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Radar comes of age – but where does it go from here?

Q&A with Joseph Hajduk, CEO of dB Control, on the latest and future trends pertaining to radar technology in the military.

Radar has – in some form or another – been in development since the early 1900s. Its applications include technologies such as Synthetic Aperture Radar (SAR), Electronic Counter Measures (ECM), and Electronic Warfare (EW) threat simulation, and its pervasiveness in U.S. Army, Navy, and Air Force operations is undeniable. However, today's radar, EW, and satcom systems are requiring ever-more-sophisticated signal amplification technology in light of increasing threats. Our recent Q&A with Joseph Hajduk, CEO of dB Control, reveals exactly why. Edited excerpts follow.

MIL EMBEDDED: Can you familiarize readers (briefly) with your company, including its offerings and the Military programs for which it's provided technology?
HAJDUK: dB Control, Inc. designs and manufactures high-power microwave amplifiers, transmitters, high- and low-voltage power supplies, and modulators for military organizations, major defense contractors, and commercial manufacturers. These products are for ground-based, shipboard, and high-altitude military manned and unmanned aircraft in applications such as multimode, pulse-Doppler, and Synthetic Aperture Radar (SAR); Electronic Counter Measures (ECM); Electronic Warfare (EW) threat simulation; airborne data links; and more. Some of the programs we have provided power for include General Atomics Aeronautical Systems' Predator B and Northrop Grumman's Fire Scout and Global Hawk aircraft. Our company's 40,000-square-foot Fremont, Calif. facility also serves as the prime depot overhaul facility for the high-voltage power supplies used in the AN/ALQ-172 jammer for the B-52H, AC-130U, MC-130H, and other aircraft.

MIL EMBEDDED: Power is emphasized more and more in military applications. What do you think the expectations for power supplies will be 5 to 10 years from now, and how will that goal be achieved?
HAJDUK: Power supplies will need to be lighter and more compact. To meet these critical requirements, Traveling Wave Tubes (TWTs) in a power-combined configuration for each frequency band are necessary. These TWTs should then be combined with solid-state amplifiers to produce smaller, lighter Microwave Power Modules (MPMs).

As an example, TWTs used for transponder amplifiers in satellites requiring Ku-band and higher frequencies will need to be even more efficient and reliable. Fortunately, the TWT amplifier's ratio of RF output power to prime power input (real efficiency) is now greater than 60 percent and will soon reach 70 percent. Plus, since TWTs have operating lives greater than 20 years, they will continue to be the best choice for providing uninterrupted service in communication and radar applications.
Over the next decade, TWT amplifiers will be the amplification device of choice for a broad range of defense systems and some commercial and industrial applications with RF power

outputs up to 2.5 kW CW and 25 kW pulse at frequencies up to 95 GHz. No single solid-state amplifier can deliver this level of peak-to-average power and bandwidth.

MIL EMBEDDED: How will SECDEF Gates' proposed defense-spending shifts affect the industry?
HAJDUK: Gates' proposal forces major defense contractors to make a rapid shift away from programs that have sustained them for years and look to more diversified applications for their technology. Once they set the new direction, subcontractors and suppliers will follow their lead. But if the Tier One contractors are slow to respond, it could have industry-wide repercussions. For example, part of Gates' plan references unmanned spy drones for now and future use. Several drones use Lynx SAR/GMTI radar systems. As prime manufacturers ramp up production of these UAVs it will be beneficial for suppliers, such as dB Control, who support those platforms and systems.

MIL EMBEDDED: Has your company made any changes in the aftermath of the proposed shifts, or is it full speed ahead on military programs?
HAJDUK: Definitely full speed ahead! In response to the U.S. Army, Navy, and Air Force's demand for reliable, high-power microwave amplifiers, radar transmitters, and power supplies, we recently signed five contracts worth a combined total of more than $10 million with major U.S. defense contractors. All five contracts have the potential for renewal over the next six to eight years. While we can't divulge the exact customers, product specifications, or specific military installations, we can tell you that:

- The largest contract worth close to $3 million is from the U.S. Air Force for high-power, power-combined Traveling Wave Tube Amplifiers (TWTAs) for radar applications.
- A multiyear contract worth $2.9 million is from an international defense contractor for a follow-on product order of X-Band TWTAs.
- Several contracts from major U.S. and foreign defense contractors, worth a combined total of $2.7 million, will provide the military with TWTAs and MPMs for SAR systems for UAVs.
- An $800,000 contract from a well-known U.S. defense contractor is for the development of high-power TWTAs for use in Intelligence, Surveillance, and Reconnaissance (ISR) data collection applications.
- A major contractor for the U.S. Navy awarded dB Control a contract worth $800,000 to provide high-power TWTAs for airborne ECM.

MIL EMBEDDED: Clearly, many of your products are geared toward radar applications. What are the latest trends in radar technology, and how are they being utilized on the battlefield?
HAJDUK: Today's radar, EW, and satcom systems require more sophisticated signal amplification technology. This is because threats have increased in volume and waveforms are becoming more exotic. In particular, to acheive low probability of detection, radars, ECM transmitters, and EW threat simulators require higher microwave power over a wider bandwidth.

MIL EMBEDDED: Which technology advancements should the next generation of radar apps comprise?
HAJDUK: Radar transmitters will most certainly benefit from the rapid advances being made in solid-state technology, as well as from the continuous improvement in the performance of Vacuum Electron Devices (VEDs). As the size and weight of VEDs continues to decrease and the efficiency and reliability continues to increase, these devices will find numerous radar applications for years to come.
However, the challenge for designers is to continue to use both technologies – solid-state and vacuum electronics – in a complementary manner, rather than as competing technologies. For example, VEDs have the advantage of low dollar cost per watt, enabling them to cost effectively meet design challenges and system specifications. Likewise, the improved thermal performance

of wideband gap semiconductor devices supports the development of a wider range of real-world applications.

MIL EMBEDDED: Is using modular designs to promote COTS really COTS, or is it more Custom Off-the-Shelf than Commercial Off-the-Shelf?
HAJDUK: While we use Commercial Off-the-Shelf components and other standard modules in our modular designs, in most cases, these COTS components are integrated into custom configurations and assemblies. So I'd say that the Commercial Off-the-Shelf components enable us to more economically produce Custom Off-the-Shelf modules for our contract manufacturing and depot repair services.

MIL EMBEDDED: How can vendors reduce customization or adjustment costs and efforts on new COTS-centric designs? Is it all worth it?
HAJDUK: Most of our products are custom designed and are not COTS-centric. In our particular case, it's not worth it.

MIL EMBEDDED: With today's economic downturn, where should wise military embedded technology companies be focusing?
HAJDUK: Military embedded technology companies should explore ways to adapt their products and services to commercial applications. For example, we're seeing that our products that were originally developed and tested for mission-critical military SAR applications are now being adapted for a variety of commercial applications, such as the SAR images taken under adverse weather conditions and through foliage. This is used to assess the best response to forest fires, for example.

MIL EMBEDDED: What are the biggest challenges for your customers and how are you remedying them?
HAJDUK: Prime concerns for our customers include reducing the size, weight, power consumption, and operating and maintenance costs of radar systems – without compromising reliability. We will continue to design new transmitters to meet these challenging requirements.

MIL EMBEDDED: Which single technology will be most influential in the military embedded market in the next two years?
HAJDUK: We believe one of the most influential technologies will be radar systems and the highly efficient, reliable products that power them. In addition to affecting overall performance, radar systems rely on high-power transmitters to amplify the waveform to the desired output power level without distortion. Perhaps that's why high-power transmitters are now recognized as one of the most critical elements in radar systems.

JOSEPH HAJDUK is CEO of dB Control. His strategy and vision enabled dB Control to grow from the start-up he co-founded in 1990 to the successful $22 million company it is today. After graduating with a BS in Engineering from Cogswell College, Joe joined Teledyne and later Aydin and Varian (now CPI), where his designs doubled AN/ALQ-172 Countermeasures Radar Warning System amplifier output. This Pave Mint Program eventually became the largest military program in Varian's history and today is supported by dB Control's depot repair service. Joe is known for his ability to turn high-power amplification concepts into reliable military and satcom products. He can be reached at jhajduk@dbcontrol.com.
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