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FEBRUARY2013

HIGH FREQUENCY ELECTRONICS

RF MEMS Switches: High-Frequency Performance and Hot-Switching Reliability

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Ideas for today's engineers: Analog · Digital · RF · Microwave · mm-wave · Lightwave

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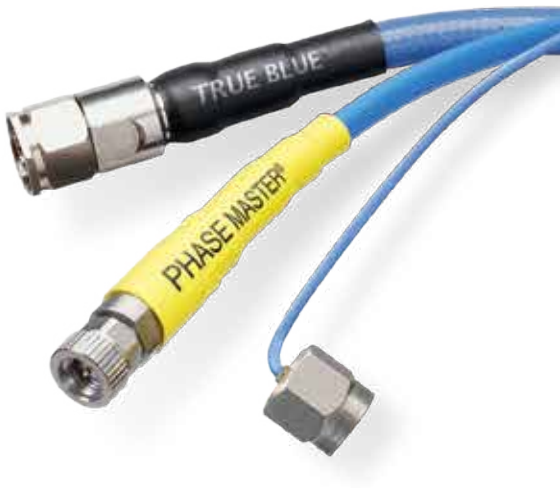

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• ZHL-50W-52	50-500	50	40	63	1395	1320
• ZHL-100W-52	50-500	50	63	79	1995	1920
LZY-1+	20-512	43	37	50	1995	1895
• ZHL-20W-13+	20-1000	50	13	20	1395	1320
• ZHL-20W-13SW+	20-1000	50	13	20	1445	1370
LZY-2+	500-1000	46	32	38	1995	1895
NEW ZHL-100W-13+	800-1000	50	79	100	2195	2095
ZHL-5W-2G+	800-2000	45	5	6	995	945
ZHL-10W-2G	800-2000	43	10	13	1295	1220
ZHL-30W-252+	700-2500	50	25	40	2995	2920
ZHL-30W-262+	2300-2550	50	20	32	1995	1920
ZHL-16W-43+	1800-4000	45	13	16	1595	1545
ZVE-3W-83+	2000-8000	36	2	3	1295	1220
ZVE-3W-183+	5900-18000	35	2	3	1295	1220

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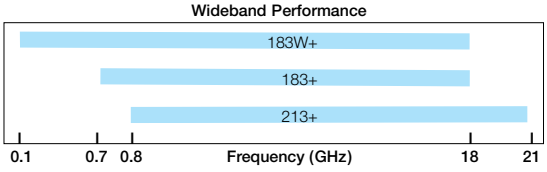

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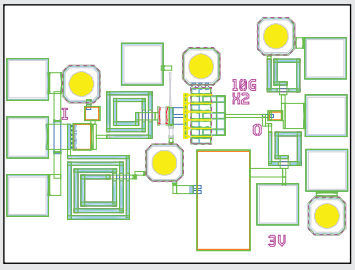

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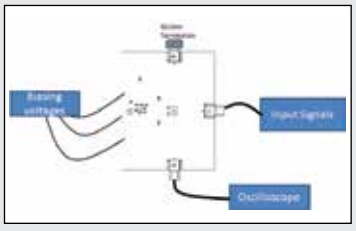

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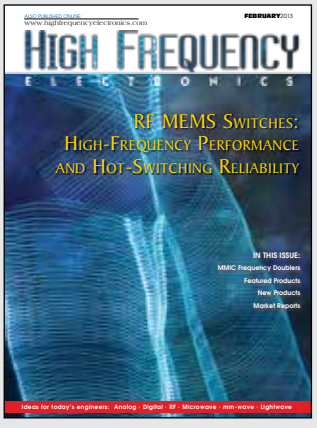

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"Duz" Math Count?

Tom Perkins
Senior Technical Editor

If the title above got your attention, I'll explain shortly. Some of this column was composed while watching the Super Bowl. A couple of months ago our Publisher suggested to our Associate Publisher/Managing Editor the possibility of a 49ers - Patriots showdown in the big game. Unfortunately for those of us in New England, Scott was only 50% correct. Still, it was a good call, considering the advanced timing of his guess.

Two things to ponder this month. One is the constant cycle of acquisitions (and sometimes demise) of microwave component and systems manufacturers which seemed to commence about 30 years ago and accelerated significantly in the 1990s and later. Recently I was looking for information on companies I dealt with a few years ago, only to learn of their absorption into other entities. One source of information, *Where are they now?,* is found on a website called Microwaves 101 that includes a long list of companies that no longer exist, along with some background information.

See: http://www.microwaves101.com/encyclopedia/wherenow.cfm.

Industry Evolution

Having firsthand knowledge of many of these companies and their casts of principal characters, I have to say that the information offered amounts to a fairly good compendium. My theory about turnover is that many first-generation companies, some of which were spawned shortly after World War II by the original scientists, engineers and entrepreneurs—many of whom became "giants" of our industry—were later sold off as there were no obvious successors to assume leadership. Many, but not all, of these pioneers became quite wealthy in the process. Other companies came and went due to involvement in narrow, niche product lines without a vision or "game plan" as to how to deal with inevitable obsolescence of product technology. Some also could not expand their frequency-range horizons. An extreme analogy in another technology would be the demise of photographic film and Polaroid images due to digital photography.

Major changes included MMICs replacing discrete devices, PLL oscillators replacing multiplier chains, stripline replacing some waveguides, microstrip replacing stripline, new forms of coax connectors, phased arrays replacing rotating antennas, and on and on. Now trending is GaN replacing high-power vacuum-tube devices. The final outcome on this one is still difficult to predict. Another story is the rise and fall of many compound semiconductor foundries. It appears that companies involved in passive circuitry components may generally have more longevity than active circuits. Capacitors, resistors, and to a lesser extent filters, couplers, etc. which come in many forms, could certainly be labeled as enduring technology.

Thus the first word of this column's title—a play on words. Anyone remember "Duz" detergent? This product was a staple when I was a kid that later disappeared, just like many microwave names and products more recently. A better analogy might be the demise of the iceman or blacksmith.

OK—what about Duz Math Count? Yes, MATHCOUNTS. Last month I had the privilege of assisting a local regional competition of MATHCOUNTS. MATHCOUNTS is a middle school mathematics competition held across all 50 states. Its founding sponsors include the CNA Foundation, the National Society of Professional Engineers, and the National Council of Teachers of Mathematics. The competition is designed for sixth, seventh, and eighth graders. Problem-solving is emphasized for both individuals and teams from competing schools, both public and private. The subject matter includes algebra, geometry, and combinatorics. These are not easy tests and perfect scores are rare, at best.

This program runs with a network of more than 17,000 volunteers including program administrators and school coaches who organize MATHCOUNTS' local and state programs. Each year over 7,000 schools run MATHCOUNTS programs. In February and March, over 500 local competitions and 56 "state" competitions are conducted. Hundreds of corporations, foundations, community organizations, and individuals generously support MATHCOUNTS programs.

STEM and the Super Bowl

I mention this because at the outset I alluded to the Super Bowl. Well, an important area which ultimately contributes to the welfare of our industry is Science, Technology, Engineering, and Mathematics (STEM). Our industry, in turn, makes many aspects of such events as the Super Bowl possible because of our bright teams of engineers. As was readily demonstrated on February 3, this even applies to venerable (and vulnerable) areas such as supplying raw AC power to such functions. So STEM education is immensely important to maintaining and growing our entire infrastructure. It is a treat to be involved in a competition that emphasizes mathematics and such with team shirts, coaches and pseudo-cheerleaders, also called "parents."

At least the East Coast team won the big contest! Condolences to Tim and 49er fans everywhere.

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March 19 – 21, 2013
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April 10 – 11, 2013
Microwave & RF
Paris
microwave-rf.com

June 2 – 7, 2013
IMS 2013
Seattle, Wash.
http://www.ims2013.org/

June 2 – 4, 2013
IEEE RFIC 2013
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http://www.rfic-ieee.org

October 15 – 18, 2013
IEEE International Symposium on Phased Array Systems & Technology
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LabVIEW user groups.
https://decibel.ni.com/content/community/zone/labviewusergroups

Call for Papers

IEEE RFIC 2013
June 2 – 4, 2013, Seattle, Wash.
Summary Deadline: February 7, 2013
Final Manuscript Deadline: March 7, 2013
http://www.rfic-ieee.org

2013 IEEE Wireless Power Transfer (WPT)
May 15 – 16, 2013, Perugia, Italy
Abstract Deadline: February 12, 2013
Final Paper Deadline: March 23, 2013
http://www.ieee.org/conferences_events/conferences/conferencedetails/index.html?Conf_ID=30420

2013 IEEE International Topical Meeting on Microwave Photonics (MWP 2013)
October 28 – 31, 2013, Annapolis, Md.
Abstract Deadline: May 1, 2013
www.mwp2013.org

2013 IEEE International Symposium on Phased Array Systems
October 15 – 18, 2013, Waltham, Mass.
Summary Deadline: December 15, 2012
Final Paper Deadline: June 1, 2013
www.array2013.org

2013 38th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz)
September 1 – 6, 2013, Mainz, Germany
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Final Paper Deadline: July 1, 2013
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Report: Compound Semi Revenue Flat

With financial results in for the second calendar quarter of 2012, the compound semiconductor industry showed sequential revenue growth, but the industry is only slightly ahead of 2011 revenue performance. The Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) viewpoint, "Compound Semiconductor Industry Review July - September 2012: Microelectronics," captures product, technology, contract and financial announcements for companies in the field.

While most of the companies highlighted in the report showed sequential revenue increases from the previous quarter, many are struggling in comparison to 2011 revenue. The result is an industry much closer to break-even than substantive growth. The report also details several silicon-based product announcements for devices that are directly competitive to their compound semiconductor equivalents.

"The positive news for the compound semiconductor industry is that most companies showed revenue growth for the quarter, making it the second consecutive quarter that the industry has seen growth," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs). "However, when you compare the results to 2011, the picture is not as clear. Using this comparison, many of these same companies are struggling to show growth and this reaffirms our position that 2012 will be a low-growth year for the industry."

Asif Anwar, Director, Strategy Analytics Strategic Technologies Practice (STP) added, "Part of the issue is the strength of some of the silicon-based product solutions. We are seeing companies like Javelin and Amalfi Semiconductor, which is now part of RFMD along with Peregrine Semiconductor, release some very innovative products that are taking share away from the incumbent compound semiconductor devices."

—Strategy Analytics
strategyanalytics.com

Base Station Market: Asia-Pacific Still a Bright Spot

Base station expenditures in Q3 2012 in the Asia-Pacific region at $7.6 billion, or more than half of the total market, continued to be more than four times higher than in Western Europe or North America, and grew 50% compared to the year ago quarter, while North America spending grew 27% year-on-year in Q3 2012.

Meanwhile the total wireless infrastructure equipment market continued its downward trend in the third quarter of 2012 reaching only $15.4 billion – a 3.1% decrease from the second quarter of 2012 and an 18.9% increase from the same quarter one year ago.

For base station equipment the highlight this quarter, similar to previous quarters, continued to be found in LTE. "Expenditures this quarter on LTE base station equipment were at the same level as Q2 2012 and almost 3 times higher than in Q3 2011 and WCDMA technologies also grew by 21% versus the year ago quarter," says Nick Marshall, principal analyst, networks.

"ABI Research expects these trends to continue throughout 2013 with strong LTE growth followed by double-digit growth for WCDMA, against a background of a declining overall market as legacy technologies phase out," continues Marshall.

—ABI Research
abiresearch.com

Femtocell Market Turning a Corner?

While the femtocell market struggled in the first half of 2012, the market has bounced back in the second half of the year. ABI Research's latest femtocell forecast update suggests that 2012 ended up with shipments reaching slightly above two million units. The shipments in the second half more than doubled from the first half, making up for some of the lost momentum.

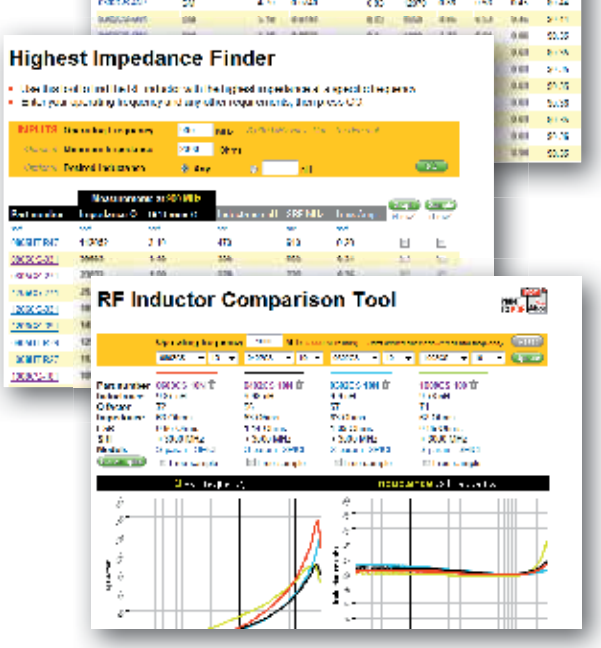
The forecast covers the enterprise and consumer femtocells market, with enterprise femtocells making up one-third of the total shipments. On the other hand, revenues from enterprise femtocells made up to two-thirds of the total revenue for femtocell access points.

Airvana, Alcatel-Lucent, and NEC/Ubiquisys remained the top vendors in terms of shipments making up 78% of the total shipments in 2012.

"The appetite for femtocells continues to persist as suggested by this second half bounce, which can be attributed largely to inventory levels needing a refresh, but also due to renewals of contracts driven by newer versions of access points. This is also evident in the continued growth in contracts which have reached a total of 130 globally, as per our estimates," says Aditya Kaul, practice director, mobile networks.

Kaul adds, "The lack of operator willingness to use femtocells as a competitive network quality differentiator, rather than a defensive churn reduction tool, continues to plague the market. Nevertheless, it is encouraging to see demand back up, with new markets such as Latin America and Russia lighting up. Competitive factors in certain markets are causing domino effects with one operator leading and the others following. This is enough to keep the momentum going forward, with new business models like femtocells as a service, adding to that momentum and bringing lower tier operators into the fold. Overall the market looks like it might be turning a corner."

—ABI Research
abiresearch.com



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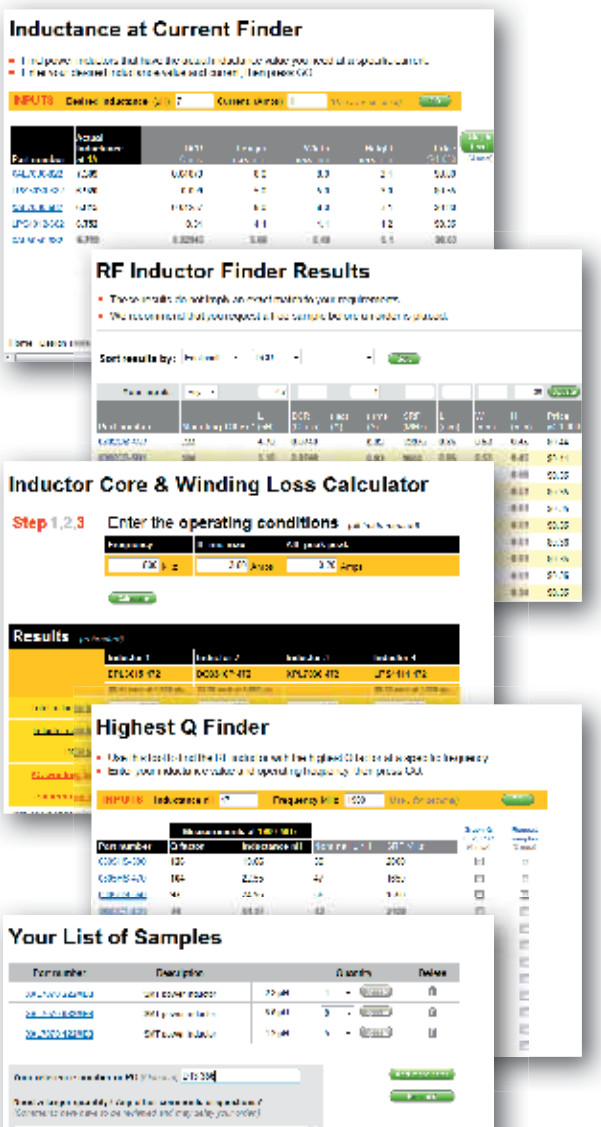

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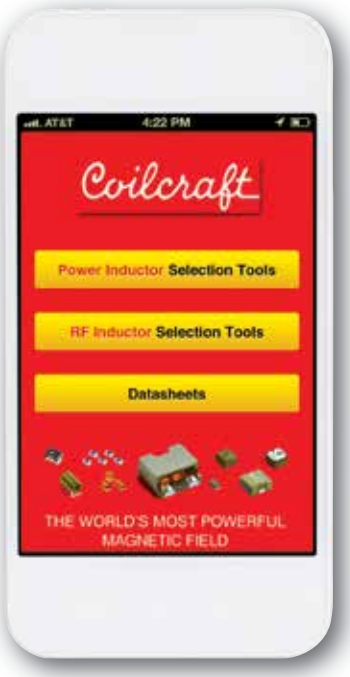

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Lockheed Martin Photo

Lockheed Martin, Grand Prairie, Texas, was awarded a $755,134,781 firm-fixed-price contract. The award will provide for the procurement of **PATRIOT Advanced Capability-3**, which includes support for Foreign Military Sales, and related services. Work will be performed in Grand Prairie; Lufkin, Texas; Camden, Ark.; Chelmsford, Mass.; and Ocala, Fla.; with an estimated completion date of July 31, 2015. One bid was solicited, with one bid received. The U.S. Army Contracting Command, Redstone Arsenal, Ala., is the contracting activity (W31P4Q-13-C-0068).


U.S. Navy Photo

Bell-Boeing Joint Project Office, Amarillo, Texas, is being awarded a $1,405,744,559 modification to the previously awarded **V-22** lot 17 advance acquisition contract (N00019-12-C-2001) for 17 fiscal 2013 **MV-22 Tiltrotor aircraft** for the Marine Corps and four fiscal 2013 CV-22 Tiltrotor aircraft for the Air Force. In addition, this modification provides funding for long lead components required for the manufacture and delivery of 19 fiscal 2014 lot 18 MV-22 Tiltrotor aircraft for the Marine Corps and three fiscal 2014 lot 18 CV-22 Tiltrotor aircraft for the Air Force. The Naval Air Systems Command, Patuxent River, Md., is the contracting activity.

Thales Raytheon Systems, Fullerton, Calif., was awarded a $14,102,920 firm-fixed-price contract. The award will provide for the contractor support services for the **Sentinel radar**. Work will be performed in Fullerton, with an estimated completion date of Dec. 31, 2013. One bid was solicited, with one bid received. The U.S. Army Contracting Command, Redstone Arsenal, Ala., is the contracting activity (W31P4Q-13-C-0091).

East Coast Microwave Distributors named **James Doyle** President and CEO. Doyle brings over 19 years of experience and joins ECM after a successful run as President and CEO of XMA Corp. Prior to that post he served as the Congressional Affairs Liaison and Director for Emerson Embedded Computing, Washington, D.C.

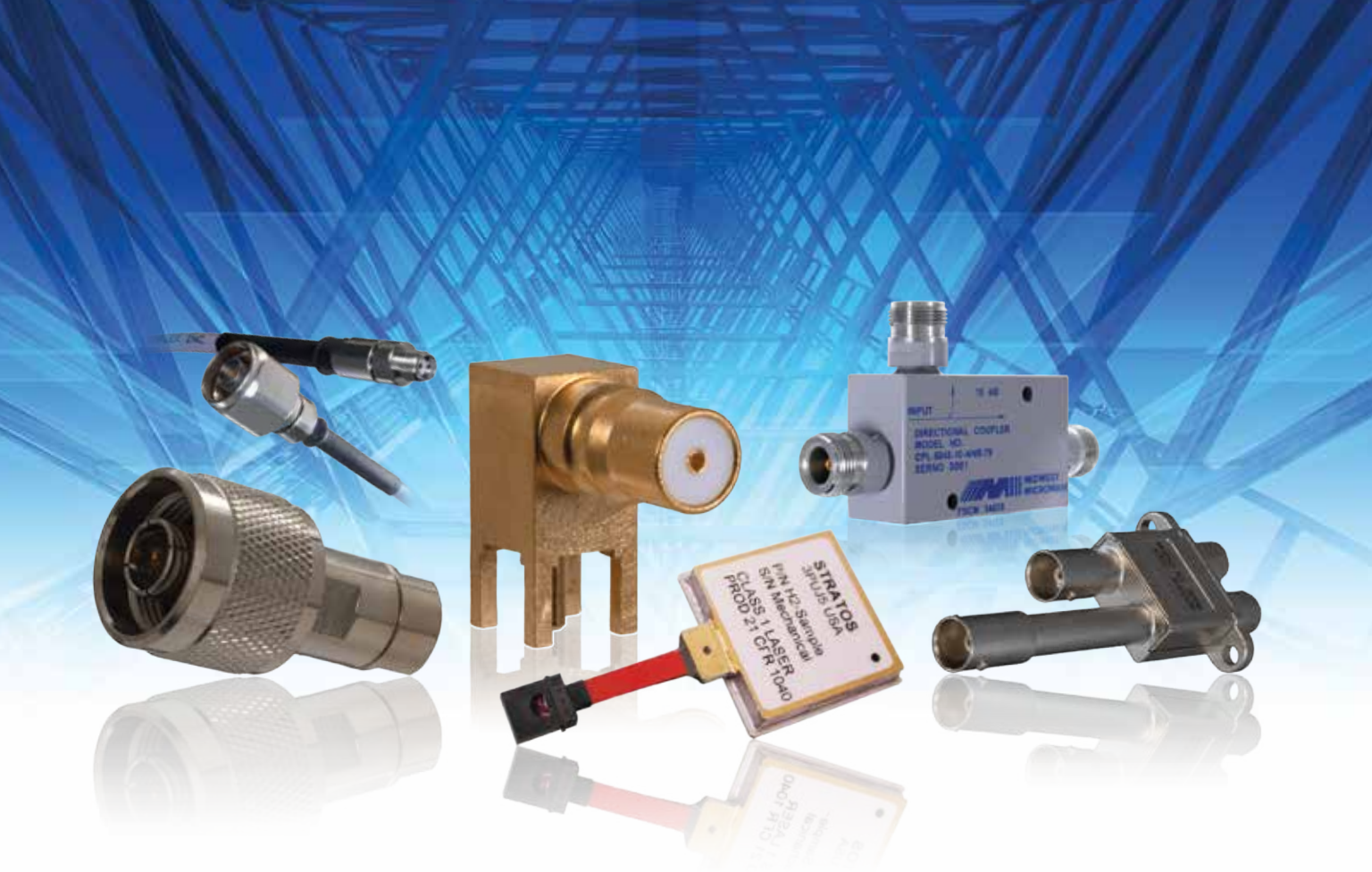
RF Micro Devices, Inc. announced that RFMD Fellow **Kevin W. Kobayashi** has been named a **Fellow of the Institute of Electrical and Electronics Engineers** (IEEE) by the IEEE Board of Directors. The IEEE grade of Fellow was conferred on Mr. Kobayashi in recognition for his extraordinary contributions to monolithic microwave integrated circuits (MMICs). **Bob Bruggeworth**, CEO and president of RFMD, said, "Kevin is an outstanding engineer with an extraordinary record of accomplishments. His extensive industry knowledge and deep expertise across multiple technologies are valuable assets to RFMD and to our customers. We stand with the IEEE in congratulating Kevin for his industry achievements and for his recognition as IEEE Fellow." Mr. Kobayashi is the principal author of 130 technical publications and the holder of 48 U.S. patents. Noteworthy are his inventions improving the broadband linearity and dynamic range of fundamental MMICs such as the Darlington pair, Gilbert cell, Doherty, cascode, and distributed amplifier topologies.

Delta Microwave, supplier of Amplifiers, Filters, Filter/Amplifiers, Multiplexers, and Integrated Microwave Assemblies, announced the appointment of **Wavelength Sales** as the company's exclusive representative in the upstate New York.

Coaxial Components Corp. appointed **Chris Feys** to the company's Quality Assurance team. As QA Manager, Feys will have overarching responsibility for all cable and connector assembly as well as product manufacturing quality control. Feys will also play an instrumental role in administering the ISO 9001:2008 and the AS 9100C processes for the company. The Stuart, Fla. firm manufactures SMA, SMB, SMC, SSMB, SSMC, SSMA, Type N, TNC and phase adjustable connectors, in addition to cable assemblies for commercial and military applications.

Agilent Technologies announced the opening of a new calibration and repair **service center** for electronic test instruments in **Hanoi, Vietnam**. The new Agilent Advantage Services facility will offer local calibration and repair services, adding to more than 50 service locations around the world. The service center technicians and engineers, who speak the local language, are thoroughly trained and have access to Agilent factory engineers. Their calibration and repair processes incorporate the same automated procedures used at service centers and mobile calibration labs around the world.

Texas Instruments Inc. announced it has joined the **Alliance for Wireless Power (A4WP).** TI will continue to develop new bqTESLA™ wireless power receiver and transmitter integrated circuits that comply with existing



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and future versions of the Wireless Power Consortium (WPC) Qi standard, and also create products that support the A4WP magnetic resonance specification. Organized in April 2012, A4WP is a group of electronics companies, including Samsung, Qualcomm and others, focused on advancing the field of wireless power by delivering a specification that permits spatial freedom. The group officially released its A4WP specification, which is based on loosely coupled magnetic resonance technology, to simultaneously charge smartphones and other portable electronics with different power requirements.

TriQuint Semiconductor researchers presented four new papers on a wide range of high performance gallium nitride (**GaN**) and gallium arsenide (**GaAs**) subjects at the recent **Compound Semiconductor IC Symposium** (CSICS) in La Jolla, CA. TriQuint's latest papers focus on process and fabrication solutions that are advancing state-of-the-art semiconductor technology. TriQuint engineers and scientists are creating mobile device, networks infrastructure, defense and foundry innovations that will connect and protect people across the globe. Paper topics covered the latest in dual-channel modulator drivers for optical networks, Doherty amplifiers and power amplifiers using GaN technology, as well as new Ka-band limiters.

LadyBug Technologies has enabled self-service, **customer-site re-certification** for its entire line of PowerSensor+™ power-measurement devices. The new procedure allows LadyBug customers to re-certify their **power meter/sensor products** on-site in the field, eliminating the need to return units to the manufacturer to obtain a re-certification certificate. For ease of use, the procedure employs Microsoft Excel® spreadsheet software, which comes pre-loaded on the vast majority of today's PCs. The new procedure can be accessed at ladybug-tech.com.

National Instruments released its **Automated Test Outlook 2013**, highlighting the company's research into the latest test and measurement technologies and methodologies. The report examines trends affecting industries such as **aerospace and defense, automotive, consumer electronics, semiconductor, telecommunications and transportation.** Engineers and managers can use the report to take advantage of the latest strategies and best practices for optimizing any test organization. Automated Test Outlook 2013 covers the following trends: Test Economics: New investment models force test departments to rethink the way they measure success; Big Analog Data: Industry leaders leverage IT infrastructures and analytic tools to make faster decisions on test data; Software-Centric Ecosystems: Open, software-centric ecosystems greatly impact the value derived from automated test systems; Test Software Quality: Engineers use software development best practices to ensure test system reliability for complex systems; Moore's Law Meets RF: New technology and instrumentation platforms drive up performance and drive down the cost of RF test equipment. To view Automated Test Outlook 2013, readers can visit www.ni.com/ato.

Analog Devices Inc. was named one of the world's **most innovative companies** according to the Thomson Reuters 2012 Top 100 Global Innovator SM program. The program analyzes patent data and related metrics using a proprietary methodology to identify the organizations that lead the world in innovation activity. This is the second straight year that Analog Devices was so honored.

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FEATURED PRODUCTS

PA Modules

RFMD's RFPA520x series three-stage WiFi PA modules are designed for 802.11b/g/n applications. Each is a high-performance, highly integrated solution with minimal external components, eliminating the need for any external matching components and reducing layout area, bill of materials, and manufacturing costs. Built with an advanced InGaP HBT process, they have high linear output power while maintaining excellent power added efficiency. RFPA5200 comes in a 4 mm x 4 mm x 1 mm, 10-pin laminate package.

RFMD
rfmd.com

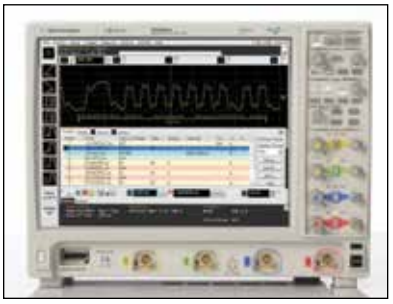
Cable Assemblies

EAM's low loss cable assemblies provide the highest level of electrical performance for applications requiring extremely low attenuation over a broad frequency range. By combining silver-plated copper center conductor, expanded PTFE tape dielectric, aluminum polyester or polymide tape, silver-plated copper outer braid, and FEP jacket, these cable assemblies achieve outstanding electrical characteristics to 18 GHz (as low as .22 dB/ft.) They feature custom connectors with rugged stainless-steel solder-clamp construction.

EAM
eamcableassemblies.com

Oscilloscope

Agilent Technologies introduced Infiniium 9000 H-Series high-definition oscilloscopes. The four new models come in bandwidths of 250 MHz, 500 MHz, 1 GHz and 2 GHz. They offer up to 12-bit vertical resolution, which represents 16 times



the quantization levels of traditional oscilloscopes with 8 bits of resolution. These scopes also include the industry's deepest standard memory (up to 100 Mpts per channel).

Agilent Technologies
agilent.com

Capacitors

Passive Plus, Inc. now offers vertical tape & reel orientation for its line of Traditional Hi-Q High Power, Low ESR/ESL, Low Noise, High Self-Resonance ultra-stable performance capacitors. Usually used for wireless broadcasting equipment, mobile base stations, GPS portables, MRI coils, and radar, these capacitors are 100% RoHS and offered in magnetic and non-magnetic terminations. Vertical orientation in tape offers even more versatility for those engineers who require this type of option.

Passive Plus
passiveplus.com

Limiter

PMI Model LM-6D7G7D9G-30W-SFF is a RF limiter that operates in the 6.7 to 7.9 GHz frequency range. This limiter can handle 30 watts CW input power and provides a maximum leakage of +18dBm. This model has a low insertion loss of 1.1 dB maximum and a recovery time of 10 usec maximum. It is supplied with SMA female connectors and the gold-plated package measures 1.0" x 0.65" x 0.38."

Planar Monolithics Industries
pmi-rf.com

Oscillator

Model SOL-24307-42-VG is a low cost, production-ready K band Varactor tuned Gunn oscillator. The center frequency of the VCO is set at 24.125 GHz with +/-150 MHz frequency modulation bandwidth and +7 dBm nominal output power. The VCO operates from a single +5 .0 Vdc power supplier and typically draws 250-mA current and requires 0 to +15 volts voltage swing for electrical tuning. It is designed and manufactured to meet FCC Part 15 regulations and exhibits - 0.8 MHz/°C frequency and - 0.03 dB/°C power stability.

SAGE Millimeter
sagemillimeter.com

Frequency Multiplier

Mini-Circuits' ZX90-2-24+ X2 frequency multiplier features: broadband; low conversion loss, 12 dB typ.; rugged construction; protected by US Patent 6,790,049. Applications: synthesizers; local oscillators.

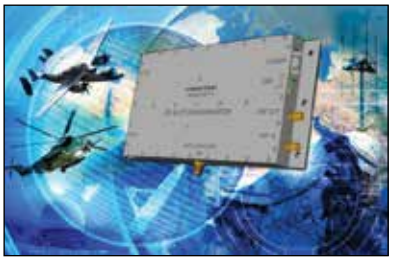
Mini-Circuits
minicircuits.com

FEATURED PRODUCTS

VCO

Z-Communications, Inc. announced a RoHS compliant VCO (voltage controlled oscillator) model CRO1200A-LF for high speed analog to digital converters. The CRO1200A-LF is designed to operate at 1200 MHz MHz within a tuning voltage range of 0.5 to 4.5 Vdc. This VCO features phase noise of -119 dBc/Hz @ 10 kHz offset and a typical tuning sensitivity of 2 MHz/V.

Z-Communications
zcomm.com



Downconverters

Pentek, Inc., announced a line of multiband, modular RF slot receivers: the Model 8111 series accepts RF signals over the range of 800 MHz to 3 GHz, downconverting them to a 225 MHz IF signal suitable for A/D conversion by any of several Pentek signal acquisition modules. "The Model 8111 complements Pentek's software radio offerings by capturing the RF signal right from the antenna and delivering the IF output straight into Pentek A/D boards," said Paul Mesibov of Pentek. "Some customers do not need an RF receiver that tunes across a wide spectrum, but rather just a slice or 'slot'."

Pentek
pentek.com

Coupler

RLC Electronics' high power directional couplers offer accurate coupling, low insertion loss and high directivity in a compact package. The standard units are optimized for two octave bandwidths and are available with a choice of coupling values. These units are ideal for sampling forward and reflected power with a negligible effect on the transmission line and very low intermodulation products.

RLC Electronics
rlcelectronics.com

Transmitter Systems

DTI Radar Transmitter Systems include switching power supplies, all solid-state pulse modulators and controls and feature full pulse flexibility from 50 ns to 10 ms and fully flexible pulse frequencies from UHF to W band. Suitable for new and retrofit radar installations, these transmitter systems are capable of driving 10 to 200 kV cathodes and provide 10 to 50% greater power efficiency and higher reliability than vacuum-tube-based systems.

Diversified Technologies Inc.
divtecs.com

YTO Guide

Micro Lambda Wireless offers the largest YIG-tuned oscillator line on the market. Designs covering frequency ranges from 500 MHz to 44 GHz in either narrow band or wide band configurations are available in the standard offerings. Permanent magnet designs covering the 2 GHz to 20 GHz fundamental ranges, through 44 GHz using frequency

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doublers and electromagnetic designs covering the 500 MHz to 40 GHz ranges in octave and multi-octave configurations.

Micro Lambda Wireless
microlambdawireless.com

Module

RF Micro Devices, Inc. introduced the highly-integrated RFFM4501E front end module (FEM) for 802.11ac notebook and mobile equipment applications. RFMD's newest WiFi FEM meets or exceeds the system requirements for 802.11ac connectivity in the 5.150 GHz — 5.850 GHz frequency band and is optimized to support multiple applications, including notebooks, mobile routers, and low-power customer premises systems.

RFMD
rfmd.com

Attenuator

Model SKA-2734033040-2828-D1 is a PIN-diode-based digital controlled attenuator. In the entire Ka Band frequency range from 26.5 to 40 GHz, it offers 3.0 dB insertion loss and 40 dB dynamic range. Attenuation flatness is +/- 1.5 dB cross the band and power handling is +23 dBm CW. Attenuation level is controlled by a digitizing driver which features 6 bits TTL control capacity. The step size of the standard model is set at 1.0 dB and control accuracy is +/- 0.5 dB; however, the attenuator is ready for up to 0.25 dB step size and +/- 0.25 dB control accuracy by carefully calibrating the system.

SAGE Millimeter
sagemillimeter.com

Design Software

AWR Design Environment™ V10.04 includes many new features and enhancements to Microwave Office®/Analog Office® circuit design software and Visual System Simulator™ (VSS) system design soft-

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* See data sheets for an extensive list of compatible hardware and software.

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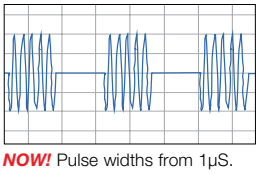

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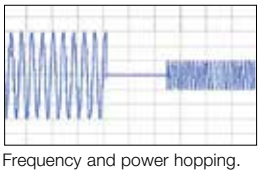
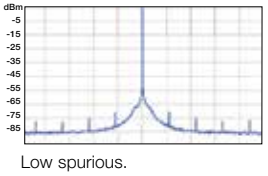


Frequency and power hopping.



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U.S. Patents 7739260, 7761442

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512 rev org

FEATURED PRODUCTS

ware, as well as AXIEM® 3D planar electromagnetic (EM) software and Analyst™3D finite element method (FEM) EM software. New features and enhancements in AWR V10.04 include: New MMIC Getting Started Guide; New SDELTAM measurement; Enhancements to optimization algorithms and yield analyses; Expanded output file support across circuit simulators; New scripts to reset the origins for layout.

AWR Corp.
awrcorp.com

Comparators

Touchstone Semiconductor announced the TSM921-TSM924, TSM931-TSM934, TSM971-TSM973 and the TSM982/TSM984 series of low voltage, low-power analog comparators. All 13 comparators are lower cost, electrically and form-factor identical to their Maxim analog comparator equivalents. Eleven of the 13 feature an integrated 1.182V voltage reference with either ±1% (TSM92x/TSM97x) or ±2% (TSM93x/TSM98x) initial accuracy. All 13 are offered in both commercial and industrial temperature ranges.

Touchstone Semiconductor
touchstonesemi.com

Synthesizer

Z-Communications, Inc. announced a RoHS compliant Phase Lock Loop Synthesizer model PCA0495B-LF for satellite modem equipment. The PCA0495B-LF is a low powered frequency synthesizer that operates from 470 to 520 MHz with a 100 kHz step size in a package measuring only 0.50 in. x 0.50 in. x 0.13 in. This miniature PLL provides phase noise of -97 dBc/Hz @ 10 kHz offset

and can be quickly and easily programmed through a 3-wire serial interface.

Z-Communications
zcomm.com

Amplifier

Model SDLVA-0R71R3-75-CD-3 is a successive detection log video amplifier that operates over the 700 to 1300 MHz frequency range. It has a dynamic range of 75 dB, a log slope of 40mV/dB. Log linearity is ±1.2 dB typical from -65 to +5 dBm input power levels and a typical TSS of -70 dBm. The limited IF output is +5 dBm typical. This model offers fast rise times of 9 nsec and fall times of 25 nsec typically. The housing measures 3.75" x 1.50" x 0.50" and is gold plated. Other frequency ranges are available.

Planar Monolithics Industries
pmi-rf.com

Filters

RFMW, Ltd. announced design and sales support for TriQuint Semiconductor BAW filters including the 885025, a Band 2 uplink filter at 1880 MHz. BAW filters offer improved power handling performance over traditional SAW filters. The TriQuint 885025 has a usable bandwidth of 60 MHz and the RoHS compliant 3 x 3 mm ceramic package can handle up to 1W (30 dBm) of CW RF energy.

RFMW, Ltd.
rfmw.com

Amplifier

Rohde & Schwarz expanded its portfolio for EMC users in broadband amplifiers by adding the new R&S BBA150. The new amp covers from 0.8 GHz to 3.0 GHz and is available in various power classes between 30 W and 200 W. In combination with the R&S BBA100, Rohde & Schwarz is now able to offer amplifier solutions ranging from 9 kHz to 3.0 GHz for EMS testing in line with several EMC standards.

Rohde & Schwarz
rohde-schwarz.com

Probing System

Tektronix, Inc. announced the industry's lowest noise and highest bandwidth 30 GHz probing system with coaxial connectors. The new P7600 Series Probing System features probe-specific DSP filters that enhance performance and minimize noise levels. When paired with the Tektronix DPO/DSA73304D oscilloscope, the P7600 Series Probing System provides connectivity and signal fidelity for high speed differential signal measurements on serial bus designs like PCI Express.

Tektronix
tektronix.com

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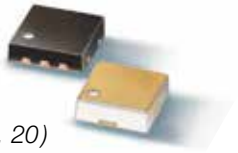

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Model Family	Freq. (GHz)	P_{MAX} (W)	Atten. (dB)	Op. Temp (°C)	Size (mm)	$ Price ea. (Qty. 20)
RCAT	DC-20	2	0-30	-45 to +125	2.3 x 2.3 x 1.1	4.95
YAT	DC-18	2	0-30	-45 to +85	2.0 x 2.0 x 0.8	2.99

Actual Size

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MMIC Frequency Doublers

By John E. Penn

Frequency multipliers can be useful for generating higher frequency sources from an existing lower frequency source.

Abstract

Several frequency doublers were designed using a 0.13 um GaAs Pseudomorphic High Electron Mobility Transistor (PHEMT) process from TriQuint Semiconductor. The design and fabrication of these circuits was performed as part of the Fall 2011 Johns Hopkins University Monolithic Microwave Integrated Circuit (MMIC) Design Course, taught by the author. The design approach is applicable to frequency multiplier MMICs that could be used for a variety of RF and Microwave systems.

Frequency multipliers can be useful for generating higher frequency sources from an existing lower frequency source. It can be simpler to take an existing Microwave communications system operating at one band and use multipliers to quickly up-convert the system for higher frequency operation. Whether mixing for up or down conversion, or directly up converting, a multiplier is one option for increasing the transmission or reception frequency.

Harmonics will be of concern with multipliers, so two of the three designs use a quarter wave stub to "short" out the fundamental input frequency, while optimizing the output load for the second harmonic. This approach could also be used for a harmonic tripler. Following is a discussion of the design and measured performance of these frequency doublers, a 10 GHz doubler, and an 8 GHz and 16 GHz doubler with harmonic stubs.

Simple Frequency Doubler at 10 GHz

The first doubler design for 10 GHz to 20 GHz operation was quickly assembled using portions of other test circuits on the JHU 2011 MMIC Design Course quarter tile. For the input match, a simple four element high-pass, low-pass network was borrowed from a 5-11 GHz broadband medium power amplifier and re-tuned for a 10 GHz input center frequency. The output match was borrowed from a 20 GHz VCO design. Simulations of the doubler (Figure 1) show a strong second harmonic, but an even stronger undesired fundamental frequency. The fundamental could be filtered from the doubler output to accentuate the second harmonic. A plot of measured versus simulated s-parameters shows good agreement (Figure 2). Note that the spectrum plot seems to follow the S21 gain, with best operation around the 10 GHz design frequency. The DC bias can be optimized for best operation, and as expected, biasing lower than Class A towards Class B tends to enhance the second harmonic, particularly at lower input drive levels. Figure 3 shows the measured performance of the second harmonic versus input power level compared to simulations at 9, 10 and 11 GHz; showing reasonable agreement with the output, typically 2 dB lower than simulations. The input DC bias supply was -3V, which is divided through resistors to supply a gate bias that is closer to pinchoff (~-0.33V) and accentuates the second harmonic at lower drive levels. Figure 4 shows

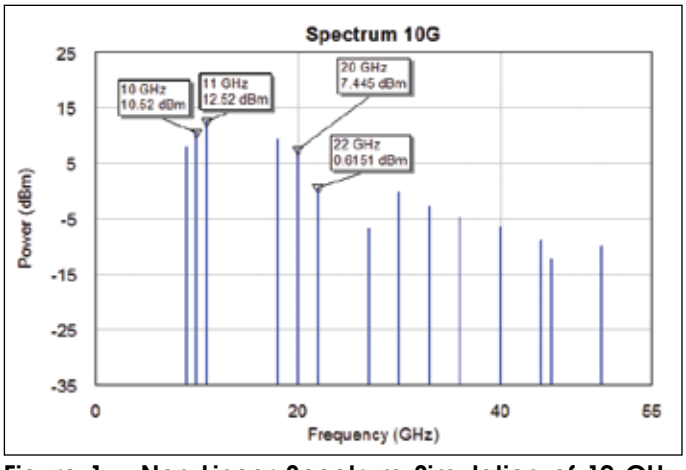

Figure 1 • Non-Linear Spectrum Simulation of 10 GHz Doubler (Inputs: 9, 10, & 11 GHz).

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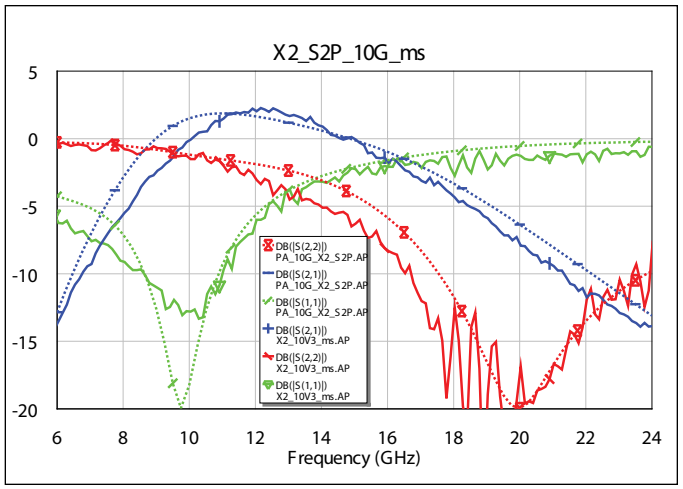

Figure 2 • S-Parameters of 10 GHz Doubler (Measured-solid, Simulated-dotted).

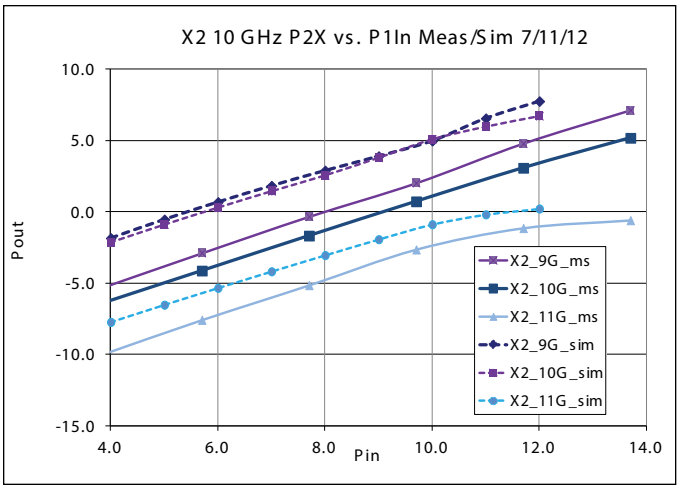

Figure 3 • 2nd Harmonic Output Power vs. Input at 9, 10, and 11 GHz (Measured, Simulated).

the same measurements at 9, 10 and 11 GHz with a -3V input DC supply versus 0V at 10 GHz ("X2_10G") which has less second harmonic at lower drive levels but nearly matches the -3V results at higher drive levels. Figure 5 shows the final layout of the 10 GHz frequency doubler.

Frequency Doubler at 8 and 16 GHz with Fundamental Harmonic Stub Attenuator

For the next doubler designs, a harmonic stub was added to attenuate the fundamental input frequency. Additional filtering might be required to attenuate harmonics, but a simple one quarter wave open circuit stub on the output presents a short circuit at the fundamental, while presenting an open circuit at the desired second harmonic. Input matching circuits were designed for low return loss at the fundamental, while output matching circuits were designed for low return loss at the second harmonic. The harmonic stub doubler design for 8 GHz to 16 GHz operation, had an input conjugately matched to S11 of the PHEMT at 8 GHz, and an output match conjugately matched to S22 of the PHEMT at 16 GHz.

Simulations of the 8 to 16 GHz doubler (Figure 6) show a strong second harmonic, with an attenuated fundamental. Additional filtering on the output of the doubler could be added to further accentuate the second harmonic. Originally, the measured versus simulated s-parameters showed poor agreement (Figure 7). Once Sonnet EM software was used to simulate the actual layout, the discrepancy in the original simulation is due to the harmonic quarter wave stub. There must have been parasitic coupling in the layout that was not included in the original simulation. Adding the Sonnet Electromagnetic (EM) simulation of the stub alone matches well with the measured data, as does the full Sonnet layout simulation as shown in Figure 8. Figure 9 shows the actual layout and the Sonnet geometry. The Sonnet EM simulation correctly simulates the affect of parasitic coupling in the quarter wave meandered stub. It should be noted that the error in

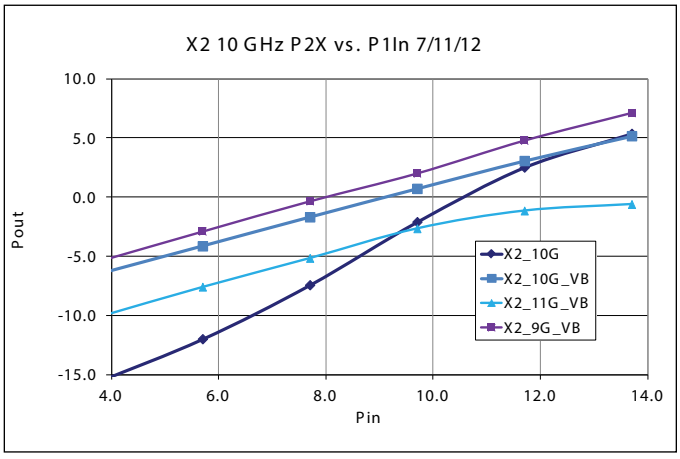

Figure 4 • Second Harmonic Output Power vs. Input Power at 9, 10, and 11 GHz (0, -3V).

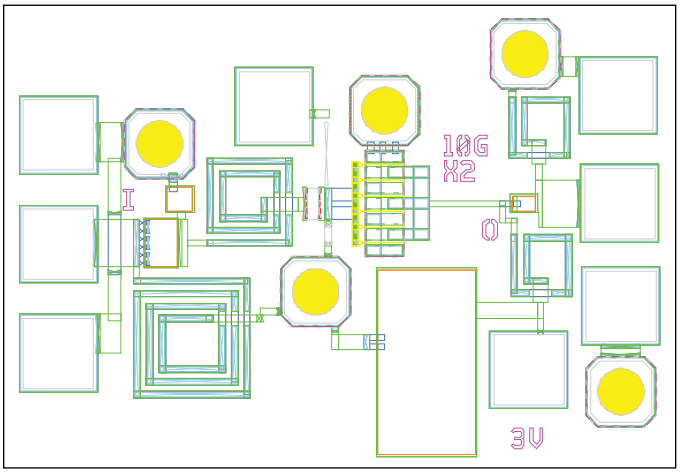

Figure 5 • Layout Plot of 10 GHz Frequency Doubler (~0.8 x 0.6mm).

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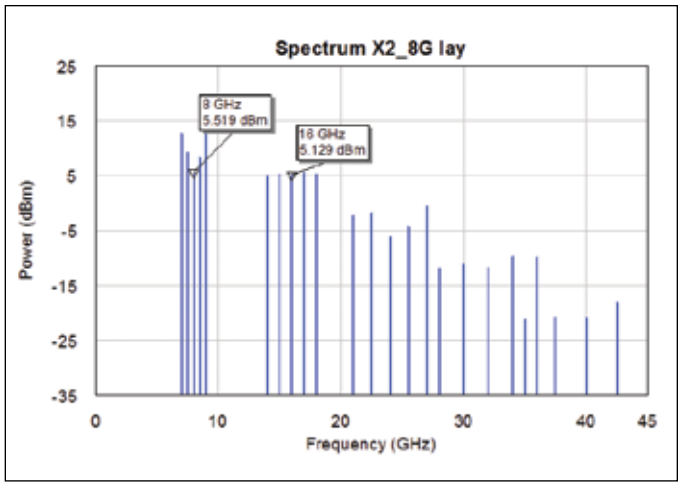


Figure 6 • Non-Linear Spectrum Simulation of 8 GHz Doubler (Inputs: 7, 7.5, 8, 8.5, & 9 GHz).

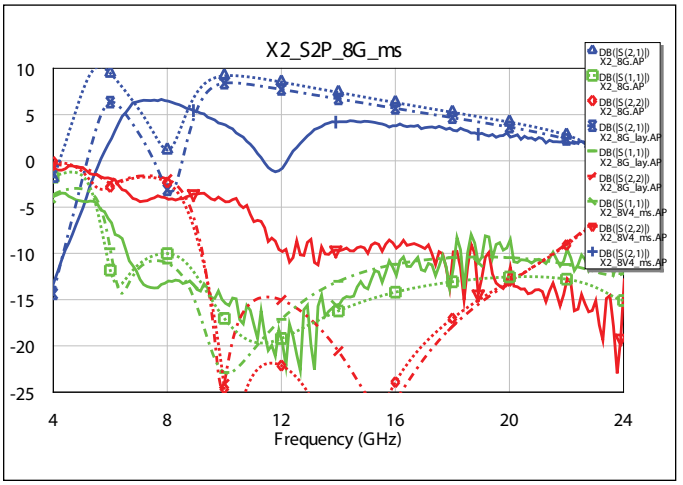


Figure 7 • S-Parameters of 8 GHz Doubler (Measured-solid, Original Simulations-dotted).

the harmonic stub simulation mostly affected the attenuation of the fundamental frequency, which shifted to a maximum attenuation at 12 GHz, rather than the desired 8 GHz, while retaining little effect on the second harmonic. Figure 10 shows the measured performance of the second harmonic versus input power level at 8, 11, 11.5, and 12 GHz; showing reasonable agreement with the output, though typically 2 dB less than simulations.

Likewise, a 16 GHz to 32 GHz doubler was designed with the same approach, with a meandered quarter wave stub approximately half as long as the 8 GHz stub previous. Unfortunately, the 16 GHz stub attenuation was also shifted up in frequency compared to the original simulations, but again, was correctly predicted with Sonnet EM. The EM simulation uses the physical layout, thus including any layout parasitics not modeled in the original linear simulations.

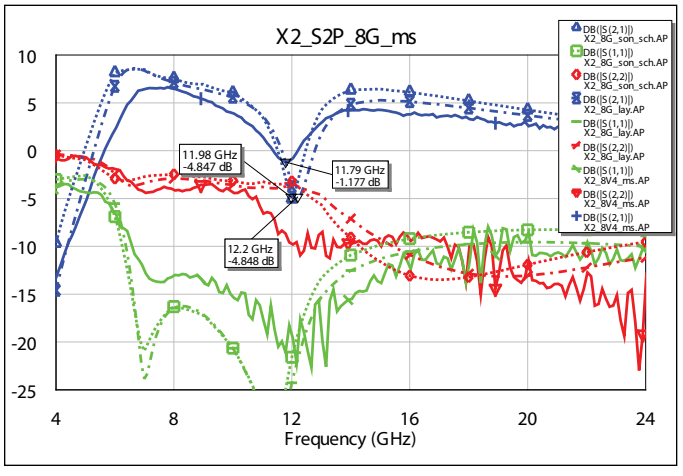


Figure 8 • S-Parameters of 8 GHz Doubler with EM Simulation (Measured-solid, Full Sonnet-dot/dash, MWO+Sonnet Stub--dotted).

Simulations of the 16 to 32 GHz doubler (Figure 11) show a strong second harmonic, with an attenuated fundamental leakage. Again, additional filtering after the doubler could be provided to further accentuate the second harmonic. Originally, the measured versus simulated s-parameters showed poor agreement (Figure 12). Sonnet software was used to simulate the actual layout, which matches well with the measured data as shown in Figure 13. Figure 14 shows the actual layout and the Sonnet EM plot which correctly simulates the affect of parasitic coupling in the quarter wave meandered stub. It should be noted that the error in the harmonic stub simulation affected the attenuation of the fundamental frequency which was shifted higher to around 21 GHz, from 16 GHz, but retained little effect on the second harmonic. Figure 15 shows the measured performance of the second harmonic versus input power level.

Summary:

These frequency doubler circuits were designed with a simple approach to illustrate a couple of concepts. First, the input match assumed a simple conjugate input match of the active device at the fundamental frequency (S11*), while the output match was designed for a conjugate output match of the active device at the second harmonic (S22*). A simple quarter wave microstrip open circuit stub was used to attenuate the fundamental helping to prevent leakage through to the output. While these simple frequency doubler MMIC circuits were used to illustrate a first cut doubler design, they also illustrate the efficacy of the non-linear and linear models, as well as, illustrating the occasional necessity for an EM simulator, such as Sonnet, to accurately predict the actual layout parasitics. These designs could be optimized further with additional non-linear simulations and/or measurements. If the chance arises, the circuits may be re-fabricated with the harmonic

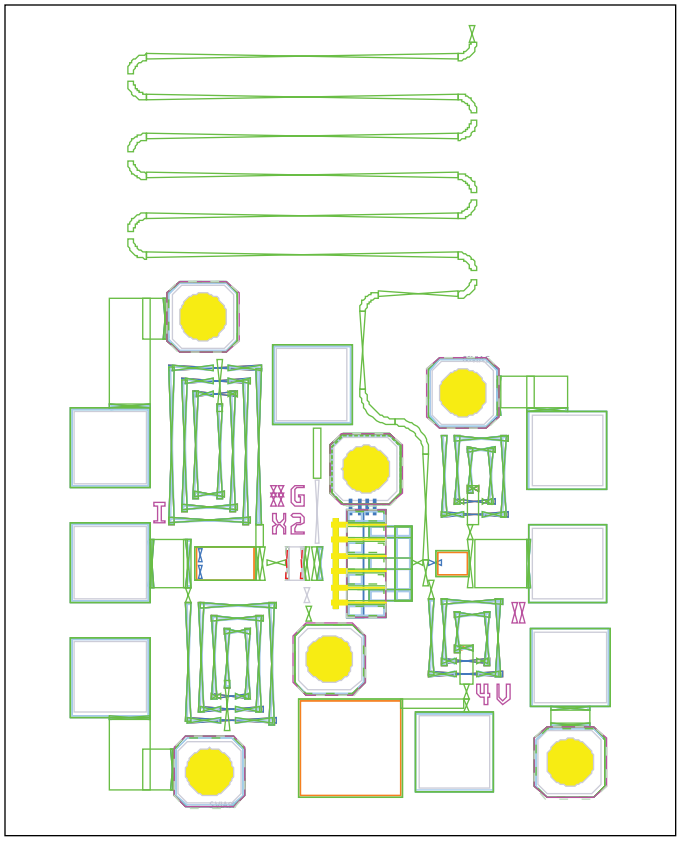
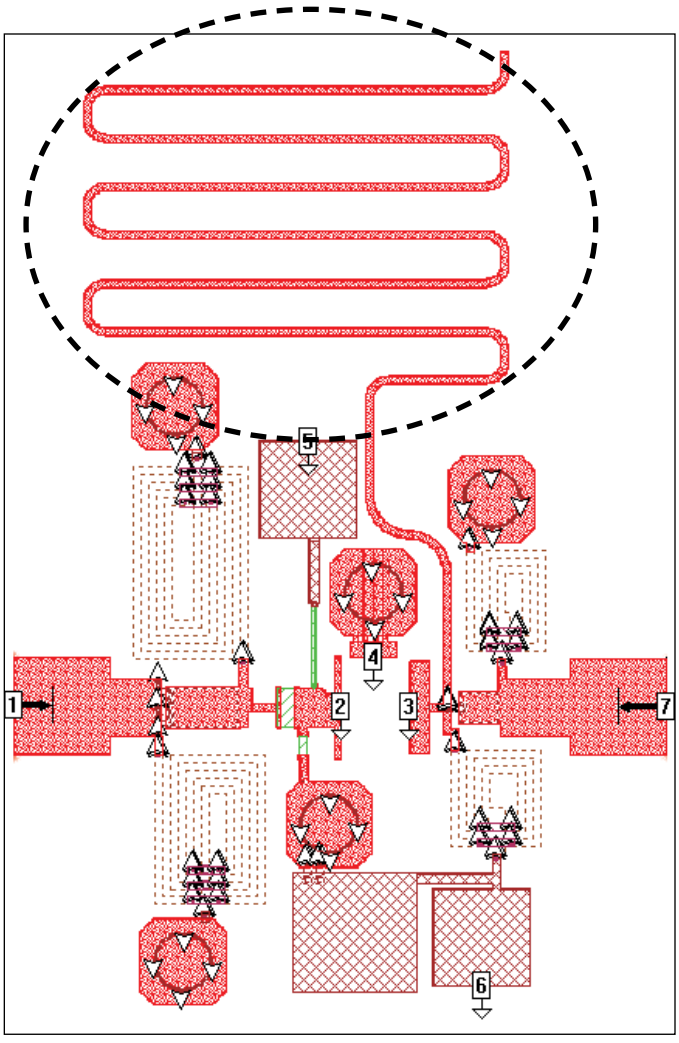


Figure 9 • Layout and Sonnet EM Plot of 8 GHz Frequency Doubler (~0.65x1.0mm).



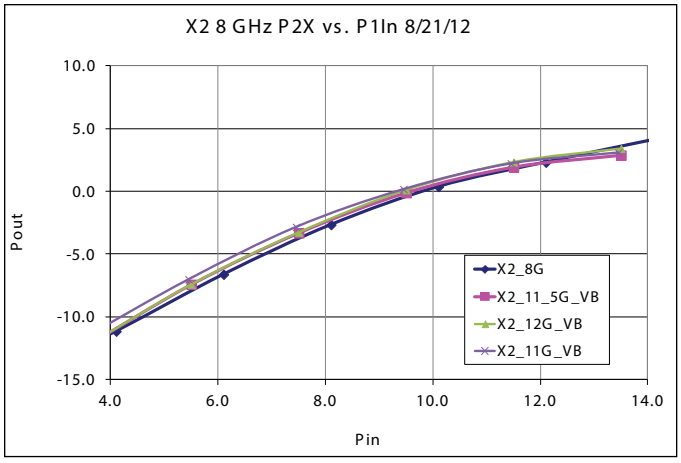


Figure 10 • 8 GHz Doubler 2nd Harmonic Output vs. Input Power at 8, 11, 11.5, and 12 GHz.

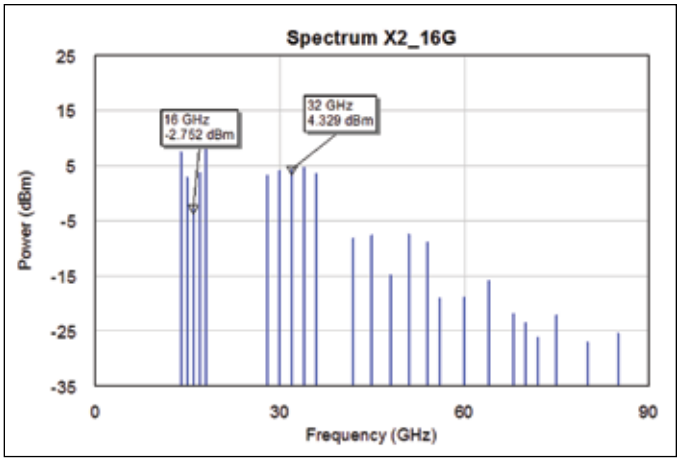


Figure 11: Non-Linear Spectrum Simulation of 16 GHz Doubler (Inputs: 15-17 GHz).

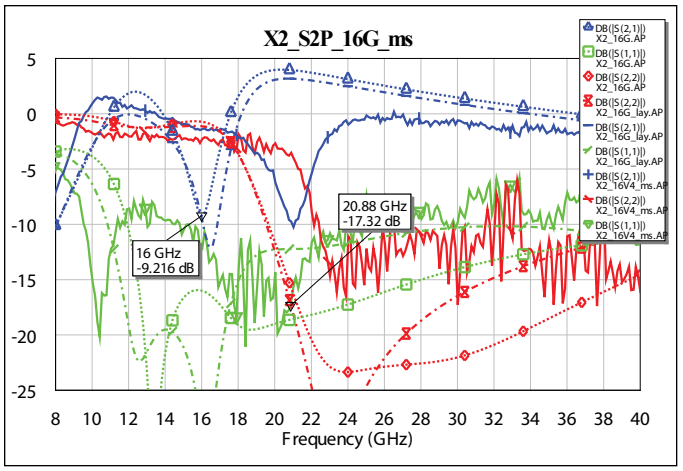


Figure 12 • S-Parameters of 16 GHz Doubler (Measured-solid, Original Simulations-dotted).

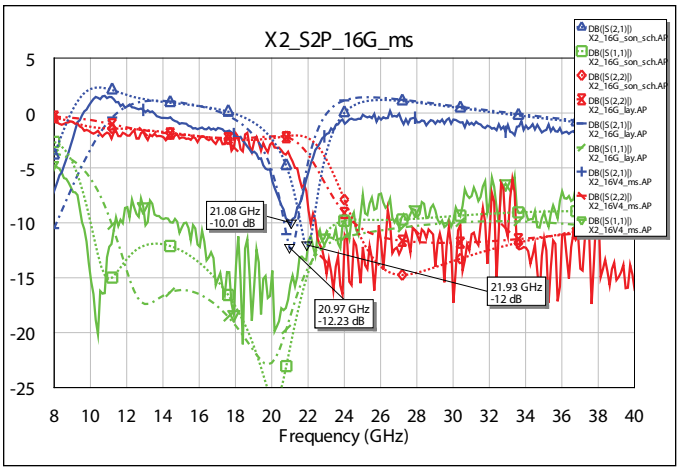


Figure 13 • S-Parameters of 16 GHz Doubler with EM Simulation (Measured-solid, Full Sonnet-dot/dash, MWO+Sonnet Stub--dotted).

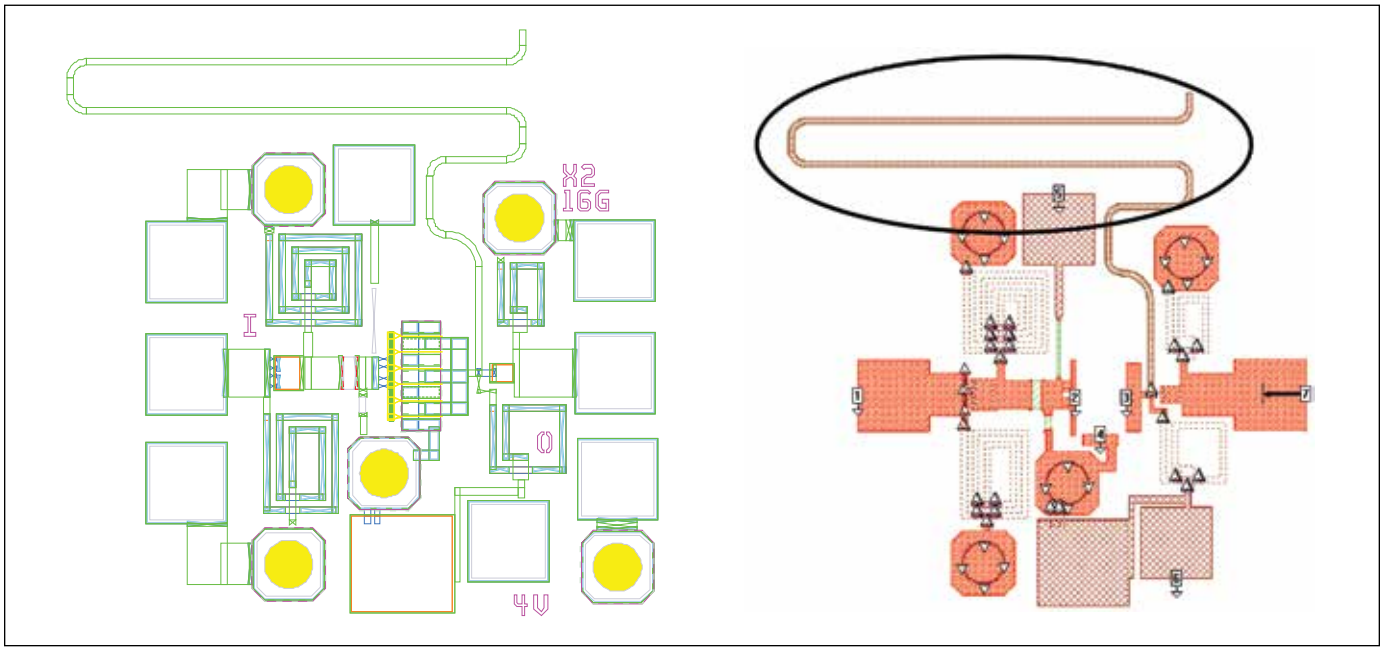


Figure 14 • Layout and Sonnet EM Plot of 16 GHz Frequency Doubler (~0.7x0.8mm).

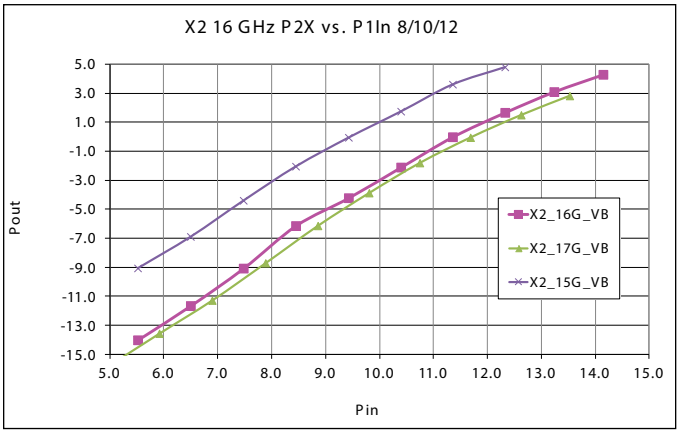


Figure 15 • 16 GHz Doubler 2nd Harmonic Output vs. Input Power at 15, 16, and 17 GHz.

stubs adjusted to account for the parasitic coupling in the layout which was correctly simulated in the EM simulation.

About the Author:

John Penn has been an adjunct professor in the Johns Hopkins University Engineering for Professionals (EP) program since the first JHU MMIC Design Course was offered in 1989. Previously, he was a full time engineer at the Applied Physics Laboratory for 26 years before joining the Army Research Laboratory in 2008. He currently serves as the Team Lead for RFIC Design in the RF Electronics Branch.

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RF MEMS Switches: High-Frequency Performance and Hot-Switching Reliability

By Tai Wen Jau

Exploring the hot-switching reliability of MEMS switches using different types of input signals.

Abstract

This article describes the S-parameter performance of on-board RF MEMS switches from DC to 4 GHz. It also explores the hot-switching reliability of MEMS switches using different types of input signals. Finally, it evaluates a possibility for improving the reliability of MEMS switches using an external circuit.

I. Introduction

Micro-electro-mechanical systems (MEMS) technology is an evolving technology that allows device fabrication using components at a submillimeter scale (1 to 100 micrometers). A wide variety of MEMS devices is available, including sensors, actuators and switches.

An RF MEMS switch is a specific type of MEMS-based device that can provide switching capability at RF (radio frequency) or even microwave frequencies. MEMS switches offer several advantages that make them an attractive alternative to conventional devices like mechanical relays and solid-state devices (PIN or FET switches): low insertion loss, high isolation, low power consumption, extreme linearity and the ability to be integrated with other electronics [1].

While the advantages are numerous, the long-term reliability of MEMS switches is relatively weak, especially when switching in the presence of input signals (hot-switching). In this paper we investigate RF MEMS switch performance and reliability issues by focusing on an off-the-shelf, ohmic-contact-based, single-pole-double-throw (SPDT) MEMS switch that is currently available.

A comparison of MEMS relays (MMR) and other solid-state devices and electro-mechanical relays (EMR) is shown in Table 1 [2].

II. On-Board RF MEMS Switch Performance

Our intent is to simulate actual use cases of an off-the-shelf, surface-mounted RF MEMS switch in a typical printed circuit board (PCB) application. We fabricated an evaluation PCB for mounting the RF MEMS switch so we could measure board-level performance like S-parameters from DC to 4 GHz.

Figure 1 shows the layout of the evaluation board. We used SMA connectors for connecting from PCB transmission lines to measuring equipment.

We used a network analyzer to make the S-parameter measurements. Below are the definitions of the network analyzer measurements we made on the evaluation board with an RF MEMS switch:

Insertion loss – S21 measurement from the common port (pole of the MEMS switch) of the board to either port A or B (throw of the switch).

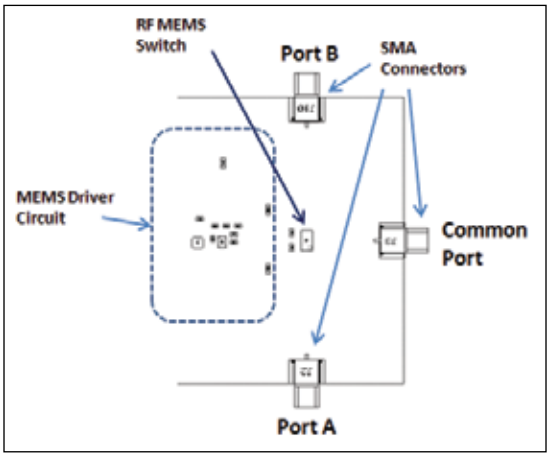

Figure 1 • MEMS evaluation board.

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Size	Small	Very small	Small	Medium	Large
Resistance	0.5 Ω	1-5 Ω	1-5 Ω	0.1 Ω	0.5 Ω
Switching power	2 W CW	0.5 W CW	5 W CW	10 W CW	35 W CW
Breakdown voltage	Low	Low	Varies	High	High
Speed	0.5-200 µs	10-100 ns	10-100 ns	0.8-10 ms	1-40 ms
Life cycle	100 million+	Billion	Billion	0.5-5 million	0.1-2 million
Frequency	Up to 70 GHz	Up to 4 GHz	Up to 20 GHz	Up to 5 GHz	Up to 40 GHz
In. loss max (dB)	0.25	0.5	0.5	0.4	0.1
Isolation min (dB)	40	30	30	40	80
3rd order harmonics	Very good	Poor	Poor	Good	Very good
Power consumption	Very low	Low	Low	Medium	High
Integration capability	Very good	Very good	Very good	Average	Difficult
Cost – SPDT type	$8 to $20	$0.5 to $4.50	$0.9 to $8	$0.85 to $12	$38 to $90

Table 1 • Comparison of MEMS relays with existing switches.

Return loss – S11 measurement at any port of the board with other ports terminated with a 50 Ω load.

Isolation – S21 measurement from the common port to either port A or port B while the switch position is intentionally set to the opposite port.

The measurement results with the analyzer are presented in Table 2 (a) to (c).

Frequency	S21 (dB)
10 MHz	-0.1
30 MHz	-0.1
300 MHz	-0.1
4 GHz	-0.7

Table 2(a) • Insertion loss of on-board MEMS switch.

Frequency	S11 (dB)
10 MHz	-43.2
30 MHz	-44.2
300 MHz	-48.2
4 GHz	-17

Table 2(b) • Return loss of on-board MEMS switch.

The on-board performance data indicates that RF MEMS switches indeed have very good high-frequency performance in terms of low insertion loss, good matching and excellent isolation.

III. Hot-Switching Reliability of RF MEMS Switches

RF MEMS switch reliability is a major concern because of the relatively new technology of the devices. Adoption of the technology is lower compared to other established components like solid-state devices and electromechanical relays, so there is not much data across industries to show the long-term behavior across the entire lifetime of the applications.

One way MEMS switches fail is through "stiction," where a switch contact is unable to be moved to another intended position when biasing voltage is applied.

Frequency	S21 (dB)
10 MHz	-100
30 MHz	-90
300 MHz	-96
4 GHz	-43

Table 2(c) • Isolation of on-board MEMS switch.

When you apply very low or no input signal during switching cycles (cold-switching), MEMS switches can last as long as specified by the manufacturer. However, when you apply significant input power to the switch during switching cycles (hot-switching), contact stiction can occur much earlier than the lifetime specified on the manufacturer's data sheet. The failure is caused by "microwelding" of the contacts during the switching transition from one position to another [3].

We evaluated the hot-switching reliability of RF MEMS switches using the same evaluation board we used for studying switch performance.

Figure 2 shows the setup of the hot-switching measurement. Input signals are continuously applied to the MEMS switch while biasing voltages are used for device switching. You can use an oscilloscope or spectrum analyzer to continuously monitor the output signal to detect any switch failures. We ran the measurement continuously until the switch failed and recorded the number of switch cycles until failure.

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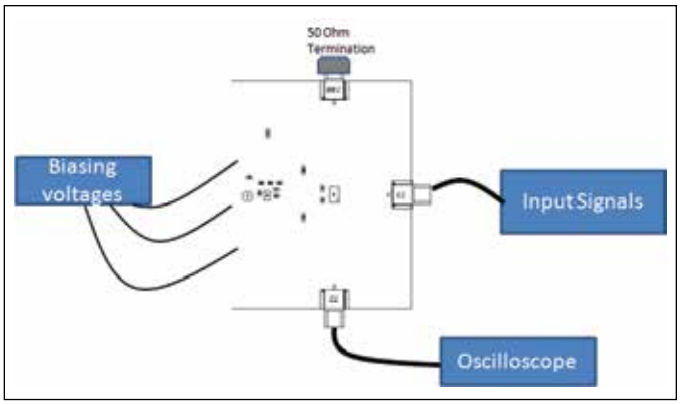

Figure 2 • Hot-switching setup.

We applied three types of signals to study the hot-switching behavior of the RF MEMS switch under different signal conditions:

(1) DC voltage at 20 V

(2) Continuous RF (2 GHz) at +30 dBm

(3) DC pulses: Peak voltage = 26 V, pulse width = 6.5 ns, pulse frequency = 50 kHz

We used three samples for each type of input signal. Tables 3 (a), (b) and (c) show the number of switch cycles it took to reach failure when high-power input signals were applied for hot-switching.

	Failure cycle
Sample 1	1,801
Sample 2	4,180
Sample 3	5,750

Table 3(a). Hot switching with DC voltage.

	Failure cycle
Sample 1	484,775
Sample 2	1,346,358
Sample 3	964,161

Table 3(b). Hot switching with continuous RF.

	Failure cycle
Sample 1	3,114,338
Sample 2	150,722
Sample 3	3,333,143

Table 3(c). Hot switching with DC pulses.

The results show that hot-switching with DC voltage has the worst reliability. This can be explained by looking at the duration of input signal voltage applied during the switching transition period. For a DC signal, the voltage is applied constantly for the whole switching transition period, and it yields the highest probability of microwelding. For signals like RF signals or pulses, the duration of peak voltage applied during switching transition is shorter than the voltage duration for DC signals, so there are fewer occurrences of microwelding. More microwelding will cause more contact damages and shorten the life of the MEMS switches.

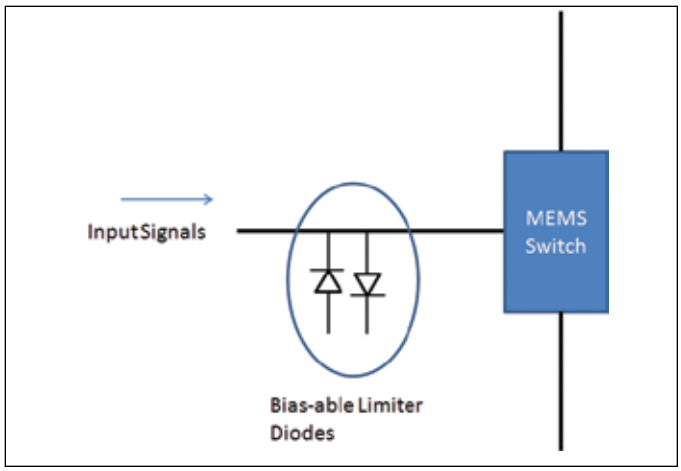

Figure 3 • Limiter diodes circuit for MEMS switches.

IV. How to Improve Hot-Switching Reliability

As we discussed in Section III, the hot-switching failure of RF MEMS switches is caused by "microwelding" of the contacts during the switching transition. There is no risk of microwelding after the switching transition completes.

Therefore, microwelding could be eliminated or reduced if there is a circuit to block or limit the input signals during the switching transition period.

Figure 3 shows a proposed circuit for this purpose. A bias-able limiter diode circuit is added to the common port of the RF MEMS switch. When there is no switching needed, the limiter diodes are reversed biased at high voltages like +/- 20 V, such that input signals are not distorted by the diodes. During switching transitions, the limiter diodes are biased at 0 V so input signals are clipped to the forward voltages of the diodes. After switching is settled, the biasing voltages for the diodes revert to +/- 20 V.

We fabricated an evaluation board based on the diode circuitry shown in Figure 3 for on-board evaluation of the RF MEMS switch. We made network analyzer measurements to study the S-parameter performance of the new circuit. Figure 4 (a) to (c) shows the respective board-level performance of the added circuit.

We repeated the hot-switching experiment with DC pulses to observe the improvement on RF MEMS reliability. Table 4 shows the results.

From the board-level S-parameter results, the addition of a limiter diode circuit will cause degradation of

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Without limiter diode circuit	With limiter diode circuit
150 thousand to 3 million cycles before failure	Up to 7.8 million cycles and no failure yet

Table 4 • RF MEMS reliability comparison.

insertion loss and return loss compared to an RF MEMS circuit without it. However, clipping of the input signals via limiter diodes during switching transitions does significantly improve the hot-switching reliability of RF MEMS switches.

V. Conclusion

We measured and analyzed the RF performance and hot-switching reliability of an RF MEMS switch mounted on a PCB. We added an external circuit to improve the hot-switching reliability of the MEMS switch. However, there are trade-offs for the addition of the external circuit in terms of insertion loss and return loss. You can use the information in this paper to determine the suitability of RF MEMS switches in your application from the perspectives of high-frequency performance, as well as hot-switching life cycles under different signal conditions.

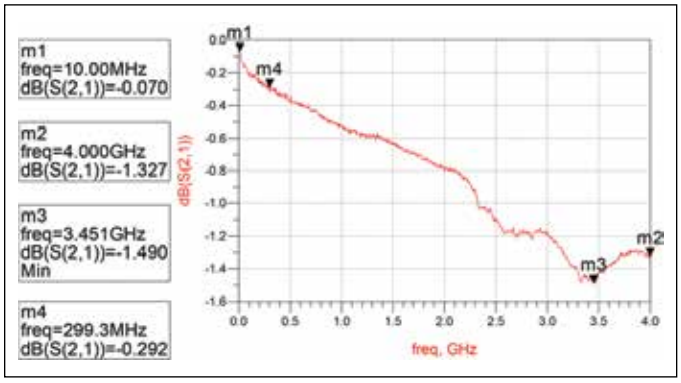

Figure 4(a) • Insertion loss of new circuit.

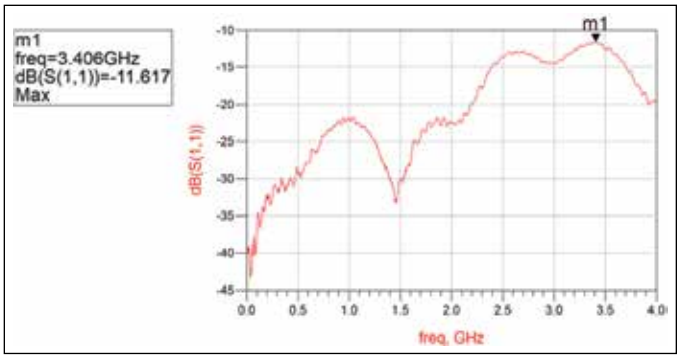

Figure 4(b) • Return loss of new circuit.

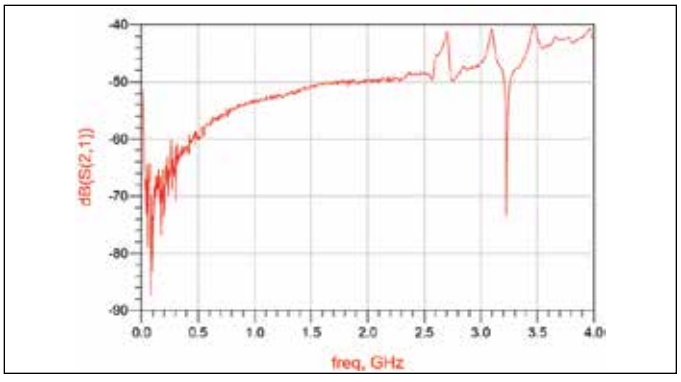

Figure 4(c) • Isolation of new circuit.

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[2] T. Campbell, "MEMS Switch Technology Approaches the 'Ideal Switch,'" Applied Microwave & Wireless, Vol. 13, No. 5.

[3] G. M. Rebeiz and J. B. Muldavin, "RF MEMS Switches and Switch Circuits," IEEE Microwave Magazine, Dec 2001

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NEW PRODUCTS

Amplifier

Comtech PST's MODEL BHED78238-200 200-watt Solid State Power Amplifier operates over 700 to 2300 MHz and features: High Power Output; Instantaneous Multi-Octave Bandwidth; Gallium Nitride (GaN) Technology; Rugged, Field Proven Construction; Multi-Tone Capability; Ethernet Interface; Fast Noise Quieting Speed; Class AB Amplifier; Digital Display and Control; ALC Circuitry.

Comtech PST
comtechpst.com

Transistors

Richardson RFPD announced availability and design support for two 35 W Gallium Nitride (GaN) radio frequency power transistors from TriQuint Semiconductor. The T1G4003532-FL and T1G4003532-FS are 37W (P3dB) discrete GaN on SiC HEMTs that operate from DC to 3.5 GHz. The devices are constructed with TriQuint's 0.25 µm process, which features advanced field plate techniques to optimize power and efficiency at high drain bias operating conditions.

Richardson RFPD
richardsonrfpd.com

Synthesizer

Texas Instruments introduced a wideband frequency synthesizer with integrated voltage-controlled oscillator (VCO) that delivers the industry's lowest phase noise. Its combination of ultra-low noise phase-locked loop (PLL) and industry's highest phase detector frequency outperforms the competition in both phase noise and spurs. The LMX2581 combines the capability to drive highest system performance along with the flexibility of a wideband frequency synthesizer that outputs 50 to 3760 MHz. It allows designers to use one frequency synthesizer to support a variety of demanding applications in wireless infrastructure, radar, defense and aerospace, and test

2 W, 5 W, and 20 W

PRECISION ATTENUATORS

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For rugged, reliable, and repeatable attenuation when accuracy is key, our customers have come to rely on Mini-Circuits Fixed Precision Attenuators, rated at 2W or 5W for DC-18 GHz signals. And now we've gone even further, with a new series of **2 W models up to 26 GHz,** and a new series of **20 W models from DC-18 GHz!** They feature stainless steel construction, precision attenuation from 1 to 50 dB, and SMA or N-type connectors for 50 Ω systems.

Inherent accuracy, and finely-graded attenuation levels, make our "BW" family invaluable on the bench or in the field. They're a ready solution for extending the range of test instrumentation or meeting circuit- and system-level requirements, such as better matching for high-VSWR components, reducing power to maximize sensitive applications, or protecting valuable circuitry. Just go to minicircuits.com—they're on the shelf and ready to ship today, at the low prices you've come to expect!

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NEW PRODUCTS

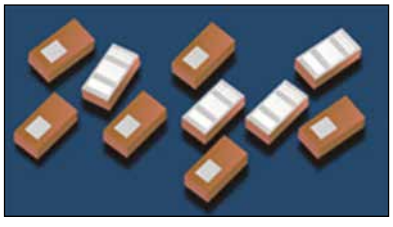
and measurement: www.ti.com/lmx2581-pr.

Texas Instruments
ti.com

MIMO

Agilent's LTE-Advanced 8 x 8 MIMO signal-generation and analysis solutions comprise Signal Studio and 89600 VSA software, as well as the Agilent X-Series vector signal generators and multichannel signal analyzer with up to eight measurement channels. The solutions support generation and analysis of FDD and TDD signals compliant with the 3GPP Release 10 standard, and are well suited for R&D and test engineers designing and evaluating transmitters, receivers, basebands, and components for LTE-Advanced base stations and mobile terminals.

Agilent Technologies
agilent.com



Filter

RFMW Ltd. announced support for Johanson Technology's 2.4 GHz, high-rejection band pass filter (BPF) with land grid array (LGA)-type terminations. This brand new BPF has the highest close-to-passband rejection with the smallest footprint ever made by JTI. With a 3 dB bandwidth of 100 MHz centered at 2.45 GHz, minimum attenuation of the 2450BP15Q0100 at 2170 MHz is 30dB, yet maximum passband insertion loss is 1.8 dB at 25° C.

RFMW
rfmw.com

Voltage Probe

The R&S RT-ZS60 active voltage probe is the perfect solution for any task requiring single-ended measurements of signal integrity. The R&S RT-ZS60 is the market's first compact, single-ended 6 GHz probe that can handle tests on high-speed interfaces such as DDR memory modules or general analyses for A&D, research or consumer electronics, for example.

Rohde & Schwarz
rohde-schwarz.com

Power Meter Re-Certification

LadyBug Technologies has enabled self-service, customer-site re-certification for its entire line of PowerSensor+™ power-measurement devices. The new procedure allows LadyBug customers to re-certify their power meter/sensor products on-site in the field, eliminating the need to return units to the manufacturer to obtain a re-certification certificate. For ease of use, the procedure employs Microsoft Excel® spreadsheet software, which comes pre-loaded on the vast majority of today's PCs. The new procedure can be accessed at ladybug-tech.com.

LadyBug Technologies
ladybug-tech.com

Teledyne's A3CP6025 Broadband Amplifier *0.01 to 6.0 GHz. Gain is 24 dB typical, output power is +25 dBm, 3rd order intercept +34 dBm. Reverse isolation -50dB. Operates on 15 VDC, 300 mA.*

Broadband Amplifiers

Teledyne's ACP20015 Ultra-Broadband Amplifier *2.0 - 20.0 GHz, 10 dB gain, 16.0 dBm typical output power. 3rd order intercept +26 dBm. -55 to +85°C, fully-hermetic. Operates on 5 VDC at 76 mA. Military or space-level manufacturing/ screening is an available option. EAR-99.*

High power, broadband, helix ***Traveling Wave Tubes*** *for ECM, Radar, Communication & Instrumentation in airborne, shipboard, ground mobile and laboratory environments.*

Traveling Wave Tubes

Ultra low phase noise ***YIG Oscillators*** *covering multi-octave bands up to 18GHz. Surface Mount or connectorized packages for commercial and military applications.*

YIGs

Ku-Band SSPA *Exceptionally small size 15W P1 Ku-Band Solid State Power Amplifier for Satcom & CDL frequency bands. Product includes Forward power detect, Thermal Monitor, VSWR monitor and high speed blanking. Unit also incorporates a low output power mode.*

SSPAs

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Cable

Mini-Circuits' Hand-Flex coaxial cable features wideband frequency coverage, DC to 18 GHz; low loss, 0.64 dB at 18 GHz; excellent return loss, 28 dB at 18 GHz; hand formable to almost any custom shape without special bending tools; 8mm bend radius for tight installations; anti-torque nut prevents cable stress during installation; insulated outer jacket standard; connector interface, meets MIL-STD-348. Applications: replacement for custom bent 0.141" semi-rigid cables; communication receivers and transmitters; military and aerospace systems.

Mini-Circuits
minicircuits.com

Downconverter

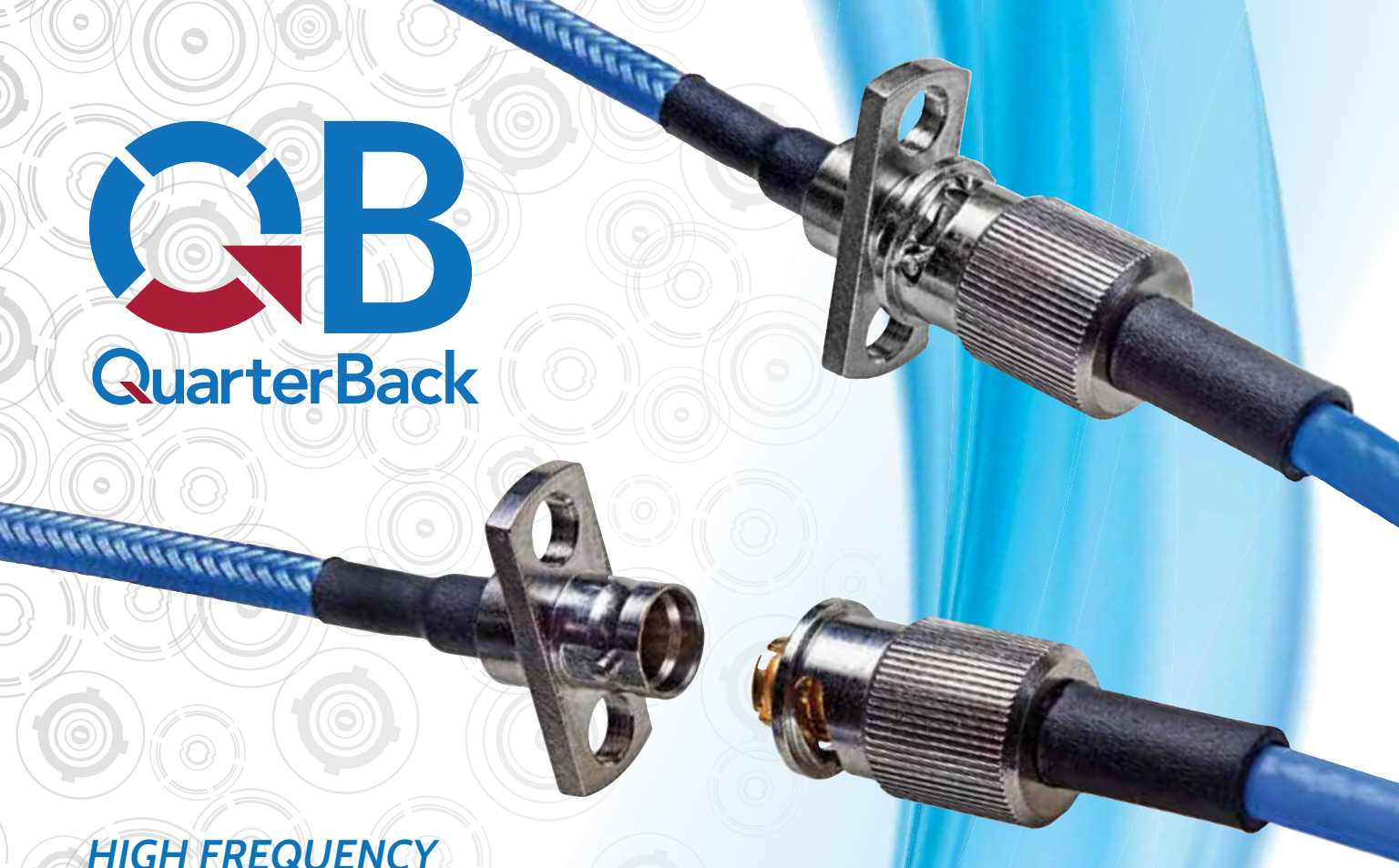
Pentek, Inc., announced an enhancement to its fastest-ever data acquisition XMC module for the popular Cobalt® family. The Model 71641, capable of digitizing one 12-bit channel at 3.6 GHz, or two channels at 1.8 GHz, comes preconfigured with a programmable one- or two-channel digital downconverter (DDC) loaded into the onboard Xilinx Virtex-6 FPGA. The new module is ideal for wideband radar and software defined radio (SDR) applications.

Pentek, Inc.
pentek.com

Handheld Analyzer

Trilithic introduced the Model 8853S Handheld Spectrum and Interference Analyzer, a 3 GHz 50 Ohm unit that can be used in 2G/3G/4G Wireless, Wireless LAN, Satellite and Microwave networks to analyze RF signals with a comprehensive scope of measurements. The analyzer includes a larger display, internal calibration and preselection to meet precision testing needs, with a familiar, intuitive user interface. It provides signal strength indication, spectrogram,

QuarterBack



HIGH FREQUENCY
CONNECTIVITY
WITH A TWIST.

SV Microwave's new QuarterBack line of connectors combines the high frequency performance of an SMP style connector with the mating durability and ease of a bayonet style connector.

- Positive Mating
- SMP (40 GHz) / SMPM (65 GHz)
- Quick Connect/Disconnect Applications
- Low Mating Forces
- High Vibration Environments
- Custom Configurations Available

Amphenol
SV MICROWAVE®
www.svmicrowave.com

NEW PRODUCTS

and waterfall diagrams to identify interference signals.

Trilithic
trilithic.com

Multimeter

The Agilent 34450A benchtop digital multimeter is capable of measuring up to 190 readings per second with 0.015 percent DCV accuracy. Its multiple connectivity options, including USB 2.0, serial interface (RS-232) and general-purpose interface bus (GPIB), give users greater flexibility when transferring data to a PC for analysis. The Agilent 34450A DMM can deliver up to 50,000 readings of on-board memory, allowing users to log up to 14 hours of data at one sample per second.

Agilent Technologies
agilent.com

Power Signal Tap

Mini-Circuits' model ZARC-20-52+ Power Signal Tap features: excellent mainline loss, 0.9 dB typ.; excellent VSWR, 1.2 typ.; input power up to 20 Watt at room temperature. Applications: instrumentation; amateur radio.

Mini-Circuits
minicircuits.com

2013 EDITORIAL CALENDAR

HIGH FREQUENCY ELECTRONICS

March
- Mixers and Modulators
- EDA
- Filters International Wireless

Bonus Distribution:
Symposium, Beijing, April 13 – 18, 2013

April
- Passive Components
- Cables and Connectors
- Engineering Education

Bonus Distribution:
CTIA, Las Vegas, May 21 – 23, 2013

May
- Millimeter Waves
- Frequency Synthesis
- IMS 2013 Preview

Bonus Distribution:
IMS 2013 Seattle, June 2 – 7, 2013
Antennas & Propagation Symposium,Orlando, June 7 – 13, 2013

June
- Antennas
- Integrated Circuits
- Defense Electronics

July
- Power Amplifiers
- Cable Assemblies and Connectors
- EMC

Bonus Distribution:
IEEE EMC, Denver, August 5 – 9, 2013
National Instruments Week, Austin, August 5 – 9, 2013

August
- ICs and Devices
- EDA
- Active Components

September
- Resistive Products
- Design Tools
- EuMW 2013 Preview

Bonus Distribution:
EuMW 2013,Nuremburg December 6 – 11, 2013,
AOC, Washington, December 13 – 18, 2013

October
- Defense Electronics
- Control Components
- Cables and Connectors Asia

Bonus Distribution:
Pacific Microwave Conference, Seoul, December 5 – 8, 2013
MILCOM, San Diego, December 19 – 21, 2013

November
- ISM Technology
- High Power Amplifiers
- RFICs and MMICs

December
- Radio Communications
- Signal Analysis
- Software Design Radio

Bonus Distribution:
Wireless Week, Austin, January 20 – 23, 2014

Press Releases
Press releases for our informational columns should be sent by the first of the month prior to the desired publication date (e.g., April 1 for the May issue). Late-breaking news can be accommodated, but please advise the editors of urgent items by telephone or e-mail.
tim@highfrequencyelectronics.com

Article Contributions
We encourage the submission of technical articles, application notes and other editorial contributions. These may be on the topics noted above, or any other subject of current interest. Contact us with article ideas:
tim@highfrequencyelectronics.com

NEW PRODUCTS

LNA

PMI Model No. PUB-15-30M20G-20-LCA is a 30 MHz to 20.0 GHz Low Noise Amplifier which provides 15 dB of gain while maintaining a gain flatness of ±2.5 dB typically over the operating frequency. The noise figure is 3 dB typical and offers a typical OP1dB of +20 dBm. The amplifier requires +12 to +15 VDC and the current draw is 225 mA typical. The unit is supplied with SMA(F) connectors in PMI's standard PE2 housing.

Planar Monolithics Industries
pmi-rf.com

Circulators

Renaissance Electronics announced the launch of its online store services that include RF and Microwave isolators and circulators. These products are available in stock, backed with Renaissance's highest quality AS9100 assurance, and still competitively priced.

Renaissance Electronics Corp.
rec-usa.com

Power Sensor

Agilent Technologies announced the Agilent U8480 Series of USB thermocouple power sensors. Based on the same front-end design as the Agilent 8480 and N8480 Series, the new U8480 Series offers improved specifications, including a measurement speed of 400 readings per second, 10 times faster than the legacy series. The U8480 Series provides the best accuracy in Agilent's power-meter and sensor portfolio and comes with a power linearity of less than 0.8 percent. As Agilent's first power sensor with the ability to measure down to DC, this series covers a broader range of test applications.

Agilent Technologies
agilent.com

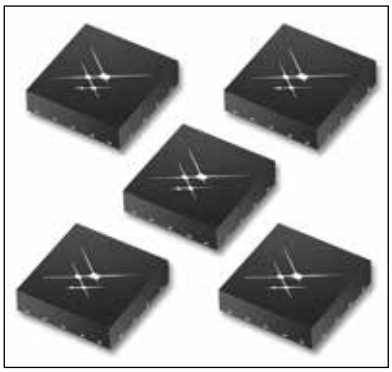
HOW TO SUBMIT

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.

tim@highfrequencyelectronics.com

NEW PRODUCTS



Switches

Skyworks announced five LTE Tx/Rx switches for smartphones and tablets. The SKY13414-485LF, SKY13415-485LF, SKY13416-485LF, SKY13417-485LF and SKY13418-485LF main/diversity antenna switches cover SP4T through SP8T, and allow up to eight bands of WCDMA/LTE. The high linearity and low insertion loss achieved by this suite of devices make them ideal for switching applications commonly used in LTE-based handsets, data cards and tablets. Their symmetric design and higher power handling also provide flexibility in signal routing for higher power TD-SCDMA/TDD-LTE, WCDMA/FDD and LTE transmit/receive functions.

Skyworks Solutions
skyworksinc.com

Connectors

Amphenol Aerospace enhanced its 2M Series connectors for interconnect applications that require high performance. These upgraded micro-miniature connectors are 71% lighter, 52% smaller and have 60% more contact density than other connectors in their class. Designed and tested to Mil-Spec standards and comparable to MIL-DTL-38999 connectors, the 2M Series connectors are intermateable and intermountable with existing micro-miniature aerospace/defense connectors. These lightweight, high density connectors maximize SWaP (size, weight and power) in a variety of high-reliability, harsh environments.

Amphenol Aerospace
amphenol-aerospace.com

Connector System

Molex Inc. introduced its Speed-Stack™ Mezzanine Connector System, a high-density, low-profile solution that supports data rates of up

to 40 Gbps per differential pair. The system is ideal for OEMs that contend with limited PCB real estate in a variety of industries including telecommunications, networking, military, medical electronics and consumer technology. The mated stack heights of 4.00 to 10.00 mm along with a 0.80 mm pitch provides design engineers with the ultimate in flexibly to address space constraints without sacrificing performance.

Molex
molex.com

Cable Assembly Guide

The Times Microwave Systems ultra-low-loss Miltech® and MTL® Cable Assembly Product Lines are featured in a newly released Slide Chart. The Slide Chart provides easy access to Electrical and Mechanical Characteristics and Electrical Performance details for the full range of ultra-low-loss standard Miltech and lightweight MTL cable sizes.

Times Microwave Systems
timesmicrowave.com

Driver

Hittite Microwave Corp. released a compact dual channel 32 Gbps Mach-Zehnder Optical Modulator Driver to further expand its fiber optics portfolio to support the next generation of 40 Gbps and 100 Gbps Metro and Long-haul applications. The HMC6620BG is the first dual channel modulator driver in a compact BGA package with excellent channel-to-channel isolation of > 30 dB up to 30 GHz and optional top or bottom cooling capability to ease space constrained module designs.

Hittite Microwave Corp.
hittite.com

Attenuators

The new R&S RSC family from Rohde & Schwarz consists of four models of the R&S RSC base unit and two external step attenuators. The base unit is available with or without internal step attenuator. The internal step attenuators come in three versions and can handle signals up to max. 18 GHz. The two external step attenuators cover frequencies up to max. 67 GHz. Every base unit can control up to four external step attenuators in parallel. The R&S RSC step attenuators allow users to attenuate signal power step by step either manually or by remote control. A typical field of application is the calibration of measuring instruments, especially receiver linearity testing.

Rohde & Schwarz
rohde-schwarz.com

Product Showcase

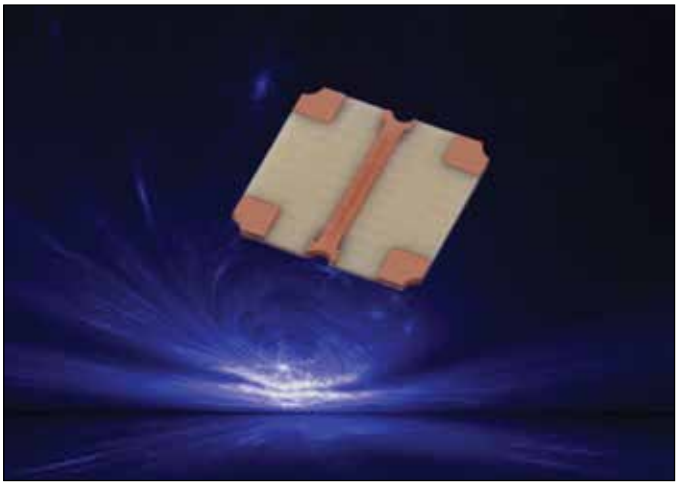
Product Showcase

Product Highlights

Spectrum Analyzer

Tektronix announced the lowest cost real-time spectrum analyzer for mid-range performance, featuring the industry's most advanced signal discovery and triggering capabilities. Included in the expanded RSA5000 Real-Time Spectrum Analyzer Series are new 26.5 GHz and 15 GHz models along with the recently-announced 110 MHz bandwidth option, which is important because many of today's wireless communications standards require engineers to see a wider frequency range.

Tektronix
tektronix.com



SMT Crossovers

AVX Corp. introduced two series of miniature RF-DC and RF-RF SMT crossovers capable of supporting frequencies up to 6 GHz. Utilizing AVX's patented MLO™ technology, which matches the CTE of PCB material and provides low loss across a wide RF spectrum, the new X2A Series RF-DC crossovers and X2B Series RF-RF crossovers provide low cost, low profile solutions for applications in which a critical RF circuit trace intersects a DC or an RF circuit: base stations, mobile communications, GPS, vehicle location systems, and wireless LANs.

AVX Corp.
avx.com

Couplers

KRYTAR's Model 102040010 and 102040010K broadband directional couplers are multi-purpose, stripline designs that exhibit excellent coupling over the 2.0 to 40.0 GHz frequency band. Targeting broadband electronic warfare systems and commercial wireless system applications, the couplers are valuable in an array of applications including signal monitoring and measurement, antenna beam forming, cable distributed systems, and military and EMC testing environments. Their compact size makes them ideal in many space-restricted applications.

KRYTAR
krytar.com

Product Highlights

CRO

Crystek's new CVCO55CXT-4812-4812 Coaxial Resonator Oscillator (CRO) is a coaxial-based VCO with an internal proprietary frequency doubler. The CVCO55CXT family's frequency doubling, 2X fundamental technology reaches new performance levels of lower phase noise and much lower harmonics over the competition, while achieving lower current consumption in the process. The CVCO55CXT-4812-4812 operates at 4812 MHz with a tuning voltage range of 0.3 Vdc to 4.7 Vdc. This coaxial VCO features a typical phase noise of -102 dBc/Hz @ 10KHz offset and has good linearity.

Crystek Corp.
crystek.com

Circulator

RADITEK's Full Band VHF/FM Radio Transmitter Band Coaxial Circulator or Isolator operates from 88-108 MHz at 100 Watts. VHF/FM Band2, Optional : 2 Watt up to 200 Watts (and Sub-Bands 87-138MHz). The above model, RADI-88-108M-N3-100WR-b has N-Type Female Connectors, 100 Watts max Reverse and 100 Watts max Forward Power handling. Specifications: 1.0 dB Insertion Loss, 16 dB Isolation, 1.40:1 VSWR, 10 to +60 ºC Operating Temp. Dimensions: 80(W) x 80(L) 24.5(H) mm.

RADITEK
raditek.com

SerDes Tester

The SV1C Personalized SerDes Tester is an ultra-portable, high-performance instrument that creates a new category of tool for high-speed digital product engineering teams. It integrates multiple technologies in order to enable the self-contained test and measurement of complex SerDes interfaces such as PCI Express Gen 3, DisplayPort, Thunderbolt, or MIPI M-PHY. Coupled with a seamless, easy-to-use development environment, this tool enables product engineers with widely varying skill sets to efficiently work with and develop SerDes verification algorithms. The SV1C fits in one hand and contains 8 independent stimulus generation ports, 8 independent capture and measurement ports and various clocking, synchronization and lane-expansion capabilities.

Introspect Technology
introspect.ca

Product Highlights

USB 2.0 Test

Agilent Technologies introduced the industry's lowest-priced USB 2.0 signal-quality test option. This option for the InfiniiVision 4000 X-Series oscilloscopes supports low-speed, full-speed and hi-speed USB applications. The USB interface is used extensively for computer applications and for a broad range of embedded connectivity applications. For years, oscilloscopes have been the primary measurement tools used by electrical engineers to verify the signal integrity of their USB designs. With the new DSOX4USBSQ signal-quality test option on Agilent's InfiniiVision 4000 X-Series oscilloscopes, engineers can now quickly verify the analog quality of their signals generated by USB hubs, hosts and devices based on USB-IF compliance standards.

Agilent Technologies
agilent.com

Amp

Empower model BBM5K8CKT (SKU 1191) is a 2500 to 6000 MHz amplifier guaranteed to deliver 100 W output power and related RF performance under all specified temperature and environmental conditions. The amplifier module is 8.0" x 6.5" x 1.0" and is suitable for broadband jamming and high power linear applications in the S/C bands. This module utilizes high power GaN on SiC transistors and also features built-in control and monitoring, with protection functions. The control system core has a built–in non-volatile memory for event recording and factory setup recovery features.

Empower RF
empowerrf.com

Resistors

Vishay Intertechnology introduced a series of axial cemented wirewound resistors that are the industry's first to offer a customized high-voltage surge withstanding capability up to 12 kV. Designed to limit in-rush currents during high voltage surges, the Vishay Draloric devices are optimized for power supplies in electronic meters, industrial and home appliances, and electronic ballasts. For increased safety in overload conditions, the devices feature non-flammable cement coatings and high-grade ceramic cores. The Z300-C series features a high-voltage surge withstand capability up to 12 kV as per IEC 61000-4-5 (1.2 µs/50 µs).

Vishay Intertechnology
vishay.com

Product Highlights

DRO

PMI Model No. PIA-12D8G-CD-1 is a Phase Locked, Dielectric Resonator Oscillator with Internal Reference having an output frequency of 12.8 GHz. This model provides a minimum output of +13 dBm with all spurs held to -80dBc and harmonics held to -25 dBc. The frequency stability is ±3 ppm with an internal reference of 100 MHz. The phase noise is as follows: -34 dBc/Hz at 1Hz, -65 dBc/Hz at 10Hz, -85 dBc at 100Hz, -108 dBc/Hz at 1kHz, -115 dBc/Hz at 10 kHz, -120 dBc/Hz at 100 kHz, and -140 dBc/Hz at 1 MHz offsets. The oscillator requires +15 VDC and 300 mA. There is a built in alarm which outputs a TTL signal when phase locked.

Planar Monolithics Industries
pmi-rf.com

Amp

L-3 Electron Devices introduced its smallest microwave power module to date. The new NanoMPM® amplifier represents a breakthrough form factor in microwave amplifiers, achieving greater than 40 watts of saturated Ku-Band output power while weighing in at less than 1.5 pounds. This ultra-compact size, weight and power (SWAP)-sensitive module is just 5.5″ x 3.04″ x 1″ in size and consumes less than 10 watts of power in standby mode, with total RF efficiency exceeding 25% during operation from a common 28 VDC bus. It is ideal for a wide variety of ground, airborne and naval applications and can be used for smaller scale communications or radar programs.

L-3 Electron Devices
L-3com.com

PA Module

TriQuint's new quad-band GSM/EDGE linear power amplifier module delivers best-in-class power-added-efficiency (PAE), providing longer battery life and more user operating time for smartphones and other mobile devices. Included on a leading chipset supplier's multi-mode reference design, the 5x3.5mm module is 30 percent smaller than previous generation products, saving board space and allowing for high levels of integration. The new TQM7M5050 is in production, and samples are available.

TriQuint Semiconductor
triquint.com

Product Highlights

T/R FEM

Skyworks' SKY65313-21 is a high performance, transmit/receive (T/R) Front-End Module (FEM). The device provides a complete T/R chain with T/R switches. The device transmit chain features +30.5 dBm output power and a 40 percent Power Added Efficiency (PAE). The device receive chain features a Low Noise Amplifier (LNA) with a 1.4 dB Noise Figure (NF) and 16.6 dB gain. The cascaded NF and gain, taking into account the 0.5 dB insertion loss transmit/receive antenna switch, are 1.9 dB and 16.1 dB, respectively, making the unit ideal for medium power microwave links such as 900 MHz ISM band applications.

Skyworks Solutions
skyworksinc.com

Microprobing Station

J microTechnology's Microwave Laboratory Microprobing Station Is a basic, rugged RF (and DC) probe station for the research of advanced active and passive components. Useful for educational training of university students in the discipline of microwave and DC microprobing. Compatible with magnetic mount ball bearing microprobing positioners. Positioners compatible with DC, AC & RF microprobes. Binocular and Trinocular stereo zoom microscope with 7-30X magnification (included wide field eyepieces), LED ring Illuminator, precision x-y stage with isolated and shielded chuck, vacuum hold down and Z-lift. Vacuum pump included.

J microTechnology
jmicrotechnology.com

Divider/Combiner

MECA Electronics introduced a QMA Power Divider/Combiner series covering the 0.698 - 2.700 GHz frequency range for use in all wireless applications from cellular through UMTS. Available in 2, 3, 4 and 8-way configurations. Since 1961, MECA has designed and manufactured an extensive line of RF/Microwave components with industry leading performance including Fixed Attenuators, Directional & Hybrid Couplers, Isolators/Circulators, Power Divider/Combiners, RF Loads, DC Blocks, Bias Tees and Adapters & Cables.

MECA Electronics
e-meca.com

Product Highlights

Receptacles

SGMC Microwave offers an extensive line of precision receptacles. 1.0 mm, 1.85 mm, 2.4 mm, 2.92 mm, 3.5 mm, N, SMA, & SSMA are some of the various interfaces we have designed. Configurations include but are not limited to Threaded Barrel, 2 & 4 hole flange, & PCB Mount (pin or tab). SGMC Microwave is a manufacturer of precision coaxial connectors including cable connectors, receptacles and adapters; it was founded to provide the Defense, Test & Measurement, Telecommunications, Satellite and Aerospace industries with high performance microwave and millimeter-wave connectors.

SGMC Microwave
sgmcmicrowave.com

Analog Front Ends

Texas Instruments Inc. introduced two analog front ends (AFEs) that provide low power, high performance and space savings for test and measurement, wireless communications and optical networking equipment. The AFE7071 is a complete radio transmitter that reduces board space by up to 80 percent compared to discrete implementations. It integrates a dual digital-to-analog converter (DAC), tunable baseband filters, IQ modulator and digital quadrature modulation correction circuit. The AFE7070 adds a direct digital synthesizer (DDS) with 32-bit numerically controlled oscillator (NCO) and LVDS output buffer.

Texas Instruments
ti.com

Amp

NXP Semiconductors released the BLF8G27LS-100V, a 100 W final stage broadband (2.5 - 2.7 GHz) amplifier that delivers improved video bandwidth for today's multi-mode, multi-carrier base station applications. Designed using NXP's 8th generation LDMOS process ensures high efficiency and proven ruggedness. The improved efficiency enables broadband operation even when used in Doherty architectures to meet the growing data demands of users. In a symmetrical 2-way Doherty, the BLF8G27LS-100V achieves 43.8% efficiency over the full 2500 MHz to 2700 MHz band. This performance comes with a peak power of 54 dBm (250W) and average power of 46.5 dBm (45W).

NXP Semiconductor
nxp.com

Product Highlights

Design Tool

Altium announced the release of its new Altium Designer 2013, designed to make it easier for users to create next generation electronic designs. This release delivers a set of new PCB features, as well as fixes to core schematic and PCB tools. It also opens up the DXP platform, presenting a wide range of opportunities for customers, partners and system integrators. Highlights include: New home page redesign with new views and sub-views into license management, plug-ins and updates, and Workspace view; Hyperlink text support in schematic documents; Enhanced customization of schematic ports; Microchip Touch Controls Support; New "silk-to-solder" mask clearance rule.

Altium
altium.com

Receiver Test

The new Agilent Power of X application note "Solutions for GNSS Receiver Testing" 5991-1742EN, provides insight into solving tough measurement problems in a unique way for both the design and manufacturing environments. The material offers information into using simulated satellite signals to quickly and accurately verify GNSS receiver operation.

Agilent Technologies
agilent.com

Divider/Combiner

Model APD-2-0518-YR1 is a 2-Way Power Divider/Combiner that operates over the frequency range of 500 MHz to 18 GHz. This model offers low loss of 3.5 dB typical (over 3 dB theoretical) with a VSWR of 1.5:1 typical into a 50 ohm impedance. The average isolation is 20 dB. This model offers a typical amplitude balance of ±0.45 dB and a typical phase balance of ±5 degrees. This model can handle input power levels of up to 25 watts into a load VSWR of 1.2:1 and up to 7.5 watts into a load VSWR of 2.0:1. The housing measures 3.75" x 1.0" x 0.4" and is gold plated.

Planar Monolithics Industries
pmi-rf.com

International Microwave Symposium
IEEE 2–7 June 2013, Seattle, WA MTT-S

INTELLECTUAL PROPERTY, PATENTS AND COMMERCIALIZATION: OPTIMIZING YOUR SUCCESS!

Join IMS2013 for what is sure to be an exciting and fervent Plenary talk led by Dr. Patrick Ennis, Global Head of Technology, Intellectual Ventures.

Invention Capital: Why the World Needs More of it

Monday, 3 June 2013

"It is an exciting time to be a technologist. Every day, breakthroughs in research laboratories offer the promise of products and solutions to meet a range of global challenges and opportunities. However, it is very difficult to successfully commercialize technology; and unfortunately most efforts fail. We need to improve the success rate, otherwise billions of dollars of R&D funding will be wasted, and innovation-driven economies will stall. Invention Capital is a missing link in the value-creation chain."

Dr. Patrick Ennis will talk about how researchers from a variety of scientific and technical fields can optimize the value- creation chain. He will be sharing new models such as Open Innovation and Invention Capital that are necessary to successfully commercialize technology, in today's challenging environment where the speed of technology development and adoption has so accelerated that even leading technology companies find it hard to just keep up. This is an opportunity for leading researchers to understand the latest trends in managing valuable IP and bringing it closer to commercialization.

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Product Highlights

Design Suite

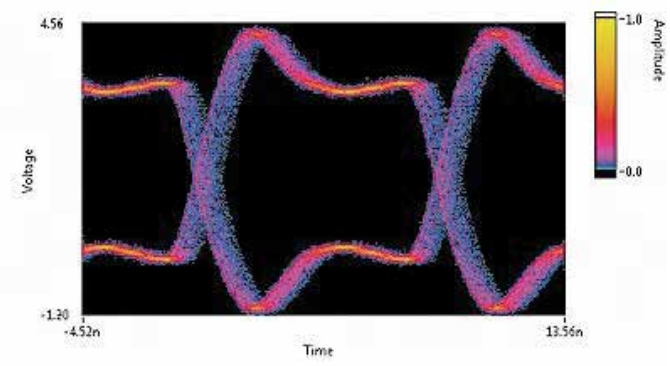
The Microwave Office® design suite is the most comprehensive software solution for designers of all types of RF and microwave circuits, from integrated microwave assemblies to monolithic microwave integrated circuits (MMICs) and everything in between. Renowned for its intuitive user-interface, the unique architecture of Microwave Office software seamlessly integrates AWR's powerful, innovative tools and technologies with application-specific tools from partner companies to bring their high-frequency designs to life quickly and easily. From design capture (schematic and layout) through to harmonic balance and time-domain simulation to synthesis and optimization and EM extraction and verification, Microwave Office software represents the future of high-frequency design.

AWR Corp.
awrcorp.com

Cable Connectors

SGMC Microwave's line of precision coaxial cable connectors for semi-rigid and flexible cables are available in direct solder and/or solder clamp attachment. Interfaces include 1.85mm, 2.4mm, 2.92mm, and 3.5mm, Type N, SMA and TNC. Popular cable types are .047", .085", .141", .250", HP120, HP160, HP190, LL142, LL120, LL250, & LL335. Bulkhead types are also available.

SGMC Microwave
sgmcmicrowave.com



Jitter Analysis

National Instruments announced the NI PXIe-5162 digitizer and updates to the LabVIEW Jitter Analysis Toolkit. The digitizer, with 10 bits of vertical resolution and a 5 GS/s sample rate, provides high-speed measurements at four times the vertical resolution of a traditional 8-bit oscilloscope. With 1.5 GHz of bandwidth and four channels in a single slot, the NI PXIe-5162 is suited for high-channel-count digitizer systems in manufacturing test, research and device characterization. Engineers can use the digitizer with LabVIEW and the LabVIEW Jitter Analysis Toolkit, which provides a library of functions optimized for performing the high-throughput jitter, eye diagram and phase noise measurements demanded by automated validation and production test environments.

National Instruments
ni.com

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US patent 6,943,629

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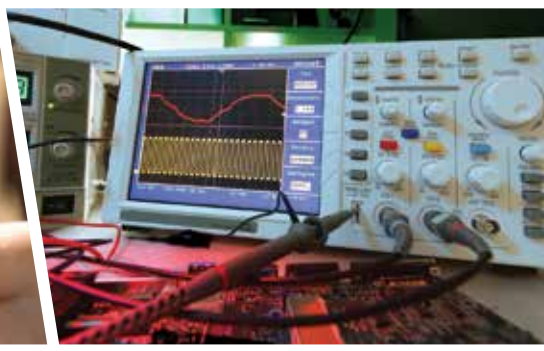

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