February 2023
Vol. 46, No.2

ASSOCIATION OF OLD CROWS
Advancing Electromagnetic Warfare TOGETHER
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JED
Journal of Electromagnetic Dominance

Compass Call – the Next Generation

Also in this Issue:

- News: UK Awards Project SOCIETAS Contract
- EW 101: Electromagnetic Protection – Pulse Doppler Radars Cont'd.

Quantic™ PMI
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- Miscellaneous Products
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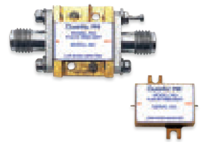
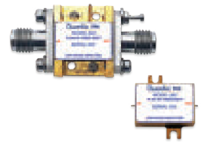
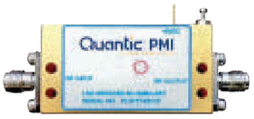


PLNA-30-10M20-292FF



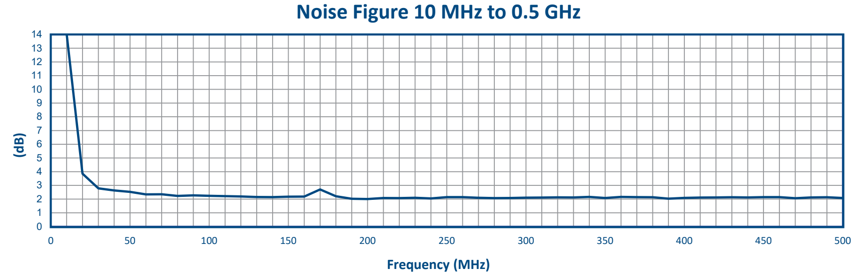
PEAFS3-14-10M22G-292FF



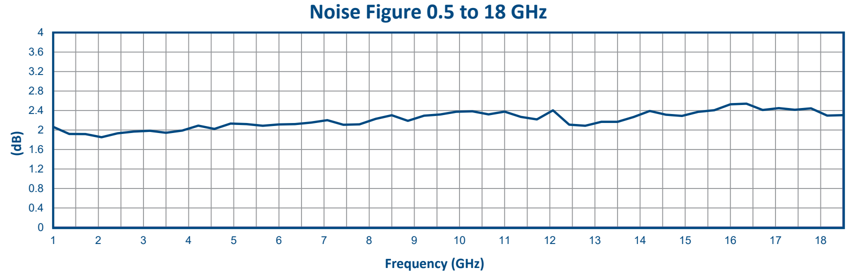
LNA-0R518G-45-10DBM-SFF

PMI Model No.	Frequency Range (GHz)	Gain (dB)	Gain Flatness (dB)	Noise Figure (dB)	OP1dB (dBm)	Configuration Size (Inches) Connectors
PEAFS3-14-10M22G-292FF	0.01 - 22	14	±0.8	2.5	+14 (0.01 - 18 GHz) +13 (18 - 22 GHz)	0.53" x 0.70" x 0.26" 2.92mm (F) Removable
PLNA-30-10M20-292FF	0.01 - 20	28	±2.5	2.5	+14 (0.01 - 18 GHz) +13 (18 - 20 GHz)	0.53" x 0.70" x 0.26" 2.92mm (F) Removable
LNA-0R518G-45-10DBM-SFF	0.5 - 18	45	±2.0	2.95	+10	0.90" x 1.67" x 0.36" SMA (F) Removable

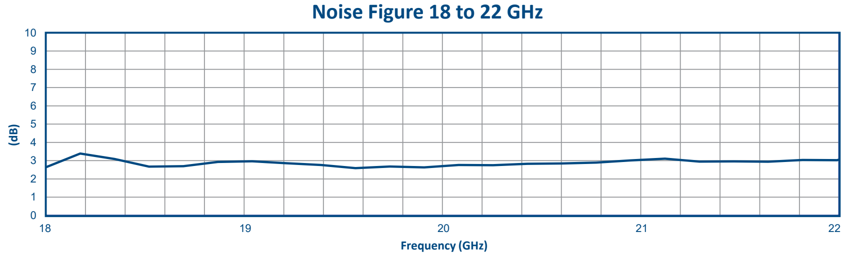
Noise Figure 10 MHz to 0.5 GHz



Noise Figure 0.5 to 18 GHz



Noise Figure 18 to 22 GHz



Typical data for Quantic PMI Model PEAFS3-14-10M22G-292FF

Quantic™ PMI
PLANAR MONOLITHICS

ISO 9001

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JED Journal of Electromagnetic Dominance

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USAF

COVER PHOTO COURTESY OF US AIR FORCE

A developmental test team from the 461st Flight Test Squadron conducted the first flight of an F-35 in the Technology Refresh 3 (TR-3) configuration at Edwards Air Force Base, CA, on January 6. The 50-minute flight marked the start of an extensive flight test campaign. TR-3 provides the computational horsepower to support modernized Block 4 software capabilities, which will provide significant EW improvements among other sensor, weapons and interoperability upgrades. F-35 JOINT PROGRAM OFFICE

Departments

STRATEGIC THINKING

Last month, the DOD issued a Request for Information (RFI) to solicit industry input as part of the process for developing a next-generation Electromagnetic Spectrum strategic roadmap. The DOD is still early in the process of implementing its plans under the 2020 EMS Superiority Strategy (EMSSS), but it is already looking to the next iteration of its strategy – in part because Congress has strongly advocated for this.

The 2020 EMSSS outlines five interdependent goals: "develop superior spectrum capabilities; evolve to an agile and fully integrated spectrum infrastructure; pursue total force readiness in the spectrum; secure enduring partnerships for spectrum advantage; and establish effective spectrum governance." One factor that underpins these goals is sharing spectrum between the government and the commercial sector. The purpose of the RFI is to help the DOD better understand what industry capabilities exist in the area of spectrum sharing.

The fact that the DOD is asking about spectrum sharing reflects a long-term shift in its thinking over the past few decades. The US has relied on EMS policy that dates back to the 1930s, which designated fixed bands of spectrum to various government entities. Commercial users could gain access to these bands via auctions. That was then, and this approach no longer works in the 21st Century. Commercial telecom companies understand this, and they have been extremely effective at efficiently utilizing the spectrum they have access to. But change is slow in the DOD, which grudgingly concedes spectrum access yet clings to its legacy systems that are built around fixed spectrum access.

The DOD has not been blind to the problem – just bureaucratically stubborn about it. When the DOD's Chief Information Officer (CIO) released its first EMS Strategy in 2013, Objective 2 was to "Accelerate the fielding of technologies that enable spectrum sharing and improve access opportunities." While this put a flag in the ground and acknowledged that the future is going to involve spectrum sharing, the DOD made little progress in this area. Since then, the pressure on the DOD to make greater progress spectrum sharing has only been increasing. The DOD owns some extremely valuable spectrum, but it's utilization rate of that spectrum is extremely low compared with the commercial sector. The advent of 5G technology has created new synergy between the commercial telecom companies and the DOD. But more needs to be accomplished, and the Senate Armed Services Committee (SASC) – which the RFI cites up front as the main reason for the DOD's action – has now taken on the role of applying greater pressure on the DOD.

When you think of the various industries that depend on the EMS, from banking to telecoms to air travel, it's not a stretch to say that the EMS is the platform upon which the US economy stands. It is also the strategic maneuver space through which almost all of the DOD's weapons systems operate. Last month's RFI was a small step forward. But the DOD needs to be more far more proactive about spectrum sharing, because its future depends on it. – *J. Knowles*

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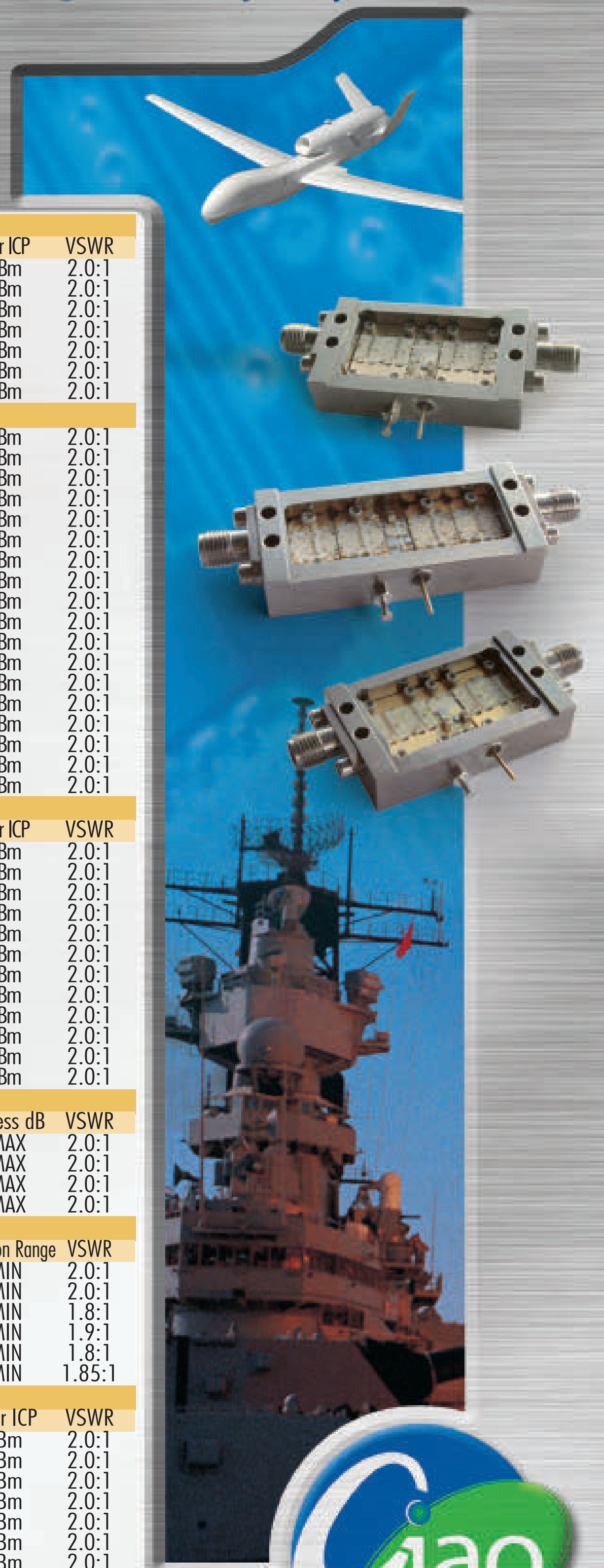

Calendar *Conferences & Trade Shows*

FEBRUARY

Aero India 2023
Feb. 3-5
Bengaluru, India
www.aeroindia.gov.in

DIMDEX
Feb. 5-7
Doha, Qatar
www.dimdex.com

AFCEA West 2023
Feb. 14-16
San Diego, CA
www.westconference.org

IDEX
Feb. 20-24
Abu Dhabi, UAE
www.idexuae.ae

Avalon 2023
Feb. 28 – March 5
Geelong, Victoria, Australia
www.airshow.com.au

MARCH

AFA Air Warfare Symposium
March 6-8
Aurora, CO
www.afa.org

Satellite 2023
March 13-16
Washington, DC
www.satshow.com

Collaborative EW 2023
March 14-16
Point Mugu, CA
www.crows.org

DSEI Japan
March 15-17
Chiba, Japan
www.dsei-japan.com

Dixie Crow Symposium 46
March 20-23
Warner Robins, GA
www.dixiecrowsympsoium.com

APRIL

Annual Directed Energy S&T Symposium
Apr. 3-5
Mobile, AL
www.deps.org

Navy League Sea-Air-Space
Apr. 3-5
National Harbor, MD
www.seaairspace.org

LAAD Defence and Security
Apr. 11-14
Rio de Janeiro, Brazil
www.laadexpo.com.br

Army Aviation Mission Solutions Summit
April 26-28
Nashville, TN
www.quad-a.org

MAY

Cyber Electromagnetic Activities (CEMA) Conference
May 2-4
Aberdeen Proving Ground, MD
www.crows.org

AOC Europe
May 15-17
Bonn, Germany
www.aoceurope.com

EW Capability Gaps and Enabling Technologies Conference
May 16-18
Crane, IN
www.crows.org

Special Operations Forces Industry Conference
May 17-21
Tampa, FL
www.sofic.org

JUNE

Cyber/EW Convergence Conference
June 6-8
Charleston, SC
www.crows.org

*AOC conferences are noted in **red**. For more info or to register, visit crows.org. Items in **blue** denote AOC Chapter events.*

Calendar *Courses & Seminars*

FEBRUARY

AOC Virtual Series Webinar: Importance of Signal Generator Phase Noise in RF/mm-Wave Subsystem
Measurements
Feb. 2
2-3 p.m. EDT
www.crows.org

AOC Virtual Series Webinar: Regaining the Spectrum Offensive
Feb. 9
2-3 p.m. EDT
www.crows.org

Communications EW
Feb. 13-17
Shrivenham, UK
www.cranfield.ac.uk

AOC Virtual Series Webinar: Joint All-Domain Command and Control (JADC2)
Feb. 23
2-3 p.m. EDT
www.crows.org

Advanced RF Electromagnetic Warfare Principles
Feb. 27 - March 3
Atlanta, GA
www.pe.gatech.edu

MARCH

AOC Virtual Series Webinar: Chinese Thinking on the Establishment of Information Dominance
March 2
2-3 p.m. EDT
www.crows.org

Advanced Radar
March 6
Shrivenham, UK
www.cranfield.ac.uk

AOC Virtual Series Webinar: Countering UAS Using EW and DEW Attack Vectors
March 9
2-3 p.m. EDT
www.crows.org

Aircraft Survivability
March 13-17
Shrivenham, UK
www.cranfield.ac.uk

IR/Visible Signature Suppression
March 21-24
Atlanta, GA
www.pe.gatech.edu

AOC Virtual Series Webinar: SDR for Strategic COMINT Applications
March 23
2-3 p.m. EDT
www.crows.org

Counter-IED Capability
March 27-31
Shrivenham, UK
www.cranfield.ac.uk

Principles of Millimeter-Wave Radar EW
March 28-29
Atlanta, GA
www.pe.gatech.edu

APRIL

AOC Virtual Series Webinar: EMS as the Context of Military Operations
Apr. 6
2-3 p.m. EDT
www.crows.org

Basic RF EW Concepts
Apr. 11-13
Atlanta, GA
www.pe.gatech.edu

AOC Virtual Series Webinar: Coexisting or Clashing: 5G with Radar/Satellite
Apr. 13
2-3 p.m. EDT
www.crows.org

AOC courses are noted in red. For more info or to register, visit crows.org. Items in blue denote AOC Chapter courses.

RECOGNIZING WHAT'S IMPORTANT

While we have all been facing many personal and professional challenges in the troubling times of late, I recently attended two events that reminded me of how tremendous our EW community is. The first event was the Gingerbread Ball, which was a joyous holiday event to celebrate our camaraderie and to benefit Fisher House Foundation. The AOC Garden State chapter was one of the multiple sponsors of this exceptional night. While I was one of only two or three former naval officers in the crowd of hundreds of primarily Army folks from the Ft Monmouth area, the solidarity of the different services represented, – many directly involved in EW – was moving. The guest speaker was Johnny "Joey" Jones, a former US Marine Corps EOD Bomb Technician Staff Sergeant and current Fox News television host who inspired the entire audience with his words and reminded us all to focus on how lucky we are every day to have what we have.

The second event was the 123rd annual Army-Navy football classic known as "America's game." Arguably one of the country's greatest rivalries, the game every year displays the grit and determination of athletes pitted against their rivals for 60 minutes who come to a somewhat miraculous realization at the end of the game that for the rest of their lives they are all teammates fighting together for their nation's defense. While I saw the SECDEF, Chairman of the Joint Chiefs, SECNAV, Chief of Naval Operations and many other dignitaries at the game, I was most impressed talking to the Navy Midshipmen and Army Cadets who form the future of two of our military services. The talent, maturity, respect and commitment immediately evident in these young men and women was truly encouraging to this Old Crow, who admittedly often gets caught up in the onslaught of mass-media politics that threaten the military readiness of our warfighters.

Watching our military communities come together in these events reminded me, once again, of my own personal experience wearing Army ACUs and Marine kamis working hand in hand with Sailors, Soldiers, Marines and Airmen to employ our EW weapon systems successfully in Iraq. The joint, coalition and partner EW teamwork unquestionably saved lives in combat.

The AOC is proud to be the premier professional association for the past, present and future EW teams across the globe. There is great pride in our common passion for enhancing EW capability that forms an enviable camaraderie. We love our AOC community, and we treasure the conferences and symposiums that provide us with the opportunity to come together and rekindle lifelong friendships and develop new professional relationships.

Always remember that we represent and serve you, the members, and are open to ideas to make our events more rewarding for you whether you represent academia, industry, Government or the military. I am looking forward to every one of our 2023 events and I hope we'll see you there! – *Brian "Hinks" Hinkley*

QINETIQ WINS UK PROJECT SOCIETAS CONTRACT

An industry team led by QinetiQ (Farnborough, UK) has been awarded an £80 million contract to deliver key electronic warfare (EW) mission data services and expertise to the UK Ministry of Defence (MoD).

Known as Project SOCIETAS, the program is designed to enable and sustain the UK's sovereign EW enterprise by establishing a partnership between the Joint Electronic Warfare Operational Support Centre (JEWOSC) and industry. QinetiQ, leading Team Pegasus, was selected over a rival Leonardo-led consortium known as Team NOVUS.

Part of the UK's Strategic Command, the MoD's JEWOSC at RAF Waddington is the entity responsible for providing EW operational support, including mission data, intelligence and information, to UK joint forces, international partners and UK industry. Recognizing concerns over the long-term availability of suitably qualified civil service and military personnel, Project SOCIETAS (formerly the JEWOSC Operating Model Option Study) has been established to secure and enhance long-term defense access to specialist suitably qualified and experienced personnel (SQEP) to sustain delivery of EW mission data and related intelligence outputs. As well as sustaining delivery of EW mission data and related intelligence outputs to the UK joint force on an assured and enduring basis, the program will additionally build and maintain the UK sovereign mission data capability and support an increased UK contribution to Five Eyes Partners (Australia, Canada, New Zealand and the United States) on EW collaboration.

Core deliverables under Project SOCIETAS comprise the provision of sustainable SQEP to the JEWOSC; provision of training and training support to ensure that authority personnel have the competencies required by the JEWOSC; provision of continuous improvement, innovation and modernization to support enhancement of the JEWOSC output; and the provision of business development capability to support the sale of EW data and provision of SQEP to support secured EW sales. Additional objectives include support to the maintenance of the JEWOSC command and information services, and to increase resilience and capacity in the supply chain.

Team Pegasus brings together the collective expertise of QinetiQ, Inzpire, SRC UK and CGI. Other partners include Metrea, Northrop Grumman, Cranfield University, Mercury, the University of Lincoln and Warner McCall.

The initial six-year contract commenced in December 2022. Contract options provide for the contract to be extended out to a 10-year term. – *R. Scott*

DOD PURSUES EMSO PROJECTS IN SMALL BUSINESS SOLICITATIONS

The DOD has released its first large batch of small business solicitations for FY2023. The topics for its Small Business Innovative Research (SBIR) Broad Agency Announcement (BAA) (DoD SBIR 2023.1) and its Small Business Technology Transfer (STTR) BAA (DOD STTR 2023.A) include several Electromagnetic Spectrum Operations (EMSO)-related efforts. These SBIR and STTR program funds research in phases. Phase 1 work usually includes paper studies to evaluate the technical feasibility of a project. Phase 2 work often includes technology development and lab demonstration. Some topics, where there is a higher level of technology maturity, are "Direct to Phase 2" efforts.

The SBIR 2023.1 solicitation includes US Air Force and US Navy research topics. Among the Air Force's EMSO related topics are:

- Advanced Millimeter-Wave Radar Absorbing Materials (Topic AF231-0012): The objective of this topic is to develop "practical absorber capabilities in the mmW bands to suppress unwanted EM interference in indoor anechoic chambers and on outdoor RCS [radar cross section] measurement ranges." The topic description says "...broad-band outdoor materials can range from 10-15 dB. Outdoor RAMs are desired to be rugged, UV and water resistant." Phase 1 calls for an "...in-depth evaluation and analysis of current RAM design/development techniques for use in indoor and outdoor RCS measurement facilities." Work will be "focused on practical, rugged field use and indoor anechoic chambers with materials optimized for performance at Ka & W frequency bands." The topic point of contact is William Parnell, (850) 882-9960, e-mail william.parnell@us.af.mil.
- Millimeter Wave (mmW) RF System on a Chip (RFSoC) Technology (Topic AF231-0013): This effort aims to leverage advances in commercial mmW RFSOC development and apply them toward developing an "integrated sensor package that incorporates RFSoC technology and is tailored to support common military radar RF bands" while featuring "arbitrary waveform generation and digital signal processing capabilities" for use in in a variety of military radar applications for test ranges. More specifically, the project seeks to provide a miniaturized mmW RFSoC that "1. Supports C, X, Ku, Ka and W military radar bands at min. 4 GHz signal bandwidth; 2. performs arbitrary waveform generation and processing of received signals over a min. of eight transmit and eight receive channels; 3. supports multi-channel synchronization of transmit and receive channels; 4. supports multi-radar (i.e., multi-chip) synchronization; and 5. use-case targets instrumentation radar at outdoor range." The topic point of contact is Jason Gallina, (850) 882-8409, e-mail jason.gallina@us.af.mil.
- Fully Adaptive Radar Electronics (FARE) (Topic AF231-D022): This proj-

ect aims to "develop new approaches targeting advanced radars employing Fully Adaptive and AI techniques." The description states, "Fully Adaptive radar (FAR) has emerged as the next generation of highly adaptable systems for military applications. FAR uses both advanced AI techniques and full-adaptivity (transmit and receive) to 'probe' the total radar environment (targets, clutter, jamming, etc.) to gain an optimal understanding of how to best prosecute its mission. This highly agile transmit probing is supported by advanced real-time adaptive waveform and MIMO techniques, high performance embedded computing (HPEC), knowledge-aided (KA) processing, model-based signal processing, and other AI techniques The goal of CFATs [Counter-Fully Adaptive Techniques] is to disrupt this channel learning OODA cycle thereby degrading its performance. These advanced techniques must themselves employ many if not all of the aforementioned Fully Adaptive systems techniques to: 1) degrade a FAR's understanding of the environment to a degree sufficient to degrade its receiver-operator-characteristic (ROC) performance, and 2) remain undetected to the victim FAR." This effort aims to leverage existing research (M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, etc.) and move directly to Phase 2. The topic point of contact is Muralidhar Rangaswamy, (937) 713-8567, e-mail muralidhar.rangaswamy@us.af.mil.

- RAdar Disruption Systems (RADS) (Topic AF231-D023): Noting that "Mechanical motion is an alternative way to manipulate radar signals, as opposed to pure electronic means," this topic "seeks to develop imaging radar disruption systems by using passive mechanical action for at least a portion of their functional mechanism." The description states, "These types of systems offer certain advantages, such as broadband response, simplicity, and likely cost. Other possible advantages include ease of operation and set up, which along with the design and operation simplicity which provides a smaller logistical tail." This is a "direct to Phase 2" effort. The topic point of contact is Robert Nelson, (937) 713-9907, e-mail robert.nelson.21@us.af.mil.

US Navy SBIR topics include:

- Broadband Antenna Solution for Vehicle-Mounted Electronic Warfare Systems (Topic N231-003): Under this project, Marine Corps Systems Command wants to "develop an innovative and operationally suitable consolidated (minimized size and weight) antenna solution for sensing and transmitting broadly across the electromagnetic spectrum with angular resolution sufficient for geolocation and direction finding." The description states, "With the emergence of ultra-wideband photonic receiver technology that can very rapidly process, de-conflict, and identify threats across the entire frequency range of the electromagnetic spectrum, there comes a need for complimentary broadband antenna hardware to sense and locate threats and transmit to defeat them." This effort calls for a four-element array weighing between 10 and 50 lb than can provide "accurate" DF and geolocation of emitters covering from DC up to 20 GHz (Threshold), 80+GHz (Objective). The topic point of contact is Alicia Owsiak, e-mail alicia.owsiak@usmc.mil.
- High Power Microwave (HPM) Solid State Amplifier Topologies (Topic N231-062): This effort will focus on developing "a radio frequency (RF) Solid State Power Amplifier (SSPA) topology specific to high power microwave (HPM) applications for use either as a stand-alone source or in an array, capable of generating a variety of waveforms while exploring the trade-off between power and bandwidth." The description adds, "Solutions could cover pulse widths ranging from nanoseconds to microseconds. Frequency interests span L, S, C, and X band SSPA topologies." The topic point of contact is Ryan Hoffman, e-mail ryan.b.hoffman.civ@us.navy.mil.
- Cognitive Tactics, Techniques and Procedures (TTP) Synthesis (Topic N231-067): The objective of this effort is to "synthesize Artificial Intelligent (AI)-generated Electronic Support (ES) and Electronic Attack (EA) Tactics, Techniques and Procedures (TTPs) in near real-time against known legacy or unknown/complex sensor waveforms using online and unsupervised Machine Learning Algorithms (MLAs) based on real-time collaborative Tactical Situational Awareness and mission objectives for Size, Weight, and Power (SWaP)-constrained unmanned and/or manned naval platforms." The description adds, "Research will develop AI-generated, machine actionable ES and EA TTPs in near real-time using online and unsupervised MLAs based on all-available information and multi-modality data present in the Electromagnetic (EM) Spectrum for a single platform and across multiple collaborative Manned/Unmanned naval platforms." It also states that this approach "…extends beyond traditional library look-up solutions that are typically pre-loaded in an on-board Mission Data File (MDF)." It will focus on augmenting and eventually replacing traditional ESM techniques libraries and databases "while reducing offline human-derived TTP development, analysis, and testing timeline by orders of magnitude." The topic point of contact is Charles Stein, e-mail charles.s.stein2.civ@us.navy.mil.

The DOD STTR 2023.A solicitation included the following EMSO-related topics:

- Coherent Sensing Approaches for Dynamic Spectrum Allocation (Topic N23A-T017): This Navy effort aims to "design a distributed, coherent sensing solution to generate a spectrum map of available channels in sparse or dense spectral environments for channel allocation in a decentralized multi-hop network." It will also "develop a scheme for sharing spectrum sensing results across the network for all channels to reach distributed consensus on the spectrum map between multiple geographically-dispersed nodes." The description states that this project will "develop the foundational mathematical analysis to address coherence for distributed sensing in dynamic spectral environments. This topic also seeks an initial design of a methodology for disseminating results and awareness across the network to achieve distributed consensus among the sensing nodes for applications, such as adapting communications within the spectrum and identifying primary and secondary users." The topic point of contact is Scott Batson, e-mail scott.c.batson.civ@us.navy.mil.

- Improved Fiber Laser for Spectral Beam Combination (Topic N231-D01): This direct to Phase 2 topic from the Navy calls for developing a "...robust, spectrally stabilized, continuous wave fiber-laser system with < 15 GHz spectral bandwidth that is free from stimulated Brillouin scattering [SBS] and thermal mode instability [TMI] at kW power levels." This work calls for developing and optimizing an "innovative prototype fiber-laser system suitable for conventional spectral beam combining" that can demonstrate greater than 1kW output, narrow spectral bandwidth (less than 15 GHz), center wavelength long-term stability (less than 50 MHz) and completely mitigate SBS and TMI. The topic point of contact is Philip Peters, (760) 939-1569.

The DOD will begin accepting proposals for SBIR 2023.1 and STTR 2023.1 via its Defense SBIR/STTR Innovation Portal on February 8. The deadline for all proposals is March 8. Details of the solicitations and topics is available at www.dodsbirsttr.mil. – *JED Staff*

NORTHROP GRUMMAN DEMONSTRATES SCALED SHIPBORNE ELECTRONIC ATTACK

Northrop Grumman (Baltimore, MD) has revealed initial testing of a prototype shipborne Ultra-Lite Electronic Attack (EA) system based on technology scaled down from the US Navy's Surface Electronic Warfare Improvement Program (SEWIP) Block 3 system.

According to the company, key components were demonstrated in collaboration with the Naval Research Laboratory (NRL) on board an unidentified DDG-51 *Arleigh Burke*-class guided-missile destroyer as part of last year's Rim of the Pacific (RIMPAC) 2022 exercise.

SEWIP Block 3 will deliver a next-generation EA capability for US Navy destroyers, aircraft carriers and large amphibious ships, integrating with the existing AN/SLQ-32(V)6 electronic support system architecture to create the AN/SLQ-32(V)7 variant. Northrop Grumman was contracted by the US Navy in February 2015 for SEWIP Block 3 design and development: the company's technical solution adopts an active electronically scanned array based on Gallium Nitride transmit/receive modules, and leverages technology previously matured and de-risked under the Office of Naval Research's Integrated Topside program.

Northrop Grumman completed SEWIP Block 3 system integration and qualification testing at its Baltimore site in mid-2021 as part of its engineering and manufacturing development contract. An Engineering Development Model is undergoing land-based testing at the Surface Combat Systems Center at Wallops Island, VA, and the first ship installation is currently in progress on board the DDG 51 Flight IIA destroyer USS *Pinckney* in San Diego.

Development of the derivative Ultra-Lite system has been self-funded by Northrop Grumman to meet anticipated Navy requirements for a more compact EA installation to support anti-ship missile defense for smaller surface combatants, which typically are not fitted with radar jamming systems. The company told *JED* that it has sought to maximize hardware commonality with the core SEWIP Block 3 system while re-architecting to enable installation on size, weight and power-constrained platforms.

For the RIMPAC 2022 demonstration, Northrop Grumman integrated Ultra-Lite EA transmit/receive technology with NRL's expeditionary EA antenna subsystem. The company said a press release that the combined system was "successfully demonstrated over many RIMPAC exercise events" and proved that the scaled EA solution "can effectively support US Navy missions."

Additional concept demonstrations are planned to run during 2023 to further demonstrate the reliability and scalability of the system to the US Navy. This will include lab trials, land-based tests and further at-sea demonstrations. – *R. Scott*

IN BRIEF

The **Defense Advanced Research Projects Agency,** Strategic Technology Office (Arlington, VA) has issued a Broad Agency Announcement (HR001123S0014) for its Cancun program, which aims to "create distributable nodes to measure the high frequency (HF) radio environment for improved warfighter situational awareness in the critical HF radio band." The program description states, "The low size, weight, power, and cost (SWaP-C) of these nodes will enable cost-effective wide-area deployments. The Cancun nodes will measure the state of the ionosphere using a sounding function, as well as record and relay portions of the HF radio band for analysis. The primary challenge in Cancun is the coordination of large numbers of Cancun units deployed over distances of well over 1,000 kilometers. Cancun will provide a command and control (C2) network and planning tools to address this challenge." The 42-month program is organized into two phases: Phase 1 is 18 months (Base), and Phase 2 (Option) is 24 months. Proposals are due by February 15. The BAA coordinator can be reached at HR001123S0014@darpa.mil.

The Training and Readiness Accelerator II (TReX II) consortium has issued a Request for Solutions (RFS) on behalf of the US Army's **Program Executive Office for Simulation Training and Instrumentation (PEO STRI)** (Orlando, FL) for its Electronic Warfare Test (EWT) Hardware in-the Loop Test Enhancements (HWILTE) Prototype Project (Solicitation TReXII-23-01). The RFS is available at the TReX II www.trexii.org. The contracting point of contact is Matthew Beatty, (407) 208-3329, e-mail matthew.c.beatty8.civ@army.mil.

The Naval Research Laboratory (NRL) (Washington, DC) has announced plans to award a sole-source contract to **Verus Research** (Albuquerque, NM) to design and build a Dual X-Band High-Power Microwave Test and Evaluation System.

The Defense Advanced Research Projects Agency (DARPA) awarded three contracts under its Multi-Spectral Sensing Technologies R&D (MuSTeR) program. **Radial Research and Development Ltd.** (Fairborn, OH) received a $5.2 million award to "investigate evolutionary and revolutionary improvements to RF sensing systems for situational awareness and targeting applications. The contractor shall seek to prove out new concepts and approaches for improving the autonomous operation of software defined radios (SDRs) and associated software systems." **Defense Engineering Corp.** (Beavercreek, OH) won a $10 million contract for AFRL's "Sensors for Unrivaled Multi-Function Missions with Integrated Technologies" effort under the MuSTeR umbrella program. The company will perform R&D for "antennas, front-end and back-end hardware for multifunction radio frequency systems and evaluate the performance of innovative antenna concepts identified by Air Force Research Laboratory with traditional and non-traditional experimentation and measurement techniques capable of comparing the innovative antennas with equivalent reference antennas." Finally, **Georgia Tech Research Institute** (Atlanta, GA) received a $22.7 million contract for AFRL's Autonomous Technology Exploratory Research effort under MuSTeR.

Naval Air Systems Command (Patuxent River, MD) awarded a $10.3 million contract modification to **Raytheon Intelligence and Space Systems** (El Segundo, CA) to conduct a "mid-band expansion trade study" in support of Next Generation Jammer program for the US Navy and the Royal Australian Air Force. NAVAIR is looking at the possibility of extending the upper frequency range of the ALQ-249 NGJ mid-band pod to cover the requirement for its NGJ High-Band (Increment 3) program. If feasible, the effort could replace the need for developing a dedicated NGJ High-Band pod for the EA-18G.

Northrop Grumman has received a $26.4 million contract option to provide electronic protection features in its Multi-Function Active Sensor (MFAS) radar on the MQ-4C Triton UAS. According to the DOD award announcement, the company will establish the "hardware baseline for the technical refresh for the MQ-4C Triton MFAS Radar Signal Processor (RSP) on the AN/ZPY-3(v) 2 Mercury Power Stream 7000 Signal Processor ...in order to implement advanced capabilities developed by the Office of Naval Research."

CAES (Lansdale, PA) said it has received a pair of contracts from **Lockheed Martin Rotary and Mission Systems** (Syracuse, NY) to support its Navy EW programs. In December, Lockheed awarded a $24.6 million subcontract to CAES to supply additional Antenna Array Panel Assemblies (AAPA) and spares for the US Navy's AN/SLQ-32(V)6 Surface Electronic Warfare Improvement Program (SEWIP) Block 2 ESM systems. CAES also received a follow-on contract from Lockheed Martin for an undisclosed amount to provide phased array antennas in support the Navy's AN/SLQ-248 Advanced Offboard EW (AOEW) system. This order covers four Low-Rate Initial Production Lot (LRIP) 2 systems. In early 2022, Lockheed tapped CAES to deliver phased arrays for four systems under LRIP 1.

EC-37B Compass Call – New Compass Call Plat

By John Haystead

After over 40 years of service on EC-130H aircraft, the Air Force is upgrading and transitioning (cross-decking) its "Compass Call" airborne tactical electronic attack weapon system onto a new Gulfstream G550 Conformal Airborne Early Warning (CAEW) platform – the EC-37B Compass Call. To perform its Counter-Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance Targeting (Counter-C5ISRT) mission, Compass Call disrupts enemy command and control communications, radars and navigation systems to restrict their battlespace coordination and to suppress their air defenses. The advanced technology being developed for the next-generation Compass Call system, combined with its integration on the new aircraft, is intended to provide increased performance at faster speeds, longer ranges and higher altitudes. Ultimately, the Air Force plans to acquire 10 EC-37B Compass Call aircraft to replace its fleet of 14 EC-130H aircraft.

BAE Systems (Nashua, New Hampshire) is the mission system prime contractor for the EC-37B Compass Call, serving as the system engineering, integration and testing lead. Says Jared Belinsky, Product Line Director of the Countermeasure & Electromagnetic Attack (CEMA) solutions at BAE, "In addition to our role as the prime mission equipment provider to the Air Force, we also serve as the integrated logistics support lead for the entire EC-37B platform. The transition to the EC-37B is an exciting cross-decking activity that will significantly improve the mission effectiveness of the system, allowing us to continue to disrupt adversary command and control communications capabilities."

Tom Huerter, Business Development Director for BAE's CEMA business area, adds that, from his perspective and background as an Electronic Countermeasures Officer flying EA-6Bs, "the operational capabilities that this platform will bring to the fight are truly transformative. It brings Compass Call from the legacy plat-

The 55th ECG began retiring its EC-130H fleet in 2020. Above, Compass Call aircraft conduct an elephant walk during a show-of-force readiness exercise at Davis-Monthan Air Force Base in June 2021.
PHOTO BY AIRMAN WILLIAM TURNBULL

US Air Force Prepares
form and System

The EC-37B is based on the Gulfstream G550 business jet. BAE SYSTEMS

form that was designed and built for the Cold War fight and puts it into a modern aircraft with an updated system capable of dealing with the threat environment of today, as well as that of the future. The challenge will only continue to grow as we fight to maintain spectrum dominance, but this platform will provide both a major new capability, as well as be highly complementary with the other EA platforms that will be in the DOD inventory, such as the EA-18G Growler. In total, it will have a dominating effect on the battlespace."

BAE is working together with L3Harris (Melbourne, Florida) the prime platform integration contractor responsible for installing all of the mission electronics, and apertures onto the EC-37B aircraft and delivering it to the Air Force. As of October 2021, L3Harris had carried out roughly a dozen test flights of the first EC-37B Compass Call aircraft at the Gulfstream facility in Savannah, Georgia. These initial tests were to certify the structural changes L3Harris had made to the aircraft to accommodate the full complement of mission equipment it will carry. They included high-altitude (around 40,000 feet) flight and other tests to make sure it could operate effectively in low temperature environments.

MISSION SYSTEM

The Compass Call mission system upgrade effort involves development and implementation of a number of incremental "baseline" capabilities, largely beginning in April of 2021, with BAE Systems' successful flight testing of its Small Adaptive Bank of Electronic Resources (SABER) technology. The SABER system will transition the Compass Call's electromagnetic warfare system from a hardware-based to a software-based capability. Built on a suite of software-defined radios using an open system architecture, SABER technology will ultimately facilitate the major software upgrade planned as part of the "Baseline 4" iteration, which is the version being developed for fielding on the next-generation EC-37B Compass Call aircraft.

Says Belinsky, with regard to the overall development and integration of SABER capabilities for the Compass Call mission, BAE wanted to both achieve risk reduction for the EC-37B Baseline 4, but also be able to provide those capabilities to the current EC-130H platform. "Warfighters have a need for those capabilities today, so SABER was our starting point to bring that technology into the program," he said. As such, there is a Baseline 3 phase of Compass Call that will provide additional interim electronic warfare capabilities for the current EC-130H platform. Baseline 3 is the first step in transitioning the program from the EC-130H to the EC-37B.

As part of the Baseline 3 work, 11 test flights of the SABER system were flown on EC-130H Compass Call aircraft at Davis Monthan AFB, Arizona. Says Belinksy, "As our first foray into an open-system hardware and software capability for Compass Call, SABER en-

Members from the 55th Electronic Combat Group pose in front of their EC-130H Compass Call aircraft during Exercise DEFENDER at Zadar, Croatia, April 2021. USAF

ables the rapid insertion and integration of new technology through software updates instead of hardware reconfiguration. They could be BAE-developed or come from 3rd-party providers, whatever the best available capability is. In May of last year, the Air Force and BAE successfully flight tested three new third-party applications. BAE integrated the applications using its non-proprietary SABER software development kit. The successful flight test will be followed by initial fielding of the capability on the EC-130H.

As explained by Belinsky, the SABER architecture effort was a risk-reduction and proof-of-concept for new capabilities that they're now incorporating into the EC-37B Baseline 4 architecture. "Using the architecture as a concept that we developed through SABER for the EC-130H, we're now bringing that architecture forward onto Baseline 4 and the EC-37B in such a way that it extends and provides even more capability than what we were able to post on the EC-130H. We're really bringing it forward in a much more extensive way, pushing the technology and capability forward and fully exploiting the advantages provided by open architectures in the E3-37B Baseline 4 system."

In conjunction with this work, in September of last year, BAE delivered "key components" for the US Air Force's first EC-37B Compass Call aircraft. The components represent the last hardware upgrades planned for Compass Call prior to moving to the much more software-oriented capabilities of the Baseline 4 system. Says Belinsky, "So we've now delivered all the electronics, apertures and all of the other equipment that enables the electromagnetic attack mission set to our customer so that it can begin its developmental and operational tests." The delivery will also support the Air Force's developmental and operational flight testing of the Baseline 3 configuration of Compass Call on EC-130H aircraft expected to begin in January 2023. "So," says Belinsky, "as of today for the EC-37B Baseline 3, we've delivered our prime mission equipment to aircraft number one to L3 Harris in Waco, Texas, so that they can incorporate it onto that first aircraft and deliver it to the Air Force, which is a process they're currently undergoing. Once they've done this, the Air Force will begin developmental and operational test of the new EC-37B which is planned for 2023."

Summing up the overall effort, Huerter explains that, "The current version of Compass Call that is on the EC-130Hs today is what we call the mid-Baseline 2. The interim Baseline 3 Compass Call architecture version is for the first five EC-37B aircraft. The second five aircraft will be the Baseline 4 system architecture capability. So, we're taking the opportunity to prove out the SABER technology and field it now on the EC-130H (as what we call a clip-in) which has been the way that added capability has been brought to that platform for forty years. SABER is foundational as we redesign the software and some of the hardware architecture for Baseline 4 but, though SABER is a great new capability and significant move forward, it's still just a kind of baby step to what becomes a broader capability and truly a rapid insertion environment with Baseline 4."

GETTING SMALL

Clearly, one of the biggest challenges in cross-decking Compass Call from the

EC-130H to the much smaller EC-37B platform was reducing the size of the system and its on-aircraft support requirements. Given that the current platform is itself packed full of equipment, this was a substantial undertaking. But, says Belinsky, "The new, modern technology available to us today is what makes this possible. As we work towards and develop an open-system hardware and software solution for the EC-37B, we're able to reduce the size, weight and power (SWAP) requirements of the prime mission equipment." In addition, he notes that the current cooling requirement for the system electronics is also dramatically reduced with modern technology. "For the amount of processing power the system has, it doesn't require nearly the amount of cooling, and we can take advantage of that as well."

Still, says Huerter, "Our engineers overcame some great challenges in taking about 18-19,000 lbs. of mission equipment and squeezing it down to about 8,000 lbs." Despite its smaller size compared with the EC-130H, Huerter points out that the Gulfstream G-550 conformal AEW aircraft was actually ideal for the cross-deck effort. "First of all, the weight capacity gave us more than what we needed, and the power and cooling available on the platform was perfect for what we needed. And, especially those large array panels on the 'cheek' gave us all the area that we needed to incorporate the arrays. It's really an ideal fit for us."

55th ELECTRONIC COMBAT GROUP

As with the Air Force's EC-130H Compass Call aircraft, the new EC-37B-hosted system will be flown and operated by the 55th Electronic Combat Group (ECG) at Davis-Monthan, AFB. Under

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the command of Col Melanie Olson, the 55th ECG is responsible for the five squadrons that provide combat ready EC-130H Compass Call aircraft, aircrew and maintainers for worldwide expeditionary deployments in support of unified combatant commanders.

Huerter says they are working very closely with the 55th ECG on the program. "The partnership between industry, Government, the Air Force and 'Big Safari' [program office] and the 55th ECG is more than I've seen before. As we provide the contract logistics support on the maintenance side, we're also developing the crew mission system simulator, which we're building for outfitting at Davis-Monthan, and helping them put together their training syllabi both there and with the Air Force Weapons School at Nellis AFB, Nevada, to help with the transition of their aircrew and maintenance teams over to the new platform."

In addition, Huerter says they're spending considerable time and effort to not only reduce the operator workload but significantly enhance mission effectiveness. "By optimizing the operator experience through various automated decision aids and improved Human to Machine Interface (HMI) tools, the EC-37B EWOs will have better situational awareness and more real time targeting capability than their EC-130H predecessors."

KEEPING PACE WITH THE THREAT

As emphasized by BAE's Belinski, "To meet the mission requirements of Compass Call, we've needed to be highly focused on, and up to date on our adversaries' command, control and communications systems as well as their air defense radars, data links and navigation systems. And so, we've strived throughout the life of this program, together with the Air Force, to keep pace with the emerging threats and to evolve the system along the way to continue to be relevant into the future."

In that regard, Huerter references the presentation by Chris O'Donnell, Deputy Assistant Secretary of Defense, Platform and Weapon Portfolio Management, at the 2022 AOC National Symposium, where he emphasized the importance of the Counter-C5ISRT mission and meeting its requirements. "Our adversaries are not waiting for us," O'Donnell told the audience. "Across all domains, they're constantly seeking to out-compete and out-innovate us. Considering our strategic competitors have advanced layered and integrated sensing and electromagnetic warfare capabilities, now more than ever, the US needs to maintain superiority across the spectrum."

As part of its work aimed at maintaining spectrum superiority, O'Donnell pointed to the DOD's creation of Integrated Acquisition Portfolio Reviews (IPRs) to strengthen the synchronization of warfighting concepts, requirements, technologies and program execution across DOD – one of which was the Counter-C5ISRT IPR. "With the completion of the Counter-C5ISRT IPR, we were able to show the Department what EW can do in order to address one of the most critical problems we currently face in a peer-to-peer competition."

O'Donnell further called out the need for "...targeted investments and innovative and novel capabilities, such as cognitive EW to counter advanced and non-traditional threats to break an adversary's kill web, with an emphasis on Counter-C5ISRT, or left-of-launch capabilities." He added, "A number of enabling technologies will allow us to keep pace with the evolving threat and to operate in a complex electromagnetic environment." And, in that regard, says Huerter, "That is the sweet spot for the E3-37B Compass Call, and that is what we're delivering to the modern battle space."

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Electromagnetic Protection (Part 10)

Pulse Doppler Radars *Cont'd.*

By Dave Adamy

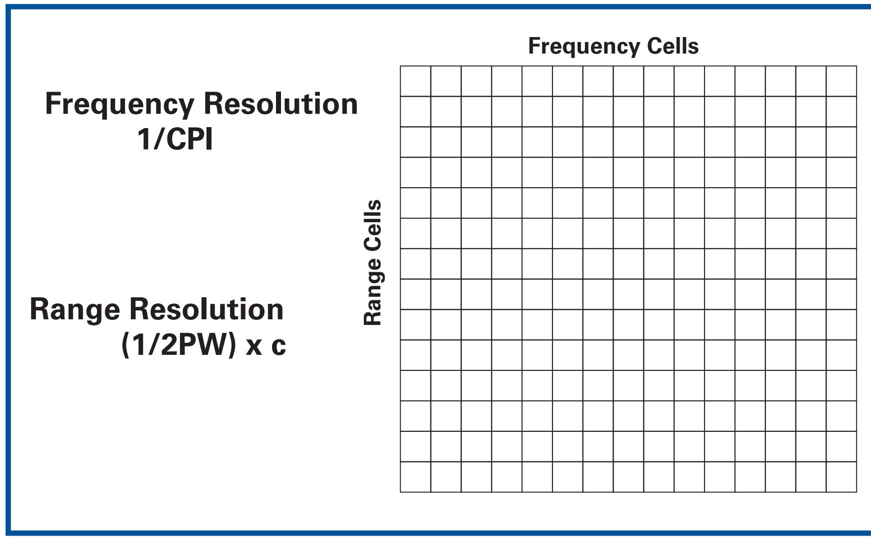

Fig. 1: *The processor of a pulse Doppler radar has a matrix of frequency vs. range for every return. The frequency cells show the received frequency of each return pulse. The range cells show the time of arrival of each return pulse.*

Pulse Doppler (PD) radars provide several types of electronic protection including: coherence, chaff rejection and anti-range gate pull-off (RGPO). These features are enabled by the fact that PD radars are coherent and that they can process multiple separate target returns.

A PD radar processor has a frequency vs. range matrix as shown in Figure 1. The frequency cells show the received frequency of each pulse, as determined by a bank of filters. The bandwidth of each filter is the inverse of the coherent processing interval, which can be as long as the time a signal is within the beam of a scanning antenna.

The range cells show the time of arrival of each returned pulse. The depth of each range cell is the radar range resolution cell. The formula to calculate this is:

(1/2 PW) c

Where: *PW* is the pulse width and
c is the speed of light

Note that multiple returns can be analyzed in this same matrix. For example, a radar's return and the received signal from a jammer will be compared.

ANALYSIS OF MULTIPLE SIGNAL RETURNS

The analysis matrix allows the PD radar to compare multiple return signals, which allows it to detect jamming signals as shown in the following figures.

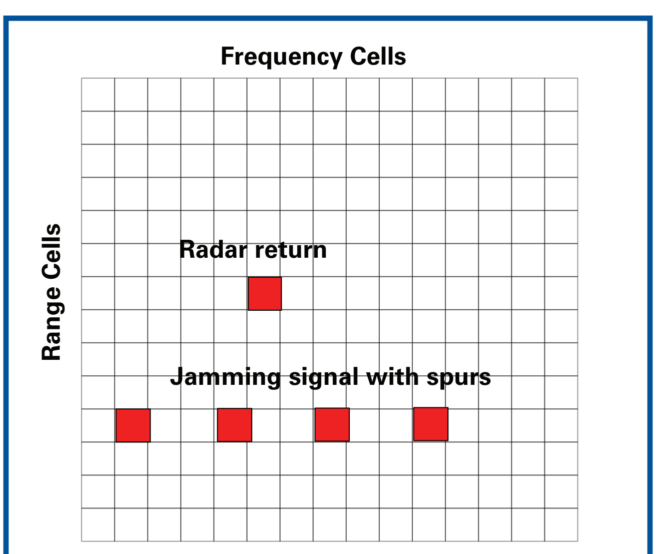

Fig. 2: *Because jammer amplifiers can generate spurious signals at higher frequencies than the intended jamming, these spurious signals will appear in the PD processing matrix, allowing the radar to detect and discriminate against the jamming signal.*

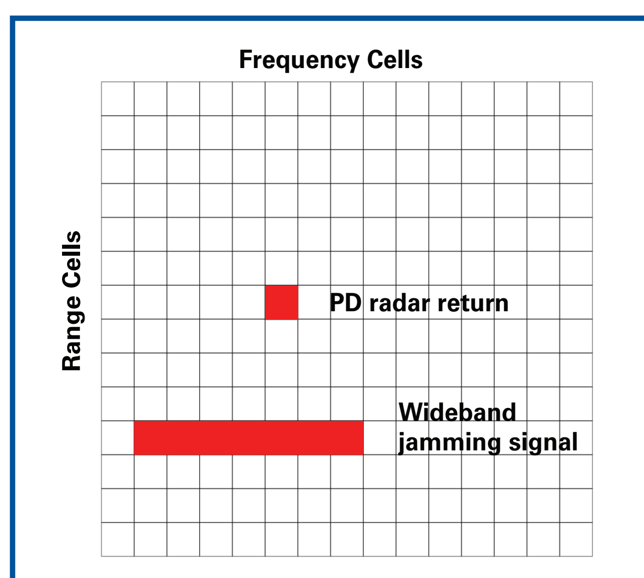

Fig. 3: *Broadband jamming places energy in multiple frequency cells. It can therefore be distinguished from the pulse Doppler radar return.*

A radar jammer typically employs a high-power transmitter which may generate spurious signals at higher frequencies as shown in Figure 2. As illustrated in the figure, the PD radar return signal will only occupy a single matrix cell. Thus, the stronger (saturated) jamming signal is identified across multiple cells.

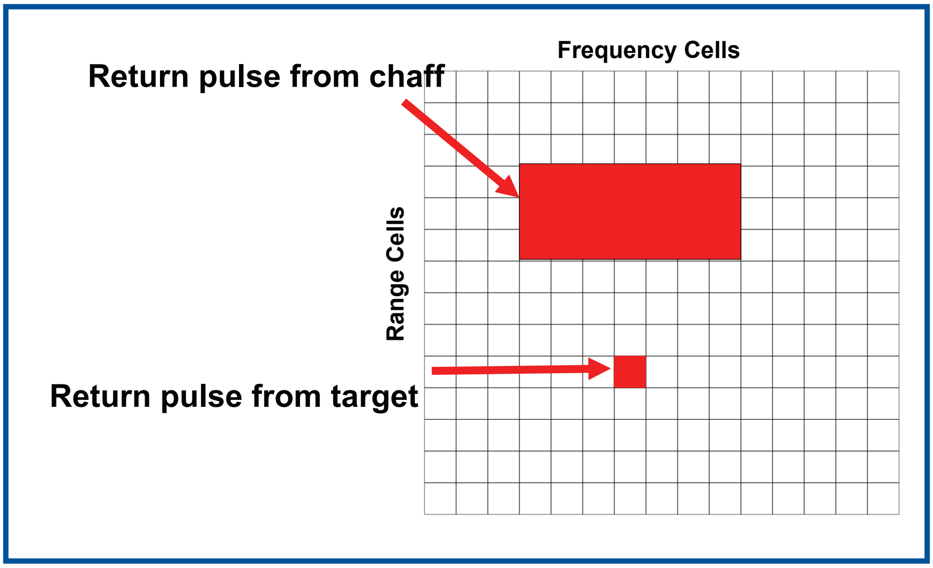

Fig. 4: *The radar return from chaff is moving around in both range and frequency because of the movement of the chaff dipoles in the cloud.*

COHERENT PULSE DOPPLER RETURNS

In a coherent radar, each pulse is a sample of the same signal. Thus, a CW signal in phase with the last return will be in phase with the new return. This allows the signal to be analyzed over multiple pulses. PD radars typically have longer pulses than non-coherent radars or jammers. This allows the frequency of the PD radar to be determined within a narrower processing bandwidth, within one pulse and over all of the pulses in the coherent processing interval. The sensitivity of the receiver is thus improved by the reduced bandwidth factor. For example, if the pulse is 10 microseconds long vs 1 microsecond long, the characteristic bandwidth is 100 kHz vs 1 MHz. The narrower bandwidth of the longer pulse improves the signal-to-noise ratio for that signal.

Another factor is coherence. If a jammer is not coherent, the signal-to-noise ratio is 3 dB worse than if the signal were coherent. This, added to the effect of the bandwidth narrowing, will give the radar return a significant advantage over the jamming signal, reducing the effective jamming-to-signal ratio (J/S) against a noncoherent jammer.

BROAD FREQUENCY JAMMING

In a PD radar, the return pulse and a jamming signal are evaluated against the matrix shown in Figure 3. Each radar return pulse will be contained in a single frequency/time cell. However, a broadband jammer signal will be received over multiple frequency cells. This means that the radar can detect the presence of jamming and can track the intended target.

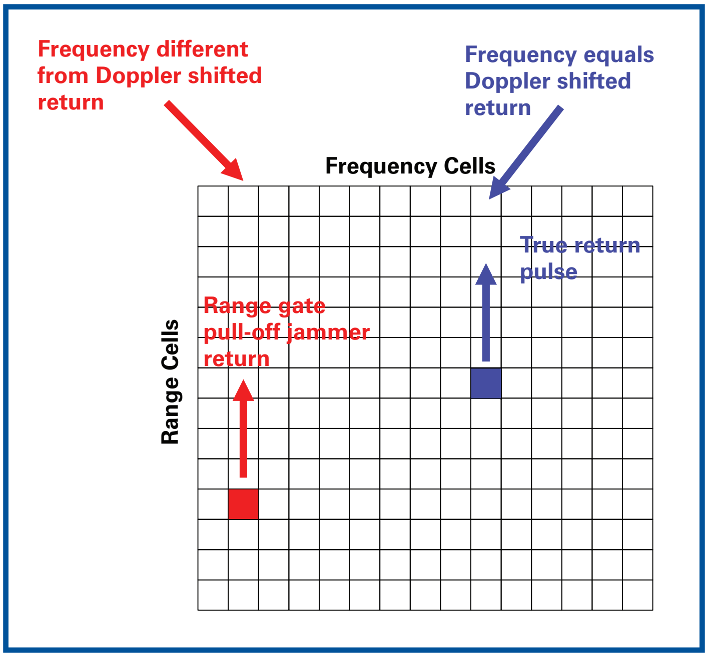

Fig. 5: *A radar calculates the range to a target by the time of arrival of the return pulse. The PD radar measures the actual return frequency, which changes by the actual rate of change of range. Since the jammer frequency is different from the Doppler shifted actual radar return, the PD radar can reject the jamming signal.*

CHAFF

Because the chaff dipoles churn in the chaff cloud, the radar return from chaff moves around in time and frequency. As shown in Figure 4, the chaff return thus occupies many matrix cells, while the PD doppler return occupies only one cell.

RGPO

A range gate pull-off (RGPO) jammer generates a strong pulse that is delayed from the radar return pulse. Each pulse is delayed a little more than the previous pulse. Since the radar determines the range to a target by the time it takes a return pulse to make the round trip to the target and back, the radar assumes that the target is moving farther away. Thus, the radar cannot accurately track the target in range. In Figure 5, the "return" (red cells) shows the jamming signal display. The blue return on the display places the return signal in the correct frequency cell as measured by the receiver bank. Thus, the true return pulse is shown in the correct range cell. By rejecting the jamming signal, the radar can accurately track its target in range.

WHAT'S NEXT

Next month, we will continue our discussion of the electronic protection advantages provide by pulse Doppler radars. Dave Adamy can be reached at dave@lynxpub.

NATIONAL ELECTRONICS MUSEUM TO MOVE, HOLD ESTATE SALE

The National Electronics Museum is moving to a new location in March.

This a considerable undertaking and they are looking for volunteer help with the move as well as donations to help with general expenses. They will be holding an estate sale in February to reduce the number of things they'll will need to take to the new location.

The in-person sale will include old electronics and radio equipment, memorabilia, books and furniture.

For more information on the date and details of the move please visit the website at www.nationalelectronicsmuseum.org and join their e-newsletter at tinyurl.com/352fpued. To mail in donations, please send to:

National Electronics Museum
P.O. Box 1693, MS 4015
Baltimore MD 21203

2022 FISHER HOUSE FOUNDATION GINGERBREAD BALL

By AOC Vice President Myles P. Murphy

As each year comes to an end and the excitement of the holiday season approaches, the Association of the United States Army (AUSA) Monmouth Chapter, the Association of Old Crows (AOC) Garden State Chapter (GSC), the Armed Forces Communications and Electronics Association Greater Monmouth Chapter, the Army Aviation Association of America (AAAA) Jersey Chapter and the New Jersey Bakers Board of Trade host the annual Gingerbread Ball to benefit the Fisher House Foundation, which they have planned all year. For over a decade, these amazing organizations and the selfless individuals that lead them have assembled and planned an incredibly noble and successful event each year to benefit the Fisher House Foundation. To date, they have raised over $1 million. This year's Gingerbread Ball was held at the beautiful Ocean Place Resort & Spa in Long Branch, New Jersey on Dec. 3.

The Fisher House Foundation builds Fisher Houses, which are a home away from home for families of patients receiving medical care at military and veterans' medical centers. Typically, the homes are located within walking distance of the facilities. The program to provide housing began in 1990 and has provided more than 11.5 million days of lodging to more than 430,000 families. There are currently 93 Fisher Houses located on 25 military installations and 36 Veterans Administration centers with more planned. A Fisher House ranges in size from 5,000- to 16,800-square-feet and provides eight to 21 suites. Each house can accommodate 16 to 42 family members.

This year's Gingerbread Ball featured a cocktail hour, silent auction, numerous raffles, AOC awards, an AOC scholarship presentation, a delicious dinner, speaker retired Marine Staff Sgt. Johnny "Joey" Jones, music by the Jazz Lobsters, dancing and the Gingerbread Ball check presentation.

Staff Sgt. Johnny "Joey" Jones provided a motivating speech about his life to date and what he has learned along the way. Staff Sgt. Jones is currently a contributor to FOX News Media. He also serves as a fill-in host for the "Fox and Friends" franchise, "The Five," "The Big Saturday Show" and "The Big Sunday Show." He also provides military analysis across all FOX News Media platforms. He was raised in Dalton, Georgia, and he subsequently enlisted in the United States Marine Corps after high school. Staff Sgt. Jones shared his experiences in Iraq and Afghanistan. He spoke about his role as an Explosive Ordnance Disposal (EOD/Bomb) technician in the Helmand Province of Afghanistan and the 2010 IED related incident that resulted in the loss of both of his legs above the knee and severe damage to his right forearm and both wrists. He spoke to the audience about helping others, making the most of their talents and the importance of counting blessings.

At the Gingerbread Ball, the AOC was honored to present a 2022 AOC Garden State Chapter Distinguished Service Award, a 2022 AOC Garden State Chapter Outstanding Achievement Award and the 2022 AOC Cyber Corps Warrant Officer Scholarship. AOC President retired Navy Captain Brian Hinkley, AOC Vice President, retired Air Force Colonel Myles Murphy and AOC Garden State Chapter President Miss Nicole Zaretski presented the awards. Miss Nicole Zaretski awarded Mr. Thomas Leshik from L3Harris with the 2022 AOC GSC Distinguished Service Award. Mr. Leshik has over 30 years of service with the Army, Special Forces, and Navy's electronic warfare communities. He a Technical Fellow for L3Harris and is considered the organization's Chief Subject Matter Expert for all Power Supply and High-Power Transmitter designs. Tom is one of the most knowledgeable people in Industry on the power supply and transmit capability of the ALQ-211, ALQ-214, and CAT Nulka systems. Over the years Tom has guided multiple designs through Design Verification Test, Environmental Qualification, System Test and fielding.

Miss Zaretski also awarded Mr. Martin Apa from L3Harris with the 2022 AOC GSC Outstanding Achievement Award. Marty has 37 years of service to the warfighting community, with 25 of them to the electronic warfare community. He also holds five US patents. Marty was one of the founding engineers of L3Harris' successful Advanced Systems business, which serves unique defense customers. In addition, he served for eight years as the Chief Engineer of that business. He was also instrumental in introducing Small Form Factor EW technology to both industry and the warfighting community. Marty's work resulted in one of the first successful flight test demonstrations of an Electronic Attack payload on a small UAS.

AOC President Brian Hinkley and AOC Vice President Myles Murphy awarded the winner of the 2022 Cyber Corps Warrant Officer Scholarship to Chief Warrant Officer 3 (CW3) Douglas B. Price. The Scholarship was established by the Laurie Buckhout Foundation in August 2020. The Cyber Corps Warrant Officers Scholarship Foundation is a non-profit organization dedicated to providing support to US Army Cyber Corps (i.e., 170A, 170B, and 170D) warrant officers by providing them with the opportunity to apply for financial assistance in gaining various levels of formal higher education. To qualify, you must be a CW3 or under, demonstrate excellent promotion potential, be in the Cyber Warfare or EW workforce (i.e., 170A, 170B, and 170D), have a minimum of two years left on active duty and be eligible and accepted to attend a Master's or PhD program. This year's winner, Chief Warrant Officer Price, is an Electromagnetic Warfare (EW) Research Scientist within the Cyberspace Operations Research Element (CORE) under the Army Cyber Institute (ACI) at West Point, where he is responsible for conducting basic and applied research on technical topics to advance Army's body of knowledge and improve EW capabilities in support of key stakeholders within DoD. CW3 Price is scheduled to complete Warrant Officer Intermediate Level Education in the summer of 2023. CW3 Price is a graduate of Western Governors University and holds a Bachelor of Science in Cybersecurity and Information Assurance. CW3 Price's personal decorations include the Bronze Star Medal (BSM) with oak leaf cluster, Meritorious Service Medal (MSM) with oak leaf cluster, the Army Commendation Medal (ARCOM) with four oak leaf clusters and the Army Achievement Medal with four oak leaf clusters. CW3 Price is pursuing a Master of Science in Cybersecurity and Information Assurance from Western Governors University.

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D9816	8-Way	330-530	10,000	50,000	0.25	1.30:1	3 1/8” EIA, N-Female
D8454	8-Way	370-450	10,000	50,000	0.25	1.30:1	3 1/8” EIA, N-Female
D5320	12-Way	470-860	500	5,000	0.30	1.30:1	All N-Female
D10119	4-Way	700-4200	2,000	15,000	0.30	1.35:1	13-30 DIN-Female, N-F
D10603	32-Way	900-925	50,000	150,000	0.15	1.25:1	WR975, 7/16-Female
D10795	32-Way	900-930	25,000	150,000	0.25	1.20:1	WR975, 4.3-10-F
D9710	8-Way	1000-2500	2,000	10,000	0.30	1.40:1	1 5/8” EIA, N-Female
D8182	5-Way	1175-1375	1,500	25,000	0.40	1.35:1	1 5/8” EIA, N-Female
D6857	32-Way	1200-1400	4,000	16,000	0.50	1.35:1	1 5/8” EIA, N-Female
D11896	4-Way	2000-2120	4,000	40,000	0.25	1.40:1	WR430, 7/16-Female
D11828	4-Way	2400-2500	3,000	25,000	0.20	1.25:1	WR340, 7/16-Female
D10851	8-Way	2400-2500	8,000	50,000	0.20	1.25:1	WR340, 7/16-Female
D11433	16-Way	2700-3500	2,000	20,000	0.30	1.35:1	WR284, N-Female
D11815	16-Way	2700-3500	6,000	40,000	0.30	1.35:1	WR284, N-Female
D12101	6-Way	2750-3750	2,000	20,000	0.35	1.40:1	WR284, N-Female
D9582	16-Way	3100-3500	2,000	16,000	0.25	1.50:1	WR284, N-Female
D12102	6-Way	5100-6000	850	4,500	0.35	1.35:1	WR159, N-Female
D12484	6-Way	8200-8600	600	700	0.35	1.25:1	WR112, SMA-Female
D12485	6-Way	9000-11,000	500	700	0.40	1.35:1	WR90, SMA-Female

Specifications subject to change without notice.

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