

MARCH 2019

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## New directions in shipboard electronics

Navy pushes shipboard unmanned systems and lethality upgrades. **PAGE 12**

## Small-form-factor embedded computing

Small boards can be as small as business cards to cram performance into small spaces. **PAGE 22**

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## THE 2019 MILITARY ELECTRONICS BUYERS GUIDE

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# Rugged Networking ON THE Tactical Edge

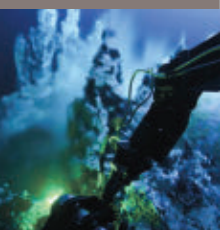
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Traditional bus-and-board embedded computing architectures are giving way to extremely small boards that can be as small as business cards — sometimes as small as postage stamps — to cram performance into small spaces.

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# Navy eyes large autonomous submarines for reconnaissance and special operations

The U.S. Navy is heading in the direction of large unmanned submarines able to act as motherships for different kinds of unmanned underwater, surface, and aerial vehicles for undersea surveillance and special operations missions.

The U.S. Naval Sea Systems Command in Washington announced a \$43 million order last month to the Boeing Defense, Space & Security segment in Huntington Beach, Calif., to build four Orca Extra-Large Unmanned Undersea Vehicles (XLUUVs).

What this could mean in practice could stretch limits of the imagination. Large autonomous undersea vessels like these could launch, recover, and recharge several different surveillance UUVs, infiltrate Navy SEALs and other special operations warfighters into contested marine areas, and even launch expendable surveillance unmanned aircraft near valuable enemy targets.

The Lockheed Martin Rotary and Mission Systems segment in Riviera Beach, Fla., also is designing prototype Orca XLUUV systems.

One thing's clear: top Navy leaders like the idea of big autonomous submarines, and they're bound to order more of them soon.

U.S. military experts have been working on a large autonomous submersible mothership for the past several years, spearheaded by the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

As far back as 2013, DARPA was asking industry to develop an unmanned submersible designed to transport and deploy unmanned aerial vehicles (UAVs) and unmanned underwater vehicles (UUVs) stealthily close to enemy operations as part of the Hydra program.

In 2015 DARPA asked industry to develop a payload-delivery system from an extra-large UUV, as part of the Hunter program. Hunter payloads were envisioned as persistent-surveillance sensors, weapons, or other UUVs and UAVs.

Also that year, the Boeing Co. and Lockheed Martin Corp. were involved in a DARPA project called Blue Wolf to develop revolutionary underwater propulsion and drag-reduction technologies to enable manned and unmanned military undersea vehicles to move through the water faster and more energy-efficiently than ever before.

Lockheed Martin also has done work for the U.S. Special Operations Command (SOCOM) Dry Combat Submersible (DCS) program to design an affordable mini-submarine able to transport Special Operations combat swimmers such as Navy SEALs covertly while minimizing swim time to keep the divers from becoming too exhausted to carry out their missions.

With last month's order to Boeing for four Orca Extra-Large Unmanned Undersea Vehicles (XLUUVs), apparently much of the research necessary

to projects like this to fruition is winding up, and now it's time for production. Notice the order came from Naval Sea Systems Command, which primarily is involved with deployable Navy surface ships and submarines, not in research to develop enabling technologies.

The modular-construction Boeing Orca XLUUVs will be open-architecture reconfigurable UUVs able to provide autonomous guidance and control, navigation, situational awareness, communications, power distribution, energy and power, propulsion and maneuvering, and mission sensors, Navy officials say.

The new large UUVs will have well-defined interfaces for cost-effective future upgrades to capitalize on advances in technology and respond to threat changes.

Boeing is building these large UUVs in Huntington Beach, City of Industry, El Cajon, and Ontario Calif.; Virginia Beach, Va.; Waukesha, Wis.; East Aurora and Farmingdale, N.Y.; Concord and Attleboro, Mass.; Camden and Fairfield, N.J.; and Smithfield, Pa. The four new Orca XLUUVs should be ready by June 2022.

It's not clear yet which segments of the Navy will be responsible for deploying and operating the Orca XLUUVs, or how these large autonomous submersible vessels will operate in the Navy's chain of command. One thing we do know: we'll see a lot more of these before too long. ◀



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## Thales-Raytheon to build 50 AN/MPQ-64 Enhanced Sentinel A3 radar systems

RF and microwave experts at Thales-Raytheon Systems Company LLC in Fullerton, Calif., will build 50 AN/MPQ-64 Enhanced Sentinel A3 radar systems under terms of a \$51.9 million contract. Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., are asking Thales-Raytheon to provide these radars for persistent air surveillance and fire control to protect against unmanned aerial vehicles (UAVs), cruise missiles, fixed-wing aircraft, and helicopters. Thales-Raytheon Systems is a 50-50 joint venture between Raytheon Co. and Thales Group. It is co-headquartered in Paris and Fullerton, Calif. The Enhanced Sentinel radar uses an X-Band 360-degree phased array air-defense radar with a 46-mile range. It has electronic counter-counter-measure capabilities, a Mode 5 identification friend or foe subsystem, and non-cooperative target recognition capabilities to identify threat aircraft. Sentinel, its generator, and command-and-control interface mount on a trailer that a M1082 truck can pull. The air-defense system interfaces with the Integrated Air and Missile Defense (IAMD) battle command system architecture, the Forward Area Air Defense Command and Control System (FAAD-C2I), and the National Capital Region Integrated Air Defense Command and Control System

## U.S and China in a quantum physics arms race that will transform warfare

In the 1970s, at the height of the Cold War, American military planners began to worry about the threat to U.S. warplanes posed by new, radar-guided missile defenses in the Soviet Union and other nations. In [PAGE 10]

## Navy asks Bell to build 25 AH-1Z Viper attack helicopters and avionics

BY John Keller

**PATUXENT RIVER NAS, Md.** — Military helicopter designers at Bell Helicopter in Fort Worth, Texas, will build 25 new AH-1Z Viper attack helicopters and avionics for the U.S. Marine Corps under terms of a near-half-billion-dollar U.S. Navy order announced in January.



The U.S. Navy is spending nearly a half billion dollars to buy 25 new AH-1Z Viper attack helicopters and avionics for the U.S. Marine Corps.

Officials of the Naval Air Systems Command announced a \$439.6 million order to Bell Helicopter, a Textron Inc. company, to manufacture and deliver 25 Lot 16 production AH-1Z aircraft. The order includes 25 stores control units.

The AH-1Z is a twin-engine attack helicopter based on the Bell AH-1W SuperCobra that features a four-blade rotor system, uprated transmission, and a new target-sighting system. It has upgraded avionics, weapons, and electro-optical sensors designed to find targets at long ranges and attack them with precision weapons.

The Marine Corps H-1 upgrades program is building new helicopters, as well as rebuilding legacy AH-1W SuperCobra attack helicopters and UH-1N Twin Huey utility helicopters, with

state-of-the-art designs. The program seeks to upgrade AH-1Ws to AH-1Zs, and UH-1Ns to UH-1Ys.

The AH-1Z helicopter can carry a payload of 5,764 pounds, can fly as fast as 222 knots, has a range of 370 nautical miles, and can fly as high as 20,000 feet above sea level. The AH-1Z has a crew of two, carries a 20-millimeter Gatling gun, and can fire 70-millimeter Hydra rockets, AIM-9 Sidewinder air-to-air missiles, and AGM-114 Hellfire air-to-ground missiles.

The attack helicopter avionics has integrated night vision goggle (NVG)-compatible glass cockpit, advanced electronic warfare self protection (EWSP) suite, and ballistically hardened

components to protect the aircraft from a broad range of enemy weapons.

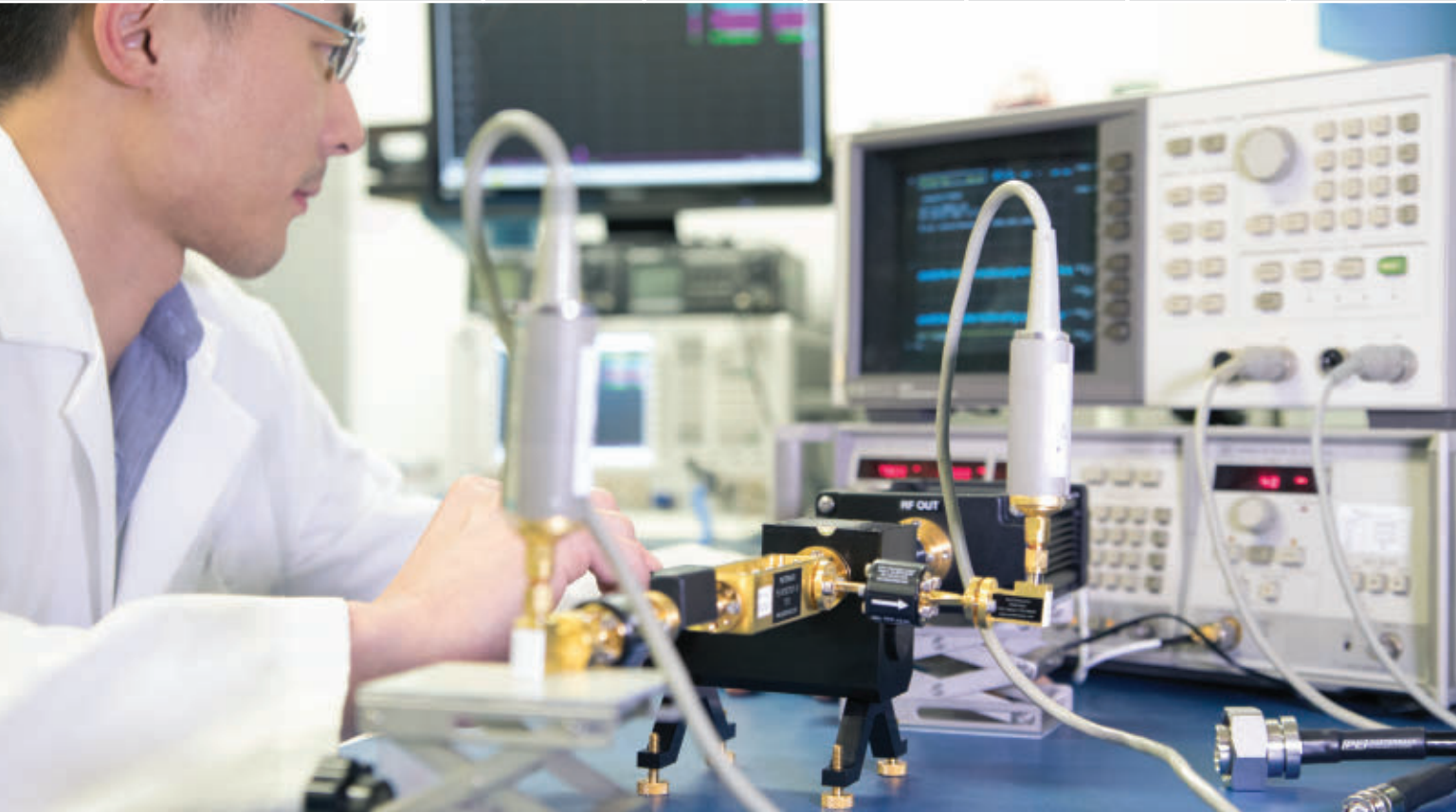
It has high-resolution forward-looking infrared resolution that provides long-range detection, identification, and engagement capabilities.

The Northrop Grumman Corp. Mission Systems segment in Woodland Hills, Calif., has developed the integrated avionics systems for the AH-1Z. The systems include two mission computers and an automatic flight control system with four-axis stability control augmentation system. Each crew station has two 8-by-6-inch multifunction displays and one 4.2-by-4.2-inch dual-function display, based on active-matrix liquid-crystal color technology.

The displays come from the L-3 Technologies Ruggedized Command



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and Control Solutions segment in San Diego. GE Aviation Systems in Grand Rapids, Mich., provides the weapon stores control and data transfer system.

Thales Avionics in Arlington, Va., provides the AH-1Z TopOwl helmet-mounted display system. It has integrated image intensifier and forward-looking infrared (FLIR) capability and provides transition from day to night use at the push of a button.

The Northrop Grumman Gen III FlightPro mission computers are the heart of the AH-1Z's integrated avionics system (IAS) that powers the helicopter's glass cockpit avionics.

The Gen III mission computer incorporates a ruggedized 6U VME PowerPC-based single board computer. Interfaces include Fast Ethernet, four serial

ports, parallel I/O, and built-in-test. FlightPro has a standard partitioned real-time operating system called INTEGRITY-178 tuMP for multicore architectures from Green Hills Software in Santa Barbara, Calif., with ARINC 653 and POSIX support.

The mission computer's standard configuration also includes a quad channel 1553 mezzanine card, high-speed serial card, digital I/O module with eight channels of opto-coupled discrete inputs, eight channels of opto-coupled discrete outputs, and 16 channels of general-purpose bi-directional discretes that can be programmed individually as outputs or inputs.

The FlightPro mission computer is capable of Required Navigation Performance/Area Navigation (RNP/RNAV) in all flight regimes, including departure,

en-route, terminal, and non-precision approach using GPS as the sole navigation source.

The flight computers use 28-volt DC or 115-volt AC three-phase 400 Hz input power, measure 13.61 by 11.5 by 7.55 inches, and weigh 30.4 pounds. The computers have rated 3,200 hours mean time between failures.

The flight computer software is RTCA DO-178C compliant, has ARINC-653 partitioning for safety and security, and complies with the Modular Open Systems Architecture (MOSA) standard. The software is aligned with the Future Airborne Capability Environment (FACE) technical standard, has hardware-independent application software developed to MIL-STD-498, under MIL-STD-882C safety program environmental qualification. [PAGE 9]

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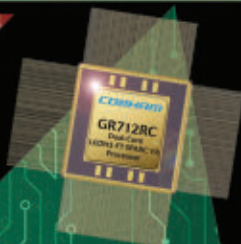
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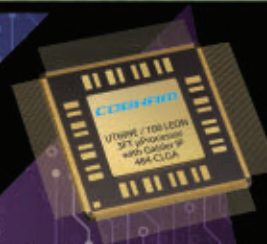
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[FROM PAGE 6] Flight computer hardware is designed to MIL-STD-461D for electro-magnetic compatibility, and is tested to MIL-STD-462 and MIL-STD 810E. FlightPro is conduction cooled, and represents “Quiet Cockpit Technology,” Northrop Grumman officials say.

Dual mission computers are the heart of Northrop Grumman’s Integrated Avionics System (IAS) that powers the glass cockpits of the AH-1Z helicopter. The mission computers provide centralized control of the IAS and display situational awareness and health monitoring information.

Additionally, the IAS and mission computers can accommodate future system upgrades; rapid insertion of new technologies; and integration of other avionics, communications, and survivability equipment. Northrop Grumman also provides the operational flight program software that controls the IAS.

On this order Bell will do the work in Fort Worth and Amarillo, Texas, and should be finished by January 2022. ◀

For more information contact **Bell Helicopter** online at [www.bellflight.com/military/bell-ah-1z](http://www.bellflight.com/military/bell-ah-1z), or **Naval Air Systems Command** at [www.navair.navy.mil](http://www.navair.navy.mil).

## Defense industry expects continued strong economic growth, investment banker says

TYSONS, Va. — Executives in the U.S. aerospace, defense, and government services industry are expecting continued moderate to strong economic growth in their businesses this year, and predict mergers and acquisitions

will increase or remain the same as 2018 — despite the takeover of the U.S. House of Representatives by Democrats.

That’s a key finding of the annual mergers and acquisitions survey of investment banker KippsDeSanto & Co. in Tysons, Va. This survey shows that deal makers are optimistic about overall economic growth and mergers and acquisitions activity for the coming year, officials of the investment banker say.

More than 80 percent of survey respondents say that 2018 federal midterm election results will have no influence on



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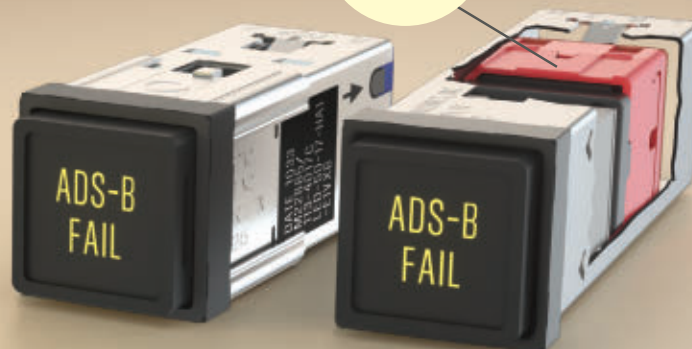
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mergers and acquisitions; those who say the midterms will affect their aerospace and defense mergers and acquisitions strategies are about equally split on whether they will be more or less aggressive.

“Our 2019 survey results suggest continued strong mergers and acquisitions activity in the aerospace, defense, and government services sectors,” says Managing Director Kevin DeSanto.

Defense spending continues to be the most important factor influencing overall mergers and acquisitions deal activity and target valuations in the U.S., the survey says. Adding critical mass with new customers (83 percent) and adding new offerings and technologies (79 percent) continue to be the top priorities. Adding scale continues to be a third priority.

In the Defense sector, the top four priority mergers and acquisitions interest areas are defense electronics; C4ISR; unmanned systems; and software.

In the Aerospace sector, the top priority area for mergers and acquisitions activity are proprietary engineered components and subsystems; machining, forming, and additive manufacturing; and supply chain management.

Overall, 222 experts who are interested in the aerospace and defense sectors participated in the survey — of those 60 percent are executive-level corporate buyers and the remainder come from private equity groups. ◀

For more information contact **KippsDeSanto & Co.** online at [www.kippsdesanto.com](http://www.kippsdesanto.com).

[FROM PAGE 4] response, engineers at places like U.S. defense giant Lockheed Martin’s famous Skunk Works stepped up work on stealth technology that could shield aircraft from the prying eyes of enemy radar. This advantage is now under threat. In November 2018, China Electronics Technology Group Corporation (CETC), China’s biggest defense electronics company, unveiled a prototype radar that it claims can detect stealth aircraft in flight. The radar uses some of the exotic phenomena of quantum physics to help reveal planes’ locations. It’s just one of several quantum-inspired technologies that could change the face of warfare. The pursuit of these technologies is triggering a new arms race between the US and China, which sees the emerging quantum era as a once-in-a-lifetime opportunity to gain the edge over its rival in military tech. ◀

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# NAVY PUSHES shipboard unmanned systems, lethality upgrades

Shipboard electronics use to be about power, navigation, and communications aboard surface warships; now it's about unmanned systems, futuristic weapons, and ocean networking. BY **Edward J. Walsh**

The U.S. Navy in 2019 is facing growing threats in the Western Pacific, Southwest Asia, and the Eastern Mediterranean — even as the Trump administration seeks to reduce U.S. military commitments overseas. To confront increasingly aggressive naval activity by China and Russia, the Navy, with strong congressional support, is pushing to increase the size of its surface fleet to 355 ships. In early 2019 the fleet had about 290 deployable surface warships.

Last October former Australian Prime Minister Kevin Rudd declared that “China intends to push the U.S. out of East Asia and the Western Pacific, and in time to surpass the U.S. as the dominant global economic power.”

Speaking then at the New China Challenge conference hosted by the U.S. Naval Institute in Annapolis, Md., Rudd said that “China hopes to achieve its national and international dominance through the hollowing-out of U.S. domestic manufacturing and technology by means of state-directed industry ... through the rapid expansion of China’s military and naval presence from the East China Sea ... and across the littoral



states of the Indian Ocean and Djibouti in the Red Sea.”

He added that “these factors, along with Russia, combine to form the central strategic challenge to U.S. security and prosperity for the future.”

Chief of Naval Operations Adm. John Richardson, in his White Paper “A Design for Maintaining Maritime Dominance 2.0,” released in December, points out that

“China and Russia are deploying all elements of their national power to achieve their global ambitions. ...

In many cases, they are gaining a competitive advantage and exploiting our vulnerabilities ... China and Russia seek to accumulate power at America’s expense.”

In January Richardson met with his Chinese navy counterpart Vice Adm. Shen Jinlong in Beijing to discuss ways of reducing tensions at sea — particularly China’s claim to the entire South China Sea.

The friendly relationship between the U.S. and Taiwan remains a sore point for China. The Pentagon has accused China of staging offensive weapons, including anti-ship and surface-to-air missiles, in



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and around the Spratly Islands, which China also claims. In 2018, citing tensions, the U.S. excluded the Chinese

navy from participating in the biannual RIMPAC exercise. China did take part in 2014 and 2016.



The Navy plans three Arleigh Burke class destroyers in its current budget, to be built to the new Flight III design.

The Navy announced the new 355-ship goal in December 2016 — a goal which the congressional fiscal year 2018 National Defense Authorization Act endorsed “as soon as practicable,” subject to available funding.

### Push for shipbuilding

The Navy’s 2019 budget would pay for 10 new ships: two Virginia-class attack submarines; three Arleigh Burke-class Aegis destroyers; one littoral combat ship (LCS); two oilers; one expeditionary sea base ship; and one salvage and rescue ship.

The current five-year shipbuilding plan seeks to build 54 new ships — 11 more than the 43 sought for fiscal year budgets 2019 to 2024 in the 2018 budget submission. These are four Burke-class destroyers, three oilers, two

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expeditionary sea base ships, one salvage-rescue ship, and one ocean surveillance ship.

The Navy has moved forward smartly on shipbuilding. In late September last year, it awarded a \$5.1 billion contract to Huntington Ingalls Industries in Newport News, Va., for six Burke destroyers and a \$3.9 billion contract to General Dynamics Bath Iron Works in Bath, Maine, for four more destroyers. These ships will be built to a Flight III design — a bow-to-stern package of new weapons and sensors, machinery controls, and hull, mechanical, and electrical upgrades.

These awards follow the long-anticipated Navy announcement that the first Flight III ships will be Jack H. Lucas (DDG-125) and Louis H. Wilson Jr. (DDG-126), to be built by Huntington Ingalls and Bath Iron Works respectively. Huntington won the Lucas contract in June 2017 and Bath Iron Works received the Wilson award in September of that year. Sixty-six Burkes of the earlier Flights I, II, and IIA designs now are in service. Patrick Gallagher (DDG-127), under construction at Bath Iron Works, will be a Flight IIA ship.

Last July the Navy awarded contract modifications — all in the \$7 million to \$8 million range — already awarded to Huntington Ingalls, Austal USA in Mobile, Ala., and General Dynamics Bath Iron Works; as well as the Lockheed Martin-Marinette Marine Corp. team in Marinette, Wis. — for concept designs for a new guided-missile frigate or FFG(X).

The Navy says the FFG(X) design work, to be completed this June, will guide final specifications to be used in the request for proposals for detail design and construction for the FFG(X). The Navy plans a construction award in 2020.

The FFG(X) program was initiated to counter widespread criticism that

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the Navy's littoral combat ships are too lightly armed and vulnerable to enemy missiles. The littoral combat ships were conceived as light, high-speed ships that will use specialized mission packages to conduct anti-surface and anti-submarine warfare, and mine countermeasures.

### Littoral combat ships

Lockheed Martin and Fincantieri Marinette Marine are teamed on the Freedom-class (LCS-1) variant of the LCS (odd hull numbers); Austal USA and Bath Iron Works build the Independence variant (LCS-2, even hull numbers). Thirteen littoral combat ships

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of both variants now are in service — six Freedom ships and seven Independence ships. Austal is building six littoral combat ships, with three more under contract. Seven Freedom-type ships are under construction at Fincantieri Marinette Marine.

The FFG(X) will be a well-armed, well-defended ship. In its request for information from industry in July 2017, the Navy cited many of the systems required, including the Component-Based Total-Ship System – 21st Century (COMBATSS-21) combat management system; SeaRAM anti-ship missile defense system; Mk 53 Nulka decoy launch system; SQS-62 variable-depth sonar; and Mk 110 57-millimeter gun.

Several new ships went to sea, started construction, and were placed on contract in the past year. The Navy commissioned Ralph Johnson (DDG-114) in Charleston, S.C., last March. Thomas Hudner (DDG-116), the 66th Burke-class ship and the 36th built by Bath Iron Works, was commissioned in Boston in December. Frank E. Peterson Jr. (DDG-121) was christened in October at the Huntington Ingalls yard in Pascagoula, Miss.

Also in December, Bath Iron Works launched Lyndon B. Johnson (DDG-1002), the third and last-of-class Zumwalt-class (DDG-1000) destroyer. The Zumwalt class ships are notable for their “tumblehome” hull and integrated electric drive propulsion. The Zumwalts are heavily armed for land- and surface-attack. Zumwalt and Michael Monsoor (DDG-1001) already are in the fleet.

In May the Navy commissioned Manchester (LCS-14), the 12th LCS to join the fleet and seventh Independence ship. Manchester will homeport in San Diego with LCS Squadron 1. Sioux City (LCS-11) was commissioned in May as the sixth Freedom ship and

13th LCS in the fleet. The ship joins LCS Squadron 2, homeporting in Mayport, Fla. The Navy accepted delivery of Tulsa (LCS-16) in April; delivery is the last step before commissioning. Indianapolis (LCS-17) was christened in April in Marinette, Wis. Cincinnati (LCS-20) was christened in May, and Kansas City (LCS-22) was christened in September — both in Mobile, Ala.



The SPY-6 Air and Missile Defense Radar (AMDR) will replace the SPY-1 aboard Flight III Burke-class destroyers for ballistic missile defense and integrated air-missile defense missions.

### Unmanned Systems

The Navy is pursuing technologies that enable remotely operated tactical systems to increase lethality and reduce costs. Many unmanned airborne, surface, and undersea vehicles (UAVs, USVs, UUVs) already are in service, and the Navy and industry are testing even more capable systems.

In a huge step forward for unmanned systems, the Naval Air Systems Command last August awarded Boeing a \$805 million engineering and manufacturing contract for design, development, production, testing, and delivery of four MQ-25A Stingray unmanned

refueling aircraft. The award aims at operational capability by 2024. Boeing's candidate, called the T-1, was developed by the company's Phantom Works.

The Navy says the UAV refueler will dramatically extend the range of Navy fighter and attack aircraft. The MQ-25A must carry 14,000 pounds of fuel and refuel aircraft 500 miles from their carriers. Lockheed Martin and General Atomics also competed for the award.

Through late summer and early fall 2018, the Naval Undersea Warfare Center sponsored an Advanced Naval Technology Exercise, or ANTX, based on the theme, “Human-Machine Interaction (HMI).” More than 50 participants from industry, university, and Navy labs provided technology demonstrations. Many of the technologies focused on command and control for unmanned vehicles.

The LCS fleet is a primary target for new unmanned systems, especially for mine countermeasures (MCM). The Navy plans to acquire 24 MCM mission packages for the LCS, which will include several unmanned systems: an MCM USV, the WLD-1 remote minehunting vehicle, which will tow the Raytheon AQS-20 sonar; the MQ-8/B/C Fire Scout vertical takeoff UAV, which is equipped with a coastal battlefield reconnaissance and analysis payload (COBRA); and the Knifefish low-frequency sonar, an unmanned influence sweep system.

At ANTX, Northrop Grumman, builder of the Fire Scout, showed an advanced mission management control system for integration of command and control for unmanned systems. The company used a Bell 407 helicopter as a Fire Scout “surrogate” fitted out with sonobuoys.

The helicopter-look-alike Fire Scout “Charlie” is just over 41 feet long and 10 feet high, weighs 6,000 pounds with a full fuel load, and is able to carry



a 500-pound internal payload or a 2,650-pound external (slung) load.

### Unmanned helicopters

The helicopter-look-alike Fire Scout "Charlie" is able to carry a 500-pound internal payload or a 2,650-pound external (slung) load. The vehicle is powered by a Rolls-Royce engine, allowing a maximum speed of 135 knots and endurance up to 12 hours. It can reach a ceiling of 16,000 feet.

In September Northrop Grumman started flight testing the MQ-8C at the company's Moss Point, Miss., facility. The aircraft already has completed initial test and operational evaluation aboard Coronado (LCS-4).

ANTX demonstrated "swarming" technology, in several vehicles fitted with processors to operate in swarms.

Aquabotix of Fall River, Mass., demonstrated Swarmdiver, a lightweight USV fitted with sensors and a processor that enables swarm operations at depths up to 150 feet.

In late July Raytheon won a \$29.6 million research award from the Office of Naval Research for the low-cost UAV Swarming Technology (LOCUST) innovative Naval prototype. The LOCUST represents research on small UAVs that swarm to approach targets.

Northrop Grumman teamed for the ANTX with Physical Optics Corp., which builds mission data loaders and data transfer systems; Ultra Electronics, a designer and builder of sonobuoys; Hydroid Inc., a unit of Sweden's Kongsberg, which manufactures marine robots; and Silvus, which develops mobile communications systems.


Kraken Robotic Systems of St. John's, Newfoundland, teamed with Thayer-Mahan of Groton, Conn., for several ANTX demonstrations. Kraken showed off its SeaScout Expeditionary Seabed Mapping and Intelligence System.

Kraken says the SeaScout is fitted with an "intelligent" winch called Tentacle that allows dynamic manual, semi-autonomous, or full autonomous control of payloads. Tentacle can operate by itself or with an autonomous launch and recovery system for manned or unmanned surface craft.

In September the Naval Surface Warfare Center's Indian Head division awarded a contract to iRobot Defense Holdings of Chelmsford, Mass., for production and support for the Man-Transportable Robotic System Mk1 program.

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In June, Six3 Advanced Systems of Dulles, Va., won a \$48.6 million NAVAIR award for installation and support for the AIRWORKS Rapid Development Product Team supporting new “counter” UAVs for defense of sensitive government sites. The work is for modeling, simulation, and command and control integration. Also last year, Northrop Grumman won five NAVAIR contracts for low-rate initial production and support for the MQ-4C Triton reconnaissance UAV.

### Ballistic missile defense

The highest-profile upgrade for the Flight III Arleigh Burke destroyers is the Raytheon-built SPY-6(v)1 air and missile defense radar or AMDR, which will replace the SPY-1 radar built in several versions since the 1980s by Lockheed Martin and installed on the Ticonderoga-class (CG-47) cruisers and all the Burke destroyers now in service.

Other Flight III improvements are more powerful air-conditioning units needed for the SPY-6(v)1; new gas turbine generators, new transformers, power conversion modules, switchgear, and new machinery control system controls.

The SPY-6(v)1 will employ a four-face S-band radar for volume search. An X-band horizon-search capability will be provided by the Northrop Grumman SPQ-9B air-search radar for the first 12 Flight III ships. The SPY-6(v)1 will use a radar suite controller for S- and X-band radar coordination and interface with baseline 10 of the Aegis combat system, now being developed by Lockheed Martin.

Raytheon and Navy officials say that the SPY-6(v)1, will be capable of surveilling twice the range of the SPY-1 for the integrated air and missile defense (IAMD) and ballistic missile defense (BMD) missions.



Boeing won the Navy's hotly contested competition for the MQ-25a long-range carrier-based refueler UAV with its T-1 aircraft.

In December the Navy and the Missile Defense Agency tested the “engage on remote” capability of the Aegis combat system, using Aegis software that will be employed from the Aegis Ashore sites in Poland and Romania against intermediate-range ballistic missiles (IRBMs).

For the test, designated FTI-03, conducted at the Pacific Missile Range Facility, Kauai, Hawaii, the Aegis system, running the baseline software program 9.B2.0, tracked an IRBM target launched from an aircraft thousands of miles away. Aegis cued the launch of an SM-3 Block 2A missile, which intercepted the target.

The FTI-03 demonstration followed an October test, called FTM-45, carried out from John Finn (DDG-113). The ship's Aegis system, running baseline 9.C2, directed the remote launch of an SM-3 block 2A to intercept a medium-range ballistic missile target.

MDA and Navy officials say that the “engage on remote” sequence uses only data provided by remote sensors; the launching platform never views the target. Engage on remote is an advanced beyond “launch on remote,” wherein

the launch site uses offboard data for the launch but relies on its own radar to lock onto the target during its terminal approach.

The Navy and MDA programs use versions of Aegis baseline 9, designated MDA baseline 5.1. The 9.B MDA program is used solely for Aegis Ashore. The Navy baseline 9.C provides BMD but also controls the ship's anti-surface, anti-submarine, and anti-air warfare missions for full-up IAMD.

The Flight III destroyers will move to the SPY-6(v)1, but the Aegis Ashore sites will use the SPY-1D(v) Aegis phased-array radar. The Aegis Ashore Romania site became operational in May 2016, using Aegis baseline 9.B1. The Poland site is set to be operational this year and will use Aegis baseline 9.B2.

Under the current plan, 11 of the Navy's 22 Ticonderoga-class cruisers will get some level of modernization. The entire Burke class will be configured for full-up BMD/IAMD capability.

### Shipboard weapons

The Navy last year started other ambitious programs to uparm the fleet. In May, Raytheon, teamed with Kongsberg



Defense of Norway, won a \$14.8 million award for an over-the-horizon weapon (OTH-W) system for littoral combat ships and the FFG(X). The team will provide Kongsberg's Naval Strike Missile (NSM) to meet the requirement.

Raytheon is prime contractor for the Navy's SM-2 anti-air defense missile, SM-3 and SM-6 ballistic missile defense weapons, evolved Seasparrow, and Tomahawk long-range cruise missile, as well as the RIM-116 rolling air-frame missile (RAM) and SeaRAM ship-board terminal defense systems.

The NSM is fitted with an advanced seeker, emits a minimal radar signature, and is capable of sea-skimming, terrain-following, and evasive maneuvers to meet the requirement of destroying targets out to 100 nautical miles.

Raytheon will build NSM launchers at its Louisville, Ky., facility and carry out integration and final assembly at its Tucson, Ariz., plant.

The Navy also has funded Raytheon to upgrade the Mk 15 Phalanx terminal defense close-in weapon system, Evolved Seasparrow Missile (ESSM), SM-2, SM-3, SM-6 missiles, and the Tomahawk cruise missile.

The Mk 15 is a 20-millimeter Gatling-gun for use against approaching anti-ship missiles. Raytheon will introduce an electric gun drive to replace the long-used pneumatic drive, and add new technology for the local and remote control stations.

The company is adding new control software for the RAM, creating an enhanced Block 2A variant. The RAM is aboard carriers and amphibious ships and the Freedom littoral combat ships.

The ESSM is a medium-range ship self-defense missile capable of intercepting high-speed, low-altitude missiles. Raytheon will transition the

missile to a dual-mode active/semi-active seeker with an IOC of 2021.

The SM-2 area air-defense missile, now fielded in Block 3A and 3B variants, will be upgraded to a Block 3C with addition of the new active/semi-active seeker, to reach IOC this year or in 2020.

The Navy is in a multi-year procurement for the SM-6 missile, capable of anti-air warfare, surface-to-surface attack, and sea-based terminal BMD. SM-6 Block 1A introduces guidance section improvements and completed land-based testing in June 2017.



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## Upgraded Tomahawk missiles

The Navy is upgrading the current Tomahawk Block 4 in three variants. The first upgrade modernizes the entire Tomahawk inventory by adding a new navigation system and more powerful radio.

In August 2017 the Navy awarded Raytheon a contract to convert several missiles to maritime strike Tomahawks (MSTs) by fitting them with a multi-mode seeker that will enable it to target ships underway.

The MST is set to reach IOC in 2021. Remaining missiles will be modified as joint multi-effects Tomahawks (JMEWS) for attack on hardened targets and area targets. The JMEWS variant will reach IOC in 2022.

Lockheed Martin has invested in the integration of a long-range anti-ship missile (LRASM) with the Navy's Mk 41 vertical launch system, which is installed on Ticonderoga-class cruisers and Burke-class destroyers. The company also has invested in a topside launcher to launch the LRASM from ships not fitted with the Mk 41.

In 2008 the Defense Advanced Research Projects Agency funded the company to modify the joint air-to-surface standoff missile-extended range (JASSM-ER) in two variants: a surface-to-surface variant called LRASMA; and a supersonic variant, which ended in 2010.

The company added new sensors and made structural changes needed for launch from the Mk 41. The missile is scheduled to be operational for the Navy's F/A-18E/F Super Hornet aircraft this year. In addition to the cruisers and destroyers, Raytheon sees a requirement for the LRASM for the FFG(X).

Raytheon won Navy contracts to support the USG-2/3 cooperative engagement capability (CEC), which it has built for many years. A November



Crewmen aboard the littoral combat ship USS Coronado prepare the MQ-8C Fire Scout UAV for launch in operational testing in June 2018.

award for \$33.8 million is for common array block antenna pre-production antenna. A \$61.9 million award in September modifies an earlier award for CEC design agent and engineering services.

The CEC is integrated with the Aegis combat system aboard cruisers, destroyers, and carriers. It uses an advanced processor to distribute sensor data among a network of CEC-equipped ships, such that all ships see the same "netted" sensor threat picture.

In July, DRS Laurel Technologies in Johnstown, Pa., won a \$9.6 million award for an option for production of CEC signal processor equipment (SDP-S) sets. Then in August \$8.7 million NAVSEA contract for production of CEC equipment sets.

Northrop Grumman, General Dynamics Mission Systems, and Lockheed Martin all won work on the Navy's long-running surface ship electronic warfare improvement program or SEWIP, an evolutionary transformation of the Navy's obsolescent SLQ-32(v) EW system, in service aboard nearly all surface ships. In September Northrop received a \$9 million modification for

long-lead material for SEWIP Block 1 low-rate initial production.

That same month Lockheed Martin was awarded \$14.7 million for SLQ-32(v)6 engineering services. In May General Dynamics won a \$9.7 million contract for SEWIP Block 1B full-rate production, which includes risk reduction and special signals intercept.

## Hull, mechanical, electrical

General Electric's Marine Solutions business group plans to propose for the FFG(X) a variant of its workhorse LM2500 engine integrated with a carbon-fiber composite enclosure module. The new enclosure module has been tested extensively as a lightweight alternative to the steel enclosure now used for the engine.

The company, working with the Navy and Bath Iron Works, finished acoustic attenuation testing of the composite module, which will house the engine. The analysis projected that the new composite module would reduce engine noise by 60 percent and weight by about 5,500 pounds.

GE and the Navy's Electric Ship Program Office have discussed potential



ways to use GE technology to produce a "power-dense" 25-megawatt gas turbine generator, using advanced power electronics to meet pulse-load needs. GE's Power Conversion business unit also is working with ONR on development of the hybrid energy storage module, which would be part of the IPES architecture.

In December, DRS Power & Control Technologies received a \$13.3 million modification to a contract for low-rate initial production of 12 shipsets of DDG-51 power conversion modules for the SPY-6(v)1 AMDR. The PCMs convert, regulate, troubleshoot, and flow power to the AMDR from the ship's service power system.

In May 2018 Philadelphia Gear Corp. won a contract valued at \$70.8 million

for two main reduction gear shipsets for Burke destroyers. Each shipset transmits power from the ship's LM2500 propulsion engines to the shafts. The two shipsets purchased are for Flight III ships Ted Stevens (DDG-128) and Scott (DDG-129). The work is expected to be complete by November 2020.

That same month Lockheed Martin's Baltimore unit won an \$11.7 million award for common machinery control system consoles for the Burke destroyer's new construction program and midlife modernization. The control system monitors the ship's auxiliary, damage control, electrical, and propulsion systems, and interfaces with the ship's power generation and distribution system. ←

## COMPANY LIST

### Aquabotix Technology Corp.

Fall River, Mass.  
<https://www.aquabotix.com>

### Austal USA

Mobile, Ala.  
<https://usa.austal.com>

### Boeing Defense, Space & Security

St. Louis  
<https://www.boeing.com/company/about-bds/>

### DRS Laurel Technologies

Johnstown, Pa.  
<https://www.leonardodrs.com>

### DRS Naval Power Systems

Milwaukee  
<https://www.leonardodrs.com/locations/drs-naval-power-systems-milwaukee-wi/>

### Endeavor Robotics

Chelmsford, Mass.  
<http://endeavorrobotics.com>

### General Atomics

San Diego  
<http://www.ga.com>

### General Dynamics Bath Iron Works

Bath, Maine  
<https://www.gdbiw.com>

### General Dynamics Mission Systems

Fairfax, Va.  
<https://gdmissonsyste.ms.com>

### Huntington Ingalls Industries

Newport News, Va.  
<https://www.huntingtoningalls.com>

### Hydroid Inc.

Pocasset, Mass.  
<https://www.hydroid.com>

### Kongsberg Defence Systems

Kongsberg, Norway  
<https://kongsberg.com/en/kds/>

### Kraken Robotic Systems

St. John's, Newfoundland  
<https://krakenrobotics.com>

### Lockheed Martin-Marinette Marine Corp.

Marinette, Wis.  
<https://www.lockheedmartin.com>

### Lockheed Martin Missiles and Fire Control

Orlando, Fla.  
<https://www.lockheedmartin.com>

### Lockheed Martin Rotary and Mission Systems

Moorestown, N.J.  
[www.lockheedmartin.com](http://www.lockheedmartin.com)

### Northrop Grumman Aerospace Systems

San Diego  
[www.northropgrumman.com](http://www.northropgrumman.com)

### Philadelphia Gear Corp.

King of Prussia, Pa.  
<https://philagear.com>

### Physical Optics Corp.

Torrance, Calif.  
<http://www.poc.com>

### Raytheon Integrated Defense Systems

Portsmouth, R.I.  
[www.raytheon.com](http://www.raytheon.com)

### Raytheon Missile Systems

Tucson, Ariz.  
[www.raytheon.com](http://www.raytheon.com)

### Silvus Technologies

Los Angeles  
<https://silvustechnologies.com>

### ThayerMahan Inc.

Groton, Conn.  
<http://www.thayermahan.com>

### Ultra Electronics Maritime Systems

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# New frontiers in small-form-factor embedded computing

Traditional bus-and-board embedded computing architectures are giving way to extremely small boards that can be as small as business cards — sometimes as small as postage stamps — to cram performance into small spaces.

BY **Jamie Whitney**

Size matters.

The best computing systems in the world can't help modern warfighters take the fight to the enemy if the warfighters can't take these systems with them. Thankfully, small form factor (SFF) and system-on-chip (SoC) embedded computing solutions are packing more and more power into smaller and smaller rugged enclosures.

For military applications, SFF and SoC solutions often are judged with consideration for size, weight, power, and cost (SWaP-C). SFF systems consist of everything from whole embedded computer systems to down to its miniaturized SDRAM.

Aneesh Kothari, vice president of marketing at Systel Inc. in Sugar Land, Texas, notes that as technology improves, engineers can fit amazing power into very small packages.

"You're taking data center processing and networking-type capabilities and you're putting it into SFF SWaP optimized systems," Kothari says. "As COTS [commercial off-the-shelf] gets more

sophisticated, we can take that COTS tech that's built to common, rugged standards and then that gives you quick time to deployment, and a rich upgrade path if you know you want to accommodate for future technology, it's relatively simple to add capability down the line."

"SFF system enclosures come in all shapes and sizes, with a variety

of backplanes, interconnect schemes, circuit board definitions, and environmental specifications," explains Rodger Hosking, vice president of Pentek Inc., in Upper Saddle River, N.J. "SSF systems are not only smaller than traditional COTS solutions, they are also less expensive, lighter, lower power, easier to install, and capable of supporting tough operating environments — all significant and often critical advantages."

He continued, "SFF systems are still attractive to customers for two major reasons. First of all, the availability of SFF systems with improved SWaP-C metrics opens up entirely new markets and opportunities for critical applications that were previously impractical. Secondly, the industry recognizes the many benefits of breaking up large, monolithic systems into smaller distributed sub-systems, each handling a portion of the system tasks."



Pentek's Talon Extreme Rugged half-ATR recorder.



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When it comes to small form factor, systems designers are looking for consolidation, points out Chris Ciufo, chief technology officer at General Micro Systems in Rancho Cucamonga, Calif. "We'd stick the VME board in a chassis, yet people wanted more and more and more in a smaller box," Ciufo says. "Smaller density, small form function was the future. Our claim to fame was to take VME boards and shrunk them into a box that is four inches square."

In addition to going smaller, what goes inside the ruggedized chassis has changed in recent years as well. "Obviously, we've transitioned from spinning drives to solid state disk drives, notes Ciufo. "In the defense industry, no one wants HDD; they want solid state disk drives (SDDs), though solid-state drives

have not come down the price density curve as fast as you'd want them to."

#### On the record

Pentek introduced its Talon RTX 25xx series this fall, which is a SFF recorder product line for extreme operating environments. Optimized for SWaP, the rugged, sealed one-quarter-ATR recorders are available with several input options and has as much as 30.7 terabytes of removable SSD storage. These



POLYRACK Tech-Group's SFF EmbedTEC.

SFF recorders provide real-time streaming data rates as fast as 4 gigabytes per second for multi-channel, wide-bandwidth RF signal recording.

"Our new extremely rugged half-ATR recorder provides real-time sustained recording rates to 4 gigabytes per second," says Chris Tojeira, recording systems director at Pentek. He added, "We can capture the full bandwidth of all eight 250 MHz 16-bit phase-coherent A/Ds in this single compact chassis."

The sealed chassis, which uses military standard circular I/O connectors to control RF emissions, protects the recorder's electronics from humidity, water, dust, sand, and salt fog. Only the fan is exposed to the outside environment, assuring all system electronics are protected in the sealed chassis. The inner plenum can be replaced to

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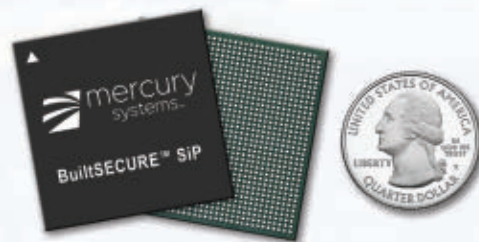


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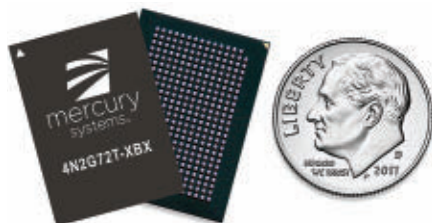


provide other cooling options, such as liquid or conduction cooling.

Designed to operate in temperatures from -40 to 60 degrees Celsius, these recorders can handle most thermal environments, making them suitable for unmanned aerial vehicles (UAVs), aircraft pods, tight equipment bays, military vehicles, and most outdoor environments.

The Pentek Talon SFF recorders offer an optional GPS receiver for precise time and position stamping. Additional QuickPac drive packs with 3.8 to 30.7 terabytes are available. Computer I/O on all models includes Gigabit Ethernet, USB 3.0, RS-232, and HDMI.

"Most SFF systems incorporate a processor to manage internal resources and to communicate with the outside world for status and control," Hosking says. "Unless a custom con-



The Mercury Systems compact 16-gigabyte DDR4 SDRAM with a dime for scale.

trol processor is required, designers have many popular standards to choose from, including Mini-ITX, COM Express, PC/104-Express, and derivatives. Using Intel, ARM, or AMD CPUs, these boards are actually small PCs with various configurations of SDRAM and FLASH memory along with USB and serial ports, PCI Express, and SATA interfaces."

## Micro machines

The General Micro Systems Peacock III S1202-XVE rugged, low-profile video server has an Intel Xeon E3 workstation CPU and triple 4K video, with

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### Multi-Protocol Flexibility

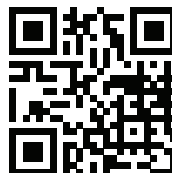
- Ethernet, MIL-STD-1553, ARINC 429/717, CANbus 2.0, RS-232/422/485, Avionics/Digital Discrete I/O, Video, WiFi, GPS, and Power Control.
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a general-purpose graphics processing unit (GPGPU) coprocessor into a sealed enclosure measuring 9.8 by 5.38 by 2.26 inches

GMS can fit as much as 63 gigabytes of DDR4 RAM into its case, along with a 1 terabyte SSD, and a removable 2.5-inch SSD that holds as much as 4 terabytes.

The S1202-XVE standard configuration supports four 1 Gigabit Ethernet and two 10 Gigabit Ethernet channels with TCP/IP offloading engine (TOE), four USB 2.0 ports with power, four USB 3.0 ports, eight buffered digital I/O lines, one DVI/HDMI and one R gigabyte of video port, and a full HD-audio headset

jack and a 5-Watt audio amplifier and mic-in. Additional I/O functions include one expansion I/O site (SAM) for I/O such as GPS, Video capture, CANbus, MIL-STD-1553, ARINC-429, and more on a PCI Express-mini card.

The conduction-cooled SFF server is equipped with a SecureDNA security suite including write protect and secure erase to all non-volatile storage, BIOS erasure, all firmware erasure.

GMS also offers a paired micro-server solution in its Golden-Eyes II S2002-MD. The two independent systems



The General Micro Systems Peacock III S1202-XVE is a rugged, low profile video server.

come with an Intel Xeon processor D with as much as 64 gigabytes of DDR4 RAM, and two 10-gigabit and three 1-gigabit Ethernet ports. The S2002 is an ultra-rugged, small, lightweight multi-domain server system with as many as 16 CPU cores and removable drives. It is designed to provide two fully-independent and isolated high-performance servers in one box while providing high workstation performance in a ruggedized, conduction-cooled, sealed system, operating from -40 to 75 C. Even the power supplies are separately isolated.

Golden-Eyes II is for military, aerospace, industrial, and commercial Red/Black networks — such as found on platforms with SIPR/NIPR networks. With the onboard 1- and 10-Gigabit Ethernet ports, Golden-Eyes II is suited as a forwardly deployed vehicle-mounted

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battlefield dual-server that offers double performance or redundancy. Alternatively, the S2002-MD works as an airborne network multi-domain server that also can drive operator consoles, such as in an ELINT platform, while recording data and distributing it to several Ethernet LANs.

"With two of these small form factor boxes, with the platform collecting signals intelligence, they can go through the data twice. The second system comes up with additional intelligence," says GMS's Ciufo.

## Thanks for the memory

BuiltSECURE technology from Mercury Systems in Andover, Mass., miniaturizes DDR4 SDRAM memory in a compact ruggedized package. These devices are suited for military and commercial aerospace applications requiring SWaP-optimized high-speed SFF DDR4.

While Mercury describes its SDRAM as "compact," it is safe to call it downright tiny. The 2-gigabyte model comes in at 8-by-14-millimeter package, and the SDRAM models come

in 2, 4, 8, and 16 gigabytes. Mercury officials say their unique DDR4 SDRAM has an 83 percent space-savings compared to discrete chip, and has as much as 93 percent component reduction.

The SDRAM has a data transfer speeds as fast as 2666 megabits per second and

Pixus Technologies RX310 commercial software defined radio.

can operate in temperatures from -55 to 125 C, which makes it suitable for military applications.

Mercury also offers a SFF solid state drive in its TR-RUST-Stor BGA line. The modules allow integration of high-capacity secure storage onto printed circuit boards. Attaching the storage to the circuit board eliminates the cost and reliability issues associated with high-speed cabling.

It also removes the potential for tampering by hot-swapping the data cable or probing plaintext data running from the host to the SSD.

The Mercury TRRUST-Stor BGA SSD product line incorporates Mercury's Sixth Generation Armor NAND Processor and 3D TLC NAND running in SLC mode. The TRRUST-Stor BGA is available with a 6 gigabit-per-second SATA interface or a fast 4-lane, NVMe interface.

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Weighing in at eight grams, the TTRUST-Stor BGA SSD line measure 32 by 22 by 3.5 millimeters and has a host-accessible capacity of 80 to 160 gigabytes. Like the SDRAM, the SSD was designed and built in a DMEA-accredited facility, has self-destruct capability, and can operate in temperatures from -40 to 85 C.

### Tuning in

This winter, Pixus Technologies in Waterloo, Ontario, rolled out the first in a planned series of SFF ruggedized commercial software defined radios (SDR) from Ettus Research in Santa Clara, Calif. SDRs use software for what was previously accomplished by hardware.

The SDR sits in a weatherproof enclosure and features IP67 sealing for water and dust ingress. It also is



ECRIN Systems Nano-Onyx ultra-SFF mission computer.

designed to MIL-STD-810 for shock and vibration, as well as to MIL-STD-461 for electro-magnetic interference.

The RX310 contains two extended bandwidth daughter board slots covering 10 MHz to 6 GHz with as much as 160 MHz of baseband bandwidth, dual 1/10 Gigabit Ethernet high-speed

interfaces, and a large user-programmable Kintex-7 field-programmable gate array (FPGA).

The unit is 302 millimeters wide, 400 millimeters long, and 98 millimeters tall with conduction-cooled fins for heat dissipation.

The RX310 series can be used in various types of airborne, shipboard, ground vehicle, or outdoor designs. Applications include signals intelligence, spectrum monitoring, passive radar, smart agriculture, smart energy, and prototyping systems for advanced wireless standards. Pole-mount and other special mounting options are available.

Light-rugged versions of the enclosure also are available, as well as ruggedized versions of other software defined radios offered by Ettus Research.

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### Embedded SFF solution

German-based POLYRACK TECH GROUP in Straubenhardt, Germany, showed off its SFF enclosures at Nuremberg's embedded world conference in late February, including its EmbedTEC.

The aluminum tabletop case is designed for small form factors such as embedded NUC (eNUC), pico-ITX (pITX, 2.5-inch), SMARC, QSeven, and single-board computers, as well as the Raspberry Pi.

It comes with a changeable front I/O Shield as well as a large aluminum cover for the heat dissipation. Alternatively, perforated side panels or small fans can add to the cooling performance on top. POLYRACK also offers various adaptations and mounting option.

### All on one

Extreme Engineering Solutions (X-ES) in Verona, Wis., continues to provide solutions in the SFF sector with its XPedite7683 single-board computer. The Xpedite7683 is a secure 3U Open-VPX based on the Intel Xeon D-1500 family of processors.

The computer board provides as many as 16 Xeon-class cores, as much as 32 gigabytes of DDR4-2133 ECC SDRAM, and XMC support, and is for computationally heavy applications requiring maximum data and information protection.

The XPedite7683 integrates Secure COTS technology with a Microsemi SmartFusion 2 security SoC for hosting custom functions to protect data from being modified or observed and provides a solution when stringent security capabilities are required.

The Microsemi SmartFusion2 can control, intercept, and monitor the Xeon D subsystem, implement penalties, and interface to the system through GPIO directly connected to the VPX backplane. Circuit board enhancements and optimized two-level maintenance (2LM) metalwork provide additional protection to the physical hardware.

Wind River VxWorks and X-ES Enterprise Linux Support Packages (XEL) are available. The XPedite7683 uses coreboot, powered by Intel's Firmware Support Package (FSP), to provide fast boot times and can simplify code traceability over legacy BIOS implementations.

### Bird of prey

Last fall Systel unveiled the SFF Falcon-Strike combat vehicle computing. The Texas-based company fits the system in an 8-by-9.5-inch enclosure that stands 6-inches tall. The Falcon-Strike uses either an Intel Xeon E3-1505L Quad-Core or i7-6822EQ Quad-Core CPU with a NVIDIA GeForce GTX 1050Ti 768 CUDA Cores GPU.

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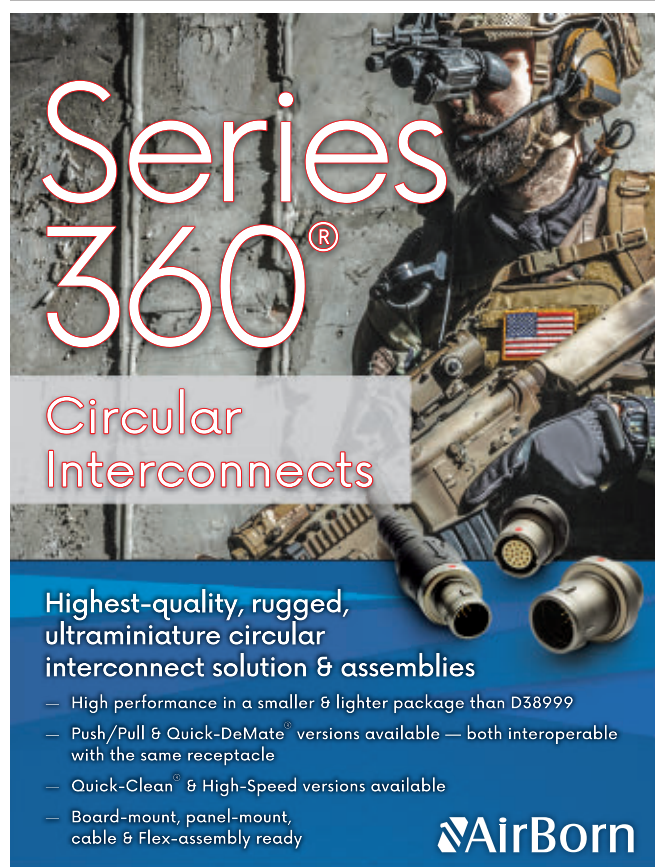
“Falcon-Strike exceeds the technology challenges and performance specifications demanded by modern defense programs and platforms,” says Systel’s Kothari. “It provides an unmatched processing combination of high-performance CPU and GPU, ultra-efficient multi-sensor capture and encode, I/O and board scalability, and secure storage – all in a SWaP optimized, single Line Replaceable Unit.”

Falcon-Strike features four HD video inputs as much as 1080-pixel resolution, as well as four HD video outputs, and a pair of 1-terabyte SSDs.

Falcon-Strike is an extreme duty system designed for mission-critical military operations involving intelligence, surveillance, and reconnaissance (ISR), counter-UAS (C-UAS), persistent surveillance, airborne law Enforcement (ALE), search and rescue (SAR), and land- and marine-based missions.

### What’s next

ECRIN Systems in Crolles, France, is developing what it calls an ultra-SFF rugged mission computer for aerospace and UAV applications, which it is calling Nano-ONYX in its COTS mission computer line.



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The Nano-ONYX is slated to have a COM-Express Module with an Intel Atom E3900 Series processor up to an Intel Core i7-7600U, as well as I/O expansion slots.

ECRIN also plans to include 4 gigabytes of DDR3L SDRAM. All that technology will sit inside a ruggedized chassis that measures 20 centimeters long, 13.5 centimeters wide, and 6.5 centimeters tall. ◀

## COMPANY LIST

### Aitech

Chatsworth, Calif.  
<http://www.rugged.com>

### Crystal Group

Hiawatha, Iowa  
<https://www.crystalrugged.com>

### Curtiss-Wright Defense Solutions

Ashburn, Va.  
<http://www.curtisswrightds.com>

### Extreme Engineering Solutions, Inc.

Middleton, Wis.  
<https://www.xes-inc.com>

### General Micro Systems

Rancho Cucamonga, Calif.  
<https://www.gms4sbc.com>

### Kontron

Fremont, Calif.  
<https://www.kontron.com>

### Mercury Systems

Andover, Mass.  
<http://www.mc.com>

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<https://core-systems.com>

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<http://www.diamondsystems.com/>

### Ecrin

Crolles, France  
<http://www.ecrin.com/en>

### Elma Electronic

Fremont, Calif.  
<http://www.elma.com>

### GammaTech Computer Corp.

Fremont, Calif.  
<https://www.gammatechusa.com>

### Getac

Irvine, Calif.  
<http://www.getac.com>

### HHCS Handheld USA Inc.

Corvallis, Ore.  
<https://www.handheldgroup.com>

### MilDef Inc.

Alexandria, Va.  
<https://www.mildef.com>

### North Atlantic Industries

Bohemia, N.Y.  
<https://www.naii.com>

### Pentek, Inc.

Upper Saddle River, N.J.  
<https://www.pentek.com>

### Sparton Rugged Electronics

Woodbridge, Ontario  
<https://www.spartonre.com>

### Technology Advancement Group (TAG) Inc.

Dulles, Va.  
<https://www.tag.com>

### V Rose Microsystems

Johnstown, N.Y.  
<http://www.vrosemicrosystems.com>

### Xplore

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## V-22 Osprey tiltrotor to receive special forces Silent Knight terrain-avoiding radar

The U.S. Naval Air System Command V-22 Joint Program Office (PMA275), which manages the Osprey program for all the U.S. services, has contracted Raytheon to integrate its next-generation multi-mode K-band AN/APQ-187 Silent Knight radar onto the Air Force's 52 Bell-Boeing CV-22B Osprey tiltrotor aircraft. The Osprey tiltrotor aircraft must be able to penetrate enemy airspace at low level in any weather conditions, using terrain-following radar to allow flight as low as 100 feet, and with a sophisticated navigation system, including a digital color moving map, three INS systems, and GPS, allowing the crew to navigate even in complete darkness.

## Raytheon wraps-up testing of SPY-6 AMDR shipboard missile-defense radar

The U.S. Navy's AN/SPY-6(V)1 Air and Missile Defense Radar (AMDR) completed its final round of developmental testing after tracking its 15th ballistic missile target. During the Jan. 31 test in Hawaii, the SPY-6 shipboard RF and microwave sensor searched, found and tracked a ballistic missile target launched from the Navy's Pacific Missile Range Facility as part of the radar's development, according to the Navy. The SPY-6 is an integral component of the Aegis combat weapons system's latest upgrade, which the Navy expects to achieve initial operational capability in 2023. The Flight III Arleigh Burke guided-missile destroyers will have the Baseline 10 system. The SPY-6 radar is up to 30 times more sensitive than the older AN/SPY-1D(v) radars, yet requires much more power. The Flight III destroyer will have a new power plant that converts 4,160-volt AC power into 1,000-volt DC power. ◀

## DRS Laurel to provide Navy with five AN/SPQ-9B shipboard radar systems

BY John Keller

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

Officials of the Naval Sea Systems Command in Washington announced a \$21.5 million order to DRS Laurel to build five AN/SPQ-9B ASMD radar systems and related equipment.

This order is part of a contract with options that could bring its cumulative value to \$263 million to provide radar systems for the U.S. Navy and the government of Japan. Last May, the Navy awarded DRS Laurel a \$64.3 million contract to build as many as 59 AN/SPQ-9B radar systems.

This order is for five AN/SPQ-9B radar systems; five combat interface kits;

three digital signal processor upgrade kits; and three periscope-detection and -discrimination upgrade kits.

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

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



The DRS Laurel Technologies segment of Leonardo DRS is building five AN/SPQ-9B anti-ship missile defense radar systems to protect U.S. Navy surface warships from anti-ship missiles.



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

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

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

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

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

in the processor cabinet. The system has an auxiliary antenna for electronic counter-countermeasures.

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

On this order DRS Laurel will do the work in Johnstown, Pa., and should be finished by April 2021. ←

For more information contact **DRS Laurel Technologies** online at [www.leonardodrs.com/locations/drs-laurel-technologies-johnstown-pa](http://www.leonardodrs.com/locations/drs-laurel-technologies-johnstown-pa), or **Naval Sea Systems Command** at [www.navsea.navy.mil](http://www.navsea.navy.mil).

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## **Navy moves forward with unmanned surface vessel for counter-mine warfare**

U.S. Navy unmanned surface vessel (USV) experts are moving forward with plans to equip the littoral combat ship with quickly deployable fast-moving unmanned boats to clear large ocean areas of sea mines that could threaten aircraft carrier battle groups, commercial ship traffic, and other ocean assets. Officials of the Naval Sea Systems Command announced a \$10.8 million order to the Textron Systems Corp. Unmanned Systems segment in Hunt Valley, Md., for engineering and technical services for the Unmanned Influence Sweep System (UISS) unmanned patrol boat. The UISS is one of the counter-mine warfare systems that will enable the littoral combat ship to perform mine warfare sweep missions. UISS will target acoustic, magnetic, and magnetic and acoustic combination mine types only. The UISS program provides rapid wide-area mine clearance to neutralize magnetic and acoustic sea mines in a small, lightweight package. The UISS uses the Textron Common Unmanned Surface Vessel (CUSV) will travel aboard the LCS and will deploy as necessary to detect, pinpoint, and trigger explosive sea mines hidden under the surface to damage or destroy surface warships or commercial shipping.

## **Two companies join project to design SWaP-C-optimized satellite payloads**

U.S. military researchers are asking two more companies to develop a constellation of small, secure, and affordable military satellites that not only are able to operate in low-Earth orbit (LEO), but also that capitalize on modern commercial satellite technologies. Officials of the U.S. Defense Advanced Research Projects

## Future deep-sea UUVs with machine autonomy are focus of DARPA Angler program

BY **John Keller**

ARLINGTON, Va. — U.S. Military researchers are asking the defense industry to develop a deep-diving unmanned underwater vehicle (UUV) and control system able to find and manipulate objects in deep-sea environments.



Machine autonomy seeks to overcome the terrain and tactical challenges of the deep-sea ocean floor.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) have issued a broad agency announcement (HR001119S0009) for the Angler project (not an acronym) for new capabilities in autonomous exploration and manipulation on the sea floor.

The deep ocean remains one of the most challenging earth-bound domains, despite breakthroughs in terrestrial robotics, space robotics, and underwater sensing, DARPA scientists explain.

While the sea floor often is gently sloping sand dunes, it also has natural and man-made obstacles that complicate search and navigation. Reefs, submarine vents, and fissures can be treacherous, and can change quickly. This represents a major challenge to classical

machine perception techniques, which rely on feature recognition.

Deep-sea missions also require continuous operation over thousands of miles without the aid of Global Positioning System (GPS) satellite navigation or human intervention, which imposes substantial autonomy requirements on an already complex system.

The DARPA Angler project has two thrusts. First it seeks to develop an autonomous undersea control system that processes mission commands and sensor inputs, understands the sea bed, and provides control inputs to unmanned vehicles to pick up and move objectives on the sea floor.

Second, the project seeks to design an underwater robot to navigate the sea floor and physically manipulate objects in deep-sea environments.



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Manipulating objects underwater can be more difficult than it sounds. Murky sea water, for example, can complicate perception, search, object recognition, and estimation. Man-made objects also may be deteriorated, slippery, or partially covered.

With these conditions in mind, deep-sea teleoperation is difficult enough; It can be next-to-impossible with vision systems and machine autonomy mixed-in.

Underwater manipulation today typically happens with remotely operated vehicles (ROVs) tethered to a surface vessel, and tele-operated by a human pilot. This can limit their utility because ROVs cannot extend beyond their tethers, and need several operators.

Wireless communications for sub-sea teleoperations, moreover, largely is impractical because seawater attenuates electromagnetic wave propagation and available bandwidth.

Instead, DARPA researchers want industry to develop the Angler robotic system capable of long-distance underwater manipulation missions. It will operate autonomously and without external communication to navigate, search, localize, and physically manipulate objects on or near the sea bed; onboard sensors will self-localize, avoid obstacles, interact with the sea bed, and manipulate objects. It also will search for and manipulate deep undersea objects in dark or murky water.

Chief enabling technologies for this project will involve manipulation and autonomy in underwater robotics, DARPA researchers say. Eventually these technologies may move to an operational military system.

DARPA researchers expect the Angler program to capitalize on land-,

space-, and floating-base robotics, terrestrial autonomous manipulation, and underwater sensing for long-distance missions on the sea bed.

The program aims to discover autonomous robotic solutions in sensing techniques for high-resolution navigation in GPS-deprived underwater environments; perception and manipulation for grasping degraded and malformed manmade objects; long-duration autonomy; and mission planning without human intervention.

Angler will fit an underwater robot with autonomy and control technologies for one long mission without human intervention. Proposers should focus on autonomy and decision support algorithms to identify and grasp challenging objects.

DARPA scientists want proposers to capitalize on existing hardware, software, simulation infrastructure, and physical interfaces as much as possible.

Capabilities of interest include long-duration machine autonomy; information fusion; object recognition; autonomous grasp planning; dynamic station keeping at or near the sea bed; and sustained sprint capabilities to evade obstacles and traffic.

DARPA will choose several contractors to work on separate aspects of the Angler program. Companies interested should submit abstracts no later than 30 Jan. 2019, and proposals no later than 23 March 2019, to the DARPA BAA Website at <https://baa.darpa.mil>. Email questions or concerns to DARPA at [HR001119S0009@darpa.mil](mailto:HR001119S0009@darpa.mil). ←

*More information is online at <https://www.fbo.gov/spg/ODA/DARPA/CMO/HR001119S0009/listing.html>.*

Agency (DARPA) in Arlington, Va., are asking Trident Systems Inc. in Fairfax, Va., and Airbus Defense and Space Inc. in Herndon, Va., to develop SWaP-optimized military communications and surveillance satellites designed to operate in LEO. Trident Systems and Airbus Defense join Blue Canyon Technologies in Boulder, Colo., on the DARPA Blackjack initiative to develop low-cost space payloads and commoditized satellite buses with low size, weight, power, and cost (SWaP-C) with similar capabilities as today's military communications that operate at geosynchronous orbit (GEO), but at a fraction of the cost. Trident Systems won a \$1.5 million contract on 8 Jan. 2019; Airbus Defense won a \$2.9 million contract on 19 Nov. 2018; and Blue Canyon won a \$1.5 million contract on 12 Oct. 2018.

## **Missile-defense wish list: space-based interceptors and drones with laser weapons**

The long-delayed Missile Defense Review calls for research and investments to ensure America's security for the next several decades: laser technology, the F-35 as an ICBM killer, and potentially putting interceptors in space. The idea of using laser weapons to take out a missile in the boost phase is not new, but it has received a boost in the past year in comments from Pentagon technological leaders. Expect some form of disaggregated space-based sensors architecture, relying on many smaller systems rather than the expensive, highly-capable systems that the U.S. has traditionally relied upon. Hosting sensor payloads on commercial satellites could also be in play. The Pentagon will launch a study, lasting approximately six months, to look into the most promising technologies for space-based interceptors, and come up with estimates for cost and time; after the study is done, the military leaders will look to move forward if it makes sense. ←



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### Ultraviolet light-emitting diodes (UVLEDs) introduced by Opto Diode

Opto Diode Corp. in Camarillo, Calif., is introducing the OD-265-001 ultraviolet light-emitting diodes (UVLEDs) for disinfection applications. The OD-265-001 narrow-spectral output ultraviolet light-emitting diode is for long-lifetime use. The device has included total power output of 0.53 milliwatts (minimum) and 0.68 milliwatts (typical), with peak emission wavelengths at 260 nanometers (minimum), 265 nanometers (typical) and 270 nanometers (maximum). The OD-265-001's spectral bandwidth at 50 percent is typically 13 nanometers. Thermal parameters for this light-emitting diode include storage temperature ranges of -40 to 100 degrees Celsius.

### How Russia or China could use counter-stealthIRST to shoot down America's stealth fighters

Once either China or Russia manages to put together a long-wave infrared search and track (IRST), high-speed data links, and the computers and algorithms for multi-ship sensor fusion, the ability of U.S. fifth-generation fighters to operate independently will diminish. With Boeing and the U.S. Navy explaining in detail how a combination of longwave IRST combined with high-speed multi-ship data networking and advanced sensor fusion algorithms can generate a weapons quality track on enemy stealth fighters, it is only a matter of time before adversaries such as Russia and China develop similar capabilities. The Navy will be fielding its new counter-stealth capabilities in the coming years as the Block III Super Hornet enters service in 2022. Given that the Russians and the Chinese possess the individual elements of all the required technologies to replicate the U.S. Navy's capabilities, it is only a matter of time before Moscow and Beijing start to field similar counter-stealth abilities. ◀

## Air Force to ask industry for 75-Watt sodium laser to create artificial stars

BY **John Keller**

**KIRTLAND AIR FORCE BASE, N.M.** — U.S. Air Force adaptive optics researchers are ready to approach industry for a new high-power sodium laser to create artificial stars for a variety of optical research at the Air Force Starfire Optical Range at Kirtland Air Force Base, N.M.

Officials of the Officials of the Air Force Research Laboratory Directed Energy Directorate at Kirtland Air Force Base issued a notice last month (FA9451-19-9-0001\_Presolicitation) for the Brighter Sodium Beacon project.

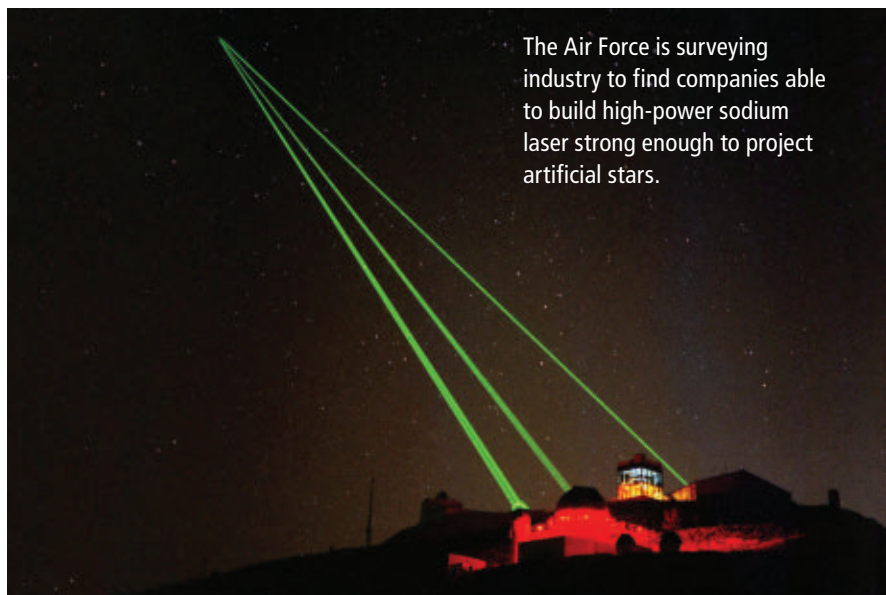
It will ask industry to develop a sodium beacon laser more powerful than 75 Watts to generate artificial stars. Researchers will issue a formal solicitation for this project by the end of March, Air Force officials say.

The powerful sodium laser will project an image in the atmosphere that looks like a bright artificial star that is within the field of view of the Starfire

Optical Range's main 3.5-meter telescope. This telescope will detect any change in the shape of the artificial star due to atmospheric turbulence. The telescope then compensates for any turbulence using adaptive optics.

Disturbances in the Earth's atmosphere cause minor distortions in beams of light. This phenomenon causes what appears to the human eye to be the twinkling of stars at night. Ground-based astronomical observatories compensate for atmospheric turbulence with adaptive optics, which act like flexible mirrors to counteract the effects of atmospheric turbulence.

The make the right corrections, however, adaptive optics need a reliable very bright star to measure atmospheric turbulence. Most natural stars aren't bright enough for this job, or are not in the Starfire Optical Range's field of view. This is where sodium laser-projected artificial stars come in. [PAGE 40]



The Air Force is surveying industry to find companies able to build high-power sodium laser strong enough to project artificial stars.



# Boeing and Lockheed Martin to build infrared search and track systems for F/A-18E/F combat aircraft

BY **John Keller**

**PATUXENT RIVER NAS, Md.** — U.S. Navy air combat experts are asking electro-optics engineers at the Boeing Co. and Lockheed Martin Corp. to build infrared search and track (IRST) sensors for the F/A-18E/F Super Hornet jet fighter-bomber to enable the aircraft to detect, track, and attack enemy aircraft in a stealthy way without making its presence known.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a \$55 million contract to the Boeing Co. Defense, Space & Security segment in St. Louis in January to build as many as six IRST Block II low-rate initial production III systems.

The Super Hornet combat aircraft IRST is a long-wave infrared detection system that targets enemy aircraft in conditions where the Super Hornet cannot use its radar. The system, which Boeing is buying from the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., uses infrared search and track technology to detect and provide weapons-quality track solutions on potentially hostile aircraft.

The IRST Block I, also called the IRST21 Sensor System, fits on the front of the Super Hornet's centerline fuel tank. Two years ago Navy leaders approved a restructured program that foregoes full-rate production of Block I sensors and proceeds directly to the Block II system.

The IRST passive search system consists of a passive long-wave infrared receiver, a processor, inertial measurement unit, and environmental control unit. The infrared receiver, processor, and inertial measurement unit fit inside the sensor, which attaches to the front of the fuel tank mounted to the aircraft on the BRU-32 bomb rack.

The Navy developed the IRST Block I using components from the F-15K/SG aircraft's infrared receiver, which is based on the IRST design of the now-retired Navy F-14 Tomcat jet fighter. IRST Block II includes improvements to the infrared receiver and updated processors. The Navy intends to produce 170 IRST systems.

Even amid electronic attack or heavy RF and infrared countermeasures, IRST provides autonomous tracking data that increases pilot reaction time, and enhances survivability by enabling first-look, first-shoot capability, Lockheed Martin officials say.



Boeing Co. and Lockheed Martin Corp. are building infrared search and track (IRST) sensors for the U.S. Navy F/A-18E/F Super Hornet jet fighter-bomber.

Infrared sensors like the IRST detect the heat from an aircraft's engine exhaust or even the heat generated by the friction of an aircraft as it passes through the atmosphere. Unlike radar, infrared sensors do not emit electronic signals,

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and do not give away their presence to adversaries. This ability can enable Super Hornet pilots to identify enemy aircraft at long ranges.

Data from theIRST system can stand alone or fuse with the Super Hornet's other on-board sensor data situational awareness. Lockheed Martin also is developing anIRST pod that can be fitted to the F-15C and F-16 jet fighters.

On this contract Boeing and Lockheed Martin will do the work in Orlando, Fla., and in St. Louis, and should be finished by December 2021. ◀

For more information contact **Boeing Defense, Space & Security** online at [www.boeing.com/company/about-bds](http://www.boeing.com/company/about-bds), Lockheed Martin Missiles and Fire Control at [www.lockheedmartin.com](http://www.lockheedmartin.com), or Naval Air Systems Command at [www.navair.navy.mil](http://www.navair.navy.mil).

**STARS** [FROM PAGE 38] Adaptive optics use this kind of a guide star as a wavefront reference source of light. The sodium laser creates the artificial guide star by shining a laser into the atmosphere. Light from the beam reflects off components in the upper atmosphere back into the telescope.

Sodium lasers for this purpose are tuned to 589.2 nanometers to energize atoms in the sodium layer of the mesosphere at an altitude of around 56 miles above the Earth's surface. The sodium atoms then re-emit the laser light, producing a glowing artificial star.

The Air Force's Starfire Optical Range helps scientists perfect adaptive optics not only for astronomical observations, but also to sharpen the focus of powerful lasers for high-resolution

satellite imaging, anti-satellite weapons, and relay mirror systems.

Last May the Air Force Research Lab issued a request for information on breakthrough research in sodium beacon lasers stronger than 50 Watts. Since then, planners have increased the desired laser's strength to more than 75 Watts.

Companies interested in this project can submit questions by email to the Air Force's Kimerie Smith at [kimerie.smith@us.af.mil](mailto:kimerie.smith@us.af.mil). Copy email questions to the Air Force's Greg Davis at [william.davis.95@us.af.mil](mailto:william.davis.95@us.af.mil). ◀

More information on the **Brighter Sodium Beacon** project is online at [https://www.fbo.gov/spg/USAF/AFMC/AFRLPLDED/FA9451-19-9-0001\\_Pre-solicitation/listing.html](https://www.fbo.gov/spg/USAF/AFMC/AFRLPLDED/FA9451-19-9-0001_Pre-solicitation/listing.html).



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# PRODUCT applications

## SMART MUNITIONS

### BAE Systems to build APKWS II precision laser-guided smart munitions

The U.S. military is upgrading laser-guided rockets that enable fixed-wing aircraft, helicopters, and unmanned aerial vehicles (UAVs) to attack lightly armored vehicles, bunkers, field fortifications, cars, and trucks with electro-optical smart munitions.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a \$225 million

APKWS uses semi-active laser guidance technology to strike soft and lightly armored targets in confined areas, it has provided the U.S. Marine Corps with a 93 percent hit rate. It is smaller and less expensive than comparable laser-guided missiles like the AGM-114 Hellfire.

The APKWS laser-guided precision munition can fit aboard the U.S. Marine Corps UH-1Y, AH-1W, and AH-1Z helicopters, the experimental Bell 407GT helicopter, the U.S. Army AH-64 Apache attack helicopter, the Eurocopter Tiger, and the Navy MH-60 Seahawk helicopter.

The system also fits aboard fixed-wing aircraft such as the AV-8B Harrier II, F-16 jet fighter, and A-10 close-air-support jet.

In the future, the APKWS is under consideration for the Navy MQ-8 Fire Scout unmanned helicopter, OH-58 helicopter, V-22 tiltrotor, AH-6 Little Bird helicopter, the A-29 Super Tucano ground-attack aircraft, and the Navy F/A-18E/F fighter-bomber.

The APKWS-equipped rocket is slightly longer than six feet, 2.75 inches in diameter, has a wingspan of 9.55 inches, and weighs 32 pounds. It uses the Hydra 70 impact-detonating, air-burst, or standoff warheads. The laser munition can hit targets as far away as three miles, flies at speeds of 2,200 miles per hour, and costs \$30,000 apiece.

On this order BAE Systems will do the work in Hudson, N.H., and Austin, Texas, and should be finished by September 2020. For more information contact **BAE Systems Electronic Systems** online at [www.baesystems.com](http://www.baesystems.com), or **Naval Air Systems Command** at [www.navair.navy.mil](http://www.navair.navy.mil). ◀



## COMMUNICATIONS AND NETWORKING

### Navy picks L-3 to provide data link to control UAVs on Littoral Combat Ship

U.S. Navy shipboard unmanned aerial vehicle (UAV) experts needed a digital data link to control the MQ-8B and MQ-8C unmanned helicopters operating from the Littoral Combat Ship. They found their solution from L-3 Communications-West in Salt Lake City.

Officials of the Naval Sea Systems Command in Washington announced a \$29.6 million order to L-3 to build the Tactical Common Data Link Maritime Shipboard Terminal Surface Terminal Equipment (TCDL MST STE) system for the Littoral Combat Ship in support of the Fire Scout UAV.

The TCDL MST STE is a family of wideband interoperable digital data links that work with unmanned and manned reconnaissance aircraft, and ensure interoperability with U.S. military aircraft and ground-control stations.

This order is to provide the TCDL MST STE system critical capability to all new construction and in-service Littoral Combat Ships (LCS). L-3 will provide three TCDL MST STE systems, which consist of below- and above-deck equipment.

The L-3 T-series model-S surface terminal is a ruggedized communications terminal that has been integrated into the Littoral Combat ship and the Coast Guard National Security Cutter. The terminal is software-configurable and supports standard common data link waveforms.

The system enables naval personnel aboard the Littoral Combat Ship to fly the Fire Scout unmanned helicopter remotely, and receive sensor information from the aircraft.

This terminal operates as part of a shipboard data link system or as a stand-alone, self-contained system for use in remote locations. The system consists of a 36-inch



order to the BAE Systems Electronic Systems segment in Hudson, N.H., to build an additional 9,999 WGU-59/B Advanced Precision Kill Weapon Systems (APKWS) II under full-rate Production Lot 7.

APKWS is an add-on kit that turns a standard unguided 2.75-inch 70-millimeter rocket into a precision laser-guided munition to give warfighters a low-cost surgical strike capability, BAE Systems officials say. Typically, the kit fits on the Hydra 70 fin-stabilized unguided air-to-ground rocket.

These new APKWS II weapons will upgrade the current 2.75-inch rocket system to a semi-active laser-guided precision weapon for the U.S. Army, Navy, Marine Corps, Air Force and the governments of Nigeria and the Netherlands. Last June BAE Systems won a \$224.3 million Navy order for 10,185 APKWS II laser-guided rockets under production lot 7.

dual-axis antenna and a series of below-deck rack-mount line-replaceable units (LRUs) that contain the microwave modem assembly, MMA, CDL interfaces, and Ethernet options for open-systems interfaces.

The system fits into a half-rack space for a single-link configuration. It also has the option to use a portable computer for configuring and monitoring performance of the system, or may be integrated into a larger system application. The data link can be scaled to a multi-link configuration by adding LRUs and antennas.

The antenna is self-contained and houses the RF power amplifier, diplexer, and receiver low-noise amplifier. This Ku band system is designed to operate in all weather conditions. The antenna can be remoted as far as 150 feet in the baseline configuration, L-3 officials say.

The Littoral Combat Ship is a class of relatively small surface vessels designed to operate in shallow coastal waters and harbors. The ships are slightly smaller than Navy guided missile frigates, and have flight decks and hangars large enough UAVs and manned helicopters, can recover and launch small boats from a stern ramp, and can carry a small assault force with fighting vehicles. The ships emphasize speed, flexible mission module space, and a shallow draft.

For this contract modification L-3 will do the work in Salt Lake City, and should be finished by September 2023. For more information contact **L-3 Communications-West** online at [www.l3t.com/csw](http://www.l3t.com/csw), or **Naval Sea Systems Command** at [www.navsea.navy.mil](http://www.navsea.navy.mil).

## SONAR SYSTEMS

### Ultra Electronics to provide sonar systems for Canadian Surface Combatant warship

Ultra Electronics Maritime Systems in Dartmouth, Nova Scotia will build and integrate the low-frequency active and passive towed-array sonar system and the company's next-generation hull-mounted sonar aboard the future Canadian Surface Combatant (CSC), Ultra officials announced.

Ultra also will lead the integration of these underwater sensors with sonobuoys and other capabilities for wide-area underwater battlespace surveillance aboard the future Canadian naval surface warship.



The Canadian Surface Combatant, based on the British Royal Navy Type 26 frigate, will replace Canada's Halifax-class frigate and Iroquois-class destroyer. A team of Lockheed Martin Canada in Ottawa and BAE Systems Maritime in Glasgow, Scotland will start building as many as 15 Canadian Surface Combatant in the early 2020s.

Ultra is the anti-submarine warfare (ASW) lead for the Canadian Surface Combatant. Also on the Lockheed Martin-BAE Systems team are CAE, L-3 Technologies, and MDA. The Canadian Surface Combatant will be designed for high-end ASW, and will be able to perform several different global missions.

For more information contact **Ultra Electronics Maritime Systems** online at [www.ultra-ms.com](http://www.ultra-ms.com).

## SATELLITE COMMUNICATIONS

### Raytheon provides secure shipboard SATCOM and computer networks

Shipboard communications experts at the Raytheon Co. will provide U.S. and allied naval forces with secure satellite communications (SATCOM) capability under terms of a \$16.7 million order announced last week.

Officials of the Space and Naval Warfare Systems Command (SPAWAR) in San Diego, are asking the Raytheon Space and Airborne Systems segment in Marlborough, Mass., to

build Navy Multiband Terminal (NMT) systems and spare parts.

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

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

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



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

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

On this order Raytheon will do the work in Largo, Fla.; and South Deerfield, Stow, and Marlborough, Mass., and should be finished by February 2020. For more information contact **Raytheon Space and Airborne Systems** online at [www.raytheon.com](http://www.raytheon.com), or **SPAWAR** at [www.public.navy.mil/spawar/Pages/default.aspx](http://www.public.navy.mil/spawar/Pages/default.aspx). ←

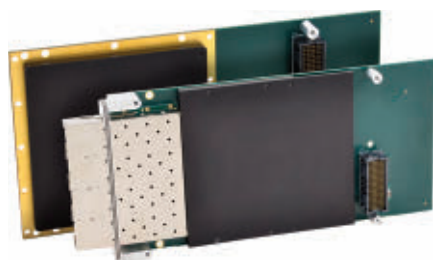




## MEZZANINE CARDS

### Rugged 10 Gigabit Ethernet XMC modules for extended temperatures introduced by Acromag

Acromag in Wixom, Mich., is introducing the XMC630 series 10 Gigabit Ethernet network interface card (NIC) switched mezzanine card (XMC) module for defense, aerospace, industrial, and scientific research computing systems. Designed for commercial off-the-shelf (COTS)



applications, these XMC modules operate in extended temperatures from -40 to 85 degrees Celsius, and offer as many as four independent 10-gigabit Ethernet interface ports. The card mounts on VME, VPX, PCI Express, and other embedded computing carrier boards. An Intel XL710 Ethernet controller provides high-performance network connectivity with advanced off-load and virtualization capabilities. Two models for extended temperatures are available. The air-cooled XMC631 model has four SFP+ connectors on the front panel for fiber optic or copper media transceivers. For more information contact **Acromag** online at [www.acromag.com](http://www.acromag.com).

## SECURE DATA STORAGE

### Curtiss-Wright receives encryption certification for secure data storage

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., has received Common Criteria certification for the hardware and software disk encryption layers in the company's Data Transport System (DTS1) network-attached storage device. The DTS1 is a

commercial off-the-shelf (COTS) data-at-rest data storage device that supports two layers of disk encryption. In the U.S., the National Information Assurance Partnership (NIAP) validates COTS information technology (IT) products to ensure they conform to the international Common Criteria Evaluation and Validation Scheme (CCEVS), which is recognized around the world by 17 Certificate-Producing countries and by 11 Certificate Consuming countries. Having received certification, the hardware and software full-disk encryption layers in the DTS1 are listed on the U.S. NIAP Product Compliant List. Curtiss-Wright also has obtained National Security Agency (NSA) approval for use of the

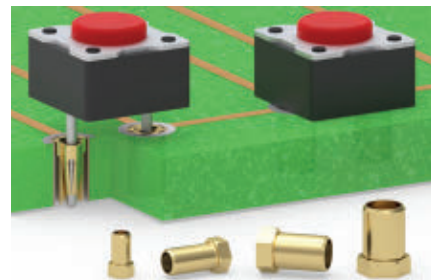


two Common Criteria-certified full-disk encryption layers as Commercial Solutions for Classified (CSfC) components for secure data storage. For more information contact **Curtiss-Wright Defense Solutions** online at [www.curtiss-wrightds.com](http://www.curtiss-wrightds.com), or **Gossamer Security Solutions** [www.gossamersec.com](http://www.gossamersec.com).

## BOARD INTERCONNECTS

### Solderless press-fit receptacles for circuit board interconnects introduced by Mill-Max

Mill-Max Manufacturing Co. in Oyster Bay, N.Y., is introducing 10 solderless press-fit receptacles delivering flush mount solutions for achieving low-profile connections for a variety of interconnect requirements, all while maintaining a zero above board profile. With the zero profile receptacles, Mill-Max has eliminated above-board



connector protrusion, to help reduce overall package height. These receptacles have a precision machined, hexagon shaped flange pressed into the circuit board plated through hole until flush with the surface of the board. No soldering is required as the pressfit forms a gas-tight connection with a properly specified plated through hole. After installation, the zero-profile board interconnects accommodate devices while minimizing overall interconnect height. They are for traditional and rigid backed flex circuit boards. The smallest of the receptacles has a lead acceptance range of 0.008 inches with 0.013 inches in diameter. The largest accepts 0.045 inches at 0.65 inches in diameter. For more information contact **Mill-Max** online at [www.mill-max.com](http://www.mill-max.com).

## CHASSIS MANAGEMENT

### Chassis manager for military embedded computing introduced by VadaTech

VadaTech Inc. in Henderson, Nev., is introducing the VPX980 chassis manager for aerospace, defense, and high-reliability embedded computing applications. The VPX980 is based on the VITA 46.11 specification that capitalizes on the Intelligent Platform Management Interface (IPMI) and AdvancedTCA Specification as its architectural foundation. The VadaTech chassis management





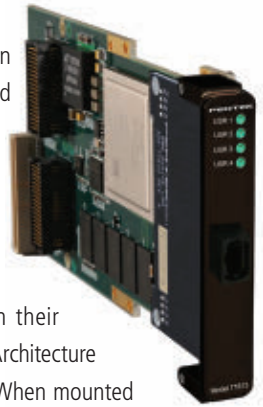
solution is derived from the VadaTech ATCA shelf manager using core interfaces such as the Simple Network Management Protocol (SNMP), Remote Management Control Protocol (RMCP), web interface, Scorpionware system management, and a command line interface. The VPX980 supports the VITA 46.11 Tier-2 command set, providing functionality in the management layer and chassis cooling capabilities. The chassis manager has taken advantage of HPM.1 PICMG specification providing a framework for upgrading the IPMC firmware. The module also has a 1000Base-TX via the front panel as well as Gigabit Ethernet going to P1 as 1000Base-BX. The VPX980 has an option for JTAG Switch Module (JSM) and optional virtual probe, easing device access within the chassis for FPGA code developers. For more information contact **VadaTech** online at [www.vadatech.com](http://www.vadatech.com).

#### EMBEDDED COMPUTING

#### **SOSA-aligned XMC embedded computing module for demanding applications introduced by Pentek**

Pentek Inc. in Upper Saddle River, N.J., is introducing the model 71813 data converter Switched Mezzanine Card (XMC) embedded computing module that aligns with the emerging Sensor Open Systems Architecture (SOSA) for compute-intensive aerospace and defense applications. The model 71813, part of the Pentek Jade family, is based on the Xilinx Kintex Ultrascale field-programmable gate array (FPGA) and has 28 pairs of low-voltage differential signaling (LVDS) digital I/O. The module is being used by Kontron America in San Diego with the Kontron VX305C-40G 3U VPX single-board computer, which also aligns with the SOSA standard of

The Open Group in San Francisco. Pentek and Kontron developed the model 71813 XMC and VX305C-40G computer board to meet the needs of the U.S. defense community in their drive for Open System Architecture computing platforms. When mounted on a compatible single-board computer, the model 71813 provides a customizable I/O signal status and control interface. In the case of a VPX implementation, the I/O is routed to the backplane where it can handle control and command signals to the chassis being defined in the evolving SOSA initiative. For more information contact **Pentek** online at [www.pentek.com](http://www.pentek.com). ←



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## DIRECTOR LIST RENTAL Kelli Berry

918 831-9782 / [kellib@pennwell.com](mailto:kellib@pennwell.com)

For assistance with marketing strategy or ad creation,  
please contact PennWell Marketing Solutions

## Kaci Wheeler

918 832-9377 / [kaciw@pennwell.com](mailto:kaciw@pennwell.com)

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# THE 2019 MILITARY ELECTRONICS BUYERS GUIDE

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- 50 Data-acquisition boards
- 50 DSP boards
- 50 FPGA boards
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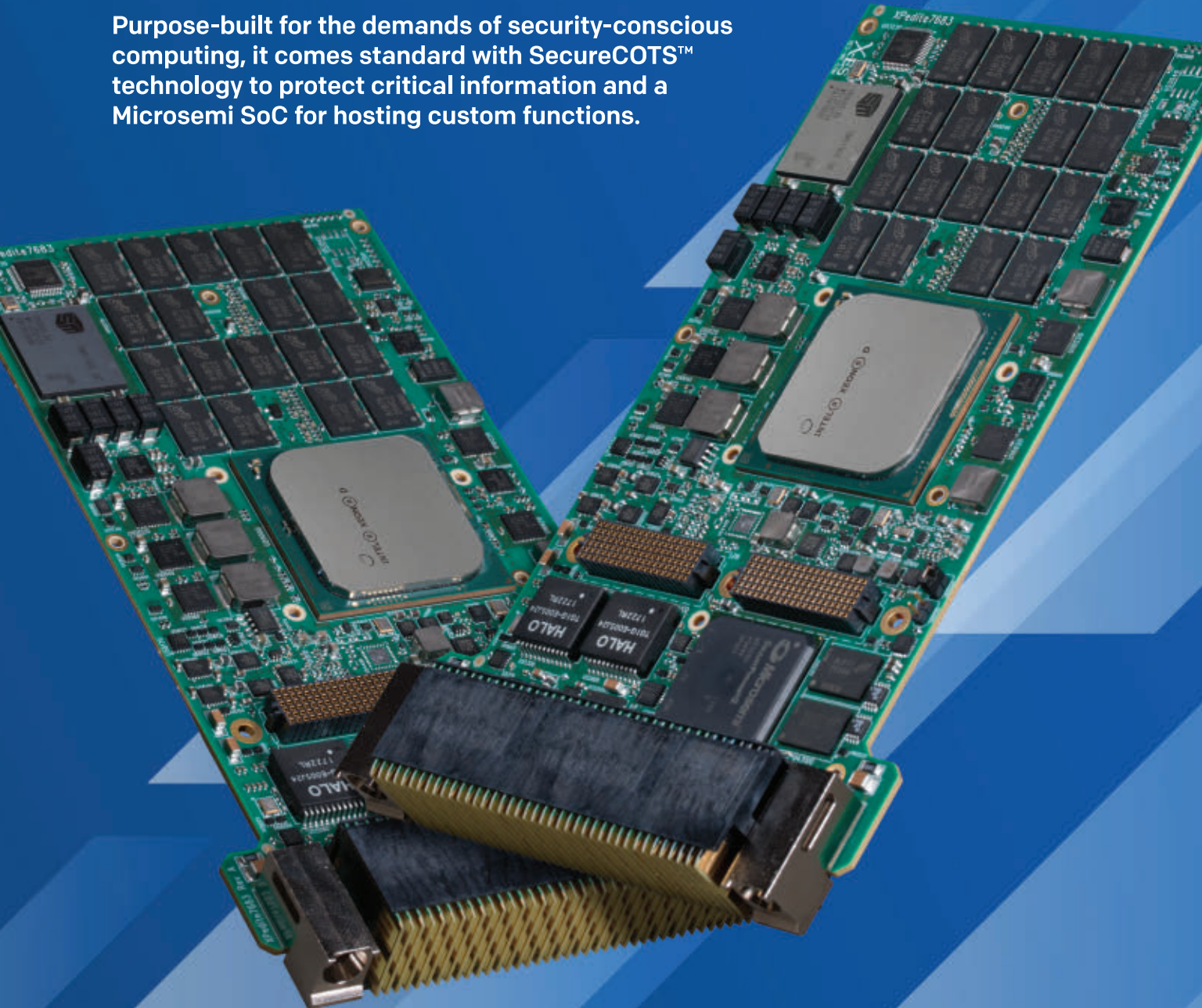
- 61 Avionics health management
- 61 Clocks/timers



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### COMMUNICATIONS/ NETWORK CONTROLLERS

- **Abaco Systems**  
(See ad page 11)
- **Acromag Inc**  
(See ad page 51)
- ADL Embedded Solutions Inc
- Aitech Defense Systems Inc
- Ampex Data Systems
- ASAP 3Sixty
- Curtiss-Wright Defense Solutions
- Diamond-MT
- ECRIN Systems
- **Elma Electronic Inc**  
(See ad page 19, 49)
- esd electronics Inc
- Eureka Dry Tech
- **Extreme Engineering Solutions Inc (X-ES)**  
(See ad page 3, 47)
- **General Micro Systems Inc**  
(See ad page 7)
- Graphic Products
- **Interface Concept**  
(See ad page 1)
- MilesTek
- MilSource
- MPL AG
- Orion Technologies LLC
- PDR Infrared SMT/PCB Rework Systems
- Plane Parts 360
- Pleora Technologies Inc
- Scalys
- Technobox Inc
- TXO Systems Ltd
- United Electronic Industries Inc
- Unlimited Purchasing

### DATA-ACQUISITION BOARDS

- **Abaco Systems**  
(See ad page 11)
- **Acromag Inc**  
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- Active Silicon Inc
- Active Silicon Ltd
- Advantech
- AIM-USA
- Aitech Defense Systems Inc
- Ampex Data Systems
- Annapolis Micro Systems Inc
- CAEN Spa
- CIC Research
- Curtiss-Wright Defense Solutions
- **Data Device Corp (DDC)**  
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- ECRIN Systems
- Elan Technical Corp
- Electronic Interconnect
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- **Extreme Engineering Solutions Inc (X-ES)**  
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(See ad page 31, back cover)
- Pleora Technologies Inc
- Scalys
- Technobox Inc
- United Electronic Industries Inc
- Vadatech Inc

### DSP BOARDS

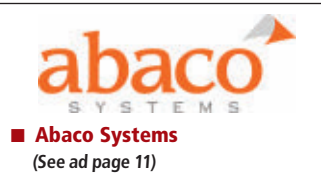
- **Acromag Inc**  
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- ADL Embedded Solutions Inc
- Advantech
- Annapolis Micro Systems Inc
- ASAP 3Sixty
- Asine Ltd
- Curtiss-Wright Defense Solutions
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- **Pentek Inc**  
(See ad page 31, back cover)
- Scalys
- Sensitron Semiconductor
- **SRCTec LLC**  
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United Electronic Industries Inc  
Vision Components GmbH

### FPGA BOARDS



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(See ad page 51)
- Active Silicon Inc
- Active Silicon Ltd



- Aitech Defense Systems Inc
- Annapolis Micro Systems Inc
- Asine Ltd
- CAEN Spa
- Curtiss-Wright Defense Solutions
- **Data Device Corp (DDC)**  
(See ad page 25)
- Diamond-MT
- ECRIN Systems
- **Elma Electronic Inc**  
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- esd electronics Inc
- Eureka Dry Tech
- **Extreme Engineering Solutions Inc (X-ES)**  
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- **General Micro Systems Inc**  
(See ad page 7)
- **Interface Concept**  
(See ad page 1)
- Ironwood Electronics
- Marvin Test Solutions Inc
- **Mercury Systems**  
(See ad page 24)
- North Atlantic Industries Inc



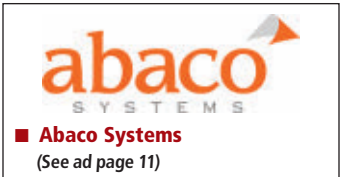
PDR Infrared SMT/PCB  
Rework Systems



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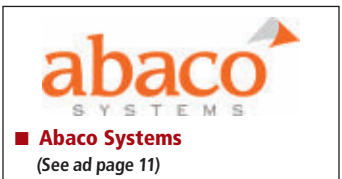
- **SRCTec LLC**  
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- Technobox Inc
- Vadatech Inc
- Vision Components GmbH
- WOLF Advanced Technology

### GRAPHICS/IMAGING BOARDS



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- Pleora Technologies Inc
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(See ad page 44)
- Scalys
- Stratign
- Vadatech Inc
- Vision Components GmbH
- WOLF Advanced Technology

### I/O BOARDS



- **Abaco Systems**  
(See ad page 11)
- AbelConn LLC
- **Acromag Inc**  
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- Active Silicon Inc
- ADL Embedded Solutions Inc
- Advantech
- AIM-USA
- Aitech Defense Systems Inc
- Annapolis Micro Systems Inc
- ASAP 3Sixty
- ASAP Components
- Buy NSN
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- Curtiss-Wright Defense Solutions
- **Data Device Corp (DDC)**  
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■ **General Micro Systems Inc**

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■ **Mercury Systems**

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MPL AG

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Rework Systems

■ **Pentek Inc**

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■ **Phoenix International**

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Plane Parts 360

Scalys

Sital Technology

■ **SRCTec LLC**

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Technobox Inc

United Electronic Industries Inc

Vadatech Inc

VersaLogic Corp

WOLF Advanced Technology

## MEMORY BOARDS

■ **Abaco Systems**

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■ **Acromag Inc**

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Advantech

Aitech Defense Systems Inc

Annapolis Micro Systems Inc

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■ **Elma Electronic Inc**

(See ad page 19, 49)

Eureka Dry Tech

■ **General Micro Systems Inc**

(See ad page 7)

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(See ad page 45)

Scalys

Technobox Inc

## MEZZANINE/DAUGHTER BOARDS

■ **Abaco Systems**

(See ad page 11)

■ **Acromag Inc**

(See ad page 51)

Active Silicon Inc

Active Silicon Ltd



**Advanced Interconnections Corp**

Aitech Defense Systems Inc

Annapolis Micro Systems Inc

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■ **Data Device Corp (DDC)**

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Diamond-MT

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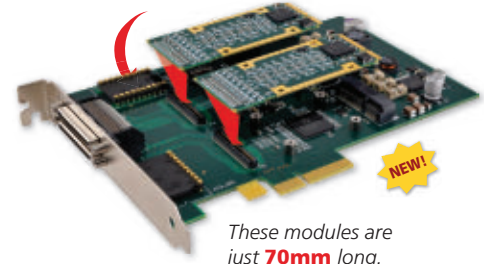
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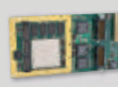


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Pleora Technologies Inc

## ■ SRCTec LLC

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Technobox Inc

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## PERIPHERAL/DEVICE CONTROLLERS

## ■ Acromag Inc

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Carling Technologies Inc

Curtiss-Wright Defense Solutions

Diamond-MT

Elan Technical Corp

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Eureka Dry Tech

## ■ Extreme Engineering Solutions Inc (X-ES)

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## ■ Holt Integrated Circuits

(See ad page 59)

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## Opal Kelly Inc

Plane Parts 360

Pleora Technologies Inc

Scalys

Sital Technology

Technobox Inc

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VersaLogic Corp

## SINGLE-BOARD COMPUTERS



## ■ Abaco Systems

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## ■ Acromag Inc

(See ad page 51)

Active Silicon Inc

Active Silicon Ltd

ADL Embedded Solutions Inc

Advantech

AIM-USA

Annapolis Micro Systems Inc

Asine Ltd

## ■ Cobham Semiconductor Solutions

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Concurrent Technologies



## ■ Crystal Group

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Curtiss-Wright Defense Solutions

## ■ Data Device Corp (DDC)

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Diamond-MT

Electronic Interconnect

## ■ Elma Electronic Inc

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esd electronics Inc

## ■ Extreme Engineering Solutions Inc (X-ES)

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## ■ General Micro Systems Inc

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Marvin Test Solutions Inc

## ■ Mercury Systems

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MilSource

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PDR Infrared SMT/PCB

Rework Systems

## ■ Pentek Inc

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Scalys

## ■ SRCTec LLC

(See ad page 37)

VersaLogic Corp

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## COMMUNICATIONS AND PERIPHERALS

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Kensington Electronics Inc

Liteway Inc

Plane Parts 360

## COMMUNICATIONS EQUIPMENT - LASER COMMUNICATIONS

Applied Optoelectronics Inc

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DLS Electronic Systems Inc

## ■ Elma Electronic Inc

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Excelitas Canada

H&L Instruments LLC

Lightel

Liteway Inc

## COMMUNICATIONS EQUIPMENT - MICROWAVE COMMUNICATIONS

Advanced Test Equipment Rentals

Anritsu

ASAP 3Sixty

Cobham Antenna Systems

Comtech PST

CTT Inc

DEV Systemtechnik GmbH

## ■ HUBER+SUHNER Inc

(See ad page 29)

Ironwood Electronics

NTS Technical Systems

PIC Wire & Cable

Polarity Inc

Quell Corp

Southwest Antennas

Triad RF Systems Inc

## COMMUNICATIONS EQUIPMENT - MILITARY TELECOMMUNICATIONS

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CTT Inc

Dawn VME Products

Delta Digital Video

DEV Systemtechnik GmbH

DLS Electronic Systems Inc

ECRIN Systems

## ■ Gemstar Custom Hard Cases

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HD Barcode

## ■ Holt Integrated Circuits

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## ■ HUBER+SUHNER Inc

(See ad page 29)

## ■ Interface Concept

(See ad page 1)

Ironwood Electronics

The Light Brigade Inc

Lightel

## ■ Milpower Source

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MilSource

North Atlantic Industries Inc

NTS Technical Systems

Orion Systems Inc

## ■ Pentek Inc

(See ad page 31, back cover)

PIC Wire & Cable

Plane Parts 360

Pleora Technologies Inc

Polarity Inc

Quell Corp

Scalys

Shoghi Communications

Sital Technology

Southwest Antennas

Statek Corp

Stratign

Tech Products Inc

Triad RF Systems Inc

TXO Systems Ltd

United Electronic Industries Inc

## COMMUNICATIONS EQUIPMENT - RADIO

Advanced Test Equipment Rentals

Anritsu

BearCom

Cadex Electronics Inc

Cobham Antenna Systems

Computer2100 LLC

DLS Electronic Systems Inc

## ■ HUBER+SUHNER Inc

(See ad page 29)

NTS Technical Systems

Orion Systems Inc

## ■ Pentek Inc

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Pryme

Quality Two-Way Radios

Quell Corp

Southwest Antennas

Statek Corp

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Triad RF Systems Inc

## COMMUNICATIONS EQUIPMENT - SATELLITE EQUIPMENT AND TELEMETRY

Acroamatics Telemetry Systems

Aitech Defense Systems Inc

Berliner Glas KGaA Herbert

Kubatz GmbH & Co

Cadex Electronics Inc

Cobham Antenna Systems

Computer2100 LLC

DEV Systemtechnik GmbH

Eureka Dry Tech

GDP Space Systems

## ■ Gemstar Custom Hard Cases

(See ad page 10)

GPS Networking

## ■ HUBER+SUHNER Inc

(See ad page 29)

LP Technologies

Masterclock Inc

## ■ Pentek Inc

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PIC Wire & Cable

Polarity Inc

Quell Corp



Shoghi Communications  
Sofradir EC Inc  
Southwest Antennas  
Stratign  
Triad RF Systems Inc

## DATA BUSES AND NETWORKING - HIGH-SPEED SWITCHED FABRICS

- **Abaco Systems**  
(See ad page 11)
- **Acromag Inc**  
(See ad page 51)

Axtrinet

- **Crystal Group**  
(See ad inside front cover)
- Curtiss-Wright Defense Solutions

- **Data Device Corp (DDC)**  
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Dawn VME Products

- **Elma Electronic Inc**  
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- **Extreme Engineering Solutions Inc (X-ES)**  
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Hi-Tech Controls

- **Interface Concept**  
(See ad page 1)

- **Mercury Systems**  
(See ad page 24)

MilSource

- **Pentek Inc**  
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## DATA BUSES AND NETWORKING - NETWORK INTERFACE CONTROLLERS

- **Abaco Systems**  
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- **Acromag Inc**  
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ASAP 3Sixty

Axtrinet

Buy NSN

- **Data Device Corp (DDC)**  
(See ad page 25)

Digital Systems Engineering Inc (DSE)  
esd electronics Inc

- **Extreme Engineering Solutions Inc (X-ES)**  
(See ad page 3, 47)

**HOLT INC.**  
INTEGRATED CIRCUITS

- **Holt Integrated Circuits**  
(See ad page 59)

- **Interface Concept**  
(See ad page 1)

MPL AG

Pleora Technologies Inc

Scalys

Shoghi Communications

Sital Technology

United Electronic Industries Inc

## DATA BUSES AND NETWORKING - TACTICAL NETWORKS

**abaco**  
SYSTEMS

- **Abaco Systems**  
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ASAP 3Sixty

## Crystal Group

(See ad inside front cover)

Digital Systems Engineering Inc (DSE)  
HD Barcode

## Interface Concept

(See ad page 1)

MilSource  
PALMARII Dynamics AB  
Pleora Technologies Inc  
Shoghi Communications

## DATA BUSES AND NETWORKING - WIRED NETWORKS

AIM-USA  
ASAP 3Sixty  
Axtrinet  
Digital Systems Engineering Inc (DSE)  
ECRIN Systems  
esd electronics Inc  
Masterclock Inc  
MilesTek  
MPL AG

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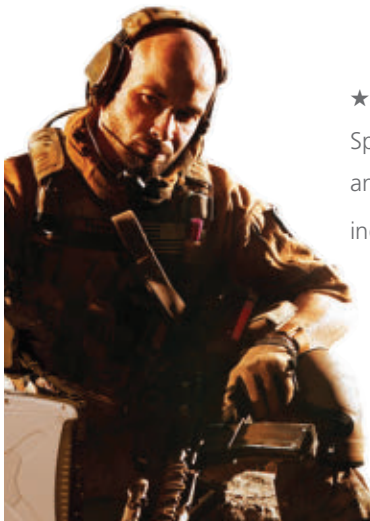
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Curtiss-Wright Defense Solutions

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(See ad page 25)
- Digital Systems Engineering Inc (DSE)

- **Elma Electronic Inc**  
(See ad page 19, 49)

- **Falcon Electronics**  
(See ad page 28)

Fischer Connectors Inc



■ **Holt Integrated Circuits**  
(See ad page 59)

PCE Instruments UK Ltd

- **Pentek Inc**  
(See ad page 31, back cover)
- **Phoenix International**  
(See ad page 45)
- **RGB Spectrum**  
(See ad page 44)

Sital Technology  
United Electronic Industries Inc

- **ZMicro Inc**  
(See ad page 61)

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## DATA STORAGE - RAID/COMPUTER FARMS

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- **Extreme Engineering Solutions Inc (X-ES)**  
(See ad page 3, 47)



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- Orion Technologies LLC
- **Phoenix International**  
(See ad page 45)
- **SMART High Reliability Solutions**  
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- **ZMicro Inc**  
(See ad page 61)

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(See ad page 45)

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- **Pentek Inc**  
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ASAP Components  
Atrenne Computing Solutions  
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Dawn VME Products  
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Diamond USA Inc

- **Elma Electronic Inc**  
(See ad page 19, 49)
- **Extreme Engineering Solutions Inc (X-ES)**  
(See ad page 3, 47)
- **General Micro Systems Inc**  
(See ad page 7)

- **Interstate Connecting Components**  
(See ad page 35)

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- **SRCTec LLC**  
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- TTI Inc

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- Plane Parts 360

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(See ad page 30)
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Amphenol Industrial Products Group
- **Applied Avionics Inc**  
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ASAP Components  
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Harwin Inc  
Hi-Tech Controls



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(See ad page 29)

Ibis Electro-Products Corp



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(See ad page 35)

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(See ad page 27)

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MilesTek  
Nelco Products  
Nicomatic  
NorComp  
ODU-USA Inc  
OFS  
Omnetics Connector Corp

- **Pasternack**  
(See ad page 5, 23, 65)

PIC Wire & Cable  
Plane Parts 360

- **Positronic**  
(See ad page 55)
- Quell Corp
- **Radiall USA**  
(See ad page 39)

Sealcon LLC  
SV Microwave  
Timbercon Inc  
Trendsetter Electronics



TTI Inc

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Dawn VME Products

■ **Elma Electronic Inc**  
(See ad page 19, 49)

Eureka Dry Tech

■ **Extreme Engineering Solutions Inc (X-ES)**  
(See ad page 3, 47)

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(See ad page 7)

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(See ad page 29)

■ **Interstate Connecting Components**  
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■ **LEMO SA**  
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Ibis Electro-Products Corp



■ **Interstate Connecting Components**  
(See ad page 35)

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Lightel  
Liteway Inc  
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(See ad page 55)  
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**COMPONENTS - FILTERS/  
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HEPA Corp  
Kensington Electronics Inc  
Lasertec Inc  
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(See ad page 8)

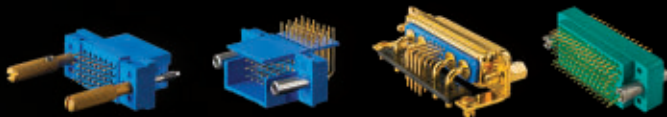
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INSTRUMENTS**

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TTI Inc

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(See ad page 57)

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(See ad page 25)



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ASAP Components

Carling Technologies Inc

### ■ Crystal Group

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### ■ Data Device Corp (DDC)

(See ad page 25)

ECRIN Systems

### ■ Elma Electronic Inc

(See ad page 19, 49)

Embassy Global

EMS Industrial & Service Co

Essex Industries

### ■ Fairview Microwave Inc

(See ad page 13)

First Sensor Inc

Hi-Tech Controls

### ■ Interstate Connecting Components

(See ad page 35)

Kensington Electronics Inc

MilesTek

MilSource

Nicomatic

OTTO Controls

### ■ Pasternack

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TXO Systems Ltd

Wilbrecht LEDCO Inc

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Diamond USA Inc

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Harwin Inc

Hi-Tech Controls



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Nelco Products

Nicomatic

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### ■ Pasternack

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Systems Inc

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Momentum Services Corp

### ■ Vicor Corp

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### ■ ZMicro Inc

(See ad page 61)

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Konica Minolta Sensing Americas Inc

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Diverse Optics Inc

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SwissOptic AG

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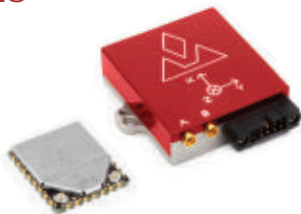


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### ■ Falcon Electronics

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Micross

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### ■ Interface Concept

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(See ad page 25)

EMS Industrial & Service Co

### ■ Interstate Connecting Components

(See ad page 35)

Renesas Electronics Corp

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EMS Industrial & Service Co

Nova Electric

Trendsetter Electronics

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CIC Research

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### ■ General Micro Systems Inc

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LEMO USA Inc

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Polarity Inc

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Diamond-MT  
EMS Industrial & Service Co  
Excelitas Technologies  
March Electronics Inc

■ **Milpower Source**  
(See ad page 33)

Nova Electric  
Sensitron Semiconductor

**SynQor**

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Tech Products Inc

Trendsetter Electronics  
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Versatile Power

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(See ad page 8)

■ **VPT Inc**  
(See ad page 15)

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Chroma Systems Solutions Inc  
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CNC Center  
Comtech PST  
CUI Inc

Custom Manufacturing &  
Engineering Inc

■ **Data Device Corp (DDC)**  
(See ad page 25)

Dawn VME Products

EaglePicher Technologies LLC

■ **Elma Electronic Inc**  
(See ad page 19, 49)

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Epec Engineered Technologies  
ESPEC North America | Qualmark  
Excelitas Technologies

■ **Extreme Engineering  
Solutions Inc (X-ES)**  
(See ad page 3, 47)

■ **Falcon Electronics**  
(See ad page 28)

FSP Group USA  
Kensington Electronics Inc  
Liteway Inc  
Microsemi Corp

■ **Milpower Source**  
(See ad page 33)

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## ■ VPT Inc (See ad page 15)

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MCG Surge Protection  
Quell Corp  
Sensitron Semiconductor  
TTI Inc

## ■ VPT Inc (See ad page 15)

## POWER ELECTRONICS - TRANSDUCERS

Allied Motion Technologies Inc  
CIC Research  
Embassy Global

## ■ Interstate Connecting Components (See ad page 35)

Kensington Electronics Inc  
Renesas Electronics Corp  
Trendsetter Electronics

## SENSORS - CHEMICAL ANALYZERS

Birk Manufacturing Inc  
DRS Daylight Solutions  
Electro Optical Components Inc (EOC)  
Sofradir EC Inc

## SENSORS - INERTIAL

Embassy Global  
First Sensor Inc



## ■ Interstate Connecting Components (See ad page 35)

Jewell Instruments

Silicon Designs Inc  
TTI Inc

## ■ VectorNav Technologies (See ad page 57)

## SENSORS - INFRARED/ ULTRAVIOLET

Boston Electronics Corp  
DRS Daylight Solutions  
Electro Optical Components Inc (EOC)

## ■ Falcon Electronics (See ad page 28)

FLIR Systems Inc  
Gigahertz-Optik Inc  
Ibis Electro-Products Corp

## ■ Interstate Connecting Components (See ad page 35)

Iscan Inc  
Konica Minolta Sensing Americas Inc  
Lasertec Inc

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

## SENSORS - LADAR/LIDAR

Analog Modules Inc  
Boston Electronics Corp  
Excelitas Canada  
First Sensor Inc  
General Atomics Aeronautical  
Systems Inc

## ■ Interstate Connecting Components (See ad page 35)

Konica Minolta Sensing Americas Inc  
Lacroix Precision Optics  
Lightel

Optikos Corp  
Quantum Composers  
RPMC Lasers Inc  
StingRay Optics LLC  
Timbercon Inc

## ■ Vicor Corp (See ad page 8)

## SENSORS - RADAR

General Atomics Aeronautical  
Systems Inc

## ■ HUBER+SUHNER Inc (See ad page 29)

## ■ Interface Concept (See ad page 1)

## ■ Interstate Connecting Components (See ad page 35)

## ■ Milpower Source (See ad page 33)

## ■ Pentek Inc (See ad page 31, back cover)

Polarity Inc

## ■ SRCTec LLC (See ad page 37)

Statek Corp

## SENSORS - SONAR

## ■ Interstate Connecting Components (See ad page 35)

## SENSORS - TACTILE

## ■ Interstate Connecting Components (See ad page 35)

## SENSORS - VISIBLE-LIGHT CAMERAS

Active Silicon Inc  
Active Silicon Ltd  
Adimec  
First Sensor Inc  
GEViCAM 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

## COMPUTERS

## AIR DATA COMPUTERS

Plane Parts 360

## ■ Systel Rugged Computers (See ad page 26)

## ■ ZMicro Inc (See ad page 61)

## DESKTOP COMPUTERS

AIM-USA  
Dynamic Systems Inc  
Graphic Products  
HD Barcode  
MPL AG  
NextComputing  
Zebra Technologies Corp

## ELECTRONIC FLIGHT BAGS (EFTS)

Zebra Technologies Corp

## EMBEDDED COMPUTERS

## ■ Abaco Systems (See ad page 11)

## ■ Acromag Inc (See ad page 51)

Active Silicon Inc  
Active Silicon Ltd

ADL Embedded Solutions Inc  
Aitech Defense Systems Inc  
Asine Ltd  
Atrenne Computing Solutions



## ■ Crystal Group (See ad inside front cover)

Curtiss-Wright Defense Solutions

## ■ Data Device Corp (DDC) (See ad page 25)

Dawn VME Products  
ECRIN Systems

## ■ Elma Electronic Inc (See ad page 19, 49)

esd electronics Inc  
Eureka Dry Tech

## ■ Extreme Engineering Solutions Inc (X-ES) (See ad page 3, 47)

## ■ Interface Concept (See ad page 1)

Matrox Imaging

## ■ Mercury Systems (See ad page 24)

MilSource  
MPL AG  
NextComputing  
Orion Technologies LLC

## ■ Pentek Inc (See ad page 31, back cover)

Scalys

## ■ Systel Rugged Computers (See ad page 26)

Technobox Inc  
United Electronic Industries Inc  
Vadatech Inc  
VersaLogic Corp  
Vision Components GmbH  
VORAGO Technologies  
Wibase Industrial Solutions  
ZARGES Inc

## ■ ZMicro Inc (See ad page 61)

## FLIGHT DIRECTORS

## ■ Crystal Group (See ad inside front cover)

UTC Aerospace Systems

## LAPTOPS/NOTEBOOKS/ HANDHELD COMPUTERS

AIM-USA  
Diamond-MT  
ECRIN Systems  
Graphic Products  
HD Barcode  
IBI Systems Inc  
NextComputing

## ■ Systel Rugged Computers (See ad page 26)



Wibase Industrial Solutions  
Zebra Technologies Corp

## MULTICOMPUTER SYSTEMS

Aitech Defense Systems Inc  
Asine Ltd

### ■ Crystal Group

(See ad inside front cover)

### ■ Elma Electronic Inc

(See ad page 19, 49)

esd electronics Inc

Forefronts Defense Systems  
March Electronics Inc

### ■ Mercury Systems

(See ad page 24)

### ■ Pentek Inc

(See ad page 31, back cover)

### ■ Systel Rugged Computers

(See ad page 26)

## RACK-MOUNT COMPUTERS

ADL Embedded Solutions Inc  
AIM-USA  
Aitech Defense Systems Inc  
Ampex Data Systems  
Asine Ltd  
Atrenne Computing Solutions

### ■ Crystal Group

(See ad inside front cover)

Dawn VME Products

ECRIN Systems

### ■ Elma Electronic Inc

(See ad page 19, 49)

esd electronics Inc

### ■ Extreme Engineering Solutions Inc (X-ES)

(See ad page 3, 47)

IBI Systems Inc

MPL AG

NextComputing

### ■ Pentek Inc

(See ad page 31, back cover)

### ■ Systel Rugged Computers

(See ad page 26)

Vadatech Inc

### ■ Vicor Corp

(See ad page 8)

Zebra Technologies Corp

### ■ ZMicro Inc

(See ad page 61)

## SERVERS

Ampex Data Systems  
ANEXIO  
Atrenne Computing Solutions

### ■ Crystal Group

(See ad inside front cover)

ECRIN Systems

### ■ Extreme Engineering Solutions Inc (X-ES)

(See ad page 3, 47)

### ■ General Micro Systems Inc

(See ad page 7)

### ■ Mercury Systems

(See ad page 24)

MPL AG

### ■ Systel Rugged Computers

(See ad page 26)

TeamEDA Inc

### ■ Vicor Corp

(See ad page 8)

### ■ ZMicro Inc

(See ad page 61)

## SPECIALIZED COMPUTERS - TEMPEST

Aitech Defense Systems Inc  
Atrenne Computing Solutions  
Forefronts Defense Systems  
MPL AG  
Orion Technologies LLC  
Scalys

### ■ Systel Rugged Computers

(See ad page 26)

Zebra Technologies Corp

## WEARABLE COMPUTERS

Dynamic Systems Inc  
HD Barcode  
Ironwood Electronics  
VersaLogic Corp  
Wibase Industrial Solutions  
Zebra Technologies Corp

## DIAGNOSTICS AND CONTROL

### AVIONICS HEALTH MANAGEMENT

#### ■ Applied Avionics Inc

(See ad page 9)

Dawn VME Products

MilesTek

### CLOCKS/TIMERS

#### ■ Applied Avionics Inc

(See ad page 9)

#### ■ HUBER+SUHNER Inc

(See ad page 29)

Masterclock Inc

RWC Testing & Lab Supplies

Trendsetter Electronics

### ENGINE CONTROLS

Carling Technologies Inc  
Ironwood Electronics  
PulseTech Products Corp  
Unlimited Purchasing  
UTC Aerospace Systems

### ENGINE MONITORING

PCE Instruments UK Ltd  
Photron USA Inc  
PulseTech Products Corp

### FUEL MANAGEMENT SYSTEMS

First Sensor Inc  
Tef Cap Industries

### HEALTH AND USAGE MONITORING (HUMS)

Dawn VME Products

TeamEDA Inc

Versatile Power

### OVERHEAT DETECTION

Dawn VME Products  
Palmer Wahl Instruments Inc  
PCE Instruments UK Ltd  
Tef Cap Industries

## ELECTRO-OPTICS

### BONDING AND ADHESIVES

Berliner Glas KGaA Herbert  
Kubatz GmbH & Co  
Comar Optics Ltd  
Diverse Optics Inc  
Finetech  
First Sensor Inc  
Knight Optical  
Master Bond  
Techsil Ltd

### CAMERAS

Accusy Phototech Ltd  
Active Silicon Inc  
Active Silicon Ltd

Adimec

First Sensor Inc

FISBA

### ■ Gemstar Custom Hard Cases

(See ad page 10)

General Atomics Aeronautical  
Systems Inc

GEViCAM Inc

Guernsey Coating Laboratories Inc

IRnova AB

ISVI Corp

Matrox Imaging

Mega Speed Corp

Navitar Inc

OPCO Laboratory

Optikos Corp

Sierra Pacific Innovations

Sofradir EC Inc

Thorlabs Inc

TNC Optics & Technologies Pte Ltd

UTC Aerospace Systems (Sensors  
Unlimited Products)

Vision Components GmbH

Z3 Technology

Zebra Technologies Corp

### ELECTRO-OPTIC MATERIALS AND SUBSTRATES

Accusy Phototech Ltd

# SMALLER. LIGHTER. FASTER.



The **ZM3 Mission Computer** is designed specifically to minimize size and weight, yet maximize performance, making it the ideal solution for airborne ISR applications.

## FULL COMPUTING CAPABILITY IN A SMALL, RUGGED PACKAGE.

**zmicro**  
zmicro.com/ZM3

# PRODUCT CATEGORIES

Advanced Precision Engineering Inc  
Comar Optics Ltd  
Diverse Optics Inc  
Embassy Global  
Ibis Electro-Products Corp  
Infinite Optics Inc  
Knight Optical  
Lasertec Inc  
MOK Optics Co Ltd  
OPCO Laboratory  
Reynard Corp  
Thorlabs Inc  
Vision Components GmbH

## EQUIPMENT MANUFACTURING

Advanced Precision Engineering Inc  
Birk Manufacturing Inc  
Finetech  
IRnova AB  
LazerArc  
Lightel  
OptoTest

## FORWARD-LOOKING INFRARED SYSTEMS

IRnova AB  
Lasertec Inc  
Optikos Corp  
Sofradir EC Inc  
UTC Aerospace Systems (Sensors  
Unlimited Products)

## LASER COMPONENTS

Accusy Phototech Ltd  
Advanced Optics Inc  
Advanced Precision Engineering Inc  
Analog Modules Inc  
Avo Photonics  
Boston Electronics Corp  
CIC Research  
Diverse Optics Inc  
ESPEC North America | Qualmark  
Excelitas Canada  
FISBA  
Go4Fiber Ltd  
Ibis Electro-Products Corp  
Infinite Optics Inc  
Knight Optical  
Krell Technologies Inc  
Lacroix Precision Optics  
Lasertec Inc  
MOK Optics Co Ltd  
OFS  
OPCO Laboratory  
Quantum Composers  
Reynard Corp  
RPMC Lasers Inc  
Thorlabs Inc  
Visotek Inc

## LASERS

Accusy Phototech Ltd  
Avo Photonics  
Boston Electronics Corp  
DRS Daylight Solutions  
Electron Test Equipment  
Electro Optical Components Inc (EOC)

Excelitas Canada  
FISBA  
General Atomics Aeronautical  
Systems Inc  
Guernsey Coating Laboratories Inc  
Konica Minolta Sensing Americas Inc  
Krell Technologies Inc  
LAS-CAD GmbH  
Lasertec Inc  
■ **Newport Corp**  
(See ad page 14)

OFS  
OPCO Laboratory  
Quantum Composers  
RPMC Lasers Inc  
SPI Lasers UK Ltd  
Thorlabs Inc  
Timbercon Inc  
TNC Optics & Technologies Pte Ltd

## LEDs

■ **Applied Avionics Inc**  
(See ad page 9)  
Diverse Optics Inc  
Electro Optical Components Inc (EOC)  
■ **Elma Electronic Inc**  
(See ad page 19, 49)

Embassy Global  
Excelitas Canada  
FiberTech Optica  
FoxFury Lighting Solutions  
GS PLASTIC OPTICS  
Konica Minolta Sensing Americas Inc  
Marktech Optoelectronics  
Microsemi Corp  
Nicomatic  
OPCO Laboratory  
Opto Diode Corp  
RPMC Lasers Inc  
StacoSystems  
Thorlabs Inc  
TTI Inc  
Wilbrecht LEDCO Inc

## LIGHTING

Aero Dynamix Inc  
Comar Optics Ltd  
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 Phototech Ltd  
Active Silicon Inc  
Aero Dynamix Inc  
■ **Applied Avionics Inc**  
(See ad page 9)

Archer OptX  
Boston Electronics Corp  
Digital Systems Engineering Inc (DSE)  
FISBA  
GS PLASTIC OPTICS  
Guernsey Coating Laboratories Inc  
Infinite Optics Inc  
IRnova AB  
Knight Optical  
Konica Minolta Sensing Americas Inc  
Lasertec Inc  
Lensel Optics Pvt Ltd  
MOK Optics Co Ltd  
N-Vision Optics  
OPCO Laboratory  
Reynard Corp  
Sierra Pacific Innovations  
Sofradir EC Inc  
SwissOptic AG  
TNC Optics & Technologies Pte Ltd  
UTC Aerospace Systems (Sensors  
Unlimited Products)  
Wilbrecht LEDCO Inc

## OPTICAL AMPLIFIERS

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

## OPTICAL COATINGS/ TREATMENTS

Accusy Phototech Ltd  
Advanced Optics Inc  
Archer OptX  
Comar Optics Ltd  
Deposition Sciences Inc (DSI)  
Diverse Optics Inc  
Electro Optical Components Inc (EOC)  
Eureka Dry Tech  
FISBA  
GS PLASTIC OPTICS  
Guernsey Coating Laboratories Inc  
Incertec  
Infinite Optics Inc  
Knight Optical  
Lacroix Precision Optics  
Lasertec Inc  
Lensel Optics Pvt Ltd  
Master Bond  
MOK Optics Co Ltd  
OPCO Laboratory  
Reynard Corp  
SwissOptic AG  
Thorlabs Inc  
Timbercon Inc

## OPTICAL DETECTORS

Accusy Phototech Ltd  
Analog Modules Inc  
aPeak Inc  
Boston Electronics Corp

Changchun Long Ze Precision  
Optics Co Ltd  
Electro Optical Components Inc (EOC)  
Excelitas Canada  
■ **Falcon Electronics**  
(See ad page 28)  
First Sensor Inc  
Gamma Scientific  
Gigahertz-Optik Inc  
GS PLASTIC OPTICS  
Guernsey Coating Laboratories Inc  
Lasertec Inc  
Martin, Froeschner & Associates  
Microsemi Corp  
Opto Diode Corp  
Photron USA Inc  
Radiant Vision Systems  
Sofradir EC Inc  
Specialised Imaging Inc  
Specialised Imaging Ltd  
Thermo Scientific - CIDTEC  
Thorlabs Inc  
TNC Optics & Technologies Pte Ltd  
UTC Aerospace Systems (Sensors  
Unlimited Products)

## OPTICAL FIBER

Aerospace Aces  
Archer OptX  
Delphi Automotive LLP  
DEV Systemtechnik GmbH  
Diamond USA Inc  
Excelitas Canada  
FiberTech Optica  
Go4Fiber Ltd  
Guernsey Coating Laboratories Inc  
Ibis Electro-Products Corp  
Infinite Optics Inc  
■ **Interstate Connecting  
Components**  
(See ad page 35)  
Krell Technologies Inc  
KSARIA Corp  
■ **LEMO SA**  
(See ad page 27)

Lightel  
MilesTek  
OFS  
OPCO Laboratory  
■ **Pentek Inc**  
(See ad page 31, back cover)

Thorlabs Inc  
Timbercon Inc  
TNC Optics & Technologies Pte Ltd

## OPTICAL FILTERS

Accusy Phototech Ltd  
Archer OptX  
Comar Optics Ltd  
Deposition Sciences Inc (DSI)  
Electro Optical Components Inc (EOC)  
Embassy Global  
FISBA  
Guernsey Coating Laboratories Inc  
Infinite Graphics Inc  
Infinite Optics Inc

ISP Optics Corp  
Knight Optical  
Lacroix Precision Optics  
Lasertec Inc  
Lensel Optics Pvt Ltd  
MOK Optics Co Ltd  
■ **Newport Corp**  
(See ad page 14)  
Reynard Corp  
Thorlabs Inc  
TNC Optics & Technologies Pte Ltd

## OPTICAL IMAGING

Accusy Phototech Ltd  
Active Silicon Inc  
Advanced Optics Inc  
Archer OpTx  
Boston Electronics Corp  
Changchun Long Ze Precision Optics Co Ltd  
Comar Optics Ltd  
FiberTech Optica  
FISBA  
GEViCAM Inc  
GS PLASTIC OPTICS  
Guernsey Coating Laboratories Inc  
H&L Instruments LLC  
Infinite Graphics Inc  
Infinite Optics Inc  
IRnova AB  
Iscan Inc  
ISP Optics Corp  
ISVI Corp  
KEYENCE Corp of America  
Lacroix Precision Optics  
Lasertec Inc  
Lensel Optics Pvt Ltd  
Navitar Inc  
OPCO Laboratory  
Optikos Corp  
Photron USA Inc  
Radiant Vision Systems  
Reynard Corp  
Shoghi Communications  
Specialised Imaging Inc  
Specialised Imaging Ltd  
StingRay Optics LLC  
Thorlabs Inc  
TNC Optics & Technologies Pte Ltd  
UTC Aerospace Systems (Sensors Unlimited Products)

## OPTICAL SWITCHES

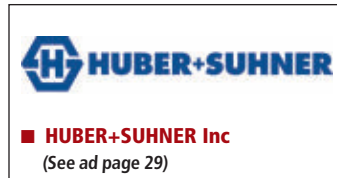
■ **Applied Avionics Inc**  
(See ad page 9)  
DEV Systemtechnik GmbH  
Embassy Global  
■ **Falcon Electronics**  
(See ad page 28)  
■ **HUBER+SUHNER Inc**  
(See ad page 29)  
Liteway Inc  
Marktech Optoelectronics  
OptoTest  
StacoSystems  
Thorlabs Inc



TTI Inc

## OPTICAL TRANSCEIVERS

Applied Optoelectronics Inc  
DEV Systemtechnik GmbH  
H&L Instruments LLC



■ **HUBER+SUHNER Inc**  
(See ad page 29)

## ■ Interstate Connecting Components

(See ad page 35)

Timbercon Inc  
TXO Systems Ltd

## OPTICS

Accusy Phototech Ltd  
Advanced Optics Inc  
Archer OpTx  
Avo Photonics  
Berliner Glas KGaA Herbert Kubatz GmbH & Co  
Comar Optics Ltd  
Deposition Sciences Inc (DSI)  
Diverse Optics Inc  
Embassy Global  
Eureka Dry Tech  
FiberTech Optica  
FISBA  
GS PLASTIC OPTICS  
Guernsey Coating Laboratories Inc  
Infinite Graphics Inc  
Infinite Optics Inc  
ISP Optics Corp  
ISVI Corp  
Knight Optical  
Krell Technologies Inc  
Lacroix Precision Optics  
LAS-CAD GmbH  
Lasertec Inc  
Lensel Optics Pvt Ltd  
MOK Optics Co Ltd  
Navitar Inc  
■ **Newport Corp**  
(See ad page 14)  
N-Vision Optics  
OPCO Laboratory  
Optikos Corp  
Radiant Vision Systems  
Reynard Corp  
StingRay Optics LLC  
SwissOptic AG  
Thorlabs Inc  
Timbercon Inc  
TNC Optics & Technologies Pte Ltd  
UTC Aerospace Systems

UTC Aerospace Systems (Sensors Unlimited Products)  
Visotek Inc

## THERMAL IMAGING

Accusy Phototech Ltd  
Active Silicon Inc  
Advanced Test Equipment Rentals  
Archer OpTx  
Birk Manufacturing Inc  
Boston Electronics Corp  
Excelitas Canada  
FISBA  
Guernsey Coating Laboratories Inc  
Infinite Optics Inc  
IRnova AB  
ISP Optics Corp  
Knight Optical  
Lasertec Inc  
N-Vision Optics  
Optikos Corp  
PCE Instruments UK Ltd  
Reynard Corp  
Sierra Pacific Innovations  
Sofradir EC Inc  
StingRay Optics LLC  
UTC Aerospace Systems (Sensors Unlimited Products)

## ULTRAVIOLET LIGHT SOURCES

FiberTech Optica  
FoxFury Lighting Solutions  
Gamma Scientific  
Gigahertz-Optik Inc  
Lasertec Inc  
Reynard Corp  
Techsil Ltd  
Wilbrecht LEDCO Inc

## NAVIGATION

### AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) EQUIPMENT

■ **Applied Avionics Inc**  
(See ad page 9)  
Shoghi Communications  
■ **SRCTec LLC**  
(See ad page 37)

## GPS SYSTEMS

■ **Applied Avionics Inc**  
(See ad page 9)  
■ **Gemstar Custom Hard Cases**  
(See ad page 10)  
■ **General Micro Systems Inc**  
(See ad page 7)  
■ **HUBER+SUHNER Inc**  
(See ad page 29)  
Ironwood Electronics  
Masterclock Inc  
■ **Pentek Inc**  
(See ad page 31, back cover)  
PIC Wire & Cable  
Shoghi Communications  
Statak Corp

■ **VectorNav Technologies**  
(See ad page 57)

## TERRAIN

■ **Applied Avionics Inc**  
(See ad page 9)  
Casey Machine Co  
Pleora Technologies Inc

## PLATFORM SYSTEMS/SUBSYSTEMS

### AUTOPILOTS

Jewell Instruments

### AVIONICS

■ **Abaco Systems**  
(See ad page 11)  
ADL Embedded Solutions Inc  
Advanced Precision Engineering Inc  
Annapolis Micro Systems Inc  
■ **Applied Avionics Inc**  
(See ad page 9)  
Asine Ltd  
Atrenne Computing Solutions  
■ **Crystal Group**  
(See ad inside front cover)  
Curtiss-Wright Defense Solutions  
Digital Systems Engineering Inc (DSE)  
DLS Electronic Systems Inc  
EaglePicher Technologies LLC  
■ **Elma Electronic Inc**  
(See ad page 19, 49)  
Essex Industries  
■ **Extreme Engineering Solutions Inc (X-ES)**  
(See ad page 3, 47)  
■ **Holt Integrated Circuits**  
(See ad page 59)  
■ **Interface Concept**  
(See ad page 1)  
Ironwood Electronics  
Jewell Instruments  
MilesTek  
Momentum Services Corp  
North Atlantic Industries Inc  
Optikos Corp  
Orion Technologies LLC  
PIC Wire & Cable  
Plane Parts 360  
Sensitron Semiconductor  
Shoghi Communications  
StacoSystems  
Statak Corp  
Unlimited Purchasing  
UTC Aerospace Systems  
■ **VectorNav Technologies**  
(See ad page 57)  
■ **Vicor Corp**  
(See ad page 8)

### CABIN MANAGEMENT SYSTEMS

DLS Electronic Systems Inc  
Statak Corp



Tef Cap Industries  
Unlimited Purchasing  
UTC Aerospace Systems

## COUNTERMEASURES

Annapolis Micro Systems Inc

### ■ Crystal Group

(See ad inside front cover)

CTT Inc

DRS Daylight Solutions

Excelitas Technologies

### ■ HUBER+SUHNER Inc

(See ad page 29)

Optikos Corp

Pleora Technologies Inc

Polarity Inc

Shoghi Communications

## ELECTRONIC FLIGHT INSTRUMENT SYSTEMS (EFIS)

Birk Manufacturing Inc

Casey Machine Co

Statek Corp

## LANDING SYSTEMS

Casey Machine Co

ESPEC North America | Qualmark

Statek Corp

UTC Aerospace Systems

## LIGHTING

Aero Dynamix Inc

DLS Electronic Systems Inc

ESPEC North America | Qualmark

FoxFury Lighting Solutions

Midstream Lighting

UTC Aerospace Systems

### ■ Vicor Corp

(See ad page 8)

## LIGHT MANAGEMENT SYSTEMS

### ■ Interface Concept

(See ad page 1)

Midstream Lighting

Radiant Vision Systems

### ■ Vicor Corp

(See ad page 8)

## NAVIGATION EQUIPMENT

Atrenne Computing Solutions

### ■ Crystal Group

(See ad inside front cover)

CTT Inc

Dawn VME Products

ESPEC North America | Qualmark

### ■ Interface Concept

(See ad page 1)

### ■ Milpower Source

(See ad page 33)

Statek Corp

### ■ VectorNav Technologies

(See ad page 57)

## SATELLITE SYSTEMS

Acroamatics Telemetry Systems

ADL Embedded Solutions Inc

Annapolis Micro Systems Inc

Berliner Glas KGaA Herbert

Kubatz GmbH & Co

Birk Manufacturing Inc

Casey Machine Co

### ■ Crystal Group

(See ad inside front cover)

DEV Systemtechnik GmbH

EaglePicher Technologies LLC

ESPEC North America | Qualmark

### ■ Gemstar Custom Hard Cases

(See ad page 10)

### ■ HUBER+SUHNER Inc

(See ad page 29)

Optikos Corp

Shoghi Communications

StingRay Optics LLC

ZARGES Inc

## SECURITY SYSTEMS

Active Silicon Inc

Active Silicon Ltd

ADL Embedded Solutions Inc

### ■ Interface Concept

(See ad page 1)

Panel Built Inc

Scalys

Shoghi Communications

StingRay Optics LLC

## SHIPBOARD/MARITIME ELECTRONICS

### ■ Abaco Systems

(See ad page 11)

Aero Dynamix Inc

Ampex Data Systems

Annapolis Micro Systems Inc

### ■ Applied Avionics Inc

(See ad page 9)

Atrenne Computing Solutions

### ■ Crystal Group

(See ad inside front cover)

Dawn VME Products

Digital Systems Engineering Inc (DSE)

### ■ Elma Electronic Inc

(See ad page 19, 49)

### ■ Gemstar Custom Hard Cases

(See ad page 10)

### ■ HUBER+SUHNER Inc

(See ad page 29)

### ■ Milpower Source

(See ad page 33)

North Atlantic Industries Inc

Orion Technologies LLC

**PENTEK**

### ■ Pentek Inc

(See ad page 31, back cover)

### ■ PICO Electronics Inc

(See ad page 21, inside back cover)

PIC Wire & Cable

### ■ RGB Spectrum

(See ad page 44)

StacoSystems

Statek Corp

VersaLogic Corp

ZARGES Inc

## TRAINING AND SIMULATION

### ■ Abaco Systems

(See ad page 11)

Ampex Data Systems



### ■ Crystal Group

(See ad inside front cover)

Delta Digital Video

GDP Space Systems

North Atlantic Industries Inc

Orion Technologies LLC

### ■ RGB Spectrum

(See ad page 44)

Shoghi Communications

Statek Corp

## UNMANNED VEHICLES

### ■ Abaco Systems

(See ad page 11)

Active Silicon Inc

Active Silicon Ltd

ADL Embedded Solutions Inc

Allied Motion Technologies Inc

Ampex Data Systems

Annapolis Micro Systems Inc

Archer OpTx

Atrenne Computing Solutions

Casey Machine Co

### ■ Crystal Group

(See ad inside front cover)

CTT Inc

Delta Digital Video

EaglePicher Technologies LLC

ESPEC North America | Qualmark

### ■ Extreme Engineering Solutions Inc (X-ES)

(See ad page 3, 47)

FLIR Systems Inc

### ■ Holt Integrated Circuits

(See ad page 59)

### ■ HUBER+SUHNER Inc

(See ad page 29)

North Atlantic Industries Inc

Orion Technologies LLC

PALMARII Dynamics AB

Sensitron Semiconductor

Shoghi Communications

Statek Corp

StingRay Optics LLC

Triad RF Systems Inc

### ■ VectorNav Technologies

(See ad page 57)

**VICOR**

### ■ Vicor Corp

(See ad page 8)

Zebra Technologies Corp

## VETRONICS

### ■ Applied Avionics Inc

(See ad page 9)

Asine Ltd

Atrenne Computing Solutions

### ■ Crystal Group

(See ad inside front cover)

Curtiss-Wright Defense Solutions

Digital Systems Engineering Inc (DSE)

### ■ Elma Electronic Inc

(See ad page 19, 49)

### ■ Holt Integrated Circuits

(See ad page 59)

North Atlantic Industries Inc

Orion Technologies LLC

Pleora Technologies Inc

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(See ad inside front cover)

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## RF AND MICROWAVE

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AR Modular RF

Comtech PST

Continental Resources

CTT Inc

Custom MMIC

DEV Systemtechnik GmbH

### ■ Fairview Microwave Inc

(See ad page 13)

### ■ Falcon Electronics

(See ad page 28)

GPS Networking

### ■ Interstate Connecting Components

(See ad page 35)

### ■ Mercury Systems

(See ad page 24)

Micross

Microsemi Corp

### ■ Pasternack

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■ **HUBER+SUHNER Inc**  
(See ad page 29)

■ **Interstate Connecting Components**  
(See ad page 35)

Masterclock Inc

■ **Pasternack**  
(See ad page 5, 23, 65)

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## BONDING AND ADHESIVES

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Master Bond  
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(See ad page 28)

■ **HUBER+SUHNER Inc**  
(See ad page 29)

Microsemi Corp

■ **Pasternack**  
(See ad page 5, 23, 65)

■ **Positronic**  
(See ad page 55)

Trendsetter Electronics



TTI Inc

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Amphenol Aerospace  
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GPS Networking

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(See ad page 35)

Keysight Technology Inc  
March Electronics Inc

Mixed Signal Integration Corp

NTS Technical Systems

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(See ad page 13)

Masterclock Inc

■ **Pasternack**  
(See ad page 5, 23, 65)

Saelig Co Inc

## HYBRIDS

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(See ad page 13)



■ **Falcon Electronics**  
(See ad page 28)

■ **Pasternack**  
(See ad page 5, 23, 65)

## MICROWAVE SUBASSEMBLIES

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(See ad page 29)

■ **Mercury Systems**  
(See ad page 24)

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(See ad page 28)

Kensington Electronics Inc

■ **Mercury Systems**  
(See ad page 24)

Mixed Signal Integration Corp

Nicomatic

■ **SRCTec LLC**  
(See ad page 37)

## MMICS

Custom MMIC

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(See ad page 13)

## OSCILLATORS/SYNTHESIZERS

Continental Resources

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(See ad page 13)

■ **Falcon Electronics**  
(See ad page 28)

Masterclock Inc

Microsemi Corp

Mixed Signal Integration Corp

■ **Pasternack**  
(See ad page 5, 23, 65)

Statek Corp

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## RF ATTENUATORS

Anritsu

Cobham Antenna Systems

Continental Resources

Custom MMIC

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■ **Fairview Microwave Inc**  
(See ad page 13)

GPS Networking  
Keysight Technology Inc

■ **Pasternack**  
(See ad page 5, 23, 65)

■ **Radiall USA**  
(See ad page 39)

SV Microwave  
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## RF PACKAGING

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(See ad page 13)

Finetech

■ **Gemstar Custom Hard Cases**  
(See ad page 10)

■ **Pasternack**  
(See ad page 5, 23, 65)

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Electro-Mech Components Inc

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(See ad page 13)

■ **Interstate Connecting Components**  
(See ad page 35)

Keysight Technology Inc  
Liteway Inc

■ **Mercury Systems**  
(See ad page 24)

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■ **Pasternack**  
(See ad page 5, 23, 65)

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(See ad page 39)

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(See ad page 5, 23, 65)

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GDP Space Systems

■ **HUBER+SUHNER Inc**  
(See ad page 29)

■ **Mercury Systems**  
(See ad page 24)

■ **Pasternack**  
(See ad page 5, 23, 65)



■ **Pentek Inc**  
(See ad page 31, back cover)

Triad RF Systems Inc

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Ironwood Electronics

■ **Mercury Systems**  
(See ad page 24)

Mixed Signal Integration Corp

■ **Pasternack**  
(See ad page 5, 23, 65)

■ **PICO Electronics Inc**  
(See ad page 21, inside back cover)

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(See ad page 9)

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(See ad page 9)

SSP Manufacturing Inc

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(See ad page 9)

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CIC Research  
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ConductRF  
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Epec Engineered Technologies

#### ■ Fairview Microwave Inc

(See ad page 13)

#### ■ Gemstar Custom Hard Cases

(See ad page 10)

Hi-Tech Controls  
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#### ■ Vicor Corp

(See ad page 8)

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(See ad page 9)

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(See ad page 9)

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(See ad page 6)

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EMS Industrial & Service Co  
Essex Industries  
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(See ad page 10)

GS PLASTIC OPTICS

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(See ad page 29)

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(See ad page 35)

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Micross  
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(See ad page 37)

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(See ad page 37)

SSP Manufacturing Inc

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Asine Ltd  
Diamond-MT  
DLS Electronic Systems Inc  
ECRIN Systems  
Embassy Global  
EMCCons Dr Rasek GmbH & Co KG  
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GL Communications Inc  
Green Hills Software Inc  
Industrial Training Consultants Inc  
Infinite Graphics Inc  
The Light Brigade Inc  
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NTS Technical Systems  
PALMARII Dynamics AB  
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(See ad inside front cover)

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Dawn VME Products  
Digital Systems Engineering Inc (DSE)  
Diverse Optics Inc  
DLS Electronic Systems Inc  
ECRIN Systems  
EMS Industrial & Service Co  
Epec Engineered Technologies

#### ■ Extreme Engineering Solutions Inc (X-ES)

(See ad page 3, 47)

First Sensor Inc

#### ■ Gemstar Custom Hard Cases

(See ad page 10)

Infinite Optics Inc

InfoSight Corp

#### ■ Interface Concept

(See ad page 1)

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Lensel Optics Pvt Ltd  
Micross  
Navitar Inc  
Nicomatic  
NorComp  
NTS Technical Systems  
Optikos Corp  
OptoTest  
Orion Systems Inc  
Orion Technologies LLC  
PALMARII Dynamics AB  
PIC Wire & Cable  
Polarity Inc

#### ■ Positronic

(See ad page 55)

Puleo Electronics Inc  
Quantum Composers  
Renesas Electronics Corp  
Reynard Corp  
Scalys  
Sofradir EC Inc  
Southwest Antennas

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(See ad page 37)

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(See ad page 28)

## ■ Interstate Connecting Components

(See ad page 35)

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SSP Manufacturing Inc



TTI Inc

Unlimited Purchasing

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Infinite Graphics Inc  
Ironwood Electronics  
Photron USA Inc  
Puleo Electronics Inc  
TeamEDA Inc  
Vision Components GmbH

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(See ad page 11)

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Cuelogic Technologies  
esd electronics Inc  
GDP Space Systems  
GL Communications Inc  
Graphic Products  
Green Hills Software Inc  
H&L Instruments LLC  
HD Barcode

#### ■ Interface Concept

(See ad page 1)

Pleora Technologies Inc  
Puleo Electronics Inc  
SYSGO

Vector Informatik GmbH

#### ■ Vocal Technologies

(See ad page 17)

Zebra Technologies Corp

### DATABASE MANAGEMENT

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Great River Technology  
TeamEDA Inc  
UTC Aerospace Systems

### DATABASES

Cuelogic Technologies  
TeamEDA Inc

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Cuelogic Technologies  
Green Hills Software Inc  
Harmonic Software Systems Ltd  
Shoghi Communications  
Sital Technology

#### ■ Vocal Technologies

(See ad page 17)

Zebra Technologies Corp

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(See ad page 11)

Cuelogic Technologies

#### ■ Data Device Corp (DDC)

(See ad page 25)

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Hitex GmbH  
Infinite Graphics Inc  
Keysight Technology Inc  
LAS-CAD GmbH  
Marvin Test Solutions Inc  
MilesTek  
Praxis Optics  
Radiant Vision Systems  
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Vector Informatik GmbH  
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Infinite Graphics Inc  
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Cuelogic Technologies  
Green Hills Software Inc  
Harmonic Software Systems Ltd  
HD Barcode  
Shoghi Communications  
SYSGO

## ■ Vocal Technologies

(See ad page 17)

Zebra Technologies Corp

### OPERATING SYSTEMS

#### ■ Abaco Systems

(See ad page 11)

#### ■ Elma Electronic Inc

(See ad page 19, 49)

Green Hills Software Inc

#### ■ Interface Concept

(See ad page 1)

SYSGO

VersaLogic Corp

Zebra Technologies Corp

### PRODUCT LIFE CYCLE MANAGEMENT (PLM)

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#### ■ SRCTec LLC

(See ad page 37)

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(See ad page 11)

esd electronics Inc

Green Hills Software Inc

Hitex GmbH

#### ■ Interface Concept

(See ad page 1)

Sital Technology

SYSGO

Vision Components GmbH

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Cobham Antenna Systems  
ConductRF  
Custom Manufacturing &  
Engineering Inc  
DataRay Inc  
Electro Optical Components Inc (EOC)

## ■ Fairview Microwave Inc

(See ad page 13)

Gamma Scientific

## ■ Gemstar Custom Hard Cases

(See ad page 10)

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Keysight Technology Inc  
Konica Minolta Sensing Americas Inc  
Martin, Froeschner & Associates  
Marvin Test Solutions Inc  
OptoTest  
Palmer Wahl Instruments Inc

## ■ Pasternack

(See ad page 5, 23, 65)

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Plane Parts 360  
Radiant Vision Systems  
Reynard Corp  
Topac Inc  
Versatile Power

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Micross  
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NTS Technical Systems  
Saelig Co Inc  
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Clark Testing  
DLS Electronic Systems Inc  
EMCCons Dr Rasek GmbH & Co KG  
Epec Engineered Technologies  
ESPEC North America | Qualmark  
NTS Technical Systems  
Screening Systems Inc

#### ■ SRCTec LLC

(See ad page 37)

### METERS

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Gamma Scientific  
■ Gemstar Custom Hard Cases  
(See ad page 10)  
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Jewell Instruments  
Keysight Technology Inc  
Konica Minolta Sensing Americas Inc  
OptoTest  
Palmer Wahl Instruments Inc  
PCE Instruments

PCE Instruments UK Ltd  
Plane Parts 360  
Radiant Vision Systems  
RWC Testing & Lab Supplies  
Saelig Co Inc  
Topac Inc

## NETWORK ANALYZERS

Advanced Test Equipment Rentals  
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Axtrinet  
ConductRF  
Continental Resources

### ■ Data Device Corp (DDC)

(See ad page 25)

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Go4Fiber Ltd  
Keysight Technology Inc  
NextComputing  
OptoTest  
PCE Instruments  
PCE Instruments UK Ltd  
Timbercon Inc  
TXO Systems Ltd  
Unlimited Purchasing  
Vector Informatik GmbH

## NETWORK/DATA BUS ANALYZERS

### ■ Abaco Systems

(See ad page 11)

AIM-USA  
Anritsu  
Axtrinet

### ■ Data Device Corp (DDC)

(See ad page 25)

Marvin Test Solutions Inc  
NextComputing  
Saelig Co Inc  
Vector Informatik GmbH  
VIAVI Solutions (formerly  
Cobham AvComm)

## OPTICAL TEST AND MEASUREMENT

4D Technology Corp  
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Anritsu  
Archer OpTx  
Aries Electronics inc  
Axtrinet  
Boston Electronics Corp  
Comar Optics Ltd  
Continental Resources  
DataRay Inc  
Diverse Optics Inc  
Electro Optical Components Inc (EOC)  
Embassy Global  
FiberTech Optica  
Gamma Scientific

### ■ Gemstar Custom Hard Cases

(See ad page 10)

GEViCAM Inc  
Gigahertz-Optik Inc  
GL Communications Inc  
Go4Fiber Ltd

GS PLASTIC OPTICS  
H&L Instruments LLC  
Ibis Electro-Products Corp  
Infinite Graphics Inc  
Infinite Optics Inc  
ISVI Corp  
KEYENCE Corp of America  
Keysight Technology Inc  
Knight Optical  
Konica Minolta Sensing Americas Inc  
Krell Technologies Inc  
KSARIA Corp  
Lacroix Precision Optics  
The Light Brigade Inc  
Lightel  
Martin, Froeschner & Associates  
Marvin Test Solutions Inc  
Momentum Services Corp  
Navitar Inc

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(See ad page 14)

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Optikos Corp  
OptoTest  
PCE Instruments  
PCE Instruments UK Ltd  
Photron USA Inc  
Quantum Composers  
Radiant Vision Systems  
RAM Optical Instrumentation  
Reynard Corp  
RFOptic  
RWC Testing & Lab Supplies  
Sofradir EC Inc  
Specialised Imaging Inc  
Specialised Imaging Ltd  
StingRay Optics LLC  
SwissOptic AG  
Thorlabs Inc  
Timbercon Inc  
UTC Aerospace Systems (Sensors  
Unlimited Products)  
Versatile Power  
Vision Components GmbH

## OSCILLOSCOPES

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CAEN Spa  
CIC Research  
Continental Resources  
Keysight Technology Inc  
PCE Instruments  
PCE Instruments UK Ltd  
Saelig Co Inc  
VIAVI Solutions (formerly  
Cobham AvComm)

## PORTABLE TEST SYSTEMS

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Anritsu  
Axtrinet  
Cadex Electronics Inc  
CAEN Spa  
Chroma Systems Solutions Inc

CIC Research  
Continental Resources  
Custom Manufacturing &  
Engineering Inc  
■ Data Device Corp (DDC)  
(See ad page 25)  
DataRay Inc  
esd electronics Inc  
ESPEC North America | Qualmark  
Gamma Scientific

### ■ Gemstar Custom Hard Cases

(See ad page 10)

GEViCAM Inc  
Gigahertz-Optik Inc  
GL Communications Inc  
Go4Fiber Ltd  
GPS Networking  
Keysight Technology Inc  
Konica Minolta Sensing Americas Inc  
Martin, Froeschner & Associates  
Marvin Test Solutions Inc  
Mega Speed Corp  
NextComputing  
NTS Technical Systems  
OptoTest  
PCE Instruments  
PCE Instruments UK Ltd

### ■ Pentek Inc

(See ad page 31, back cover)

Radiant Vision Systems  
RWC Testing & Lab Supplies  
Saelig Co Inc  
Silicon Designs Inc  
Transient Specialists  
United Electronic Industries Inc  
Vector Informatik GmbH  
Versatile Power  
VIAVI Solutions (formerly  
Cobham AvComm)

## SOFTWARE-DRIVEN INSTRUMENTATION

### ■ Abaco Systems

(See ad page 11)

AIM-USA  
Chroma Systems Solutions Inc  
DataRay Inc  
Gamma Scientific  
Keysight Technology Inc  
Konica Minolta Sensing Americas Inc  
Marvin Test Solutions Inc  
OptoTest  
PCE Instruments UK Ltd  
Radiant Vision Systems  
Versatile Power  
VIAVI Solutions (formerly  
Cobham AvComm)  
Vision Components GmbH

## SPECTRUM ANALYZERS

Advanced Test Equipment Rentals  
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Computer2100 LLC  
Continental Resources  
DRS Daylight Solutions  
Eastern Applied Research Inc

FiberTech Optica  
Gamma Scientific  
Keysight Technology Inc  
LP Technologies  
■ Newport Corp  
(See ad page 14)  
PCE Instruments  
PCE Instruments UK Ltd  
Saelig Co Inc  
Thorlabs Inc  
VIAVI Solutions (formerly  
Cobham AvComm)

## THERMAL MANAGEMENT/ COOLING SYSTEMS

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Annapolis Micro Systems Inc  
Atrenne Computing Solutions  
BV Thermal Systems  
Casey Machine Co  
D6 Industries Inc  
Dawn VME Products  
Electronic Interconnect

### ■ Elma Electronic Inc

(See ad page 19, 49)

### ■ Extreme Engineering Solutions Inc (X-ES)

(See ad page 3, 47)

### ■ Interface Concept

(See ad page 1)

Orion Technologies LLC

### ■ Systel Rugged Computers

(See ad page 26)

### CONVECTION COOLING

ADL Embedded Solutions Inc  
Annapolis Micro Systems Inc  
Atrenne Computing Solutions  
BV Thermal Systems  
Casey Machine Co  
D6 Industries Inc  
Dawn VME Products  
Electronic Interconnect

### ■ Extreme Engineering Solutions Inc (X-ES)

(See ad page 3, 47)

### ■ Interface Concept

(See ad page 1)

### ■ Systel Rugged Computers

(See ad page 26)

### LIQUID COOLING

Atrenne Computing Solutions  
BV Thermal Systems  
Casey Machine Co

### ■ Crystal Group

(See ad inside front cover)

D6 Industries Inc  
SSP Manufacturing Inc

### ■ Systel Rugged Computers

(See ad page 26)



## 4D Technology Corp

(div of Nanometrics Inc),  
3280 E Hemisphere Loop, Suite 146,  
Tucson, AZ 85706, 520-294-5600,  
info@4dtechnology.com,  
www.4dtechnology.com

## 4Lasers

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sales@4lasers.com, www.4lasers.com

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## ■ Abaco Systems

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the world leader in VITA technology  
boards. Delivers state-of-the-art  
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and support programs that reduce  
time to deployment, cost and risk.

(See ad page 11)

## AbelConn LLC

(div of Celestica), 9210 Science Ctr Dr,  
New Hope, MN 55428, 763-533-3533,  
sales@atrenne.com, www.abelconn.com

## Accusy Phototech Ltd

50 W Jiangbin Rd, #1-1405, Fuzhou,  
Fujian 350002, China,  
86-130-6721-1468, sales@accusy.com,  
www.accusy.com

## Acroamatics Telemetry Systems

(div of Delta Information Systems Inc),  
7230 Hollister Ave, Suite 100,  
Goleta, CA 93117, 805-967-9909,  
support@acroamatics.com,  
www.acroamatics.com

## ■ Acromag Inc

Embedded Solutions Div,  
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(See ad page 51)

## Active Silicon Inc

479 Jumpers Hole Rd, Suite 301,  
Severna Park, MD 21146, 410-696-7642,  
info@activesilicon.com,  
www.activesilicon.com

## Active Silicon Ltd

Pinewood Mews, Bond Close, Iwer,  
Buckinghamshire SLO ONA, UK,  
44-1753-650-600,  
info@activesilicon.com,  
www.activesilicon.com

## ADCO Circuits

2868 Bond St, Rochester Hills, MI 48309,  
248-853-6620, sales@adcoircuits.com,  
www.adcoircuits.com

## Adimec

(div of Adimec Advanced Image Systems  
BV), 130 New Boston St, Suite 204,  
Woburn, MA 01801, 781-279-0770,  
salesus@adimec.us, www.adimec.com

## ADL Embedded Solutions Inc

4411 Morena Blvd, Suite 101, San Diego,  
CA 92117-4345, 855-727-4200,  
sales@adl-usa.com, www.adl-usa.com

## Advance Circuit Technology Inc

19 Jet View Dr, Rochester, NY 14624,  
585-328-2000, sales@advcircuit.com,  
www.advcircuit.com



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www.advancedoptics.com

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tnelson@ape10.com, www.ape10.com

## Advanced Test Equipment Rentals

10401 Roselle St, San Diego, CA 92121,  
800-404-2832, rentals@atecorp.com,  
www.atecorp.com

## Advantech

380 Fairview Way, Milpitas, CA 95035,  
408-519-3898, buy@advantech.com,  
www.advantech.com

## Aero Dynamix Inc

3227 W Euleess Blvd, Euleess, TX 76040,  
817-571-0729,  
sparker@aerodynamix.com,  
www.aerodynamix.com

## Aerospace Aces

40 Eastern Ave, Unit 319, Malden, MA  
02184, 857-323-5480,  
sales@aerospaceaces.com,  
www.aerospaceaces.com

## Aerospace Simplified

1028 W Rosewood Ave, Suite 170B,  
Spokane, WA 99208, 509-449-7700,  
sales@aerospacesimplified.com,  
www.aerospacesimplified.com

## AGDisplays

(sub of AssetGenie Inc), 220 Huff Ave,  
Suite 400, Greensburg, PA 15601,  
724-552-4904, sales@agdisplays.com,  
www.agdisplays.com

## AIM-USA

7 Neshaminy Interplex, Suite 211, Trevose,  
PA 19053, 267-982-2600,  
salesusa@aim-online.com,  
www.aim-online.com

## ■ AirBorn Inc

3500 Airborn Cir, Georgetown, TX  
78626, 512-863-5585,  
abinfo@airborn.com,  
www.airborn.com

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connectors and electronic components  
for OEMs. Serves customers  
across many industries including  
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(See ad page 30)

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19756 Prairie St, Chatsworth, CA 91311,  
888-248-3248, sales@rugged.com,  
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## Allied Motion Technologies Inc

495 Commerce Dr, Amherst, NY 14228,  
716-242-7535,  
inquiry@alliedmotion.com,  
www.alliedmotion.com

## Altron

6700 Bunker Lake Blvd NW, Minneapolis,  
MN 55303, 763-427-7735,  
sales@altronmfg.com,  
www.altronmfg.com

## Ampex Data Systems

(div of Delta Information Systems Inc),  
26460 Corporate Ave, Hayward,  
CA 94545-3914, 650-367-2011,  
info@ampex.com, www.ampex.com

## Amphenol Aerospace

(div of Amphenol Corp), 40-60 Delaware  
Ave, Sidney, NY 13838, 800-678-0141,  
cservice@amphenol-aao.com,  
www.amphenol-aerospace.com

## Amphenol Industrial Products Group

40-60 Delaware Ave, Sidney, NY  
13838-1395, 800-678-0141,  
mhartman@amphenol-aio.com,  
www.amphenol-industrial.com

## AMWEI Thermistor Sensor

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North Area, Shenzhen High Tech Industrial  
Pk, Nanshan, Shenzhen, Guangdong  
518057, China, 86-755-2657-0111,  
sales@amwei.com, www.amwei.com

## Analog Modules Inc

(sub of Heico Corp), 126 Baywood Ave, Longwood, FL 32750-3426, 407-339-4355, sales@analogmodules.com, www.analogmodules.com

## ANEXIO

5 West Hargett St, 11th Fl, Raleigh, NC 27601, 877-687-0003, info@anexio.com, www.anexio.com

## Annapolis Micro Systems Inc

190 Admiral Cochrane Dr, Suite 130, Annapolis, MD 21401, 410-841-2514, winfo@annapmicro.com, www.annapmicro.com

## Anritsu

450 Century Pkwy, Suite 190, Allen, TX 75013, 972-644-1777, www.anritsu.com

## aPeak Inc

73 Lexington St, Newton, MA 02466, 617-964-1709, info@apeakinc.com, www.apeakinc.com

## ■ Applied Avionics Inc

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(See ad page 9)

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## Archer OptX

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## Aries Electronics inc

2609 Bartram Rd, Bristol, PA 19007, 215-781-9956, info@arieselec.com, www.arieselec.com

## Arkema Inc

900 First Ave, King of Prussia, PA 19406, 610-205-7000, arkema.usph-general@arkema-inc.com, www.arkema-america.com

## AR Modular RF

21222 30th Dr SE, Suite 200, Bothell, WA 98021, 425-485-9000, armodularsales@arworld.us, www.arwww-modularrf.com

## ASAP 3Sixty

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1028 W Rosewood Ave, Suite 170B, Spokane, WA 99208, 509-449-7700, sales@asapbuying.com, www.asapbuying.com

## ASAP Components

410 Lord Berkley Rd, Raleigh, NC 27610, 919-348-0404, sales@asap-components.com, www.asap-components.com

## Asine Ltd

20 Histadrut St, Hod Hasharon 45101, Israel, 972-9-740-3048, info@asinegroup.com, www.asinegroup.com

## Atrenne Computing Solutions

(div of Celestica), 10 Mupac Dr, Brockton, MA 02301, 508-588-6110, sales@atrenne.com, www.atrenne.com

## Avo Photonics

120 Welsh Rd, Horsham, PA 19044, 215-441-0107, sales@avophotonics.com, www.avophotonics.com

## Axtrinet

(div of Xentech Solutions Ltd), 6 Stanta Business Ctr, 3 Soothouse Spring, St Albans, Hertfordshire AL3 6PF, UK, 44-1727-867-795, enquiries@axtrinet.com, www.axtrinet.com

## BearCom

4009 Distribution Dr, Garland, TX 75041, 800-527-1670, info@bearcom.com, www.bearcom.com

## Berliner Glas KGaA Herbert Kubatz GmbH & Co

Space Div, (sub of Berliner Glas Group), Waldkraiburger Str 5, Berlin 12347, Germany, 49-30-60905-0, info@berlinerglas.de, www.berlinerglas.de

## Birk Manufacturing Inc

14 Capitol Dr, East Lyme, CT 06333, 860-739-4170, sales@birkmfg.com, www.birkmfg.com

## Boston Electronics Corp

91 Boylston St, Brookline, MA 02445, 617-566-3821, boselec@boselec.com, www.boselec.com

## Bravo Communications Inc

3463 Meadowlands Ln, San Jose, CA 95135, 408-270-1547, sales@bravobravo.com, www.bravobravo.com

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## BV Thermal Systems

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## Cadex Electronics Inc

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## CAEN Spa

Via Vetraia 11, Viareggio, (LU) 55049, Italy, 39-0-58-4388-398, j.givoletti@caen.it, www.caen.it

## Carling Technologies Inc

60 Johnson Ave, Plainville, CT 06062-1177, 860-793-9281, jayra.lasalle@carlingtech.com, www.carlingtech.com

## Casey Machine Co

74 Ward Rd, Lancaster, NY 14086, 716-651-0150, techsales@caseymachine.com, www.caseymachine.com

## Central Semiconductor Corp

145 Adams Ave, Hauppauge, NY 11788, 631-435-1110, tdonofrio@centralsemi.com, www.centralsemi.com

## Cerion Advanced Materials

1 Blossom Rd, Rochester, NY 14610, 585-513-0788, info@cerionam.com, www.cerionadvancedmaterials.com

## Changchun Long Ze Precision Optics Co Ltd

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## Chroma Systems Solutions Inc

19772 Pauling, Foothill Ranch, CA 92610, 949-600-6400, sales@chromausa.com, www.chromausa.com

## CIC Research

427 S Grand Ave, San Jacinto, CA 92582, cicel@cic-research.com, www.cic-research.com

## Clark Testing

1801 Rt 51, Jefferson Hills, PA 15025, 412-387-1001, info@clarktesting.com, www.clarktesting.com

## ClearDrain

(div of Melville Industries Inc), PO Box 555, Willingboro, NJ 08046, 856-461-0091, sales@cleardrainusa.com, www.cleardrainusa.com

## CNC Center

1652 Old Apex Rd, Cary, NC 27513, 919-650-2703, sales@cnccenter.com, www.cnccenter.com

## Cobham Antenna Systems

Lambda House, Little Green, Newmarket, Suffolk CB8 9RG, UK, 44-1638-732-177, newmarket.sales@cobham.com, www.european-antennas.co.uk

## Cobham RAD Solutions

5030 Centennial Blvd, Colorado Springs, CO 80919, 719-531-0800, info-ams@aeroflex.com, www.aeroflex.com/rad

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## Comar Optics Ltd

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## Complete Sourcing Solutions

5319 SW Westgate Dr, #24D, Portland, OR 97221, 503-374-0340, sales@completesourcingsolutions.com, www.completesourcingsolutions.com

## Computer2100 LLC

207 S Whittemore St, St Johns, MI 48879, 989-224-9080, wavecomusa@wavecomusa.com, www.wavecomusa.com

## Comtech PST

(sub of Comtech Telecommunications Corp), 105 Baylis Rd, Melville, NY 11747, 631-777-8900, bob.califra@comtechpst.com, www.comtechpst.com

## Concurrent Technologies

4 Gilberd Ct, Newcomen Way, Colchester, Essex CO4 9WN, UK, 44-1206-752-626, sales@gocct.com, www.gocct.com

## ConductRF

(sub of Electronic Assemblies Mfg Inc), 126 Merrimack St, Methuen, MA 01844, 978-374-6840, sales@conductrf.com, www.conductrf.com

## Continental Resources

Test Equipment Div, 175 Middlesex Tpk, PO Box 9137, Bedford, MA 01730-9137, 800-937-4688, testequipmentteam@conres.com, www.conres.com/test-equipment

## Cortec Corp

4119 White Bear Pkwy, St Paul, MN 55110, 651-429-1100, productinfo@cortecvci.com, www.cortecvci.com



## Crystal Group

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(See ad inside front cover)

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## Cuelogic Technologies

134 W 29th St, Suite 905, New York, NY 10001, 347-374-8437, info@cuelogic.com, www.cuelogic.com

## CUI Inc

20050 SW 112th Ave, Tualatin, OR 97062, 503-612-2300, sales@cui.com, www.cui.com

## Curtiss-Wright Defense Solutions

(sub of Curtiss-Wright Corp), 20130 Lakeview Ctr Plaza, Suite 200, Ashburn, VA 20147, 703-779-7800, ds@curtisswright.com, www.curtisswrightds.com

## Custom Manufacturing & Engineering Inc

3690 70th Ave N, Pinellas Park, FL 33781, 727-547-9799, sales@custom-mfg-eng.com, www.custom-mfg-eng.com

## Custom MMIC

300 Apollo Dr, Chelmsford, MA 01824, 978-467-4290, www.custommmic.com

## D6 Industries Inc

601 S Union St, Lawrence, MA 01843, 978-989-0981, djones@d6industries.com, www.d6industries.com

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(See ad page 25)

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1675 Market St, Redding, CA 96001, 530-395-2500, sales@dataray.com, www.dataray.com

## Dawn VME Products

47915 Westinghouse Dr, Fremont, CA 94539, 800-258-3296, mail@dawnvme.com, www.dawnvme.com

## Delphi Automotive LLP

5725 Delphi Dr, Troy, MI 48098, 248-813-2000, www.delphi.com

## Delta Digital Video

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## Deposition Sciences Inc (DSI)

(sub of Lockheed Martin), 3300 Coffey Ln, Santa Rosa, CA 95403, 707-573-6700, solutions@depisci.com, www.depisci.com

## Device Engineering Inc

480 E Alamo Dr, Chandler, AZ 85225, 480-303-0822, info@deiaz.com, www.deiaz.com

## DEV Systemtechnik GmbH

Gruener Weg 4A, Friedberg, Hesse 61169, Germany, 49-6031-6975-100, info@dev-systemtechnik.com, www.dev-systemtechnik.com

## Diamond-MT

213 Chestnut St, Johnstown, PA 15906, 814-535-3505, www.paryleneconformalcoating.com

## Diamond USA Inc

85 Rangeway Rd, Bldg 3, North Billerica, MA 01862, 978-256-6544, sales@diausa.com, www.diausa.com

## Digital Systems Engineering Inc (DSE)

17491 N 93rd St, Scottsdale, AZ 85255, 480-515-1110, info@digitalsys.com, www.digitalsys.com

## Diverse Optics Inc

10310 Regis Ct, Rancho Cucamonga, CA 91730, 909-593-9330, info@diverseoptics.com, www.diverseoptics.com

## DLS Electronic Systems Inc

1250 Peterson Dr, Wheeling, IL 60090, 847-537-6400, jblack@dlsemc.com, www.dlsemc.com

## DRS Daylight Solutions

15378 Ave of Science, Suite 200, San Diego, CA 92128, 858-432-7500, sci-sales@daylightsolutions.com, www.daylightsolutions.com

## Dynamic Systems Inc

11411 NE 124th St, Suite 275, Kirkland, WA 98034, 425-284-1662, robf@dsales.com, www.dynamic-systemsinc.com/software/equipment-tool-tracking-software

## EaglePicher Technologies LLC

C and Porter Sts, PO Box 47, Joplin, MO 64802, 417-623-8000, info@eaglepichertechnologies.com, www.eaglepicher.com

## Eastern Applied Research Inc

6614 Lincoln Ave, Lockport, NY 14094, 716-201-1115, sales@easternapplied.com, www.easternapplied.com

## ECRIN Systems

143 Rue Louis Neel, Crolles 38920, France, 33-1-69-07-83-22, sales@ecrin.com, www.ecrin.com/en

## ECS

3560 Rogue River Hwy, Grants Pass, OR 97527, 541-476-8871, protect@ecscase.com, www.ecscase.com

## Elan Technical Corp

9919 Valley View Rd, Eden Prairie, MN 55344, 952-452-8667, elantechnical@sbcglobal.net, www.elantechnical.com

## Electro-Mech Components Inc

1826 Floradale Ave, South El Monte, CA 91733-3689, 626-442-7180, info@electromechcomp.com, www.electromechcomp.com

## Electronic Interconnect

2700 W Touhy Ave, Elk Grove Village, IL 60007, 800-364-4844, sales@eiconnect.com, www.eiconnect.com

## Electron Test Equipment

Alexandra House Ballsbridge Business Pk, Dublin D24 PPT3, Ireland, 353-1-902-6678, info@electrontest.com, www.electrontest.com

## Electro Optical Components Inc (EOC)

5464 Skylane Blvd, Suite D, Santa Rosa, CA 95403, 707-568-1642, info@eoc-inc.com, www.eoc-inc.com

## Elma Electronic Inc

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Designs integrated subsystems, rugged chassis, ATRs and board-level solutions for high-performance embedded computing for a wide range of defense applications. Standard and rugged VPX, VME, cPCI, cPCI Serial and SFF processor boards, storage, NAS, networking, I/O and OS support for standard or custom solutions. Is ISO 9001 and AS9100 certified.

(See ad page 19, 49)



## Embassy Global

5999 S Park Ave, Suite 144, Hamburg, NY 14075, 800-309-6150, inquiries@embassyglobalpr.com, www.embassyglobal.com

## EMCCons Dr Rasek GmbH & Co KG

Boelwiese 8, Ebermannstadt 91320, Germany, 49-9194-7262-0, info@emcc.de, www.emcc.de

## EMS Industrial & Service Co

10800 N Main St, Richmond, IL 60071, 815-678-2700, www.ems-industrial.com

## Epec Engineered Technologies

176 Samuel Barnett Blvd, New Bedford, MA 02745, 508-995-5171, sales@epectec.com, www.epectec.com

## EPiX Inc

381 Lexington Dr, Buffalo Grove, IL 60089, 847-465-1818, epix@epixinc.com, www.epixinc.com

## esd electronics Inc

70 Federal St, Suite 2, Greenfield, MA 01301, 413-772317-0, us-sales@esd-electronics.com, www.esd-electronics.us

## ESPEC North America | Qualmark

10390 E 48th Ave, Denver, CO 80238, 303-254-8800, sales@espec.com, www.qualmark.com

## Essex Industries

7700 Gravois Rd, St Louis, MO 63123, 314-832-4500, info@essexind.com, www.essexindustries.com

## ETM Electromatic Inc

35451 Dumbarton C, Newark, CA 94560, 510-797-1100, salesetm@etm-inc.com, www.etm-inc.com

## Eureka Dry Tech

(sub of Taiwan Dry Tech Corp), 3F, 59 Sec 4, Xinyi Rd, Taipei City 106, Taiwan, 886-2-2755-4545, sales@eurekadrytech.com, www.eurekadrytech.com

## Evans Co

33 Eastern Ave, East Providence, RI 02914, 401-434-5600, engineering@evanstechnology.com, www.evanstechnology.com

## Excelitas Canada

Defense Sensors Div, 22001 Dumberry Rd, Vaudreuil-Dorion, QC J7V 8P7, Canada, 450-424-3300, aes.na@excelitas.com, www.excelitas.com

## Excelitas Technologies

Energetic Systems Div, 1100 Vanguard Blvd, Miamisburg, OH 45342, 937-865-3800, aes.na@excelitas.com, www.excelitas.com/pages/product/energetic-systems.aspx

## Excelitas Technologies

200 West St, Suite E403, Waltham, MA 02451, 800-775-6786, generalinquiries.na@excelitas.com, www.excelitas.com

## Excelitas Technologies

Power Systems Div, 1330 E Cypress St, Covina, CA 91724, 626-967-9521, aes.na@excelitas.com, www.excelitas.com

## ■ Extreme Engineering Solutions Inc (X-ES)

9901 Silicon Prairie Pkwy, Verona, WI 53593, 608-833-1155, sales@xes-inc.com, www.xes-inc.com

*Is a leader in the design, manufacture, and support of standard and custom embedded computing solutions. Provides an extensive portfolio of commercial and ruggedized single-board computers (SBCs), I/O, SSD storage, networking, backplanes, enclosures, power modules, and integrated systems.*

(See ad page 3, 47)

## ■ Fairview Microwave Inc

(an Infinite Electronics brand), 301 Leora Ln, Suite 100, Lewisville, TX 75056, 800-715-4396, sales@fairviewmicrowave.com, www.fairviewmicrowave.com

*Is a leading provider of high-quality RF and microwave components including adapters, connectors, attenuators, coaxial cables, terminations, and much more. Specializing in immediate product needs, offers same-day shipping on thousands of in-stock items with no minimum purchasing requirements.*

(See ad page 13)



## ■ Falcon Electronics

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*Distributes military, hi-rel and space-grade semiconductors including ARINC 429/1553 databus products, power supplies, data acquisition circuits, solid-state data storage and full MIL-SMD static RAMs. Supplies companies including API Technologies, Datel, DPACI, FMJ, Holt, Mercury Systems, Microsemi, PDI, Semtech, SMART Modular Technologies, TT electronics, Vishay and Xtreme Semiconductor.*

(See ad page 28)

## Falcon Electronics

1505 W University Dr, Suite 105, Tempe, AZ 85281, 480-829-1100, ian@falconelec.com, www.falconelec.com

## FiberTech Optica

330 Gage Ave, Suite 1, Kitchener, ON N2M 5C6, Canada, 519-745-2763, info@fto.ca, www.fto.ca

## Finetech

560 E Germann Rd, Suite 103, Gilbert, AZ 85297, 480-893-1630, www.finetechusa.com

## First Level Inc

3109 Espresso Way, York, PA 17406, 717-266-2450, info@firstlevelinc.com, www.firstlevelinc.com

## First Sensor Inc

905 S Main St, Suite 201, Mansfield, MA 02048, 508-339-2955, us@first-sensor.com, www.first-sensor.com

## FISBA

Optical Solutions Div, Rorschacherstr 268, St Gallen 9016, Switzerland, 41-71-282-3131, info@fisba.com, www.fisba.com

## Fischer Connectors Inc

1735 Founders Pkwy, Suite 100, Alpharetta, GA 30009, 678-393-5400, mail@fischerconnectors.com, www.fischerconnectors.com

## FLIR Systems Inc

27700A SW Parkway Ave, Wilsonville, OR 97070, 503-498-3457, david.strong@flir.com, www.flir.com/gs

## Forefronts Defense Systems

(sub of Forefronts Technologies Group), PO Box 427, Dufur, OR 97021-0427, 541-508-0424, operations@forefronts.com, www.forefronts.com

## FoxFury Lighting Solutions

3528 Seagate Way, Suite 100, Oceanside, CA 92056, 760-945-4231, marketing@foxfury.com, www.foxfury.com

## FSP Group USA

14284 Albers Way, Chino, CA 91710, 909-606-0960, info@fspgroupusa.com, www.fspgroupusa.com

## Gamma Scientific

9925 Carroll Canyon Rd, San Diego, CA 92131, 858-279-8034, contact@gamma-sci.com, www.gamma-sci.com

## GDP Space Systems

(div of Delta Information Systems Inc), 747 Dresher Rd, Suite 125, Horsham, PA 19044, 215-657-5270, clang@delta-info.com, www.gdpsspace.com

## ■ Gemstar Custom Hard Cases

103 Mensing Way, Cannon Falls, MN 55009, 507-263-4770, sales@gemstarmfg.com, www.gemstarmfg.com

*Is an engineering-based solutions provider with over 50 years of manufacturing experience and protective packaging knowledge. The company is family-owned, supported by long-term employees, and has a firm history rooted in custom, made-to-order manufacturing and the dedication of a customer-centric organization. All cases are made in the USA.*

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## General Atomics

### Aeronautical Systems Inc

14200 Kirkham Way, Poway, CA 92064, 858-312-2810, asi-mediarelations@ga-asi.com, www.ga-asi.com

## ■ General Micro Systems Inc

8358 Maple Pl, Rancho Cucamonga, CA 91730, 909-980-4863, [www.gms4sbc.com](http://www.gms4sbc.com)

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(See ad page 7)

## Gentec Electro-Optics Inc

445 St-Jean Baptiste, Suite 160, Quebec City, QC G2E 5N7, Canada, 418-651-8003, [info@gentec-eo.com](mailto:info@gentec-eo.com), [www.gentec-eo.com](http://www.gentec-eo.com)

## GEViCAM Inc

691 S Milpitas Blvd, Suite 115, Milpitas, CA 95035, 408-945-9900, [info@gevicam.com](mailto:info@gevicam.com), [www.gevicam.com](http://www.gevicam.com)

## Gigahertz-Optik Inc

(sub of Gigahertz-Optik GmbH), Bldg B, Suite 205, 110 Haverhill Rd, Amesbury, MA 01913, 978-462-1818, [b.angelo@gigahertz-optik.com](mailto:b.angelo@gigahertz-optik.com), [www.gigahertz-optik.com](http://www.gigahertz-optik.com)

## GL Communications Inc

818 W Diamond Ave, 3rd Fl, Gaithersburg, MD 20878, 301-670-4784, [info@gl.com](mailto:info@gl.com), [www.gl.com](http://www.gl.com)

## Go4Fiber Ltd

Unit 9A, Union Hing Yip Bldg, 20 Hing Yip St, Kwun Tong, Hong Kong, 852-2174-1338, [sales\\_group@go4fiber.com](mailto:sales_group@go4fiber.com), [www.go4fiber.com](http://www.go4fiber.com)

## Gowanda Electronics

Magnetics Div, (div of Gowanda Components Group), 1 Magnetics Pkwy, PO Box 111, Gowanda, NY 14070, 716-532-2234, [sales@gowanda.com](mailto:sales@gowanda.com), [www.gowanda.com](http://www.gowanda.com)

## GPS Networking

373 E Industrial Blvd, Pueblo West, CO 81007, 719-595-9880, [salesinfo@gpsnetworking.com](mailto:salesinfo@gpsnetworking.com), [www.gpsnetworking.com](http://www.gpsnetworking.com)

## Graphic Products

9825 SW Sunshine Ct, Beaverton, OR 97005, 503-644-5572, [info@graphicproducts.com](mailto:info@graphicproducts.com), [www.graphicproducts.com](http://www.graphicproducts.com)

## Great River Technology

4910 Alameda Blvd NE, Albuquerque, NM 87113, 505-881-6262, [sales@greatrivertech.com](mailto:sales@greatrivertech.com), [www.greatrivertech.com](http://www.greatrivertech.com)

## Green Hills Software Inc

30 W Sola St, Santa Barbara, CA 93101, 805-965-6044, [info@ghs.com](mailto:info@ghs.com), [www.ghs.com](http://www.ghs.com)

## GS PLASTIC OPTICS

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## Guernsey Coating Laboratories Inc

1788 Goodyear Ave, Ventura, CA 93003, 805-642-1508, [sales@guernseycoating.com](mailto:sales@guernseycoating.com), [www.guernseycoating.com](http://www.guernseycoating.com)

## H&L Instruments LLC

34 Post Rd, PO Box 580, North Hampton, NH 03862-0580, 603-964-1818, [rlandman@hlinstruments.com](mailto:rlandman@hlinstruments.com), [www.hlinstruments.com](http://www.hlinstruments.com)

## Harmonic Software Systems Ltd

1 Willow Pl, Rosier Business Pk, Coneyhurst Rd, Billingshurst, West Sussex RH14 9DE, UK, 44-1403-784-500, [sales@harmonicss.co.uk](mailto:sales@harmonicss.co.uk), [www.harmonicss.co.uk](http://www.harmonicss.co.uk)

## Harwin Inc

(div of Harwin PLC), 3602 Northgate Ct, Suite 33, New Albany, IN 47150, 603-893-5376, [dbeck@harwin.com](mailto:dbeck@harwin.com), [www.harwin.com](http://www.harwin.com)

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Complete Inspection Systems Div, 334 Fourth Ave, Indialantic, FL 32903, 321-952-2490, [gparish@autoproofpro.com](mailto:gparish@autoproofpro.com), [www.hdbarcode.com](http://www.hdbarcode.com)

## Henkel Corp

14000 Jamboree Rd, Irvine, CA 92606, 714-368-8000, [eva.laus@henkel.com](mailto:eva.laus@henkel.com), [www.henkel-northamerica.com](http://www.henkel-northamerica.com)

## HEPA Corp

3071 E Coronado St, Anaheim, CA 92806, 714-630-5700, [info@hepa.com](mailto:info@hepa.com), [www.hepa.com](http://www.hepa.com)

## Hexion Inc

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## High Energy Devices LLC

26 Hollenberg Ct, Bridgeton, MO 63044, 314-291-0030, [info@highenergydevices.com](mailto:info@highenergydevices.com), [www.highenergydevices.com](http://www.highenergydevices.com)

## Hi-Tech Controls

7374 S Eagle St, Centennial, CO 80112-4240, 303-680-5159, [info@hitechcontrols.com](mailto:info@hitechcontrols.com), [www.hitechcontrols.com](http://www.hitechcontrols.com)

## Hitex GmbH

Greschbachstr 12, Karlsruhe D-76229, Germany, 49-721-9628-0, [sales@hitex.de](mailto:sales@hitex.de), [www.hitex.com](http://www.hitex.com)

## Hoists Direct LLC

123 Charter St, Albemarle, NC 28001, 704-985-1110, [info@hoistsdirect.com](mailto:info@hoistsdirect.com), [www.hoistsdirect.com](http://www.hoistsdirect.com)



## ■ Holt Integrated Circuits

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(See ad page 59)



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(sub of HUBER+SUHNER AG), 8530 Steele Creek Pl Dr, Suite H, Charlotte, NC 28273, 704-790-7300, [info.na@hubersuhner.com](mailto:info.na@hubersuhner.com), [www.hubersuhner.com](http://www.hubersuhner.com)

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(See ad page 29)

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## IBI Systems Inc

6842 NW 20th Ave, Ft Lauderdale, FL 33309, 954-978-9225, [ibisys@aol.com](mailto:ibisys@aol.com), [www.ibi-systems.com](http://www.ibi-systems.com)

## Incertec

500 73rd Ave NE, Suite 123, Fridley, MN 55432, 763-251-9962, [socialmedia@incertec.com](mailto:socialmedia@incertec.com), [www.incertec.com](http://www.incertec.com)

## Industrial Training Consultants Inc

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## Infinite Graphics Inc

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## Infinite Optics Inc

1712 Newport Cir, Suite F, Santa Ana, CA 92705-5118, 714-557-2299, [stan@infiniteoptics.com](mailto:stan@infiniteoptics.com), [www.infiniteoptics.com](http://www.infiniteoptics.com)

## InfoSight Corp

20700 US Hwy 23, PO Box 5000, Chillicothe, OH 45601, 740-642-3600, [sales@infosight.com](mailto:sales@infosight.com), [www.infosight.com](http://www.infosight.com)

## ■ Interface Concept

3, Rue Felix Le Dantec, Quimper 29000, France, 33-2-98-57-30-30, [info@interfaceconcept.com](mailto:info@interfaceconcept.com), [www.interfaceconcept.com](http://www.interfaceconcept.com)

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division of Heilind Mil-Aero.

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Electrum 236, Kista SE-164 40, Sweden,  
46-8-793-66-00, info@ir-nova.se,  
www.irnova.se

## Ironwood Electronics

1335 Eagandale Ct, Eagan, MN 55121,  
952-229-8200,  
info@ironwoodelectronics.com,  
www.ironwoodelectronics.com

## Iscan Inc

21 Cabot Rd, Woburn, MA 01801,  
781-932-1199, info@iscaninc.com,  
www.iscaninc.com

## ISP Optics Corp

2603 Challenger Tech Ct, Suite 100,  
Orlando, FL 32826, 800-909-4207,  
sales@isptoptics.com, www.isptoptics.com

## ISVI Corp

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Gunpo-si, Gyeonggi-do 15850,  
South Korea, 82-31-427-3245,  
sales@isvi-corp.com, www.isvi-corp.com

## Jewell Instruments

850 Perimeter Rd, Manchester, NH 03103,  
603-669-6400,  
sales@jewellinstruments.com,  
www.jewellinstruments.com

## John Evans' Sons

1 Spring Ave, Lansdale, PA 19446,  
215-368-7700,  
sales@springcompany.com,  
www.springcompany.com

## Kensington Electronics Inc

11801 Stonehollow Dr, Suite 150, Austin,  
TX 78758, 512-339-3300,  
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## KEYENCE Corp of America

Microscope Div, 500 Park Blvd, Suite 200,  
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microscopes@keyence.com,  
www.keyence.com

## Keysight Technology Inc

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CA 95403-1738, 800-829-4444,  
www.keysight.com

## Knight Optical

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North Kingstown, RI  
02852, 401-583-7846,  
usasales@knightoptical.com,  
www.knightoptical.com

## Konica Minolta Sensing Americas Inc

101 Williams Dr, Ramsey, NJ 07446,  
201-236-4300,  
marketing.sus@konicaminolta.com,  
https://sensing.konicaminolta.us

## Krell Technologies Inc

11-13 Evergreen Ave, Neptune City, NJ  
07753, 732-775-7355,  
sales@krelltech.com, www.krelltech.com

## KSARIA Corp

Mission Critical Connectivity Solutions Div,  
300 Griffin Brook Dr, Methuen, MA  
01844, 978-933-0003,  
barredondo@ksaria.com, www.ksaria.com

## Lacroix Precision Optics

50 LaCroix Dr, PO Box 2556, Batesville, AR  
72503, 870-698-1881,  
info@lacroixoptical.com,  
www.lacroixoptics.com

## Lansdale Semiconductor Inc

5245 S 39th St, Phoenix, AZ 85040-9008,  
602-438-0123, lansdale@lansdale.com,  
www.lansdale.com

## LAS-CAD GmbH

Brunhildenstr 9, Munich 80639, Germany,  
49-89-173607, info@las-cad.com,  
www.las-cad.com

## Lasertec Inc

177 CongYang Rd, ChengYang, Qingdao,  
Shandong 266107, China,  
86-532-6895-9242, sales@lcoptical.com,  
www.lcoptical.com

## LazerArc

(div of Motion Index Drives Inc), 1204 E  
Maple, Troy, MI 48063, 877-795-9692,  
info@lazerarc.com, www.lazerarc.com

## ■ LEMO SA

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info-us@lemo.com, www.lemo.com

## Lensel Optics Pvt Ltd

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Maharashtra 411019, India,  
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milind@lenseloptics.com,  
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## The Light Brigade Inc

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98032, 425-291-4254,  
carole@lightbrigade.com,  
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## Lightel

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98057, 425-277-8000,  
sales@lightel.com, www.lightel.com

## Lightstec Co Ltd

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Zhongshan, Guangdong 528415,  
China, 86-760-8982-0100,  
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## Liteway Inc

166 Haverford Rd, Hicksville, NY 11801,  
516-931-2800, sales2@liteway.com,  
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## LP Technologies

1919 N Amidon St, Suite 216, Wichita, KS  
67203, 316-831-9696, sales@lptech.com,  
www.lptech.com

## Macken Instruments Inc

3196 Coffey Ln, Suite 604, Santa Rosa,  
CA 95403, 707-566-2110,  
info@macken.com, www.macken.com

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800-343-2050, mkt.nafta@mahr.com,  
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## March Electronics Inc

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800-444-6056,  
sales@marchelectronics.com,  
www.marchelectronics.com

## Marktech Optoelectronics

3 Northway Ln N, Latham, NY 12110,  
518-956-2980, info@marktechopt.com,  
www.marktechopt.com

## Martin, Froeschner & Associates

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925-989-4930, sales@mfaoptics.com,  
www.mfaoptics.com

## Marvin Test Solutions Inc

1770 Kettering, Irvine, CA 92614,  
949-263-2222, sales@marvintest.com,  
www.marvintest.com

## Master Bond

154 Hobart St, Hackensack, NJ 07601,  
201-343-8983, main@masterbond.com,  
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## Masterclock Inc

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636-724-3666, sales@masterclock.com,  
www.masterclock.com

## Matrox Imaging

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Canada, 800-804-6243,  
imaging.info@matrox.com,  
www.matrox.com/imaging

## MCG Surge Protection

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631-586-5125, info1@mcgsurge.com,  
www.mcgsurge.com

## Mega Speed Corp

45 Main St S, Unit B, Minnedosa, MB  
R0J 1E0, Canada, 204-867-3767,  
sales@megaspeedusa.com,  
www.megaspeedusa.com

## ■ Mercury Systems

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gdonahue@mrchy.com,  
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## Micross

7725 N Orange Blossom Tr, Orlando, FL 32810, 407-298-7100, sales@micross.com, www.micross.com

## Microsemi Corp

1 Enterprise, Aliso Viejo, CA 92656, 949-380-6100, www.microsemi.com

## Midstream Lighting

Wessex House, 1 Chesham St, London SW1X 8ND, UK, 44-2075-848-310, sales@midstreamlighting.com, www.midstreamlighting.com

## Milestek

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(See ad page 33)

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## Momentive Performance Materials Inc

260 Hudson River Rd, Waterford, NY 12188, 614-986-2495, commercial.services@momentive.com, www.momentive.com

## Momentum Services

(div of MOGAS Industries Inc), 14206 E Hardy St, Houston, TX 77039, 281-449-0294, calexander@momentumsvcs.com, www.momentumsvcs.com

## Momentum Services Corp

4682 Calle Bolero, Unit C, Camarillo, CA 93012, 805-384-1900, sales@momentum-fpd.com, www.momentum-fpd.com

## MPL AG

Taefernstr 20, Daettwil 5405, Switzerland, 41-56-483-34-34, info@mpl.ch, www.mpl.ch

## Navitar Inc

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## Nelco Products

49 S Maple Ave, Marlton, NJ 08053, 866-635-2660, bmazzio@nelcoproducts.com, www.wiremarkersplus.com

## Nelson Design Services Inc

3501 W Moreland Rd, Willow Grove, PA 19090, 215-784-9600, sales@nelson-design.com, www.nelson-design.com

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(See ad page 14)

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## Nicomatic

450 Progress Dr, Horsham, PA 19044, 215-444-9580, usa@nicomatic.com, www.nicomatic.com

## NorComp

3801 Shutterfly Rd, #200, Charlotte, NC 28217, 704-424-5448, sales@norcomp.net, www.norcomp.net

## Nord-Lock Inc

(sub of Nord-Lock International), 1000 Gregg St, Carnegie, PA 15106, 412-279-1149, bolting@nord-lock.com, www.nord-lock.com

## North Atlantic Industries Inc

110 Wilbur Pl, Bohemia, NY 11716, 631-567-1100, info@naii.com, www.naii.com

## Nova Electric

(div of Technology Dynamics Inc), 100 School St, Bergenfield, NJ 07621-2915, 201-385-0500, howard@novaelectric.com, www.novaelectric.com

## NTS Technical Systems

1701 E Plano Pkwy, Plano, TX 75074, 978-727-3793, jeffrey.viel@nts.com, www.nts.com

## N-Vision Optics

220 Reservoir St, Suite 26, Needham, MA 02494, 781-505-8360, info@nvisionoptics.com, www.nvisionoptics.com

## ODU-USA Inc

(div of OTTO Dunkel), 300 Camarillo Ranch Rd, Suite A, Camarillo, CA 93012, 805-484-0540, sales@odu-usa.com, www.odu-usa.com

## OFS

2000 Northeast Expwy, Norcross, GA 30071, 770-798-5555, www.ofsoptics.com

## Omnetics Connector Corp

7260 Commerce Cir E, Minneapolis, MN 55432, 763-572-0656, sales@omnetics.com, www.omnetics.com



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## Optikos Corp

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## Opto Diode Corp

(an ITW Co), 1260 Calle Suerte, Camarillo, CA 93012, 805-499-0335, sales@optodiode.com, www.optodiode.com

## OptoTest

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## Orion Systems Inc

1800 Byberry Rd, Suite 1300, Huntingdon Valley, PA 19006, 215-659-1207, info@orionsystemsinc.net, www.orionsystemsinc.net

## Orion Technologies LLC

12605 Challenger Pkwy, Suite 130, Orlando, FL 32826, 407-845-1700, sales@oriontechnologies.com, www.oriontechnologies.com

## OTTO Controls

2 E Main St, Carpentersville, IL 60110, 847-428-7171, info@ottoexcellence.com, www.otto-controls.com

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## Palmer Wahl Instruments Inc

234 Old Weaverville Rd, Asheville, NC 28804, 828-658-3131, info@palmerwahl.com, www.palmerwahl.com

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## Parasoft

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## Part Miner

1160 Hooksett Rd, Hooksett, NH 03106, 603-218-3767, tim@part-miner.com, www.part-miner.com

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(See ad page 5, 23, 65)

## PCE Instruments

(div of PCE Americas Inc), 711 Commerce Way, Suite 8, Jupiter, FL 33458,  
561-320-9162, info@pce-americas.com,  
www.pce-instruments.com

## PCE Instruments UK Ltd

Unit 11 S Point, Ensign Way,  
Southampton, Hampshire SO31 4RF, UK,  
44-2380-987-030,  
info@industrial-needs.com,  
www.pce-instruments.com

## PDR Infrared SMT/PCB Rework Systems

3869 Dividend Dr, Shingle Springs, CA  
95682, 530-676-6262, sales@pdrxy.com,  
www.pdr-rework.com

# PENTEK

## ■ Pentek Inc

1 Park Way, Upper Saddle River, NJ  
07458, 201-818-5900,  
info@pentek.com, www.pentek.com

Designs COTS digital signal processing (DSP), software radio, radar, FPGA and data acquisition commercial and conduction-cooled boards for cPCI, PCIe, VPX, AMC and XMC. Builds high-performance, portable, rackmount and rugged recording systems. Is ISO 9001:2000 certified.

(See ad page 31, back cover)

## ■ Phoenix International

812 W Southern Ave, Orange, CA  
92865, 714-283-4800,  
info@phenxint.com,  
www.phenxint.com

Manufactures rugged COTS mass data storage systems for many host operating systems/networks. Systems range in applications from multi-terabyte fibre channel, 10GbE iSCSI and SAS RAID, NAS, and storage area network configurations, to plug-in conduction cooled VPX SSD storage modules. Is an AS9100/ISO 9001-certified, service-disabled, veteran-owned small business.

(See ad page 45)

## The Phoenix Co of Chicago Inc & Affiliated Cos

22 Great Hill Rd, Naugatuck, CT 06770,  
203-729-9090,  
www.phoenixofchicago.com,  
www.phoenixofchicago.com

## Photron USA Inc

9520 Padgett St, Suite 110, San Diego, CA  
92126-4446, 858-684-3555,  
image@photron.com, www.photron.com

## ■ PICO Electronics Inc

143 Sparks Ave, Pelham, NY 10803,  
914-738-1400,  
info@picoelectronics.com,  
www.picoelectronics.com

Manufactures military, COTS, and industrial DC/DC converters, high-voltage modules, AC/DC power supplies, inductors, and transformers. MIL-PRF units, environmental screening, and custom specifications are available from an ISO-AS9100C approved facility.

(See ad page 21, inside back cover)

## PIC Wire & Cable

(div of The Angelus Corp),  
N53 W24747 S Corporate Cir, Sussex,  
WI 53089-0330, 262-246-0500,  
sales@picwire.com, www.picwire.com

## Plane Parts 360

5319 SW Westgate, Suite 24D, Portland,  
OR 97221, 503-374-0340,  
sales@planeparts360.com,  
www.planeparts360.com

## Pleora Technologies Inc

340 Terry Fox Dr, Suite 300, Ottawa, ON  
K2K 3A2, Canada, 613-270-0625,  
info@pleora.com, www.pleora.com

## Polarity Inc

11294 Sunrise Pk Dr, Rancho Cordova, CA  
95742, 916-635-3050,  
sales@polarity.net, www.polarity.net

## ■ Positronic

423 N Campbell Ave, Springfield, MO  
65806-1007, 417-866-2322,  
info@connectpositronic.com,  
www.connectpositronic.com

Manufactures high-reliability power connectors, D-subminiature connectors, rectangular connectors, and circular connectors. Offers many performance options, including mil-spec and space flight. Has supported military electronics for more than 40 years. The company offers customer support through detailed catalogs, easy-to-use website and local technical customer service.

(See ad page 55)

## Power n Sun

Suite 2305, Burlington Tower, Business Bay, Dubai, United Arab Emirates,  
971-4-3686393, info@powernsun.com,  
www.powernsun.com

## Praxis Optics

75 Quail Run, Elmira, NY 14903,  
505-239-9095,  
optalix@praxis-optics.com,  
www.praxis-optics.com

## Premier Magnetics

20381 Barents Sea Cir, Lake Forest, CA  
92630, 949-452-0511,  
sales@premiermag.com,  
www.premiermag.com

## Pryme

911 Mariner St, Brea, CA 92821,  
714-257-0300,  
sales.service@pryme.com,  
www.pryme.com

## Puleo Electronics Inc

39 Hutcheson Pl, Lynbrook, NY 11563,  
516-599-4875, sales@puleoinc.com,  
www.annunciator.com

## PulseTech Products Corp

1100 S Kimball Ave, Southlake, TX 76092,  
817-329-6099, ppc@pulsetech.net,  
www.pulsetech.net

## QA Systems Ltd

2 Palace Yard Mews, Bath, Somerset  
BA1 2NH, UK, 44-122-532-1888,  
info@qa-systems.com,  
www.qa-systems.com

## Quality Two-Way Radios

43537 Ridge Pk Dr, Temecula, CA 92590,  
951-530-3052,  
sales@quality2wayradios.com,  
www.quality2wayradios.com

## Quantum Composers

212 Discovery Dr, Bozeman, MT 59718,  
406-582-0227,  
sales@quantumcomposers.com,  
www.quantumcomposers.com

## Quell Corp

5639 Jefferson St NE, Albuquerque, NM  
87109, 505-243-1423,  
eeseal@quell.us, www.eeseal.com

## ■ Radiall USA

8950 S 52nd St, Suite 401, Tempe, AZ  
85284, 480-682-9400,  
infousa@radiall.com,  
www.radiall.com

Is a global manufacturer of interconnect components for the aerospace, defense, industrial, medical, space, test and measurement and telecommunication markets. For over 65 years, has provided innovative RF coaxial connectors and cable assemblies, optical technology, coaxial switches, microwave components and multipin connectors to help simplify customers' lives.

(See ad page 39)

## Radiant Vision Systems

18640 NE 67th Ct, Redmond, WA 98052,  
425-844-0152,  
info@radiantvs.com,  
www.radiantvisionsystems.com

## RAM Optical Instrumentation

(div of Quality Vision International Inc),  
1175 North St, Rochester, NY 14621,  
585-758-1300, info@ramoptical.com,  
www.ramoptical.com

## Reelcraft Industries Inc

2842 E Business Hwy 30, Columbia City,  
IN 46725, 260-248-8188,  
reelcraft@reelcraft.com,  
www.reelcraft.com

## Renesas Electronics Corp

1001 Murphy Ranch Rd, Milpitas, CA  
95035, 408-432-8888, www.renesas.com

## Reynard Corp

1020 Calle Sombra, San Clemente, CA  
92673, 949-366-8866,  
sales@reynardcorp.com,  
www.reynardcorp.com

## RFOptic

PO Box 312, Einat 4880500, Israel,  
972-76-540-0180, sales@rfoptic.com,  
www.rfoptic.com

## RFQ Experts

4915 54 St, Suite 329, Red Deer, AB  
T4N 2G7, Canada, 780-851-3631,  
sales@rfqexperts.com,  
www.rfqexperts.com

## ■ RGB Spectrum

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(See ad page 44)

## RPML Lasers Inc

203 Joseph St, O'Fallon, MO 63366,  
636-272-7227, info@rpmlasers.com,  
www.rpmlasers.com

## RWC Testing & Lab Supplies

1821 N Zaragoza Rd, PMB 640, El Paso,  
TX 79936, 915-852-3375,  
customerservice@rwc-testing.com,  
www.rwc-testing.com

## Saelig Co Inc

71 Perinton Pkwy, Fairport, NY 14450,  
585-385-1750, sales@saelig.com,  
www.saelig.com

## Santa Barbara Imaging

396 S San Marcos Rd, Santa Barbara, CA  
93111, 805-729-0422,  
sales@santabarbaraimaging.com,  
www.santabarbaraimaging.com

## Scalys

Haaksbergerstr 67, Hengelo 7554 PA,  
Netherlands, 31-74-255-57-12,  
hans.klos@scalys.com, www.scalys.com

## Schmit Prototypes

1801 Indianhead Dr, Menomonie, MN  
54751, 715-235-8474,  
data@schmitprototypes.com,  
www.schmitprototypes.com

## Schroff GmbH

Langenalber Str 96-100, Straubenhardt  
D-75334, Germany, 49-7082-794-0,  
info@schroff.de, www.schroff.biz

## SCHURTER

447 Aviation Blvd, Santa Rosa, CA 95403,  
707-636-3000, info@schurterinc.com,  
www.schurter.com

## Screening Systems Inc

1999 S Bascom Ave, Suite 700, Campbell,  
CA 95008, 949-855-1751,  
sales@scrsys.com, www.scrsys.com

## Sealcon LLC

7374 S Eagle St, Centennial, CO  
80112-4240, 303-699-1135,  
info@sealconusa.com,  
www.sealconusa.com

## Sensitron Semiconductor

(div of RSM Electron Power Inc),  
100 Engineers Rd, Hauppauge,  
NY 11788, 631-586-7600,  
sales@sensitron.com, www.sensitron.com

## Shoghi Communications

74 Electronic Complex, Industrial Area  
Shoghi, Shimla, Himachal Pradesh  
173219, India, 91-177-2860630,  
marketing@shoghicom.com,  
www.shoghicom.com

## Sierra Pacific Innovations

6620 S Tenaya Way, Suite 200,  
Las Vegas, NV 89113, 702-369-3966,  
sales@x20.org, www.x20.org

## Silicon Designs Inc

13905 NE 128th St, Kirkland, WA 98034,  
425-391-8329,  
sales@silicondesigns.com,  
www.silicondesigns.com

## Sital Technology

17 Atir Yeda St, Kfar-Saba 44643, Israel,  
972-9-763-3300, info@sitaltech.com,  
www.sitaltech.com

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510-623-1231, info@smarth.com,  
www.smarth.com

*Is a market pioneer of secure, ruggedized solid-state drives (SSDs) and continues to be a technology leader, employing current and next-generation defense-focused designs. Utilizing Flash technology backed with proven world-class support, the company designs and manufactures high-performance military and industrial SSDs with many additional attributes.*

(See ad page 53)

## Sofradir EC Inc

(sub of Sofradir), 373 US Hwy 46, Fairfield,  
NJ 07004, 973-882-0211,  
info@sofradir-ec.com,  
www.sofradir-ec.com

## Southwest Antennas

8145 Ronson Rd, Suite B, San Diego, CA  
92111, 858-277-3300,  
sales@southwestantennas.com,  
www.southwestantennas.com

## Specialised Imaging Inc

40935 County Ctr Dr, Suite D, Temecula,  
CA 92591, 951-296-6406,  
frank@specialised-imaging.com,  
www.specialised-imaging.com

## Specialised Imaging Ltd

Silk Mill Industrial Estate, Unit 32,  
Brook St, Tring, Herts HP23 5EF, UK,  
44-1442-827-728,  
wai@specialised-imaging.com,  
www.specialised-imaging.com

## SPI Lasers UK Ltd

6 Wellington Pk, Tollbar Way, Hedge End,  
Southampton SO30 2QU, UK,  
44-1489-779-696, sales@spilasers.com,  
www.spilasers.com

## ■ SRCTec LLC

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13212, 315-452-8700,  
inquiries@srcinc.com,  
www.srtecems.com

*Offers turnkey electronics manufacturing services (EMS), circuit card assembly (CCA), build-to-print and custom manufacturing services including test, design, environmental qualification, and a host of specialized requirements for the design and production of products.*

(See ad page 37)

## SSP Manufacturing Inc

83 Spring Ln, Hackettstown, NJ 07840,  
908-852-3125, sspseals@gmail.com,  
www.sspseals.com

## StacoSystems

7 Morgan, Irvine, CA 92618,  
949-297-8700, sales@stacosystems.com,  
www.stacosystems.com

## Star Tech Instruments

PO Box 1822, New Fairfield, CT 06812,  
203-312-0767,  
info@startechinstruments.com,  
www.startechinstruments.com

## Statek Corp

512 N Main St, Orange, CA 92868,  
714-639-7810, sales@statek.com,  
www.statek.com

## StingRay Optics LLC

(a Gooch & Housego Co), 17A Bradco St,  
Keene, NH 03431, 603-358-5577,  
info@stingrayoptics.com,  
www.stingrayoptics.com

## Stratign

PO Box 124010, Dubai,  
United Arab Emirates, 97-14-2995886,  
marketing@stratign.com,  
www.stratign.com

## Sunrez Corp

392 Coogan Way, El Cajon, CA 92020,  
619-442-3353, mlivesay@sunrez.com,  
www.sunrez.com

## SV Microwave

(div of Amphenol), 2400 Centrepark W Dr,  
West Palm Beach, FL 33409,  
561-840-1800, sales@svmicro.com,  
www.svmicrowave.com

## SwissOptic AG

(sub of Berliner Glas Group),  
Heinrich-Wild-Str, Heerbrugg,  
Kanton St Gallen CH 9435, Switzerland,  
41-71-727-3074,  
swissoptic@swissoptic.com,  
www.swissoptic.com



## SynQor Inc

155 Swanson Rd, Boxborough, MA  
01719-1316, 978-849-0600,  
power@synqor.com, www.synqor.com

*Supplies power conversion solutions to the military market. The innovative products are designed for today's leading-edge power infrastructure hardware. The MilQor series of military ruggedized UPS, power systems, hi-rel and Mil-COTS converters and filters brings the company's field proven high-efficiency synchronous-rectifier technology to the military industry.*

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info@sysgo.com, www.sysgo.com

## ■ Systel Rugged Computers

1655 Industrial Blvd, Sugar Land, TX  
77478, 281-313-3600,  
sales@systelusa.com,  
www.systelusa.com

*Is the leading designer and manufacturer of custom and COTS rugged computing systems. Is a proud supplier of the US Armed Forces and is an ISO 9001 certified company with systems deployed worldwide for mission-critical applications.*

(See ad page 26)

## TeamEDA Inc

1001 Elm St, Suite 305, Manchester, NH  
03101, 603-656-5200,  
info@teameda.com, www.teameda.com



## Tech-Etch Inc

45 Aldrin Rd, Plymouth, MA 02360,  
508-747-0300, sales@tech-etch.com,  
www.tech-etch.com

## Technobox Inc

154 Cooper Rd, Suite 901, West Berlin, NJ  
08091-9112, 856-809-2306,  
info@technobox.com,  
www.technobox.com

## Tech Products Inc

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718-442-4900,  
eorders@techproducts.com,  
www.techproducts.com

## Techsil Ltd

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Bidford-on-Avon B50 4JN, UK,  
44-1789-773-232,  
technical@techsil.co.uk, www.techsil.co.uk

## Tef Cap Industries

1155 Phoenixville Pike, Suite 103,  
West Chester, PA 19380, 610-692-2576,  
tefcapind@tefcap.com, www.tefcap.com

## Teledyne Storm Microwave

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10221 Werch Dr, Woodridge,  
IL 60517, 630-754-3300,  
storm\_microwave@teledyne.com,  
www.teledynestorm.com

## Thermo Scientific - CIDTEC

(a part of Thermo Fisher Scientific),  
101 Commerce Blvd, Liverpool,  
NY 13088-4507, 315-451-9410,  
tony.chapman@thermofisher.com,  
www.thermofisher.com/cidtec

## Thorlabs Inc

56 Sparta Ave, Newton, NJ 07860,  
973-579-7227, sales@thorlabs.com,  
www.thorlabs.com

## Tianjin Anson International Co Ltd

Bldg 2, Huaqiang New Times, Xiang Rd,  
Anyang, Henan 455000, China,  
86-372-536-8538,  
info@pellet-making.com,  
www.pellet-making.com

## Timbercon Inc

20245 SW 95th Ave, Tualatin, OR 97062,  
888-827-8141, info@timbercon.com,  
www.timbercon.com

## TNC Optics & Technologies Pte Ltd

Blk 3015A Ubi Rd 1 #04-08/10, Kampong  
Ubi Industrial Estate, 408705, Singapore,  
65-674-46912, ronaldkoh@tncoptics.com,  
www.tncoptics.com

## Topac Inc

231 Chief Justice Cushing Hwy, Cohasset,  
MA 02025, 781-740-8778,  
sales@topac.com, www.topac.com

## Traco Power North America

(div of Traco Electronic AG Switzerland),  
2025 Gateway Pl, Suite 330,  
San Jose, CA 95110, 408-916-4570,  
salesusa@tracopower.com,  
www.tracopower.com

## Transient Specialists

7704 S Grant St, Burr Ridge, IL 60527,  
630-887-0329,  
jeff@transientspecialists.com,  
www.transientspecialists.com

## Trendsetter Electronics

2500 NE Inner Loop, Bldg 1, Suite 105,  
Georgetown, TX 78626,  
512-310-8858, sales@trendsetter.com,  
www.trendsetter.com

## Triad RF Systems Inc

11 Harts Ln, Suite 1, East Brunswick, NJ  
08816, 855-558-1001,  
pat@triadrf.com, www.triadrf.com

## Trion Technology

2131 Sunnyside Blvd, Clearwater, FL  
33765, 727-461-1888,  
info@triontech.com, www.triontech.com



## TTI Inc

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76106-1896, 817-740-9000,  
information@ttiinc.com, www.ttiinc.com

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Chepstow NP16 6UP, UK,  
44-129-162-3813,  
info@txo-systems.com,  
www.txo-systems.com

## Unified Infotech

79 Madison Ave, New York, NY 10016,  
800-820-9286,  
contacts@unifiedinfotech.net,  
www.unifiedinfotech.net

## United Electronic Industries Inc

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508-921-4600, info@ueidaq.com,  
www.ueidaq.com

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704-423-7000,  
communications@utas.utc.com,  
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08540, 609-333-8200,  
sui\_infos@utas.utc.com,  
www.sensorsinc.com

## Vadatech Inc

198 N Gibson Rd, Henderson, NV 89014,  
702-896-3337, info@vadatech.com,  
www.vadatech.com

## Vector Informatik GmbH

Ingersheimer Str 24, Stuttgart 70499,  
Germany, 49-711-80670-0,  
sales@vector.com,  
www.avionics-networking.com

## VectorNav Technologies

10501 Markison Rd, Dallas, TX  
75238, 512-772-3615,  
sales@vectornav.com,  
www.vectornav.com

*Specializes in manufacturing high-performance inertial navigation systems using the latest miniature MEMS sensor and GPS/GNSS technology. Since its founding in 2008, the company has been providing customers worldwide access to high-quality, fully calibrated inertial sensors with advanced, aerospace-grade digital filtering technology, expanding the possibilities of today's inertial navigation technology.*

(See ad page 57)

## Velmex Inc

7550 State Rts 5 and 20, Bloomfield, NY  
14469, 585-657-6151,  
info@velmex.com, www.velmex.com

## Venture Mfg Co

3636 Dayton Pk Dr, Dayton, OH 45414,  
937-233-8792,  
sales@venturemfgco.com,  
www.venturemfgco.com

## VersaLogic Corp

12100 SW Tualatin Rd, Tualatin, OR  
97062, 503-747-2261,  
info@versalogic.com,  
www.versalogic.com

## Versatile Power

743 Camden Ave, Campbell, CA 95008,  
408-341-4604,  
sales@versatilepower.com,  
www.versatilepower.com

## VIAVI Solutions (formerly Cobham AvComm)

10200 W York St, Wichita, KS 67215,  
316-522-4981, info-test@aeroflex.com,  
http://ats.aeroflex.com



## ■ Vicor Corp

25 Frontage Rd, Andover, MA  
01810, 978-470-2900,  
apps@vicorpower.com,  
www.vicorpower.com

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(See ad page 8)

## Vision Components GmbH

Ottostr 2, Ettlingen 76275, Germany,  
49-724-321-6724,  
info@vision-components.com,  
www.vision-components.com

## Visotek Inc

11700 Belden Ct, Livonia, MI 48150,  
734-427-4800, info@visotekinc.com,  
www.visotekinc.com

## VistaVu Solutions Inc

30 Springborough Blvd, #214, Calgary, AB  
T3H 0N9, Canada, 403-263-2727,  
vistavu@vistavusolutions.com,  
www.vistavusolutions.com

### ■ Vocal Technologies

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Amherst, NY 14228, 716-688-4675,  
sales@vocal.com, www.vocal.com

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(See ad page 17)

### VORAGO Technologies

1501 S Mopac Expwy, Suite 350, Austin,  
TX 78746, 512-633-7992,  
info@voragotech.com,  
www.voragotech.com

### ■ VPT Inc

(sub of HEICO Corp), 19909 120th  
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WA 98011, 425-353-3010,  
vptsales@vptpower.com,  
www.vptpower.com

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(See ad page 15)

### Westboro Photonics

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K1Z 7L9, Canada, 613-729-0614,  
info@wphotonics.com,  
www.wphotonics.com

### Whitmor/Wirenetics

27737 Ave Hopkins, Valencia, CA 91355,  
661-257-2400, sales@wirenetics.com,  
www.wireandcable.com

### Wibase Industrial Solutions

17F, 3-1, Park St, Nangang Dist, Taipei City  
115, Taiwan, 886-2-6616-0888,  
contactus@wibase.com, www.wibase.com

### Wilbrecht LEDCO Inc

Microprecision Electronics Div,  
1400 Energy Pk Dr, Suite 20, St  
Paul, MN 55108, 651-659-0919,  
info@wilbrechtledco.com,  
www.wilbrechtledco.com

### WOLF Advanced Technology

175 Mostar St, Suite 200, Stouffville, ON  
L4A 0Y2, Canada, 905-852-1163,  
sales@wolf-at.com,  
www.wolfadvancedtechnology.com

### Xilinx

2100 Logic Dr, San Jose, CA 95124,  
408-559-7778, www.xilinx.com

### Z3 Technology

100 N 8th St, Suite 250, Lincoln, NE  
68521, 402-323-0702,  
sales@z3technology.com,  
www.z3technology.com

### ZARGES Inc

1440 Center Pk Dr, Charlotte, NC 28217,  
704-357-6285, sales@zargescases.com,  
www.zargescases.com

### Zebra Technologies Corp

3 Overlook Point, Lincolnshire, IL 60069,  
631-897-9848, dgutierrez2@zebra.com,  
www.zebra.com/us/en

### ■ ZMicro Inc

9820 Summers Ridge Rd, San Diego,  
CA 92121, 858-831-7000,  
sales@zmicro.com, www.zmicro.com

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(See ad page 61)

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# PICO

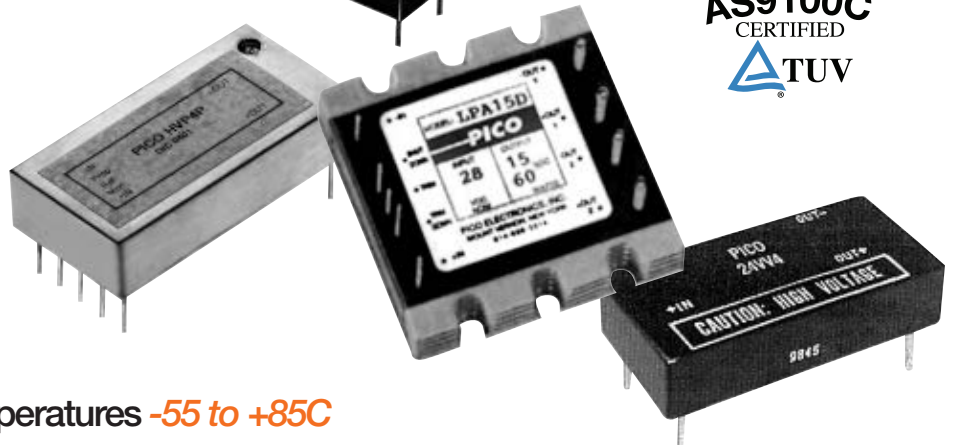


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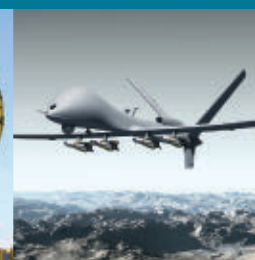
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