

# JED

Journal of Electromagnetic Dominance



## 2022 EW/SIGINT Resource Guide

**US Army Brings EMSO to the Air Defense Fight**  
**News: USAF's "Monster" Program for AI/ML**  
**EW 101: 5G Communications – Testing and Training**



# HENSOLDT

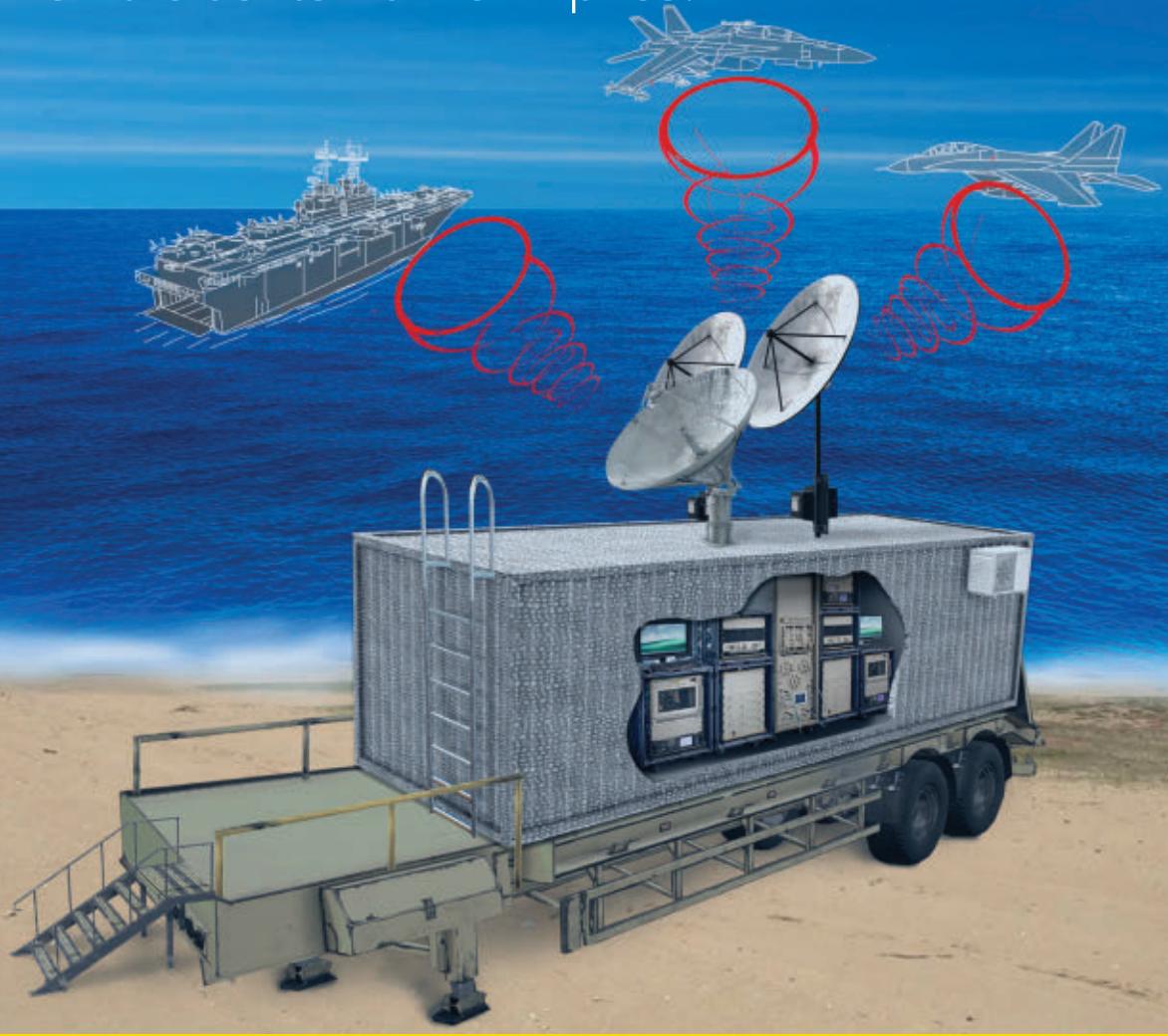
## Knowledge is Power



### Proven solutions in Strategic and Tactical SIGINT

- Multi Domain Integration and real time data exchange enables a combined electronic order of battle.
- Exceptional detection, identification and tracking by digital frontend receiver Kalætron® Integral.
- Flexible and operationally proven Spectrum Battle Management Suite (SBMS) software.

# Ultra CHAMELEON, as flexible as its name implies.



The complete solution for radar target generation and ECM signal generation.

Using a multiple channel, multi-DRFM architecture, CHAMELEON can simultaneously generate complex radar targets together with jamming signals in a unique and highly-programmable way.

The simulator features 3D radar target modelling with true multipoint scatterers, clutter, and ECM signal generation.

The CHAMELEON can be delivered in a variety of form factors, as an indoor rack-mounted system or as a complete self-enclosed system.

For more information about Ultra Specialist RF solutions, visit [ultra.group/intelligence-communications](http://ultra.group/intelligence-communications).



## ULTRA

Ultra Intelligence & Communications  
[sales@ultra-us-gbs.com](mailto:sales@ultra-us-gbs.com) | [www.ultra.group](http://www.ultra.group)

© 2021 Ultra Electronics Ltd. All rights reserved.

# JED

# CONTENTS

Journal of Electromagnetic Dominance

October 2021 • Volume 44, Issue 10

## 18 Features

### US Army Brings EMSO to the Air Defense Fight

By John Haystead



The US Army is modernizing the entire sensor-to-shooter network of its air defense capabilities. In this month's JED, we look at the CJADC2 initiative and its impact on modernizing the C2 framework for air defense systems.

US ARMY PHOTO

## 24 2022 EW/SIGINT Resource Guide

By JED Staff

## 14 News

- US AIR FORCE TO DEVELOP AI/ML EW TECHNOLOGIES UNDER PROJECT KAIJU
- EMSO RESEARCH TOPICS IN DOD SMALL BUSINESS SOLICITATION
- FLEXDAR DISTRIBUTED DIGITAL RADAR TESTBED STARTS TRIALS

## 58 AOC Europe 2021



A US Marine Corps UH-1Y Venom attached to Marine Light Attack Helicopter Squadron 367 carries an ALQ-231(V)3 Intrepid Tiger II electronic attack pod during exercises at Marine Corps Training Area Bellows (Oahu, HI) in July. Since achieving initial operational capability in 2015, the Intrepid Tiger II system continues to evolve. In June, Naval Air Systems Command conducted flight tests of an internally mounted version, ALQ-231-(V)4, on an MV-22 Osprey.

LCPL SAMANTHA SANCHEZ, USMC

## Departments

- 6 The View from Here
- 8 Conferences Calendar
- 10 Courses Calendar
- 12 President's Message
- 55 EW 101
- 64 AOC News
- 66 AOC Industry and Institute/University Members
- 67 Index of Advertisers
- 70 JED QuickLook

COVER PHOTO COURTESY OF US NAVY

# A<sup>2</sup>PATS<sup>®</sup> REACHES NEW HEIGHTS



CHOSEN FOR  
F-35 BLOCK IV



MULTI-DOMAIN

AIR

LAND

SEA

SPACE

MULTI-SPECTRAL

SIGINT

ELINT

COMINT

EO/IR

World's leading Signal Intelligence (SIGINT), Communication Intelligence (COMINT) and combined EO/IR environment simulator.

- >> Automated AI/ML training set generation.
- >> Closed-Loop reactive simulation.
- >> Two-Way Cognitive EW "Sparring".

Discover how our portfolio of test, training & simulation tools support all-domain operations

AOC International Symposium & Convention  
Nov 30-Dec 2, 2021 | Booth #455

AOC Europe 2021  
Oct 11-13, 2021 | Exhibit Hall, Booth D2

**TEXTRON** Systems

► PUSHING PAST POSSIBLE

[TextronSystems.com](http://TextronSystems.com)



© 2021 Textron Systems Corporation.

(800) 655-2616 | [electronicsystems@textronsystems.com](mailto:electronicsystems@textronsystems.com)

# TAKING MEASURE

**This month's JED** features our annual Electronic Warfare (EW) and Signals Intelligence (SIGINT) Resource Guide. *JED* started publishing a Resource Guide in the 1980s, and the industry it catalogs has seen lots of changes since then. In the 1990s, when I arrived at *JED*, the defense electronics sector was undergoing post-Cold-War consolidation, especially among the systems developers. At the same time, the DOD was reducing its workforce, which led to tremendous growth in companies that provide engineering services and program support, including EW and SIGINT program offices. With this industry structure in place, the DOD has steadily increased its EMS-related spending over the past 15 years. The result is a defense electronics industry with hundreds of new companies – mostly small firms – established over the past 15 years.

Working on the Resource Guide every year gives me an opportunity to take a rough measure of our industry. The growing number of EW and SIGINT companies suggests the top firms are not taking all of the money and opportunities. Using the analogy of a rain forest, while there are several large trees that appear to be grabbing most of the available sunlight (i.e., government funding) there is also plenty of opportunity for the smaller plants to thrive on the forest floor. So, one way of looking at the growing number of companies in the Resource Guide over the past 15 years is that it reflects a very healthy industry. Investors certainly see this, because they keep funding new companies.

While the EW and SIGINT industry is a very mature one – dating back to the 1940s – the Resource Guide shows that it also has pockets of growth that are very young and dynamic. For example, the number of counter-UAS companies grew about 30%-40% every year from 2015-2020. In a sign that the counter-UAS market is maturing (though by no means shrinking in terms of spending) the Resource Guide shows that several companies have either shut down or are no longer serving this market. At the same time, however, other markets are growing. For example, several software companies are popping up to meet the demand for Artificial Intelligence-enabled EW and SIGINT systems. The EW and SIGINT market continues to be very dynamic.

I hope you will take time to browse the Resource Guide – maybe find new suppliers for your program or potential customers for your company (or perhaps discover a few new competitors). We do our best to maintain the Resource Guide's accuracy and make it useful for you, and we also offer an online version of the Guide at [www.crows.org](http://www.crows.org). That said, I apologize ahead of time for any omissions or errors. We are tracking a large and rapidly growing EW and SIGINT industry that offers thousands of products and services. It's a challenge. Please send any corrections or additions to us at [JED@naylor.com](mailto:JED@naylor.com). We will include the updates in our next Resource Guide. In the meantime, please remember that we list all companies for free. So, please do not hesitate to reach out to us if we have not included your company. Thank you, and enjoy your October *JED*. – *J. Knowles*

## EDITORIAL STAFF

**Editor:** John Knowles  
**Publisher:** John Bacon  
**Senior Editor:** John Haystead  
**Managing Editors:** Monica Elliot and Aaron Brand  
**Technical Editor:** Barry Manz  
**Contributing Writers:**  
Dave Adamy, Luca Peruzzi, Richard Scott,  
Dr. David Stoudt, and Andrew White  
**Proofreaders:** Ken Janssens, Shauna Keedian  
**Sales Manager:** Kira Krewson  
**Sales Administrator:** Amanda Glass

## EDITORIAL ADVISORY BOARD

**Mr. Petter Bedoire**  
Chief Technology Officer, Saab  
**Dr. William Conley**  
Chief Technology Officer, Mercury Systems  
**COL Kevin Chaney**  
Program Manager, Aircraft Survivability Equipment,  
PEO IEW&S, US Army  
**Mr. David Harrold**  
VP & GM, Countermeasures and Electromagnetic  
Attack Systems, BAE Systems  
**Mr. Rick Lu**  
President and CEO, Spectranetix Inc.  
**Mr. Steve Mensh**  
Senior Vice President and General Manager,  
Textron Systems Electronic Systems  
**Mr. Edgar Maimon**  
General Manager, Elbit Systems EW and SIGINT  
– Elsira  
**Mr. Marvin Potts**  
Technical Director, System Technology Office  
Air Force Research Lab Sensors Div.  
**Mr. Steve Tourangeau**  
Dean, Reginald Victor Jones (RVJ) Institute, Center  
of Excellence for EMSO  
**Maj Corby Carlson,**  
Electromagnetic Spectrum Operations School (EM-  
SOS)\*, 479 Operations Support Squadron  
Naval Air Station Pensacola  
**Dr. Rich Wittstruck**  
Senior Advisor, Asst. Secretary of the Army,  
Acquisition, Logistics and Technology

## PRODUCTION STAFF

**Layout & Design:** Barry Senyk  
**Advertising Art:** Elaine Connell  
**Contact the Editor:** (978) 509-1450,  
JEDeditor@naylor.com  
**Contact the Sales Manager:**  
(800) 369-6220 or kkrewson@naylor.com

**Subscription Information:**  
Please contact Glorianne O'Neilin  
at (703) 549-1600 or e-mail [oneilin@crows.org](mailto:oneilin@crows.org).

*Journal of Electromagnetic Dominance*  
is published for the AOC by

**NAYLOR**

ASSOCIATION SOLUTIONS  
1430 Spring Hill Road, 6th Floor  
McLean, VA 22102  
Tel (800) 369-6220  
[www.naylor.com](http://www.naylor.com)

©2021 Association of Old Crows/Naylor, LLC. All rights reserved. The contents of this publication may not be reproduced by any means, in whole or in part, without the prior written authorization of the publisher.

Editorial: The articles and editorials appearing in this magazine do not represent an official AOC position, except for the official notices printed in the "Association News" section or unless specifically identified as an AOC position.

COVER PHOTO COURTESY OF US NAVY

PUBLISHED SEPTEMBER 2021/JED-M1021/2492



# We've Got Your Back.

**For over a decade, Signal Hound has provided unrivaled value in RF test equipment.**

We are passionate about providing RF professionals of all types with powerful tools to get the job done. Whether it's in the lab, on the test line or in the field, we have been your consistent source for affordable and reliable products. No matter the challenge, our dynamic and responsive team is here for you. Our dedication to supplying exceptional tools to the test equipment industry remains constant and we look forward to continuing to impress you with our outstanding products.

**Our Commitment to You is Constant  
SIGNAL HOUND HAS YOUR BACK.**

**Signal Hound®**

[SignalHound.com](http://SignalHound.com)

Made in the USA 

© 2021 Signal Hound, Inc. All rights reserved.

## Calendar Conferences & Trade Shows

### OCTOBER

#### AOC Europe

October 11-13  
Liverpool, UK  
[www.aoceurope.org](http://www.aoceurope.org)

#### AUSA 2021

October 11-13  
Washington, DC  
[www.ausa.org](http://www.ausa.org)

#### 10th Annual AOC Pacific Conference

October 18-22  
Honolulu, HI  
[www.fbcinc.com/e/aocpacific](http://www.fbcinc.com/e/aocpacific)

#### AUVSU Unmanned Systems Defense

Phase III – Virtual  
October 19-21  
[www.auvsu.org](http://www.auvsu.org)

#### Precision Strike Technology Symposium (PSTS-21)

October 19-21  
Laurel, MD  
[www.ndia.org](http://www.ndia.org)

#### Seoul ADEX 2021

October 19-24  
Seoul, ROK  
[www.seouladex.com](http://www.seouladex.com)

#### Directed Energy Systems Symposium

October 25-29  
Washington, DC  
[www.deps.org](http://www.deps.org)

### NOVEMBER

#### Defense & Security 2021

November 1-4  
Bangkok, Thailand  
[www.asiandefense.com](http://www.asiandefense.com)

#### 2021 Aircraft Survivability Symposium

November 2-4  
Monterey, CA  
[www.ndia.org](http://www.ndia.org)

#### Dubai Airshow 2021

November 14-18  
Dubai, UAE  
[www.dubaiairshow.aero](http://www.dubaiairshow.aero)

#### MILCOM 2021

November 29 – December 2  
San Diego, CA  
[www.milcom.org](http://www.milcom.org)

#### I/ITSEC

November 29 – December 3  
Orlando, FL  
[www.iitsec.org](http://www.iitsec.org)

#### 58th Annual AOC International Symposium & Convention

November 30 – December 2  
Washington, DC  
[www.crows.org](http://www.crows.org)

#### Avalon 2021

November 30 – December 5  
Geelong, Victoria, Australia  
[www.airshow.com.au](http://www.airshow.com.au)

### JANUARY 2022

#### Surface Navy Association 34th National Symposium

January 10-14  
Arlington, VA  
[www.navysna.org](http://www.navysna.org)

### FEBRUARY 2022

#### Modern Threats: Surface-to-Air Missile Systems Conference 2022

February 1-2  
Redstone Arsenal, AL  
[www.crows.org](http://www.crows.org)

#### European Microwave Week 2022

February 13-18  
London, UK  
[www.eumwa.org](http://www.eumwa.org)

#### Singapore Airshow

February 15-20  
Singapore  
[www.singaporeairshow.com](http://www.singaporeairshow.com) 

AOC conferences are noted in red. For more info or to register, visit [crows.org](http://crows.org). Items in blue denote AOC Chapter events.





## FPGAs Your Way

Acromag's high-performance XMC, PMC and mPCIe-based FPGA modules feature a user-customizable Xilinx® FPGA. These modules allow you to develop and store your own instruction sets in the FPGA for a variety of adaptive computing applications.

Select from several models with up to 410K logic cells optimized for logic, DSP, or PowerPC. The high-speed memory and fast bus interfaces rapidly move data.

### Choose Your Performance Level

Zync® UltraScale+™ MPSoC FPGA module  
Artix®-7 FPGA module  
Kintex®-7 FPGA module  
Spartan®-6 FPGA module



ISO9001  
AS9100  
MADE IN USA  
248-295-0310

### High-Speed Sampling and Stimulus

- Fast response I/O processing loops run at FPGA speeds
- Simultaneous parallel logic rather than sequential code
- FPGAs for real-time data acquisition and processing
- FPGAs provide deterministic I/O

### Flexible I/O Front Interface

AXM Series extension modules offer numerous I/O options for Acromag's PMC and XMC modules with configurable FPGA. These extension modules plug into the front mezzanine on Acromag's FPGAs.



- A/D, D/A
- Digital I/O
- Serial communication

 Visit [Acromag.com/FPGAS](http://Acromag.com/FPGAS)  
TO SEE WHAT'S NEW

Embedded I/O Solutions You Can Depend On.

## Calendar Courses & Seminars

### OCTOBER

#### AOC Virtual Series Webinar: 5G for Critical Communications

October 7  
1400-1500 EST  
[www.crows.org](http://www.crows.org)

#### AOC Professional Development Course: 21st Century Electronic Warfare

October 9-10  
Liverpool, UK  
[www.crows.org](http://www.crows.org)

#### AOC Virtual Series Webinar: What SOSA™ Means to the Warfighter

October 14  
1400-1500 EST  
[www.crows.org](http://www.crows.org)

#### Airborne EW System Integration

October 19-21  
Atlanta, GA  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

#### Electromagnetic Materials and Measurements: RAM, Radome and RAS

October 19-21  
Atlanta, GA  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

#### AOC Virtual Series Webinar: Eliminating the Pain of Transitioning EW Systems from Lab Tests to Field Tests

October 21  
1400-1500 EST  
[www.crows.org](http://www.crows.org)

#### Principles of Modern Radar

October 25-29  
Atlanta, GA  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

#### Signals Intelligence (SIGINT) Fundamentals

October 26-27  
Lake Buena Vista, FL  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

#### Basic EO-IR Concepts

October 26-28  
Lake Buena Vista, FL  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

#### Basic RF Electronic Warfare Concepts

October 26-28  
Atlanta, GA  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

#### Phased Array Radar Systems

October 26-28  
Atlanta, GA  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

### NOVEMBER

#### AOC Virtual Series Webinar: The Spectrum of AI Applications

November 4  
1400-1500 EST  
[www.crows.org](http://www.crows.org)

#### Radar Principles

November 15-19  
Shrivenham, Swindon, UK  
[www.cranfield.ac.uk](http://www.cranfield.ac.uk)

#### Basic Radar Concepts

November 16-18  
Lake Buena Vista, FL  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

#### Fundamentals of Radar Signal Processing

November 16-19  
Lake Buena Vista, FL  
[www.pe.gatech.edu](http://www.pe.gatech.edu)

### DECEMBER

#### AOC Professional Development Course: Machine Learning for Electronic Warfare

December 3-4  
Washington, DC  
[www.crows.org](http://www.crows.org)

#### AOC Professional Development Course: Space Electronic Warfare

December 3-4  
Washington, DC  
[www.crows.org](http://www.crows.org)

AOC courses are noted in red. For more info or to register, visit [crows.org](http://crows.org). Items in blue denote AOC Chapter courses.

**iRF Solutions**

# intelligent RF solutions

## Tactical - Interoperable - Reconfigurable

[www.irf-solutions.com](http://www.irf-solutions.com)  
443-595-8500  
[engage@irf-solutions.com](mailto:engage@irf-solutions.com)

**DELIVERING MAXIMUM PERFORMANCE  
WITH THE LITERAIL, WIDERAIL, AND  
ULTRARAIL FAMILY OF MICROWAVE  
RECEIVERS**

**AI for RF**

- BANDWIDTHS UP TO 500MHz
- INTEGRATED FPGA RESOURCES
- FREQUENCY COVERAGE 0.5 TO 44GHz
- AUTOMATED SPECTRUM SITUATIONAL AWARENESS
- LATEST ULTRARAIL RECEIVER BANDWIDTHS >1GHz, FREQUENCY COVERAGE TO 100GHz

# RF Amplifiers and Sub-Assemblies for Every Application

Delivery from Stock to 2 Weeks ARO from the catalog or built to your specifications!

- Competitive Pricing & Fast Delivery
- Military Reliability & Qualification
- Various Options: Temperature Compensation, Input Limiter Protection, Detectors/TTL & More
- Unconditionally Stable (100% tested)

ISO 9001:2000  
and AS9100B  
CERTIFIED

## OCTAVE BAND LOW NOISE AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB)	MIN	Noise Figure (dB)	Power-out @ P1-dB	3rd Order ICP	VSWR
CA01-2110	0.5-1.0	28	1.0 MAX	0.7 TYP	+10 MIN	+20 dBm	2.0:1
CA12-2110	1.0-2.0	30	1.0 MAX	0.7 TYP	+10 MIN	+20 dBm	2.0:1
CA24-2111	2.0-4.0	29	1.1 MAX	0.95 TYP	+10 MIN	+20 dBm	2.0:1
CA48-2111	4.0-8.0	29	1.3 MAX	1.0 TYP	+10 MIN	+20 dBm	2.0:1
CA812-3111	8.0-12.0	27	1.6 MAX	1.4 TYP	+10 MIN	+20 dBm	2.0:1
CA1218-4111	12.0-18.0	25	1.9 MAX	1.7 TYP	+10 MIN	+20 dBm	2.0:1
CA1826-2110	18.0-26.5	32	3.0 MAX	2.5 TYP	+10 MIN	+20 dBm	2.0:1

## NARROW BAND LOW NOISE AND MEDIUM POWER AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB)	MIN	Noise Figure (dB)	Power-out @ P1-dB	3rd Order ICP	VSWR
CA01-2111	0.4 - 0.5	28	0.6 MAX	0.4 TYP	+10 MIN	+20 dBm	2.0:1
CA01-2113	0.8 - 1.0	28	0.6 MAX	0.4 TYP	+10 MIN	+20 dBm	2.0:1
CA12-3117	1.2 - 1.6	25	0.6 MAX	0.4 TYP	+10 MIN	+20 dBm	2.0:1
CA23-3111	2.2 - 2.4	30	0.6 MAX	0.45 TYP	+10 MIN	+20 dBm	2.0:1
CA23-3116	2.7 - 2.9	29	0.7 MAX	0.5 TYP	+10 MIN	+20 dBm	2.0:1
CA34-2110	3.7 - 4.2	28	1.0 MAX	0.5 TYP	+10 MIN	+20 dBm	2.0:1
CA56-3110	5.4 - 5.9	40	1.0 MAX	0.5 TYP	+10 MIN	+20 dBm	2.0:1
CA78-4110	7.25 - 7.75	32	1.2 MAX	1.0 TYP	+10 MIN	+20 dBm	2.0:1
CA910-3110	9.0 - 10.6	25	1.4 MAX	1.2 TYP	+10 MIN	+20 dBm	2.0:1
CA1315-3110	13.75 - 15.4	25	1.6 MAX	1.4 TYP	+10 MIN	+20 dBm	2.0:1
CA12-3114	1.35 - 1.85	30	4.0 MAX	3.0 TYP	+33 MIN	+41 dBm	2.0:1
CA34-6116	3.1 - 3.5	40	4.5 MAX	3.5 TYP	+35 MIN	+43 dBm	2.0:1
CA56-6114	5.9 - 6.4	30	5.0 MAX	4.0 TYP	+30 MIN	+40 dBm	2.0:1
CA812-6115	8.0 - 12.0	30	4.5 MAX	3.5 TYP	+30 MIN	+40 dBm	2.0:1
CA812-6116	8.0 - 12.0	30	5.0 MAX	4.0 TYP	+33 MIN	+41 dBm	2.0:1
CA1213-7110	12.2 - 13.25	28	6.0 MAX	5.5 TYP	+33 MIN	+42 dBm	2.0:1
CA1415-7110	14.0 - 15.0	30	5.0 MAX	4.0 TYP	+30 MIN	+40 dBm	2.0:1
CA1722-4110	17.0 - 22.0	25	3.5 MAX	2.8 TYP	+21 MIN	+31 dBm	2.0:1

## ULTRA-BROADBAND & MULTI-OCTAVE BAND AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB)	MIN	Noise Figure (dB)	Power-out @ P1-dB	3rd Order ICP	VSWR
CA0102-3111	0.1-2.0	28	1.6 Max	1.2 TYP	+10 MIN	+20 dBm	2.0:1
CA0106-3111	0.1-6.0	28	1.9 Max	1.5 TYP	+10 MIN	+20 dBm	2.0:1
CA0108-3110	0.1-8.0	26	2.2 Max	1.8 TYP	+10 MIN	+20 dBm	2.0:1
CA0108-4112	0.1-8.0	32	3.0 MAX	1.8 TYP	+22 MIN	+32 dBm	2.0:1
CA02-3112	0.5-2.0	36	4.5 MAX	2.5 TYP	+30 MIN	+40 dBm	2.0:1
CA26-3110	2.0-6.0	26	2.0 MAX	1.5 TYP	+10 MIN	+20 dBm	2.0:1
CA26-4114	2.0-6.0	22	5.0 MAX	3.5 TYP	+30 MIN	+40 dBm	2.0:1
CA618-4112	6.0-18.0	25	5.0 MAX	3.5 TYP	+23 MIN	+33 dBm	2.0:1
CA618-6114	6.0-18.0	35	5.0 MAX	3.5 TYP	+30 MIN	+40 dBm	2.0:1
CA218-4116	2.0-18.0	30	3.5 MAX	2.8 TYP	+10 MIN	+20 dBm	2.0:1
CA218-4110	2.0-18.0	30	5.0 MAX	3.5 TYP	+20 MIN	+30 dBm	2.0:1
CA218-4112	2.0-18.0	29	5.0 MAX	3.5 TYP	+24 MIN	+34 dBm	2.0:1

## LIMITING AMPLIFIERS

Model No.	Freq (GHz)	Input Dynamic Range	Output Power Range Psat	Power Flatness dB	VSWR
CLA24-4001	2.0 - 4.0	-28 to +10 dBm	+7 to +11 dBm	+/- 1.5 MAX	2.0:1
CLA26-8001	2.0 - 6.0	-50 to +20 dBm	+14 to +18 dBm	+/- 1.5 MAX	2.0:1
CLA712-5001	7.0 - 12.4	-21 to +10 dBm	+14 to +19 dBm	+/- 1.5 MAX	2.0:1
CLA618-1201	6.0 - 18.0	-50 to +20 dBm	+14 to +19 dBm	+/- 1.5 MAX	2.0:1

## AMPLIFIERS WITH INTEGRATED GAIN ATTENUATION

Model No.	Freq (GHz)	Gain (dB) MIN	Noise Figure (dB)	Power-out @ P1-dB	Gain Attenuation Range	VSWR	
CA001-2511A	0.025-0.150	21	5.0 MAX	3.5 TYP	+12 MIN	30 dB MIN	2.0:1
CA05-3110A	0.5-5.5	23	2.5 MAX	1.5 TYP	+18 MIN	20 dB MIN	2.0:1
CA56-3110A	5.85-6.425	28	2.5 MAX	1.5 TYP	+16 MIN	22 dB MIN	1.8:1
CA612-4110A	6.0-12.0	24	2.5 MAX	1.5 TYP	+12 MIN	15 dB MIN	1.9:1
CA1315-4110A	13.75-15.4	25	2.2 MAX	1.6 TYP	+16 MIN	20 dB MIN	1.8:1
CA1518-4110A	15.0-18.0	30	3.0 MAX	2.0 TYP	+18 MIN	20 dB MIN	1.85:1

## LOW FREQUENCY AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB) MIN	Noise Figure dB	Power-out @ P1-dB	3rd Order ICP	VSWR	
CA001-2110	0.01-0.10	18	4.0 MAX	2.2 TYP	+10 MIN	+20 dBm	2.0:1
CA001-2211	0.04-0.15	24	3.5 MAX	2.2 TYP	+13 MIN	+23 dBm	2.0:1
CA001-2215	0.04-0.15	23	4.0 MAX	2.2 TYP	+23 MIN	+33 dBm	2.0:1
CA001-3113	0.01-1.0	28	4.0 MAX	2.8 TYP	+17 MIN	+27 dBm	2.0:1
CA002-3114	0.01-2.0	27	4.0 MAX	2.8 TYP	+20 MIN	+30 dBm	2.0:1
CA003-3116	0.01-3.0	18	4.0 MAX	2.8 TYP	+25 MIN	+35 dBm	2.0:1
CA004-3112	0.01-4.0	32	4.0 MAX	2.8 TYP	+15 MIN	+25 dBm	2.0:1

CIAO Wireless can easily modify any of its standard models to meet your "exact" requirements at the Catalog Pricing.

Visit our web site at [www.ciaowireless.com](http://www.ciaowireless.com) for our complete product offering.



Ciao Wireless, Inc. 4000 Via Pescador, Camarillo, CA 93012

Tel (805) 389-3224 Fax (805) 389-3629 sales@ciaowireless.com



# CHALLENGING TIMES

**I know that** it will be October when you read this, but as I write this message at the end of August I am filled with mixed emotions for myself, my brothers and sisters in arms, and those that are in harm's way as nations close their chapter on Afghanistan and the United States closes Operation Enduring Freedom. I have had a number of memories flood into my mind over the past few weeks, including watching the evacuation of Saigon on the evening news, and then watching similar events unfold in Kabul, and wondering how could we have let this happen again.

I also remember the events of Sept. 11 and how that day evolved, as well as the following weeks, months, years and decades. I remember exactly what I was doing on that fateful Tuesday morning. I was on alert for the USSTRATCOM 2001 Global Guardian Exercise; it would be the last time that USSTRATCOM would generate the entire bomber fleet. We were in the Alert Facility awaiting the aircraft response portion of the exercise, and I was speaking with our Operations Group Commander, as I was assuming my new role as the Wing EWO. As we were speaking, we saw the North Tower burning after the first aircraft struck. Thinking this was an accident, we then watched as the second airliner impacted the South Tower. The "Horn" went off within 10 seconds of the South Tower being hit, directing us to report to our aircraft. We all went to our respective aircraft and prepared for whatever the National Command Authority would direct us to do. We ended up returning to the Alert Facility and then back to the aircraft, and watched Air Force One land and the President disembark and then head to the headquarters to speak to the nation. Once we knew the attacks were over, we immediately began the process to re-configure the aircraft for deployment to Diego Garcia, where we supported the air campaign of Operation Enduring Freedom.

Reflecting on the last 20 years, some may ask, "was it worth it?" Yes, it was. We touched and influenced a generation, and those that experienced the positive impacts of freedom, service and opportunity will remember. I will also state with conviction that we, as Spectrum Warriors, made a definite and absolute difference, and that we as a community not only experienced positive and negative lessons, but that we learned from those lessons and experiences. Have we learned everything? No, we are not perfect. But I look at the EMSO programs we are investing in, the approved Spectrum Strategy and Implementation Plan, and other achievements, and I know that we are making a difference with new concept and capabilities.

October is AOC election month, and I need your help to "get out the vote." This is your opportunity to choose the members of the 2022 Board of Directors. Please take a moment to help shape the future of our Association. - *Glenn "Powder" Carlson*



### Association of Old Crows

1001 N. Fairfax St., Suite 300  
Alexandria, VA 22314  
Phone: (703) 549-1600  
Fax: (703) 549-2589

**PRESIDENT** – Glenn "Powder" Carlson

**VICE PRESIDENT** – Brian Hinkley

**SECRETARY** – Mark Schallheim

**TREASURER** – Greg Patschke

**PAST PRESIDENT**  
Muddy Watters

### AT-LARGE DIRECTORS

Bob Andrews  
Brian Hinkley  
Greg Patschke  
Haruko Kawahigashi  
Mike Ryan  
Richard Wittstruck

### APPOINTED DIRECTORS

Jesse Bourque  
Tuhin Das

### REGIONAL DIRECTORS

**Central:** Keith Everly  
**Mid-Atlantic:** Jim Pryor  
**Northeastern:** Myles Murphy  
**Northwestern:** Mark Schallheim  
**Mountain-Western:** Sam Roberts  
**Pacific:** Rick Lu  
**Southern:** Karen Brigance  
**International I:** Sue Robertson  
**International II:** Jurgen Opfer

### AOC FOUNDATION ADJUNCT GOVERNORS

Charles Quintero  
Gary Lyke

### AOC PROFESSIONAL STAFF

Shelley Frost  
*Executive Director*  
frost@crows.org  
Glorianne O'Neill  
*Director, Membership Operations*  
oneillin@crows.org  
Amy Belicev  
*Director, Meetings & Events*  
belicev@crows.org  
Hollann Schwartz  
*Director, Marketing & Communications*  
schwartz@crows.org  
Ken Miller  
*Director, Advocacy & Outreach*  
kmiller@crows.org  
Sean Fitzgerald  
*Sales and Client Operations Manager*  
fitzgerald@crows.org  
Christine Armstrong  
*Senior Conference Manager*  
armstrong@crows.org  
Blain Bekele  
*Membership Support and STEM Coordinator*  
blain@crows.org

Meron Bekele

*Membership Coordinator*

meron@crows.org

Raleigh Leavitt

*Education Coordinator*

leavitt@crows.org

Caleb Herr

*Senior Digital Marketing Associate*

herr@crows.org

Tori Cruz

*Coordinator, Meetings and Events*

cruz@crows.org

Tala Alshaboot

*Research Assistant*

tala@crows.org

# PROVEN POWER



**SOLID  
STATE  
PERFORMANCE**



## **Model BME49189-50 & BME69189-100**

4-18 GHz, 50 Watts & 6-18 GHz, 100 Watts Solid State Power Amplifier Module

- Full Power Across the Entire Bandwidth
- Maintains Output Power, Gain, and Efficiency with Real World Load Conditions
- Superior Harmonics AND Input /Output VSWR
- Compact, Lightweight, and Usable in the Harshest Environments
- 28 VDC GaN Technology
- High Speed Blanking
- Operating Temperature: -40° C to 55° C



## **Model BME2969-100 & BME2969-200**

2-6GHz, 100 & 200 Watts Solid State Power Amplifier Module

- High Efficiency Over the Entire Bandwidth
- RF Input/Output Sample Ports
- Internal DC to DC Converters
- External T/R Switch Available
- Maintains Output Power with Real-World Load Conditions
- Operating Temperature: -40° C to 55° C
- Also Available in 300 Watts



*Subsidiary of Comtech Telecommunications Corporation*  
[www.comtechpst.com](http://www.comtechpst.com)

**Contact our sales & marketing department today to discuss your exact project needs.**  
**Comtech...meeting needs, exceeding expectations.**

105 Baylis Road, Melville, NY 11747  
Tel: (631) 777-8900 • Fax: (631) 777-8877

417 Boston Street, Topsfield, MA 01983  
Tel: (978) 887-5754 • Fax: (978) 887-7244

## US AIR FORCE TO DEVELOP AI/ML EW TECHNOLOGIES UNDER PROJECT KAIJU

The Air Force Research Lab's Sensors Directorate (Wright-Patterson AFB, OH) is planning to embark on a major research and development effort that focuses on developing Artificial Intelligence (AI) and Machine Learning (ML) technologies for electromagnetic warfare (EW) applications.

Last month, the Directorate's Spectrum Warfare Division, RF Electronic Warfare Branch (AFRL/RYWE) issued a Notice of Contract Action (NOCA) for Project Kaiju, a five-year, \$150 million effort to develop a range of AI/ML-related technologies and resources to advance EW technology against emerging Integrated Air Defense System (IADS) capabilities. The program description states, "As IADS advance towards employing multi-spectrum capabilities, a foreseeable problem is the relevancy and effectiveness of countermeasures (CMs) developed for a single spectrum when they are employed against a multi-spectrum threat." Potential adversaries are developing multi-spectral sensor and missile seeker technologies that combine RF, EO and IR performance on a single air defense system or missile, which will challenge the Air Force's single-mode EW systems. The description goes on to say, "With adversaries understanding the importance of HVAA [High Value Airborne Assets] to mission success, as well as their vulnerabilities, HVAA may become a likely target for emerging longer-range advanced threats. Continued HVAA Protection is key for the AF to maintain air superiority and satisfy their core mission goals (e.g., Intelligence, surveillance, and reconnaissance (ISR), Global Reach, command and control (C<sub>2</sub>), etc.)".

The goal of Project Kaiju is to develop autonomous AI/ML-based EW systems that do not depend on communicating with AI/ML resources in other locations. The program description explains, "As AI/ML advances, it will be able to process and utilize larger amounts of data in real-time, opening the potential for autonomous EW on an asset. This ability to have the capability for on-board data collect and analysis will be necessary for future closed-loop real-time autonomous reac-

tions to changes or unknowns in the perceived Electromagnetic Spectrum (EMS) environment (i.e., closed-loop sensing and self-protect jamming). Essential for rapid insertion and assessment of AI/ML technology are the adoption of open standards, agile Devops/algorithm development, and process validation tools environments." (For more on AI/ML-based EW, see the September 2021 *JED*.)

Project Kaiju comprises nine research areas that will investigate many facets of AI/ML technology, from modeling and simulation to software defined radios to algorithm development. In keeping with the project name (Kaiju refers to the genre of Japanese monster movies), all nine research areas are named after classic movie "creatures." Here are the descriptions from the NOCA:

**(Gamera) Big Data for Cognitive EW (CEW) Research:** Conduct a study that investigates which key community developed tools should be integrated into a common and modular framework to generate "Big Data."

**(King Ghidorah) Software-Defined Radio (SDR) Research:** SDR code library requires in-depth investigation of target system hardware for the purpose of understanding its operation for the purpose of creating the best possible SDR emulation of the target system. Procurement of target systems, development of data links to interface with SDRs and other equipment to command and control systems, disassembly (to include destructive testing) of target systems, lab, field and flight testing, and procurement of candidate SDR hardware/software.

**(Mecha Rodan) Multi-Spectrum Threat Defeat:** Refine existing Multi-Spectrum modeling and simulation environments to add advanced capabilities (including model accuracy) that span across Electronic Support (ES) and Electronic Attack (EA).

**(Kumonga) RAPTURE Laboratory:** Design, fabricate, test, and document special-purpose hardware to meet research and development test requirements for Size, Weight, and Power (SWAP)-constrained program requirements. Perform lab and field testing of

custom designed hardware (includes soldering surface mount Printed Circuit Board (PCB)'s, modifying PCB's, assembling custom cables, computer aided design (CAD) of custom enclosures, and assembly of the final product).

**(Mothra) EA Demo:** Build a reconfigurable EA processing framework for assessment of EA capabilities (emitter tracking, technique selection, technique generation).

**(King Kong) Real Time Algorithm Development:** Utilize government-furnished hardware architecture description to determine the viability of government-furnished non-real-time machine learning algorithms for real-time applications.

**(Baragon) RF EW Demonstrator (REWD) for Next Sortie Mission Data Reprogramming:** Develop, mature, and evaluate advanced EW algorithmic concepts to detect, sort, identify, disambiguate, and track complex emitters in complex environments. This includes leveraging algorithms developed under Defense Advanced Research Projects Agency's Adaptive Radar Countermeasures (ARC), AFRL's Electronic Support Critical Experiment (ESCE), and ONR's Reactive Electronic Attack Measures (REAM) programs. Baragon will also include integrating multi-sourced processing chains, closed-loop software component control and tuning, component performance comparison, analysis and visualization products to aid human/machine teaming and trust.

**(Colossus) Advanced Threat Defeat (ATD):** Develop novel and cognitive electronic warfare capabilities to generate multi-layered EA techniques resulting in long-range kill webs. Leverage distributed sensing, machine learning and AI and align with Advanced Battle Management System (ABMS) concepts for autonomous vehicles to enable Joint All Domain Command and Control (JADC<sub>2</sub>) resulting in coordinated joint fires and convergence of EW effects.

**(Godzilla) Program Management:** Perform program management of scope, schedule, cost, and risk for the overall contract and for each individual research project and development activity.

The NOCA also notes, "Additionally, this BAA will address the issues both individually and collectively. No R&D conducted under this program will be done in isolation, but rather in full consideration of how the new technologies can progress toward full integration with large, complex systems, ready to transition to support of the warfighter."

Project Kaiju is expected to run for 63 months with a total program budget of \$150 million. AFRL expects to award two contracts. The main contract, valued at \$135 million, covers all tasks and technical objectives. The second is a \$15 million "niche" contract that will incorporate Godzilla and focus on one or more of the Mothra, King Kong, Baragon and Colossus efforts.

AFRL expects to hold a Project Kaiju Industry Day later this month, which will likely be a virtual event. It plans to issue a Broad Agency Announcement (BAA FA8650-22-S-1004) in January. The technical point of contact is Gary Kaufman, AFRL/RWYR, (937) 713-4007, e-mail gary.kaufman.1@us.af.mil. - J. Knowles

## EMSO RESEARCH TOPICS IN DOD SMALL BUSINESS SOLICITATION

The Department of Defense has released its third and final Small Business Innovative Research (SBIR) Program Broad Agency Announcement (BAA) for FY2021, which includes several EMS-related research topics.

### Army

- Real Time Electronic Warfare Receiver Surrogate (RTERS) (Topic A21-108) will focus on developing a prototype system (a receiver/ processor, a display, a mouse, a keyboard, and a Double Layer DVD RW drive to perform command, control, data exchange and data storage) that can "evaluate EW techniques and Electronic Intelligence (ELINT) information as a surrogate radar receiver system," according to the program description. The RTERS will perform two primary functions: 1) receive the proper signals of a CW, modulated waveforms and pulse radar information and store these parameters and 2) show the effects on a simulated Plan Position Indicator when

countermeasure signals are presented at the RTERS antenna inputs. The system will receive, process and display radar signals from L, S, C, X and Ku bands and feature an antenna subsystem that can scan 360 degrees continuously through mechanical and/or electronic means. The technical point of contact is Bing Mak, (443) 861-0575, e-mail bing.mak.civ@mail.mil.

- Small Form Factor Hardware Standards (Topic A21-112) calls for developing small form factor hardware modules (roughly MXM size ~ 80x80mm surface area) that. The Army is pursuing Command, Control, Communications, Computers, and Cyber (C5ISR)/Electronic Warfare (EW) Modular Open Suite of Standards (CMOSS), Sensor Open Systems Architecture (SOSA), and Hardware Open Systems Technology (HOST) hardware standards based on 3U and 6U Open VPX standards. These efforts are primarily designed to meet the needs of most Army air and ground platforms, but they do not meet the needs of the Army's emerging small



## Tactical EW systems for mission dominance

HENSOLDT's GEW® Tactical Electronic Warfare Systems (TEWS) deliver true spectrum dominance on the battlefield. State-of-the-art Electronic Support (ES) and Electronic Attack (EA) solutions are integrated to offer advanced intelligence and countermeasures for superiority in the electro-magnetic battlespace.

**Hensoldt South Africa.**

[www.hensoldt.co.za](http://www.hensoldt.co.za)

**HENSOLDT**  
Detect and Protect

## News

UASs and unmanned ground vehicles. This effort addresses that gap and delivers the benefits of CMOSS, SOSA and HOST to these smaller unmanned platforms. Additional requirements include: Ethernet and PCIe connectivity; RF connectivity similar to VITA 67; optical connectivity similar to VITA 66; and providing modularity similar to CMOSS standards (i.e., modularity between vendor payloads in a chassis without modifications to the back-plane). The technical point of contact is Trent Styrcula, (443) 861-0515, email trent.l.styrcula.civ@mail.mil.

- Novel Processor Architectures for Probabilistic Computing in Survivability Controllers (Topic A21-114) addresses development of probabilistic processor architectures that leverage artificial intelligence and machine learning to support active defense and survivability systems on Army ground vehicles. According to the topic description, “Future military ground vehicles, especially those with active defense and survivability components, will have increased automation requiring more and more computing capacity to distill incoming sensor data and rapidly make

autonomous decisions in real-time. While traditional processor architectures are very well suited for deterministically processing relatively small data sets in real-time, as the size of the data sets grows, scaling of traditional processors within the constraints of the ground platform SWaP, environment, and cost targets becomes infeasible. The goal of this project is to identify and examine alternative candidate computing solutions for probabilistic data processing and decision making that would be cost-effective and scalable to the growing processing needs of

### FLEXDAR DISTRIBUTED DIGITAL RADAR TESTBED STARTS TRIALS

The Naval Research Laboratory (NRL) has begun technology demonstrations using a novel distributed S-band digital radar testbed built in partnership with Raytheon Missiles and Defense's Advanced Technology group.

Known as the Flexible Distributed Array Radar (FlexDAR), the software-defined system comprises two experimental phased-array radars equipped with digital beam forming, communications, and network-linked, distributed radar tracking. According to NRL, the FlexDAR concept affords significant performance improvements in detection range, tracking accuracy, and electronic protection when operated in a distributed configuration.

The FlexDAR concept was conceived by NRL to demonstrate new and advanced capabilities enabled by the implementation of every-element digital beamforming (EEDBF) antenna arrays combined with network coordination and precise time synchronization. EEDBF is an emerging technology enabling multiple simultaneous full-gain receive beams within each radar's field of view which, when combined with network coordination and precise time synchronization, enables new and advanced radar capabilities. This, along with flexible digital processing, offers a number of attractive features well beyond the capabilities of conventional arrays and radar systems.

Raytheon was originally contracted for FlexDAR in 2014 as part of the

Office of Naval Research's (ONR's) Integrated Topside (InTop) program. InTop was an Innovative Naval Prototype (INP) effort to demonstrate distributed and shared multifunction RF apertures for radar, communications and electronic warfare, together with associated resource management techniques.

Engineers and scientists from NRL's Radar and Information Technology divisions led the development of the technical aspects of the FlexDAR program. Requirements for the arrays were developed by the NRL team, with Raytheon selected in competition to build the two 1,008-element arrays. NRL personnel designed and implemented the radar signal processing and tracking algorithms, network coordination techniques, and an advanced graphical user interface, referred to as the FlexDAR Back-End (FBE). The first phase of the FlexDAR program saw Raytheon design the radar front-end and demonstrate all critical components and sub-assemblies. Subsequently, the company manufactured, integrated and tested two phased-array FlexDAR Front-End (FFE) subsystems based on the NRL requirements. The FFE implements EEDBF and is integrated with the FBE using only a few high-speed fiber-optic Ethernet connections and a single analog signal to provide a common clock. The FBE and FFE are built using open standards.

The NRL and Raytheon team integrated the systems and have verified many of the key capabilities of FlexDAR, including low antenna side lobe levels, multiple simultaneous and independent receive beams, multiple simultaneous sub-apertures, distributed radar tracking, and data throughput. NRL completed the installation of FlexDAR earlier this year and began demonstrations with nodes operating at the NRL Chesapeake Bay Detachment in Maryland and at the NASA Wallops Flight Facility in Virginia. Verification of capabilities is ongoing, and the testbed will support continued development and demonstration of advanced distributed radar concepts.

According to Raytheon, the program “demonstrates both radar and radar-to-radar communications functions so as to implement bi-static exchange and control. This provides increased detection and firm-track range, and improved electronic protection relative to existing standalone monostatic radars.”

While FlexDAR work started under the InTop INP, the program has now flowed into ONR's follow-on Electromagnetic Maneuver Command and Control (EMC2) INP effort. EMC2 is prototyping technologies enabling advanced multifunction RF architectures that integrate EW, radar, communications and Information Operations functions across common infrastructures. – R. Scott

the Army's ground vehicle fleet." Phase 1 calls for a feasibility study, concept development, theoretical performance analysis, risk analysis, cost analysis and concept design of a probabilistic processor computing platform. The technical point of contact is Andrey Shvartsman, (586) 282-0902, e-mail andrey.shvartsman.civ@mail.mil.

### Navy

Automated High Frequency Communications Planner (Topic N213-142) focuses on the Navy's need to communicate via HF systems when its preferred SATCOM systems are not available in degraded or denied electromagnetic operating environments. The goal is to develop a fully automated planning tool that uses ionospheric analysis and modeling to analyze HF propagation conditions and creates frequency plans for HF communications. Phase 1 work calls for defining the "automated HF communications planning tool architecture that will optimize HF channel selection based on real-time ionospheric and propagation information, as well as prediction data; and enable monitoring and control of local and distant radios." The technical point of contact is McLaina Oum, e-mail mclaina.oum.civ@us.navy.mil.

The full list of DoD SBIR 2021.3 topics is available at [www.dodsbirsttr.mil](http://www.dodsbirsttr.mil). Proposals are due by October 21. – J. Knowles

### IN BRIEF

The Australian Army and the Australian Defence Innovation Hub are soliciting proposals in support of next-generation" Personal Electronic Countermeasures (Personal ECM) systems" to protect Australian Defence Force personnel against remote control improvised explosive devices (RCIEDs). According to the program description, "Army seeks to explore improvements in Personal ECM system components (for example processing, amplifiers, antennas and batteries) that can be integrated into a single solution, and are easy to operate. Next Generation Personal ECM systems will need to be interoperable with other radio frequency (RF) and electrical systems, and able to log operational data to support exploitation." Program goals include: 1-2 kg system weight, hardware and software upgrades over the life of the

program, and rapid reprogramming. The solicitation can be viewed at [www.innovationhub.defence.gov.au](http://www.innovationhub.defence.gov.au). Proposals are due by October 14.

**US Space Command** has issued a Sources Sought notice to build and integrate a Space Electromagnetic Warfare Operating Location (SEWOL) in the continental US. According to the notice, the SEWOL program encompasses four primary functions: 1) The Space EW Common Operating Picture (SEWCOP); 2) Mission Planning, Execution, and Command & Control (C2) Infrastructure and Applications; 3) Remote Space EW Physical & Cloud based Infrastructure; and 4) Mission Resiliency and Assurance Infrastructure. The contractor will integrate the Counter Communications System (Block 10) Meadowlands and its remote operations capability (developed by L3Harris Technologies) into the SEWOL, as well as the Remote Modular Terminal (RMT). (The Space force issued an RFI for the Remote Modular Terminal in July.) The program is scheduled to run from 2022 through 2027. Space Systems Com-

mand plans to hold a SEWOL Industry Day in El Segundo, CA, in early October. The point of contact is Maj Clifford Johnson, e-mail clifford.johnson.6@us.af.mil.

The **US Army Communications-Electronics Command (CECOM) Security Assistance Management Directorate (SAMD)** issued a sources-sought Request for Information on behalf of the Romanian Army to replace or upgrade the country's Guardian and Kestrel RCIED jammers. The Romanian Army's requirement is for 94 vehicle-mounted jammers and 68 manpack systems. At a minimum, the systems must cover 20-2500MHz with 10-60W power output, perform barrage and sweep jamming, and provide an operational range of jamming 50m, signal level 80dBm. Targets at 10W include civil remote control toys, 350MHz TETRA, industrial remote control devices, VHF/UHF walkie-talkie, CDMA 800MHz, GSM900, GSM1800/GSM1900/PHS/CDMA, 3G 3G2 at 2000-2500MHz. The contracting point of contact is Charrissa Stancell, (410) 278-5424, e-mail charrissa.m.stancell.civ@mail.mil. ↗

**INTERFACE CONCEPT**  
ADVANCED ELECTRONIC SOLUTIONS  
[www.interfaceconcept.com](http://www.interfaceconcept.com)

## OPTIMIZED SINGLE BOARD COMPUTERS

Rely on cost-effective all-in-one unique solutions with processor platforms including on-board FPGAs, PCIe Switch and XMC board

- Wide SBC range: single or dual Intel® Xeon-D, NXP QorIQ® and multicore ARM processors
- 3U and 6U VPX, 6U VME form factors
- Bundle example: rugged 6U VPX dual Xeon SBC + Ethernet switch + Comm subsystem (XMC board)
- All BIOS, UEFI, UBOOT, Built-in-tests developed by IC
- MCOTS and custom designs based on your specific needs
- Applications: Radars, Electronic warfare, C4ISR, mission computers, IA

Since 1987, Interface Concept has been a leading developer and manufacturer of leading-edge HPEC embedded boards and systems for military, aerospace and industrial applications.

Elma Electronic Inc. is the North American sales and support provider for Interface Concept.

For more info, contact:  
**ELMA**  
 Your Solution Partner  
[www.elma.com](http://www.elma.com)  
[sales@elma.com](mailto:sales@elma.com) • 510-656-3400

# US Army Brings EMSO to the Air Defense Fight

By John Haystead

## Electromagnetic Spectrum Operations

(EMSO) have a growing role within the US Army's Air and Missile Defense (AMD) mission. On the one hand, the use of EMSO capabilities is clearly well underway on the countermeasures side. In addition to the deployment of highly-powerful and sensitive GaN-based arrays in air defense radars and active jamming systems, the Army is very active in the development of new Directed Energy (DE) weapons, such as High-Energy Lasers (HEL) and High-Power Microwave (HPM) for use in the AMD countermeasures role.

On the other hand, the integration and use of passive RF sensor technologies, such as passive radar and Electronic Support Measures (ESM) systems that serve as an adjunct to active radar sensors, leads to a much more complex paradigm. Any attempt at answering this question immediately involves examining not just the Army's overall initiatives for modernizing its forces for the future fight against peer and near-peer adversaries, but also that of the other services, the overall DOD future warfighting strategy and priorities and the considerations of US Allies and partners. These factors all have a direct impact on the shape and expectations of its AMD capabilities.

Starting at the DOD-level, the overall driver is to provide an all-inclusive, military-wide, integrated, distributed and fully-coordinated sensor-to-sensor and sensor-to-shooter capability that can incorporate all possible sources of threat data and countermeasure options. This brings us to the Combined Joint All-Domain Command & Control (CJADC2) initiative – the artificial intelligence (AI) and machine learning (ML)-enabled battlefield management framework to integrate and connect Allies and the Joint Force into all-domain (sea, air, land, cyber and space) operations to produce overmatch.

The Joint Staff is leading efforts to move CJADC2 from concept to policies, doctrine and requirements, and has designated the Air Force as the executive agent for technology development. The Air Force has proposed its Advanced Battle Management System (ABMS) as the architecture to provide the foundation of the CJADC2. The Navy has also announced that it plans to integrate its "Project Overmatch" into the overall CJADC2 concept. Project Overmatch is intended to "develop a new fleet architec-

ture using artificial intelligence and manned/unmanned teaming to enable Distributed Maritime Operations."

The Army also plans to contribute to the CJADC2 initiative through its "Project Convergence" exercises aimed at advancing and integrating the Army's contributions to the Joint Force through an AI/ML-enabled battlefield management system. "It ensures that the Army, as part of the Joint fight, can rapidly and continuously integrate or 'converge' effects across all domains to overmatch our adversaries in competition and conflict." Through Army Futures Command (AFC), the Service has conducted a series of experiments demonstrating the ability to provide access to Joint and coalition networks.

## ARMY AMD

Stepping down a level to address the Army's specific AMD mission, one of its top six modernization priorities, the discussion begins with the Service's "Air and Missile Defense 2028" document. Released in 2019, and developed by the US Army Space and Missile Defense Command (USASMD), Army Forces Strategic Command and informed by the 2018 National Defense Strategy and 2019 National Military Strategy, it provides the Army's overarching vision for the AMD force.

As in all military mission challenges, the strategy/solution begins with the threat, and there is a growing and advancing challenge for air defense capabilities from such threats as UAVs and drone swarms, sophisticated jamming, stealth technology, hypersonic weapon systems, etc. As described in the AMD 2028 document, "the future operating environment is characterized by increasingly complex threats, sustained operational tempo, limited resources, and the ability of adversaries to contest US forces in all domains." AMD 2028 identifies four specific lines of effort (LOEs): Develop Air and Missile Defense Capabilities; Build AMD Capacity for Multi-Domain Operations; Provide Trained and Ready AMD Forces; and Maintain Forward Presence and Build Allied and Partner Capacity.

As described by BG Brian Gibson, Director of the Air and Missile Defense Cross Functional Team (CFT) at Army Futures Command (Ft. Sill, OK), "The AMD 2028 strategy is our guiding document to provide us the way forward for AMD. The guidance

presents three key and essential tasks that we can't forget as we develop our capabilities and work through these Lines of Effort (LOEs). The first one is to protect the maneuver force, the second is to protect fixed and semi-fixed assets that enable dominant maneuver, and the third is to confer our capabilities to provide Joint windows of opportunity. These three essential tasks, proceeding along different timelines, fundamentally guide us to the AMD force outcomes that we're seeking to achieve."

Gibson emphasizes that one of the document's LOEs deals specifically with Allies and partners – "by with, and through them, that remains as well a work in progress for not only the robust capabilities that we share with them today as we operate side-by-side, but those that we're developing for the future. Says Gibson, "Within our CFT, we're not just focused on modernization of our own Army's AMD force, but on making sure that what we do is important for our Joint Integrated Air and Missile Defense (IAMD) force, as well as our international partners and Allies. This is a team sport; we can't protect everything, and we can't do it alone. Many times it's our partners and Allies that allow the Joint force to be successful."

In fact, Gibson says, "A keystone of the Army modernization strategy, and how we've organized across the Army with CFTs and priorities of programs, especially in AMD space, is working together with a whole bunch of other folks to achieve our desired outcomes. It's important to note that this effort is being conducted by a 'team of teams.'" In addition to the AMD CFT, these team members include the Program Executive Officer for Missiles and Space (PEO-MS) at Redstone Arsenal, and the Army Rapid Capabilities and Critical Technologies Office (RCCTO).

Says Gibson, "Within the AMD force, we're arguably seeking to achieve the greatest amount of modernization since the Cold War. I know that seems to roll off the tongue fairly easily, but it's also very true. As we pursue this modernization path, it's all about the central idea of attempting to increase our capabilities in speed, range, and convergence. But, the level of activity that we're pursuing inside of the Army, and the Branch specifically, is not just about new capabilities. Yes, those are important and are a big piece of it, but it's also about new formations who will be outfitted with those new capabilities. We need to continuously remember that it's always about the people, always has been,



*The Army's Lower Tier Air and Missile Defense System (LTAMDS) will provide new radar capabilities that could prove effective against hypersonic weapons.*

RAYTHEON IMAGE

and always will be. As we seek to deliver all these things, our focus is always at the soldier level, and as we go about our rapid developments, to make sure that the soldiers' input is absolutely understood, paramount, and welcome."

LTG Neil Thurgood, Director of Hypersonics, Directed Energy, Space and Rapid Acquisition at the Army Rapid Capabilities and Critical Technologies Office (RCCTO), adds that, "At the end of the day, the three Army organizations being covered in this [JED] article exist to get equipment to soldiers to fight on the battlefield, to put them in a place to be successful, and through the control of the common interfaces under PEO-MS, and with the requirements

and the vision that we have under General Gibson and the AMD community, the technology can be feathered into the system at a much faster pace, and leverage a much broader industrial base than just the traditional primes. There is a great opportunity here and a great focus that the Army has put on its modernization programs."

#### IAMD/IBCS

Heading up PEO-MS, MG Robert Rasch Jr., says his organization "is moving quickly in a lot of areas to try to make up for, quite frankly, an area that, given the recent fights we've been in, we may not have invested in as much as we would have liked to."

Says Rasch, "The key piece of this, within PEO-MS, is the Integrated Air and Missile Defense Battle Command System (IBCS)." IBCS is the command-and-control software that, along with the Integrated Fire Control Network, enables the integration of sensors and weapons to perform the AMD functions required to prosecute current and emerging threats. IBCS provides the ability to use any connected sensor to support the use of the best shooter.

Says Rasch, "IBCS is not a new activity – having been ongoing for about a decade now – but given where we are now with the program, having completed a limited user test last year, the Milestone C decision this last January, and heading into



Above, soldiers from the 3-6 Air and Missile Defense Test Detachment (3-6 AMDTD) participate in IBCS air defense intercept tests at White Sands Missile Range, New Mexico, in late 2019.

US ARMY IMAGE

Initial Operational Test and Evaluation (IOT&E) just within the month, we're in a really good place to make it a reality."

As Rasch describes, IBCS opens up Army AMD architecturally, allowing for rapid integration of new technologies as they become available. "We've been working diligently with both existing program managers and industry partners, as well as looking forward with the other Services, industry and the Science and Technology (S&T) community on things that could possibly come down the pipe. And what we've found through this learning opportunity is that by decoupling and allocating what would traditionally be a very tight kill-chain in an AMD architecture, that given the state-of-the-art of today's technology and having standards for interfaces for sensors and shooters, that we can do much more toward creating a more robust, layered air defense capability, which is what the users always ask for."

As the Army moves forward with IBCS, RCCTO's Thurgood notes that, "by opening the aperture for things to be integrated into the system, we really do two things for both our industry and our soldiers. Sometimes we think these are divergent paths, but they're actually parallel paths that bring us to the desired outcome for speed, range and convergence on the battlefield. The first part of this is that an integrated battle command system allows a common interface and an open architecture which absolutely opens competition in industry. No longer is it a single integrated prime contractor that we have to stick with for 10-20 years. Instead, we now have the ability to bring in technology as it is available through the control of the interfaces and entry into the IBCS architecture. The second part is that it actually opens the door for technology to be applied quicker and get into the hands of soldiers quicker."

Rasch says the focus for ICBS has always been on getting the architecture right not just for the Army but for Joint capabilities, "because AMD is, and always has been, a Joint endeavor. Now, with CJADC<sub>2</sub> providing the top-level standards for information flow, our job on the Army side is to make sure we can tie into that set of information as needed using the right standards and the right



Drones are a growing concern for ground forces. Above, an adversary UAS flies near a Sentinel Radar during a CJADC<sub>2</sub> demonstration at Sembach Kaserne, Germany, in February. US Air Forces in Europe conducted the CJADC<sub>2</sub> demonstration to highlight the force's ability to integrate network solutions and connect multiple sensors to a common operating network.

US AIR FORCE PHOTO

communication methods, whether satellite, fiber, RF communications, etc. to make sure that we can provide what we need to provide and consume what we need to consume."

RCCTO's Thurgood reiterates the point. "There are communications that happen at the squad level that have to be linked to the platoon level, to the company command level, to the battalion and brigade level echelons, etc. That linkage happens between the Services and between our Allies and partner nations in that same sort of hierarchical relationship. So CJADC<sub>2</sub>, at the top level, is going to feed IBCS, and in some cases IBCS will feed into the CJADC<sub>2</sub> environment. The command and control structures have to be worked as independent Services, as well as the Joint environment. Those linkages and interfaces have to have both a vertical and horizontal component, which is why this integration is part of the challenge. IBCS is a powerful capability and as CJADC<sub>2</sub> matures, we will continue to be consumers and users simultaneously."

The CFT's Gibson describes IBIS as "a kind of pathfinder representation of what CJADC<sub>2</sub> is envisioning to accomplish DOD-wide. It's the idea of 'any sensor/best shooter together with the right C2.' ICBS is an instantiation of that in

and of itself that seeks to break apart the limitations imposed by the tight coupling of our sensor and weapon system capabilities. Our number one priority is Integrated Air and Missile Defense (IAMD). It's the key to today, and also to our future – unlocking stove-pipe weapons systems of the past, where we couldn't connect an array of sensors, shooters, and the right C2. It has been, and will remain, our number one priority and we're in a good spot with that."

As pointed out by Gibson, however, "CJADC<sub>2</sub> is not just about AMD, it's about communications architectures, networks and data. It's also about things that matter inside Service lines, as Generals Rasch and Thurgood just talked about, and the need to make sure we're connected. So, we're very well nested at the Departmental level with the work that CJADC<sub>2</sub> is seeking to achieve and ICBS is a subset of that work."

## EMSO ROLE

In getting to the nitty gritty of the topic of this article, it certainly seems likely that EMSO technology, and specifically passive sensor systems, can potentially contribute significant additional capabilities to the AMD mission, but how much, what types, and where and when this can be brought about is



The Army Rapid Capabilities and Critical Technologies Office (RCCTO) has been developing a laser-equipped Directed Energy Maneuver Short-Range Air Defense (DE M-SHORAD) system, and it held a "shoot off" in August. The RCCTO plans to deliver a platoon of four systems in FY2022.

US ARMY IMAGE

difficult to pin down. In order to get an appreciation of the Army's thinking, and the extent of its efforts on this possibility, there appears to be a need to "read between the lines." One thing is definitely clear, however, such capabilities will definitely not be integrated directly into individual active surveillance and targeting systems. It will be done through the Army's IBCS and DOD's CJAD2 overall C2 network architectures.

In a broad-brush perspective on the subject, the CFT's Gibson, says "With regard to the incorporation and integration of passive EMSO sensor technologies and systems within our AMD capabilities, there are some things that we're not able to discuss because of classification and security concerns, but absolutely we're looking to have as broad of a dialogue as we can and whatever advantages that we can provide to our warfighters, we should seek to achieve. The more arrows

that we put in our quiver, the better we are at providing the necessary protection for the Joint force. Fundamentally, the idea of pursuing advanced technologies or other things that allow us to achieve that, we absolutely should seek to understand them, develop them, and if capable and mature enough, to field those capabilities based on the time and space at that particular time. We, and others besides AMD, are seeking to change the calculus and seeking to achieve an unfair fight (overmatch). And, we're seeking it in multiple ways and across multiple lines of effort."

Adds Rasch, "Not only is there not any single weapon system that solves all of our AMD problems, there is not a single sensor either. It's really about thickening the sensor network with a variety of radars and other sensor types, and as you look at the different capabilities that each brings to that mix, this creates

a dilemma in itself for an enemy. This is particularly true in the EMSO world in presenting these dilemmas to the enemy and how they will attempt to create offensive and sometimes defensive capabilities to counter them. We focus a lot of attention on that, on the capabilities of the systems both existing, new, and under development to look for the best mix of sensors that then support the shooters. The key is to have an architecture where we don't have to have them all at one place, but have the flexibility to provide our soldiers based upon the situation on the battlefield to have the right set of information flowing in from that set of sensors, whether organic Army, Joint, or in the future from CJADC2 to then cue one or a variety of shooters at the right point in time based upon the threat. That's ultimately what we're trying to achieve across this portfolio of capabilities." ↗

# The Next Big Thing in RFSoC is Here. *(And it's only 2.5 inches wide!)*

Now Available with  
**Gen 3**  
**RFSoC!**



## Small | Powerful | Deployable

Pentek's Model 6001 Gen 1 and 6003 Gen 3 RFSoC QuartzXM® modules let you quickly develop and deploy RFSoC technology, while optimizing your system for SWaP

Mounted on your custom carrier or Pentek's proven 3U VPX, SOSA Aligned 3U VPX, PCIe and SFF platforms, both QuartzXM modules come pre-loaded with a full suite of IP modules, robust software, and fully integrated hardware — all geared to shorten time to market and reduce design risk.

And at only 4"x2.5", it can be deployed in extremely compact environments, including aircraft pods, unmanned vehicles, mast-mounted radars and more.

- **QuartzXM eXpress Module** speeds migration to custom form factors
- **Powerful Zynq® Ultrascale+™ RFSoC** with built-in wideband A/Ds, D/As and ARM processors
- **Dual 100 GigE** interfaces for extreme system connectivity
- **Robust Factory-Installed IP** for synchronous real-time data acquisition, waveform generation and more
- **Board Resources** include PCIe Gen.3 x8 and 16 GB DDR4 SDRAM
- **Navigator® Design Suite** BSP and FPGA design kit for seamless integration with Xilinx Vivado®

**All this plus FREE lifetime applications support!**



RFSoC Gen 3 Product Family

**UQUARTZ** **NAVIGATOR**  
Design Suite



Unleash the Power of the RFSoC.  
Download the FREE White Paper!  
[www.pentek.com/go/jedrfsoc](http://www.pentek.com/go/jedrfsoc)

**PENTEK**  
Now Part of Mercury

Pentek, Inc., One Park Way, Upper Saddle River, NJ 07458  
Phone: 201-818-5900 • Fax: 201-818-5904 • email: [info@pentek.com](mailto:info@pentek.com) • [www.pentek.com](http://www.pentek.com)  
Worldwide Distribution & Support. Copyright © 2021 Pentek, Inc. Pentek, Quartz, QuartzXM and Navigator are trademarks of Pentek, Inc. Other trademarks are properties of their respective owners.



# 2022 EW/SIGINT Resource Guide

Welcome to the 2022 Electronic Warfare and Signals Intelligence Resource Guide. This guide is the print snapshot of the AOC's online EW/SIGINT Resource Guide, edited by *JED* editors. It is designed to list companies and organizations that manufacture products or provide services in the areas of electronic warfare and signals intelligence. This year, we added some new categories.

ISTOCK.COM/DIKOBRAZIY



## ABOUT THIS GUIDE

This guide was assembled by *JED*'s editorial staff, based on our own research and from updated information provided to us by companies. Though we have attempted to produce a comprehensive listing, we expect this guide to continue to grow. If your company conducts business in the EW or SIGINT markets and it does not appear in this year's guide, please see the note below on how to have your company listed.

## HOW TO USE THIS GUIDE

The guide's first section contains a "company listing," in which companies are featured in alphabetical order. The second section includes product and service categories, roughly organized by components/subsystems, software and services. The third section lists the companies in each category. Refer back to the company section for website and location data on listed companies.

## GET LISTED

If your company is missing or your data requires additional updates, please provide your information to us via e-mail to [JEDeditor@naylorcom](mailto:JEDeditor@naylorcom) so we may update our files. Please note that our next print guide will appear in October 2022, however, the online resource guide is live year-round at [www.ewsigint.net](http://www.ewsigint.net).

Visit the **JED Defense Electronics Resource Guide** on-line at  
**[www.jed.onlinemarketbase.org](http://www.jed.onlinemarketbase.org)**

## #

**3dB Labs**  
www.3db-labs.com

## A

**Aaronia AG**  
www.aaronia.com  
**Abaco Systems**  
www.abaco.com  
**Acromag**  
www.acromag.com  
**Adamy Engineering**  
dave@lynxpub.com  
**ADC Embedded Solutions**  
www.adl-usa.com  
**Advanced Electronics Company - Military Systems Business Unit**  
www.aecl.com  
**Advanced Microwave Inc.**  
www.advmic.com  
**Advanced Protection Systems**  
www.apsystems.tech  
**Advanced Testing Technologies Inc.**  
www.attinet.com  
**Aeromaoz**  
www.aeromaoz.com  
**Aeronix, Inc.**  
www.aeronix.com  
**Aethercomm, Inc.**  
www.aethercomm.com  
**Airborne Systems Limited**  
www.airborne-sys.com  
**Airborne Tactical Advantage Company**  
www.atacusa.com  
**AirScan Inc.**  
www.airscan.com  
**Aitech**  
www.aitechsystems.com  
**AKON, Inc.**  
www.akoninc.com  
**Alaris Antennas**  
www.alarisantennas.com  
**Albrecht Telecommunications**  
www.albrecht-telcom.ch  
**Alion Science and Technology**  
www.alionscience.com  
**Alker Optical Equipment**  
www.alker.co.uk  
**Allen-Vanguard Corp.**  
www.allenvanguard.com  
**Alpha Design Technologies Pvt. Ltd.**  
www.adtl.co.in  
**AMCOM Communications**  
www.amcomus.com  
**Amentum**  
www.amentum.com

**American Microwave Corp.**  
www.americanmicrowavecorp.com  
**Ampex**  
www.ampex.com  
**Amplifier Solutions Corp.**  
www.amplifiersolutions.com  
**AmpliTech**  
www.amplitechinc.com  
**Amplus Corporation**  
www.amplus-corp.com  
**AMT Microwave Corp.**  
www.amt-microwave.com  
**Analog Devices Inc.**  
www.analog.com  
**Anatech Electronics**  
www.anatechelectronics.com  
**Annapolis Micro Systems, Inc.**  
www.annapmicro.com  
**Anritsu**  
www.anritsu.com  
**ANSYS, Inc.**  
www.ansys.com  
**Antenna Authority**  
www.antennaauthorityinc.com  
**Antenna Experts**  
www.antennaexperts.in  
**Antenna Research Associates (ARA) Inc.**  
wwwара-inc.com  
**AntiDrone**  
https://anti-drone.eu  
**APITech**  
www.apitech.com  
**ApisSys**  
www.apissys.com  
**ApolloShield**  
www.apolloshield.com  
**Applied EM Inc.**  
www.appliedem.com  
**Applied Radar Inc.**  
www.appliedradar.com  
**Applied Research Associates**  
www.ara.com  
**Applied Systems Engineering Inc.**  
www.applsyst.com  
**Applied Technology Institute (ATI)**  
www.aticourses.com  
**Applied Thin Film Products**  
www.thinfilm.com  
**AR RF/Microwave Instrumentation**  
www.arworld.us  
**ARC Technologies**  
www.arc-tech.com  
**Arctan, Inc.**  
www.arctan-group.com  
**Argon ST, a Boeing Company**  
www.argonst.com  
**Armtec Defense Technologies**  
www.armtecdefense.com

**ARS Products**  
www.arsproducts.com  
**ArtSYS360**  
www.artsys360.com  
**ASELSAN A.S.**  
www.aselsan.com.tr  
**Assemblies Inc.**  
www.assembliesinc.net  
**Association of Old Crows**  
www.crows.org  
**Astronautics C.A. Ltd.**  
www.astronautics.co.il  
**ATDI**  
www.atdi.com  
**Atkinson Aeronautics and Technology Inc.**  
www.ataero.com  
**Atlanta Micro**  
www.atlantamicro.com  
**Atos**  
www.atos.net  
**Atrenne**  
www.atrenne.com  
**ATS Cases**  
www.atscases.com  
**Avalon Electronics, Inc.**  
www.avalonelectronics.co.uk  
**AVdef - Aviation Defence Service**  
www.avdef.fr  
**Axient**  
www.axient.com  
**Azure Summit Technology**  
www.azuresummit.com

## B

**B&K Precision**  
www.bkprecision.com  
**Babcock International Group, Defence and Security Div.**  
www.babcockinternational.com  
**BAE Systems**  
www.baesystems.com  
**BARCO**  
www.barco.com  
**Base2 Engineering LLC**  
www.base2engineering.com  
**BATS**  
www.bats.be  
**Battlespace Simulations, Inc.**  
www.bssim.com  
**BC Systems**  
www.bcpowersys.com  
**Behlman Electronics**  
www.behlman.com  
**BEL - Bharat Electronics Ltd.**  
www.bel-india.com  
**Berkeley Nucleonics Corp.**  
www.berkeleynucleonics.com  
**BIRD Aerostystems**  
www.birdaero.com  
**Bird Technologies**  
www.bird-technologies.com

## BittWare

www.bittware.com  
**BJG Electronics**  
www.bjgelectronics.com  
**Black Sage**  
www.blacksagetech.com  
**Blue Halo**

www.bluehalo.com  
**Blue Ridge**  
Envisioneering, Inc.  
www.br-envision.com  
**Boeing Military Aircraft**  
www.boeing.com  
**Boger Electronics**  
www.boger.de  
**Booz Allen Hamilton, Inc.**  
www.boozaallen.com  
**Boyd Corporation**  
www.boydcorp.com  
**BSC Filters**  
www.dovermpg.com/  
bscfilters

## C

**C&S Antennas**  
www.csantennas.com  
**Cablex PTY Ltd.**  
www.cablex.com.au  
**CACI Technologies Inc.**  
www.caci.com  
**CAL-AV Labs Inc.**  
www.cal-av.com  
**Carlisle Interconnect Technologies**  
www.carlisleit.com  
**CDM Electronics**  
www.cdmelectronics.com  
**CEA Technologies**  
www.cea.com.au  
**CerbAir**  
www.cerbair.com  
**Chemring Australia**  
www.chemring.com.au  
**Chemring Countermeasures UK**  
www.chemring.com  
**Chemring Countermeasures USA**  
www.chemrin.com  
**Chemring Technology Solutions**  
www.chemring.com  
**Chesapeake Technology Intl (CTI)**  
www.ctic.us  
**Chordell Systems**  
www.chordell.com  
**CI Systems (Israel) Ltd.**  
www.ci-systems.com  
**Ciao Wireless, Inc.**  
www.ciaowireless.com  
**CILAS**  
www.cilas.com  
**Citadel Defense**  
www.dronecitadel.com

**Clausewitz Technology**

[www.clausewitztechnology.com](http://www.clausewitztechnology.com)

**Clearbox Systems**

[www.clearboxsystems.com.au](http://www.clearboxsystems.com.au)

**Cobham**

[www.cobham.com](http://www.cobham.com)

**Coherent Inc.**

[www.coherent.com](http://www.coherent.com)

**COJOT**

[www.cojot.com](http://www.cojot.com)

**Coleman Microwave Company**

[www.colemanmw.com](http://www.colemanmw.com)

**Collins Aerospace**

[www.collinsaerospace.com](http://www.collinsaerospace.com)

**Colorado Engineering Inc.**

[www.coloradoengineering.com](http://www.coloradoengineering.com)

**COMINT Consulting**

[www.comintconsulting.com](http://www.comintconsulting.com)

**Communication Power Corporation**

[www.cpcamps.com](http://www.cpcamps.com)

**Communications & Power Industries, Inc (CPI)**

[www.cpii.com](http://www.cpii.com)

**Communications Audit UK Limited**

[www.commsaudit.com](http://www.commsaudit.com)

**Completer.net**

[www.completer.net](http://www.completer.net)

**COMSEC LLC**

[www.comsecllc.com](http://www.comsecllc.com)

**Comtech PST**

[www.comtechpst.com](http://www.comtechpst.com)

**Concurrent Technologies**

[www.ctc.com](http://www.ctc.com)

**Conduant Corp.**

[www.conduant.com](http://www.conduant.com)

**Corvus**

[www.corvus-consulting-llc.com](http://www.corvus-consulting-llc.com)

**CP Cases**

[www.cpcases.com](http://www.cpcases.com)

**Crane Aerospace & Electronics**

[www.craneae.com](http://www.craneae.com)

**CRFS**

[www.crfss.com](http://www.crfss.com)

**CSIR - DPSS**

[www.csir.co.za](http://www.csir.co.za)

**CTL SystemWare**

[www.sysware.com](http://www.sysware.com)

**CTS Technology Co. Ltd.**

[www.ctstechnologys.com](http://www.ctstechnologys.com)

**CTT, Inc.**

[www.cttinc.com](http://www.cttinc.com)

**Cubic Nuvotronics**

[www.nuvotronics.com](http://www.nuvotronics.com)

**Cuming Microwave Corp.**

[www.cumingmicrowave.com](http://www.cumingmicrowave.com)

**Curtiss-Wright Defense Solutions**

[www.curtaiswrightds.com](http://www.curtaiswrightds.com)

**Custom Cable Assemblies, Inc.**

[www.customcableinc.com](http://www.customcableinc.com)

**CyberRadio Solutions**

[www.cyberradiosolutions.com](http://www.cyberradiosolutions.com)

**D****D-Fend Solutions A.D. Ltd.**

[www.d-fendsolutions.com](http://www.d-fendsolutions.com)

**DAICO Industries**

[www.daico.com](http://www.daico.com)

**DaqScribe Solutions, LLC**

[www.daqscribe.com](http://www.daqscribe.com)

**DARE Electronics, Inc.**

[www.dareelectronics.com](http://www.dareelectronics.com)

**Darkblade Systems****Corporation**

[www.darkbladesystems.com](http://www.darkbladesystems.com)

**Dayton-Granger**

[www.daytongranger.com](http://www.daytongranger.com)

**dB Control**

[www.dBControl.com](http://www.dBControl.com)

**DCS Corp.**

[www.dcscorp.com](http://www.dcscorp.com)

**Decodio AG**

[www.decodio.com](http://www.decodio.com)

**DeDrone**

[www.dedrone.com](http://www.dedrone.com)

**Deepwave Digital**

[www.deepwavedigital.com](http://www.deepwavedigital.com)

**Defence Research and****Development Canada**

[www.drdc-rddc.gc.ca](http://www.drdc-rddc.gc.ca)

**Défense Conseil****International (DCI)**

[www.groupedci.com](http://www.groupedci.com)

**Defense Engineering Corp.**

[www.defengcorp.com](http://www.defengcorp.com)

**Defense Research****Associates, Inc.**

[www.dra-engineering.com](http://www.dra-engineering.com)

**Delphi Engineering Group**

[www.delphieng.com](http://www.delphieng.com)

**Department 13**

[www.department13.com](http://www.department13.com)

**DeTect Inc.**

[www.detect-inc.com](http://www.detect-inc.com)

**DHPC Technologies**

[www.dhptech.com](http://www.dhptech.com)

**Diamond Microwave**

[www.diamondmw.com](http://www.diamondmw.com)

**Diehl Defence**

[www.diehl.com](http://www.diehl.com)

**Digital Receiver Technology, A Boeing Company (DRT)**

[www.drti.com](http://www.drti.com)

**DILAS Diodenlaser GmbH**

[www.dilas.com](http://www.dilas.com)

**diminuSys**

[www.diminusys.com](http://www.diminusys.com)

**Dow-Key Microwave**

[www.dowkey.com](http://www.dowkey.com)

**Dr. EW (Johnny Heikell)**

[www.heikell.fi](http://www.heikell.fi)

**Dragoon ITCN**

[www.dragoonitcn.com](http://www.dragoonitcn.com)

**Draken International**

[www.draken.aero](http://www.draken.aero)

**Dreamlab Technologies AG**

[www.dreamlab.net](http://www.dreamlab.net)

**DroneShield**

[www.droneshield.com](http://www.droneshield.com)

**DRS Daylight Solutions**

[www.daylightsolutions.com](http://www.daylightsolutions.com)

**DSE International**

[www.dseinternational.com](http://www.dseinternational.com)

**D-TA Systems**

[www.d-ta.com](http://www.d-ta.com)

**Ducommun Technologies**

[www.ducommun.com](http://www.ducommun.com)

**Dynamic Analytics & Test, Inc.**

[www.dat-inc.com](http://www.dat-inc.com)

**Dynamic Signals LLC**

[www.dynamicsignals.com](http://www.dynamicsignals.com)

**DynaWave Inc.**

[www.dynawave.com](http://www.dynawave.com)

**Dynetics Inc.**

[www.dynetics.com](http://www.dynetics.com)

**E****Ecrin Systems**

[www.ecrin.com](http://www.ecrin.com)

**ECS, LLC**

[www.ecs-federal.com](http://www.ecs-federal.com)

**ECS Composites**

[www.ecscomposites.com](http://www.ecscomposites.com)

**Elbit Systems**

[www.elbitsystems.com](http://www.elbitsystems.com)

**ELDES S.r.l.**

[www.eldesradar.com](http://www.eldesradar.com)

**Electro-Metrics Corp.**

[www.electro-metrics.com](http://www.electro-metrics.com)

**Electronic Warfare Studying Group, Korean Institute of Electromagnetic Engineering & Science**

[www.kiees.or.kr/english](http://www.kiees.or.kr/english)

**Electronic Warfare Tactical/Training Support**

[www.ewtsllc.com](http://www.ewtsllc.com)

**Elektrobit**

[www.elektrobit.com](http://www.elektrobit.com)

**Elettronica SpA**

[www\\_elt-roma.com](http://www_elt-roma.com)

**Elite RF**

[www.eliterflc.com](http://www.eliterflc.com)

**Elma Electronic**

[www.elma.com](http://www.elma.com)

**ELTA Systems Ltd.**

[www.iai.co.il](http://www.iai.co.il)

**EM Research**

[www.emresearch.com](http://www.emresearch.com)

**Emhiser Research, Inc.**

[www.emhiser.com](http://www.emhiser.com)

**Empower RF Systems**

[www.EmpowerRF.com](http://www.EmpowerRF.com)

**Enablia S.R.L.**

[www.enablia.com](http://www.enablia.com)

**Enterprise Control Systems**

[www.enterprisecontrol.co.uk](http://www.enterprisecontrol.co.uk)

**Epiq Solutions**

[www.epiqsolutions.com](http://www.epiqsolutions.com)

**ERZIA Technologies SL**

[www.erzia.com](http://www.erzia.com)

**Espy Corp.**

[www.espy.com](http://www.espy.com)

**ESROE Limited**

[www.esroe.com](http://www.esroe.com)

**Esterline Defense Technologies**

[www.estrlne.com](http://www.estrlne.com)

**ET Industries**

[www.etiworld.com](http://www.etiworld.com)

**ETL Systems**

[www.etlsystems.com](http://www.etlsystems.com)

**ETM Electromatic Inc.**

[www.etm-inc.com](http://www.etm-inc.com)

**ETS-Lindgren**

[www.ets-lindgren.com](http://www.ets-lindgren.com)

**Evans Capacitor Company**

[www.evanscap.com](http://www.evanscap.com)

**EW Solutions Ltd.**

[www.solutions-ew.com](http://www.solutions-ew.com)

**EWA - Electronic Warfare Associates**

[www.ewa.com](http://www.ewa.com)

**Excelitas Technologies**

[www.excelitas.com](http://www.excelitas.com)

**Exodus Advanced Communications**

[www.exoduscomm.com](http://www.exoduscomm.com)

**Extant Aerospace**

[www.extantaerospace.com](http://www.extantaerospace.com)

**Extreme Engineering Solutions (X-ES)**

[www.xes-inc.com](http://www.xes-inc.com)

**F****Fairview Microwave**

[www.fairviewmicrowave.com](http://www.fairviewmicrowave.com)

**FEI-Elcom Tech**

[www.fei-elcomtech.com](http://www.fei-elcomtech.com)

**FEI-Zyfer**

[www.zyfer.com](http://www.zyfer.com)

**First RF Corp.**

[www.firstrf.com](http://www.firstrf.com)

**Flann Microwave**

[www.flann.com](http://www.flann.com)

**FLEXCO Microwave**

[www.flexcomw.com](http://www.flexcomw.com)

**FMV Test & Evaluation**

[www.fmv.se](http://www.fmv.se)

**Fractal Antenna Systems**

[www.fractenna.com](http://www.fractenna.com)

**FS Antennentechnik GmbH**

[www.fsant.de](http://www.fsant.de)

**G****Galleon Embedded Computing**

[www.galleonec.com](http://www.galleonec.com)

**General Atomics**

[www.ga.com](http://www.ga.com)

# The Only Full EcoSystem of 3U & 6U 100Gb Ethernet SOSA™-Aligned Products



6.4 Tb/s  
100GbE  
SWITCHING



FPGA  
DIGITIZING &  
PROCESSING



CHASSIS,  
BACKPLANE &  
SECURE  
CHASSIS MANAGER

16 TB DEPTH &  
5 GB/s RATE  
RECORDING



Annapolis  
Micro Systems

We GUARANTEE Seamless 100GbE System Integration  
Because We Design and Manufacture Every Product

## COMPANY LISTINGS

### General Dynamics Mission Systems

[www.gdmissons.com](http://www.gdmissons.com)  
**Genesis EW Ltd.**  
<https://genesisew.wixsite.com/genesis-ew>

### Georgia Tech Research Institute

[www.gtri.gatech.edu](http://www.gtri.gatech.edu)  
**GEW Technologies (Pty) Ltd.**

[www.gew.co.za](http://www.gew.co.za)  
**Giga-tronics Inc.**

[www.gigatronics.com](http://www.gigatronics.com)  
**Glenair, Inc.**

[www.glenair.com](http://www.glenair.com)  
**GMS Computing Engines**

[www.gms4sb.com](http://www.gms4sb.com)  
**Good Will Instrument Co. Ltd.**

[www.gwinstek.com](http://www.gwinstek.com)  
**Gowanda Components Group**  
[www.gowandacomponentsgroup.com](http://www.gowandacomponentsgroup.com)

### H

#### HARP

[www.harpurge.com](http://www.harpurge.com)

**Hascall-Denke**  
[www.hascall-denke.com](http://www.hascall-denke.com)

**HawkEye 360**  
[www.he360.com](http://www.he360.com)

**HAVELSAN**  
[www.havelsan.com.tr](http://www.havelsan.com.tr)

**Hegarty Research LLC**  
[www.hegartyresearch.com](http://www.hegartyresearch.com)

**Hensoldt**  
[www.hensoldt.net](http://www.hensoldt.net)

**Hermetic Solutions**  
[www.hermeticsolutions.com](http://www.hermeticsolutions.com)

**Herotek, Inc.**  
[www.herotek.com](http://www.herotek.com)

**Herrick Technology Labs**  
[www.herricktechlabs.com](http://www.herricktechlabs.com)

**High + Mighty International**  
[www.anti-drones.net](http://www.anti-drones.net)

**Honeywell Aerospace**  
[www.aerospace.honeywell.com](http://www.aerospace.honeywell.com)

**Horizon Technologies**  
[www.horizontechnologies.eu](http://www.horizontechnologies.eu)

**HP Marketing and Consulting Wüst GmbH**  
[www.hp-jammer.de](http://www.hp-jammer.de)

**HUBER+SUHNER AG**  
[www.hubersuhner.com](http://www.hubersuhner.com)

**Hunan NovaSky Electronic Technology**  
[www.novaskycn](http://www.novaskycn)

### I

#### IACIT

<http://iacit.com.br>

**IDSI LLC**  
[www.idsillc.com](http://www.idsillc.com)

### I.F. Engineering Corp.

[www.ifengineering.com](http://www.ifengineering.com)  
**IFI - Instruments for Industry Inc.**

[www.ifi.com](http://www.ifi.com)

### IKHANA Aircraft Services

[www.ikhaganagroup.com](http://www.ikhaganagroup.com)

### IMI Systems

[www.imisystems.com](http://www.imisystems.com)

### Impact Cases

[www.impactcases.com](http://www.impactcases.com)

### INDRA

[www.indracompany.com](http://www.indracompany.com)

### INNOSYSTECH GmbH

[www.innosystec.de](http://www.innosystec.de)

### Innovative Integration

[www.innovative-dsp.com](http://www.innovative-dsp.com)

### Intel Product Solutions Group

[www.intel.com](http://www.intel.com)

### Intelligent Automation Inc.

[www.i-a-i.com](http://www.i-a-i.com)

### Interface Concept

[www.interfaceconcept.com](http://www.interfaceconcept.com)

### Invisible Interdiction

<http://www.invisidiction.com>

### iRF Solutions

[www.irf-solutions.com](http://www.irf-solutions.com)

### ISPAS AS

[www.ispas.biz](http://www.ispas.biz)

### ITA International

[https://ita-intl.com](http://www.ita-intl.com)

### iVeia, LLC

[www.iveia.com](http://www.iveia.com)

### IW Microwave

[www.iw-microwave.com](http://www.iw-microwave.com)

### IZT GmbH

[www.itz-labs.de](http://www.itz-labs.de)

### J

### Jabil Defense and Aerospace Services

[www.jabil.com](http://www.jabil.com)

### Jackson Labs Technologies, Inc.

[www.jackson-labs.com](http://www.jackson-labs.com)

### JB Management, Inc.

[www.gojbim.com](http://www.gojbim.com)

### JEM Engineering

[www.jemengineering.com](http://www.jemengineering.com)

### Jenkins Engineering Defence Systems

[www.jeds.com.au](http://www.jeds.com.au)

### Jersey Microwave

[www.jersemicrowave.com](http://www.jersemicrowave.com)

### JFW Industries

[www.jfwindustries.com](http://www.jfwindustries.com)

### Jordan Electronic Logistic Support - Electronic Warfare

[www.jels-tech.com](http://www.jels-tech.com)

### JT4 LLC

[www.jt4llc.com](http://www.jt4llc.com)

### K

### K&L Microwave, Inc.

[www.klmicrowave.com](http://www.klmicrowave.com)

### Kerberos International

[www.bererosinc.com](http://www.bererosinc.com)

### Keysight Technologies

[www.keysight.com](http://www.keysight.com)

### Kihomac, Inc.

[www.kihomac.com](http://www.kihomac.com)

### Kirintec

[www.kirintec.com](http://www.kirintec.com)

### Kleos Space

[www.kleos.space](http://www.kleos.space)

### KMIC Technology, Inc.

[www.kmictech.com](http://www.kmictech.com)

### Knowles Precision Devices

[www.knowlescapacitors.com](http://www.knowlescapacitors.com)

### Kranze Technology Solutions, Inc. (KTS)

[www.kranzetech.com](http://www.kranzetech.com)

### Kratos Defense & Security Solutions, Inc.

[www.kratosdefense.com](http://www.kratosdefense.com)

### Krytar Inc.

[www.krytar.com](http://www.krytar.com)

### L

### L3Harris Technologies

[www.l3harris.com](http://www.l3harris.com)

### Lacroix

[www.lacroixds.com](http://www.lacroixds.com)

### Laird Technologies

[www.lairdtech.com](http://www.lairdtech.com)

### LCR Embedded Systems

[www.lcrembeddedsystems.com](http://www.lcrembeddedsystems.com)

### Leidos, Inc.

[www.leidos.com](http://www.leidos.com)

### Leonardo

[www.leonardocompany.com](http://www.leonardocompany.com)

### Lexatys

[www.lexatys.com](http://www.lexatys.com)

### Link Microtek

[www.linkmicrotek.com](http://www.linkmicrotek.com)

### Linwave Technology

[www.linwave.co.uk](http://www.linwave.co.uk)

### Liteye Systems, Inc.

[www.liteye.com](http://www.liteye.com)

### Littelfuse

[www.littelfuse.com](http://www.littelfuse.com)

### Lockheed Martin

[www.lockheedmartin.com](http://www.lockheedmartin.com)

### LOG.IN Srl

[www.loginshowroom.com](http://www.loginshowroom.com)

### Logus Microwave

[www.logus.com](http://www.logus.com)

### LS Telcom

[www.lstelcom.com](http://www.lstelcom.com)

### M

### MACOM

[www.macom.com](http://www.macom.com)

### MagiQ Technologies, Inc.

[www.magiqtech.com](http://www.magiqtech.com)

### ManTech International Corp.

[www.mantech.com](http://www.mantech.com)

### MarServices GmbH

[www.marservices.de](http://www.marservices.de)

### MASS

[www.mass.co.uk](http://www.mass.co.uk)

### MBDA

[www.mbda-systems.com](http://www.mbda-systems.com)

### MC Countermeasures Inc.

[www.mc-cm.com](http://www.mc-cm.com)

### MCTech

[www.mctech-jammers.com](http://www.mctech-jammers.com)

### MECA Electronics

[www.e-meca.com](http://www.e-meca.com)

### MegaPhase

[www.megaphase.com](http://www.megaphase.com)

### Meggitt

[www.meggitt.com](http://www.meggitt.com)

### Mercer Engineering Research Center

[www.merc-merc.org](http://www.merc-merc.org)

### Mercury Systems

[www.mrcy.com](http://www.mrcy.com)

### Meritis Group

[www.meritis.ch](http://www.meritis.ch)

### MES S.p.A.

[www.mesroma.it](http://www.mesroma.it)

### Meta Aerospace

[www.meta.aero](http://www.meta.aero)

### Metamagnetics

[www.mtmgx.com](http://www.mtmgx.com)

### Metis Aerospace Ltd.

[www.metisaerospace.com](http://www.metisaerospace.com)

### Micro Lambda Wireless, Inc.

[www.microlambda-wireless.com](http://www.microlambda-wireless.com)

### Micronetixx, P.A.

[www.micronetixx.com](http://www.micronetixx.com)

### Microphase Corp.

[www.microphase.com](http://www.microphase.com)

### Microwave Amplifiers Ltd.

[www.microwaveamps.co.uk](http://www.microwaveamps.co.uk)

### Microwave Applications Group

[www.magsmx.com](http://www.magsmx.com)

### Microwave Communications Laboratories

[www.mcli.com](http://www.mcli.com)

### Microwave Dynamics

[www.microwave-dynamics.com](http://www.microwave-dynamics.com)

### Microwave Engineering Corp.

[www.microwaveeng.com](http://www.microwaveeng.com)

### Microwave Filter Company

[www.microwavefilter.com](http://www.microwavefilter.com)

### Microwave Products Group

[www.dovermpg.com](http://www.dovermpg.com)

### Microwave Specialty Company

[www.microwavespecialty.com](http://www.microwavespecialty.com)

### Microwave Vision Group

[www.mvg-world.com](http://www.mvg-world.com)

### Mid-Atlantic RF Systems

[www.midatlanticrf.com](http://www.midatlanticrf.com)

**Midwest Microwave Solutions Inc.**

www.mms-rf.com

**Military Optical RF Equipment Ltd.**

www.eimore.co.il

**MILMEGA, a Teseq Company**

www.milmega.co.uk

**Milso AB**

www.milso.se

**Mini-Circuits**

www.minicircuits.com

**Mission Microwave**

www.missionmicrowave.com

**The Mitre Corporation**

www.mitre.org

**Mitsubishi Electric Corp.**

www.mitsubishielectric.com

**Modern Technology Solutions, Inc.**

www.mtsi-va.com

**Momentive Performance Materials**

www.momentive.com

**Montena Technology sa**

www.montena.com

**Motorola Solutions - Applied Technology Division**

www.motorolasolutions.com

**MRSL**

www.mrsl.com

**mWave Industries, LLC**

www.mwavellc.com

**My-konsult**

www.mykonsult.com

**MyDefence Communication**

http://mydefence.dk

**N****N-Ask Incorporated**

www.nask.world

**Narda Safety Test Solutions**

www.narda-sts.com

**National Instruments Corp. (NI)**

www.ni.com

**NEC Network and Sensor Systems, Ltd.**

www.necnets.co.jp

**NEL Frequency Controls, Inc.**

www.nelfc.com

**Netline Communications Technologies**

www.netlinetech.com

**New Wave Design & Verification**

www.newwavedv.com

**Norden Millimeter, Inc.**

www.nordengroup.com

**Northeast Information Discovery, Inc.**

www.neidinc.com

**Northrop Grumman Corp.**

www.northropgrumman.com

**Nova Integration Solutions**

www.novaintegration.com

**Nova Systems**

www.novadefence.com.au

**Novatech Instruments**

www.novatech-instr.com

**NovAtel**

www.novatel.com

**Novator Solutions AB**

www.novatorsolutions.com

**NuWaves Engineering**

www.nuwaves.com

**NXP Semiconductors**

www.nxp.com

**O****Ocean Microwave Corp.**

www.oceanmicrowave.com

**Octane Wireless**

www.octanewireless.com

**OEwaves**

www.oewaves.com

**OPHIR RF**

www.ophirrf.com

**Orad**

www.orad.cc

**Overlook Systems**

Technologies, Inc.

www.overlooksyst.com

**P****Parker Aerospace**

www.parker.com

**Parry Labs**

www.parrylabs.com

**Parsec**

www.parsec.co.za

**Parsons**

www.parsons.com

**Pasternack Enterprises**

www.pasterback.com

**Patria**

www.patriagroup.com

**Pelican Cases**

www.pelican.com

**Pendar Technologies**

www.pendartechnologies.com

**Pentek**

www.pentek.com

**Peralex**

www.peralex.com

**Per Vices Corp.**

www.pervices.com

**Petards Group**

www.petards.com

**Phase II Staffing and Contracting LLC**

www.p2sc.net

**Phase Matrix**

www.phasematrix.net

**Phasor Innovation PTY Ltd.**

www.phasorinnovation.com

**Phoenix Air**

www.phoenixair.com

**Photonis Defense, Inc.**

www.photonisdefense.com

**Pixus Technologies**

www.pixustechnologies.com

**PKI Electronic Intelligence**

www.pkl-electronic.com

**Planar Monolithics****Industries, Inc.**

www.pmi-rf.com

**PLATH AG**

www.plath-ag.ch

**PLATH GmbH & Co KG**

www.plath.de

**PLATH Signal Products**www.plath-signal  
products.com**Plexsa Manufacturing**

www.plexsa.com

**Plextek DTS**

www.plextek-dts.com

**Pole/Zero Corp.**

www.polezero.com

**Pranalytica**

www.pranalytica.com

**Precision Connector, Inc.**

www.precisionconnector.com

**Precision Display****Technologies**

www.pdt-usa.com

**PROCITEC GmbH**

www.procitec.de

**Q****Q Microwave, Inc.**

www.qmicrowave.com

**QinetiQ Ltd.**

www.QinetiQ.com

**Qnion Co., Ltd.**

www.qnion.com

**Qorvo**

www.qorvo.com

**QRC Technologies**

www.qrctech.com

**Quarterwave Corp.**

www.quarterwave.com

**QuinStar Technology, Inc.**

www.quinstar.com

**R****R.A. Wood Associates**

www.rawood.com

**RADA USA**

www.radausa.com

**Radiall**

www.radiall.com

**Radio Reconnaissance Technologies**

www.radiorecon.com

**Radixon**

www.radixon.com

**RADX Technologies, Inc.**

www.radxtech.com

**NEW WAVE DV**  
Design & Verification

- ETHERNET • FIBRE CHANNEL • MIL1394 •
- sFPDP • ARINC 818 • CUSTOM •

**RUGGED HIGH-PERFORMANCE INTERFACES & COMPUTING SOLUTIONS**

Customized or Off-The-Shelf High-Speed Serial Interfaces, FPGA Coprocessors, Maintenance/Sustainment Equipment, and IP cores

Trusted Embedded and Test Solutions

**INTERESTED IN LEARNING MORE?**

New Wave Design & Verification  
[www.newwavedv.com](http://www.newwavedv.com)  
Tel: +1.952.224.9201  
[info@newwavedv.com](mailto:info@newwavedv.com)

**Rafael – Advanced Defense Systems LTD**  
[www.rafael.co.il](http://www.rafael.co.il)  
**Rantelon**  
[www.rantelon.ee](http://www.rantelon.ee)  
**Raytheon**  
[www.raytheon.com](http://www.raytheon.com)  
**Red Rapids**  
[www.redrapids.com](http://www.redrapids.com)  
**Renaissance Electronics Corp.**  
[www.rec-usa.com](http://www.rec-usa.com)  
**Research Associates of Syracuse (RAS)**  
[www.ras.com](http://www.ras.com)  
**Research Electronics International (REI)**  
[www.reiusa.net](http://www.reiusa.net)  
**Reut Systems & Technologies (RST)**  
[www.rst-tech.co.il](http://www.rst-tech.co.il)  
**RF Engines Ltd.**  
[www.rfel.com](http://www.rfel.com)  
**RF Industries**  
[www.rfindustries.com](http://www.rfindustries.com)  
**RF Logic**  
[www.rflogic.net](http://www.rflogic.net)  
**RFcore Co., Ltd.**  
[www.rfcore.com](http://www.rfcore.com)  
**RFHIC USA**  
[www.rfhic.com](http://www.rfhic.com)  
**RH Laboratories**  
[www.rh-labs.com](http://www.rh-labs.com)  
**Rheinmetall Defence**  
[www.rheinmetall-defence.com](http://www.rheinmetall-defence.com)  
**Rincon Research Corporation**  
[www.rincon.com](http://www.rincon.com)  
**Riverside Research Institute**  
[www.riversideresearch.org](http://www.riversideresearch.org)  
**Rodale Electronics Inc.**  
[www.rodaleelectronics.com](http://www.rodaleelectronics.com)  
**Rodelco Electronics Corp.**  
[www.rodelco-usa.com](http://www.rodelco-usa.com)  
**Rohde & Schwarz GmbH & Co. KG**  
[www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
**Rotating Precision Mechanisms, Inc.**  
[www.rpm-psi.com](http://www.rpm-psi.com)  
**RUAG – Aerospace**  
[www.ruag.com](http://www.ruag.com)  
**Rubisoft**  
[www.rubisoft.fr](http://www.rubisoft.fr)  
**RVJ Institute**  
[www.rvjinstitute.org](http://www.rvjinstitute.org)

**S**  
**S2 Corp.**  
[www.s2corporation.com](http://www.s2corporation.com)  
**Saab**  
[www.saabgroup.com](http://www.saabgroup.com)

**Safran Electronics and Defense**  
[www.safran-electronics-defense.com](http://www.safran-electronics-defense.com)  
**Sagax Communications**  
[www.sagax-communications.com](http://www.sagax-communications.com)  
**Sage Millimeter**  
[www.sagemillimeter.com](http://www.sagemillimeter.com)  
**SAIC**  
[www.saic.com](http://www.saic.com)  
**Samel 90**  
[www.samel90.com](http://www.samel90.com)  
**Santa Barbara Infrared Inc.**  
[www.sbir.com](http://www.sbir.com)  
**Schaefer Electronics**  
[www.schaeferpower.com](http://www.schaeferpower.com)  
**Scientific Research Corp.**  
[www.scires.com](http://www.scires.com)  
**SEA**  
[www.sea.co.uk](http://www.sea.co.uk)  
**Sechan Electronics Inc.**  
[www.sechan.com](http://www.sechan.com)  
**Select Fabricators**  
[www.select-fabricators.com](http://www.select-fabricators.com)  
**Sensofusion**  
[www.sensofusion.com](http://www.sensofusion.com)  
**SensorCom Inc.**  
[www.sensorcominc.com](http://www.sensorcominc.com)  
**Seqtor ApS**  
[www.seqtor.com](http://www.seqtor.com)  
**Serpikom**  
[www.serpikom.eu](http://www.serpikom.eu)  
**SESP Group**  
[www.sesp.com](http://www.sesp.com)  
**Seven Technologies Group**  
[www.7techgroup.com](http://www.7techgroup.com)  
**Shadow Technologies**  
[www.35technologiesgroup.wordpress.com](http://www.35technologiesgroup.wordpress.com)  
**Shakespeare Military Products**  
[www.shakespeare-military.com](http://www.shakespeare-military.com)  
**Shoghi Communications Ltd.**  
[www.shoghi.co.in](http://www.shoghi.co.in)  
**Sierra Nevada Corp.**  
[www.sncorp.com](http://www.sncorp.com)  
**Signal Antenna Systems Inc.**  
[www.signalantenna.com](http://www.signalantenna.com)  
**Signal Hound**  
[www.signalhound.com](http://www.signalhound.com)  
**SignalCore Inc.**  
[www.signalcore.com](http://www.signalcore.com)  
**Silentium Defence**  
[www.silentium-defence.com.au](http://www.silentium-defence.com.au)  
**Silver Palm Technologies**  
[www.silverpalmtech.com](http://www.silverpalmtech.com)  
**Simulation Technologies**  
[www.simtechinc.com](http://www.simtechinc.com)  
**SimVentions**  
[www.simventions.com](http://www.simventions.com)  
**SINTIS Technology Ltd.**  
[www.sintistechology.com](http://www.sintistechology.com)

**Sivers IMA AB**  
[www.siversima.com](http://www.siversima.com)  
**SkySafe**  
[www.skysafe.io](http://www.skysafe.io)  
**Skyworks Solutions**  
[www.skyworksinc.com](http://www.skyworksinc.com)  
**SMAG Mobile Antenna Masts GmbH**  
[www.smam.de](http://www.smam.de)  
**Smiths Interconnect**  
[www.smithsinterconnect.com](http://www.smithsinterconnect.com)  
**Solid State Devices, Inc.**  
[www.ssdi-power.com](http://www.ssdi-power.com)  
**Southwest Antennas**  
[www.southwestantennas.com](http://www.southwestantennas.com)  
**Southwest Microwave**  
[www.southwestmicrowave.com](http://www.southwestmicrowave.com)  
**Southwest Research Institute (SwRI)**  
[www.swri.org](http://www.swri.org)  
**Spatial and Spectral Research**  
[www.ssrllc.us](http://www.ssrllc.us)  
**Spectra Research**  
[www.spectra-research.com](http://www.spectra-research.com)  
**Spectranetix Inc.**  
[www.spectranetix.com](http://www.spectranetix.com)  
**Spharea GmbH**  
[www.spharea.de](http://www.spharea.de)  
**Spirent Communications**  
[www.spirent.com](http://www.spirent.com)  
**SRC, Inc.**  
[www.srcinc.com](http://www.srcinc.com)  
**SRI International**  
[www.sri.com](http://www.sri.com)  
**Stearite Antennas**  
[www.stearite-antennas.co.uk](http://www.stearite-antennas.co.uk)  
**SteelRock Technologies**  
[www.sruav.co.uk](http://www.sruav.co.uk)  
**SunCastle Microwave, LLC**  
[www.suncastlemicrowave.com](http://www.suncastlemicrowave.com)  
**Sundance DSP**  
[www.sundancedsp.com](http://www.sundancedsp.com)  
**SURVICE Engineering Co.**  
[www.survice.com](http://www.survice.com)  
**Syncopated**  
[www.syncopatedproducts.com](http://www.syncopatedproducts.com)  
**Syncopated Engineering**  
[www.syncopatedengr.com](http://www.syncopatedengr.com)  
**Syntonic Microwave Corp.**  
[www.syntonicmicrowave.com](http://www.syntonicmicrowave.com)  
**Sypris Solutions**  
[www.sypris.com](http://www.sypris.com)  
**Systematic**  
[www.systematic.com](http://www.systematic.com)  
**Systems & Processes Engineering Corp. (SPEC)**  
[www.spec.com](http://www.spec.com)

**T**  
**Tabor Electronics**  
[www.taborelec.com](http://www.taborelec.com)  
**TACO Antenna**  
[www.tacoantenna.com](http://www.tacoantenna.com)  
**Tampa Microwave**  
[www.tampamicrowave.com](http://www.tampamicrowave.com)

**Tata Advanced Systems Limited (TASL)**  
[www.tataadvancedsystems.com](http://www.tataadvancedsystems.com)  
**Tata Power Strategic Electronics Division**  
[www.tatapowersed.com](http://www.tatapowersed.com)  
**TCI International, Inc.,**  
[www.tcibr.com](http://www.tcibr.com)  
**TE Connectivity**  
[www.te.com](http://www.te.com)  
**TechComm**  
[www.techcommdf.com](http://www.techcommdf.com)  
**Tech Resources, Inc. (TRI)**  
[www.trimilford.com](http://www.trimilford.com)  
**TEK Microsystems, Inc.**  
[www.tekmicro.com](http://www.tekmicro.com)  
**Tektronix, Inc.**  
[www.tek.com](http://www.tek.com)  
**Teledyne Defense Electronics**  
[www.teledynedefenseelectronics.com](http://www.teledynedefenseelectronics.com)  
**Teleplan Globe Defence**  
[www.teleplanglobe.no/defence](http://www.teleplanglobe.no/defence)  
**TeleRadio Engineering Pte Ltd.**  
[www.skydroner.com](http://www.skydroner.com)  
**Ten-Tec**  
[www.tentec.com](http://www.tentec.com)  
**Terma A/S**  
[www.terma.com](http://www.terma.com)  
**Terra Hexen Group**  
[www.terrahexen.com](http://www.terrahexen.com)  
**TEVET**  
[www.tevetllc.com](http://www.tevetllc.com)  
**Texas Instruments**  
[www.ti.com](http://www.ti.com)  
**Textron Systems Corporation**  
[www.textronsystems.com](http://www.textronsystems.com)  
**Textron Systems Electronic Systems LTD UK**  
[www.textronsystems.com](http://www.textronsystems.com)  
**Thales**  
[www.thalesgroup.com](http://www.thalesgroup.com)  
**Thermacore**  
[www.thermacore.com](http://www.thermacore.com)  
**Thermodyne Cases & Racks**  
[www.thermodyne.com](http://www.thermodyne.com)  
**ThinkRF**  
[www.thinkrf.com](http://www.thinkrf.com)  
**Times Microwave Systems**  
[www.timesmicrowave.com](http://www.timesmicrowave.com)  
**TINEX AS**  
[www.tinex.no](http://www.tinex.no)  
**TJR Global**  
[www.trjglobal.com](http://www.trjglobal.com)  
**TMC Design Corp.**  
[www.tmcdesign.com](http://www.tmcdesign.com)  
**TMD Technologies Ltd.**  
[www.tmd.co.uk](http://www.tmd.co.uk)  
**Top Aces**  
[www.topaces.com](http://www.topaces.com)  
**Toyon Research Corp.**  
[www.toyon.com](http://www.toyon.com)

**Transformational Security LLC**  
www.powerfulsecurity.com  
**TRD Consultancy Pte Ltd.**  
www.trd.com  
**Trenton Systems**  
www.trentonsystems.com  
**Tri Star Engineering, Inc.**  
www.star3.com  
**Triad RF Systems Inc.**  
www.triadrf.com  
**TriaSys Technologies Corp.**  
www.triasys.us  
**Trident Infosol**  
www.tridentinfosol.com  
**Trident Systems Inc.**  
www.tridsys.com  
**Trival Antene**  
www.trivalantene.si  
**TrustComm**  
www.trustcomm.com  
**TSF5**  
www.tsf5.com  
**Tsunami Cases**  
www.tsunamicase.com  
**TTE Filters**  
www.tte.com  
**TTM Technologies**  
www.ttm.com  
**TUALCOM, Inc.**  
www.tualcom.com

**TÜV SÜD**  
www.tuv-sud.com  
**U**  
**U B Corp.**  
www.ubcorp.com  
**Ultra Electronics - Australia**  
www.ultra-electronics.com.au  
**Ultra Electronics - Herley**  
www.ultra-herley.com  
**Ultra Electronics Limited - EWST**  
www.ultra-cis.com  
**Ultraview Corp.**  
www.ultraviewcorp.com  
**United Electronic Industries**  
www.ueidaq.com  
**United Monolithic Semiconductor**  
www.ums-gaas.com  
**Unseenlabs**  
www.unseenlabs.space  
**URC Systems**  
www.urc-systems.cz  
**US Dynamics Corp.**  
www.usdynamicscorp.com  
**US Technologies-Aldetec**  
www.ust-aldetec.com  
**V**  
**VadaTech, Inc.**  
www.vadatech.com

**Vadum Inc.**  
www.vaduminc.com  
**Valkyrie Enterprises LLC**  
www.valkyrie.com  
**Varilog Research, Inc.**  
www.varilog.com  
**Vecicma Networks**  
www.vecima.com  
**Verint**  
www.verint.com  
**ViaSat, Inc.**  
www.viasat.com  
**VIAVI Solutions, Inc.**  
www.viavisolutions.com  
**Victor Corp.**  
www.vicorpowers.com  
**Virtualabs srl**  
www.virtualabs.it  
**W**  
**W.L. Gore and Associates, Inc. (Gore)**  
www.gore.com/cables  
**Wang Electro-Opto Corp.**  
www.weo.com  
**Warfare Solutions LLC**  
www.warfaresolutions.com  
**Warrior Support Solutions, LLC**  
www.warriorss.com  
**Wavepoint Research, Inc.**  
www.wavepointresearch.com

**WDS Radar**  
www.wdsradar.com  
**Wenteq Microwave Corporation**  
www.wenteq.com  
**Werlatone, Inc.**  
www.werlatone.com  
**WGS Systems, Inc.**  
www.wgssystems.com  
**WhiteFox Defense Technologies, Inc.**  
www.whitefoxdefense.com  
**Wide Band Systems Inc.**  
www.widebandsystems.com  
**Wideband Systems, Inc.**  
www.wideband-sys.com  
**Winchester Interconnect**  
www.winconn.com  
**Windfreak Technologies, LLC**  
www.windfreaktech.com  
**Wolfspeed**  
www.wolfspeed.com  
**Wright Technologies Inc.**  
www.wrighttec.com

**Z**  
**Zarges, Inc.**  
www.zargesusa.com  
**Zeta Associates**  
www.zai.com

## PHILPOTT BALL & WERNER

### Investment Bankers

- Philpott Ball & Werner advises companies throughout North America and Western Europe that design and produce highly-engineered products, software and systems for the Aerospace, Defense, Intel and Technology Markets.

- PB&W's services include company sales, mergers & acquisitions, private placements, fairness opinions and valuations.

- Driven by a research focused approach, in-depth market knowledge, strong industry relationships and transaction expertise, PB&W strives for industry-leading client returns.

Boston  
50 Dunham Rd  
Suite 1450  
Beverly, MA 01915  
978.526.4200

[www.pbandw.com](http://www.pbandw.com)

Charlotte  
11325 N Community House Rd  
Suite 430  
Charlotte, NC 28277  
704.358.8094

## PB&W

### Latest Transactions





**SAVE  
THE DATE**

REGISTRATION OPENS  
NOVEMBER!

## Modern Threats: SAM Systems



FEBRUARY 1-2, 2022

Redstone Arsenal, AL

## Advanced and Emerging MANPADS/EO/IR

Join AOC at this two-day conference in Huntsville, AL, with classified presentations on the most recent analysis of advanced and emerging worldwide manportable air defense systems (MANPADS) and electro-optical/infrared (EO/IR) guided surface-to-air missile (SAM) systems. The event will be hosted by the Defense Intelligence Agency Missile and Space Intelligence Center (DIA/MSIC) on Redstone Arsenal.

The conference is relevant to the current day warfighter, intelligence officers, and those in the acquisition community associated with research, development, and testing of countermeasures and missile warning sensors.

VISIT [CROWS.ORG](http://CROWS.ORG) FOR MORE INFORMATION



### SPONSORSHIP OPPORTUNITIES

Contact Sean Fitzgerald at  
[Fitzgerald@crows.org](mailto:Fitzgerald@crows.org)

## AOC SPONSORSHIP OPPORTUNITIES IN 2022

**The AOC bridges the gap between Electromagnetic Warfare practitioners, Industry partners, Policymakers, and procurement decision-makers.**

**AOC Conferences, Webinars, Courses, Career Center, and the Annual AOC International Symposium & Convention are the perfect place to:**

- + Target a niche audience or reach out to a broad market, depending on event topic and attendee composition
- + Develop personal relationships with clients
- + Showcase a full product range
- + Get immediate feedback and accelerate the buying process
- + Launch a new product
- + Raise brand awareness

**Secure your sponsorship positions TODAY...  
before your competition does.**

#### Sponsorship Catalog:

[crows.org/2022SponsorshipCatalog](http://crows.org/2022SponsorshipCatalog)

#### Contact Sean Fitzgerald:

[fitzgerald@crows.org](mailto:fitzgerald@crows.org) or 703-549-1600 ext. 222

# 2022 EW/SIGINT Resource Guide

## CATEGORY LISTINGS



ISTOCK.COM/MARIGOLD\_88

### RF MICROWAVE COMPONENTS & SUBSYSTEMS

Antennas/Arrays.....	34
Antenna Mounts/ Support Structures.....	34
Antenna Radomes.....	34
Active RF Components.....	34
Analog-to-Digital Converters.....	34
Digital-to-Analog Converter Boards.....	34
Semiconductor Integrated Circuits.....	34
Digital Signal Processors .....	34
ASICs.....	34
FPGAs and FPGA Boards.....	34
Frequency Converters.....	35
Frequency Synthesizers.....	35
Oscillators.....	35
Low Noise Amplifiers .....	35
Passive RF Components.....	36
Converters and Mixers.....	36
Couplers .....	36
Fiber-Optic Cable.....	36
Fiber-Optic Connectors.....	36
Filters and Diplexers .....	36
Power Dividers/ Combiners.....	36
RF Switches.....	36
RF Absorptive Materials/ Shielding .....	36
RF Cables/ Cable Assemblies .....	37
RF Connectors and Adapters.....	37
Waveguides.....	37
Digital Frequency Discriminators.....	37
Digital RF Memories.....	37
Integrated Microwave Assemblies.....	37
RF Receivers .....	37
RF Tuners.....	38
Signal Conditioners .....	38
Displays .....	38
Solid-State Power Amplifiers .....	38
GaN/GaAs Transistors .....	38

TWTs ..... 38

TWT Assemblies ..... 38

Microwave Power  
Modules (MPMs)..... 38

Power Supplies ..... 38

Data Recorders..... 38

Signal Analysis Systems .....

RF/Microwave Chassis and  
Enclosures..... 39

Transport Cases..... 39

### TEST EQUIPMENT

Oscilloscopes..... 39

Signal Generators..... 39

Spectrum Analyzers..... 39

Power Meters..... 39

Network Analyzers..... 39

Automatic Test  
Equipment .....

### EO/IR COMPONENTS & SUBSYSTEMS

IR Detectors..... 39

Fine-Track Sensors..... 39

### EW & SIGINT SYSTEMS

Radar Warning Receivers  
(RWRs) and Electronic  
Support Measures  
(ESM) Systems .....

RWR and ESM –  
Antennas .....

RWR and ESM –  
Receivers .....

Radar Jammers..... 39

Radar Jammers –  
Antennas .....

Radar Jammers –  
DRFMs .....

Radar Jammers –  
Exciters .....

Radar Jammers –  
Power Amplifiers .....

Airborne Active  
RF Decoys..... 40

EW Suite Managers/  
Controllers..... 40

Passive Missile  
Warning Systems..... 40

Active (Pulse Doppler)  
Missile Warming

Systems .....

Laser Warning Systems .....

Directed IR  
Countermeasures

(DIRCM) Systems .....

DIRCM –  
Fine-Track Sensors .....

DIRCM – Lasers .....

Airborne Decoy  
Dispensers .....

Airborne IR Decoys/  
Countermeasures Flares .....

Airborne Chaff  
Countermeasures .....

Maneuvering Air-Launched  
Decoys .....

Anti-Radiation  
Homing Missiles .....

Naval Decoy Launchers .....

Naval IR Decoys .....

Naval Chaff  
Countermeasures .....

Naval RF Reflector Decoys .....

Active RF Naval Decoys .....

Multispectral Obscurants/  
Smoke .....

Communications ESM  
Systems .....

Comms ESM – Antennas .....

Comms ESM – Receivers .....

Communications Jammers .....

Comms Jammer –  
Antennas .....

Comms Jammer – DRFMs .....

Comms Jammer –  
Power Amplifiers .....

Counter-UAS Systems  
(EW) .....

GPS Jammers .....

ELINT Systems .....

ELINT Systems –  
Antennas .....

ELINT Systems –  
Tuners .....

ELINT Systems –  
Receivers .....

COMINT Systems .....

COMINT Systems –  
Antennas .....

COMINT Systems –  
Tuners .....

COMINT Systems –  
Receivers .....

Direction Finding  
Systems .....

GPS Anti-Jam  
Receiver Systems .....

### EW SIMULATORS

Field/Flightline RF  
EW Testers .....

EW Antenna Couplers .....

EO/IR Stimulators .....

Laboratory EW  
Simulators .....

RF Range Threat  
Simulators .....

IR Range Threat  
Simulators .....

### EW & SIGINT SERVICES

EW Consulting Services .....

EW Design Engineering  
Services .....

EW System Integration  
Services .....

EW Software  
Development .....

EW Database  
Development .....

EW Operational Support  
Centers .....

Space-Based RF Emitter  
Mapping Services .....

EW/SIGINT Mission  
Planning Software .....

Operational EW  
Training Software .....

Operational EW  
Training Services .....

EW Testing Services .....

SIGINT Consulting  
Services .....

SIGINT Design  
Engineering Services .....

SIGINT System  
Integration Services .....

SIGINT Software  
Development .....

Professional Development  
Courses and Seminars .....



# PRODUCT/SERVICE LISTINGS

## RF MICROWAVE COMPONENTS & SUBSYSTEMS

### Antennas/Arrays

Aero Telemetry  
Alaris Antennas  
AMT Microwave Corp.  
Antenna Authority  
Antenna Experts  
Antenna Research Associates  
APITech  
Applied EM Inc.  
ARA, Inc.  
CAL-AV Labs Inc.  
CEA Technologies  
Cobham  
COJOT  
Communications & Power Industries, Inc (CPI)  
Cubic Nuvotronics  
Dayton-Granger  
Defence Research and Development Canada  
Electro-Metrics  
ET Industries  
ETS-Lindgren  
European Antennas  
First RF Corp.  
Flann Microwave  
Fractal Antenna Systems  
FS Antennentechnik GmbH  
Hascall-Denke  
HUBER+SUHNER AG  
IFI - Instruments for Industry Inc.  
JEM Engineering  
Jenkins Engineering Defence Systems  
Kratos  
L3Harris - Linkabit  
L3Harris - Randtron Antenna Systems  
Leonardo  
Link Microtek  
MEDAV GmbH  
Meggit  
Micronetixx, P.A.  
Mercury Systems  
Microwave Applications Group  
Microwave Engineering Corp.  
Microwave Specialty Company  
Microwave Technologies Inc.  
Montena Technology sa  
mWave Industries, LLC  
NovAtel  
Ocean Microwave Corp.  
Octane Wireless  
PCTEL Inc.  
Phasor Innovation PTY Ltd.  
QuinStar Technology, Inc.  
Plath Signal Products  
Radio Reconnaissance Technologies  
Rantelon

Rincon Research Corporation  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG  
Rubisoft  
Saab  
SATIMO  
Seqtor ApS  
Shakespeare Military Antenna Products  
Signal Antenna Systems Inc.  
SMAG Mobile Antenna Masts GmbH  
Southwest Antennas  
Stearite Antennas  
SunCastle Microwave LLC  
TACO Antenna  
Tech Resources, Inc.  
TechComm  
TECOM Industries, Inc.  
Transformational Security LLC  
Trival Antene  
U B Corp.  
Ultra Electronics - Herley  
Wang Electro-Opto Corp.

### Antenna Mounts/ Support Structures

Cobham  
Dayton-Granger  
IKHANA Aircraft Services  
Hascall-Denke  
L3Harris - Randtron Antenna Systems  
Rotating Precision Mechanisms, Inc.  
SMAG Mobile Antenna Masts GmbH  
Stearite Antennas  
TECOM Industries, Inc.

### Antenna Radomes

CEA Technologies  
Cobham  
Dayton-Granger  
HUBER+SUHNER AG  
IKHANA Aircraft Services  
L3Harris - Randtron Antenna Systems  
Meggit - Baltimore  
Stearite Antennas  
TECOM Industries, Inc.

### Active RF Components

AKON, Inc.  
Analog Devices Inc.  
Anaren, Inc.  
Applied Thin Film Products  
Cobham  
Comtech PST  
Crane Aerospace & Electronics  
EM Research  
ET Industries  
I.F. Engineering Corp.

Jabil Defense and Aerospace Services  
Jersey Microwave  
L3Harris - Electron Device Division  
L3Harris - Narda-Miteq  
MACOM  
Mercury Systems  
Micro Lambda Wireless, Inc.  
Phasor Innovation PTY Ltd.  
Pole/Zero Corp.  
Rodelco Electronics Corp.  
Tektronix, Inc.  
Teledyne Defense Electronics  
TRAK Microwave  
US Dynamics Corp.  
Wolfspeed

### Analog-to-Digital Converter Boards

Abaco Systems  
ApisSys  
Analog Devices Inc.  
Annapolis Micro Systems, Inc.  
Avalon Electronics, Inc.  
Bittware, Inc.  
CEA Technologies  
Cobham  
Curtiss-Wright Defense Solutions  
Delphi Engineering Group  
Dynamic Signals LLC  
Interface Concept  
Innovative Integration  
Intersil  
iVeia, LLC  
Mercury Systems  
Pentek  
Protium Technologies, Inc.  
Red Rapids  
Rockwell Collins  
Spectrum Signal Processing  
Sundance DSP  
TEK Microsystems, Inc.  
Tektronix, Inc.  
Teledyne Defense Electronics  
Texas Instruments  
Themis  
Ultraview Corp.  
VadaTech, Inc.  
X-COM Systems, LLC

### Digital-to-Analog Converter Boards

Abaco Systems  
Annapolis Micro Systems, Inc.  
ApisSys  
Applied Radar Inc.  
BAE Systems  
BittWare  
Colorado Engineering Inc.  
Curtiss-Wright Defense Solutions  
Elma Electronics  
Extreme Engineering Solutions  
Delphi Engineering Group  
Dynamic Signals LLC  
Elma Electronic  
Galleon Embedded Computing  
Innovative Integration  
Interface Concept  
Intel Product Solutions Group  
iRF Solutions  
iVeia, LLC  
Keysight Technologies

iVeia, LLC  
MACOM  
Mercury Systems  
Red Rapids  
Tektronix, Inc.  
Teledyne Defense Electronics  
X-COM Systems, LLC

### Semiconductor Integrated Circuits

Cobham Sensor Systems  
Hittite Microwave  
Intersil  
MACOM  
Tektronix, Inc.  
Teledyne Defense Electronics

### Digital Signal Processors

Abaco Systems  
Analog Devices Inc.  
Annapolis Micro Systems, Inc.  
BAE Systems  
BittWare  
Colorado Engineering Inc.  
Curtiss-Wright Defense Solutions  
Dynamic Signals LLC  
ELDES S.r.l. - Radar Division  
Intel Product Solutions Group  
Interface Concept  
iVeia, LLC  
Mercury Systems  
Protium Technologies, Inc.  
RFEL Ltd.  
Rockwell Collins

### ASICs

Cobham  
Mercury Systems  
Tektronix, Inc.  
Teledyne Defense Electronics

### FPGAs and FPGA Boards

Abaco Systems  
Annapolis Micro Systems, Inc.  
ApisSys  
Applied Radar Inc.  
BAE Systems  
BittWare  
Colorado Engineering Inc.  
Curtiss-Wright Defense Solutions  
Elma Electronics  
Extreme Engineering Solutions  
Delphi Engineering Group  
Dynamic Signals LLC  
Elma Electronic  
Galleon Embedded Computing  
Innovative Integration  
Interface Concept  
Intel Product Solutions Group  
iRF Solutions  
iVeia, LLC  
Keysight Technologies

Mercury Systems  
Nallatech, Inc.  
New Wave Design &  
Verification  
Parsec  
Pentek  
Red Rapids  
Rincon Research Corporation  
TEK Microsystems, Inc.  
Trenton Systems  
Ultraview Corp.

**Frequency Converters**

AKON, Inc.  
Analog Devices Inc.  
Anaren, Inc.  
Applied Radar Inc.  
Cobham  
Crane Aerospace & Electronics  
CTT, Inc.  
EM Research  
FEI-Elcom Tech  
I.F. Engineering Corp.  
iRF Solutions  
Jersey Microwave  
K&L Microwave, Inc.  
KMIC Technology, Inc.  
Kratos  
L3Harris - Microwave West  
L3Harris - Narda-Miteq  
Mercury Systems  
Norden Millimeter  
NuWaves Engineering  
Planar Monolithics Industries,  
Red Rapids  
Renaissance Electronics Corp.  
SignalCore  
TRAK Microwave  
Ultra Electronics - Herley  
Wright Technologies, Inc.

**Frequency Synthesizers**

AKON, Inc.  
Analog Devices  
Anritsu  
Berkley Nucleonics  
Cobham  
Crane Aerospace and  
Electronics  
EM Research  
FEI-Elcom Tech  
iRF Solutions  
Kratos  
L3Harris - Narda-Miteq  
MagiQ Technologies Inc.  
Mercury Systems  
Micro Lambda Wireless, Inc.  
NEL Frequency Controls, Inc.  
Novatech Instruments  
Phase Matrix  
Planar Monolithics Industries,  
Inc.  
Renaissance Electronics Corp.  
RFcore Co, Ltd.  
Rodelco Electronics Corp.  
SignalCore  
Sivers IMA AB  
Tabor Electronics  
Teledyne Technologies

TRAK Microwave  
Ultra Electronics - Herley  
Ultraview Corp.  
Wide Band Systems Inc.

**Oscillators**

Analog Devices Inc.  
Cobham  
dB Control  
EM Research  
FEI-Elcom Tech  
Jackson Labs Technologies Inc.  
Jersey Microwave  
Kratos  
L3Harris - Narda-Miteq  
MACOM

Mercury Systems  
Micro Lambda Wireless, Inc.  
Microwave Dynamics  
NEL Frequency Controls, Inc.  
Norden Millimeter  
Pascall Electronics Limited  
Phase Matrix  
Qorvo  
QuinStar Technology, Inc.  
Renaissance Electronics Corp.  
Sivers IMA AB  
Skyworks Solutions  
Syntonic Microwave  
TRAK Microwave  
Ultra Electronics - Herley  
Vectron International

**Low Noise Amplifiers**

AKON, Inc.  
AMCOM Communications  
Amplifier Solutions Corp.  
AmpliTech  
Analog Devices  
APITech  
ARS Products  
Atlanta Micro  
Ciao Wireless, Inc.  
Cobham  
CTT, Inc.  
Elite RF  
Endwave Corp.  
ERZIA Technologies SL  
Herotek, Inc.

**NORDEN MILLIMETER**

Norden Millimeter develops frequency multipliers, converters, and amplifiers between 0.5 and 110 GHz.

**One of our more popular products is our 18 to 40 GHz down converter. Available with a 0.5-18 GHz bypass, variable gain, temp compensation, and military environmental requirements.**

[www.NordenGroup.com](http://www.NordenGroup.com)  
(530) 642-9123  
[Sales@NordenGroup.com](mailto:Sales@NordenGroup.com)



Jersey Microwave  
K&L Microwave, Inc.  
Keragis  
KMIC Technology, Inc.  
L3Harris – Narda-Miteq  
MACOM  
Mercury Systems  
Microwave Communications Laboratories  
Microwave Dynamics  
Norden Millimeter  
NuWaves Engineering  
Pascall Electronics Limited  
Pasternak  
Planar Monolithics Industries, Inc.  
Pole/Zero Corp.  
Qorvo  
QuinStar Technology, Inc.  
Renaissance Electronics Corp.  
RFHIC  
Rodelco Electronics Corp.  
Sage Millimeter  
Smiths Interconnect  
Teledyne Defense Electronics  
TRAK Microwave  
Triad RF Systems Inc.  
Ultra Electronics – Herley  
US Dynamics Corp.  
US Technologies-Aldetec  
Wenteq Microwave Corporation  
Wolfspeed  
Wright Technologies, Inc.

### **Passive RF Components**

AMCOM Communications  
American Microwave Corp.  
Analog Devices Inc.  
Anaren, Inc.  
Anritsu  
APITech  
Applied Thin Film Products  
Bird Technologies  
Cobham  
Coleman Microwave Company  
Crane Aerospace & Electronics  
Cubic Nuvotronics  
Dayton-Granger  
Dielectric Labs  
Dow-Key Microwave  
Ducommun Technologies  
Emhiser Research, Inc.  
Endwave Corp.  
ET Industries  
Herotek, Inc.  
Honeywell Aerospace  
HUBER+SUHNER AG  
I.F. Engineering Corp.  
Jabil Defense and Aerospace Services  
JFW Industries  
K&L Microwave, Inc.  
Kratos  
Krytar, Inc.  
L3Harris – Narda-Miteq  
Lexatys  
Link Microtek  
Logus Microwave

Lorch Microwave  
MACOM  
MECA Electronics  
Mercury Systems  
Microphase Corp.  
Microwave Applications Group  
Microwave Communications Laboratories  
Microwave Engineering Corp.  
Microwave Products Group  
Pascall Electronics Limited  
Picosecond Pulse Labs  
Planar Monolithics Industries, Q Microwave, Inc.  
Qorvo  
QuinStar Technology, Inc.  
Radiall  
Renaissance Electronics Corp.  
RH Laboratories  
Rodelco Electronics Corp.  
Skyworks Solutions  
Smiths Interconnect  
Solid State Devices, Inc.  
Teledyne Defense Electronics  
TRU Corp.  
TTE Filters  
Werlatone, Inc.

### **Converters and Mixers**

Advanced Microwave Inc.  
AKON, Inc.  
Anaren, Inc.  
Anritsu  
Cobham  
EM Research  
FEL-Elcom Tech  
I.F. Engineering Corp.  
Jersey Microwave  
KMIC Technology, Inc.  
L3Harris – Narda-Miteq  
Mercury Systems  
QuinStar Technology, Inc.  
RH Laboratories  
Rodelco Electronics Corp.  
Teledyne Defense Electronics  
US Technologies-Aldetec

### **Couplers**

Anaren, Inc.  
ARS Products  
Atlanta Micro  
BJG Electronics  
Cobham  
Cubic Nuvotronics  
DynaWave Inc.  
ET Industries  
Ferrite Microwave Technologies  
Honeywell Aerospace  
HUBER+SUHNER AG  
I.F. Engineering Corp.  
Jabil Defense and Aerospace Services  
JFW Industries  
K&L Microwave, Inc.  
Kratos  
Krytar Inc.  
L3Harris – Narda-Miteq  
MECA Electronics  
Mercury Systems  
Microwave Communications Laboratories  
Microwave Engineering Corp.

Planar Monolithics Industries, Precision Connector  
Qorvo  
Radiall  
RF Industries  
Rohde & Schwarz GmbH & Co. KG  
Southwest Microwave  
TE Connectivity  
Werlatone, Inc.  
Winreak Technologies, LLC

### **Fiber-Optic Cable**

Alker Optical Equipment Assemblies, Inc.  
HUBER+SUHNER AG  
Meggitt Defense Systems W.L. Gore & Associates, Inc. (Gore)

### **Fiber-Optic Connectors**

Assemblies, Inc.  
BJG Electronics  
HUBER+SUHNER AG  
Meggitt Defense Systems

### **Filters and Diplexers**

AKON, Inc.  
Anatech Electronics  
Atlanta Micro  
BSC Filters  
Cobham  
Coleman Microwave Company  
Cubic Nuvotronics  
Dayton-Granger  
Endwave Corp.  
ET Industries  
Ferrite Microwave Technologies  
Gowanda Components Group  
Honeywell Aerospace  
HUBER+SUHNER AG  
KMIC Technology, Inc.  
L3Harris – Narda-Miteq  
Lexatys  
Link Microtek  
Lorch Microwave  
MECA Electronics  
MEMtroncs Corp.  
Mercury Systems  
Metamagnetics  
Micro Lambda Wireless, Inc.  
Micronetixx, P.A.  
Microphase Corp.  
Microwave Communications Laboratories  
Microwave Engineering Corp.

Microwave Filter Company  
Microwave Products Group  
OEwaves  
Physical Optics Corp.  
Picosecond Pulse Labs  
Plexsa Manufacturing  
Pole/Zero Corp.  
Q Microwave, Inc.  
Syntonic Microwave  
Werlatone, Inc.

### **Power Dividers/Combiners**

American Microwave  
Anatech Electronics  
Anaren, Inc.  
Cobham  
Comtech PST  
Cubic Nuvotronics  
EMS Technologies, Inc.  
ET Industries  
HUBER+SUHNER  
I.F. Engineering Corp.  
JFW Industries  
K&L Microwave, Inc.  
Krytar, Inc.  
L3Harris – Narda MECA Electronics  
Mercury Systems  
Micronetixx, P.A.  
Microwave Applications Group  
Microwave Communications Laboratories  
Microwave Engineering Corp.  
Planar Monolithics Industries, Inc.

QuinStar Technology, Inc.  
Renaissance Electronics Corp.  
Rodelco Electronics Corp.  
Rohde & Schwarz GmbH & Co. KG  
Teledyne Defense Electronics  
TTE Filters  
Werlatone, Inc.

### **RF Switches**

Aethercomm, Inc.  
AKON, Inc.  
Alaris Antennas  
American Microwave  
Analog Devices  
APITech  
Atlanta Micro  
Cobham  
Comtech PST  
Dow-Key Microwave  
iRF Solutions  
JFW Industries  
Kratos  
L3Harris – Narda-Miteq  
MACOM  
Microwave Applications Group  
Microwave Products Group  
Mini-Circuits  
Pasternack Enterprises  
Rohde & Schwarz GmbH & Co. KG  
Skyworks Solutions

### **RF Absorptive Materials/Shielding**

ARC Technologies  
Boyd Corporation  
Cuming Microwave Corp.  
ETS-Lindgren  
Select Fabricators  
Zarges, Inc.

**RF Cables/  
Cable Assemblies**

Anatech Electronics  
 Assemblies Inc.  
 Cablex PTY Ltd.  
 Carlisle Interconnect Technologies  
 CDM Electronics  
 Cobham  
 Custom Cable Assemblies, Inc.  
 Dayton-Granger  
 FLEXCO Microwave  
 Glenair  
 HUBER+SUHNER AG  
 Insulated Wire (IW)  
 MECA Electronics  
 MegaPhase  
 Micro-Coax, Inc.  
 Molex  
 Montena Technology sa  
 Radiall  
 RF Industries  
 RF Logic  
 Shadow Technologies  
 TE Connectivity  
 Teledyne Defense Electronics  
 Times Microwave Systems  
 TRU Corp.  
 W.L. Gore & Associates, Inc. (Gore)

**RF Connectors and Adapters**

Acewavetech  
 Amphenol RF  
 BJC Electronics  
 BTC Electronics  
 Cinch Connectivity Solutions  
 Cobham  
 Custom Cable Assemblies  
 Delta Electronics Mfg. Corp.  
 Digi-Key  
 Dynawave Inc.  
 Fairview Microwave  
 Gigalane  
 Glenair  
 Hermetic Solutions  
 Huber + Suhner  
 Insulated Wire (IW)  
 JFW Industries  
 Krytar  
 Maury Microwave  
 Meca Electronics  
 Megaphase  
 Microwave Communications Laboratories Inc.  
 Molex  
 Pasternack  
 Radiall  
 Sage Millimeter  
 Santron  
 Smiths Interconnect  
 Southwest Microwave  
 Spectrum Elektrotechnik GmbH  
 TE Connectivity  
 Times Microwave Systems

**Waveguides**

Anatech Electronics  
 Cobham  
 Dow-Key Microwave  
 Ferrite Microwave Technologies  
 Honeywell Aerospace  
 K&L Microwave, Inc.  
 Keragis  
 Link Microtek  
 Micronetixx, P.A.  
 Microwave Applications Group  
 Microwave Communications Laboratories  
 Microwave Engineering Corp.  
 Montena Technology sa  
 Q Microwave, Inc.  
 Smiths Interconnect  
 Steatite Antennas  
 Teledyne Defense Electronics  
 Ultra Electronics – Herley

**Digital Frequency Discriminators**

AKON, Inc.  
 Anaren, Inc.  
 CSIR – DPSS  
 L3Harris – Narda-Miteq  
 Mercury Systems  
 Teledyne Defense Electronics  
 Triasys  
 TUALCOM, Inc.  
 Wide Band Systems Inc.

**Digital RF Memories**

Anaren, Inc.  
 Annapolis Micro Systems, Inc.  
 CSIR – DPSS  
 Curtiss-Wright Defense Solutions  
 L3Harris  
 Mercury Systems

Reut Systems and Technologies (RST)

Saab  
 Systems & Processes Engineering Corp. (SPEC)  
 TEK Microsystems, Inc.  
 Ultra Electronics – Herley

**Integrated Microwave Assemblies**

AKON, Inc.  
 American Microwave Corp.  
 Anaren, Inc.  
 APITech  
 ARS Products  
 Cobham  
 Comtech PST  
 Crane Aerospace & Electronics  
 CTT Inc.  
 Dow-Key Microwave  
 ERZIA Technologies SL  
 FEI-Elcom Tech  
 Jabil Defense and Aerospace Services  
 Kratos

L3Harris  
 LaBarge, Inc.  
 Lexatys  
 Lorch Microwave  
 Mercury Systems  
 Microphase Corp.  
 Microwave Applications Group  
 Microwave Products Group  
 NEL Frequency Controls, Inc.  
 Planar Monolithics Industries, Inc.  
 Quarterwave Corp.  
 Renaissance Electronics Corp.  
 RFcore Co, Ltd.  
 Rockwell Collins  
 Rodelco Electronics Corp.  
 Tektronix, Inc.  
 Teledyne Defense Electronics

Ultra Electronics – Herley  
 US Dynamics Corp.

**RF Receivers**

AKON, Inc.  
 Anaren, Inc.  
 Argon ST  
 Atos  
 BAE Systems  
 Chemring Technology Solutions  
 Clearbox Systems  
 Cobham  
 Communications & Power Industries, Inc (CPI)  
 Communications Audit UK Ltd.  
 Curtiss-Wright Defense Solutions  
 D-TA Systems  
 Dayton-Granger  
 Digital Receiver Technology  
 ELDES S.r.l. – Radar Division  
 Epiq Solutions  
 Emhiser Research Inc.  
 FEI-Elcom Tech  
 iRF Solutions  
 IZT GmbH  
 Jersey Microwave  
 Kratos  
 L3Harris – Linkabit  
 Leonardo DRS  
 MEDAV GmbH  
 Mercury Systems  
 Mid-Atlantic RF Systems  
 National Instruments Corp. (NI)  
 Norden Millimeter  
 Plextek Consulting  
 Radio Reconnaissance Technologies  
 Raytheon  
 RFEL Ltd.

# ARS Products

## Communications Band Receiver Range Extension Products



We also design & manufacture an extensive line of switch matrices & RF signal routers!

- Adaptable Multi-Couplers
- Programmable Notch Filters
  - Selectively attenuate interfering signals
  - High power versions available
- Co-Located Cancellers
  - Referenced & referenceless versions
  - Attenuate co-located transmitters
- Non-Reflective Limiters
  - These receiver protectors do not reradiate the limited signal

43 Lathrop Road Extension Plainfield, CT 06374      860-564-0208      [www.arsproducts.com](http://www.arsproducts.com)



Rockwell Collins  
Rohde & Schwarz GmbH &  
Co. KG  
Kratos  
Signal Hound  
Spectranetix, Inc.  
Spectrum Signal Processing  
Tampa Microwave  
Teledyne Defense Electronics  
Ten-Tec  
Triasys  
Trident Systems Inc.  
Ultra Electronics – Herley

#### **RF Tuners**

AKON, Inc.  
ASELSAN  
Atlanta Micro  
Chemring Technology  
Solutions  
Cobham  
Communications Audit UK  
Ltd.  
CyberRadio Solutions  
D-TA Systems Inc.  
Digital Receiver Technology  
diminuSys  
Elektrobit  
Epiq Solutions  
FEL-Elcom Tech  
FS Antennentechnik GmbH  
iRF Solutions  
IZT GmbH  
Leonardo DRS  
Mercury Systems  
Mid-Atlantic RF Systems  
Midwest Microwave Solutions  
Inc.  
Norden Millimeter, Inc.  
NuWaves Engineering  
Pentek  
R.A. Wood Associates  
Radixon  
Rockwell Collins  
Rohde & Schwarz GmbH &  
Co. KG  
Saab Medav  
Silver Palm Technologies  
Syntonic Microwave Corp.  
Systems & Processes  
Engineering Corp. (SPEC)  
Teledyne Defense Electronics  
Zeta Associates

#### **Signal Conditioners**

ARS Products  
Cobham  
Pole/Zero Corp.  
Rantelon  
RFEL Ltd.  
Teledyne Defense Electronics  
Terma

#### **Displays**

Aeromaoz  
Astronautics C.A. Ltd.  
BARCO  
Curtiss-Wright Defense  
Solutions

Ecrin Systems  
L3Harris  
Lockheed Martin  
Meggitt Defense Systems  
Precision Display Technologies  
Terma  
Z Microsystems, Inc.

#### **Solid-State Power Amplifiers**

Aero Telemetry  
Aethercomm, Inc.  
AMCOM Communications  
Applied Systems Engineering  
Inc.  
AR RF/Microwave  
Instrumentation  
BC Systems  
Cobham  
Communication Power  
Corporation  
Comtech PST  
CTT, Inc.  
dB Control  
Diamond Microwave  
Elite RF  
Emhiser Research, Inc.  
Empower RF Systems  
ERZIA Technologies SL  
ETL Systems  
ETM Electromatic Inc.  
Exodus Advanced  
Communications  
IFI – Instruments for Industry  
Inc.  
Keragis  
KMIC Technology, Inc.  
Kratos  
L3Harris – Narda-Miteq  
Linwave Technology  
MACOM  
Mercury Systems  
Microwave Amplifiers Ltd.  
Microwave Dynamics  
Mid-Atlantic RF Systems  
MILMEGA, a Teseq Company  
Mission Microwave  
NEC Network and Sensor  
Systems, Ltd.  
NuWaves Engineering  
OPHIR RF  
Protium Technologies, Inc.  
Qorvo  
Quarterwave Corp.  
Rantelon  
RFHIC  
Rodelco Electronics Corp.  
Rohde & Schwarz GmbH &  
Co. KG  
Smiths Interconnect  
Teledyne Defense Electronics  
Thales Microwave and  
Imaging Systems  
TMD Technologies Ltd.  
Triad RF Systems Inc.  
Triton Services Inc.  
US Technologies-Aldetec  
WDS Radar

#### **GaN/GaAs Transistors**

Analog Devices Inc.  
AMCOM Communications  
MACOM  
Mercury Systems  
Northrop Grumman  
NXP  
Qorvo  
United Monolithic  
Semiconductor  
Wolfspeed

#### **TWTs**

Communications & Power  
Industries, Inc (CPI)  
dB Control  
L3Harris – Electron Devices  
Division  
NEC Network and Sensor  
Systems, Ltd.  
Photonis Defense, Inc.  
Teledyne Defense Electronics  
Thales Microwave and  
Imaging Systems  
TMD Technologies Ltd.

#### **TWT Assemblies**

Applied Systems Engineering  
Inc.  
Cobham  
Communications & Power  
Industries, Inc (CPI)  
Comtech PST  
dB Control  
ETM Electromatic Inc.  
IFI – Instruments for Industry  
Inc.  
L3Harris – Electron  
Technologies, Inc.  
L3Harris – Narda-Miteq  
NEC Network and Sensor  
Systems, Ltd.  
Photonis Defense, Inc.  
Quarterwave Corp.  
Teledyne Defense Electronics  
Thales Microwave and  
Imaging Systems  
TMD Technologies Ltd.

#### **Microwave Power Modules (MPMs)**

Communications & Power  
Industries, Inc (CPI)  
dB Control  
L3Harris – Electron Devices  
Division  
NEC Network and Sensor  
Systems, Ltd.  
Photonis Defense, Inc.  
Teledyne Defense Electronics  
Thales Microwave and  
Imaging Systems  
TMD Technologies Ltd.  
WDS Radar

#### **Power Supplies**

APITech  
BC Systems  
Behlman Electronics

Communications & Power  
Industries, Inc (CPI)  
Crane Aerospace & Electronics  
dB Control  
ETM Electromatic, Inc.  
Schaefer Electronics  
Vicor Corp.

#### **Data Recorders**

Ampex  
Annapolis Micro Systems, Inc.  
Avalon Electronics, Inc.  
Conduant Corp.  
Curtiss-Wright Defense  
Solutions  
D-TA Systems Inc.  
Delphi Engineering Group  
DSPCon, Inc.  
Dynamic Signals LLC  
Elma Electronics  
Galleon Embedded Computing  
IZT GmbH  
Keysight Technologies  
Kratos  
L3Harris – Communications  
Systems - East  
Leonardo DRS  
Mercury Systems  
Novator Solutions AB  
Pentek  
PROCITEC GmbH  
RADX Technologies, Inc.  
Rincon Research Corporation  
Rising Edge Technologies  
Rohde & Schwarz GmbH &  
Co. KG  
Scientific Research Corp.  
Serpikom  
Shoghi Communications Ltd.  
Signami-DCS – EW/Range  
Sypris Solutions  
TEK Microsystems  
Tektronix, Inc.  
Wideband Systems Inc.  
X-COM Systems, LLC

#### **Signal Analysis Systems**

Annapolis Micro Systems, Inc.  
Berkley Nucleonics  
Cobham  
COMSEC LLC  
Hensoldt South Africa  
Innovative Signals Technology  
(ISigTech)  
ITAS A/S  
IZT GmbH  
Keysight Technologies  
Mercury Systems  
Novator Solutions AB  
Patria  
Plath Signal Products  
PROCITEC GmbH  
RADX Technologies, Inc.  
Rantelon  
Rincon Research Corporation  
Rockwell Collins  
Rohde & Schwarz GmbH &  
Co. KG  
Serpikom

Signal Hound  
X-COM Systems, LLC

### RF/Microwave Chassis and Enclosures

ADC Embedded Solutions  
Aitech  
Atrenne  
Collins Aerospace  
Extreme Engineering Solutions  
LCR Embedded Systems  
Mercury Systems  
Nova Integration Solutions  
Parker Aerospace  
Pixus Technologies  
Trident Infosol  
United Electronic Industries

### Transport Cases

ATS Cases  
CP Cases  
ECS Composites  
Impact Cases  
Pelican Cases  
Tsunami Cases  
Thermodyne  
Zarges

## TEST EQUIPMENT

### Oscilloscopes

B&K Precision Corp.  
Berkley Nucleonics  
Dynamic Signals LLC  
Keysight Technologies  
National Instruments Corp. (NI)  
Rohde & Schwarz GmbH & Co. KG  
Tektronix, Inc.  
Teledyne Defense Electronics

### Signal Generators

Anritsu  
B&K Precision Corp.  
Berkley Nucleonics  
Cobham  
Cyber Radio Solutions  
Dynamic Signals LLC  
FEI-Elcom Tech  
ISPAS AS  
IZT GmbH  
Keysight Technologies  
Mercury Systems  
National Instruments Corp. (NI)  
Novatech Instruments  
Phase Matrix  
RADX Technologies, Inc.  
Rohde & Schwarz GmbH & Co. KG  
Signal Hound  
Tabor Electronics  
Tektronix, Inc.  
Textron Systems Corporation  
Varilog Research, Inc.

### Spectrum Analyzers

Aaronia AG  
Anritsu  
B&K Precision Corp.  
Berkley Nucleonics  
Cobham  
COMSEC LLC  
Epiq Solutions  
ESPY Corp.  
Good Will Instrument Co., Ltd.  
Keysight Technologies  
National Instruments Corp. (NI)  
RADX Technologies, Inc.  
Research Electronics International (REI)  
Rohde & Schwarz GmbH & Co. KG  
Signal Hound  
Tektronix, Inc.  
ThinkRF  
WhiteFox Defense Technologies, Inc.

### Power Meters

Anritsu  
Keysight Technologies  
Krytar, Inc.  
Mercury Systems  
Rohde & Schwarz GmbH & Co. KG  
Werlatone, Inc.

### Network Analyzers

Anritsu  
DaqScribe Solutions, LLC  
Keysight Technologies  
RADX Technologies, Inc.  
Rohde & Schwarz GmbH & Co. KG  
Tektronix, Inc.

### Automatic Test Equipment

Advanced Testing Technologies Inc.  
ARS Products  
Berkley Nucleonics  
Cobham  
COMSEC LLC  
Dow Key Microwave Corp.  
ELDES S.r.l. – Radar Division  
Electronic Systems  
INDRA  
Keysight Technologies  
L3Harris  
Leonardo DRS  
Meggitt Defense Systems  
Mercer Engineering Research Center  
MES S.p.A.  
National Instruments Corp. (NI)  
RADX Technologies, Inc.  
Rodale Electronics Inc.  
Rohde & Schwarz GmbH & Co. KG  
RUAG – Aerospace  
Signal Hound

### Spirent Communications

Tabor Electronics  
Tech Resources, Inc.  
Tektronix, Inc.  
Textron Systems Corporation  
TRU Corp.  
ViaSat, Inc.  
VIAVI Solutions, Inc.

## EO/IR COMPONENTS & SUBSYSTEMS

### IR Detectors

Defense Research Associates, Inc.  
Leonardo DRS  
Textron Systems Electronic Systems LTD UK

### Fine-Track Sensors

BAE Systems  
L3Harris  
Northrop Grumman  
Teledyne Defense Electronics

## EW & SIGINT SYSTEMS

### Radar Warning Receivers (RWRs) and ESM Systems

Aeronix, Inc.  
Argon ST  
ASELSAN  
BAE Systems  
BEL – Bharat Electronics Ltd.  
Elbit Systems  
Elettronica SpA  
ELTA Systems Ltd.  
HawkEye 360  
Hensoldt  
INDRA  
L3Harris  
Leonardo  
Lockheed Martin  
Microwave Technologies Inc.  
Northrop Grumman  
Plextek Consulting  
Rafael – Advanced Defense Systems Ltd.  
Saab  
Sierra Nevada Corp.  
Systems & Processes Engineering Corp. (SPEC)  
Thales  
Teledyne Defense Electronics  
Telemus  
Trident Systems Inc.  
TUALCOM, Inc.

### Radar Jammers

ASELSAN  
BAE Systems  
BEL – Bharat Electronics Ltd.  
Elbit Systems  
Elettronica SpA  
ELTA Systems Ltd.  
INDRA  
L3Harris Technologies  
Leonardo  
MC Countermeasures Inc.  
MyKonsult  
Northrop Grumman  
QinetiQ Ltd.  
Rafael – Advanced Defense Systems Ltd.  
Raytheon  
Rodale Electronics Inc.  
Saab  
Southwest Research Institute  
Thales Airborne Systems

### RWR and ESM – Antennas

AMT Microwave Corp.  
ASELSAN  
BAE Systems  
BEL – Bharat Electronics Ltd.  
Cobham  
Elbit Systems  
Electro-Metrics

### First RF Corp.

Fractal Antenna Systems  
IFI – Instruments for Industry Inc.  
JEM Engineering  
L3Harris – Randtron Antenna Systems  
Link Microtek  
Microwave Specialty Company  
Rafael – Advanced Defense Systems Ltd.  
Rohde & Schwarz GmbH & Co. KG  
Saab – Electronic Defence Systems  
Stearite Antennas

### RWR and ESM – Receivers

Aeronix  
Argon ST  
Atos  
Cobham  
Elettronica SpA  
ELTA Systems Ltd.  
ESROE Limited  
FEI-Elcom Tech  
Leonardo  
Lockheed Martin  
Mercury Systems  
Microwave Technologies Inc.  
Northrop Grumman  
Plextek Consulting  
Rafael – Advanced Defense Systems Ltd.  
Saab  
Sierra Nevada Corp.  
Systems & Processes Engineering Corp. (SPEC)  
Thales  
Teledyne Defense Electronics  
Telemus  
Trident Systems Inc.  
TUALCOM, Inc.

ASELSAN  
BAE Systems  
BEL – Bharat Electronics Ltd.  
Elbit Systems  
Elettronica SpA  
ELTA Systems Ltd.  
INDRA  
L3Harris Technologies  
Leonardo  
MC Countermeasures Inc.  
MyKonsult  
Northrop Grumman  
QinetiQ Ltd.  
Rafael – Advanced Defense Systems Ltd.  
Raytheon  
Rodale Electronics Inc.  
Saab  
Southwest Research Institute  
Thales Airborne Systems

AMT Microwave Corp.  
ASELSAN



BAE Systems  
BEL - Bharat Electronics Ltd.  
Cobham  
Elbit Systems  
Electro-Metrics  
First RF Corp.  
Fractal Antenna Systems  
IFI - Instruments for Industry Inc.  
JEM Engineering  
L3Harris - Randtron Antenna Systems  
Link Microtek  
Microwave Specialty Company  
Rafael - Advanced Defense Systems Ltd.  
Stearite Antennas  
Times Microwave Systems

#### Radar Jammers – DRFMs

Anaren, Inc.  
CSIR - DPSS  
Curtiss-Wright Defense Solutions  
L3Harris  
Leonardo  
MC Countermeasures Inc.  
Mercury Systems  
Military Optical RF Equipment Ltd.  
Rafael - Advanced Defense Systems Ltd.  
Saab  
TEK Microsystems, Inc.  
Ultra Electronics - Herley

#### Radar Jammers – Exciters

Cobham  
Elbit Systems  
ELTA  
FEI-Elcom Tech  
L3Harris  
Mercury Systems  
Microwave Products Group  
Northrop Grumman  
Rafael - Advanced Defense Systems Ltd.

#### Radar Jammers – Power Amplifiers

Aethercomm, Inc.  
Applied Systems Engineering Inc.  
Communications & Power Industries, Inc (CPI)  
Comtech PST  
dB Control  
Empower RF Systems  
ERZIA Technologies SL  
L3Harris - Electron Device Division  
Leonardo  
MACOM  
Photonis Defense, Inc.  
Qorvo  
Teledyne Defense Electronics  
Thales Microwave and Imaging Systems  
TMD Technologies Ltd.

#### Airborne Active RF Decoys

BAE Systems  
Hensoldt  
Leonardo  
Rafael - Advanced Defense Systems Ltd.  
Raytheon  
Systems & Processes Engineering Corp. (SPEC)  
Thales Airborne Systems

#### EW Suite Managers/Controllers

BIRD Aerospace  
Leonardo  
Northrop Grumman  
Rafael - Advanced Defense Systems Ltd.  
Terma

#### Passive Missile Warning Systems

BAE Systems  
Elbit Systems  
Hensoldt  
Lockheed Martin  
MBDA  
Northrop Grumman  
Saab  
Thales Airborne Systems

#### Active (Pulse Doppler) Missile Warning Systems

ELTA Systems Ltd.  
Leonardo - Airborne and Space Systems Division  
Thales

#### Laser Warning Systems

Collins Aerospace  
ELTA Systems Ltd.  
Leonardo  
Saab

#### Directed IR Countermeasures (DIRCM) Systems

BAE Systems  
BIRD Aerospace  
Elbit Systems  
Elettronica SpA  
INDRA  
Leonardo  
Northrop Grumman

#### DIRCM – Fine-Track Sensors

Defense Research Associates, Inc.  
ElectroOptic Industries Ltd.  
Leonardo DRS

#### DIRCM – Lasers

BAE Systems  
CILAS  
Coherent Inc.  
DILAS  
Elbit Systems  
Leonardo  
Leonardo Daylight Solutions

Lockheed Martin  
Northrop Grumman  
Pendar Technologies  
Pranalytica

#### Airborne Decoy Dispensers

ASELSAN  
BAE Systems  
Cobham  
Extant Aerospace  
Hensoldt  
IMI Systems  
Leonardo  
MBDA  
Meggitt Defense Systems  
MES SpA  
Petards Group  
Rodale Electronics Inc.  
Saab  
Terma  
Thales Airborne Systems

#### Airborne IR Decoys/Countermeasures Flares

Armetec Defense Technologies  
Chemring Countermeasures UK  
Chemring Countermeasures USA  
Esterline Defense Technologies  
IMI Systems  
Lacroix Defense and Security  
MBDA  
Rheinmetall Defence

#### Airborne Chaff Countermeasures

Armetec Defense Technologies  
Chemring Countermeasures UK  
Cherming Countermeasures USA  
Esterline Defense Technologies  
IMI Systems  
Lacroix Defense and Security

#### Maneuvering Air-Launched Decoys

IMI Systems  
Raytheon

#### Anti-Radiation Homing Missiles

Lockheed Martin  
Northrop Grumman  
Raytheon

#### Naval Decoy Launchers

Lacroix Defense and Security  
Lockheed Martin  
Rafael - Advanced Defense Systems Ltd.  
Rheinmetall Defence  
Safran Electronics and Defense  
SEA  
Sechan Electronics

Terma

#### Naval IR Decoys

Armetec Defense Technologies  
Chemring Countermeasures UK  
Chemring Countermeasures USA  
Lacroix Defense and Security  
Rafael - Advanced Defense Systems Ltd.  
Rheinmetall Defence

#### Naval Chaff Countermeasures

Armetec Defense Technologies  
Chemring Countermeasures UK  
Chemring Countermeasures USA  
Lacroix Defense and Security  
Rafael - Advanced Defense Systems Ltd.  
Rheinmetall Defence

#### Naval RF Reflector Decoys

Airborne Systems Limited  
Elbit Systems EW and SIGINT - Elisra  
Rafael - Advanced Defense Systems Ltd.

#### Active RF Naval Decoys

BAE SYSTEMS Australia  
L3Harris  
Leonardo  
Lockheed Martin  
Rafael - Advanced Defense Systems Ltd.  
Thales

#### Multispectral Obscurants/Smoke

Armetec Defense Technologies  
Chemring Countermeasures UK  
Chemring Countermeasures USA  
L3Harris  
Lacroix Defense and Security  
Rheinmetall Defense

#### Communications ESM Systems

ASELSAN  
BAE Systems  
Chemring Technology Solutions  
CRFS  
CTL SystemWare  
Decodio AG  
Defence Research and Development Canada  
Digital Receiver Technology  
Elettronica SpA  
ELTA Systems Ltd.  
Epiq Solutions  
ESPY Corp.



ASSOCIATION  
OF OLD CROWS

# WHAT'S HAPPENING AT AOC IN 2021!



## AOC Europe

October 11-13, 2021  
Liverpool, UK

**Still time to register.**  
[AOCEurope.org](http://AOCEurope.org)



**58<sup>th</sup> Annual AOC International Symposium & Convention**  
November 30 - December 2, 2021 | Washington, DC

**Registration Now Open!**  
[58.crows.org](http://58.crows.org)

## Podcasts

AOC has two Podcasts, *The History of Crows* and *From the Crows' Nest*.

**Subscribe at**  
[crows.org/podcast](http://crows.org/podcast)



Focusing on leading issues of the day related to electromagnetic spectrum operations (EMSO)



Covering some of the most important discoveries, battles, and events that shaped what we know today as electromagnetic spectrum operations.

## Virtual Series Webinars

Bite-sized educational sessions on a myriad of technical topics in EW.

**Check out the schedule at**  
[crows.org/Webinar\\_schedule](http://crows.org/Webinar_schedule)



## Educational Courses

Professional development for the EMS workforce through world-class courses.

**Start learning at**  
[crows.org/PDC\\_Schedule](http://crows.org/PDC_Schedule)



## Collaborative EW Symposium

March 29-31, 2022  
Pt. Mugu, CA

**Save the date!**



## Modern Threats: Surface-to-Air Missile Systems Conference 2022

February 1-2, 2022  
Redstone Arsenal, AL

**Save the date!**

**Check out [crows.org](http://crows.org) for up-to-date information on events, resources and products.**



EWA Government Systems, Inc.  
General Dynamics Mission Systems  
Hensoldt South Africa  
INDRA  
IZT GmbH  
Kerberos International  
Kratos  
L3Harris  
L3Harris Narda Safety Test Solutions  
L3Harris TRL Technology  
Leonardo DRS  
Lockheed Martin  
LS Telcom  
Metis Aerospace Ltd.  
Microwave Products Group  
N-Ask Incorporated  
Netline Communications Technologies  
Northrop Grumman Corp.  
Peralex  
PLATH Signal Products  
Professional Development TSCM Group  
Radixon  
Raytheon  
Research Electronics International (REI)  
Rincon Research Corporation  
Rohde & Schwarz GmbH & Co. KG  
Saab Medav  
Seqtor ApS  
Serpikom  
Shoghi Communications Ltd.  
Sierra Nevada Corp.  
Southwest Research Institute  
Spectranetix, Inc.  
Tata Advanced Systems Limited (TASL)  
Tata Power Strategic Electronics Division  
TCI International, Inc.  
Thales  
ThinkRF  
URC Systems  
VIAVI Solutions, Inc.

#### **Comms ESM – Antennas**

Alaris Antennas  
AMT Microwave Corp.  
Antenna Authority  
Antenna Experts  
Antenna Research Associates  
Antenna Systems and Solutions  
Applied EM Inc.  
ARA, Inc.  
CEA Technologies  
Cobham  
COJOT  
Defence Research and Development Canada  
Electro-Metrics  
ET Industries  
ETS-Lindgren  
European Antennas

First RF Corp.  
Flann Microwave  
Fractal Antenna Systems  
FS Antennentechnik GmbH  
JEM Engineering  
L3Harris  
Leonardo DRS  
Link Microtek  
Micronetixx, P.A.  
Mercury Systems  
Microwave Engineering Corp.  
Microwave Specialty Company  
Microwave Technologies Inc.  
Ocean Microwave Corp.  
Octane Wireless  
PCTEL Inc.  
PLATH GmbH  
QuinStar Technology, Inc.  
Radio Reconnaissance Technologies  
Rantelton  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG  
Rubisoft  
Saab  
SATIMO  
Stearite Antennas  
TCI International, Inc.

#### **Comms ESM – Receivers**

Argon ST  
Atos  
BAE Systems  
Chemring Technology Solutions  
Communications Audit UK Ltd.  
Cyber Radio Solutions  
Deepwave Digital  
Digital Receiver Technology  
D-TA Systems  
Emhiser Research Inc.  
Enablia S.R.L.  
Epiq Solutions  
FEI-Elcom Tech  
Herrick Technologies  
iRF Solutions  
IZT GmbH  
Jersey Microwave  
Kratos  
L3Harris  
L3Harris Narda Safety Test Solutions  
Leonardo DRS  
LOG.IN Srl  
Mercury Systems  
Mid-Atlantic RF Systems  
Norden Millimeter  
OEwaves  
Per Vices Corp.  
PLATH Signal Products  
Plextek Consulting  
Radio Reconnaissance Technologies  
Radixon  
Raytheon  
RFEL Ltd.  
Rockwell Collins

Rohde & Schwarz GmbH & Co. KG  
Saab Medav  
Sagax Communications  
SignalHound  
Spectrum Signal Processing  
Syncopated  
Tampa Microwave  
Teledyne Defense Electronics  
Ten-Tec  
Triasys  
Wide Band Systems Inc.

#### **Communications Jammers**

Aegis Corea  
Albrecht Telecommunications  
Allen-Vanguard Corp.  
ASELSAN  
BAE Systems  
Chesapeake Technology Intl (CTI)  
Cobham  
DSE International  
Elbit Systems  
Elettronica SpA  
ELTA Systems Ltd.  
Enterprise Control Systems  
Hensoldt  
Hensoldt South Africa  
Honeywell Aerospace  
HP Marketing and Consulting  
INDRA  
Kerberos International  
L3Harris  
L3Harris TRL Technology  
Leonardo  
Lockheed Martin  
Mitsubishi Electric Corp.  
Motorola Solutions – Applied Technology  
Netline Communications Technologies  
PKI Electronic Intelligence  
PLATH Signal Products  
Radixon  
Rantelton  
Raytheon  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG  
Samel 90  
Serpikom  
SESP Group  
Shoghi Communications Ltd.  
Sierra Nevada Corp.  
Southwest Research Institute  
Spectranetix, Inc.  
Tata Advanced Systems Limited  
Tata Power  
Thales  
URC Systems

#### **Comms Jammer – DRFMs**

Anaren, Inc.  
CSIR – DPSS  
Curtiss-Wright  
Defense Solutions  
Epiq Solutions  
L3Harris  
Mercury Systems  
Saab  
Systems & Processes Engineering Corp. (SPEC)  
TEK Microsystems, Inc.  
Ultra Electronics – Herley

#### **Comms Jammer – Power Amplifiers**

Aethercomm, Inc.  
Amplifier Technology  
Applied Systems Engineering Inc.  
BC Systems  
Comtech PST  
CTT, Inc.  
dB Control  
Emhiser Research, Inc.  
Empower RF Systems  
IFI – Instruments for Industry Inc.  
Keragis  
KMIC Technology, Inc.  
L3Harris  
Linwave Technology  
Mercury Systems

#### **Comms Jammer – Antennas**

Alaris Antennas  
Applied EM Inc.  
CEA Technologies  
Cobham  
COJOT

Microwave Amplifiers Ltd.  
Mid-Atlantic RF Systems  
MILMEGA, a Teseq Company  
NEC Network and Sensor Systems, Ltd.  
OPHIR RF  
Photonis Defense, Inc.  
Qorvo  
Quarterwave Corp.  
Rantelton  
RF Core Co, Ltd.  
RFHIC  
Rodelco Electronics Corp.  
Smiths Interconnect

**Counter-UAS Systems (EW)**

Aaronia AG  
Advanced Protection Systems  
Alion Science and Technology  
Allen-Vanguard  
Atos  
AntiDrone  
ApolloShield  
ArtSYS360  
ASELSAN Inc.  
BATS  
Blind Tiger  
CACI  
CerbAir  
Citadel Defense  
CRFS  
CTS Technology Co. Ltd.  
D-Fend Solutions A.D. Ltd.  
DeDrone

Department 13  
DeTect Inc.  
Diehl Defence  
Drone Defence  
DroneShield  
Elbit Systems  
Elettronica SpA  
Elta Systems Ltd.  
Enterprise Control Systems  
HARP  
Hensoldt  
Hensoldt South Africa  
High + Mighty International  
HIK Vision  
HP Marketing and Consulting  
Hunan NovaSky Electronic Technology  
IACIT  
IMI Systems  
Indra  
Kirintec  
L3 Technologies  
Leonardo  
Liteye Systems, Inc.  
Lockheed Martin  
LS Telcom  
MCTech  
Meritis Group  
MyDefence Communication  
Netline  
Northrop Grumman  
Orad  
Phantom Technologies Ltd.

PKI Electronic Intelligence GmbH  
Radio Hill Technologies  
Rantelton  
Rohde & Schwarz GmbH & Co. KG  
Samel 90 PLC  
Sensofusion  
Serpikom  
SESP Group  
Sierra Nevada Corp.  
Silentium Defence  
SINTIS Technology Ltd.  
Skysafe  
SRC, Inc.  
SteelRock Technologies  
Teleradio Engineering  
Terra Hexen  
TCI International, Inc.  
TRD Consultancy Pte Ltd.

**GPS Jammers**

Defence Research and Development Canada  
Elbit Systems  
Empower RF Systems  
L3Harris  
Scientific Research Corp.  
Thales

**ELINT Systems**

Aeronix, Inc.  
Avalon Electronics, Inc.  
Azure Summit Technology

BAE Systems  
BEL - Bharat Electronics Ltd.  
DaqScribe Solutions, LLC  
Elbit Systems  
Elettronica SpA  
ELTA Systems Ltd.  
INDRA  
iRF Solutions

Jordan Electronic Logistic Support – Electronic Warfare

L3Harris  
Lockheed Martin  
Microwave Technologies Inc.  
Northrop Grumman

Patria  
QinetiQ Ltd.  
Rafael – Advanced Defense Systems Ltd.

Raytheon  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG

Rubisoft  
Saab  
Sierra Nevada Corp.  
Spectranetix, Inc.  
Teledyne Defense Electronics  
Telemus  
Thales Airborne Systems  
Ultra Electronics – Australia  
VIAVI Solutions, Inc.

**ELINT Systems – Antennas**

Alaris Antennas

# Spherical vision. Complete Protection.



Fixed and rotary wing aircraft are high value assets, and targets for hostile fire and man-portable missiles; situational awareness is critical.

Leonardo designs MAIR – a Threat Warning System (TWS) that automatically detects and tracks numerous hostile threats, such as missile launches including MANPADS and hostile fire; providing crews with immediate, accurate spherical situational awareness and enhanced navigation.

Inspired by the vision, curiosity and creativity of the great master inventor - Leonardo is designing the technology of tomorrow

Scan code to learn more



[leonardocompany.com](http://leonardocompany.com)

Helicopters | Aeronautics | Electronics, Defence & Security Systems | Space

 **LEONARDO**  
ELECTRONICS



AMT Microwave Corp.  
Antenna Authority  
Antenna Research Associates  
Antenna Systems and Solutions  
Applied EM Inc.  
CAL-AV Labs Inc.  
CEA Technologies  
Cobham  
Communications & Power Industries, Inc (CPI)  
Comtech PST  
Defence Research and Development Canada  
Electro-Metrics  
ET Industries  
ETS-Lindgren  
European Antennas  
First RF Corp.  
Flann Microwave  
Fractal Antenna Systems  
FS Antennentechnik GmbH  
HUBER+SUHNER AG  
IFI - Instruments for Industry Inc.  
JEM Engineering  
Jenkins Engineering Defence Systems  
L3Harris  
Leonardo DRS  
Link Microtek  
Micronetixx, P.A.  
Mercury Systems  
Microwave Engineering Corp.  
Microwave Specialty Company  
Microwave Technologies Inc.  
Ocean Microwave Corp.  
Octane Wireless  
PCTEL Inc. - Antenna Products  
QuinStar Technology, Inc.  
Radio Reconnaissance Technologies  
Rafael - Advanced Defense Systems Ltd.  
Randtron Antenna Systems  
Rohde & Schwarz GmbH & Co. KG  
Steatite Antennas  
Telemus

**ELINT Systems – Tuners**

AKON, Inc.  
D-TA Systems Inc.  
Epiq Solutions  
FEI-Elcom Tech  
iRF Solutions  
Leonardo DRS  
Mercury Systems  
Midwest Microwave  
NuWaves Engineering  
R. A. Wood Associates  
Rafael - Advanced Defense Systems Ltd.  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG

**ELINT Systems – Receivers**

Aeronix, Inc..  
Argon ST  
Atos  
Avalon Electronics  
Azure Summit Technology  
Chemring Technology Solutions  
Cobham  
Communications Audit UK Ltd.  
D-TA Systems  
Elbit Systems  
Elettronica SpA  
ELTA Systems Ltd.  
Emhiser Research Inc.  
FEI-Elcom Tech  
iRF Solutions  
IZT GmbH  
Kratos  
L3Harris  
Leonardo DRS  
Lockheed Martin  
Mercury Systems  
Mid-Atlantic RF Systems  
Motorola Solutions – Applied Technology  
Patria  
Plextek Consulting  
Rafael – Advanced Defense Systems Ltd.  
Raytheon  
Research Associates of Syracuse (RAS)  
Rohde & Schwarz GmbH & Co. KG  
Sierra Nevada Corp.  
Teledyne Defense Electronics  
Telemus  
Thales  
TUALCOM, Inc.  
Wide Band Systems Inc.

**COMINT Systems**

Argon ST  
Avalon Electronics, Inc.  
BAE Systems  
BATS  
Chemring Technology Solutions  
CRFS  
CyberRadio Solutions  
DaqScribe Solutions, LLC  
Decodio AG  
Digital Receiver Technology  
Elbit Systems  
ELTA Systems Ltd.  
ESPY Corp.  
General Dynamics  
Hensoldt  
Hensoldt South Africa  
Jordan Electronic Logistic Support – Electronic Warfare  
L3Harris  
L3Harris Narda Safety Test Solutions  
Leonardo DRS  
Lockheed Martin  
LS Telcom

N-Ask Incorporated  
Northrop Grumman  
PLATH GmbH  
PROCITEC GmbH  
QinetiQ Ltd.  
Radio Reconnaissance Technologies  
Radixon  
Raytheon  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG  
Rubisoft  
Saab Medav  
Serpikom  
Sierra Nevada Corp.  
Southwest Research Institute  
Spectranetix, Inc.  
Tata Advanced Systems  
TCI International, Inc.  
Thales Defense and Security Transformational Security LLC  
WGS Systems, Inc.

**COMINT Systems – Antennas**

Alaris Antennas  
AMT Microwave Corp.  
Antenna Authority  
Antenna Research Associates  
Antenna Systems and Solutions  
Applied EM Inc.  
ARA, Inc.  
CAL-AV Labs Inc.  
CEA Technologies  
Cobham  
Defence Research and Development Canada  
Defence Systems  
Electro-Metrics  
ET Industries  
ETS-Lindgren  
European Antennas  
First RF Corp.  
Flann Microwave  
Fractal Antenna Systems  
FS Antennentechnik GmbH  
HUBER+SUHNER AG  
IFI - Instruments for Industry Inc.  
JEM Engineering  
Jenkins Engineering  
L3Harris  
Leonardo DRS  
Link Microtek  
Micronetixx, P.A.  
Mercury Systems  
Microwave Engineering Corp.  
Microwave Technologies Inc.  
Ocean Microwave Corp.  
Octane Wireless  
PCTEL Inc. - Antenna Products

PLATH Signal Products  
QuinStar Technology, Inc.  
Radio Reconnaissance Technologies  
Rantel

Rohde & Schwarz GmbH & Co. KG  
Southwest Research Institute  
Steatite Antennas  
TCI International, Inc.

Rohde & Schwarz GmbH & Co. KG  
Southwest Research Institute  
Steatite Antennas  
TCI International, Inc.

**COMINT Systems – Tuners**

AKON, Inc.  
Communications Audit UK Ltd.  
Cyber Radio Solutions  
D-TA Systems Inc.  
Epiq Solutions  
FEI-Elcom Tech  
iRF Solutions  
IZT GmbH  
Leonardo DRS  
Mid-Atlantic RF Systems  
Midwest Microwave Solutions Inc.  
Radixon  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG  
Saab Medav  
URC Systems  
Zeta Associates

**COMINT Systems – Receivers**

Argon ST  
Atos  
Avalon Electronics  
Azure Summit Technology, Inc.  
BAE Systems  
Communications Audit UK Ltd.  
CRFS  
Cyber Radio Solutions  
D-TA Systems  
Deepwave Digital  
Digital Receiver Technology  
Emhiser Research Inc.  
Enablia S.R.L.  
ESPY Corp.  
FEI-Elcom Tech  
Hensoldt South Africa  
Herrick Technology Labs  
iRF Solutions  
IZT GmbH  
Jersey Microwave  
Kratos  
L3Harris – Linkabit  
L3Harris Narda Safety Test Solutions  
Leonardo DRS  
MEDAV GmbH  
Mercury Systems  
Mid-Atlantic RF Systems  
Norden Millimeter  
OEwaves  
Per Vices Corp.  
PLATH Signal Products  
Plextek Consulting  
Protium Technologies, Inc.  
Radio Reconnaissance Technologies  
Radixon

Raytheon  
RFEL Ltd.  
Rockwell Collins  
Rohde & Schwarz GmbH & Co. KG  
Roke Manor Research Ltd.  
Sagax Communications  
Spectrum Signal Processing  
Syncopated  
Syncopated Engineering  
Tampa Microwave  
Ten-Tec  
Wide Band Systems Inc.  
X-COM Systems, LLC

### **Direction Finding Systems**

Argon ST  
Azure Summit Technology, Inc.  
BAE Systems  
CEA Technologies  
Communications Audit UK Ltd.  
DATONG plc  
Elbit Systems EW and SIGINT – Elisra  
ESPY Corp.  
Hensoldt South Africa  
INDRA  
IZT GmbH  
Jenkins Engineering Defence Systems  
Kerberos International  
L3Harris – Linkabit  
L3Harris TRL Technology  
Leonardo DRS  
LS Telcom  
MEDAV GmbH  
Mitsubishi Electric Corp.  
National Instruments Corp.  
PLATH Signal Products  
QinetiQ Ltd.  
QRC Technologies  
Radio Reconnaissance Technologies  
Rantel  
Raytheon  
Rohde & Schwarz GmbH & Co. KG  
Roke Manor Research Ltd (Chemring Group)  
Serpikom  
Shoghi Communications Ltd.  
SRC, Inc.  
Tata Advanced Systems Limited (TASL)  
TCI International, Inc.  
TechComm  
Telemus  
Thales Defense and Security

### **GPS Anti-Jam Receiver Systems**

Boeing  
Lockheed Martin MST  
NovAtel  
Raytheon

## **EW SIMULATORS**

### **Field/Flightline RF EW Testers**

Dragoon ITCN  
Keysight Technologies  
L3Harris  
Leonardo DRS  
Spherea GmbH  
SRC, Inc.  
Tech Resources, Inc.  
Telemus  
Textron Systems Corporation  
Ultra Electronics Limited – EWST

### **EW Antenna Couplers**

L3Harris  
Leonardo DRS  
Rohde & Schwarz GmbH & Co. KG  
Tech Resources, Inc.

### **EO/IR Simulators**

CI Systems (Israel) Ltd.  
Defense Research Associates, Inc.  
Rohde & Schwarz GmbH & Co. KG  
RUAG – Aerospace  
Textron Systems Electronic Systems LTD UK  
Ultra Electronics Limited – EWST

### **Laboratory EW Simulators**

CSIR – DPSS  
DaqScribe Solutions, LLC  
ELDES S.r.l. – Radar Division  
EW Simulation Technology Ltd.  
FEL-Elcom Tech  
Giga-tronics  
Hensoldt South Africa  
Herrick Technology Labs  
ITT Test and Support Systems  
IZT GmbH  
Keysight Technologies  
Lockheed Martin – Aeronautics  
MASS  
Mercury Systems  
National Instruments Corp.  
Northrop Grumman Mission Systems  
Rafael – Advanced Defense Systems Ltd.  
Reut Systems and Technologies (RST)  
Rohde & Schwarz GmbH & Co. KG  
Scientific Research Corp.  
SRC, Inc.  
Tactical Technologies Inc. a Leonardo Company  
Textron Systems Corporation  
Thales Airborne Systems  
TMC Design, Inc.

Ultra Electronics Limited – EWST  
Varilog Research Inc.  
ViaSat, Inc. – RF Simulation Group

### **RF Range Threat Simulators**

D-TA Systems  
ELDES S.r.l. – Radar Division  
Keysight Technologies  
Leonardo DRS  
Northrop Grumman Amherst Systems  
Rafael – Advanced Defense Systems Ltd.  
Reut Systems and Technologies (RST)

Rohde & Schwarz GmbH & Co. KG  
SRC, Inc.  
Systems & Processes Engineering Corp. (SPEC)  
Telemus  
Textron Systems Corporation  
Ultra Electronics Limited – EWST

### **IR Range Threat Simulators**

EWA Government Systems, Inc.  
Leonardo DRS  
Northrop Grumman Mission Systems  
Scientific Research Corp.  
Textron Systems Corporation

## **EW & SIGINT SERVICES**

### **EW Consulting Services**

Adamy Engineering  
Amentum  
ATDI Ltd.  
Atkinson Aeronautics and Technology Inc.  
Booz Allen Hamilton, Inc.  
Clausewitz Technology  
Cobham AvComm  
Corvus  
CSIR – DPSS  
Darkblade Systems Corporation  
Défense Conseil International  
Defense Engineering Corp.  
Defense Research Associates, Inc.  
DePriest Associates, Inc.  
DEWC Pty Ltd.  
DHPC Technologies  
Dr. EW (Johnny Heikell)  
Dynamic Analytics & Test, Inc.  
Dynetics Inc.  
ECS  
Electronic Warfare Studying Group, Korean Institute of Electromagnetic Engineering & Science  
ETL Technologies Ltd.  
EW Solutions Ltd.

EWA – Electronic Warfare Associates  
EWTS  
FMV Test & Evaluation  
Georgia Tech Research Institute  
ITA International  
JB Management, Inc.  
Kihomac, Inc.  
Kranze Technology Solutions, Inc. (KTS)  
L3Harris  
Leidos  
LS Telcom  
MacAulay-Brown – Alion Science  
MarServices GmbH  
MASS  
Mercer Engineering Research Center  
Metamagnetics  
Micronetixx, P.A.  
Milso AB  
The Mitre Corporation  
Multiconsult SRL  
My-konsult  
Northeast Information Discovery, Inc.  
Nova Systems  
Overlook Systems Technologies, Inc.  
Parry Labs  
Phase II Staffing and Contracting LLC  
Physical Optics Corp.  
Qnion Co., Ltd.  
QuantiTech  
Research Associates of Syracuse (RAS)  
Reut Systems and Technologies (RST)  
Riverside Research Institute  
Rohde & Schwarz GmbH & Co. KG  
RUAG – Aerospace  
RVJ Institute  
Spatial and Spectral Research  
Teledyne Defense Electronics  
TEVET  
TMC Design, Inc.  
Tri Star Engineering, Inc.  
Triasys  
Vadum  
Virtualabs srl  
Warrior Support Solutions, LLC  
Wavepoint Research, Inc.

EWA – Electronic Warfare Associates

EWTS  
FMV Test & Evaluation  
Georgia Tech Research Institute  
ITA International  
JB Management, Inc.  
Kihomac, Inc.  
Kranze Technology Solutions, Inc. (KTS)  
L3Harris  
Leidos  
LS Telcom  
MacAulay-Brown – Alion Science  
MarServices GmbH  
MASS

Mercer Engineering Research Center  
Metamagnetics  
Micronetixx, P.A.  
Milso AB  
The Mitre Corporation  
Multiconsult SRL  
My-konsult  
Northeast Information Discovery, Inc.  
Nova Systems  
Overlook Systems Technologies, Inc.  
Parry Labs  
Phase II Staffing and Contracting LLC  
Physical Optics Corp.  
Qnion Co., Ltd.  
QuantiTech  
Research Associates of Syracuse (RAS)  
Reut Systems and Technologies (RST)

Riverside Research Institute  
Rohde & Schwarz GmbH & Co. KG  
RUAG – Aerospace  
RVJ Institute  
Spatial and Spectral Research  
Teledyne Defense Electronics  
TEVET  
TMC Design, Inc.  
Tri Star Engineering, Inc.  
Triasys  
Vadum  
Virtualabs srl  
Warrior Support Solutions, LLC  
Wavepoint Research, Inc.

### **EW Design Engineering Services**

Alion Science and Technology – Defense Operations  
Alpha Design Technologies Pvt. Ltd.  
AMEWAS, Inc.  
ASELSAN Inc.  
Base2 Engineering LLC  
BEL – Bharat Electronics Ltd.  
Booz Allen Hamilton, Inc.



CACI Technologies Inc.  
Cobham Defense Systems  
Colorado Engineering Inc.  
Concurrent Technologies  
Defence Research and  
Defense Engineering Corp.  
Defense Research Associates,  
Inc.  
Development Canada  
DHPC Technologies  
Dow-Key Microwave  
Dynetics Inc.  
ECS.  
EMS Technologies, Inc. –  
Defense and Space  
Georgia Tech Research  
Institute  
IKHANA Aircraft Services  
L3Harris  
Leonardo – Airborne and  
Space Systems Division  
Lockheed Martin – Rotary and  
Mission Systems (RMS)  
LS Telcom  
MacAulay-Brown – Alion  
Science  
MarServices GmbH  
MASS  
Mercer Engineering Research  
Center  
The Mitre Corporation  
Motorola Solutions – Applied  
Technology  
Northrop Grumman Mission  
Systems  
Northeast Information  
Discovery, Inc.  
Nova Systems  
Overlook Systems  
Technologies, Inc.  
Parry Labs  
Phasor Innovation PTY Ltd.  
Physical Optics Corp.  
Qnion Co., Ltd.  
Research Associates of  
Syracuse (RAS)  
Reut Systems and  
Technologies (RST)  
Rodale Electronics Inc.  
Rohde & Schwarz GmbH &  
Co. KG  
RUAG – Aerospace  
SAIC  
Scientific Research Corp.  
Signami-DCS – EW/Range  
Spectra Research  
Teledyne Defense Electronics  
Terma  
TMC Design, Inc.  
TriaSys Technologies Corp.  
Tri-Star Engineering, Inc.  
Ultra Electronics – Australia  
Valkyrie Enterprises LLC  
Varilog Research Inc.  
Virtualabs srl  
Zeta Associates

### **EW System Integration Services**

ASELSAN Inc.  
ATDI  
Babcock International Group  
BAE SYSTEMS Australia  
Boeing Military Aircraft  
Booz Allen Hamilton, Inc.  
Chemring Technology  
Solutions  
Chesapeake Technology Intl  
(CTI)  
Cobham Defense Systems  
Darkblade Systems  
Corporation  
Elbit Systems EW and SIGINT  
– Elisra  
ELTA Systems Ltd.  
EW Solutions Ltd.  
General Dynamics Mission  
Systems  
Hensoldt  
IKHANA Aircraft Services  
INDRA  
JB Management, Inc.  
L3Harris  
LCR Embedded Systems  
Leonardo – Airborne and  
Space Systems Division  
Leonardo DRS  
Lockheed Martin – Rotary and  
Mission Systems (RMS)  
LS Telcom  
MASS  
Mercer Engineering Research  
Center  
Northrop Grumman Mission  
Systems  
Parry Labs  
Qnion Co., Ltd.  
Rockwell Collins  
Rohde & Schwarz GmbH &  
Co. KG  
RUAG – Aerospace  
Scientific Research Corp.  
Signami-DCS – EW/Range  
Southwest Research Institute  
Terma  
Telemus  
TEVET  
Thales Airborne Systems  
TINEX AS  
TMC Design, Inc.  
TriaSys Technologies Corp.  
Wavepoint Research, Inc.

### **EW Software Development**

3db Labs  
Amplus Corporation  
ANSYS, Inc.  
Arctan, Inc.  
ASELSAN Inc.  
ATDI Ltd.  
Battlespace Simulations, Inc.  
BEL – Bharat Electronics Ltd.  
Booz Allen Hamilton, Inc.  
Chesapeake Technology Intl  
(CTI)  
Concurrent Technologies

CSIR – DPSS  
DCS Corp.  
Deepwave Digital  
Defence Systems  
Défense Conseil International  
Defense Research Associates,  
Inc.  
Dynamic Analytics & Test, Inc.  
Dynetics Inc.  
Elbit Systems EW and SIGINT  
– Elisra  
Elettronica SpA  
ESROE Limited  
EWA – Electronic Warfare  
Associates  
Genesis EW  
Georgia Tech  
Research Institute  
HAVELSAN  
INNOSYSTECH GmbH  
Intelligent Automation Inc.  
JB Management, Inc.  
Jenkins Engineering  
L3Harris  
L3Harris TRL Technology  
Leonardo – Airborne and  
Space Systems Division  
LS Telcom  
MASS  
Mercer Engineering  
Research Center  
Motorola Solutions –  
Applied Technology  
Northrop Grumman Corp. –  
Aerospace Systems  
Northrop Grumman  
Mission Systems  
Northrop Grumman Corp. –  
Technical Services  
Nova Systems  
PROCITEC GmbH  
Qnion Co., Ltd.  
Research Associates of  
Syracuse (RAS)  
RFEL Ltd.  
Rodale Electronics Inc.  
Rohde & Schwarz GmbH &  
Co. KG  
RUAG – Aerospace  
Scientific Research Corp.  
Sierra Nevada Corp.  
Spatial and Spectral Research  
SRC, Inc.  
Telemus  
Terma  
Textron Systems Corporation  
TriaSys Technologies Corp.  
Vadum  
Varilog Research Inc.  
Virtualabs srl  
Wavepoint Research, Inc.

### **EW Database Development**

Amentum  
Battlespace Simulations, Inc.  
Défense Conseil International  
Dynetics Inc.  
Elbit Systems EW and  
SIGINT – Elisra

ESROE Limited  
EW Solutions Ltd.  
EWA – Electronic  
Warfare Associates  
Georgia Tech  
Research Institute  
Hensoldt South Africa  
LS Telcom  
MASS  
Mercer Engineering  
Research Center  
Rohde & Schwarz GmbH  
& Co. KG  
Systematic  
Serpikom  
Thales Airborne Systems  
Wavepoint Research, Inc.

### **EW Operational Support Centers**

Elbit Systems EW and  
SIGINT – Elisra  
EWA – Electronic  
Warfare Associates  
Georgia Tech  
Research Institute  
Hensoldt South Africa  
LS Telcom  
MASS  
Telemus  
Thales Airborne Systems

### **Space-Based RF Emitter Mapping Services**

Hawkeye360  
Horizon Technologies  
Kleos Space  
Unseenlabs

### **EW/SIGINT Mission Planning Software**

Amentum  
ATDI  
Chesapeake Technology  
Intl (CTI)  
EWA – Electronic Warfare  
Associates  
Kratos  
Leonardo – Airborne and  
Space Systems Division  
LS Telcom  
MASS  
Raytheon  
Rohde & Schwarz GmbH &  
Co. KG  
Safran Electronics and  
Defense  
Scientific Research Corp.  
Telemus  
Teleplan Globe Defence  
Thales Defense and Security

### **Operational EW Training Software**

Alion Science and Technology  
Amplus Corporation  
Battlespace Simulations, Inc.  
CACI Technologies Inc.



ASSOCIATION  
OF OLD CROWS

## Take a Listen to the AOC Podcasts

Brought to you by the Association of Old Crows



This regularly scheduled podcast, hosted by Ken Miller, AOC's Director of Advocacy and Outreach, will feature interviews, analysis, and discussions covering leading issues of the day related to electromagnetic spectrum operations (EMSO). This will include current events and news from around the world, US Congress and the annual defense budget, and military news from the US and allied countries.

We will also bring you closer to AOC events and provide a forum to dive deeper into policy issues impacting our community.

**[crows.org/FromtheCrowsNest](http://crows.org/FromtheCrowsNest)**



This podcast will take you on a journey throughout time and around the world to meet the inventors, the battles, and the technology that has not only shaped military operations - how we fight - but also how we live.

The History of Crows will cover some of the most important discoveries, battles, and events that shaped what we know today as electromagnetic spectrum operations. Episodes that take you deeper into our history will be added periodically.

**[crows.org/HistoryOfCrows](http://crows.org/HistoryOfCrows)**

## Interested In Being a Guest?

Send your ideas and recommendations to Ken Miller, Director of Advocacy and Outreach, at [kmiller@crows.org](mailto:kmiller@crows.org). We look forward to hearing from you!

## Interested In Becoming a Sponsor?

For more information and to secure your sponsorship, please contact Sean Fitzgerald, AOC's Manager of Sales and Client Operations, at [fitzgerald@crows.org](mailto:fitzgerald@crows.org).



Chesapeake Technology  
Intl (CTI)  
Défense Conseil International  
Diehl Defence  
ELDES S.r.l. – Radar Division  
EWA Government  
Systems, Inc.  
EWTS  
FMV Test & Evaluation  
General Dynamics  
Mission Systems  
Genesis EW  
JT4 LLC  
Leonardo DRS  
LS Telcom  
MASS  
Rohde & Schwarz GmbH &  
Co. KG  
SAIC  
Scientific Research Corp.  
Serpikom  
Sierra Nevada Corp.  
Telemus  
Thales Defense and Security  
Ultra Electronics – Australia  
Virtualabs srl

### **Operational EW Training Services**

ATDI  
Adamy Engineering  
Airborne Tactical Advantage  
Company  
AvDef – Aviation  
Defence Service  
Battlespace Simulations, Inc.  
CACI Technologies Inc.  
CTL SystemWare  
Darkblade Systems  
Corporation  
Défense Conseil International  
Defence Research and  
Development Canada  
DEWC Pty Ltd.  
Discovery Air  
Defence Services  
Draken International  
ETL Technologies Ltd.  
HAVELSAN  
Hensoldt South Africa  
JB Management, Inc.  
L3Harris TRL Technology  
Leonardo DRS  
MASS  
Mercury Electronic  
Warfare Ltd.  
My-konsult  
Northrop Grumman Corp. –  
Technical Services  
Phoenix Air  
Rohde & Schwarz GmbH  
& Co. KG  
Scientific Research Corp.  
Sierra Nevada Corp.  
Thales Defense and Security  
Thales Airborne Systems  
Ultra Electronics – Australia

### **EW Testing Services**

Advantage Company  
Advanced Compliance  
Solutions  
Amentum  
Airborne Tactical  
Advantage Company  
Applied Research Associates  
Blue Halo  
Cobham Aviation Services –  
Special Mission  
DCS Corp.  
Defense Research  
Associates, Inc.  
DEWC Pty Ltd.  
DHPC Technologies  
Dynamic Analytics  
& Test, Inc.  
Dynetics Inc.  
ELDES S.r.l. – Radar Division  
EWTS  
FMV Test & Evaluation  
JB Management, Inc.  
Keysight Technologies  
Kranze Technology Solutions,  
Inc. (KTS)  
Lockheed Martin –  
Aeronautics  
MASS  
Modern Technology Solutions,  
Inc.  
Overlook Systems  
Technologies, Inc.  
Phoenix Air  
Scientific Research Corp.  
SURVICE Engineering Co.  
Teledyne Defense Electronics  
TEVET  
Textron Systems Electronic  
Systems LTD UK  
TINEX AS  
Toyon Research Corp.  
TriaSys Technologies Corp.  
Ultra Electronics – Herley  
Varilog Research, Inc.

### **SIGINT Consulting Services**

3SDL  
Adamy Engineering  
Amentum  
Aeronix, Inc.  
Babcock International Group  
Chordell Systems  
COMSEC LLC  
Darkblade Systems  
Corporation  
DHPC Technologies  
Digital Receiver Technology  
Dreamlab Technologies AG  
ETL Technologies Ltd.  
EW Solutions Ltd.  
EWA Government  
Systems, Inc.  
Genesis EW  
Hegarty Research LLC  
Hensoldt South Africa  
Innovative Signals Technology  
(ISigTech)  
L3Harris

Leidos  
MacAulay-Brown –  
Alion Science  
ManTech International Corp.  
MarServices GmbH  
MASS  
The Mitre Corporation  
Northeast Information  
Discovery, Inc.  
Plath GmbH  
QinetiQ Ltd.  
Rohde & Schwarz GmbH  
& Co. KG  
Shoghi Communications Ltd.  
Spatial and Spectral Research  
Teledyne Defense Electronics  
Teleplan Globe Defence  
TriaSys Technologies Corp.

### **SIGINT Design Engineering Services**

Amentum  
Aeronix, Inc.  
AirScan Inc.  
AMEWAS, Inc.  
Argon ST  
Base2 Engineering LLC  
Blue Ridge  
Envisioneering, Inc.  
CACI Technologies Inc.  
Chemring Technology  
Solutions  
Chordell Systems  
Concurrent Technologies  
Darkblade Systems  
Corporation  
DHPC Technologies  
Digital Receiver Technology  
ESPY Corp.  
Genesis EW  
Hensoldt South Africa  
Innovative Signals Technology  
(ISigTech)  
IZT GmbH  
L3Harris  
L3Harris – Communication  
Systems-East  
L3Harris – Linkabit  
LOG.IN Srl  
ManTech International Corp.  
MarServices GmbH  
MASS  
The Mitre Corporation  
Motorola Solutions –  
Applied Technology  
Northrop Grumman Mission  
Systems  
Northeast Information  
Discovery, Inc.  
Parsons  
Phasor Innovation PTY Ltd.  
Plath GmbH  
Raytheon  
Rising Edge Technologies  
Rohde & Schwarz GmbH  
& Co. KG  
Rubisoft  
Shoghi Communications Ltd.  
SimVentions

Spectrum Signal Processing  
SRI International  
Teledyne Defense Electronics  
Thales Defense and Security  
TriaSys Technologies Corp.  
Ultra Electronics – Australia  
Valkyrie Enterprises LLC  
Varilog Research Inc.  
WGS Systems, Inc.

SIGINT System  
Integration Services

AirScan Inc.  
Argon ST  
Azure Summit Technology,  
Inc.  
Babcock International Group  
Boeing Military Aircraft  
CACI Technologies Inc.  
Chesapeake Technology Intl  
(CTI)  
Darkblade Systems  
Corporation  
DSPCon, Inc.  
Elbit Systems EW and SIGINT  
– Elisra  
ELTA Systems Ltd.  
General Atomics  
General Dynamics Mission  
Systems  
Hensoldt South Africa  
IKHANA Aircraft Services  
INNOSYSTECH GmbH  
Innovative Signals Technology  
(ISigTech)  
L3Harris  
L3Harris – Linkabit  
LCR Embedded Systems  
Leonardo DRS  
Lockheed Martin – IS&GS –  
Littleton  
Lockheed Martin – Rotary and  
Mission Systems (RMS)  
LOG.IN Srl  
MarServices GmbH  
MASS  
MEDAV GmbH  
Northrop Grumman Mission  
Systems  
Parsons  
Patria  
Plath GmbH  
Radio Reconnaissance  
Technologies  
Raytheon  
Research Electronics  
International (REI)  
RF COM Sistemas Ltda.  
RFEL Ltd.  
Rincon Research Corporation  
Rising Edge Technologies  
Rohde & Schwarz GmbH &  
Co. KG  
Scientific Research Corp.  
Thales Airborne Systems  
Thales Defense and Security  
TINEX AS  
ThinkRF  
TriaSys Technologies Corp.

WGS Systems, Inc.

**SIGINT Software Development**

3dB Labs

3SDL

Aeronix, Inc.

AMEWAS, Inc.

Amplus Corporation

Arctan, Inc.

Argon ST

Blue Ridge

Envisioneering, Inc.

C&amp;S Intelligence Services

CACI-SystemWare Inc.

Chemring Technology

Solutions

Chesapeake Technology

Intl (CTI)

Chordell Systems

COMINT Consulting

Communications Audit

UK Ltd.

COMSEC LLC

Concurrent Technologies

Deepwave Digital

Decodio AG

Dreamlab Technologies AG

Elbit Systems EW and

SIGINT – Elisra

ESPY Corp.

EWA Government Systems

General Dynamics

Mission Systems

Genesis EW

Georgia Tech

Research Institute

Hegarty Research LLC

Hensoldt South Africa

INNOSYSTECH GmbH

Innovative Signals Technology  
(ISigTech)

Intelligent Automation Inc.

IZT GmbH

Jenkins Engineering

Defence Systems

L3Harris

L3Harris – Communication  
Systems-East

L3Harris – Linkabit

L3Harris TRL Technology

Leonardo DRS

Lockheed Martin –  
IS&GS – Littleton

LOG.IN Srl

MacAulay-Brown, Inc.

MASS

MEDAV GmbH

Motorola Solutions –  
Applied Technology

MRSL

N-Ask Incorporated

Northrop Grumman

Mission Systems

Northeast Information

Discovery, Inc.

Parry Labs

Parsons

Peralex

Plath GmbH

Professional Development

TSCM Group

QinetiQ Ltd.

QRC Technologies

Radio Reconnaissance  
TechnologiesRaytheon – Space and  
Airborne SystemsResearch Electronics  
International (REI)

RF Engines Ltd.

Rising Edge Technologies

Rohde & Schwarz GmbH &  
Co. KG

Rubisoft

SAIC

Scientific Research Corp.

SensorCom Inc.

Serpikom

Shoghi Communications Ltd.

Signami-DCS – EW/Range

SimVentions

Southwest Research Institute

Spatial and Spectral Research

Spectrum Signal Processing

SRI International

SRC, Inc.

TechComm

Teleplan AS

Thales Defense and Security

ThinkRF

Transformational Security

LLC

TriaSys Technologies Corp.

TSF5

URC Systems

Varilog Research Inc.

WGS Systems, Inc.

X-COM Systems, LLC

Zeta Associates

**Professional Development Courses/Seminars**

Adamy Engineering

AirScan Inc.

Applied Technology  
Institute (ATI)

Association of Old Crows

CACI Technologies Inc.

CSIR – DPSS

EW Solutions Ltd.

Georgia Tech  
Research Institute

JB Management, Inc.

Keysight Technologies

LS Telcom

Mass

Mercury Electronic

Warfare Ltd.

Research Associates of  
Syracuse (RAS)

**Pacific Defense builds advanced,  
upgradeable and affordable CMOSS  
and SOSA multi-domain solutions  
designed to be adaptive and  
rapidly deployable.**



www.pacific-defense.com

The Pacific Defense Family



- ◆ Electronic Warfare
- ◆ Signals Intelligence Collection
- ◆ Tactical Communications
- ◆ Tactical Networking
- ◆ Offensive Cyber Operations
- ◆ All-Domain Command and Control

# AOC Webinars



AOC Webinars has been a tremendous asset providing the AOC's audience with learning, advocacy, and the exchange of information. Register today to hear from subject-matter experts on all things EW!

## 5g for Critical Communications

Presenter: Andreas Roessler



October 7, 2021

## Eliminating the Pain of Transitioning EW Systems from Lab to Field

Presenter: David Murray



October 21, 2021

## What SOSA™ Means to the Warfighter

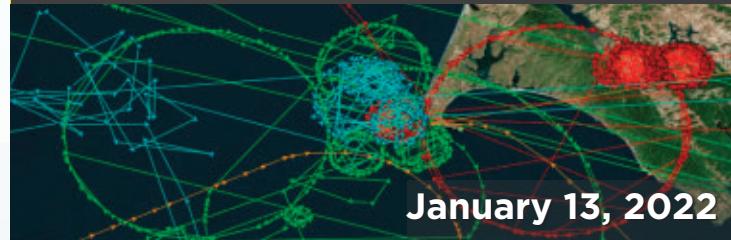
Presenter: SOSA Panel



October 14, 2021

## GPS Spoofing - History and Prevention

Presenter: Dana Goward



January 13, 2022

## Microwave Photonics Improving DRFM Capabilities Against a New Generation of Radars

Presenter: Renan Richter



January 27, 2022

## Tactical Electronic Support Measures (ESM)

Presenter: Dr. Clayton Stewart



February 24, 2022

## How To Use Simulation To Align Your Work Team

Presenter: John Kolm



March 10, 2022

For more upcoming AOC Virtual Series Webinars, visit [crows.org](http://crows.org)

WASHINGTON D.C.

58<sup>TH</sup>



AOC INTERNATIONAL  
SYMPOSIUM & CONVENTION

NOV. 30-DEC. 2, 2021

ATTENDANCE IS MISSION-CRITICAL



**REGISTER NOW AT [58.CROWS.ORG!](http://58.crows.org)**

**58.crows.org**

*Host Sponsor*



**L3HARRIS**

# WHO SHOULD ATTEND

AOC 2021, the Association of Old Crow's International Symposium & Convention, brings together the *full spectrum of people* working in electromagnetic spectrum operations.



## ACTIVE DUTY TO VETERAN

No matter what your mission, you need an advantage in the spectrum. A better understanding of the invaluable role of spectrum in military operations is imperative for success.

## JUNIOR ENGINEER TO PRINCIPAL ENGINEER

You are the technology makers, the rapidly evolving designers. Through research and development, you are solving the problems and providing the solutions to the war fighters.

## CASUAL TO PRO

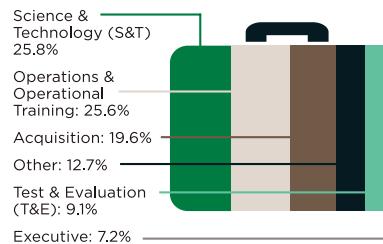
The spectrum is part of your world and touches everything you do. You need to join our mission in order to gain the knowledge you need to drive decisions in your organization.

## SUPPORT OUR MISSION • INFLUENCE OUR MISSION • LEARN OUR MISSION

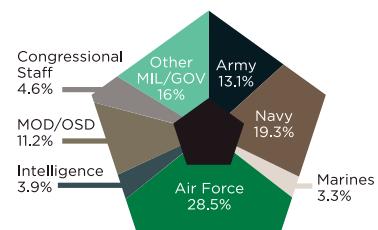
*"Attending allowed me to engage with the end-user community and learn what is happening across DoD as well as educate myself on the art of the possible."*

- Dr. Ilya Lipkin,  
Technical Expert,  
Open Architecture

### MIL/GOV Breakdown by Job Function



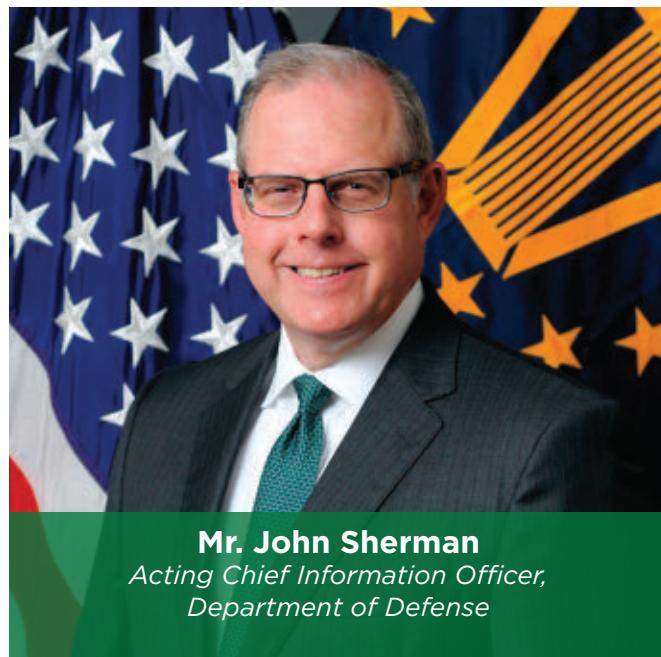
### MIL/GOV Breakdown by Employer



## KEYNOTE SPEAKERS

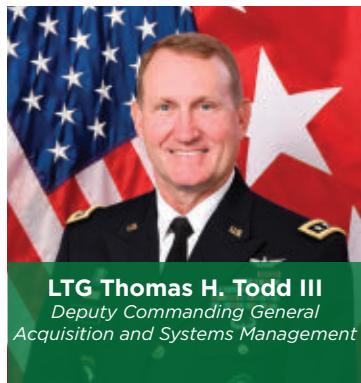


**Lt. Gen. S. Clinton Hinote**  
Deputy Chief of Staff for Strategy,  
Integration and Requirements,  
U.S. Air Force



**Mr. John Sherman**  
Acting Chief Information Officer,  
Department of Defense

# SPEAKER SPOTLIGHT



**LTG Thomas H. Todd III**  
Deputy Commanding General  
Acquisition and Systems Management



**Dr. Victoria Coleman**  
Chief Scientist  
United States Air Force



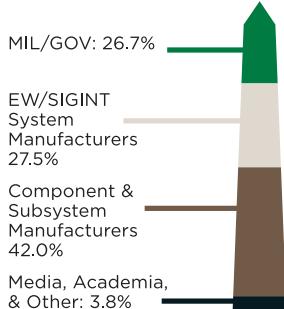
**Ms. Michèle Flournoy**  
Co-Founder & Managing Partner  
WestExec Advisors



**The Honorable Heidi Shyu**  
Chief Technology Officer  
Under Secretary of Defense for  
Research & Engineering (OUSD(R&E))

View the full list of our prestigious speakers at [crows.org/2021Speakers](http://crows.org/2021Speakers)

## Attendance Profile



*"The AOC International Symposium & Convention is invaluable to the government and to industry. As the Army's Capability Manager for Electronic Warfare, the annual convention was critical to my understanding of the state of industry. Now, as a member of industry, the event provides outstanding networking and showcasing opportunities. To my knowledge, there is no greater aggregation of EW professionals at one time than this event."*

- COL (Ret.) Mark Dotson, Director, Army Accounts, AnaVation, LLC

## EXHIBIT HALL SPACE IS NEARLY FULL!

Booth space on the convention show floor is almost gone! Don't let the opportunity to exhibit at the biggest Electromagnetic Warfare event of the year pass you by. To learn more about sponsoring and exhibiting contact **Sean Fitzgerald** at [fitzgerald@crows.org](mailto:fitzgerald@crows.org), or go to [58.crows.org](http://58.crows.org).

## 2021 EXHIBITOR LISTINGS

3dB Labs  
Advanced Test Equipment Rentals  
Aethercomm  
Alaris USA LLC  
American Standard Circuits  
Ampex Data Systems  
AmpliTech Incorporated  
Analog Devices  
Annapolis Micro Systems, Inc.  
Anritsu Company  
Antenna Research Associates, Inc.  
AOC EW Europe 2022  
API Technologies Corporation  
ApisSys  
ASELSAN A.S  
Atlanta Micro, Inc.  
BAE Systems  
CAES  
Colorado Engineering Incorporated  
Communications & Power Industries LLC  
Comtech PST  
Conduant Corporation  
Crane Aerospace & Electronics  
CRFS  
dB Control  
Decodio AG  
Digital Receiver Technology (DRT)  
Directed Energy Professional Society (DEPS)  
D-TA Systems  
Elbit America  
Elite RF  
Empower RF Systems  
Epiq Solutions  
EWA Government Systems

Georgia Tech Research Institute  
Giga-tronics  
Glenair, Inc.  
Gowanda Electronics  
HawkEye 360  
Herrick Technology Laboratories, Inc  
Intel Corporation  
Intelligent Automation, Inc.  
Interface Concept  
iRF-Intelligent RF Solutions  
Keysight  
Kratos General Microwave  
L3Harris  
Leonardo DRS  
Lockheed Martin  
Meggitt  
Metamagnetics  
Microwave Products Group  
Microwave Specialty Company  
Motorola Solutions, Inc.  
Noology NA Inc.  
Northeast Information Discovery, Inc.  
Northrop Grumman  
NSI-MI Technologies  
Ophir RF  
Pacific Defense  
Pentek, Now part of Mercury  
Persistent Systems  
Photonis Defense Incorporated  
Physical Optics Corporation  
Planar Monolithics Industries, Inc  
PLATH Signal Products GmbH & Co. KG  
Plexsa Manufacturing  
Procitec GmbH

Q Microwave, Inc.  
Qorvo  
Raytheon Intelligence & Space  
Research Electronics International  
RFHIC US Corporation  
Rohde & Schwarz USA, Inc.  
Rotating Precision Mechanisms Inc  
RVJ Institute  
Samtec  
Select Fabricators  
Shadow Technologies, Inc.  
Sierra Nevada Corp  
Signal Hound  
SignalCore Incorporated  
SRC, Inc.  
TCI  
TE Connectivity  
Teledyne Defense Electronics  
Telspan Data  
Terma North America  
TEVET  
Textron  
TMD Technologies, LLC  
Transhield Incorporated  
Trenton Systems  
Ultra  
Vadum Incorporated  
VIAVI Solutions  
Vishay Specialty Thin Film  
Wideband Systems  
Xilinx Incorporated  
Zarges Incorporated

\*As of September 10, 2021

# REGISTRATION INFORMATION

## Master Pass

The 'Master Pass' includes access to keynote sessions, all symposium sessions Tuesday-Thursday, the Welcome Reception; the exhibit hall, lunches and happy hours, First-Time Attendee Orientation, and to all recorded keynote sessions and all briefings as released by the speakers. *Registration does not include access to the Program Manager Briefing Series or post-convention courses.*

	<del>By 8/31</del>	9/1-11/5	11/6-On-Site
Industry (Member)	<del>\$695</del>	\$795	\$895
Industry (Non-Member)	<del>\$895</del>	\$995	\$1095
Academia*	<del>\$445</del>	\$545	\$645
Young Crows (35 and younger)*	<del>\$445</del>	\$545	\$645
Government Civilian*	<del>FREE</del>	FREE	FREE
Military in Uniform**	<del>FREE</del>	FREE	FREE

\*Must present proper ID for discounted price, see 58.crows.org for more information.

\*\*Duty uniform must be worn each day. If not, a fee of \$100 will be assessed.

## Need help justifying your attendance?

We have resources for you to use at [crows.org/JustificationLetter](http://crows.org/JustificationLetter)

## Exhibition Only Pass

This complimentary registration type provides access to the Welcome Reception, keynote sessions and the exhibit hall. *It does not allow access to all other symposium sessions, Program Manager Briefing Series or post-convention courses.*

Exhibition Only	<del>FREE</del>	FREE	FREE
-----------------	-----------------	------	------

## HOTEL INFORMATION

AOC has negotiated special rates for AOC attendees during their stay in DC with the **Courtyard/Residence Inn by Marriott Downtown/Convention Center**. Housing deadline fast approaching, book your room by November 8.

Book your room now at [crows.org/2021HotelTravel](http://crows.org/2021HotelTravel)

## POST-CONVENTION COURSES

*Extend your convention experience by signing up for a post-convention AOC professional development course. These courses are taught by our subject matter experts.*



### Space Electronic Warfare

December 3-4, 2021

Presented by Dave Adamy

### Machine Learning for EW

December 3-4, 2021

Presented by Kyle Davidson

Get more information online at [crows.org/2021Courses](http://crows.org/2021Courses)

*Separate registration required.*

#CROWS2021

## 5G Communications – Part 7

# Testing and Training Using 5G

By Dave Adamy

**This discussion is** focused on testing and training using simulated signals rather than on open range testing. First, we will consider the simulation process, and then we will move to the nature of the transmissions between the location of the simulator and the locations at which the testing or training takes place.

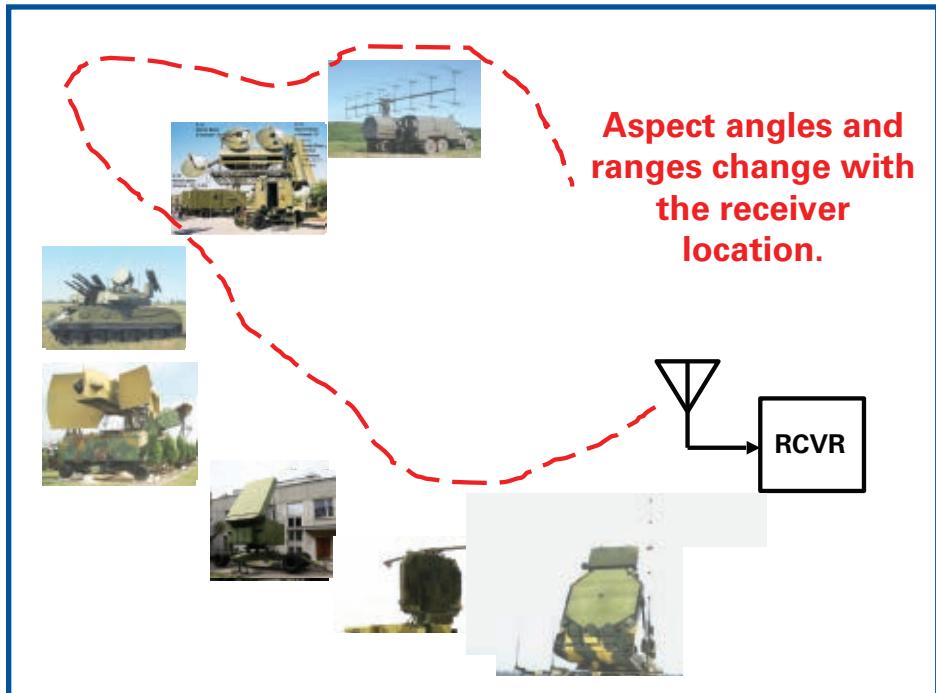
When an EW system is tested away from an open air range, the antennas at each of the system's input ports are replaced by cables that are directly coupled to a threat simulator that provides outputs to the EW system. This allows the EW system to experience full operation in an electromagnetic environment without moving from the test facility. However, simulators can be large, complex and difficult to move. Thus, it is desirable to be able to transport those output signals over great distances from the

threat simulation facility to other test facilities that may house remote EW systems or weapons system trainers. This entails lots of wideband, high throughput communication between the electromagnetic environment simulators and the EW systems. With its high bandwidth and low latency, 5G communications technology is well-suited to this task.

### SIMULATION

An EW system under test needs to be evaluated to determine that it can provide adequate response to an array of threats in a situation that does not yet exist. Thus, a simulator can provide a series of signals to system receivers just as they would be received in a real-world situation. Also, the reactions of enemy radars and radios to the actions of friendly EW systems can be a part of the simulation. This same simulation, with different fidelity, can enable operator training at remote locations.

The simulation process starts with the description of a gaming area. This is a volume (defined in a computer) in which all of the enemy assets are located along with the terrain over which



*Fig. 1: The illustration above shows the relative location of the threat radars on a test range (i.e., gaming area). An aircraft carrying an EW system under test will encounter these threats and respond to them, depending on the scenario. Depending on the location of each threat, the EW system will "see" each of the threats from a different aspect and range.*

the simulated action takes place. An EW system under test is assumed to be mounted on a platform that moves through the gaming area as it performs a mission. An example is an aircraft penetrating a hostile air defense network to strike an important target. This simulated motion is important because it will determine the order in which the EW system will see the threats, the ranges and angles at which the tested system will encounter those threats and the timing of those encounters. Timing is very important because every part of an EW system requires a finite time to perform each of its contributing functions. Thus there is a function throughput limitation that must be tested along with the performance of each required task. The timing of actions and reactions are also important to the training process.

Once the gaming area is established, a threat laydown is performed. A very simple threat laydown is illustrated in **Figure 1**. A realistic laydown would cover a very large area and can include both radar and communications threats. The EW system (mounted on a strike aircraft) is assumed to move relative to those threats to accomplish the aircraft's mission.

A simulator needs to generate threat signals as they would be received by each of the EW system's antennas – accounting for dynamic motion as the platform on which the system is mounted would encounter the threats while passing through the gaming area.

Now consider **Figure 2**, which shows an EW receiving antenna on a platform encountering a hostile emitter. In this figure, we consider only one receiving antenna, and will consider the way that signals which would be output from that antenna can be simulated. The antenna is offset from the velocity vector of the platform in both azimuth and elevation, and the offset angle to the received signal from the boresight is a spherical angle which can be calculated. Likewise, if the hostile emitter is moving (as shown in Figure 2), its antenna boresight is offset from the velocity vector of its platform by a spherical angle.

The strength of the received signal is a function of the boresight gains of the transmit and receive antennas and the gain reductions caused by their spherical offset angles from the signal path. It is also a function of the hostile transmitter power and the range between the hostile emitter and the platform.

The received signal frequency is changed from the transmitted signal frequency by the Doppler shift. The Doppler shift is a function of the rate of change of the range between the emitter and the platform, which can be calculated from the motion of the platforms and the geometry. For example, if the spherical angle between the platform velocity vector and the received signal vector is 45°, and the spherical angle between the hostile emitter velocity vector and the signal vector emitter is 60°, then the rate of change of range is:

$$V_{\text{emitter}} \cos 60^\circ + V_{\text{platform}} \cos 45^\circ$$

So the Doppler shift ( $\Delta f$ ) is:

$$(F/c)(V_{\text{emitter}} \cos 60^\circ + V_{\text{platform}} \cos 45^\circ)$$

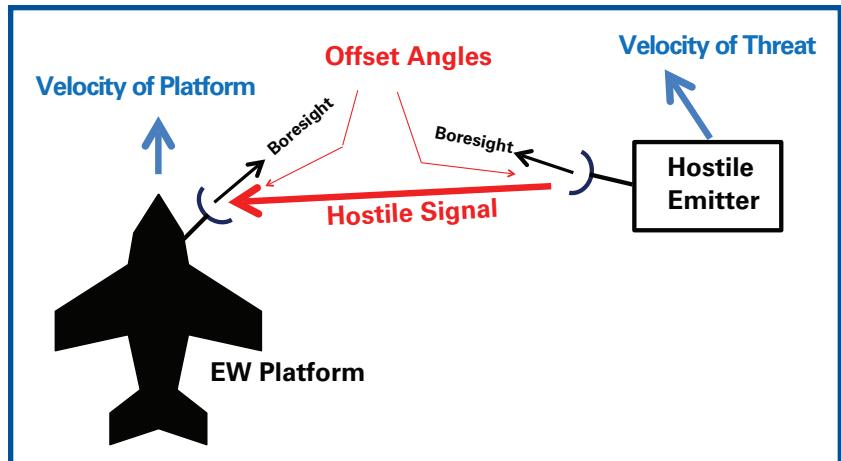
Where F is the transmitted frequency and c is the speed of light.

**Figure 3** shows the transmitter and the receiver as located in the gaming area. The propagation range is the square root of the sum of the squares of the differences between the x, y and z locations of the transmitter and the receiver. The transmitter to receiver range is:

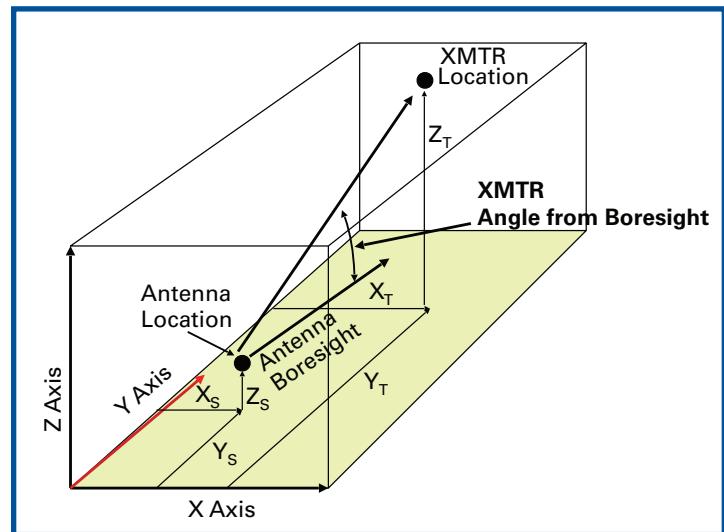
#### Square root of ( $\Delta x^2 + \Delta y^2 + \Delta z^2$ )

If the x axis distance is 10 km, the y axis distance is 40 km and the z axis distance is 2 km, the propagation range is:

$$\sqrt{100 + 1600 + 4} \text{ km} = 41.3 \text{ km}$$



**Fig. 2:** The antenna for which the simulator generates an output signal is oriented relative to the platform on which it is mounted and moves with that platform. A received signal comes from an emitter on a hostile platform, which can also be moving. The antenna gain reductions for both antennas and the rate of change of range between the two platforms must be calculated.



**Fig. 3:** The range between the receiving antenna and the transmitter is calculated from their relative locations in the gaming area.

Now the signal output from the receiving antenna can be described in terms of the received power (which is increased from the transmitter power by the product of the gains of the two antennas as reduced by the angular offset reductions). It is also reduced by the propagation loss. Depending on the location of the transmitter and receiver relative to the terrain in the gaming area, the propagation loss will be either "line of sight" "two ray" or "knife edge diffraction" which are described in the EW101 columns in the July, August and September 2007 JED issues. Since those columns were published 14 years ago, we will take a break from the 5G discussion next month to review the formulas for those three propagation models before proceeding.

#### WHAT'S NEXT

Next month, we will review the propagation formulas for transmission between two isotropic antennas depending on the local terrain, then we will resume the 5G discussion the following month. For your comments and suggestions, Dave Adamy can be reached at dave@lynxpub.com.

# RULE THE SPECTRUM

with MONARCH Systems and SCEPTRE Software



## PROVEN HARDWARE SOLUTIONS

- Ultra-wideband RF record and playback
- 1/10/40/100 Gbps IQ streaming
- VITA 49.2 compliant
- Options covering HF to 70 GHz
- Compatible with 40+ different receivers
- Over 200 TB integrated storage
- Remote web interface, open API

## REAL-TIME SIGNAL PROCESSING

- Spectrum analyzers and oscilloscopes
- RF survey and change detection
- MIDAS Pulse Descriptor Word generation
- Digital and analog demodulators
- LPI/LPD detection
- JICD 4.2 TDOA/FDOA/LOB geolocation
- Comprehensive intercept database & mapping

## EMBEDDED SYSTEMS & SERVERS – FULLY CUSTOMIZABLE & SCALABLE



### MAN PACKABLE EMBEDDED SYSTEMS

MONARCH-LT-10G-ES  
70 MHz – 6 GHz  
50 MHz IQ Record & Playback



### RUGGEDIZED 2U SERVER

MONARCH-RRM-10G  
100 MHz – 40 GHz  
2 GHz IQ Record & Playback

**3dB**  
LABS

[www.3db-labs.com](http://www.3db-labs.com)

©2021 3dB LABS, INC. ALL RIGHTS RESERVED.

# AOC Europe 2021

## Multi-Domain Operations for Electromagnetic Spectrum Dominance

**In October, world-leading** experts from the military, government, academia and industry will come together at the 25<sup>th</sup> AOC Europe event in Liverpool, England, to exchange ideas and information and review the latest developments in electromagnetic (EM) and information-related fields.

Under an overarching theme of “Multi-Domain Operations for Electromagnetic Spectrum Dominance,” attendees will progress their understanding of the issues, technology and capabilities that underpin their national EW abilities and allow them to enhance these capabilities both nationally and in international collaborative defence.

The Multi-Domain Battlefield includes the EM domain and information domain (including cyber operations), as well as the land, maritime, air and space domains. As the EM and information domains underpin and enable every decision, communication and navigation system as well as defensive and offensive

actions, spectrum management capabilities are vital to all warfare – and especially to manoeuvre warfare.

“We all know that without spectrum dominance the war is lost before it is begun,” Dr Sue Robertson, AOC International Region 1 Director said. “At AOC Europe, we will consider new and current threat systems and strategies for defeating them, alongside the technological developments most likely to influence the complex electromagnetic warfare of the future.”

This will be the first AOC Europe conference put together under Dr Robertson’s guidance. With more than 25 years’ experience working in the field of EW and extensive understanding of working with data analysis for airborne and ship ESM systems, Dr Robertson has developed flight trials programmes and produced hundreds of reports on ESM performance issues. Dr Robertson has also developed software for ESM testing and techniques for extracting data from flight trials for the population of ELINT databases. Alongside this, she has contributed ev-



idence to UK Parliamentary Committees on subjects such as Maritime Reconnaissance and Security issues and has acted as an advisor on ISTAR matters to the UK Commons Defence Select Committee.

The conference agenda has been put together by Dr Robertson to reflect the growing importance of EW capabilities in mitigating the threats of the evolving battlespace. "AOC provides a forum for experts, academics and specialist equipment manufacturers to share information, ideas and technological advances to allow the development of sophisticated electronic warfare systems," Dr Robertson said. "Within the context of the multi-domain battlefield, we have put together a conference agenda featuring some of the brightest minds currently working in this sphere, with the goal of touching on a wide range of topics from where we are today, to where we need to go in the future."

AOC Europe 2021 session topics in support of the conference theme include operational updates and activities, global EW threat developments, national perspectives on EW, cyber and information security, advances in platform protection, and technological innovations and developments.

Day one will begin with a welcome from President of the AOC, Powder Carlson; International Region 1 Director, Dr Sue Robertson; and UK Chapter President, Chris Howe. The opening address from Air Cdre Jason Crawford, Commander Joint CEMA Group, Royal Air Force, will discuss "Platforms, Sensors and Data: Paradigm Shifts in EW Capability Development," followed by the land operations perspective with a presentation from Lt Col Chris Fogarty, CO 14 Sig RHQ, British Army, on "Gazing into the Crystal Ball – What Will EWSI Look Like in the Next Decade?"

Other day one sessions include a range of topics including Joint Electromagnetic Spectrum Operations at US European Command from Mark Haselden, Principal Systems Engineer, The MITRE Corporation; "Air Dominance – Survivability & Lethality Enablers" from Gene McFalls, Senior Manager, Air Dominance Programs, Raytheon; and a look at "The Need for SEAD" by Tom Withington of *Armada International*, among others.

Afternoon sessions will include presentations on the topics of "EW and Cyber-over-RF: Similarities and Differences," "NATO Next Generation Rotorcraft Activities," "Open Standards, Multi-Domain Integration, and the National Prosperity Agenda," and "Unstructured Training with Computer Games," among others.

Day two of the conference will begin with a special feature of AOC Europe 2021, a session on next generation air platform survivability by the NATO Air Platform Protection Group that will include the multi-sensor threat challenge, advances in defensive aids systems and the future of NATO SEAD. Speakers in these sessions include Mark Elson MBE, Dstl Fellow, Electromagnetic Protection Group, Dstl; Chris Greenwood, SO1 Prot



Air Cap, RAF; Matt Cook, Air Protection Science Adviser, RAF Air Command, Ministry of Defence; John Bowker, Systems Lead Air Survivability, DSTL; Mark Threadgold, Dstl Fellow, Electromagnetic Protection Group, DSTL; and Alex Defazio, NATO SEAD/AEA Capability Area Facilitator. The session will end with a group discussion.

The technical advances session will include a look at developments in "Low SWaP RF Payloads for SUAS" (Peter Doig, Business Development Director, Plextek), "Edge Computing for SIGINT Application" (Marc Houry, Head of Product Management, Avantix), "Geo-Location of RF Emissions" (Juergen Gehrig, Narda Safety Test Solutions) and "New Ultra-Wideband Tech – The Good and the Bad" (Dan Pleasant, Solutions Architect, Keysight Technologies).

The electronic protection session will include a look at HPRF DE technology opportunities and challenges, EA challenges in present and future OP scenarios, disrupting adversary comms and a study on quantum radar countermeasures; with the conference to culminate with presentations from Dr David Stupple (City University London), Andrew Owen (Rohde & Schwarz) and Mark Neasham (Leonardo) considering issues including emerging threats in ELINT, keeping pace with modern/future radar and meeting the future threat of EW operational support.

Following 18 months of disruption, attendees to the AOC Europe 2021 conference will not only benefit from the learning, recognition, progress and business opportunities presented by AOC events, but a return to the opportunities that are so vital to progression through in-person collaboration.

"Being a member of the AOC brings benefits of networking at local chapter level, but at the 25<sup>th</sup> AOC Europe conference there will be opportunities for AOC members to meet with others from across the globe, to learn more about what other chapters get up to and to gain ideas for invigorating their own chapters," Dr Robertson said. "I look forward to welcoming the EW community to Liverpool in October to discuss, collaborate and progress our collective understanding of the issues affecting our sector."

# Multi-Domain Operations for Elect

## Day One

Tuesday 12 October 2021

DAY ONE: MORNING SESSION	
0800 – 0900	Registration & Refreshments
Session One – Welcome & Keynote Addresses	
0900 – 0910	<b>Chairman's Opening Remarks and AOC Welcome</b>  <b>Air Marshal Philip Sturley CB MBE RAF (Retd)</b>
	<b>Powder Carlson, AOC President</b> <b>Dr Sue Robertson, AOC International Region 1 Director</b> <b>Chris Howe MBE, President AOC UK Chapter</b>
0910 – 0940	<b>Opening Address</b>  “Platforms, Sensors and Data. Paradigm Shifts in EW Capability Development”  <b>Air Cdre Jason Crawford</b> , Commander Joint Cyber Electromagnetic Activities Group, Royal Air Force Digby
0940-1005	“Gazing into the Crystal Ball – What Will EWSI Look Like in the Next Decade?”  <b>Lt Colonel Chris Fogarty</b> (14SIG-RHQ-CO)
1005 – 1030	“Joint Electromagnetic Spectrum Operations at U.S. European Command”  <b>Mark Haseldon</b> (MITRE corporation)
1030 – 1100	<b>Refreshment Break &amp; Networking</b>

Session Two - EMSO & Spectrum Dominance	
<b>Chairman: Air Marshal Philip Sturley CB MBE RAF (Retd)</b>	
1100 – 1120	“The Need for SEAD”  <b>Dr Tom Withington</b> (Armada International )
1120 – 1140	“How Can You Dominate an Unknown Spectrum?”  <b>Dr Nitzan Barkay (Elta)</b>
1140 – 1200	“How Advanced Integrated Sensors Can Address the Challenges of the Digital Battlespace”  <b>Chris Squier</b> (Roke)
1200 – 1220	“Air Dominance – Survivability & Lethality Enablers”  <b>Gene McFalls</b> (Raytheon)
1220 – 1240	“Multi-Function/Multi-Domain”  <b>Glenn “Powder” Carlson (AOC)</b>
1240 – 1400	<b>Lunch Break &amp; Networking</b>
DAY ONE: AFTERNOON SESSION	
Session Three – CEMA, Cyber and Systems	
<b>Chairman: Air Marshal Philip Sturley CB MBE, RAF (Retd)</b>	
1400 – 1420	“Iranian Cyber-Attacks: Impacts and Indicators”  <b>Dr Justin Pelletier</b> (Rochester Institute of Technology) (Virtual)
1420 – 1440	“EW and Cyber-over-RF: Similarities and Differences”  <b>Uri Barkan</b> (Sigmabit)

# Magnetic Spectrum Dominance

1440 – 1500	“NATO Next Generation Rotorcraft Activities” <b>Patrick Collins</b> (DE&S)
1500 – 1520	“Open Standards, Multi-Domain Integration, and the National Prosperity Agenda” <b>Andy Jubb</b> (L3Harris)
1520 – 1550	<b>Refreshment Break and Networking in the Exhibition Hall</b>

<b>Session Four – Advances Testing &amp; Training and Technology</b>	
<b>Chairman:</b> Air Marshal Philip Sturley CB MBE, RAF (Retd)	
1550 – 1610	“Low-SwAP Low-Cost CESM Force Multipliers” <b>Chris Slack</b> (Procitec)
1610 – 1630	“Unstructured Training with Computer Games” <b>Ed Oates</b> (Cranfield University)
1630 – 1650	“Pod-Mounted ASMD Evaluation Facility” <b>Andrea Volpi</b> (Eldes)
1650 – 1710	“LVC in EW Aircrew Training” <b>Paul Vavra</b> (Leonardo)
1710 – 1730	<b>TBD</b>
1730	Day One Announcements / Wash-up
1735	<b>DAY ONE CLOSE</b>

## Day Two

### Wednesday 13 October 2021

<b>DAY TWO: MORNING SESSION</b>	
<b>Session Five – Special Session – Next Generation Air Survivability</b>	
<i>By NATO Air Platform Protection Group</i>	
	<b>Chairman:</b> – <b>Mark Elson MBE, Dstl Fellow</b>
0900 – 0920	“Next Generation Air Survivability (NGAS) – A UK and NATO Perspective” <b>Wg Cdr Chris Greenwood and Mark Elson</b> (Dstl)
0920 – 0940	“The Multi-Sensor Threat (MST) Challenge” <b>Matt Cook</b> (MoD)
0940 – 1000	“NATO Defensive Aids System (NDAS) Platform-Level Approach” <b>John Bowker</b> (Dstl)
1000 – 1020	“Develop and Assure for Future Solutions” <b>Mark Threadgold</b> (Dstl)
1020 – 1040	“NATO Future SEAD” <b>Alex DeFazio</b> (NATO)
1040 – 1100	<b>Group Discussion</b>
1100 – 1130	<b>Refreshment Break &amp; Networking</b>

<b><i>Session Six – Technological Advances</i></b>	
<b><i>Chairman: Air Marshal Philip Sturley CB MBE, RAF (Retd)</i></b>	
1130 – 1150	“Low SWaP RF Payloads for SUAS” <b>Peter Doig</b> (Plextek)
1150 – 1210	“Edge Computing for SIGINT application” <b>Marc Houry</b> (Avantix)
1210 – 1230	“Geo-Location of RF Emissions” <b>Juergen Gehrig</b> (Narda Safety Test Solutions)
1230 – 1250	“New Ultra Wideband Tech - The Good and the Bad” <b>Dan Pleasant</b> (Keysight)
1250 – 1400	<b>Lunch Break &amp; Networking</b>

<b><i>Session Eight – Future EW Threats and Platforms</i></b>	
<b><i>Chairman: Air Marshal Philip Sturley CB MBE, RAF (Retd)</i></b>	
1540 – 1605	“Resilience of Satellite Systems to Support Autonomous Military Operations” <b>Professor David Stupples</b> (City University London)
1605 – 1630	“How Do We Keep Pace with Modern/Future Radar” <b>Andrew Owen</b> (Rohde and Schwarz)
1630 – 1655	“EW Operational Support – Meeting the Future Threat” <b>Mark Neasham</b> (Leonardo)
1655 – 1700	Appreciation – Farewell <i>Chairman: Air Marshal Philip Sturley</i>
<b>CONFERENCE CLOSE</b>	

<b>DAY TWO: AFTERNOON SESSION</b>	
<b><i>Session Seven – Electronic Protection</i></b>	
<b><i>Chairman: Air Marshal Philip Sturley CB MBE, RAF (Retd)</i></b>	
1400 – 1420	“HPRF DE Technology Opportunities and Challenges” <b>Dr Richard Hoad</b> (Qinetiq)
1420 – 1440	“EA Challenges in Present and Future OP Scenarios” <b>David Lazaro</b> (Indra)
1440 – 1500	“Disrupting Adversary Comms” <b>Dr Ayodeji Sunday</b> (Keysite UK)
1500 – 1520	“A Study on Quantum Radar Countermeasures” <b>Dr Qinghan Xiao</b> (DTA Canada)
1520 – 1540	<b>Refreshment Break &amp; Networking</b>

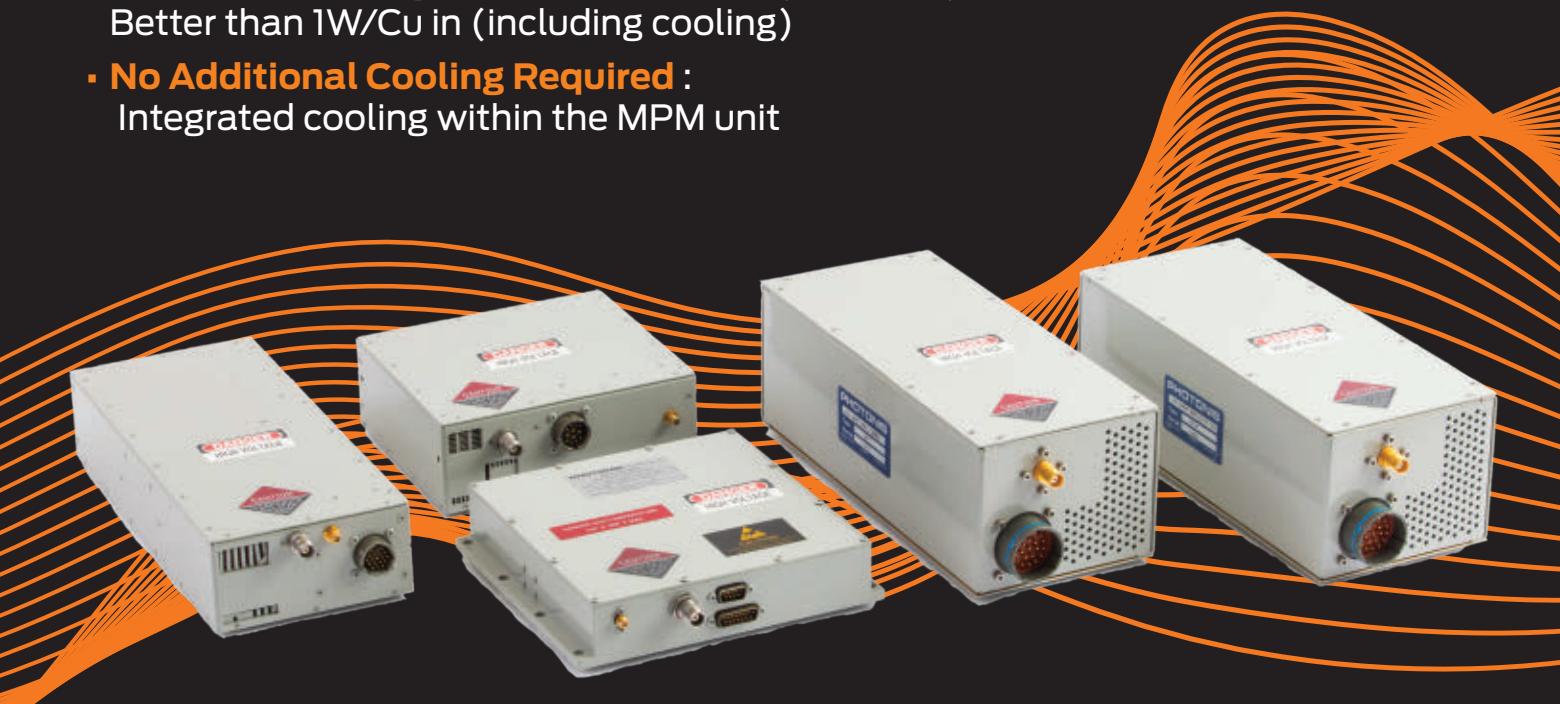


# UH-OH!

## YOUR GaN IS GONE AND YOU'RE OUT OF GaAs....

Trust Photonis Defense MPMs with integrated TWTs for maximum jamming performance.

- **Higher Efficiency than Solid State:**  
>35% efficiency vs. <10%
- **Wider Bandwidth at full CW Power :**  
200W min over full bandwidth from 2-8 GHz and or 6-18 GHz
- **Greater Reliability :**  
Proven in a direct comparison study<sup>1</sup>
- **Lowest Size, Weight, Power and Cost (SWaP-C) :**  
Better than 1W/Cu in (including cooling)
- **No Additional Cooling Required :**  
Integrated cooling within the MPM unit



Learn more about our various MPMs and TWTs  
by visiting our website [www.photonisdefense.com/MPM](http://www.photonisdefense.com/MPM).  
Attending AOC Europe? Visit with our specialist Stand-C 7!

## CAST YOUR VOTE FOR THE AOC BOARD MEMBERS

The AOC Board of Directors elections are open! Exercise your right to decide the future of this organization by participating.

By now, you should have received an email with a username and password from our independent election service – Elections On-Line. This password is secure and unique to you. If you did not receive the email from Elections On-Line, please check your spam folder. If you have not received it, please contact Glorianne O'Neilin at [oneilin@crows.org](mailto:oneilin@crows.org).

To find out more information about our candidates and watch their candidate videos, please go to [www.crows.org/page/elections](http://www.crows.org/page/elections).

### List of Candidates

#### President-Elect

- Brian Hinkley
- Sharon Lyczak

#### At-Large Director (2 available)

- Nino Amoroso
- Steve Oatman
- Pedro Vasquez

#### Central Region Director

- Michael Gardner
- Jim Utt

#### Mid-Atlantic Region Director

- Dennis Monahan
- Chuck Quintero

#### Mountain-Western Region Director

- Wayne Shaw

## CONGRATULATIONS ARE IN ORDER


ISTOCK.COM/SKYNESTER

Congratulations to this year's Chapter of the Year and Chapter Greatest Increase winners!

### Chapter of the Year

#### Large Category

*Chapter of the Year – Dixie Crow Chapter*

*Distinguished Chapter – UK Chapter*

*Excellent Chapter – Capitol Club Chapter*

#### Medium Category

*Chapter of the Year – Garden State Chapter*

*Distinguished Chapters*

APG Susquehanna Roost

Patriots Roost

Palmetto Roost

*Outstanding Chapters*

Billy Mitchell Chapter

Granite State Chapter

Mugu Chapter

Windy City Chapter

#### Small Category

*Chapter of the Year – Diamondhead Chapter*

*Excellent Chapters*

Pikes Peak Chapter

Whidbey Roost Chapter

### Chapter Greatest Increase Winners

#### Northeast Region:

Garden State Chapter

#### Mid-Atlantic Region:

Independence Roost Chapter

#### Southern Region:

Peachtree Roost Chapter

#### Central Region:

Kittyhawk Chapter

#### Mountain Western Region:

Billy Mitchell Chapter

#### North Western Region:

Frozen Crows Chapter

#### Pacific Region:

Greater La Chapter

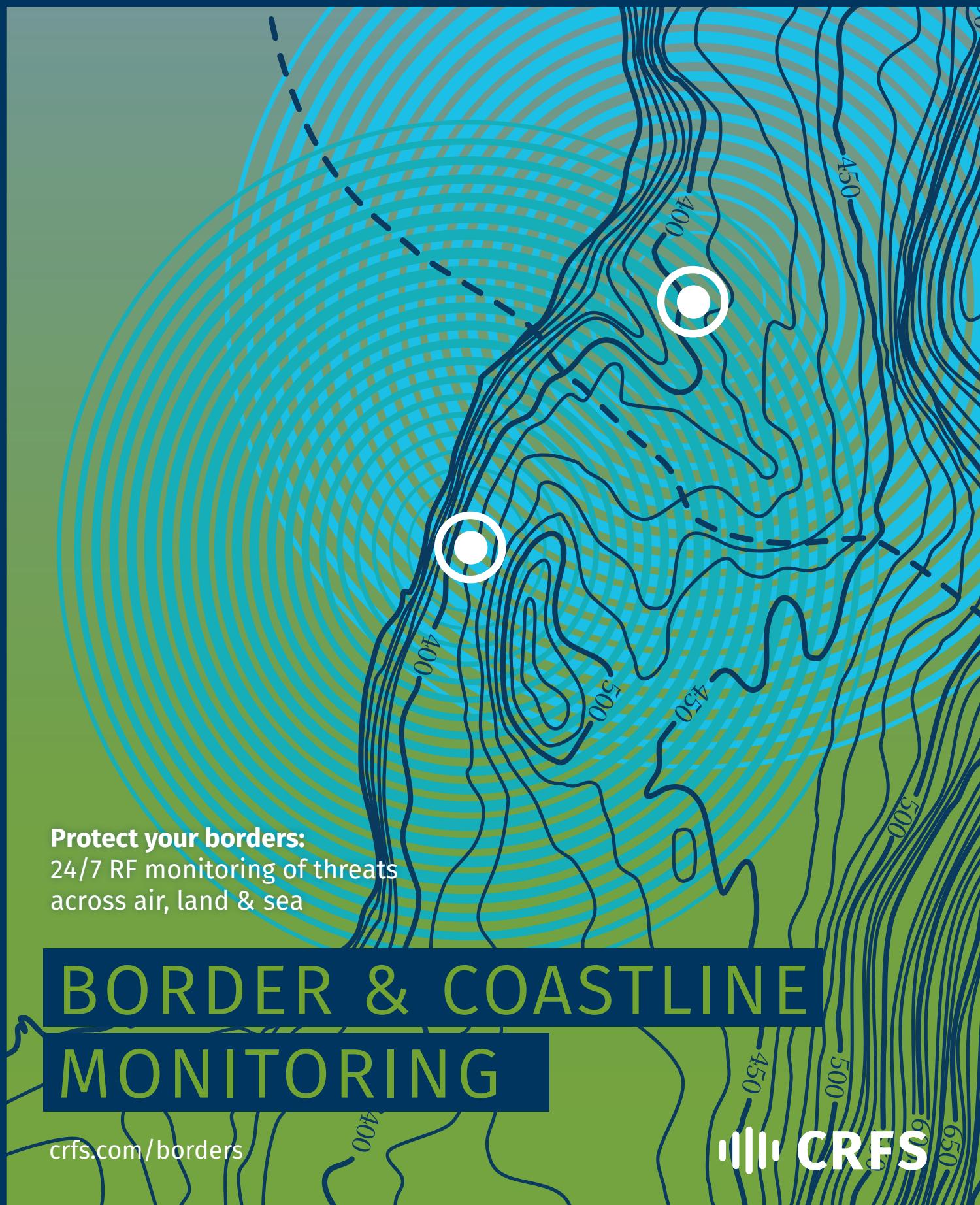
#### International Region I:

Arctic Roost Chapter

#### International Region II:

Australian Chapter (*Region winner and overall Greatest Increase winner*) 

DETECT • LOCATE • PROTECT



# AOC Members

## SUSTAINING

BAE Systems  
Bharat Electronics Ltd  
CACI International Inc.  
Chemring Group PLC  
Electronic Warfare Associates, Inc.  
General Atomics Aeronautical Systems, Inc.  
General Dynamics  
Keysight Technologies  
L-3 Harris  
Leonardo  
Perspecta  
Raytheon Intelligence & Space  
Rohde & Schwarz USA  
Saab Sensor Systems Germany GmbH  
SRC, Inc.

## MILITARY UNITS

30 Cdo IX Gp RM  
547 IS  
57 IS/DOD  
Air Command Denmark  
Detachment-A 743d  
Helicopter Wing 53  
IWTG Norfolk  
Japan Air Self-Defense Force  
NASIC/AC  
NIWTG SD  
Zentrum Elektronischer Kampf  
Fliegende Waffensysteme

## INSTITUTES/ UNIVERSITIES

Georgia Tech Research Institute (GTRI)  
Mercer Engineering Research Center (MERC)  
Riverside Research Institute  
RVJ Institute

## GOVERNMENT GROUPS

ACEASPO  
Australia Department of Defence DIO  
DE&S  
Defence Science & Technology Agency (DSTA)  
DOD  
Los Alamos National Lab  
New Zealand Defence Technology Agency  
NGA – National Geospatial Intelligence Agency  
NLR – Royal Netherlands Aerospace Centre  
Swedish Defence Materiel Administration T&E Directorate (FMV T&E)

## GROUPS

35 Technologies Group, Inc.  
3dB Labs Inc.  
3SDL Ltd.  
Abaco Systems  
ACE Consulting Group  
Advanced Test Equipment Rentals  
ALARIS Antennas  
Alion Science and Technology  
Allen-Vanguard  
Ampex Data Systems

Analog Devices  
API Technologies  
ApisSys SAS  
Apogee Engineering  
Applied Systems Engineering, Inc.  
Armtec Defense Technologies  
Aselsan A.S.  
Atkinson Aeronautics & Technology, Inc.  
Atlanta Micro, Inc.  
Avix  
Babcock International Group  
Base2 Engineering LLC  
Battelle Memorial Institute  
Beca Applied Technologies Ltd.  
Black Horse Solutions, Inc.  
Blue Ridge Envisioneering, Inc.  
Booz Allen Hamilton, Inc.  
Boyd Corporation  
Cablex PTY Ltd.  
CEA Technologies, Incorporated  
Centauri  
Centerline Technologies LLC  
Clearbox Systems  
Cobham Advanced Electronic Solutions  
Communication Power Corporation  
Communications & Power Industries LLC  
Comsec LLC  
Comtech PST Corporation  
Crescend Technologies, LLC, Defense Solutions  
CRFS Inc.  
CRFS Limited  
CSIR DPSS  
Cubic Defense  
D-TA Systems, Inc.  
Daqscribe  
Darkblade Systems  
Dayton Development Coalition  
dB Control  
Decodio AG  
Defense Research Associates Inc.  
DEFTEC Corporation  
DEWC Group  
Dreamlab Technologies AG  
DRONESHIELD  
DRT, Inc.  
Eagle Sales Corp.  
ELBIT Systems of America  
Elbit Systems of EW & SIGINT Elisra  
ELDES S.r.l.  
Elettronica S.p.A  
Empower RF Systems  
Epiq Solutions  
ESROE Limited  
Evans Capacitor Company  
Galleon Embedded Computing  
GFD GmbH  
Gigatronics Incorporated  
Hammer Defense Technologies LLC  
HASCO  
HawkEye360  
Hegarty Research LLC  
Hensoldt Sensors GmbH

Hermetic Solutions  
Herrick Technology Laboratories, Inc.  
Hughes  
IDS International Government Services

Indra  
Intelligent RF Solutions  
Interface Concept  
ITA International, LLC  
IW Microwave Products Division  
JT4, LLC  
Kihomac, Inc.  
Kirintec  
Kranze Technology Solutions, Inc. (KTS)  
Kratos General Microwave Corporation  
L3Harris TRL Technology  
LCR Embedded Systems  
Leonardo DRS  
Leonardo Electronics-US  
Liteye Systems, Inc.  
MarServices GmbH  
Mass Consultants Ltd.  
MBDA France  
MC Countermeasures, Inc.  
MDA  
MDSI  
MegaPhase LLC  
Meggitt Baltimore  
Meggitt Defense Systems  
Meta Mission Data Ltd.  
Microwave Products Group  
Milpower Source, Inc.  
Milso AB  
Mission Microwave Technologies  
The MITRE Corporation  
Molex  
Motorola Solutions  
MRC Gigacomp  
MTSI  
My-Konsult  
MyDefence System Integration  
N-Ask Incorporated  
Nagravision S.A.  
NEL Frequency Controls, Inc.  
Northeast Information Discovery Inc.  
Northrop Grumman Defense Systems – Advanced Weapons  
Novator Solutions AB  
OCS America, Inc.  
Parsons  
Pentek  
Penten  
Persistent Systems, LLC  
Perspecta  
Phasor Innovation  
Photonis Defense Inc.  
Physical Optics Corporation  
Plath GmbH  
PredaSAR  
PROCITEC GmbH  
QinetiQ Target Systems  
Qnion Co., Ltd.  
QuantiTech  
RADA Technologies LLC  
RAFAEL Advanced Defense Systems Ltd.

Research Associates of Syracuse, Inc.  
Rincon Research Corporation  
Rohde & Schwarz GmbH & Co. KG

Rohde & Schwarz Norge AS  
Roschi Rohde & Schwarz AG  
Rotating Precision Mechanisms  
Rowden Technologies  
S2 Corporation  
School of Information Operations (SOIO)  
SciEngines GmbH  
Scientific Research Corp.  
SEA Corp.  
Serpikom  
Sierra Nevada Corporation  
Signal Hound  
Silver Palm Technologies  
SimVentions  
SMAG Mobile Antenna Masts GmbH  
Smiths Interconnect  
Spectranetix, Inc.  
Spherea GmbH  
Spirent Communications  
SR Technologies  
STEATITE  
Swisscom Broadcast AG  
SYPAQ  
Systems & Processes Engineering Corp. (SPEC)  
Tabor Electronics  
TCI International, Inc.  
Tech Resources, Inc.  
Teledyne Technologies, Inc.  
Telemus Inc.  
Teleplan Globe Defence  
TERMA  
Tevet LLC  
Textron Systems  
Textron Systems Electronic Systems UK Ltd.  
ThinkRF  
Tinex AS  
TMC Design  
TMD Technologies Ltd.  
Transformational Security LLC  
Transhield Inc.  
Trenton Systems  
Trideum  
TUALCOM, Inc.  
Ultra Electronics - EWST  
Ultra Electronics Avalon Systems  
unival group GmbH  
Valiant Integrated Services  
Valkyrie Enterprises LLC  
Verus Research  
VIAVI Solutions  
Vic Myers Associates  
Vigilant Drone Defense Inc.  
VITEC  
W.L. Gore and Associates  
Warrior Support Solutions LLC  
WGS Systems, Inc.  
X-COM Systems  
ZARGES, Inc  
Zentrum Elektronischer Kampf  
Fliegende Waffensysteme

*JED, Journal of Electromagnetic Dominance* (ISSN 0192-429X), is published monthly by Naylor, LLC, for the Association of Old Crows, 1001 N. Fairfax St., Suite 300, Alexandria, VA 22314.

Periodicals postage paid at Alexandria, VA, and additional mailing offices. Subscriptions: *JED, Journal of Electromagnetic Dominance*, is sent to AOC members and subscribers only. Subscription rates for paid subscribers are \$160 per year in the US, \$240 per year elsewhere; single copies and back issues (if available) \$12 each in the US; \$25 elsewhere.

**POSTMASTER:**

Send address changes to *JED, Journal of Electromagnetic Dominance*  
c/o Association of Old Crows  
1001 N. Fairfax St., Suite 300  
Alexandria, VA 22314

**Subscription Information:**

Glorianne O'Neilin  
(703) 549-1600  
[oneilin@crows.org](mailto:oneilin@crows.org)

## **JED Sales Offices**

**NAYLOR**  
ASSOCIATION SOLUTIONS

1430 Spring Hill Road, 6th Floor  
McLean, VA 22102  
Tel (800) 369-6220  
[www.naylor.com](http://www.naylor.com)

**Project Manager:**

Kira Krewson  
Direct: +1 (770) 810-6982  
[kkrewson@naylor.com](mailto:kkrewson@naylor.com)

**Project Coordinator:**

Alexandra Lewis  
Direct: +1 (352) 333-3409  
[alewis@naylor.com](mailto:alewis@naylor.com)

**Advertising Sales Representatives:**

Shaun Greyling  
Direct: +1 (352) 333-3385  
[sgreyling@naylor.com](mailto:sgreyling@naylor.com)

Robert Shafer

Direct: +1 (770) 810-6986  
[rshafer@naylor.com](mailto:rshafer@naylor.com)

Chris Zabel

Direct: +1 (352) 333-3420  
[czaibel@naylor.com](mailto:czaibel@naylor.com)

**NAYLOR (Canada) Inc.**

200 – 1200 Portage Ave.  
Winnipeg, MB R3G 0T5 Canada  
Toll Free (US): (800) 665-2456  
Fax: +1 (204) 947-2047

## **Index of Advertisers**

<b>3dB Labs Inc.</b>	<a href="http://www.3db-labs.com">www.3db-labs.com</a>	57
<b>Acromag, Inc.</b>	<a href="http://www.acromag.com">www.acromag.com</a>	9
<b>AMETEK Abaco Systems</b>	<a href="http://www.abaco.com">www.abaco.com</a>	8
<b>Annapolis Micro Systems Inc.</b>	<a href="http://www.annapmicro.com">www.annapmicro.com</a>	27
<b>ARS Products</b>	<a href="http://www.arsproducts.com">www.arsproducts.com</a>	37
<b>BAE Systems</b>	<a href="http://www.baesystems.com">www.baesystems.com</a>	Outside Back Cover
<b>Ciao Wireless, Inc.</b>	<a href="http://www.ciaowireless.com">www.ciaowireless.com</a>	11
<b>Comtech PST Corp.</b>	<a href="http://www.comtechpst.com">www.comtechpst.com</a>	13
<b>CRFS</b>	<a href="http://www.crfs.com">www.crfs.com</a>	65
<b>Empower RF Systems, Inc.</b>	<a href="http://www.EmpowerRF.com">www.EmpowerRF.com</a>	Inside Back Cover
<b>Hensoldt</b>	<a href="http://www.hensoldt.net">www.hensoldt.net</a>	Inside Front Cover
<b>Hensoldt South Africa</b>	<a href="http://www.hensoldt.co.za">www.hensoldt.co.za</a>	15
<b>Interface Concept</b>	<a href="http://www.interfaceconcept.com">www.interfaceconcept.com</a>	17
<b>iRF – Intelligent RF Solutions</b>	<a href="http://www.irf-solutions.com">www.irf-solutions.com</a>	10
<b>Leonardo</b>	<a href="http://www.leonardocompany.com">www.leonardocompany.com</a>	43
<b>New Wave Design &amp; Verification</b>	<a href="http://www.newwavedv.com">www.newwavedv.com</a>	29
<b>Norden Millimeter, Inc.</b>	<a href="http://www.nordengroup.com">www.nordengroup.com</a>	35
<b>Pacific Defense</b>	<a href="http://www.pacific-defense.com">www.pacific-defense.com</a>	49
<b>Pentek Inc., now part of Mercury</b>	<a href="http://www.pentek.com">www.pentek.com</a>	23
<b>Philpott Ball &amp; Werner</b>	<a href="http://www.pbandw.com">www.pbandw.com</a>	31
<b>Photonis USA PA, Inc.</b>	<a href="http://www.photonisdefense.com">www.photonisdefense.com</a>	63
<b>Signal Hound</b>	<a href="http://www.SignalHound.com">www.SignalHound.com</a>	7
<b>Textron Systems</b>	<a href="http://www.TextronSystems.com">www.TextronSystems.com</a>	5
<b>Ultra Electronics Limited – EWST</b>	<a href="http://www.ultra.group">www.ultra.group</a>	3

# THE ABSOLUTE AUTHORITY IN ELECTRONIC WARFARE... ON THE GO!

\*\*\*\*\*

Featuring a new look, new layout and sponsored content, it's easier than ever to stay in touch with the EW and SIGINT industry. No matter where you are, you can access weekly updates on industry news and AOC events.

Put the power of the Absolute Authority in Electronic Warfare behind you! Read the new *eCrow* today!



**eCrow**  
Advancing Electromagnetic Warfare TOGETHER

Industry News

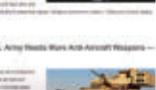
INDUSTRY NEWS: Honeywell Augments Battle Management for Electronic Warfare Operators



INDUSTRY NEWS: Investment of Millions to Provide Intelligence for Urban Missions



INDUSTRY NEWS: The U.S. Army Heats Up Anti-Aircraft Missions — and Fast



INDUSTRY NEWS: The Marine Corps Wants to Use Cyber War Like Special Ops





Miss an issue? Read past issues at  
[www.ecrow.org/newsletterArchive.asp](http://www.ecrow.org/newsletterArchive.asp)

**ASSOCIATION  
OF OLD CROWS**

**UNITED STATES POSTAL SERVICE® (All Periodicals Publications Except Requester Publications)**

1. Publication Title

2. Publication Number

3. Filing Date

4. Issue Frequency

5. Number of Issues Published Annually

6. Annual Subscription Price

7. Complete Mailing Address of Known Office of Publication (Not printer) (Street, city, county, state, and ZIP+4<sup>®</sup>)

Contact Person

Telephone (Include area code)

8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not printer)

Managing Editor (Name and complete mailing address)

9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor (Do not leave blank)

Publisher (Name and complete mailing address)

Editor (Name and complete mailing address)

Managing Editor (Name and complete mailing address)

10. Owner (Do not leave blank. If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of the individual owners. If owned by a partnership or other unincorporated firm, give its name and address as well as those of each individual owner. If the publication is published by a nonprofit organization, give its name and address.)

Full Name

Complete Mailing Address

13. Publication Title		14. Issue Date for Circulation Data Below	
15. Extent and Nature of Circulation			
		Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies ( <i>Net press run</i> )			
(1) Mailed Outside-County Paid Subscriptions Stated on PS Form 3541 (include paid distribution above nominal rate, advertiser's proof copies, and exchange copies)			
b. Paid Circulation	(2) Mailed In-County Paid Subscriptions Stated on PS Form 3541 ( <i>Include paid distribution above nominal rate, advertiser's proof copies, and exchange copies</i> )		
(3) Paid Distribution Outside the Mails Including Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid Distribution Outside USPS®			
(4) Paid Distribution by Other Classes of Mail Through the USPS (e.g., First-Class Mail®)			
c. Total Paid Distribution ( <i>Sum of 15d, 1f, 2, 3, and 4</i> )		▲	
d. Free or Nominal Rate Outside-County Copies Included on PS Form 3541			
(1) Free or Nominal Rate In-County Copies Included on PS Form 3541			
(2) Free or Nominal Rate In-County Copies Included on PS Form 3541			
(3) Free or Nominal Rate Copies Mailed at Other Classes Through the USPS (e.g., First-Class Mail)			
(4) Free or Nominal Rate Distribution Outside the Mail ( <i>Carriers or other means</i> )			
e. Total Free or Nominal Rate Distribution ( <i>Sum of 15d, 1f, 2, 3 and 4</i> )			
f. Total Distribution ( <i>Sum of 15c and 15e</i> )		▲	
g. Copies not Distributed ( <i>See Instructions to Publishers #4 (page #3)</i> )		▲	
h. Total ( <i>Sum of 15f and g</i> )			
i. Percent Paid ( <i>15c divided by 15f times 100</i> )		▲	
* If you are claiming electronic copies, go to line 16 on page 3. If you are not claiming electronic copies, skip to line 17 on page 3.			

12. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates) (Check one)  
The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes:  
 Has Not Changed During Preceding 12 Months  
 Has Changed During Preceding 12 Months (Publisher must submit explanation of change with this statement)

PS Form 3526, July 2014 (Page 1 of 4) (see instructions Page A) PSN: 7530-01-000-9931

PRIVACY NOTICE: See our privacy policy on [www.usps.com](http://www.usps.com).



**UNITED STATES  
POSTAL SERVICE® (All Periodicals Publications Except Requester Publications)**

16. Electronic Copy Circulation

	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Paid Electronic Copies	▲	
b. Total Paid Print Copies (Line 15c) + Paid Electronic Copies (Line 16a)	▲	
c. Total Print Distribution (Line 15f) + Paid Electronic Copies (Line 16a)	▲	
d. Percent Paid (Both Print & Electronic Copies) (16b divided by 16c × 100)	▲	

I certify that 50% of all my distributed copies (electronic and print) are paid above a nominal price.

17. Publication of Statement of Ownership

If the publication is a general publication, publication of this statement is required. Will be printed

in the \_\_\_\_\_ issue of this publication.

18. Signature and Title of Editor, Publisher, Business Manager, or Owner

_____ Signature	Date
--------------------	------

I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).

**Instructions to Publishers**

1. Complete and file one copy of this form with your postmaster annually on or before October 1. Keep a copy of the completed form for your records.
2. In cases where the stockholder or security holder is a trustee in items 10 or 11, include the name of the person or corporation for whom the trustee is acting. Also include in item 10 the names and addresses of all stockholders owning or holding one (1) percent or more of the total amount of stock. If not owned by a corporation, give the name and address of each individual owner. If owned by a partnership or other unincorporated firm, give its name and address as well as the name and address of each individual owner. If the publication is published by a nonprofit organization, give its name and address and complete item 12. In item 11, include all bondholders, mortgagees, and other security holders owning or holding one (1) percent or more of the total amount of bonds, mortgages, or other securities. If none, check the box. Use blank sheets if more space is required.
3. Be sure to furnish all circulation information called for in item 15. Free Non-Requested circulation must be shown in item 15d.
4. Item 15g. Copies not Distributed, must include (1) newsstand copies returned to the publisher, (2) estimated returns from news agents, and (3), copies for office use, leftovers, spoiled, and all other copies not distributed.
5. If the publication had Periodicals authorization as a general publication, this Statement of Ownership, Management, and Circulation must be published, i.e., it must be printed in any issue that's primary mailed distribution is produced not later than October 10 for publications issued more frequently than weekly; or not later than October 31 for publications issued weekly or less frequently but more frequently than monthly; or in the first issue that's primary mailed distribution is produced after October 1 for all other publications.
6. In item 16, check the box if electronic copies are being included in your total distribution and complete line items 16a through d.
7. In item 17, report the date of the issue in which this Statement of Ownership will be published, if applicable.
8. Item 17 must be signed.

**Failure to file or publish a statement of ownership may lead to suspension of periodicals authorization.**

# JED QuickLook

Details	Page #	Details	Page #
"Air and Missile Defense 2028," US Army.....	18	Integrated Topside (InTop), ONR .....	16
AOC Chapter Awards .....	64	<b>LTG Neil Thurgood</b> , Rapid Capabilities and Critical Technologies Office (RCCTO) .....	20
AOC Election.....	64	<b>MG Robert Rasch Jr.</b> , PEO Missiles and Space.....	20
AOC Europe Preview.....	58	Novel Processor Architectures for Probabilistic Computing in Survivability Controllers, SBIR Topic .....	16
Automated High Frequency Communications Planner, SBIR Topic .....	17	Personal Electronic Countermeasures Systems, Australian Army .....	17
<b>BG Brian Gibson</b> , Director, Air and Missile Defense Cross Functional Team (CFT) .....	18	Project Convergence .....	18
Combined Joint All-Domain Command & Control (CJADC <sub>2</sub> ) .....	18	Project Kaiju, AFRL.....	14
Electromagnetic Maneuver Command and Control (EMC <sub>2</sub> ), ONR .....	16	Raytheon, Flexible Distributed Array Radar (FlexDAR).....	16
Every-element digital beamforming (EEDBF) .....	16	RCIED jammer requirement, Romanian Army .....	17
EW 101: Testing and Training Using 5G.....	55	Real Time Electronic Warfare Receiver Surrogate (RTERS) , SBIR Topic .....	15
EW and SIGINT Resource Guide .....	24	Small Form Factor Hardware Standards, SBIR Topic .....	15
Flexible Distributed Array Radar (FlexDAR), NRL.....	16	Space Electromagnetic Warfare Operating Location (SEWOL), US Space Command .....	17
Integrated Air and Missile Defense Battle Command System (IBCS) .....	20		



An EA-18G from the VAQ-141 Shadowhawks flies above the USS Ronald Reagan in the Gulf of Oman. At the time of the photo (in July), VAQ-141 was assigned to the US 5th Fleet area of operations.

USN PHOTO

**SOLID  
STATE**

**RF**

# POWER AMPLIFIERS

for Maximum Power Down Range

HF to X-Band

MULTI mission

▷ **EW**



▷ **Radar**

▷ **Satcom**

▷ **Threat Simulation**

▷ **Communications**

▷ **Test**



LIQUID COOLED

SCALABLE SSPAs

- ☒ Hundreds of kW - Pulse and CW
- ☒ No Single Point of RF Failure
- ☒ "On Air" Hot Swapping
- ☒ Long Pulse Widths and 500KHz PRF's



## MODULES

- ☒ Built in Protections
- ☒ 48V Models Available
- ☒ Rugged and Highly Reliable
- ☒ Custom Designs Available
- ☒ Feature Rich with Digital or Analog Controls

AIR COOLED

## MULTI mode SSPAs

- ☒ Mission Scenario Configurable
- ☒ Pre-loaded Jamming Modes
- ☒ Field Proven in Mobile Applications
- ☒ High MTBF's
- ☒ Best in Class SWaP



**AOC Europe**  
Liverpool, UK  
12-13 October 2021

BOOTH  
**F7**



**EMPOWER**  
RF SYSTEMS, INC.



[www.EmpowerRF.com](http://www.EmpowerRF.com)



1(310)412-8100

Innovation where it counts.

# Spectrum dominance

The multi-domain battlespace continues to evolve with never-before-seen threats. Our warfighters need weapon and defensive systems with agile, reprogrammable mission data to stay a step ahead. Flight-tested, Eagle Passive Active Warning Survivability System (EPAWSS) ensures that warfighters can outpace advanced threats in highly contested environments and return home safely.

[baesystems.com/EPAWSS](http://baesystems.com/EPAWSS)



**BAE SYSTEMS**