Exploring Four Innovations’ Impact on Radar Technology

5G Trends for 2019

Tom Perkins: Medical Devices – Safety is Priority One

In the News

Featured Products

Product Highlights

Ideas for Today’s Engineers: Analog · Digital · RF · Microwave · MM-Wave · Lightwave
C.W. SWIFT & Associates, Inc.

C.W. SWIFT & Associates distributes our extensive inventory of SGMC Microwave’s quality products ... OFF THE SHELF!

Including These Connector Series

<table>
<thead>
<tr>
<th>Connector Series</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.85mm</td>
<td>DC-65 GHz</td>
</tr>
<tr>
<td>2.4mm</td>
<td>DC-50 GHz</td>
</tr>
<tr>
<td>2.92mm</td>
<td>DC-40 GHz</td>
</tr>
<tr>
<td>3.5mm</td>
<td>DC-34 GHz</td>
</tr>
<tr>
<td>7mm</td>
<td>DC-18 GHz</td>
</tr>
<tr>
<td>SSMA</td>
<td>DC-40 GHz</td>
</tr>
</tbody>
</table>

ISO 9001:2008

C.W. SWIFT & Associates, Inc.
15216 Burbank Blvd., Van Nuys, CA 91411
Tel: 800-642-7692 or 818-989-1133 or Fax: 818-989-4784
sales@cwswift.com • www.cwswift.com

CLOSED EVERY ST. PATRICK’S DAY!
Attenuators and Terminations
DC to 50 GHz, power handling up to 1000W
Available with various connector options and Low PIM.

Bias Tees, DC Blocks and Power Dividers
Up to 50 GHz
Including broadband and high current bias tees, high voltage and broadband dc blocks and resistive or Wilkinson power dividers.

Gain Equalizers and Phase Shifters
DC to 40 GHz
Fixed and adjustable gain equalizers and manually adjustable phase shifters.

Adapters, Connectors and Accessories
DC to 65 GHz
Adapters with various connector configurations, Planar Crown® and Planar Blindmate® connector systems, dust caps, opens, shorts, open/short/loads and impedance matching pads.
Now over 60 MMIC models In Stock covering applications above 26 GHz

MULTI-OCTAVE BANDWIDTHS

UP TO 43.5 GHz

Attenuators | Couplers | Mixers
Multipliers | Reflectionless Filters | Splitter/Combiners

Now over 60 MMIC models In Stock covering applications above 26 GHz
Now over 60 MMIC models in stock covering applications above 26 GHz.

Attenuators | Couplers | Mixers
Multipliers | Reflectionless Filters | Splitter/Combiners

Available in Plastic SMT & Unpackaged Die

MULTI-OCTAVE BANDWIDTHS UP TO 43.5 GHz

Available in Plastic SMT & Unpackaged Die

Mini-Circuits®

www.minicircuits.com  P.O. Box 350166, Brooklyn, NY 11235-0003  (718) 934-4500  sales@minicircuits.com
22: Feature Article

What’s Next: Exploring Four Innovations’ Impact on Radar Technology

By National Instruments

In aerospace and defense, some of the biggest areas of innovation and investment aren’t on the battlefield, but rather in the electromagnetic spectrum. From electronic countermeasures to electronic counter-countermeasures, techniques for intelligence, surveillance, and reconnaissance systems are evolving quickly.

This means engineers’ jobs are ever-evolving and more challenging than ever. System complexity may be increasing, but timelines and budgets certainly aren’t. Yet, underlying technologies are stepping up their game with the ability to design more sophisticated systems more quickly.

34: Feature Article

2019 5G Predictions

By Tom Cameron

2019 will be the year when we see the first commercial networks turning on and first handsets arriving in the market. Like previous generations, 5G will have low initial penetration but will accelerate in coming years as technology matures and user devices emerge.
NI AWR DESIGN ENVIRONMENT

SIMPLY SMARTER
FILTER DESIGN

NI AWR Design Environment is one platform integrating system, circuit, and electromagnetic analysis that addresses all stages and types of filter development. From lumped-element or distributed filters to more complex multiplexed, high-power, and high-Q cavity filters, the software supports the latest materials and topologies, enabling filter designers to meet challenging performance metrics and size, cost, and time-to-market goals.

Simply smarter filter design.

Learn more at awrcorp.com/filter
Medical Devices: Safety is Priority One

Tom Perkins
Senior Technical Editor

Medical electrical and electronic equipment are subject to unique conditions that can be critical to life sustainability and health. As a result, there are international standards that govern the safety of medical equipment and define detailed technical design requirements with all the associated needs for testing and compliance certification.

The original standard was established approximately 40 years ago. An update will soon be effective to deal more realistically with the latest Wi-Fi, Bluetooth, cellular phone, and other emissions. IEC/EN 60601-1-2 Electromagnetic Disturbances – Requirements and Tests sets medical device EMC requirements, defining limits on the amount of electromagnetic radiation a medical device can produce. It also provides test criteria to ensure that the device continues to operate safely in the presence of external electromagnetic interference.

On December 31, 2018, the fourth edition of standard EN/IEC 60601-1-2 will become mandatory. This specifies increased safety for medical devices. The result is additional evaluations beyond those imposed by previous editions. Emissions and immunity tests for medical products are similar to those applied to radio, television, networking equipment, computers, etc., but goes beyond requiring that basic safety and essential performance of the devices be preserved. This is a risk management process. There is special contingency for environments that may present high levels of electromagnetic disturbance, such as industrial sites and radio-therapy treatment rooms. Prior to developing a test plan, it must be determined what functions and their associated parameters need to be evaluated during immunity tests.

Highlights of Changes

The 4th edition includes three environments: professional healthcare, home healthcare, and special. The ESD levels have been increased from ± 6 to ± 8 kilovolts for contact discharges and ± 8 to ± 15 kilovolts for air discharges. Radiated immunity frequency limits have been increased slightly from 2,500 to 2,700 MHz. A proximity test was added. The modulation frequency is now 1,000 Hz. If a different modulation frequency is identified in the risk management process, it should be used.

If a wireless receiver is incorporated, an exclusion band cannot be used for its operating frequency. The Electrical Fast Transient/Burst (EFT/B) test is specified to be performed using a 100 kHz repetition frequency. DC power ports longer than 3 meters and signal ports that connect to outside cables are now subject to surge test. The conducted immunity frequency range and test levels were not changed, but a new test level at 6 Vrms was added for
some ISM and amateur radio bands. The power frequency magnetic fields (applicable only to products with magnetically sensitive components or circuitry), have been increased from 3 to 30 A/m. Allowable voltage dips have changed and transient conduction on DC power test for equipment installed in vehicles with 12 or 24 volt systems have been added.

Other requirements for various AC supply conditions have been relaxed as well, as lessor documentation tables. IEC/EN 60601-1-2 addresses the use of radios in a medical device. An exemption for the main transmit signal from the radiated emissions limits (with provision that they meet the national requirements) is defined. All other emissions must comply with the radiated emissions limits of the new code. The radio function must be tested at the complete product level.

One ubiquitous area that will be broadly impacted is power supply design. It has been suggested that equipment designers would be well served to select medical grade power supplies that comply with both IEC 60601-1 edition 3.1 and the 4th edition EMC standards. For example, in a radio frequency ablation system two possible scenarios could present unacceptable safety risk. The RF power setting could change, or the device could power on unintentionally.

While reducing time cycles for cost efficiency by, for example, monitoring multi-functions simultaneously, test modes must be realistic, reflecting real-world conditions. It may not always be possible to implement test-time reducing features and yet comply with the requirements of the entity or government agency that is responsible for reviewing the test data.

Summary

Acute product knowledge and often medical expertise is required to properly identify patient safety and how it relates to basic functions of medical devices. Typical device categories would include items like remote data logging telemetry systems, ablation systems, infusion pumps, and home patient monitoring systems. For many of these products, an assessment/update regarding the 4th edition will require testing and well considered updates to documents supplied to the end user (not always a medical professional or one with knowledge of electromagnetics). Risk management is very important. Electromagnetic compliance and compatibility must be an essential part of an assessment of the medical product’s safety and performance.

Powerful Payload & RF Link Emulator

- Link emulation: Delay, Doppler, AWGN, Phase shift
- Real time control for Arial Vehicle (UAV) testing
- Payload: MUX, Compression, Phase noise, Group delay
- Multipath: 12 paths per channel
- Up to sixteen synchronous channels with correlation

DBm Corp, Inc
32A Spruce Street • Oakland, NJ 07436
Tel (201) 677-0008 • Fax (201) 677-9444
email: info@dbmcorp.com www.dbmcorp.com

Get info at www.HFeLink.com
Meetings and Events

IEEE Radio Wireless Symposium 2019
January 20 – 23, 2019
Orlando
https://www.radiowirelessweek.org/

IMS 2019
June 3 - 7, 2019
Boston
https://ims-ieee.org/

IEEE Wireless Power Transfer Conference
June 18 - 21, 2019
London
https://www.mtt.org/conference-calendar

2019 IEEE WIE Leadership Summits
IEEE Women in Engineering International Leadership Summits (WIE ILS) provide regional opportunities to foster networking, mentorship, and collaboration. IEEE WIE will continue the WIE ILS program in 2019 as part of the portfolio of global initiatives that focus on Empowerment, Entrepreneurship, Leadership, and Emerging/Future Technology. https://wie.ieee.org/leadership-summits2019/

Company-Sponsored Training & Tools

Analog Devices
Training, tutorials and seminars.

NI AWR
On-site and online training, and open training courses on design software.

National Instruments
LabVIEW Core 1
Online
http://sine.ni.com/tacs/app/fp/p/ap/ov/pg/1/

LabVIEW Core 2
Online
http://sine.ni.com/tacs/app/fp/p/ap/ov/pg/1/

Object-Oriented Design and Programming in LabVIEW Online
http://sine.ni.com/tacs/app/fp/p/ap/ov/pg/1/

Free, online LabVIEW training for students and teachers.
http://sine.ni.com/nievents/app/results/p/country/us/type/webcasts/

HFE’s January Issue
Cables, Test & Measurement

Was Your Paper Rejected by a Symposium?

HFE Wants to See It
Email Summary to:
tim@highfrequencyelectronics.com
Lowest Noise in the Industry

Wide Band, Fast Tune Frequency Synthesizers

Industry Leading Performance!
The LUXYN™ MLVS-Series Frequency Synthesizers from Micro Lambda Wireless is one of the fastest and quietest synthesizers on the market. Standard frequency models are available covering 500 MHz to 20 GHz and 500 MHz to 10 GHz with options to cover down to 50 MHz and up to 21 GHz in a single unit.

With the lowest noise in the industry, (phase noise at 5 GHz is -130 dBc/Hz @ 10 kHz offset and at 10 GHz is -125 dBc/Hz @ 10 kHz offset), these synthesizers are designed for low noise & fast tune applications such as Receiving Systems, Frequency Converters and Test & Measurement Equipment.

For more information contact Micro Lambda Wireless.

www.microlambdawireless.com

Micro Lambda is a ISO 9001:2015 Registered Company

“Look to the leader in YIG-Technology”
5G Threatens to Displace Current Smartphone Leaders

Every new generation of mobile technology has resulted in huge disruption with market leaders stumbling, losing position and in most cases never recovering their former glory. Will 5G be any different? Probably not, according to Strategy Analytics smartphone consultants.

The latest report, “Winners and Losers in a Disrupted 5G Future” concludes:

- It is highly likely that the current top 3 smartphone vendors globally (Samsung, Huawei, Apple) will see their share decline.
- With each new generation (GSM, WCDMA, LTE) we have seen major changes in design language and use cases. Generation-led design changes have disrupted the status quo on numerous occasions.
- Nokia peaked in 2G and lost 1/3 of its share in 3G and disappeared in the 4G world.
- Motorola lost four-fifths of its global handset market share in the transition from 2G peak to 3G peak.
- Samsung grabbed opportunity in the transition to 3G, doubled its share, expanded to be a global leader with a “first with tech” brand claim.
- Chinese vendors burst onto the global stage in 4G with Huawei surging to #2 globally with its fast follower, affordable tech mantra.

Strategy Analytics has identified two main groups of vendors in the fight for 5G: Adaptive Local players and Global Scale Seekers. Chris Ambrosio, Director Consulting notes “Adaptive Local Players like Sharp, ZTE and more recently Sony have consolidated cost basis and a smaller, localized market presence. These vendors need to be more agile in how they market their brands and link features and technology to drive local brand value. Being able to align technology and feature choices with mobile operator needs is critical to survival but profits are possible if SG&A costs are managed effectively.

Cliff Raskind, Director Consulting adds “The second group for 5G is Global Scale Seekers. These players like Xiaomi, Vivo and OPPO have expanded their presence beyond local or domestic markets by establishing sales, marketing and distribution resources in enough markets to scale above 80M units and have established profit centers. Xiaomi is cash rich, has strong presence in China and India and Europe and soon will be competing strongly in the Americas with a broad range of smart devices. Deep marketing pockets and best in class consumer insights outside of China will be critical”

Ken Hyers, Director of Emerging Device Technologies comments “Smartphone vendors face a complex transition to 5G and to new foldable, rollable designs simultaneously at a time when consumers are increasingly reluctant to spend $800 - $1000+ for incremental improvements.

Competition on the basis of technology advantage will be extremely challenging and inevitably short lived without a healthy portfolio of intellectual property holdings. 5G represents opportunities for new vendors to emerge and for long time industry strugglers to reinvent themselves while current market leaders face reinvigorated competition.”

—Strategy Analytics
strategyanalytics.com

2019 Predictions: Customer Trust and User Experience Critical

Analysts at Strategy Analytics have released their top 10 predictions for 2019. Strategy Analytics identifies customer trust, improved Human Machine Interface and user experience to be the common glue that links automated vehicles, AI, 5G, intelligent home, IoT and workforce mobility and media/entertainment markets. Continued disruption is certain across the automotive, telecoms, media and technology value chains. The technology landscape and pace of innovation remains strong and the battle for brand relevance, brand fit across different customer segments will intensify in 2019 and beyond.

The latest report “2019 Predictions: Customer Trust and User Experience Critical across Automated Vehicles, AI, 5G and Connected Solutions” has key predictions for 2019, including:

1. At least 5 automated driving trials will be launched in 2019 – mostly from companies that are not mainstream automakers
2. Amazon and Google dominate Smart Speakers and Screens today but buyers are ready to consider many other brands for their purchases in 2019.
3. Commercial 5G networks will be in place in 15 markets at some level in 2019 but subs under 6M
4. 5G Smartphones will be Niche and Expensive Unless Subsidies Return. Foldable devices fun but still work in progress.
5. Silicon technology will capture market share in 5G millimeter wave front end functions
6. On-device AI Engines will Drive up Mid-Range Device Costs
7. Artificial Intelligence in the media and other industries will be slowed by a shortage of skilled practitioners.
8. Consumer trust in digital services will continue to fall during 2019 representing huge opportunities and challenges.
9. Global mobile workforce spending remains healthy. 42% of surveyed companies indicated IT spending will increase 1 - 6% in the next 5 years
10. Compliance and Tangible Business Benefits key for IoT but profitable participation will remain extremely tough.

—Strategy Analytics
strategyanalytics.com
Exceptionally high Q, low DCR and a wide range of inductance values make our wirewound chip inductors a sure bet!

Engineers love our high-performance, low-cost, wirewound ceramic chip inductors; considered by most to be the best performing wirewounds available.

For example, our 0201HL Series is offered in seven inductance values ranging from 22 to 51 nH – the highest currently offered in an 0201 (0603) package – making them fully optimized for impedance matching in 700 MHz band LTE and 5G applications.

Our 0402DC and 0805HP Series provide the industry’s highest Q factors in their respective sizes for super low loss in high frequency circuits. Select values from 2.6 to 820 nH, including 0.1 nH increments from 2.8 to 10 nH in the 0402DC Series.

Find out why our customers are so bullish on our wirewound ceramic chip inductors. Order your free samples today at www.coilcraft.com.
In a recent test series at Yuma Proving Ground in Arizona, DARPA's Collaborative Operations in Denied Environment (CODE) program demonstrated the ability of CODE-equipped Unmanned Aerial Systems (UASs) to adapt and respond to unexpected threats in an anti-access area denial (A2AD) environment. The UASs efficiently shared information, cooperatively planned and allocated mission objectives, made coordinated tactical decisions, and collaboratively reacted to a dynamic, high-threat environment with minimal communication.

The air vehicles initially operated with supervisory mission commander interaction. When communications were degraded or denied, CODE vehicles retained mission plan intent to accomplish mission objectives without live human direction. The ability for CODE-enabled vehicles to interact when communications are degraded is an important step toward the program goal to conduct dynamic, long-distance engagements of highly mobile ground and maritime targets in contested or denied battlespace.

“The test series expanded on previously demonstrated approaches to low bandwidth collaborative sensing and on-board planning. It demonstrated the ability to operate in more challenging scenarios, where both communications and GPS navigation were denied for extended periods,” said Scott Wierzbanowski, DARPA program manager for CODE.

During the three-week ground and flight test series in a live/virtual/constructive (LVC) environment, up to six live and 24 virtual UASs served as surrogate strike assets, receiving mission objectives from a human mission commander. The systems then autonomously collaborated to navigate, search, localize, and engage both pre-planned and pop-up targets protected by a simulated Integrated Air Defense System (IADS) in communications- and GPS-denied scenarios.

“The demonstrated behaviors are the building blocks for an autonomous team that can collaborate and adjust to mission requirements and a changing environment,” said Wierzbanowski.

The DARPA team also has advanced the infrastructure necessary to support further development, integration, and testing of CODE as it transitions to future autonomous systems.

Achievements include incorporation of third-party autonomy algorithms into the current software build, the creation of a government repository and lab test environment for the CODE algorithms, and the successful demonstration of the Johns Hopkins University Applied Physics Laboratory White Force Network capability to provide constructive threats and effects in an LVC test environment.

CODE's scalable capabilities could greatly enhance the survivability, flexibility, and effectiveness of existing air platforms, as well as reduce the development times and costs of future systems.

Further development of CODE and associated infrastructure will continue under DARPA until the conclusion of the program in spring 2019, followed by full transition of the CODE software repository to Naval Air Systems Command.

—DARPA

Program Targets Innovative Propulsion Solutions for Ground-Based Weapons Delivery System

The joint DARPA/U.S. Army Operational Fires (OpFires) program will soon kick off with three performers awarded contracts to begin work: Aerojet Rocketdyne, Exquadrum, and Sierra Nevada Corporation. OpFires aims to develop and demonstrate a novel ground-launched system enabling hypersonic boost glide weapons to penetrate modern enemy air defenses and rapidly and precisely engage critical time sensitive targets.
Low Insertion Loss from 16 KHz to 30 GHz

Advantages:
• Broadband Performance
• Low insertion Loss
• Flat Frequency Response
• Excellent Return Loss
• Unit-to-Unit Performance Repeatability
• Rugged Ceramic Construction

Features:
• EIA 0201Case Size
• Capacitance: 100 nF
• Operating Frequency: 16 KHz to 30 GHz
• Insertion Loss: <0.5 dB typ.
• Low Loss X5R Dielectric
• Voltage Rating: 16 WVDC
• Solderable SMT Terminations
• RoHS Compliant
OpFires seeks to develop innovative propulsion solutions that will enable a mobile, ground-launched tactical weapons delivery system capable of carrying a variety of payloads to a variety of ranges. Phase 1 of the program will be a 12-month effort focused on early development and demonstration of booster solutions that provide variable thrust propulsion across robust operational parameters in large tactical missiles.

“OpFires represents a critical capability development in support of the Army’s investments in long-range precision fires,” says DARPA’s OpFires program manager, Maj. Amber Walker (U.S. Army). “These awards are the first step in the process to deliver this capability in support of U.S. overmatch.”

The OpFires program will conduct a series of subsystem tests designed to evaluate component design and system compatibility for future tactical operating environments. Phase 2 will mature designs and demonstrate performance with hot/static fire tests targeted for late 2020. Phase 3, which will focus on weapon system integration, will culminate in integrated end-to-end flight tests in 2022.

—DARPA

Squad X provides Army and Marine dismounted units with autonomous systems equipped with off-the-shelf technologies and novel sensing tools developed via DARPA’s Squad X Core Technologies program. The technologies aim to increase squads’ situational awareness and lethality, allowing enemy engagement with greater tempo and from longer ranges.

The Squad X program manager in DARPA’s Tactical Technology Office, Lt. Col. Phil Root (U.S. Army), said Experiment 1 demonstrated the ability for the squad to communicate and collaborate, even while “dancing on the edge of connectivity.”

The squad members involved in the test runs praised the streamlined tools, which allowed them to take advantage of capabilities that previously had been too heavy or cumbersome for individual Soldiers and Marines to use in demanding field conditions.

“Each run, they learned a bit more on the systems and how they could support the operation,” said Root, who is also program manager for Squad X Core Technologies. “By the end, they were using the unmanned ground and aerial systems to maximize the squad’s combat power and allow a squad to complete a mission that normally would take a platoon to execute.”

—DARPA
Whether your coaxial application is at the tower top, GPS or in the base station, RF products designed and manufactured by PolyPhaser set the standard for the industry.

Superior Protection
PolyPhaser’s superior RF designs and platforms include system level protection, DC Pass, DC Block, Bias-T and Ultra-Low PIM products.

Patented Technology
Our patented designs are engineered for low voltage let-through and superior RF integrity, offering the industry’s best performing surge arrestors.

Guaranteed Performance
PolyPhaser’s field-tested product platform, is backed by a ten-year warranty and can be found in mission-critical communication applications in more than 160 countries.
Module: GPS Upgrade

Jackson Labs Technologies announced the 1-inch square Micro-Transcoder™ module which allows glue-less retrofitting of existing GPS equipment by upgrading the customers’ GPS systems with secure and assured PNT capability. The Micro-Transcoder™ is by a large margin the world’s smallest, full-constellation, stand-alone, real-time 10-channel GPS simulator.

The Micro-Transcoder™ achieves hardening of the customers’ GPS equipment by splicing the unit in-between the existing antenna and the users’ GPS receiver, and taking the output of any secure PNT source such as INS, SAASM, M-code, Iridium STL, or concurrent GNSS receiver and encoding (RF modulating) the baseband PNT and UTC timing information into a standard GPS L1 RF signal. This RF signal can then be received by any legacy GPS receiver. The unit can act as a GPS Firewall to identify and block jamming and spoofing attempts, and to provide an alternate PNT source during fully GPS-denied operation.

Jackson Labs Technologies
jackson-labs.com

5G White Paper

Skyworks’ latest white paper explores the challenges and opportunities associated with 5G and offers some practical solutions for 4G/5G dual connectivity and early network deployments. Given our role as an innovator of leading wireless technologies spanning generations of standards, we provide our unique perspective on the 5G rollout, illustrating how new radio features can be employed across different usage cases. In our newest video, “Sky5™ Makes 5G Work,” we describe the looming digital traffic jam and how our Sky5™ platform will empower the 5G revolution.

Skyworks
skyworksinc.com

Standard Converter Products

Norden announced that it now stocks standard converter products. Pictured is a NDC184010217N14 that operates at 18 - 40 GHz. Although we offer standard products, we also offer engineering support for converters that require custom design and packaging, custom LO and IF Frequency selection, conversion gain, and linearity requirements. With our extensive experience in design and manufacturing Norden can always deliver high quality converters 500 MHz - 110 GHz.

Norden Millimeter
nordengroup.com

Board Edge 2.92mm

Withwave’s Board Edge 2.92 mm is specially designed for high frequency substrates to minimize electromagnetic effects from coaxial to microstrip/CPW structure. We have various types of Board Edge products according to substrate clearance. We solve your performance and cost problems.

Features
- DC to 40 GHz
- Board Clearance: 0.6, 0.8, 1.0, 1.1, 1.2, 1.5, 1.6, 1.7, 2.1, 2.3 & 3.6 mm
- Easy Installation on designed substrate
- Applications
- RFIC Chip set evaluation board
- High data rate ASIC and SoC evaluation module test
- Substrate Characterization

Withwave
with-wave.com

VNA Coaxial Calibration Kit

Model STQ-TO-VFVM-U3-CKIT1 is a 1.85 mm coaxial vector network analyzer (VNA) calibration kit designed to work with industry standard network analyzers in the frequency range of DC to 67 GHz. The calibration kit consists of 1.85 mm male and female opens, shorts, matching loads, 1.85 mm male to male, male to female, and female to female adapters, and a 5/16” Hex Torque wrench. It is collected in a wooden box and is an ideal higher performance metrology grade calibration set for VNA system calibrations.

SAGE Millimeter
sagemillimeter.com

Pulse Power Meter

LadyBug Technologies’ thermally stabilized LB680A RF Pulse Power
The Right RF Parts.
Right Away.

We're RF On Demand, with over one million RF and microwave components in stock and ready to ship. You can count on us to stock the RF parts you need and reliably ship them when you need them. Add Fairview Microwave to your team and consider it done.

Fairviewmicrowave.com
1.800.715.4396

an INFINIT® company
Sensor is ideal for Defense and Commercial applications. The USB sensor makes measurements up to 20 GHz (18.6 GHz with Type-N connector). Order with the connector you need and place the sensor directly on your DUT for the absolute best match and accuracy. The LB680A now includes Option 004, wide bandwidth video. With its 35ns typical video rise time, the sensor is capable of making statistical and pulse profiling measurements on radar, communication signals and more.

LadyBug Technologies
ladybug-tech.com

Detectors and More
Herotek has been a quality supplier of RF and Microwave components since 1982. Herotek is a broad-based, high technology company supplying parts for the Military, Industrial and Commercial markets with designs from DC to 75 GHz. It offers standard products as well as thousands of custom designs, and is happy to match existing products. Herotek offers Detectors, Comb Generators, Limiters, Switches, GaAsFet Amplifiers (Broadband, Low Noise, and Power) and integrated subsystems of many types, including up and down converters, multipliers, harmonic mixers, and transceivers.

Herotek
herotek.com

Coaxial Cable Assembly, Phase Matched
Model SCW-VMVM012-F1-PM is a 12” long, flexible, phase matched coaxial cable with 1.85 (V) mm male connectors that cover the frequency range of DC to 67 GHz. The coaxial cable utilizes the highest quality test instrumentation grade cable and a precision manufacturing process to guarantee superior microwave performance and mechanical durability. Impedance is 50 ohms. Other lengths are offered under different models.

SAGE Millimeter
sagemillimeter.com

VNA Extension Modules
OML offers three configurations of the VNA Frequency Extension Module to expand your existing Keysight or Anritsu vector network analyzer to millimeter frequencies: T/R, T, and S. Depending on your S-parameter needs, refer to the following block diagrams to configure our module(s) with your existing VNA test port(s). With flexible ordering configurations, we can satisfy your preferences for economical and high performance needs.

OML
omlinc.com

Precision Receptacles
SGMC Microwave offers an extensive line of Precision Receptacles. 1.0mm, 1.85mm, 2.4mm, 2.92mm, 3.5mm, N, SMA, & SSMA are some of the various interfaces we have readily available. Configurations include, but are not limited to Threaded...
RF & MICROWAVE SWITCHES
The patented design of our highly reliable, high performance switches guarantee operation up to 10 million cycles, frequency range up to 50 GHz and superior repeatability.

ANTENNAS
A complete range of antennas dedicated to military & industrial markets including radio tactical communications, GPS, vehicle mounted, LMR/PMR and telemetry applications.

RF COAXIAL CONNECTORS
Offering over 13,000 part numbers and 55 product series including AEP® and Mil QPL connectors, the RF Coaxial Connector range is the largest in the industry and has been a part of the our diverse portfolio for over 60 years.

RF CABLE ASSEMBLIES
TestPro™ is Radiall’s innovative solution designed for test and lab measurements. The complete RF Cable Assemblies range offers flexible, semi rigid and hand-formable cable assemblies.

Call us today and let our experience work for you!
Barrel (spark plug), 2 & 4 hole flange, PCB Mount (pin or tab), and Extended Pin & Dielectric. Special/Custom Design service & modifications are also available. SGMC: the name to count on for Quality, Performance, and Reliability.

SGMC Microwave
sgmemicrowave.com

Common Mode Chokes
Coilcraft’s new 1812CAN Series common mode chokes provide noise suppression on CAN (1 Mbps) or CAN FD (5 Mbps) data lines in automotive and industrial automation applications. CAN Common Mode Chokes are the most commonly-used filter component to attenuate common mode noise at the CAN bus (Controller Area Network) transceiver’s output. The 1812CAN Series can also be used for the FlexRay automotive bus system.

Coilcraft
coilcraft.com

E-Band Mixer
Spacek Labs model M80 5X2B is an E-band mixer covering the two radio bands of 71 to 76 GHz and 81 to 86 GHz. The mixer includes an integrated LO doubler, so that the customer need only supply a 39 GHz source with +16 dBm of power. Spacek can also supply a phase locked source with the assembly. The conversion loss over the band is 6 dB typ and 9 dB max, with an IF frequency range of 2 to 8 GHz. The input P1dB is 6 dBm typ, and the bias is +12 VDC at 10 mA. The RF ports is WR 12 waveguide, LO input port is 2.92mm coax connector and the IF port connector is SMA (f).

Spacek Labs
spaceklabs.com

HOW TO SUBMIT
Product Releases to HFE
To be considered for publication, please submit text in Word along with a 300 dpi min. color JPG image of your product.
Submit to:
tim@highfrequencyelectronics.com
240 MHz - 18 GHz
- Case Styles as small as 0603
- Power Handling up to 3W
- Rugged Construction for Harsh Environments
- Outstanding Repeatability
System complexity may be increasing, but timelines and budgets certainly aren’t.

In aerospace and defense, some of the biggest areas of innovation and investment aren’t on the battlefield, but rather in the electromagnetic spectrum. From electronic countermeasures to electronic counter-countermeasures, techniques for intelligence, surveillance, and reconnaissance systems are evolving quickly.

This means engineers’ jobs are ever-evolving and more challenging than ever. System complexity may be increasing, but timelines and budgets certainly aren’t. Yet, underlying technologies are stepping up their game with the ability to design more sophisticated systems more quickly.

Four recent innovations will have huge enabling impacts on radar technology over the next several years:

**Gallium Nitride for Front-End Components**

Gallium Nitride (GaN), considered by some to be the biggest semiconductor innovation since silicon, is a material that is capable of operating at a much higher voltage than conventional semiconductor material. Higher voltage means better efficiency, so RF power amplifiers and attenuators using GaN consume less power and produce less heat. As more GaN-based RF component suppliers enter the market with production-ready, reliable products, the use of GaN-based amplifiers has increased.

This technology is important for the evolution of active electronically scanned array (AESA) radar systems. An AESA is a fully active array with hundreds or thousands of antennas, each with its own phase and gain control. Using a phased array of transmitters and receivers, these radar systems steer beams electronically without physically moving the antenna. These types of radar systems are growing in popularity because of their increased power on target, spatial resolution and improved robustness compared with other conventional radars. For example, if
one element in the array fails, the radar continues to operate. The increased use of GaN amplifiers in AESA radars should offer better performance, achieving equivalent output power with smaller form factors and requiring less cooling.

As applications and solutions using GaN technology grow more advanced, correlating component-level test results with those at a system level becomes more critical. Traditional methods of component test using vector network analyzers provide an accurate and narrowband view of forward and reflected gain and phase. However, the continuous wave (CW) stimulus in this popular method does not accurately reflect the actual signal environment the component is ultimately used in. As an alternative, you can take advantage of the wideband flexibility of vector signal analyzers and vector signal generators to create pulses and modulated stimuli more representative of real-world applications and their environments. Combining this capability with S-parameter analysis is an increasingly more strategic method of testing at a component level.

High-Speed Data Converters for Transmit and Receive

Another exciting advancement is in converter technology. The latest analog-to-digital converters (ADCs) and digital-to-analog converters (DACs) being released by major semiconductor companies are ultra-fast.

This is great news for radar, because the wider bandwidth not only allows for better spatial resolution but also makes it possible to implement some pretty interesting techniques. For example, a radar can hop around to different frequencies to avoid detection or use the same sensor to act as both a communications system and a radar simultaneously.

These converters are so fast that it’s actually possible to perform “direct RF sampling,” which simply means sampling so fast that you can acquire RF signals directly without up- or down-converting.

For example, the newest FlexRIO transceiver has 12-bit resolution up to 6.4 GS/s. At these rates, it’s possible to directly sample RF input signals up to C-band by moving much of the signal processing to the digital domain. This is also a big deal for AESA radars, because when you’re dealing with thousands of antennas, you can reduce the size and cost significantly by eliminating mixers and local oscillators.
Evolving FPGA Technology for Cognitive Techniques

Unsurprisingly, FPGA technology also continues to improve year after year. The computational capability of today’s FPGAs opens the door for innovative techniques that weren’t possible five years ago.

For example, engineers are now applying machine learning techniques so that radars are more responsive to their environment. By using machine learning, radars can perform new techniques like automatically recognizing different targets, or adjusting their operating frequency or waveform based on what’s going on around them.

In addition, higher level FPGA programming tools like the LabVIEW FPGA Module are becoming more capable, making it easier to port algorithms to FPGAs. This is a game changer for engineers and scientists who don’t have previous hardware description language (HDL) expertise or who have tight timelines. The tight integration between NI hardware and software allows LabVIEW FPGA to go a step further by abstracting the hardware infrastructure, such as PCI Express, memory controllers and clocking.

High-Bandwidth Data Buses for Sensor Fusion

Another key technology that’s paved the way for radar innovation is the evolution toward higher bandwidth data buses such as PCI Express Gen 3 and Xilinx Aurora. Using these buses allows you to aggregate data from multiple sensors for centralized processing.

In the same way that autonomous vehicles use sensor fusion to aggregate data from sensors like radar and LiDAR, you can use sensor fusion for fighters such as the F-35. Combining the data from radars, electronic countermeasure devices, communications devices and other sensors ultimately provides pilots better situational awareness.

With the rapid evolution of these underlying technologies, it’s unsurprising that radar techniques and architectures are also evolving. As technology continues to
PASSIVE PRODUCTS

NOW up to 65 GHz

Adapters • Attenuators • Couplers
DC Blocks • Splitters • Terminations
With the advent of the FPGAs and rapid adoption of new converters and streaming technologies in modular form factors, COTS solutions not only meet specification requirements but can offer flexibility to ensure systems achieve the longevity required for longer life cycles. By rapidly incorporating these technologies in modular, COTS form factors, NI enables engineers to meet the evolving requirements of advanced radar systems while also meeting strict timelines and budgets.
Delta & A.E. Petsche
your one-stop shop for
all your QPL requirements
MIL-PRF-39012 & MIL-PRF-55339
2019 5G Predictions

By Tom Cameron

2019 will be the year when we see the first commercial networks turning on and first handsets arriving in the market. Like previous generations, 5G will have low initial penetration but will accelerate in coming years as technology matures and user devices emerge. Like 4G, it will take several years from initial launch until 5G is the dominant technology globally. Based on recent announcements from key industry players (i.e. Verizon, AT&T, Sprint and T-Mobile), first 5G commercial deployments will likely commence during the second half of 2019 with a target to have 5G commercial service available in 2020.

One question to consider is will these networks be “true 5G?” It will depend on how 5G is defined. An accepted definition of a 5G subscriber is a device supporting the NR protocol connected to an NR basestation. This is independent of which spectrum band the network utilizes. While some may consider 5G only as operating in mmwave spectrum, truly all spectrum is 5G spectrum and we will see NR deployed across the entire spectrum range, depending on what assets operators have available to support their strategy. If you recall the original IMT2020 KPIs set out by the ITU, there are several requirements which will certainly be met, such as spectral efficiency improvements and super-high user data rates. However, don't expect all the KPIs to be achieved by any operator on Day 1. This is the reason why standards work is ongoing after Release 15. It will take time to evolve the network technology to meet all the original IMT2020 goals set out, such as ultra-high reliability and low latency.

The 5G standard timeline will continue to evolve.

The initial Release 15 specification (non-standalone, or NSA) was agreed upon and released at the end of 2017. There was a mid-year drop addressing standalone (SA) in June 2018, and we will continue to see a few late drops toward the end of 2018 into early 2019 mainly addressing dual connectivity. While there will be future enhancements, Release 15 laid down the foundation to enable initial SoCs to be defined and subsequent first user devices to be available in 2019. Work on Release 16 has started already, with a target to complete by the end of 2019. Major elements of the next release improve the wireless industry's ability to address vertical markets including enhancements to V2X, industrial IoT, and URLLC. Also included are the exploration of 5G in unlicensed bands, 5G for non-terrestrial use cases (satellite) and the move to higher-frequency bands above 52.6 GHz. There will be work toward various enhancements to
improve network efficiency, interference mitigation, MIMO enhancements, and exploration to improve location and positioning.

For the sub-6-GHz infrastructure, Release 15 radio standards specifications are comprehensive, and we do not see the standards activity having material impact on the analog radio going forward. Most of the forward-looking features reside in the baseband and generally will be implemented in software. This enables operators to install “5G-ready” equipment now and evolve as new features become available. For mmWave, we are still early in the game, and there may be some modifications to the standards as the industry learns and refines use cases. The Release 15 specifications are adequate to support first commercial deployments. However, the industry does not stand still, and 5G radios continue to evolve across all bands to deliver a lower cost of ownership to the operator.

There are hurdles that need to be cleared before full 5G deployment can be achieved.

First, we need new spectrum. This is well underway globally, whether it be mid-band or high-band spectrum, with many countries allocating spectrum for 5G. Ideal spectrum allocations for 5G are on the order of 50 MHz or more of contiguous spectrum to take full advantage of NR. Cost-effective 5G devices are required to drive subscriber adoption, whether these be user devices or machine-type devices. As with previous generations, we will see network infrastructure coverage roll out first and then capacity layered on as demand builds. In sub-6 GHz, we will see the coverage layer built on massive MIMO using existing infrastructure followed by densification. Small-cell deployments will be more critical to 5G to take advantage of higher-frequency spectrum. Overall, whether an operator capacity layer relies on massive MIMO, mmWave, or small cells, 5G will be built on a proliferation of antennae, which, in turn, drives a proliferation of radios.

While some may consider 5G only as operating in mmwave spectrum, truly all spectrum is 5G spectrum and we will see NR deployed across the entire spectrum range.
High Frequency Electronics

5G

Factors. Macro base stations in the low bands will expand MIMO channel counts from 2T2R to 4T4R and possibly higher. Massive MIMO radios will have increased radio density per system ranging from 16T16R to 64T64R, and mmWave radios will have up to 256 RF channels in the analog beamformers. The drive for smaller, more efficient radios that we have seen in 4G continues and, in fact, accelerates as we move into this age of beamforming radios. As an industry, we need to continue to reduce size, weight, and power (SWaP) consumption while supporting wider bandwidths and higher operating frequencies. There are various approaches to reduce the SWaP consumption of the radio systems, the most common approach leveraging circuit integration and Moore’s Law to shrink the size and improve power efficiency.

There will be exciting 5G applications coming in 2019. Initially, 5G will provide the ability to deliver mobile broadband at lower cost to operators, but as full NR capability emerges, there are some exciting applications and use cases forthcoming. Industrial automation is one of the promising use cases that may leverage the low latency and high reliability provided by future 5G networks. There is a range of possible wireless use cases from predictive maintenance to AR/VR for troubleshooting and repair, remotely controlled and cooperative robotics to fully autonomous robotics. Initially, wireless networks need to provide similar connectivity to existing wired industrial Ethernet networks, but going forward, 5G may be leveraged to evolve factories to create more flexible and efficient production lines.

Autonomous vehicles are quickly evolving with onboard sensor technologies and computing power gaining the ability to replicate the human driver. However, many agree that for Level 5 autonomy, reliable, ultra-low-latency wide-area connectivity will be required. The wide-area connectivity will complement the power of the onboard sensors and decision making by providing situational awareness and extend the vehicle’s ability to look down the road to make decisions in a fraction of a second. Going forward, the evolution of 5G-based C-V2X enables vehicles to share their sensor data across a wide area so that vehicles may better predict road conditions to plan their routes and take evasive action to avoid unsafe situations.

About the Author
Tom Cameron is Director of Wireless Technology at Analog Devices.
New reduced size models (0805)
- Insertion loss as low as 0.8 dB
- Higher rejection rate, up to 45 dB
- Over 230 models in stock!
ARE YOU 5G-READY?

LET US BE YOUR ONE-STOP SHOP FOR MMWAVE COMPONENTS & SUBASSEMBLIES.

SAGE Millimeter, Inc.

WWW.SAGEMILLIMETER.COM

MADE IN USA
VIEW PRICING, LEADTIME, AND INVENTORY

NEW SAGE WEBSITE

Over 2,500 millimeterwave components off-the-shelf, in stock, and ready to ship guaranteed in only 1-3 days.

SAGE STOCKROOM
DC to 67 GHz, 3 dB Attenuation, 1.85 mm (V) Coaxial Attenuator

Model SCA-03-VMVF-S2 is a 3 dB coaxial attenuator that is used in millimeterwave systems and operates from DC to 67 GHz. The attenuator has a typical attenuation value of 3 dB across the frequency range. While the attenuator is designed and fabricated for full 1.85 mm coaxial band applications, the attenuation value of this model will have a wide range due to its broadband coverage. Various attenuation values are available under different model numbers.

SAGE Millimeter
sagemillimeter.com

DC to 67 GHz, 1.85 mm Female to 1.85 mm Female Coaxial Adapter

Model SCT-VFVF-UB is a 1.85 mm female to 1.85 mm female coaxial adapter that covers the frequency range of DC to 67 GHz. This coaxial adapter offers efficient transitioning between the coaxial connectors with a high return loss and typical insertion loss of 0.6 dB. The impedance of the adapter is 50 Ohms. Other configurations are available under different model numbers.

SAGE Millimeter
sagemillimeter.com
Thank You for being part of our history... and our future:
For fifty years, we at Mini-Circuits have remained committed to creating high-quality products quickly and efficiently, at competitive prices, and with uncompromising service and technical support. For fifty years, you have rewarded our commitment by trusting us with your business. We pledge to work even harder as we move forward to keep earning your confidence and adding value to your work.
Pasternack expanded its line of RF coaxial probes into the 40 GHz operating frequency range for use in microwave components, high-speed communications and networking.

Pasternack’s extended line of coaxial RF probes now includes 4 models that deliver 10 dB maximum return loss over the broad frequency range of DC-40 GHz. These probes are offered in GS and GSG configurations with a pitch of 800 or 1500 microns and a 2.92mm interface. They are gold-plated and have compliant pogo pin contacts that allow for a wide range of probing angles. These RF coaxial probes can be used by hand, with or without a probe positioner, and can be cable mounted or mounted with Pasternack’s multi-axis probe positioner. They are ideal for signal integrity measurement, chip evaluation, coplanar waveguide, Gigabit SERDES, substrate characterization and test fixture applications.

“We are excited to offer this unique extension of our already successful line of RF probes. The extended 40 GHz frequency range of these GS and GSG probes will help testers cover a whole new range of applications, including 28 Gbps data channels,” said Dan Birch, Product Manager.

Pasternack’s new expanded line of coaxial RF probes is in stock and ready for immediate shipment with no minimum order quantity. For detailed information on these products, please visit https://www.pasternack.com/pages/rf-microwave-and-millimeter-wave-products/coaxial-rf-probes-and-positioner.html.
Product Focus

Pulse Power Meter

Sensors are housed in a robust metal enclosure for durability and offer a variety of connectors including N, SMA, 3.5mm and 2.92mm so that you can obtain the best possible match.

LadyBug Technologies’ thermally stabilized LB680A RF Pulse Power Sensor is ideal for Defense and Commercial applications. The USB sensor makes measurements up to 20 GHz (18.6 GHz with Type-N connector). Order with the connector you need and place the sensor directly on your DUT for the absolute best match and accuracy.

The LB680A now includes Option 004, wide bandwidth video. With its 35ns typical video rise time, the sensor is capable of making statistical and pulse profiling measurements on radar, communication signals and more.

The included full featured software is capable of making a wide range of measurements such as Crest Factor, Droop, Peak & Pulse Power along with Average Power and statistical information like CDF, PDF and CCDF. Drivers for ATE users along with example code in various platforms are all provided.

These advanced features, combined with LadyBug’s patented No-Zero before use, make an ideal solution for test systems, the lab and general use.

We manufacture a broad line of high quality first tier NIST traceable USB power sensors. Our sensors are compatible with Windows XP, Win 7, 8 & Win 10; in 32 and 64 bit systems. We offer LINUX compatible sensors along with the only Optional SPI & I2C power sensor available. With our patented NoZero NoCal feature, it is not necessary to zero or calibrate before making measurements, even for low level measurements requiring high accuracy. Simply connect and measure. The sensors are housed in a robust metal enclosure for durability and offer a variety of connectors including N, SMA, 3.5mm and 2.92mm so that you can obtain the best possible match. We include limit free, flexible applications for use with our products at no additional cost.

LadyBug Technologies
ladybug-tech.com
Dedicated, Proactive Support for Instruments and More

Keysight Technologies announced KeysightCare, a new service model that offers design and test engineers dedicated, proactive support for instruments, software, and solutions.

Not maintaining equipment can lead to costly errors that delay product development and put a customer’s potential market advantages at risk. Addressing these issues starts with keeping equipment up-to-date with the latest software and current calibration. KeysightCare offers unparalleled access to a range of resources such as technical experts, training materials, productivity tools, knowledge centers, and success managers, to speed customer innovation, and accelerate product time-to-market.

KeysightCare provides:
- A choice of service-level agreements that help prioritize support and deliver rapid response times via a dedicated portal that tracks support cases and offers access to relevant expert information
- Improved predictability of projects with scheduled calibration of test equipment and certified precision to support the intense demands of the latest industry applications and standards
- Insight into potential issues before they happen, with proactive notifications of the latest software and firmware updates, and access to online resources such as the Keysight Knowledge Center and productivity tools.

Enhanced productivity of engineering teams with dedicated access to experts who possess deep knowledge and understanding of current and changing technologies, as well as industry standards

“Our customers need to meet a faster technology development cycle. They cannot be late due to delays caused by lack of software and hardware updates, test equipment failure, test methodology questions, or equipment calibration requirements,” stated John Page, president of Keysight Global Services. “KeysightCare offers enhanced service levels that will enable engineers to deliver better, faster results, consistently.”

KeysightCare is offered in three service levels: Assured, Enhanced, and Performance:

The KeysightCare Assured service level offers committed response time to get customers the technical answers they need, faster. A customer portal delivers access to a cloud-based knowledge base containing the latest information developed through decades of R&D and test experience, plus online support to manage service requests, and access to expert advice related to test and measurement challenges.

The KeysightCare Enhanced service level enables customers to avoid costly errors and delays with ongoing calibration, personalized support, and faster response times with a customer service manager focused on quickly identifying the procedure, test expert, or equipment updates needed to address a specific challenge.

The KeysightCare Performance service level is ideal for customers focused on being first to market or who have a mission-critical project. It offers all the benefits of the previous tiers, plus emergency access to support outside normal business hours, and on-site services designed to keep customers efficiently operating from design to manufacturing.

Keysight
keysight.com
KRYTAR, founded by Thomas J. Russell in 1975, is a privately owned California corporation specializing in the manufacture of Ultra Broadband mmWave, Microwave, and RF components and test equipment for both commercial and military applications. The KRYTAR product line includes directional couplers, directional detectors, 3 dB hybrids, MLDD power dividers/combiners, detectors, terminations, coaxial adapters and a power meter. Our products cover the DC to 67.0 GHz frequency range. The broadband design expertise at KRYTAR has created unique new designs, several of which are patented. KRYTAR has applied these designs to consistently introduce technologically advanced products with superior electrical performance and ruggedness.

Our modern facility houses a completely equipped machine shop, including CNC lathes and mills. The corporation also possesses all the electronic test equipment necessary for testing its products from DC to 67 GHz.

Included in the test equipment is a Hewlett Packard 8510B Automatic Network Analyzer with 8515A (45 MHz – 26.5 GHz) and 8517A (45 MHz – 50.0 GHz) S-Parameter Test Sets and Agilent Technologies E8361A PNA Series Network Analyzer (10 MHz – 67 GHz). The KRYTAR Quality Assurance Program is in accordance with MIL-I-45208 including a calibration system per MIL-STD-45662. To ensure reliability and performance, the quality assurance system controls all phases of manufacturing: purchasing, machining, processes, assembling, testing and shipping.

KRYTAR
krytar.com
Oscillators, Filters, Synthesizers, and More

“

Our YIG devices and equipment offer the biggest names in the EW, ISM, and aerospace industry the lowest phase noise and superior multi-octave tuning capability.

"
Ducommun offers a diverse array of design, engineering and manufacturing capabilities that service the aerospace and defense market, oil & gas exploration, test and measurement, telecommunications, space and medical markets. With over 50 years of heritage in custom product solutions, the Ducommun team can support your Human Machine Interface, Motion Control Device, RF and custom electronics manufacturing needs.

Founded in 1849, Ducommun is the oldest company in California. Evolving from a hardware supply store opened by Charles Ducommun in Los Angeles during the California Gold Rush, the company assisted in the birth of the aerospace industry in Southern California by providing aircraft aluminum to early aerospace pioneers like Lindbergh, Douglas and Lockheed.

Today, Ducommun is a global provider of innovative manufacturing solutions for customers in the aerospace, defense and industrial markets. We specialize in two core areas – Electronic Systems and Structural Systems – to produce complex products and components for commercial aircraft platforms, mission-critical military and space programs, and sophisticated industrial applications.

Our company is organized to leverage our full spectrum of capabilities through common, companywide processes and value-added services like new product introduction, supply chain strategies, and program management that create value for the customer and to facilitate ease of doing business.

Electronics Solutions – Full-service manufacturing services for high mix, low volume production of complex electronics used in high cost of failure applications. Key competencies include high-reliability interconnect systems, printed circuit board assemblies, and integrated electronic, electromechanical and mechanical assemblies and systems.

Structures Solutions – Large, complex contoured structural components and assemblies for aerospace and other applications. Our integrated processes include stretch-forming, thermal-forming, chemical milling, precision fabrication, machining, finishing processes, and integration of components into subassemblies.

Ducommun
ducommun.com

---

**MM-Wave, Microwave, and More**

Ducommun offers a full portfolio of millimeter wave products up to 110 GHz.

**mmW Products**

**DC-110 GHz**

Trust in Ducommun mmW Products for all your high frequency testing needs. Ducommun offers a full portfolio of millimeter wave products up to 110 GHz.

<table>
<thead>
<tr>
<th><strong>Amplifiers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Offering 0.03 to 110 GHz</td>
</tr>
<tr>
<td>Low noise / high power</td>
</tr>
<tr>
<td>Single DC supply / internal regulated sequential biasing</td>
</tr>
<tr>
<td>Broadband or custom design</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Up/Down Converters</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Full waveguide band capability</td>
</tr>
<tr>
<td>Low spurious / harmonics</td>
</tr>
<tr>
<td>Low LO frequency &amp; power</td>
</tr>
<tr>
<td>Compact lightweight</td>
</tr>
</tbody>
</table>

| **MMW mixer/multiplier/SNA extender solutions** |
|----------------|----------------|
| K, Ka, O, U, V, E, W full band |
| Broadband and low harmonic / spur |
| Custom design |
| Low cost solution |

<table>
<thead>
<tr>
<th><strong>Transceivers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>TRX for K, Ka, O, U, V, E &amp; W bands</td>
</tr>
<tr>
<td>Integrated modular design</td>
</tr>
<tr>
<td>High sensitivity / low cost</td>
</tr>
<tr>
<td>Custom design per request</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Pin Diode Switches</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>SPST to SP8T configurations</td>
</tr>
<tr>
<td>Nano second (ns) level switching</td>
</tr>
<tr>
<td>0.03 GHz to 110 GHz</td>
</tr>
<tr>
<td>Reflective and absorptive</td>
</tr>
</tbody>
</table>

For additional information contact our sales team at:
10-513-7256 or rfsales@ducommun.com

Get info at www.HFeLink.com
Precision SMA Panel Cable Connectors

SMA Female/Jack 2 and 4 Hole configurations for .085 Semi-Rigid Cable (Direct Solder)

Featuring:
- DC-26.5 GHz
- Low VSWR & Insertion Loss
- Gold Plated 303 Stainless Steel Bodies for solder ability and durability.

- Quality, Performance, & Reliability you can count on.

SGMC MICROWAVE is a registered ISO 9001:2015 manufacturer of precision coaxial connectors including cable connectors, adapters, and receptacles. Located in Melbourne, Florida, SGMC Microwave was founded to provide the microwave and millimeter-wave industry with high-quality products that meet the demands of the most advanced applications.

1.85mm Male Direct Solder One-Step Cable Connectors for .085” Cables
with high-quality products that are precision grade and readily available.

We are committed to quality and performance and consider our connectors “precision components.” Total customer satisfaction by meeting or exceeding expectations is our primary mission.

1.85mm Male Direct Solder One-Step Cable Connectors for .085” Cables

SGMC Microwave’s One-Step connectors have “Captivated” center contacts offering excellent performance up to 65 GHz (usable up to 67 GHz). With no loose parts to handle, assembly is as simple as trimming the cable and then inserting it into the body for soldering.

- DC-65 GHz / VSWR: 1.25:1 Max per connector
- Captivated center contact (beryllium Copper, gold plated)
- Body Components (Corrosion resistant Type 303 Stainless steel, passivated)

Download the SGMC Microwave product catalog at http://www.sgmcmicrowave.com/content/SGMC_MICROWAVE_2013_PRODUCT_CATALOG.pdf

SGMC Microwave
sgmcmicrowave.com

How to BOOST SALES Via a Cost-Effective PR Campaign

- Press Releases
- Articles
- White Papers
- Online and in Print

Tim Burkhard has 30 years of proven experience promoting companies, technology, and products in the RF and Microwave space. Multiple studies show that increasing PR increases your bottom line, in good times and bad.

Cost-effective and targeted PR, promotion, and advertising experience.

Exposure equals leads equals sales opportunities. Call or email today for a free quote from a proven professional.

Tim Burkhard
tpburk@aol.com  707-544-9977
Pin Diode Switch

PMI Model No. P16T-100M20G-60-T-512-SFF is a single pole, sixteen throw, absorptive pin diode switch that operates from 0.1 to 20.0 GHz. This model has a typical insertion loss of 8.5 dB and 60 dB of isolation. It operates at 20 dBm CW and is controlled with 4-Bit decoded TTL logic. Other features include removable SMA connectors, +5 VDC @ 750 mA Max, gold plated finish and 8.0” x 3.0” x 0.65” package size.

Planar Monolithics Industries
pmi-rf.com

Attenuator

PMI Model DTA-26R5G40G-30-CD-1-OPT32G37G is a 10-Bit programmable 30 dB PIN diode attenuator with a step resolution of 0.03 dB over the frequency range of 32.0 to 37.0 GHz. This model operates on a single +15 VDC supply and draws only 50 mA of current. Very high levels of attenuation accuracy of 0.03 dB are achieved. This attenuator provides ultra-fast switching speeds of 300 ns and has an operating input power rating of +10 dBm. This model is supplied in a small, light-weight housing measuring 2.0 x 1.8 x 0.5 inches.

Planar Monolithics Industries
pmi-rf.com
Custom Microwave Components and More

Designers in the RF-microwave industry require higher frequencies, lower spurious and phase-noise performance, smaller footprints, and more cost-effective components and assemblies.

Oscillator-Based Microwave Components

NI's broad array of microwave components include voltage-controlled oscillators (VCOs), fixed-tuned oscillators (FTOs), phase-locked oscillators (PLOs), digitally tuned oscillators (DTOs), high-speed clocks, and frequency multipliers up to 67 GHz and beyond.

Integrated Microwave Assemblies (IMAs)

To respond to rapid advances in technology across multiple industries, the NI team leverages its extensive microwave-technology knowledge to design and manufacture highly complex, multi-function integrated microwave assemblies (IMAs) as solutions for engineering challenges.

QuickSyn Frequency Synthesizers

The popular QuickSyn frequency synthesizer is widely utilized in both military and commercial applications.

NI Microwave Components
http://ni-microwavecomponents.com/
Ceramic Capacitors

PPI has the 01005BB Broadband 100nF Ceramic Capacitors. The 01005BB104 – the industry's smallest 100nF broadband part characterized for RF performance -- has a case measuring (mils) 16 x 8 x 8, and offers resonant free RF coupling/DC blocking from 16 kHz (lower 3-dB frequency) to beyond 65 GHz with < 1 dB insertion loss and < -15 dB return loss on suitable substrates. The 01005BB104 is rated at a DC working voltage (WVDC) of 4.0 and is available in a nickel-tin termination.

The 01005BB104 has global RF models available (with 90-day free trials) from Modelithics Inc. that enable accurate CAD simulation on various substrates, with a range of mounting pad dimensions. All lots are tested at RF frequencies to insure performance consistency.

Passive Plus
passiveplus.com

Low ESR/ESL Capacitor Series

Passive Plus, Inc. (PPI) offers a Low ESR/ESL EIA capacitor series. These multi-layer capacitors have been developed for High-Q and Microwave applications, where the need for Low Noise, High Self-Resonance, and High Working Voltage are required. They exhibit ultra-stable performance over temperature and are fully RoHS compliant.

With over 30 years in the RF/Microwave industry, Passive Plus, Inc. manufactures high quality, high power passive components using state-of-the-art manufacturing techniques. Specializing in Magnetic & Non-Magnetic HI-Q Capacitors product lines, PPI supplies reliable quality components to the Military, Medical, Semiconductor, Broadcast and Telecommunications Industries.

Passive Plus
passiveplus.com
Power Amp

Skyworks announced its latest cellular infrastructure innovation, the SKY66313-11, a wide instantaneous bandwidth power amplifier with industry-leading efficiency for FDD/TDD 4G LTE and 5G applications. This breakthrough solution is utilized in small cell and massive MIMO base stations to deliver higher data rates and enhanced network efficiency that result in improved carrier capacity and greater coverage for data-intensive, multimedia and Internet of Things devices.

The amplifier’s highly efficient design boasts fully-matched input/output and high gain for best-in-class operation. With an integrated on-chip active bias circuit, the device provides excellent performance over temperature, voltage and process variations and facilitates faster design cycles.

Skyworks
skyworksinc.com

Mobile Antenna Solution

Skyworks is proud to announce its latest mobile antenna solution, the SKY13699-21, which offers exceptional insertion loss/isolation performance in an exceptionally compact package – minimizing signal loss and footprint challenges for system designers.

Intelligent antenna management plays a critical role in today’s high performance smartphones, particularly with the onset of 5G and the addition of new features and performance requirements. Selecting an antenna that delivers the best transmit power and receive sensitivity is integral in reducing the chances of dropped calls.

Skyworks
skyworksinc.com
Fairview Microwave unveiled a new line of seamless and twistable flexible waveguides covering 10 frequency bands from WR-137 to WR-22 and operating in the 5.85 GHz to 50 GHz range. Typical applications include base stations, DAS systems, antennas and test instrumentation.

Fairview Microwave’s new line of flexible waveguides consists of 78 models – 39 seamless and 39 twistable, all operating in the same wide range of frequencies. All models are offered with UG-style square/round cover and CPR-style flanges, and are available in lengths of 6 to 36-inches.

The seamless models in this series are constructed of a solid piece of brass that is pressed into shape. These flexible waveguides deliver VSWR as low as 1.07:1, max power as high as 5 kW, insertion loss as low as 0.06 dB and can be used in pressurized applications.

The twistable models are made with twist-flex material that is wound, interlocking brass which allows it to slide on itself, making it able to twist in different directions. These flexible waveguides provide max power as high as 1.5 kW, insertion loss as low as 0.15 dB and VSWR as low as 1.05:1.

“This new product line is the perfect addition to our quickly growing, comprehensive family of ready-to-ship waveguide solutions. These flexible waveguide components deliver designers and engineers with an in-stock source of wide-range, flexible waveguide solutions for their applications up to 50 GHz,” explains Steven Pong, RF Passive Components Product Manager.

Fairview Microwave’s new flexible waveguides are in stock and ready for immediate shipment with no minimum order quantity.

Fairview Microwave offers immediate delivery of RF components including attenuators, adapters, coaxial cable assemblies, connectors, terminations and much more. All products are shipped same-day from the company’s ISO 9001:2008 certified production facilities in Lewisville, Texas. Fairview Microwave is an Infinite Electronics brand.

**Fairview Microwave**

fairviewmicrowave.com
RF Transistors and More

AMCOM RF Transistors include Discrete Power GaN HEMTs, GaAs FET (good linearity at back-off) and GaAs pHEMT (good power density and efficiency).

AMCOM has all the expertise, manpower, space, and equipment for manufacturing state-of-the-art products. Some of our capabilities are: active device design, MMIC design, and power amplifier module design. In addition, we are experts in device/MMIC packaging, module assembly and RF/DC testing. For active devices, we either procure parts such as silicon LDMOS, or GaN HEMT, or we use a semiconductor foundry to fabricate our own proprietary device/MMIC.

AMCOM was established in December 1996 by a group of microwave designers experienced in both microwave circuit design and microwave device fabrication technology. It is located in Gaithersburg, Maryland, USA, about 20 miles northwest of Washington, DC.

The company has earned a reputation as a leading edge microwave design organization that includes power FETs, MMIC power amplifiers, as well as high-power amplifier modules with RF and DC connectors that are ready to be used in microwave systems. One of our specialty products is high-power, broadband, high-efficiency power amplifiers.

AMCOM
amcomusa.com

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency</th>
<th>V_supply</th>
<th>I_dq</th>
<th>Gain</th>
<th>P1dB</th>
<th>Psat</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM003040SF-4H</td>
<td>0.05-3GHz</td>
<td>24-28V</td>
<td>3.5A</td>
<td>43dB</td>
<td>41dBm</td>
<td>42dBm</td>
</tr>
<tr>
<td>AM004042SF-2H</td>
<td>0.05-4GHz</td>
<td>40-50V</td>
<td>1.5A</td>
<td>24dB</td>
<td>40dBm</td>
<td>42dBm</td>
</tr>
<tr>
<td>AM042644SF-3H</td>
<td>0.3-2.6GHz</td>
<td>28-32V</td>
<td>2.7A</td>
<td>35dB</td>
<td>43dBm</td>
<td>44dBm</td>
</tr>
<tr>
<td>AM153042SF-4H</td>
<td>1.3-3.4GHz</td>
<td>15-20V</td>
<td>6A</td>
<td>36dB</td>
<td>42dBm</td>
<td>43dBm</td>
</tr>
<tr>
<td>AM206545SF-3H</td>
<td>2-6.5GHz</td>
<td>32-40V</td>
<td>2.5A</td>
<td>28dB</td>
<td>38.5dBm</td>
<td>45dBm</td>
</tr>
<tr>
<td>AM02018041SF-3H</td>
<td>2-18GHz</td>
<td>32-40V</td>
<td>3.4A</td>
<td>26dB</td>
<td>36.5dBm</td>
<td>41dBm</td>
</tr>
<tr>
<td>AM07511242SF-3H</td>
<td>7.5-11.2GHz</td>
<td>12-15V</td>
<td>5.5A</td>
<td>23dB</td>
<td>40.5dBm</td>
<td>41.5dBm</td>
</tr>
<tr>
<td>AM08513241SF-3H</td>
<td>8.5-13.2GHz</td>
<td>12-15V</td>
<td>6A</td>
<td>25dB</td>
<td>40.5dBm</td>
<td>41.5dBm</td>
</tr>
<tr>
<td>AM00010037UM-1H</td>
<td>0.05-10GHz</td>
<td>+28,-2V</td>
<td>0.3A</td>
<td>13dB</td>
<td>30dBm</td>
<td>37dBm</td>
</tr>
<tr>
<td>AM30040031SF-3H</td>
<td>30-40GHz</td>
<td>+6,-0.6V</td>
<td>1A</td>
<td>17dB</td>
<td>27dBm</td>
<td>31dBm</td>
</tr>
</tbody>
</table>

For more detailed information please visit:
www.amcomusa.com

Get info at www.HFeLink.com
Get Up to Speed with Training in 2019

Founded in 1985, Besser Associates delivers live and alternative media training to professionals working with analog, RF, wireless, digital, and networking technologies. We’ve trained over 60,000 people in these industries. Our instruction combines theory with hands-on practice, the latest tools and technology, and the most appropriate training media for individualized, meaningful participant experiences. This education is critical to process and product innovation in the highly competitive RF, wireless, and networking industries. Training options include our public courses, customized/private courses at your facility, and online/eLearning courses.

**RF Technology Certification**
Next Session Starts Jan 25, 2019 – Online

**Applied RF Engineering I**
Next Session Starts Jan. 14, 2019 - Online - Rex Frobenius

**Radio Systems: RF Transceiver Design from Antenna to Bits & Back**
Feb. 25 - Mar. 01, 2019, San Diego, CA - Dr. Waleed Khalil

**mm-Wave RFIC and MMIC Design Techniques**
February 25-27, 2019, San Diego, CA - Dr. Ali Darwish

**Transceiver and Systems Design for Digital Communications**
February 25-27, 2019, San Diego, CA - Scott Bullock

**Cognitive Radios, Networks, & Systems for Digital Communications**
Feb. 28-Mar. 01, 2019, San Diego, CA - Scott Bullock

**GaN Power Amplifiers - Web Classroom**
April 2-4, 2019, Online, On-Demand - Dr. Ali Darwish

**Phase Noise & Jitter - Web Classroom**
April 8-10, 2019, Online, On-Demand - Dr. Waleed Khalil

**EMI/EMC and Signal Integrity Boot Camp**
July 29 to August 2, 2019, San Diego, CA - Dr. Arturo Mediano

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  info@besserassociates.com

Get info at www.HFeLink.com
Updated Website: Surge Protection Solutions

PolyPhaser, developer of patented RF protection solutions, launched a completely updated website with online purchasing capabilities and same-day shipping for many of its most popular surge protection solutions.

PolyPhaser’s new ecommerce website allows customers to place and track orders, access expanded product specifications, check product inventory levels, engage in live online chat support, and much more. The updated website makes it easier for the company’s global customer base to purchase and receive industry-leading RF surge protection devices and other key PolyPhaser products.

“Our goal, as always, is to meet the requirements of our customers,” said Laurie Addison, Infinite Electronics’ Vice President of Marketing. “The updated PolyPhaser website offers our customers another way to streamline their purchasing processes and to address their urgent product needs while enabling us the ability to provide comprehensive solutions with speed and accuracy.”

Users can purchase PolyPhaser products using a credit card or purchase order number. Larger orders can still be quoted directly through the PolyPhaser sales team, or through the “contact us” form on the new website.

Key features of PolyPhaser’s new ecommerce website include:
- Online shopping, including order placement and tracking
- Same-day shipping of in-stock products
- Real-time inventory levels for every product
- 24/7 support through online chat
- Expanded specifications to help with product selection
- Comprehensive resource center for additional support

The e-commerce PolyPhaser website is online now. Market-based solutions pages, key corporate information and additional help is offered to provide a complete vision of PolyPhaser’s capabilities and role in the industry. Visit the new website at https://www.polyphaser.com.

PolyPhaser
polyphaser.com
PIM Finder: Pinpoint and Detect External PIM Sources

External PIM sources have a direct impact on data rates and PIM Finder identifies those causes, allowing for better performance.

“LTE and 5G high data rate modulation schemes require clean spectrum to operate to their potential,” said Tony Langelaan, Product Line Manager, Kaelus Test & Measurement. “External PIM sources have a direct impact on data rates and PIM Finder identifies those causes, allowing for better performance.”

Product Features:
- Ideal for all testing scenarios including tower, rooftop, DAS and small cell sites
- Pinpoints external PIM (outside antenna infrastructure)
- Locates PIM sources in the 560-2750MHz frequency range
- One-handed operation, direct connection from iVA to low-PIM probe
- Small and lightweight, allows for working in hard to access areas
- iPA provides up to 2x20W RF carriers to be transmitted
- iVA provides a receiver for measuring externally generated PIM

Kaelus
kaelus.com

Kaelus, a leading supplier of high-quality, PIM test and measurement instruments and RF conditioning solutions, has debuted PIM Finder, software designed to accurately identify and locate external PIM sources outside antenna infrastructure.

Used in combination with the Kaelus iVA Cable & Antenna analyzer and the iPA portable PIM analyzer, PIM finder is a software option available through Kaelus Unify, used to pinpoint and detect external PIM sources such as loose mounting and cable brackets, fasteners, parapet walls and more, while allowing for the elimination of key causes of PIM interference.
High Output, Low Rise Time Pulsers

Avtech pioneered the design of subnanosecond rise time pulse generators and now offers over 35 models which provide 40-300 ps rise times with 5 to 100 Volt output amplitudes and PRF to 200 MHz.

<table>
<thead>
<tr>
<th>Ampl</th>
<th>Rise</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 V</td>
<td>500 ps</td>
<td>AVR-E3-B</td>
</tr>
<tr>
<td>50 V</td>
<td>500 ps</td>
<td>AVR-E5-B</td>
</tr>
<tr>
<td>20 V</td>
<td>200 ps</td>
<td>AVMR-2D-B</td>
</tr>
<tr>
<td>15 V</td>
<td>100 ps</td>
<td>AVM-2-C</td>
</tr>
<tr>
<td>10 V</td>
<td>100 ps</td>
<td>AVP-AV-1-B</td>
</tr>
<tr>
<td>10 V</td>
<td>50 ps</td>
<td>AVP-35A-C</td>
</tr>
<tr>
<td>5 V</td>
<td>40 ps</td>
<td>AVP-25A-C</td>
</tr>
</tbody>
</table>

We offer over 500 standard models.

Pricing, manuals, datasheets and test results:
www.avtechpulse.com
AVTECH ELECTROSYSTEMS LTD.

Model AVP-35A-C provides up to 10V with < 50 ps rise times. Typical waveform, 50 ps/div, 5V/div.
At the other extreme.
Model AVI-VHV2A-B provides up to 100V with < 300 ps rise times.
Sub-nanosecond rise time pulsers for every amplitude range!

Varian 6900G CW TWTA’s
VZL6943G5M 1 to 2GHz 200 W
VZ56953G5M 2 to 4GHz 200 W
VZC6963G5M 4 to 8GHz 200 W

PRICE: $31,500 each
PHONE: 732-240-6895
CELL: 732-995-8086
DudleyLab.com

RF Bay, Inc.
19225 Orbit Drive, Gaithersburg, MD 20879
Tel: (301) 880-0921, Fax: (301) 560-8007, Mobile: (240) 645-8591
Email: sales@rfbayinc.com, Website: www.rfbayinc.com

Waveguide Components from 2.6GHz to 110GHz
- Waveguide straight sections, bends and twists
- Waveguide flange adapters
- Waveguide Tee
- Waveguide switches
- Multi hole directional couplers
- Cross directional couplers
- Fixed and variable waveguide attenuators
- Variable waveguide shorts
- Variable phase shifters
- Transition, waveguide terminations
- High power waveguide terminations
- Waveguide to Coaxial adapters
- Standard gain horn antennas

Wenreq Microwave Corporation
1070 Hamilton Rd., Suite A, Corte, CA 92021
Phone: (650) 355-8666, Fax: (650) 625-3107
Email: sales@wenreq.com Website: www.wenreq.com

Sector Microwave
Don’t sweat over your switching needs.
Our Waveguide and Coaxial switches are COOL!!
(631)242-2300 Phone (631)242-8158 Fax
www.sectormicrowave.com

www.highfrequencyelectronics.com
**Product Highlights**

**Modular RF Switch and Control Platform for a Range of Test Scenarios**

Rohde & Schwarz has completely revised the hardware and software for the new generation of the R&S OSP open switch and control platform. It is now optimized for more modules and even shorter switching times. The R&S OSP allows users to combine a wide variety of switch and control modules to form a cost-effective, customized control center for their test setup. The new R&S OSP platform supports the previous platform’s modules.

Test setups for new technologies such as 5G and state-of-the-art radar technology require switch and control technology with large frequency ranges and short switching times. To meet this requirement, Rohde & Schwarz has completely revised its platform and now presents the new R&S OSP220/230/320 units and the new R&S OSP-B200S2 satellite box.

The new generation offers special features such as the optional R&S OSP-K100 trigger function. Hardware-based switching of predefined paths is possible using the external trigger inputs and outputs. This allows users to reduce switching times even further compared to a LAN based trigger. Such short switching times are necessary, for example, to trigger the high-speed solid-state relays in antenna arrays and radar modules. The R&S OSP320 provides an additional digital address input on its rear panel for direct triggering of predefined paths.

**New operating concept**

Users will appreciate the new web interface that gives them full control of the platform. Separate software is no longer needed to configure an R&S OSP. The display automatically adjusts to the size of the screen. If the controlling PC has a large monitor, several switch modules are displayed at the same time. This provides a clearer overview of complicated interconnections. Path control allows users to combine the relay switches of one or more R&S OSPs to define paths. These paths can be preconfigured in virtual mode without having all devices and modules available.

**Virtually unlimited expandability**

The new R&S OSP product family starts with the three R&S OSP220/230/320 units. These units offer five, six or ten module slots on the front and rear panel. Customers can decide themselves where to place the cabling based on their specific requirements. The module slots can be combined to form larger application-specific modules.

Since previous R&S OSP modules can be used with the new R&S OSP generation, a comprehensive range of modules is available, including RF relays, electromechanical coaxial relays up to 67 GHz, solid-state relays and digital I/O and multiplexer modules. Customers can use the new switch and control unit as a desktop model for lab measurements or as a control center for complex rack-based test systems. Over a LAN, several R&S OSPs can be combined using a master/slave configuration to create a complex switch network of 20, 50 or more relays.

The compact R&S OSP-B200S2 satellite box enables remote operation, for example, in a shielded test chamber. The satellite box moves switch and control tasks closer to the DUT or the antennas. This reduces the number of long RF cables, improves the RF performance of the setup and saves money. Depending on the application, the satellite box is triggered using a serial electrical bus cable or a fiber-optic connection.

**Rohde & Schwarz**

rohde-schwarz.com
Power Sensor: Advanced Video Filters

LadyBug Technologies’ LB480A and LB680A RF Power Sensors with Option 004 make wide bandwidth time domain trace measurements. The detected video filters include a selection of 9 frequencies between 100 kHz and 10 MHz. The filters are ideal for honing in on signals modulation information and can reduce noise not associated with the desired video information. Signals can be cleaned and important information extracted by combining the video filters with LadyBug’s advanced averaging techniques. Additionally, the sensors can make statistical measurements with LadyBig’s Power Meter software. Extensive programmatic support is provided for system builders. Filters are included with option 004 on Ladybug LB480A (50-MHz to 8-GHz) and LB680A (50-MHz to 20-GHz) power sensors. All sensors offer programmatic access.

LadyBug Technologies LLC
ladybug-tech.com

Direct Reading Attenuator

SAGE Millimeter now offers full waveguide band high performance direct reading attenuators in W, E, and V Band. Model STA-60-10-D8 is an instrumentation grade, high precision and high attenuation range direct reading, rotary vane attenuator for use in millimeter wave test set across the standard W-band frequency range of 75 to 110 GHz. It has a large scale calibrated dial which indicates the attenuation value directly. The attenuator is an ideal piece of equipment in waveguide systems where a broad direct reading of attenuation is required. It exhibits exceptional repeatability during frequent attenuation setting operations. It exhibits 1.2 dB typical insertion loss and up to maximum 70 dB attenuation. The accuracy is 0.1 dB or 1% of the reading up to 60 dB, and “for reference only” above 70 dB.

SAGE Millimeter
sagemillimeter.com
**Product Highlights**

**44GHz SPDT Switches**

Analog Devices announced its 44 GHz single-pole, double-throw (SPDT) switches, the ADRF5024 and ADRF5025 in advanced Silicon-on-Insulator (SOI) technology. They are broadband, with the ADRF5024 yielding flat frequency response from 100 MHz to 44 GHz, while the ADRF5025 from 9 kHz to 44 GHz, with repeatable characteristics better than 1.7 dB insertion loss and 35 dB channel to channel isolation. Both parts support 27 dBm power handling for both through and hot-switching conditions. The new switches come in a compact, highly reliable, 2.25 mm x 2.25 mm surface-mount-technology (SMT) compatible package, exhibiting electrical performance beyond incumbent solutions, which will benefit radio frequency (RF) and microwave design experts, saving bias power, eliminating peripheral components and achieving higher integration in systems such as phased arrays, portable instrumentation, high resolution body scanners and next generation millimeter-wave communication infrastructure for emerging 5G and high-constellation satellite networks.

Analog Devices
analog.com

---

**Comb Generator Series**

Herotek has expanded pre-amp comb generator GCA Series to include the new .750” (N3 package) long surface mount package for convenient placement on PCB Boards. Our GCA Series Comb Generators are used for Frequency Multipliers, Frequency Synthesizers, and built-in test source. GCA Series requires only +10 dBm or 0 dBm input for input frequency ranges from 250 MHz to 2000 MHz. Our GC Series (without preamp) also is offered in our “L” package, which is .53” long.

Herotek
herotek.com
Enclosure: Highest EMI/RFI Protection Available

The US National Defense Authorization Bill H.R 1540 now passed the House and the Senate. The bill requires our nation’s Defense and infrastructure to sustain an EMP attack both natural and man-made. The threats that the bill mainly focuses on are the following:

EMP weapons: These weapons on a large scale could have a catastrophic effect such as damaging the power systems, electronics and information systems that make up our nation’s infra-

structure. On a smaller directional scale, the weapons can damage surveillance systems, industrial production lines and automotive electronics.

Solar storms: Geomagnetic storms could damage large transformers hence resulting in a blackout for almost a year. They also have a devastating effect on the electronics that are crucial for the infrastructure of our country.

Equipto’s new R6 shielded enclosure line offers the highest level of protection to your electronics both from Electromagnetic Pulse and Electromagnetic Radiation effects. The R6’s cost-effective design is compact and mobile while providing Shielding Effectiveness comparable to an anechoic chamber.

Equipto Electronics
equiptoelec.com

Equipto Electronics is a premier provider of metal packaging solutions for Mil/Aero, transportation, communications and industrial electronics. Our extensive product lines allow us to quickly customize standard products to meet your needs or we can provide full-custom enclosures. Quantities small or large are not a problem. We are ISO 9001:2008 certified and 8(a) qualified by the Small Business Administration.

Get info at www.HFeLink.com
Mixer: Handheld Spectrum Analyzers

OML’s mixer series, MxxHxDC, is specifically designed for handheld spectrum analyzers as a portable solution for millimeter wave spectrum analysis measurement. Utilizing the handheld spectrum analyzer tracking generator as an LO source and the built-in DC supply; this harmonic mixer provides you the ease of portable field measurement in a one box solution.

Available in waveguide bands WR-12 (60-90 GHz), WR-15 (50-75 GHz) WR-10 (75-110 GHz). OML’s innovative millimeter wave frequency extension products can help you with your testing in the emerging application areas such as WiGig, 5G, collision avoidance radar systems, E-Band backhaul and military & defense.

OML
omlinc.com

Frequency Extension Modules

OML’s Signal Generator Frequency Extension Module can extend the frequency range of your existing 20 GHz microwave synthesizer to millimeter wave frequencies. Modules are available to span the waveguide bands between 50 and 500 GHz. These source modules are RoHS compliant. In addition, an option is available for manual power sweeps using a micrometer as a tuning mechanism. The standard source module has a prerequisite for +12V that is easily satisfied with many commercially available power supplies. As an alternative, a specialized option is available (SxxMS-AG) that enables the the Keysight PSG to satisfy the source module’s power supply prerequisite.

OML
omlinc.com

Making the Connection in Handheld Solutions

*Available in WR-10, WR-12, WR-15 & Ext. WR -12 (56-94 GHz)

*For measurements in: 5G, WiGig, Auto Radar & E-Band Backhaul

*No external LO source or DC Power required

Introducing the first portable solution for millimeter wave spectrum analysis measurement.
App Note: Design of a BAW Quadplexer Module Using NI AWR Software

This application note describes the design of a carrier aggregation (CA) bulk acoustic wave (BAW) quadplexer module. The module is intended for the LTE-3 and LTE-7 bands, with high in-band and cross-band isolation.

Qorvo TQQ1003 and TQQ1007 BAW duplexers were used for the duplexer and the circuit was designed with the NI AWR Design Environment platform, specifically Microwave Office circuit design software. The design is described in steps: filter, t-junction, diplexer, and quadplexer.

NI AWR

RFIC PA Development White Paper

A new white paper on RF integrated circuit (RFIC) power amplifier (PA) design for next-generation communication and radar systems has been added to the NI AWR software resource library.

Future 5G communications, which will increase mobile broadband traffic and provide higher data rates, will require adding more spectrum, making that spectrum more efficient, and building out ultra-dense network configurations.

This white paper examines some of the challenges in designing RFIC-based PAs for future 5G communication systems and discusses amplifier basics with a focus on the constituent components and most common PA performance metrics used in communication systems with digitally-modulated waveforms.

NI AWR
IMS2019
2-7 June 2019
Boston 2019
The Hub of Microwaves
Boston Convention & Exhibition Center
Boston, Massachusetts
Submit your Paper Today!
Secure your Booth Space Now!
www.ims-ieee.org
**PRODUCT SPOTLIGHT**

**Wideband MMIC Amplifier Die Covers DC to 7 GHz**
Mini-Circuits’ GALI-39-D+ is a wideband MMIC amplifier die with a wide operating frequency range from DC to 7 GHz. This model operates on a 35mA supply and provides 19.7 dB gain, +10.5 dBm output power at 1 dB compression, 2.4 dB noise figure, and +22.9 dBm IP3. Designed using a patented transient-protected Darlington configuration and fabricated with InGaP HBT technology, the amplifier provides outstanding reliability and repeatability. GALI-39-D+ is available in small quantity gel-paks of 10, 50, and 100 KGD (“Known Good Dice”) as well as partial and full production wafers.

**Tiny LTCC Band Pass Filter, 3400 to 3850 MHz**
The BFCV-3641+ LTCC band pass filter has a passband from 3400 to 3850 MHz, supporting a variety of applications such as software defined radio, WLAN, and more. This model provides 1.6 dB passband insertion loss, typical stopband rejection from 20 to 35 dB, and RF input power handling up to 0.5W. Its LTCC construction enables tiny size (0.12 x 0.10 x 0.06”), excellent thermal stability from -55 to +100˚C, and outstanding reliability for tough operating conditions.

**Ultra-Wideband Coaxial 2-Way 0° Splitter/Combiner Covers 10 to 50 GHz**
Mini-Circuits ZN2PD-V54+ is an ultra-wideband coaxial 2-way 0° splitter/combiner providing coverage from 10 to 50 GHz, supporting a wide range of applications including 5G, Ku-Band, K-Band, and Ka-Band SatCom, microwave point-to-point backhaul, instrumention and more. This model provides 10W power handling as a splitter with 1.0 dB insertion loss, 23 dB isolation, 1.0 dB amplitude unbalance, and DC passing up to 440mA (220mA each port). The splitter/combiner comes housed in a rugged, aluminum alloy case measuring 1.0 x 1.0 x 0.37” with 1.85mm female connectors.

**Wideband Surface Mount Bias-Tee Covers 10 MHz to 6 GHz**
Mini-Circuits’ RCBT-63+ is a surface-mount bias-tee with an operating frequency range from 10 MHz to 6 GHz. This model provides low insertion loss of 1.0 dB, 20 dB isolation, VSWR of 1.3:1 with RF input power handling up to +30 dBm and DC current handling up to 500mA. The unit comes housed in a miniature, plastic package measuring 0.25 x 0.31 x 0.16”.

**Ultra-Wideband HandFlex™ Interconnect Cables, DC-40 GHz**
Mini-Circuits’ 086-KM+ series of HandFlex™ interconnect cables is ideal for interconnection of a wide variety of cable assemblies from DC to 40 GHz. 2.92mm Male connectors at both ends are ideal for making secure connections in assemblies using 2.92mm, 3.5mm and SMA connector types. Tight minimum bend radius of 6mm makes these cables perfect for installations in tight spots, and hand formable cable construction allows easy bending to almost any shape without special bending tools often needed in semi-rigid cable assemblies. Model 086-9KM+ is 9 inches in length and provides 30 dB return loss at 40 GHz, 1.4 dB insertion loss at 40 GHz, and 7W power handling at 40 GHz. 086-series Handflex interconnect cables come in a variety of lengths, diameters and connector configurations to meet your needs for everything from military and aerospace systems to environmental test chambers and more!

**Ultra-Wideband MMIC Precision Fixed Attenuator, DC to 40 GHz**
Mini-Circuits’ KAT series of MMIC precision fixed attenuators extends coverage to a wide array of applications from DC to 40 GHz including 5G systems, microwave communications, satellite, defense and aerospace, and more. These fixed-value, absorptive attenuators are fabricated through highly repetitive MMIC processing with thin-film resistors on GaAs substrates and achieve ultra-wideband performance. Model KAT-4+ provides 4 dB nominal attenuation with ±0.3 dB flatness, 1.7W RF power handling, and 1.2:1 typical VSWR. KAT-series attenuators are housed in tiny 2x2mm QFN packages giving users the capability to utilize pick and place assembly for high frequency applications.
The industry's largest selection includes THOUSANDS of models from 2 kHz to 65 GHz, with up to 300 W power handling, in coaxial, flat-pack, surface mount and rack mount housings for 50 and 75 Ω systems.

From 2-way through 48-way designs, with 0°, 90°, or 180° phase configurations, Mini-Circuits' power splitter/combiners offer a vast selection of features and capabilities to meet your needs from high power and low insertion loss to ultra-tiny LTCC units and much more.

Need to find the right models fast? Visit minicircuits.com and use Yoni2®, our patented search engine that searches actual test data for the models that meet your specific requirements! You'll find test data, S-parameters, PCB layouts, pricing, real-time availability, and everything you need to make a smart decision fast!

All Mini-Circuits' catalog models are available off the shelf for immediate shipment, so check out our website today for delivery as soon as tomorrow!
POWER SPLITTERS/COMBINERS

from 2 kHz to 65 GHz as low as $0.89ea. (qty. 1000)

NEW!

COVERING 10 to 65 GHz IN A SINGLE MODEL

ZN2PD-E653+

The industry’s largest selection includes THOUSANDS of models from 2 kHz to 65 GHz, with up to 300 W power handling, in coaxial, flat-pack, surface mount and rack mount housings for 50 and 75Ω systems.

From 2-way through 48-way designs, with 0°, 90°, or 180° phase configurations, Mini-Circuits’ power splitter/combiners offer a vast selection of features and capabilities to meet your needs from high power and low insertion loss to ultra-tiny LTCC units and much more.

Need to find the right models fast? Visit minicircuits.com and use Yoni2®!

It’s our patented search engine that searches actual test data for the models that meet your specific requirements! You’ll find test data, S-parameters, PCB layouts, pricing, real-time availability, and everything you need to make a smart decision fast!

All Mini-Circuits’ catalog models are available off the shelf for immediate shipment, so check out our website today for delivery as soon as tomorrow!
Advertiser Index

<table>
<thead>
<tr>
<th>Company</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCOM</td>
<td>49</td>
</tr>
<tr>
<td>American Technical Ceramics</td>
<td>13</td>
</tr>
<tr>
<td>API Technologies</td>
<td>1</td>
</tr>
<tr>
<td>Avtech</td>
<td>53</td>
</tr>
<tr>
<td>Besser Associates</td>
<td>50</td>
</tr>
<tr>
<td>CoiCraft</td>
<td>11</td>
</tr>
<tr>
<td>C. W. Swift &amp; Associates</td>
<td>C2</td>
</tr>
<tr>
<td>dBm</td>
<td>7</td>
</tr>
<tr>
<td>Delta Electronics</td>
<td>27</td>
</tr>
<tr>
<td>Ducommun</td>
<td>30</td>
</tr>
<tr>
<td>Ducommun</td>
<td>41</td>
</tr>
<tr>
<td>Dudley Lab</td>
<td>53</td>
</tr>
<tr>
<td>Equipto Electronics</td>
<td>57</td>
</tr>
<tr>
<td>Fairview Microwave</td>
<td>17</td>
</tr>
<tr>
<td>Herotek</td>
<td>14</td>
</tr>
<tr>
<td>IMS2019</td>
<td>60</td>
</tr>
<tr>
<td>KRYTAR</td>
<td>39</td>
</tr>
<tr>
<td>Micro Lambda Wireless</td>
<td>9</td>
</tr>
<tr>
<td>Microwave Components</td>
<td>19</td>
</tr>
<tr>
<td>Mini-Circuits</td>
<td>2, 3</td>
</tr>
<tr>
<td>Mini-Circuits</td>
<td>21</td>
</tr>
<tr>
<td>Mini-Circuits</td>
<td>25</td>
</tr>
<tr>
<td>Mini-Circuits</td>
<td>31</td>
</tr>
<tr>
<td>Mini-Circuits</td>
<td>35</td>
</tr>
<tr>
<td>Mini-Circuits</td>
<td>62, 63</td>
</tr>
<tr>
<td>National Instruments</td>
<td>5</td>
</tr>
<tr>
<td>National Instruments</td>
<td>45</td>
</tr>
<tr>
<td>Norden Millimeter</td>
<td>23</td>
</tr>
<tr>
<td>OML</td>
<td>58</td>
</tr>
<tr>
<td>Passive Plus</td>
<td>18</td>
</tr>
<tr>
<td>Pasternack</td>
<td>36</td>
</tr>
<tr>
<td>Pasternack</td>
<td>C4</td>
</tr>
<tr>
<td>PolyPhaser</td>
<td>15</td>
</tr>
<tr>
<td>Pulsar Microwave</td>
<td>20</td>
</tr>
<tr>
<td>RF Bay</td>
<td>53</td>
</tr>
<tr>
<td>SAGE Millimeter</td>
<td>32, 33</td>
</tr>
<tr>
<td>Satellink</td>
<td>53</td>
</tr>
<tr>
<td>Sector Microwave</td>
<td>53</td>
</tr>
<tr>
<td>SGMC Microwave</td>
<td>C3</td>
</tr>
<tr>
<td>Spacek Labs</td>
<td>29</td>
</tr>
<tr>
<td>Wenteq Microwave</td>
<td>53</td>
</tr>
</tbody>
</table>

The ad index is provided as an additional service by the publisher, who assumes no responsibility for errors or omissions.

Find our advertisers’ Web sites using HFeLink™

1. Go to our company information Web site: www.HFeLink.com, or
2. From www.highfrequencyelectronics.com, click on the HFeLink reminder on the home page
3. Companies in our current issue are listed, or you can choose one of our recent issues
4. Find the company you want ... and just click!
5. Or ... view our Online Edition and simply click on any ad!

High Frequency Electronics (USPS 024-316) is published monthly by Summit Technical Media, LLC, 3 Hawk Dr., Bedford, NH 03110. Vol. 17 No.12 December 2018. Periodicals Postage Paid at Manchester, NH and at additional mailing offices. POSTMASTER: Send address corrections to High Frequency Electronics, PO Box 10621, Bedford, NH 03110-0621. Subscriptions are free to qualified technical and management personnel involved in the design, manufacture and distribution of electronic equipment and systems at high frequencies. Copyright © 2018 Summit Technical Media, LLC
QUALITY, PERFORMANCE AND RELIABILITY IN PRECISION COAXIAL CONNECTORS

EDGE LAUNCH CONNECTORS

BETWEEN SERIES ADAPTERS

BULKHEAD & PANEL ADAPTERS

IN SERIES ADAPTERS

CABLE CONNECTORS

CUSTOM DESIGNS

ADAPTERS · CABLE CONNECTORS · RECEPTACLES · CUSTOM DESIGNS

Including These Connector Series

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Frequency Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.85mm</td>
<td>DC-65 GHz</td>
</tr>
<tr>
<td>2.4mm</td>
<td>DC-50 GHz</td>
</tr>
<tr>
<td>2.92mm</td>
<td>DC-40 GHz</td>
</tr>
<tr>
<td>3.5mm</td>
<td>DC-34 GHz</td>
</tr>
<tr>
<td>7mm</td>
<td>DC-18 GHz</td>
</tr>
<tr>
<td>SSMA</td>
<td>DC-40 GHz</td>
</tr>
</tbody>
</table>

ISO 9001:2008

SGMC Microwave — The name to count on for Quality, Performance and Reliability! Please contact us today by Phone, Fax or Email.

Manufacturer of Precision Coaxial Connectors
620 Atlantis Road, Melbourne, FL 32904
Phone: 321-409-0509  Fax: 321-409-0510
sales@sgmcmicrowave.com
www.sgmcmicrowave.com

Get info at www.HFeLink.com
Armed with the world’s largest selection of in-stock, ready to ship RF components, and the brains to back them up, Pasternack Applications Engineers stand ready to troubleshoot your technical issues and think creatively to deliver solutions for all your RF project needs. Whether you’ve hit a design snag, you’re looking for a hard to find part or simply need it by tomorrow, our Applications Engineers are at your service. Call or visit us at pasternack.com to learn more.

866.727.8376
Pasternack.com

an INFINITI company

You Engineer the Future.
We’ll Supply the Components... Today!