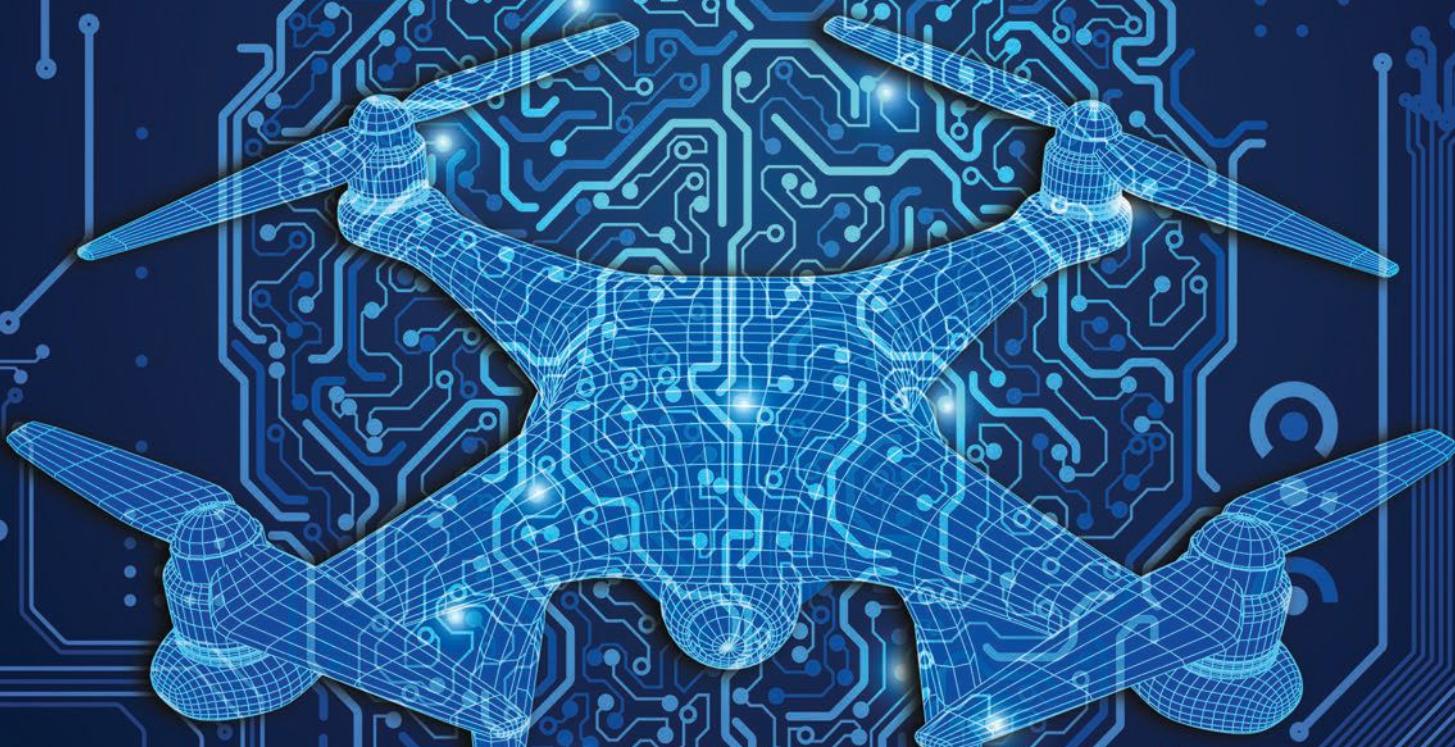


Vol. 68 • No. 12

December 2025

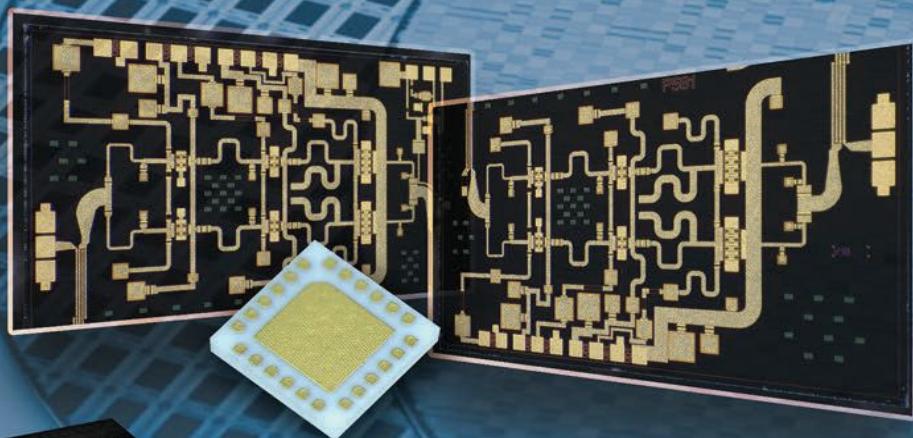
Microwave Journal



horizon
house®

Founded in 1958

mwjournal.com


QFN and SiP (System-In-Package) available
RF Distributed Low Noise Amplifiers

PN	Freq Low (GHz)	Freq High (GHz)	Gain (dB)	NF(dB)	P1dB (dBm)	Voltage (VDC)	Current (mA)	Package
MMW001T	DC	20.0	17~19	1~3.5	23 @ 10GHz	8.0	145	die
MMW4FP	DC	50.00	16.00	4.00	24.00	10	200	die
MMW507	0.20	22.0	14.0	4 - 6	28.0	10.0	350	die
MMW508	DC	30.0	14.0	2.5dB @ 15GHz	24.5	10.0	200	die
MMW509	30KHz	45.0	15.0		20.0	6.0	190	die
MMW510	DC	45.0	11.0	4.5	15.5	6.0	100	die
MMW510F	DC	30.00	20.00	2.50	22.00			die
MMW511	0.04	65.0	10.0	9.0	18.0	8.0	250	die
MMW512	DC	65.0	10.0	5.0	14.5	4.5	85	die
MMW5FN	DC	67.00	14.00	2.00	19.00	4.5	81	die
MMW5FP	DC	67.00	14.00	4.00	21.00	8	140	die
MMW011	DC	12.0	14.0		30.5	12.0	350	die

Low Noise Amplifiers

PN	Freq Low (GHz)	Freq High (GHz)	Gain (dB)	NF(dB)	P1dB (dBm)	Voltage (VDC)	Current (mA)	Package
MML040	6.0	18.0	24.0	1.5	14.0	5.0	35	die
MML058	1.0	18.0	15.0	1.7	17.0	5.0	35	die
MML063	18.0	40.0	11.0	2.9	15.0	5.0	52	die
MML080	0.8	18.0	16.5/15.5	1.9/1.7	18/17.5	5.0	65/40	die
MML081	2.0	18.0	25/23	1.0/1.0	16/9.5	5.0	37/24	die
MML083	0.1	20.0	23.0	1.6	11.0	5.0	58	die

RF Driver Amplifier

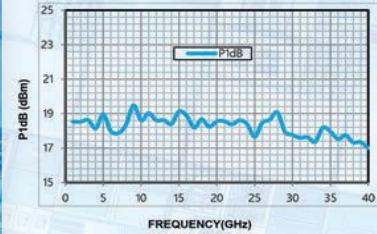
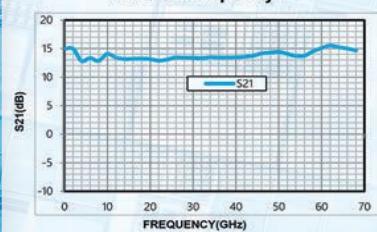
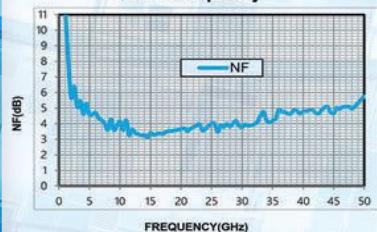
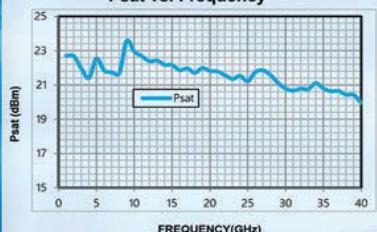
PN	Freq Low (GHz)	Freq High (GHz)	Gain (dB)	NF(dB)	P1dB (dBm)	Voltage (VDC)	Current (mA)	Package
MM3006	2.0	20.0	19.5	2.5	22.0	7.0	130	die
MM3014	6.0	20.0	15.0	-	19.5	5.0	107	die
MM3017T	17.0	43.0	25.0		22.0	5.0	140	die
MM3031T	20.0	43.0	20.0		24.0	5.0	480	die
MM3051	17.0	24.0	25.0	-	25.0	5.0	220	die
MM3058	18.0	40.0	20/19.5	2.5/2.3	16/14	5/4	69/52	die
MM3059	18.0	40.0	16/16	2.5/2.3	16/15	5/4	67/50	die

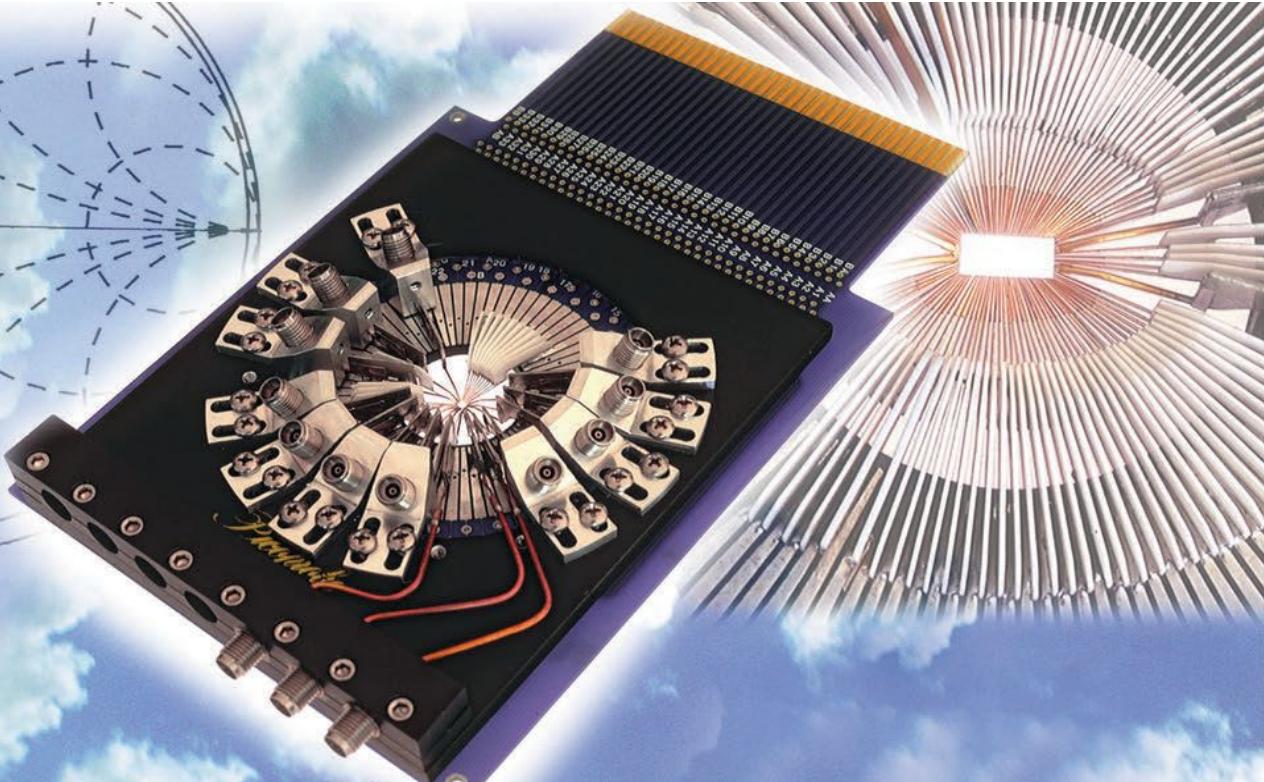
GaAs Medium Power Amplifier

PN	Freq Low (GHz)	Freq High (GHz)	Gain (dB)	P1dB (dBm)	Psat (dBm)	Voltage (VDC)	Current (mA)	Package
MMP107	17.0	21.0	19.0	30.0	30.0	6.0	400	die
MMP108	18.0	28.0	14.0	31.5	31.0	6.0	650	die
MMP111	26.0	34.0	25.5	33.5	33.5	6.0	1300	die
MMP112	2.0	6.0	20.0	31.5	32.0	8.0	365	die
MMP501	20.0	44.0	15.0	27 -- 32	29 - 34	5.0	1200	die
MMP502	18.0	47.0	14.0	28.0	30.0	5.0	1500	die

Miller MMIC is a global provider of RF semiconductor solutions with expertise in GaAs and GaN processes. We offer a diverse range of products tailored to various wireless applications. Our product lineup encompasses a wide array of offerings, including Low Noise Amplifiers, Distributed Amplifiers, Power Amplifiers, Driver Amplifiers, RF Switches, RF PIN Diode Switches, and numerous other voltage- and digitally-controllable RF components.

PN: MMW5FP
RF GaAs MMIC DC-67GHz

P1dB vs. Frequency

Gain vs. Frequency

NF vs. Frequency

Psat vs. Frequency




Picoprobe®

Picoprobe elevates probe cards to a higher level...

(...110 GHz to be exact.)

Since 1981, GGB Industries, Inc., has blazed the on-chip measurement trail with innovative designs, quality craftsmanship, and highly reliable products. Our line of custom microwave probe cards continues our tradition of manufacturing exceptional testing instruments.



Through unique modular design techniques, hundreds of low frequency probe needles and a variety of microwave probes with operating frequencies from DC to 40, 67, or even 110 GHz can be custom configured to your layout.



Our patented probe structures provide the precision and ruggedness you require for both production and characterization testing. And only Picoprobe® offers the lowest loss, best match, low inductance power supplies, and current sources on a single probe card.

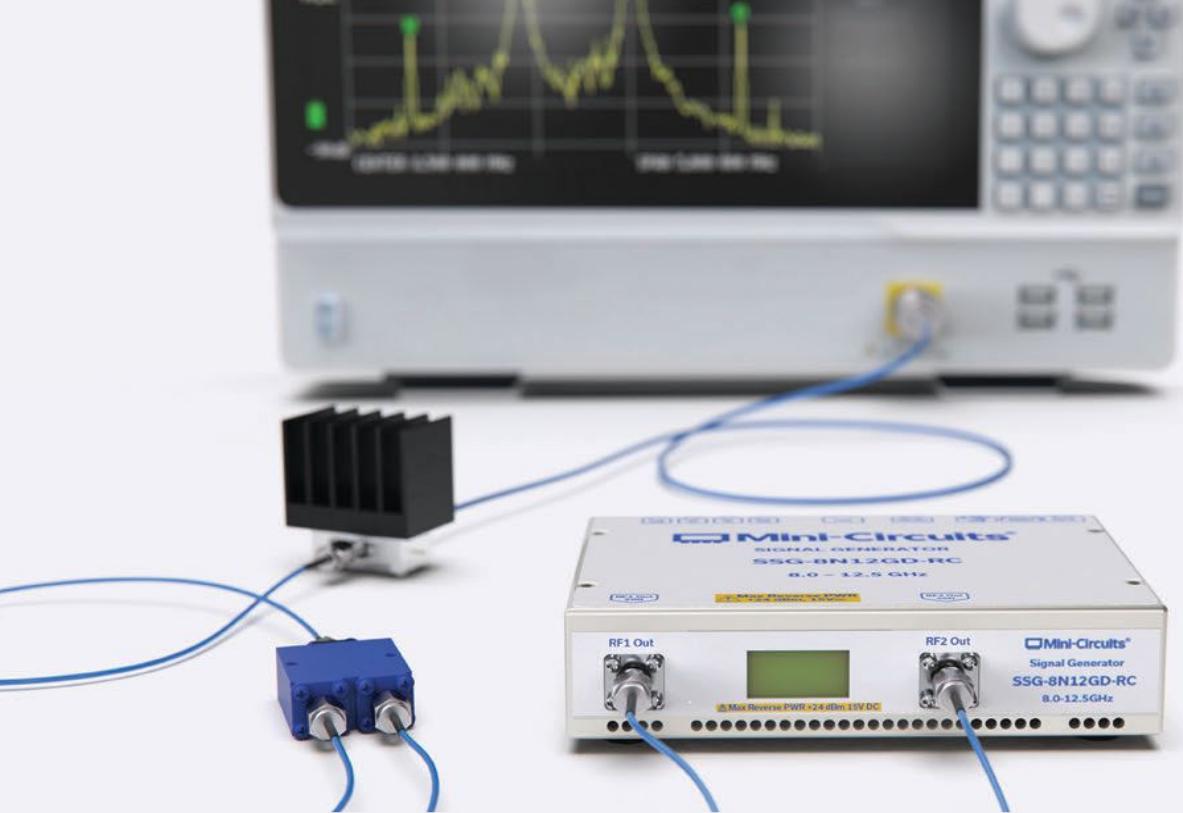
Our proven probe card design technology allows full visibility with inking capability and ensures reliable contacts, even when probing non-planar structures.

Not only do you get all the attractive features mentioned, but you get personal, professional service, rapid response, and continuous product support--all at an affordable price so your project can be completed on time and within budget.

Typical Specs	10GHz	20GHz	40GHz
Insertion Loss	0.6 dB	0.8 dB	1.3 dB
Return Loss	22 dB	18 dB	15 dB



For technical assistance, custom product designs, or off-the-shelf delivery, call GGB Industries, Inc., at (239) 643-4400.



SSG SERIES

Signal Generators

Single-Channel & Dual Channel

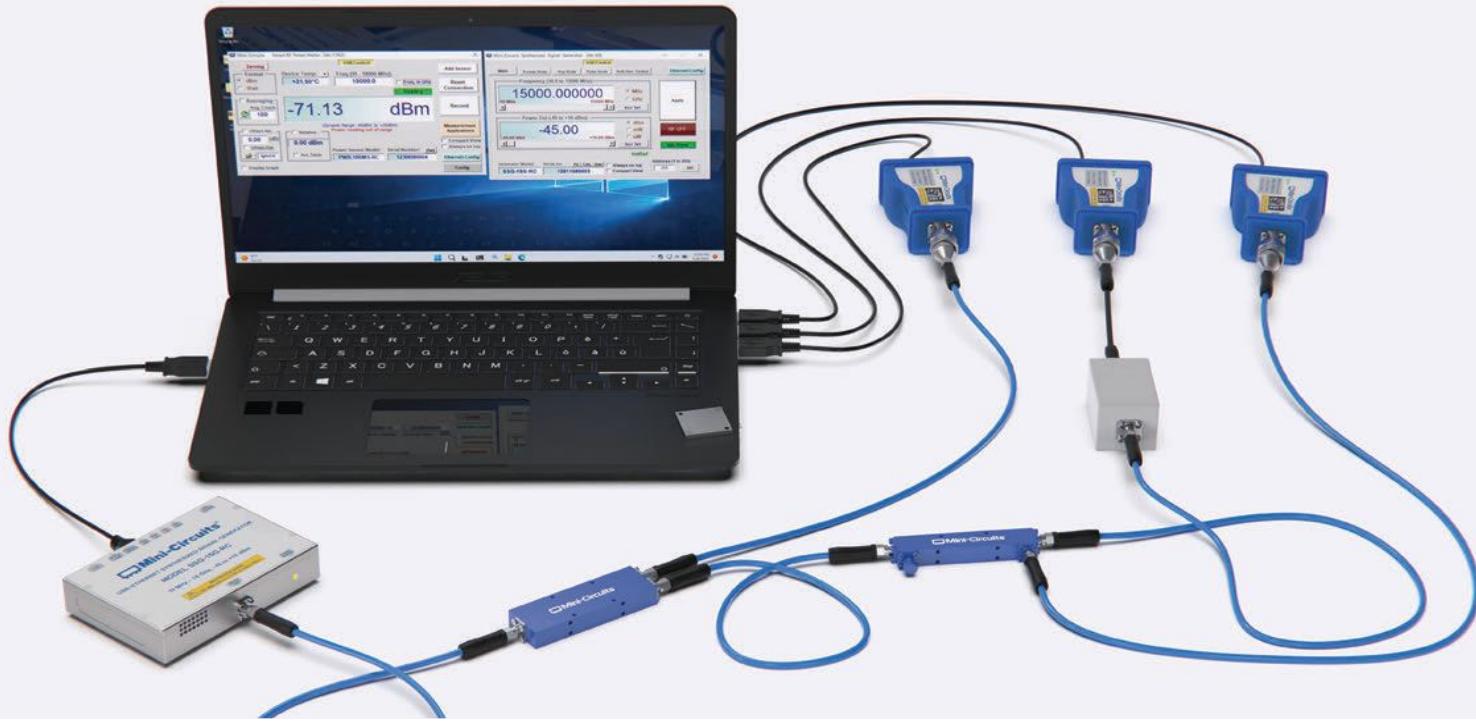
Highlights

- Wide output power range
- Dual outputs with 360° independent phase control
- Pulsed, CW, AM, FM, and chirp modulations
- USB, Ethernet & PoE control interfaces
- Daisy chain port for multi-module control
- Compact housing, 3.6 x 5.1 x 1.2"



LEARN MORE

Model Number	Frequency	Output Power	# Channels	Release Status
SSG-8N12G-RC	8 to 12.5 GHz	-55 to 23 dBm	1	Production
SSG-8N12GD-RC	8 to 12.5 GHz	-55 to 23 dBm	2	Production
SSG-5N9G-RC	5 to 9 GHz	-55 to 23 dBm	1	Production
SSG-5N9GD-RC	5 to 9 GHz	-55 to 23 dBm	2	Production
SSG-9G-RC	0.01 to 9 GHz	-50 to 15 dBm	1	Q2, 2025
SSG-9GD-RC	0.01 to 9 GHz	-50 to 15 dBm	2	Q2, 2025
SSG-R7N6G-RC	0.7 to 6 GHz	-55 to 23 dBm	1	Q2, 2025
SSG-R7N6GD-RC	0.7 to 6 GHz	-55 to 23 dBm	2	Q3, 2025
SSG-1R5G-RC	0.02 to 1.5 GHz	-55 to 23 dBm	1	Q3, 2025
SSG-1R5GD-RC	0.02 to 1.5 GHz	-55 to 23 dBm	2	Q3, 2025



PWR SERIES

Power Sensors

Turn Your PC into a High-Performance Power Meter



LEARN MORE

- Dynamic range options spanning -60 to +20 dBm
- CW, true RMS, peak and average measurement capability
- Sample rates up to 80 million samples per second
- 50 and 75Ω models
- Software package supports automated measurement with statistical analysis and time domain plots
- No external calibration required

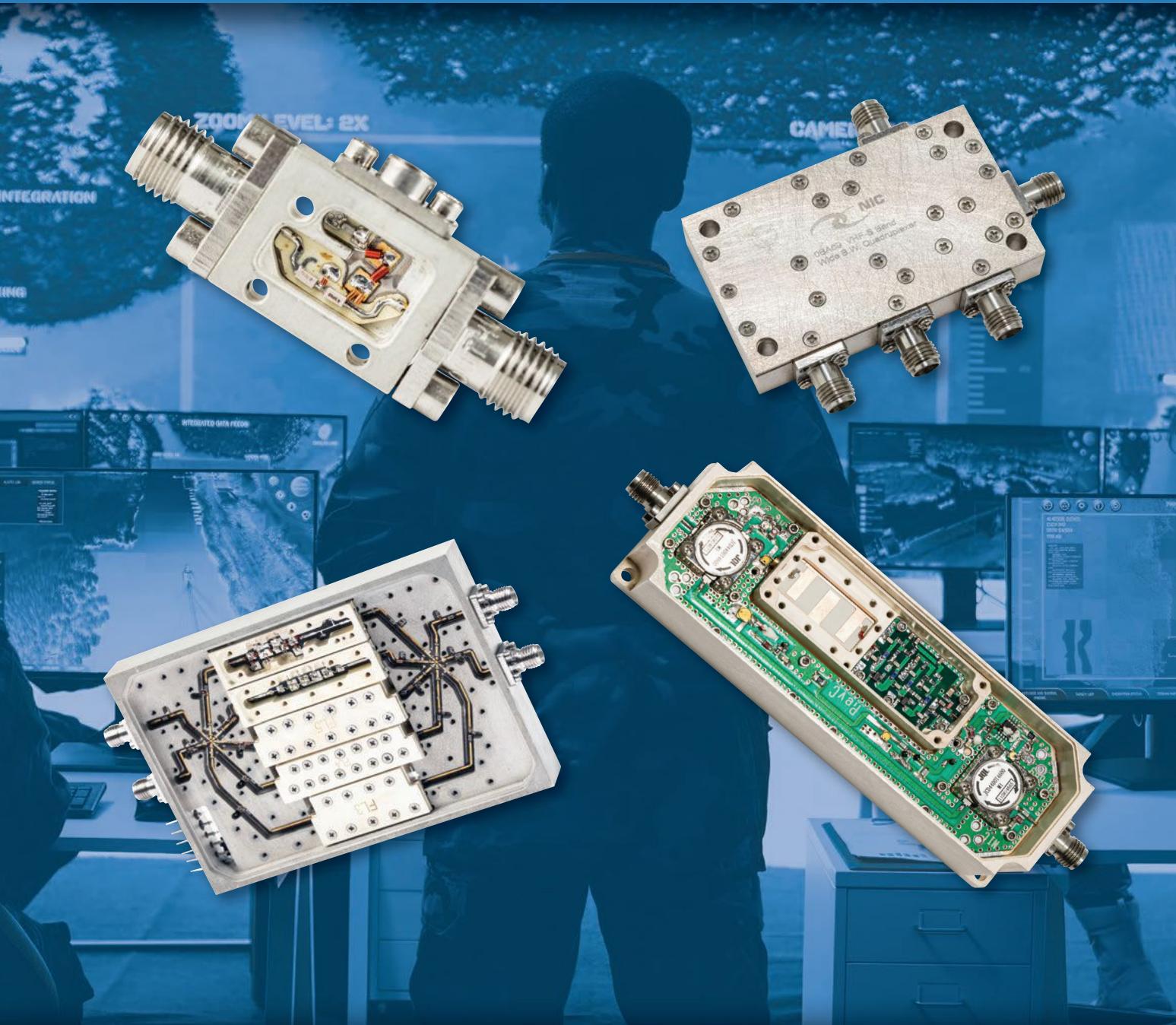
Model #	Control Interface	Measurement Type	Freq. Range (MHz)	Input Power Range (dBm)	Measurement Speed (ms)
PWR-40PW-RC	USB & Ethernet	Peak & Avg.	500-40000	-20 to 20	5.00E-05
PWR-18PWHS-RC	USB & Ethernet	Peak & Avg.	50-18000	-60 to 20	1.30E-05
PWR-18RMS-RC	USB & Ethernet	RMS	50-18000	-60 to 20	0.5
PWR-9PWHS-RC	USB & Ethernet	Peak & Avg.	50-9000	-60 to 20	0.000013
PWR-9RMS-RC	USB & Ethernet	RMS	50-9000	-60 to 20	0.5
PWR-8P-RC	USB & Ethernet	Peak & Avg.	10-8000	-60 to 20	0.002
PWR-8FS	USB	CW	1-8000	-30 to 20	10
PWR-8GHS	USB	CW	1-8000	-30 to 20	30
PWR-8GHS-RC	USB & Ethernet	CW	1-8000	-30 to 20	30
PWR-8PW-RC	USB & Ethernet	Peak & Avg.	10-8000	-60 to 20	0.00005

ADVANCED RF INTEGRATION



TAILORED FOR CRITICAL APPLICATIONS

DC - 26GHz



DIPLEXERS/MULTIPLEXERS | FILTER-LNA'S | TX-RX ASSEMBLIES | SWITCHED FILTER BANKS

Radar | EW | Guidance & Navigation | Communications | GPS & Satellite



ISO 9001:2015
AS9100
CERTIFIED

NIC NETWORKS
INTERNATIONAL
CORPORATION
www.nickc.com



sales@nickc.com
913.685.3400
15237 Broadmoor
Overland Park, KS

We Don't Just Claim Best-in-Class. We Deliver It

Our amplifiers and surface-mount filters set the standard for RF performance. Designed, tested, and proven in mission-critical environments. US-manufactured.



High Q SMT Filters 1-10 GHz

The best performance at this size in the industry

- High selectivity with low insertion loss
- For lowpass, highpass, bandpass, notch, and diplexer applications
- Custom solutions available, including multiplexers & switched filter banks

High Power SAW Filters from 20 MHz up to 1.5 GHz

Input power options up to +35 dBm CW

- Narrow, wide, and fractional bandwidths
- Ultra-flat group delay and excellent spurious rejection
- Semi-standard and custom solutions

Ultra-Low Phase Noise &

High Linearity Amplifiers

- Ultra-low phase noise (-182 dBc at 100 kHz)
- Ultra high linearity (IP2 to +100 dBm, IP3 to +61dBm)
- Widest selection of MIL space-qualifiable products
- Modified standards at no extra charge



**SPECTRUM
CONTROL**™

The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

spectrumcontrol.com © 2025 Spectrum Control, Inc. All rights reserved

ACCESS

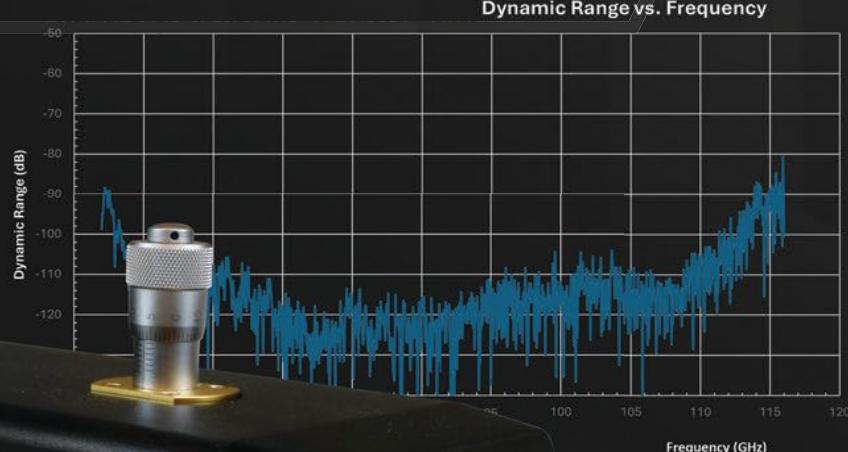
ERAVANT

MAKING MILLIMETERWAVE ACCESSIBLE

CAPABLE. COMPACT. ACCESSIBLE.

VNA Frequency Extenders

- Extended Frequency Bands
- Excellent Dynamic Range
- Pricing built for scalability



WG Port	Frequency Range	Dynamic Range (Typical @ 10Hz BW)	Test Port Output Power (Typical)	Phase Stability (@300 Hz BW)	Magnitude Stability (@300 Hz BW)	Directivity (Typical)
V-Band	45 to 80 GHz	120 dB	+13 dBm	±2 °	±0.3 dB	30 dB
E-Band	55 to 95 GHz	120 dB	+13 dBm	±2 °	±0.3 dB	30 dB
W-Band	67 to 116 GHz	120 dB	+7 dBm	±2 °	±0.3 dB	30 dB

** Additional frequency bands & configurations are available online—scan the QR code to explore the full ACCESS lineup.

WWW.ERAVANT.COM



Adapters • Amplifiers • Antenna Feeds • Antennas • Attenuators • Bias Tees • Cable Assemblies • Corner Reflectors • Couplers • DC Blocks • Detectors • Ferrite Devices • Filters • Frequency Converters • Frequency Multipliers • Limiters • Magic Tees • Mixers • Noise Sources • Oscillators • Phase Shifters • Power Dividers • Radar Sensors • Subassemblies • Switches • Termination Loads • Test Equipment • Test Hardware & Accessories • TX/RX Modules • Uni-Guide™ • Waveguide Sections

www.eravant.com 501 Amapola Avenue Torrance, CA 90501
T: 424-757-0168 F: 424-757-0188 support@eravant.com



BROADBAND SSPA / EMC BENCHTOP SOLID STATE POWER AMPLIFIER

0.1-22GHZ
ULTRA BROADBAND SSPA

RFLUPA01M22GA
4W 0.1-22GHZ



RFLUPA0218GB
20W 1-19GHZ



6-18GHZ 800W
CW REMC06G18GG
18-40GHZ 200W
CW REMC18G40GQ



0. 1-6GHZ VHZ,
UHF, L, S, C BAND

RFLUPA02G06GC
100W 2-6GHZ



RFLUPA0706GD
30W 0.7-6GHz



MADE IN
USA

6-18GHZ C, X, KU BAND



RFLUPA0618GD
60W 6-18GHz



RFLUPA06G12GB
25W 6-12GHz

RFLUPA08G11GA
50W 8-11GHz

RFLUPA08G11GA
50W 8-11GHz

18-50GHZ K, KA, V BAND



RFLUPA18G47GC
2W 18-47GHz



RFLUPA27G34GB
15W 27-34GHz



RFLUPA47G53GA2
10W 47-53GHz



RFLUPA27G34GB
30W 18-40GHz

BENCHTOP RF MICROWAVE SYSTEM POWER AMPLIFIER



REMC02G06GE
600W 2-6GHz



REMC18G40GC2
40W 18-40GHz



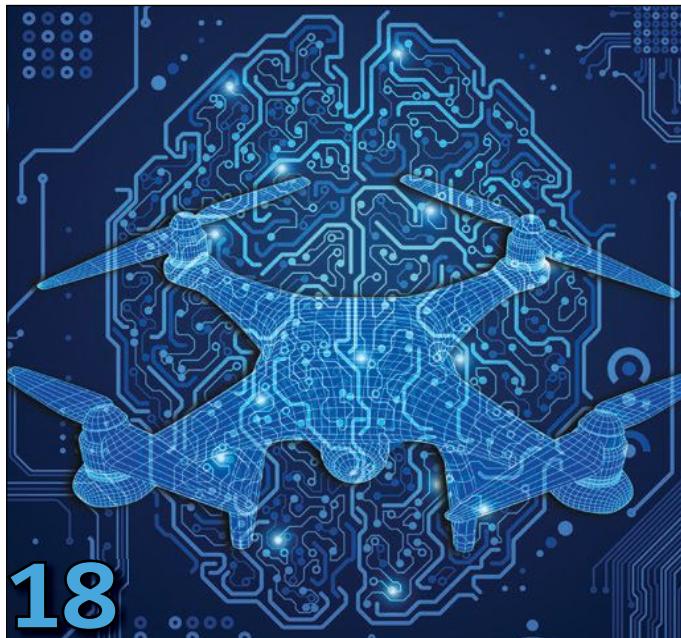
RAMP30G65GG
8W 30-65GHz



RAMP06G18GA
10W 6-18GHz



RAMPOOM65GA
DC-65GHz



18

Cover Feature

- 18** **The Role of Drones in Improving ESM Validation**

Klaus Aude, Quadsat

Special Report

- 40** **mmWave and UWB Security Screening Systems**

Patrick Hindle, *Microwave Journal*



40

48



online *spotlight*

Look for this month's exclusive article online at mwjournal.com

Understanding Different UWB Link Budgets

Byung-Jun Jang, Kookmin University

Technical Features

- 48** **Advanced Testing of Next-Generation DRFM Jammers**

Yassen Mikhailov, Rohde & Schwarz

- 58** **The Design of Very Narrowband Tunnel Diode Negative Resistance Amplifiers**

Alfred Grayzel and Ash (Ashok) Gorwara, Gorwara & Associates International, Inc.

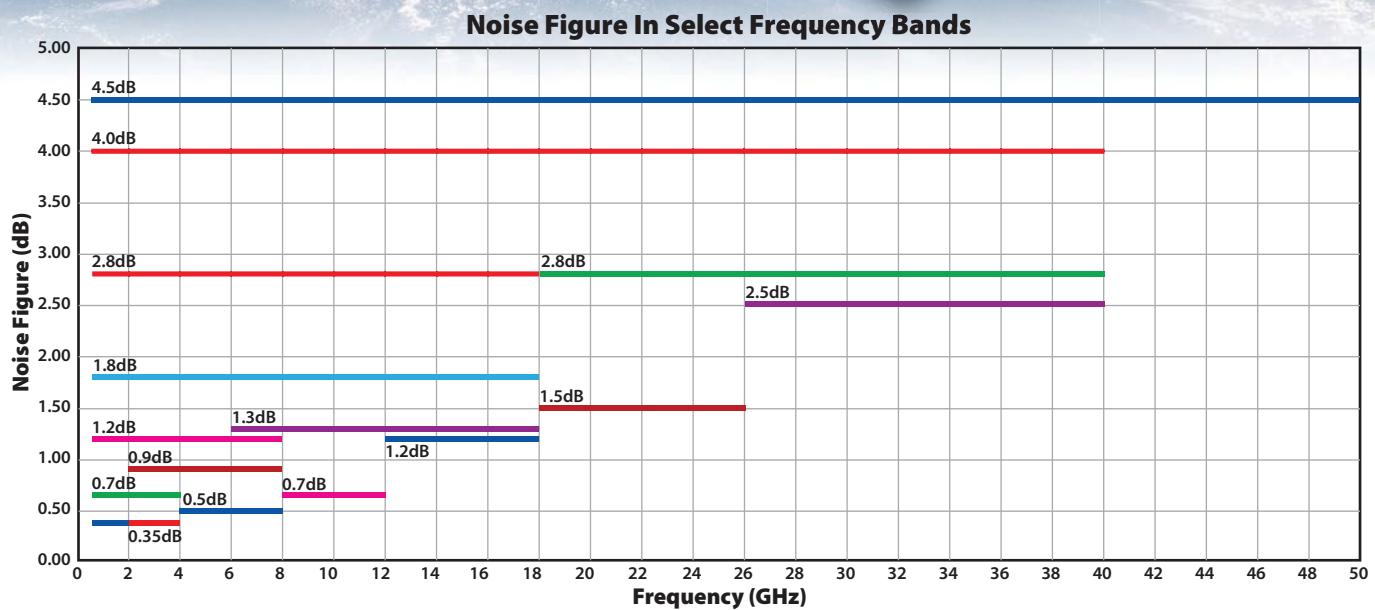
- 64** **Design of Four-Way Power Divider Based on Dielectric Window**

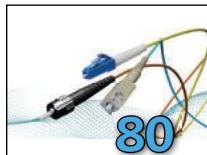
Yansha Wei, Xiufang Wang, Pengxin Mao, Tailai Ni, Hao Wang, Bangji Wang and Qingxiang Liu, School of Physical Sciences and Technology, Southwest Jiaotong University

2025 Editorial Index

A complete listing of 2025 *Microwave Journal* articles, organized by subject and indexed alphabetically by author, can be found at mwjournal.com/edindex2025.

Has Amplifier Performance or Delivery Stalled Your Program?





80



82

Product Features

80 RF over Fiber Cable Assemblies in Military and Aerospace

Pasternack

82 Tracking the Trajectory: How ESA Technologies Are Shaping Aerospace Test and Measurement

Emerson

Tech Briefs

88 Phase Difference for UWB Direction-Finding in Simulation Software

Remcom

89 65 GHz Harsh Environment Attenuators and Terminations

XMA Corporation, an Amphenol Company

Departments

17	Mark Your Calendar	91	New Products
29	Defense News	94	Book End
33	Commercial Market	96	Ad Index
36	Around the Circuit	96	Sales Reps
90	Making Waves	98	Fabs & Labs

Microwave Journal (USPS 396-250) (ISSN 0192-6225) is published monthly by Horizon House Publications Inc., 685 Canton St., Norwood, MA 02062. Periodicals postage paid at Norwood, MA 02062 and additional mailing offices.

Photocopy Rights: Permission to photocopy for internal or personal use, or the internal or personal use of specific clients, is granted by Microwave Journal for users through Copyright Clearance Center provided that the base fee of \$5.00 per copy of the article, plus \$1.00 per page, is paid directly to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923 USA (978) 750-8400. For government and/or educational classroom use, the Copyright Clearance Center should be contacted. The rate for this use is 0.03 cents per page. Please specify ISSN 0192-6225 Microwave Journal International. Microwave Journal can also be purchased on 35 mm film from University Microfilms, Periodic Entry Department, 300 N. Zeeb Rd., Ann Arbor, MI 48106 (313) 761-4700. Reprints: For PDF reprints, contact Barbara Walsh at (781) 769-9750.

POSTMASTER: Email address corrections to [mjw@e-circ.net](mailto:mwj@e-circ.net). Subscription information: (978) 671-0446. This journal is issued without charge upon written request to qualified persons working in the RF & microwave industry. Other subscriptions are: domestic, \$130.00 per year, two-year subscriptions, \$200.00; foreign, \$225.00 per year, two-year subscriptions, \$400.00; back issues (if available) and single copies, \$20.00 domestic and \$30.00 foreign. Claims for missing issues must be filed within 90 days of date of issue for complimentary replacement.

©2025 by Horizon House Publications Inc.
Posted under Canadian international publications mail agreement #PM40612608

STAFF

Group Director: Carl Sheffres

Associate Publisher: Michael Hallman

Media Director: Patrick Hindle

Brand & Content Director: Jennifer DiMarco

Technical Editor: Del Pierson

Associate Technical Editor: Cliff Drubin

Editorial & Media Specialist: Kelley Roche

Associate Editor: Kaitlyn Joyner

Multimedia Staff Editor: Barbara Walsh

Electronic Marketing Manager: Chris Stanfa

Senior Digital Content Specialist: Lauren Tully

Digital Content Specialist: Vincent Carrabino

Director of Production & Distribution:

Edward Kiessling

Art Director: Janice Levenson

Graphic Designer: Ann Pierce

EUROPE

Office Manager: Nina Plesu

CORPORATE STAFF

CEO: William M. Bazzi

President: Ivar Bazzi

Vice President: Jared Bazzi

EDITORIAL REVIEW BOARD

A. Chenakin	A. Poddar
R. Dahle	C. Puente
K. Galitskaya	B. Rautio
R. Hershtig	M. Roberg
E. Higham	U. Rohde
D. Jorgesen	F. Schindler
W. Lohmeyer	R. Smith
M. Ozalas	D. Vye

EXECUTIVE EDITORIAL OFFICE

685 Canton Street, Norwood, MA 02062

Tel: (781) 769-9750

FAX: (781) 769-5037

e-mail: [mjw@mwjournal.com](mailto:mwj@mwjournal.com)

EUROPEAN EDITORIAL OFFICE

16 Sussex Street, London SW1V 4RW, England

Tel: Editorial: +44 207 596 8730 Sales: +44 207 596 8740

FAX: +44 207 596 8749

SUBSCRIPTION SERVICES

Send subscription inquiries and address changes to:

Tel: (978) 671-0446

e-mail: [mjw@e-circ.net](mailto:mwj@e-circ.net)

www.mwj.com

Printed in the USA

From Introduction to Production



RFMW®



Highly Skilled, Experienced, Technical Sales

World-leading Manufacturers of RF, Microwave, and Power
Best-in-class Logistics and Supply Chain Solutions



Amplifiers | Antennas | Attenuators | Beamformers | Cable Assemblies | Couplers
Combiners & Splitters | Diodes | Filters | Interconnect | Mixers | MMICs & RFICs
Resistors & Terminations | Switches | Test & Measurement | Transistors | Oscillators & Timing

Ask the Experts
www.RFMW.com

Sales@RFMW.com | Toll Free: +1-877-367-7369
188 Martinvale Lane, San Jose, CA 95119 U.S.A.



Access webinars on-demand from the archived webinars and events page at www.mwjournal.com/events

WHITE PAPERS



Optimizing Antennas Installed Performance



WURTH ELEKTRONIK
MORE THAN YOU EXPECT

Microwave Journal podcasts include the RF microwave update series, Frequency Matters, plus interviews with industry experts and executives.

**PODCASTS
LISTEN NOW**

<https://podcasts.microwavejournal.com>



Suja Ramnath, President and CEO at **Integra Technologies**, discusses the company's high voltage GaN status and integrated solutions that are positioning the company for growth.



Executive Interview



Join Us Online



Follow us
@Pathindle
@MWJEditor

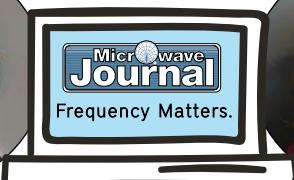


Join us at the
RF and
Microwave
Community

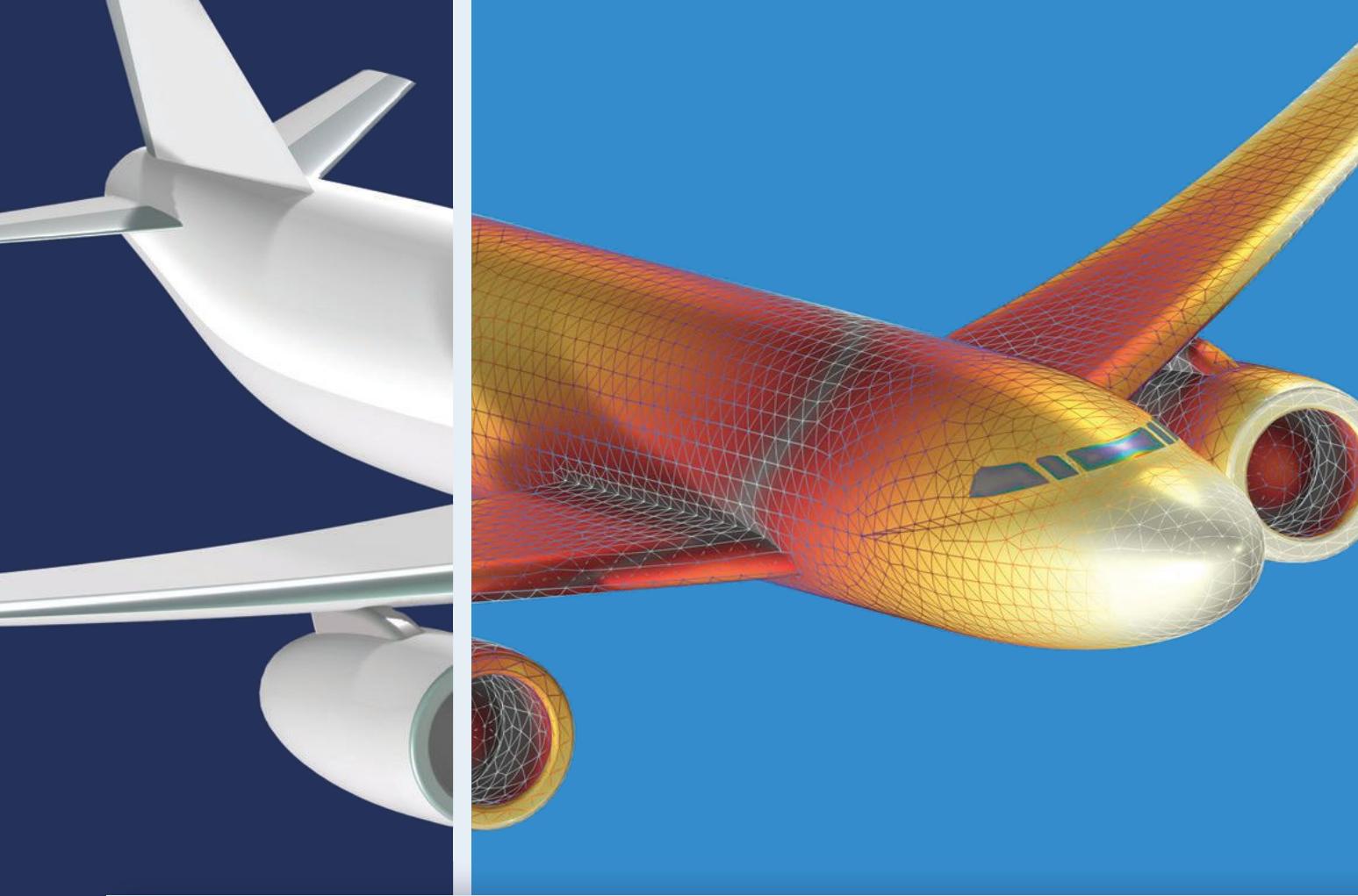


Become a fan at
[facebook.com/
microwavejournal](http://facebook.com/microwavejournal)

Catch Frequency Matters, the industry update from **Microwave Journal**, microwavejournal.com/FrequencyMatters



Visit us @ mwjournal.com



Take the Lead in Aerospace & Defense Design

with COMSOL Multiphysics®

Multiphysics simulation software feeds the innovation of A&D products that deliver on safety and performance. By building models that accurately represent the real world, engineers are able to develop, test, and verify their designs faster.

» comsol.com/feature/aerospace-defense

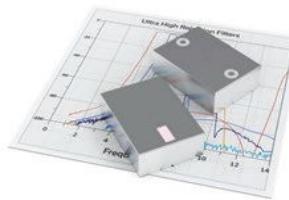
LTCC Filter Innovations

The Industry's Widest Selection

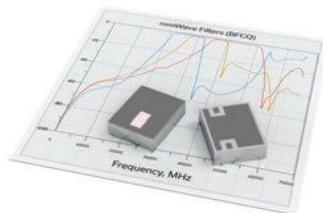


Ultra-High Rejection

- Rejection floor down to 100+ dB
- Excellent selectivity
- Built-in shielding
- 1812 package style
- Patent pending



[LEARN MORE](#)

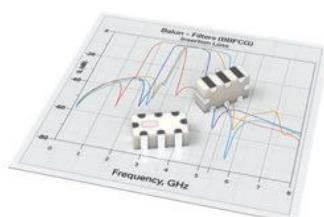
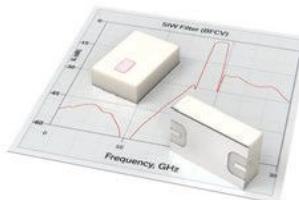


mmWave Passbands

- Passbands to 50+ GHz
- The industry's widest selection of LTCC filters optimized for 5G FR2 bands
- Growing selection of models for Ku- and Ka-band Satcom downlink
- 1812 & 1008 package styles

Substrate Integrated Waveguide

- First commercially available SIW LTCC filter in the industry
- Narrow bandwidth (~5%) and good selectivity
- Internally shielded to prevent detuning
- 1210 package style



Integrated Balun-Bandpass Filters

- Combine balun transformer and bandpass filter in a single device
- Saves space and simplifies board layouts in ADCs, DACs and other circuits
- 1210, 1008 & 0805 package styles

MARK YOUR CALENDAR

STAY CONNECTED TO COMING EVENTS



DECEMBER

14-18
MAPCON 2025

Kochi, Kerala, India
<https://ieeemapcon.org>



JANUARY

6-9
CES 2026

Las Vegas, Nev.
www.ces.tech



18-21

IEEE Radio & Wireless Week

Los Angeles, Calif.
www.radiowirelessweek.org



FEBRUARY

7-9

IEEE IMFW

Hong Kong, China
www.imfw-ieee.org



Register online at
mwjournal.com

ONLINE PAPER SERIES



2/18

**Chiplets and 3D Heterogenous
Integration**

24-26

DesignCon

Santa Clara, Calif.
www.designcon.com

DESIGNCON 2026
WHERE THE CHIP MEETS THE BOARD
Host Sponsor **Amphenol**

MARCH

9-11

German Microwave Conference

Karlsruhe, Germany
www.gemic2026.kit.edu



23-26

Satellite x GovMilSpace

Washington D.C.
www.SATShow.com



24-26

EMV

Cologne, Germany
[https://emv.mesago.com](http://emv.mesago.com)



APRIL

20-21

IEEE WAMICON

Clearwater, Fla.
www.ieewamicon.org



Register online at
mwjournal.com

ONLINE PAPER SERIES

2/18

**Chiplets and 3D Heterogenous
Integration**

Call for Papers
Deadlines

1/16

Annual Microwave Power Symposium (IMPI)



2/9

International Conference on Microwave Acoustics & Mechanics (IC-MAM)



FOR DETAILS VISIT MWJOURNAL.COM/EVENTS

The Role of Drones in Improving ESM Validation

Klaus Aude
Quadsat, Odense, Denmark

Electronic support measures (ESMs) play an integral role in military electronic warfare (EW) systems. They provide military intelligence via an array of surveillance devices used to perform critical tasks such as 'listening' to the enemy, identifying, intercepting, locating and analyzing sources of electromagnetic (EM) energy so that threats may be realized before they can harm.

At this fragile point in time, where the present geopolitical situation is unstable, military and defense organizations are on a high level of alert, and therefore, their reliance upon ESM is crucial. Thus, it is vital that ESMs are operated nominally, as a failure of these systems could mean an enemy's successful attempt to permeate defenses.

A 2023 Forecast International report on the ESM market predicted that \$7.2 billion would be spent in the next decade on a global scale. This gives an idea of just how critical these systems are and the role they

play in underpinning situational awareness and informed decision-making.

ESMs are utilized on all platforms, including land, sea and air, and operate on the RF spectrum. Like all RF systems, they must be maintained to ensure accuracy and reliability. An important aspect of this maintenance is testing.

ESMs should be tested on a regular basis. The testing schedule is determined according to a number of factors, including the critical nature of the ESM, the current threat landscape, the need for compliance and frequency of mandatory testing, the risk profile of the system (how likely it is to be breached) and the budget available.

For vessels in particular, this maintenance can be problematic in addition to being costly. Vessels must be taken to a specific testing site with specialized equipment for testing ESMs, which are often far away from their operational location. This involves taking the vessel out of op-

erational service for around two to three weeks as it travels to the port concerned, taking the crew with it.

Testing must then be completed and any issues resolved before it is allowed to return to base and resume normal operations. Despite the inconvenience, cost of validation and impact on operations, it is also imperative that testing is completed to guarantee the smooth running of ESM on board, and this cannot be compromised.

ESM TESTING

It is prudent to test an ESM both before deployment and once it has been deployed in its operational environment to ensure it can operate as expected in those conditions. At this point, testing should be more thorough to pick up issues caused by environmental factors. This will also help identify problems that equipment may have developed since type approval was granted. Testing should also occur when changes to the operational environment are

mercury

RF SWITCH FILTERING IN A CHIP

Mercury's AM3195 filter bank combines 6 RF signal chains into one small, powerful chip to deliver clearer signals with lower loss.

FEATURES

- 2-18GHz Frequency Range
- 5 Filtered Channels + 1 Bypass
- +6 dB Gain
- 6db Noise Figure
- +50 dBm OIP2
- +3.3V/5V Operation
- < 300 mW Power Consumption
- 6mm QFN
- -40C to +85C Operation

mrcy.com/am3195



Innovation that matters®

CoverFeature

identified, such as the installation of other equipment in the vicinity that may cause interference.

Software updates may also have an impact on ESM performance, and it may be necessary to verify capabilities following updates. This depends primarily on whether the update is major or minor. Testing should be prioritized after hardware changes, for example, repairing or replacing antennas, as these can also have an impact on ESMs. Similarly, testing should be prioritized when a network is expanded to verify that all is working well.

If problems are identified with the performance on ESM, it is important to continue testing to better understand the root of performance issues. Test failures can be due to age, malfunction or human error, and determining the cause prompts appropriate action to be taken to resolve the issue.

It is also important to test before any critical mission where failure of the equipment would be a serious problem. This ensures that any anomalies can be resolved and the system properly calibrated ahead of the mission.

THE IMPORTANCE OF REAL-WORLD TESTING

As with any system, there are shortcomings in ESM, and it is critical that the systems are geared up to operate in both current and fu-

ture environments. Testing is the process that underpins this. However, testing in a lab environment can yield misleading results; therefore, testing in the real world, where daily operations occur, is essential to obtain an accurate picture of the ESM's performance. Additionally, the signals that ESMs will face in the future are expected to become increasingly complex. For example, the multi-orbit satellite signals and next-generation active electronically scanned array radars are set to have big impacts on an already congested EM environment. They make the case for regular testing more vital for the continued effective operation of ESMs.

Enabling this testing has previously involved lab-based tests or range testing, where simulation of real-world scenarios has taken place. However, this involves having to transport the equipment to the lab at great financial and resource cost. This is especially challenging in defense environments where things change fast. Fortunately, there is another way to ad-



▲ Fig. 1 A UAV with an RF payload flying near a ship.

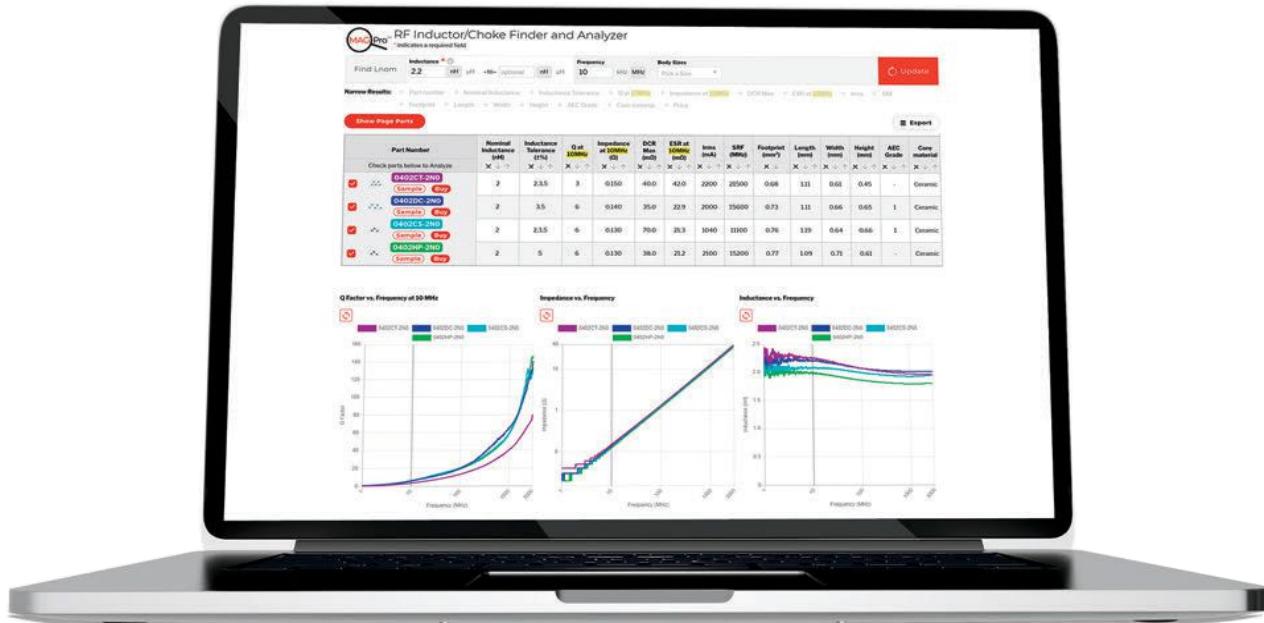
dress this challenge, which enables the testing of ESMs in their operational environment, and it comes in the form of unmanned aerial vehicles (UAVs).

UAV TESTING: WHAT DOES IT INVOLVE?

Testing with UAVs is still a new concept to defense forces. By their nature, UAVs are easy to transport and can be fitted with many different types of payloads to fulfill different tasks and applications. Instead of sailing a vessel all the way to a test site, which will result in the loss of hours of operations due to its being removed from service, and loss of man-hours as the crew must remain on board yet cannot operate, a drone is deployed to the vessel to carry out the ESM testing. **Figure 1**

An advertisement for MECA Electronics, Inc. The top half features a satellite in space with the MECA logo and text 'Celebrating 65 Years'. The bottom half is a white background with text and images of various RF components. On the left, there are three images of power dividers/combiners: one labeled '5-6 GHz/5-8 GHz' and '20-500 MHz', another labeled '20-500 MHz', and a third labeled '6-40 GHz'. To the right, there is a list of product categories: HYBRID COUPLERS, LOW PIM PRODUCTS, ADAPTERS & CABLES, DIRECTIONAL COUPLERS, INTEGRATED ASSEMBLIES, POWER DIVIDERS & COMBINERS, DC BLOCKS, BIAS TEES, ISOLATOR, ATTENUATORS, TERMINATIONS, and ML SERIES PRODUCTS. The bottom of the ad features the website 'www.e-MECA.com' and the phone number '973-625-0661'.

Find the Right Part Faster



Designed by Engineers for Engineers, our **MAGPro®** RF Inductor and Choke Finder helps you determine the optimal parts for your desired L@frequency or Z@frequency quickly, reducing your design cycle time.

Coilcraft's patented **MAGPro** online inductor analysis tools are designed to enable inductor selection and circuit optimization based on sound engineering principles and measured data.

The RF Inductor Choke Finder and Analyzer offers two search options. The L @ Frequency option identifies inductors suitable for your L, Q, and current requirements and displays

a full range of performance graphs including L, Q and ESR at frequency.

For RF choke applications, the Z @ Frequency tool searches thousands of part numbers for your desired impedance and lets you select the desired choke based on size, performance, or a combination of the two.

Reduce your design cycle time with confidence at www.coilcraft.com/tools

Coilcraft®

WWW.COILCRAFT.COM

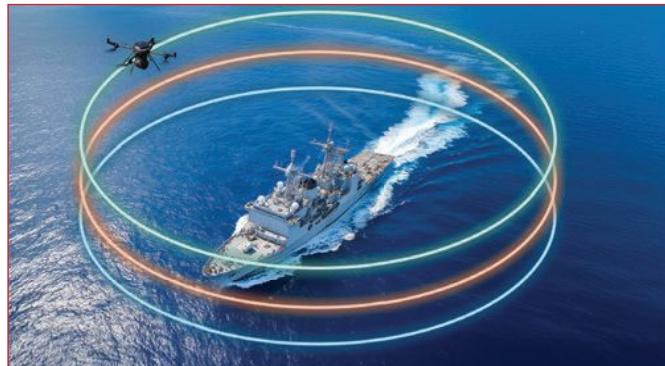


▲ Fig. 2 An on-ship operator ready for take-off.

shows a Class 1 UAV equipped with an RF payload getting ready to begin a measurement.

On vessels, as on any other platform, every system that is deployed impacts every other system around it. That system can be tested on a sub-system in a lab and given a clean bill of health; however, when deployed out in the field, it is surrounded by multiple systems and under the influence of various environmental factors. The interference of these systems and environmental challenges can be significant and negatively impact the performance. In addition, not all negative environmental factors are obvious to observe. For example, in the case of antennas, reflectivity can have an impact on how RF signals are received and can cause degradation and loss of throughput, neither of which is obvious to the naked eye. Any drop in performance can have a significant impact on services, affecting the accuracy and reliability of the system, so it is critical to ensure that the right testing regimes are put in place to evaluate the system in its own environment.

It can be complex and often time-consuming to test, correct and optimize the different components. If a



▲ Fig. 3 Examples of flight paths taken by the drone around a ship.

system is tested out in the field, *in situ*, these different factors can be considered and dealt with before being retested. Using a drone to carry out the tests and to pinpoint where the issues are means that there is no requirement to get the vessel to a specific dock where it can be tested.

Fitted with a specialized payload that covers a wide range of frequencies from very low to very high, the UAV can be positioned at different elevation angles, emulating threats at various altitudes, thus ensuring performance checks and calibration across the entire operational range of the ESM system. **Figure 2** shows an operator getting ready to run a test from a UAV.

The drone is flown either in circles at different altitudes or away from or towards the ship, as demonstrated in **Figure 3**. The position of the drone is then compared to the information collected by the ESM system, allowing for an assessment of detection quality as well as for calibration of any misalignment offsets. In Figure 3, each flight path is a concentric circle around the ESM at different elevations. These flight paths would emulate targets coming from different directions and elevations, essentially testing the entire operational range of the ESM.



Unlocking Access to mmWave Power

Elve mmWave amplifiers are built for scale. Leveraging advanced materials and manufacturing, Elve amplifiers deliver power at K, Q, V, E, and W-bands with high efficiency in a compact form.

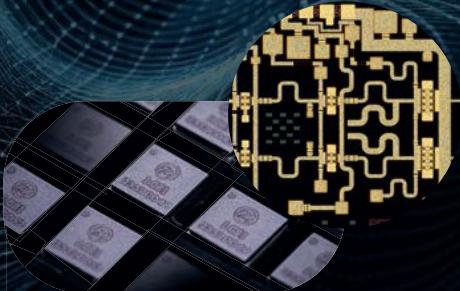
info@elvespeed.com • elvespeed.com

Elve



World's 1st AI Driven RFIC
DESIGN PLATFORM

A PUSH-BUTTON GDS TAPE-OUT READY SOLUTION



END APPLICATIONS CUSTOMERS

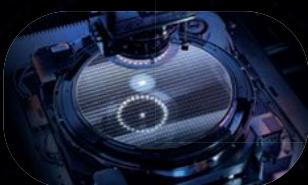
PERFORMANCE-DRIVEN FOCUS
EXPANDED DESIGN CHOICES
ENHANCED SECURITY AND CONFIDENTIALITY
REDUCED DEPENDENCE ON IC VENDORS
SIGNIFICANT COST SAVINGS

SEMICONDUCTOR COMPANIES

HUGE DESIGN COST REDUCTION
TAILORED TO CUSTOMER NEEDS
100X, 1000X FASTER
SUCCESSFUL RATE INCREASE



TRULY ENABLES A "**DIRECT INTERACTION**"
MODEL FOR THE RFIC INDUSTRY ACROSS EVERY SECTOR.



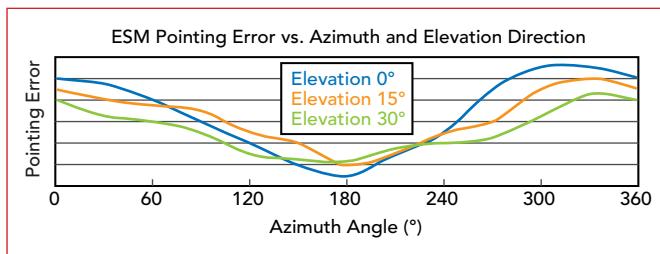
FOUNDRIES

HIGHER REVENUE GREATER DESIGN VOLUME
EXPANDED CUSTOMER BASE LOWERING DESIGN ENTRY BARRIERS
ACCELERATED PRODUCT ITERATION

S I M P L E 3 S T E P S

- LOGIN WWW.RAPIDRF.AI
- ENTER DESIGN TARGET
- PRESS "**GENERATE**"

A TAPE-OUT-READY GDS FILE WILL BE GENERATED AND **AVAILABLE FOR DOWNLOAD**.



▲ Fig. 4 Example of results of pointing error after a multi-elevation test.

The drone is able to achieve highly accurate measurements due to the centimeter-level positioning of the real-time kinematics (RTK) GNSS. Even at over 100 meters of test distance, it puts the measurement uncertainty below a tenth of a degree.

Using multiple payloads that test different frequencies, the drones give flexibility and range to the testing process, offering the operators insight into exactly what is being emitted by satcom and radar in real time and the ability to calibrate those systems before testing again for on-vessel validation. **Figure 4** shows an example of the results of pointing error after a test at different elevations. These errors can be translated into system offsets, which are then used as corrections on actual targets.

Investment in a system of this kind can result in long-

term cost savings. To test the ESMs on board a vessel costs tens of thousands of dollars, but once a drone system has been invested in, the return on investment outweighs its cost. Results are in real time, allowing immediate action and rectification to avoid further issues. The frequency of testing can also be increased to ensure that the ESMs are continuously performing as they are expected to, with no disruption to the vessel's daily operations. These measurements can be completed whilst the ship is in motion, going towards a destination or performing other critical activities, without impacting the measurement accuracy.

The drone payload can be used to self-test on board the vessel between missions, for EW training and fleet readiness exercises and for in-theatre validation of threat libraries. In addition, it can be used to verify the system integrity after maintenance and for crew training and blind zone mapping to detect any coverage gaps or areas of degradation.

INTELLIGENCE GATHERING

The use of drones equipped with RF payloads in the battlespace environment also lends itself to intelligence gathering. By pairing a highly effective payload with a long-endurance, resilient unmanned aircraft system (UAS) platform, a highly effective, scalable and tactically agile solution is created, enabling real-time EM spectrum intelligence in complex operational environments.

Where **PERFORMANCE** Meets **PURPOSE**

BSC criteria labs DowKey Microwave Espy K&L MICROWAVE MPG SOLUTIONS POLE ZERO

Satellite 2026 – Washington, DC • March 23-26 • Booth #2831 • mpgdover.com



Ku/Ka/V/E-Band Power Amplifier MMICs

**Maximized performance for
linear power applications**

Ku/Ka-Band MMIC Die and Packaged MMICs

MMIC Die:

NPA1020-DE	12.5 - 14.5 GHz	15 W
NPA2020-DE	23.0 - 25.0 GHz	10 W
NPA2001-DE	26.5 - 29.5 GHz	35 W
NPA2002-DE	27.0 - 30.0 GHz	35 W
NPA2003-DE	27.5 - 31.0 GHz	35 W
NPA2004-DE	25.0 - 27.5 GHz	40 W
NPA2030-DE	27.5 - 31.0 GHz	20 W
NPA2040-DE	27.5 - 31.0 GHz	10 W

QFN Packaged MMICs:

NPQ2101-SM	27.5 - 31.0 GHz	5 W
NPQ2103-SM	27.5 - 31.0 GHz	8 W
NPQ2105-SM	27.5 - 31.0 GHz	12 W
NPQ2107-SM	27.5 - 31.0 GHz	17 W

Contact Nxbeam for Flange
Packaged Options



V-Band MMICs

MMIC Die:

NPA4000-DE	47.0 - 52.0 GHz	1.5 W
NPA4010-DE	47.0 - 52.0 GHz	3.0 W

E-Band MMICs

MMIC Die:

NPA7000-DE	65.0 - 76.0 GHz	1.0 W
------------	-----------------	-------



CoverFeature

This kind of advanced spectrum monitoring tool is essential for modern operational environments. The drone effectively becomes an EM support measure that can listen for signals around the vessel without emitting a signal of its own. If the drone is used to map the EM environment, commanders can build up a detailed picture of where the enemy is located, where the threats lie and the type of communications

networks that are being used. This can also provide them with immediate warnings of danger to the vessel and assure spectrum dominance, which is the goal of any force in EW situations. Across a mission, the drone provides enhanced situational awareness at a lower cost than other methods, enabling the command chain to see the bigger picture and therefore make more informed and timely decisions when

it counts.

Ships equipped with these spectrum monitoring tools can apply them to EW and RF systems as well. Such drone payloads can generate radiation patterns, calibrate and optimize antennas, troubleshoot malfunctions and provide an overall health check of a multitude of systems.

Protecting a Vital Line of Defense

For navies all over the world, testing is fraught with challenges, and the method of testing is inefficient and often ineffective, as testing environments cannot replicate real-world scenarios. Additionally, current test methods are costly, and the expense must be laid out at least twice a year if the ESMs on board are to operate nominally.

UAVs offer a different, highly flexible approach to testing, enabling validation to be carried out in situ rather than involving redirection of the vessel to a port with testing facilities. The importance of the ability to test in the actual operational environment cannot be underestimated, especially given the increasing complexity of the RF landscape. New developments are causing unexpected congestion, and the crowding is expected to increase further with the deployment of new and evolving technologies. Testing with a UAV puts defense forces on the front foot, saving money and allowing them to see how ESMs are performing in real time, enabling them to recalibrate and test again.

Ownership of UAVs and RF payloads allows flexibility in testing. Once a system is invested in, it can be used to test ESMs on multiple platforms, eliminating the need for them to be taken out of service for long periods and encouraging more regular testing, which has a positive effect on the quality of monitoring.

In a world that is unpredictable, ESMs are imperative to offer situational awareness and information on both allied and enemy intent. Therefore, the meticulous maintenance of these systems cannot be compromised, and UAV testing enables validation without the litany of challenges that in-port testing presents. ■

Cover your bases with KRYTAR



These principles form the basis for the steady growth that has earned KRYTAR an enviable reputation in the microwave community.

Cover your bases. Contact KRYTAR today for more information.

MIL-Qualified RF, Microwave & mmW Components

- Directional Couplers to 110 GHz**
- 3 dB 90° Hybrid Couplers to 44 GHz**
- 3 dB 180° Hybrid Couplers to 40 GHz**
- NEW! Beamforming Networks to 40 GHz**
- Power Dividers to 45 GHz**
- Detectors to 40 GHz**
- NEW! Space Applications**
- Custom Design Solutions**



KRYTAR®

www.krytar.com

1288 Anvilwood Avenue • Sunnyvale, CA 94089

Toll FREE: +1.877.734.5999 • FAX: +1.408.734.3017 • E-mail: sales@krytar.com





EMC Broadband RF Power Amplifier

High Power Solid State

**FREQUENCY UP TO 90GHZ****POWER UP TO 2KW CW****BENCHTOP AND RACKMOUNT****REMC06G18GG** 6-18GHZ 400W

- AUTOMATIC BUILT IN SELF CALIBRATION AND BIAS ADJUSTMENT.
- OVER TEMPERATURE, CURRENT, INPUT POWER PROTECTION.
- VSWR MEASUREMENT AND OPEN CIRCUIT PROTECTION.
- USER FRIENDLY CONTROL INTERFACE.
- REMOTE ETHERNET CONTROL AND FIRMWARE UPDATE.
- HIGH POWER EFFICIENCY AND LIGHTWEIGHT.

**RAMP42G47GA** 42-47GHZ 8W**RAMP18G40GB-U** 18-40G 20W**RAMP05M80GC** 0.5-80GHZ**REMC02G06GE** 2-6GHZ 500W**REMC18G40GQ** 18-40GHZ 200W CW

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
CA56-5114	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 for our complete product offering.





Thales Unveils Space Surveillance Radar AURORE – Unique in Europe

As part of the Action and Space Resilience (ARES) program, Thales has been notified of a contract from the French Defence Procurement Agency (DGA) to develop, deliver and deploy a new ground-based low orbit space surveillance radar system. Called AURORE, it will watch the satellites and debris in low orbit from the Earth.

This ground-breaking radar system provides continuous monitoring and tracking of multiple space objects simultaneously. It will strengthen French capabilities for assessing the space situation. AURORE will be the largest surveillance radar deployed in Europe.

In the context of the increasing militarization of space, this decision marks an important milestone for European and French sovereignty, by providing unprecedented detection capabilities to enhance military space surveillance missions of activities in low orbit.

As space operations are challenged by a substantial increase in threats, from military to space debris, the ability to identify and track multiple small objects in space in real time makes all the difference when it comes to space sovereignty and protecting the skies.

Designed and manufactured at Thales' Limours site, the AURORE radar also benefits from the expertise gained through partnerships with several French SMEs.

AURORE is a software-defined radar operating in the ultra-high frequency (UHF) band, that will provide continuous surveillance and simultaneous multi-tracking of numerous space objects with a fast low Earth orbit responsiveness time, and the generation of a high-resolution picture of the space environment in real time.

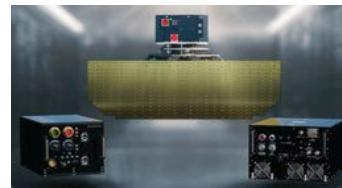
The modularity of its architecture will form the backbone of a comprehensive roadmap aimed at expanding the product portfolio with a new family of UHF radars capable of meeting the needs of multiple critical missions, enabling protection against emerging ballistic and hypersonic threats.

Raytheon Begins Initial Production of SharpSight Surveillance Radar

Raytheon, an RTX business, has launched the initial production of its new SharpSight multi-domain surveillance radar. This next-generation system will provide high-altitude, real-time, high-

resolution imaging with wide-area search and tracking for land and maritime surveillance, operating day or night in any weather condition.

SharpSight fuses the capabilities of two of Raytheon's proven radar families — the Highly Integrated Synthetic Aperture Radar (HISAR) and the SeaVue Multi-Role Radar — and can be rapidly integrated on a variety of manned and unmanned systems. Its open architecture enables inexpensive, rapid upgrades, ensuring operators remain ahead of emerging threats.



SharpSight (Source: RTX)

"This radar represents the next step in Raytheon's long legacy of intelligence, surveillance and reconnaissance innovation," said Daniel Theisen, president of Advanced Products and Solutions at Raytheon. "By merging the proven capabilities of HISAR and SeaVue, we're delivering a flexible, exportable and affordable radar system designed to outperform on the most demanding multi-domain surveillance missions."

SharpSight is designed for high-altitude precision and persistence, enabling critical missions such as anti-surface warfare, border protection, coastal monitoring, search and rescue and long-range surveillance. It conforms with the latest U.S. Government export policy guidance enabling these advanced intelligence, surveillance and reconnaissance capabilities to be offered to global partners and allies.

Leonidas Autonomous Robotic for Mobile C-UAS

Lepirus and General Dynamics Land Systems (GDLS) announced the introduction of Leonidas Autonomous Robotic (Leonidas AR), a mobile counter-unmanned aerial systems (C-UAS) capability featuring Epirus' Leonidas high-power microwave (HPM) platform integrated with GDLS's Tracked Robot 10-ton (TRX) unmanned ground vehicle.

Leonidas AR, powered by GDLS TRX, is a robotic ground vehicle equipped with Epirus' HPM technology for mobile C-UAS and short-range air defense. The integrated system is highly maneuverable for C-UAS on the move and a low-cost, low-collateral electronic defeat mechanism ideal for the evolving drone threat environment.

"Epirus' partnership with GDLS is an industry-leading collaboration that continues to deliver real results. Together, we are bringing world-first capabilities to market that directly answer the call of the Army Transformation Initiative," said Andy Lowery, Epirus CEO. "The marriage of neo-primes and primes is how the U.S. defense industrial

For More Information

Visit mwjournal.com for more defense news.



Leonidas (Source: Epirus)

base can best ensure victory as the battlefield continues to rapidly evolve."

Leonidas is a modular, scalable, proven HPM solution that uses weaponized electromagnetic interference to disable electronic targets. The platform delivers a one-to-many engagement for swarm defense by which one Leonidas system can disable entire swarms of drones.

Leonidas is software-defined, which empowers operators to define safe zones and notch out specific frequencies for low-collateral effects, as well as the ability to alter waveforms, modulate energy outputs and introduce new tactics of engagement for greater effectiveness on target. Software also enables rapid innovation and feature updates without removing the system from the battlefield.

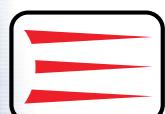
GDLS' TRX features AI-enhanced design, lightweight material, a hybrid-electric propulsion system and dynamic suspension for all-terrain mobility across combat environments. The vehicle features integrated radar for 360-degree sensing, on-board computing for maximum capability, a state-of-the-art battery system that allows for 300+ miles of range and a maximum speed of

45 miles per hour. It can be autonomously or remotely operated in high-risk environments to reduce manning and protect air defenders. GDLS is also developing a wheeled variant to support customer needs.

"By combining GDLS' decades of leadership in development and deployment of ground combat vehicles with Epirus' premier non-kinetic C-UAS effector, Leonidas AR achieves the level of next-generation technology that today's battlefields demand. This new capability was born out of a partnership that leverages the best of American innovation to help our warfighters stay a step ahead," added Jim Pasquarette, vice president, U.S. Strategy & Business Development, GDLS.

Leonidas AR is the second mobile C-UAS system co-developed by Epirus and GDLS after the companies entered into a teaming agreement in 2021. In 2022, the companies introduced Leonidas Stryker, which features the Leonidas HPM platform integrated with GDLS' Stryker, the U.S. Army's largest and most reliable combat vehicle fleet.

The partnership between GDLS and Epirus underscores how victory in The Sixth Domain will come from blending the scale and sustainment of traditional primes with the agility and disruptive innovation of neo-primes, creating hybrid ecosystems that can rapidly integrate, produce at scale and deliver mission-ready solutions across the modern battlespace.



**EMPOWER
RF SYSTEMS**

AMPLIFIERS

**YOU
CAN**

TRUST

**ENGINEERING
EXCELLENCE**

**PRECISION
BUILD**

**TESTED
THOROUGHLY**

**DEPLOYED
SUCCESSFULLY**



Reactel, Inc.

Reacting First to All Your Filter Needs.

Filter Solutions For Mission Critical Applications

High Performance, Rugged Packaging, Small Size and Weight

Great things *can* come in small packages. Reactel filters are ideally suited for the demanding environments that unmanned vehicles encounter.

Many manufacturers rely on Reactel to provide units which are:
High performance - Lightweight - Low profile

Contact a Reactel engineer with your filter or multiplexer requirements. We can create a unit which will be the perfect fit for your applications.



RF & Microwave Filters - Multiplexers - Multifunction Assemblies



8031 Cessna Avenue • Gaithersburg, Maryland 20879 • (301) 519-3660 • reactel@reactel.com • reactel.com



DC TO 50 GHz

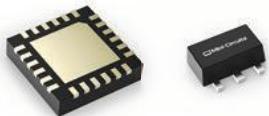
MMIC Amplifiers

300+ Models Designed in House



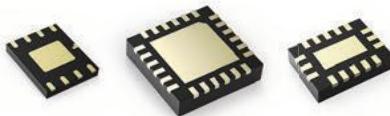
Options for Every Requirement

CATV (75Ω)



Supporting DOCSIS® 3.1 and 4.0 requirements

Dual Matched



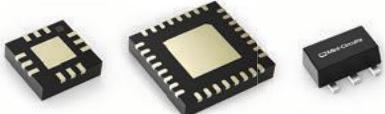
Save space in balanced and push-pull configurations

Hi-Rel



Rugged ceramic package meets MIL requirements for harsh operating conditions

High Linearity



High dynamic range over wide bandwidths up to 45 GHz

Low Noise



NF as low as 0.38 dB for sensitive receiver applications

Low Additive Phase Noise



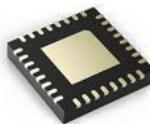
As low as -173 dBc/Hz @ 10 kHz offset

RF Transistors



<1 dB NF with footprints as small as 1.18 x 1.42mm

Variable Gain



Up to 31.5 dB digital gain control

Wideband Gain Blocks



Flat gain for broadband and multi-band use



What 6G Will Bring to the World of Telecoms



The industry is constantly advancing, and the next generation of wireless communications, 6G, is beginning to enter standardization, as reported by IDTechEx in the new report "6G Market 2026-2036: Technology, Trends, Forecasts, Players." So, what is 6G, why is it needed and how does it offer to change the game after the somewhat lackluster performance of its predecessor, 5G?

The telecom industry deploys new generations of wireless communications roughly every 10 years, with 5G replacing 4G around 2020 and 6G expected to enter commercial use around 2030. 6G will utilize new frequency spectrum to deliver faster data speeds at reduced latency, with industry touting theoretical peak speeds of 1 Tbps. Pushing higher frequencies brings greater signal attenuation in air, restricting transmission range and introducing line-of-sight considerations.

For this reason, 6G will require a new radio design with new semiconductors to increase link range. Beyond just faster speeds and new spectrum, 6G is expected to leverage new antenna architectures and disruptive technologies to bring greater connectivity throughout urban environments and unlock new applications.

6G is expected to also have more integration with non-terrestrial networks, beyond relying solely on traditional ground-based masts.

Whilst formal designation of spectrum for 6G has not yet been finalized, the industry is coalescing around the so-called cmWave (7 to 15 GHz) for the bulk of traffic needs. This region offers a good balance of bandwidth without being hamstrung by excessive signal attenuation. For high speed applications, mmWave (24 to 100 GHz) is being discussed, although mmWave was heavily promoted for 5G and has seen little commercial rollouts thus far in the 5G rollout. IDTechEx expects these high bandwidth services to be restricted to extremely dense areas, such as stadiums and crowded urban zones.

Beyond mmWave, the higher sub-THz band could offer incredible data transfer rates and low latency communications, but at the cost of enormous signal attenuation, likely requiring some form of network repeaters or RIS to make sub-THz viable.

The entire 6G ecosystem is searching for applications that can be unlocked by 6G and ultimately monetized to provide a return on investment for the capital expenditures required to build out a new network.

Some applications touted for 5G are being promoted once more, such as digital twinning and autonomous driving. Other more novel use cases such as integrated sensing and communication are being explored, whereby high frequency signals are used to locate and track objects within an area.

IDTechEx covers a variety of communications/non-traditional use cases for 6G in the report "6G Market 2026-2036: Technology, Trends, Forecasts, Players," and assesses that conventional data speeds and network traffic are unlikely to be major drivers towards 6G; in other words, the industry needs to find new applications that can be monetized.

Advancing AI-Driven, Self-Managing Networks

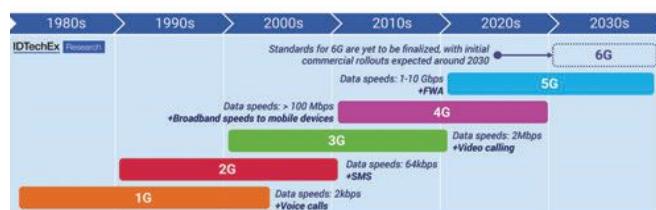


The new 5G Americas white paper, "Enabling Intent-Based Autonomous Networks," explores how telecom operators can use AI-driven, self-configuring and self-healing systems to meet the rising complexity of 5G, AI, IoT and cloud-native services. This report highlights the technologies, standards and strategies enabling intent-based autonomous networks (ANs) to deliver scalable, resilient and customer-centric connectivity.

"Intent-based ANs represent a critical step forward in making telecom infrastructure adaptive, efficient and aligned with business outcomes," said Viet Nguyen, president of 5G Americas. "By embracing AI, open standards and phased adoption, the industry can achieve sustainable efficiency, deliver superior customer experiences and create new opportunities for innovation."

The white paper highlights several key advancements enabling autonomous networking:

- Intent-Driven Automation: High-level business goals are translated into dynamic, real-time network behavior, enabling adaptive, self-configuring and self-healing operations
- AI, Open APIs & Observability: AI/ML, generative AI and agentic AI power closed-loop operations and predictive optimization; open APIs ensure multi-vendor interoperability; observability frameworks provide real-time visibility, trust and security
- Business Outcomes: Closed-loop automation, energy optimization and predictive assurance reduce churn, improve service level agreement management and deliver cost savings through greater agility and efficiency
- Standards & Ecosystem Collaboration: TM Forum, O-RAN Alliance and 3GPP are advancing frameworks for scalable intent-based adoption, while vendors embed these capabilities into OSS/BSS,



Evolution of Global Communications (Source: IDTechEx)

For More Information

Visit mwjournal.com for more commercial market news.

CommercialMarket

- RAN and orchestration platforms
- North American Leadership: Regional operators are focusing on customer experience, energy optimization and fault management, positioning North America as a benchmark for global best practices.

The paper also outlines a phased roadmap for implementation, emphasizing governance, automation-ready infrastructure and cross-domain orchestration as practical steps toward maturity. It stresses that collaboration, trust and industry alignment will be vital to combat legacy systems, data silos and security risks.

To download the white paper and explore more insights on the path to ANs, visit 5G Americas' website.

Enhancing Emergency Services Communications in Challenging Environments



he Wireless Broadband Alliance (WBA) has launched three reports, providing a framework for how Wi-Fi, Passpoint® and Open-Roaming™ can facilitate and sustain emergency calling and priority communications around the world. Developed by WBA's Mission Critical & Emergency Services Program, the framework demonstrates how across in-

door venues, dense public spaces and other challenging environments, Wi-Fi further enhances the availability, reliability and performance of communications networks between the public, first responders, public safety organizations and emergency services.

Wi-Fi has already proved a critical line of communications in emergency situations, such as Hurricane Katrina when cell towers were affected. Equally, in densely populated public spaces and indoor environments, Wi-Fi can be a lifeline for communication between the public, emergency services and first responders, where other methods may be limited by signal strength, connection density and bandwidth.

These papers provide a framework and practical advice to the emergency services, public safety organizations, mobile operators, device manufacturers and Wi-Fi providers. They explain how Wi-Fi extends traditional mobile services to enhance public safety responses, while also helping mobile operators manage the signal challenges of indoor spaces, densely populated public spaces and weak or dead spots.

Crucially, the papers also demonstrate how enhanced mission critical communication services can be delivered for emergency services personnel, ensuring they are able to manage and coordinate responses through robust two-way communications in large operations such as disaster recovery and crowd control.

Advancing RF Performance - Together.

Trans-Tech

LARK ENGINEERING
RF TECHNOLOGIES

Made in the USA

sales@trans-techinc.com

Components that move the world forward.

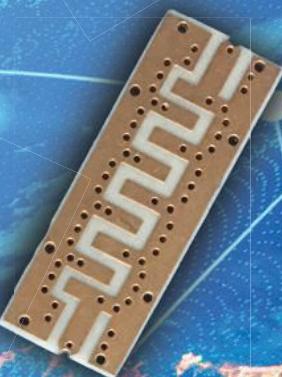
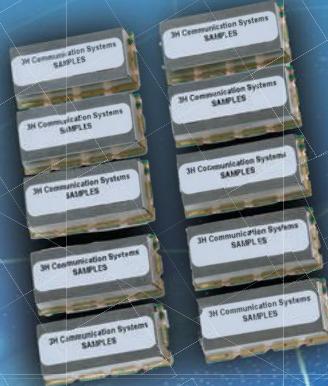
From the frontlines of defense to the backbone of communications, Trans-Tech and Lark Engineering deliver advanced ceramic and RF technologies trusted by engineers worldwide for precision, reliability, and performance.

RF Filters • Diplexers • Duplexers • Patch antenna elements
Circulators & Isolators • Inductors • Ceramic enabled devices



ENGINEERED FOR EXCELLENCE, PROVEN BY PERFORMANCE

3H Communication Systems offers RF/microwave filter solutions that are innovative, high quality, cost-effective, DC to 50 GHz, with a 5-year warranty.



LC • CERAMIC • CAVITY • PRINTED • MULTIPLEXERS •
SWITCHED FILTER BANKS • MULTI-FUNCTION ASSEMBLIES



949.529.1583 | sales@3hcomm.com
3HCommunicationSystems.com



Around the Circuit

Barbara Walsh, Multimedia Staff Editor

MERGERS & ACQUISITIONS

Keysight Technologies Inc. announced the completion of its acquisition of the **Optical Solutions Group** from **Synopsys, Inc.** and **PowerArtist** from **Ansys Inc.** These acquisitions complement and expand Keysight's design engineering software portfolio and computer-aided engineering capabilities, enabling customers to take innovative designs to market faster. The Optical Solutions Group, a developer of optical design and analysis software tools, brings intelligent, predictive optical design tools to Keysight, such as CODE V for imaging systems design, LightTools for illumination design, LucidShape for automotive lighting design, ImSym for imaging systems virtual prototyping and RSoft photonic device tools for rigorous electromagnetic simulations of photonic and optoelectronic devices.

Skyworks and **Qorvo** announced that they have entered into a definitive agreement to combine the two companies in a cash-and-stock transaction that values the combined enterprise at approximately \$22 billion to create a U.S.-based, global leader in high performance RF, analog and mixed-signal semiconductors. Under the terms of the agreement, Qorvo shareholders will receive \$32.50 in cash and 0.960 of a Skyworks common share for each Qorvo share held at the close of the transaction, which implies a combined enterprise value of approximately \$22 billion. Upon closing, Skyworks shareholders will own approximately 63 percent of the combined company, while Qorvo shareholders will own approximately 37 percent, on a fully diluted basis.

Molex announced that it has signed an agreement to acquire **Smiths Interconnect**. Smiths Interconnect, a subsidiary of U.K.-based Smiths Group plc, is a provider of high-reliability connectivity products and solutions serving the aerospace and defense, medical, semiconductor test and industrial markets. Smiths will receive cash consideration for the transaction, subject to customary adjustments for working capital, cash and debt. Smiths Interconnect designs and manufactures technically differentiated electronic components, along with microwave, optical and RF products and subsystems that connect, protect and control critical applications. Smiths Interconnect has 21 sales, R&D and manufacturing locations across 12 countries.

COLLABORATIONS

Nokia and **Rohde & Schwarz** have created and successfully tested a 6G radio receiver that uses AI technologies to overcome one of the biggest anticipated challenges of 6G network rollouts, coverage limitations inherent in 6G's higher frequency spectrum. The machine learning capabilities in the receiver greatly boost uplink distance, enhancing coverage for future 6G net-

works. This will help operators roll out 6G over their existing 5G footprints, reducing deployment costs and accelerating time to market. Nokia Bell Labs developed the receiver and validated it using 6G test equipment and methodologies from Rohde & Schwarz.

MACOM Technology Solutions Inc. announced that it has entered into an agreement with **HRL Laboratories** to license and manufacture HRL's proprietary 40 nm T3L GaN-on-SiC process technology. HRL and MACOM will work collaboratively on a rapid process transfer of this proprietary semiconductor process from HRL's facility to one of MACOM's U.S. Trusted Foundries. Under the agreement, MACOM will have an exclusive license to manufacture products based on the T3L process.

Anduril announced a partnership with **General Dynamics Land Systems (GDLS)** to bring Spark radar into military platforms and maneuver networks, starting with armored vehicles and expanding to command posts, missile launchers and fire elements. As an experienced and forward-leaning company in the design, development and production of tracked and wheeled military equipment, GDLS brings deep understanding of how modern vehicles operate and how they need to evolve. Pairing this expertise with Anduril's software-driven sensors and battle management technologies is a critical step toward enabling distributed, formation-level protection future conflicts demand.

ACHIEVEMENTS

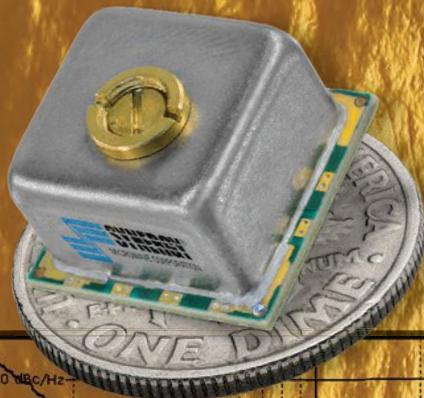
Quantic Wenzel announced its selection to deliver space-qualified 10 MHz oven-controlled crystal oscillators in support of NASA's Venus Synthetic Aperture Radar (VenSAR), an instrument designed to fly on the European Space Agency's (ESA) Envision mission. Envision will study Venus's atmosphere, surface and subsurface with unprecedented detail. The Envision mission will also investigate Venus's geological activity, atmosphere and interior structure. VenSAR, provided by NASA's Jet Propulsion Laboratory in Southern California, will provide targeted high-resolution imagery, topography, polarimetry and microwave emissivity measurements integral to deciphering the key science questions about the geological evolution and state of the surface of Venus.

Spectrum Control has achieved Cybersecurity Maturity Model Certification (CMMC) Level 2, the U.S. Department of Defense's (DOD's) advanced standard for protecting Controlled Unclassified Information (CUI). This independently verified certification demonstrates Spectrum Control's ability to safeguard sensitive defense and aerospace data in accordance with NIST SP 800-171, reaffirming Spectrum Control's commitment to the military and aerospace markets. CMMC is a framework established by the DOD to enhance the cybersecurity posture of its supply chain. It aims to ensure that defense contractors and subcontractors implement appropriate cybersecurity practices to protect sensitive information, such as CUI, from cyber threats.

For More Information

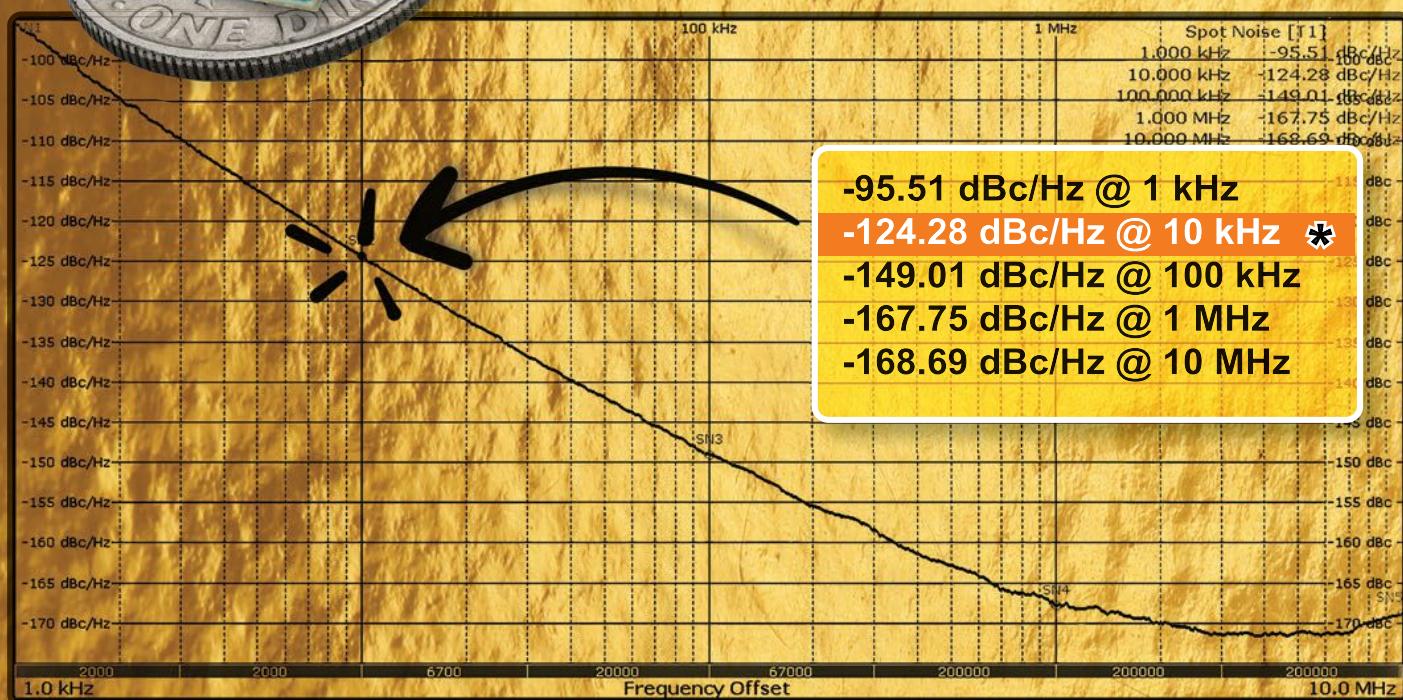
For up-to-date news briefs, visit mwjournal.com

GOLD STANDARD



GSDRO series

* Typical For 10 GHz RF Output



FEATURES:

- Exceptional Phase Noise
- Lead Free RoHS Compliant
- Patented Technology

Applications:

Radar, Test Equipment,
5G, Frequency Synthesizer

Now Up To
22 GHz!

Check out our website for available frequencies.

Talk To Us About Your Custom Requirements.



Phone: (973) 881-8800 | Fax: (973) 881-8361

E-mail: sales@synergymwave.com | Web: www.synergymwave.com

Mail: 201 McLean Boulevard, Paterson, NJ 07504



FEI-Elcom Tech

6501 Series UP/Down Converters

PRECISION. SPEED. MISSION-READY.

KEY FEATURES:

- Wide Frequency Tuning Range
6 to 18 GHz (option: 2-18 GHz)
- 1 GHz BW L-Band
- Ultra Fast Tuning
- Two/Four Phase-Matched Tuners
in 6U VPX (2 Slot Wide)
- Dual Up/Down Conversion or
Quad Down Conversion
- Independent Synthesizers
(LO's) option
- Phase Coherent Switching

APPLICATIONS:

- Electronic Warfare (ECM)
- Monopulse RADAR Receivers
- Radar Warning Receivers (RWR)
- Real-Time Spectrum Analysis (RTSA)



<https://fei-elcomtech.com/down-converters-tuners/>



Leading the Way in Precious Metal Reclamation



Refiners of gold, silver, platinum, palladium, rhodium, iridium, and ruthenium

(401) 490-4555 | www.qml.us

Around the Circuit

Teledyne e2v Semiconductors announced the successful initial qualification of its 16 GB Space DDR4 memory, marking a key milestone in the advancement of high-reliability memory solutions for space-grade applications. This 16 GB DDR4 device is part of Teledyne e2v's portfolio of radiation-tolerant memory products, which includes the 8 GB DDR4 variant qualified last year. Doubling capacity while maintaining the same form factor and pin compatibility, the 16 GB version offers seamless integration into next-generation satellite systems without requiring hardware redesign. The initial qualification confirms the long-term reliability and robustness of the 16 GB DDR4 product.

CONTRACTS

Rohde & Schwarz Australia has awarded a contract to **Sitep Australia** to equip the **Royal Australian Navy**'s first three Hunter Class frigates with its antenna technology for the Ultra High Frequency Military Satellite Communication (UHF-MILSATCOM) system. Antenna technology from Sitep will be equipped as part of the Hunter Class frigate UHF-MILSATCOM system following a contract with Rohde & Schwarz to supply their NAVICS communications technology for the first three ships of the Hunter Class Frigate Program.

Raytheon has been selected by the German government to provide the Raytheon-built SPY-6(V)1 radar for installation on eight of its F127 frigates under a requested foreign military sales contract with the U.S. Navy. The contract, which would also include comprehensive support and services to adapt the radar to the ship's design, will make Germany the first international customer for SPY-6. SPY-6(V)1 features four array faces — each equipped with 37 radar modular assemblies — providing continuous, 360-degree situational awareness. It is part of the U.S. Navy's SPY-6 family of radars that performs air and missile defense on seven classes of ships and is a giant leap in capability for the fleet.

REP APPOINTMENTS

Modelithics® welcomes **Guerrilla RF** into the Modelithics Vendor Partner (MVP) Program at the Sponsoring level. Through the MVP Program, Guerrilla RF and Modelithics are collaborating to accelerate the product development process for today's design engineers by providing world-class data along with highly accurate and scalable models.

Square Peg Communications announced a distribution agreement with **Artiza Networks**. Under the agreement, Artiza will expand the reach and availability of the Square Peg's RLS-2100 Radio Link Simulator into the Japanese market. Japanese SATCOM operators, manufacturers, integrators and chipset developers can now validate and emulate SATCOM environments in a laboratory setting. The technology enables seamless integration of satellite and terrestrial networks in the lab, eliminating the need for costly on-orbit testing. The RLS-2100 is ideal for emulating 5G non-terrestrial network and high-altitude platform station terminals, direct-to-device and hybrid communications systems.

From Ground to Deep Space

A spectrum of solutions for RF & Microwave



**Commercial off-the-shelf
rad tolerant parts**



**Complex, large format
RF/MW PCBs**



**High power microwave solutions
from L to Q-band**



**RF/MW components, modules
and integrated assemblies**



**High speed IP modems with
TRANSEC capability**



Ultra reliable switching solutions



**Microwave & high voltage
ruggedized interconnects**



mmWave and UWB Security Screening Systems

Patrick Hindle

Microwave Journal, Norwood, Mass.

mmWave imaging has emerged over the last decade as one of the primary non-ionizing technologies for screening people at airports, transit hubs, stadiums and other high-throughput checkpoints. Unlike X-ray backscatter or traditional metal detectors, mmWave systems illuminate the subject with very low-power electromagnetic (EM) waves. These systems can detect metallic and non-metallic objects (plastics, ceramics, powders, liquids) that are worn on or concealed beneath clothing, and depending on design, can operate either as a static portal (stand-still scan) or as a walk-through (people keep moving) for a high-throughput solution.

The full-body scanner market is undergoing significant growth. In 2023, the global full-body scanner market (all technologies) was valued at approximately \$179 million, with projected CAGR of approximately 16 percent to 2030.¹ Focusing on mmWave specifically, one market forecast anticipates growth from approximately \$450 million in 2023 to \$787 million in 2030 (CAGR around 8.3 percent),² while others suggest an overall scanner market reaching half a billion dollars by the late 2020s.³ Relative growth is strongest in Asia-Pacific and emerging economies, where airport expansion, infrastructure investment and rising security budgets create demand for modern screening systems. Meanwhile, North America and Europe continue to drive adoption in retrofit and new-terminal projects.

As scan speed and image resolution have improved over the years, mmWave security scanning systems have become the leading technology for airport security systems and

are replacing X-ray systems in many airports. Newer walk-through systems now offer high-throughput solutions for airports and other venues, along with convenience for the people being scanned. To protect the privacy and comfort of the people being scanned and ensure a stress-free working environment for security staff, the new scanners take advantage of advanced AI and machine learning (ML) techniques to avoid displaying actual body images and speed up the scanning process.

WHY UWB OR MMWAVE?

In choosing the best wavelength, there is a trade-off between penetration and spatial resolution. A spatial resolution of about 2 mm is considered adequate for security applications, so E-Band (60 to 90 GHz) provides reliable object detection and adequate penetration to reach the surface of the skin according to Rohde & Schwarz,⁴ although some companies are using ultra-wideband (UWB) frequencies in the 3.1 to 10.6 GHz range. These systems use wavelengths short enough to provide useful spatial resolution for detecting objects on the body, but are non-ionizing (they do not remove electrons or cause DNA damage like X-rays), so they are safer than X-ray systems to use for security scanning. They are also better than metal detectors since they detect non-metallic objects and liquids. Companies design systems to regulatory exposure limits (ICNIRP, IEEE standards) and typically operate at very low power levels. The scientific literature and regulatory overviews show that properly certified mmWave screening devices operate within accepted safety margins for public use.⁵

AI AND ML

Modern screening systems rely heavily on AI and ML to automate threat detection, reduce false positives and simplify operator workflows. Rather than showing raw body images, algorithms generate symbolic avatars or generic outlines highlighting zones of interest. Raw imagery is typically deleted or overwritten within seconds to protect privacy. High-performing systems aim to detect very small objects (e.g., thin plastic cards, powders) while maintaining acceptable false alarm rates, while adversarial robustness (i.e., resistance to attempts to fool the system via small perturbations) is a growing concern in algorithm design. These systems generate a large amount of data, so AI and ML are needed to analyze and properly interpret the data for object detection.

COMMERCIAL SURVEY

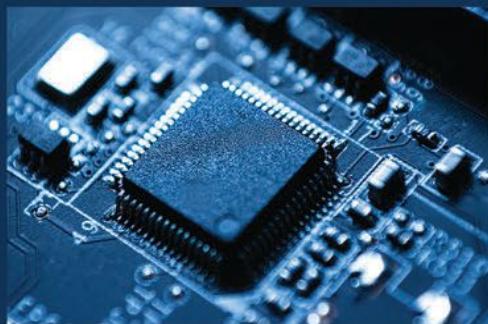
Several companies in the industry are designing and supplying these systems to airports and other venues for security scanning, including Rohde & Schwarz, Leidos, Liberty Defense, InsTech Netherlands, Vayyar Imaging and Evolv. The following is a summary of the various systems and their key features.

Rohde & Schwarz — QPS Product Family

Rohde & Schwarz (R&S) offers the QPS family of mmWave personnel scanners, including static portal devices such as the QPS201, shown in **Figure 1**, and walk-through configurations (e.g., WALK2000) intended for airports, critical infrastructure and enterprise screening. The QPS line emphasizes very high-resolution imaging, multistatic arrays and

Leaders in High-fidelity Signal Solutions

Maury Microwave has a comprehensive portfolio of high-integrity signal solutions that drives innovation from concept to field operation. Noise sources, signal generators, synthesizers, and modules provide advanced, flexible signal generation, from low phase noise to wide bandwidth. Solid-state amplifiers deliver broadband, high-power performance with excellent linearity, while StabilityPlus™ cables maintain amplitude and phase stability with flexure. Together, these solutions deliver the highest signal fidelity to empower the future of connectivity.



From R&D...



SGX1000 RF Signal Generators, UFX Programmable Noise Generators and MPA Series Amplifiers

...Through Manufacturing...



HS, HSX, and HSY Series Ultra Low Phase Noise Multi-channel RF Synthesizers

...To Deployment...



HSM Series RF Synthesizer Modules and Interconnects



...And Maintenance



4500C Power Measurement Analyzer and RTP4000 and RTP5000 USB Peak Power Sensors

Learn More at
maurymw.com





▲ Fig. 1 R&S QPS201 mmWave security scanner.

millisecond-class acquisition times.⁶ R&S systems have been widely deployed in Europe and were certified by the FAA a couple of years ago so are being deployed in some U.S. airports.⁷ R&S has demonstrated a true walk-through concept for the future, where passengers walk down a hallway with sensors in the wall that scan them as they progress to their gate. There is no waiting in lines as it is part of the building, and anyone flagged is just stopped as they exit the hallway area.

Key specifications:

- Frequency range: 70 to 80 GHz
- Transmit power: approximately 1 mW
- Throughput: 750 to 900 people per hour
- Multistatic operation with thousands of transmitter and receiver antennas per panel (synthesized aperture)
- Data acquisition time: approximately 24 ms per panel (fast capture), enabling rapid screening
- Privacy modes: symbolic/gender-neutral avatar alerts (no photographic images stored/displayed).

Pros:

- High spatial resolution and short acquisition times — suitable for detailed localization of small threats
- Material-agnostic detection (can detect metals, plastics, ceramics and liquids) because mmWave senses EM contrast and scattering rather than electrical conductivity alone
- Regulatory compliance and certification for aviation screening and explicit attention to privacy and operator ergonomics.

Leidos — Pro:Vision Family

Leidos (which acquired the L3Harris security detection business) produces the Pro:Vision line (see **Figure 2**), a mmWave people scanner widely used in aviation and critical infrastructure. The Pro:Vision 3 is the



▲ Fig. 2 Leidos Pro:Vision mmWave security scanner.

current generation, using wideband mmWave antennas and deep learning algorithms for faster decisions and lower false alarm rates.⁸

Key specifications:

- Frequency range: 20 to 40 GHz
- Throughput: Pro:Vision 3 is specified to achieve > 400 people per hour in optimized operational modes
- Scan/decision time: Several implementations report around 4 seconds per passenger
- Wideband mmWave operation and AI/deep learning classification to reduce false positives; ECAC EU Standard 2.1 certification has been achieved.

Pros:

- Field-proven deployments and certifications (the Pro:Vision family is widely deployed and has relevant aviation certifications)
- Balanced throughput and resolution — designed for airport checkpoints where passenger flow and low false alarms are critical.

Liberty Defense — HEXWAVE Walk-Through Portal

Liberty Defense's HEXWAVE, as shown in **Figure 3**, is a walk-through people-screening system that explicitly combines mmWave radar, 3D video rate imaging and AI to deliver touchless detection of metallic and non-metallic threats. The company positions HEXWAVE as a high-throughput, flexible and mobile solution for airports and other venues. It uses technology developed at MIT Lincoln Labs, and the TSA started deploying their systems in 2024.⁹



▲ Fig. 3 Liberty Defense's HEXWAVE security scanner.

The system operates in the UWB frequency range, so it is the only one covered that is not a true mmWave system.

Key specifications:

- Frequency range: 6 to 10.6 GHz
- Throughput: over 700 people per hour
- Detection scope: detection of metallic/non-metallic threats, including 3D-printed/ghost guns, ceramic knives, IEDs, powders, liquids.

Pros:

- True walk-through portal with high advertised throughput and low friction — no divestiture of personal items and minimal behavior change by passengers
- Designed for modular deployment (mobile, fixed, indoor/outdoor) and over-the-air AI updates to address evolving threats.

InsTech Netherlands — NUCTECH FMW1000AA

InsTech Netherlands uses mmWave technology to detect concealed objects inside or under clothing, including but not limited to metal/non-metallic weapons, IEDs, liquids, narcotics, etc. Their NUCTECH FMW1000AA system (see **Figure 4**) uses a wide bandwidth, 3D ho



▲ Fig. 4 InsTech Netherlands NUCTECH FMW1000AA mmWave security scanner.



Achieve Complete Spectral Dominance.

Precision Multi-Channel Receiver for Complex RF Environments.

The new PCR4200 from Signal Hound is a versatile, multi-channel receiver built for demanding defense and intelligence applications. With four phase-coherent channels, ultra-low phase noise, and a 110 dB dynamic range, it delivers exceptional accuracy, and flexibility. Each channel can share a high-performance LO for coherence or operate independently, with sweep speeds up to 200 GHz/s. A built-in VSG, GPS, and calibrated I/Q data simplify system alignment, synchronization, and deployment.

Signal Hound®

SignalHound.com

Made in the USA



© 2025 Signal Hound. All rights reserved.

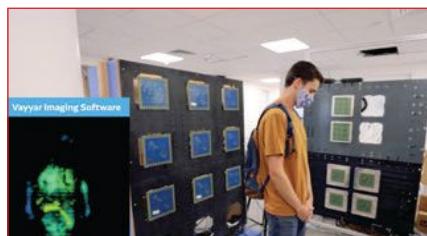
Special Report

lographic microwave imaging technique with neural network-based deep learning to achieve automatic threat recognition.¹⁰

- Scan time: 2 seconds
 - Throughput: over 400 people per hour
 - Compact system with privacy protection.
- Pros:**
- Small footprint
 - Wide channel to allow wheelchair access.

Vayyar Imaging — ECS1000 Wall Scanner

Vayyar's mmWave technology now powers a scanning solution that enables a wide range of security applications. Their high-resolution 4D imaging-radar-on-chip solutions detect small, concealed objects made of various materials, including metal, ceramic and glass, as well as 3D printed weapons.¹¹ Security personnel can now perform rapid, nonintrusive searches, enabled by advanced ML engines trained to identify suspicious objects of all shapes and dimensions.



▲ Fig. 5 Vayyar Imaging ECS1000 wall scanners with scan image.

The ECS1000 wall scanner houses multiple RF boards with thousands of transceivers, as shown in *Figure 5*. The compact, portable scanner is built around a single RF board, housing hundreds of transceivers. The receivers record high-resolution 3D reflections, which are processed by Vayyar's software to create granular imaging that includes both intensity and phase data. ML software determines if any controlled objects are present, in which case the security operator is notified about their location and can take further action. It appears the company is just supplying boards or hand scanners at this point that can be made into a full system.



▲ Fig. 6 Evolv's security scanner in use at an event.

Evolv Technology — Express / Edge / eXpedite

Evolv is widely included in the modern screening marketplace, but Evolv's flagship Express and Edge products, as demonstrated in *Figure 6*, are not mmWave radar imagers in the sense of the portal scanners mentioned previously. Evolv systems use advanced sensor arrays and sensor fusion with AI using extremely low frequency (1 to 300 Hz) radio sensing, proprietary sensor arrays and AI models to detect concealed threats while supporting very high-throughput.¹² Evolv's systems oc-



Is Your Project Caught in the “Cost-Quality-Schedule” Triangle?

ANOISON ADDRESSES THE COMMON PROJECT MANAGEMENT CHALLENGE BY OFFERING:

QUALITY

- MEETS OR EXCEEDS YOUR PERFORMANCE REQUIREMENTS
- SPECIAL DESIGNS FOR YOUR UNIQUE NEEDS
- PRECISION GRADE MMWAVE COMPONENTS

COST:

- PRICES THAT WON'T BREAK THE BANK

SCHEDULE

- QUICK TURNS FOR UNIQUE DESIGNS
- SHORT LEAD TIMES AND TIMELY DELIVERY



When you cannot afford compromise....

Anoison Achieves where others can only Try!

Anoison Electronics, LLC
www.anoison.com
800.537.0680
512.607.6667

VISIT US AT IMS 2026 IN BOSTON BOOTH 21057

CLICK ON QR CODE TO VISIT OUR WEBSITE



Enabling Reliable Wireless Connectivity for AI-Driven Robotics

Ensuring Multi-Radio Coexistence for Edge Robotics

AI-enabled robots operate as Edge systems, combining embedded intelligence with continuous wireless connectivity to external networks or cloud-based AI. Their communication subsystems must maintain ultra-low latency and high reliability while multiple radios function simultaneously — a key challenge for ensuring stable and predictable performance...

With MVG's Latest Multi-Probe Near-Field Measurement Technology

StarLab and SG Evo deliver the precision and speed needed to assess antenna behavior and validate multi-radio coexistence (MRC). Built for intelligent and connected robotic platforms, these systems perform accurate OTA and antenna performance testing across the full range of wireless communication bands.

• StarLab

Compact and scalable platform for rapid, accurate antenna characterization of intelligent and connected Edge devices.



- Antenna and OTA Measurement
- Configurable frequency range: 650 MHz – 50 GHz
- Unlimited sampling for high-res measurements
- 5G FR1/FR2/FR3 and early 6G

• SG Evo

High-precision near-field system designed for large, heavy, or complex robotic platforms.

- Antenna and OTA Measurement
- Precision arch mechanism minimizing gravitational deflection
- Custom mechanical interfaces and scan configurations
- Frequency coverage from 400 MHz to 50 GHz



Special Report

cup a different part of the technology/design space but are used in the same applications as mmWave and UWB scanners. Evolv is a spin-off from Intellectual Ventures that developed metamaterials technology that is used by companies including Kymeta, Echodyne, Pivotal Commwave and Evolv.

SUMMARY

mmWave security scanning systems are now a leading technology for high-throughput security scanning systems in airports, transit hubs, stadiums and other checkpoints, as they can detect hidden metallic and non-metallic objects, have fast scanning speeds and offer safety and privacy for people being scanned. They are safer than X-ray systems and can detect non-metallic objects that metal detectors cannot. With newer walk-through systems, they promise convenience for both the staff and the people being scanned. New AI and ML techniques have improved detection accuracy and privacy in these systems, making them the best alternative to meet today's security needs in airports and venues. While these systems still face some challenges, such as false alarms, human-body complexity, calibration drift, deployment cost and adversarial threat evolution, the coming decade will likely bring innovations in snapshot imaging, compressive sensing, algorithmic robustness, meta-surface integration, portability and fusion of multiple sensor modalities that will overcome them. ■

References:

1. "Full-body Scanner Market (2024 - 2030)," Grand View Research, Web: <https://www.grandviewresearch.com/industry-analysis/full-body-scanner-market-report>.
2. "Millimeter Wave Body Scanner Market," Persistence Market Research, November 2023, Web: <https://www.persistencemarketresearch.com/market-research/millimeter-wave-body-scanner-market.asp?>.
3. "Millimeter Wave Body Scanners Decade Long Trends, Analysis and Forecast 2025-2034," Data Insights Market, June 2025, Web: <https://www.datainsightsmarket.com/reports/millimeter-wave-body-scanners-668033>.
4. S. Ahmed and A. Schiessl, "mmWave Technology Enables Faster, Safer, Privacy-Conscious Travel," *Microwave Journal*, September 2019.
5. P. Mehta and R. Smith-Bindman, "Airport Full-body Screening: What is the Risk?" *Arch Intern Med.* 2011 June 27;171(12):1112-5. doi: 10.1001/archinternmed.2011.105. Epub 2011 Mar 28. PMID: 21444831; PMCID: PMC3936792.
6. QPS201 Security Scanner, Rohde & Schwarz, Web: https://www.rohde-schwarz.com/us/products/aerospace-defense-security/security-scanner/qps201-security-scanner_63493-332676.html.
7. "Rohde & Schwarz Receives TSA Award to Supply AIT to U.S. Airport Security Screening Checkpoints," *Microwave Journal*, December 12, 2023, Web: <https://www.microwavejournal.com/articles/41231-rohde-schwarz-receives-tsa-award-to-supply-ait-to-us-airport-security-screening-checkpoints>.
8. Pro:Vision, Leidos, Web: <https://www.leidos.com/markets/aviation/security-detection/aviation-checkpoint/people-screening>.
9. A. Tantillo, "Walkthrough Screening System Enhances Security at Airports Nationwide," *Lincoln Laboratory*, July 1, 2025, Web: <https://www.ll.mit.edu/news/walkthrough-screening-system-enhances-security-airports-nationwide>.
10. NUCTECH FMW1000AA, InsTech Netherlands, Web: <https://instechnl.com/products/nuctech-mw1000aa-millimeter-wave-human-body-inspection-system>.
11. Public Safety, Vayyar, Web: <https://vayyar.com/public-safety/>.
12. Evolv Express, Evolv, Web: <https://evolv.com/concealed-weapons-detection/express/>.

GaN GaN RF Device and PA

MMIC&SIP&Module

Si Beamforming Chip

RF FEM Chip

4D Radar

Phased-Array

Cold-Atom

GaAs/GaN MMIC

GaN Device

RF FEM

Infiwave

INFINITE INNOVATING BEYOND WAVES

Infiwave www.infiwave.com [+86-400-998-9038](tel:+86-400-998-9038) sales@infiwave.com

High Density Without Compromise!



- **Test & Measurement**
- **Broadcast**
- **Medical**

[Learn More](#)



High Density Enhances Efficiency with Improved Performance

Step into the next generation of RF performance and high density with the new PX and PRX connector families. Designed as a superior alternative to traditional coax connectors or as an upgrade for existing multi-pin solutions, these advanced connectors offer exceptional performance and scalability, available in configurations ranging from 13 to 53 pins.

Impedance	Frequency	Housing Contact #	Contact Size	Cable Types
50 Ohm	100 MHz to 67 GHz	13, 26, 28, 53	16	RG-178, 316, 405, M17/151(.047")
75 Ohm	100 MHz to 18 GHz	13, 23, 48	12	RG-179, SS75086



Leading Blindmate Microwave Contact Technology

Advanced Testing of Next-Generation DRFM Jammers

Yassen Mikhailov
Rohde & Schwarz, Munich, Germany

THE ROLE OF DRFM IN MODERN ELECTRONIC WARFARE

In the evolving landscape of electronic warfare (EW), digital radio frequency memory (DRFM) systems have emerged as indispensable tools for deception, spoofing and jamming. DRFMs operate by digitizing incoming RF signals, storing them and retransmitting them with precise control over delay, phase and frequency. This process allows DRFMs to effectively manipulate an adversary's radar through techniques such as false target generation, range gate pull-off, velocity deception and coherent spoofing.

As radar systems become more agile, employing frequency-hopping, pulse compression and complex modulation schemes, the demands on DRFM fidelity and timing precision increase significantly. Testing such systems requires instruments that can match or exceed the signal dynamics of modern radars, such as Rohde & Schwarz's FSWX.

The FSWX is a high-performance, multi-channel signal and spectrum analyzer designed for demanding applications, including DRFM testing. It provides synchronized, phase-coherent measurement capabilities, enabling engineers to simultaneously analyze the input and output of a DRFM system. FSWX has an analysis bandwidth of up to 8 GHz in single-channel mode, and 4 GHz per channel in dual-channel mode. The multi-channel architecture is crucial, facilitating timing

alignment and phase coherence assessment, both critical metrics for evaluating deception effectiveness.

KEY DRFM TESTING PARAMETERS

When thoroughly testing a DRFM, several characteristics are paramount. Test instruments and the accompanying software must provide the tools to accurately assess each of these:

- **Amplitude fidelity:** Ensuring the retransmitted signal accurately matches the amplitude of the original. Test instruments must have a high dynamic range and accurate power measurements to enable comparisons with high accuracy. This is vital for preventing the deception from being easily identified by the target radar.
- **Phase-coherence:** Detecting subtle phase shifts that could betray the deception. Instrumentation must provide precise phase measurements and identify even minute discrepancies. Maintaining phase-coherence is essential for convincing deception scenarios.
- **Time delay:** Measuring the latency introduced by the DRFM. Precise delay measurements are essential for accurate deception timing, particularly in range gate pull-off (RGPO) and Doppler deception.
- **Spectral integrity:** Evaluating spurious emissions, harmonics and spectral regrowth. Test instruments must provide detailed

spectral analysis, ensuring the retransmitted signal does not reveal the presence of a jammer through unwanted emissions.

- **Group delay:** Analyzing signal delay across frequency, particularly important for compatibility with chirped radar signals. Instrumentation should ensure accurate replication of chirped waveforms.
- **Modulation quality:** Assessing error vector magnitude (EVM) and I/Q imbalance in modulated signal playback. Signal and spectrum analyzers must be combined with appropriate digital demodulation options to verify the integrity of complex radar signals.
- **Spur and intermodulation characterization:** Evaluating the signal purity of the DRFM under multi-tone or modulated excitation. Test instruments must provide identification and quantification of the smallest spurious signals and intermodulation products, indicating potential weaknesses in the DRFM's design.

These capabilities provide a comprehensive view of DRFM behavior, from initial signal reception to final retransmission, ensuring its effectiveness and adherence to performance specifications. The related test solutions would enable engineers to move beyond simple pass/fail criteria to a deep understanding of the DRFM's strengths and weaknesses. Rohde & Schwarz's FSWX spectrum and signal analyzer

SMASHING

Performance BARRIERS



When Every Milliwatt Counts

Introducing the first six models in a groundbreaking new family of ultra-low DC power, low noise amplifiers, redefining performance across 6 to 40 GHz. Consuming 18 to 50 mW from a single supply, these amplifiers deliver exceptional efficiency, making them the ultimate solution for next-generation phased-array, SATCOM, and other low-DC power systems. Housed in a compact 3 mm QFN package and requiring only a minimal application circuit, this LNA family is engineered for seamless integration into even the most space-constrained designs. And with noise figures as low as 1.4 dB and gain up to 29 dB, they set a new benchmark for wideband coverage, cutting-edge efficiency, and design simplicity.

- Noise figure as low as 1.4 dB
- 18-50 mW DC power
- Gain up to 29 dB



Global Distribution Partner
Contact: sales@rfmw.com



The Trusted Leader When Performance Matters
www.markimicrowave.com

Technical Feature

meets these testing capabilities and incorporates a preselection stage to suppress out-of-band interferers.

LEVERAGING SOFTWARE FOR ADVANCED DRFM TESTING

The core capabilities of signal and spectrum analyzers are further enhanced by dedicated software options, enabling in-depth analysis of specific DRFM functions.

Mastering Radar Pulse Deception

Pulse analysis software, such as the KM700 from Rohde & Schwarz, can transform signal and spectrum analyzers into powerful pulsed signal analyzers, vital for evaluating deceptive techniques relying on pulse manipulation. For example, KM700 delivers:

- **Precise pulse parameter measurements:** Accurate determination of pulse width, amplitude, rise/fall times, pulse repetition interval (PRI), duty cycle, pulse shape and overshoot. These measurements are foundational for verifying the accurate replica-
- **Advanced pulse train analysis:** Examination of pulse repetition frequency (PRF) spectrums, PRI histograms and pulse-to-pulse variations to verify accurate replication of radar pulse sequences and deceptive maneuvers. Analyzing these patterns reveals the DRFM's ability to convincingly mimic complex radar behaviors.
- **Pulse modulation analysis:** Support for chirp pulse, pulse width modulation (PWM), pulse position modulation (PPM) and phase modulation analysis, ensuring the DRFM accurately handles complex radar waveforms.
- **Advanced triggering:** Flexible triggering options based on amplitude, width, PRI and patterns, allowing for focused analysis of specific signals and events within a pulse train.
- **Statistical analysis:** Providing insights into the consistency and repeatability of DRFM performance across multiple pulses, essential for assessing the reliability

The LBSF09A compact thermally stable power meter

To 75 GHz

- Smallest traceable power sensor in the world
- 1MHz to 9GHz
- ATE Friendly, plus software package
- USBTMC USB HID Optional SPI/I2C



LadyBug Technologies, Boise, ID, USA
Leaders in RF & Microwave Power Measurement

tion of radar pulse characteristics.

of the deception. An example of pulse analysis is shown in **Figure 1**.

- **Segmented capture:** Capturing and analyzing long-duration radar signals by dividing them into triggered segments, crucial for complex scenarios and intermittent signals. This feature improves efficiency when analyzing prolonged radar engagements.

SEGMENTED CAPTURE FOR LONG-DURATION TESTING

Software additions can support segmented capture, enabling the analysis of long-duration radar signals by dividing them into individually triggered, time-aligned segments. This functionality is useful in scenarios where radar emissions occur intermittently or when multiple pulse types must be captured across extended periods.

Segmented capture can enable:

- **Extended radar scenario coverage:** Analyze radar scan patterns or time-varying deception signals.
- **Statistical pulse analysis over time:** Capture and analyze pulse characteristics across numerous segments.
- **Efficient handling of burst radars:** Reduce memory consumption by focusing only on signal-rich intervals.
- **Detection of rare pulse anomalies:** Identify timing irregularities or modulation errors.

By leveraging segmented triggering modes, such as pulse, amplitude or frequency conditions, engineers can perform precise, event-based data acquisition over durations that are not possible with continuous recording methods.

To further support comprehensive radar testing, the FSWX supports segmented capture, enabling analysis of long-duration signals by breaking them into individually triggered, time-aligned segments. With event-based triggering such as pulse detection, amplitude threshold or frequency shift, it captures only meaningful data, improving memory efficiency and analysis focus.

Bradford RF Sales

Established in 2006 | www.bradfordrfsales.com



Proudly Serving New England for 20 Years

At Bradford RF Sales, our motto has always been:
“Selling is About Helping People.”

We look forward to 2026, as we celebrate twenty years
of helping our New England customers and our great suppliers.



Signed with us in 2025

Manufacturers' Representatives for New England
58 Beechwood Drive North Andover, MA 01845
www.bradfordrfsales.com

**Microwave, RF, and Electronic Products
for Military & Commercial Applications**

Technical Feature



▲ Fig. 1 Example of deceptive technique analysis with VSE-K6 pulse analysis.

TRANSIENT PULSE ANALYSIS: CAPTURING INTERMITTENT EVENTS

Providing both general multi-domain (AM/FM/PM) and spectrogram-based signals, as well as frequency modulated continuous wave (FMCW) demodulation analysis, allows characterization of the capture/replay behavior of the deceptive jammer, as demonstrated in **Figure 2**. This is crucial for identifying switching transients, spurious artifacts or the fidelity of the replayed scenario introduced during deceptive maneuvers. The FSWX provides these analyses, including these key enabling capabilities:

- **Advanced triggering and gating:** Pre/post trigger capture and gated analysis allows the isolation of the exact transient of interest (e.g., on-off transitions, memory over-

write events), including amplitude, width, slope and window for capturing specific events, including those with unpredictable timing.

- **Time-domain visualization:** Features waterfall displays and zoom/pan tools for detailed inspection of transient waveforms, enabling visual identification of subtle anomalies, such as spurious components at switching instants, spectral regrowth, sidebands and other transient events.
- **Chirp or hopping measurements:** Has a complete capture sequence as well as accurate analysis of one-shot signals, including chirp rate, chirp bandwidth, hop count, hop frequencies and many other parameters providing critical information about transient events of the deceptive maneuver.



▲ Fig. 2 Example of pulse modulation analysis with K710 transient analysis.

PRACTICAL APPS: VALIDATING DECEPTIVE TECHNIQUES

In addition to the basic DRFM testing parameters, specific scenarios require a particular set of capabilities. For example, RGPO validation requires users to precisely measure the PRI shift induced by the DRFM and verify its accuracy. Simultaneously, users monitor any transient signals generated during the PRI shift, indicating potential vulnerabilities. They must ensure the phase relationship between the original and retransmitted signals remains consistent throughout the maneuver. Another scenario to consider is velocity deception validation. Users must analyze the Doppler shift introduced by the DRFM, comparing it to the expected value based on the desired velocity deception. They must also verify that

Space & Mil-Qualified Components to 50 GHz

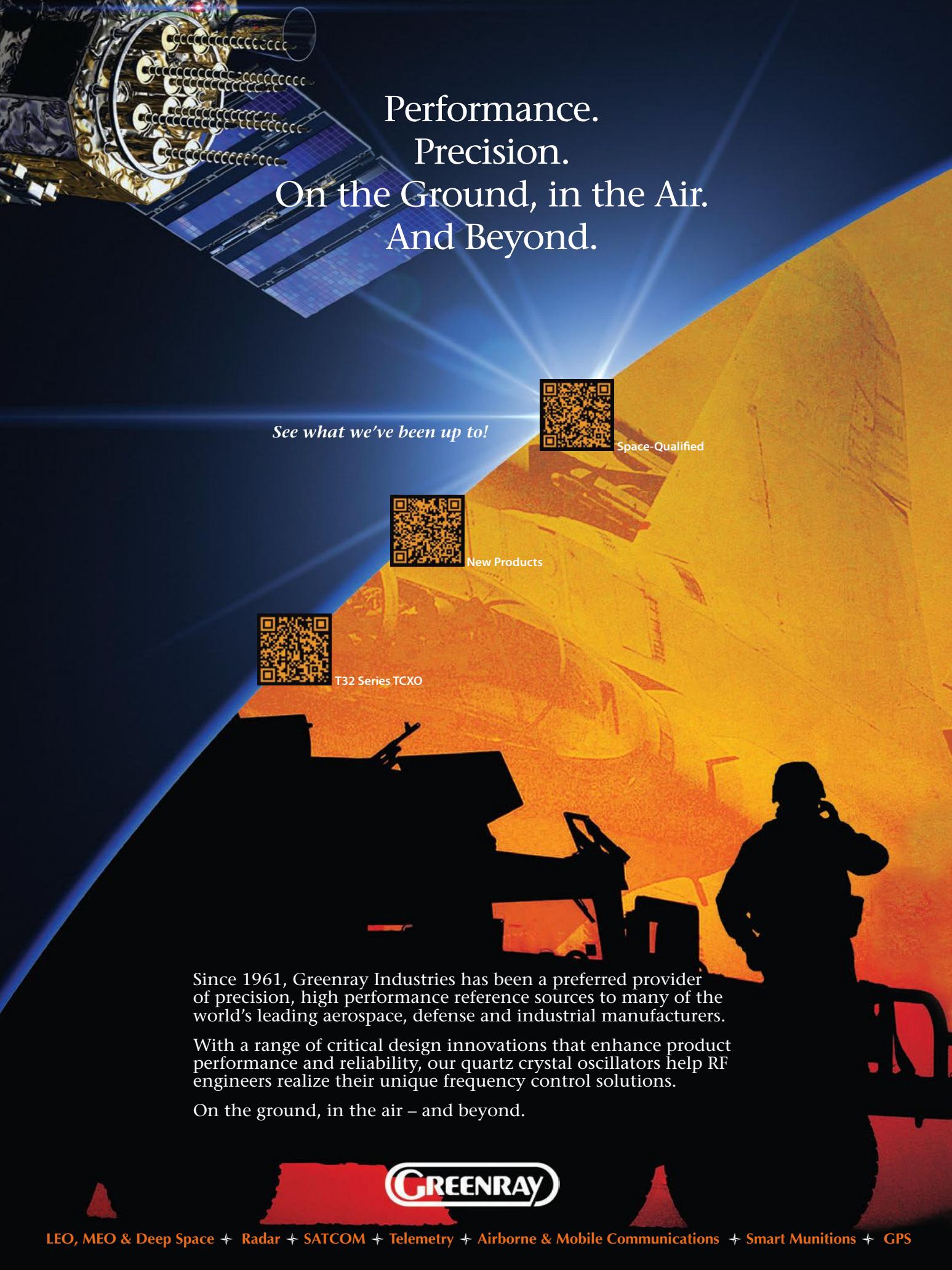
- Attenuators
- Terminations
- Dividers
- DC Blocks
- Tuners
- High Performance Designs
- Power Handling to Design Specs
- Frequency Range: DC to 50 GHz

We Are Weinschel Since 1988

WEINSCHEL ASSOCIATES
BROADBAND RF & MICROWAVE SOLUTIONS

2505 Back Acre Circle, Mount Airy, MD 21771 • 301.963.4630 • sales@WeinschelAssociates.com

www.WeinschelAssociates.com



Performance. Precision. On the Ground, in the Air. And Beyond.

See what we've been up to!



Space-Qualified



New Products



T32 Series TCXO

Since 1961, Greenray Industries has been a preferred provider of precision, high performance reference sources to many of the world's leading aerospace, defense and industrial manufacturers.

With a range of critical design innovations that enhance product performance and reliability, our quartz crystal oscillators help RF engineers realize their unique frequency control solutions.

On the ground, in the air – and beyond.



Technical Feature

the phase-coherence is maintained throughout the velocity deception, preventing the radar from detecting inconsistencies. Users can perform extended offline analysis using the captured data. An additional scenario is false target generation validation, where users must compare the amplitude, pulse shape, modulation and timing characteristics of the generated false target with those of a real target. They can evaluate

the effectiveness of the deception by assessing how convincingly the false target replicates the characteristics of a genuine threat. Finally, a challenging scenario is coherent spoofing analysis, where users verify the phase-coherence between the original and retransmitted signals over extended periods. Even minute phase deviations can reveal deception, so users should watch for performance degradation over time.

ADVANCED ANALYSIS & CHARACTERIZATION

Signal and spectrum analyzers, including the FSWX, verify that a DRFM can perform a deceptive technique and enable detailed characterization of its performance limits. This includes latency analysis, spectral purity analysis, modulation analysis and occupied bandwidth analysis (OBA). Latency is one of the most critical performance evaluations in DRFM testing. It directly determines how accurately and effectively a DRFM can deceive the victim radar. Precisely measuring the delay introduced by the DRFM at various frequencies and signal levels identifies potential bottlenecks and helps optimize the system for minimal delay. Delays can be caused by A/D and D/A conversion time, digital memory storage and processing, reconstruction and propagation delay through the RF front-end. In a radar and DRFM context, unwanted components such as spurs, harmonics, phase noise, intermodulation products and jitter show that a signal has been improperly reconstructed. Identifying and quantifying spurious emissions and intermodulation products generated by the DRFM minimizes the risk of detection and compromising the jammer. Maintaining the same spectrum content as the radar signal is paramount in ensuring a successful deception campaign. A modern radar waveform is rarely just a simple pulse. It often carries complex modulation, such as linear frequency modulation (chirp or FMCW) and inter-pulse coding with phase-coded sequences (e.g., Barker or polyphase codes). When a DRFM receives and retransmits such signals, it must preserve both the time-domain and modulation fidelity. Any error in modulation reproduction, such as frequency slope distortion in a chirp or phase discontinuities in a coded pulse, can make the spoofed signal look artificial to a radar receiver, rendering the deception ineffective. Evaluating the accuracy of the DRFM's modulation reproduction ensures that the retransmitted signals maintain the integrity of the original radar waveforms. FSWX supports I/Q analysis with image suppression for improved spectral clarity,



**Trusted Solutions
Agile Development
On-time Delivery**

Peak Performance in Every Environment

For aerospace & defense:

X-Band Coaxial Circulator

The 3A8BT-1 (8.0–12.0 GHz, 400W Peak, 100W CW) is a full X-band coaxial circulator designed to meet the demanding requirements of aerospace and defense applications.

This component boasts high operational performance across a broad temperature range (-40°C to +80°C) and in high-power applications. It can also be customized to meet specific requirements.



For airborne radar:

X-Band Waveguide Circulator

The 3WR90-4 is an X-band waveguide (WR-90) circulator engineered for 1kW peak performance at 45,000 feet.

Designed for 9345 MHz, it is purpose-built to maintain signal integrity in demanding environments, making it ideal for airborne radar. It can also be customized for other challenging X-band applications.



Get the edge in
your RF designs:

www.aeminc.com/rec-dec-2025

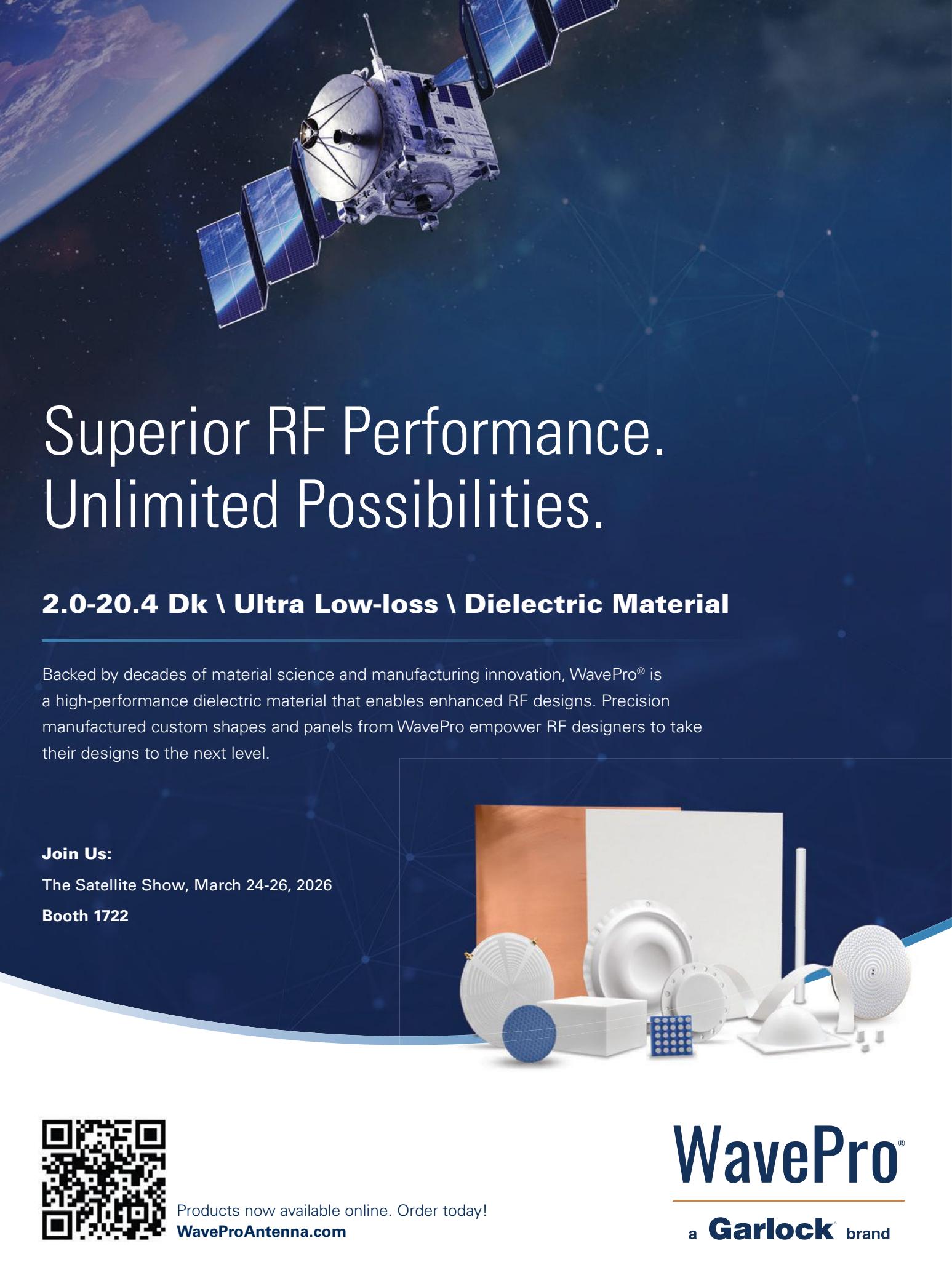


www.aeminc.com

Innovation to Power Your Vision

978-772-7774





Superior RF Performance. Unlimited Possibilities.

2.0-20.4 Dk \ Ultra Low-loss \ Dielectric Material

Backed by decades of material science and manufacturing innovation, WavePro® is a high-performance dielectric material that enables enhanced RF designs. Precision manufactured custom shapes and panels from WavePro empower RF designers to take their designs to the next level.

Join Us:

The Satellite Show, March 24-26, 2026

Booth 1722

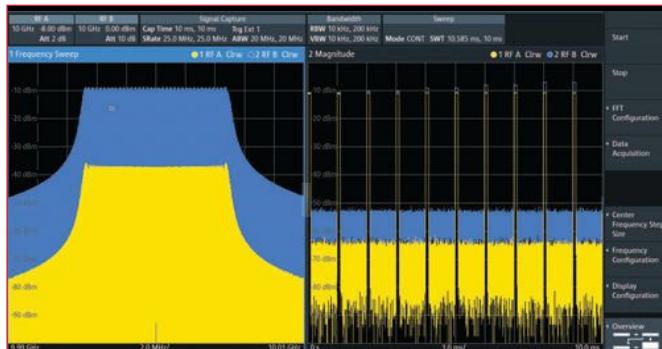


Products now available online. Order today!
WaveProAntenna.com

WavePro®

a **Garlock**® brand

Technical Feature



▲ Fig. 3 Example of IQ capture spectrum with FSWX.

as demonstrated in **Figure 3**. The OBW test ensures that the DRFM output stays within the defined bandwidth limits and does not generate out-of-band emissions that could reveal a spoofing attempt. The OBA measurement ensures that



▲ Fig. 4 Rohde & Schwarz's FSWX product.

the retransmitted (spoofed) signal maintains the same spectral content, both frequency content and power distribution, as the incoming radar signal. A wider than expected OBW could be an indication of spectral regrowth or unwanted modulation artifacts, as an example. At the same time, a narrower OBW could indicate loss of detail or filtering effects that might make the victim radar lose fidelity in the spoofing signal.

Why Risk It?

In space, there are no second chances. A single **commercial-grade resistor** could mean mission failure—susceptible to **radiation damage, temperature extremes, and outgassing**.

Would you trust a component that wasn't built for the vacuum of space?

Space missions demand **precision, resilience, and absolute reliability**. Only **space-qualified resistors** are engineered to withstand the **extreme conditions of space** without compromising performance.

Don't gamble with your mission. Choose resistors that meet **MIL-Spec, NASA, and ESA standards** to ensure success beyond Earth's atmosphere.

Why Risk It?
Use components designed for the final frontier.



State of the Art, Inc.
RESISTIVE PRODUCTS
www.resistor.com



2470 Fox Hill Road, State College, PA 16803-1797
Phone: 800-458-3401 or 814-355-8004 • Fax: 814-355-2714
E-mail: sales@resistor.com • Source code: 56235

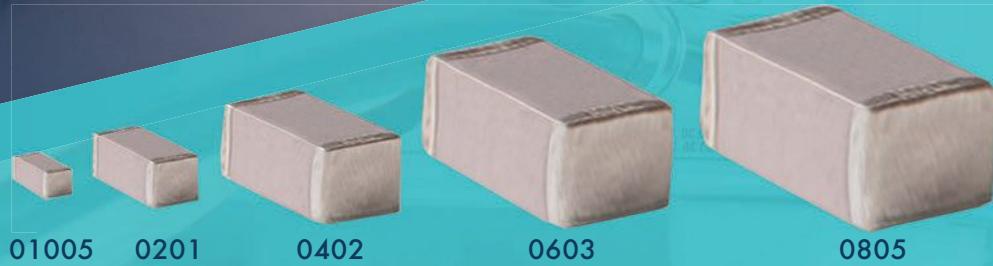
QUALIFICATIONS ISO9001 & AS9100 • MIL-PRF-55342 • MIL-PRF-32159 • MIL-PRF-914

ASSETS FOR DRFM TEST AND VALIDATION

Signal and spectrum analyzers, such as Rohde & Schwarz's FSWX, as shown in **Figure 4**, provide a comprehensive and powerful platform for validating and/or testing next-generation DRFM jammers. From precise parameter measurements to complex deception scenario analysis, these analyzers empower engineers to develop and deploy effective EW systems capable of operating in today's increasingly complex dense emitter electromagnetic environments. The flexibility, accuracy, multi-channel architecture and advanced analysis tools make the FSWX an indispensable tool for ensuring the superiority of modern electronic warfare capabilities and maintaining a critical advantage during EW missions. ■

For product details, visit:
<https://www.rohde-schwarz.com/product/fswx>

You CAN'T Build Without iNRCORE



SIGNAL

Ethernet, Transceiver Modules, MIL-STD-1553, Data Bus Couplers, Baluns, Delay Lines



CAPACITORS

High-Q/Low ESR Multi-Layer Ceramic, Broadband, Single Layer, Thin Film, Variable



FILTERS

Bandpass, High Pass, Low Pass, Notch, EMI/RFI, Bias Tee, Amplitude Equalizer, Diplexers/Multiplexers



INDUCTORS

Conical, Ceramic Chip, High Frequency, High Q, Planar, Toroidal, CMC, THT, SMT, MIL-STD-981, MIL-PRF-27



For more information
SCAN HERE!



www.iNRCORE.com

+1-215-781-6400

The Design of Very Narrowband Tunnel Diode Negative Resistance Amplifiers

Alfred Grayzel and Ash (Ashok) Gorwara
Gorwara & Associates International, Inc., Fort Lauderdale, Fla.

Grayzel¹ presented the theory of the Grayzel narrowband negative resistance amplifier (GNRA)^{2,3} with experimental confirmation. The gain as a function of frequency of a negative resistance amplifier that used an operational amplifier to generate the negative resistance and a circulator at its output was measured. The amplifier can operate at any frequency where there is negative resistance and is not dependent upon how it is realized.

This article describes the design of a negative resistance amplifier using a 3 dB directional coupler or hybrid coupler and matched tunnel diodes. Diodes produced from the same wafer are very closely matched, and the value of the negative resistance can be fine-tuned by "tweaking" the bias voltage. MMIC miniature 3 dB directional couplers have been developed,⁴⁻⁶ and their small footprints make the GNRA suitable for cell phones and other hand-held communication or military devices.

Superconductor filters are currently used in various applications, particularly in communication systems and scientific research, where very narrowband filters are required.

Mobile communication base stations use them to enhance signal quality, and radio astronomers use

them to improve the sensitivity of radio telescopes. Additionally, military communication systems, radar and other areas requiring narrowband filters employ superconductor filters. The GNRA, once fully developed, will be able to replace them.

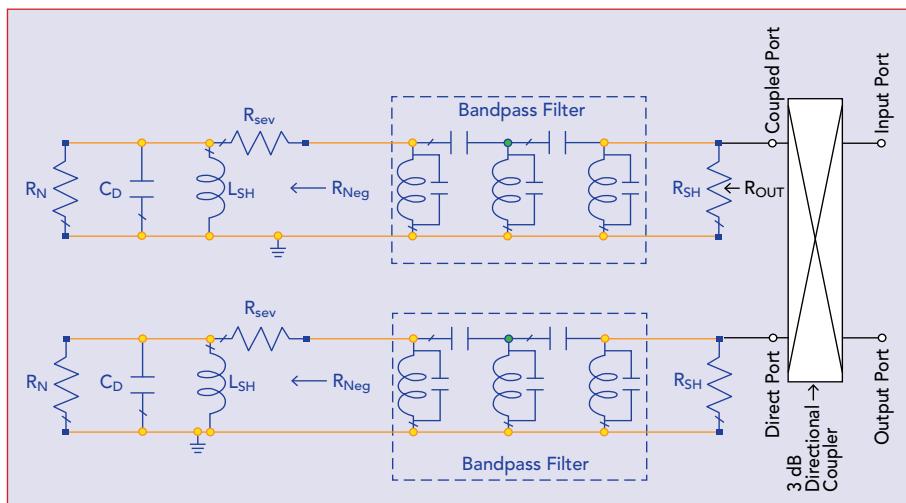
A 2.9 GHz tunnel diode amplifier is analyzed, and its gain is simulated as a function of frequency. Tunnel diodes are very low noise devices and can operate at very high frequencies.⁷ It is shown that negative resistance amplifiers with bandwidths of less than 0.004 percent are achievable.*

*Patents US11,863,131 B1 and US12,052,002 B2

25 DB NEGATIVE RESISTANCE AMPLIFIER DESIGN

Figure 1 shows the schematic of a tunnel diode negative resistance amplifier. Two identical negative resistance circuits are connected to a 3 dB directional coupler; one is connected to the direct port and the other is connected to the coupled port. An ideal directional coupler is assumed with equal coupling to both ports. A signal at the input port of the directional coupler will appear at the output port with a gain in dB given by Equation 1.

$$\text{Gain} = 20 \log \left| \frac{(Z_0 - R_{\text{out}})}{(Z_0 + R_{\text{out}})} \right| \quad (1)$$



▲ Fig. 1 Tunnel diode negative resistance amplifier schematic.



FIELD REPLACEABLE RF Connectors

San-tron introduces the next generation of high-performance field replaceable connectors.

Offered in connector series **SMA, 2.92mm, 2.4mm and 1.85mm** and designed to be optimally matched to most connectorized assemblies for low VSWR, rugged dependability, & exceptional repeatability.

Designed.
Machined.
Assembled.
Tested.



4 Turnpike Road, Ipswich, MA 01938
978-356-1585 | info@santron.com

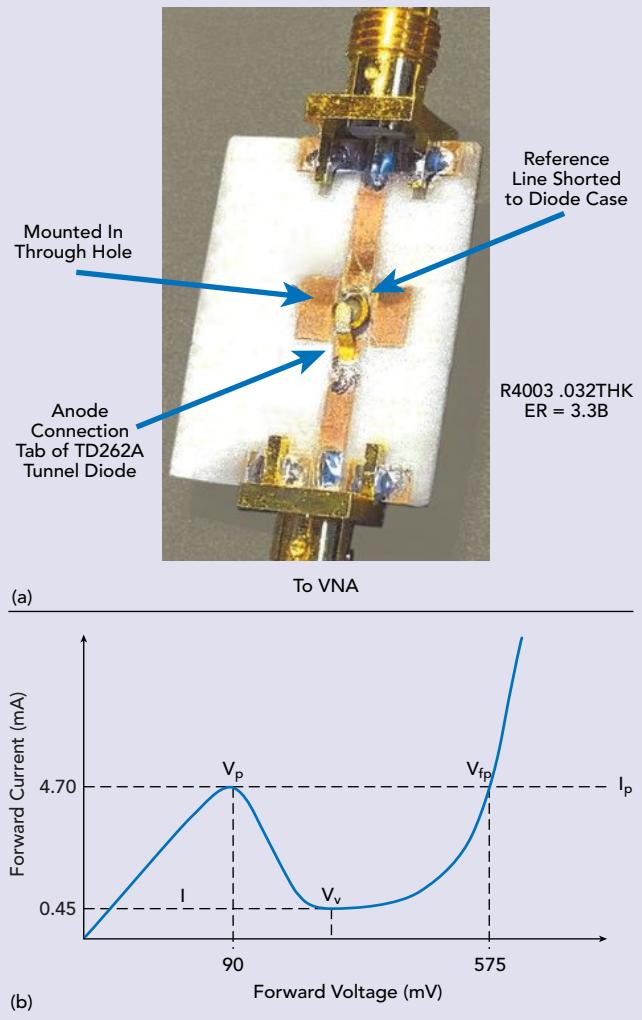
www.santron.com



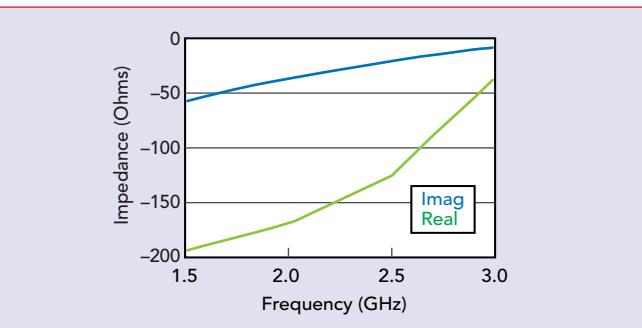
AS 9100D
CERTIFIED
ISO 9001



Technical Feature



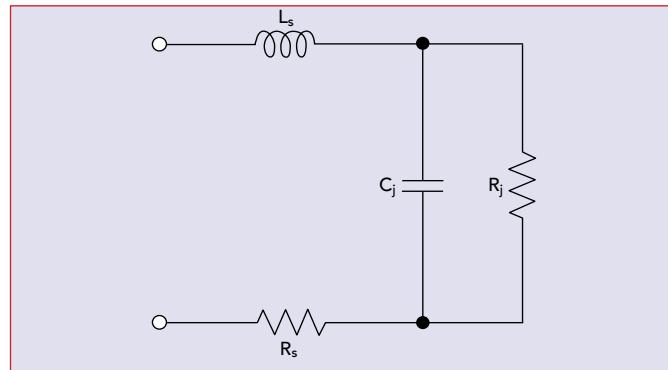
▲ Fig. 2 TD262A tunnel diode test fixture (a) and characteristic curve (b).



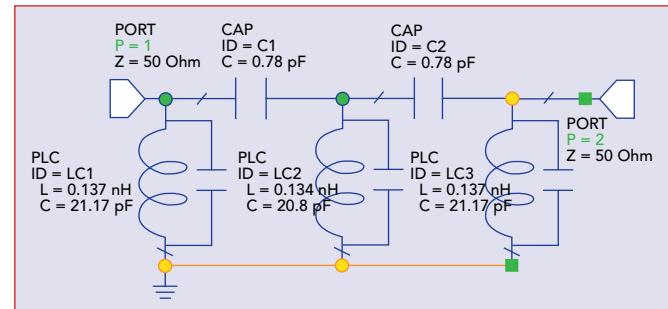
▲ Fig. 3 TD262A tunnel diode measured impedance.

Where R_{out} is the resistance presented to the directional coupler at the resonant frequency by each of the negative resistance circuits.

Solving Equation 1 for a gain of 25 dB yields $R_{out} = -44.68 \Omega$. With reference to Figure 1, R_n is the negative resistance and X_{Cd} is the capacitive reactance of the tunnel diode, equal to the real and imaginary part of Z_d , respectively. L_{sh} resonates the diode at the center frequency of the amplifier. R_{ser} is chosen to achieve the desired negative resistance R_{neg} . A bandpass filter is



▲ Fig. 4 Packaged tunnel diode equivalent circuit.



▲ Fig. 5 Butterworth bandpass filter schematic.

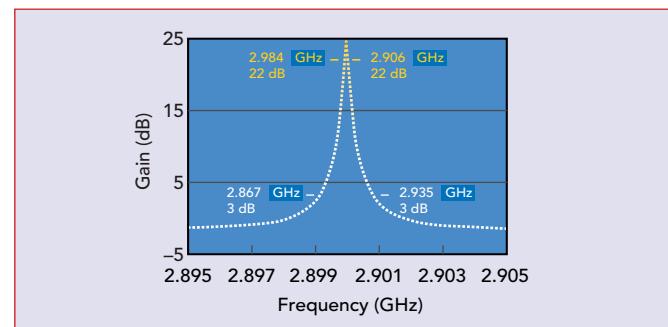
connected to R_{ser} , followed by a shunt resistor R_{sh} .

For this example, an American Microsemiconductor TD262A tunnel diode is measured as a function of frequency, as shown in Figure 2. The test fixture is shown in Figure 2a. The measurements (see Figure 2b) determine the required bias voltage to obtain the proper negative resistance.

A resistor is mounted in series with the diode such that the total resistance is positive, and impedance is measured using a VNA. A simple program subtracts the value of the series resistor and calculates the value of the real and imaginary parts of Z_d (see Figure 3).

The equivalent circuit of a packaged tunnel diode is shown in Figure 4.⁸ The highest frequency at which there is negative resistance is constrained by the capacitance C_j , which for the TD262A is about 3.5 GHz. The TD262A is mounted in a low frequency package, which restricts this frequency. High frequency assembly and fixtures using chip and wire are required for operation at mmWave frequencies.

An amplifier with a gain of 25 dB is designed to oper-



▲ Fig. 6 Gain versus frequency of negative resistance amplifier with $R_{sh} = 100 \Omega$.



GaN

Pioneering GaN technology in space

For over 50 years, Infineon IR HiRel has made history by powering countless space missions that unlock the secrets of our universe and advance critical climate research on our planet.

Continuing this proud tradition of innovation, Infineon IR HiRel recently launched the industry's first rad hard Gallium Nitride (GaN) transistor, manufactured in our own fabrication facility, achieving the highest Qualified Manufacturers List (QML) standards for space and defense applications, as defined by the Defense Logistics Agency (DLA). Our 100 V GaN device has undergone the most rigorous testing and certification process in the industry, ensuring consistent quality and reliability in extreme environment applications.

Explore our portfolio of rad hard products and design with complete confidence, knowing you are using the best radiation hardened power, RF, and memory products available, all backed by a global technology leader.



www.infineon.com/hirel

IOR HiRel
An Infineon Technologies Company

X - BAND HP LIMITERS

8-12 GHz, 100 Watt CW,
1 KW Peak



- High power protection 100W CW and 1 KW peak (1 microsec pulse width)
- Very low leakage level (+10 dBm typ.)
- Low insertion loss and VSWR.
- Ideal for Radar Application
- Fast recovery time, 1 Microsec Typ.
- Built-In DC Block @ input and output.
- Hermetically sealed module
- Removable connectors for surface mount installation.

Typical Performance @ + 25 Deg. C

MODEL	FREQ RANGE (GHz)	MAXIMUM ¹ INSERTION LOSS (dB)	MAX ¹ VSWR	MAX INPUT CW (W)
LS0812PP100A	8-12	2.0	2:1	100

Note: 1. Insertion Loss and VSWR tested at -10 dBm.

Note: 2. Limiting threshold level, +4 dBm typ @input power which makes insertion loss 1 dB higher than @-10 dBm.

Note: 3. Power rating derated to 20% @ 125 Deg. C.

Note 4. Typ. leakage @ 1W CW +6 dBm, @25 W CW +10 dBm, @ 100W CW +13 dBm.

Other Products: Detectors, Amplifiers, Switches, Comb Generators, Impulse Generators, Multipliers, Integrated Subassemblies

Please call for Detailed Brochures



The Microwave Products Source . .

Made in U.S.A

ISO 9001-2008
Certified



155 Baytech Drive, San Jose, CA 95134
Tel: (408) 941-8399 . Fax: (408) 941-8388
Email: Info@herotek.com
Website: www.herotek.com
Visa/Mastercard Accepted

Technical Feature

TABLE 1
 R_{neg} , R_{ser} , 3 dB BW, Percent BW and Delta as a function of R_{sh}

R_{sh} (Ω)	R_{neg} (Ω)	R_{ser} (Ω)	3 dB BW (MHz)	BW (%)	Delta (MHz)
100	-30.88	25.6	22	0.76	34
50	-23.6	32.9	5	0.17	25
25	-16	40.4	1.7	0.06	7
10	-8.2	48.3	0.190	0.034	3
5	-4.5	61.0	0.110	0.004	0.860

ate at 2.9 GHz. It can be seen from Figure 3 that R_n equals -56.5Ω and X_{Cd} equals -12.7Ω . To resonate the diode at 2.9 GHz, L_{sh} is set to 0.237 nH . The bandpass filter is shown in **Figure 5**. It is a 10 percent bandwidth Butterworth filter centered at 2.9 GHz.

At 2.9 GHz, the resonant frequency of both the diode and the filter, the parallel combination of R_{neg} and R_{sh} must be equal to -44.68Ω . The value of R_{neg} is given by Equation 2.

$$R_{\text{neg}} = \frac{-44.68(R_{\text{sh}})}{(R_{\text{sh}} + 44.68)} \quad (2)$$

The computed gain versus frequency of the negative resistance amplifier shown in Figure 1, with a peak gain of 25 dB and R_{sh} equal to 100Ω , is plotted in **Figure 6**. R_{neg} is found from Equation (2) to be -30.88Ω , and since R_n equals -56.5Ω , R_{ser} is set to 25.6Ω .

The 3 dB bandwidth is 22 MHz. Delta is the difference between the frequency at which the gain equals 3 dB and the center frequency of 2.9 GHz; this value is 34 MHz. In **Table 1**, R_{neg} , R_{ser} , 3 dB bandwidth, percent bandwidth and Delta are tabulated for various values of R_{sh} . As can be seen from the table, percent bandwidths less than 0.004 percent are achievable.

CONCLUSION

A narrowband negative resistance amplifier is equivalent to a low noise amplifier followed by a narrowband filter. This filter can have bandwidths only achievable with superconductors. Grayzel¹ presented the theory of the narrowband negative resistance amplifier, which was experimentally verified. In this article, the design of a narrowband negative resistance tunnel diode amplifier is pre-

sented and analyzed. It is shown that the bandwidth is a function of R_{sh} , the shunt resistor at the output of the negative resistance network and that percent bandwidths of less than 0.004 percent can be achieved. The circuits can be small and suitable for hand-held devices such as cell phones, as well as for miniature communication, telecommunication and defense receiver front ends. ■

ACKNOWLEDGMENT

The authors would like to thank Michael Hillbun, CTO of Diamond Engineering, for his contributions to the design and fabrication of the tunnel diode test fixture and for providing the measured data.

References

1. "A Negative Resistance Amplifier with 0.5 Percent Bandwidth," *Microwave Journal*, Vol. 66 No 5, May 2023, pp. 90-94.
2. A. I. Grayzel and A. Gorwara, "Very Narrowband and Wideband Negative Resistance Amplifiers with a Tuneable Center Frequency Using a Coupler," U.S. Patent 12 052 002 B2, July 30, 2024.
3. A. I. Grayzel, "Very Narrowband and Wideband Negative Resistance Amplifiers with a Tunable Center Frequency," U.S. Patent: US 11 863 131 B1, January 2, 2024.
4. MQH-2R58R5CH MMIC 2.5-8.5 GHz Quadrature Coupler, Marki Microwave, Web: <https://markimicrowave.com/products/bare-die/quad-hybrids/mqh-2r58r5ch/>.
5. Miniature Surface Mount 90-degree Hybrid Couplers, Innovative Power Products, Web: <https://innovativepp.com/product-category/view-all-products/90-degree-hybrid-couplers/>.
6. Miniature 3 dB Hybrid Couplers, Mini-Circuits, Web: https://www.minicircuits.com/WebStore/90_180_degree_hybrid.html.
7. F. Sterzer, "Tunnel Diode Devices," *Advances in Microwaves*, Vol. 2, Edited by L. Young, Academic Press, 1967.
8. Tunnel Diodes for Switching and Microwave Applications, RCA, 1963, p. 18.

RF-LAMBDA

THE LEADER OF RF BROADBAND SOLUTIONS

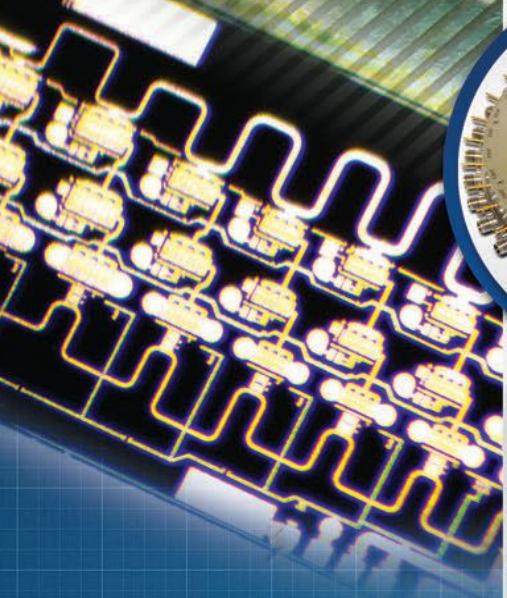
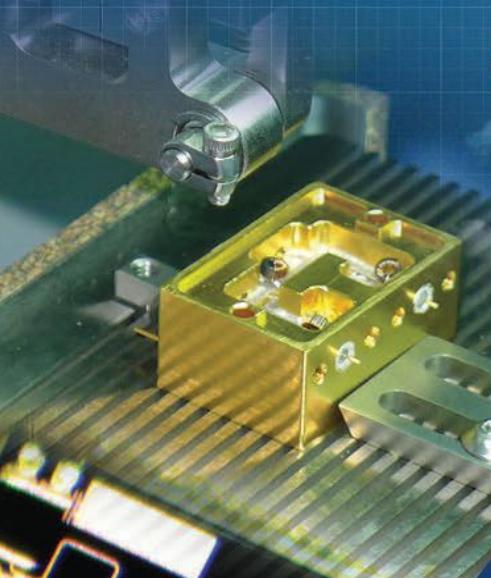
EUROPE

DEUTSCHLAND



RF SWITCHES

MM / MICROWAVE DC-90GHz



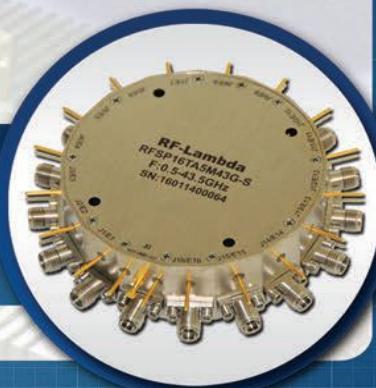
160 CHANNELS
mm/Microwave

0.05-20GHz
Filter Bank Switch Matrix
For Phase Array Radar Application Satellite communication.



PN: RFSP32TA5M43G
SP32T SWITCH 0.5-43.5GHz

PN: RFSP16TA5M43G
SP16T SWITCH 0.5-43.5GHz





Design of Four-Way Power Divider Based on Dielectric Window

Yansha Wei, Xiufang Wang, Pengxin Mao, Tailai Ni, Hao Wang, Bangji Wang and Qingxiang Liu
School of Physical Sciences and Technology, Southwest Jiaotong University, Chengdu, China

Power dividers are passive microwave components used in microwave systems to proportionally distribute power from a microwave source to antenna array elements.¹ The radiation efficiency of high-power microwave systems is greatly impacted by power divider performance. Parameters used to measure performance include return loss, insertion loss, power handling capability (PHC), amplitude and phase imbalance, bandwidth and isolation.²

The waveguide-based power divider (PD) stands out for its high PHC, low insertion loss and wide bandwidth when compared with planar microstrip structures. This makes it a popular choice for high-power microwave systems.³

Waveguide PDs can be classified into several categories depending on the architecture, such as T-junction,^{4,5} Magic-T,⁶⁻⁸ ridge waveguide,^{9,10} Riblet-type,^{11,12} Gysel structure⁹⁻¹³ and branch guide.¹⁴⁻¹⁵ In practice, each has its advantages, disadvantages and limitations.

Waveguide T-junctions feature simple structures and are easy to design; however, matching and isolation between output ports are poor. Magic-T PDs demonstrate enhanced impedance matching and port

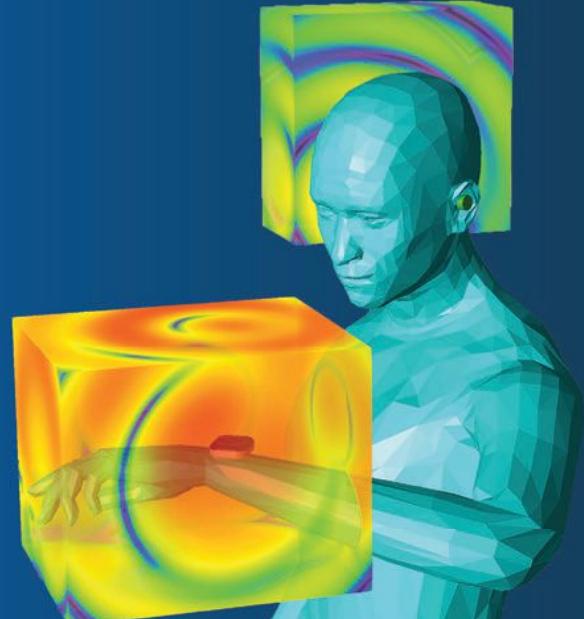
isolation; however, the four waveguide arms of the conventional Magic-T are in the E- and H-planes, creating more difficult assembly and fabrication processes.

In recent years, coplanar waveguide Magic-Ts based on transition structures have been investigated. Ameri et al.⁸ introduced a broadband and low loss E-plane waveguide Magic-T incorporating an innovative air-filled self-suspended rectangular-to-co-axial transmission line to interface the sum port of the Magic-T with the T-junction. This structure provided a higher PHC compared to a Magic-T microstrip probe, reaching up to 20 kW.

The Magic-T structure features a single isolated port, whereas the waveguide Gysel PD offers two isolated ports, which is more desirable in practical applications. Fahmi et al.⁹ described two different designs of ridge waveguide Gysel PDs for E-plane and H-plane configurations that combine the advantages of ridge waveguide and Gysel types to achieve a compact size, wider bandwidth and good PHC. The E-plane-aligned design provides better PHC through a vertically stacked arrangement of ridge waveguides, and simulated results show a PHC of around 50 kW across the operating range.

These designs successfully achieve high

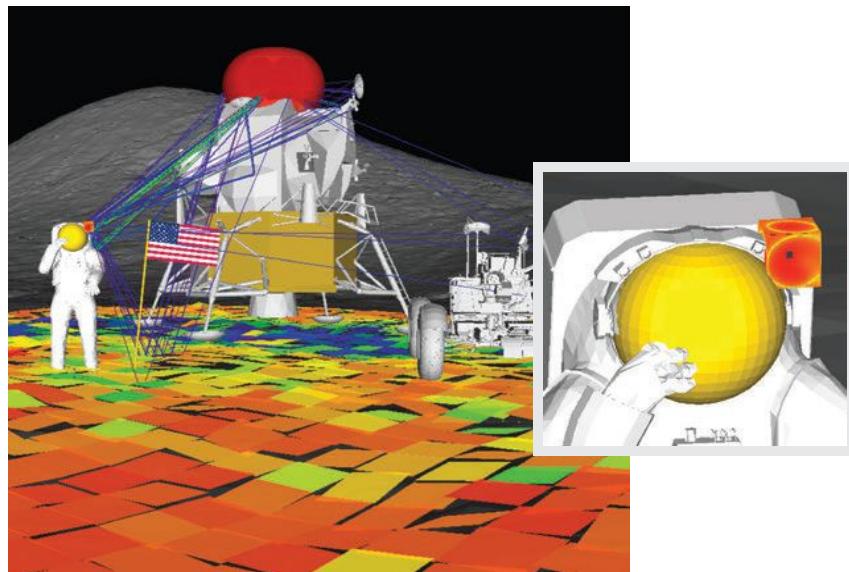
Analyze Mobility and Performance of Body-Worn Devices



Electromagnetic Simulation Software from Remcom

Remcom's Huygens surface capability incorporates near-field antenna effects into simulations of antenna performance so that mobility, multipath, and interactions with body-worn devices may be analyzed in realistic environments.

- GNSS positioning
- NASA Artemis Program
- Body Area Networks (BANs) and sidelink communications
- 5G/6G connectivity for UAVs, automotive, and robotics

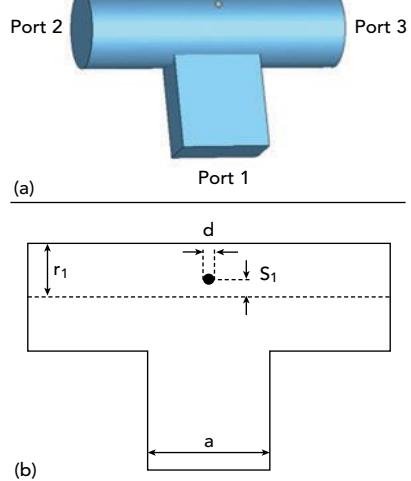


RF Digital Twin of Apollo 15 Mission: Wireless InSite simulation of coverage and multipath from an antenna mounted on the lunar lander to a near-field Huygens antenna on the astronaut's helmet.

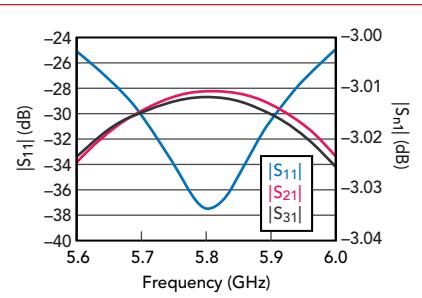
Learn more at

www.remcom.com/animate-on-body ▶▶

For 30 years Remcom's software has enabled the world's most advanced engineering teams to deliver their devices to market.



▲ Fig. 1 T-junction PD structure: 3D view (a) and longitudinal cross-section (b). isolation, a broad bandwidth and a compact size. However, limited PHC makes them inappropriate for use in high-power systems. To obtain high PHC and good transmission efficiency, the four-way equal PD described in this work is based on a dielectric window. It is designed to



▲ Fig. 2 T-junction PD simulated S-parameters.

operate in the C-Band.

To enhance its PHC, the T-junction connected to the microwave source is vacuum sealed, since the breakdown field strength in a vacuum substantially exceeds that in air. An 'I'-shaped dielectric window with low loss organic materials is used for sealing. Furthermore, to feed an array antenna with the circular waveguide TM_{01} mode, a TE_{10} to TM_{01} mode converter is designed and integrated into the PD output.

ANALYSIS AND DESIGN

The PD comprises three components: T-junction, dielectric window and mode converter. These are individually designed and characterized, and are then integrated and optimized.

T-Junction PD

The T-junction is the fundamental component, shown in **Figure 1**. A four-way PD is constructed by cascading three T-junctions. The interior of the T-junction PD is vacuum sealed at a high atmospheric pressure. To avoid deformation of rectangular waveguide edges due to the pressure difference, a circular waveguide with better pressure resistance is used at the output. The larger cross-sectional area of a circular waveguide also permits microwave energy to be distributed more uniformly.

Theoretical analysis shows that the T-junction without a modulator results in high reflections and low energy transfer efficiency.¹⁶ Hence, a metal post is added at the waveguide junction to improve matching performance and extend the bandwidth. Power distribution is influenced by the position of the metal post. To achieve equal power

division, the matching post is positioned along the center line of the wide edge of the input rectangular waveguide. Excellent performance is obtained by adjusting the diameter d of the metal post and the distance S_1 of the post from the center. Electromagnetic simulation software is employed to optimize the design until $|S_{11}|$ is below -20 dB, as demonstrated in **Figure 2**. The transmission coefficients of the two output ports are around -3 dB, achieving equal power distribution.

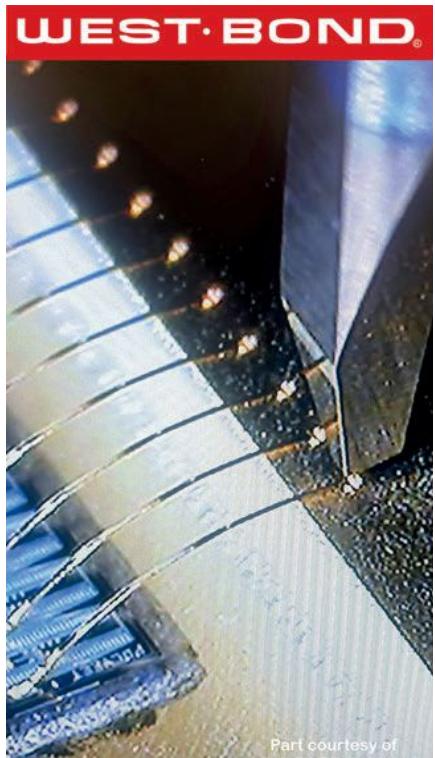
Dielectric Window

The dielectric window acts as a barrier between the vacuum and the atmosphere while ensuring maximum power transmission. Based on the shape, dielectric windows can be classified into categories such as pillbox windows, rectangular windows and coaxial windows. Among these, the pillbox window is widely used in microwave vacuum electronic devices due to its simple structure, high PHC, wide operating bandwidth and mature fabrication process.^{17,18}

In this work, low loss polyethylene with a dielectric constant of 2.0 is used as the window material. Since organic materials cannot be fixed by welding, a groove in the waveguide wall is required to secure the window disk into a conventional pillbox window, which can easily lead to an increase in field strength at the triple point (vacuum-dielectric-metal junction — see **Figure 3**).

To address this, the conventional pillbox window structure is improved; the edge of the window disk is designed to protrude outward with a specific thickness and extends longitudinally to match the length of the circular waveguide. As a result, the longitudinal cross-section of the window from the "I" is transformed into an "I" shape. The "I"-shaped dielectric window is secured with a sealing ring, which does not affect the field distribution on the surface of the dielectric window.

The "I"-shaped structural design can maintain a certain height between the triple point and the window surface, making it difficult for electrons emitted from the triple point to travel to the window



Wedge, Ball and Ribbon
Wire Bonding and Die Bonding
westbond.com

0.5~8GHz 1x16 & 1x64

WIDEBAND SOLID STATE SWITCH MATRIX

Applications: 5G RRU, WiFi 6/7, Antennas Array & Phased Array



- ✓ **Wide Broadband** 0.5~8GHz
- ✓ **Low I.L.** 4.4dB@6GHz
5.0dB@8GHz
- ✓ **High Iso.** 80dB Typ.

- ✓ **Excellent Phase & Amplitude Consistency**
- ✓ **High Reliability & High Repeatability**
- ✓ **USB/Ethernet** (Other optional)
- ✓ **Fast TTL Control Can be Customized**

The newly launched solid-state switch matrices operate across a broad frequency range of 0.5 to 8 GHz, offering low insertion loss, high isolation, fast switching, and high reliability. Engineered for precision, the matrices provide excellent consistency in both amplitude and phase across all output ports through meticulous design and thorough optimization. Available in configurations from 1x16 up to 1x64, the largest 1x64 matrix delivers insertion loss ≤ 5 dB and isolation ≥ 70 dB. The product includes control software and supports multiple interface options—USB, Ethernet, and TTL—enabling smooth integration into systems for 5G RRU, WiFi 6E, antenna arrays, and phased array applications.

More Information-
Scan the QR Code



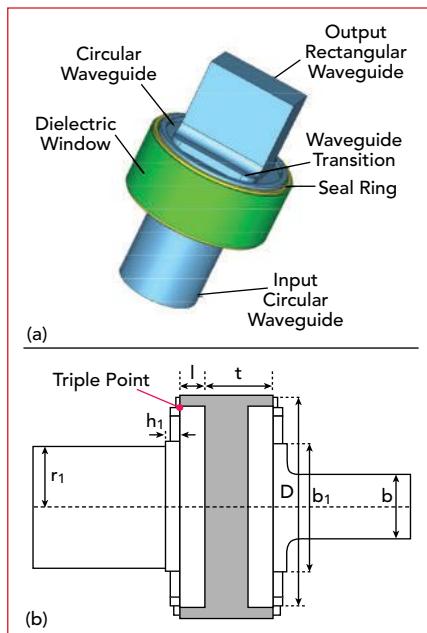
www.micable.cn

sales@micable.cn

MiCable Inc.

Call: +86-591-87382856

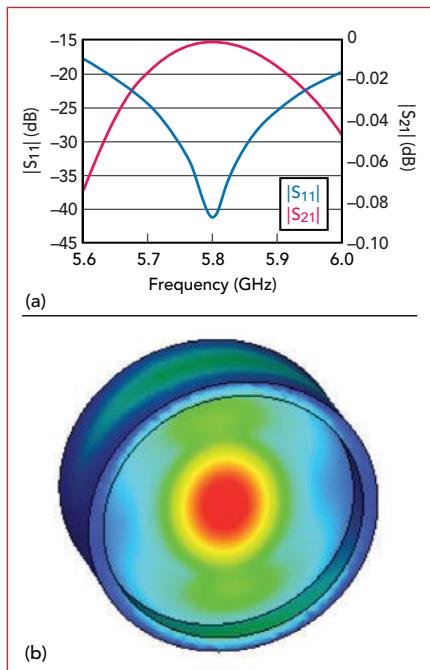
Technical Feature



▲ Fig. 3 Dielectric window structure: 3D view (a) and longitudinal cross-section (b).

surface, thereby suppressing secondary electron multiplication and effectively avoiding flashover breakdown of the dielectric window.

The dielectric window assembly contains the input and output rect-



▲ Fig. 4 Simulated optimized dielectric window S-parameters (a) and field distribution at the window surface (b).

angular waveguide sections, waveguide transition section, circular waveguide section and dielectric window, as shown in Figure 3. The

window diameter is typically chosen to be equal to the length of the input or output rectangular waveguide diagonal.¹⁹ The diagonal length of the standard BJ48 rectangular waveguide is approximately 52.5 mm.

To further reduce the window's surface field strength, the diameter of the dielectric window is increased to operate in an over-mode condition. The initial diameter of the window disk is selected to be 70 mm, and a rectangular transition waveguide is employed to control higher-order modes in the structure. The thickness of the window disk is half the waveguide wavelength of the filling medium to withstand the pressure difference between the vacuum and the gas.

The structural dimensions obtained from initial calculations are optimized. Figure 4 shows the simulation results. $|S_{11}|$ is below -20 dB across the 400 MHz bandwidth, while the surface electric field exhibits a well-defined TE_{11} mode distribution; the field strength is maximum in the center of the win-

THE NEXT-GEN MINIATURE RUBIDIUM ATOMIC CLOCK

MIRA

SMALLER.
STRONGER.
SMARTER.

SAFRAN

MIRA™ is the second-generation Miniature Rubidium Atomic clock developed by Safran Electronics & Defense. It is designed to augment precision timing technology for defense, aerospace, telecom, and industrial markets.



Cutting-edge Connectivity

Reliable and customizable
solutions for mission
critical military applications

We offer:



RF Board-Level Components

- Very Broad Portfolio
- High Reliability Options



RF Cable Assemblies

- Semi-rigid, Conformable, Flexible
- NEW Ultra-Reliable Connector



RF Filters

- Variety of Technologies/Topologies
- Tailored Solutions Available



RF Isolators & Cirulators

- Variety of Technologies/Topologies
- Tailored Solutions Available



Multi-Function Assemblies (MFAs)

- Combined Functionality (filter/isolate/combine/couple)
- Optimized Performance



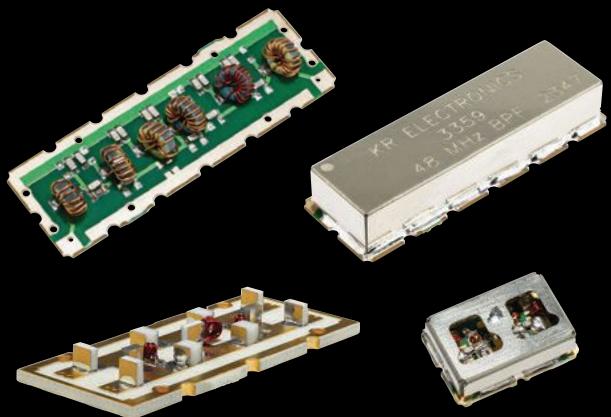
Optical Transceivers

- 10 or 28 Gbps channels in 4TRX, 12RX, 12TX, or 12TRX (10 Gbps only) configurations
- Qualified to MIL-STD 883 shock and vibration requirements

**INNOVATIVE
FILTER SOLUTIONS
DC – 40GHz**



Extensive Catalog of Standard Designs | Quick Prototype Delivery (3-4 wks)



Anti-Aliasing | Delay Equalized | Matched | Linear Phase | Diplexers | Absorptive

Military | Microwave Medical Imaging | Positive Train Control | Commercial



ISO 9001:2015
AS9100
CERTIFIED



sales@krfilters.com

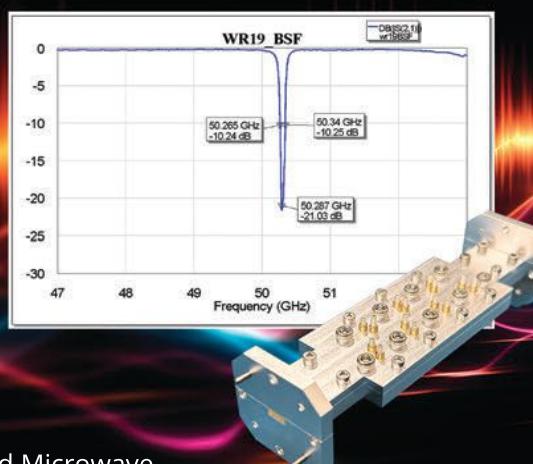
913.685.3400

15237 Broadmoor
Overland Park, KS

krfilters.com

WR19 Narrowband Bandstop Filter

10dB notch between 50.265 to 50.34 GHz



Exceed Microwave
designs and produces
narrowband waveguide
bandstop filters.

- ✓ Designed and Manufactured in USA
- ✓ AS9100D / ISO9001:2015 Certified
- ✓ ITAR Registered



+1 (424) 558-8341
sales@exceedmicrowave.com
exceedmicrowave.com

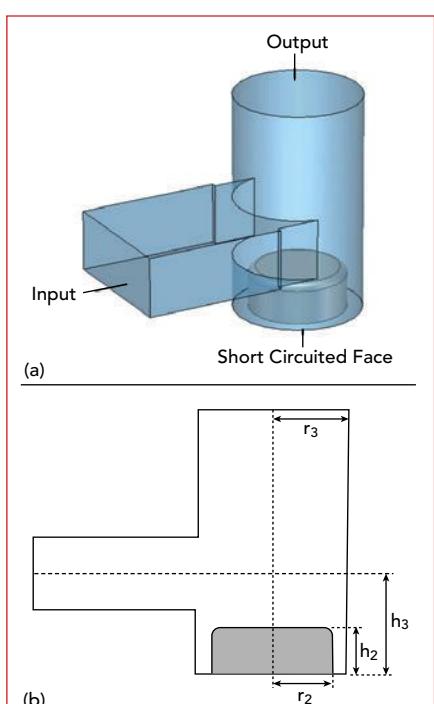


Technical Feature

dow disk and decreases toward the edge.

TE₁₀-to-TM₀₁ Mode Converter

The mode converter produces a desired output mode for propagation. In a radial line antenna array system, the PD network and antenna array are in parallel planes; thus, the microwave path must be turned 90 degrees. For this purpose, a TE₁₀-to-TM₀₁ mode converter within a right-angled structure is designed, as demonstrated in **Figure 5**.



▲ **Fig. 5** TE₁₀-to-TM₀₁ mode converter structure: 3D view (a) and longitudinal cross-section (b).

The mode converter comprises a circular waveguide section with a short-circuit termination and an orthogonally intersecting rectangular waveguide. The orthogonal intersection of the two waveguides is the mode-conversion region. Electromagnetic waves entering through the rectangular waveguide generate a transmitted component propagating in the negative direction along the circular waveguide. By setting the length of the short-circuit section to half the guide wavelength, the electric field is reflected at the shorting plate to the output. A metal cylindrical tuning screw is incorporated at the shorting plate to adjust matching and increase the bandwidth.

In the mode-conversion region, higher-order modes may be generated due to structural discontinuities. Mode control is performed by selecting a suitable circular waveguide diameter. The condition for transmitting the TM₀₁ mode while suppressing TE₂₁ and other higher modes in a circular waveguide can be derived with **Equation 1**.

$$2.06\alpha < \lambda_0 < 2.62\alpha \quad (1)$$

Where α is the radius of the circular waveguide.

The short-circuited section with the added matching screw can be considered a coaxial waveguide, transmitting TEM waves with a phase velocity essentially equal to the speed of light. Consequently, the short-circuited segment is equivalently composed of a circular waveguide and a coaxial waveguide. To achieve single-port output, this composite structure must still satisfy the half-wavelength condition of the equivalent waveguide. The lengths of the coaxial and circular waveguide sections are calculated separately, adhering to the relationship in **Equation 2**.²⁰

MI-WAVE

Millimeter Wave Products Inc.

SYSTEMS AND SOLUTIONS

AEROSPACE | DEFENSE | COMMERCIAL | SPACE

Assemblies, Subsystems, Custom Products, Prototypes, Mass Volume Production



ACTIVE | ANTENNAS | PASSIVE

Low Noise Amplifiers

Power Amplifiers

Mixers

Voltage-Controlled Oscillators

Frequency Multipliers

Frequency Synthesizers

Switches

Transmitters / Transceivers

Detectors

Conical Horns

Corrugated Conical Horns

Horn Lens Antennas

Omni Directional Antennas

Spot Focusing Antennas

Standard Gain Horns

Waveguide Probe Antennas

Wide Angle Scalar Horns

Attenuators

Isolators & Circulators

Filters

Waveguides

Phase Shifters

Power Dividers/Combiners

Terminations

Adapters

Couplers

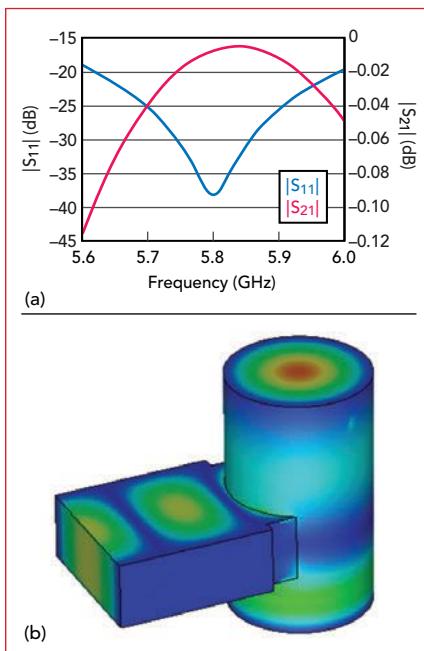


2007 Gandy Blvd N Suite 1310
St. Petersburg, FL 33702



Tel: (727) 563-0034

Email: sales@miwv.com



▲ Fig. 6 Simulated mode converter S-parameters (a) and field distribution (b).

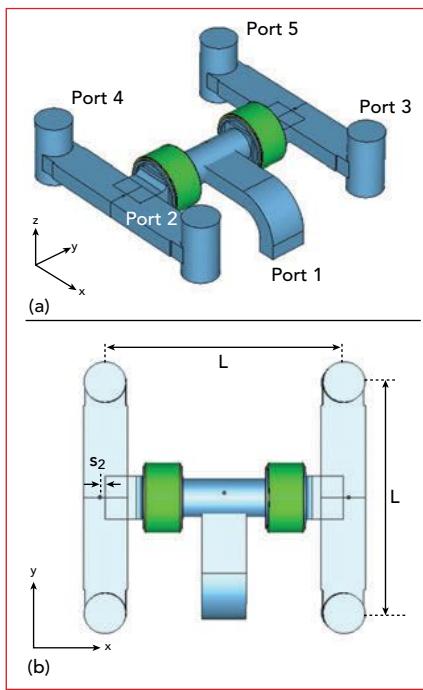
$$\frac{h_3 - h_2}{\lambda_{g(\text{TM}01)}} + \frac{h_2}{\lambda_0} = \frac{1}{2} \quad (2)$$

Where h_3 is the total length of the short-circuited section and h_2 is the height of the tuning screw.

By adjusting the values of h_2 and h_3 , a high mode-conversion efficiency is achieved, as shown in **Figure 6**. Figure 6a shows good matching performance with transmission efficiency exceeding 99 percent within the operating bandwidth. Figure 6b shows the field distribution. The axial field pattern confirms that a TM_{01} mode is successfully formed at the converter output.

FOUR-WAY PD SIMULATION AND OPTIMIZATION

Figure 7 shows the overall structure of the four-way PD. The input power from Port 1 is initially split into two equal-amplitude signals through the primary T-junction. These divided signals are subsequently further divided into four outputs by two more T-junctions after transmission through a dielectric window. Finally, the rectangular waveguide output TE_{10} mode is converted into the circular TM_{01} mode via mode converters. The input side of the dielectric window is maintained under vacuum, while the output side is filled with SF_6 gas at a specified pressure and concentration.

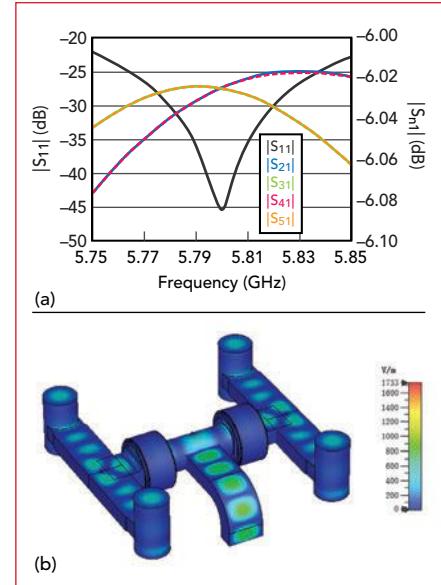


▲ Fig. 7 PD configuration: 3D view (a) and top view (b).

To achieve optimal performance, parameters that affect the matching performance of the four-way PD are analyzed. Excellent performance is achieved by adjusting the metal post locations s_1 and s_2 in the two-stage cascaded T-junctions. Optimized parameter dimensions are listed in **Table 1**.

Simulated S-parameters are plotted in **Figure 8a**. $|S_{11}|$ is below -22 dB over the operating band and is less than -45 dB at the center frequency. Transmission coefficients are greater than -6.1 dB across the band. Considering that the theoretical distribution loss for a four-way PD is 6 dB, the simulated insertion loss is below 0.1 dB.

The simulation demonstrates equal power division with an amplitude imbalance of less than 0.05 dB. The maximum electric field strength is 1733 V/m (see **Figure 8b**), which occurs in the vacuum region. When the input power is 0.5 W, the PHC can be calculated using **Equation 3**.



▲ Fig. 8 Four-way PD simulated S-parameters (a) and field distribution (b).

$$P_{\text{br}} = 0.5 \left(\frac{E_{\text{br}}}{E_{\text{max}}} \right)^2 \quad (3)$$

Based on the vacuum breakdown threshold of 20 MV/m, the calculated PHC reaches 66.59 MW in the vacuum section. The overall PHC of the system is limited by the dielectric window. The maximum value of the electric field of the dielectric window is simulated to be 561 V/m. Assuming a breakdown threshold of 6 MV/m for polyethylene, the derived PHC for the window is 57.2 MW. Similarly, the power capacity of the mode converter is calculated to be 82.8 MW. Therefore, the four-way PD's overall PHC is as high as 57.2 MW.

MEASUREMENTS

A prototype four-way PD, as shown in **Figure 9**, is measured with a vector network analyzer. One coaxial-to-rectangular waveguide and four coaxial-to-circular waveguide adapters are used to connect the ports for testing.

Measured and simulated $|S_{11}|$ are compared in **Figure 10a**. Mea-

TABLE 1

OPTIMIZED PARAMETER VALUES

Parameter	d	s_1	s_2	l	t	D	b_1
Value (mm)	3.6	6.6	5.7	12	12.5	70	46
Parameter	h_1	h_2	h_3	r_1	r_2	r_3	L
Value (mm)	3.5	15	31	21.5	17.8	22.5	264

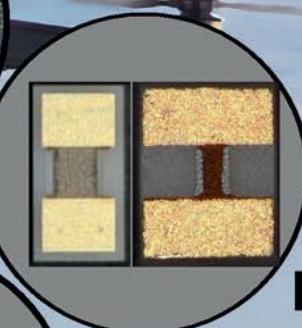


HIGH RELIABILITY BROADBAND COMPONENTS

PPI Broadband components are essential in High-Frequency/RF and high-speed data systems found in drones and related equipment.

They deliver stable, accurate signal performance across a wide frequency range, supporting applications like signal filtering, blocking, coupling, and high-frequency communication — including advanced uses such as anti-drone and professional communication systems.

Their compact size and high capacitance make them ideal for the space-limited demands of drone technology.



Broadband Capacitors

5 case sizes, 10nF & 100nF
up to 67 GHz

Broadband Resistors

1209 & 2010 sizes
up to 67 GHz

Broadband Conical Inductors

Flying Leads & SMT
up to 110 GHz

Reach out for
Availability

www.passiveplus.com
+ (631) 425-0938
sales@passiveplus.com



Technical Feature

sured values are better than -15 dB within the operating band. At the center frequency, $|S_{11}|$ is less than -35 dB. Measured results are uniformly higher, which may be due to errors in manufacturing, assembly and measurement. Considering that waveguide converters and matched loads are used in testing, the effects of non-ideal contacts and mismatches are unavoidable.

The measured transmission coef-

ficients of the four-way PD, as seen in **Figure 10b**, are greater than -6.35 dB across the operational frequency range. In the measurement process, rectangular-to-coaxial and circular-to-coaxial waveguide converters employed for testing introduce additional insertion loss. The intrinsic insertion loss of the four-way PD is determined by subtracting the insertion losses of both converters from the total measured value.

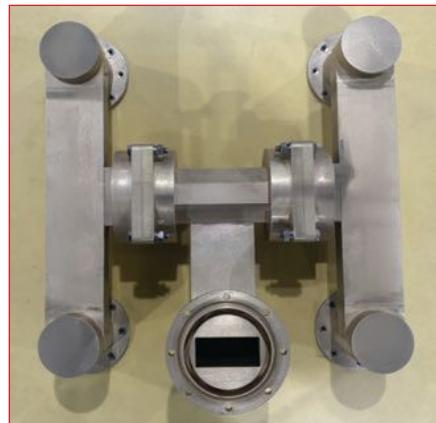
narda Safety Test Solutions

Drone localization with SignalShark and ADFA DF Antenna

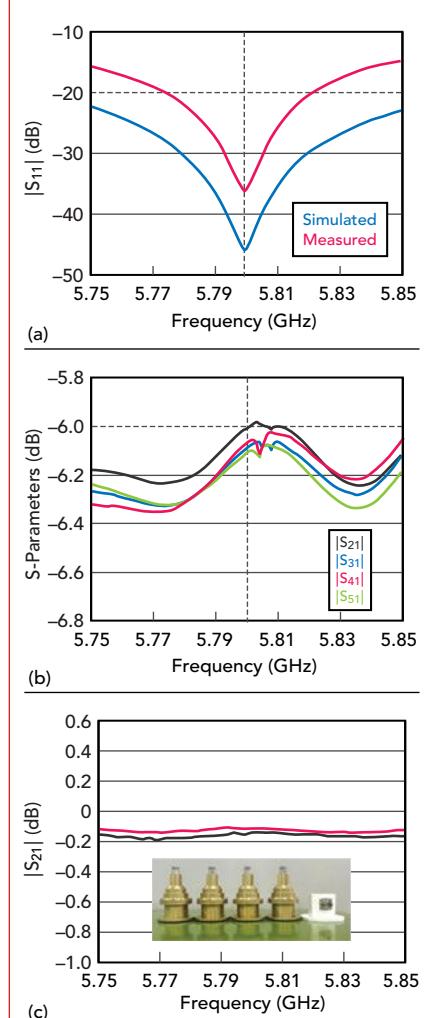
- HDR enables reliable operation even in interfered environments
- High sensitivity for early detection
- Azimuth and elevation data for precise localization
- Rugged Design, can be deployed in under 15 minutes

www.narda-sts.com

Figure 10c shows the insertion loss results obtained through back-to-back measurements of two identical converters, from which the insertion loss of a single coaxial-to-rectangular waveguide converter is



▲ **Fig. 9** Prototype four-way power divider.



▲ **Fig. 10** Measured and simulated $|S_{11}|$ (a), measured transmission coefficients (b) and measured insertion loss of the adapters (c).

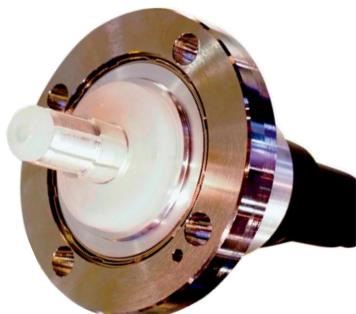


INSULATED WIRE
INCORPORATED

MAXIMUM POWER!

Insulated Wire's laminated EPTFE dielectric provides industry leading attenuation performance which translates to MAXIMUM power handling capability!

Our range of extremely low loss/phase stable cable designs are available with a range of industry standard high power interfaces and provide performance from -55C to +200C for a diverse range of commercial and military applications including de-frosting, EMC/EMI testing, directed energy and communications systems.



Low loss/phase stable:	2801 4806 7506	1.9KW (c.w) @ 1 GHz, 450W @ 18 GHz 17KW @ 13.56 MHz, 3.2KW (c.w) @ 1 GHz 10 kW (c.w) @ 1 GHz 5.5 kW (c.w) @ 2.45 GHz
In the Re-Flex™ family:	RF250	1 kW (c.w) @ 1 GHz

Interconnect options include C, SC, LC, HN, 7/16, 1 5/8" & 3 1/8"EIA flange sizes with different styles available across the range, contact us or your local representative with your requirements!

CALL US TODAY

with your project specs and we'll show you the most reliable way to get connected in the industry.

AS9100 Rev. D & ISO9001:2015 certified.



SCAN THIS CODE
TO FIND OUT HOW YOU
CAN GET CONNECTED

We're how the microwave industry
gets connected!



www.insulatedwire.com

t + 1 631 4724070
e nysales@insulatedwire.com

TABLE 2 COMPARISON WITH OTHER WORK

Reference	f_0 (GHz)	Insertion Loss (dB)	Amplitude Imbalance (dB)	PHC (kW)	Structure	Occupied Area (λ^2)*
21	3.7	0.2	± 0.1	13.5	Composite Cavity	2.16×2.16
9	4.0	1.0	± 0.2	-	Ridge Waveguide	1.6×1.5
3	4.9	0.8	± 0.7	-	Quasi-Planar	-
22	9.0	0.4	0.3	46	Magic-T	1.1×1.1
8	10.3	0.8	± 0.5	20	Waveguide	4.93×3.9
This Work	5.8	0.2	± 0.1	57,200	Waveguide	5.97×5.97

* λ is the free space wavelength at f_0

GET THE PERFORMANCE YOU NEED

ULTRA BROADBAND

SWITCHES

- SP1T to SP128T
- DC - 26.5 GHz
- Reflective
- Absorptive
- Switch Matrixes
- Custom Designs

OPTIONS

- Optimized Narrow Bands
- Up to 120 dB Isolation
- High & Low Power Models
- Phase & Amplitude Matched
- Switching Speed 20 μ sec max
- Custom Logic

Electrical Specifications

MODEL	FREQUENCY GHz	MAX INSERTION LOSS	V.S.W.R. MAX
SP1T	2-18 GHz	2.3	2:1
SP2T	2-18 GHz	2.5	2:1
SP4T	2-18 GHz	2.8	2:1
SP8T	2-18 GHz	4.0	2:1
SP16T	2-18 GHz	7.0	2:1

Absorptive • 60dB isolation • 1 μ sec switching speed • + 20 dBm cw, 1 w max

2 Emery Avenue
Randolph, NJ 07869 USA
973-361-5700 Fax: 973-361-5722
www.gtmicrowave.com
e-mail: sales@gtmicrowave.com

estimated to be approximately 0.10 dB, while that of a single coaxial-circular waveguide converter is approximately 0.07 dB. After compensating for the waveguide converter losses, the PD exhibits a low insertion loss of less than 0.2 dB. In addition, it demonstrates excellent amplitude imbalance within ± 0.1 dB at the designed frequency.

The characteristics and performance of this design are compared with other work in **Table 2**. This design provides a combination of higher PHC, lower insertion loss and better amplitude balance.

CONCLUSION

A C-Band four-way equal PD with a dielectric window provides high PHC, low loss and excellent amplitude balance. By evacuating the interior of the input T-junction and sealing it with low loss material dielectric windows, PHC is significantly enhanced. A mode converter enables the PD to produce a TM_{01} mode output, facilitating connection to the next structure. Simulation demonstrates MW-level PHC with low loss and superior amplitude balance. ■

ACKNOWLEDGMENT

This work was supported in part by the Fundamental Research Funds for the Central Universities under Grant 2682024GF013.

References

1. C. A. Sreejith, M. Tamang and K. S. Beenamole, "High Power Ratio Waveguide Power Divider," *IEEE Microwaves, Antennas, and Propagation Conference*, December 2022.
2. O. Wossugieniri, H. Faezi and M. Fallah, "Compact 2-Way H-Plane Power Dividers for a Rectangular Waveguide in Ku Band," *22nd International Microwave and Radar Conference*, May 2018.
3. K. J. Song, S. Y. Hu, F. Zhang and Y. Zhu, "Four-Way Chained Quasi-Planar Power Divider Using Rectangular Coaxial Wave-

HIGH POWER COUPLERS

5 - 500 Watts



Model #	Frequency (MHz)	Coupling (dB) [Nom]	Coupling Flatness (dB)	Mainline Loss (dB) [Typ./Max.]	Directivity (dB) [Typ./Min.]	Input Power (Watts) [Avg.]
SDCHP-125	10 - 250	18.5	0.5	0.1 / 0.4	24 / 19	30
SDCHP-140	10 - 400	18.75	1	0.5 / 0.85	27 / 22	25
SBCHP-1100	10 - 1000	10	0.5	1.2 / 1.4	17 / 15	5
KBK-HP-1100	10 - 1000	10	0.5	1.2 / 1.4	17 / 15	5
KDK-HP-255	20 - 550	20	0.4	0.25 / 0.35	23 / 18	27.5
SDCHP-255	20 - 550	20	0.4	0.25 / 0.35	23 / 20	27.5
SDCHP-335	30 - 350	20.1	0.85	0.24 / 0.32	24 / 20	75
SDCHP-484	40 - 840	19.2	0.9	0.3 / 0.4	24 / 20	30
SCCHP-560	50 - 560	14.6	0.7	0.48 / 0.65	23 / 20	75
SCCHP-990	90 - 900	15.2	0.6	0.52 / 0.64	20 / 17	38.3
SBCHP-2080	200 - 800	12.3	0.7	0.64 / 0.80	24 / 18	48.3
SBCHP-2082	200 - 820	11.0	0.5	0.74 / 0.9	22 / 19	22.5
KDS-30-30-3	27 - 512	27.5	0.75	0.3 / 0.4	23 / 15	50
KDS-30-30	30 - 512	27.5	0.75	0.3 / 0.4	23 / 15	50
KBK-10-225	225 - 400	11	0.5	0.6 / 0.7	25 / 18	50
KBS-10-225	225 - 400	10.5	0.5	0.6 / 0.7	25 / 18	50
KDK-20-225	225 - 400	20	0.5	0.2 / 0.4	25 / 18	50
KDS-20-225	225 - 400	20	0.5	0.2 / 0.4	25 / 18	50
KEK-706H	500 - 2500	31.5	2.5	0.28 / 0.4	18 / 12	100
SCS-8012D	800 - 1200	20	0.6	0.22 / 0.25	22 / 18	100
KEK-704DH-2	850 - 1250	30	0.25	0.20 / 0.30	28 / 25	500
KEK-704H	850 - 960	30.5	0.25	0.08 / 0.20	38 / 30	500
SCS100800-10	1000 - 8000	10.5	2	1.2 / 1.8	8 / 5	25
SCS100800-16	1000 - 7800	16.8	2.8	0.7 / 1	14 / 5	25
SCS100800-20	1000 - 7800	20.5	2	0.4 / 0.75	12 / 5	25
SCS-1522B	1500 - 2200	10	--	0.65 / 0.75	23 / 18	100
SCS-1522D	1500 - 2200	20	--	0.32 / 0.38	23 / 20	100
SCS1701650-16	1500 - 15500	17	2.5	1 / 1.4	16 / 5	25
SCS1701650-20	1700 - 15000	21	2.5	0.9 / 1.3	10 / 7	25
SDC360440-10	3600 - 4400	8.6	0.25	0.7 / 1.4	18 / 10	10
SDC360440-20	3600 - 4400	19	0.25	0.7 / 1.2	16 / 10	10

New Models!

Talk To Us About Your Custom Requirements

Technical Feature

- guide," *IEEE Microwave and Wireless Components Letters*, Vol. 25, No. 6, June 2015, pp. 373–375.
- 4. Z. Xu, J. Xu, Y. Cui and C. Qian, "A Novel Rectangular Waveguide T-Junction for Power Combining Application," *IEEE Microwave and Wireless Components Letters*, Vol. 25, No. 8, August 2015, pp. 529–531.
 - 5. B. Wang, B. Tian and C. -T. Wang, "Power Divider/Combiner of Waveguide E-T Junction Based on Thin Film Resistor," *Journal of Infrared and Millimeter Waves*, Vol. 36, No. 1, February 2017.
 - 6. R. Vincenti Gatti, R. Rossi, M. Dionigi and A. Spigarelli, "An X-Band Compact and Low-Profile Waveguide Magic-T," *International Journal of RF and Microwave Computer-Aided Engineering*, Vol. 29, No. 9, May 2019.
 - 7. E. Ameri, M. Khalaj-Amirhosseini, S. H. Sedighy and Yousef Azizi, "Design of New Wideband Waveguide Magic-T for X-Band Applications," *Microwave and Optical Technology Letters*, Vol. 65, No. 9, May 2023, pp. 2530–2534.
 - 8. C. Guo, J. Li, Yang Yu, F. Zhang, Y. Zhu, Q. Yang, W. Zhu, S. Zhu, X. Shang, Y. Gao, Y. Wang, G. -L. Huang, Q. S. Cheng and A. Zhang, "A 3-D Printed E-Plane Waveguide Magic-T Using Air-Filled Coax-to-Waveguide Transitions," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 67, No. 12, December 2019, pp. 4984–4994.
 - 9. M. M. Fahmi, J. A. Ruiz-Cruz and R. R. Mansour, "Compact Ridge Waveguide Gysel Combiners for High-Power Applications," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 67, No. 3, March 2019, pp. 968–977.
 - 10. J. Wu, C. Wang and Y. Guo, "Ridged Waveguide Magic Tees Based on 3-D Printing Technology," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 68, No. 10, October 2020, pp. 4267–4275.
 - 11. G. A. Kumar, B. Biswas and D. R. Poddar, "A Compact Broadband Riblet-Type Three-Way Power Divider in Rectangular Waveguides," *IEEE Microwave and Wireless Components Letters*, Vol. 27, No. 2, February 2017, pp. 141–143.
 - 12. K. Sharma, B. Biswas and S. K. Parui, "Design of a Compact Low Loss Four-Way Power Divider at W-Band," *7th International Conference on Electronics, Materials Engineering & Nano-Technology*, December 2023.
 - 13. K. Nobandegani and S. E. Hosseini, "Gysel Power Divider Realized by Ridge Gap Waveguide Technology," *IEEE Access*, Vol. 9, May 2021, pp. 72103–72110.
 - 14. Y. Liu and B. Zhang, "The Design of 220 GHz Four-Way Power Divider Based on E-Plane Directional Waveguide Hybrid," *14th UK-Europe-China Workshop on Millimetre-Waves and Terahertz Technologies*, September 2021.
 - 15. J. Ding, Y. Zhao, J. -X. Ge and S. Shi, "A 90 Degree Waveguide Hybrid with Low Amplitude Imbalance in Full W-Band," *Journal of Infrared, Millimeter, and Terahertz Waves*, Vol. 40, No. 4, April 2019, pp. 429–434.
 - 16. W. Lei, L. Li-hao and Y. Zhi-guo, "A Novel Power Splitter Based on the Waveguide E-Type T Junction," *Proceedings of the 5th Global Symposium on Millimeter-Waves*, May 2012.
 - 17. S. Liu, "A RF Window for Broadband Millimeter Wave Tubes," *International Journal of Infrared and Millimeter Waves*, Vol. 17, No. 1, January 1996, pp. 121–126.
 - 18. M. Cook, C. D. Joye, T. Kimura, E. L. Wright and J. P. Calame, "Broadband 220 GHz Vacuum Window for a Traveling Wave Tube Amplifier," *IEEE Transactions on Electron Devices*, Vol. 60, No. 3, March 2013, pp. 1257–1259.
 - 19. Y. -G. Ding, "Theory and Computer Simulation of High Power Klystron," *National Defense Industry Press*, Beijing, China, 2008, pp. 383–388.
 - 20. J. Zhang, Q. Liu, X. Li and Y. Liang, "A Compact TE11-TM01 Mode Converter for HPM Application," *Journal of Electromagnetic Waves and Applications*, Vol. 32, No. 17, April 2018, pp. 2314–2320.
 - 21. Y. -X. Huang, Y. -X. Yan, Y. -J. Yang and J. -X. Chen, "Broadband Low-Loss Four-Way Power Divider Using Composite Cavity," *IEEE Microwave and Wireless Technology Letters*, Vol. 34, No. 6, June 2024, pp. 595–598.
 - 22. L. Guo, J. Li, W. Huang, H. Shao and T. Ba, "A Compact Four-Way Power Combiner," *IEEE Microwave and Wireless Components Letters*, Vol. 27, No. 3, March 2017, pp. 239–241.



Get Up to Speed — Fast!

Register Now!

RF Technology Certification

Next Session Starts Soon! - Online

mmWave RFIC and MMIC Design Techniques

Contact us for the latest schedule.

Applied RF Engineering Certification - Online, On Demand

Applied RF Engineering 1, 2, and 3 plus RF Mentor Subscription

Radio Systems: RF Transceiver Design from Antenna to Bits & Back

Contact us for the latest schedule.

RF Productivity: Test Equipment

On Demand - Online

RF Power Amplifier Design Techniques

On Demand - Online

RF, Digital High Speed, PCB & EMI Design Fundamentals

On Demand - Online

RF and Wireless Made Simple

On Demand - Online

RF Wireless Circuit, System, and Test Fundamentals

On Demand - Online

www.BesserAssociates.com

Corporate Training Services

Besser Associates can provide our online and traditional classroom courses exclusively for your team. Our instructors can present almost any course from our full catalog at your domestic or international location. Contact us for more details!



www.besserassociates.com

RF Mentor Academy Subscription: Access select Besser online training courses & premium tutorials.

info@besserassociates.com



0.5 ~ 6GHz SURFACE MOUNT 90 ° HYBRID

High Power Handling

100W

Low VSWR / Low Insertion Loss / High Isolation

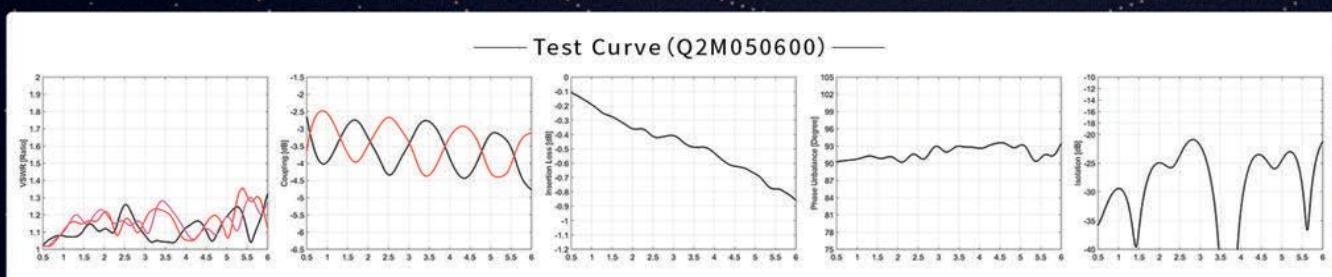
Excellent Amplitude & Phase Unbalance

Small Case Style, High-Performance & Cost-Effective



Freq. Range (GHz)	P / N	Nominal Phase Unbal. (Deg.)	Ports VSWR Max.(:1)	Insertion Loss* Max.(dB)	Amplitude Unbal. Max.(dB)	Phase Unbal. Max.(Deg.)	Isolation Min.(dB)	Power Max.(W)
0.5-6	Q2M050600	90	1.5	1.2	±1	±6	15	100

*Above Theoretical 3dB and Amplitude Unbalance



More Information-
Scan the QR Code



www.micable.cn

sales@micable.cn

Micable Inc.

+86-591-87382856

RF over Fiber Cable Assemblies in Military and Aerospace

Pasternack
Irvine, Calif.

Hybrid RF-over-Fiber (RFoF) communication systems are emerging as promising interference-resistant solutions in the military and aerospace industry. Their capability to transmit RF signals over long distances with minimal loss makes them suitable for both ground-based and aerospace applications, including UAVs and fighter aircraft such as F-15s. Trends driving this adoption include the demand for rugged designs, the need for futureproofing, the increased importance of cost efficiency and the desire for EMI immunity.

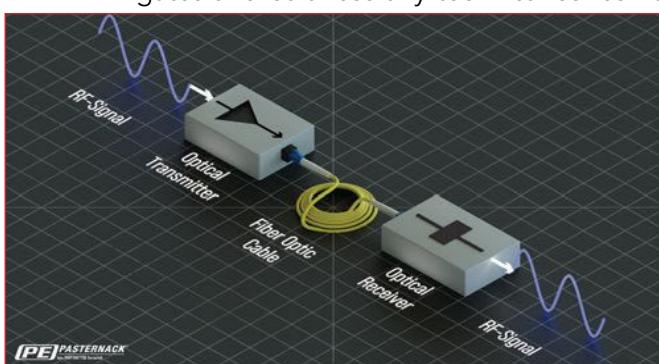
This approach merges the capabilities of RF and fiber technologies by converting RF signals into optical signals for transmission, then back to RF at the destination, as shown in **Figure 1**. The use of fiber allows for a cleaner signal that travels further with better protection. This hybrid system mitigates and balances any technical concerns

and challenges inherent to standalone RF or fiber systems, including signal jamming and interception.

BENEFITS OF HYBRID RFoF ASSEMBLIES

Hybrid RFoF systems provide long-reach, low loss and EMI immune RF transport across commercial, industrial, aerospace and military defense applications. By transmitting RF signals optically, these systems experience lower attenuation across longer distances, for example, greater than 20 km with fiber versus 30 meters with RF coax, while offering larger bandwidth for high speed communication across mission critical platforms. This allows sensitive RF equipment to be placed in controlled environments, while antennas and sensors operate remotely.

Fiber-optic cable offers a lightweight solution to traditional copper cabling, addressing the space and weight limitations encountered in aerospace systems. Additionally, when impacted by long distances, RF coaxial cables can experience signal loss that requires occasional amplification by adding additional components. Hybrid RFoF systems carry a clean RF signal further with better protection and a lower level of signal loss, which in turn saves space. RFoF isolates the signal from the environmental stressors that normally affect electrical cables, such as EMI, RF interference (RFI), ground loops or lightning-induced surges.



▲ Fig. 1 Example of an RFoF system.

ProductFeature



▲ Fig. 2 Examples of RFoF cables.

Military and aerospace vehicles often maneuver through rough terrain and strong winds with high vibrations and extreme temperatures. Signal integrity and latency are important to ensure safe operation and landings, making ruggedized components essential for these environments.

RF VS. FIBER VS. HYBRID BENEFITS

With military and aerospace systems demanding both signal and power transmission, there are some important differences between hybrid RFoF, legacy RF and fiber-optic cabling approaches, depending on the needs of a project.

RF cables are best used with short-range links, such as connecting antennas to radios in base stations. Legacy RF systems are beneficial where existing infrastructure is based on coaxial cabling. Additionally, RF cable assemblies are useful for applications where signal and DC power are transmitted together, like voice over internet protocol (VoIP) phones and security cameras.

Fiber-optic cables are useful for long-haul communications such as telecom backbones, submarine links, satellite and UAV ground stations. High speed digital systems benefit from fiber with 5G front haul as well as high frequency trading networks. Weight and space constraints are improved from the fiber's lightweight construction for aircraft and satellite applications. Fiber also assists with futureproofing, enabling higher frequency and increased bandwidth over longer distances.

Hybrid RFoF systems merge the

low loss, EMI immune advantages of fiber with the convenience of integrated power delivery by converting the RF into an optical signal for long distance transmission, then converting the signal back to RF. The benefits of RF and fiber are combined, allowing futureproofing, reduced maintenance and minimal signal loss. Fiber-optic cable assemblies are now the standard choice for telecom, defense radar/communications, broadcast uplinks and industrial automation. **Figure 2** shows examples of these cables.

MOVING FORWARD

Military and aerospace applications expect precision and reliability from their communication systems. RFoF is still navigating a slower adoption curve in the industry, but continued advancements are likely to help the next generation future-proof these systems for success. Data demand, bandwidth requirements, latency, interference management, optical component advancements and more will continue to push military and aerospace toward adopting new technologies for innovative solutions. Fiber cables have continued to evolve in speed and versatility, creating additional opportunities to increase operational efficiency.

Other potential avenues for RFoF technology can include integration with edge computing, integrated sensing and communication and multi-channel wavelength multiplexing, not to mention increased capabilities to handle security, resilience and redundancy demands. For optimal support, training and education can help move the industry forward, ensuring all parties are aware of challenges and solutions that will help overcome technical barriers for success.

VENDORVIEW

Pasternack
Irvine, Calif.
www.pasternack.com

SigaTek
Wide-Band Microwave
Communication Components
Same Day Shipping



Power Dividers
DC-70 Ghz



Directional Couplers
DC-70 Ghz



90° & 180° Hybrids
0.5-40 Ghz



Bias Tees DC-40 Ghz
High Current up to 2 A



Voltage Controlled
Phase Shifters
180° & 360°



High Power Couplers
Up to 2500 Watts

423 Black Oak Ridge Road
Wayne, NJ 07470
973-706-8475

www.sigatek.com

Tracking the Trajectory: How ESA Technologies Are Shaping Aerospace Test and Measurement

Emerson
Austin, Texas

Electronically-scanned array (ESA) systems are reshaping aerospace capabilities across missions ranging from low Earth orbit (LEO) constellations to hypersonic defense. These arrays are central to radar, electronic warfare (EW), communications and sensing applications, and their rapid evolution reflects broader industry trends. As digital convergence, cognitive functionality and real-time adaptability become defining characteristics, ESA technologies are being tasked with performing more functions, within tighter mechanical constraints, under increasingly complex operational conditions.

This transformation introduces both opportunities and challenges for aerospace engineers. ESA systems are more capable than ever, but they are also more difficult to design, integrate and validate. Understanding the trends shaping this evolution across antenna architecture, digital transformation, multifunction operation and real-world emulation offers critical insight into the direction of modern aerospace systems.

FREQUENCY, SIZE AND PERFORMANCE IN ESA DESIGN

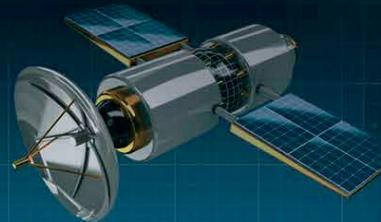
ESA architecture is driven by required performance characteristics such as operating frequencies, output power and attenuation. The physical dimensions of the antenna are determined by the spacing of transmit

and receive modules, typically placed at one-half wavelength intervals. As a result, antenna size scales inversely with operating frequency. Low frequency S-Band active electronically scanned arrays (AESAs), such as those used in PAVE PAWS or Cobra Dane for early warning detection and orbit launch surveillance, can span tens of meters and occupy the face of a building. Higher frequency mmWave arrays at Ka-Band or above can be compact enough for small UAVs or CubeSats.

At any fixed frequency, increasing the number of transmit/receive modules (TRMs) enhances system performance. Beamwidth is inversely proportional to aperture size, while gain is directly proportional. Larger arrays reduce sidelobes, improve clutter rejection and provide better angular resolution. These attributes are critical for long-range surveillance and target tracking. However, having more TRMs increases system complexity, power demands, thermal load and total cost, including the time and expense of validating hundreds or thousands of signal paths.

DIGITAL TRMS AND HIGH SPEED INTERFACES

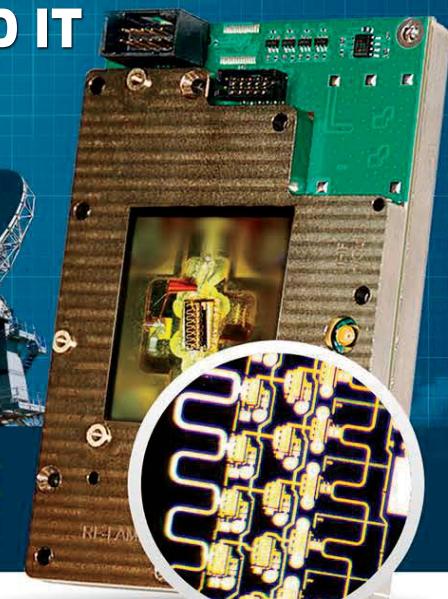
To address these issues, a major architectural shift involves adopting digital TRMs (DTRM), which integrate analog-to-digital and digital-to-analog conversion within



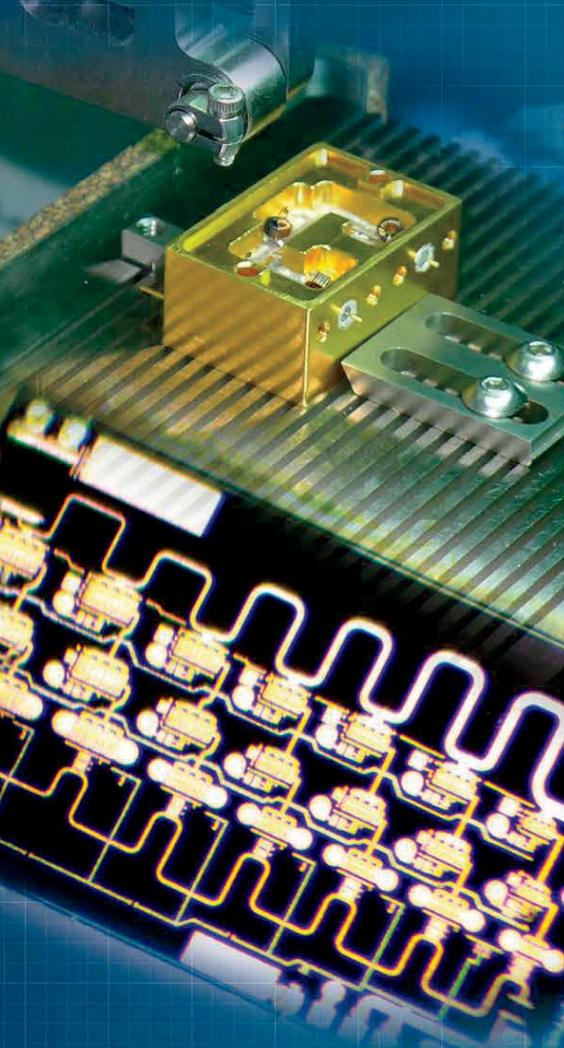
RF T/R MODULES UP TO 70GHz DREAM? WE REALIZED IT

LOW LOSS **NO MORE CONNECTORS**
GaN, GaAs SiGe **DIE BASED BONDING**
SIZE AND **WEIGHT REDUCTION 90%**

HERMETICALLY SEALED
AIRBORNE APPLICATION



SATCOM TR MODULE RX 50GHz TX 22GHz



TX/RX MODULE Connectorized Solution



RF Switch 67GHz
RFSP8TA series

RF RECEIVER

DC-67GHz
RF Limiter



RF Filter Bank

RF TRANSMITTER

0.01- 22G 8W PA
PN: RFLUPA01G22GA



RF Switch 67GHz
RFSP8TA series



0.05-50GHz LNA
PN: RLNA00M50GA

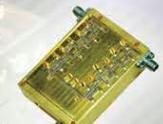


0.1-40GHz
Digital Phase Shifter
Attenuator
PN: RFDAT0040G5A

LO SECTION Oscillator



RF Mixer



RF Mixer

OUTPUT



INPUT

each module. Instead of relying on analog RF ports, these modules transmit digitized I and Q data via high speed serial interfaces such as JESD204C, 100 Gigabit Ethernet or Aurora.

This transition to digital simplifies integration with embedded beam-forming and digital signal processing architectures and improves data fidelity and synchronization. However, it also disrupts legacy test workflows. Traditional RF instruments, such as vector signal analyzers and network analyzers, cannot stimulate or measure digital-only devices.

To meet this need, test environments must incorporate digitally native platforms. The Emerson PXI-based instrumentation provides a flexible approach. The PXIe-5842 vector signal transceiver covers 30 MHz to 54 GHz and supports up to 4 GHz of instantaneous bandwidth. It enables measurement of critical metrics, including error vector magnitude, adjacent channel power, third-order intercept, noise figure and power-added efficiency. These measurements are vital for verifying DTRM performance, especially in applications involving radar or satellite communications (satcom).

AGILE ANTENNAS AND HIGH-THROUGHPUT FROM ORBIT

Shifts in satcom strategies have also driven ESA technologies to be central to the next wave of satcom. LEO constellations are replacing legacy geostationary systems with fleets of small satellites positioned 500 to 1200 km above Earth. These satellites deliver lower latency, higher bandwidth and global coverage, especially in remote and underserved regions.

LEO satellite payloads increasingly rely on electronically-steered antennas. These arrays can form multiple beams, dynamically track moving terminals and support spot beam architectures that optimize throughput. With operating frequencies often in the Ku- and Ka-Band, these systems require precise, wideband test instrumentation.

The PXI platform leverages the synchronization of multiple modular instruments, such as the PXIe-5842 and PXIe-7903, allowing real-time signal processing of modulated sig-

nals and enabling emulation and analysis of the entire communication chains at wide bandwidths as required by satellite links. These capabilities support verification of spectral efficiency, digital beam-forming and link-layer protocols. As LEO satellites integrate with 5G and upcoming 6G networks, test environments must also support compliance with 3GPP Release 17 and 18 for non-terrestrial network operation in the FR2 frequency range.

TESTING MULTIFUNCTION ARRAYS WITH MODULAR PLATFORMS

In order to more effectively leverage on-board constraints, ESA systems on modern aerospace platforms are increasingly more flexible and perform multiple roles. A single array, as demonstrated in **Figure 1**, may be tasked with air-to-air radar, electronic attack, satcom and GPS-based navigation. These functions may operate concurrently, either across separate subarrays or time-shared on the full aperture.

Multifunctionality demands flexible, high-throughput test strategies. Modular platforms such as PXI offer significant advantages in this context. A combination of vector signal transceivers, vector network analyzers, source measurement units and timing modules allows engineers to configure tests dynamically and evaluate all operating modes without re-cabling or realigning systems.

The PXIe-5633 network analyzer, for example, enables continuous wave and pulsed S-parameter measurements and can be paired with a VST to support spectral and modulation testing. SMUs can deliver programmable power for both steady-state and pulsed operation, allowing characterization under real-world thermal and electrical loads. Coordinated timing through the PXI backplane ensures phase-aligned, deterministic measurements across all instruments.

SHIFTING LEFT WITH HARDWARE IN THE LOOP

This complexity results in increasing impracticalities for testing ESA systems during late-stage integration due to their complexity and interdependence with other systems. To address this, hardware in the loop (HIL) environments allow validation to begin earlier, bringing real-world conditions into the lab where developers can simulate full mission profiles and evaluate system behavior under realistic threat, mobility and interference conditions.

Modern HIL setups are capable of emulating multiple emitters, receivers, platforms and environmental variables. PXI-based tools such as the PXIe-5842 allow synchronized measurements across multiple instruments, enabling analysis of large instantaneous bandwidths across multiple channels. This enables testing of system-of-systems (SoS) behavior, such as cooperative radar tracking, electronic protection and spectrum sharing. PXI platforms play a key role here by offering synchronized timing, low-latency signal generation and support for advanced RF measurement libraries such as RFmx. These capabilities help validate beam agility, waveform switching and spectrum awareness in real time.

ADAPTIVE BEHAVIOR AND COGNITIVE ESA VALIDATION

Cognitive capability is becoming a defining feature of next-generation aerospace systems. Electromagnetic spectrum operation platforms, including those that are ESA-based, can now learn from environmental conditions, optimize their transmit



▲ Fig. 1 Example of a multipurpose array.

SIX DAYS

THREE CONFERENCES

ONE EXHIBITION

EUROPE'S PREMIER
MICROWAVE, RF, WIRELESS AND
RADAR EVENT



EUROPEAN MICROWAVE WEEK 2026

SAVE THE DATE



EXCEL LONDON, UK



4TH - 9TH OCTOBER 2026

THE 29TH EUROPEAN MICROWAVE
WEEK COMBINES THREE CONFERENCES:

- The European Microwave Conference (EuMC)
- The European Microwave Integrated Circuits Conference (EuMIC)
- The European Radar Conference (EuRAD)

PLUS:

- Workshops, Short Courses, Focussed/Special Sessions
- Defence Forum, Space Forum, 6G Forum & Automotive Forum
- Student Activities

ALSO: The European Microwave Exhibition

6TH - 8TH OCTOBER 2026



EUROPEAN MICROWAVE ASSOCIATION



Media partner:



Co-organiser:



Technical co-sponsors:



EuMIC
THE EUROPEAN MICROWAVE
INTEGRATED CIRCUITS CONFERENCE



EuMC
THE EUROPEAN
MICROWAVE CONFERENCE



EuRAD
THE EUROPEAN
RADAR CONFERENCE



Supported by:



THE EUROPEAN SPACE AGENCY

INTERESTED IN EXHIBITING?
CALL +44(0) 20 7596 8742 OR VISIT WWW.EUMW.EU

CERNEX, Inc. & CernexWave

RF, MICROWAVE & MILLIMETER-WAVE COMPONENTS AND SUB-SYSTEMS UP TO 500GHz

5G Ready

- AMPLIFIERS UP TO 160GHz
- FREQUENCY MULTIPLIERS/ DIVIDERS UP TO 160GHz
- ANTENNAS UP TO 500GHz



- COUPLERS UP TO 220GHz
- ISOLATORS/CIRCULATORS UP TO 160GHz
- FILTERS/DIPLEXERS/SOURCES UP TO 160GHz
- SWITCHES UP TO 160GHz
- PHASE SHIFTERS UP TO 160GHz
- TRANSITIONS/ADAPTERS UP TO 500GHz
- WAVEGUIDE PRODUCTS UP TO 1THz
- TERMINATIONS/LOADS UP TO 325GHz
- MIXERS UP TO 500GHz



- ATTENUATORS UP TO 160GHz
- POWER COMBINERS/DIVIDERS EQUALIZERS
- CABLE ASSEMBLIES/ CONNECTORS UP TO 110GHz
- SUB-SYSTEMS UP TO 110GHz
- DETECTORS UP TO 500GHz
- LIMITERS UP TO 160GHz
- BIAS TEE UP TO 110GHz

Add: 1710 Zanker Road Suite 103, San Jose, CA 95112
Tel: (408) 541-9226 Fax: (408) 541-9229
www.cernex.com www.cernexwave.com
E mail: sales@cernex.com

Product Feature

chains and adapt waveforms to mission requirements. For example, an EW system might use machine learning to classify emitters and choose jamming techniques in real time. **Figure 2** shows an artist's rendition of an EW system in action.

Validating these systems requires more than performance measurements. Engineers must assess behavior under varying inputs, determine whether learning is occurring as intended and verify that adaptations do not degrade mission-critical functionality. This demands repeated testing in diverse scenarios using RF emulation, signal synthesis and behavior logging.

Test strategies must evolve to treat cognitive systems more like dynamic decision-makers than static signal chains. Measurement platforms should support traceability, closed-loop analysis and the ability to replay and modify mission scenarios. Just as human pilots must be trained and reassessed under stress conditions, cognitive ESA systems must be evaluated continuously under varied and unpredictable RF environments.

HYPERSONICS AND THE NEED FOR HIGH SPEED AGILITY

Lastly, the rapid emergence of hypersonic platforms poses a unique challenge to radar and tracking systems. These vehicles travel faster than Mach 5, often exceeding Mach 10, with extreme maneuverability and very low radar cross sections. Doppler shifts at these speeds can exceed 30 MHz, requiring radar systems with wide instantaneous bandwidth, high update rates and rapid reconfiguration.

To meet these requirements, ESA radar systems are adopting wideband, multichannel architectures and integrating GaN amplifiers for greater output power and efficiency. However, GaN devices demand highly accurate testing due to their nonlinear behavior, high power density and sensitivity to thermal and electrical stress.



▲ **Fig. 2** Example of an EW system in action, including ground, air and sea.

To test and validate these systems, simulated environments using FPGA-based radar emulation, wideband signal generation and synchronized measurement systems provide an effective alternative to expensive live-fire testing. These setups allow engineers to validate waveform design, beam agility and system response to high speed targets under repeatable and cost-effective conditions with flexibility that allows for ever-changing test requirements.

AEROSPACE READINESS THROUGH ADVANCED TESTING

ESA systems in aerospace applications are becoming more compact, intelligent and multifunctional. They are also more difficult to characterize due to integrated digital interfaces, cognitive features and demanding mission profiles. Success requires a new test philosophy based on flexibility, coordination and realism.

PXI instrumentation provides the modularity and performance required to meet these challenges. By supporting both device-level validation and system-level emulation, PXI-based platforms help accelerate development cycles, reduce integration risk and ensure mission readiness.

Aerospace innovation will increasingly be defined by the ability to adapt across frequency domains, functional modes and operating environments. ESA systems are enabling that adaptability. With the right test strategies, engineers can unlock their full potential and keep pace with the evolving demands of aerospace technology.

Emerson
Austin, Texas
www.ni.com

Featuring Keynotes • Technical Sessions • Workshops

EDI CON Online delivers essential technical training and information directly to engineers' desktops and mobile devices. Enjoy free, real-time training with simple registration and easy access.

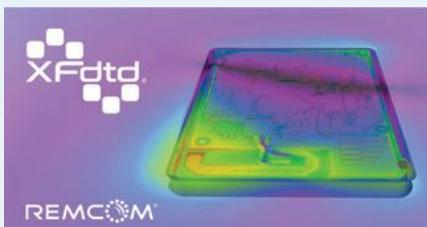


**NOW AVAILABLE
ON DEMAND**

5G/6G, IoT, Radar/Automotive/SATCOM

SI/PI/PCB/Interconnect/EMI

EDICONONLINE.COM



The new release of Remcom's XFDTD introduces a suite of tools designed to address the evolving challenges of modern antenna design, including a phase difference post-processing tool for phased array analysis, enhanced flexibility for far-zone pattern visualization and significant performance improvements to expedite workflows.

A new far-zone post-processing tool enables engineers to calculate and plot the phase difference between antenna elements, a critical capability for designers of phased arrays used in angle of arrival estimation for direction-finding systems. With the rapid growth of ultra-wideband (UWB) technology for high-precision indoor localization and tracking, accurately simu-

Phase Difference for UWB Direction-Finding in Simulation Software

lating the phase difference of arrival is essential for predicting system performance. By including a phase unwrapping option, XFDTD provides engineers with unambiguous results that are comparable to real-world measurements and eliminates a manual correction step.

Additionally, the far-zone spherical coordinate system can be reoriented, allowing users to generate 2D pattern cuts along any arbitrary plane. This provides a more discerning method for analyzing as-installed antenna performance on intricate platforms such as vehicles and aircraft. By providing insight into an antenna's full 3D radiation characteristics, XFDTD enables engineers to evaluate devices' real world performance.

Further enhancements focus on simulation fidelity, including support for waveguide ports utilizing XFDTD's XACT Accurate Cell Technology® conformal meshing feature. This sub-cellular conformal meshing technique allows the FDTD solver to represent curved surfaces and fine geometric features with high precision without the need for an excessively fine and computationally expensive grid. Applying this technology to waveguide ports improves simulation accuracy and higher-fidelity results for components like filters and couplers without sacrificing speed and efficiency.

VENDORVIEW

Remcom
State College, Penn.
www.remcom.com

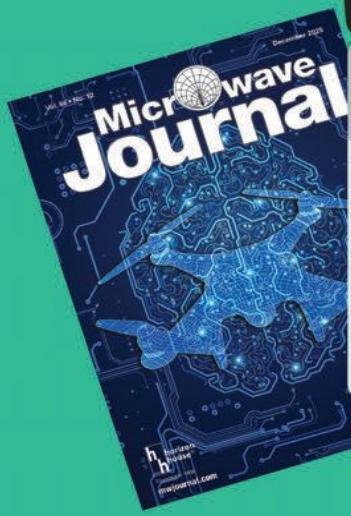


Frequency Matters.

Catch up on the latest industry news with the bi-weekly video update
Frequency Matters from Microwave Journal @ www.microwavejournal.com/frequencymatters

The Role of Drones in Improving ESM Validation

mmWave and UWB Security Screening Systems



Microwave Journal

Frequency Matters.

Advanced Testing of Next-Generation DRFM Jammers

The Design of Very Narrowband Tunnel Diode Negative Resistance Amplifiers

Sponsored By



RFMW



MICROCHIP



65 GHz Harsh Environment Attenuators and Terminations

XMA's 65 GHz coaxial attenuator and termination product lines are designed for high frequency systems in new space, quantum computing and military applications. The 65 GHz product line uses 1.85 mm connectors and operates from DC to 65 GHz up to 1 W of input power. The attenuators and terminations have VSWR values of 1.65:1 and 1.60:1 maximum at 65 GHz, respectively. XMA's attenuators are offered in a variety of attenuation levels, from 0 to 30 dB, including custom attenuation values for customer-specific applications. The 65 GHz product line is offered in a variety of outer conductor materials, including nonmagnetic

stainless steel and gold-plated copper. Product performance is driven by XMA's proprietary thin-film resistor chips, which are designed and produced in XMA's New Hampshire, U.S. facility. XMA's substrate materials and resistive layers make the products ideal candidates for harsh environment applications. XMA's coaxial products are designed and assembled to thermally ground the signal, further ensuring consistent performance in a variety of harsh environments.

XMA offers fully space-qualified 65 GHz products that have space heritage in LEO satellite constellation systems. These attenuators and terminations are fully TVAC compliant and have excellent G load stan-

dards exceeding 50 g RMS for 180 seconds on the X, Y and Z axes. In addition to their space heritage, XMA also offers 65 GHz products for use in cryogenic quantum computing applications. Their cryogenic components maintain consistent attenuation and VSWR from room temperature to millikelvin temperatures. In addition to 65 GHz attenuators and terminations, XMA offers DC blocks, directional couplers, power dividers, equalizers, infrared filters and a variety of cryogenic components for quantum computing.

XMA Corporation, an Amphenol Company
Manchester, N.H.
xmacorp.com

Become a Sponsor or Exhibitor at



19 - 24 April

Dublin, Ireland

EuCAP 2026 offers your company a great opportunity to showcase brand, solutions, innovation or just to keep in touch with your current and prospective clients.

More information on different options, package prices as well as registration forms are available in our sponsoring and exhibitor brochure.



<https://www.eucap2026.org/sponsors-exhibitors>

To find out more about sponsorship and exhibition opportunities at EuCAP 2026 or if you have any questions or requests, please get in touch with Exhibition-Sponsors@eucap2026.org.



Scan this QR code to download the Sponsors & Exhibitors Brochure

EurAAP

MAKING WAVES



Multi-Chip Synchronization of Two 16T/16R Systems

Witness a multi-chip sync across two X-Band 16T/16R systems with different spatial distances from their sync source.

Analog Devices

www.analog.com/en/resources/media-center/videos/6375180704112.html



New UWB Application Lab

Infineon Technologies established a dedicated ultra-wideband (UWB) Application Lab in Graz, Austria. Developed in collaboration with Silicon Austria Labs, the lab focuses on advancing UWB technology, exploring innovative use cases and delivering real-world applications for automotive, industrial, IoT and consumer markets.

Infineon Technologies
www.infineon.com



RFMW Expert Product Pick: Knowles MLSG Flatpack Aluminum Electrolytic Capacitors



RFMW Technical Marketing Manager Kirk Barton goes over a product of choice, the Knowles MLSG Flatpack™ series capacitor.

RFMW
<https://rfmwblog.com/>



MP1900A PCIe® 6.0 Rx and Tx LEQ Tests

Demonstration Video

Anritsu's video provides a step-by-step demonstration of how to use the Return Path Optimization Function of the MP1900A to perform PCIe6 RxLEQ tests.

Anritsu
bit.ly/43E4ZxK



SignalShark - Passive Drone Detection

With Narda's SignalShark, security authorities stay in control: cutting-edge RF direction finding detects drones in seconds — ensuring maximum safety, seamless monitoring and uncompromising airspace protection.

Narda Safety Test Solutions GmbH
www.narda-sts.com/index.php?eID=dumpFile&t=f&f=5745&dl=1&t=64dfe5a0fd3bec41de58ed14646909c53478a7e1



Building for What's Next

SV Micro just celebrated a major milestone, the ribbon-cutting of their new 31,000 sq. ft. Mesa, Ariz., facility. This expansion unites what were once two separate manufacturing buildings into one continuous, integrated space.

SV Micro
www.svmicrowave.com



NEW PRODUCTS

FOR MORE NEW PRODUCTS, VISIT WWW.MWJOURNAL.COM/BUYERSGUIDE
FEATURING  VENDORVIEW STOREFRONTS

DEVICES/ COMPONENTS/MODULES

Low-Cost Switched Filter Banks

 VENDORVIEW



Switched filter banks (SFBs) can have two to six channels and operate from 0.1 to 6.0 GHz in SMT or connectorized housings. Low

insertion loss: 1:0 to 3.0 dB typ., return loss: 12 dB min., isolation: 22 to 60 dB, power supply: 5 VDC, switching speed 135 ns typ., prices as low as \$250 for production quantities. This does not obsolete 3H robust mil SFBs that operate from 0.1 to 18.0 GHz, including high power options.

3H Communications

www.3hcommunicationsystems.com

SMT Microstrip Circulators and Isolators

 VENDORVIEW



Cernexwave's SMT microstrip circulators and isolators are an ideal solution for broadband or narrowband signal

control in a very small package. They are tailored to the exact frequency you need while maintaining low insertion loss and high isolation. Cernexwave can customize the size, shape and port locations to fit perfectly in your system. They can operate from as low as 2 GHz to as high as 30 GHz and handle power levels of 20 W or higher.

Cernexwave

www.cernexwave.com

Molded Power Inductors



Coilcraft's KTA3030 Series molded power inductors offer ultra-low inductance values starting from 40 nH, making them ideal for today's low-voltage, high-current DC-DC converters. Designed for single-phase and multiphase VRMs and PoL regulators, the KTA3030 delivers fast transient response, high current handling, and low DC as well as AC losses in a compact package. The series is ideal for modern CPUs, GPUs, ASICs and SoCs in servers, data centers, automotive and other power applications.

Coilcraft
www.coilcraft.com

8-Channel USB Programmable Attenuator

 VENDORVIEW



JFW model 50P-2140 SMA is an 8-channel USB programmable attenuator. It operates from 200 to 6000 MHz with attenuation range 0 to 95 dB by 1 dB steps. All eight attenuators are individually controlled. Test software is provided with the USB attenuator. If you would like to integrate the USB attenuator into your script testing, a JFW Python library is available upon request.

JFW Industries
www.jfwindustries.com

Passive MMIC Surface-Mount Bandpass Filter

 VENDORVIEW

The MFBP-00086CSP3 passive MMIC surface mount bandpass filter is an ideal solution for small form factor, high rejection filtering. The MFBP-00086CSP3 features a 12.7 to 17.9 GHz 1 dBc passband and 1.9 dB center frequency insertion loss. Passive GaAs MMIC technology allows production of smaller filter constructions that replace larger form factor circuit board constructions. Tight fabrication tolerances allow for less unit-to-unit variation than traditional filter technologies. The MFBP-00086CSP3 is available in our 3.5 x 3.5 mm CSP3 chip scale package.

Marki Microwave
www.markimicrowave.com

High-Power Surface-Mount 90-Degree Hybrid

 VENDORVIEW



Micable released the new 2.7~3.5 GHz high power surface-mount 90-degree hybrid. It has low insertion loss (0.2 dB max.), excellent VSWR (1.3:1 max.), extremely good amplitude unbalance (± 0.25 dB max.) and phase unbalance (± 5 degrees max.), high isolation (18 dB min.) and 300 W power handling capability with excellent stability and heat dissipation ability in a small package. It is suitable for power amplifier, power combining network, antenna feed network, modulator and phase shifter applications.

Micable Inc.
www.micable.cn

Surface-Mount SP4T Switch

 VENDORVIEW



Mini-Circuits' model M4SWA4-34DR+ single-pole, four-throw (SP4T) absorptive

GaAs MMIC switch covers the wide frequency range of DC to 30 GHz with input IP3 of +33 dBm or better. It features an internal driver and holds typical insertion loss to 0.9 dB at 10 MHz and 3.3 dB at 30 GHz. Isolation between switch ports is typically 76 dB at 10 MHz and 42 dB at 30 GHz. The switch is supplied in a 4 x 4 mm 24-lead QFN-style package.

Mini-Circuits
www.minicircuits.com

Tubular Filters

 VENDORVIEW



Reactel tubular filters are able to satisfy a variety of filter requirements. These versatile units cover

the broad frequency range of 10 MHz to 18 GHz, range in diameters from 1/4 to 1 1/8 in. and can handle power up to 200 W in the standard design. All standard tubular filters utilize a low ripple Chebyshev design which offers the best compromise of low loss, low VSWR and high selectivity. Each filter situation is unique. 10 MHz to 18 GHz.

Reactel Inc.
www.reactel.com

RF Switches



Conquer the harshest environments with DC to 18 GHz RF switches from Renaissance Electronics, an AEM company. Delivering exceptional performance for ground, sea, airborne and space applications, these switches are hermetically sealed for maximum protection and unwavering signal integrity. Available in Failsafe and Latching configurations, and adaptable from SP2T through SP8T configurations to meet your precise needs.

Renaissance/AEM
www.aeminc.com

New Products

Compact, Broadband Blocking Capacitors

VENDORVIEW



Knowles' Milli-Cap® broadband blocking capacitors are designed to minimize parasitics and deliver stable, low loss performance across wide frequency ranges. Their ultra-high series resonance and very low inductance make them ideal for demanding RF applications like test equipment, fiber-optic modules and broadband mmWave systems. With 0201, 0402 and 0602 footprints, they conserve board space while behaving like ideal capacitors, ensuring signal integrity and efficiency where every fraction of a dB matters.

RFMW
www.rfmw.com

For use with Aluminum, Kovar and other package materials



SPECIAL HERMETIC PRODUCTS, INC.
PO BOX 269 - WILTON - NH - 03086
(603) 654-2002 - Fax (603) 654-2533
E-mail: sales@shp-seals.com
Web: www.shp-seals.com

RF Amplifiers, Isolators and Circulators from 20MHz to 40GHz

- Super low noise RF amplifiers
- Broadband low noise amplifiers
- Input PIN diode protected low noise amplifiers
- General purpose gain block amplifiers
- High power RF amplifiers and broadband power amplifiers



- RF isolators and circulators
- High power coaxial and waveguide terminations
- High power coaxial attenuators
- PIN diode power limiters
- Active up and down converters

Wenteq Microwave Corporation

138 W Pomona Ave, Monrovia, CA 91016

Phone: (626) 305-6666, Fax: (626) 602-3101

Email: sales@wenteq.com, Website: www.wenteq.com

30 kHz~1.0 GHz Broadband Power Limiter



Model PL0100-01-30 is a PIN-diode based power limiter module designed to protect RF systems from ESD and input power surge damages up to 30 dBm power. It operates in the frequency range from 30 kHz to 1.0 GHz with 0.2 dB typical insertion loss and 1.2:1 max. VSWR. Compression starts when the input power reaches +7dBm and the leaked power at +27 dBm is less than +13 dBm. The package size of the amplifier is 0.75 x 0.70 x 0.4 in.

Wenteq Microwave
www.wenteq.com

AMPLIFIERS

W-Band Amplifier

VENDORVIEW



Providing 18 dB small-signal gain across the 75 to 110 GHz range, model SBP-7531141833-1010-C1-HR delivers +33 dBm saturated output power. The amplifier operates from a single +18 VDC supply and features WR-10 waveguide ports with anti-cocking flanges for reliable alignment.

Eravant
www.eravant.com

400 W High-Power Solid-State Amplifier



The Exodus AMP40051, 10.0 to 13.0 GHz solid-state amplifier producing > 400 W of power with 56 dB of gain. Ideal for EMI/RFI, lab, CW/Pulse and communications

NewProducts

applications. It is a rack-mounted system with wide bandwidth and built-in protection circuits. Also available are extensive monitoring parameters for forward/reflected power, voltages, currents and temperature with local LCD/remote interfaces in a rugged, reliable, compact design.

Exodus Advanced Communications
www.exoduscomm.com

Variable Gain Amplifier

VENDORVIEW



Quantic PMI Model PE2-34-2G18G-3R5-15-SFF-VVG-DD is a voltage variable gain amplifier with integrated diode detector operating over the frequency range of 2 to 18 GHz, optimized for 5.5 to 18 GHz that provides a gain of 30 dB with a gain flatness of ± 1.5 dB, a noise figure of 3.7 dB and an OP1dB of 10 dBm. Supplied in our standard PE2 housing that measures $1.08 \times 0.71 \times 0.29$ in. and can be used as SMA connectorized or as a surface-mount component.

Quantic PMI
www.quanticpmi.com

SOURCES

Combined Local Oscillator, Mixer & Amplifier

VENDORVIEW



The Combined Local Oscillator, Mixer and Amplifier (LO-MIX) offers a compact, competitively priced cost solution available in a frequency range from 2 to 45 GHz. It delivers up to +25 dBm output power with low VSWR (max. 2.5:1), low power consumption and low phase noise. An internal voltage regulator ensures stable performance across demanding applications.

Quantic MWD
www.quanticmwd.com

TEST & MEASUREMENT

Port Extender

VENDORVIEW



Copper Mountain Technologies (CMT) introduced the 75Ω PE0312-75 port extender, which expands CMT's product portfolio for 75Ω test solutions. This new product enhances the flexibility of multi-port testing for broadband, telecommunications, cable and RF research and production applications in 75Ω environments. The PE0312-75 is a USB-controlled, 12-port extender or switch, designed specifically for 75Ω measurements. It enables seamless expansion from a 2-port VNA to 12 ports for multiple devices or multi-output DUTs, without the need for re-cabling, streamlining complex test configurations.

Copper Mountain Technologies
www.coppermountaintech.com

Waveform Generators

VENDORVIEW



One year after launching its flagship 63xx series of arbitrary waveform generators (AWGs), Spectrum Instrumentation now introduces a new direct digital synthesis (DDS) option, significantly expanding the functionality of these already powerful instruments. In AWG mode, the products generate waveforms at up to 10 GSPS with 16-bit resolution and bandwidths reaching 3.9 GHz. In the new DDS-Mode, the 63xx series AWGs offer 64 individual sine waves on one generator channel, each changing frequency, amplitude and phase in steps of only 3.2 ns.

Spectrum Instrumentation
www.spectrum-instrumentation.com

IEEE Wireless and Microwave Technology Conference

WAMICON 2026 - Clearwater Beach, Florida

Marriott Sand Key

April 20-21, 2026



JOIN US

WAMICON 2026 will be held in Clearwater Beach, Florida on April 20-21, 2026. The conference addresses multidisciplinary research and technology trends in RF, Microwave and Wireless Communications.



CALL FOR PAPERS

WAMICON 2026 focus is *"Intelligent Heterogeneous Radio Hardware and Emerging Devices for Next-G Wireless and Beyond."* Submissions welcomed on all aspects of RF, Microwave and mmWave devices and systems along with hardware and software technologies enabling intelligent communications and sensing.

Prospective authors are invited to submit original work for presentation and publication in IEEE Xplore. Topics of interest include:

- Power Amplifiers, Active Components & Systems
- Passive Components & Antennas
- mmWave to THz Technologies
- Space & Emerging Applications
- Internet of Everything (IoE) & Machine Learning

Visit www.ieewamicon.org for complete submission details.

Important Dates

Paper Submission: February 6, 2026

Author Notification: March 9, 2026

Final Papers Due: March 23, 2026



www.ieewamicon.org

Exhibit/Sponsor Opportunities Available!

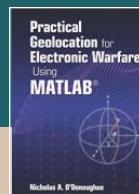
Email: arogers@modelithics.com

jaime@jlegercommunications.com

Piotr.Kulik@ucf.edu



Review by Brian Rautio



Bookend

Practical Geolocation for Electronic Warfare Using MATLAB

By Nicholas O'Donoughue

Having recently finished watching the new Masters of the Air series, while reading "Practical Geolocation for Electronic Warfare Using MATLAB," it was easy to draw parallels between the World War II European air campaign and modern electronic warfare (EW). The skies of World War II weren't a new frontier at the time, but the preceding exponential rise in flight technology brought gravity to it that had never existed. Similarly, modern processing and reliance on electronics have made EW indispensable. All that is not to say Dr. O'Donoughue has written a book on tactics or strategy — no, the situation is clearly out of scope, giving way to the underlying processes and algorithms — but the applications live in your mind as you read, motivating understanding of the material. Locations become helicopters or satellites, coor-

dinate systems become battlefields or orbits.

Modern geolocation is presented as an algorithmic version of systems engineering. Topics are wide and varied, including linear algebra, coordinate systems, programming, transforms, error estimation and more. Readers in any technical field will benefit from this book; the concepts collected have wide applications, are presented clearly and have many helpful citations. I was happy to grab an idea or two for EM-analysis preconditioners, for example.

Concepts are well-illustrated with figures and code examples, and Artech House has kindly printed the hardcover book in four-color, which makes it easier to parse. Each chapter highlights key concepts with exercises at the end, and the length, content and pace are all well-managed. This would be a

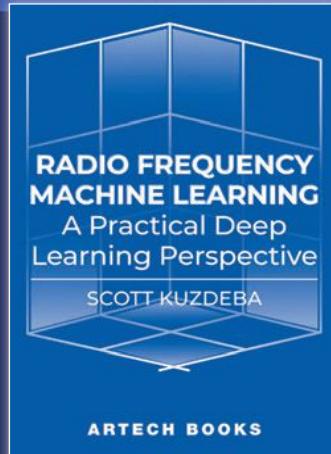
great companion for a 400- or 500-level course on related subject matter, and not necessarily microwave-related. The digital version also has videos, and the GitHub site is of special note. Shared with a related book from the same author, "Emitter Detection and Geolocation for Electronic Warfare" (2019), it has a set of MATLAB code, including examples. This is a fine book that I would recommend to anyone whose curiosity is piqued by the title.

ISBN: 9781630818883

Pages: 220

Copyright: 2022

To order this book, contact:
Artech House
us.artechhouse.com



Radio Frequency Machine Learning: A Practical Deep Learning Perspective

Author: Scott Kuzdeba

ISBN 13: 978-1-68569-033-5

ePub: 978-1-68569-034-2

Publication Date: January 2025

Subject Area: Microwave and RF Engineering

Binding / pp: Hardcover / 310pp

Price: \$144 / £114

Radio Frequency Machine Learning: A Practical Deep Learning Perspective goes beyond general introductions to deep learning, offering a focused exploration of how modern deep learning techniques can be applied directly to radio frequency (RF) challenges.

- ▶ Covers a wide range of applications, including classification tasks where deep learning is used to label and categorize signals based on a labeled training dataset, as well as clustering tasks that group similar signals together without labels.
- ▶ Investigates advanced topics like RF sensor control, feedback mechanisms, and real-time system operations, offering a comprehensive understanding of how deep learning can be integrated into dynamic RF environments.
- ▶ Addresses the practical concerns of deploying machine learning in operational RF systems.
- ▶ Explores emerging trends like edge computing and federated learning, offering a forward-looking perspective on the continued evolution of RF machine learning.

Whether the reader is just beginning the journey into RF machine learning or is looking to refine skills, this book provides an essential resource for understanding the intersection of deep learning and RF technology. This is a must-have resource for anyone interested in the cutting edge of wireless technologies and their potential to shape the future of communication.

 **ARTECH HOUSE**
BOSTON | LONDON

To learn more, please visit:
<https://us.artechhouse.com/>
<https://uk.artechhouse.com/>

EUROPE'S PREMIER
MICROWAVE, RF, WIRELESS AND
RADAR EVENT



EUROPEAN
MICROWAVE WEEK
EXCEL, LONDON
4th-9th OCTOBER 2026
www.eumw.eu

EUROPEAN MICROWAVE WEEK 2026

THE EUROPEAN MICROWAVE EXHIBITION



EXCEL LONDON, UK



6TH - 8TH OCTOBER 2026

- 10,000 sqm of gross exhibition space
- Around 5,000 attendees
- 1,700 - 2,000 Conference delegates
- In excess of 300 international exhibitors (including Asia and US as well as Europe)

INTERESTED IN EXHIBITING?

Please contact one of our International Sales Team:

Richard Vaughan,
International Sales Manager
rvaughan@horizonhouse.co.uk

Gaston Traboulsi, France
gtraboulsi@horizonhouse.com

Mike Hallman, USA
mhallman@horizonhouse.com

Victoria and Norbert Hufmann,
Germany, Austria & Switzerland

victoria@hufmann.info

norbert@hufmann.info

Katsuhiro Ishii, Japan

amskatsu@dream.com

Jaeho Chinn, Korea

inter11@jesmedia.com

CALL +44(0) 20 7596 8742 OR VISIT WWW.EUMW.EU

Advertising Index

Advertiser	Page No.	Advertiser	Page No.	Advertiser	Page No.
3H Communication Systems.....	35	IEEE WAMICON 2026	93	RapidRF AI Inc.....	23
Aaronia AG.....	COV 3	Infineon IR HiRel.....	61	Reactel, Incorporated.....	31
Anoison Electronics LLC.....	44	Infiwave	46	Remcom	65
Artech House	94	iNRCORE	57	Renaissance Electronics (An AEM Company).....	54
B&Z Technologies, LLC	11	Insulated Wire, Inc.....	75	Res-NET Microwave Inc.	92
Besser Associates.....	78	KR Electronics, Inc.....	70	RF-Lambda.....	9, 27, 63, 83
Bradford RF Sales	51	KRYTAR	26	RFMW	13, 49
Cernex, Inc.....	86	LadyBug Technologies LLC.....	50	Safran Electronics & Defense	68
Ciao Wireless, Inc.....	28	Marki Microwave, Inc.....	49	Santron Inc.	59
Coilcraft.....	21	Maury Microwave Corporation	41	Sigatek LLC	81
COMSOL, Inc.....	15	MECA Electronics, Inc.....	20	Signal Hound	43
EDI CON Online 2025.....	87	Mercury Systems, Inc.....	19	Smiths Interconnect	69
Electro Technik Industries, Inc.....	92	Micable Electronic Technology Group	67, 79	Special Hermetic Products, Inc.	92
Elve, Inc.....	22	Microwave Journal.....	88	Spectrum Control	7
Empower RF Systems, Inc.....	30	Microwave Products Group (a Dover Company).....	24	State of the Art, Inc.....	56
ERAVANT.....	8	Microwave Vision Group.....	45	Synergy Microwave Corporation.....	37, 77
EuCAP 2026.....	89	Miller MMIC	COV 2	Teledyne ADE	39
EuMW 2026.....	85, 95	Millimeter Wave Products Inc.....	71	The Phoenix Company of Chicago.....	47
Exceed Microwave	70	Mini-Circuits	4-5, 16, 32, 97	Trans-Tech	34
FEI-Elcom Tech.....	38	Narda Safety Test Solutions GmbH.....	74	WavePro, a Garlock Brand....	55
G.T. Microwave Inc.	76	Networks International Corporation.....	6	Weinschel Associates.....	52
GGB Industries, Inc.....	3	Nxbeam	25	Wenteq Microwave Corporation.....	92
Greenray Industries, Inc.....	53	Passive Plus	73	Werlatone, Inc.....	COV 4
Herotek, Inc.....	62	QML Inc.....	38	West Bond Inc.....	66

Sales Representatives

Eastern and Central Time Zones

Carl Sheffres
Group Director
(New England, New York, Eastern Canada)
Tel: (781) 619-1949
csheffres@mwjournal.com

Michael Hallman
Associate Publisher
(NJ, Mid-Atlantic, Southeast, Midwest, TX)
Tel: (301) 371-8830
Cell: (781) 363-0338
mhallman@mwjournal.com

Pacific and Mountain Time Zones

Brian Landy
Western Reg. Sales Mgr.
(CA, AZ, OR, WA, ID, NV, UT, NM, CO, WY, MT, ND, SD, NE & Western Canada)
Tel: (831) 426-4143
Cell: (831) 713-9085
blandy@mwjournal.com

International Sales

Michael O'Kane
Tel: +44 (0) 1875 825 700
Cell: +44 (0) 7961 038 245
mokane@horizonhouse.com

Germany, Austria, and Switzerland (German-speaking)
Victoria and Norbert Hufmann
Tel: +49 911 9397 6442
victoria@hufmann.info
norbert@hufmann.info

Korea

Jaeho Chinn
JES MEDIA, INC.
Tel: +82 2 481-3411
inter11@jesmedia.com

China

Shanghai
Linda Li
ACT International
Tel: +86 136 7154 0807
linda@actintl.com.hk

Shenzhen

Linda Li
ACT International
Tel: +86 136 7154 0807
lindal@actintl.com.hk

Hong Kong

Floyd Chun
ACT International
Tel: +86 137 2429 8335
floyd@actintl.com.hk

Taiwan, Singapore

Simon Lee
ACT International
Tel: +852 2838 6298
simonlee@actintl.com.hk

Japan

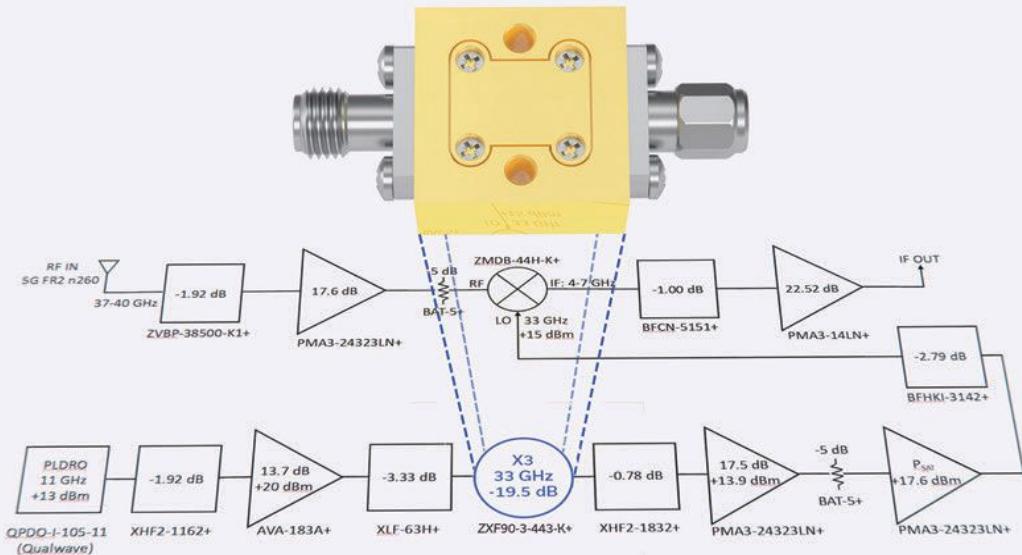
Katsuhiro Ishii
Ace Media Service Inc.
Tel: +81 3 5691 3335
amskatsu@dream.com

Submitting ad material?
Visit: www.adshuttle.com/mw
(866) 774-5784
outside the U.S. call
+1-414-566-6940

Ed Kiessling
(781) 619-1963
eKiessling@mwjournal.com



Corporate Headquarters: 685 Canton Street, Norwood, MA 02062 • Tel: (781) 769-9750



9 TO 72 GHz

Coaxial Frequency Multipliers

For High-Frequency LO Chains,
Upconverters & More

[LEARN MORE](#)



**High-frequency multipliers cover 9 to 72 GHz with
+12 to +20 dBm input in compact, coaxial housings.**



Model Name	Description	F Low	F High
ZXF90-3-223-K+	X3 Frequency Multiplier, SMA-F to 2.92 mm-M, 50Ω	10 GHz	22 GHz
ZXF90-3-443-K+	X3 Frequency Multiplier, SMA-F to 2.92 mm-M, 50Ω	20 GHz	43.5 GHz
ZXF90-3-453-V+	X3 Frequency Multiplier, SMA-F to 1.85 mm-M, 50Ω	20 GHz	45 GHz
ZXF90-3-64-E+	X3 Frequency Multiplier, 2.92 mm-F to 1.85 mm-M, 50Ω	30 GHz	60 GHz
ZXF90-3-723-E+	X3 Frequency Multiplier, 2.92 mm-F to 1.85 mm-M, 50Ω	40 GHz	72 GHz
ZXF90-2-44-K+	X2 Frequency Multiplier, 2.92 mm-F to 2.92 mm-F, 50Ω	12.4 GHz	40 GHz
ZXF90-2-153-K+	X2 Frequency Multiplier, 2.92 mm-F to 2.92 mm-F, 50Ω	9 GHz	15 GHz

FABS and LABS

PseudolithIC: Bringing Compound Semiconductors into the Age of RF CMOS



PseudolithIC, a leader in semiconductor heterogeneous integration, was founded in 2021 by Florian Herrault and James Buckwalter, who both remain in leadership as the company grows. PseudolithIC is headquartered in Santa Barbara, Calif., and focuses on creating solutions for satellite communication, cellular and backhaul communications, sensing, aerospace and defense, IoT and long-range radar. PseudolithIC combines highly differentiated semiconductor materials and functionalities into single chips, offering the performance of a MMIC in an RFIC ecosystem. This heterogeneous integration yields a 10 to 100x improvement in performance and efficiency compared to a monolithic approach. Additionally, this approach enables a highly scalable manufacturing process by lowering costs and eliminating waste.

PseudolithIC wafers are constructed from compound semiconductor chiplets embedded in a CMOS wafer. The PseudolithIC approach is categorized as an interposer-based approach where the small, 4 to 6 in. compound semiconductor wafer is diced into chiplets. Common compound semiconductors include GaAs, GaN and SiC. The chiplets are then integrated into a single wafer through cavities etched into a 200 or 300 mm silicon wafer, and interconnects are formed between the chiplets and the silicon interposer. To remove heat from the transistors, the backside of the wafer is metallized to create a thermal backplane. By constraining the compound semiconductor wafer area to realize only transistor chiplets, the cost of each transistor drops dramatically relative to a MMIC. MMIC costs are determined by a combination of wafer yield, die area and screening costs. By combining the low cost and high production quality of the commer-

cial silicon CMOS wafer and constraining the use of the compound semiconductors to only transistor chiplets, costs drop without compromising performance.

PseudolithIC's unique chipsets are applicable to a wide range of applications, including mmWave power amplifiers, low noise amplifiers and Tx/Rx front ends. PseudolithIC's mmWave power amplifiers combine Si CMOS, GaN and InP to operate at the Ka- and W-Bands. The LNAs use the heterogeneous approach to lower both the noise figure and power consumption, lowering costs and overall system power needs. Similarly, the PseudolithIC-powered Tx/Rx front ends enhance efficiency and lower power consumption. Each of these products can be amplified with built-in circuit intelligence and operate in harsh environments, including those with high radiation, cryogenic temperature exposure and mechanical shock.

PseudolithIC partners with world-class foundries globally and owns its heterogeneous integration process and capabilities, supplemented with a variety of in-house design and test capabilities. PseudolithIC designs new products using custom multi-technology process design kits and EDA tools. The team is able to test these new designs with in-house S-parameter, power and noise measurement systems through the W-Band. Additionally, they have a probe station with advanced thermal cycling capabilities for accelerated lifetime measurements. The combination of custom design tools, close foundry partnerships, heterogeneous integration capabilities and in-house test equipment allows for a quick prototyping phase, enabling PseudolithIC-powered products to hit the market sooner.

www.pseudolithic.com/



SPECTRAN® V6
BEYOND REALTIME

Setting the Mobile Benchmark

The **ULTIMATE** Real-Time Spectrum Analyzer Tablet

8 | 18 | 55 | 140 GHz 2x 490 MHz RTBW



HIGH-END SPECTRUM ANALYZER:

- 9 kHz up to 140 GHz
- Optional Tx (Generator)
- 2x 490 MHz Bandwidth
- 3 THz/s Sweep Speed
- 16-Bit ADC
- -170dBm/Hz | 4dB NF
- IQ Recording & Playback
- 8h Continuous Runtime
- Temp. Range -40° to +60°
- GPS & Time Server
- Opt. Handle & Stand
- Incl. RTSA-Software

RUGGED PREMIUM PC POWER:

- 15.6" 1500nit FullHD Touchscreen
- AMD 8-Core 8845HS CPU
- 64 GB LPDDR5 RAM
- Up to 64 TB Highspeed SSD
- 2x M.2 2280 & 3x M.2 2242
- Many I/Os incl. USB4, SD & HDMI
- SIM slot, opt. WiFi, Bluetooth, 5G
- SFP+ 10G Ethernet, SATA, RS232
- Rugged Aluminum Casing
- Hot-Swap Batteries
- Front & Rear Cameras, Smart Pen
- Windows or Linux

MADE IN GERMANY

www.aaroniausa.com

ubuy@aaroniausa.com

+1 (214) 935-9800

www.aaronia.com

mail@aaronia.de

+49 6556 900 310

AARONIA AG
WWW.AARONIA.COM



UNLEASH THE POWER

SUPERIOR EMC/EMI TESTING SOLUTIONS

WIDE BANDWIDTH | HIGH POWER | SUPERIOR PERFORMANCE

0.01 TO 220 MHZ | 0.01 TO 1000 MHZ | 80 TO 1000 MHZ | 600 TO 8000 MHZ | 6 TO 18 GHZ



QUADRATURE HYBRIDS



HIGH-POWER COMBINERS



DIRECTIONAL COUPLERS



DIGITAL POWER METERS

WERLATONE'S EMC/EMI TESTING SOLUTIONS ARE EMBEDDED IN EMC AMPLIFIERS,
TEST CHAMBERS, AND TEST LABS WORLDWIDE.

WE OFFER A VARIETY OF POWER LEVELS RANGING FROM 10 W CW TO 20 KW CW.

WERLATONE'S HIGH-POWER, MISMATCH-TOLERANT® SOLUTIONS ARE DESIGNED
TO OPERATE IN EXTREME LOAD MISMATCH CONDITIONS.

BRING US YOUR CHALLENGE | WWW.WERLATONE.COM



LEARN MORE

