature carefully. "They want to be sure you're not drawing a lot of power out of that battery or requiring a lot of weight," says Patrick Quinn, senior product line manager for data acquisition at Curtiss-Wright Corp. based in Davidson, N.C. Customers are asking for low power consumption from data acquisition products, which can be achieved by making sure it's possible to turn off channels that aren't being used and other established methods.

"For hypersonic missiles, electronics SWaP are critical parameters," said Emil Kheyfets, director of military and aerospace products and director of engineering for Aitech Defense Systems in Chatsworth, Calif.. "Electronics need to be small, light and low power to minimize the amount of energy required to achieve and to maintain hypersonic speed.

"Besides SWaP, other high-altitude operating conditions should be taken into consideration, like cold start temperatures (well below typical -40 degrees C) and Single Event Effect (SEE) mitigation techniques for active components," Kheyfets says."

In regards to temperature, Curtiss-Wright's Quinn compares the altitude at which hypersonic vehicles fly to conditions on board a commercial airplane. "There's not a lot of windows you can open up in an airplane to breathe. We have to be able to fly in an almost airless environment, which means … we rely on transporting our heat off into a shroud or another part of the vehicle."

Hypersonic weapons must endure heat similar to that of spacecraft re-entering the Earth's atmosphere.

This is not particular to hypersonic flight, but is one of numerous known aerospace considerations.

Quinn also noted that the data acquisition electronics he works with are conduction cooled, with other aspects of the design channeling heat away from circuit boards. Liquid cooling may be useful for other applications, depending on need.

"One thing I've noticed from hypersonics that we don't see from other customers is the type of sensors they use — a lot of heat flux sensors," Quinn says.

As well as extreme thermal, mechanical, and chemical environments, the equipment needs to stand up to shock waves. With those come scalding heat, which furthermore can lead to chemical reactions such as ionizing molecules — a factor in radio blackouts. Curtiss-Wright Defense Solutions details some of these challenges in the white paper "Flight Test Instrumentation Solutions for Hypersonic Vehicles."

All of that can cause major problems when it comes to sensors and data collection and retrieval. DARPA created the High Enthalpy Aperture Technology (HEAT) program to focus on the challenges facing RF and infrared apertures on hypersonic missiles and aircraft. Three companies — the General Electric GE Global Research Division in Niskayuna, N.Y.; the Lockheed Martin Corp. Missiles and Fire Control segment in Orlando, Fla.; and the Georgia Tech Research Corp. in Atlanta — won contracts to develop materials to shield sensors from heat and vibration.

Their work will involve developing integrated RF aperture materials, infrared aperture materials, and next-generation aperture materials, including rugged RF radomes and infrared windows. They'll look into "affordable and manufacturable means of controlling thermo-optical and elastic-optical effects; maintaining desired transmission amplitude and bandwidth; and reducing thermal deformation, mismatch, and radiation."

When it comes to communications and flight recording, the risk of data loss is high because of telemetry dropout problems that develop at these speeds, according to a February 2021 Curtiss-Wright case study about a hypersonic test bed.

That case included "the need to withstand more severe shock, vibration, and temperatures that equipment onboard a hypersonic vehicle would encounter compared to that experienced on a large aircraft. There was also a need to cope with the conditions found at altitudes above 100,000 feet."

These components might be custom-built for use in harsh environments, or ruggedized commercial off-the-shelf products adapted to harsh environments. Industry standards like the Cisco IE standards, VITA standards, and many others, provide a baseline for performance in harsh environments. Common military flight test standards include TmNS and IRIG 106, with some overlap between them.

Another major factor in the Curtiss-Wright project was expense. To improve efficiency and reliability, Curtiss-Wright engineers doubled-up on several components. Data recorders gathered information once in real-time, and then again a short time later to double-check on details.

Due to the anticipated need for these to operate at extreme altitudes, variants were optimized for such conditions by removing certain types of capacitors. This helps ensure that the flight test team could monitor the subset of the data being telemetered to ground in real-time while conducting more detailed analysis at a later date on the more complete data set that was recorded onboard in two locations," wrote the authors, Curtiss-Wright's Paul Cook; Quinn; and Stephen Willis.

A brief history of hypersonic flight

Curtiss-Wright experts also knew to draw from components that had already been tested in the environment conditions they would face — in this case, their own data acquisition units. Some of this type of equipment has been around for decades. After all, hypersonic flight was first achieved in 1949.

At that time, the first man-made object to travel at these speeds was a multi-stage missile. The WAC Corporal rocket, mounted on top of a German V-2 rocket, reached five times the speed of sound. Not long before that, legendary American test pilot Chuck Yeager had become the first person to break the sound barrier, piloting a Bell X-1 rocket plane in the fall of 1947.

While hypersonic flight may sound exotic, Curtiss-Wright's Cook and Quinn say that some of the electronics packaging hardware on the inside is fairly traditional, even though the size on the outside has changed as vehicles become smaller in diameter. While there are few constraints on hardware, that's not the case for power consumption; flight time makes power draw on the battery variable.

That small size does mean companies are drawing from commercial technology makers, who have had plenty of practice over the last decade shrinking the size of electronics components.

"All the vehicles are smaller in diameter, which drives: How do we make things smaller?" Curtiss-Wright's Cook points out. "We all have cell phones. It took the commercial industry all that money to make them smaller, to make chips to make the boards smaller, the subsystems are much smaller. We're using the commercial technology — which has gotten very small because of the cell phone industry — in our military application to make our hardware smaller and the vehicles smaller. Everyone benefits from that. That is the trend today."

Today and into the future

Since those first flights, understanding of the conditions beyond Mach 5 has improved. there is no dramatic visible change in the color of the air or a sound effect between Mach 4.99 and 5.01, as there is with a sonic boom at Mach 1, point out experts at the Smithsonian National Air and Space Museum in Washington. Instead, the important factor is the intensity of the physical phenomenon experienced at speeds beyond Mach 5.

Ruggedizing components sufficiently to operate through these speeds could include changing their internal heating and dissipating heat,

WHO'S WHO IN COMPONENTS FOR HYPERSONIC FLIGHT

Aitech
Chatsworth, Calif.
https://aitechsystems.com

Curtiss-Wright Corp.
Davidson, N.C.
https://curtisswright.com

General Electric GE Global Research Division
Niskayuna, N.Y.
www.ge.com/research/research-engine/rd-facilities/niskayuna

Georgia Tech Research Corp.
Atlanta
https://gtrc.gatech.edu

Hermeus Corp.
Atlanta
www.hermeus.com

L3Harris Technologies Inc.
Melbourne, Fla.
www.l3harris.com

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

which can be difficult. Testing a vehicle or weapon expected to travel at hypersonic speeds can be difficult and expensive. In a white paper on flight test instrumentation for hypersonic vehicles, the Curtiss-Wright authors note that "If the acquisition chassis malfunctions during flight, then the test points will need to be re-flown. This incurs a large expense, especially if the test article is unrecoverable, as is often the case for ordnance testing."

Data security

Another major factor with military equipment is data security. If a vehicle is intercepted or lost, the rugged or ruggedized sensors must not sacrifice data security for the sake of their unique application. The National Institute of Standards and Technology (NIST) provides certifications for encryption for protecting streaming telemetry data in cases like this. Other specific considerations must be taken when a vehicle is flying outside of the U.S.

"Adversaries may try to intercept things during test flights," points out Curtiss-Wright's Cook. "It's all Ethernet based, and we are always going to have some kind of security risk."

What's next? Cook says he expects requirements to involve very low current draws. An upcoming challenge might be changing how to test for these vehicles and components. At the same time, software is getting better and easier to analyze much earlier in the design process, saving time and money. "When we do an analysis of the design they can do a fix much earlier in the development … instead of finding out later after the board has burnt up that they have a problem," Cook says.

Flight testing, however, is another matter. "The ultimate is how do you demonstrate a vehicle that flies that fast and that far in the Earth today," Cook says. "We do all our flight tests in the U.S., and they may fly over the Pacific Ocean over U.S.-owned property. To be able to demonstrate a vehicle that flies around the world and gets there in 30 minutes, that's a bigger challenge for the hypersonic industry. Being able to schedule what countries you are flying through to be able to demonstrate that vehicle is probably much more difficult than it is to design the vehicle to do that."

Putting the squeeze on RF and microwave gear

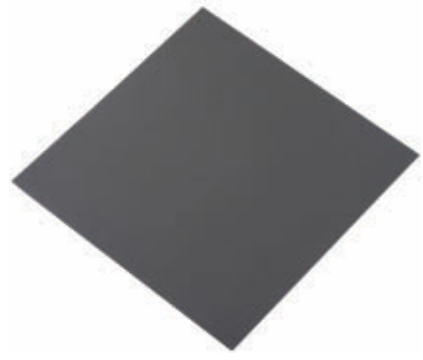
Systems designers of communications, electronic warfare (EW), and advanced test instruments under pressure to reduce size, weight, power consumption, and cost.

BY **Jamie Whitney**

Radio frequency (RF) and microwave technologies for military and aerospace applications like communications, surveillance, and sensors are being asked to do more in an increasingly cluttered spectrum while end-users ask for smaller size, weight, power consumption, and cost (SWaP-C), as well as the ability to perform in harsh environments.

Not only that, but the military's desire for open-architecture, vendor-neutral systems like the Sensor Open Systems Architecture (SOSA) standard are driving trends in the RF and microwave applications, points out Rodger Hosking, vice president of embedded computing and signals intelligence expert Pentek Inc. in Upper Saddle River, N.J.

"Shrinking dimensions of new RF and microwave components and the advent of system-on-chip acquisition and FPGA [field-programmable gate array] devices like RFSoC support small-form-factor subsystems for radar, countermeasures, and communications," Hosking says. "Since many of these use phased-array antennas, signal channel counts are increasing, thus favoring simpler and shorter connections within the housings. The strong open-architecture directives from the DOD [the U.S. Department of Defense] to spur vendor interoperability, lower acquisition costs, and shorter cycles for new technology insertion led directly to the SOSA initiative."



Laird's new RF-LW series of absorbers have higher permeability and permittivity than standard magnetic fillers.

The Open Group, which oversees SOSA standards, comprises more than 750 companies worldwide. SOSA aims to reduce time, risk, and costs for development cycles, systems integration, sustainment, and modernization. In addition, the group aims to increase commonality and reuse, support incremental improvements, mitigate obsolescence, and isolate the effects of change.

Software and FPGA IP development tools are becoming more critical in system design efforts," Hosking says. "Vendors who provide a high initial level of basic functionality for system interfaces, signal acquisition and generation, timing, and data formatting, along with the tools to customize the products for specific applications, offer significant advantages to mil-aero system integrators."

Focus on 5G

Fifth-generation cellular telecommunications technology — better known as 5G — is influencing not only consumer devices but also how the military is fashioning data transfer and communications systems. The military, for example, could use 5G technology to improve intelligence, surveillance, and reconnaissance (ISR) systems, command and control, and signal processing.

Military experts will be able to use three segments of the electromagnetic (EM) spectrum, including low band frequencies lower that 1 GHz; mid band, which operates between 1 and 6 GHz; and high band, which operates between 24 and 300 GHz.

Currently, consumer 5G devices operate at 6 GHz and below. High band, also known as millimeter wave, allows for much faster data transfer rates, but requires for a clear area between devices and the tower as buildings or even rain can absorb or disrupt the signal.

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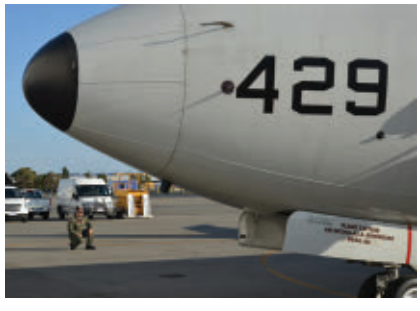
Pentek's model 6353 is an 8-channel RFSoC transceiver subsystem, housed in a small rugged chassis with 5 GS/sec A/D converters and 10 GS/sec D/A converters.

"Certainly, the electronic device development to support 5G as well as the upcoming 6G has also positively impacted the RF and microwave with smaller, higher-frequency, more efficient devices," says Paul Cook, director of missile systems and product line manager at Curtiss-Wright Defense Solutions in Ashburn, Va. "The 5G network is in review to be used instead of our traditional means of transmitting data but not all of the feasibility studies provide a positive solution to replace our current transmission solutions."

The military also has unique wireless communications needs at the leading edge of the battlefield. While commercial telecommunications companies can put up towers in static urban, suburban, and rural environments, the constantly changing nature of the battlefield coupled with the constant threat of enemies trying to jam signals, adds significant difficulty.

"The 5G promise of seamless connectivity of wideband digital wireless service to any customer in any location satisfies a critical objective for military warfighters during an operation," says Pentek's Hosking. "Harnessing 5G technology by adding security encryption and distributing portable microcells in a combat zone is extremely attractive to defense organizations."



A U.S. Navy electronic warfare operator watches the exterior of a P-8A Poseidon maritime patrol aircraft during a high-frequency radio check before a mission.

Testing 5G compliance

This spring, Anritsu Co. in Allen, Texas, introduced the ME7803NR RF regulatory test and measurement system for regulatory compliance testing of 5G wireless communications systems.

The ME7803NR conducts ARIB/ETSI/FCC-compliant frequency range (FR) 1 RF tests on 5G New Radio (NR) UE. It supports certified North American, European, and Asian bands, as well as emerging regional bands planned for deployment, including 5G NR bands and 5G Non-Standalone (NSA) mode LTE bands used as LTE anchors.

At the core of the ME7803NR is the radio communications test station MT8000A, which simulates a 5G NR base station. The system also integrates the MT8821C radio communication analyzer operating as an LTE anchor, as well as a combination of the MS2840A/MS2850A spectrum analyzers/signal analyzers, MG3710E vector signal generator, and mg3694c signal generator.

The system makes its measurements using 5G NR NSA mode call connections. Additionally, it can test for spurious and interference, which fills a test void for many companies. A built-in calibration function changes the connection configuration, for improved measurement stability and measured value reliability.

Measurement efficiency and quality of 5G terminals come from the easy-to-operate GUI. In addition to evaluating RF performance of 5G UE to ensure they comply with leading regulatory requirements, the ME7803NR easily determines if radio waves are being used efficiently.

RF and microwave applications

Curtiss-Wright's Cook says that systems designers are looking for 5G capability in new RF and microwave technology. "That again has resulted in a perfect fit to replace our current infrastructure." Cook notes that the Curtiss-Wright TTS-9800-2 series multimode transmitter uses 5G technology while providing high RF power efficiency.

"The TTS-9800-2 multi-band transmitter took advantage of the device breakthroughs in the commercial, 5G market to provide a transmitting platform that operates in three frequency bands, provides the latest multipath compensation techniques," Cook says. This would not have been possible 10 years ago without the various RF devices developed for 5G."

A Marine Corps technician sets up a high-frequency radio onboard the forward-deployed amphibious assault ship USS America (LHA 6).

A Navy electronics technician conducts maintenance on a receiver-transmitter unit in a UHF radio room aboard the Nimitz-class aircraft carrier USS Carl Vinson.

The TTS-9800-2 is suitable for flight test instrumentation, unmanned aerial vehicle (UAV) communications, spacecraft instrumentation, and launch vehicle telemetry. With multiband functionality (L, S, and C-Bands), device is frequency agile, operating at 1435.5 to 1534.5 MHz, 1750.0 to 1855.0 MHz; 2200.0 to 2400.0 MHz; 4400.0 to 4940.0 MHz; and 5091.0 to 5250.0 MHz.

Pentek's model 6353 is an 8-channel RFSoC transceiver sub-system, housed in a small rugged chassis with 5 GS/sec A/D converters and 10 GS/sec D/A converters. It is designed for extreme environments, like an antenna mast, aircraft pod, or unmanned vehicle. Digitized signals flow over dual 100 gigabit Ethernet optical cables to a host processor at rates up to 24 gigabytes per second.

"Pentek's model 5553 SOSA-aligned 3U VPX RFSoC Processor offers the same Gen 3 RFSoC device as above," Hosking says. "It is extremely well-suited for phased-array radar and electronic warfare applications and supports synchronization across all channels and multiple boards."

Absorbing microwaves

Laird R&F Products in Carlsbad, Calif., has developed a series of lightweight and corrosion-resistant microwave absorbers that perform reliably at low frequencies and amid harsh environmental conditions. Designed to meet the needs of military and aerospace design engineers working to attenuate surface currents, internal cavity noise and surface reflections in electronics systems.

Laird's new RF-LW series of absorbers have higher permeability and permittivity than standard magnetic fillers. Permittivity refers to the ability of a substance to store electrical energy in an electric field.

"Historically, absorbing materials used at low frequencies have been thick and heavy and vulnerable to

Anritsu's ME7803NR is a single solution to conduct ARIB/ETSI/FCC-compliant frequency range (FR) 1 RF tests on 5G New Radio (NR) UE.

corrosion," says Rick Johnson, aerospace and defense director at Laird R&F Products. "To address this issue, we investigated new metal alloys, particle morphology and processing parameters to develop particles with higher magnetic permeability and permittivity than traditional iron fillers. The result is the RF-LW series of absorbers, which are resistant to corrosion and thinner and lighter than traditional iron-loaded materials."

Johnson explains that the RF-LW series of absorbers is the result of Laird looking to improve on the microwave absorbing technologies that have been around since early in the Cold War.

The RF-LW series comes in three materials, including nitrile, fluorosilicone, and silicone elastomers. According to Laird, nitrile elastomers offer fuel and fluid resistance and are effective on military aircraft and naval ships across a wide range of temperatures — from -65 to 280 degrees Fahrenheit.

Fluorosilicone elastomers perform reliably in high-temperature applications — up to 475 degrees Fahrenheit. These rugged elastomers also withstand exposure to harsh substances such as jet fuel and deicing fluids.

Silicone elastomers are most effective within electronics housings, whereas the nitrile and fluorosilicone elastomers are designed for use on the outside of military vehicles and equipment.

The Curtiss-Wright Defense Solutions TTS-9800-2 series multimode transmitter uses 5G technology while providing high RF power efficiency.

In addition, Laird R&F Products can assess absorber performance across frequencies and angles of incidence at various thicknesses and weights. Then, the Laird R&F Products team can optimize absorber design and performance.

Internal interference

In 2020, Laird's Johnson told Military & Aerospace Electronics that manufacturers are also tackling issues related to internal high frequency electromagnetic interference.

"So, normally, if you've got a noisy chip, you can put a board-level shield around it or something else to mitigate it," Johnson says. "If you start having these problems in the microwave and millimeter wave frequencies, the wavelengths are getting so small that traditional EMI shielding doesn't work properly. So,

WHO'S WHO IN RF & MICROWAVE TECHNOLOGIES

Aitech
Chatsworth, Calif.
www.rugged.com

Anritsu America Test and Measurement
Morgan Hill, Calif.
www.anritsu.com

Crystal Group
Hiawatha, Iowa
www.crystalrugged.com

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

dB Control
Fremont, Calif.
www.dbcontrol.com

Elma Electronic
Fremont, Calif.
www.elma.com

Fairview Microwave Inc.
Lewisville, Texas
www.fairviewmicrowave.com

Laird R&F Products
Chesterfield, Mo.
www.laird.com

Mercury Systems
Andover, Mass.
www.mrcy.com

Micro Lambda Wireless
Fremont, Calif.
www.microlambdawireless.com

Mini-Circuits
Brooklyn, N.Y.
www.minicircuits.com/

Northrop Grumman Corp.
Falls Church, Va.
www.northropgrumman.com/

Pasternack Enterprises
Irvine, Calif.
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Pentek Inc.
Upper Saddle River, N.J.
www.pentek.com

RIGOL
Beaverton, Ore.
www.rigolna.com

Smiths Interconnect
London
https://www.smithsinterconnect.com/

Southwest Microwave, Inc.
Tempe, Ariz.
www.southwestmicrowave.com/

ThinkRF
Kanata, Ontario
www.thinkrf.com

Triad RF Systems
East Brunswick, N.J.
www.triadrf.com

VPT
Blacksburg, Va.
www.vptpower.com

W.L. Gore
Newark, Del
www.gore.com

you have to augment it by putting absorbers in there, which will then absorb the energy. So, it is not only just keeping the energy inside the box and meeting FCC requirements, but also stopping one component from interfering with another. So, it's used a lot in automotive radars between the transceiver in the transceiver assembly. It's used in high frequency EMI applications for data communications and automotive electronics. And then certainly military 5G uses the material similarly inside of an assembly to kill internal reflections."

Defending warfighters

When it comes to trends in RF and microwave technologies, the mil-aero industry is tasked not only with protecting equipment from RF and microwave interference and utilizing the spectrum to gain an advantage over adversaries, but to keep warfighters out of harm's way.

For the last two decades, improvised explosive devices (IEDs) have proved to be a formidable weapon that allows adversaries to U.S. and allied forces to cause casualties without facing down better equipped and trained warfighters.

Often, IEDs are detonated by using radio frequencies from a distance. The explosives are also generally hidden from plain view, so actively jamming radio frequencies is needed. The DOD continues to rely on electronic warfare experts at Northrop Grumman Corp., based in Falls Church, Va., to provide Joint Counter-Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) increment one block one (I1B1) systems for American and allied forces.

The JCREW I1B1, formerly known as JCREW 3.3, is the first-generation system that develops a common open architecture across all three capabilities and provides protection with RF jammers for worldwide military operations.

The system jams a wide range of IEDs and creates a protective barrier around Marine Corps infantry and their equipment while minimizing disruption to friendly communications systems.

AMRAAM is the U.S. military's most advanced radar-guided air-to-air missile.

Raytheon to build hundreds of AMRAAM radar-guided air-to-air missiles

BY **John Keller**

EGLIN AIR FORCE BASE, Fla. — U.S. military airborne weapons experts are ordering several hundred of the nation's most sophisticated radar-guided air-to-air missiles for the U.S. Air Force, Navy, and military allies under terms of a half-billion-dollar contract announced in April.

Officials of the Air Force Life Cycle Manager Center at Eglin Air Force Base, Fla., are awarding a $518.4 million contract to the Raytheon Co. Missile Systems segment in Tucson, Ariz., for Lot 34 production of the AIM-120 Advanced Medium Range Air to Air Missile (AMRAAM) for the U.S. and foreign militaries.

AMRAAM is one of the world's most advanced all-weather, all-environment medium range air-to-air missiles. The system is an active radar-guided intercept missile with inherent electronic protection capabilities for air-to-air applications against massed penetration aircraft and is designed to replace the AIM-7 Sparrow air-to-air missile.

This contract involves foreign military sales (FMS) to Bulgaria, Canada, Denmark, Indonesia, Japan, Portugal, Qatar, Saudi Arabia, Slovakia, and South Korea.

The contract includes captive air training missiles, guidance sections, AMRAAM telemetry systems, spare parts, and other production engineering support hardware.

Each AMRAAM lot typically contains between 400 and 500 missiles. The latest version of the missile, the AIM-120D, has improved accuracy via Global Positioning System aided navigation, improved network compatibility, and enhanced aircrew survivability.

The AMRAAM missile has air-to-air and surface-launch versions. In the air-to-air role, the weapon's advanced active guidance section provides the aircrew find targets quickly in challenging environments, Raytheon officials say.

AMRAAM has scored combat victories in Iraq, Bosnia, and Kosovo, Raytheon says. It uses digital technology, micro-miniaturized solid-state electronics, and active radar guidance for air combat and air defense.

AMRAAM provides multi-shot capability, and can be launched day or night, in all weather conditions. Its autonomous guidance capability provides the pilot with launch-and-leave ability to provide fast engagement of follow-on targets or the option to fire first and then run from targets.

AMRAAM's capabilities include quick fly-out, immunity to countermeasures, and the ability to reject radar clutter to attack low-altitude targets. The missile has active radar guidance, multi-shot capability, and the ability to launch from aircraft or from surface-to-air missile sites.

Raytheon also is developing the AMRAAM Extended Range missile for ground-based air defense, AMRAAM-ER will enable intercepts at longer distances and higher altitudes.

Procured by 36 countries, the AMRAAM has been integrated onto the F-16, F-15, F/A-18, F-22, Typhoon, Gripen, Tornado, and Harrier combat jets. The AIM-120C5 and AIM-120C7 are being integrated onto the F-35 Joint Strike Fighter.

On this contract Raytheon will do the work in Tucson, Ariz., and should be finished by December 2023. For more information contact Raytheon Missile Systems online at www.raytheon.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Lockheed Martin to provide radar signal processing for E-2D surveillance aircraft

BY **John Keller**

PATUXENT RIVER NAS, Md. — Airborne radar experts at Lockheed Martin Corp. will provide 12 advanced radar signal processing retrofit systems for the U.S. Navy E-2D carrier-based radar early warning aircraft under terms of a $22.8 million order.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Lockheed Martin Rotary and Mission Systems segment in Liverpool, N.Y., to build 12 retrofit advanced radar processor systems for the E-2D Advanced Hawkeye aircraft.

The Navy Northrop Grumman E-2D is a tactical airborne early warning (AEW) aircraft designed to operate from aircraft carriers. The twin-engine turboprop aircraft has a distinctive antenna, and provides the carrier battle group with wide-area radar surveillance for enemy monitoring and combat air traffic control.

The E-2D aircraft uses the Lockheed Martin AN/APY-9 radar for Navy carrier surveillance and theater air and missile defense missions. The AN/APY-9 provides the enhanced airborne command and control and expanded surveillance for the E-2D. The radar detects small maneuverable targets in difficult coastal-water and overland environments.

The AN/APY-9 radar for the E-2D surveillance aircraft features advanced radar signal processing subsystems to enable flexible radar beam management and enhanced target processing to help the radar pinpoint and track enemy aircraft and missiles, and reject clutter and radar interference.

The AN/APY-9 radar for the E-2D surveillance aircraft features advanced radar signal processing subsystems to enable flexible radar beam management and enhanced target processing.

The AN/APY-9 features mechanical and electronic scanning modes, providing the warfighter with 360-degree situational awareness around the aircraft, and the ability to augment mechanical scanning with electronic scanning to dedicate extra resources to challenging targets or 90-degree sectors in any direction.

The AN/APY-9 Radar detects air and sea surface targets simultaneously with its space-time adaptive processing (STAP) architecture, which suppresses clutter, jamming, and other sources of electromagnetic interference to focus on the target.

The AN/APY-9 operates at UHF which excels at long-range detection of difficult-to-find targets. High-power solid-state transmitter electronics increases reliability and sensitivity.

The radar has a high-reliability solid-state transmitter design, digital receivers, and exciter for waveform flexibility, low noise, and increased sensitivity. Its open-systems-architecture processor supports continuous technology insertion, and its circuit card computer hardware architecture simplifies system maintenance.

On this order Lockheed Martin will do the work in Liverpool, N.Y., and in Andover, Mass., and should be finished by April 2025. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com, or Naval Air Systems Command at www.navair.navy.mil.

The U.S. Army's future vertical-lift aircraft that will replace the Black Hawk helicopter likely will be able to operated piloted or unmanned.

Future replacement for Black Hawk enters new development phase; downselect next year

BY **John Keller**

REDSTONE ARSENAL, Ala. — The U.S. Army is starting the second and final development phase of the Future Long-Range Assault Aircraft (FLRAA) before downselecting to one contractor sometime next year to build vertical-lift prototypes of the replacement for the Sikorsky UH-60 Black Hawk utility helicopter.

Officials of the Army Contracting Command at Redstone Arsenal awarded two contracts — one to Bell Textron Inc. in Fort Worth, Texas, and the other to Sikorsky Aircraft, a Lockheed Martin company in Stratford, Conn. for the FLRAA Competitive Demonstration and Risk Reduction Phase 2 project.

Army leaders want to start fielding the FLRAA as a Black Hawk replacement by 2030. The project's second phase will help determine if the FLRAA will be suitable for Special Forces uses, for medical evacuation, and if the design could be exportable.

It's likely this new helicopter replacement will be an optionally piloted aircraft, meaning it will be able to carry out missions as a manned or unmanned vertical-lift aircraft.

At the same Time, Army experts are working with Bell and Sikorsky to start integrating the FLRAA's major subsystems and the candidate weapons systems. Bell won a $292.6 million order and Sikorsky won a $284.4 million order on 30 March to begin the FLRAA's second phase.

The Army also has a contract solicitation out to find ways to develop open-systems enabling technologies to manage aircraft crew member

cognitive workload, as part of the Revolutionary Technology and Strategies for the Holistic Situational Awareness—Decision Making (HSA-DM) program.

The technologies developed from this future aircraft program potentially are for integration into avionics for the FLRAA and the Future Attack Reconnaissance Aircraft (FARA). Suggested technologies must conform to the Modular Open Systems Approach (MOSA) and Future Airborne Capability Environment (FACE) industry standards.

This program could develop avionics technologies for the FLRAA to include synthetic vision for operating in dust or snow; vertical-lift integrated mission equipment; a joint common avionics architecture; route optimization; survivability against networked threats; piloted and unmanned aircraft teaming; command and control; and multi-role mission systems.

This project to develop advanced avionics for the FLRAA and other future Army aircraft has four separate efforts: information management; data and sensor fusion; autonomous decision aiding and information distillation; and human-machine interfaces.

Information management seeks to identify information management technologies to receive, process, store, and transmit terabytes of data and knowledge products from several sources simultaneously.

Data and sensor fusion seeks to identify technologies to accept data from several sensors, databases, and networks, and fuse the data into a comprehensive "own-ship" world model or information manager.

Autonomous decision aiding and information distillation seeks to identify technologies capable of distilling data and information into knowledge products for crew member adjudication and/or autonomous decision making.

Human machine interfaces seeks to identify technologies that facilitate intuitive communication of operational knowledge to and from aircraft crew members.

The types of avionics systems that could be part of this program — and by extension part of the FLRAA — include communications; aircraft status; navigation; augmented flight control; weapons; crew systems; and fused sensor data. Proposed technologies meet standards for cyber security and information assurance.

On these orders Bell will do the work in Fort Worth, Texas; Owego, N.Y.; Wichita, Kan.; Torrance and Garden Grove, Calif.; Jackson and Grand Rapids, Mich.; Indianapolis; Cary, N.C.; Kirkland, Wash.; Tallassee, Ala,; Lod, Israel; Papendrecht, Netherlands; and Ajax, Ontario, and should be finished by March, 2022.

Sikorsky, meanwhile, will do the work in Ridley Park, Coatesville, and King of Prussia, Pa.; Stratford, Conn.; Owego, N.Y.; Fort Worth, Texas; and Jupiter, and Orlando, Fla., and should be finished by May 2022.

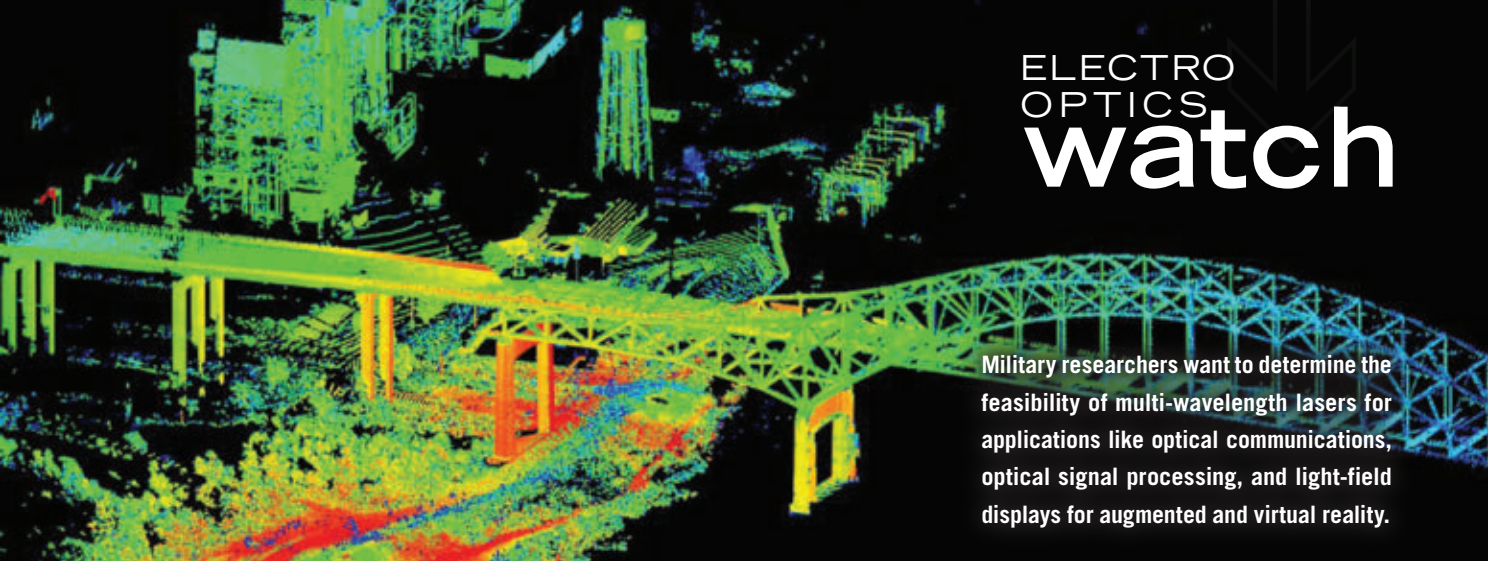
For more information contact Bell Textron online at www.textron.com/About/Our-Businesses/Bell, Sikorsky at www.lockheedmartin.com/en-us/capabilities/sikorsky.html, or the Army Contracting Command at www.army.mil/acc.

Boeing, General Atomics, and Kratos to develop unmanned aircraft to team with piloted planes

The U.S. Air Force has awarded contracts to three companies to produce missionized unmanned aerial vehicle (UAV) prototypes with the ability to fly in experimentation events while teaming with manned aircraft. The Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio, awarded contracts to The Boeing Co. for $25.7 million; General Atomics Aeronautical Systems Inc. for $14.3 million; and Kratos Unmanned Aerial Systems Inc. for $37.8 million. The aim of the Skyborg Vanguard program is to integrate autonomous attritable UAV technology with open missions systems to enable manned-unmanned teaming.

Navy evaluating unmanned cargo aircraft for long-range resupply missions

U.S. Navy aviation experts have acquired an unmanned aerial vehicle (UAV) to demonstrate long-range naval ship-to-ship and ship-to-shore cargo transport. Officials from the U.S. Naval Air Warfare Center Aircraft Division (NAWCAD) at Patuxent River Naval Air Station, Md., received the logistics UAV in October from commercial manufacturer Skyways in Austin, Texas. Naval personnel are evaluating the cargo UAV, called Blue Water Maritime Logistics UAS, and tailoring it to Military Sealift (MSC) and Fleet Forces Command (FFC) requirements. Once NAWCAD fine-tunes the unmanned cargo aircraft, Blue Water will head to the Atlantic for experimentation with the fleet through most of 2021.



Military researchers want to determine the feasibility of multi-wavelength lasers for applications like optical communications, optical signal processing, and light-field displays for augmented and virtual reality.

DARPA eyes multi-wavelength lasers for optical computing, sensors, and LiDAR

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are surveying industry to determine the feasibility of multi-wavelength lasers for integrated silicon photonics in military applications like optical communications, optical signal processing, and light-field displays for augmented and virtual reality.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has issued a small-business opportunity solicitation (HR001121S0007-07) for the Multi-Wavelength Laser Sources project.

The goal is to develop efficient, compact, manufacturable multi-wavelength laser sources that are critical for co-packaged optical interconnects, advanced data processing, sensors, and other emerging silicon photonics applications.

These kinds of electro-optical enabling technologies also will support the DARPA Package for Extreme Scalability (PIPES) program, which seeks to enable next-generation microelectronics with co-packaged optical I/O for future high-performance military and commercial systems such as optical computing.

In the military, multi-wavelength lasers are expected to be important building blocks for high-throughput interconnects in high-performance computing; edge processing; emerging artificial intelligence (AI) and machine learning systems; sensors; high-bandwidth microwave photonic systems; and coherent light direction and ranging (LiDAR).

Short-reach optical interconnects historically have used a small portion of the optical spectrum, with current architectures using only one to a few wavelengths per fiber, DARPA researchers explain. However, as the demands on bandwidth and efficiency increase, advances in compact multi-wavelength laser sources are required to enable next-generation co-packaged photonic I/O.

DARPA researchers are looking for technical approaches to multi-wavelength laser sources that are compatible with chip-scale fabrication and integration methods.

They want solutions that deliver at least 16 laser channels on a regular frequency grid, with about 100 to 800 GHz spacing, in the O-band and C-band of the spectrum to provide milliwatt power levels per channel.

Companies interested must show a feasible path for a multi-wavelength laser, and describe potential commercial applications. DARPA wants to find a domestic commercial source for multi-wavelength laser sources specifically targeting optical interconnects and computing.

Proposers must outline a clear path to deliver hardware prototypes within two years, and deliver 10 multi-wavelength laser prototypes by program's end with electronic control and optical fiber outputs.

Companies interested should upload proposals no later than 25 May 2021 to the Defense SBIR/STTR Innovation Portal at www.dodsbirsttr.mil. Email questions or concerns to DARPA at HR001121S0007@darpa.mil. More information is online at https://beta.sam.gov/opp/2e23f6a5e3104da6bf819d31822edb95/view.

Avionics touchscreen in the F-35 can be hard to use during turbulence

The F-35 joint strike fighter is the most crammed-with-digital-tech fighter jet in history, the product of a multi-decade, trillion-dollar design process that has been famously messy. But the jet is out there, and pilots are flying it. One big design shift with the F-35 is that it removes many of the small physical avionics switches that crowded older jet cockpits, and replaces them with a big touchscreen. In theory the all-glass display is great. Its touchscreen, you can set it up to show pretty much anything you want in any layout you want. Take, for example, a fuel display. You can have it in a large window that shows you everything you could possibly want to know about the aircraft's fuel system.

Navy to deploy 60-kilowatt laser weapons aboard Burke-class destroyers

Navy destroyers soon will be armed with high-power 60-kilowatt laser weapons that can track and incinerate attacking drone targets at sea. Lasers have been operational for years, as the Navy's Laser Weapons System (LAWs) went to sea aboard the amphibious transport dock USS Ponce since 2014. Yet the service has been working for many years with industry to refine, sharpen, strengthen, and power-scale new laser weapons. One of them, called High Energy Laser with Integrated Optical-dazzler and Surveillance (HELIOS), soon will be arming U.S. Navy Arleigh Burke-class Flight IIA destroyers. HELIOS is go on the Burke-class destroyer USS Preble later this year.

Universal input displays for test and measurement introduced by Acromag

Acromag in Wixom, Mich., is introducing the VPM3000 series of universal input displays with transmitter and alarm capabilities for manufacturing test and measurement and control applications. These instruments combine the digital indicator function of a panel meter with optional signal conditioning for 4-to-20-milliamp transmitter output and alarm trip solid-state relays. The 1.2 inch high numerals are visible from far away, even in bright sunlight. Field-selectable inputs accept process current and voltage and temperature sensor signals including plus-or-minus 20 milliamps, zero-to-10 volts, plus-or-minus 10 volts, Pt RTDs, and most common thermocouple varieties. Models are available for operation from 85-to-265 volts AC or 12-to-36 volts DC power sources. For more information contact Acromag online at www.acromag.com.

China said to be developing anti-satellite lasers to blind U.S. satellites

China is building destructive space weapons that will blind U.S. reconnaissance satellites, a new intelligence report has revealed. "China has already fielded ground-based [Anti-Satellite weapons] missiles intended to destroy satellites in [low Earth orbit] and ground-based ASAT lasers probably intended to blind or damage sensitive space-based optical sensors on LEO satellites," according to an annual threat assessment report from the Office of the Director of National Intelligence (ODNI). The report assessed threats to the U.S., ranging from issues like the coronavirus pandemic, climate change, terror organizations, weapons of mass destruction, and nation-state competitors like China and Russia. One key realm in which the ODNI has identified China to have an especially aggressive hold is its anti-satellite (ASAT) weapons.

RF AND MICROWAVE

Navy picks high-power amplifiers from North Star Scientific for E-2D carrier aircraft

U.S. Navy avionics experts needed high-power amplifier units for the E-2D Advanced Hawkeye carrier-based surveillance aircraft. They found their solution from North Star Scientific Corp. in Kapolei, Hawaii.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., has announced a $9.6 million order to North Star Scientific for 42 high-power amplifiers for the Navy E-2D fleet. The order includes engineering and engineering data support for high-power amplifier unit kitting, installation, and testing.

North Star Scientific will provide 13 high-power amplifier units for E-2D crypto modernization and frequency remapping aircraft retrofits; 10 amplifiers for E-2D tactical targeting network technology (TTNT) production aircraft; 10 spare amplifiers; five amplifiers for system configuration set-11 E-2C aircraft,; and four amplifiers for E-2D TTNT aircraft retrofits.

North Star Scientific specializes in designing military communications and radar equipment for military systems like the Northrop Grumman E-2 Hawkeye radar plane; the Lockheed Martin's P-3 Orion maritime patrol aircraft; the littoral combat ship; and other air and sea unmanned vehicles.

In addition to other RF and microwave products, the company builds the Radio Frequency Monitor; UHF VHF AIS Diplexer; 50-Watt Remote Amplifier; Trigger Pulse RF Amplifier; 3-Way RF Switch; Vehicle RF Matrix Switch; Shipboard RF Matrix Switch; 100-Watt Amplifier;; VRC-99B 180-Watt Amplifier; Direction Finding Antenna; High-Voltage Modulator; TCDL Antenna; TR Switch; and Solid-State/Vacuum Hybrid.

Among the power amplifiers from North Star Scientific is the airborne VRC99B 50-Watt power amplifier for different aircraft. It has a frequency range of 1.7 to 2 GHz; a minimum power output of 50 Watts; an input voltage of 28 volts DC; RS-422 Control; and measures 7.75 inches wide, 6.39 inches high, and 11.32 inches long.

North Star Scientific offers design capabilities that involve antenna/microwave design and analysis; digital, analog, and high voltage design; MIL-STD 461; MIL-STD 704; MIL-STD 810; MIL-HDBK 217; field-programmable gate array (FPGA) programming; microprocessor programming; LabView programming; custom test equipment; CAD modeling; thermal-fluid analysis; and structural analysis.

The company's test capabilities include antenna measurement; shock and vibration; temperature cycling and thermal shock; humidity; altitude; combined temperature and altitude; combined temperature and humidity; rapid decompression; salt fog; EMI; flow rate and pressure drop; wire bond pull; hermeticity; and internal gas analysis.

On this order North Star Scientific will do the work in Kapolei, Hawaii; and Carlsbad, Calif., and should be finished in August 2022. For more information contact North Star Scientific online at www.nsshawaii.com.

COMPUTERS AND NETWORKING

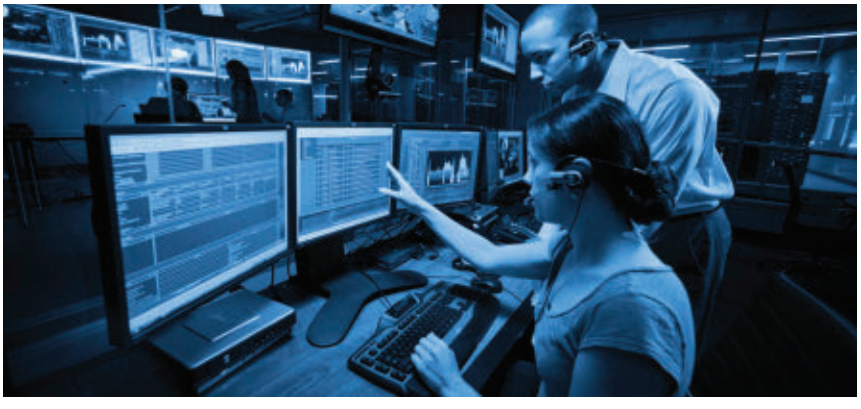
Navy looks to Perspecta for network, computers, and information security

U.S. Navy information technology (IT) experts needed computer and networking support for more than 650,000 Navy and Marine Corps users of the Next Generation Enterprise Network (NGEN). They found their solution from Perspecta Enterprise Solutions LLC in Herndon, Va.

Officials of the Naval Information Warfare Systems Command in San Diego announced a $797.3 million order to Perspecta for NGEN support for about 400,000 user seats at more than 2,500 locations. The order brings the value of Perspecta's NGEN contract to $6.7 billion.

NGEN provides network-centric data and IT support through a common computing and communications environment to Navy and Marine Corps military, civilian, and contractor users. Services involve enterprise, network, voice, video, data, information security, and testing.

NGEN represents the evolution of Navy enterprise networks for Navy and Marine Corps personnel. It provides enterprise network services originally consolidated in 2000 under



the Navy Marine Corps Intranet (NMCI) contract, which provided IT services to more than 700,000 Navy and Marine Corps users.

The transition from NMCI to NGEN sought to maintain services, provide government control, and maintain information security.

On this order Perspecta will do the work throughout the U.S., and should be finished by September 2021. For more information contact Perspecta Enterprise Solutions online at https://perspecta.com.

SOFTWARE

Raytheon to develop battle management software for theater military planning

Battle management experts at Raytheon Technologies Corp. will help U.S. military researchers develop softwae to boost the effectiveness of large-scale military planning through theater-scale command and control with automation and predictive analytics.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., awarded a $10.4 million contract to Raytheon Missiles & Defense in collaboration with Raytheon Intelligence & Space for the Joint All-Domain Warfighting Software (JAWS) program.

JAWS considers dynamic coordination of kill webs across the battlespace, since sensors, weapons, and decision makers are not always in the same place.

This approach to command and control enables flexibility by enabling decision makers to optimize assignments by developing software to set up synchronized kill webs that operate on and under the sea, on land, in the air, in space, and in the electromagnetic spectrum.

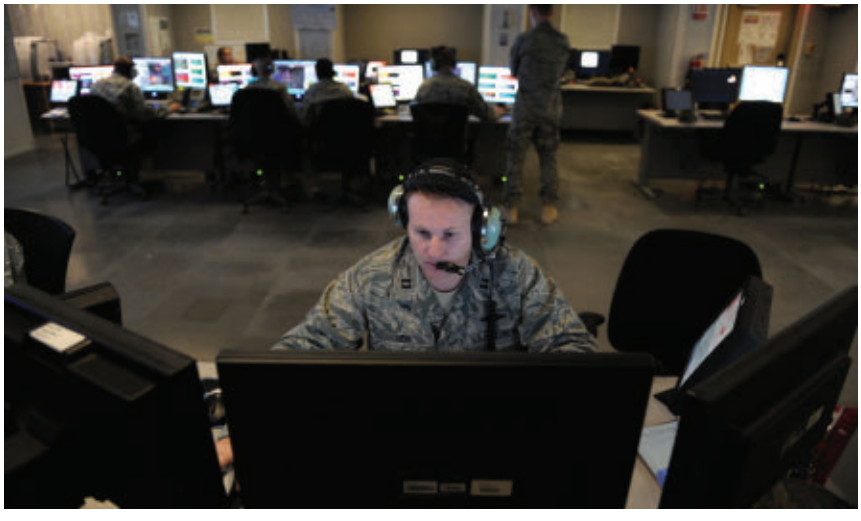
The primary issues for command and control are sensing, communications, and weapons. JAWS defines sensing is the ability to detect, geolocate, and identify potential targets for attack.

Communications is the ability to pass data at the right time and quickly enough to deploy, maintain, and maneuver, assets. Weapons involves choosing the right weapon for the job.

Coordinating kill webs in areas as large as military theaters typically are centralized and difficult to scale. This can result in flexibility at low military echelons, but in cumbersome human-intensive planning at high echelons, with widespread use of tactical radios with targeting information.

Instead, the JAWS program seeks to develop the software tools that create a distributed command and control structure using dynamic teaming and machine-to-machine interfaces to enable centralized and distributed planning and execution combinations.

For example, when few targets and resources are involved, much of the overall battlespace can push to the tactical edge without significant coordination. Yet with many targets over large areas, theater level coordination is necessary to allocate resources efficiently.



JAWS is not intended to prescribe command structures but enable them based on mission need; it is inherently a man-machine team. The tools developed in JAWS should support the speeds necessary to decision makers to synchronize kill webs at scale.

The intended users of JAWS are the joint force commanders working across military services and warfare domains. Select command and control forces at the tactical edge will interface with JAWS for tight coordination.

The JAWS program should yield new capabilities that include:

— extendable architectures that abstract essential resource and tasking data dependencies for rapid integration of new sensors, communication concepts, and weapon systems;

— ways to abstract and resolve sequences of events like coordinated fires with variable planning horizons; and

— ways to safeguard warfighting capability amid intermittent or permanent loss of information flow between any nodes.

DARPA researchers want to demonstrate solutions in a live, virtual, constructive environment to consider various scenarios and evaluate command and control features. This virtual environment will call for four rackmount computer servers with 500 gigabytes of memory, 100 cores on CPU; and one terabyte of solid-state data storage.

The test environment also will have 500 terabytes of network-attached data storage; and five desktop workstations with 10-core CPUs, and 256 gigabytes of memory, one terabyte of disk storage.

On this contract Raytheon will do the work in Tewksbury, Cambridge, and Woburn, Mass.; Richardson and McKinney, Texas; Centennial, Colo.; and Nashua, N.H., and should be finished by April 2022.

For more information contact Raytheon Intelligence & Space and Raytheon Missiles & Defense online at www.rtx.com, or DARPA at www.darpa.mil.

DISPLAYS

Rugged LCD monitors for aircraft, ships, and land-based uses introduced by EIZO

EIZO Rugged Solutions Inc. in Altamonte Springs, Fla., is introducing three commercial off-the-shelf (COTS) rugged liquid crystal display (LCD) monitors for use in aircraft, surface ships, submarines, and land-based military applications. The EIZO Talon RGD3202W (32-inch), RGD2802 (28-inch), and RGD2102W (21.5-inch) LCD monitors are for displaying detailed information in naval displays, target tracking, mission-control centers, and airborne surveillance operations. The displays are ready for deployment in extreme environments with ruggedized features such as sunlight readability, water resistance with IP65, built-in heaters, and conformal coating to protect components. The displays are tested to resist the effects of vibration, shock, altitude, and extreme temperatures to comply with MIL-STD-810 and MIL-STD-461. The RGD3202W 32-inch model has 3840 by 2160) resolution for displaying detailed rugged applications in full across a spacious screen. For more information contact EIZO Rugged Solutions online at www.eizorugged.com/products/rugged-monitors.

CABLING AND CONNECTORS

Cables and assemblies, and connector caps introduced by PolyPhaser

PolyPhaser, an Infinite Electronics brand in Hayden, Idaho, is introducing RF cable and assemblies, as well as connector caps, for laboratory and deployed RF and microwave applications. These offerings help PolyPhaser to be

a single source for RF and microwave protection solutions to simplify projects and eliminate delays. PolyPhaser's RF products are in stock for same-day shipping. New products include outdoor-rated flexible coax RF cable and assemblies with inline surge protection with DC pass surge protection in the connector; connector caps, components that protect open connectors and interfaces from potential damage; and cables and accessories to help accelerate deployment. For more information contact PolyPhaser online at www.polyphaser.com.

SPACE ELECTRONICS

Radiation-hardened integrated circuits for space applications introduced by Apogee

Apogee Semiconductor in Plano, Texas, is introducing the AP54RHC RadHard logic family for space applications that required radiation-hardened integrated circuits, like small satellites. The AP54RHC is based on the Apogee Transistor-Adjusted-Layout for Radiation (TalRad) design methodology that improves the radiation performance of commercial-process technologies to enable rapid creation of radiation-hardened designs quickly. The AP54RHC integrated circuits are built with cold-sparing capabilities and triple redundancy for reliability and area savings. The AP54RHC family offers total ionizing dose (TID) resilience of 30 kilorads, and single-event latchup hardening to with 80 MeV-cm2/mg. The device is encapsulated in a 14-pin plastic

thin-shrink small outline package (TSSOP). The AP54RHC family includes functions such as level-translators, majority voters, transceivers, and logic gates. Evaluation units are available now and flight units will be available this summer. For more information contact Apogee Semiconductor online at www.apogeesemi.com.

BOARD PRODUCTS

XMC embedded computing module for communications introduced by Pentek

Pentek Inc. in Upper Saddle River, N.J., is introducing the Jade model 71891 Switched Mezzanine Card (XMC) module, an L-Band RF tuner with two 400 MHz A/D converters for connection to SATCOM or communications system L-band signals. The Jade model 71891 embedded computing module is based on the high-density Xilinx Kintex UltraScale field-programmable gate array (FPGA). A front-panel SSMC connector accepts L-Band signals between 925 and 2175 MHz, typically from an L-Band antenna or a low noise block (LNB). With its programmable low-noise amplifier, the Maxim MAX2121 tuner converts these L-Band signals to IF or baseband using a broadband

I/Q analog downconverter followed by 123 MHz low pass anti-aliasing filters. Digitizing the two analog tuner outputs are two Texas Instruments ADS5474 400 MHz 14-bit A/D converters to capture 123 MHz bandwidth. Two independent A/D and display data channels are available for digitizing and downconverting two signals with different center frequencies and bandwidths. For more information contact Pentek online at www.pentek.com.

AVIONICS

MIL-STD-1553 DO-254-certifiable IP core for avionics introduced by Holt

Holt Integrated Circuits in Mission Viejo, Calif., is introducing the HI-6300 MIL-STD-1553 DO-254-certifiable IP core for military and commercial avionics applications. The commercial

off-the-shelf (COTS) 1553 IP core is available with a DO-254 certification data package, which includes the IP core as encrypted source code, data, test bench, and design artifacts to demonstrate the IP core meets DO-254 DAL A and complies with CAST 33 and AC20-152A. The RTCA DO-254/EUROCAE ED-80 (DO-254) standard provides guidance and recommendations for how to meet design-assurance objectives of complex electronic hardware in avionics. The IP core is based on, and software-compatible with, Holt's HI-6130 and MAMBATM monolithic protocol ICs for MIL-STD-1553. The core supports bus controller, monitor terminal, and remote terminal functions. All options have a high-performance synchronous host interface that connects to AMBA AXI4 interface protocol or PCI-Express. Enabled terminals communicate with the MIL-STD-1553 buses through an HI-1587 shared dual bus transceiver and external isolation transformer. For more information contact Holt Integrated Circuits online at www.holtic.com.

RUGGED COMPUTERS

Rugged small-form-factor embedded computing system introduced by Abaco

Abaco Systems Inc. in Huntsville, Ala., is introducing the MAGIC1A 3U-VPX high-performance

PRODUCT & LITERATURE SHOWCASE

embedded computing (HPEC) system for military and industrial applications. The MAGIC1A small-form-factor embedded computer takes a modular, scalable approach to system design and architecture to deliver graphics and computer processing in a rugged, small, and power-efficient design. The MAGIC1A serves as an upgrade to its predecessor, the MAGIC1, by delivering increases in power supply capability, an enhanced removable hard drive, and a more modular approach to system design allowing for upgrades over time. The rugged computer provides increases in CPU and GPU performance, with the Quad Core Intel Xeon E3-1505M v6 that runs at 3 GHz base frequency to 4 GHz Turbo Boost. Its NVIDIA Pascal Quadro P2000 graphics processing unit offers with 768 cores, 4 gigabytes of GDDR5 memory, and CUDA software support. It delivers as much as 2.3 teraFLOPS of floating point performance. For more information contact Abaco Systems online at www.abaco.com.

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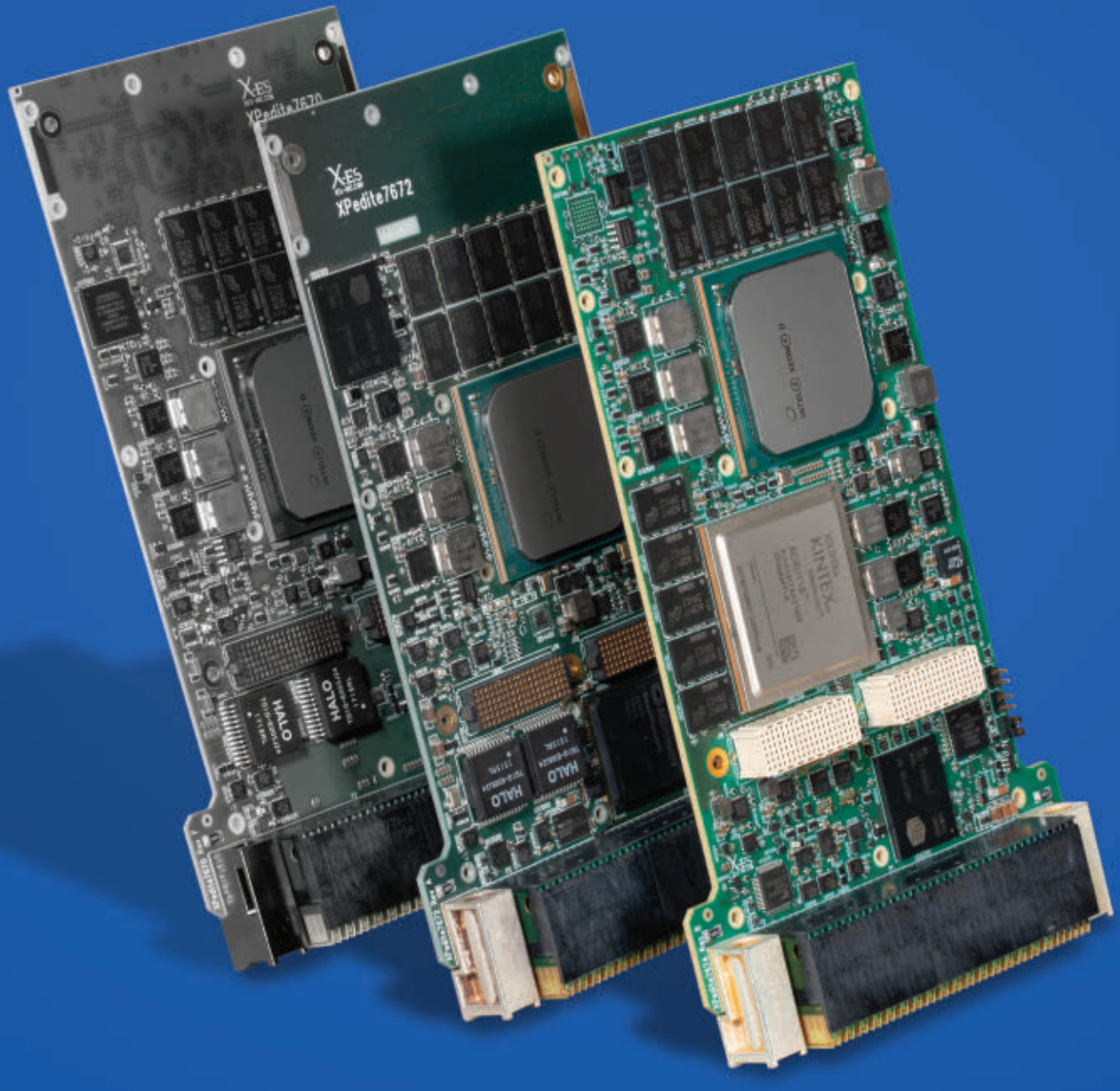

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AbelConn LLC

Acromag Inc
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Active Silicon Inc
ADL Embedded Solutions Inc
AdTech Ceramics
Advantech
Aitech
AMOtronics
Annapolis Micro Systems Inc
See ad on page 34
Apex Waves
ASAP 3Sixty
ASAP Components
CAEN Spa
Concurrent Technologies
Critical Link LLC
Curtiss-Wright Defense Solutions
Data Device Corp (DDC)
Dawn VME Products
See ad on page 8
Diamond-MT
Eagle PLC
ECRIN Systems
EDT | Engineering Design Team Inc
Elma Electronic Inc
See ad on page 21
esd electronics Inc
ESPEC North America | Qualmark
Eureka Dry Tech
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
General Micro Systems Inc
See ad on inside front cover
GiDEL
Interface Concept
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Marvin Test Solutions Inc
Matrox Imaging
Mercury Systems
MPL AG
MRO Electric
MRO Stock
New Wave Design and Verification
See ad on page 27
North Atlantic Industries Inc
See ad on page 43
Opal Kelly Inc
Orion Technologies LLC
PDR Infrared SMT/PCB Rework Systems
Pentek Inc
See ad on back cover
Phoenix International
See ad on page 39
Plane Parts 360
Red Rapids
Scalys
Sealevel Systems
See ad on page 11
Sital Technology
Smiths Interconnect
SRCTec LLC
Sundance DSP
Technobox Inc
Technotronix Inc
Trenton Systems Inc
United Electronic Industries Inc
VersaLogic Corp
WOLF Advanced Technology

MEMORY BOARDS

Abaco Systems
Acromag Inc
See ad on page 10
Advantech
Aitech
Annapolis Micro Systems Inc
See ad on page 34
ASAP 3Sixty
Critical Link LLC
Curtiss-Wright Defense Solutions
ECRIN Systems
Elma Electronic Inc
See ad on page 21

Eureka Dry Tech
Extreme Engineering Solutions (X-ES)
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General Micro Systems Inc
See ad on inside front cover
GiDEL
Greenliant
Phoenix International
See ad on page 39
Printed Circuits LLC
Scalys
Smiths Interconnect
Technobox Inc
Viking Technology

MEZZANINE/ DAUGHTER BOARDS

Abaco Systems

Acromag Inc
See ad on page 10

Active Silicon Inc
Active Silicon Ltd
Advanced Interconnections Corp
Aitech
Alta Data Technologies
Annapolis Micro Systems Inc
See ad on page 34
Concurrent Technologies
Critical Link LLC
Curtiss-Wright Defense Solutions
Data Device Corp (DDC)
Diamond-MT
Dspnor AS
ECRIN Systems
EDT | Engineering Design Team Inc
Elma Electronic Inc
See ad on page 21
esd electronics Inc
Eureka Dry Tech
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
General Micro Systems Inc
See ad on inside front cover
Interface Concept
See ad on page 29
MPL AG
New Wave Design and Verification
See ad on page 27
Orion Technologies LLC
Pentek Inc
See ad on back cover
Pleora Technologies Inc
Printed Circuits LLC
Red Rapids
Smiths Interconnect
SRCTec LLC
Sundance DSP
Technobox Inc
Teledyne e2v
Trenton Systems Inc
VersaLogic Corp
WOLF Advanced Technology

PERIPHERAL/ DEVICE CONTROLLERS

Acromag Inc
See ad on page 10
ADL Embedded Solutions Inc
Aitech
AMOtronics
Apex Waves
Concurrent Technologies
Critical Link LLC
Curtiss-Wright Defense Solutions
Dawn VME Products
See ad on page 8
Diamond-MT
Eagle PLC
ECRIN Systems
Elma Electronic Inc
See ad on page 21
Eureka Dry Tech
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41

Holt Integrated Circuits
See ad on page 19

MPL AG
MRO Electric
MRO Stock
Opal Kelly Inc
Plane Parts 360
Pleora Technologies Inc
Scalys
Sital Technology
Smiths Interconnect
Sundance DSP
Technobox Inc
United Electronic Industries Inc
VersaLogic Corp

SINGLE-BOARD COMPUTERS

Abaco Systems

Acromag Inc
See ad on page 10

Active Silicon Inc
Active Silicon Ltd
ADL Embedded Solutions Inc
Advantech
Aitech
Annapolis Micro Systems Inc
See ad on page 34
Cobham Semiconductor Solutions
Concurrent Technologies
Critical Link LLC
Crystal Group
Curtiss-Wright Defense Solutions
Data Device Corp (DDC)
Diamond-MT
Dynatem
Elma Electronic Inc
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esd electronics Inc
Extreme Engineering Solutions (X-ES)
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General Micro Systems Inc
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Interface Concept
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Marvin Test Solutions Inc
Mercury Systems
Milpower Source
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MilSource
MPL AG
MRO Stock
North Atlantic Industries Inc
See ad on page 43
Orion Technologies LLC
PDR Infrared SMT/PCB Rework Systems
Pentek Inc
See ad on back cover
Scalys
Smiths Interconnect
SRCTec LLC
Sundance DSP
Trenton Systems Inc
VersaLogic Corp
Vision Components GmbH

COMMUNICATIONS AND PERIPHERALS

AUDIO EQUIPMENT

ASAP 3Sixty
Fair-Rite Products Corp
Liteway Inc
Minoru Co Ltd
Plane Parts 360

COMMUNICATIONS EQUIPMENT - LASER COMMUNICATIONS

Applied Optoelectronics Inc
ASAP 3Sixty
Bodkin Design & Engineering LLC
DLS Electronic Systems Inc
Excelitas Canada
FARO Technologies Inc
Fibercore Ltd
H&L Instruments LLC
Lightel
Liteway Inc
Micro Laser Systems Inc

COMMUNICATIONS EQUIPMENT - MICROWAVE COMMUNICATIONS

Advanced Test Equipment Rentals
Anritsu
ASAP 3Sixty
Carolina Microwave Associates Inc
Cobham Antenna Systems
CTT Inc
DEV Systemtechnik GmbH
Evans Capacitor Co
See ad on page 17
HUBER+SUHNER Inc
Ironwood Electronics
Minoru Co Ltd
NTS Technical Systems
Pentek Inc
See ad on back cover
PIC Wire & Cable
Polarity Inc
Pro-Comm Inc
Quell Corp
Times Microwave Systems
Triad RF Systems Inc

COMMUNICATIONS EQUIPMENT - MILITARY TELECOMMUNICATIONS

Advanced Test Equipment Rentals
Anritsu
API Technologies Corp
ASAP 3Sixty
Cadex Electronics Inc
Carolina Microwave Associates Inc
Cobham Antenna Systems
Crystal Group
CTT Inc
Dawn VME Products
See ad on page 8
Dayton T Brown Inc
Delta Digital Video
DEV Systemtechnik GmbH
DLS Electronic Systems Inc
ECRIN Systems
EDT | Engineering Design Team Inc
Evans Capacitor Co
See ad on page 17
Fair-Rite Products Corp
Gemstar Custom Hard Cases
GiDEL
HD Barcode
Henkel Corp
Holt Integrated Circuits
See ad on page 19
HUBER+SUHNER Inc
Interface Concept
See ad on page 29
Ironwood Electronics
Lightel
MilSource
NextGen Adhesives
North Atlantic Industries Inc
See ad on page 43
NTS Technical Systems
NuWaves Engineering
Orion Technologies LLC
Pentek Inc
See ad on back cover
Per Vices Corp
PIC Wire & Cable
Plane Parts 360
Pleora Technologies Inc
Polarity Inc
Quell Corp
Rohde & Schwarz USA Inc
Scalys
Shoghi Communications
Sital Technology
Stratign
SynQor Inc
See ad on page 7
Tech Products Inc
Technotronix Inc
The Light Brigade Inc
Trenton Systems Inc
Triad RF Systems Inc
TXO Systems Ltd
United Electronic Industries Inc

COMMUNICATIONS EQUIPMENT - RADIO

Advanced Test Equipment Rentals
Anritsu
BearCom
Cadex Electronics Inc
Carolina Microwave Associates Inc
Cobham Antenna Systems
Computer2100 LLC
DLS Electronic Systems Inc
EDT | Engineering Design Team Inc
Fair-Rite Products Corp
Henkel Corp
HUBER+SUHNER Inc
Interface Concept
See ad on page 29
Minoru Co Ltd
NTS Technical Systems
NuWaves Engineering
Pentek Inc
See ad on back cover
Per Vices Corp
Pryme
Quality Two-Way Radios
Quell Corp
Red Rapids
Rohde & Schwarz USA Inc
Sealevel Systems
See ad on page 11
Stratign
Triad RF Systems Inc

COMMUNICATIONS EQUIPMENT - SATELLITE EQUIPMENT AND TELEMETRY

Acroamatics Telemetry Systems
Advanced Cooling Technologies Inc (ACT)
Aitech
Berliner Glas KGaA Herbert Kubatz GmbH & Co
Cadex Electronics Inc
Carolina Microwave Associates Inc
Cobham Antenna Systems
Computer2100 LLC
Crane Aerospace & Electronics
Dayton T Brown Inc
DEV Systemtechnik GmbH
Eureka Dry Tech
GDP Space Systems
Gemstar Custom Hard Cases
GPS Networking
Henkel Corp
HUBER+SUHNER Inc
L3Harris Technologies
LP Technologies
Masterclock Inc
NuWaves Engineering
Pentek Inc
See ad on back cover
Per Vices Corp

PIC Wire & Cable
Polarity Inc
Quell Corp
Red Rapids
Shoghi Communications
Stratign
SynQor Inc
See ad on page 7
Technotronix Inc
Triad RF Systems Inc

DATA BUSES AND NETWORKING - HIGH-SPEED SWITCHED FABRICS

Abaco Systems
Acromag Inc
See ad on page 10
Aitech
Axtrinet
CAEN Spa
Crystal Group
Curtiss-Wright Defense Solutions
Data Device Corp (DDC)
Dawn VME Products
See ad on page 8
Dynatem
Elma Electronic Inc
See ad on page 21
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Hi-Tech Controls
Interface Concept
See ad on page 29
Mercury Systems
Milpower Source
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MilSource
New Wave Design and Verification
See ad on page 27
Orion Technologies LLC
Pentek Inc
See ad on back cover
Trenton Systems Inc

DATA BUSES AND NETWORKING - NETWORK INTERFACE CONTROLLERS

Abaco Systems
Acromag Inc
See ad on page 10
Aitech
Alta Data Technologies
ASAP 3Sixty
Axtrinet
Data Device Corp (DDC)
Dawn VME Products
See ad on page 8
Digital Systems Engineering Inc (DSE)
Dynatem
Elma Electronic Inc
See ad on page 21
esd electronics Inc
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Masterclock Inc
MilesTek

Holt Integrated Circuits
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Interface Concept
See ad on page 29
MPL AG
New Wave Design and Verification
See ad on page 27
Pentek Inc
See ad on back cover
Pleora Technologies Inc
Scalys
Shoghi Communications
Sital Technology
United Electronic Industries Inc

DATA BUSES AND NETWORKING - TACTICAL NETWORKS

Abaco Systems
ASAP 3Sixty
Crystal Group
Digital Systems Engineering Inc (DSE)
Dynatem
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
HD Barcode
Interface Concept
See ad on page 29
Milpower Source
See ad on page 25
MilSource
PALMARII Dynamics AB
Pentek Inc
See ad on back cover
Pleora Technologies Inc
Sealevel Systems
See ad on page 11
Shoghi Communications

DATA BUSES AND NETWORKING - WIRED NETWORKS

Alta Data Technologies
ASAP 3Sixty
AstroNova Aerospace
Axtrinet
Digital Systems Engineering Inc (DSE)
Dynatem
ECRIN Systems
esd electronics Inc
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Masterclock Inc
MilesTek

Milpower Source
See ad on page 25

MPL AG
New Wave Design and Verification
See ad on page 27
Pentek Inc
See ad on back cover
PIC Wire & Cable
Pleora Technologies Inc
Powell Electronics
TXO Systems Ltd

DATA BUSES AND NETWORKING - WIRELESS NETWORKS

ASAP 3Sixty
Cobham Antenna Systems
Dynatem
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Fair-Rite Products Corp
Gemstar Custom Hard Cases
Minoru Co Ltd
PALMARII Dynamics AB
Pentek Inc
See ad on back cover
Per Vices Corp
PIC Wire & Cable
Polarity Inc
Silvus Technologies Inc
Stratign
Triad RF Systems Inc
TXO Systems Ltd
UsedCisco.com

DATA STORAGE - DATA RECORDERS

Acromag Inc
See ad on page 10
Aitech
Ampex Data Systems
Annapolis Micro Systems Inc
See ad on page 34
Cepoint Networks LLC
Curtiss-Wright Defense Solutions
Data Device Corp (DDC)
Digital Systems Engineering Inc (DSE)
EDT | Engineering Design Team Inc
Falcon Electronics
Fischer Connectors Inc
GiDEL

Holt Integrated Circuits
See ad on page 19

New Wave Design and Verification
See ad on page 27
PCE Instruments UK Ltd
Pentek Inc
See ad on back cover
Phoenix International
See ad on page 39
RGB Spectrum
See ad on page 38
Sital Technology
United Electronic Industries Inc
ZMicro Inc

DATA STORAGE - OPTICAL MEMORY

Eureka Dry Tech
Pentek Inc
See ad on back cover
Zebra Technologies Corp

DATA STORAGE - RAID/ COMPUTER FARMS

Cepoint Networks LLC
Crystal Group
Curtiss-Wright Defense Solutions
Elma Electronic Inc
See ad on page 21
GiDEL
Pentek Inc
See ad on back cover
Phoenix International
See ad on page 39
Zebra Technologies Corp

DATA STORAGE - SOLID-STATE MEMORY

Aitech
Ampex Data Systems
ASAP 3Sixty
Cepoint Networks LLC
Curtiss-Wright Defense Solutions
Elma Electronic Inc
See ad on page 21
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Falcon Electronics
Greenliant
Intel Corp
Interface Concept
See ad on page 29
Orion Technologies LLC
Pentek Inc
See ad on back cover
Phoenix International
See ad on page 39
SMART Modular Technologies
Viking Technology
ZMicro Inc

DATA STORAGE - TAPE MEMORY

ASAP 3Sixty
Eureka Dry Tech
Pentek Inc
See ad on back cover
Phoenix International
See ad on page 39

FREQUENCY MANAGEMENT SYSTEMS

Computer2100 LLC
HUBER+SUHNER Inc
Pentek Inc
See ad on back cover
Per Vices Corp

COMPONENTS/ POWER ELECTRONICS/ SENSORS

ADHESIVES, ENCAPSULANTS AND BONDINGS

Alfa International
Arkema Inc
Diamond-MT
Electrolube
First Sensor Inc
Henkel Corp
Hexion Inc
Master Bond
Momentive Performance Materials Inc
NextGen Adhesives
Rudolph Bros & Co
Specialty Coating Systems
Techsil Ltd

COMPONENTS - ALTIMETERS

ASAP 3Sixty
ASAP Components
Dayton T Brown Inc
Lintech Components
Unlimited Purchasing

COMPONENTS - BACKPLANES

AbelConn LLC
ADCO Circuits
Aitech
ASAP Components
Atrenne Computing Solutions
CNC Center
Dawn VME Products
See ad on page 8
Diamond USA Inc
Diamond-MT
Elma Electronic Inc
See ad on page 21
Extreme Engineering Solutions (X-ES)
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General Micro Systems Inc
See ad on inside front cover

Interstate Connecting Components
See ad on page 13
LCR Embedded Systems
Orion Technologies LLC
Pixus Technologies
See ad on page 30
Schroff GmbH
Smiths Interconnect
SRCTec LLC
Trenton Systems Inc
TTI Inc

COMPONENTS - CIRCUIT BREAKERS

ASAP Components
CNC Center
Data Device Corp (DDC)
Dayton T Brown Inc
EMS Industrial & Service Co
Interstate Connecting Components
See ad on page 13
Lintech Components
Plane Parts 360

COMPONENTS - CONNECTORS

AbelConn LLC
Advanced Interconnections Corp
Aiconics
AirBorn Inc
Amphenol Industrial Products Group
API Technologies Corp
Applied Avionics
See ad on page 9
Aries Electronics inc
ASAP Components
Casey Machine Co
Cinch Connectivity Solutions
CNC Center
ConductRF
CUI Inc
Delphi Automotive LLP
Diamond USA Inc
Eaton
EMS Industrial & Service Co
Fairview Microwave Inc
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Fischer Connectors Inc
Hermetic Solutions Group
Hi-Tech Controls
HUBER+SUHNER Inc
Ibis Electro-Products Corp
Integra Technologies LLC
Interstate Connecting Components
See ad on page 13
Ironwood Electronics
LEMO SA
LEMO USA Inc
Lintech Components
March Electronics Inc
MilesTek
Mill-Max Mfg Corp
Minoru Co Ltd
Nelco Products
NextGen Adhesives
Nicomatic
NorComp
OFS
Omnetics Connector Corp
Pasternack
See ad on pages 5, 23
PIC Wire & Cable
Pickering Interfaces
Plane Parts 360
Powell Electronics
Quell Corp
Radiall USA
Sealcon LLC
Smiths Interconnect
SOURIAU
Southwest Microwave
SV Microwave
Timbercon Inc
Times Microwave Systems
Trendsetter Electronics
TTI Inc
Wiselink

COMPONENTS - CONTROL HEADS

ASAP Components
Casey Machine Co
Essex Industries
MRO Stock

COMPONENTS - ENCLOSURES AND CHASSIS

AbelConn LLC
AdTech Ceramics
Advanced Precision Engineering Inc
ASAP Components
Atrenne Computing Solutions
Cepoint Networks LLC
CNC Center
Crystal Group
Dawn VME Products
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Dayton T Brown Inc
EDT | Engineering Design Team Inc
Elma Electronic Inc
See ad on page 21
Eureka Dry Tech
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Gemstar Custom Hard Cases
General Micro Systems Inc
See ad on inside front cover
Hermetic Solutions Group
Hi-Tech Controls
HUBER+SUHNER Inc
Interstate Connecting Components
See ad on page 13
LCR Embedded Systems
LEMO SA
Orion Technologies LLC
Pickering Interfaces
Pixus Technologies
See ad on page 30
Schroff GmbH
Sealcon LLC
United Electronic Industries Inc
Verotec Inc

COMPONENTS - FASTENERS

ASAP Components
Casey Machine Co
Evans Co
Excelitas Technologies
Hi-Tech Controls
Lintech Components
Nelco Products
Nord-Lock Inc
Part Miner
Plane Parts 360
Sealcon LLC
Tef Cap Industries
Unlimited Purchasing

COMPONENTS - FIBER OPTICS

AirBorn Inc
AMOtronics
API Technologies Corp
ASAP Components
Bodkin Design & Engineering LLC
Diamond USA Inc
Excelitas Canada
Fibercore Ltd
Fischer Connectors Inc
H&L Instruments LLC
HUBER+SUHNER Inc
Ibis Electro-Products Corp
Interstate Connecting Components
See ad on page 13
Lacroix Precision Optics
LaserOptec
Lasertec Inc
LEMO SA
Lightel
Liteway Inc
LLC VTC BASPIK Ltd
Marktech Optoelectronics Inc
MilesTek
OFS
OPCO Laboratory
Photonchina Co Ltd
Powell Electronics
Timbercon Inc
TXO Systems Ltd

COMPONENTS - FILTERS/GASKETING

API Technologies Corp
ASAP Components
Lasertec Inc
Quell Corp
TTE Filters
Vicor Corp

COMPONENTS - FLIGHT INSTRUMENTS

Aero Dynamix Inc
Applied Avionics
See ad on page 9
ASAP Components
DLS Electronic Systems Inc
ESPEC North America | Qualmark
Momentum FPD Services Corp
Plane Parts 360

COMPONENTS - GYROSCOPES

Analog Devices Inc
Dexter Magnetic Technologies Inc
Gooch & Housego Plc
Jewell Instruments
Unlimited Purchasing
VectorNav Technologies

COMPONENTS - HOLD-DOWNS

Tef Cap Industries

COMPONENTS - HUMAN-MACHINE INTERFACES

Aero Dynamix Inc
Allied International
Applied Avionics
See ad on page 9
CNC Center
Dynatem
Eagle PLC
Epec Engineered Technologies
Essex Industries
Ibis Electro-Products Corp
Nicomatic
Pleora Technologies Inc

COMPONENTS - LATCHES AND HINGES

ASAP Components
Pixus Technologies
See ad on page 30

COMPONENTS - MEMS AND NANOTECHNOLOGY

AdTech Ceramics
Aerotech Inc
Analog Devices Inc
Crane Aerospace & Electronics
CUI Inc
Embassy Global
First Sensor Inc
Hi-Tech Controls
Ironwood Electronics
Jewell Instruments
LLC VTC BASPIK Ltd
Minoru Co Ltd
Powell Electronics
Silicon Designs Inc
TTI Inc
VectorNav Technologies

COMPONENTS - RADIATION-HARDENED COMPONENTS

Analog Devices Inc
API Technologies Corp
Cobham RAD Solutions
Cobham Semiconductor Solutions
Crane Aerospace & Electronics
Data Device Corp (DDC)
Falcon Electronics
Fibercore Ltd
IR HiRel - An Infineon Technologies Co
Linear Integrated Systems
Renesas Electronics Corp
Sensitron Semiconductor
Teledyne e2v
Trendsetter Electronics
VPT Inc
See ad on page 6

COMPONENTS - RELAYS

Applied Avionics
See ad on page 9
ASAP Components
Data Device Corp (DDC)
Delphi Automotive LLP
Falcon Electronics
Integra Technologies LLC
Interstate Connecting Components
See ad on page 13
IR HiRel - An Infineon Technologies Co
Lintech Components
Minoru Co Ltd
Pickering Interfaces
Powell Electronics
Sensitron Semiconductor
TTI Inc
Unlimited Purchasing
Wiselink

COMPONENTS - SWITCHES

Abaco Systems
Analog Devices Inc
Applied Avionics
See ad on page 9
ASAP Components
AstroNova Aerospace
Crystal Group
Custom MMIC
Data Device Corp (DDC)
Delphi Automotive LLP
Dynatem
ECRIN Systems
Electrolube
Embassy Global
EMS Industrial & Service Co
Essex Industries
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Fairview Microwave Inc
See ad on page 15
First Sensor Inc
Haydon Kerk Motion Solutions Inc
Hi-Tech Controls
Interstate Connecting Components
See ad on page 13
IR HiRel - An Infineon Technologies Co
Linear Integrated Systems
Lintech Components
Marktech Optoelectronics Inc
MilesTek
MilSource
MRO Stock
Nicomatic
OTTO

Pasternack
See ad on pages 5, 23
Pickering Interfaces
Powell Electronics
TTI Inc
TXO Systems Ltd
Wilbrecht LEDCO Inc

COMPONENTS - WIRE AND CABLE

Abaco Systems
Adaptive Innovations Corp
AirBorn Inc
Amphenol Industrial Products Group
AMWEI Thermistor Sensor
ASAP Components
Birk Manufacturing Inc
ConductRF
Diamond USA Inc
Eaton
Electro-Mech Components Inc
EMS Industrial & Service Co
Epec Engineered Technologies
ESAM Inc
Essex Industries
Fair-Rite Products Corp
Fairview Microwave Inc
See ad on page 15
Fischer Connectors Inc
Hi-Tech Controls
HUBER+SUHNER Inc
Ibis Electro-Products Corp
Indium Corp
Interstate Connecting Components
See ad on page 13
LEMO SA
LEMO USA Inc
MEGA Electronics Inc
MilesTek
Nelco Products
Nicomatic
NorComp
Pasternack
See ad on pages 5, 23
PIC Wire & Cable
Pickering Interfaces
Powell Electronics
Saelig Co Inc
Sealcon LLC
Smiths Interconnect
Southwest Microwave
SV Microwave
Tech Products Inc
Tef Cap Industries
Timbercon Inc
Times Microwave Systems
TTI Inc
TXO Systems Ltd
Venture Mfg Co
Wiselink

DISPLAYS - COCKPIT DISPLAYS

Aero Dynamix Inc
Applied Avionics
See ad on page 9
ASAP Components
Curtiss-Wright Defense Solutions
Digital Systems Engineering Inc (DSE)
Epec Engineered Technologies
ESPEC North America | Qualmark
General Atomics Aeronautical Systems Inc
Konica Minolta Sensing Americas Inc
Lintech Components
Momentum FPD Services Corp
Rogerson Kratos
Vicor Corp
ZMicro Inc

DISPLAYS - ELECTROLUMINESCENT (EL) DISPLAYS

Aero Dynamix Inc
Epec Engineered Technologies
Konica Minolta Sensing Americas Inc

DISPLAYS - ENHANCED/ SYNTHETIC VISION SYSTEMS

ZMicro Inc

DISPLAYS - HEADS-UP DISPLAYS

Digital Systems Engineering Inc (DSE)
Konica Minolta Sensing Americas Inc
Minoru Co Ltd
Pleora Technologies Inc
SwissOptic AG

DISPLAYS - HELMET-MOUNTED DISPLAYS (HMD)

PNY

DISPLAYS - IN-FLIGHT ENTERTAINMENT SYSTEM DISPLAYS

Cepoint Networks LLC
DLS Electronic Systems Inc
ESPEC North America | Qualmark
HUBER+SUHNER Inc
Momentum FPD Services Corp
Vicor Corp

DISPLAYS - LIQUID CRYSTAL DISPLAYS

Crystal Group
Digital Systems Engineering Inc (DSE)
Epec Engineered Technologies
ESPEC North America | Qualmark
Minoru Co Ltd
Momentum FPD Services Corp
TTI Inc

DISPLAYS - ORGANIC LIGHT-EMITTING DIODE (OLED) DISPLAYS

Konica Minolta Sensing Americas Inc
Lightstec Co Ltd
Marktech Optoelectronics Inc
TTI Inc

DISPLAYS - PLASMA DISPLAYS

ECRIN Systems

INTEGRATED CIRCUITS, ANALOG - BIPOLAR TRANSISTORS

ASAP Components
Device Engineering Inc
Falcon Electronics
IR HiRel - An Infineon Technologies Co
Linear Integrated Systems
SRCTec LLC
TTI Inc

INTEGRATED CIRCUITS, ANALOG - IGBTS

Advanced Cooling Technologies Inc (ACT)
Falcon Electronics
IR HiRel - An Infineon Technologies Co
Polarity Inc
Sensitron Semiconductor
SRCTec LLC
TTI Inc

INTEGRATED CIRCUITS, ANALOG - MOSFETS

Falcon Electronics

IR HiRel - An Infineon Technologies Co
Linear Integrated Systems
Micross
Polarity Inc
Renesas Electronics Corp
Sensitron Semiconductor
Trendsetter Electronics
TTI Inc

INTEGRATED CIRCUITS, ANALOG - PASSIVE COMPONENTS

Amphenol Industrial Products Group
API Technologies Corp
ConductRF
Crane Aerospace & Electronics
Data Device Corp (DDC)
Dexter Magnetic Technologies Inc
Evans Capacitor Co
See ad on page 17
Falcon Electronics
Gowanda Electronics
Hermetic Solutions Group
Holt Integrated Circuits
See ad on page 19
HUBER+SUHNER Inc
Lintech Components
March Electronics Inc
Micross
Nicomatic
PICO Electronics Inc
See ad on inside back cover
Trendsetter Electronics
TTE Filters
TTI Inc

INTEGRATED CIRCUITS, ANALOG - POWER DISCRETE DEVICES

API Technologies Corp
ASAP Components
Falcon Electronics
IR HiRel - An Infineon Technologies Co
Linear Integrated Systems
Lintech Components
Sensitron Semiconductor
Trendsetter Electronics
TTI Inc
Vicor Corp

INTEGRATED CIRCUITS, ANALOG - POWER INTEGRATED CIRCUITS

API Technologies Corp
Data Device Corp (DDC)
EMS Industrial & Service Co
Falcon Electronics
Holt Integrated Circuits
See ad on page 19
IR HiRel - An Infineon Technologies Co
Ironwood Electronics
Micross
Renesas Electronics Corp
Sensitron Semiconductor
SynQor Inc
See ad on page 7
Teledyne e2v
Trendsetter Electronics
Vicor Corp
VPT Inc
See ad on page 6

INTEGRATED CIRCUITS, ANALOG - RECTIFIERS

ASAP Components
Crane Aerospace & Electronics
Falcon Electronics
IR HiRel - An Infineon Technologies Co
Sensitron Semiconductor
Trendsetter Electronics
TTI Inc

INTEGRATED CIRCUITS, ANALOG - THYRISTORS

Falcon Electronics
Trendsetter Electronics
TTI Inc

INTEGRATED CIRCUITS, DIGITAL - A-D CONVERTERS

Cobham RAD Solutions
Cobham Semiconductor Solutions
Data Device Corp (DDC)
Falcon Electronics
General Micro Systems Inc
See ad on inside front cover
Micross
North Atlantic Industries Inc
See ad on page 43
Pentek Inc
See ad on back cover
Renesas Electronics Corp
Teledyne e2v
Trenton Systems Inc
United Electronic Industries Inc

INTEGRATED CIRCUITS, DIGITAL - ASICS

API Technologies Corp
Cobham Semiconductor Solutions
Data Device Corp (DDC)
Device Engineering Inc
Intel Corp
Micross
Pentek Inc
See ad on back cover

INTEGRATED CIRCUITS, DIGITAL - COMMUNICATIONS/ NETWORKING ICS

Analog Devices Inc
Cobham Semiconductor Solutions
Data Device Corp (DDC)
Device Engineering Inc
Falcon Electronics
Holt Integrated Circuits
See ad on page 19
Intel Corp
Milpower Source
See ad on page 25
New Wave Design and Verification
See ad on page 27
Pentek Inc
See ad on back cover
Unlimited Purchasing

INTEGRATED CIRCUITS, DIGITAL - D-A CONVERTERS

Applied Avionics
See ad on page 9
Data Device Corp (DDC)
Falcon Electronics

Micross

North Atlantic Industries Inc
See ad on page 43

Pentek Inc
See ad on back cover

Renesas Electronics Corp
Teledyne e2v
Trenton Systems Inc
United Electronic Industries Inc

INTEGRATED CIRCUITS, DIGITAL - DIGITAL SIGNAL PROCESSORS

Cobham Semiconductor Solutions
Device Engineering Inc
Ironwood Electronics

Pentek Inc
See ad on back cover

INTEGRATED CIRCUITS, DIGITAL - FPGAS

Cobham Semiconductor Solutions
Falcon Electronics
Intel Corp

Interface Concept
See ad on page 29

Ironwood Electronics
Lintech Components
Micross

New Wave Design and Verification
See ad on page 27

Opal Kelly Inc

Pentek Inc
See ad on back cover

Renesas Electronics Corp
Teledyne e2v
Xilinx

INTEGRATED CIRCUITS, DIGITAL - GENERAL-PURPOSE ICS

Analog Devices Inc
Cobham Semiconductor Solutions
Falcon Electronics

Pentek Inc
See ad on back cover

Renesas Electronics Corp
Teledyne e2v

INTEGRATED CIRCUITS, DIGITAL - GRAPHICS ICS

Pentek Inc
See ad on back cover

PNY
Trenton Systems Inc

INTEGRATED CIRCUITS, DIGITAL - IP CORES

Cobham Semiconductor Solutions

New Wave Design and Verification
See ad on page 27

Pentek Inc
See ad on back cover

Pleora Technologies Inc

INTEGRATED CIRCUITS, DIGITAL - MEMORY ICS

Cobham Semiconductor Solutions
Falcon Electronics
Greenliant
Micross

Pentek Inc
See ad on back cover

Teledyne e2v
Trenton Systems Inc
Viking Technology

INTEGRATED CIRCUITS, DIGITAL - MICROPROCESSORS/ MICROCONTROLLERS

Cobham Semiconductor Solutions
Coherent Logix Inc
Device Engineering Inc
Falcon Electronics
Integra Technologies LLC
Intel Corp
Ironwood Electronics
Micross
Part Miner

Pentek Inc
See ad on back cover

Teledyne e2v
Trendsetter Electronics
Trenton Systems Inc
Viking Technology

INTEGRATED CIRCUITS, DIGITAL - MIXED-SIGNAL ICS

Cobham Semiconductor Solutions
Falcon Electronics

Holt Integrated Circuits
See ad on page 19

Lintech Components
Micross

Pentek Inc
See ad on back cover

Renesas Electronics Corp
Teledyne e2v

INTEGRATED CIRCUITS, DIGITAL - NETWORK INTERFACE ICS

Data Device Corp (DDC)
Device Engineering Inc

Holt Integrated Circuits
See ad on page 19

Milpower Source
See ad on page 25

MRO Stock

New Wave Design and Verification
See ad on page 27

North Atlantic Industries Inc
See ad on page 43

Pentek Inc
See ad on back cover

Unlimited Purchasing

INTEGRATED CIRCUITS, DIGITAL - PERIPHERAL/ SUPPORT ICS

Device Engineering Inc

Holt Integrated Circuits
See ad on page 19

Pentek Inc
See ad on back cover

INTEGRATED CIRCUITS, DIGITAL - SOLID-STATE MEMORY

Device Engineering Inc
Falcon Electronics
Greenliant
Lintech Components

Pentek Inc
See ad on back cover

Viking Technology
Zebra Technologies Corp

POWER ELECTRONICS - ACTUATORS

Aerotech Inc
Allied Motion Technologies Inc
ASAP Components
Delphi Automotive LLP
Dexter Magnetic Technologies Inc
DLS Electronic Systems Inc
Haydon Kerk Motion Solutions Inc
Powell Electronics
Unlimited Purchasing
UTC Aerospace Systems
Velmex Inc
Venture Mfg Co

POWER ELECTRONICS - AUXILIARY POWER UNITS (APUS)

Nova Electric

SynQor Inc
See ad on page 7

Vicor Corp

POWER ELECTRONICS - BATTERIES

Ametek IntelliPower Inc
Cadex Electronics Inc
EaglePicher Technologies LLC
Epec Engineered Technologies

Milpower Source
See ad on page 25

Nova Electric
Power n Sun

SynQor Inc
See ad on page 7

POWER ELECTRONICS - CIRCUIT BREAKERS

CNC Center
Data Device Corp (DDC)
EMS Industrial & Service Co

Interstate Connecting Components
See ad on page 13

Lintech Components

Milpower Source
See ad on page 25

MRO Stock
Renesas Electronics Corp

POWER ELECTRONICS - EMERGENCY POWER UNITS

Allied International
Ametek IntelliPower Inc
EaglePicher Technologies LLC
EMS Industrial & Service Co
ESPEC North America | Qualmark
Nova Electric

SynQor Inc
See ad on page 7

Trendsetter Electronics

POWER ELECTRONICS - GENERATORS

Allied Motion Technologies Inc
EMS Industrial & Service Co
Power n Sun

POWER ELECTRONICS - INVERTERS/CONVERTERS

Allied International
Allied Motion Technologies Inc
Ametek IntelliPower Inc
API Technologies Corp
Chroma Systems Solutions Inc
Crane Aerospace & Electronics
Custom Manufacturing & Engineering Inc
Delphi Automotive LLP
Eagle PLC
EMS Industrial & Service Co
Excelitas Technologies
Fair-Rite Products Corp

General Micro Systems Inc
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LEMO USA Inc

Milpower Source
See ad on page 25

MRO Electric
Nova Electric
Polarity Inc
Power n Sun
Renesas Electronics Corp

SynQor Inc
See ad on page 7

Unitron LP
Viable Power Conversion Technologies
Vicor Corp

VPT Inc
See ad on page 6

POWER ELECTRONICS - MOTOR CONTROLLERS

Aerotech Inc
Allied Motion Technologies Inc
CNC Center
Crane Aerospace & Electronics
Data Device Corp (DDC)
Eagle PLC
Fair-Rite Products Corp
Haydon Kerk Motion Solutions Inc
IR HiRel - An Infineon Technologies Co
Modicon PLC
MRO Electric
MRO Stock

North Atlantic Industries Inc
See ad on page 43

Renesas Electronics Corp
Sensitron Semiconductor

SynQor Inc
See ad on page 7

United Electronic Industries Inc
Velmex Inc
Vicor Corp

POWER ELECTRONICS - MOTORS

Aerotech Inc
Allied Motion Technologies Inc
CNC Center
Diamond-MT
Eagle PLC
Haydon Kerk Motion Solutions Inc
Modicon PLC
MRO Electric
MRO Stock
Velmex Inc
Venture Mfg Co

POWER ELECTRONICS - POWER DISTRIBUTION SYSTEMS AND EQUIPMENT

Allied International
Allied Motion Technologies Inc
Ametek IntelliPower Inc
API Technologies Corp
CNC Center
Crane Aerospace & Electronics
Custom Manufacturing & Engineering Inc
Data Device Corp (DDC)
Delphi Automotive LLP
Diamond-MT
Eagle PLC
EMS Industrial & Service Co
Excelitas Technologies

IR HiRel - An Infineon Technologies Co
March Electronics Inc
Mech-Tronics

Modicon PLC
MRO Electric
MRO Stock
Nova Electric
Sensitron Semiconductor

Tech Products Inc
Trendsetter Electronics
Unitron LP
UTC Aerospace Systems
Versatile Power
Viable Power Conversion Technologies
Vicor Corp

POWER ELECTRONICS - POWER SUPPLIES

Advanced Test Equipment Rentals
Allied International
Ametek IntelliPower Inc
Analog Modules Inc
API Technologies Corp
ASAP Components
CAEN Spa
Chroma Systems Solutions Inc
CNC Center
Crane Aerospace & Electronics
CUI Inc
Custom Manufacturing & Engineering Inc
Data Device Corp (DDC)

Diversified Technologies Inc
Eagle PLC
EaglePicher Technologies LLC

EMS Industrial & Service Co
Epec Engineered Technologies
ESPEC North America | Qualmark

Excelitas Technologies

Fair-Rite Products Corp
Falcon Electronics
Henkel Corp
IR HiRel - An Infineon Technologies Co
Leonardo DRS
Lintech Components
Liteway Inc
Mech-Tronics
MEGA Electronics Inc

Modicon PLC
MRO Electric
MRO Stock

Nova Electric
Orion Technologies LLC

Polarity Inc
Reelcraft Industries Inc
Renesas Electronics Corp
Schroff GmbH
Sensitron Semiconductor

Technology Dynamics Inc
Trendsetter Electronics
United Electronic Industries Inc
Unitron LP
VersaLogic Corp
Versatile Power
Viable Power Conversion Technologies
Vicor Corp

POWER ELECTRONICS - TRANSDUCERS

Allied Motion Technologies Inc
Embassy Global

Powell Electronics
Renesas Electronics Corp
Trendsetter Electronics
Weschler Instruments

POWER ELECTRONICS - TRANSIENT VOLTAGE SUPPRESSORS

Fair-Rite Products Corp
Falcon Electronics
High Energy Devices LLC
Quell Corp
Sensitron Semiconductor

Technology Dynamics Inc

SENSORS - CHEMICAL ANALYZERS

Birk Manufacturing Inc
Headwall Photonics Inc
Pembroke Instruments LLC

SENSORS - INERTIAL

Allied International
Embassy Global
First Sensor Inc

Jewell Instruments
Pembroke Instruments LLC
Silicon Designs Inc
VectorNav Technologies

SENSORS - INFRARED/ ULTRAVIOLET

Bodkin Design & Engineering LLC
Boston Electronics Corp
CAEN Spa
Falcon Electronics
Fibercore Ltd
FLIR Systems Inc
Gigahertz-Optik Inc
Headwall Photonics Inc
Ibis Electro-Products Corp

Iscan Inc
Konica Minolta Sensing Americas Inc
Lasertec Inc

Optikos Corp
Opto Diode Corp
Palmer Wahl Instruments Inc
Pembroke Instruments LLC
Powell Electronics
Specialised Imaging Ltd
StingRay Optics LLC
SwissOptic AG
Thermo Scientific - CIDTEC
Thermoteknix Systems Ltd
UTC Aerospace Systems (Sensors Unlimited Products)

SENSORS - LADAR/LIDAR

AMOtronics
Analog Modules Inc
Areté
Boston Electronics Corp
Dexter Magnetic Technologies Inc
Excelitas Canada
Fair-Rite Products Corp
Fibercore Ltd
First Sensor Inc
General Atomics Aeronautical Systems Inc

Konica Minolta Sensing Americas Inc
Lacroix Precision Optics
Lightel
Optikos Corp
RPMC Lasers Inc
StingRay Optics LLC
Timbercon Inc
Vicor Corp

SENSORS - RADAR

Advanced Energy Industries Inc
Analog Devices Inc
CAEN Spa
Cambridge Pixel
Dexter Magnetic Technologies Inc
Dspnor AS
Fair-Rite Products Corp
Fibercore Ltd
General Atomics Aeronautical Systems Inc
Henkel Corp
HUBER+SUHNER Inc

Lockheed Martin

Per Vices Corp
Polarity Inc
SRCTec LLC
Systems & Technology Research
United Electronic Industries Inc

SENSORS - SONAR

Fair-Rite Products Corp
Fibercore Ltd
Henkel Corp

Kraken Robotic Systems

SENSORS - TACTILE

Fibercore Ltd

Powell Electronics

SENSORS - VISIBLE-LIGHT CAMERAS

Active Silicon Inc
Active Silicon Ltd
Adimec
Bodkin Design & Engineering LLC
Canon Medical Systems, USA, Video Sensing Division
Critical Link LLC
First Sensor Inc
GEViCAM Inc
Headwall Photonics Inc
Iscan Inc
ISVI Corp

Mega Speed Corp
Optikos Corp
Photron USA Inc
Radiant Vision Systems
Specialised Imaging Inc
Specialised Imaging Ltd
Thermo Scientific - CIDTEC
UTC Aerospace Systems (Sensors Unlimited Products)
Vision Components GmbH
XIMEA

COMPUTERS

AIR DATA COMPUTERS

Cepoint Networks LLC
Fair-Rite Products Corp

Plane Parts 360
Systel Rugged Computers
Wind River
ZMicro Inc

DESKTOP COMPUTERS

Cepoint Networks LLC
Dynamic Systems Inc
HD Barcode
MPL AG
NextComputing

PNY
Red Rapids
Zebra Technologies Corp

ELECTRONIC FLIGHT BAGS (EFTS)

Zebra Technologies Corp

EMBEDDED COMPUTERS

Abaco Systems

Active Silicon Inc
Active Silicon Ltd
ADL Embedded Solutions Inc
Alta Data Technologies

Atrenne Computing Solutions
Cepoint Networks LLC
Crystal Group
Data Device Corp (DDC)

Dawn VME Products
See ad on page 8
Dspnor AS
Dynatem
ECRIN Systems
Elma Electronic Inc
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esd electronics Inc
Eureka Dry Tech
Extreme Engineering Solutions (X-ES)
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Interface Concept
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LCR Embedded Systems
Matrox Imaging
Mercury Systems
Milpower Source
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MilSource
MPL AG
Neousys Technology Inc
NextComputing
North Atlantic Industries Inc
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Orion Technologies LLC
Pentek Inc
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Pixus Technologies
See ad on page 30
PNY
Scalys
Sealevel Systems
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Secord Solutions
Systel Rugged Computers
Technobox Inc
Trenton Systems Inc
United Electronic Industries Inc
VersaLogic Corp
Vision Components GmbH
Wibase Industrial Solutions
WIN Enterprises
ZMicro Inc

FLIGHT DIRECTORS

Pentek Inc
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UTC Aerospace Systems
Wind River

LAPTOPS/NOTEBOOKS/ HANDHELD COMPUTERS

Cepoint Networks LLC
Diamond-MT
ECRIN Systems
GRiD Defence Systems
Handheld US
HD Barcode
IBI Systems Inc
NextComputing
Pentek Inc
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Systel Rugged Computers
Wibase Industrial Solutions
Zebra Technologies Corp

MULTICOMPUTER SYSTEMS

Crystal Group
Elma Electronic Inc
See ad on page 21
esd electronics Inc
Forefronts Defense Systems
March Electronics Inc
Mercury Systems
Orion Technologies LLC
Pentek Inc
See ad on back cover
Pixus Technologies
See ad on page 30
PNY
Systel Rugged Computers
Trenton Systems Inc

RACK-MOUNT COMPUTERS

ADL Embedded Solutions Inc
Ampex Data Systems
AnD Cable Products Inc
Annapolis Micro Systems Inc
See ad on page 34
Atrenne Computing Solutions
Cepoint Networks LLC
Crystal Group
Dawn VME Products
See ad on page 8
Dynatem
ECRIN Systems
EDT | Engineering Design Team Inc
Elma Electronic Inc
See ad on page 21
esd electronics Inc
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
IBI Systems Inc
LCR Embedded Systems
Mercury Systems
MPL AG
NextComputing
Pentek Inc
See ad on back cover
Pixus Technologies
See ad on page 30
PNY
Sealevel Systems
See ad on page 11
Systel Rugged Computers
Trenton Systems Inc
Vicor Corp
Zebra Technologies Corp
ZMicro Inc

SERVERS

Ampex Data Systems
ANEXIO
Atrenne Computing Solutions
Cepoint Networks LLC
Crystal Group
Dynatem
ECRIN Systems
EDT | Engineering Design Team Inc
Elma Electronic Inc
See ad on page 21
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
General Micro Systems Inc
See ad on inside front cover
GRiD Defence Systems
Mercury Systems
MPL AG
Pentek Inc
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PNY
Red Rapids
Systel Rugged Computers
TeamEDA Inc
Trenton Systems Inc
Vicor Corp
ZMicro Inc

SPECIALIZED COMPUTERS - TEMPEST

Atrenne Computing Solutions
Elma Electronic Inc
See ad on page 21
Forefronts Defense Systems
GRiD Defence Systems
MPL AG
Orion Technologies LLC
Pentek Inc
See ad on back cover
Scalys
Systel Rugged Computers
Zebra Technologies Corp

WEARABLE COMPUTERS

Dynamic Systems Inc
Elma Electronic Inc
See ad on page 21
HD Barcode
Ironwood Electronics
Milpower Source
See ad on page 25
Minoru Co Ltd
VersaLogic Corp
Wearin' SA
Wibase Industrial Solutions
Zebra Technologies Corp

DIAGNOSTICS AND CONTROL

AVIONICS HEALTH MANAGEMENT

Applied Avionics
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Dawn VME Products
See ad on page 8
GRiD Defence Systems
MilesTek
Pentek Inc
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United Electronic Industries Inc

CLOCKS/TIMERS

AMOtronics
Applied Avionics
See ad on page 9
HUBER+SUHNER Inc
Masterclock Inc
Pentek Inc
See ad on back cover
RWC Testing & Lab Supplies
Trendsetter Electronics
Weschler Instruments

ENGINE CONTROLS

Ironwood Electronics
Pentek Inc
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PulseTech Products Corp
Unlimited Purchasing
UTC Aerospace Systems

ENGINE MONITORING

Crane Aerospace & Electronics
Fair-Rite Products Corp
PCE Instruments UK Ltd
Pentek Inc
See ad on back cover
Photron USA Inc
PulseTech Products Corp
United Electronic Industries Inc
Weschler Instruments

FUEL MANAGEMENT SYSTEMS

Crane Aerospace & Electronics
First Sensor Inc
Pentek Inc
See ad on back cover
Tef Cap Industries

HEALTH AND USAGE MONITORING (HUMS)

Dawn VME Products
See ad on page 8
Pentek Inc
See ad on back cover
TeamEDA Inc
United Electronic Industries Inc
Versatile Power

ICE DETECTION

Pentek Inc
See ad on back cover

OVERHEAT DETECTION

Dawn VME Products
See ad on page 8
Palmer Wahl Instruments Inc
PCE Instruments UK Ltd
Pentek Inc
See ad on back cover
Tef Cap Industries

ELECTRO-OPTICS

BONDING AND ADHESIVES

Alfa International
Berliner Glas KGaA Herbert Kubatz GmbH & Co
Electrolube
First Sensor Inc
Henkel Corp
Knight Optical
Master Bond
NextGen Adhesives
Rudolph Bros & Co
Techsil Ltd

CAMERAS

Accusy Photontech Ltd
Active Silicon Inc
Active Silicon Ltd
Adimec
Bodkin Design & Engineering LLC
Canon Medical Systems, USA, Video Sensing Division
e-con Systems India Pvt Ltd
First Sensor Inc
Gemstar Custom Hard Cases
General Atomics Aeronautical Systems Inc
GEViCAM Inc
Guernsey Coating Laboratories Inc
IO Industries Inc
IRnova AB
ISVI Corp
Matrox Imaging
Mega Speed Corp
NextGen Adhesives
OPCO Laboratory
Optikos Corp
Photonchina Co Ltd
Princeton Infrared Technologies Inc (PIRT)
Sierra Pacific Innovations
Teledyne DALSA
TNC Optics & Technologies Pte Ltd
UTC Aerospace Systems (Sensors Unlimited Products)
Vision Components GmbH
West Coast Tech Ltd
XIMEA
Zebra Technologies Corp

ELECTRO-OPTIC MATERIALS AND SUBSTRATES

Accusy Photontech Ltd
AdTech Ceramics
Advanced Precision Engineering Inc
Bodkin Design & Engineering LLC
Embassy Global
Gooch & Housego Plc
Ibis Electro-Products Corp
Infinite Optics Inc
Knight Optical
Lasertec Inc
LLC VTC BASPIK Ltd
MOK Optics Co Ltd
NextGen Adhesives

OPCO Laboratory
PG&O - Precision Glass & Optics
Reynard Corp
Vision Components GmbH
West Coast Tech Ltd

EQUIPMENT MANUFACTURING

Advanced Precision Engineering Inc
Birk Manufacturing Inc
Bodkin Design & Engineering LLC
IRnova AB
Lightel
OptoTest
Pentek Inc
See ad on back cover
Princeton Infrared Technologies Inc (PIRT)

FORWARD-LOOKING INFRARED SYSTEMS

Bodkin Design & Engineering LLC
IRnova AB
Lasertec Inc
Optikos Corp
Pentek Inc
See ad on back cover
Princeton Infrared Technologies Inc (PIRT)
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd

LASER COMPONENTS

Accusy Photontech Ltd
AdTech Ceramics
Advanced Precision Engineering Inc
Analog Modules Inc
Avo Photonics
Boston Electronics Corp
ESPEC North America | Qualmark
Evans Capacitor Co
See ad on page 17
Excelitas Canada
FARO Technologies Inc
Gooch & Housego Plc
Ibis Electro-Products Corp
Infinite Optics Inc
Knight Optical
Krell Technologies Inc
Kugler of America Ltd
Lacroix Precision Optics
LaserOptec
Lasertec Inc
Micro Laser Systems Inc
MOK Optics Co Ltd
NextGen Adhesives
OFS
OPCO Laboratory
Photonchina Co Ltd
Reynard Corp
RPMC Lasers Inc
Visotek Inc
West Coast Tech Ltd

LASERS

Accusy Photontech Ltd
Avo Photonics
Boston Electronics Corp
Electron Test Equipment
Excelitas Canada
Fibercore Ltd
General Atomics Aeronautical Systems Inc
Gooch & Housego Plc
Guernsey Coating Laboratories Inc
Konica Minolta Sensing Americas Inc
Krell Technologies Inc
LAS-CAD GmbH
Lasertec Inc
Micro Laser Systems Inc
NextGen Adhesives
OFS
OPCO Laboratory
RPMC Lasers Inc
SPI Lasers UK Ltd
Timbercon Inc
TNC Optics & Technologies Pte Ltd
West Coast Tech Ltd

LEDS

Applied Avionics
See ad on page 9
CAEN Spa
Dynotron
Electrolube
Embassy Global
Excelitas Canada
FoxFury Lighting Solutions
GS PLASTIC OPTICS
Konica Minolta Sensing Americas Inc
Lambda Research Corp
Marktech Optoelectronics Inc
Nicomatic
OPCO Laboratory
Opto Diode Corp
OSI OptoElectronics Inc
Wilbrecht LEDCO Inc
Wiselink

LIGHTING

Aero Dynamix Inc
Dynotron
ESPEC North America | Qualmark
FoxFury Lighting Solutions
Guernsey Coating Laboratories Inc
Infinite Optics Inc
Konica Minolta Sensing Americas Inc
MFG LED Lighting
Midstream Lighting
OPCO Laboratory
Power n Sun
Reynard Corp
TNC Optics & Technologies Pte Ltd
Versatile Power

NIGHT VISION

Accusy Photontech Ltd
Active Silicon Inc
Aero Dynamix Inc
Applied Avionics
See ad on page 9
Archer OpTx
Boston Electronics Corp
Digital Systems Engineering Inc (DSE)
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
Infinite Optics Inc
IRnova AB
JML Optical Industries LLC
Knight Optical
Konica Minolta Sensing Americas Inc
Lasertec Inc
Lensel Optics Pvt Ltd
LLC VTC BASPIK Ltd
MOK Optics Co Ltd
N-Vision Optics
OPCO Laboratory
Princeton Infrared Technologies Inc (PIRT)
Reynard Corp
Sierra Pacific Innovations
SwissOptic AG
Thermoteknix Systems Ltd
TNC Optics & Technologies Pte Ltd
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd
Wilbrecht LEDCO Inc

OPTICAL AMPLIFIERS

Custom MMIC
DEV Systemtechnik GmbH
OFS
Opto Diode Corp
OSI OptoElectronics Inc
Reynard Corp
RPMC Lasers Inc
Specialised Imaging Inc
Specialised Imaging Ltd

OPTICAL COATINGS/ TREATMENTS

Accusy Photontech Ltd
Archer OpTx
Deposition Sciences Inc (DSI)
Electrolube
Eureka Dry Tech
Gooch & Housego Plc
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
Incertec
Infinite Optics Inc
JML Optical Industries LLC
Knight Optical
Lacroix Precision Optics
LaserOptec
Lasertec Inc
Lensel Optics Pvt Ltd
Master Bond
MOK Optics Co Ltd
NextGen Adhesives
OPCO Laboratory
OSI OptoElectronics Inc
PG&O - Precision Glass & Optics
Reynard Corp
Rudolph Bros & Co
Specialty Coating Systems
SwissOptic AG
Timbercon Inc
West Coast Tech Ltd

OPTICAL DETECTORS

Accusy Photontech Ltd
Analog Modules Inc
aPeak Inc
Boston Electronics Corp
Canon Medical Systems, USA, Video Sensing Division
Changchun Long Ze Precision Optics Co Ltd
Excelitas Canada
Falcon Electronics
First Sensor Inc
Gigahertz-Optik Inc
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
JML Optical Industries LLC
Lasertec Inc
Marktech Optoelectronics Inc
NextGen Adhesives
Opto Diode Corp
OSI OptoElectronics Inc
Photron USA Inc
Princeton Infrared Technologies Inc (PIRT)
Radiant Vision Systems
Specialised Imaging Inc
Specialised Imaging Ltd
Thermo Scientific - CIDTEC
TNC Optics & Technologies Pte Ltd
UTC Aerospace Systems (Sensors Unlimited Products)

OPTICAL FIBER

Aerospace Aces
Alfa International
Archer OpTx
Delphi Automotive LLP
DEV Systemtechnik GmbH
Diamond USA Inc
Excelitas Canada
Guernsey Coating Laboratories Inc
Ibis Electro-Products Corp
Infinite Optics Inc
Interstate Connecting Components
See ad on page 13
Krell Technologies Inc
LEMO SA
Lightel
Micro Laser Systems Inc
MilesTek
NextGen Adhesives
OFS
OPCO Laboratory
Timbercon Inc
TNC Optics & Technologies Pte Ltd

OPTICAL FILTERS

Accusy Photontech Ltd
Archer OpTx
Deposition Sciences Inc (DSI)
Embassy Global
Guernsey Coating Laboratories Inc
Infinite Graphics Inc
Infinite Optics Inc
ISP Optics Corp
Knight Optical
Lacroix Precision Optics
LaserOptec
Lasertec Inc
Lensel Optics Pvt Ltd
MOK Optics Co Ltd
PG&O - Precision Glass & Optics
Reynard Corp
TNC Optics & Technologies Pte Ltd
West Coast Tech Ltd

OPTICAL IMAGING

Accusy Photontech Ltd
Active Silicon Inc
Archer OpTx
Bodkin Design & Engineering LLC
Boston Electronics Corp
Canon Medical Systems, USA, Video Sensing Division
Changchun Long Ze Precision Optics Co Ltd
GEViCAM Inc
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
H&L Instruments LLC
Headwall Photonics Inc
Infinite Graphics Inc
Infinite Optics Inc
IRnova AB
Iscan Inc
ISP Optics Corp
ISVI Corp
JML Optical Industries LLC
KEYENCE Corp of America
Lacroix Precision Optics
Lambda Research Corp
LaserOptec
Lasertec Inc
Lensel Optics Pvt Ltd

Logos Technologies LLC

NextGen Adhesives
OPCO Laboratory
Optikos Corp
Pentek Inc
See ad on back cover
Photron USA Inc
Princeton Infrared Technologies Inc (PIRT)
Radiant Vision Systems
Reynard Corp
Shoghi Communications
Specialised Imaging Inc
Specialised Imaging Ltd
StingRay Optics LLC
TNC Optics & Technologies Pte Ltd
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd

OPTICAL SWITCHES

Applied Avionics
See ad on page 9
DEV Systemtechnik GmbH
Elma Electronic Inc
See ad on page 21
Embassy Global
Falcon Electronics
Gooch & Housego Plc
HUBER+SUHNER Inc
Liteway Inc

Marktech Optoelectronics Inc
OptoTest
OSI OptoElectronics Inc
Pentek Inc
See ad on back cover
Pickering Interfaces

OPTICAL TRANSCEIVERS

Applied Optoelectronics Inc
DEV Systemtechnik GmbH
Elma Electronic Inc
See ad on page 21
Fibercore Ltd
H&L Instruments LLC
HUBER+SUHNER Inc
Interstate Connecting Components
See ad on page 13
New Wave Design and Verification
See ad on page 27
NextGen Adhesives
Pentek Inc
See ad on back cover
Timbercon Inc
TXO Systems Ltd

OPTICS

Accusy Photontech Ltd
Archer OpTx
Avo Photonics
Berliner Glas KGaA Herbert Kubatz GmbH & Co
Deposition Sciences Inc (DSI)
Embassy Global
Eureka Dry Tech
Fibercore Ltd
Gooch & Housego Plc
GS PLASTIC OPTICS
Guernsey Coating Laboratories Inc
Headwall Photonics Inc
Infinite Graphics Inc
Infinite Optics Inc
ISP Optics Corp
ISVI Corp
JML Optical Industries LLC
Knight Optical
Krell Technologies Inc
Kugler of America Ltd
Lacroix Precision Optics
Lambda Research Corp
LAS-CAD GmbH
LaserOptec
Lasertec Inc
Lensel Optics Pvt Ltd
LLC VTC BASPIK Ltd
Micro Laser Systems Inc
MOK Optics Co Ltd
N-Vision Optics
OPCO Laboratory
Optikos Corp
Pentek Inc
See ad on back cover
PG&O - Precision Glass & Optics
Photonchina Co Ltd
Radiant Vision Systems
Reynard Corp
StingRay Optics LLC
SwissOptic AG
Timbercon Inc
TNC Optics & Technologies Pte Ltd
UTC Aerospace Systems
UTC Aerospace Systems (Sensors Unlimited Products)
Visotek Inc
West Coast Tech Ltd

THERMAL IMAGING

Accusy Photontech Ltd
Active Silicon Inc
Advanced Test Equipment Rentals
Archer OpTx
Birk Manufacturing Inc
Bodkin Design & Engineering LLC
Boston Electronics Corp
Excelitas Canada
Guernsey Coating Laboratories Inc
Headwall Photonics Inc
Infinite Optics Inc
IRnova AB
ISP Optics Corp
Knight Optical
LaserOptec
Lasertec Inc
N-Vision Optics
Optikos Corp
PCE Instruments UK Ltd
Pentek Inc
See ad on back cover
Princeton Infrared Technologies Inc (PIRT)
Reynard Corp
Sierra Pacific Innovations
StingRay Optics LLC
Thermoteknix Systems Ltd
UTC Aerospace Systems (Sensors Unlimited Products)
West Coast Tech Ltd

ULTRAVIOLET LIGHT SOURCES

FoxFury Lighting Solutions
Gigahertz-Optik Inc
Lasertec Inc
Micro Laser Systems Inc
Opto Diode Corp
Reynard Corp
RPMC Lasers Inc
Techsil Ltd
Wilbrecht LEDCO Inc

NAVIGATION

AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) EQUIPMENT

Applied Avionics
See ad on page 9
Cepoint Networks LLC
Dexter Magnetic Technologies Inc
Pentek Inc
See ad on back cover
Shoghi Communications
SRCTec LLC

GPS SYSTEMS

Applied Avionics
See ad on page 9
Carolina Microwave Associates Inc
Cepoint Networks LLC
Dexter Magnetic Technologies Inc
ESPEC North America | Qualmark
Gemstar Custom Hard Cases
General Micro Systems Inc
See ad on inside front cover
HUBER+SUHNER Inc
Ironwood Electronics
Masterclock Inc
Pentek Inc
See ad on back cover
PIC Wire & Cable
Rohde & Schwarz USA Inc
Shoghi Communications
VectorNav Technologies

TERRAIN

Applied Avionics
See ad on page 9
Applied Physical Sciences Corp (APS)
Casey Machine Co
Pentek Inc
See ad on back cover
Pleora Technologies Inc

PLATFORM SYSTEMS/ SUBSYSTEMS

AUTOPILOTS

Jewell Instruments
Pentek Inc
See ad on back cover

AVIONICS

Abaco Systems
ADL Embedded Solutions Inc
Advanced Cooling Technologies Inc (ACT)
Advanced Precision Engineering Inc
Analog Devices Inc
Annapolis Micro Systems Inc
See ad on page 34
Applied Avionics
See ad on page 9
AstroNova Aerospace
Atrenne Computing Solutions
Crane Aerospace & Electronics
Crystal Group
Dayton T Brown Inc
Digital Systems Engineering Inc (DSE)
DLS Electronic Systems Inc
EaglePicher Technologies LLC
Elma Electronic Inc
See ad on page 21
ESPEC North America | Qualmark
Essex Industries
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Fair-Rite Products Corp
Holt Integrated Circuits
See ad on page 19
Interface Concept
See ad on page 29
Ironwood Electronics
Jewell Instruments
MilesTek
Momentum FPD Services Corp
New Wave Design and Verification
See ad on page 27
North Atlantic Industries Inc
See ad on page 43
Optikos Corp
Orion Technologies LLC
Pentek Inc
See ad on back cover
PIC Wire & Cable
Pixus Technologies
See ad on page 30
Plane Parts 360
Rogerson Kratos
Sensitron Semiconductor
Shoghi Communications
SynQor Inc
See ad on page 7
United Electronic Industries Inc
Unlimited Purchasing
UTC Aerospace Systems
VectorNav Technologies
Viable Power Conversion Technologies
Vicor Corp

CABIN MANAGEMENT SYSTEMS

Crane Aerospace & Electronics
DLS Electronic Systems Inc
Fair-Rite Products Corp
Pentek Inc
See ad on back cover
SynQor Inc
See ad on page 7
Tef Cap Industries
Unlimited Purchasing
UTC Aerospace Systems

COUNTERMEASURES

Annapolis Micro Systems Inc
See ad on page 34
Crystal Group
CTT Inc
Excelitas Technologies
HUBER+SUHNER Inc
Logos Technologies LLC
Mercury Systems
New Wave Design and Verification
See ad on page 27
Optikos Corp
Pentek Inc
See ad on back cover
Pleora Technologies Inc
Polarity Inc
Shoghi Communications
SynQor Inc
See ad on page 7
Viable Power Conversion Technologies

ELECTRONIC FLIGHT INSTRUMENT SYSTEMS (EFIS)

Analog Devices Inc
Birk Manufacturing Inc
Casey Machine Co
ESPEC North America | Qualmark
Fair-Rite Products Corp
Pentek Inc
See ad on back cover
Pixus Technologies
See ad on page 30
Rogerson Kratos
SynQor Inc
See ad on page 7
Wind River

LANDING SYSTEMS

Casey Machine Co
Crane Aerospace & Electronics
ESPEC North America | Qualmark
Pentek Inc
See ad on back cover
SynQor Inc
See ad on page 7
UTC Aerospace Systems

LIGHT MANAGEMENT SYSTEMS

Interface Concept
See ad on page 29
LaserOptec
Midstream Lighting
Pentek Inc
See ad on back cover
Radiant Vision Systems
SynQor Inc
See ad on page 7

LIGHTING

Aero Dynamix Inc
DLS Electronic Systems Inc
ESPEC North America | Qualmark
FoxFury Lighting Solutions
Midstream Lighting
SynQor Inc
See ad on page 7
UTC Aerospace Systems
Vicor Corp

NAVIGATION EQUIPMENT

Atrenne Computing Solutions

Crystal Group
CTT Inc
Dawn VME Products
See ad on page 8
Elma Electronic Inc
See ad on page 21
ESPEC North America | Qualmark
Henkel Corp
Interface Concept
See ad on page 29
Pentek Inc
See ad on back cover
SynQor Inc
See ad on page 7
VectorNav Technologies

SATELLITE SYSTEMS

Acroamatics Telemetry Systems
ADL Embedded Solutions Inc

Analog Devices Inc

Annapolis Micro Systems Inc
See ad on page 34
Berliner Glas KGaA Herbert Kubatz GmbH & Co
Birk Manufacturing Inc
Carolina Microwave Associates Inc
Casey Machine Co
Crane Aerospace & Electronics
DEV Systemtechnik GmbH
EaglePicher Technologies LLC
Elma Electronic Inc
See ad on page 21
ESPEC North America | Qualmark
Gemstar Custom Hard Cases
Henkel Corp
HUBER+SUHNER Inc
Optikos Corp
Pentek Inc
See ad on back cover
Shoghi Communications
StingRay Optics LLC
SynQor Inc
See ad on page 7

SECURITY SYSTEMS

Active Silicon Inc
Active Silicon Ltd
ADL Embedded Solutions Inc
Cepoint Networks LLC
Dspnor AS
Elma Electronic Inc
See ad on page 21
Fair-Rite Products Corp
GiDEL
Interface Concept
See ad on page 29

Logos Technologies LLC

Panel Built Inc
Pentek Inc
See ad on back cover
Scalys
Shoghi Communications
Southwest Microwave
StingRay Optics LLC
SynQor Inc
See ad on page 7

SHIPBOARD/MARITIME ELECTRONICS

Advanced Cooling Technologies Inc (ACT)
Aero Dynamix Inc
Ampex Data Systems
Annapolis Micro Systems Inc
See ad on page 34
Applied Avionics
See ad on page 9
Atrenne Computing Solutions
Carolina Microwave Associates Inc
Dawn VME Products
See ad on page 8
Dayton T Brown Inc
Digital Systems Engineering Inc (DSE)
Dspnor AS
Elma Electronic Inc
See ad on page 21
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Gemstar Custom Hard Cases
Henkel Corp
HUBER+SUHNER Inc
Interface Concept
See ad on page 29
Milpower Source
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New Wave Design and Verification
See ad on page 27
North Atlantic Industries Inc
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Orion Technologies LLC
Pentek Inc
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PIC Wire & Cable
PICO Electronics Inc
See ad on inside back cover
Pixus Technologies
See ad on page 30
RGB Spectrum
See ad on page 38
Smiths Interconnect
SynQor Inc
See ad on page 7
VersaLogic Corp
Viable Power Conversion Technologies

TRAINING AND SIMULATION

Ampex Data Systems
Delta Digital Video
Dspnor AS
Elma Electronic Inc
See ad on page 21
GDP Space Systems
Mercury Systems
New Wave Design and Verification
See ad on page 27
North Atlantic Industries Inc
See ad on page 43
Orion Technologies LLC
Pentek Inc
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Pixus Technologies
See ad on page 30
PNY
RGB Spectrum
See ad on page 38
Shoghi Communications
SynQor Inc
See ad on page 7
United Electronic Industries Inc
Viable Power Conversion Technologies

UNMANNED VEHICLES

Active Silicon Inc
Active Silicon Ltd
ADL Embedded Solutions Inc
Allied Motion Technologies Inc
Ampex Data Systems
Annapolis Micro Systems Inc
See ad on page 34
Archer OpTx
Atrenne Computing Solutions
Bell
Carolina Microwave Associates Inc
Casey Machine Co
CTT Inc
Dawn VME Products
See ad on page 8
Delta Digital Video
EaglePicher Technologies LLC
Elma Electronic Inc
See ad on page 21
ESPEC North America | Qualmark
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
Fair-Rite Products Corp
FLIR Systems Inc
GiDEL
Henkel Corp
Holt Integrated Circuits
See ad on page 19
HUBER+SUHNER Inc
Logos Technologies LLC
New Wave Design and Verification
See ad on page 27
North Atlantic Industries Inc
See ad on page 43
Orion Technologies LLC
PALMARII Dynamics AB
Pelorus Naval Systems Inc
Pentek Inc
See ad on back cover
Pixus Technologies
See ad on page 30
Sensitron Semiconductor
Shoghi Communications
StingRay Optics LLC
SynQor Inc
See ad on page 7
Triad RF Systems Inc
United Electronic Industries Inc
VectorNav Technologies
Viable Power Conversion Technologies
Wind River
Zebra Technologies Corp

VETRONICS

Applied Avionics
See ad on page 9
Atrenne Computing Solutions
Dawn VME Products
See ad on page 8
Digital Systems Engineering Inc (DSE)
Elma Electronic Inc
See ad on page 21
Holt Integrated Circuits
See ad on page 19
North Atlantic Industries Inc
See ad on page 43
Orion Technologies LLC
Pentek Inc
See ad on back cover
Pleora Technologies Inc
Sensitron Semiconductor
SynQor Inc
See ad on page 7

WEATHER SYSTEMS

Birk Manufacturing Inc
Columbia Weather Systems Inc
PCE Instruments UK Ltd
Pentek Inc
See ad on back cover
Pixus Technologies
See ad on page 30
SynQor Inc
See ad on page 7

WEIGHT AND BALANCE SYSTEMS

SynQor Inc
See ad on page 7

RF AND MICROWAVE

AMPLIFIERS

Advanced Test Equipment Rentals

Analog Devices Inc

Analog Modules Inc
API Technologies Corp
AR Modular RF
CTT Inc
Custom MMIC
DEV Systemtechnik GmbH
Dexter Magnetic Technologies Inc
Fair-Rite Products Corp
Fairview Microwave Inc
See ad on page 15
Falcon Electronics
GPS Networking
I2R Electronics
Interstate Connecting Components
See ad on page 13
Mercury Systems
Micross
NuWaves Engineering
Pasternack
See ad on pages 5, 23
Pickering Interfaces
Polarity Inc
Powell Electronics
Pro-Comm Inc
Renesas Electronics Corp
RFMW
Triad RF Systems Inc
WDS Radar
Wiselink

ANTENNAS

Advanced Test Equipment Rentals
Analog Devices Inc
API Technologies Corp
ASAP Aerospace Hub
Carolina Microwave Associates Inc
Cobham Antenna Systems
Cubic Corp
Dexter Magnetic Technologies Inc
Fair-Rite Products Corp
Fairview Microwave Inc
See ad on page 15
GPS Networking
Henkel Corp
HUBER+SUHNER Inc
I2R Electronics
Infinite Electronics Inc
Interstate Connecting Components
See ad on page 13
Masterclock Inc
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
PIC Wire & Cable
Powell Electronics
Radiall USA
RFMW
Rohde & Schwarz USA Inc
Southwest Microwave

BONDING AND ADHESIVES

Alfa International
Electrolube
Henkel Corp
Indium Corp
Master Bond
NextGen Adhesives
Rudolph Bros & Co
Techsil Ltd

DIPLEXERS/ MULTIPLEXERS

Apex Waves
API Technologies Corp
Carolina Microwave Associates Inc
DEV Systemtechnik GmbH
Fairview Microwave Inc
See ad on page 15
NuWaves Engineering
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Pickering Interfaces
RFMW
TTE Filters

DISCRETE COMPONENTS

Analog Devices Inc

ASAP Aerospace Hub
Cobham Antenna Systems
Fairview Microwave Inc
See ad on page 15
Falcon Electronics
Gooch & Housego Plc
Gowanda Electronics
HUBER+SUHNER Inc
Integra Technologies LLC
IR HiRel - An Infineon Technologies Co
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Powell Electronics
RFMW
Trendsetter Electronics
Wiselink

FILTERS

Analog Devices Inc
API Technologies Corp
ASAP Aerospace Hub
Carolina Microwave Associates Inc
Cobham Antenna Systems
Dexter Magnetic Technologies Inc
Fairview Microwave Inc
See ad on page 15
Gooch & Housego Plc
GPS Networking
Interstate Connecting Components
See ad on page 13
Keysight Technologies Inc
March Electronics Inc
Mixed Signal Integration Corp
NTS Technical Systems
NuWaves Engineering
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Powell Electronics
Quell Corp
RFMW
SynQor Inc
See ad on page 7
TTE Filters

FREQUENCY SYNTHESIZERS

Analog Devices Inc
Fairview Microwave Inc
See ad on page 15
I2R Electronics
Masterclock Inc
NuWaves Engineering
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
RFMW
Saelig Co Inc

HYBRIDS

API Technologies Corp
Fairview Microwave Inc
See ad on page 15
Falcon Electronics
I2R Electronics
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
RFMW
Wiselink

MICROWAVE SUBASSEMBLIES

Analog Devices Inc
API Technologies Corp
Carolina Microwave Associates Inc
ConductRF
CTT Inc
Fairview Microwave Inc
See ad on page 15
Gowanda Electronics
Hermetic Solutions Group
HUBER+SUHNER Inc
I2R Electronics
Mercury Systems
NuWaves Engineering
Pentek Inc
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Pickering Interfaces
Pro-Comm Inc
Technotronix Inc
Teledyne Storm Microwave
The Phoenix Co of Chicago Inc & Affiliated Cos
Triad RF Systems Inc
TTE Filters
Wiselink

MIXED-SIGNAL DEVICES

Apex Waves
API Technologies Corp
Cobham Antenna Systems
Fairview Microwave Inc
See ad on page 15
Falcon Electronics
Mercury Systems
Mixed Signal Integration Corp
Nicomatic
Pentek Inc
See ad on back cover
Per Vices Corp
RFMW
SRCTec LLC

MMICS

AdTech Ceramics

Analog Devices Inc

API Technologies Corp
Custom MMIC
Fairview Microwave Inc
See ad on page 15
HRL Laboratories LLC
I2R Electronics
Pentek Inc
See ad on back cover
RFMW
Tomahawk Robotics

OSCILLATORS/ SYNTHESIZERS

Analog Devices Inc
API Technologies Corp
ASAP Aerospace Hub
Device Engineering Inc
Fairview Microwave Inc
See ad on page 15
Falcon Electronics
I2R Electronics
Masterclock Inc
Mixed Signal Integration Corp
NuWaves Engineering
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Pro-Comm Inc
RFMW

RF ATTENUATORS

Analog Devices Inc
Anritsu
API Technologies Corp
Carolina Microwave Associates Inc
Cobham Antenna Systems
Custom MMIC
DEV Systemtechnik GmbH
Fair-Rite Products Corp
Fairview Microwave Inc
See ad on page 15
Gooch & Housego Plc
GPS Networking
Keysight Technologies Inc
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Pickering Interfaces
Powell Electronics
Radiall USA
RFMW
SV Microwave
Wiselink

RF PACKAGING

AdTech Ceramics
Analog Devices Inc
API Technologies Corp
Aries Electronics inc
Fairview Microwave Inc
See ad on page 15
First Level Inc
Gemstar Custom Hard Cases
Hermetic Solutions Group
Indium Corp
Integra Technologies LLC
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Pixus Technologies
See ad on page 30
Tech Products Inc

RF SWITCHES

Analog Devices Inc
API Technologies Corp
ConductRF
DEV Systemtechnik GmbH
Electro-Mech Components Inc
Elma Electronic Inc
See ad on page 21
Fairview Microwave Inc
See ad on page 15
Gooch & Housego Plc
Interstate Connecting Components
See ad on page 13
Keysight Technologies Inc
Liteway Inc
Mercury Systems
MilesTek
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Pickering Interfaces
Polarity Inc
Powell Electronics
Radiall USA
RFMW
Technotronix Inc
ViaLite Communications

SIGNAL GENERATORS

Advanced Test Equipment Rentals
AMOtronics
Analog Devices Inc
Anritsu
Apex Waves
API Technologies Corp
ASAP Aerospace Hub
Berkeley Nucleonics Corp
Computer2100 LLC
Fairview Microwave Inc
See ad on page 15
Keysight Technologies Inc
Masterclock Inc
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Per Vices Corp
Pickering Interfaces
Pro-Comm Inc
Rohde & Schwarz USA Inc
Saelig Co Inc
Transient Specialists

TRANSMIT/RECEIVE MODULES

Acroamatics Telemetry Systems
Analog Devices Inc
API Technologies Corp
ASAP Aerospace Hub
CTT Inc
DEV Systemtechnik GmbH
Device Engineering Inc
Elma Electronic Inc
See ad on page 21
Fairview Microwave Inc
See ad on page 15
GDP Space Systems
Henkel Corp
HUBER+SUHNER Inc
I2R Electronics
NuWaves Engineering
Pasternack
See ad on pages 5, 23
Pentek Inc
See ad on back cover
Per Vices Corp
Powell Electronics
RFMW
Triad RF Systems Inc

UP/DOWN CONVERTERS

Analog Devices Inc
Apex Waves
API Technologies Corp
CTT Inc
EDT | Engineering Design Team Inc
Fairview Microwave Inc
See ad on page 15
I2R Electronics
Ironwood Electronics
MEGA Electronics Inc
Mixed Signal Integration Corp
NuWaves Engineering
Pasternack
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Pentek Inc
See ad on back cover
Per Vices Corp
PICO Electronics Inc
See ad on inside back cover
Polarity Inc
Red Rapids
RFMW
Triad RF Systems Inc

SAFETY EQUIPMENT AND COMPONENTS

ALARM SYSTEMS

Applied Avionics
See ad on page 9
Graphic Products
Pentek Inc
See ad on back cover
Plane Parts 360
Puleo Electronics Inc

ALTITUDE ALERTS

Applied Avionics
See ad on page 9
Dayton T Brown Inc

ANTI-ICING EQUIPMENT

Dayton T Brown Inc
Plane Parts 360
UTC Aerospace Systems

ANTI-STATIC EQUIPMENT

Dayton T Brown Inc
Eureka Dry Tech
Minoru Co Ltd
Quell Corp
Reelcraft Industries Inc
Tef Cap Industries

COLLISION AVOIDANCE SYSTEMS

Applied Avionics
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Pentek Inc
See ad on back cover

EMERGENCY LOCATOR TRANSMITTERS (EFTS)

Pentek Inc
See ad on back cover

EMI/RFI

Advanced Test Equipment Rentals
API Technologies Corp
Clark Testing
ConductRF
Dayton T Brown Inc
Elma Electronic Inc
See ad on page 21
EMCCons Dr Rasek GmbH & Co KG
EMS Industrial & Service Co
Epec Engineered Technologies
Fair-Rite Products Corp
Fairview Microwave Inc
See ad on page 15
Gemstar Custom Hard Cases
Hi-Tech Controls
Minoru Co Ltd
Nicomatic
Pentek Inc
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Quell Corp
SynQor Inc
See ad on page 7
Techsil Ltd

FIRE DETECTION

Applied Avionics
See ad on page 9
Brook One Corp
Pentek Inc
See ad on back cover
Stat-X Fire Suppression

STALL WARNING

Applied Avionics
See ad on page 9
Pentek Inc
See ad on back cover

TERRAIN AWARENESS WARNING SYSTEMS (TAWS)

Applied Avionics
See ad on page 9
Pentek Inc
See ad on back cover

WINDSHEAR WARNING SYSTEMS

Applied Avionics
See ad on page 9
Pentek Inc
See ad on back cover

SERVICES

ASSEMBLY/ SUBCONTRACT SERVICES

AbelConn LLC
Adaptive Innovations Corp
ADCO Circuits
Advanced Component Testing
Advanced Precision Engineering Inc
Alfa International
aPeak Inc
Atrenne Computing Solutions
Avo Photonics
Berliner Glas KGaA Herbert Kubatz GmbH & Co
Carolina Microwave Associates Inc
Cobham RAD Solutions
Cobham Semiconductor Solutions
ConductRF
CTT Inc
Custom Manufacturing & Engineering Inc
Electro-Mech Components Inc
EMCCons Dr Rasek GmbH & Co KG
EMS Industrial & Service Co
ESAM Inc
Essex Industries
Fischer Connectors Inc
Gemstar Custom Hard Cases
GS PLASTIC OPTICS
HUBER+SUHNER Inc
Integra Technologies LLC
Interstate Connecting Components
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Jewell Instruments
John Evans' Sons
Knight Optical
Lensel Optics Pvt Ltd
March Electronics Inc
Master Bond
Micross
Nelson Design Services Inc
Nicomatic
Nova Electric
NTS Technical Systems
NuWaves Engineering
Optikos Corp
Pentek Inc
See ad on back cover
Photonchina Co Ltd
PIC Wire & Cable
Polarity Inc
Powell Electronics
Pro-Comm Inc
Reynard Corp
Sealcon LLC
Secord Solutions
Specialty Coating Systems
SRCTec LLC
SwissOptic AG
Teledyne e2v
United Electronic Industries Inc
Viable Power Conversion Technologies
Visotek Inc

CALIBRATION SERVICES

aPeak Inc
Custom Manufacturing & Engineering Inc
Eastern Applied Research Inc
EMCCons Dr Rasek GmbH & Co KG
ESPEC North America | Qualmark
Keysight Technologies Inc
Mahr Inc
Monocle Industries
Optikos Corp
OptoTest
Palmer Wahl Instruments Inc
Pentek Inc
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Radiant Vision Systems
Rohde & Schwarz USA Inc
SRCTec LLC

CONSULTANTS

Adaptive Innovations Corp
AEi Systems
Alfa International
Americon
AnD Cable Products Inc
Annapolis Micro Systems Inc
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Archer OpTx
Bodkin Design & Engineering LLC
Concurrent Technologies
Dayton T Brown Inc
Deloitte
Diamond-MT
DLS Electronic Systems Inc
ECRIN Systems
Embassy Global
EMCCons Dr Rasek GmbH & Co KG
Forefronts Defense Systems
GL Communications Inc
Graphic Products
Green Hills Software Inc
Industrial Training Consultants Inc
Infinite Graphics Inc
Integra Technologies LLC
Logos Technologies LLC
Nelson Design Services Inc
NTS Technical Systems
NuWaves Engineering
PALMARII Dynamics AB
Pelorus Naval Systems Inc
Pentek Inc
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Puleo Electronics Inc
R Blaine Industries Inc
Secord Solutions
Specialised Imaging Inc
Specialised Imaging Ltd
Sunrez Corp
TeamEDA Inc
The Light Brigade Inc
Triad RF Systems Inc
TXO Systems Ltd
Viking Equipment Finance
Visotek Inc

DESIGN ENGINEERING

Active Silicon Inc
ADCO Circuits
ADL Embedded Solutions Inc
AEi Systems
Aero Dynamix Inc
Alfa International
Allied Motion Technologies Inc
Americon
AMOtronics
Annapolis Micro Systems Inc
See ad on page 34
aPeak Inc
API Technologies Corp
Archer OpTx
Avo Photonics
Birk Manufacturing Inc
Carolina Microwave Associates Inc
Clark Testing
Concurrent Technologies
Critical Link LLC
Custom Manufacturing & Engineering Inc
D6 Industries Inc
Dawn VME Products
See ad on page 8
Dayton T Brown Inc
Digital Systems Engineering Inc (DSE)
DLS Electronic Systems Inc
Dynatem
ECRIN Systems
EDT | Engineering Design Team Inc
EMS Industrial & Service Co
Epec Engineered Technologies
Extreme Engineering Solutions (X-ES)
See ad on pages 3, 41
First Sensor Inc
Gemstar Custom Hard Cases
Hermetic Solutions Group
Infinite Optics Inc
InfoSight Corp
Integra Technologies LLC
Interface Concept
See ad on page 29
Jewell Instruments
John Evans' Sons
Leidos
Lensel Optics Pvt Ltd

Logos Technologies LLC

Micross
New Wave Design and Verification
See ad on page 27
Nicomatic
NorComp
North Atlantic Industries Inc
See ad on page 43
Northrop Grumman Corp
NTS Technical Systems
NuWaves Engineering
Optikos Corp
OptoTest
Orion Technologies LLC
PALMARII Dynamics AB
Pelorus Naval Systems Inc
Pentek Inc
See ad on back cover
Per Vices Corp
PIC Wire & Cable
Pixus Technologies
See ad on page 30
Polarity Inc
Puleo Electronics Inc
R Blaine Industries Inc
Raytheon Technologies Corp
Renesas Electronics Corp
Reynard Corp
Rogerson Kratos
Scalys
Secord Solutions
Southwest Microwave
SRCTec LLC
StingRay Optics LLC
TeamEDA Inc
Teledyne e2v
Viable Power Conversion Technologies
Vision Components GmbH
VPT Inc
See ad on page 6
WOLF Advanced Technology

DISTRIBUTORS

Acromag Inc
See ad on page 10
Aerospace Aces
Allied International

CNC Center
Eagle PLC
EMS Industrial & Service Co
Falcon Electronics
Interstate Connecting Components
See ad on page 13
LaserOptec
Lintech Components
Mahr Inc
Micross
Modicon PLC
MRO Electric
MRO Stock
Nelco Products
Pentek Inc
See ad on back cover
Powell Electronics
Saelig Co Inc
Sealcon LLC
STI Electronics Inc
Unlimited Purchasing
Weschler Instruments

SOFTWARE

APPLICATIONS

AdaCore
Annapolis Micro Systems Inc
See ad on page 34
C3.ai
Computer2100 LLC
Cuelogic Technologies
Dspnor AS
Dynamic Systems Inc
esd electronics Inc
GiDEL
HD Barcode
iBASEt
Infinite Graphics Inc
Ironwood Electronics
Pentek Inc
See ad on back cover
Photron USA Inc
Puleo Electronics Inc
Science Applications International Corp (SAIC)
Secord Solutions
TeamEDA Inc
United Electronic Industries Inc
Vision Components GmbH
Wind River

COMMUNICATIONS/ NETWORKING

Acroamatics Telemetry Systems
Critical Link LLC
Cuelogic Technologies
Dynatem
esd electronics Inc
GDP Space Systems
GL Communications Inc
Green Hills Software Inc
H&L Instruments LLC
HD Barcode
iBASEt
Interface Concept
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New Wave Design and Verification
See ad on page 27
Pentek Inc
See ad on back cover
Pleora Technologies Inc
Puleo Electronics Inc
SYSGO
Wind River
Zebra Technologies Corp

DATA SECURITY

Ampex Data Systems
Annapolis Micro Systems Inc
See ad on page 34
Cuelogic Technologies
Dynatem
Green Hills Software Inc
Kitware Inc
Pentek Inc
See ad on back cover
Shoghi Communications
Sital Technology
Wind River
Zebra Technologies Corp

DATABASE MANAGEMENT

Cuelogic Technologies
Pentek Inc
See ad on back cover
Secord Solutions
TeamEDA Inc
UTC Aerospace Systems

DATABASES

Cuelogic Technologies
Pentek Inc
See ad on back cover
Secord Solutions
TeamEDA Inc

DESIGN AND DEVELOPMENT TOOLS

AdaCore
AEi Systems
Annapolis Micro Systems Inc
See ad on page 34
Cuelogic Technologies
Data Device Corp (DDC)
Dynatem
GiDEL
Green Hills Software Inc
Hitex GmbH
Infinite Graphics Inc
Keysight Technologies Inc
Lambda Research Corp
LAS-CAD GmbH
Marvin Test Solutions Inc
MilesTek
Pentek Inc
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Radiant Vision Systems
TeamEDA Inc
Unified Infotech
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Wiselink; Singapore, www.wiselink.com.sg

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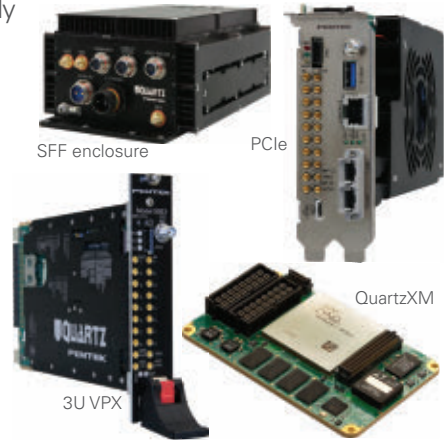

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