APRIL 2000

RF design®

Engineering RF & Wireless Products . . . . DC to Light
www.rfdesign.com

The dawn of economic wireless communications

A unique approach to reducing EMI

Do you really need an external antenna?

Amplifiers for emerging Ka-band technologies

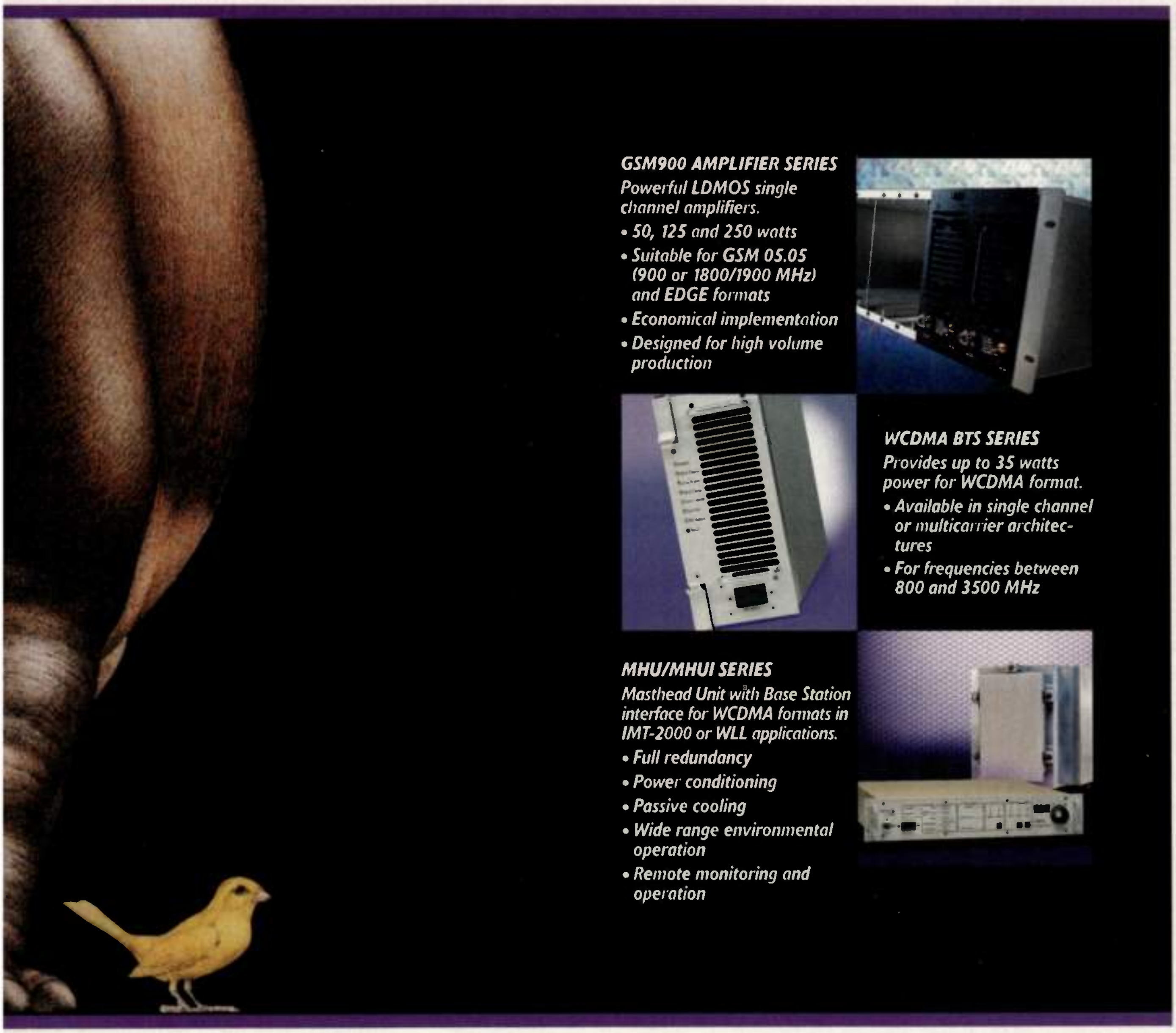
An INTERTEC®/PRIMEDIA Publication

AT AML, SIZE REALLY

We have the capacity to handle product volume & design complexity requirements of any dimension...at astonishing speed.

AML Communications has an announcement of significant proportions. We are now re-engineered and specially equipped to accommodate the varying wireless production requirements of OEMs. By combining effective MRP with lean manufacturing techniques and unmatched technological innovation, we have the flexibility to handle custom and

DOESN'T MATTER.



standard product runs . . . low and high volume run rates . . . and uneven delivery requirements. Partnering with AML Communications gives you the freedom to be highly responsive to continually changing market requirements. Plus you'll have the assurance of dealing with an ISO 9001 certified company.

ANSI·RAB QMS ACCREDITED

ISO 9001 CERTIFIED

Whether your requirements are big or small — from a first article pilot run to large volume production — we're ready when you are.

Ask for our white paper, *Lean Manufacturing Optimized for Wireless Amplifier Production*. 805.388.1345

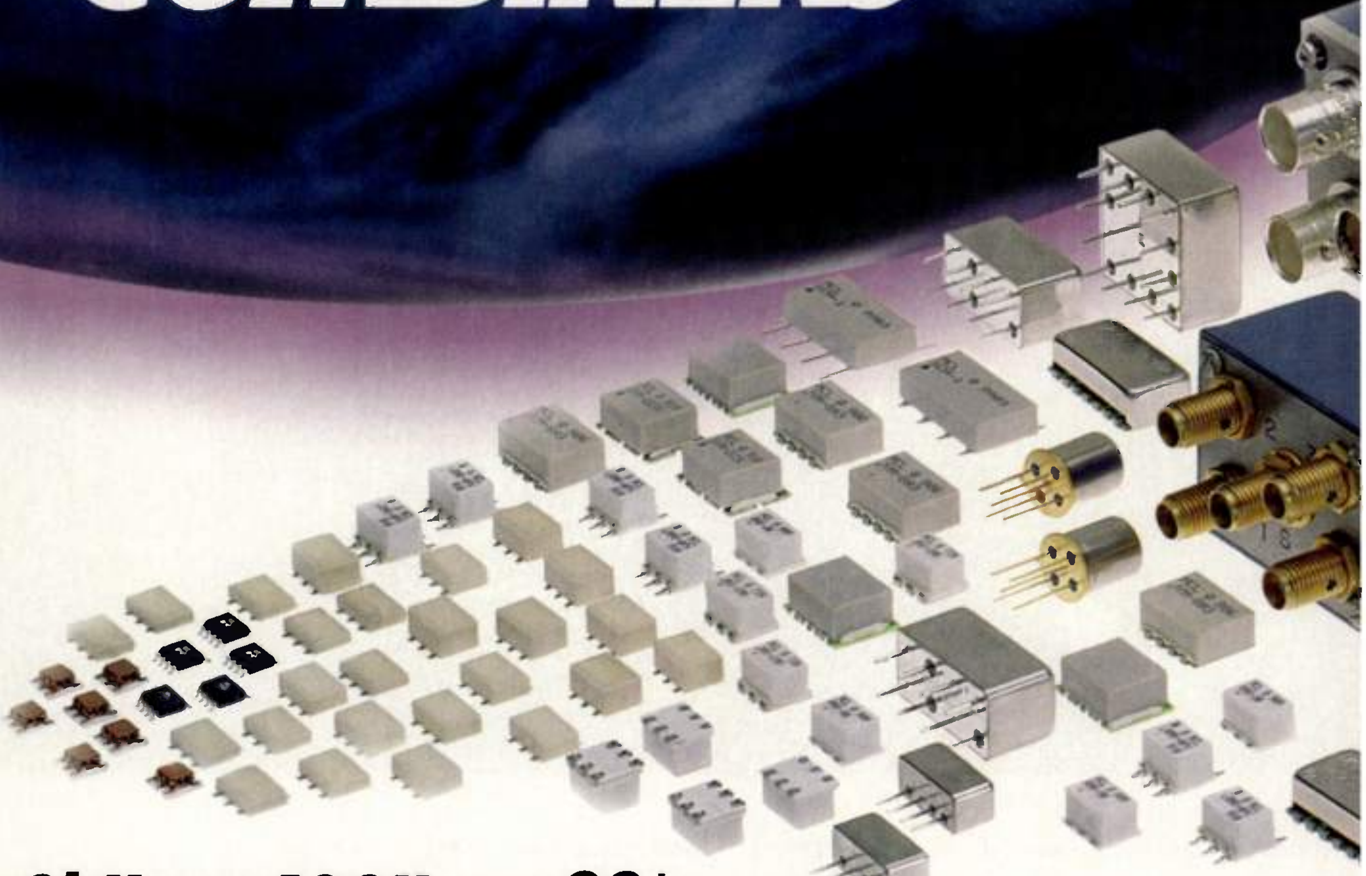
www.amlj.com • e-mail: sales@amlj.com

AML Communications

INFO/CARD 10

THE WORLD'S LARGEST SELECTION

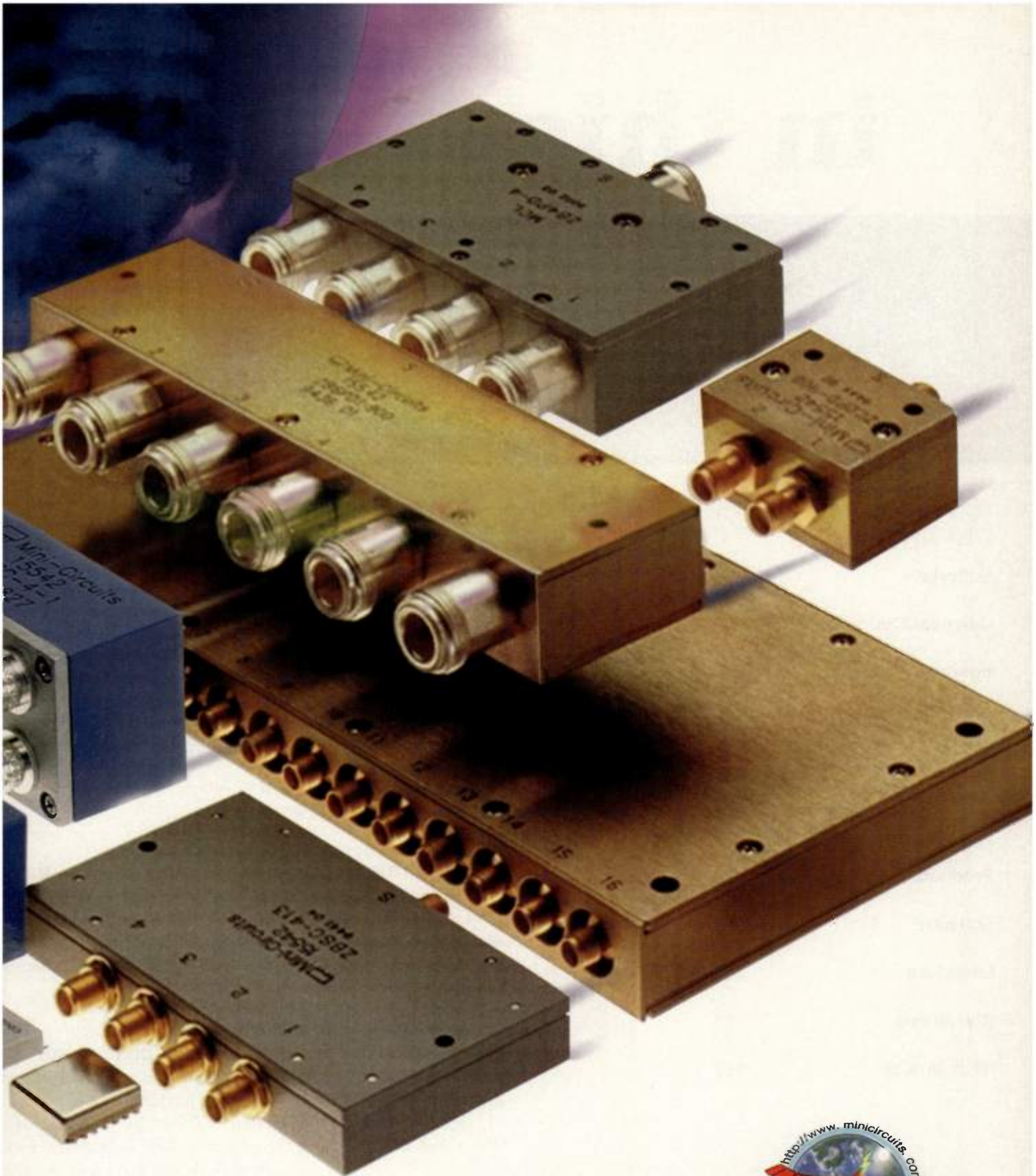
POWER SPLITTERS/ COMBINERS



2kHz to 10GHz *from* 99¢

Choose from over 550 standard off-the-shelf models from 2way and 3way to 48way; 0°, 90°, and 180°; 50 and 75 ohms covering 2kHz to 10GHz. Mini-Circuits will also supply your special needs and custom designs such as wider bandwidths, higher isolation, lower insertion loss and phase matched ports...all at catalog prices with rapid turnaround time. Case styles include surface mount, plug-in, flat pack, and coaxial connectorized... and custom case styles are no problem! Super-miniature and ultra-low profile surface mount units provide excellent solutions in cellular communications, cable systems, and countless wireless applications. And all units come with a 1 year guarantee and skinny 4.5 sigma performance repeatability unit-to-unit and production run to production run. Add fast delivery, unsurpassed applications support and value pricing, and the decision is easy. Call Mini-Circuits today!

Mini-Circuits...we're redefining what VALUE is all about!



see us on the web
http://www.minicircuits.com

Mini-Circuits®

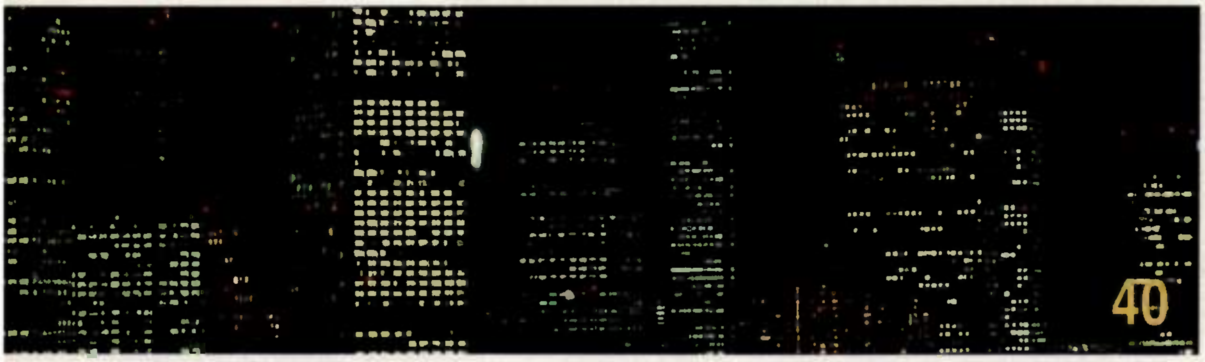
US 15 INT L 16
CIRCLE READER SERVICE CARD

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 *INTERNET* http://www.minicircuits.com
For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE • EEM • MICROWAVE PRODUCT DATA DIRECTORY • WWW.RFGLOBALNET.COM

ISO 9001 CERTIFIED

F 194 Rev B

in this issue



DEPARTMENTS

RF DESIGN (ISSN:0163-321X USPS: 453-490) is published monthly. April 2000, Vol. 23, No.4. *RF Design* is a registered trademark of Intertec Publishing, A PRIMEDIA Company. Copyright 1999 by Intertec Publishing, 9800 Metcalf Ave., Overland Park, KS 66212-2215. Editorial and advertising offices at 5680 Greenwood Plaza Blvd., Suite 100, Englewood, CO 80111, 303-741-2901. Printed in USA. Periodicals postage paid at Overland Park, KS, and at additional mailing offices. Canada Post Publications Mail (Canadian Distribution) Sales Agreement No. 1071211. Subscription office: *RF Design*, P.O Box 12907, Overland Park, KS 66282-2907. Subscriptions are $48 per year ($82 for two years) in the United States; $68 (surface mail) or $108 (air mail) per year for countries outside the U.S. Payment must be made in U.S. funds and accompany request. Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by Intertec Publishing, provided the base fee of U.S. $2.25 per copy, plus U.S. $00.00 per page is paid directly to Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923 USA. The fee code for users of this Transactional Reporting Service is ISSN 0163-321X/1999 $2.25 + $00.00. For those organizations that have been granted a photocopying license by CCC, a separate system of payment has been arranged. Prior to photocopying items for educational classroom use, please contact the CCC at 978-750-8400. Organizations or individuals with large quantity photocopy or reprint requirements should contact Jenny Eisele at 913-967-1966. **SUBSCRIPTION INQUIRIES: 800-441-0294.** POSTMASTER & SUBSCRIBERS: Please send address changes to RF Design, P.O. Box 12907, Overland Park, KS 66282-2907.

BLUE CELL MIXERS

0.8 to 6.7GHz from $5.95 (10-49)

•low conversion loss •thin profile •superb temperature stability •low cost

Unleash extra performance from your higher frequency designs by upgrading now to Mini-Circuits level 0 to level 17 (LO) Blue Cell™ mixers. State-of-the-art automated manufacturing using multilayer thick film ceramic construction delivers superb temperature stability, low conversion loss, high repeatability, and very low cost per unit. This process also results in a phenomenally thin package standing only 0.070" high! Scoop the competition and upgrade to the next level of performance in your higher frequency products...contact Mini-Circuits for Blue Cell™ mixers today.

Mini-Circuits...we're redefining what VALUE is all about!

Model No.	Level (LO)	Freq. (GHz)	Price $ea.	Model No.	Level (LO)	Freq. (GHz)	Price $ea.
MBA-10VL	0	0.8-1.0	5.95	MBA-15LH	+10	1.2-2.4	6.95
MBA-10L	+3	0.8-1.0	6.95	MBA-18LH	+10	1.6-3.2	6.95
MBA-15L	+4	1.2-2.4	6.95	MBA-25LH	+10	2.2-3.6	6.95
MBA-18L	+4	1.6-3.2	6.95	MBA-35LH	+10	3.0-4.0	6.95
MBA-25L	+4	2.0-3.0	6.95	MBA-9MH	+13	0.8-1.0	7.95
MBA-35L	+4	3.0-4.0	6.95	MBA-12MH	+13	0.8-2.5	7.95
MBA-9	+7	0.8-1.0	5.95	MBA-15MH	+13	1.4-2.4	7.95
MBA-12	+7	0.8-2.5	5.95	MBA-18MH	+13	1.6-3.2	7.95
MBA-26	+7	2.2-2.7	5.95	MBA-25MH	+13	2.0-3.0	7.95
MBA-591	+7	2.8-5.9	6.95	MBA-35MH	+13	3.0-4.0	7.95
MBA-671	+7	2.4-6.7	8.95	MBA-9H	+17	0.8-1.0	9.95
				MBA-12H	+17	0.8-2.5	9.95

BLUE CELL TECHNOLOGY

ACTUAL SIZE

Protected by U.S. patents 5,534,830 5,640,132 5,640,134 5,640,699

Mini-Circuits®

US 43 INT'L 44
CIRCLE READER SERVICE CARD

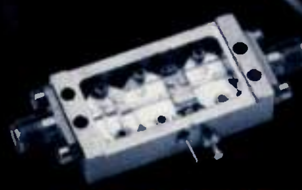
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

YONI™ *The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At:* **http://www.minicircuits.com**

ISO 9001 CERTIFIED

F 314 Rev. Org.

Ultra-Broad Band AMPLIFIERS



ULTRA BROAD BAND

Model	Freq. Range GHz	Gain dB min	N/F dB max	Gain Flat +/-dB	1 dB Comp. pt. dBm min	3rd Order ICP typ
JCA018-200	0.5-18.0	24	3.8	2.5	0	10
JCA018-203	0.5-18.0	20	5.0	2.5	7	17
JCA018-204	0.5-18.0	25	4.0	2.5	10	20
JCA018-300	0.5-18.0	30	3.8	2.5	0	10
JCA018-303	0.5-18.0	27	5.0	2.5	7	17
JCA018-400	0.5-18.0	37	3.8	2.5	0	10
JCA018-403	0.5-18.0	35	5.0	2.5	7	17
JCA018-504	0.5-18.0	40	5.0	2.5	10	20
JCA218-200	2.0-18.0	15	5.0	2.5	10	20
JCA218-206	2.0-18.0	17	5.0	2.5	15	25
JCA218-300	2.0-18.0	23	5.0	2.5	10	20
JCA218-306	2.0-18.0	22	5.0	2.5	15	25
JCA218-307	2.0-18.0	20	5.0	2.5	21	31
JCA218-400	2.0-18.0	29	5.0	2.5	10	20
JCA218-406	2.0-18.0	30	5.0	2.5	15	25
JCA218-407	2.0-18.0	30	5.0	2.5	21	31
JCA218-506	2.0-18.0	35	5.0	2.5	15	25
JCA218-507	2.0-18.0	35	5.0	2.5	18	28

Features/Options:

- Removable SMA Connectors
- Competitive Pricing
- Compact Size
- Quick Delivery
- Alternate Gain/Noise/Power/VSWR levels if required

JCA TECHNOLOGY

DELIVERY IN 2-4 WEEKS ARO

4000 Via Pescador, Camarillo, CA 93012
(805) 445-9888 Fax: (805) 987-6990
email: jca@jcatech.com
www.jcatech.com

INFO/CARD 19 or visit www.rfdesign.com

RF editorial

I got the wireless Internet blues

By Roger Lesser
Editor
roger_lesser@intertec.com

Educating Roger

During an editor's day event hosted by Ericsson Microelectronics, Morgan Hill, CA, I got hands on experience "building" a surface mount device. After doing a pick and place procedure and then moving to gold wire bonding, I didn't come close to making a working device. The capacitor I placed was skewed and my wire-bonding job was just as humorous.

In the time it took me to "build" my device, the ladies who helped guide me through the process could have built dozens. My thanks to Phi Pham for her guidance, Beatrix Brakee for her patience, and Emelia Szczyglewski for allowing me to get in the way of what was a very professional operation. (Of course, I'm showing off my effort like a first grader who brings home that piece of "art" that ends up on the refrigerator.)

Bluetooth and beyond

This year's Wireless Symposium was memorable for one reason—the amount of emphasis on Bluetooth. A year or so ago, we heard a lot of talk but saw little reality. This year, companies like Ericsson and Texas Instruments made a point of demonstrating they are ready to field products that support the wireless connectivity applications that Bluetooth envisions. I left San Jose with a feeling that maybe, just maybe, we are seeing the reality behind Bluetooth's potential and not just hype.

Beyond the Internet?

After a day at home I was winging my way to New Orleans and CTIA. I was looking forward to CTIA to see just what the handset manufacturers and carriers were doing with wireless connectivity. Well, to be honest, I was also looking forward to New Orleans, too. I love the blues and took advantage of seeing Buddy Guy.

After listening to Bill "it's a windowful world" Gates wax philosophical about the wireless Windows environment Microsoft envisions, it was off to the show floor. It was then that I thought back to Buddy Guy. For within a matter of a few hours, "I Got the Wireless Internet Blues."

I'm concerned there is way too much attention being paid to wireless Internet at the expense of other wireless connectivity applications. The Bluetooth special interest group (SIG) notes Bluetooth is "The technology that propels you into a new dimension in wireless connectivity." Does that mean just the Internet?

I have to admit, at this point in the drive to wireless connectivity and interoperability, wireless Internet applications make sense—especially with the zeal consumers are showing for the Internet. A zeal that is causing the FCC to look at frequencies as commodities that can be sold or leased. The FCC credits the Internet as one of the drivers behind their action, noting that the volume of traffic on the Internet doubles every 100 days. Most of the increase is coming from wireless devices.

OK, call me an Internet curmudgeon, but I see the day when the consumer will realize there has to be more to wireless connectivity than surfing the Net or getting e-mail. Bluetooth and WAP use the Internet as a piece of the connectivity puzzle, and will depend on it for other wireless connectivity capabilities. And that's the rub. Internet connectivity is part of the solution not the entire solution.

The Bluetooth SIG and WAP communities need to get the word out to the consumer now that they can offer more than Internet connectivity. Take a page from Bill "Austin Powers" Gates on how to build anticipation. But, do more than build anticipation. Educate the consumer. Then get ready for the real wireless explosion.

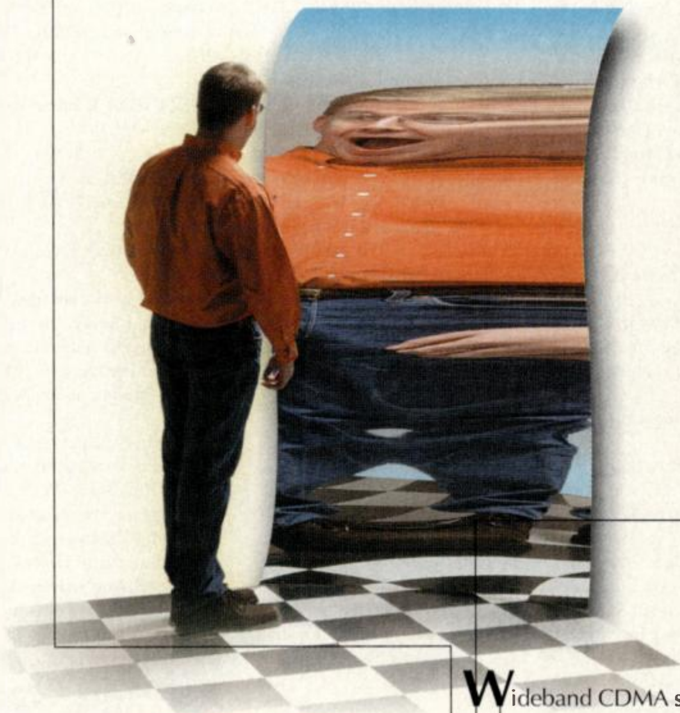
RF

SPIRENT
Communications

CDMA Gets Wide!

Extend your product's performance with **TAS' 3G CDMA test solution.**

3GPDP



tas®
Telecom Analysis Systems

Wideband CDMA stretches old algorithms to new limits. Algorithms such as RAKE finger tracking and wideband channel estimation. These key ingredients of wideband 3G designs must perform over a broad range of environments. *Environments that change...**Quickly.***

That's the reason the TAS 4500 FLEX5 RF Channel Emulator comes equipped with a powerful new dynamic channel emulation mode called 3GPDP (Power-Delay Profiles). Use 3GPDP to test your receiver designs under the most challenging RF channel conditions. FLEX5 meets all W-CDMA and cdma2000 test specifications. But why stop there? Program 3GPDP's Moving Propagation and Birth-Death channel models to emulate any environment you can dream up.

TAS is a SPIRENT Communications company. SPIRENT Communications is at the leading edge of wireless and broadband communication technology advancement. Our test solutions are integral to the development and deployment of next-generation communication technology. To find out more about SPIRENT or TAS and our products, visit our web site or give us a call.

www.taskit.com

34 Industrial Way East ▪ Eatontown, NJ 07724-3319 ▪ Phone: (732) 544-8700 ▪ FAX: (732) 544-8347 ▪ Email: sales@taskit.com

INFO/CARD 2

Editorial Forum

By Ramona Isbell, Executive Editor

Much ado in the ITU

The International Telecommunications Union (ITU) has had a busy year so far. At the top of the union's "to-do" list is the continued development of next-generation wireless services and systems under the auspices of "Working Party 8F," which is a group of experts assigned to this task. The goal of this newly created ITU group is to act as a forum for user requirements — and as a catalyst for translating those realities into technical reality. In a nutshell, this means the Working Party 85 needs to provide firm guidance during IMT-2000's continuous system development.

The team had its first meeting in March under the leadership of chairman Stephen Blust of U.S.-based BellSouth Cellular. He, along with three vice-chairs and more than 150 industry representatives, addressed such issues as spectrum needs, higher data rate capabilities, Internet Protocol (IP)-based service and system needs beyond IMT-2000. Dealing with these issues and the ever-changing industry needs will be not be simple. If Blust can live up to his aspirations, he'll need to maintain strong synergy among the powerful representatives from the industry's regulators, manufacturers and international operators, along with the folks from the ITU.

An even more significant ITU action is its recent commitment to re-engineer itself to better meet the evolving telecommunications market. A 27-member Reform Advisory Panel (RAP), set up by ITU Secretary-General Yoshio Utsumi, has identified key principles to guide the ITU's reform. One key point in the reform agenda is to define the ITU's future role in Internet governance.

To date, the Internet phenomenon has progressed without any formal guidance or government regulation. It's commendable of the ITU to realize that as the Internet continues its march into voice telephony and mobile communications, a strong organization with harmonized global leadership can play an effective role in shaping this emerging market.

RF design

Engineering RF & Wireless Products ...... DC to Light

Established 1978

Editorial offices
5680 Greenwood Plaza Blvd., Suite 100
Englewood, CO 80111
720-489-3100; Fax 720-489-3253;
e-mail *rfdesign@intertec.com*
Web site **www.rfdesign.com**

Editor Roger Lesser
Executive Editor Ramona Vassar Isbell
Senior Associate Editor Nikki Chandler
Associate Editor Cristina Aguilar
Technology Editor Ernest Worthman
Art Director Valerie J. Hermanson
Editorial Director Don Bishop, 913-967-1741

Group Publisher Mercy Contreras
Marketing Director Patricia Kowalczewski
Marketing Services Supervisor Karen Clark
Sr. Classified Ad Coord. Annette Hulsey, 913-967-1746
Ad Production Coord. Margaret May, 720-489-3279
Senior Circulation Manager Julie Neely

Director of Production Barbara B. VanSickle
Desktop Publishing Coordinator Shawn Warren
Electronic Publishing Technicians Leigh Cullen, Bonnie Long
Directories Issues Manager Deborah Dickson
Reprints Manager Jenny Eisele, 913-967-1966
List Rental Manager Lori Christie, 913-967-1875

Customer Service 800-441-0294

Subscription inquiries
P.O. Box 12907, Overland Park, KS 66282-2907
800-441-0294; Fax 913-967-1903

Editorial Review Board

Andy Przedpelski, *Chairman*	The Shedd Group
Madjid A. Belkerdid, Ph.D.	Univ. of Central Florida
Alex Burwasser	RF Products
Robert Feeney, Ph.D.	Georgia Tech University
Joe Gorin	Agilent
Dave Krautheimer	MITEQ
Ed Oxner	InterFET
Raymond Sicotte	American Microwave
Robert J. Zavrel, Jr.	Atmel

Intertec Publishing, A PRIMEDIA Company
9800 Metcalf Ave.
Overland Park, KS 66212-2215
913-341-1300; Fax 913-967-1898

President / CEO Cameron Bisho
Vice President — Communications Division Larry Lannon
Vice President — Production Jack Morri
Vice President — Circulation Nick Cavna
Director, Editorial Development Tom Coo
Director Advertising Services Nancy Hup
Corporate Creative Director Doug Coonro
Corporate Circulation Director Sheri Gron
Division Director of Marketing Stephanie Hanawa

PRIMEDIA Business-to-Business Group
President / CEO David G. Ferr

PRIMEDIA Inc.
Chairmen and CEO Tom Roger
President Charles McCurd
Vice Chairman Beverly C. Che

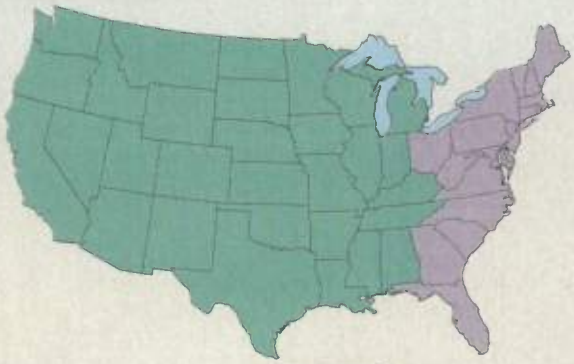
Copies of most issues printed within the past two years are available for $10 postpaid from Intertec Publishing Corporation, a PRIMEDIA company customer service, 800-441-0294; Fax 913-967-1899. Photocopies are unavailable from the publisher.

Photocopies in paper and electronic formats are available from Information Express, 3221 Porter Drive, Palo Alto, CA 94304-1225, Tel: 650-494-8787. Photocopies are also available via microform and/or electronic databases from Bell & Howell Information and Learning, 300 North Zeeb Rd., P.O. Box 1346, Ann Arbor, MI 48106-1346; Tel. 800-521-0600 (+1 734-761-4700 outside North America) or check **www.umi.com** for additional information on format availability.

AMERICAN BUSINESS PRESS ABP

INTERTEC PUBLISHING A PRIMEDIA COMPANY

advertising sales staff



Phil Cook
Marketing Manager–West
16795 Von Karman Ave.
Suite 110
Irvine, CA 92714
Tel. 949-838-2165
Fax: 949-252-0556
e-mail: *phil_cook@intertec.com*

David Jeans
Marketing Manager–East
5680 Greenwood Plaza Blvd.
Suite 100
Englewood, CO 80111
Tel. 720-489-3201
Fax: 720-489-3253
e-mail: *david_jeans@intertec.com*

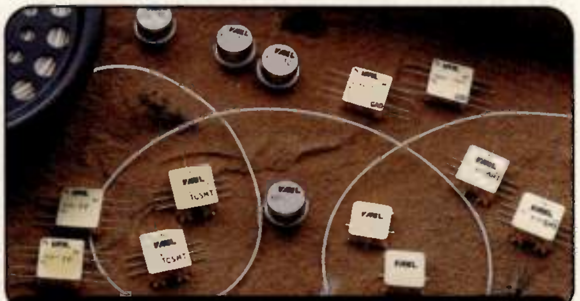
Europe: Stephen Bell
P.O. Box 98, Worcester Park, Surrey, KT4 8WB, United Kingdon
Tel. +44.208.286.8889; Fax: +44.181.286.8898; e-mail: *stephenbell@email.msn.com*

Israel: Asa Talbar
Talbar Media
Tel. +972.3.562.9565;
Fax +972.3.562.9567
e-mail: *talbar@inter.net.il*

Classifieds: Dawn Rhoden
9800 Metcalf Ave.
Overland Park, KS 66212-2215
Tel. 913-967-1861; Fax: 913-967-1735
e-mail: *dawn_rhoden@intertec.com*

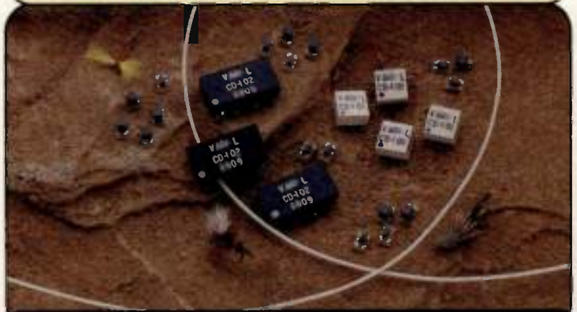
Commercial Signal Sources

- High Performance Voltage Controlled Oscillator Modules
- High Performance PLL Synthesizer Modules



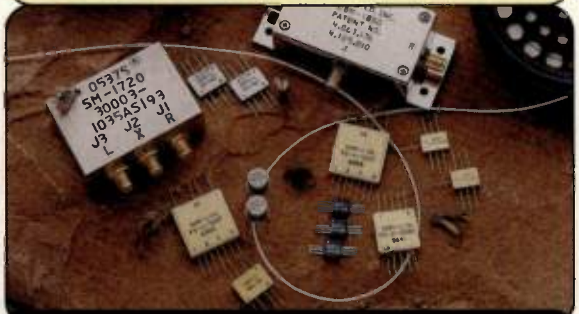
Military Signal Sources

- Ruggedized High Performance Hybrid
- Voltage Controlled Oscillators



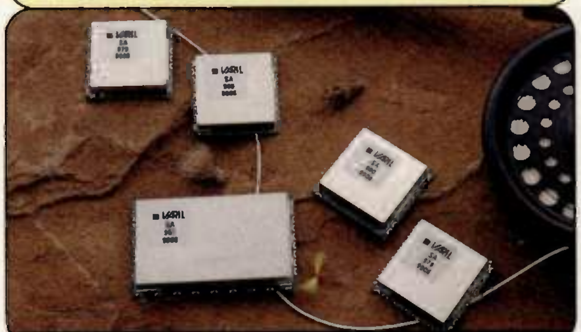
Commercial Signal Processing

- High Performance Wideband RF Transformers
- High Performance Power Dividers and Couplers
- High Performance Double Balanced Mixers
- High Performance RF Chokes
- High Performance Bias Tees



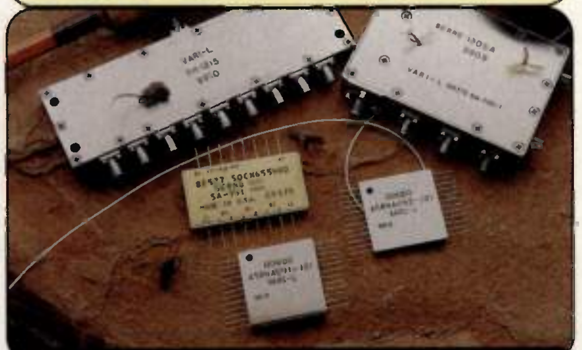
Military Signal Processing

- Ruggedized Double Balanced Mixers
- Ruggedized Wideband RF Transformers
- Ruggedized Power Dividers and Couplers
- Ruggedized I/Q Modulators and Demodulators



Commercial Special Assemblies

- Special Frequency Conversion Modules
- Special Frequency Generation Modules



Military Special Assemblies

- Ruggedized Special Frequency Generation Assemblies
- Ruggedized Special Frequency Conversion Assemblies
- Ruggedized Special RF Distribution Assemblies

Subscriber Signal Sources

- Miniature Voltage Controlled Oscillator Modules
- Miniature PLL Synthesizer Modules

VARIL

We Have A Part In Your Future

4895 Peoria Street
Denver, Colorado 80239
☎ 303.371.1560
fax 303.371.0845
e-mail: sales@vari-l.com

VARI-L is a precision manufacturer of RF components for a wide range of aerospace, commercial, military, space and subscriber applications.

At VARI-L, our continued focus on research and development and commitment to enhancing manufacturing technology is intended to ensure that "We have a part in your future."

PROUDLY MADE IN THE USA

Contact the VARI-L Sales Department for your special microwave and RF component assembly needs.

ISO 9001 Certified

VARI-L Company, Inc. www.vari-l.com

INFO/CARD 2

DIVERSITY

COMPONENTS

WRH

When the crowd wants **variety**,

a true artist delivers.

RFMD has **ready-to-ship** components for every wireless application. Transceivers, power amps, quad mods – we've got a million of 'em – loaded with onboard features and **designed to perform**.

Special requests? No problem – our engineers choose from **six process technologies** to create a custom IC in tune with your specs.

When you need a **proven performer**, depend on RFMD. And just wait 'til you see what we do for an encore . . .

DIVERSITY – it sets us apart.

RF MICRO·DEVICES®

Proprietary, State-Of-The-Art
RF Integrated Circuits℠

7628 Thorndike Road
Greensboro, NC 27409-9421

Phone 336.664.1233
Fax 336.664.0454

Mention diversity when contacting us.

www.rfmd.com

TM & © 1999, RF Micro Devices, Inc.

INFO/CARD 58

RF calendar

April 10-12 **DSP World Spring Design Conference**—*San Jose*—Information: Miller Freeman. Tel. 415.538.3848 or 888.239.5563; e-mail *dspworld@mfi.com*.

10–14 **IEEE IFIP 2000 Network Operations and Management Symposium**—*Honolulu*—Information: Cayle Weisman, IEEE Communications Society. Tel. 212.705.8941; Fax 212.705.8999; e-mail *noms2000@comsoc.org*.

April 26–28 **Global Wireless Convergence—4th Annual Summit 2000**—*Cancun*—Information: Universal Wireless Communications Consortium, 1800 - 112th Ave, NE, #260E, Bellevue, WA 98004-2937. Tel. 425.372.8922; Web site **www.uwcc.org**.

May 1–3 **Internet Device Builder Conference**—*Santa Clara, CA*—Information:IDB 2000 Customer Service. 611 Route 46 West, Hasbrouck Heights, NJ 07604. Tel. 888.947.3734; Fax 201.393.6297; Web site **www.iDeviceBuilder.com**.

8–10 **Embedded Systems Conference**—*Napa, CA*—Information: Miller Freeman. Tel. 415.538.3848; Fax 888.239.5563; e-mail *esc@mfi.com*.

16–17 **Broadband Wireless Access**—*London*—Information: Laura Sykes. Tel. +44.171.636.1976. Web site **www.ibctelecoms.com/bwa**.

18 **Wireless Networks: The Third Generation**—*Washington, DC*—Information: Telcordia Technologies. Tel. 800.521..2673. Web site **www.telecom-info.tecordia.com**.

21–24 **50th Electronic Components and Technology Conference**—*Las Vegas, NV*—Information: Jim Bruorton. Tel. 864.963.6621. Web site **www.ectc.net**.

June 4–8 **Supercomm 2000** —*Atlanta*—Information: Tel. 800.278.7372; Web site **www.supercomm2000.com**.

11–16 **2000 IEEE MTT-S International Microwave Symposium** —*Boston*—Information: Web site **www.ims2000.org**.

14–19 **IEEE International Conference on Third Generation Wireless Communications**—*Silicon Valley, CA*—Information: Willie W. LU, 1960 Linden Lane, Milpitas, CA 95035. e-mail *wwlu@ieee.org*; Web site **www.3Gwireless.com**.

18–22 **IEEE International Conference on Communications**—*New Orleans*—Information: Richard W. Miller, Tel. 504.528.2553; e-mail *r.w.miller@ieee.org*; Web site **www.icc00.org**.

RF courses

Georgia Institute of Technology—*Infrared Technology and Applications*—Apr 4–7; *Competitive Technological Intelligence*—Apr 17–19; *Phased-Array Radar System Design*—Apr 18–21; *RF and Wireless Principles and Practice*—Apr 10–14, Atlanta. Information: Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385. Tel. 404.385.3502; e-mail *conted@gatech.edu;* Web site **www.conted.gatech.edu**.

UCLA—*Microelctromechanical Systems: Technology, Design and, Application*—*April 24–28;Charge Coupled Devices/CMOS Imaging Sensors and Cameras*—May 8–12; *Compression for Digital TV*—May 10–12;*Digital Signal Processing: Theory, Algorithms, and Implementation*—May 15–19; *Honeycomb Sandwich Structures*—May16–19; Information: Information Systems and Technical Management Short Courses, Los Angeles, CA. Tel. 310.825.3344; e-mail mhenness@unex.ucla.edu,Web site **www.uclaextenstion.org/shortcourses**.

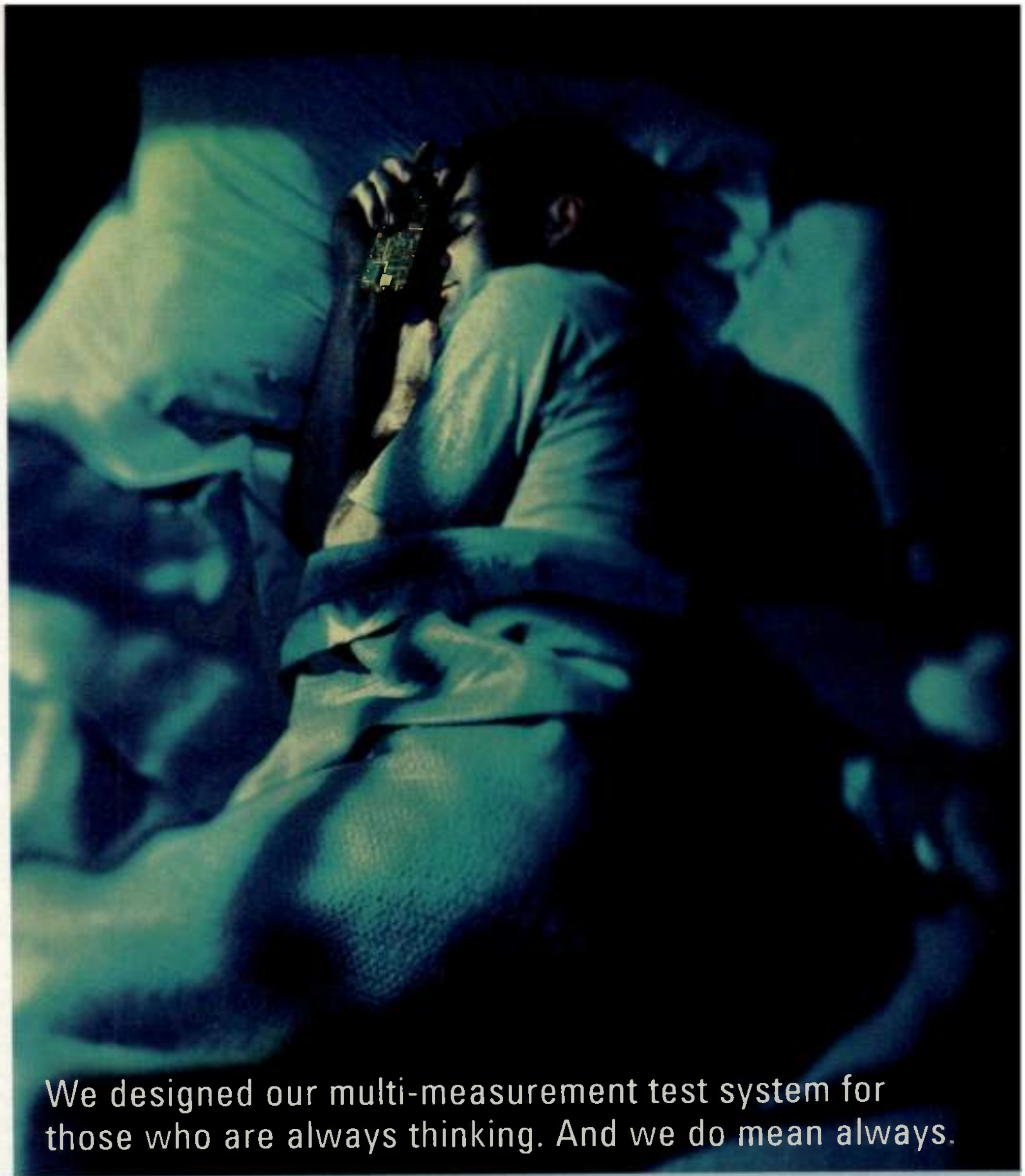
Virginia Tech—*Antennas: Principles, Design and Measurements*—May 22–25, Orlando. Information: Dr. Warren Stutzman, Virginia Tech, Electrical Engineering Dept., Blacksburg, VA 2401-0111. Tel. 540.231.8401; Web site **www.usit.com/antenna**.

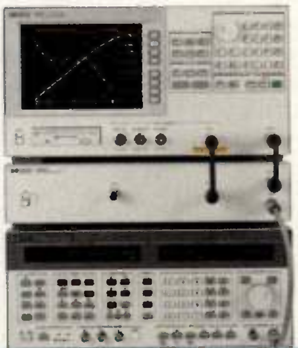
Henry Ott Consultants—*Electromagnetic Compatibility Engineering*—Apr 26–28, East Hanover, NJ. Information: Henry Ott Consultants, 48 Baker Road, Livingston, NJ 07039. Tel. 973.992.1793; Fax 973.533.1442.

University of Missouri-Rolla—*Grounding and Shielding Electronic Sysems; Circuit Board Layout to Reduce Noise Emission and Susceptibility*—April 12–14,Columbus,OH; April 17–19, Chicago IL, June 5–7, Minneapolis, MN, Aug. 16–18, Baltimore, MD. Information:Continuing Education office. Tel. 573.341.4132. Web site **www.umr.edu/~conted**.

Besser Associates—*RFIC Techniques for Wireless Applications*—April 10–12, Mountain View, CA; *RF CMOS Design*—April 13–14, Mountain View, CA; *Frequency Synthesis Technology and Applications in Wireless Systems*—April 17–19, Mountain View, CA; *Applied RF Techniques I*—April 24–28, Mountain View, CA; *Advanced Wireless and Microwave Techniques*—May 8–12, Mountain View, CA. Information:Continuing Education office. Tel. 573.341.4132. Web site **www.bessercourse.com**.

National Institute of Standards and Technology—*Understanding the Characteristics of Clocks and Oscillators, Making Precise Time and Frequency Measurements, and Synchronizing Precision Time Systems*—June 13–16, Boulder, CO. Information:Wendy Ortega Henderson, Tel. 303.497.3693. Web site **www.boulder.nist.gov/t**.





The 4352S VCO/PLL Signal Test System

A great idea can come to you at any time. But how far you take it often depends on your ability to test that idea.

That's why we created our Agilent Technologies 4352S VCO/PLL Signal Test System. It's the only one-box solution that allows you to test eight multi-measurement parameters (RF power, frequency, phase noise, frequency transient, tuning sensitivity, spectrum, dc power consumption current and FM deviation) from 10 MHz-12.6 GHz.

Plus, the system's built-in instrument programming and powerful analysis functions (which include customizable displays) let you easily compare measurements and determine trade-offs—so you can quickly and effectively optimize your design.

There's even a dc power supply and ultra-low noise dc tuning voltage, so you can feel confident you're evaluating the actual performance of your circuit.

At Agilent, we know it's your job to always be thinking of ideas. And it's our job to make sure testing them isn't a nightmare.

www.agilent.com/find/4352S

1-800-452-4844, Ext. 6940

Agilent Technologies
Innovating the HP Way

©2000 Agilent Technologies

INFO/CARD 5

Will WAP lead the way by 2003?

Wireless Application Protocol (WAP) and Bluetooth technology may represent the greatest revenue potential for U.S. and Western European mobile operators, according to a recently released study by VisionGain, United Kingdom.

The WAP Report predicts that by 2003, 95% of handsets shipped by manufacturers to Western Europe and the United States will be WAP-enabled; 70% will incorporate Bluetooth technology. Of the 1,000 plus mobile users VisionGain surveyed throughout Europe, more than 50% said they would consider replacing their wireline with a wireless handset.

Citing the confluence of wireless and IP network prevalence as setting the stage for more widespread wireless data adoption, the report views WAP as a critical transition protocol to emerging mobile multimedia arena.

"VisionGain believes that WAP offers operators a way of differentiating themselves from their competition and an opportunity to test near-3G services," said Bill Patterson, VisionGain's senior analyst.

New cellular standards published by TIA

The Telecommunications Industry Association (TIA) has published a new standard "Mobile Station-Base Station Compatibility Standard for Enhanced 800 MHz Analog Standard," TIA/EIA-691; and a new interim standard, " Base Station-Mobile Station Compatibility Specification for 800 MHz Cellular, Auxiliary and Residential Services," TIA/EIA/IS - 91-A.These technical requirements form a compatibility standard for a cellular radio telecommunications system. Their purpose is to ensure that a mobile station can obtain services in any cellular system manufactured according to both standards. These requirements do not cover equipment performance or measurement procedures.

Home connectivity market to reach $5.7 billion by 2004

The worldwide home networking equipment and residential gateway market is expected to grow from more than $600 million in 2000 to more than $5.7 billion by 2004, according to recent research by Cahner In-Stat Group.

This growth will be spurred by the growing interest in home connectivity from numerous technology industries.

"All aspects of the connected home-communications, entertainment and home systems management will be interconnected in the future using networking and Internet technology," said Mike Wolf, senior analyst for Cahners In-Stat Group.

The networked home will move from today's first generation products, such as basic PC adapter cards and simple gateways, to tomorrow's, where connectivity technology is embedded in recognizable devices that non-technical users are familiar and comfortable with.

New connectivity—based services, enabled through home networking technology, will help drive growth in this market. Additional voice lines, home management and monitoring, as well as new value added entertainment services will create a $3 billion connectivity services market by 2004.

Companies team to develop 3G radio chip

Analog Devices, Norwood, MA, and Mitsubishi Electric, Japan, have developed a radio chip for use in third generation (3G) cellular phones. The direct conversion radio chip is used in cellular handsets for the W-CDMA. Direct conversion (zero IF) eliminates the intermediary frequency section of traditional radio technologies. Direct conversion enables radio designers to take a high frequency of RF input signal directly to baseband or low frequencies, eliminating scores of components and boosting efficiency.

The new chip includes variable-gain amplifiers, baseband channel filters, and a wide-range logarithmic amplifier for RSSI detection. It consumes low power and the direct coversion architecture eliminates many of the oscillators and filters required by recievers.

Photon switch aids photon, electron conversion

Agilent's photonic switching platform is an optical technology capable of routing communications traffic without the costly conversion from photons to electrons and back to photons.

This ability to manage communications traffic in the optical domain has been called the "missing link" for the next-generation all-optical network. By elminating the eqipment needed to translate the basic light signals into electrical signals for the purpose of routing those signals, improvements in capacity and cost reductions are made possible.

The switch— based on a combination of inkjet and planar lightwave circuit technologies—is already in trials with several industry company's for integration into complex communications network elements.

EMC product standard changes for converters

The EMC product standard for "variable-speed drives" frequency converters EN 618003 has been supplemented by Annex A11. The new standard contains a number of changes and more details than the 1997 published standard.

The new version mandates that eqipment be sold with the warning label, "This equipment is not designed to be run from a low-voltage household supply network, as it is liable to cause radio interference." The annex now defines limit values for this equipment with respect to line-run noise parameters between 0.15 and 30 MHz, depending on the dimensions of the converter. The principle of protection of adjacent installations remains unchanged.

Contracts

Qualcomm will replace Burlington's mobile units—Qualcomm, San Diego, announced Burlington Motor Carriers, Daleville, IN, has elected to replace its currently installed mobile communications system units with Qualcomm's OmniTracs Mobile information management systems units.

Motorola, Telefon AB L.M. Ericsson win Turkish contract—Motorola, Northbrook, IL, and Telefon AB L.M. Ericsson, Sweden, have won contracts with more than $2 billion to provide mobile phone equipment in Turkey.

IFR wins $8.1 million British contract—IFR Systems,Wichita, KS, has won a contract from British Telecommunications, UK, valued at $8.1 million, over three years to supply calibration and maintenance services for BT's electronic test equipment used in field and laborator applications throughout the UK.

Continued on page 18

Only $36^{95} ea.(qty. 1-49)

2W SMA DC to 18 GHz ATTENUATORS

How can you buy attenuators that combine world renowned engineering expertise with high quality stainless steel construction, low cost, and off-the-shelf availability? Specify Mini-Circuits fixed attenuators! Built tough to handle 2 watts average with 125 watts peak power, this attenuator series supplies precision accurate 1dB to 40dB attenuation values with high temperature stability and excellent phase linearity in the wide DC to 18GHz band. Call Mini-Circuits and capture this next generation of value for your system integration today!

Mini-Circuits...we're redefining what VALUE is all about!

Model	Attenuation (dB) Nominal	Attenuation (dB) Accuracy*	Length (Inches)
BW-S1W2	1	±0.40	.85
BW-S2W2	2	±0.40	.85
BW-S3W2	3	±0.40	.85
BW-S4W2	4	±0.40	.85
BW-S5W2	5	±0.40	.85
BW-S6W2	6	±0.40	.85
BW-S7W2	7	±0.60	.85
BW-S8W2	8	±0.60	.85
BW-S9W2	9	±0.60	.85
BW-S10W2	10	±0.60	.85
BW-S12W2	12	±0.60	.85
BW-S15W2	15	±0.60	.99
BW-S20W2	20	±0.60	.99
BW-S30W2	30	±0.85	.99
BW-S40W2	40	±0.85	.99

Equipped with SMA male and female connectors.
.312" across hex flats.
*At 25°C includes power and frequency variations up to 12.4GHz. Above 12.4GHz add 0.5dB typ. to accuracy.

ALL VALUES IN STOCK

Mini-Circuits® Celebrates Year 2000!

Buy 1 Get 1 Free!

Buy Up To 25 Units Of Each Model At The Regular Price
Get An Equal Amount FREE!
Offer expires May 31, 2000

Mini-Circuits®

US INT'L
CIRCLE READER SERVICE CARD

P.O.Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

YONI™ *The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: http://www.minicircuits.com*

ISO 9001 CERTIFIED

F 276 Rev E

BUSINESS BRIEFS

Power Amplifier patent awarded—Anadigic's, Warren, NJ, has been granted a US patent for its single-chip power amplifier architecture. The company has been awarded a total of 18 patents and has five patents pending.

Psion, Motorola to develop wireless Internet devices—Handheld computer manufacturer Psion, UK, has announced plans to develop mobile Internet access devices with Motorola, Northbrook, IL. They expect to launch the products worldwide during the first half of 2001. Psion and Motorola will market the wireless devices separately, but the new products will carry the logos of both companies.

Qualcomm forms agreement with Telson—Qualcomm, San Diego, has entered into a worldwide CDMA subscriber unit license agreement with Telson Information & Communications of Korea. Under the agreement, Qualcomm has granted Telson I&C a license under Qualcomm's proprietary CDMA technology and patents to develop, manufacture and sell subscriber unit products for cdmaOne, cdma2000 and HDR air interface technologies.

Rogers, Kuraray to develop new circuit material—Rogers, Rogers, CT, and Kuraray, Japan, have signed an agreement to develop LCP-based film technology into circuit materials for specific market applications.

Microchip Technology opens new design center—Microchip Technology, Chandler, AZ, has opened a design center in Bangalore, India. The new design center will support design and development efforts for the company's integrated circuits, embedded software and applications and local sales operations.

Varetis, Hewlett-Packard Mobile E-services join forces—Varetis AG, formerly pc-plus Informatik AG, Germany, has joined Hewlett-Packard Mobile E-services Bazaar to better facilitate the application of wireless application protocol (WAP) technology in the expanding field of e-services.

Metricom selects Hirschmann as antenna supplier—Metricom, Los Gatos, CA, has selected Hirschmann, Pine Brook, NJ, as a supplier of custom designed wired access point antennas. The Hirschmann antennas provide RF communications at both the 900 MHz band and the 2.4 GHz band.

Calibre, Infineon team to dual source products—Calibre, San Jose, a cordless connectivity hardware and software subsystems supplier, has reached an agreement with Infineon Technologies, Germany, to dual source selected products in their IrDA compatible data transceiver product lines.

RF Micro Devices, ShareWave team to design radio—RF Micro Devices, Greensboro, NC, has collaborated with ShareWave, El Dorado Hills, CA, on the design of the radio used by ShareWave's OEM customers.

Pulse forms new group—Pulse, San Diego, has formed a group dedicated to developing and supporting a broad range of off-the-shelf electronic components for the cable market.

Quake Wireless, Samsung form alliance—Quake Wireless, San Diego, has entered into a strategic alliance with Samsung Electro-Mechanics, Korea. Samsung will manufacture Quake's satellite communications products that enable companies to track, monitor, and provide two-way data communications capabilities between fixed and mobile assets worldwide.

Agilent, SyntheSys form licensing agreement—Agilent Technologies, Palo Alto, CA, has signed a licensing agreement with SyntheSys Research, Menlo Park, CA, for its error-analysis technology. This technology will allow engineers the ability to uncover the causes behind errors in digital components and system hardware.

Ultra RF, GHz form strategic alliance—Ultra RF, Sunnyvale, and GHz Technology, Santa Clara, have formed a strategic alliance. Under alliance terms, Ultra RF will supply ultra gold silicon LDMOS wafers to GHz for inclusion in devices targeting avionics, broadcast and other non-wireless applications.

Adicom Wireless, Dragon Telecommunications team up—Adicom Wireless, Hayward, CA, has forged an alliance with Dragon Telecommunications, China. The company has signed a contract with Piono High Tech, a subsidiary of GDT in Shenzhen, Guangdong province, to manufacture and market Adicom's Aditus family of wireless access products under the Piono name throughout China.

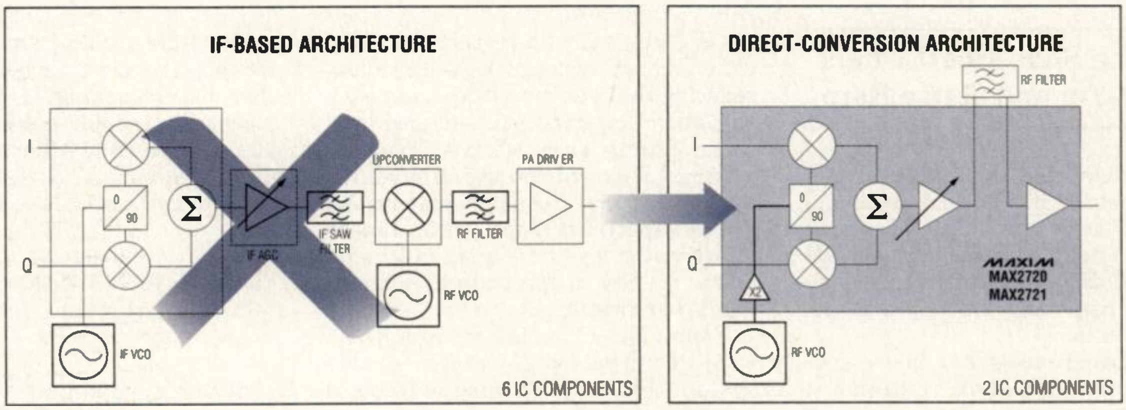
Ultima Communication, Silicon Wave form license agreement—Ultima Communication, Carlsbad CA, and Silicon Wave, San Diego, have formed a cross-license agreement for protocol software for the implementation of Bluetooth wireless technology. Under the agreement, both companies will be allowed to deliver complete software solutions to OEM's looking to add Bluetooth functionality to their products, while minimizing the development cycle.

Panasonic, Mitel, Philsar team—Panasonic, Japan, is co-developing a module for next generation Bluetooth systems with Mitel Semiconductor and Philsar Semiconductor. The trio's product will be a complete module designed to accelerate the development of Bluetooth systems with low power consumption cost and time to market.

WORLD'S ONLY FULLY INTEGRATED 2.5GHz DIRECT I/Q TRANSMITTER

Ideal for Wideband CDMA Wireless Local Loop Systems

Reduce cost, component count, and board space and increase manufacturing yield with the MAX2720/MAX2721 direct I/Q transmitters. By utilizing a direct conversion architecture and expert RF integration, these transmitters reduce the number of RFIC components from 6 to 2, saving 35% cost, 50% board space, and reducing costly production alignment time.



MAX2720/MAX2721 Features:

- 1.7GHz to 2.1GHz RF Output (MAX2720)
- 2.1GHz to 2.5GHz RF Output (MAX2721)
- 35dB Gain Control Range
- Integrated PA Driver with +13dBm Output P1dB
- Full LO or 1/2 LO Frequency Input
- 33dB Carrier Suppression
- 40dB Sideband Suppression
- +2.7V to +3.3V Single Supply
- 1µA Shutdown Mode

Why Direct Conversion?

- Eliminate IF SAW Filter, Upconverter, and VCO
- Reduce Number of ICs from 6 to 2
- Save 35% in IC Cost
- Save 50% in Board Space
- Reduce Production Alignment Time
- Increase Manufacturing Yield

Other Applications:

- PCS/DCS Base-Stations
- MMDS, LMDS
- 2.4GHz ISM Band Radios

Subscribe to Maxim's EE-Mail™ today to receive automatic new product updates via e-mail. Go to www.maxim-ic.com for easy signup.

CALL TOLL-FREE 1-800-998-8800 for a Design Guide or Free Sample
6:00 a.m. – 6:00 p.m. Pacific Standard Time

1999 EDITION!
FREE FULL-LINE DATA CATALOG
ON CD-ROM

MAXIM

www.maxim-ic.com

NEW! Get Price, Delivery, and Place Orders Online at www.maxim-ic.com

Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086, (408) 737-7600, FAX (408) 737-7194.

Distributed by Maxim Distribution, Arrow, Avnet Electronics Marketing, CAM RPC, Digi-Key, Elmo, Nu Horizons, and Zeus.
Distributed in Canada by Arrow and Avnet Electronics Marketing.

MAXIM is a registered trademark of Maxim Integrated Products. © 2000 Maxim Integrated Products.

INFO/CARD 6

Spread spectrum and PLL technology combine to reduce EMI

Combining state-of-the-art spread spectrum and PLL design offers 10 dB improvement in measured EMI.

By I-The Sha, Albert Chen, Kuang-Yu, and Jeffry Keip

This article will examine the design parameters of a spread spectrum clock generator that uses advanced PLL technology to reduce measured EMI by 10 dB. The result is a design solution to pass tough FCC Class B system qualification.

A numerical model has been successfully developed to implement spread spectrum in Phase-Locked Loops (PLLs). Using this patent pending technology, a modulating signal is generated by circuitry injected into the feedback path of the PLL.

Spread spectrum clock generators are a proven and reliable method to reduce the spectral amplitude of EMI components over a substantial bandwidth. The spread spectrum clock block diagram is shown in Figure 1. This technique includes modulation inside closed loop operation.

By spreading the bandwidth, the amplitude of the synthesized clock signal is decreased with respect to its fundamental and harmonics. As a result of reducing the peak amplitudes, the peak radiated electromagnetic emission level is significantly lower when compared to a typical narrow band signal produced by conventional frequency generators. Spread spectrum clock generation is effective for lowering a signal's peak power density in spectrum by increasing its bandwidth.

From Figure 1, a time-varying model would be developed by state variable system. Finite difference method is applied to develop the numerical model. Then, the best modulating profile is determined by the least square error method. A 4.5 to 5.5 MHz reference frequency following the input divider is recommended. That range of reference frequency optimizes the resolution of modulation shape and silicon area occupied.

Numerical modeling

A state variable PLL in time-varying model can be derived as:

$$dx/dt = A(t) \bullet x(t) + B \bullet u(t) \qquad (1)$$

The state variable x(t) is a 3 • 1 ve tor. A(t) is a 3 • 3 time-varying matri that makes equation (1) be a nonlinea model. B is simply a constant and u(is a 3 • 1 vector. After applying finit difference method to equation (1), th discrete system is defined by equatio (2).

$$x(N+1) = A(N+1) \bullet x(N) \bullet \Delta t(N+1) + B \bullet u(N) \bullet \Delta t(N+1) + x(N) \qquad (2)$$

Δt is a time step between the present and next cycle. For the given tria values of A(N+1), x(N) and Δt(N+1 x(N+1) can be solved to match an modulation waveform by least squar error theory. The equation is iterate until optimal results are received.

Modulation profile

The shape of the modulation waveform is critical to maximum EMI reduction. The modulation profile used t accomplish the greatest reduction i EMI is shown in Figure 2. The perio of the modulation is shown as a percentage of the period length along th x-axis. The amount that the frequenc is varied is shown along the y-axis also shown as a percentage of the tota frequency spread. The modulatin signal has a frequency of approximately 31 KHz. Actually, any modulating frequency can be achieved b using feedback path control.

As shown in Figure 3, each harmonic of a modulated clock has a muc lower amplitude than that of an unmodulated signal. The reduction i amplitude is dependent on the harmonic number, the frequency deviation, the percentage of spread, and th modulation frequency.

Spread spectrum jitter

The cycle-to-cycle jitter induced by th modulating clock is insignificant compared to the PLL's original cycle-to-cycl jitter. For example, applying a 100 MHz clock with ±1% deviation to Figure 2, th

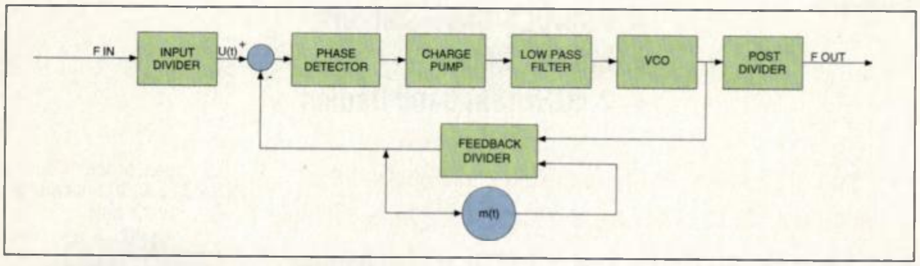


Figure 1. Block Diagram of spread spectrum PLL.

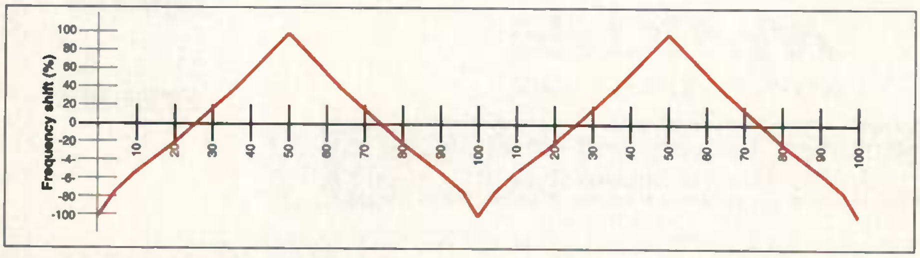


Figure 2. Lexmark modulation waveform profile.

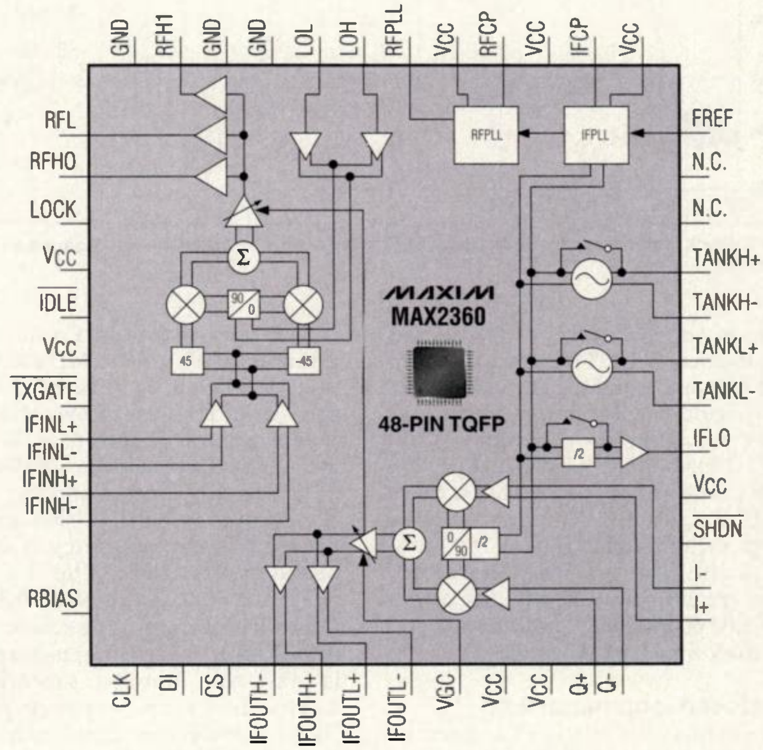
WORLD'S MOST INTEGRATED TRANSMIT IC FOR DUAL-BAND CELLULAR PHONES—SAMPLING NOW

The New MAX2360 is Designed for cdmaOne™, cdma2000™, TDMA, EDGE, and W-CDMA Dual-Band Cellular Phones

The MAX2360 is part of Maxim's cdmaOne chipset and, together with MAX2320, MAX2310, and MAX2264, forms a complete cdmaOne antenna-to-baseband solution.

Features:

- Dual-Band I/Q Modulator
- Upconverters
- +7dBm (-54dBc ACPR) PA Drivers
- IF VCOs
- Dual-Band IF/RF PLLs
- Serial Interface Control
- Saves up to Three SAW RF Filters and PA Drivers
- Supports Dual IFs
- PCS Only (MAX2362) and Cellular Only (MAX2364) Versions Available



The highly integrated MAX2360 saves cost and size in dual-band cellular phones.

cdmaOne and cdma2000 are trademarks of the CDMA Development Group.

Subscribe to Maxim's EE-Mail™ today to receive automatic new product updates via e-mail. Go to www.maxim-ic.com for easy signup.

1999 EDITION! FREE FULL-LINE DATA CATALOG ON CD-ROM

CALL TOLL-FREE 1-800-998-8800 for a Design Guide or Free Sample
6:00 a.m. – 6:00 p.m. Pacific Standard Time

MAXIM
www.maxim-ic.com

NEW! Get Price, Delivery, and Place Orders Online at www.maxim-ic.com

Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086, (408) 737-7600, FAX (408) 737-7194.
Distributed by Maxim Distribution, Arrow, Avnet Electronics Marketing, CAM RPC, Digi-Key, Elmo, Nu Horizons, and Zeus.
Distributed in Canada by Arrow and Avnet Electronics Marketing.

MAXIM is a registered trademark of Maxim Integrated Products. © 2000 Maxim Integrated Products.

INFO/CARD 8

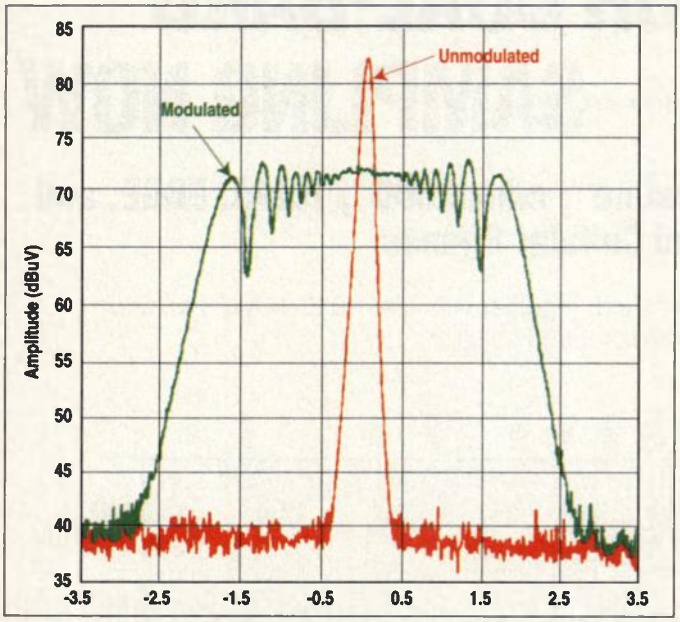


Figure 3. Clock harmonic with and without SSCG modulation in the frequency domain.

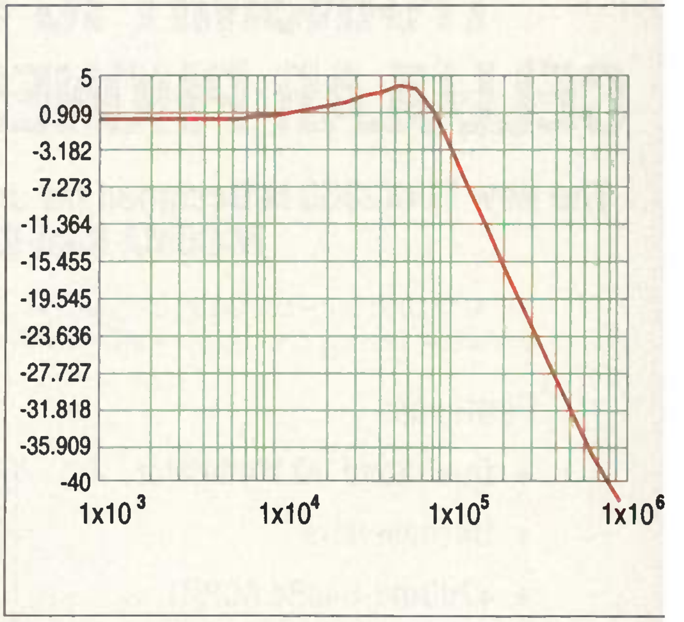


Figure 4. PLL Closed loop bandwidth.

period of the waveform is 50 kHz at 100% location. A 100 MHz clock points to 0% of frequency shift. Then the peak-to-peak period displacement from f_{min}(-100%) to f_{max}(+100%) equals (1/(100 MHz(1-1%))-1/(100 MHz)(1+1%))) = 200 ps. One half period of modulation takes 10µs from f_{min} to f_{max}. Thus, the number of clock cycles is 10µs/10ns = 1000 in a half modulation period. Therefore, spread spectrum only contributes, on average, 200 ps/1000 = 0.2 ps jitter to a 100 MHz clock with ± 1% deviation.

PLL closed loop bandwidth

The bandwidth of the PLL must be larger than the modulation frequency to allow the modulation signal pass through. Equation 3, a transfer function developed from Figure 1, shows the PLL bandwidth in the frequency domain. VCO is the vco gain of the PLL. CP is the charge pump current and C_1, C_2, R_1 are the components in the loop filter. FBD is the number of feedback divider. m(t) is used for modulating signal.

The parameters in Equation 3 are given as VCO = 50.43 MHz/v, C_1 = 500 pf, C_2 = 2000 pf, R_1 = 5k, FBD = 45 and cp = 1mA. Figure 4 shows the normalized transfer function in Bode plot form. The -3dB point is located at 100 KHz which is larger than the modulation frequency, but still low enough to prevent high frequency noise from passing through it. The 2 dominate poles can be found at 59.97 KHz using MathCad. Damping factor of PLL is 0.444. After inverse Laplace transform is taken to a unit step times Equation 3, the unit step response presents PLL's acquisition time from one frequency to another frequency.

Measurement and results

This feedback path modulation technique has been successfully designed into two product families. In Figure 5, a 50 KHz modulating frequency is used to modulate a clock. The target deviation of the profile is + 0.5%. Test results show a 49.78 KHz frequency modulation signal spreading a 100.2785 MHz with peak-peak 0.986 MHz deviatior The measurements show the error from target profile to be 1.635% max mum in peak-peak deviation and 0.44 maximum in modulation frequency.

Meanwhile the jitter shows only 1 p increase after turning on the sprea spectrum features. Figures 6 show unmodulated and modulated 100 MH clock jitter measurements, respectively

Comparing the modulated an unmodulated fifth harmonic of th clock spectrum measures 8.33 dl reduction in Figure 7.

Products and applications:

There are many different families c devices with spread spectrum PLL' incorporated in them. The family upor which this article is based is a singl PLL based device which can be provid ed in 8 or 16 pin SOIC's. Various exist ing options simply take an input signa

$$H(s)=\frac{VCO\bullet\frac{cp}{C_1}\left(s+\frac{1}{R\bullet C_2}\right)}{\left(s^3+\frac{C_1+C_2}{R_1\bullet C_1\bullet C_2}\bullet s^2+cp\bullet\frac{VCO}{C_1\cdot\frac{FBS}{1+m(t)\bullet FBS}}\bullet s+\frac{cp\bullet VCO}{R_1\bullet C_1\bullet C_2\bullet\frac{FBD}{1+FBD\bullet m(t)}}\right)}$$

Equation 3. The transfer function.

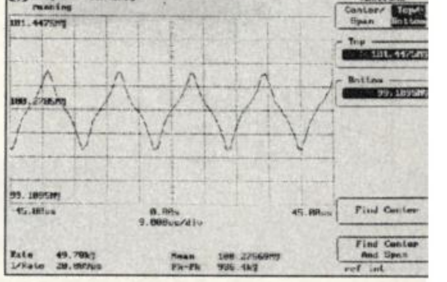


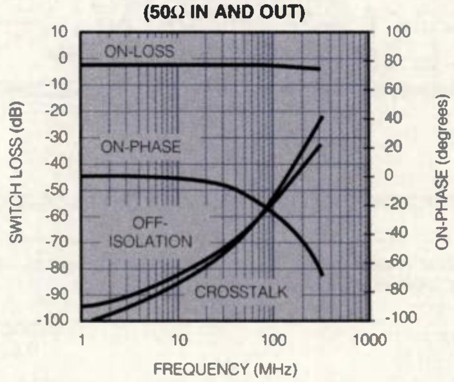
Figure 5. Modulation waveform generated b W48S101 product.

VIDEO/RF SWITCHES PROVIDE -50dB OFF-ISOLATION & CROSSTALK @ 100MHz

New 20Ω Video/RF Switches are Ideally Suited for Catscan & Ultrasound

The MAX4545 family of wide-bandwidth video/RF switches is ideally suited for 75Ω systems. These devices offer low on-resistance (20Ω) and only 1dB of insertion loss. They operate from either a ±2.7V to ±5.5V dual supply or a +2V to +12V single supply, and can handle Rail-to-Rail® analog signals in either direction. Off-isolation and crosstalk are greater than -50dB at 100MHz for all part types. They also feature very low output capacitance (11pF) and a passband bandwidth greater than 300MHz. Harmonic distortion is less than 0.004%, with a guaranteed R_{ON} flatness of 0.5Ω max over the $2V_{p-p}$ signal range. All devices are designed for channel-to-channel matching (1Ω max) and low charge injection (5pC max). They are available in plastic DIP, SOIC, SSOP, and QSOP packages tested over the commercial and extended temperature ranges.

MAX4567
FREQUENCY RESPONSE
(50Ω IN AND OUT)



Choose the Best Video/RF Switch for Your Application

PART	FUNCTION	R_{ON} (Ω max)	R_{ON} MATCHING (Ω max)	R_{ON} FLATNESS (Ω max)	OFF-ISOLATION 10MHz/100MHz (dB typ)	CROSSTALK 10MHz/100MHz (dB typ)	THD (%)	PACKAGES
MAX4545	Quad SPST	20	1	0.5	-80/50	-88/50	0.004	20-Pin DIP, SOIC, SSOP
MAX4546	Dual SPDT	20	1	0.5	-80/50	-80/50	0.004	16-Pin DIP, SOIC, QSOP
MAX4547	Dual SPDT (High-Isolation Pinout)	20	1	0.5	-82/55	-84/55	0.004	16-Pin DIP, SOIC, QSOP
MAX4565	Quad SPST	60	2.5	2	-80/55	-80/55	0.02	20-Pin DIP, SOIC, SSOP
MAX4566	Dual SPDT	60	2.5	2	-80/55	-80/55	0.02	16-Pin DIP, SOIC, QSOP
MAX4567	Dual SPDT (High-Isolation Pinout)	60	2.5	2	-83/55	-87/55	0.02	16-Pin DIP, SOIC, QSOP

Rail-to-Rail is a registered trademark of Nippon Motorola Ltd.

Subscribe to Maxim's EE-Mail™ today to receive automatic new product updates via e-mail. Go to www.maxim-ic.com for easy signup.

CALL TOLL-FREE 1-800-998-8800 for a Design Guide or Free Sample
6:00 a.m. – 6:00 p.m. Pacific Standard Time

MAXIM
www.maxim-ic.com

1999 EDITION!
FREE FULL-LINE DATA CATALOG
ON CD-ROM

ISO 9001

NEW! Get Price, Delivery, and Place Orders Online at www.maxim-ic.com

Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086, (408) 737-7600, FAX (408) 737-7194.
Distributed by Maxim Distribution, Arrow, Avnet Electronics Marketing, CAM RPC, Digi-Key, Elmo, Nu Horizons, and Zeus.
Distributed in Canada by Arrow and Avnet Electronics Marketing.

MAXIM is a registered trademark of Maxim Integrated Products. © 2000 Maxim Integrated Products.

INFO/CARD 9

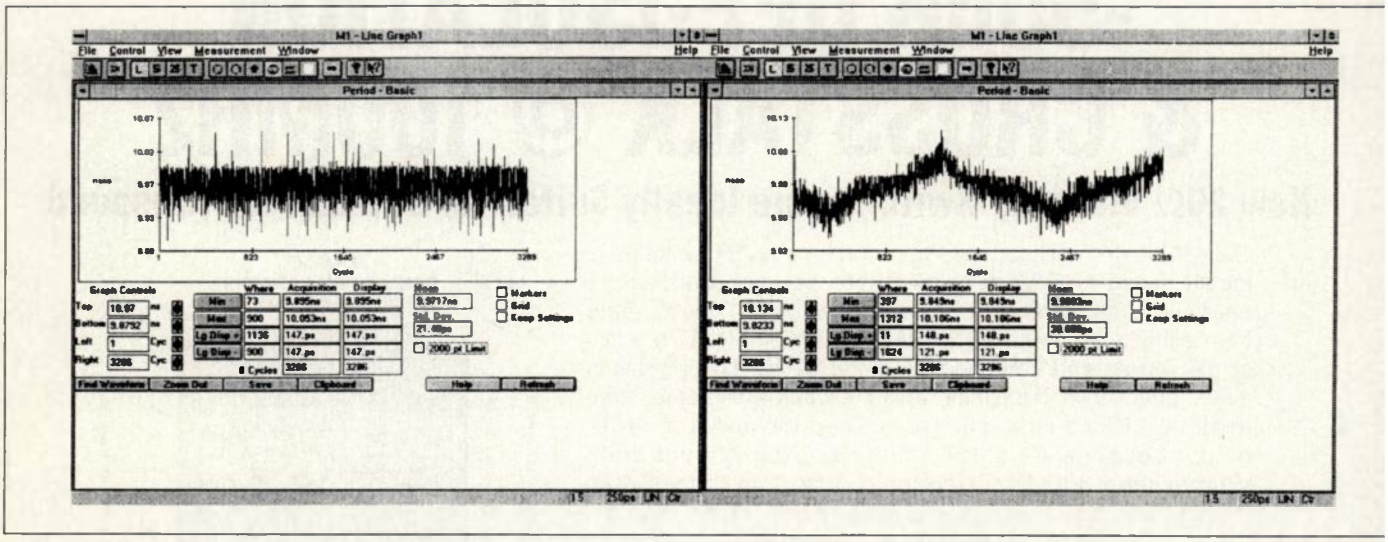


Figure 6. Test results showing the largest displacement of 147ps induces cycle-to-cycle jitter at unmodulated 100MHz clock and 148ps cycle-to-cycle jitter a modulated 100MHz clock.

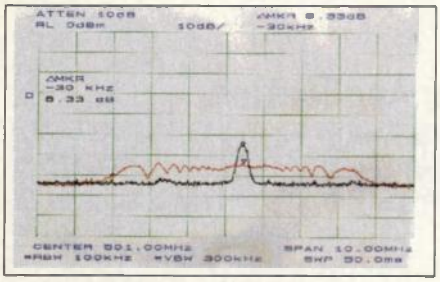


Figure 7. Graph of EMI at 5th harmonic.

and offer at the output 1to6 copies of the input with a selected spread spectrum component added. Some options offer simple multiplication of input frequencies on top of the spread spectrum addition, and through metal mask variations on the base, the device has the ability to provide a wide variety of output frequencies for any given input. A wide variety of systems including printers, fax machines, home video game systems, and disk drives have found spread spectrum clocks useful for some of the frequencies required by their components. Some types of drivers (print heads for example) will not function acceptably using today's spread spectrum clocks, but future devices are under development as possible solutions for such applications.

A second family of products utilizing spread spectrum technology has two PLLs, but only one of them offers the SSCG feature. This is a line of clock generators for 66 and 100 MHz chip set requirements. Virtually all motherboard manufacturers have embraced the SSCG technology.

Conclusions

The numerical model of spread spectrum control in feedback path is a nonlinear differential system. Finite difference is a very powerful method to solve time-varying nonlinear system solutions. Least square error is a popular numerical method to apply to fit a curve. It always follows the ideal spread spectrum waveform closely. Therefore, the modulation profile is mathematically derived as providing maximized reduction of EMI over a given variation range, without adding any significant amount of cycle-to-cycle clock jitter. All the measured results show good match to target design. Theoretically, feedback modulation is not only able to achieve any deviation precisely, but also to have better EMI reduction. Higher resolution and smooth profile are desired for modulating profile that reduces more power density in all harmonics.

RF

References:

1.Hardin, K. B., Fessler J. T. and Bush, D. R., "A study of the interference Potential of Spread Spectrum Clock Generation Techniques", IEEE 1995, pp.624-629.

2.Hardin, K. B., Fessler J. T. and Bush, D. R., "Spread Spectrum Clock Generation for the Reduction of Radiated Emission", Proceedings of the 1994 IEEE International Symposium on Electromagnetic Compatibility, Chicago, IL. August 22-26, pp 227-231.

3.Gardner, F.M., Phase-Locked Loop Techniques, 2nd ed., John Wiely & Sons, 1980.

About the authors

I-The Sha is currently a Senior Design Engineer at Timing Technology Division in Cypress Semiconductor. He has Ph.D. in Electrical Engineering from University of Missouri-Columbia. He has worked in the field of 2-Dimensional device physics by Finite Element and Finite Difference for couple years. He can be reached at 408-544-1026 or by e-mail at *isi@cypress.com.*

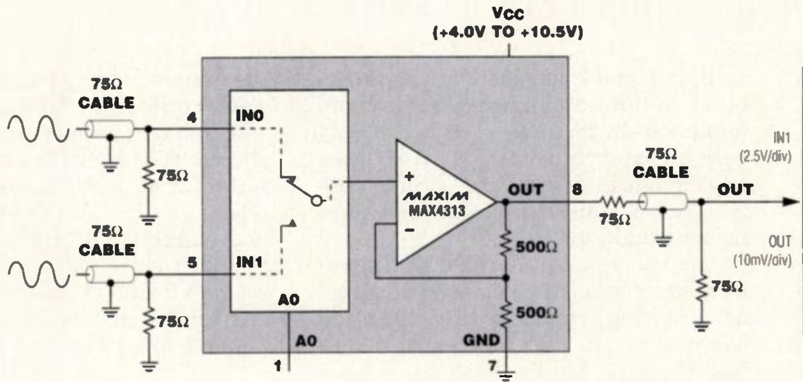
Albert Chen has M.S.E.E. from University of Missouri-Columbia. He is currently employed at Timing Technology Division in Cypress Semiconductor, as a Design Manager. He can be reached by e-mail at *icj@cypress.com.*

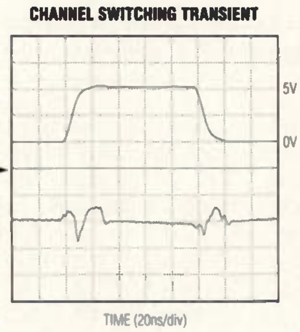
Kuang-Yu Chen has M.S.E.E. from San Jose State University. He is currently employed at Timing Technology Division in Cypress Semiconductor, as a Design Vice President. He can be reached by e-mail at *ick@cypress.com.*

Jeffry Keip is the product Marketing Manager for Spread Spectrum timing devices and Zero Delay Buffers at Cypress Semiconductor. He has over four years experience in support of timing technology. He received his B.S. in Electrical Engineering from the University of California at Davis. He can be reached by e mail at *IKL@cypress.com.*

FIRST 345MHz SINGLE-SUPPLY 2/4/8-CHANNEL VIDEO MUX/AMPS

Ultra-Low Switching Glitch of 10mVp-p





Clean Switching, Simple Solutions

- Low 6.1mA Supply Current (MAX4310/13)
- Single-Supply Operation to +4.0V
- Rail-to-Rail® Outputs

8-PIN µMAX
ACTUAL SIZE
3.05mm x 5.03mm

- Ultra-Low Switching Glitch of 10mVp-p
- 345MHz -3dB BW (MAX4311)

Choose Maxim for the Ideal Mux/Amp for Your Video Switching Application

PART	NO. OF CHANNELS	MINIMUM STABLE GAIN (V/V)	-3dB SMALL-SIGNAL BANDWIDTH (MHz)	0.1dB GAIN FLATNESS (MHz)	DIFFERENTIAL GAIN/PHASE (%/°)	SLEW RATE (V/µs)	CHANNEL SWITCHING TIME (ns)	SWITCHING TRANSIENT (mVp-p)
MAX4310	2	1	280	60	0.06/0.08	460	40	10
MAX4313	2	Fixed gain of 2	150	40	0.09/0.03	540	40	10
MAX4311	4	1	345	40	0.06/0.08	430	40	10
MAX4314	4	Fixed gain of 2	127	78	0.09/0.03	430	40	10
MAX4312	8	1	265	35	0.06/0.08	345	40	10
MAX4315	8	Fixed gain of 2	97	46	0.09/0.03	310	40	10

Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.

Subscribe to Maxim's EE-Mail™ today to receive automatic new product updates via e-mail. Go to www.maxim-ic.com for easy signup.

CALL TOLL-FREE 1-800-998-8800 for a Design Guide or Free Sample
6:00 a.m. – 6:00 p.m. Pacific Standard Time

1999 EDITION!
FREE FULL-LINE DATA CATALOG
ON CD-ROM

MAXIM
www.maxim-ic.com

NEW! Get Price, Delivery, and Place Orders Online at www.maxim-ic.com

Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086, (408) 737-7600, FAX (408) 737-7194.

Distributed by Maxim Distribution, Arrow, Avnet Electronics Marketing, CAM RPC, Digi-Key, Elmo, Nu Horizons, and Zeus.
Distributed in Canada by Arrow and Avnet Electronics Marketing.

MAXIM is a registered trademark of Maxim Integrated Products. © 2000 Maxim Integrated Products.

INFO/CARD 13

Embedded antennas—technology for next generation handsets

External antennas have long been the bane for handsets and their designers Embedded antennas may be the solution they've been looking for.

By David McCartney

Today, wireless handsets represent a mere shadow of their technological past. Just a few years ago, the ratio of mobile to portable handsets in cellular was 90% mobile to 10% portable. In contrast, today's radio ratio is 95% portable to 5% mobile. During this transition, there have been several hundred or more technological innovations applied to the current crop of modern wireless handsets. These innovations have empowered manufacturers to increase performance, reduce weight and size and reduce cost.

For example, handset designers have migrated from 14 V to 3 V. They have developed dynamic usage and application DSPs and have gone from analog to digital, and from single-mode, single-band to dual-mode, dual/triple-band handsets. In fact, just about the only design aspect that has not experienced any significant innovation is the antenna. Well, it's about time antenna technology caught up.

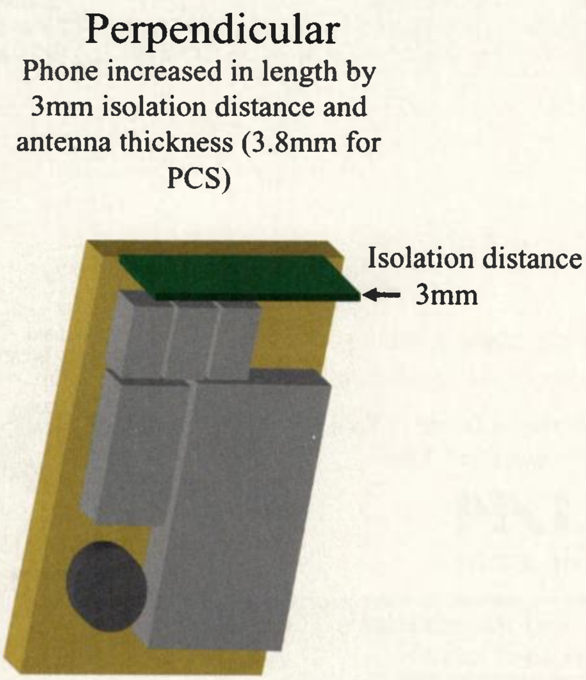
And today, it has — thanks to significant developments in embedded antenna technology that just may mean the end of problem-ridden external antennas. Long the Achilles heal of any wireless handset, external antennas have suffered from breakage issues, performance issues, cost issues, and, finally, ergonomic issues.

Next generation antennas

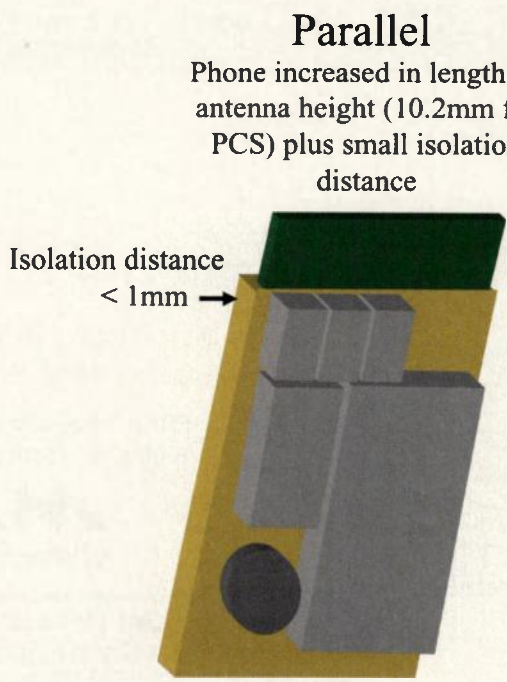
Embedded antennas, especially patch antennas, are not new. But they have met with limited success mainly due to the limitations of performance (designers have demanded whip-lik performance). Ongoing antenn research and development has provide the market with products that elim nated this performance issue. Ne offerings provide both embedded an omni-directional antennas with 1 dE to 5 dBi gain, voltage standing wav ratio (VSWR) of less than 2:1, and significant cost reduction when com pared to today's whips.

Embedded antenna design criteria

Antennas are being developed o both proprietary and open designs an several series of antennas are availabl for use in cellular and PCS wireles handsets. These antennas are a highl efficient resonator designed to act a the frequency-determining element c an asymmetrical dipole antenna. Th



Perpendicular – phone increased in length by 3 mm isolation distance and antenna thickness.



Parallel – phone increased in length by antenna height plus small isolation dis tance.

POWER DIVIDERS

0.5 to 10GHz

2 to 32 Way from $54.95 (1-9)

Looking for a "perfect fit" power divider for your 50 or 75 ohm design...*f a s t ?* Just call Mini-Circuits! Our quick response and wide variety can provide on-target performance to match your needs exactly. That's because we've developed a vast inventory of low cost/high value SMA and Type-N connectorized units covering cellular, GSM, ISM, PCS, and satellite bands. Select from 2 to 32way models, wide band units and microstrip designs going down to 500MHz...all guaranteed to ship within one week. Mini-Circuits power dividers are built tough to handle high matched power with good VSWR, low insertion loss, and high isolation between ports. And for even lower frequency applications, check out our family of torroidal transmission line power splitters and combiners with frequencies as low as 500Hz. If you're looking for a better blend of usability and affordability, put the power of Mini-Circuits to work for you today!

Mini-Circuits...we're redefining what VALUE is all about!

Model	No. Of Models	Freq. Range (GHz)
2WAY-0°	70	0.50-10.0
2WAY-90°	2	1.00-4.20
2WAY-180°	2	1.00-2.49
3WAY	11	0.50-4.20
4WAY	38	0.67-8.40
5WAY	4	0.80-1.80
6WAY	11	0.80-5.00
7WAY	1	1.81-1.99
8WAY	28	0.80-8.40
9WAY	2	0.80-4.80
10WAY	5	0.75-2.40
12WAY	5	0.80-4.20
16WAY	8	0.80-4.80
32WAY	1	0.95-1.75

For detailed model numbers, specifications, and prices, consult our web site, RF/IF Designer's Handbook, or call Mini-Circuits.

Mini-Circuits®

US 90 INT'L 91
CIRCLE READER SERVICE CARD

P.O Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718)332-4661 *INTERNET* http://www.minicircuits.com

For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE • EEM • MICROWAVE PRODUCT DATA DIRECTORY • WWW.RFGLOBALNET.COM

ISO 9001 CERTIFIED

F 177 Rev C

Get Your Hands Off the Antenna

Embedded antennas (like all antennas) face the challenges of coverage by the hand and the resulting detuning to the antenna. As handset designers start working with this new embedded antenna alternative, the major mechanical issue becomes the location of the antenna in relation to the hand. As handsets become increasingly smaller, the hand detuning issue is an even more critical factor for the industrial designer, the electrical engineer, and finally the marketing department that must promote the device.

In addition, designers today want to maximize reception and minimize the rate at which the body blocks or absorbs the power radiating from wireless antennas. Because the position of the antenna, relative to the user, affects the absorption rate, the application of embedded antennas offer designers a new alternative. The search for a less obtrusive antenna than the monopole (whip) has led RangeStar to develop directional embedded antennas that do not require extension of the handset case. The top-mounted and back-mounted versions of these embedded antennas offer the designer new alternatives as well as an increase in performance.

Specifically the back-mounted embedded antenna, which is placed at the top rear of the handset, places the handset chassis between the user and the antenna during a call. This C energy pattern redirects, in the case of RangeStar's 'C' planar antenna, up to 15dB front to back. This placement substantially reduces the peak specific absorption rate (SAR) in the user's head. These new SAR reduced embedded antennas have encouraging application potential

The radiation characteristics of these medium-to-high SAR reduction antennas can now achieve the bandwidths necessary for today's cellular/PCS and cordless applications. Thus they hold tremendous promise for the future, with continued improvements in performance and cost in cellular/PCS or cordless handsets worldwide.

Low SAR 1.8 GHz/1.9 GHz C-Planar antennas

Size	1.2 x 0.8 x 0.25
Weight	2.5 grams, nominal
performance	3 to 4 dB over whip
Applications	Cellular phones, WLANs, hearing impaired wireless products

Moderate SAR 1.8GHz/1.9 GHz R-planar Antennas

Size	1 x 0.5 x 0.09
weight	1.8 grams, nominal
Performance	1 to 2 dB over whip
Applications	1.9 GHz cellular/PCS phones where PWB space is available on or above existing PCB

Omni antenna for 800/900 MHz, 1.8/1.9 GHz and dual band

Size	1.25 x 0.5 x 0.03
Weight	1 gram nominal
Performance	gain comparable to whip
Applications	800 MHz, 900 MHz and dual-band cellular/PCS, cordless phones and WLL

second half of the dipole is provided by the Printed Circuit Board (PCB) of the wireless device.

To assist with the design and implementation of these new embedded antennas, it is necessary to understand certain design criteria. Such criteria include antenna isolation, ground plane length and feed points. These design elements are critical to achieving the best-embedded antenna performance in a handset.

Antenna isolation

The first criteria, antenna isolation from the transceiver circuitry, is needed to prevent detuning of the antenna element. It can be achieved by mounting the antenna at right angles to the PCB and leaving a small separation between the components and the antenna, or by mounting the antenna parallel to the PCB or at the end of the PCB.

The performance figures of the two configurations are similar, and the trade-off between the two mounting methods is the overall length of the device, which depends on isolation distance and antenna dimensions.

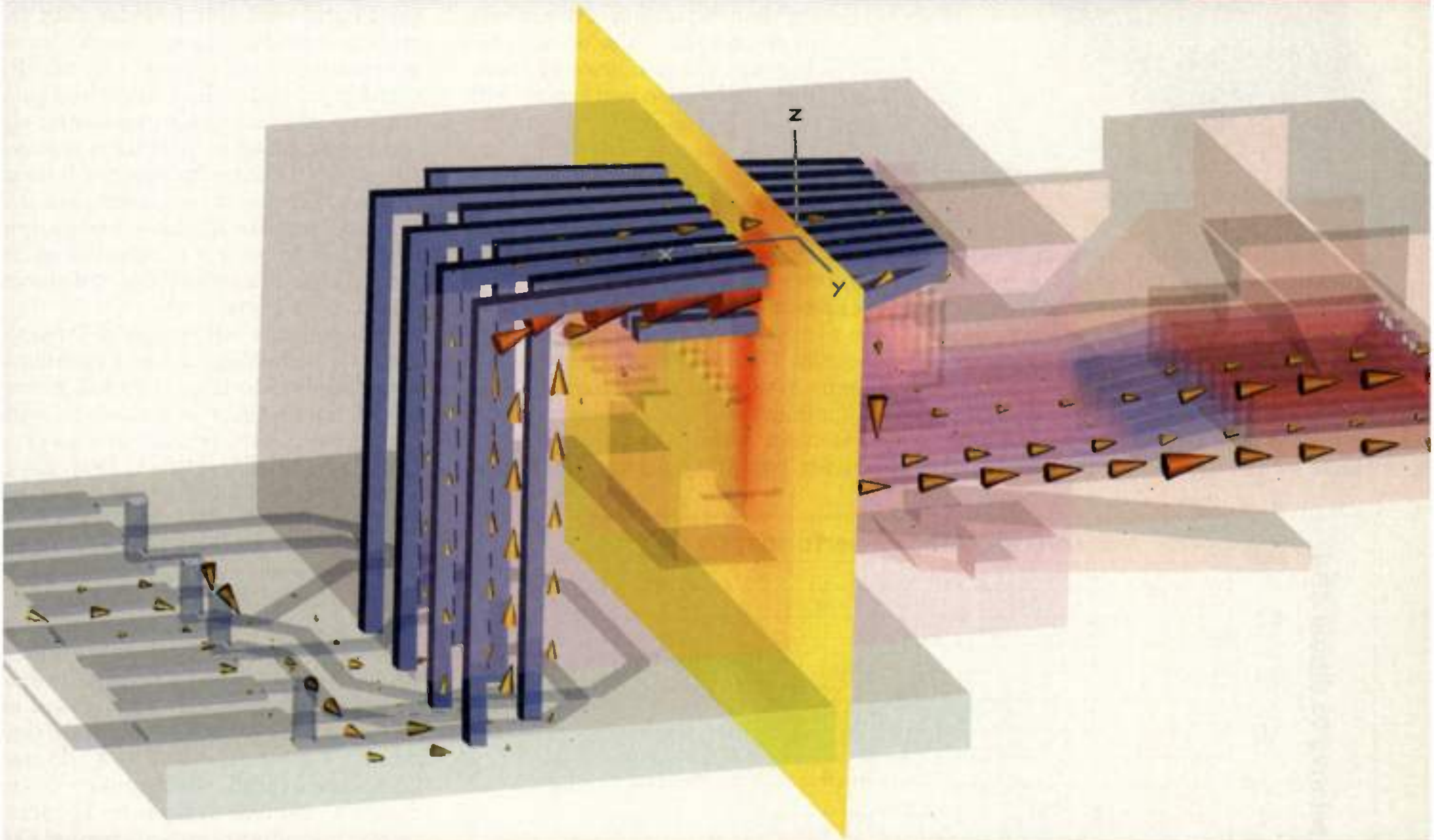
- Isolation Distance — With the parallel design, no isolation distance is required other than to ensure that the PCB ground plane is not touching or located behind the antenna. Therefore isolation distance is typically less than 1 mm. In the case of perpendicular mounting, the antenna element must be some 3 mm from any active elements or the ground plane on the PCB.
- Antenna Dimensions — In the perpendicular design, an antenna's dimensions are not a factor in overall length of the device. There is no increase in height other than that necessary for the isolation distance. With the parallel mounting, the length has to be increased by the height of the antenna which can be anywhere from 10 mm to 17 mm for current designs.

With the emphasis manufacturers place on minimal phone footprint designers focus on the perpendicular mounting configuration for most applications—with the exception of fold phones, which offer excellent platforms for parallel mounting.

Ground plane length

Because these new antennas in effect use the ground plane as the main radiating element, the effect of overall ground plane length on the performance

Why accept second best? We don't.



3D EM Simulation

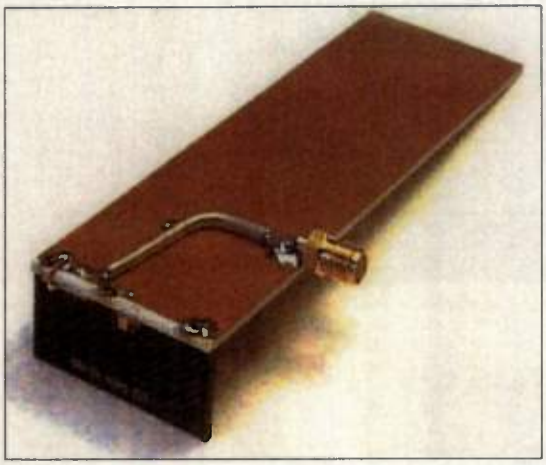
→ Actually we have only modest needs. For example, bad quality is something we can't accept. This attitude ensures our technical leadership in the field of 3D EM simulation: The incorporation of the Perfect Boundary Approximation™ (PBA) technique allows an accurate modeling of curved surfaces while maintaining the unparalleled performance of the FI method in the time domain.

The applications of **CST MICROWAVE STUDIO™** include the simulation of waveguides, couplers, filters, power splitters, multiplexers, switches, planar structures, coax and multipin connectors, MMIC packages, all kinds of antennas, and many other structures.

CST
COMPUTER SIMULATION TECHNOLOGY

CST. CHANGING THE STANDARDS.
CST of America, Inc. · Cambridge, Massachusetts · **http://www.cst-america.com**
To request literature or a free demo CD, **617-576-5857**, or **info@cst-america.com**

INFO/CARD 17



Example of ground plane design.

and radiation pattern of the embedded antenna is critical. The effects of ground plane size on a manufacturers' cellular band antennas have been formally documented. A typical antenna was mounted on ground planes ranging from 3 to 5.5 inches in half-inch steps. For each ground-plane size, the antenna was tuned to the U.S. cellular frequency band, and Smith charts and gain patterns were recorded.

The data shows that the antenna favors a 1.5 inch by 4.5 inch ground plane for both VSWR bandwidth and gain performance. Any deviation from this size diminishes the bandwidth and gain performance.

Increasing handset designers' understanding of the effects of ground plane size on the tuning and performance of these new embedded antennas will allow for maximum performance.

Feed points

The final essential design criteria is the ability to feed the embedded antenna. This is where embedded antennas can offer significant advantage as compared to existing external antennas. With the dualband external antenna in use today, designers have to use a minimum of three diplexers. Next generation antennas can offer the designer two alternatives: the single feed point and the dual feed point.

Single/dual-port T-planar antenna theory

•Single RF Port

Traditional cellular/PCS handset have been designed with a single fee point for their existing antenna net works. A single feed point antenn allows for the rapid integration of dual-band embedded device into th standard product design, with a mini mum number of changes to the R matching circuitry. In a single feed poin antenna, the independent antenna ele ments are joined to produce a commo RF port. This introduces some interac tion between the two elements, but it i minimal compared with other design and, more importantly, because of th trace design, it is predictable and stable

•Dual RF Ports

A significant advantage of T-plana antenna technology is the flexibility i gives handset designers. This flexibilit allows the designer to review the addi tional components that are used i their antenna network designs t accommodate single feed point devices such as whips.

The ability to offer independent R ports to the antenna for the two band allows the designer to evaluate th use of diplexers and/or band switches and the reduction or elimination o these devices can significantly reduc component count and cost. From a electrical perspective, the dual fee point T-planar antenna desig increases overall performance of th device's antenna system by reducin losses in the antenna-matching net work. And, with the use of indepen dent feeds, further reduction of th interaction of the two antenna ele ments can be achieved.

One additional advantage of the dua feed point design, indicated by previou research, is the potential to make th

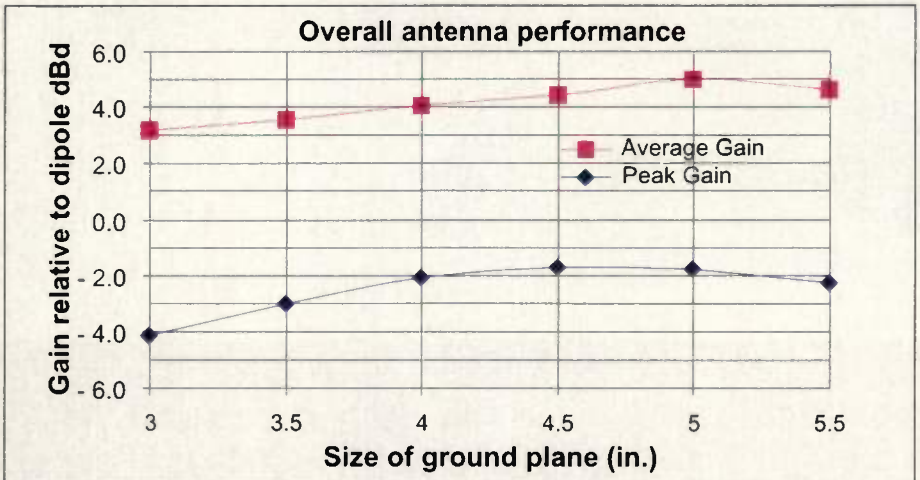
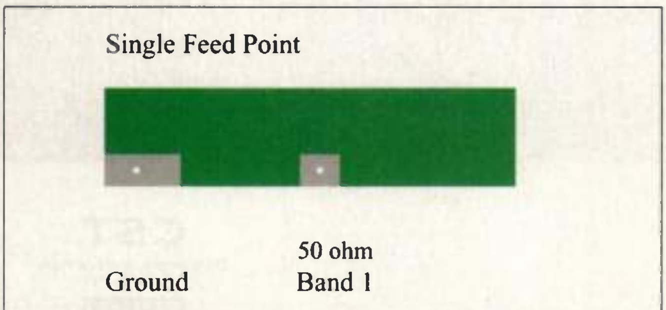
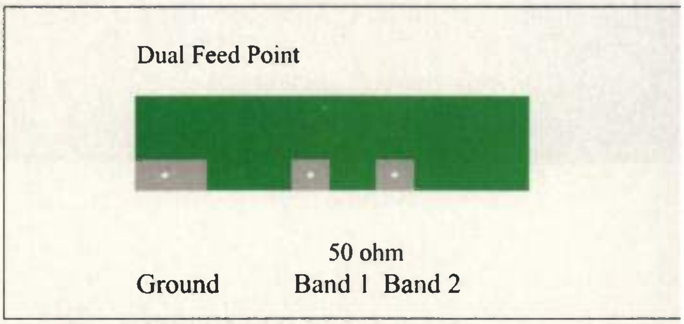


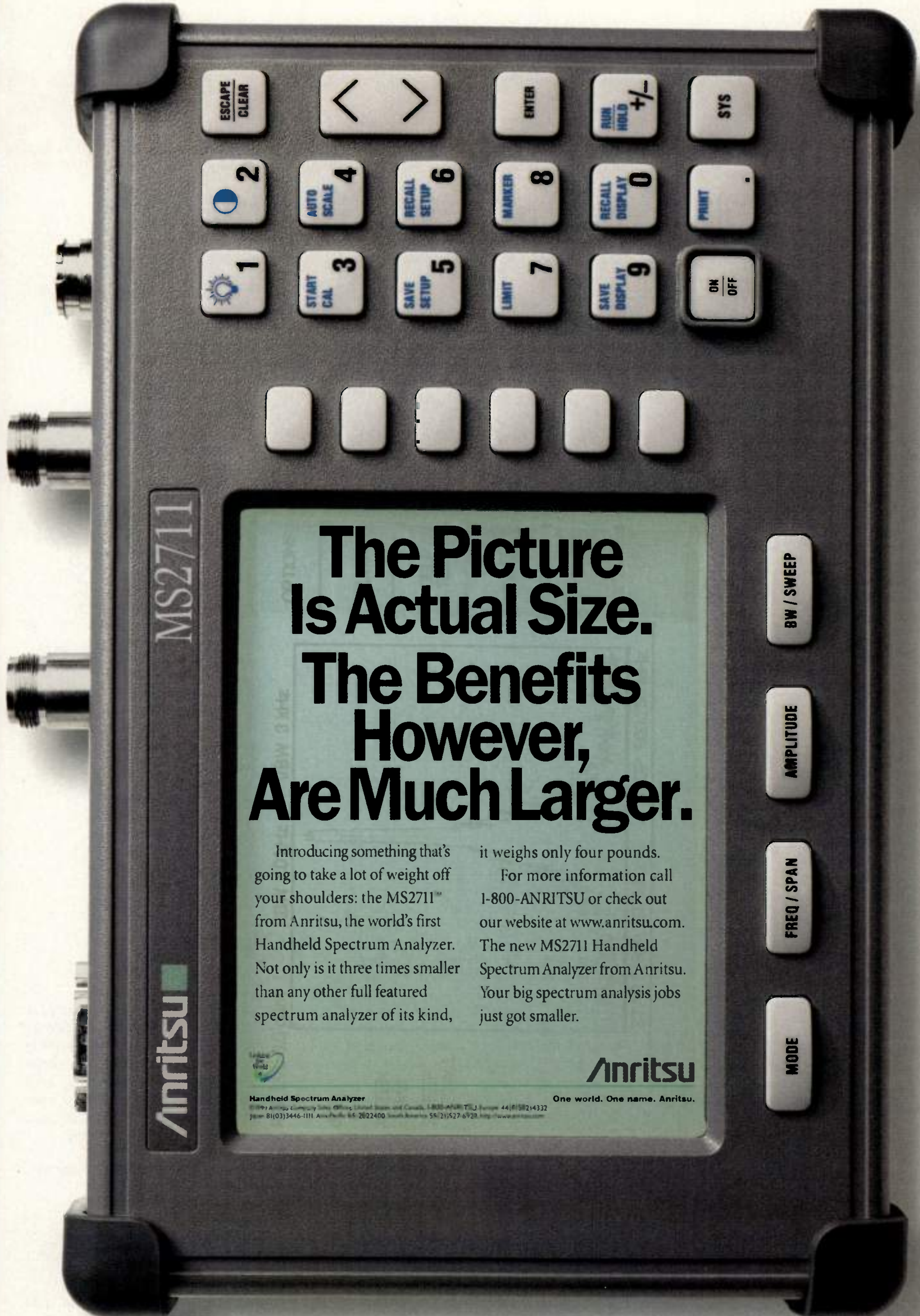
Chart of the overall antenna performance relative to the ground plane.



Single RF (feed) port design.



Dual RF (feed) port design.

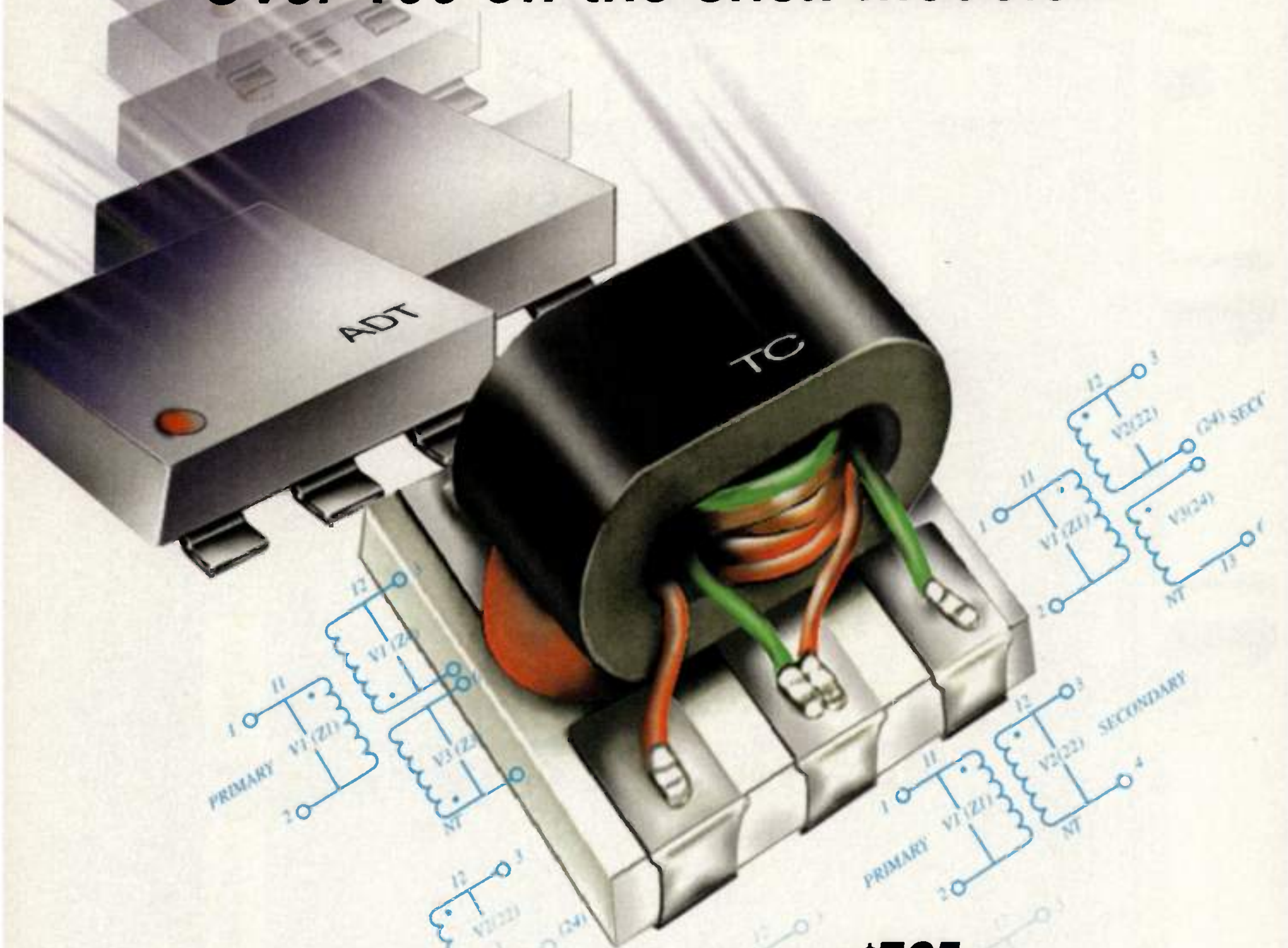

ESCAPE CLEAR
ENTER
RUN HOLD +/–
SYS
AUTO SCALE 4
RECALL SETUP 6
MARKER 8
RECALL DISPLAY 0
PRINT .
START CAL 3
SAVE SETUP 5
LIMIT 7
SAVE DISPLAY 9
ON OFF
MS2711
Anritsu
BW / SWEEP
AMPLITUDE
FREQ / SPAN
MODE
The Picture Is Actual Size. The Benefits However, Are Much Larger.
Introducing something that's going to take a lot of weight off your shoulders: the MS2711™ from Anritsu, the world's first Handheld Spectrum Analyzer. Not only is it three times smaller than any other full featured spectrum analyzer of its kind, it weighs only four pounds.
For more information call 1-800-ANRITSU or check out our website at www.anritsu.com. The new MS2711 Handheld Spectrum Analyzer from Anritsu. Your big spectrum analysis jobs just got smaller.
Anritsu
Handheld Spectrum Analyzer
One world. One name. Anritsu.

INFO/CARD 14

SURFACE MOUNT

RF TRANSFORMERS

Over 100 off-the-shelf models...



4kHz to 2200MHz from $1.95 ea. (qty.1-9)

What makes Mini-Circuits your single source for surface mount RF transformers? Variety, availability, performance, and price! From wide band transformers with low droop and fast risetime capabilities for pulse applications, to a particular impedance ratio from 1:1 through 1:36 specified for a wide range of impedance coverage, we will work with you on your design challenges. Tangible benefits such as very high dielectric breakdown voltage, excellent amplitude and phase unbalance for balanced to unbalanced applications, and easy to use surface mount package styles make Mini-Circuits surface mount transformers a great value. Our new ADT transformers are changing the face of RF transformer design with patent pending *it*™ Innovative Technology delivering small size, low cost, and better performance. This same leading edge transformer expertise can also develop your custom designs at catalog prices. So, simplify your transformer search...Big Time! Capitalize on the quality, design know-how, and off-the-shelf variety from Mini-Circuits. Call today!

Mini-Circuits...we're redefining what VALUE is all about!

Mini-Circuits®

US 30 INT'L 31
CIRCLE READER SERVICE CARD

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718)332-4661 *INTERNET* http://www.minicircuits.com

For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE • EEM • MICROWAVE PRODUCT DATA DIRECTORY • WWW.RFGLOBALNET.COM

ISO 9001 CERTIFIED

F 290 Rev Orig

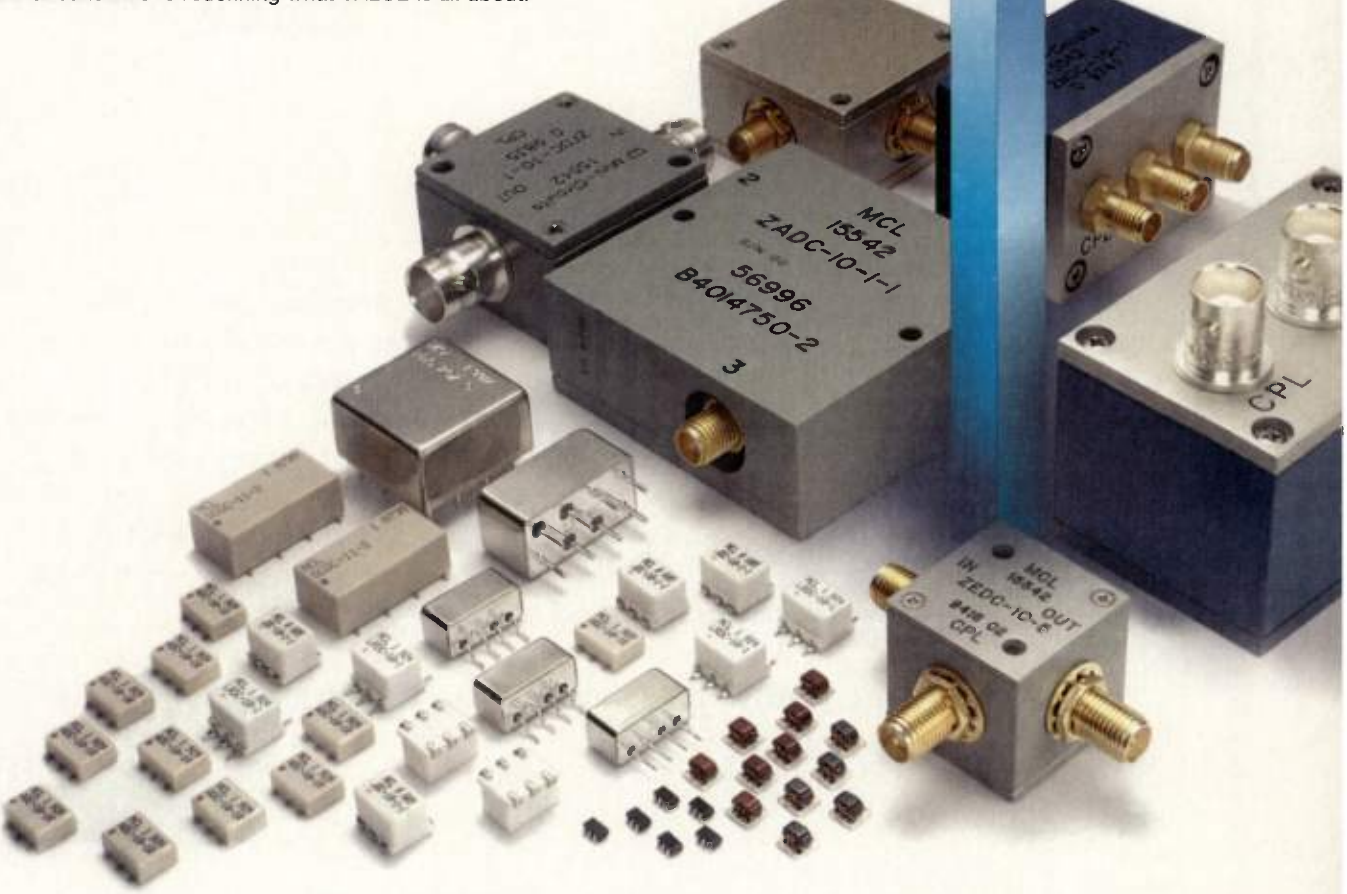
broadband directional couplers

10kHz to 2600MHz 6 to 30dB

from 99¢

Achieve accurate power sampling with high directivity and very little insertion loss using Mini-Circuits surface mount, plug-in, and coaxial directional couplers. Finding the right model for your design layouts is easy with our large, off-the-shelf selection of over 100 models in 6 to 30dB coupling ratios. Choose from broadband 50 and 75 ohm couplers capable of handling input power as high as 25 watts. High performance bi-directional couplers for monitoring forward and reflected power up to 10W are available as well. Now, highly accurate power sampling and value pricing have merged! The result...Mini-Circuits broadband directional couplers. To order, contact Mini-Circuits today!

Mini-Circuits...we're redefining what VALUE is all about!



Mini-Circuits®

US 32 INT'L 33
CIRCLE READER SERVICE CARD

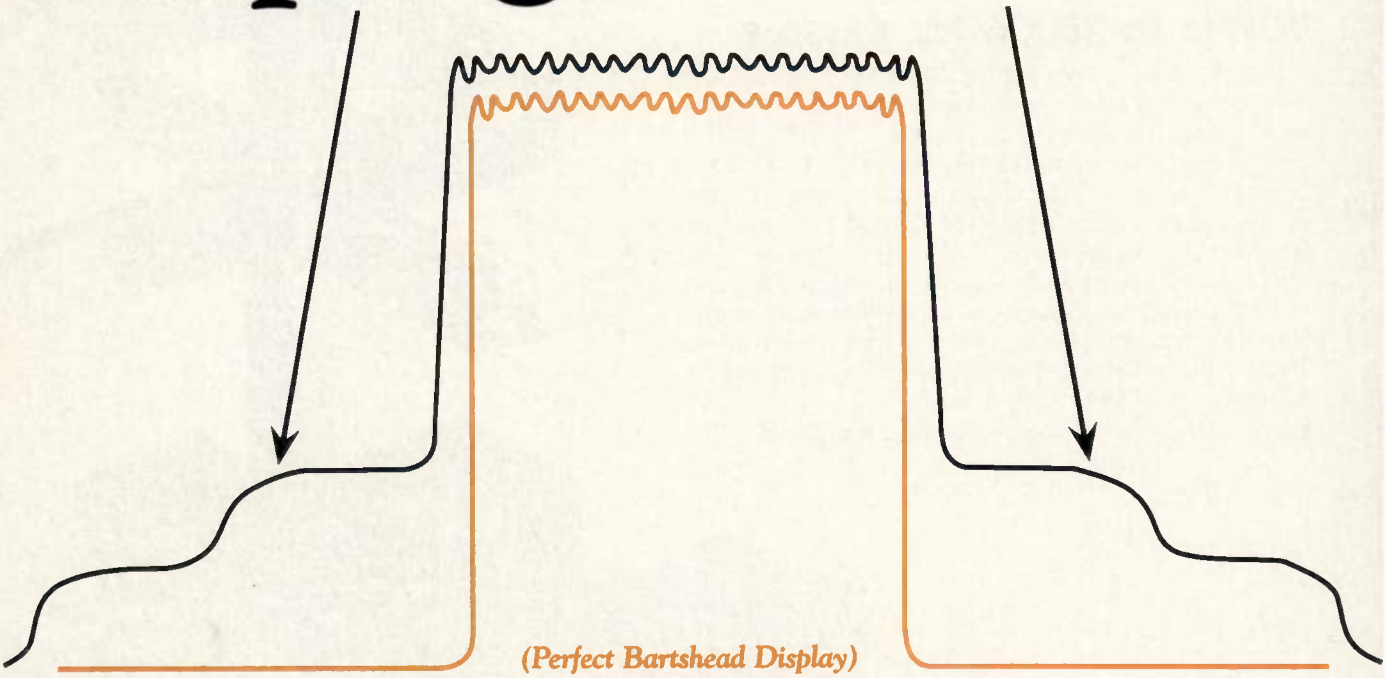
P.O.Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: **http://www.minicircuits.com**

ISO 9001 CERTIFIED

F 309 Rev. Org.

Danger. Sloping Shoulders.



Spectral growth can compromise the most precise CDMA technologies. Often, the difficulty lies in the transmission equipment, a potent source of distortion or the "shoulders" you see on your display. Now there are amplifiers that help you eliminate shoulders, keep the space between carriers narrow and optimize bandwidth.

AR "S" Series amplifiers are uniquely linear. Thanks to their exceptional design, CDMA signals get amplified but distortion stays low. You quickly pinpoint problems when testing your driver amp (or other transmission equipment) because you know the one place it's not coming from (the AR test amp).

"S" Series amplifiers offer a broad band that accommodates the 0.8 to 0.9 GHz, 1.85 to 1.99 GHz and 3.5 GHz frequencies used in wireless transmission. Plus spurious emissions and noise figures that are unusually low.

Email us for a copy of our new microwave brochure and specs at info@ar-amps.com.

www.ar-amps.com/@/rfd-shoulders

ISO 9001
Certified

Copyright© 1998 Amplifier Research. The orange stripe on AR products is Reg. U.S. Pat. & Tm. Off.

ar® AMPLIFIER® RESEARCH

The Force Behind The Field.

USA 215-723-8181 or 800-933-8181 for an applications engineer.
In Europe, call EMV– Munich: 89-614-1710 • London: 01908-566556 • Paris: 1-64-61-63-29 • Amsterdam: 31-172-423-000

INFO/CARD 83

nc346 series

nc5000 series

nc100-400 series

Broadband Precision Calibrated Noise Sources

- Designed for precision noise figure measurement applications.
- Available with coaxial or waveguide outputs.
- Noise figure meter compatible.

NC346 SERIES Standard Models		
MODEL	FREQUENCY RANGE	OUTPUT ENR
NC346A	0.01 GHz – 18 GHz	5 – 7 dB
NC346B	0.01 GHz – 18 GHz	14 – 16 dB
NC346E	0.01 GHz – 26.5 GHz	19 – 25 dB
NC346Ka	0.1 GHz – 40 GHz	10 – 17 dB
NC346V	0.1 GHz – 55 GHz	7 – 21 dB

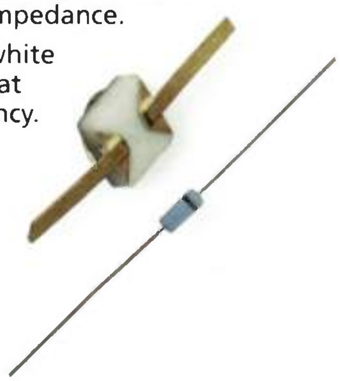
Broadband Calibrated Millimeter-wave Noise Sources

- Designed to replace cumbersome gas-tube noise sources.
- Provide stability, switching speed and ripple-free response over standard waveguide bands.
- Provide narrow or wideband performance with low or high output.
- Noise figure meter compatible.

NC5000 SERIES Standard Models		
MODEL	FREQUENCY RANGE	WAVEGUIDE
NC5142	18 GHz – 26.5 GHz	WR-42
NC5128	26.5 GHz – 40 GHz	WR-28
NC5122	33 GHz – 50 GHz	WR-22
NC5115	50 GHz – 75 GHz	WR-15
NC5110	75 GHz – 110 GHz	WR-10

Chips and Noise Diodes

- Designed for microwave applications requiring a 50-ohm impedance.
- Deliver symmetrical white Gaussian noise and flat output versus frequency.
- Available in a wide variety of package styles and special configurations.



NC100/200/300/400 SERIES Standard Models	
MODEL	FREQUENCY RANGE
NC104	0.1 Hz – 3 MHz
NC203	0.1 Hz – 100 MHz
NC302L	10 Hz – 3 GHz
NC303	10 Hz – 8 GHz
NC401	100 MHz – 18 GHz
NC406C	18 GHz – 110 GHz

Engineers rely on Noise Com components... every day, everywhere!

Around the globe, wireless systems manufacturers and service providers are getting reliable test results from Noise Com generators, noise sources and modules. Every day. For cellular, PCS, satellite, and radar test applications. Again and again, our components and instruments pass the only test that counts —*they deliver superb performance in the field.*

Choose the application, and there's a Noise Com solution to fit. Each backed by years of research and proven performance. And by the best technical service and support in the business.

Pictured here are just a few of our widely-acclaimed noise sources and generators. Want more details? Ask for our catalog, the *Designers' Guide to Broadband Noise Products.*

It's easy to reach us at Noise Com:

by phone: (201) 261-8797
by fax: (201) 261-8339
by e-mail: info@noisecom.com
or visit our Web site:
http://www.noisecom.com

NOISE/COM
East 64 Midland Avenue
Paramus, New Jersey 07652

nc500 series

nc2000 series

ufx7000 series

Every day, our noise components pass the toughest test there is.

Yours.

New!

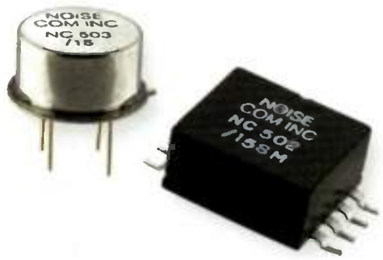
DESIGNERS' GUIDE TO BROADBAND NOISE PRODUCTS

Call Today 201-261-8797 or request it on our website www.noisecom.com

NOISE/COM

BITE Modules

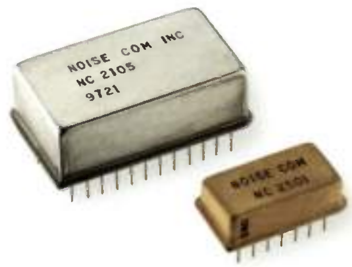
- Designed as an economical solution for built-in test requirements.
- Contain complete biasing networks; need no external components.
- Available in TO-8 cans and flat packs.



NC500 SERIES Standard Models		
MODEL	FREQUENCY RANGE	OUTPUT ENR
NC502/15	0.2 MHz – 1 GHz	31 dB
NC503/15	0.2 MHz – 2 GHz	31 dB
NC506/15	0.2 MHz – 5 GHz	31 dB
NC513/15	0.2 MHz – 2 GHz	51 dB

Broadband Amplified Noise Modules

- Designed for circuit board mounting.
- Provide a high-level noise output.
- Available in 24- and 14-pin packages.



NC2000 SERIES Standard Models		
MODEL	FREQUENCY RANGE	OUTPUT
NC2101	100 Hz – 20 kHz	0.15 Vrms
NC2105	500 Hz – 10 MHz	0.15 Vrms
NC2201	1 MHz – 100 MHz	+5 dBm
NC2601	1 MHz – 2 GHz	-5 dBm

Broadband Noise Generators

- Designed for easy operation.
- Feature dedicated control and programming keys; large 4 x 20 LCD display.
- Output power control, filter setting, and attenuator step size for noise and signal performed from front panel, or remotely using IEEE-488 interface.

UFX7000 SERIES Standard Models		
MODEL	FREQUENCY RANGE	OUTPUT POWE
UFX7107	100 Hz – 100 MHz	+13 dBm
UFX7108	100 Hz – 500 MHz	+10 dBm
UFX7112	1 MHz – 2 GHz	+0 dBm
UFX7218	2 GHz – 18 GHz	-20 dBm
UFX7911	5 MHz – 1 GHz	+30 dBm

IMS 2000 BOSTON

International Microwave Symposium

Boston, Massachusetts

IEEE Microwave Theory and Techniques Society

June 11–16, 2000

MARK YOUR CALENDAR NOW TO ATTEND THE

2000 IEEE MTT-S International Microwave Symposium & Exhibition
June 11–16, 2000
John B. Hynes Veterans Memorial Convention Center

Featuring Technical Sessions and Workshops for Wireless, Commercial and Military Applications.

- ICs for Wireless Communications
- Microwave Vehicular Technology
- CAD Design Methodology
- Power Devices and MMICs
- Wireless Communication Systems and Technologies
- Power Amplifiers for Wireless Applications
- Subsystems for Commercial Communications
- Biological Effects and Medical Applications
- Signal Generation, Frequency Conversion and Control Circuits
- Filters and Multiplexers
- Ferrite Components
- Guided Waves and Propagation Characteristics
- Transistor Power Amplification
- Nonlinear Modeling and Analysis
- Measurement Theory and Techniques
- High Power Sources and Control
- Low Noise Receivers
- Manufacturing, Production and Packaging
- Advances in Hybrid Technology
- Millimeter and Submillimeter Wave Technology
- Monolithic Technology
- Active and Quasi-optic Arrays
- Lightwave Technology and Techniques
- Superconductivity Technology
- Microwave Digital Processing
- Full Guest Program — Bring the Family!

In addition to the outstanding Symposium, visit the World's Largest Microwave Exhibition, featuring more than 400 industry innovators displaying their newest wireless and commercial products and services. Once again this year, industry representatives will be presenting application and marketing seminars on the exhibition floor which will be open to all attendees.

❑ Yes, I would like additional information on attending MTT-S '00. Please send it to:

Name ______________________ Title ______________________

Organization ______________________

Address ______________________

City ______________________ State ________ Zip Code ____________

Country ______________________ Telephone ______________________

Microwave Journal®, 685 Canton St., Norwood, MA 02062 ■ FAX: 781-769-5037

RFD

Access MTT-S On-Line at *Microwave Journal*® via http://www.mwjournal.com.

INFO/CARD 82

device smaller as the interaction between the two antenna elements is decreased.

Such an antenna design can operate within a single cellular/PCS band or operate simultaneously in a dual band environment as seen in Europe (900/1800MHz) and the United States (800/1900MHz). The key to operating simultaneously in two frequency bands is the selection of trace designs for two elements that are independent of one another. Current designs allow for either one or two RF feed points for dual band operation, with both solutions at 50 Ω impedance.

With the use of embedded antennas, no matching network components are required, and therefore the overall cost advantage of embedded antennas is significant. With the elimination of even single diplexers and any matching components, an embedded antenna more than reduces its application cost compared to an external antenna by 100 percent. *RF*

About the author

David McCartney is the Executive Vice President of RangeStar.

His responsibilities span product development, engineering, marketing and sales. A wireless industry veteran with more than two decades of experience, McCartney served most recently as vice president of marketing and sales for Bosch Telecom, where he guided the market introduction of the Bosch World 718, the first wireless phone to permit seamless international roaming. His career also includes tenures with Motorola and Ericsson, where he held management positions in marketing, sales, operations and international business development. McCartney received a BS degree from Iowa State University and a MBA degree from Lynchburg College. He can be reached at RangeStar's Web site—**www.rangestar.com** or email at *info@rangestar.com*

INFO/CARD 18 or visit **www.rfdesign.com**

Our idea of GaAs PHEMT consistency.

Agilent Technologies' Second Generation PHEMT process FETs and amplifiers are so consistent, you'd think we cloned them!

Introducing the first products in Agilent's Second Generation PHEMT process – a process designed specifically for repeatability and high performance. These new parts allow predictable designs, better yields and fewer surprises in your base station, handset or other wireless application.

In fact, we're so confident of their performance that we include distribution charts of key specifications right on the data sheets. An industry first.

Already designed into several major CDMA handsets, the MGA-72543 LNA's integral switch allows you to bypass the amplifier, reducing system current needs. The ATF-34143 FET with its low noise figure and excellent linearity at 4V, is perfect for base station LNA applications. The ATF-35143 FET offers economical low noise performance for portable applications.

Add it all up and you'd have a hard time finding a more consistent bunch of parts anywhere.

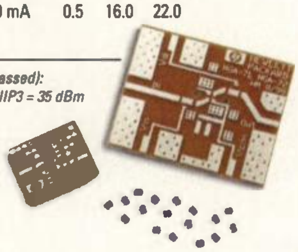
For more product information, technical literature, samples, demo boards and participating distributors, please visit our website.

www.agilent.com/view/consistent

Typical performance @ 2 GHz

Part Number	Bias	NF (dB)	Gain (dB)	IP3 (dBm)
MGA-72543* (input)	3V, 5-60 mA	1.5	14.4	3.5-14.8
ATF-34143 (output)	4V, 60 mA	0.5	17.5	31.5
ATF-35143 (output)	2V, 15 mA	0.4	18.0	21.0
ATF-38143 (output) *coming soon*	2V, 10 mA	0.5	16.0	22.0

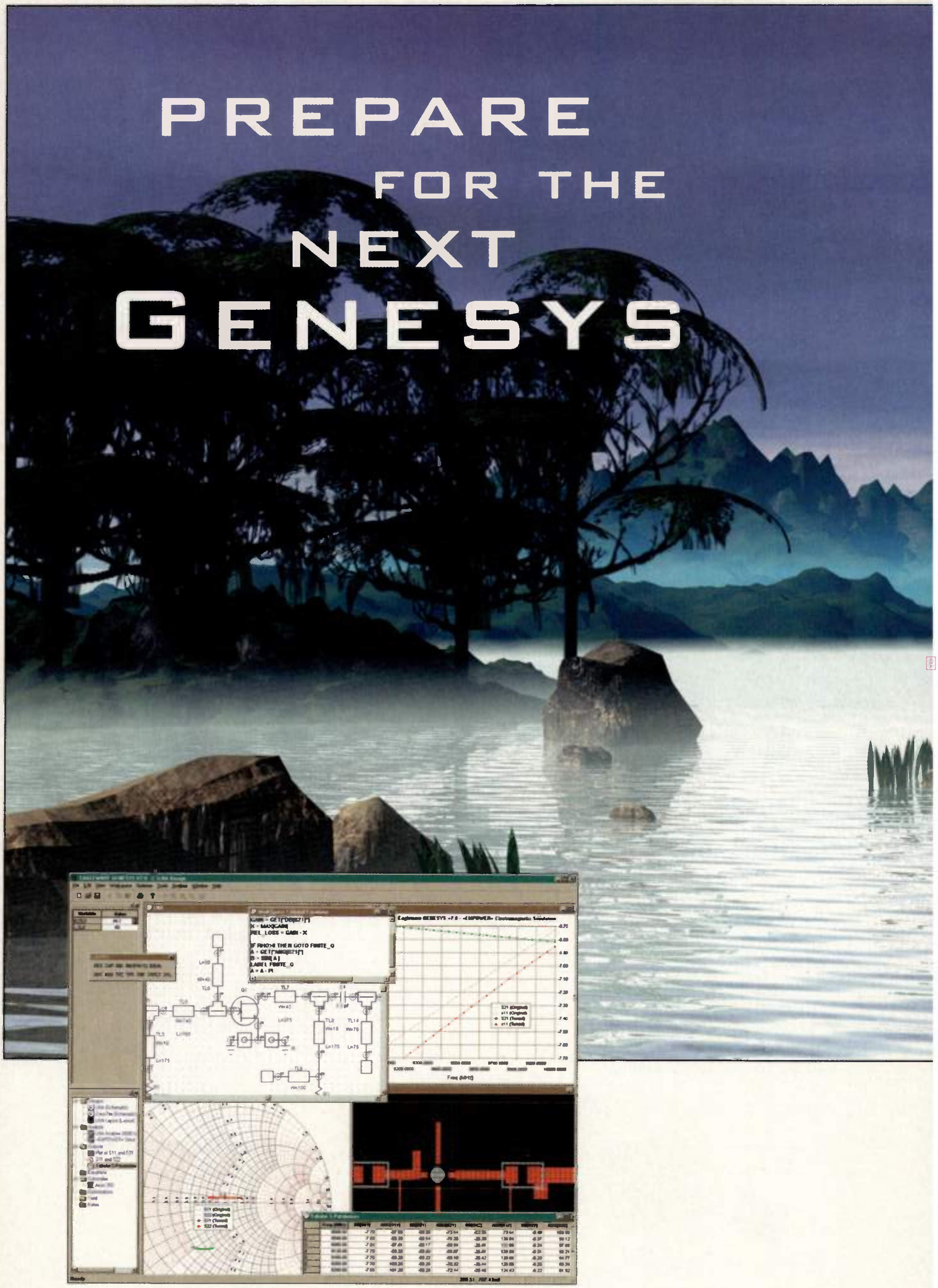
** as a switch (amp bypassed): insertion loss = 2.5 dB, IIP3 = 35 dBm*

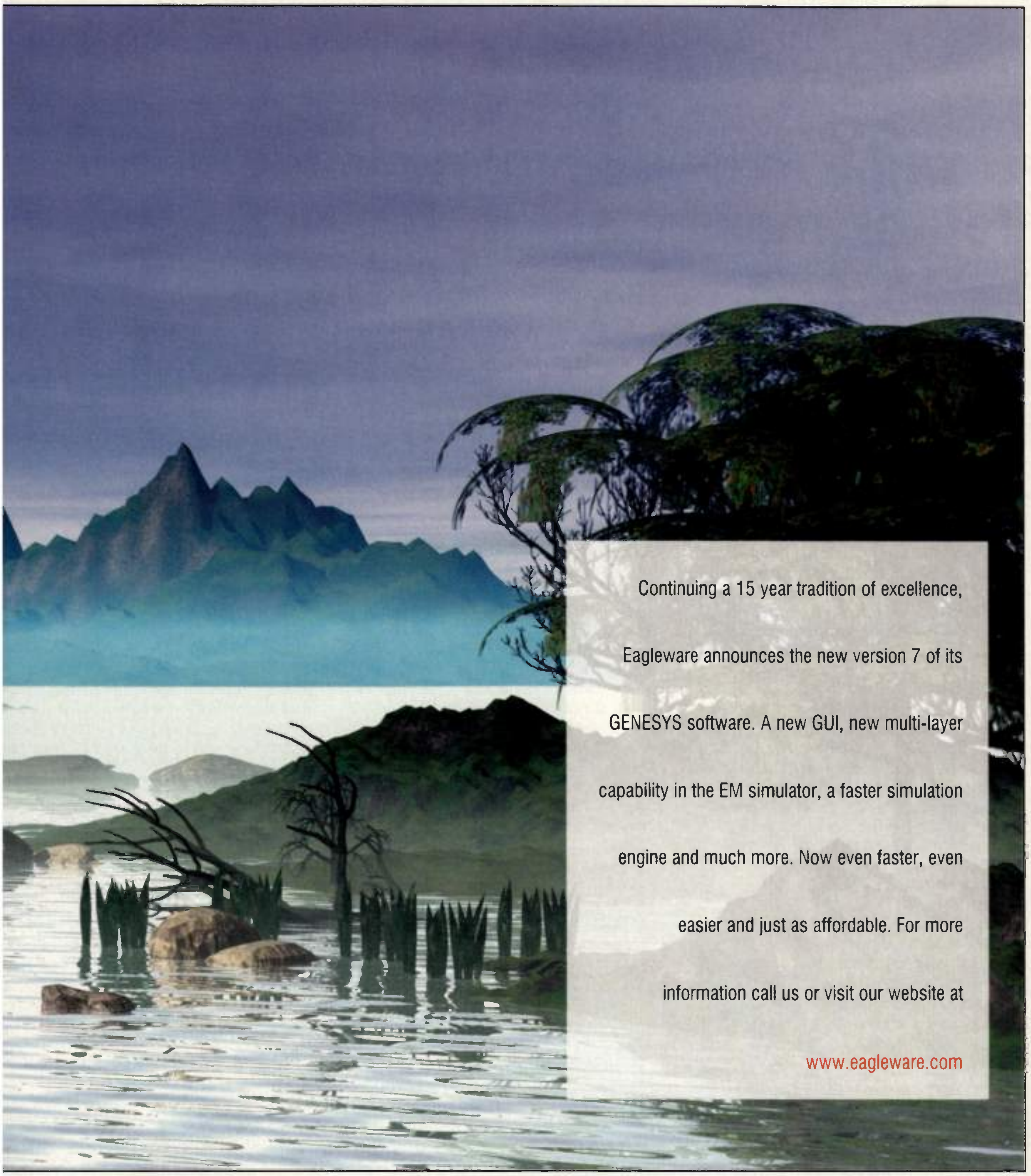


Agilent Technologies
Innovating the HP Way

INFO/CARD 20

PL47R-11/99


PREPARE
FOR THE
NEXT
GENESYS



fast, easy, affordable

EAGLEWARE

RF and Microwave Design Software

tel: 770.939.0156 | fax: 770.939.0157

INFO/CARD 86

Fixed wireless communications for the mass market

With an open market for many communications services, the current challenge is to offer a cost-effective package of services to both consumers and small businesses.

By Adel Ghanem, Ph.D.

Fixed wireless could provide the best opportunity for a competitive alternative to wireline communications services but so far has had a minimal impact. The obvious competitive "no-brainer" has become an implementation and success story "no-gainer."

A closer look at the reasons why suggests the opportunity has not passed us by. We've merely been focusing attentions on selling solutions destined for mediocre success—and/or failure—from the start.

It's time to take advantage of the lessons learned from past successes and failures. By concentrating efforts on sound RF principles, innovative technology, efficient design and pro-competitive public policy and regulations, we can provide fixed wireless solutions that offer an economic and competitive alternative to everything the wireline public network has to offer—voice, data, even video

What's needed

First and foremost, a competitive fixed wireless offering needs to be focused on the mass market as opposed to the current focus on the high-end, large business users. A solution that isn't designed with the residential and small office home office (SOHO) market in mind at the outset is less likely to be an economic alternative in hindsight.

There is no lack of telecommunications alternatives for high-end business customers. And as these solutions—wireline and wireless—become more and more competitive, they could become economic options for medium-size businesses. But they will likely never become an economic alternative for the residential and SOHO markets. From the capacity, functionality, and ease of installation points of view, they weren't designed with those customers in mind—a major distinction.

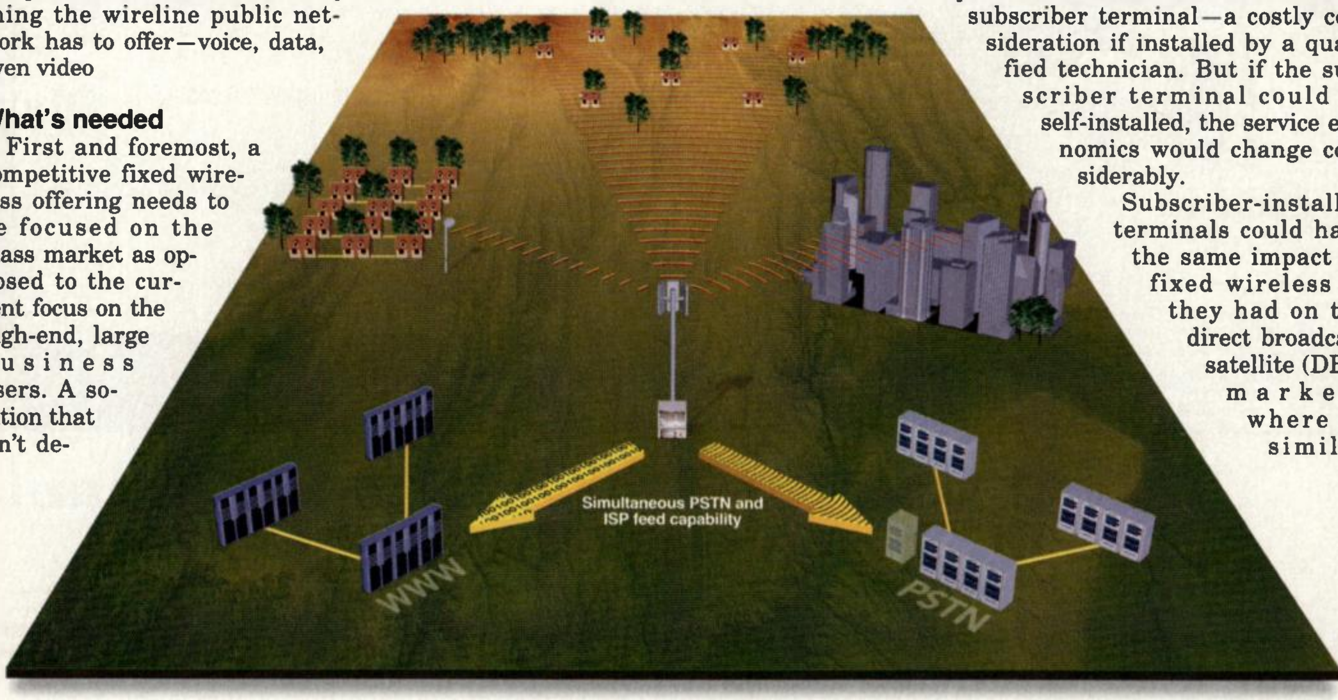
The economics of the mass market are all about cost and price. This isn't a new or major revelation. Cellular and personal communications system (PCS) carriers have proven that we sell a lot more wireless service with free or $49 phones than with $249 or $1,499 phones.

But it's a well known fact that ce lular networks and service weren't, in tially, designed for the mass marke Actually, cellular was once viewed a having very limited market potentia It is a good example of a technology ap plication which found/developed a siz able market and continues to reinver itself to become more acceptable and a fordable to a wider audience.

Fixed wireless solutions, designe for the mass market, need special a tention paid to technologies and spec fications that allow cost effective ne works to be built. PCS carriers helpe drive efforts to incorporate cost-savin technologies into their networks be cause without a lower operating cost- and corresponding lower overall se vice costs—there was little hope c attracting customers away from ce lular.

Fixed wireless networks preser similar challenges and bigger opportu nities. By definition, fixed wireless re quires the installation of a "fixed subscriber terminal—a costly cor sideration if installed by a qual fied technician. But if the sub scriber terminal could b self-installed, the service eco nomics would change cor siderably.

Subscriber-installe terminals could hav the same impact o fixed wireless a they had on th direct broadcas satellite (DBS market where simila



Can this be tomorow's fixed wireless landscape?

NEW ERA AMPLIFIERS

WOW! DC to 8GHz (up to +18.5dBm output)

From $1.19 (1000 qty.)

Mini-Circuits ushers-in a new era of technology and economy with ERA monolithic GaAs amplifiers. Just check the specs! These surface mount and drop-in amplifiers cover your applications to 8GHz with higher gain, more output, and flatter response. Characterized with S-parameter data, these amplifiers are very easy to use. Simply sketch an interconnect layout, and the design is done. And ERA's are engineered with wider bandwidths to eliminate your need for costly compensation networks and extra gain stages. So, review your present design and replace with Mini-Circuits new ERA technology. Lower overall cost, wide bandwidth, and lots to...*gain!*

Mini-Circuits...we're redefining what VALUE is all about!

Model	*Freq. (MHz)	Gain (dB)	Max. Power Out (dBm, @ 1dB Comp)	Dynamic Range NF(dB)	Dynamic Range IP3(dBm)	@Device Current(mA)	①Price $ ea. (10 Qty.)
ERA-1	DC-8000	11.8	11.7	5.3	26.0	40	1.80
ERA-1SM	DC-8000	11.8	11.3	5.5	26.0	40	1.85
ERA-2	DC-6000	15.6	12.8	4.7	26.0	40	1.95
ERA-2SM	DC-6000	15.2	12.4	4.6	26.0	40	2.00
ERA-3	DC-3000	20.8	12.1	3.8	23.0	35	2.10
ERA-3SM	DC-3000	20.2	11.5	3.8	23.0	35	2.15
ERA-4	DC-4000	13.5	▲17.0	5.5	▲32.5	65	4.15
ERA-4SM	DC-4000	13.5	▲16.8	5.2	▲33.0	65	4.20
ERA-5	DC-4000	18.8	▲18.4	4.5	▲33.0	65	4.15
ERA-5SM	DC-4000	18.5	▲18.4	4.3	▲32.5	65	4.20
ERA-6	DC-4000	11.3	▲18.5	8.4	▲36.5	70	4.15
ERA-6SM	DC-4000	11.3	▲17.9	8.4	▲36.0	70	4.20

Note: Specs typical at 2GHz, 25°C. Exception: ▲ indicates typ. numbers tested at 1GHz.
* Low frequency cutoff determined by external coupling capacitors.
① Price (ea.) Qty.1000: ERA-1 $1.19, -2 $1.33, -3 $1.48, -4, -5 or -6 $2.95. SM option same price.

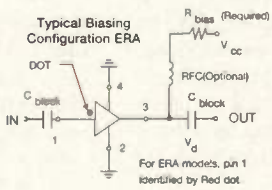
DESIGNER'S AMPLIFIER KITS:
K1-ERA: 10 of each ERA-1,-2,-3 (30 pieces) only $49.95
K1-ERASM: 10 of each ERA-1SM,-2SM,-3SM (30 pieces) only $49.95
K2-ERA: 10 of each ERA-4,-5 (20 pieces) only $69.95
K2-ERASM: 10 each ERA-4SM,-5SM (20 pieces) only $69.95
K3-ERASM: 10 each ERA-4SM,-5SM,-6SM (30 pieces) only $99.95

Chip Coupling Capacitors at 12¢ each (50 min.)

Size (mils)	Value
80x50	10, 22, 47, 68, 100, 220, 470, 680, 1000, 2200, 4700, 6800, 10,000 pf
120x60	.002, .047, .068, .1 µf

ACTUAL SIZE

Typical Biasing Configuration ERA



Free User Guide!
Packed with comprehensive technical support. Shipped with order, or call for your free copy today.

Mini-Circuits®

US 38 INT'L 39
CIRCLE READER SERVICE CARD

P.O Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718)332-4661 *INTERNET* http://www.minicircuits.com
For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE • EEM • MICROWAVE PRODUCT DATA DIRECTORY • WWW.RFGLOBALNET.COM

ISO 9001 *CERTIFIED*

F 214 Rev F

problem existed. Initially, special technicians were required for all satellite installations, which delayed the overall service penetration. The solution to this dilemma was a self-installation kit and a bit of innovative technology.

Today, the self-directing installation kit guides the subscriber through the process. A signal at the set-top receiver tells them when the satellite dish is positioned properly for the strongest signal strength. By removing a major implementation cost and hurdle, the service is applicable and appealing to a wider audience, while improving the overall economics of the business plan

All of the above-described factors play a role today in fixed wireless implementations. And they further suggest what else needs to change. Meeting these conditions for economic, competitive, self-installed fixed wireless equipment and services suggests efforts should be concentrated on finding solutions that operate in lower, rather than higher, frequency bands—counter to all existing efforts to date.

Wireless systems operating in lower frequency bands reduce the point-to-point or line-of-sight requirements, making self-installation possible and eliminating a major cost and implementation hurdle. And that factor alone will have a major impact on the economics of fixed wireless infrastructure and implementations.

Furthermore, the availability of spectrum in the lower or sub-2.5 GHz frequency bands suggests other RF technologies, such as time-division duplexing (TDD), must be considered for fixed wireless applications. Lower frequencies allow for a less complex RF solution and TDD implementations worldwide have proven efficient, cost-effective and viable for mass-market applications.

Fixed wireless systems based on TDD technology and operating in sub-2.5 GHz offer the best opportunity for a cost-effective, competitive alternative to wireline telecommunications services. And competitive service providers—wireless or wireline—should concentrate efforts on seeing these solutions are given a fair opportunity to be brought to market.

The search for higher ground: an historical perspective

Prior to the Telecommunications Act of 1996 there wasn't much emphasis on mass-market competitive local exchange services. And given the state-of-the-art in wireless technology, lower frequencies weren't a fixed wireless service option. It is difficult to say—from a chicken-and-egg perspective—which came first or mattered most, but both prevented serious consideration and development of cost-effective fixed wireless solutions.

The lack of competitive incentive prior to 1996 is perhaps easiest to explain. Although fixed wireless offers no-brainer status as a competitive local exchange alternative, there wasn't a carrier group particularly interested in pursuing the residential opportunity—wireless or wireline.

From 1992 on, most of the wireless attention was centered on PCS spectrum auctions and bringing competitive alternatives to the "cellular" duopoly. Mobility was key in every wireless business plan and although fixed wireless was not prohibited in any way, it did not reflect the interests of auction participants or the best perceived market opportunity for the available spectrum.

Likewise, in the same time frame on the wireline side, competitive local exchange carriers (CLECs) were still known as competitive access providers (CAPs). All their efforts were concentrated on constructing fiber optic rings and providing lower cost and reliable wireline telecommunications service alternatives for lucrative business customers. Residential and SOHO subscribers were not on the radar screen.

Cable TV companies expressed interest and "dabbled" in telecommunications trials but the complexities of providing high-reliability telephone services ran counter to their existing operations. So despite their interest in expanding the service offerings to their residential customer base, their existing cable plant prevented execution of the strategy.

With the only available lower frequency spectrum being "reserved" for mobility applications and a general lack of interest in competitive residential local exchange services, fixed wireless applications garnered very little service interest.

The impact of available wireless technologies factored into the fixed wireless development equation as well. At the time, most wireless equipment manufacturers developed solutions based on state-of-the-art frequency d vision duplexing (FDD) access scheme to support the needed high-speed m bility.

In contrast to TDD, FDD divides i transmission into transmit (upband and receive (downband) frequencie separated by a guard band of a specif size. The use of FDD for wireless appl cations was widely accepted and i many respects the defacto standard. I fact, the PCS spectrum allocations wer established with FDD duplexing i mind.

The selection of FDD by equipmen manufacturers for mobility application led to the same choice for fixed wir less. Despite the lack of interest withi the U.S., fixed wireless became a pr ferred solution for basic telecommun cations in many competitive offering worldwide, especially in underdeve oped regions. To compete for thes worldwide contracts, vendors needed t include fixed wireless systems in the product line. For obvious reasons c convenience and economies of scale equipment manufacturers develope fixed wireless solutions, from thei stable of available mobility solution that were already based on FDD tech nology.

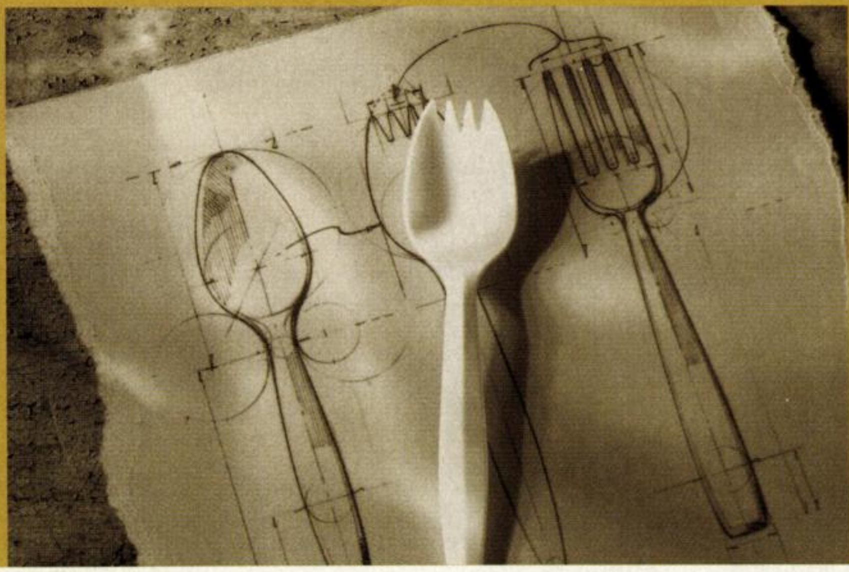
In turn, the use of FDD in produ offerings pushed fixed wireless appl cations into higher and higher fre quency bands where paired-bands ca still be allocated. The lack of larg blocks of spectrum—required fo FDD—in the U.S. and most of th world prevented consideration of lowe frequency applications.

This fluke of logic, convenienc and/or progression of events, is wh fixed wireless solutions have encour tered only mediocre success from th start. Fixed wireless developed into higher frequency wireless mobilit "adaptation" instead of a lower fre quency "designed for the masses" eff cient, economic alternative to wireline' hold on residential access.

Low frequency advantages

It's not that it isn't possible to cor struct an efficient, cost-effective fixe wireless system at higher frequencies But given the alternative of lowe versus higher frequency solutions wh wouldn't choose sub-2.5 GHz?

Wireless technology gets better an more stable every day but some basi facts and laws of physics will neve change. A rainstorm still wipes ou



Every once in a while someone comes along with the perfect combination. When you're testing 2G and 3G products, you can't afford to choose between accuracy and speed. But most of the time, that's exactly what you're forced to do.

We've got the perfect solution. The Agilent Technologies E4406A Vector Signal Analyzer. We designed the E4406A specifically for the manufacturing test needs of 2G and 3G base stations and components. It has unmatched test speed—up to 5 times faster than the competition. Amplitude accuracy of .5dB for critical measurements. And pre-configured measurements for faster setup than traditional spectrum analyzers. So you get all the speed you want. Along with all the accuracy you need. And that's a combination you don't see very often.

Agilent Technologies' E4406A Vector Signal Analyzer

For more information about our E4406A VSA, or to get a FREE copy of *Performing cdma2000 Measurements Today*, visit our web site. Or call us at the number listed below. Because whether it's today's formats or formats of the future, you still have to be perfect.

www.agilent.com/find/vsa

1-800-452-4844*, Ext. 6937

Agilent Technologies
Innovating the HP Way

©2000 Agilent Technologies. ADEP3466011/RFD *In Canada, call 1-877-894-4414, Ext.6937.

INFO/CARD 21

wireless transmission at 24 GHz and even a simple rainy day can block signals at 3 GHz.

Even foliage and building obstructions have a greater impact at higher frequencies. For example, a 3.6 GHz fixed wireless installation in Poland worked perfectly following its fall installation but ground to a halt in spring. The strange phenomenon design engineers failed to account for was the annual reappearance of tree leaves.

At lower frequencies, Mother Nature would not have had an impact. And while design options include raising antennas to "see" over the trees, trees will continue to grow and the problem will likely reoccur.

Urban fixed wireless deployments can be even more disconcerting. Building heights and other obstructions force the use of sophisticated modeling tools and experienced technicians for mapping and installation on a sight-by-sight basis. Certainly not an economic, low-cost alternative.

In-building penetration could also benefit from lower frequency transmission and impact fixed wireless applications. Who hasn't noticed the difference between in-building penetration of cellular and PCS frequencies in the U.S.? Because of its sub 1.0 GHz frequency, cellular exhibits greater in-building penetration when compared to PCS at 1.9 GHz. Even in the middle of a building you will likely receive a cellular call, whereas PCS transmission in the lobby of many high-rise buildings gets dicey. Now consider the implications of these same frequencies on fixed wireless where you don't have the option of "walking" the antenna for better reception.

In fact, all wireless applications at high frequencies require line-of-sight transmission for optimal performance. This restriction alone can kill the economics of an urban or even suburban fixed wireless application.

In contrast, lower frequencies don't require line-of-sight, nor is it necessary to pinpoint antennas with laser-beam precision. Signals are more tolerant and can bend around and penetrate a wider range of structures. And imagine the impact on a fixed wireless business case if the subscriber terminal could be self-installed or placed within the home or business.

The business case drives all wireless ventures and the "numbers" have to work. Low frequency fixed wireless has a business case advantage in the overall cost of system equipment. For the same output power, the cell size is larger at lower frequencies, requiring fewer base stations and reducing infrastructure costs.

For example, a fixed wireless application in a sub-2.5 GHz frequency provides a cell size range of 15-25 km. With that coverage, many urban and suburban applications could be handled with a single cell and base station.

In contrast, at higher frequencies the laws of physics shrink the cell radius and coverage for the same system output power. It forces operating in a micro rather than macro cellular environment with corresponding effects on design, equipment costs and ease of installation. Not to mention that high-frequency transceivers are just more complex and require greater attention to detail.

In totality, the combination of all these factors suggest lower frequencies are the economic choice for fixed wireless applications if providers are serious about providing a "competitive" alternative to wireline.

Enter TDD

Yet, that assertion contains a Catch-22 of sorts. With the last sub-2.5 GHz spectrum going to PCS mobility applications there hasn't been sufficient lower frequency spectrum available.

Taken at face value, the assertion is true. There isn't sufficient lower frequency spectrum to accommodate fixed wireless or even other mobility applications—if FDD is the duplexing assumption.

That frequency quandary forced manufacturers, carriers, governments and regulators worldwide to search, select and set-aside spectrum blocks at higher frequencies for fixed wireless applications. But the logic behind the search for a frequency "home" that meets the needs and requirements of a particular wireless "technology" is counterintuitive. FDD isn't required or necessary for many fixed wireless applications.

Selecting wireless technologies and frequencies that maximize the economics and business case of a mass-market application should have been the thrust. And under those assumptions, time division duplexing in sub-2.5 GHz frequency bands is the logical choice.

For starters, TDD spectrum coul be squeezed into any available cor tiguous spectrum. Because the tran mission is time-slot, rather than fre quency-based, it requires a singl contiguous chunk of spectrum fo transmitting and receiving. Its "Ping Pong" transmission approach is ver effective for fixed applications an slow-speed mobility.

TDD transceivers are also signif cantly less complex and more cost effe tive than FDD transceivers on both th subscriber and base station side. Fo the base station, TDD eliminates th need for expensive duplexers. Wit subscriber equipment, the transceive is much simpler and more cost effectiv to implement.

One reason is TDD's channel reci procity. Because it uses the sam channel for transmitting and receiving channel characteristics seen at the bas station could be considered as identica to those of the subscriber unit. Thi channel reciprocity simplifies the TD equipment design considerably.

There have been past concerns abou TDD and its susceptibility to echo an difficulty with synchronization. But th industry and technology has evolved t ensure these concerns are no longe valid. Proper system design and tech nology innovations have significantl reduced the potential of echo in eve the longest TDD links. Further, wit global positioning satellite (GPS) tech nology, all cells can be synchronized t the same clock, guaranteeing the syn chronization between the transmit an receive time slots in all adjacent cells thereby eliminating possible inter-cel interference.

The only remaining concern sur rounding TDD technology is that i hasn't received sufficient market atten tion as a competitive fixed wireless al ternative. It's not that there aren't suc cessful TDD implementation worldwide. In fact, TDD success storie include wireless PBX technologies (lik personal handiphone systems {PHS} i Japan, digital european cordless tele phone {DECT} in Europe) and a number of fixed wireless advance code-division multiple access (A CDMA)[1] implementations around th world. By design, PHS and DECT tak a micro-cellular approach while A CDMA offers the wide-area and high capacity coverage of a macro-cellula design.

INNOVATIVE MIXERS

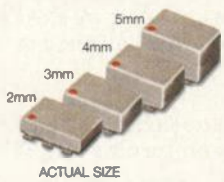
.smaller size .better performance .lower cost

50kHz to 4200MHz

WOW! from $1.99 (10-49)

it™ innovative technology

Searching high and low for a better frequency mixer? Then take a closer look at the Innovative Technology built into Mini-Circuits ADE mixers. ***Smaller size*** is achieved using an ultra-slim, patent pending package with a profile as low as 0.080 inches (2mm) in height. Electrically, ADE mixers deliver ***better performance*** than previous generation mixers through all welded connections and unique assembly construction which reduces parasitic inductance. The result is dramatically improved high frequency and IP2-IP3 performance. Plus, ADE's innovative package design allows water wash to drain and eliminates the possibility of residue entrapment. Another ADE high point is the ***lower cost***...priced from only $1.99 each (qty.10-49). So, if you've been searching high and low for a mixer to exceed expectations...ADE is *it*™



ADE Mixers...Innovations Without Traditional Limitations!

ADE* TYPICAL SPECIFICATIONS:

Model	Height (mm)	Freq. (MHz)	LO (dBm)	Conv. Loss Midband (dB)	L-R Isol. Bandwide (dB)	IP3 (dBm) @ Midband	Price ($ea.) Qty. 10-49
ADE-1L	3	2-500	+3	5.2	55**	16	3.95
ADE-3L	4	0.2-400	+3	5.3	47**	10	4.25
ADE-1	4	0.5-500	+7	5.0	55••	15	1.99
ADE-1ASK	3	2-600	+7	5.3	50••	16	3.95
ADE-2ASK	3	1-1000	+7	5.4	45••	12	4.25
ADE-6	5	0.05-250	+7	4.6	40	10	4.95
ADE-12	2	50-1000	+7	7.0	35	17	2.95
ADE-4	3	200-1000	+7	6.8	53**	15	4.25
ADE-14	2	800-1000	+7	7.4	32	17	3.25
ADE-901	3	800-1000	+7	5.9	32	13	2.95
ADE-5	3	5-1500	+7	6.6	40••	15	3.45
ADE-13	2	50-1600	+7	8.1	40••	11	3.10
ADE-20	3	1500-2000	+7	5.4	31	14	4.95
ADE-18	3	1700-2500	+7	4.9	27	10	3.45
ADE-3GL	2	2100-2600	+7	6.0	34	17	4.95
ADE-3G	3	2300-2700	+7	5.6	36	13	3.45
ADE-28	3	1500-2800	+7	5.1	30	8	5.95
ADE-30	3	200-3000	+7	4.5	35	14	6.95
ADE-32	3	2500-3200	+7	5.4	29	15	6.95
ADE-35	3	1600-3500	+7	6.3	25	11	4.95
ADE-18W	3	1750-3500	+7	5.4	33	11	3.95
ADE-30W	3	300-4000	+7	6.8	35	12	8.95
ADE-1LH	4	0.5-500	+10	5.0	55••	15	2.99
ADE-1LHW	3	2-750	+10	5.3	52••	15	4.95
ADE-1MH	3	2-500	+13	5.2	50••	17	5.95
ADE-1MHW	4	0.5-600	+13	5.2	53••	17	6.45
ADE-12MH	3	10-1200	+13	6.3	45••	22	6.45
ADE-25MH	3	5-2500	+13	6.9	34••	18	6.95
ADE-35MH	3	5-3500	+13	6.9	33••	18	9.95
ADE-42MH	3	5-4200	+13	7.5	29••	17	14.95
ADE-1H	4	0.5-500	+17	5.3	52••	23	4.95
ADE-10H	3	400-1000	+17	7.0	39	30	7.95
ADE-12H	3	500-1200	+17	6.7	34	28	8.95
ADE-17H	3	100-1700	+17	7.2	36	25	8.95
ADE-20H	3	1500-2000	+17	5.2	29	24	8.95

Component mounting area on customer PC board is 0.320"x 0.290".
••Specified midband. **Patent Pending.*

Mini-Circuits®

US INT'L
CIRCLE READER SERVICE CARD

P.O.Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

YONI™ ***The Design Engineers Search Engine*** *Provides ACTUAL Data Instantly From MINI-CIRCUITS At: http://www.minicircuits.com*

ISO 9001 CERTIFIED

F 267 Rev J

The encouraging fact is that TDD can offer an efficient, cost-effective infrastructure alternative for competitive fixed wireless applications targeted at a mass market—if lower frequencies can be made available.

What needs to happen

The challenge of finding lower-frequency available spectrum isn't as large an "if" as it might first appear. But there are a number of factors needing sufficient attention to bring lower frequency fixed wireless TDD applications to market.

First and foremost we need to generate more serious attention to providing a competitive alternative to incumbent local exchange carrier (ILEC) telecommunications services. And that attention should be concentrated on encouraging fixed wireless applications.

Regional bell operating companies (RBOCs) are slowly being allowed into the long distance market because local exchange competition "exists." But that competition is hardly ubiquitous and there are really no serious alternatives available for the mass-market residential customer aside from using the RBOCs own outside plant facilities.

AT&T has switched local exchange access strategies a number of times from the wireless "Project Angel" to a $100 billion gamble on cable TV infrastructure. Apparently it is "serious" about local exchange alternatives, but hasn't yet hit on a killer, cost-effective strategy (perhaps we should take another look at recently announced fixed wireless products using newly developed CDMA/TDD technologies).

Making lower frequency fixed wireless TDD applications a possibility requires cooperation from the FCC and other regulatory bodies to ensure rules and regulations support rather than hinder the opportunity for a mass-market success story. That could include removing requirements that suggest, dictate or favor specific technologies, such as FDD. Taking a bold step and encouraging or specifying the use of TDD for specific spectrum allocations is another option.

Existing unintentional restrictions include mobile antenna output power requirements. Because mobile applications use omnidirectional antennas, output power is restricted to reduce radiation patterns and possible interference among the mobile units. But the same requirements aren't necessary for fixed wireless applications.

With fixed wireless using directional antennas, transmit power can remain high without creating the same interference problems. The results are increased link budgets, resulting in wider and better coverage for the same or reduced cost — a plus for cost-effective, mass-market implementations.

Eliminating the restriction could open up D, E and F allocations in the PCS bands for fixed wireless consideration. Many of these PCS auction winners have yet to deploy because the spectrum allocations are limited in size to support high capacity mobile networks. Rather than sit on valuable spectrum or introduce yet another risky mobile application, perhaps TDD-based fixed wireless deserves a second look.

Additional lower frequency spectrum is now available with more to come in the future. Examples include the upcoming 700 MHz auction of vacated television channel frequencies and spectrum in the 400 MHz range now used by analog services being phased out.

Recent moves by the FCC regarding the 700 MHz frequencies suggest more of an FDD slant. But while it is possible to construct a paired band out of the available 30 MHz to allow for FDD applications, using the band for TDD implementations eliminates the need for significant guard bands and hence increases the available spectrum for wireless communications services.

Lastly, a concerted effort by equipment manufacturers to explore and expand TDD options is warranted. Carriers have been "pushed" into higher frequency applications because FDD solutions are what wireless equipment manufacturers have had to offer.

The future

Wireless equipment vendors need to focus energies on turning out TDD applications that ensure the competitive success of a mass-market fixed wireless alternative to wireline. That translates to modular equipment configurations that offer a "pay as you grow" philosophy for prospective carriers without the deep pockets of an AT&T or MCI WorldComm.

Carriers can not depend on a "build it and they will come" wireless equipment mentality. As sure a bet as alternative residential and SOHO local exchange service may appear — considering the unmet demand for inexpensive, high-bandwidth Internet connections - carriers still need scalable solutions, providing cost-effective implementations and realistic returns for 100 or 100,000 subscribers.

These equipment, regulatory and competitive environment goals are attainable and the alternative of TDD-based fixed wireless access solutions is realistic. But the cycle of technology dictating wireless solutions needs to end.

Communications services for the mass-market require solutions designed to incorporate every frequency, wireless technology and implementation advantage possible. Lower frequency TDD fixed wireless applications are the real competitive opportunity. Adapting what's convenient and available should not be an option. RF

About the author

Adel Ghanem, Ph.D., has served as Adicom's President and Chief Executive Officer since December 1995. Prior to co-founding Adicom, Dr. Ghanem was vice president of technology development at TCSI corporation and the director of access systems with Southwestern Bell. Dr. Ghanem ha also worked at Pacific Bell, and L. M. Ericsson. Dr. Ghanem received a Ph.D. in Electrical and Computer Engineering from SUNY. Adicom is located at 26142 Eden Landing Road, A-1, Hayward, California, 94545. Tel. 510.781.5520. **www.adicomwireless.com**.

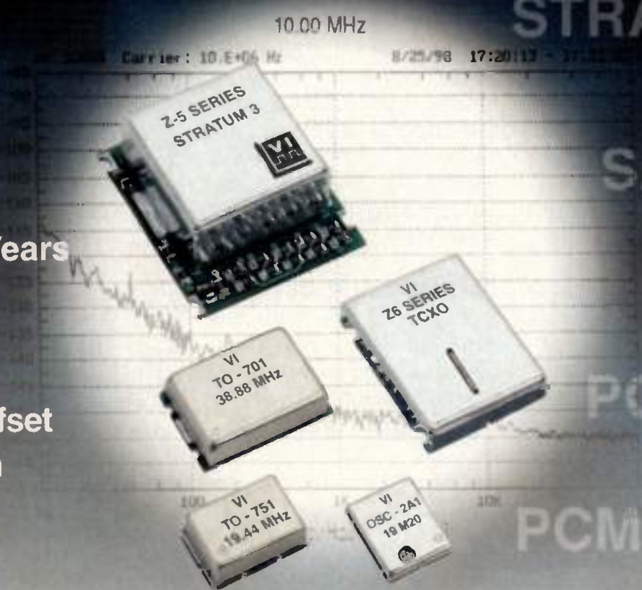
One

source

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

omplete Range
f TCXO's...

- Frequencies to 160 MHz
- Models From 2.5 ppm to 0.05 ppm
- Aging to 0.7 ppm for 10 Years
- Satcom TCXO's ±$1x10^{-7}$ 0°C to + 70°C
- Phase Noise as low as -155 dBc offset @ 1 KHz offset
- Low Power Consumption
- Small Size, Low Profile
- Surface Mount Designs



STRATUM 3
SONET/SDH
SATCOM
ROUTERS
PICO CELLS
PCS
GSM
GPS
PCMCIA

New Stratum 3 Design

We *are* the One!

VI VECTRON INTERNATIONAL
A DOVER TECHNOLOGIES COMPANY

166 Glover Avenue, Norwalk, CT 06856
Tel. 1-88-VECTRON-1 • Fax. 1-888-FAX-VECTRON
e-mail: vectron@vectron.com
www.tcxo.com www.vectron.com

INFO/CARD 22

3.7 Watt Ka-band power module for local multi-point distribution systems applications

Crowding of lower frequencies promise to open a host of Ka-band multipoin distribution applications and products.

By Carlton T. Creamer,
James J. Komiak,
Wendell Kong, P.C. Chao,
Kirby Nichols,
Christopher O'Neil,
Scott MacKelvey,
Paul D. Cooper
and Dana Wheeler

As demand for broadband data distribution increases and as lower frequency bands become saturated, communications providers are increasingly focusing on Ka-band for next generation terrestrial systems. A number of terrestrial wireless systems currently exist including local, multi-point distribution systems (LMDS) at frequencies of 27 to 30 GHz, and digital radio at 28 and 38 GHz. Considerable growth in these areas is projected. Designers of these systems require low cost solid state power amplifiers (SSPAs) as the output stages for radio transmitters. The moderate power requirements range from 1 to 5 W.

This article describes the design, fabrication and test of a 3.7 W, Ka-band high power module. These results were achieved using gallium arsenide pseudomorphic high-electron mobility transistors (GaAs pHEMT), monolithic microwave integrated circuit based (MMIC) power amplifiers designed and fabricated using 0.15 µm fully selective gate recess technology .

Approach

The LMDS module design exploits recent advances in Ka-band power MMIC amplifier design and fabrication. The newly developed chips include the power Amplifier MMIC and the driver Amplifier MMIC. [1].

The output periphery is 6.4 mm with a 3.2:1 2nd to 1st stage ratio (2 mm 1st stage).

The measured 3 dB compressed output power is > 34 dBm (> 33 dBm at 1 dB compression) with a dB associated power gain and a 25% power added efficiency at 30 GHz. From 28 to 33 GHz, the 3 dB compressed output power is > 32 dBm. The driver MMIC is a similar two-stage Class AB design with a 3.33:1 aspect ratio (600 µm driving 2 mm). Saturated 3 dB gain compression chip power averaged 28.0 dBm and 13 dB associated power gain at 30 GHz. From 28 to 33 GHz, the 3 dB compressed output power is > 25 dBm. The drain bias for the chip set is +4.5 volts (See figures 1 and 2.)

The third MMIC amplifier used as a simple gain block is a commercially available 26 to 40 GHz balanced LNA design (not shown).

LMDS module design

Figure 3 presents the module block diagram. The projected performance is summarized in the table below the figure. The major elements of the power modul design are the MMIC amplifiers, a tw way signal combiner and a package t

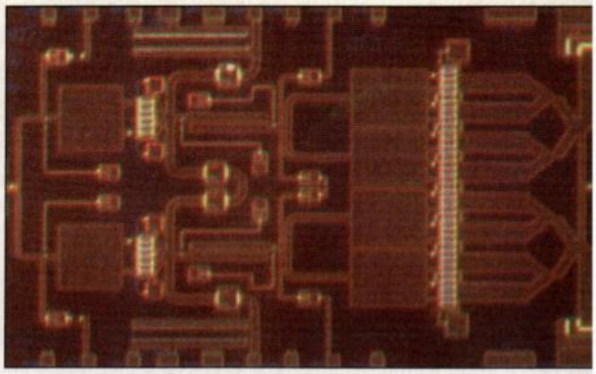


Figure 1. Two-stage output amplifier.

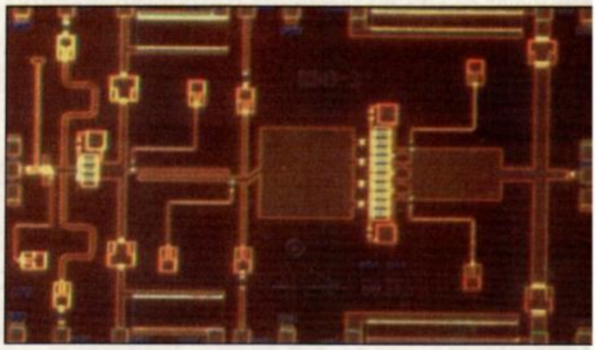
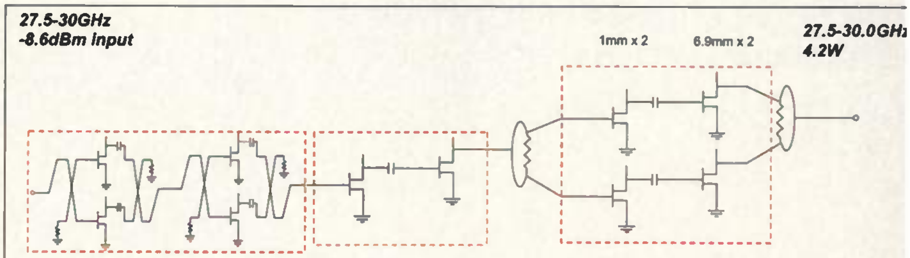


Figure 2. Two-stage driver amplifier.

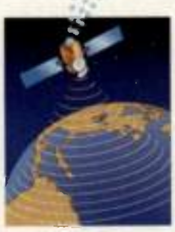


Description	Transition	Device	DA	Divider	PA	Combiner	Transition	Total
RF output power	–8.9	6.1	22.6	19.1	34.1	36.6	36.3	36.3
Gain	–0.3	15	16.5	–0.5	15	–0.5	–0.3	44.9
DC power		0.3	4.2		20			24.5

Figure 3. Block diagram of the Ka-band power amplifier and value table.

THE GLOBAL SOLUTION... AND BEYOND!

10MHz to 7GHz AMPLIFIERS from $99.95 (1-9 qty.)



From amateur radio to cellular to satellite applications, with medium output power up to 17dBm, Mini-Circuits versatile ZJL and ZKL connectorized amplifiers offer the broad range of choices designers demand for achieving high system performance goals. Ultra-wideband models deliver **gain ranging from 9 to 40dB** and IP3 up to +32dBm. But beyond the performance and reliability built into these miniature 12V amplifiers lies another important feature, the low price...from only $99.95! Call now for fast delivery.

Mini-Circuits...we're redefining what VALUE is all about!

SPECIFICATIONS

Model	Freq (MHz)	Gain (typ) Midband (dB)	Gain (typ) Flat (±dB)	Max. P_{out}[1] (dBm)	Dynamic Range (Typ @2GHz[2]) NF(dB)	Dynamic Range (Typ @2GHz[2]) IP3(dBm)	I(mA)[3]	Price $ea. (1-9)
ZJL-5G	20-5000	9.0	±0.55	15.0	8.5	32.0	80	129.95
ZJL-7G	20-7000	10.0	±1.0	8.0	5.0	24.0	50	99.95
ZJL-4G	20-4000	12.4	±0.25	13.5	5.5	30.5	75	129.95
ZJL-6G	20-6000	13.0	±1.6	9.0	4.5	24.0	50	114.95
ZJL-4HG	20-4000	17.0	±1.5	15.0	4.5	30.5	75	129.95
ZJL-3G	20-3000	19.0	±2.2	8.0	3.8	22.0	45	114.95
ZKL-2R7	10-2700	24.0	±0.7	13.0	5.0	30.0	120	149.95
ZKL-2R5	10-2500	30.0	±1.5	15.0	5.0	31.0	120	149.95
ZKL-2	10-2000	33.5	±1.0	15.0	4.0	31.0	120	149.95
ZKL-1R5	10-1500	40.0	±1.2	15.0	3.0	31.0	115	149.95

NOTES:
1. Typical at 1dB compression.
2. ZKL dynamic range specified at 1GHz.
3. All units at 12V DC.

ZJL ZKL

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718)332-4661 *INTERNET* http://www.minicircuits.com

US 36 INT'L 37
CIRCLE READER SERVICE CARD

For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE • EEM • MICROWAVE PRODUCT DATA DIRECTORY • WWW.RFGLOBALNET.COM

ISO 9001 CERTIFIED

F 232 Rev D

isolate the electronics from the operating environment and complete the thermal path. Solid state Ka-band amplifiers, that incorporate combining schemes, require low loss solutions in order to achieve the highest power levels while preserving DC to RF efficiency. A simple single section Wilkinson combiner realized as an MIC circuit fabricated on .010" Al_2O_3, was selected for this application. It provides efficient signal combining with adequate bandwidth. The design was initially analyzed using Libra and completed by performing a 2-dimensional EM simulation of the layout. The predicted insertion loss is < 0.5 dB.

Package design

A properly designed millimeter wave power amplifier package includes a light weight, hermetic mode free enclosure, a low loss transition from the microstrip environment inside the package to the user interface (in this case, coax), and DC bias and distribution circuitry. Materials are carefully selected to maintain low thermal impedance, and CTEs that match closely to the hybrid and MMIC components. We chose a light weight aluminum package and copper moly carriers, that screw into the housing floor, to provide low thermal impedance. The transition is a simple air-line design that mates to a glass to metal seal and V-connector. Low and high pass DC filtering circuits are incorporated as part of the power distribution. Resistive dividers are used to reduce gate bias supply to quiescent levels. Smaller resistance values are favored at the cost of slightly higher power consumption from the minus supply. This is done to minimize gate voltage variations under RF drive and helps to preserve overall module efficiency.

Integration and test results

Two modules were assembled and

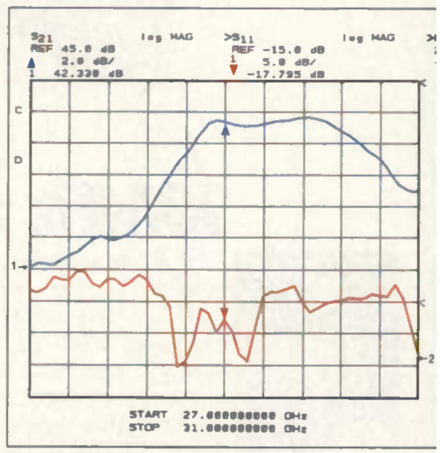
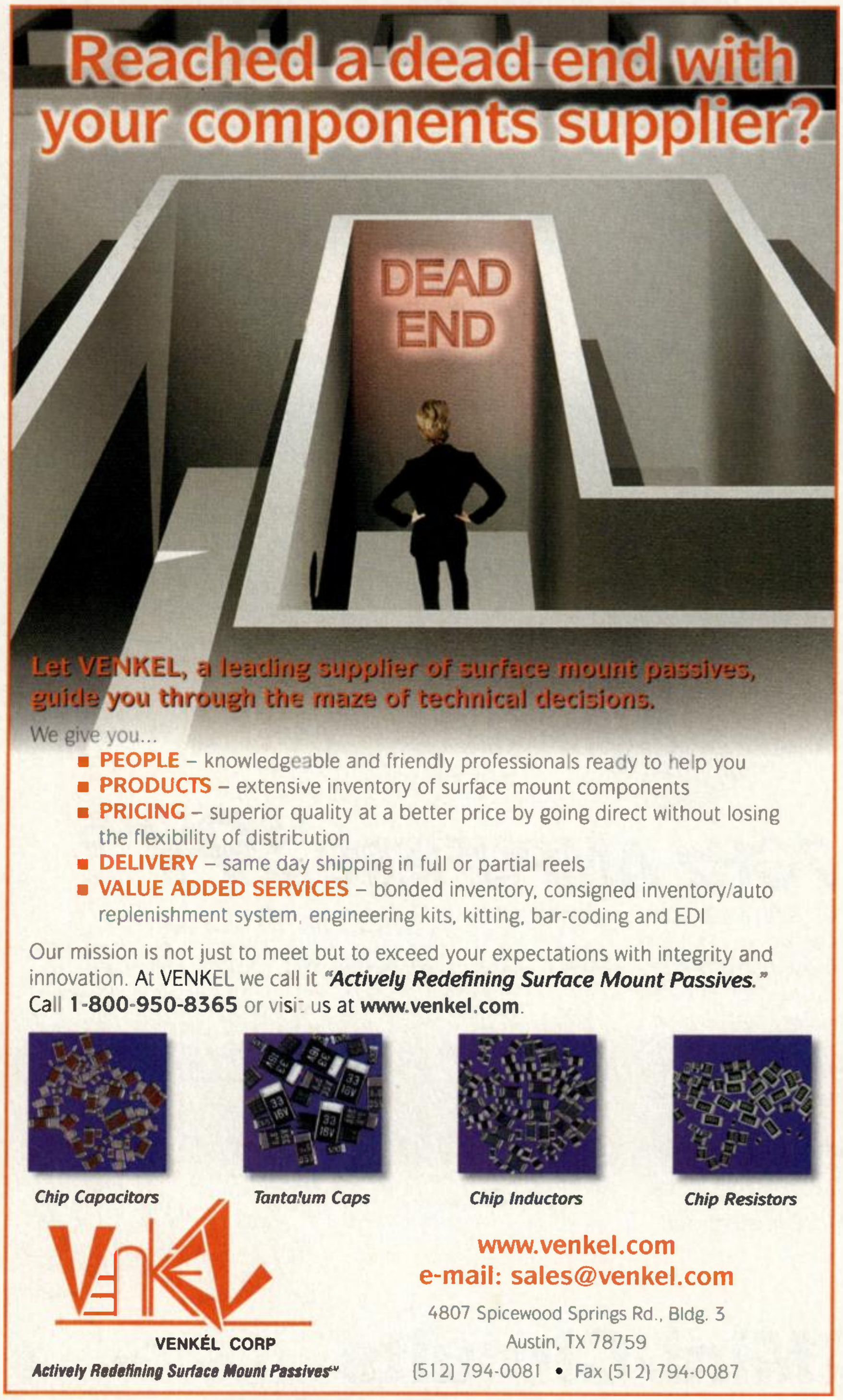


Figure 4. Small signal gain and input.

tested. The results were very similar and only the results of the first module are reported here. The module operates from a +5.0 volt drain supply and a 1.0 V gate supply. It consumes 24.5 W of power at quiescent bias.

The measurements included gain, input return loss, output power, power added efficiency (PAE) and



INFO/CARD 23 or visit www.rfdesign.com

HITTITE GaAs SWITCHES!

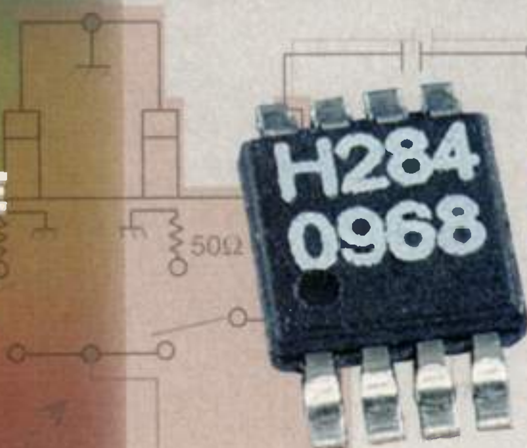
SPDT REFLECTIVE & NON-REFLECTIVE

BROADBAND TO 8.0 GHz

HIGH ISOLATION TO 50 dB

POSITIVE CONTROL +3V TO +5V

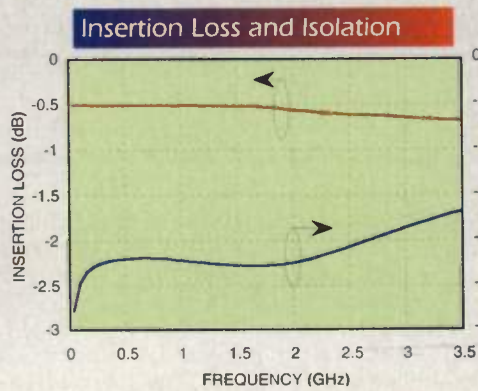
OFF-THE-SHELF !



HMC284MS8G

NON-REFLECTIVE SPDT DC-3.5 GHz

- 45 dB ISOLATION
- IDEAL FOR CELLULAR/PCS & WLL APPLICATIONS



HITTITE MICROWAVE OFFERS A FULL RANGE OF MMIC STANDARD & CUSTOM PRODUCTS COVERING RF TO 40 GHz FOR COMMERCIAL, MILITARY, AND SPACE APPLICATIONS. OUR CUSTOM ASIC & MIXED SIGNAL DESIGN/MANUFACTURING CAPABILITIES UTILIZE THE BEST, PRODUCTION READY MESFET, PHEMT, HBT, OR BiCMOS WAFER FOUNDRIES. WE CAN PROVIDE CREATIVE SOLUTIONS FOR YOUR UNIQUE MULTI-FUNCTION MMIC, MULTI-CHIP MODULE OR SUB-SYSTEM REQUIREMENTS.

CHECK-OUT OUR LINE OF IN-STOCK, LOW COST SPDT SWITCHES

Part Number	Frequency (GHz)	IL/Iso (dB)	IP3 (dBm)	SMT PKG	Description
HMC284MS8G	DC - 3.5	0.5/45	+48	MSOP8G	Hi Isolation/Non-Reflective
HMC194MS8	DC - 3.0	0.7/50	+43	MSOP8	Hi Isolation/Reflective
HMC221	DC - 3.0	0.4/28	+45	SOT26	Low Loss/Reflective
HMC190MS8	DC - 3.0	0.4/27	+50	MSOP8	Low Loss/Reflective
HMC239S8	DC - 2.5	0.4/29	+50	SOIC8	Industry Standard
HMC224MS8	5.0 - 6.0	1.2/31	+42	MSOP8	Hi Linearity T/R, +3 to +5V
HMC174MS8	DC - 3.0	0.5/25	+60	MSOP8	Hi Linearity T/R, +3 to +5V
HMC226	DC - 2.0	0.5/20	+61	SOT26	Hi Linearity T/R, +3V
HMC132C8	DC - 8.0	1.5/50	+42	C8	Broadband/Non-Reflective

** Data is Midband Typical*

WE ALSO OFFER (+) BIAS SP4T, 6T, 8T SWITCHES COVERING DC - 3.5 GHz

www.hittite.com/switch.htm

Request Our Catalog/CD!

PRODUCT SPECIFICATIONS ARE GUARANTEED, -40 °C TO +85 °C...

Hittite
MICROWAVE CORPORATION

VISA MasterCard WE ACCEPT

www.hittite.com

PHONE: 978 250 3343 ◆ FAX: 978 250 3373
12 Elizabeth Drive, Chelmsford, MA 01824 USA

TÜV ISO 9001

INFO/CARD 25

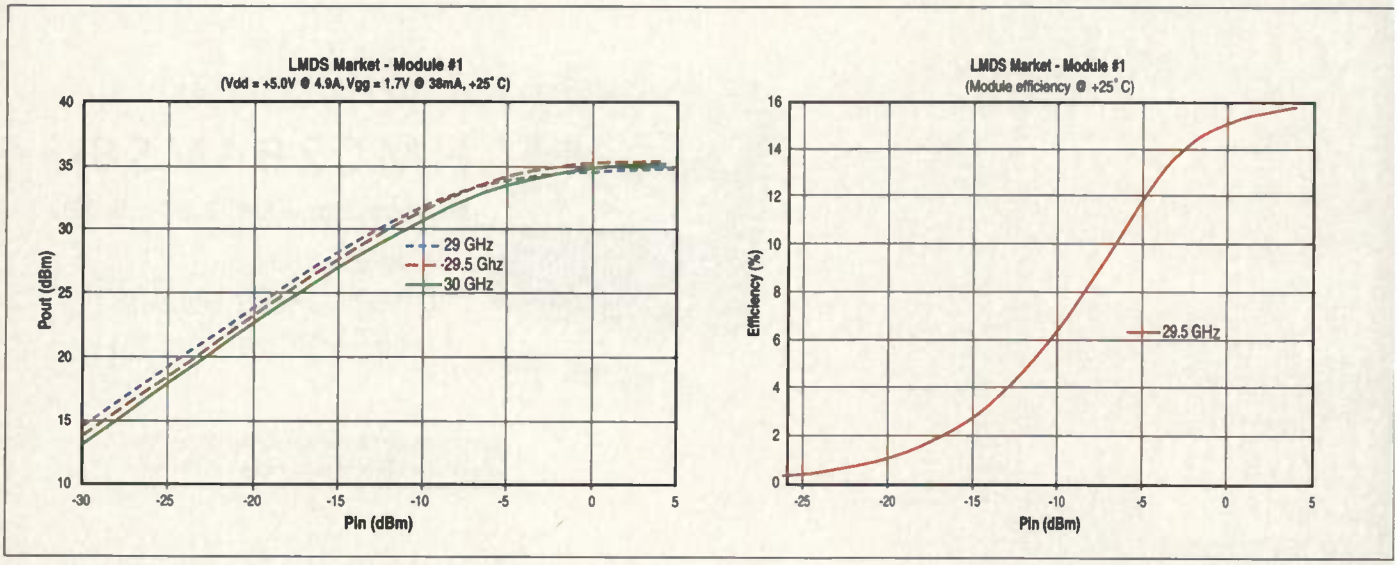


Figure 5. Output power and P.A.E. vs. input power of the LMDS module.

intercept point. Overall performance was excellent.

Small signal gain averaged 42.5 dB and was centered at 29.5 GHz. The 1 .0 dB bandwidth is 1.7 GHz. This was achieved with minimal tuning and is close to the projected performance. The input match was better than 1.62:1 across the full 1B bandwidth. The results are shown in Figure 4.

Measured saturated output power was 3.72 W (35.7 dBm) at 29.5 GHz. 1.0 dB gain compression power was 32.8 dBm (1.9 W). The power added efficiency was 15.8% at saturation. Transfer curves are shown in Figure 5.

The results matched the projected results within 0.6 dB (note that the MMIC data used for purposes of the performance projection is from pulsed on-wafer measurement at 25% duty cycle). This is primarily due to higher channel temperatures as a result of packaging and CW operation. Even small thermal resistances of the attachment and mounting surface materials result in substantial temperature increases when handling large power dissipations.

Intercept point

Two tone measurements of the module were made at four power levels ranging from 100 mW to 1.0 W output power at 29.5 GHz. Upper and lower third order intercept point (TOI) values are shown in Figure 6. Average magnitude of the upper and lower TOI is 38.6 dBm at an output power of 1.0 W.

Conclusion and recommendations

A high gain, multi-watt Ka-band power amplifier module for LMDS applications has been successfully demonstrated using high power commercially available power chips fabricated in the Sanders foundry. Producing the lowest cost final product will require implementation of alternative packaging technologies that are in development.

RF

References:

[1] J. J. Komiak, W. Kong, P.C. Chao, K. Nichols, "3 Watt Ka-Band MMIC HPA and Driver Amplifier Implemented in a Fully Selective 0.15 um Power PHEMT Process," 1998 IEEE GaAs IC Symposium.

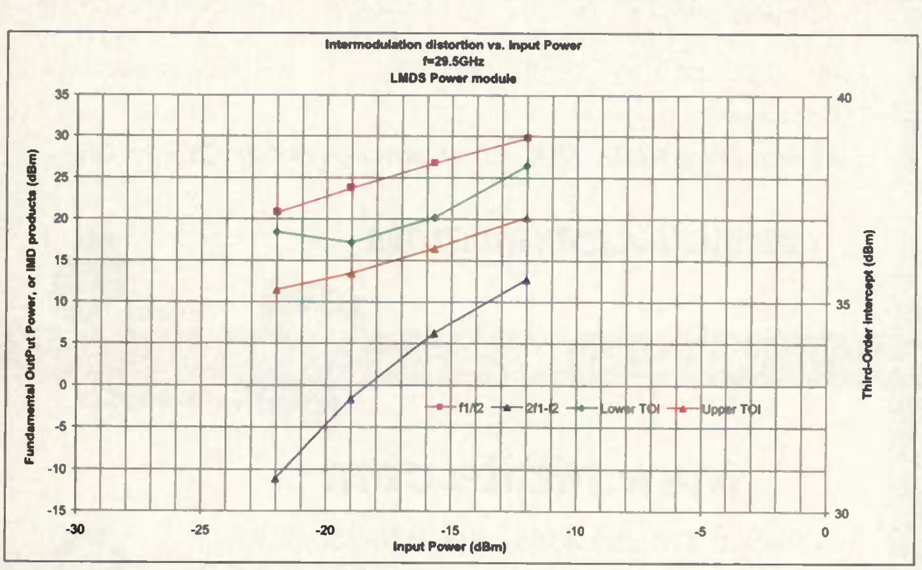
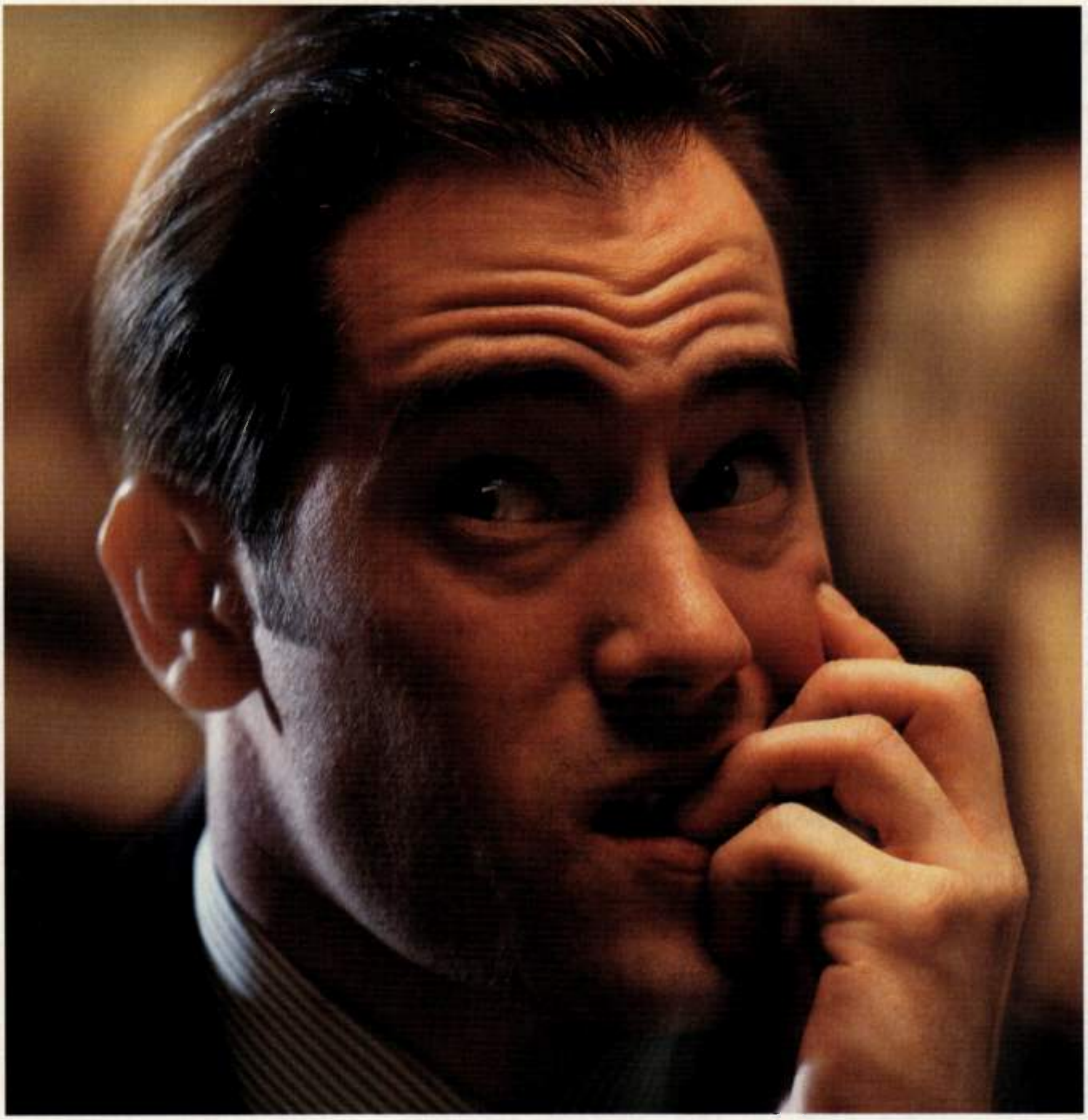


Figure 6. Photo of LMDS Ka-band amplifier.

About the authors

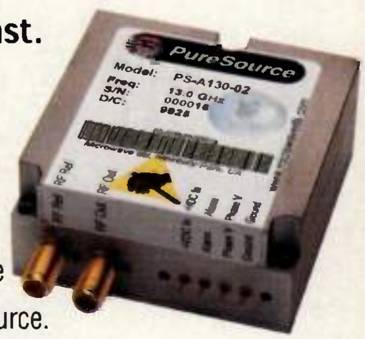
Carlton T. Creamer, James J. Komiak, Wendell Kong, P.C. Chao, Kirby Nichols, Scott MacKelvey, work in the Microwave Space and Mission Electronics of Sanders, A Lockheed Martin Company, Nashua, NH. 03061.

Thought you had to sacrifice performance for reliability?



Think again.

Introducing PureSource. Lasting reliability at last.



Now there's PureSource. Engineered for maintenance-free performance and generating very little heat, these high performance sources are tweak-free for at least ten years. The PureSource lines are engineered to get the maxium performance out of your system with low microphonics, low phase jitter, low spurious products and low aging. For clean performance, low bit error rate, and maintenance-free reliability there's only one word to think about. PureSource.

PureSource

Lasting reliability at last.

A Microwave dB product • Tel: 805-499-0410
Fax: 805-498-0054 • **www.microwavedb.com**

INFO/CARD 26

Time and Frequency

Each month, the product focus highlights a specific area of RF products and provides selected product information. This month, the product focus features time and frequency products.

High performance oven controlled crystal oscillators

Raltron Electronics' OX-2000 series of OCXO are available in frequencies from 1 MHz to 160 MHz and are package in the popular 14-pin DIP configuration. The line features stability of ±0.1 ppm from 0° C to 50° C and meets ANSI Stratum-3 requirements, including ±4.6 ppm total stability over its lifetime and ±0.37 ppm over a holdover period that includes variations in temperature, supply voltage, load variations and 24 hour aging. The 14-pin DIP packages measure less than 10 mm in height for OCXOs to 60 MHz and 12.7 mm in height for OCXOs above 60 MHz to frequency limits, which include SONET and ATM applications. The device design uses contemporary semiconductor-heating for the unit's crystal and oscillator components to insure the product reaches thermal stability and specifications within 1.5 minutes. The units consume less than 2.5 W during warmup and less than 1 W, steady state at 25° C.
Raltron Electronics
INFO CARD 115

VCO offers battery saving capability for portable radio applications

Z-Communications introduces its model CLV0905E VCO. The device generates frequencies between 896 and 914 MHz from 0.5 to 4.5 VDC of control voltage. It is well suited for applications such as portable radios because of its energy conserving design. The unit draws only 11 mA from a 5 VDC supply. Further, the device exhibits a clean spectral signal of –115 dBc/Hz, typically, at 10 Hz from the carrier while attenuating the second harmonic to better than –25 dBc. The device features 1.1:1 linearity over frequency and temperature and can be utilized in designs that can take error voltage directly from the IC's charge pump circuity. The oscillator provides a –5 dBm of output into a 50 W load and is designed to operate over the commercial range of –30° C to +85° C. The device also pulls less than 2 MHz with a 14 dB return loss, any phase and uses less than 2 MHz/V within a 5% change in supply voltage.
Z-Communications
INFO CARD 116

12.5 to 3000MHz
SURFACE MOUNT VCO's from $13.95

Time after time, you'll find Mini-Circuits surface mount voltage controlled oscillators the tough, reliable, high performance solution for your wireless designs. JTOS broadband models span 12.5 to 3000MHz with linear tuning characteristics, low -120dBc/Hz phase noise (typ. at 100kHz offset), and excellent -25dBc (typ) harmonic suppression. JCOS low noise models typically exhibit -132dBc/Hz phase noise at 100kHz offset, and phase noise for all models is characterized up to 1MHz offset. Miniature J leaded surface mount packages occupy minimum board space, while tape and reel availability for high speed production can rocket your design from manufacturing to market with lightning speed. Soar to new heights...specify Mini-Circuits surface mount VCO's.

ACTUAL SIZE

Mini-Circuits...we're redefining what VALUE is all about!

JTOS/JCOS SPECIFICATIONS

Model	Freq. Range (MHz)	Phase Noise (dBc/Hz) SSB@ 10kHzTyp.	Harmonics (dBc) Typ.	V_{tune}** 1V to:	Current (mA) @+12V DC Max.	Price $ea. (5-49)*
JTOS-25	12.5-25	-115	-26	11V	20	18.95
JTOS-50	25-47	-108	-19	15V	20	13.95
JTOS-75	37.5-75	-110	-27	16V	20	13.95
JTOS-100	50-100	-108	-35	16V	18	13.95
JTOS-150	75-150	-106	-23	16V	20	13.95
JTOS-200	100-200	-105	-25	16V	20	13.95
JTOS-300	150-280	-102	-28	16V	20	15.95
JTOS-400	200-380	-102	-25	16V	20	15.95
JTOS-535	300-525	-97	-28	16V	20	15.95
JTOS-765	485-765	-98	-30	16V	20	16.95
JTOS-1000W	500-1000	-94	-26	18V	25	21.95
JTOS-1025	685-1025	-94	-28	16V	22	18.95
JTOS-1300	900-1300	-95	-28	20V	30	18.95
JTOS-1550	1150-1550	-101	-20	***	30	19.95
JTOS-1650	1200-1650	-95	-20	13V	30	19.95
JTOS-1750	1350-1750	-101	-16	***	30	19.95
JTOS-1910	1625-1910	-92	-13	12V	20	19.95
JTOS-1950	1550-1950	-103	-14	***	30	19.95
JTOS-2000	1370-2000	-95	-11	22V	30 (@8V)	19.95
JTOS-3000	2300-3000	-90	-22	***	25 (@5V)	20.95
JCOS-820WLN	780-860	-112	-13	***	25 (@9V)	49.95
JCOS-820BLN	807-832	-112	-24	14V	25 (@10V)	49.95
JCOS-1100LN	1079-1114	-110	-15	***	25 (@8V)	49.95

Notes: *Prices for JCOS models are for 1 to 9 quantity. **Required to cover frequency range. ***Tuning Voltage for JTOS-3000 is 0.5 to 12V, JTOS-1550, JTOS-1750, and JTOS-1950 is 0.5 to 20V, and JCOS-820WLN and JCOS-1100LN is 0 to 20V. For additional spec information and details about 5V tuning models available, consult RF/IF Designer's Guide, our Internet Site, or call Mini-Circuits.

DESIGNER'S KITS AVAILABLE

K-JTOS1 $149.95 (Contains 1ea. all JTOS models except JTOS-25, -1000W, -1300 to -3000).
K-JTOS2 $99.95 (Contains 1ea. JTOS-50, -100, -200, -400, -535, -765, -1025).
K-JTOS3 $114.95 (Contains 2ea. JTOS-1300, -1650, -1910).

Mini-Circuits®

US 67 INT'L 68
CIRCLE READER SERVICE CARD

P.O.Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

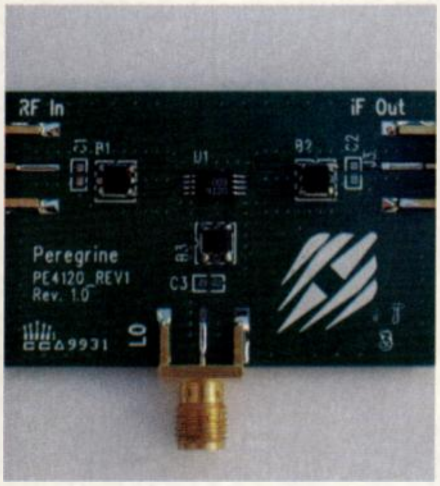
The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: http://www.minicircuits.com

ISO 9001 CERTIFIED

F 234 Rev. E

Low-loss, high-linearity MOSFET quad mixer

Peregrine Semiconductor's high-linearity MOSFET quad mixer that is



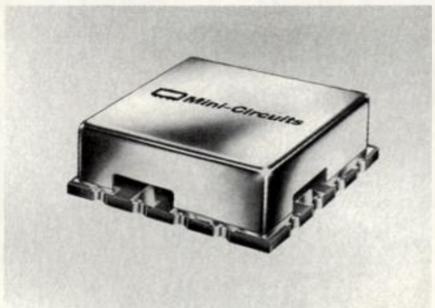
designed to provide functions ranging from frequency conversion to phase detection at up to 2.5 GHz. A conversion loss of 6 dB across its entire operating frequency range makes the device appropriate for such applications as cellular and PCS base stations and cable modems. The PE4120 is manufactured using the company's proprietary UTSi process and features 500 MHz to 2.5 GHz frequency functionality, and mixes IF and LO frequencies to provide a RF output. The IP3 of the device is 28 dBm, LO-IF isolation is 36 dB and LO-RF isolation is 34 dB. The device functions from –40° C to +85° C and is offered in 8-pin TSSOP and SOT-23 packages.
Peregrine Semiconductor
INFO CARD 117

Dual band programmable noise generator

Noise Com offers a new dual-band VXI9000 series programmable noise generator. The VXIbus device has the ability to switch between two noise bands, within the same instrument, providing dual frequency capability. Available options include a signal and noise combiner, 0.1 dB precision attenuator steps for both the signal and noise path and custom noise filtering. Frequency ranges are available from 10 Hz to 40 GHz.
Noise Com
INFO CARD 118

Cellular band VCOs and wideband PCS mixer

Two new components from Mini-Circuits have been introduced for the cellular and PCS markets. The ROS-900PV VCOs works with a 4.5 V supply voltage and 0.5 to 5 V minimum to maximum tuning voltage, making them suitable for integration with monolithic PLL chips and commercial synthesizers. The VCOs feature a 1 MHz, typical, modulation bandwidth, excellent tuning linearity and –102 dBc/Hz typical phase noise at 10 kHz offset. The ADE-42MH wideband microwave mixer features 5 MHz to 4.2 GHz band-



width, low midband conversion loss of 7.5 dB typical. Midband, typical IP3 is +17 dBm and typical L-R nd L-I isolation is 29 and 26 dB respectively.
Mini-Circuits
INFO CARD 119

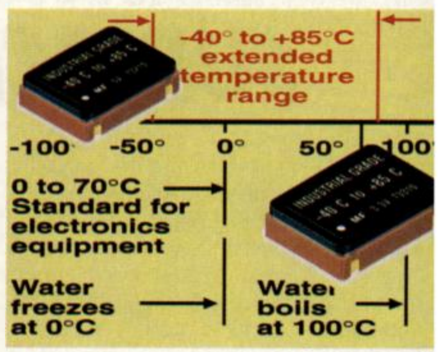
Chipset level support for wireless networking

Fox Electronics is now stocking a standard, off-of-the-shelf crystal oscillator designed for Intersi's PRISM I, II, and III chipsets has been announced by Fox Electronics. The F4106-440 CMOS oscillator is offered in an industry standard 5 X 7 mm ceramic SMD package.

Offering stability of ±25 ppm the oscil lator features 3.3 V operation, a 1. mm low profile footprint, a frequency o 44 MHz and a standard operating tem perature of –10° C to +70° C. Als available is an extended temperatur version (–40° C to +70° C) and a specia 22 MHz version for PRISM I.
Fox Electronics
INFO CARD 120

Industry grade SMD clock oscillators

Miniature industrial grade clock oscillators have been developed by MI Electronics. The surface mount devices T3312 and T3212, are based upon mili tary-grade manufacturing and featur a design based upon inverted mes crystals and rugged multilaye gold/ceramic packaging. The device feature 5 ps RMS jitter over a th extended temperature range of –40° C to +85° C. The devices offer time an frequency reference signals from 2 kHz to 100 MHz. Accuracy is main tained to ±50 ppm over the full temper ature range. The devices operate fron 3.3 VDC (T3312) or 5V (T3212) an draw 35 and 45 mA of maximum loa current, respectively. Waveform sym metry is 45/55 and both models ar



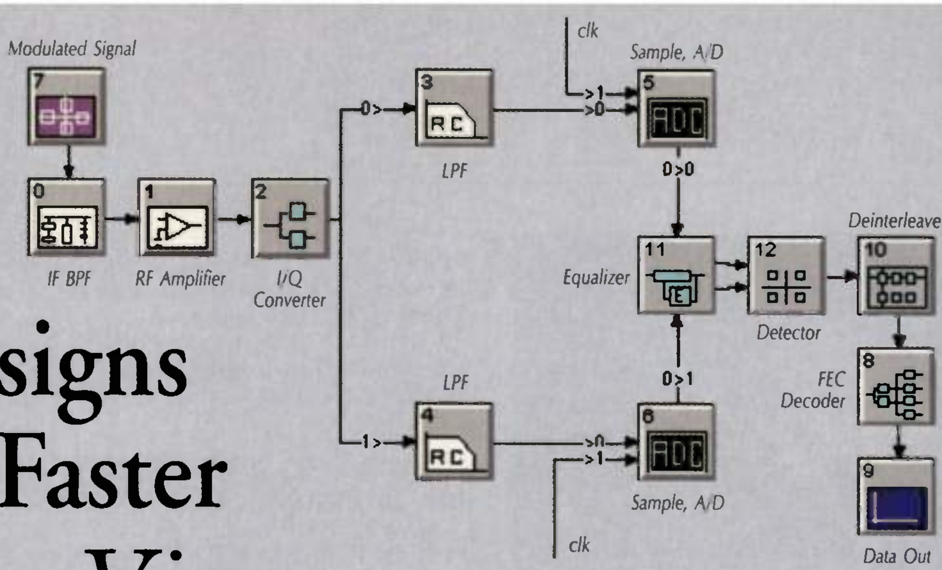
capable of driving both CMOS and TTL Loads. Technically, the device holds ± 50 ppm frequency stability over the specified temperature range and long-term drift fo the devices is specified at ± 1 ppm/year, with first year drift o less than ± 3 ppm.
MF Electronics
INFO CARD 121

Ovenized VCO for Stratm 3 performance levels.

The K2000 series of voltage controlled ovenized crystal oscillators is

Get Your Comm Designs to Market Faster Using SystemView

BY ELANIX®



Mixed-Mode Receiver System Simulation

You've tried other software, but you simply haven't found the digital and analog design tools you need in a single integrated environment. Until now. SystemView by ELANIX bridges the gap between digital and analog design. SystemView provides the tools you need to model your complete system, from RF to bits.

■ End to End Comm Systems

Design and test digital/analog communications systems such as CDMA, GSM, DVB, QPSK, and QAM. Includes your choice of error correcting encoders/decoders and modulators/demodulators.

■ Bit-True DSP Design

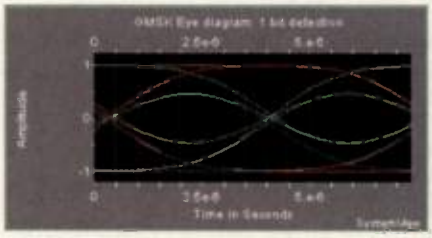
Supports all major fixed and floating-point processors. Simulates accurately to the bit level. Generates overflow, underflow and carry flags.

■ Distortion-True RF/Analog Design

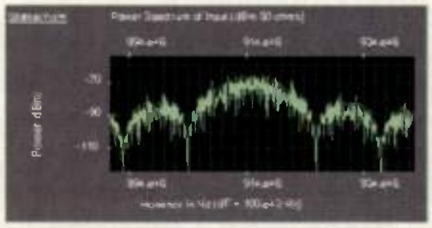
Includes circuit components such as distortion-true mixers, amplifiers, RLC circuits, opamp circuits, etc. Allows creation of complete TX/RX systems, including propagated noise figure.

■ Interface to MATLAB®

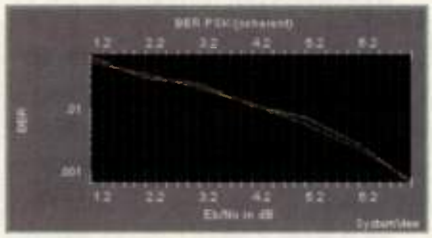
Use the new SystemView M-link™ option to incorporate MATLAB, Simulink® and third party libraries and systems into your SystemView design.



GMSK Eye Diagram (1-bit Detection)



Input Power Spectrum



Theoretical vs. Actual BER (Coherent PSK)

■ Attend a FREE SystemView Design Seminar in Your Area

Attend a FREE half-day seminar to see how SystemView can improve time to market and reduce cost. Seminars cover the design flow from algorithm design to implementation, using a QPSK system as the design example. Call Elanix or browse our web site for dates and locations.

What They're Saying About SystemView

"No other program with so much simulation power is as easy to use. When you finish a session with SystemView you realize that you've spent all the time applying engineering principles and none of the time struggling with the computer."
- Richard Chick, MIT Lincoln Labs -

"We use SystemView very heavily, not only in the brainstorming/prototyping stage, but also throughout the development process — right up to the point where we're actually building silicon."
- Steven Hall, CommQuest Technologies -

"For digital filter design, SystemView was indispensable due to its accurate simulation of the fixed point arithmetic mode employed on the actual DSP processor used in my design."
- Bisla Balvinder, Itron -

Request or download your FREE evaluation software today:

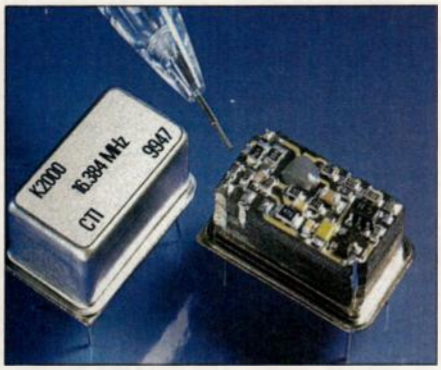
1-800-5-ELANIX
www.elanix.com

ELANIX INCORPORATED

5655 Lindero Canyon Road, Westlake Village, CA 91362, Phone: 818-597-1414, Fax: 818-597-1427, elanix@elanix.com, www.elanix.com

SystemView by ELANIX is a registered trademark of Elanix, Inc. MATLAB and Simulink are registered trademarks of The MathWorks, Inc. Xilinx is a registered trademark of Xilinx, Inc.

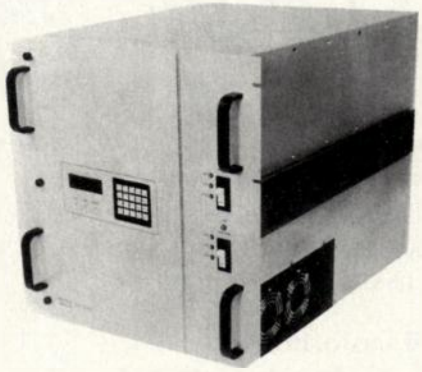
INFO/CARD 45



designed for Stratum 3 timing and synchronization applications. Housed in hermetically sealed DIL 14 packages, the devices are intended for either +5 or +12 VDC supply voltages. Frequency stability is less than ± 0.1 ppm after aging, from 0° C to +70° C for the 12 V model. Overall frequency stability, including temperature, voltage, load and aging is less that 370 ppb/day. The devices will hold frequency to within ±4 ppm over 10 years. Phase noise is less than –95 dBc/Hz at 10 Hz and voltage pull/hold in function is greater than ±10 ppm. The series is available as standard to 20 MHz with options to 38.88 MHz.
Champion Technologies
INFO CARD 122

IF switching matrix offers low crosstalk

Matrix Systems has debuted the model 13098 200 MHz IF switching matrix. The device is capable o switching up to 128, each, inputs and outputs. The device covers the 7C MHz band with ± 20 MHz and the 160 MHz band with ± 40 MHz. Features include a three-stage architecture with auto routing, non-blocking full fan out, 60 dB isolation at 20C MHz, solid state contacts, RS-232 and IEEE-488 interface, switchpoint status feedback, redundant signal paths and power supplies. Additionally, the unit can be programmed via a keypad input and offer low crosstalk.
Matrix Systems
INFO CARD 123



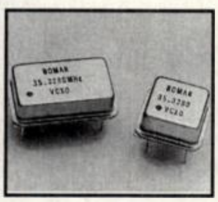
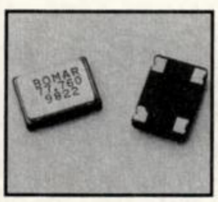
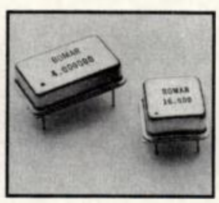
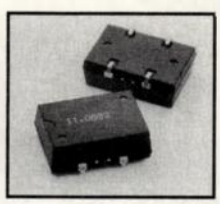
Time and frequency simulation software

Optotek's transient analysis simulator, MMICAD Waveform software improves the application of time-domain simulation by predicting waveforms in fast, nonlinear circuits. MMICAD WAVEFORM can also use complex, externally-defined waveforms such

THE FUTURE IS NOW AT BOMAR

For more than 35 years, customers have purchased high quality Quartz Crystals, Clock Oscillators and VCXO's from a manufacturer whose name you can trust, Bomar Crystal Company. See for yourself what others have always known.

Bomar offers
- Tight Tolerances
- Extended Temperatures
- Standard Lead Time = 10 Days
- Frequencies From 1KHz to 160MHz

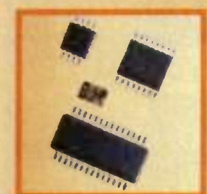

BOMAR Crystal Company

201 Blackford Ave., Middlesex, NJ 08846
Phone: 800-526-3935 Fax: 800-777-2197
www.bomarcrystal.com e-mail: sales@bomarcrystal.com

INFO/CARD 106 or visit **www.rfdesign.com**

Shape your form factors

with fewer components and smaller batteries



Empowering wireless telecom RF-IC solutions

TEMIC Semiconductors offers SiGe ICs, such as U7006B, that feature extremely high integration. With fewer components, you design smaller, lighter phones. High efficiency and low supply voltage (e.g. T0930: PAE > 50%, V = 1.8 V) mean they are also lower in power consumption. This lets you both slim down bulky batteries and extend talk-time. Our SiGe products deliver high gain and low noise figures (e.g. U7006B: G = 19 dB, NF = 1.6 dB @ 2 GHz), enabling higher sensitivity at low supply current. Available now, benefit from our full SiGe range being manufactured in high volume.

	P/N	Description	Application
✓	U7004B/ U7006B	1.9-GHz PA + LNA	DECT RF Front End
✓	T0930	900-MHz PA	2-way pager
✓	TST0950	900-MHz LNA	GSM, ISM
✓	TST0912	900-MHz PA	GSM

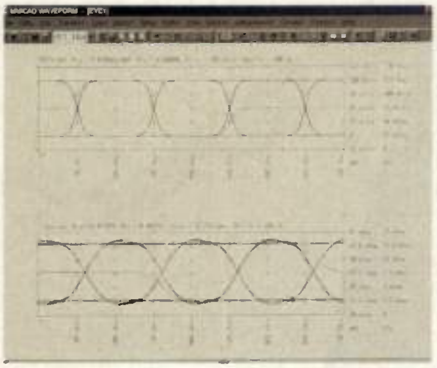
PA: Power Amplifier *LNA: Low Noise Amplifier*

www.temic-semi.com/sige.htm

TEMIC
Semiconductors

→ TEMIC SEMICONDUCTORS IS AN ATMEL COMPANY

INFO/CARD 34



as Pseudo Random Bit Sequences (PRBS) or WCDMA. MMICAD waveform can be used to advantage in the design of GaAs ICs for use in high speed optical communication modules, improved RF/microwave packages, or nonlinear transmission lines. The new software is intended for the design of circuits where difficulties are experienced with conventional time domain and/or harmonic balance simulators. The new simulator is constructed as a two-component, character mode executable comprising the S-parameter-to-impulse data converter that transforms the S-parameter circuit response to an equivalent impulse response in the time domain and the time domain simulator itself. Each component is constructed as a stand-alone executable running under Microsoft Windows 95/98/NT and can interfaces with the other components of the MMICAD CAE/CAT software suite (for example, the MMICAD Linear Simulator and LASIMOTM transistor parameter extractor).
Optotek
INFO CARD 124

Versatile OCXO for GPS and Stratum 3E

A new line of oven controlled crystal oscillators has been introduced by C-MAC. The OXCOs claim stability of ±0.002 ppm across an operating temperature range of –20° C to +75° C. The devices are built around SC cut quartz crystals and can be used in

GPS applications as well as econom cal Stratum 3E switching. The device are available in frequency from 2. MHz to 20 MHz, or up to 40 MHz wit some degradation in stability. Th CFPO-4 series is designed on a smal er footprint, thereby finding a home i basestation CDMA and GSM an SONET/SDH systems as well.
C-MAC Frequency Products
INFO CARD 125

RF

INFO/CARD 99 or visit **www.rfdesign.com**

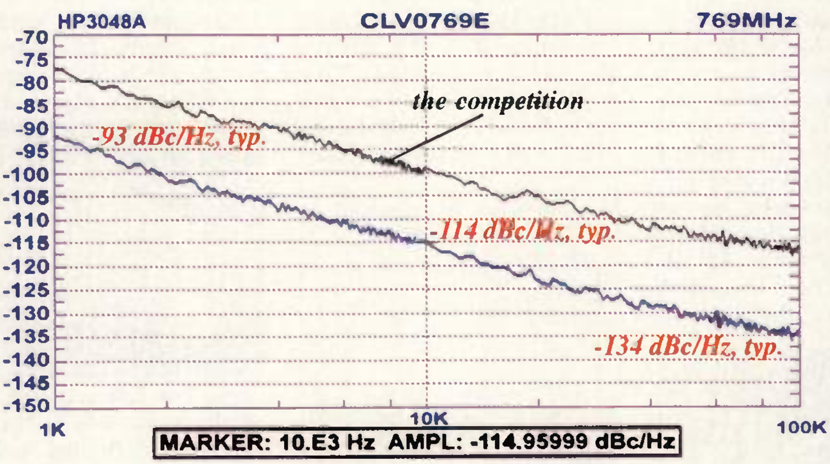
INFO/CARD 81 or visit **www.rfdesign.com**

All VCOs should be this good . . .

Setting the standard for VCO performance.

Designing today's advanced radios is tough enough when you have VCOs that don't give you the margin you need. Our CLV line of patented ultra-low noise VCOs will give you that margin ... and more!

Part No:	Freq. Range:	V_{tune}	Φ_n at 10kHz	V_{supply}
CLV0769E	734-804	1-4	-112	5
CLV0815E	806-824	0.5-4.5	-113	5
CLV0945E	936-953	0.5-4.5	-114	5
CLV1320E	1295-1335	1-5	-113	5
CLV1525E	1500-1550	0.3-4.7	-110	5



Learn more about Z-COMM's CLV product line by visiting our web site at http://www.zcomm.com/ for datasheets, outline drawings, tape and reel specifications, and application notes, as well as our complete product catalog and custom VCO inquiry form.

Come to the source ...

Z-COMM.

Z-Communications, Inc.

9939 Via Pasar • San Diego, CA 92126

(619) 621-2700 • Fax: (619) 621-2722

WWW: http://www.zcomm.com/

INFO/CARD 41

Cable network and interference analyzer

Telecom Analysis Systems has added the TAS 8250 test system to its product line. The tester is designed to emulate critical hybrid fiber/coax (HFC) cable network impairments in a controllable laboratory instrument. It's designed for evaluating the transmission performance of cable modem termination systems, set-top boxes, HDTV equipment and IP telephony products. It can emulate both upstream (5 to 42 MHz) and downstream (50 to 860 MHz) HFC channel characteristics. Impairments emulated by the device include amplitude tilt, IMD, group delay distortion, noise and interference. A built-in diplex filter combines the upstream and downstream channels from the CMTS or headend into a single interface, allowing single or multiple subscriber devices to be tested. Taskit software can be used to provide a GUI for controlling the set and it can be integrated with either the TAS 4500 or HP 89441 for additional testing capabilities.
TAS
INFO/CARD 126

Spread spectrum data transceiver

RF Neulink has released a spread spectrum data transceiver for use in the 2.4 GHz band. The SS9600 data transceiver is designed for point-to-point and point-to-multipoint data communications. The unit integrates a built-in modem with data rates of up to a 9600 bp/s over-the-air rate. The system employs true frequency hopping and multiple units can be combined to offer a system with up to 238 units. Operating in the 2.4 GHz unlicensed band, the unit is plug-and-play and contains built-in, self adjusting power control.

RF Neulink
INFO/CARD 127

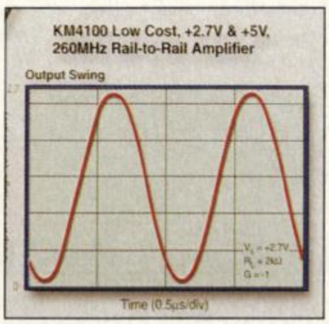
Dual-band down converter chip

A dual-band downconverter chip for GSM and TDMA cellular phones has been devleoped by Motorola. The chip is contained in a single, 24-pin plastic TQFP SMT package. Each downconverter in the MC13740A contains a low-noise gain-selectable amplifier, a buffered LO output and a mixer. The mixer's linearity and selectable gain provide the ability to meet cellular system linearity, while maintaining low power consumption. Offering open collector outputs and off-chip LNA matching, the device is usable in GSM900, DCS1800 PCS1900 and TDMA applications.

Motorola
INFO/CARD 128

2.7 and 5.0 volt rail-to-rail amplifiers

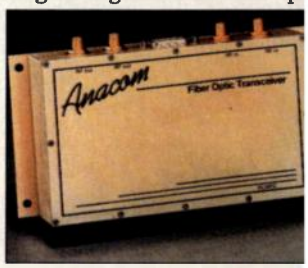
Kota Microcircuits has announced a family of rail-to-rail amplifiers. The models KM4100 (single with disable) and KM4200 (dual) are single supply voltage feedback amplifiers. Designed for low power, battery powered commercial applications such as GSM, W-CDMA basestations, portable instrumentation, set top boxes and computers. Features include low supply currents (4.2 mA), 150 V/µs slew rates and ±90 mA of output current. They are availble in SOT23-5 and SOT23-6 packaging (varies with model).



KOTA Microcircuits
INFO/CARD 129

Four channel WDM transciver

Anacom systems has intr duced the AC 234 fiber opt transceiver pair for transm ting RF signals over fiber opt cable. The link is designed f applications where there expensive, or limited availab ity of fiber optics. The devi can transmit two broadbar channels, simultaneously, both directions over a sing fiber cable. Designed for use PCS/PCN, cellular and WI applications, the device ut lizes wavelength division mu tiplexing (WDM) to accor plish transmitting the tv pairs. the device accepts tv independent RF signals v two coax connectors from tl base station and conver them into optical sigans. I installation location between the remote antenn location and the base.



Anacom Systems
INFO/CARD 130

NEW PRODUCTS

NO.69

RF/IF MICROWAVE COMPONENTS

FROM $4.45

RF TRANSFORMERS HAVE 4:1 IMPEDANCE 200 TO 1400MHz

Broad band TCM4-14 surface mount RF transformers from Mini-Circuits operate in the 200 to 1400MHz band with 4:1 impedance ratio. Referenced to midband loss (0.8dB typ), insertion loss is 1dB from 800MHz to 1000MHz, 2dB in the 300 to 1300MHz range, and 3dB band wide when operated within -20°C to +85°C (max.). Open case design has plastic base with solder plated leads, and applications include impedance matching and baluns. RF power is 250mW (max.).

FEATURED PRODUCT

FROM $7.95

3000 TO 4000MHz MIXER IS TEMPERATURE STABLE

Higher frequency designs will benefit from Mini-Circuits patented family of MBA model Blue Cell™ mixers, which deliver a unique combination of low conversion loss, superb temperature stability, thin 0.07" profile, and low cost. This level 13 (LO) MBA-35MH model spans 3000MHz to 4000MHz with 22dB L-R, 14dB L-I isolation and low 5.1dB midband conversion loss (all typ). Operating temperature is -40°C to +85°C (max.) and applications include satellite and PCMCIA.

FROM $19.95

1550 TO 1720MHz VCO HAS LINEAR TUNING

The ROS-1720 voltage controlled oscillator from Mini-Circuits operates within the 1550MHz to 1720MHz band targeting PCS and DCS applications with low -141dBc/Hz SSB phase noise typical at 1MHz offset, wide 3dB modulation bandwidth typical at 18000kHz, and 28-34MHz/V (typ) linear tuning sensitivity. Housed in a miniature 0.5"x0.5"x0.18" industry standard package, typical power output is 7dBm.

it™

FROM $12.95

50 TO 200MHz MAGIC-TEE OPERATES WITH LOW LOSS

Mini-Circuits has introduced a versatile 2way-0°/180° power splitter and combiner for the 50 to 200MHz band. Model AMT-2 typically has low insertion loss (0.25dB S-1 and S-2, 0.8dB J-1 and J-2), very good 1.10:1 input/1.12:1 output VSWR, plus excellent 0.1dB amplitude and 1 degree phase unbalance. Designed for 50 ohm systems, this 4 port hybrid covers IF receiver and satellite applications. Maximum power input as a splitter is 0.5W.

824 TO 849MHz COAXIAL AMPLIFIER FEATURES LOW NOISE

This 824 to 849MHz cellular band ZQL-900LN low noise amplifier from Mini-Circuits typically provides high 16.5dB gain (±0.2db flatness), ultra-low 1.0dB noise figure, and 22.5dBm maximum power output at 1dB compression. High +35dBm IP3 helps suppress noisy intermodulation products, and operating temperatures range from -40°C to +70°C maximum. Equipped with 50 ohm SMA-Female connectors.

FROM $229

6 pc. KIT $150

2W SMA ATTENUATORS AVAILABLE IN DESIGNER'S KIT

Six different DC to 18GHz fixed attenuators from Mini-Circuits "BW" series are now available at a special evaluation price in designer's kit form. Kit number K-BW2 contains units that display nominal attenuation values of 3dB, 6dB, 10dB, 20dB, 30dB, and 40dB. Built tough to handle 2W average, 125W peak power, these miniature stainless steel precision attenuators are ideal for matching, test set-ups, and instrumentation applications. Available from stock.

Mini-Circuits®

US 70 INT'L 71
CIRCLE READER SERVICE CARD

P.O.Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

YONI™ The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: http://www.minicircuits.com

ISO 9001 CERTIFIED

F 321 Rev. Org.

AMPLIFIERS

Broadband driver amplifier

EiC's Model EC-1017 is an internally matched broadband driver amplifier optimized for commercial mobile applications. The device offers power down capability and high linearity. The amplifier operates with voltages of +3.5 to +5.0VDC. It provides +17 dBm of saturated output power when operating from a +3.5 VDC supply. Typical gain is 9 dB at 1.9 GHz, with +15 dBm of output power at 1dB compression. Third order intercept point is +25 dBm with a noise figure at 5 dB and an input loss return of 11 dB. The amplif er typically draws 55 mA current fro a +3.5 VDC supply and consumes 1 µA, or less, in power-down mode. It i supplied in a plastic, surface-mour SOIC-8 slug package.

EiC
INFO/CARD 131

Rail-to-rail 1MHz SC70 op amp with 1µA shutdown

Maxim Integrated Products ha introduced the Max4400/Max440 rail-to-rail op amps. The device include a 1 µA shutdown and come i SC70 packages. These devices cor sume 320 µA in normal operatio and achieve a 1 MHz gain-bandwidt product. Operating from a singl +2.5V to +5.5V supply, these unity gain stable op amps are ideal fo portable/batter-powered application They offer low power consumptio without sacrificing bandwidth o gain accuracy. The Max4400 i offered in 5-pin SC70 and 5-pi SOT23 packages. They are specifie over the temperature range of –40° to +125° C.

Maxim
INFO/CARD 132

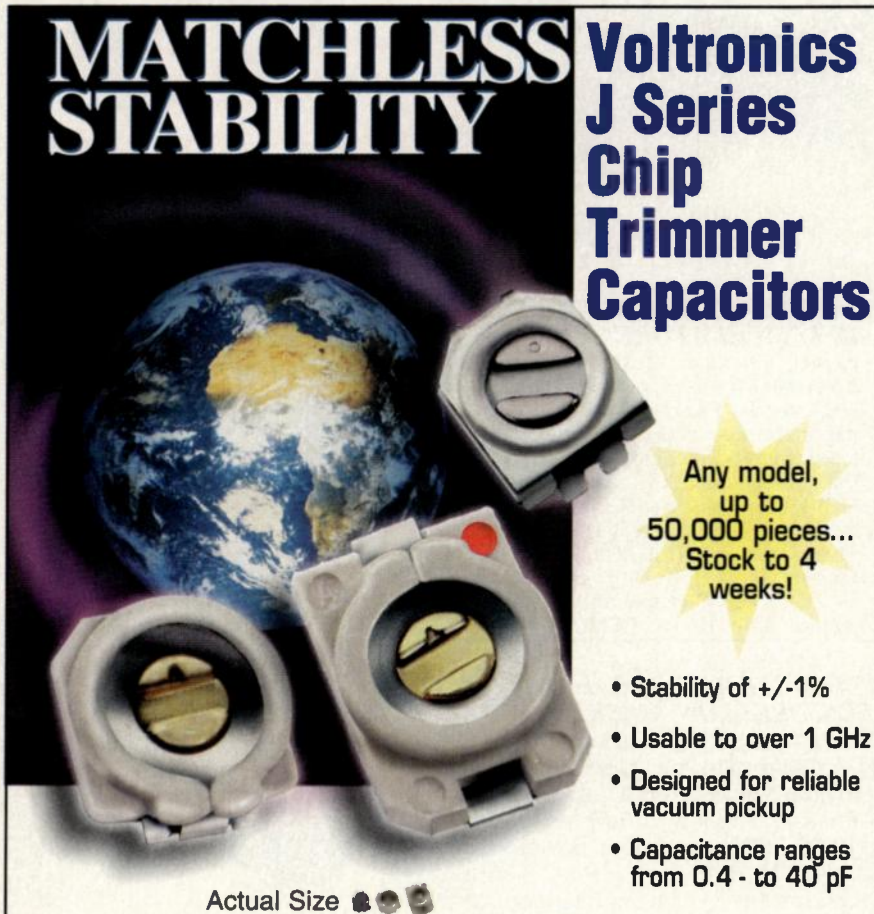
80 db ultra high dynamic range chip

The model SDLVAC-0120-80 is 300 MHz to 2 GHz successive detec tion logarithmic video amplifier chi (SDLVA-chip). It offers a –75 to + dBm dynamic range with a log slop of 25 mV/dB (10 to 50 mV/dB avail able). The log linearity is ±1.0 d over the operating temperature o –40° C to +85° C typical. The chi provides 20 MHz video bandwit and a limited IF output of –20 dBr minimum. It operates from +5 VD @ +80mA and –5 VDC @–135mA an measures 0.50" x 0.35" x 0.09".

Planar Monolithics
INFO/CARD 133

InGap CDMA amplifier

Celeritek's new CHP 1232-PM is CDMA 50 Ω matched 6 mm squar power amplifier module for PCS wireless local loop and other hig bandwidth wireless data markets The InGap HBT amplifier modul offers a smaller footprint than simi lar products, integrates (14) sup porting components, and has bee specifically developed to meet th



Voltronics J Series Chip Trimmer Capacitors

- Stability of +/-1%
- Usable to over 1 GHz
- Designed for reliable vacuum pickup
- Capacitance ranges from 0.4 - to 40 pF

The J Series delivers unexcelled stability for demanding applications, from wireless base stations to CATV amplifiers, cordless phones to pagers, heart monitors to wireless microphones.

To get all of the details, visit our web site at www.voltronicscorp.com.

The Trimmer Capacitor Company
Voltronics INTERNATIONAL CORPORATION
100 Ford Road • Denville, NJ 07834
973.586.8585 • FAX : 973.586.3404
e-mail: info@voltronicscorp.com

INFO/CARD 96 or visit www.rfdesign.com


MMICAD
WAVEFORM
Time domain simulation of waveforms in highly nonlinear microwave and optoelectronic circuits
Complements frequency domain circuit simulators allowing:
• prediction of voltage waveforms at every node in a nonlinear circuit
• analysis of pulsed RF network responses
• analysis of filter step-function
• examination of transient and start-up times in oscillators
• visualization of switching waveforms in fast digital circuits
Imports processed S-parameter data, supports advanced GaAs MESFET/HEMT models and integrates with the other components of Optotek's MMICAD Suite for PCs.
• SCHEMATIC CAPTURE
• LINEAR CIRCUIT SIMULATION
• NONLINEAR WAVEFORM SIMULATOR
• LAYOUT
• DATA ACQUISITION
• TEST EQUIPMENT CONTROL
• YIELD ANALYSIS
• FILTER SYNTHESIS
• SMALL AND LARGE SIGNAL MODELLING
OPTOTEK
62 Steacie Drive
Kanata, ON
K2K 2A9
Phone: (613) 591-0336
North America: (800) 361-2911
Fax: (613) 591-0584
www.optotek.com
sales@optotek.com
MMICAD
...the right tool for the job
INFO/CARD 35

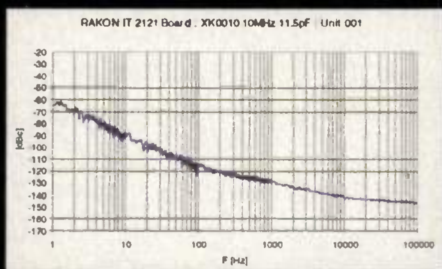
continuing requirements for small, low-cost, high capacity wireless voice and data applications. It is a linear efficient three-stage power amplifier developed for PCS CDMA handsets and infrastructure systems, WCDMA 3G handsets and wireless local loop (WLL) subscriber units that operate in the 1.85 to 1.91 GHz frequency range. Typical features include operation as low as 3.2 volts from a single positive supply, 30 dB gain at operating output power, 35% linear power added efficiency, and +28 dBm output power (IS-98 CDMA mode.

Celeritek
INFO/CARD 134

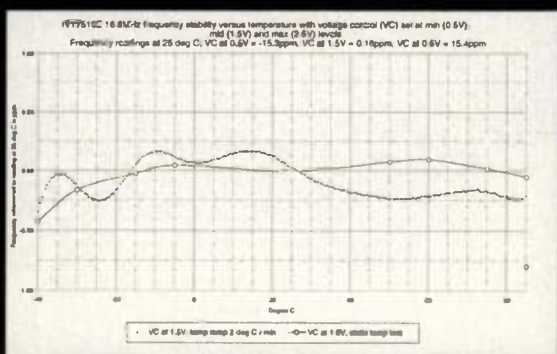
More innovation from Rakon

The leaders in crystal technology present the 7500 series oscillators. Featuring outstanding temperature stability and no frequency perturbations, at low cost.

Rakon's new IT7500 and IVT7500 oscillators lead the way for a new generation of products. The 7500 series features an analogue IC for temperature compensation. This analogue IC has no erratic frequency jumps unlike previous digital compensation attempts.
The unit can operate on any supply voltage between 2.7 and 5.5 volts, and consumes only 1.2mA typically.
Clipped Sinewave frequency outputs ranging from 10MHz to 26MHz are available.



Both the IT7500 and IVT7500 provide excellent temperature stability performance for low cost, making it the oscillator of choice for GSM/TDMA/AMPS cellular phones, PCMCIA CDPD cards, two-way pagers and many other wireless applications.



RAKON LIMITED
1 Pacific Rise, Mt Wellington, Auckland, New Zealand. Private Bag 99943, Newmarket.

Fax: +64-9-573 5559 Phone: +64-9-573 5554

View and download product information from our Web site or e-mail: sales@rakon.com

www.rakon.com

INFO/CARD 78 or visit www.rfdesign.com

2.25 KW C-Band TWT Amplifier

The 2.25 kW C-Band TWT amplifie model VZC-6967B4, has been refined provide an improved user interface ar CE certification for European safe requirements. It works with earli models of 2.25 kW TWTAs and fix satellite service applications.

CPI
INFO/CARD 135

Wireless communication modules

Ericsson has released a series wireless communication modules desi nated as the GM25, GM22, DM10 ar DM20. The GM22 is a dual band GS module handling voice, SMS and fa The GM25 is a dual band GSM modu handling voice, SMS, fax and data. Th DM10 is a dual band AMPS ar TDMA, 850 MHz module, handlir voice, SMS, fax and data. Finally, th DM20 for AMPs 850 MHz and TDM 850/1900 MHz module, handling voic SMS, fax and data.

Ericsson
INFO/CARD 136

SUBSYSTEMS

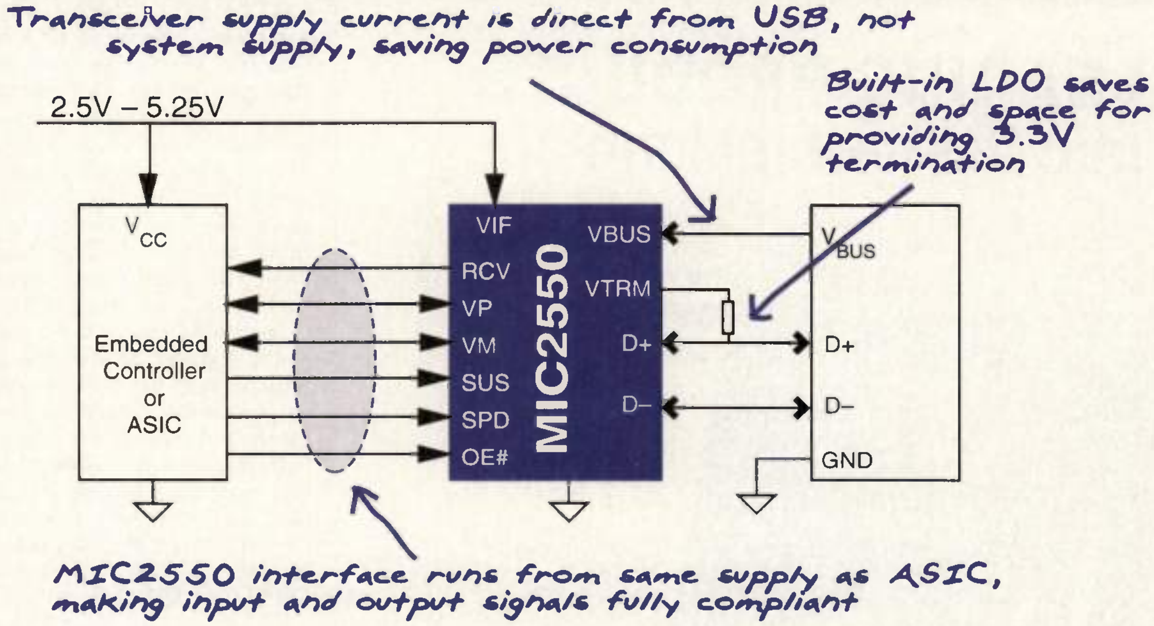
RAM-based baseband chipset for GSM handsets

Analog's AD20msp430 SoftFor chipset is the first completely RAM based baseband chipset for wireles handsets. The device is a next genera tion GSM baseband chipset that pr vides cellular phone manufacture with the functionality to customize fe tures and options entirely in softwar Network operators can also add or r move features over the airwaves. As RAM-based chipset, GSM phone ma ufactures can load different softwa version to support an entire family high-end to low-end phones using common hardware platform. Th chipset allows designer to build appl cations, such as GSM mobile phone PDA-type platforms and Internet a pliances that accommodate 2.5G wir less data communication standards, i cluding GPRS and HSCSD and a forward compatible with future 3G ce lular standards.

Analog devices
INFO/CARD 137

USB Transceiver for Less

(Less Power Consumption, Space & Cost)



The Good Stuff

- Compliant to USB specifications
- Interfaces to standard SIE interface
- Unique dual supply voltage operation
- Low and full speed support
- Operates down to 2.5V
- Integrated LDO for speed termination voltage
- Low power suspend mode
- Low height TSSOP package

Micrel's new USB transceiver will save your next USB peripheral design time, cost, and reduce design complexity.

The MIC2550 employs a unique dual supply voltage design which allows operation down to 2.5V on the system side, and connects directly to the USB voltage bus. An integrated LDO provides the speed termination voltage without requiring additional space or cost.

With the MIC2550, you can operate your embedded controller or ASIC from 2.5V to 5.5V without additional voltage translation circuitry or special I/O cells to support USB's 3.3V signalling.

In addition, the MIC2550 takes its operating power direct from the USB voltage bus, decreasing power consumption from the system battery.

Contact us for more information — Don't forget to bookmark our website for updates!

www.micrel.com/ads.html
Literature: 1-800-401-9572
Direct: (408) 944-0800

Stocking Distributors:
Arrow (800) 777-2776 • Future (800) 388-8731
Newark (800) 463-9275 • Nu Horizons (888) 747-6046

MICREL
The Infinite Bandwidth Company™

INFO/CARD 40

TDMA IC's for cellular/PCS phone applications

The TriQuint TQ5122, cellular frequency band receiver and the TQ5622, PCS frequency band receiver, are complementary devices designed for use in IS-136, TDMA or equivalent wireless handsets. Both are low current devices that include a power down or sleep mode to extend both standby and talk times in wireless applications. They include an LNA mixer, LO buffer and IF buffer amplifier and operate from a single 2.8 V power supply. Additionally, they are designed to minimize the number of external bypass and matching elements to keep board space and cost t a minimum.

TriQuint Semiconductor
INFO/CARD 138

INFO/CARD 46 or visit **www.rfdesign.com**

32-Channel digital receiver for FPDP connectivity

The Pentek model 6536 is a mult channel VME board that accepts dig tized data from four parallel inputs a sampling rates up to 40 MHz. The de vice has been developed for applica tion into original equipment manufac turer's and systems integrator' products. The unit is designed for ad dressing high-speed processing task including summation of multipl channels for beamforming applica tions, direction finding, demodulatior decryption and other signal analysi tasks, such as medical imaging an analysis of many forms of radar o sonar signals. The device can be cor figured with up to 32 channels of nar rowband receivers to perform fre quency down conversion, lowpas filtering and decimation of the sam pled output. Each of the 32 receiver can independently select any one c the four A/D input sources.

Pentek
INFO/CARD 139

IrDA-compatible transceiver enables handheld devices

IrDA-compatible infrared transceiv er in a sunk mounting package tha can be affixed to the edge of a printe circuit board. With a 115.2 kbp/s max mum data rate, the transceiver i offered in a notched surface-moun "Dracula" package measuring 13 mm 7.5 mm. Its height profile of 1.8 mr over the PCB will enhance the abilit of designers to slenderize IR-enable palmtops and other mobile system while providing IR connectivity at dis tances up to 1 meter.

Vishay
INFO/CARD 140

TEST AND MEASUREMENT

Monopulse beacon radar test set

The Monopulse Beacon test set i specifically designed for field techn cians to certify Monopulse Secondar

At Trilithic, we understand that everyone's needs are a little different. And we're a little different in the way our engineers see the world. That's how we're able to create some of the most innovative products in the industry, including our line of custom filters. We offer a complete selection of filters (bandpass, lowpass, highpass, bandreject, helical resonators and dielectric resonators) in a variety of formats (surface mount, PC mount, cavity, combline, tubular, tunable, miniature, connectorized, hermetically sealed). Our filters can be designed for commercial, space, military and industrial applications. With a frequency range of 30 KHz to 18 GHz, and power up to 4 kW CW, we can customize a filter to cover the depth and breadth of any project. Put simply, no application is alien to us.

Call 1-800-TRILITHIC for more information & don't forget to ask for your free catalog.

TRILITHIC
Hard Working Engineers–Like You

9202 East 33rd Street / Indianapolis, IN 46235
800TRILITHIC (800-874-5484) (317)895-3600 (317)895-3612 Fax
E-Mail: sales@trilithic.com / Internet:www.trilithic.com

INFO/CARD 47

Surveillance Radar (MSSR) system sensitivity and target detection. It provides the ability to test the MSSR from end-to-end, through the injection of ATCRBS signals or mode S RF test targets into the MSSR front end. MSSR test targets can be observed at various points in the MSSR system and when used for overall system sensitivity, can be processed through to the controller's display. The MBTS primary functions include measuring and calibrating receiver sensitivity, measuring and calibrating fixed thresholds, measuring and calibrating sensitivity time constant curves, measuring and calibrating delta/sum threshold, measuring and calibrating sum/omni threshold and testing and alignment of receivers, using pulsed and CW monopulse receiver signals.
Freestate Electronics
INFO/CARD 141

Multi-channel digital pulse generator

The Model 555 digital pulse generator from Berkeley is capable of digital delay and pulse generation of multi-channel, 1 ns-resolution timing, delaying, gating, pulsing and syncing functions. Each channel provides both delay and width functions, so a 2 channel model 555 provides the same delay and width functionality of competitive 4-channel units. The 555 is available in 2, 4 and 8 channel configurations and can provide precise delays and widths with 1 ns resolution for times up to 100 seconds. These pulses are synchronized to a common trigger or an internal trigger.
Berkeley Nucleonics
INFO/CARD 142

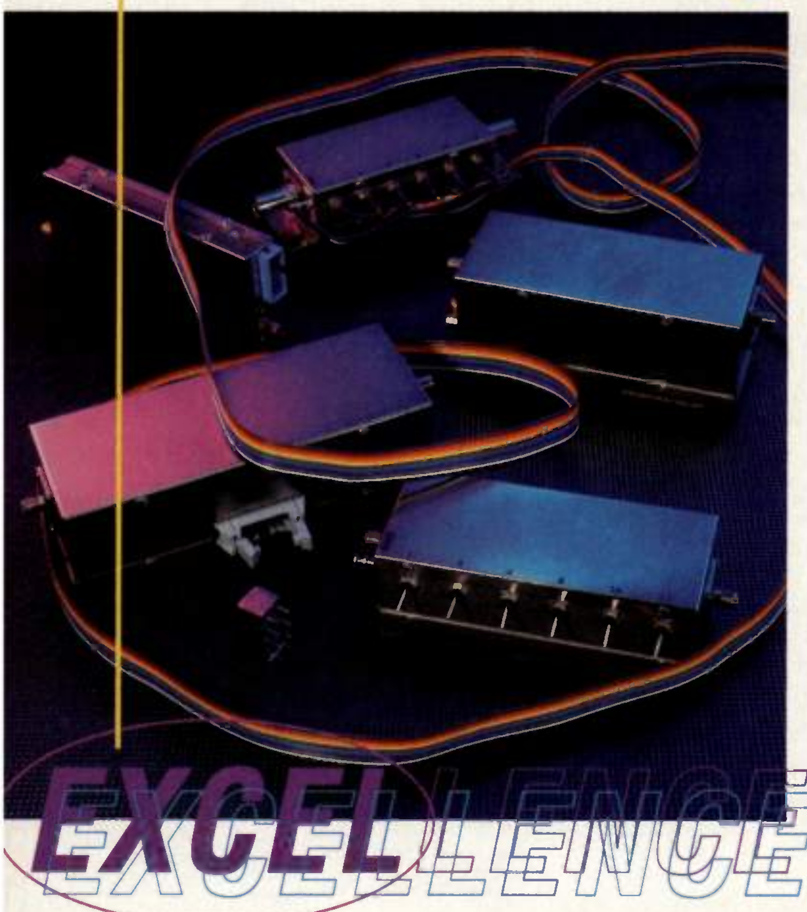
Amplifier for IEC measurements

The 150W1000 is a broadband test amplifier offering 150 W minimum power and frequency response from 80-1000 MHz. The unit is designed to provide a margin of power when testing to IEC 10V/m requirements at 3 meters from 80 to 90 MHz. This addresses the issue of lower power amplifiers that may not be able to gen erate a sufficiently strong field at th bottom end of the frequency range The amplifier is equipped with a DC that provides local and remote contr of the amplifier. A four line digital dis play, menu assigned softkeys, rotar knob, and four dedicated switche offer control and status reporting ca pability. Operational presentation c forward and reflected power, contr status and reports of internal ampli fier status are also provided.
Amplifier Research
INFO/CARD 143

B series offers cable and antenna analyzer

Anritsu's latest hand-held instru ments from their site master cable an antenna analyzer product family fea ture increased rejection of interferenc signals, distance-to-fault measuremen capabilities, enhanced range and number of other features. With the Sit Master B series, network operators an service providers can pinpoint problem much faster and more accurately tha

Innovatio

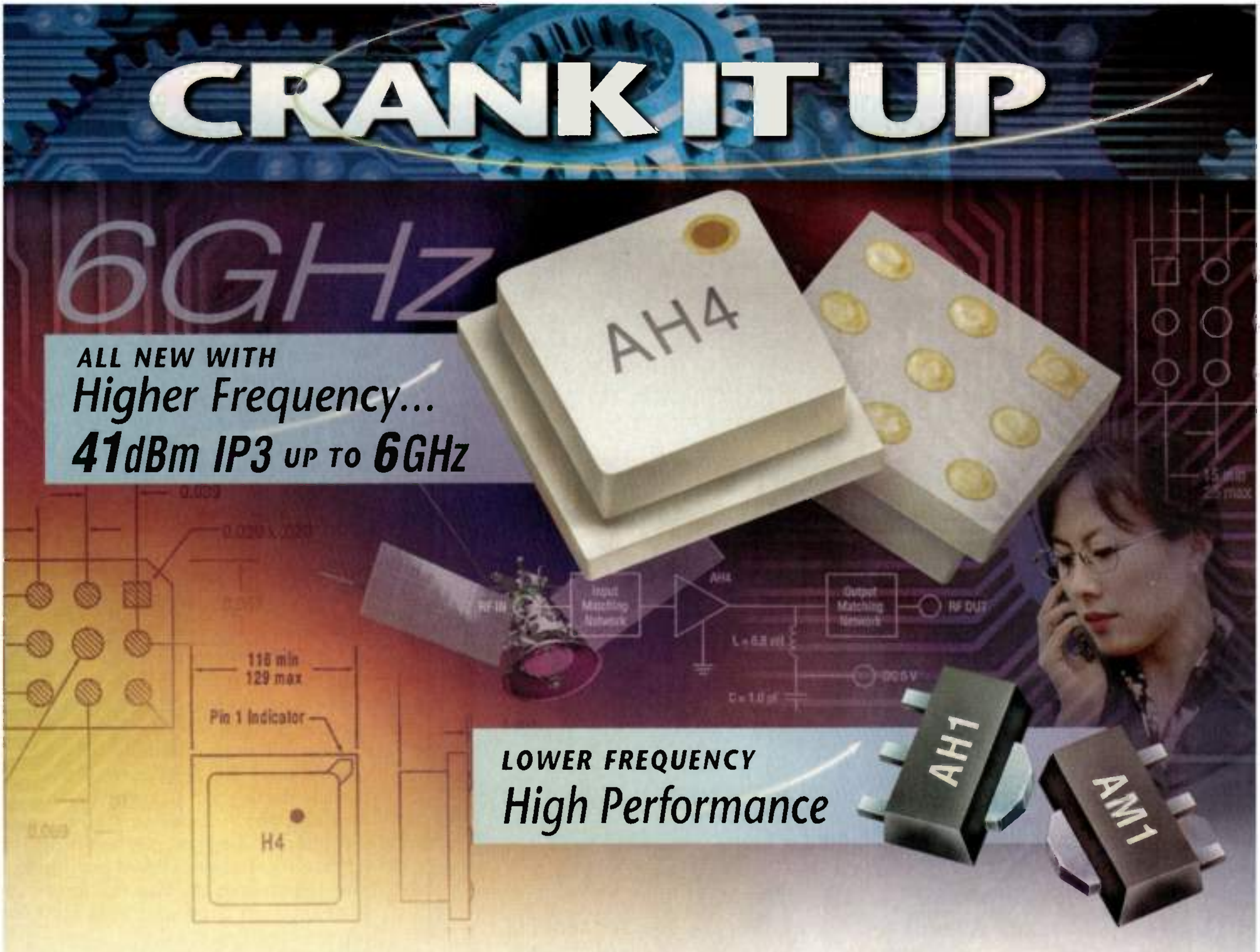


JFW has designed and manufactures over 1200 differen programmable attenuators. Features include wide attenuation ranges, optional step sizes, various package styles and connector options to provide system designer the flexibility required in today's global market.

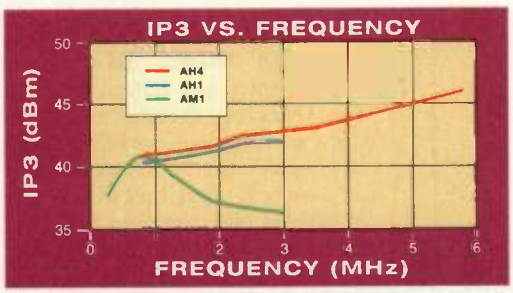
- ***New*** DC-2500 MHz Low Cost/High Performance series
- Solid-State, wide band models
- Models with frequency ranges up to 5Ghz
- GPIB controlled models available
- 50 and 75 ohm impedances available

JFW Industries, Inc.
5134 Commerce Square Drive • Indianapolis, Indiana 46
Tele. (317) 887-1340 ***Fax*** (317) 881-6790
Internet– http://www.jfwindustries.com
E-mail– sales@jfwindustries.com
ISO 9001 Certified

INFO/CARD 50 or visit **www.rfdesign.com**



Need Higher Frequency? You need Watkins-Johnson's new AH4 amplifier.



WJ High Dynamic Range Amplifiers

Product	Frequency (MHz)	IP3 (dBm, typ.)	P1dB (dBm, typ.)	NF (dB, typ.)	Bias current (mA, typ.)
AH4	100-6000	41	21	3.9	150
AH1	250-3000	41	21	2.7	150
AM1	250-3000	36	18	2.6	75

High IP3 up to 6 GHz is what our new AH4 is all about. Combined with a low noise figure, it's the perfect choice for today's multichannel wireless systems. Drawing only 150mA and operating from a single positive supply, the AH4 delivers an IP3 of 41dBm. A great price combined with the outstanding linear efficiency up to 6 GHz makes this a versatile amplifier. It is perfect for multiple sockets, reducing overall part count.

Need lower frequency performance? Both the AH1 and AM1 offer low noise figures which, together with their inherent high IP3, deliver superior performance at the best price in the industry.

For more details, call our toll free number or fax us at 650-813-2447. Email us at wireless.info@wj.com to request data sheets and a complete catalog.

Visit us on the web at www.wj.com

1-800-WJ1-4401

WATKINS-JOHNSON

Distributed In U.S.A. by Nu Horizons Electronics: 888-747-6846; **Richardson Electronics:** 800-348-5580

In Europe call WJ: +44-1252-661761 or your local Richardson Electronics Office: **France:** (01) 55 66 00 30; **Germany:** (089) 890 214 0; **Italy:** (055) 420 10 30 **UK:** (01753) 733010

INFO/CARD 51

before. Other features include a high-resolution full VGA display, field-replaceable NiMH battery that consistently provides 2.5 hours of operating time and enough memory to store up to 200 time and date stamped measurements and can be custom labeled.
Anritsu
INFO/CARD 144

Wideband vector signal analyzer

The Agilent 89600 series VSA offers a 36 MHz bandwidth capacity for measuring RF signals up to 2.7 GHz. Applications include cellular and satellite communications, digital video and local multipoint distribution service (LDMS). It is also avai able with a VXI-based front end usin one or two baseband inputs coverin bandwidths to 40 MHz. The 89600 i an integrated solution of VXI harc ware and measurement software tha resides on PC using Windows NT. It i designed for use as a PC hosted VS. for communications design. Th device offers design simulation, moc eling and documentation in a singl integrated interface.
Agilent
INFO/CARD 145

Low profile EL choke coil

The D31FU is a low profile unshielded inductor designed for us as an EL inverter IC choke coil. Th coils are available in 0.10 to 1.2 ml inductance values have a 3.3 mm 3.3 mm footprint with a height profil of only 1.7 mm maximum. The serie can be used for electro-luminescenc backlighting implementation i portable applications including cellu lar phones, pagers, personal digita assistants, handheld test equipment and chronographs. The inductors ar packaged on tape and reel in 3,00 piece quantities.
Toko
INFO/CARD 146

PASSIVE COMPONENTS

Dual tracking precision trimmer capacitors

Voltronics has expanded its line o dual tracking precision trimmer capac itors to work in the GHz range. Th tuning screw of the split stator styl adjusts two capacitors at the same rat and have one common terminal. Th sapphire dielectric part, V6152, tune from 0.5 to 3.5 pF, is 0.48" long an can be used to over 2 GHz. At 25 MHz, the Q is over 1500 and it can b tuned over 10 full turns.
Voltronics
INFO/CARD 147

Ultra-low ESR microwave capacitors

ATC's 600 series capacitors offer a ESR of 80 mΩ at 1 GHz. Designe around RF and Microwave applica tions, this NPO capacitor support requirements where low loss and high

AEA VIA Impedance ANALYZER

The AEA Division of Tempo specializes in hand-held test instruments for the wireless communications industry


VIA-HF

We are pleased to introduce the new ***VIA-HF Impedance Analyzer*** in the same compact and portable package as the AEA SWR Analyst products. This product offers virtually all the features of the SWR Analyst products plus many additional features such as Graphical presentation of Impedance, Resistance, and Reactance curves. The ***distance to the nearest short or open*** in a coaxial cable can easily be determined. You can tune antennas, receivers and most tuned circuits over the **frequency range of 100 kHz to 54 MHz with resolution of 1kHz/div. to 2 MHz/div. for a 20 MHz wide display.**

The VIA-HF includes a ***Relative Field Strength*** indicator mode plus an RS-232 port for connection to a PC. ***Windows 95/2000*** compatible ***VIA Director Software*** (included) allows printing out multiple overlapping curves.

Curves can also be stored to hard disk and can be easily inserted into report documents. A simple loop probe on the end of a short piece of coax lets the VIA-HF be used as a sophisticated ***"RF Dipper"*** or for injecting a ***signal-tracing*** signal into a receiver. The signal generator mode places a trigger pulse on the RS-232 port.

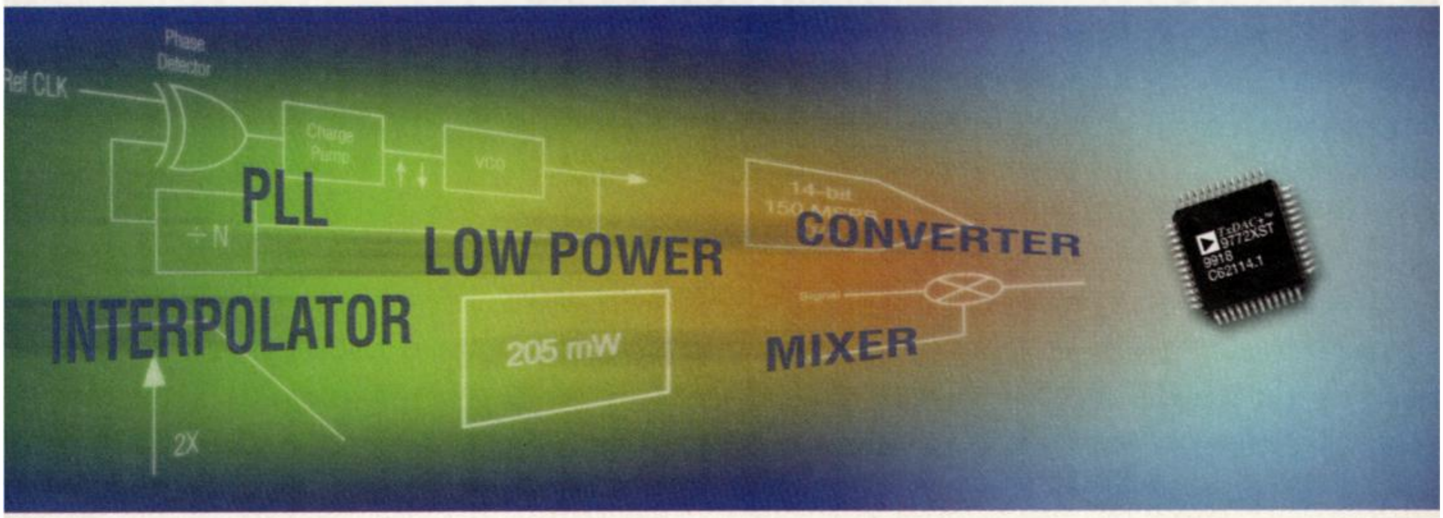
See complete information on these and other AEA products on our website.

www.aea-wireless.com
1-800-258-7805
FAX: 1-760-598-5634

AEA
A Division of
Tempo
A COMMUNICATIONS COMPANY

INFO/CARD 42 or visit **www.rfdesign.com**

Eliminate transmit mixers with this 14-bit, 150 MSPS Direct-IF DAC.



Third generation TxDAC+® shortens the distance from processor to antenna.

The very first DAC to offer Direct-IF, the 14-bit, 150 MSPS, AD9772 is a new generation of the TxDAC+ family for advanced communications designs. With a 2X interpolation filter, internal PLL and $f_S/4$ digital mixer, the AD9772 combines the power of high-performance signal processing with an outstanding third generation core. It delivers superior baseband performance with SFDR beyond 75dBc for a 2 to 35 MHz band, and 75 dB ACPR performance. It's available in a 48-lead LQFP and is priced at $32.18*. For software digital radios, point-to-point microwave, WLL or third generation base stations, this DAC is built for the communications needs of the next millennium.

More Architectural Possibilities *Wireless infrastructure networks of the future are based on breakthrough signal processing ICs like the AD9772 from Analog Devices. These include Direct-IF conversion ADCs, Direct-IF transmission DACs, Direct-RF products, and SoftCell™—a complete family of scalable solutions for multi-standard, multicarrier, software digital radios.*

For free sample, data sheet and evaluation board information:
Visit www.analog.com/TxDAC or call 1-800-ANALOGD.

ANALOG DEVICES

THE WORLD'S NUMBER ONE BRAND FOR HIGH-PERFORMANCE ANALOG ICs.

INFO/CARD 52

*USD 1,000s, recommended resale, FOB U.S.A. Ad Code 3864

Sprague Goodman

SURFCOIL® Inductors & Transformers

SMT TUNABLE RF COILS
- Inductance from 14 nH to 680 µH
- Tuning range up to ±7.5%
- Five terminal pad layout allows for a variety of inductor and transformer configurations

SMT AIR COIL
- Inductance from 5.3 to 43.0 nH
- 2 sizes:
  3.7 x 4.4 x 3.2 mm
  7.1 x 4.4 x 3.2 mm

SMT TRANSFORMERS
- Encapsulated 4.5 x 3.4 x 3.1 mm
- Bobbin wound 4.4 x 4.4 x 3.3 mm
- Dual aperture cores
  Baluns
  Directional couplers
  Power splitters
  2 windings (with and without tap)
  3 sizes: 4.5 x 4.5 x 2.8 mm
  5.7 x 5.7 x 4 mm
  6.5 x 5.7 x 4 mm

SURFCOIL® SMT CHIP INDUCTORS
- Inductance from 2.2 nH to 1 mH
- 13 model series in 6 sizes
  1.0 x 0.5 x 0.5 mm (0402)
  1.6 x 0.8 x 0.8 mm (0603)
  2.00 x 1.25 x 1.25 mm (0805)
  2.5 x 2.0 x 1.6 mm (1008)
  3.2 x 2.5 x 2.2 mm (1210)
  4.5 x 3.2 x 3.2 mm (1812)
- Shielded, unshielded, ferrite core and nonmagnetic models
- Operating temp: -40° to +85°C
- Carrier and reel standard

For information on these and our other quality products, visit our website or phone, fax or write today.

SPRAGUE GOODMAN

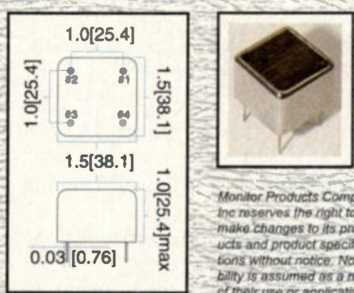
1700 Shames Drive, Westbury, NY 11590
Tel: 516-334-8700 • Fax: 516-334-8771
Website: http://www.spraguegoodman.com

INFO/CARD 54 or visit **www.rfdesign.com**

High Performance, Low Cost, Low Current OCXO with Tight

Monitor Products' SO-1321 OCXO combines high stability with low cost in a compact package. It is ideal for use in instrumentation, telecommunications and any application requiring a high stability frequency source.

- Frequency output ranges from 1.0~50.0 MHz
- Various output waveform options
- Input voltage options (5.0~24.0V)
- Frequency stabilities to ±1 x 10⁻⁹
- Electronic trim option



Units=inches [mm]

Monitor Products Company Inc reserves the right to make changes to its products and product specifications without notice. No liability is assumed as a result of their use or application.

CORPORATE OFFICE & FACTORY 502 Via del Monte, Oceanside, CA 92054, Tel : 760.433.4510

Regional Sales Office 3415 Custer Rd, Ste 117, Plano, TX 75023, Tel : 972.758.8687

Monitor Products has a proven 70-year track record as a manufacturer in the frequency control market. If our extensive selection of standard and engineered crystals, clock oscillators, VCXOs, TCXOs, VCTCXOs and OCXOs does not meet your spec, we will work with your design team to devise a cus-

MONITOR PRODUCTS COMPANY INC
A Bowthorpe company

INFO/CARD 55 or visit **www.rfdesign.com**

performance are paramount. With u to 100 pF in a 0603 case size, the 60 series has a rated voltage of 250 volt All parts are available laser marke and in tape and reel.
American Technical Ceramics
INFO/CARD 148

Rugged, economical power resistors

1ohm's high power, tubular resisto are wirewound on ceramic tubes an enamel coated for durability. Range include fixed, tapped and adjustable, 2 to 225 W, 0.1 Ω to 1.5 MΩ, ±20 to 40 ppm/° C, and 1 to 5% tolerances. Non inductive types and other ranges ar also offered. Application includes pow products, motor controls, dummy load load banks, bleeder and bias circui and shunt resistors.
1ohm
INFO/CARD 149

Inductor series comes in surface mount package

The Model DR333-7 series SM filter inductors have high-energ storage capacity to provide efficient fi tering of "ripple" in the input or outpu channels of the power supply Available with frequency range of 0. to 10 MHz, a broad selection on c standard inductance values and cu rent ratings up to 3.6 A, the series ar effective in filtering 2nd and 3rd orde harmonics of the ripple frequency i DC-DC converter power supplies rate at 50 W and lower. The series is avai able in five different model familie and designed in a wide range of perfo mance configurations. Inductanc ranges available are from 0.47 µ (±10%) at 1 kHz with a DCR of 20 Ω a 0.075 A. Operation temperature is –4 to +85° C.
Datatronics
INFO/CARD 150

High speed decoupler in a 0508 package

AVX has expanded its line of IDC to include a 0508 chip with a mea sured inductance of 110 pH and avai able in capacitance values of up to 1. µF . The 05058 IDC connects wit eight vias to power and ground plane offering a solution for the high spee decoupling necessary with today' high-speed microprocessors.
AVX
INFO/CARD 151

BIPOLAR AMPLIFIERS

STANDARD OPTIONS

- Connector Options: SMA, BNC, Type N
- Integrated Limiters
- Input Bias Tee for Fiberoptic Photodetectors

FREQUENCY (MHz)	MODEL NUMBER	GAIN (dB, Min.)	GAIN FLATNESS (±dB, Max.)	VSWR IN/OUT	NOISE FIGURE (dB, Max.) F_1	$F_ø$	F_2	OUTPUT POWER (dBm, Min.)	DOMESTIC PRICE (1-9 PCS)
0.01 – 200	AU-1442	35	0.5	2.0:1	1.2	1.2	1.2	5	$300
0.01 – 200	AU-1447	56	0.5	2.0:1	1.2	1.2	1.2	12	$325
0.01 – 500	AU-1310	30	0.5	2.0:1	1.3	1.4	1.5	8	$300
0.01 – 500	AU-1332	45	0.5	2.0:1	1.3	1.4	1.5	10	$325
0.01 – 1000	AM-1300	27	0.75	2.0:1	1.4	1.6	1.8	8	$325
0.01 – 1000	AM-1431	35	0.75	2.0:1	1.4	1.6	1.8	10	$350
0.02 – 1000	AM-1551	38	1.0	2.0:1	1.4	1.6	1.8	15	$350
1 – 100	AU-3A-0110	55	0.5	2.0:1	1.2	1.2	1.2	12	$300
1 – 200	AU-1464	35	0.5	2.0:1	1.2	1.2	1.2	6	$275
1 – 200	AU-1494	56	0.5	2.0:1	1.2	1.2	1.2	11	$300
1 – 500	AU-2A-0150	30	0.5	2.0:1	1.3	1.4	1.5	8	$275
1 – 500	AU-3A-0150	45	0.5	2.0:1	1.3	1.4	1.5	10	$300
1 – 500	AU-4A-0150	60	0.5	2.0:1	1.3	1.4	1.5	10	$325
1 – 1000	AM-2A-000110	26	0.75	2.0:1	1.4	1.6	1.8	8	$300
1 – 1000	AM-3A-000110	35	0.75	2.0:1	1.4	1.6	1.8	8	$325
1 – 1000	AM-4A-000110	51	1.0	2.0:1	1.4	1.6	1.8	9	$350
5 – 300	AU-1021	24	0.5	2.0:1	2.4	2.5	2.7	20	$275
5 – 300	AU-1525	61	0.5	2.0:1	1.2	1.2	1.3	20	$350
100 – 1000	AM-1412	35	0.75	2.0:1	1.4	1.6	1.8	15	$350
100 – 2000	AM-1526	9	1.0	2.0:1	8	5.5	5.5	20	$350
200 – 2000	AMMIC-1427	20	1.5	2.2:1	4.2	4.3	4.6	14	$375
500 – 1000	AM-2A-0510	24	0.5	2.0:1	1.4	1.5	1.6	0	$300
500 – 1000	AM-3A-0510	38	0.5	2.0:1	1.4	1.5	1.6	9	$325
500 – 2000	AM-3A-0520	29	0.75	2.0:1	1.4	1.9	2.4	3	$350
1000 – 2000	AM-3A-1020	29	0.5	2.0:1	1.8	2.1	2.4	10	$325
1000 – 2000	AM-1477	39	1.0	2.0:1	1.8	2.1	2.4	15	$350
1000 – 2000	AM-4A-1020	40	0.75	2.0:1	1.8	2.1	2.4	10	$350

3 YEAR WARRANTY

NQA ISO 9001 REGISTERED COMPANY

Maximum 2 week delivery for small quantities. For additional information, please contact Bill Pope at (516) 439-9115 or e-mail wpope@miteq.com

MITEQ

100 Davids Drive, Hauppauge, NY 11788
TEL: (516) 436-7400 • FAX: (516) 439-9333/436-7430
www.miteq.com

INFO/CARD 56

INFO/CARD 11 or visit www.rfdesign.com

INFO/CARD 59 or visit www.rfdesign.com

CABLES AND CONNECTORS

Right angle bend assemblie and adapters

The 3221-1-L series of pre-ber right angle assemblies uses th center conductor of 0.141" semigri cable as the contact. This desigı combined with an ultra-short SM plug provides the same or smalle profile as a right angle connectc without the performance penalty User specified lengths to 60" ar available as well as bent assemblie and adapters using other connector and cable.

Coaxial Components
INFO/CARD 152

New line of MHV connectors

The MHV connector series provid shielded disconnects where high volt ages are present and the BNC typ interface required. Center contacts ar recessed within lengthened dielectri material to provide protection agains electrical shock when handling unmat ed connectors. These non-constan impedance MHV connectors are buil to MIL-39012 interface specification and feature nickel-plated, machin brass bodies, gold-plated pins and con tracts and Teflon insulation fo enhanced performance.

RF connectors
INFO/CARD 153

Vertical, low profile TNC conector

Die cast vertical TNC, CTP-TV-04 for 50Ω and the CTP-7TV-042 fo 75 Ω connectors are die cast zinc witl nickel plating. The connector center i phosphor bronze with gold plating anc the insulator is PE606. This combina tion allows the jack to perform proper ly over the life of the end product. Th frequency range is DC to 4 GHz Applications include cell phone, air craft, communication antennas as wel as other RF applications.

Connect-Tech Products
INFO/CARD 154

Ringflare one piece connector family

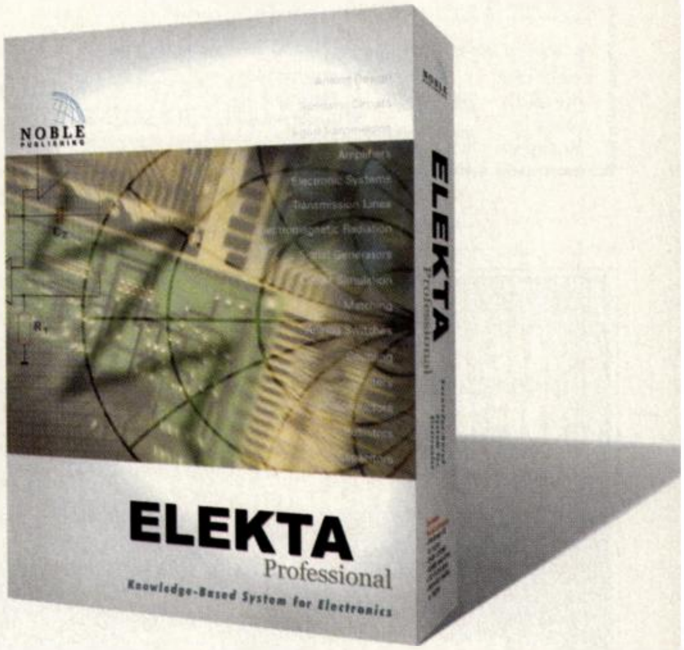
The ringflare connectors have fac

You have questions...

How many microvolts is –85 dBm at 50 ohms?
What is the spectral content of QPSK?
What the resistor color code and standard values?
How do digital IIR and FIR filters work?
What mixer spurs result from 70 MHz RF and 18.1 MHz LO?
How does an active filter work?
How do I wind a 120 nH inductor?
What capacitor resonates with 2.2 μH at 10.7 MHz?
What VSWR corresponds to 12 dB return loss?
What's the effect of reducing Q from 300 to 100?
What is Miller effect?
How do I perform two-port transformations?
How is bias set on bipolar transistors and FETs?
What are the basics of SPICE analysis?
What do all those noise parameters mean?
How do I make a 700 Hz active bandpass filter?
What are Maxwell's equations?
Can I graph the sin(x)/x curve?
What dimensions do I need for a 50 ohm microstrip?
How do I match 25 +j40 ohms to my 75 ohm system?
Where can I find a review of Kirchoff's Laws?
How much antenna gain does my system need?
How do I bias a BFR91 or 2N2222 transistor?
Will I get bad crosstalk between lines on my p.c. board?
Can I perform basic transfer function math?
How can a beginner learn about components at RF?
What's the difference between linear and non-linear?
What is the capacitance of two 1×1 cm plates spaced 1 mm?
Why do we use feedback?
I know RF, but where can I find digital basics?
Can I do vector to scalar conversons?
What is the AC impedance of a parallel R-C network?
What is a conductor's skin depth at 900 MHz?
What do those thermal resistance numbers mean?
Can I visualize the field lines between capacitor plates?
What is the mismatch loss of a 5.22:1 VSWR?
How do I simulate a darlington pair amplifier?
What are the resistor values for a 50 ohm 6 dB pad?
Should I use a pi or tee matching network in my circuit?

ELEKTA
Professional

has the answers!



SPECIAL INTRODUCTORY OFFER

$89

shipped FREE within US and Canada
($109 shipped worldwide)
This is a limited time offer

NOBLE PUBLISHING

For information or to order contact:
Noble Publishing, 4772 Stone Drive, Tucker GA 30084
Tel: 770-908-2320 • Fax: 770-939-0157
www.noblepub.com

INFO/CARD 60

* Dealer inquiries invited

tory preset captivated inner contact pins for guaranteed pin depth needing no verification or adjustment. A fully weatherproof seal is achieved through the connectors' prelubricated integral O-ring-to-cable seal that is seated on the corrugated copper outer conductor of the coaxial cable. The connectors install ten times faster than multiple component connectors

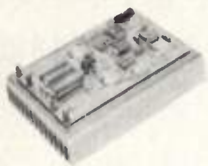
Andrew
INFO/CARD 155

Low loss cable assemblies for communication devices

Lightweight aluminum cable assemblies that offer the electrical characte istics of copper jacketed, low loss sen rigid cable assemblies are now ava able with a soft, lightweight Aluminu outer conductor. These low-loss cab assemblies are supplied with crimp-c or conventional connectors. The cabl are designed for electronics applic tions where lightweight and easy-t bend qualities are applicable. Typic applications include Instrumentatio television, HF communication and av ation. The cables offer VSWR of 1.35 to 18 GHz for assemblies with tv straight connectors, 1.40:1 to18 GHz f assemblies with one straight connect and one right angle connector ar 1.45:1 to 18GHz for assemblies wit two right angle connectors.

RFCircuits
INFO/CARD 156

HF LINEAR AMPLIFIERS - BROADBAND TRANSFORMERS



HF AMPLIFIERS per MOTOROLA BULLETINS
Complete Parts List for HF Amplifiers Described in the MOTOROLA R.F. Device Data
AN758 300W
AN762 140W
AN779L 20W
AN779H 20W
AR313 300W
EB63 140W
EB27A 300W
EB104 600W
AR305 300W
NEW!! 1K WATT 2-50 MHz Amplifier
MOTOROLA AR347
POWER SPLITTERS and COMBINERS
2—30MHz
600 Watt PEP 2—Port .... $ 69.95
1000 Watt PEP 2—Port .... $ 79.95
1200 Watt PEP 4—Port .... $ 89.95

2 METER VHF AMPLIFIERS
35 Watt Model 335A.......... $ 79.95 Kit
75 Watt Model 875A .... $119.95 Kit
Available in kit or wired/tested

100 WATT 420-450 MHz PUSH-PULL LINEAR AMPLIFIER — SSB-FM-ATV
KEB67—PK (Kit)........................ $159.95
KEB67—PCB (PC Board) .... $ 18.00
KEB67—I (Manual) .... $ 5.00
We also stock Hard-to-Find parts
CHIP CAPS—Kemet/ATC
METALCLAD MICA CAPS—Unelco/Semco
RF POWER TRANSISTORS
MINI—CIRCUIT MIXERS
SBL—1 (1—500Mz).............. $ 6.50
SBL—1X (10—1000Mz) .... $ 7.95
ARCO TRIMMER CAPACITORS
Broadband HF Transformers

For detailed information and prices, call or write for our free catalog.
www.communication-concepts.com

Celebrating our 20th Year in Business
VISA
CCI Communication Concepts Inc.
508 Millstone Drive • Beavercreek, OH 45434-5840 • (937) 426-8600
FAX (937) 429-3811 • E-mail: cci.dayton@pobox.com
MasterCard
Celebrating our 20th Year in Business

INFO/CARD 92 or visit www.rfdesign.com

RIDE THE WAVE OF PHONON'S EXPERTISE!

SAW components and subsystems for IF signal processing in military and professional OEM equipment.

Engineering support and unique design capabilities enable prototype development allowing more competitive NRE pricing and quick delivery.

COMMUNICATIONS: IF bandpass filtering for: cellular base stations, microwave links, mobile digital radio, MSK matched filters.

RADAR: Wide band matched filters, pulse compression using bi-phase, linear and non-linear frequency modulations.

ELECTRONIC WARFARE: Real time spectrum analysis, channelized filter banks, delay lines.

SPACE: High reliability SAW components for satellite use.

PHONON CORPORATION

PHONON CORPORATION
P.O. Box 549
90 Wolcott Road, Simsbury, CT 06070
Tel: (860) 651–0211 Fax: (860) 651–8618

INFO/CARD 61 or visit www.rfdesign.com

SEMICONDUCTORS/ ICS

Single-chip, ISM band transmitter

The NT2800 is a complete, singl chip, FM/FSK transmitter IC, whic will operate in any 26 MHz band fro 800 MHz to 1.0 GHz, on a 2.7 to 3.3 supply. The device integrates on-chip VCO, phase-locked loop, and referen oscillator. Tuning is accomplished via 3-wire serial interface. Power output +1.5 dBm at 50 Ω and packaging is 16-pin TSSOP.

Numa Technologies
INFO/CARD 157

PHEMT GaAS IC high linearity SPDT switch

Alpha Industries' PHEMT GaA FET IC high linearity SPDT switch fea tures +2.5 to +5V linear operation a input power levels greater than +3 dBm. The AS191-73 transmit/receiv switch features low insertion loss (0. dB @ 0.9 GHz), high isolation (27 dB 0.9 GHz) and can be used in many ana log and digital wireless communicatio systems including cellular, GSM an DECT applications.

Alpha Industries
INFO/CARD 158

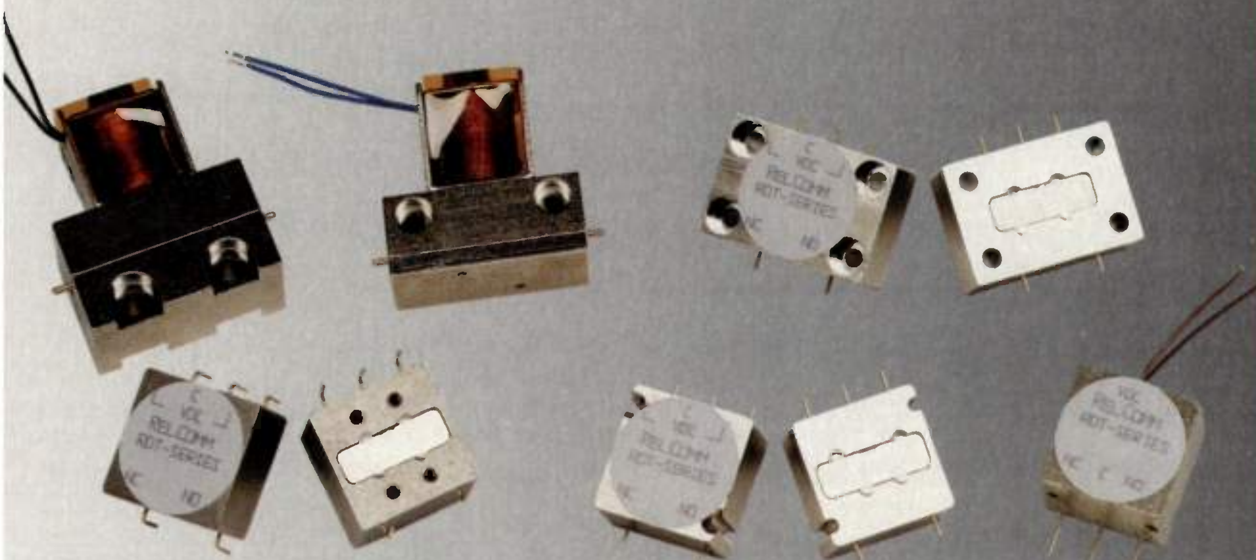
Second generation GaAs devices

Oki Semiconductor has three add

Design Enhanced Application Specific

SMT COAXIAL RELAYS

Now Very Affordable



Typical Insertion Loss is 0.07dB at 900MHz, 0.12dB at 1900 MHz
Typical Isolation is 85dB at 900MHz; 75dB at 1900MHz
Designs available up to 8GHz

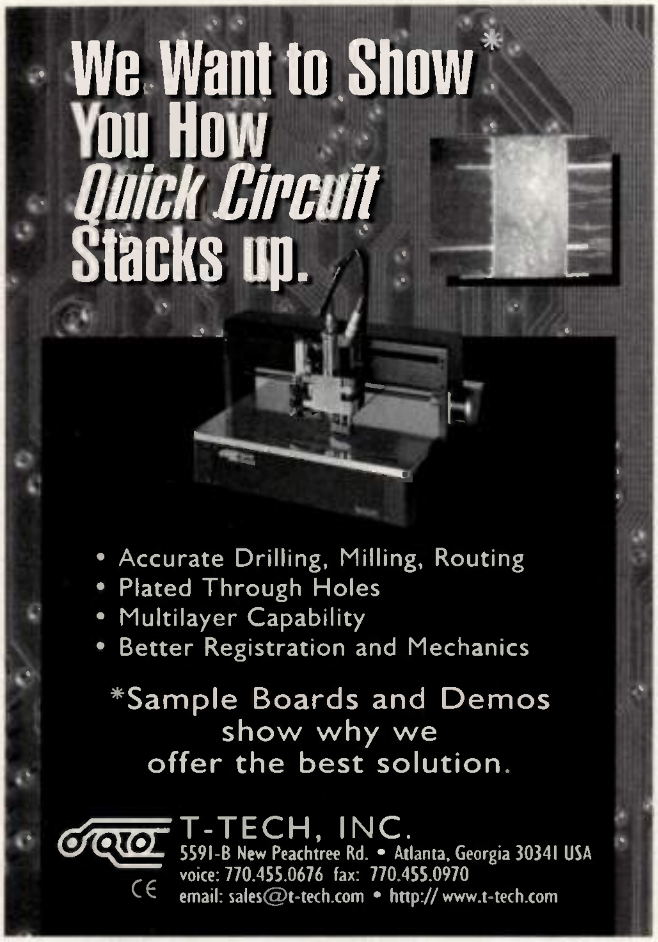
RELCOMM
TECHNOLOGIES, INC.

COMMITMENT TO SERVE THE CHANGING NEEDS OF THE CUSTOMER BY DESIGN

INFO/CARD 12

EXCELLENCE BY DESIGN

) Beam Street, Salisbury, Maryland 21801 Sales Office...410-749-4488; Fax...410-860-2327



INFO/CARD 24 or visit **www. rfdesign.com**

tions for its gallium arsenide (GaAs) product famil[y] Operating at 10 Gbps, Oki's devices can be used in lon[g] and short-haul optical communications networks. Th[e] devices include a limiting amplifier, 16:1 multiplexer an[d] a 1:16 demultiplexer and are designed for both receive[r] and transmitter applications at optical carrier rates of 1[0] Gbps (OC-192).
Oki Semiconductor
INFO/CARD 159

GaAs HBT FET LNS for L and S band receiver

A miniature GaAs heterojunction bipolar FET from NE[C] by California Eastern Laboratories requires a single powe[r] supply. The requirement for a second, negative supply i[s] eliminated. Designed for use as an LNA in TDMA handset and other L and S band receiver designs, the NE5211 delivers low noise/high gain performance.
CEL
INFO/CARD 160

Low-drift RF detector/ controller

Analog Devices' RF detector/controller enables precis[e] temperature stable power amplifier control and support

Continued on page 8

INFO/CARD 62 or visit **www. rfdesign.com**

INFO/CARD 65 or visit **www. rfdesign.com**

Get a clear shot on MCX and Mini-75 Ohm SMB Connectors

king for the right combination of quality connectors, ice and support? Richardson Electronics has a clear on true 75-ohm coaxial connectors and terminations Johnson Components... And, we won't leave you ind the eight ball!

nologies such as Digital Video, CATV and Computer working have been traditionally based on the 75-ohm smission impedance standard. Increasing signal speeds ese applications demand the proper selection of coaxial es and connectors for optimum performance. ardson Electronics meets the needs of these evolving nologies with a broad line of true 75-ohm coaxial nectors and terminations manufactured by Johnson nponents.

All of Johnson Components 75-ohm connectors have been designed to exhibit low VSWR, resulting in efficient signal and data transfer. The 75-ohm connectors will also mechanically mate with their 50-ohm counterparts, which prevents damage due to accidental misapplication. Johnson Components' 75-ohm product lines distributed by Richardson Electronics include flexible plugs and jacks, PC mount plugs and jacks, in-series matched adapters, between-series adapters, original end launch design, terminations and 50 to 75-ohm minimum loss matching pads.

Depend on Richardson's extensive inventory and efficient distribution system to get your order shipped same day (as late as 6 p.m. CST). Remember, the solution to your interconnect needs are only a phone call away.

Call Richardson Electronics for Johnson Components interconnect products — 1-800-RF POWER

RELL Online catalog.rell.com Catalog

Visit our online catalog at *catalog.rell.com*

Johnson Components™

Richardson Electronics

gineered Solutions

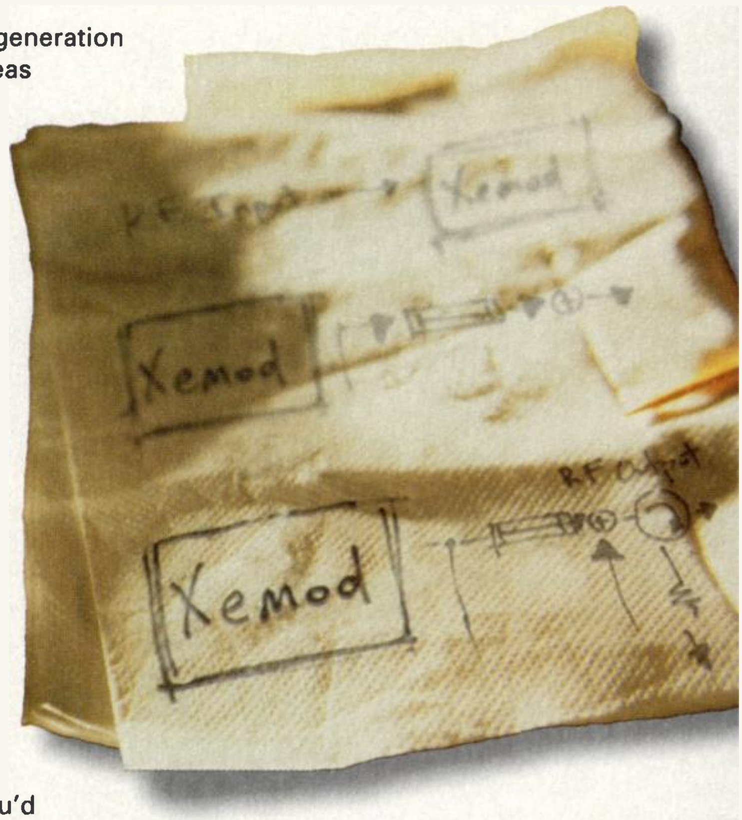
More than 60 locations worldwide to serve you. Email: ssc@rell.com, **Internet:** www.rfpowernet.com/Johnson_Components.asp, **Toll Free:** 800-RF Power or 800-737-6937 (U.S. & Canada), **Australia:** Castle Hill, ACN 069 808 108, +61 (2) 9894-7288, Baywater, ACN 069 808 108, +61 (3) 9738-0733, **Brazil:** Sao Paulo, +55 (11) 820-6199, **China:** Shanghai, +86 (21) 6440-0807, **Colombia:** Sante Fe de Bogota, DC, (57-1) 636-1028, **France:** Colombes Cedex, +33 (1) 55.66.00.30, **Germany:** Puchheim, +49 (89) 890 214-0, Hamburg, +49 (40) 555 88 410, **Italy:** Sesto Fiorentino (FI), +39 (055) 420831, Agrate Brianza (MI), +39 (039) 653145, Roma, +39 (06) 41.73.37.51, **Japan:** Osaka, +81 (6) 6314-5557, Tokyo, +81 (3) 5215-1577, **Korea:** Seoul, +82 (2) 539-4731, **Mexico:** Mexico City, +52 (5) 674-2228, Guadalajara, +52 (3) 645-4641, **Netherlands:** Amsterdam, +31 (20) 446 7070, **Philippines:** 63-2-633-9480, **Singapore:** +65 487-5995, **Spain:** Madrid, +34 (91) 528 3700, Barcelona, +34 (93) 415 8303, **Sweden:** Stockholm, +46 8 564 705 90, **Taiwan:** Taipei, +886 (2) 86915238, **Thailand:** Bangkok, +66 (2) 749-4402, **Turkey:** Içlevent Istanbul, +90 212 264 3721 **United Kingdom:** Lincoln, +44 (1522) 542631, Slough, +44 (1753) 733010, **Vietnam:** Ho Chi Minh City, +84 8.811.1919. For other international inquiries call **Corporate Headquarters:** LaFox, IL (630) 208-2200, Fax (630) 208-2550. MK0523 ©2000 Richardson Electronics, Ltd.

00-RF-POWER • www.rfpowernet.com/Johnson_Components.asp • ssc@rell.com

XEMOD

Xemod high-power RF amplifier modules...

...because you have enough to worry about.

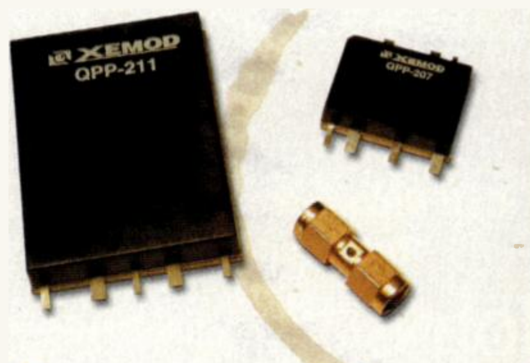


When your job is designing the next generation of high-power RF amplifiers, good ideas can come to you at any time. Don't let the difficulties of amplifier stage design inhibit your creativity. Take advantage of Xemod QuikPAC™ RF power modules.

QuikPAC modules' consistent, reliable performance enables lower dollar-per-Watt designs, quicker. And they plug so easily into your designs, you can focus your expertise where it belongs—on innovation and functionality.

Of course, because our focus is on building QuikPAC modules, we have solutions for all common wireless bands, including hard-to-develop stages for 2.1GHz amplifiers. So you can complete new products for new frequencies and new markets faster than if you'd developed amplifiers the old-fashioned way. And with no sacrifice of performance.

To find out how QuikPAC technology can shorten design cycles, lower development costs across the wireless spectrum, and free you to be more creative, call Xemod at 1-408-748-7360 or visit us on the web at **www.xemod.com**.



Xemod, Inc.

3350 Scott Blvd., Bldg. 49
Santa Clara, CA 95054
408-748-7360

INFO/CARD 69

Get the Data Now!!

Find out information on all the products, software and literature described in this issue. Circle the reader service number on the right and mail in the card today...

...or go to **www.rfdesign.com** and click on the "Get the Data Now" page for links to the advertiser's home page, product data links and links to companies mentioned in literature, software and products.

ADVERTISERS

COMPANY NAME	PAGE NO.	READER SVC. NO.	PRODUCT CAT.
AEA	72	42	Analyzer
Agilent Technologies	15	5	Test System
	43	21	VSA's
	37	20	FET's
AML Communications	2,3	10	Amplifiers
Amplifier Research	34	83	Amplifiers
Analog Devices	73	52	RFIC's
Anritsu Company	31	14	Spectrum Analyzer
Applied Wave Research	91	76	Software
Aries Electronics	76	11	Test Accessories
Bomar Crystal	58	106	Crystals
CAD Designs	88	74	Software
Calif. Eastern Labs/NEC	BC	57	Oscillators
Coilcraft	93	53	Inductors
Communications Concepts	78	92	Transformers
CST of America	29	17	Software
DB Products	36	18	Switches
Dielectric Labs	94	4	High Q Capacitors
Eagleware	38,39	86	Software
Elanix Inc.	57	45	Software
Hermetic Technology	90	98	Component Packages
Hittite Microwave Corp.	51	25	Switches
IEEE MTT-S	35	82	Trade Show
Industry Click	89	72	Internet
Intern. Crystal Manuf.	90	75	Crystals
JCA Technology	8	19	Amplifiers
JFW Industries	70	50	Attenuators
Johanson Technology	76	59	Capacitors
Leader Tech	68	46	EMI/RFI Shielding
Maxim Integrated Prod.	19	6	Transmitter
	21	8	Transmit IC
	23	9	Switches
	25	13	Switches
Megaphase	60	99	Coaxial Cables
Micrel Semiconductors	67	40	Transceiver
Micro Tools	88	7	CNC Machines
Microwave DB	53	26	Oscillators
Microwave Filter Co.	80	65	Filters
Mini-Circuits	4,5	15,16	Splitters/Combiners
	7	43,44	Mixers
	17	27,28	Antennuators
	27	90,91	Connectors
	32,33	30,31,32,33	RF Transformers
	41	38,39	Amplifiers
	45	63,64	Mixers
	49	36,37	Amplifiers
	55	67,68	VCO's
	63	70,71	Micro Components
	103	48,49	Switches
MITEQ	75	56	Amplifiers
Monitor Products	74	55	Oscillators
Nemal Electronics	88	29	Connectors
Noble Publishing	77	60	Software
Noise/Com	34A	1	Noise Generators
Optotek Ltd.	65	35	Waveforms
Phonon Corp.	78	61	Subsystems
Rakon Ltd	66	78	Oscillators
Raltron Electronics	80	62	Oscillators
Relcomm Technologies	79	12	Coaxial Relay
RF Microdevices	12,13	58	RF Components
Richardson Electronics	81	66	Connectors
Sprague-Goodman	74	54	Transformers
Surcom Associates	90	73	Capacitors
Telecom Analysis Systems (TAS)	9	2	Test Equipment
Temic	59	34	Semiconductors
Trilithic	69	47	Filters
T-Tech Inc.	80	24	Circuit Prototyping
Vari-L	11	3	Signal Sources
Vectron International	47	22	Oscillators
Venkel	50	23	Capacitors
Voltronics Intl.	64	96	Capacitors
Watkins-Johnson	71	51	Amplifiers
Xemod	82	69	Amplifiers
Z-Communications	61	41	Oscillators

EDITORIAL

COMPANY NAME	READER SVC. NO	PAGE NO.
1ohm	149	74
Advanced Power Technology	164	88
Agilent	145	72
Alpha Industries	158	78
American Technical Ceramics	148	74
Amplifier Research	143	70
Anacom Systems	130	62
Analog Devices	137	66
Analog Devices	161	88
Andrew	155	76
Anritsu	144	70
Artech House Publishers	175	92
AVX	151	74
Berkeley Nucleonics	142	70
CEL	160	80
Celeritek	134	66
C-Mac	170	92
Coaxial Components	152	76
CPI	135	64
Datatronics	150	74
EiC	131	64
Elanix	168	90
Equipto Electronics	174	92
Ericsson	136	66
Ericsson	165	88
Freestate Electronics	141	70
KOTA Microcircuits	129	62
Maxim	132	64
Maxim	162	88
Microchip Technology	163	88
Motorola	128	62
Numa Technologies	157	78
Oki Semiconductor	159	80
Omron	171	92
Pentek	139	68
Planar Monolithics	132	64
Princeton Electronic Systems	173	92
Qualcomm	166	90
RF Circuits	156	78
RF Connectors	153	76
RF Neulink	127	62
Sprague-Goodman	169	92
TAS	126	62
Toko	146	72
TriQuint Semiconductor	138	68
United Chemi-Con	172	92
Vishay	140	68
Voltronics	147	72
Xpedion	167	90

all current and emerging cellular standards. The AD8314 replaces discrete diode detectors and offers wireless designers a single-package, temperature-stable IC solution. Operating at up to a 2.5 GHz operating frequency with 45 dB dynamic range, the AD8314 handles a wide signal range. The AD8314 also minimizes board area due to 8-pin microSOIC packaging.
Analog Devices
INFO/CARD 161

Transmitter IC's for dual-band cellular phones

The MAX2360/ MAX2364/ MAX2362 baseband-to-PA are complete dual-band cellular phone transmitter devices by Maxim. They are designed for dual-band, tri-mode and single mode N-CDMA, TDMA, EDGE and W-CDMA cellular phones. The trio are offered in a 48-pin TQFP package.
Maxim
INFO/CARD 162

Flash MCU family offers enhanced design flexibility

Microchip Technology's 28-pin PIC16F879 and 40/44-pin PIC16F871 flash microcontrollers (MCUs), expand the PIC16F87X family of flash devices. With 2K x 14 bits of cost-effective flash memory and 64 bytes of EEPROM data memory, the MCUs have brownout detection, up to 5 MIPS performance at 20 MHz, USART communications capability for peripheral expansion, two 8-bit timers, a 16-bit timer and an operating voltage of 2.0-5.5 volts. The PIC16F870 has a 5-channel 10-bit (±1LSB) A/D converter. The PIC16F871 features an 8-channel 10-bit (±1 LSB) A/D converter and a parallel slave port.
Microchip Technology
INFO/CARD 163

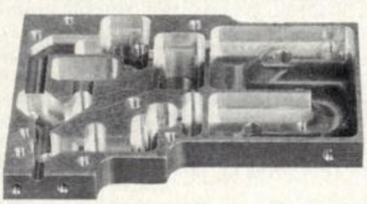
Class C, D and E RF power MOSFET

The ARF 450 is a matched pair of power MOSFETs in a common source configuration. It is designed for p/ opertion in RF power amplifiers up t 120 W. Rated power dissapation : 650W and the unit operates with up t a 150 V supply.
Advanced Power Technology
INFO/CARD 164

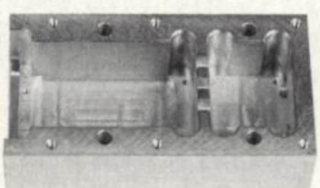
RF power transistor for GSM applications

Ericsson Microelectronics ha added the PTF 10149 RF power trai sistor to its portfolio of GSM device. The device, based on GOLDMOS tecl nology, is designed for use in the 92 to 960 MHz GSM band. The device output power is 70 W, and 16 dB gai Additionally, efficiency is rated a 50%, and it has a linearity of ±0.25 across the band. The device operate from 28 VDC with a minimum drai source breakdown voltage of 65 V runs in n-channel enhancement mod has a load mismatch tolerance of 5: and IMD3 is –39 dBc at 20 W PEP.
Ericsson
INFO/CARD 165

QUANTITY TOO SMALL FOR DIE CASTINGS?



Precision manufactured on our CNC machining centers



MICROTOOL INC.

14430 West 100th Street
Lenexa, KS 66215
Phone (913) 492-1588
Fax (913) 492-1591
microtool-usa.com

INFO/CARD 7 or visit **www.rfdesign.com**

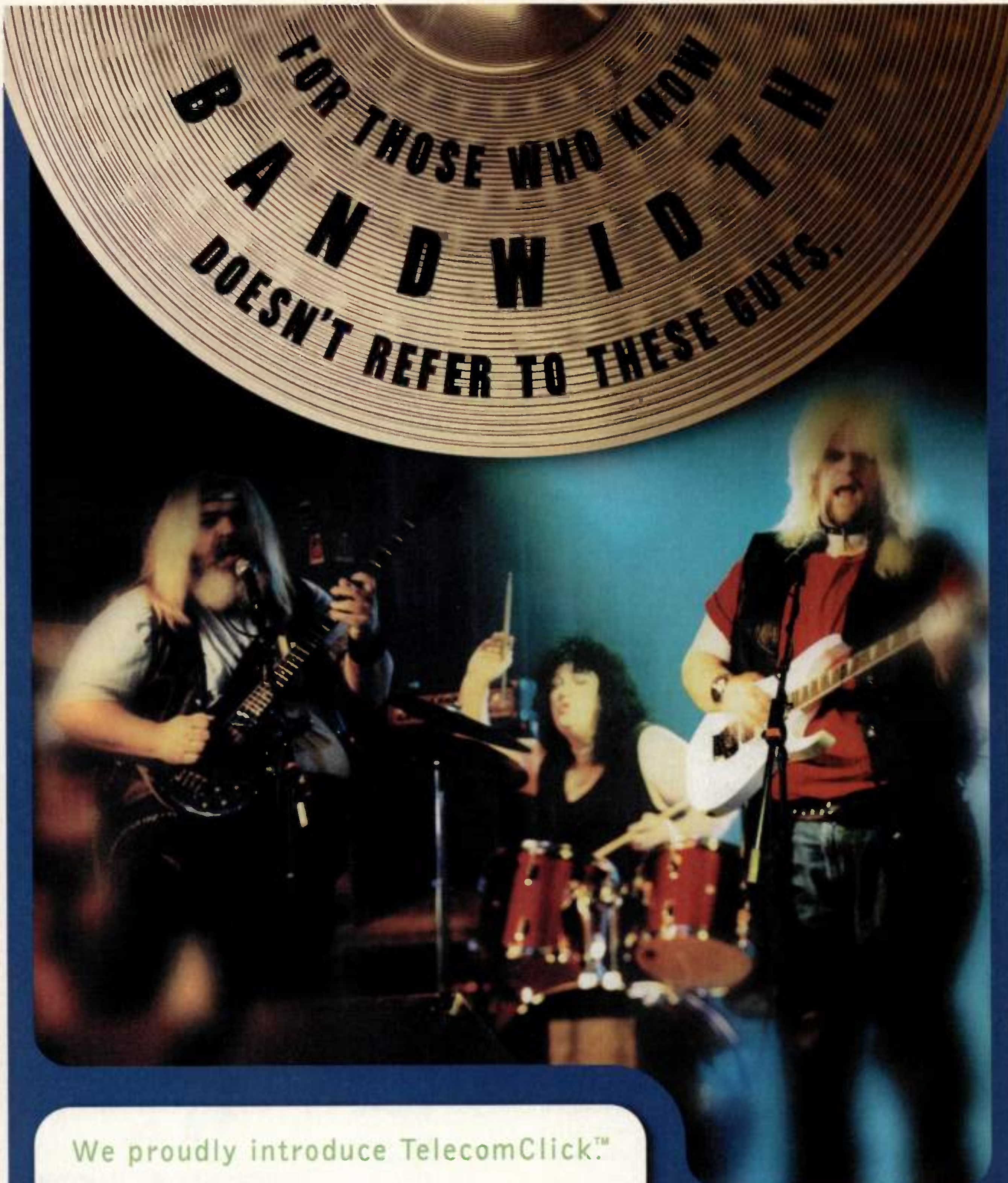
800-522-2253
This Number May Not Save Your Life...
But it could make it a lot easier! Especially when it comes to ordering non-standard connectors.
RF/MICROWAVE CONNECTORS
- Specials our specialty virtually any SMA, N, TNC, BNC, SMB, or SMC delivered in 2-4 weeks
- Cross reference library to all major manufacturers.
- Large inventory of piece parts for all types of coaxial connectors.
- Experts in supplying "hard to get" RF connectors.
- Connectors supplied to your drawings and specs.
- Our 56 Standard adapters can satisfy virtually any combination of requirements, between SMA, TNC, N, 7mm, BNC and others.
- Extensive inventory of passive RF/Microwave components including attenuators, terminations and dividers.

NEMAL
Cable & Connectors for the Electronics Industry
NEMAL ELECTRONICS INTERNATIONAL, INC.
12240 N.E. 14TH AVENUE
NORTH MIAMI, FL 33161
TEL: 305-899-0900 • FAX: 305-895-8178
E-MAIL: INFO@NEMAL.COM
URL: WWW.NEMAL.COM

INFO/CARD 29 or visit **www.rfdesign.com**

Are you STILL using that legacy design system?
RF Designer
Windows + AutoCAD® + CAD Design Software = the world's most powerful & flexible EDA tool
AutoCAD is now a smart EDA tool!
RF / MICROWAVE, BGA, CSP, FLEX, all MCM types, IC TEST PCBs
FREE CD VIDEO DEMOS
WWW.CAD-DESIGN.COM
CDS CAD DESIGN SOFTWARE
3211 Scott Blvd., Suite #103
Santa Clara, CA 95054
1-877-CAD-USER
Ask about our in-house design services.
CAD Design Services, Inc.

INFO/CARD 74 or visit **www.rfdesign.com**



We proudly introduce TelecomClick™

We're the most comprehensive source of telecommunications information on the web. A place to get smart about the ever-changing telecom industry. A destination for people with telecommunications on the brain. With TelecomClick, you get in-depth analysis and insight from the leading industry publications. And our nine channels dedicated to the global telecommunications market keep you abreast of the latest news and innovations. No matter what you're looking for in the telecommunications arena, you'll find it free of charge at TelecomClick. Go to www.telecomclick.com. Get connected.

TelecomClick™
an IndustryClick community

Where telecom clicks on the web.

INFO/CARD 72

Modem, software for CDMA design

MSM 3300 chipset and system software is Qualcomm's first multimedia enabled mobile station modem based on the MSM 3100 chipset architecture. The chipset and system software will enable the design of CDMA handsets and data devices with feature sets and high performance. Higher on-chip integration provides advanced Bluetooth, as well as multimedia features such as Qtunes, moving picture experts group (MPEG-1) Layer 3 (MP3) player software and compact media extension (CMX) musical instrument digital interface (MIDI)-based multimedia software. The package also supports GPS applications with its gpsOne position locations technology in the MSM 3300.
Qualcomm
INFO/CARD 166

Software designed to improve productivity

Xpedion Design Systems' COSSAP System Level Design product family integrates its Golden Gate family of RF simulation and behavioral modeling products. Combining the two products is designed to improve time to market and designer productivity for RF and wireless communication designs. The Golden Gate-COSSAP interface unifies bottom-up and top-down design methodologies for existing 2G and the evolving 3G and Bluetooth communication standards. Combining the power of GoldenGate with COSSAP allows designers to make critical design trade-offs at both the circuit and system level, throughout the wireless communication system development cycle.
Xpedion
INFO/CARD 167

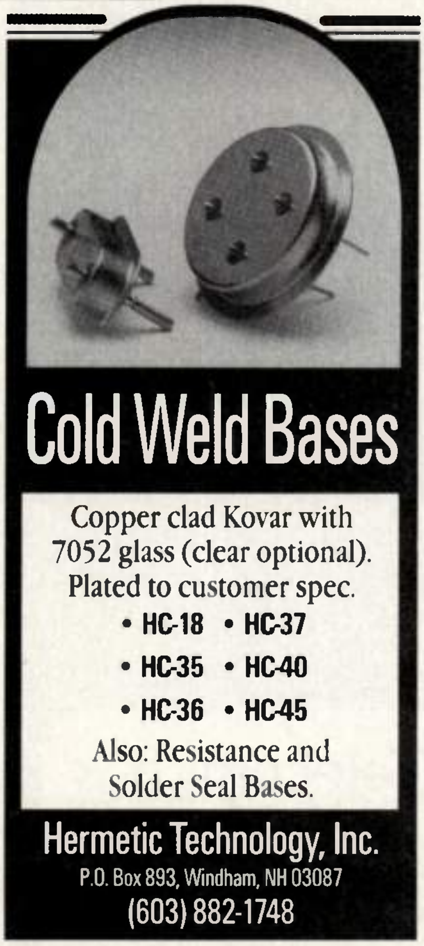
Software suite targets 2G, 3G, Bluetooth designers

Elanix and Xpedion's integrated software suite has Elanix's system-leve design software and Xpedion's golde gate/sim, RF and microwave simulatio software. The suite allows designers t immediately see the impact of desig changes at any level of abstractio much earlier in the design cycle, re ducing development cycle times. Th software is targeted to 2G, 3G an Bluetooth product designers.
Elanix
INFO/CARD 168

RF Design Online

For more information on items noted in the software column, check out the *RF Design* Web site **www.rfdesign.com** editorial links, for direct links to company Web sites.

Intertec Subscriber Privacy Notification: Intertec Publishing makes portions of our magazine subscriber lists available to carefully screened companie that offer products and services directly related to the industries we cover. Any subscriber who does not want to receive mailings from third-party companie should contact the Intertec subscriber service department at 800.441.0294 (US) or 913.967.1707 (outside US).

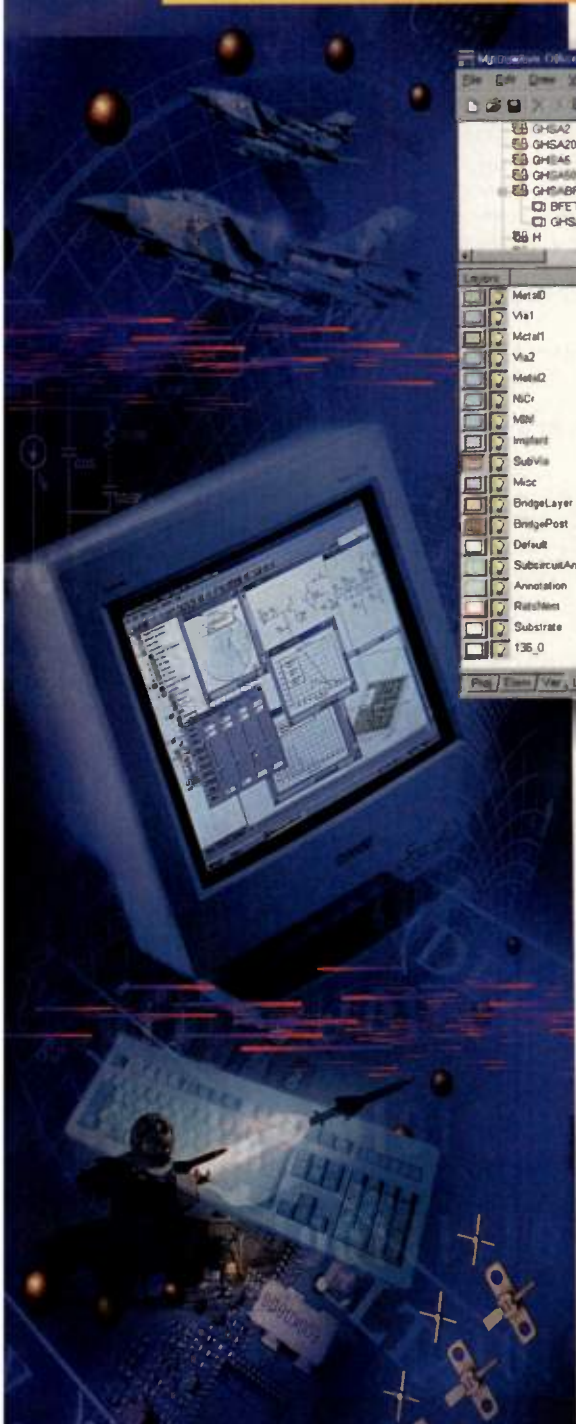


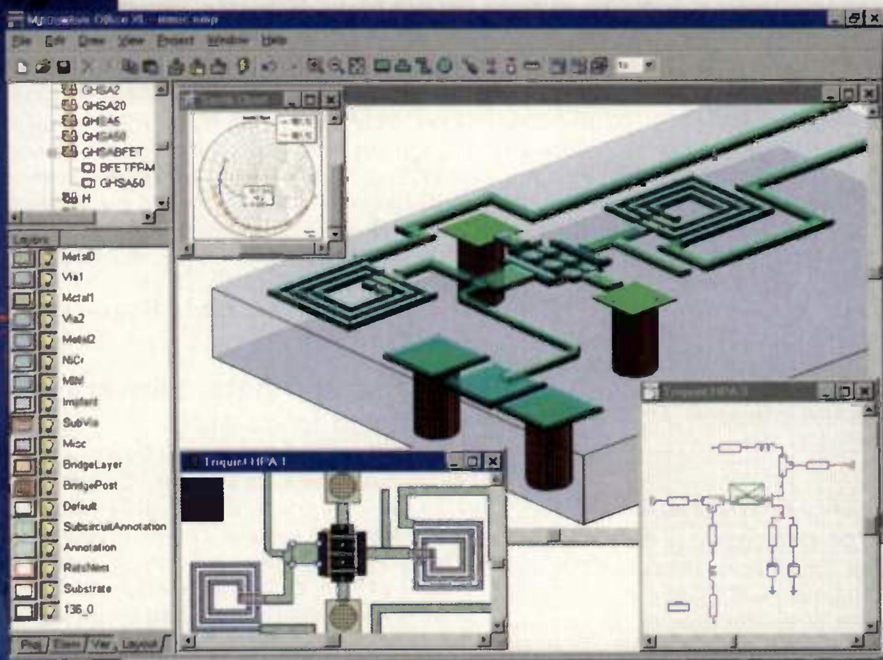
INFO/CARD 98 or visit www.rfdesign.com

INFO/CARD 75 or visit www.rfdesign.com

INFO/CARD 73 or visit www.rfdesign.com

Microwave Office™ 2000





The World of RF & Microwave Design has Changed Forever!

Microwave Office 2000 is the revolutionary high-frequency design solution that is changing all the rules! This award winning design suite now includes the ultimate microwave layout solution, statistical design capabilities, yield optimization, MMIC foundry library support, plus new EM-based discontinuity models for incredibly accurate simulations up to millimeterwave frequencies and beyond. New schematic data translators will import Agilent EEsof Series IV or ADS designs directly into Microwave Office. Finally you can say good bye to the expensive and cumbersome solutions of the past. For more information call your AWR sales representative!

Microwave Office 2000

30 Day Trial Software
Free Download from
www.mwoffice.com

AWR

Applied Wave Research, Inc.
1960 E. Grand Avenue, Suite 530, El Segundo, CA 90245
Tel: (310) 726-3000 Fax: (310) 726-3005

INFO/CARD 76

Guide features control components specifications

Sprague Goodman Electronics'new product selection guide offers specifications for their complete line of frequency control components. This edition includes the new Surfcoil SMT inductors and transformers, and tuning varactors to the range of air, ceramic, glass, mica, plastic, quartz, and sapphire dielectric trimmer capacitors. Specifications are given for the surface mount, inductors, metalized inductors and LC tuners, microwave tuners and tuning tools.

Sprague-Goodman
INFO/CARD 169

Data book, CD-Rom list control products, devices

C-Mac Frequency Products' Crystal Product Data Book 2000 and CD-ROM contain a large selection of the company's frequency control products with detailed specifications of hundreds of standard and custom frequency control devices. Customers can specify and order components from the book and CD-Rom using provided specifications and controlled issue numbers.

C-Mac
INFO/CARD 170

Catalog lists RFID systems, products

Omron offers a 117-page catalog featuring its line of RFID systems including tags, antennas and controllers. The catalog features information about Omron's V600 series electromagnetic RFID system, the V620 microwave RFID system and V700 series electromagnetic inductive system. It also includes a product selection guide to aid in choosing the proper model for the application, a section of complimentary products and reference information.

Omron
INFO/CARD 171

Aluminum capacitors, guidelines in catalog

United Chemi-Con offers its latest catalog of aluminum electrolytic capacitors. At 480 pages, it includes 9,000 different part numbers comprising 74 new or enhanced capacitor series. There are sizes, styles and operating characteristics for most application.

United Chemi-Con
INFO/CARD 172

Catalog offers range of frequency synthesizers

Princeton Electronic Systems' catalog features their low noise VCOs (to-112 dBc/Hz@10 KHz offset) and low noise, small footprint, synthesizers for wireless communication applications. The catalog lists the new release of 5V and 3 V VCOs and a wide range of single, dual and fixed frequency synthesizers.

Princeton Electronic Systems
INFO/CARD 173

Cooled cabinets, blowers featured in catalog

Equipto Electronics offers a catalog with information for electronic system designers who require cabinets that are cooled. The catalog also features a blower and fan selection nomograph to assist designers in evaluating their cooling requirements. Sixteen blowers and eight fan sizes are standard catalog choices, with more than 200 additional sizes available by special order. Louvering, grilling, insulation, heaters and air conditioners are also available. Other options include dust filters, fan guards, adapters for 24" panel widths and honeycomb grills to meet RFI requirements. Visit the company's Web site to request a catalog.

Equipto Electronics
INFO/CARD 174

Book offers tips to tackle CDMA problems

Artech House Publishers' *Signal Processing Applications in CDMA Communications*, by Hui Liu, is a book that details the author's in-depth research of key CDMA signal processing issues and offers solutions to problems such as diversity combining, multiuser detection, channel estimation and carrier synchronization. With a brief CDMA primer, the book features complete signal processing solutions including blind multiuser detection for DCMA systems with short codes, long codes and antenna diversities to meet the problems faced in wideband CDMA detection.

Artech House Publishers
INFO/CARD 175

On The Web

Web site offers products, data sheets

Signal Technology's Olektron Operation's updated Web site includes more than a dozen new products and a complete list of available product data sheets in PDF format. Items offered include new lines of switch combiners and multifunction log amps.

Signal Technology
INFO/CARD 176

Web site provides designers' resource

W.L. Gore & Associates Web site offers an on-line resource to designers facing EMI/RFI shielding problems. The site provides a compilation of technical, product and standards information for beginning and experienced engineers handling EMI. The resource also includes a primer on basic design for electromagnetic in interference control that covers key issues and terminology; electrical and mechanical design modules; a discussion of rapid prototyping services; and information on reducing manufacturing cost. Links to related industry sites and current industry events are also on-line.

Gore
INFO/CARD 177

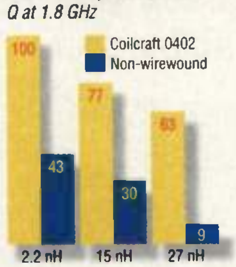
RF Design Online!

For more information on items noted in the literature column, check out the *RF Design* Web site **www.rfdesign.com** editorial links, for direct links to company Web sites.

Introducing the first 0402 wirewound inductors

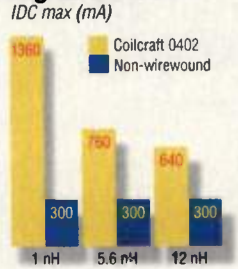
Little specks. Big specs.

Once again, Coilcraft proves that you don't have to give up performance to get a smaller form factor.



These new wirewound 0402 chip coils have Q factors that are comparable to our 0603 chips. And far higher than competitive parts.

SRFs remain comfortably above your operating frequency.



And compared to non-wirewound coils, our 0402 inductors handle 200% to 300% more current!

We'll be happy to send you free evaluation samples, or you can order **Designer's Kit C128** containing ±5% tolerance versions of all 20 inductance values.

For complete specifications and samples, visit our web site or call **800-322-2645.**

Coilcraft

Cary IL 60013 847-639-6400 Fax 847-639-1469
www.coilcraft.com info@coilcraft.com

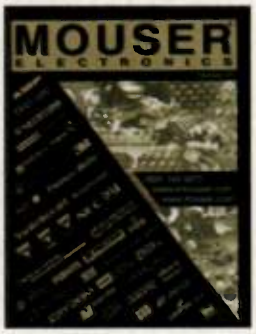
INFO/CARD 53


C06
Ultra High Q Porcelain Capacitors
457
300
• Resonance free wireless performance
• High Q • Stable TC • EIA 0603 case size
• SMD compatibility • Ceramic reliability
New CapCad v3 available • Engineering Kits available
Dielectric Laboratories has the High Q capacitors you need at the right price.
Applications
• DC blocking • Filtering
• Amplifier matching networks
• VCO frequency stabilization
• Diplexers • Antenna matching
See us on the web!
www.dilabs.com
C06 0603
C08 0805
C11 0505
C17 1111
C21 1915
C22 2225
C40 3838
DLI
DIELECTRIC LABORATORIES
A DOVER TECHNOLOGIES COMPANY
Call The Solutions Experts At Dielectric Labs
2777 Route 20 East, Cazenovia, NY 13035
Ph: 315-655-8710 • Fax: 315-655-8179

INFO CARD 4

ELECTRONICS COMPONENT DISTRIBUTOR

Mouser Electronics presents its newest catalog. We offer same-day shipping, helpful technical assistance, and a broad inventory selection. No minimum order required. Features 60,000+ components from 200+ leading suppliers including: 3M, Alpha Wire, Amp, Amphenol, General Semiconductor, NEC, Microelectronics, Vectrol, Vishay Dale, Vishay Sprague, to name a few. **Also view our catalog at www.mouser.com.** The website features: Secure online ordering; Product Search- Complete Line Card- Spec Sheets; Search by part number, keyword, cross-reference, or manufacturer.



MOUSER ELECTRONICS
958 N Main St, Mansfield, TX 76063
For catalog (800) 992-9943 / (817) 483-6828
or FAX: (817) 483-6899
E-Mail: catalog@mouser.com

INFO/CARD 200

RF-CHART™ for Windows 95/98/NT4
RF-Design using the Smith Chart

- Impedance Matching
- Small Transistor Design
- Stability Analysis
- Noise & Gain Circles
- Microstrip Matching
- Circuit Q, VSWR
- Ploting of Data
- Etc.

JCP Software & Company
9528 Miramar Rd. #214
San Diego, CA 92126
jcpsoft@jcpsoftware.com

FREE demo at http://www.jcpsoftware.com

INFO/CARD 201

2-4 GHZ Digital Controlled Attenuator

Description:
UMCC's Model AT-D000-HD is a solid state Digital variable attenuator. Attenuation level is set via an eight bit TTL binary code covering 60dB dynamic range. Unit is equipped with internal voltage regulators along with temperature compensation circuitry for guaranteed performance and accuracy in all extreme conditions. Unit measures 2.3" x 1.6" x 0.5" in size.

Key Specifications:

- Insertion Loss: 1.5 dB Max
- Attenuation Range / Resolution: 60dB / 0.25dB Steps
- VSWR (All Settings): 1.5:1 Max
- Attenuation Frequency Flatness: ±0.30 dB @ 10dB; ±0.80 dB @ 20dB; ±1.50 dB @ 40dB; ±1.60 dB @ 60 dB
- Transfer Function Accuracy: 0 - 10 dB @ ±0.25 dB Max; 10 - 30 dB @ ±0.50 dB Max; 30 - 50 dB @ ±1.0 dB Max; 50 - 60 dB @ ±1.5 dB Max
- Switching Time: 500 nS Max
- Operating RF Power: 100 mW CW/Peak
- Power Supplies: +12 to +15VDC @ 60 mA; -12 to -15 VDC @ 50 mA

Universal Microwave Components Corp.
5702-D General Washington Drive
Alexandria, Virginia 22312
Tel: (703) 642-6332 • Fax: (703) 642-2568
E-Mail: UMCC111@AOL.Com
Web Site: http://members.aol.com/UMCC111

INFO/CARD 202

RF Signal Generator

$1495
100 KHz to 1000 MHz

- Calibrated AM/FM Modulation
- Synthesized, 10 Hz step size
- Max 0 dbm output, +13 dbm optional
- 130 db solid state attenuator
- Reverse power protection
- 1 ppm Time Base, 0.1 ppm optional
- Level flatness of ± 0.5 db
- RS-232 interface option

Ramsey Electronics, Inc.
793 Canning Parkway Victor, NY 14564
Tel: 716-924-4560 Fax: 716-924-4886
email: RFtest@Ramseyelectronics.com
www.RamseyElectronics.com

INFO/CARD 203

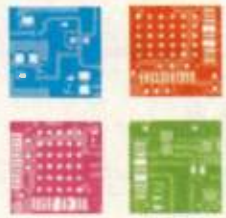
CRYSTALS OSCILLATORS FILTERS
TCXOS VCTCXOS VCXOS

FILTRONETICS INC
FREQUENCY PRODUCTS

6010 Parretta Drive • Kansas City, MO 64120
(816) 231-7375 • FAX:(816) 241-0368
www.filtro.net filtro@filtro.net

INFO/CARD 204

LABTECH
www.labtechcircuits.com



high specification
microwave printed circuitry
email:sales@labtechcircuits.com

INFO/CARD 205

Synthesizers & Rb Standards
"Precision You Can Afford"

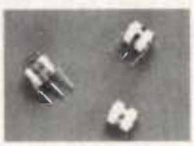
- Rubidium Frequency Standards
  - 2950AR Rubidium Standard (Bench, shown)
  - 1450A Rubidium+DDS Synthesizer (Rack)
- OEM Modules and PC-based Synthesizers
  - DDS7m *(New)* 68MHz RS232 & Parallel Control
  - DDS6m 40MHz RS232 Controlled
  - DDS5m Locks to Standards. RS232 & Dip Switch
  - DDS3pc & DDS7pc *(New)* PC ISA-bus to 68 MHz
- Bench Top Synthesizers
  - 2910A Series 1μHz steps to 48MHz

Novatech Instruments, Inc.
206.301.8986 (v), 206.363.4367 (fax)
Specs and Prices: www.eskimo.com/~ntsales

INFO/CARD 206

SURGE PROTECTION

- COAXIAL Surge Suppressors for PCS, GPS, RF Equipment
- AC Protector UL1449



- Surge Arrester Gas Tubes
- Voltage from 75V To 1500V
- Available in Surface Mount

CITEL
Reliability in Surge Protection

CITEL, Inc.
Tel: 305-621-0022
Fax: 305-621-0766

www.citelprotection.com

INFO/CARD 207
See us at CWTA Booth #540

0.1MHz to 3.1GHz Portable Spectrum Analyzers

- PS - 550 0.1 - 550MHz PS - 5A 0.1 - 1100MHz (1300MHz optional) PS - 5B 0.1 - 2050MHz (2 bands) PS - 5C 0.1 - 3100MHz (3 bands)
- Center/Marker frequency display with on screen marker cursor
- Measurement Range: -108 to +20 dBm
- Five Resolution Bandwidths: 10KHz, 30KHz, 100KHz, 300KHz, 1MHz
- 50 dB Input Attenuator in 10 dB steps
- 2 / 10 dB/Div vertical display with Base Line Clipper
- Built - in AM/FM demodulation with monitoring speaker
- Optional built-in Tracking Generator
- AC / DC / Battery powered (optional internal +12V battery pack)
- Lightweight - Portable operating Size: 11.5" x 5.4" x 12.9"

Price: PS-550 $1675 PS-5A $2275 PS-5B $2875 PS-5C $3175

V.Tech Instruments, Inc.
171 Burns Ave, Lodi, N J 07644
Tel: 973-546-7635
Fax: 973-546-7651
E-mail: vtechinst@erols.com

INFO/CARD 208

YES,

We Do Coaxial, Triaxial & Semi Rigid

Coastel Cable Tools introduces their latest portable hand-held coaxial cable stripper, the Port-a-Strip. This precision tool is powered by a removable Ni-Cad Battery Pak or an optional A/C Power Supply.

Coastel Cable Tools
1211 South Salina Street
Syracuse, NY 13202 USA
Phone: 315-471-5361
Fax: 315-472-1765
www.coasteltools.com

INFO/CARD 209

MICROWAVE ISOLATORS/CIRCULATORS

Freq. 0.45 to 26.5 GHz
Insertion loss <0.3 dB
Isolation >23 dB
VSWR 1.25:1

Low Cost/High Volume Production Capability

- Drop-in Packages
- High Power Coaxial packages
- Surface Mount Packages
- Multiple connector options
- High Isolation/Multijunction
- MIL-I-45208 Qualified
- Four port custom designs
- Just in Time delivery
- Reflection sensing tabs
- Custom design capability

NOVA MICROWAVE
380 Tennant Ave., Morgan Hill,, CA 95037
http://www.novamicro.com
Tel. 408-778-2746 • Fax: 779-5967
email: novamic@msn.com

INFO/CARD 210

CONNECTORS

www.connectorcity.com
CONNECTOR CITY
THE VALUE OF CONNECTIONS
800-490-4965
575 SE ASHLEY PLACE • GRANTS PASS, OR 97

INFO/CARD 211

RF marketplace

RF design

Reserve your spot in the next issue!

Dawn Rhoden
Classified Advertising Manager

Phone: 913-967-1861
888-234-0448
Fax: 913-967-1735
Mail: 9800 Metcalf Ave., Overland Park, KS 66212

At a glance...

RF design

Career Opportunities

R.F. ENGINEERS: NATIONWIDE
R.F./WIRELESS/RECEIVERS/AMPS
CDMA/TDMA/SPREAD SPECTRUM
SATELLITE & ANTENNA DESIGN
Respond to: CTH Corporation
2204 Bahia Vista #D7, Sarasota, FL 34239
Phone: 941/362-2773 • Fax: 941/362-0217
E-mail: cth@home.com

RF Job Network™
Job-Listings for RF/Wireless/Microwave Engineers
www.rfjn.com
Free to Job-Seekers / $100 for Employers

CAREER OPPORTUNITIES NATIONWIDE
Engineers & Tech's
Systems and Components, RF, PCS, Microwave, Antenna, Network, Software, Sales, Dig. & Analog, Mixed Signals, many more. Resume to Peter Ansara, c/o ABF, P.O. Box 6037, Plymouth, MA 02362. Tel: (508) 830-0079, Fax (508) 830-1424 or pa@ansara.com.
See our web site: http://www.ansara.com

Looking to fill a position in your company?
Advertise in the Career Opportunities section of RF Design!

www.rfdesign.com

nautel

Engineers

Nautel is one of the world's leading high power, solid state RF equipment designers. We are traditionally at the forefront of technology in the field of broadcast transmitters and are expanding into industrial applications. Nautel is looking for highly motivated individuals to explore the opportunities and challenges of the new millennium. We have projects in our existing expertise and exciting new areas of research. Nautel is offering an excellent salary and benefits plan to high tech professionals seeking a challenge.

An innovative work environment in a picturesque, highly affordable community can be yours. We want to hear from you if you have research and/or design experience in one or more of the following:

- RF Circuit Design
- HF Power Supplies
- Microprocessor Control Systems
- DSP
- Digital Electronics
- Business Development

Please visit our website for more information:
www.nautel.com

Apply to:
Nautel Limited
Attn: ADMIN
RR#1 Tantallon
Hackett's Cove, NS B0J 3J0
Fax: (902) 823-3183
E-mail: info@nautel.com

Nautel's Research, Development and Manufacturing facilities are located in Hackett's Cove, Nova Scotia, Canada, in the heart of the Maritime's ocean playground. The province is a mosaic of diverse, yet equally beautiful landscapes. It's business center, the Halifax Regional Municipality, is vibrant, rich in history and culture, and is the home of some of the world's most creative and innovative companies, leading the way in technological advances.

Not just talk.

Cool wireless opportunities in coastal North County San Diego.

Live and breathe technology. With the wireless phones we're making, you'll be connecting with CDMA technology that integrates voice, data/fax, GPS, and the Internet. Our engineers get involved in concept-to-completion projects that create major impact. If you want an environment that's not just great to look at, but where your ideas can get attention, look no further. Industry Week named us one of the "World's Top 100 Best Managed Companies." And our phone with Internet access has just been named one of 1999's Best Products by Business Week magazine. The opportunities are here. What will you make of them?

Join our highly talented team in a small company environment with all the resources you need, from start to finish. We offer generous compensation, a fully-paid benefits program, and a state-of-the-art engineering design facility overlooking the Pacific Ocean in beautiful Carlsbad, California.

We have immediate openings for the following individuals.
For details on these positions, visit our website at **www.densowireless.com**

• Project Manager • RF Design Engineers • RF Design Engineers – Mfg. Support

DENSO
Wireless Professional Staffing
jobs@densolabs.com (ASCII text only)
Fax (760) 929-3317
5770 Armada Drive
Carlsbad, CA 92008
EOE

DENSO

Real products.
Real opportunities.

densowireless.com

Ever notice that top minds think alike? It's certainly the norm at Thomson Consumer Electronics, where the top minds, top brand names and top technologies come together in the development of today's most exciting, most advanced electronics for the entertainment industry.

We have opportunities available at our Americas Headquarters, in Indianapolis, IN, in the following areas:

DTV Software Developer 0069

Successful candidates should possess a BSEE degree, MSEE preferred, and a minimum of 3 years' experience in embedded software development and a good understanding of real-time OS concepts. Experience with WinCE/Windows application and driver development and/or experience in box/network security would be a strong plus.

DTV Software Developer 0070

Successful candidates should possess a BSEE, MSEE preferred, and a minimum of 3 years' experience in embedded software development and a good understanding of real-time OS concepts. Experience with WinCE/Windows application and driver development and/or database development and techniques would be a strong plus.

DTV Software Developer 0071

Successful candidates should possess a BSEE degree, MSEE preferred, with a minimum of 3 years' experience in embedded real-time software development and a good understanding of real-time kernel/OS concepts. Experience with WinCE/Windows application development and/or networking development would be a very strong plus. Knowledge of 1394, TCP/UDP/IP, AV/C, HPNA would also be a plus.

DTV Software Developer 0072

Successful candidates should possess a BSEE degree, MSEE preferred, with a minimum of 3 years' experience in embedded real-time software development and a good understanding of real-time kernel/OS concepts. Experience with WinCE/Windows interrupt and driver development would be a very strong plus. Knowledge in driver and communication bus protocols development such as 1394, PCI, IDE, ATAPI is also a plus.

Advanced Digital Architecture 0074

Successful candidates should possess a BSEE/BSCS degree; MSEE preferred. Skills desired include working with real-time operating systems in embedded products (5 yrs.), proficiency with C/C++ and familiarity with internet protocols and communication stacks. Candidates should be experienced with MPEG audio/video, microprocessors and Board Support Packages. Must be able to communicate ideas and work with a small team.

RCA
PROSCAN®
GE

We offer a competitive salary and benefits package, as well as the opportunity to engage your talents in an environment of cutting-edge technology and no-holds-barred thinking. For immediate consideration, please send your resume and salary requirements, in confidence to:

Staffing, Job #_______RF
Thomson Consumer Electronics
INH110, P.O. Box 1976
Indianapolis, IN 46206-1976

Fax: (317) 587-6762

E-mail: jobopps@indy.tce.com

For more information on our job opportunities, visit our Web site at:

www.thomson-multimedia.com

An Equal Opportunity Employer.

THOMSON

Channel Master®

A global leader in antenna technology and communications products for 50 years

IS GROWING

Ideally located in Central North Carolina 30 minutes from the Research Triangle has immediate openings for:

SR. MICROWAVE DEVELOPMENT ENGINEERS

Needed for Ku-Band radio development and support of existing broadband products. Systems operating to 23 GHz.

MICROWAVE AND RF GROUP MANAGER

Needed to oversee and assist in the development of satellite Tx/Rx systems and Terrestrial Microwave products. Thorough systems understanding and strong component design background a requirement.

Channel Master provides competitive salaries, comprehensive benefit package including profit sharing and 401K, and a tuition assistance program.

Send resume with salary history to:
Director, Human Resources
Channel Master
1315 Industrial Park Drive
Smithfield, NC 27577

www.channelmaster.com

An Equal Opportunity Employer M/F/D/V

The World's Leading Manufacturer of TV Reception Products Since 1949.

---

www.rfdesign.com

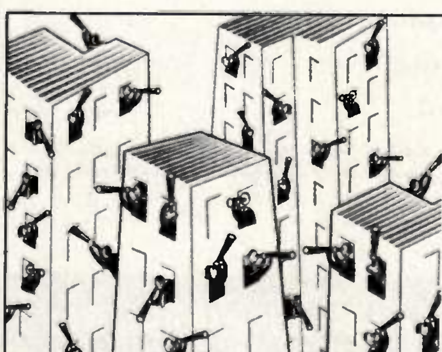
Products & Services

Filters to 50 GHz

- Waveguide
- Stripline/Microstrip
- Transmission Line
- Miniature/Subminiature
- Lumped Constant.

For more information, ask for our RF Catalog.

MFC
MICROWAVE FILTER COMPANY
6743 KINNE STREET, E. SYRACUSE, NY 13057
315-438-4700 · 800-448-1666 · FAX: 315-463-1467
E-MAIL: mfcsales@microwavefilter.com
http://www.microwavefilter.com



Looking to fill a position in your company?

Advertise in the Career Opportunities section of *RF Design*!

Call 888-234-0448 for more information.

RF Field Engineer

;martLink Development Network, Inc., a nanufacturer of leading edge two-way adio networking and trunking controller ystems, seeks an experienced individual or the installation and maintenance of its vide area networking and trunking ystems.

Qualified candidates for this position nust have a minimum of 5+ years in the onfiguration and installation of RF ystems. Candidates must be familiar with runked repeater systems, preferably LTR runked format. Experience in antenna ystems, multicouplers, combiners, and 'arious RF test equipment is a must. Experience with multiplexers, microwave ınd Spread Spectrum point-to-point ystems would be helpful.

Extensive travel with be required. Relocation to Research Triangle Park area n N. Carolina is also required. Exceptional salary and benefits offered.

'lease fax resume to 919.303.2533.

SMARTLINK

Make contact!

(With an RF Engineer or Technician, that is!)

Advertise in the Career Opportunities section of RF Design!

Freedom of mobility.
Freedom of invention.

At Nokia, you have unlimited access to a career filled with new possibilities, creating technology that speaks the universal language of communication. At Nokia, your personal achievement is enhanced by the freedom of mobility.

Nokia is a global company whose key growth areas are wireless and wireline telecommunications. We are a pioneer in mobile telephony, and the world's leading mobile phone supplier.

There are positions currently available at Nokia in San Diego, for individuals who thrive in a culture where setting new standards is all in a day's work.

- JUNIOR RF/IC DESIGN ENGINEERS
- RF/IC DESIGN ENGINEERS
- RF ENGINEERS
- RF FREQUENCY/SYNTHESIZER DESIGN ENGINEERS
- RF TEST ENGINEERS

Nokia offers a culture rich in diversity, personal and professional growth, generous compensation, and exceptional benefits that only a leader in its field could provide. Interested candidates should forward a resume to: Nokia Mobile Phones, 12278 Scripps Summit Dr., San Diego, CA 92131; E-mail: sandiego.resumes@nokia.com Fax: 858-831-6502. Equal Opportunity Employer.

NOKIA
CONNECTING PEOPLE

www.nokia.com

Can't wait for the next issue?

Check out the RF Design web site for career opportunities!

www.rfdesign.com

YOU'VE NEVER HAD A FUTURE LIKE THIS BEFORE.SM

Career potential without boundaries. That's what you can expect from Nextel, where engineering breakthroughs are the norm. With innovations like our four-in-one wireless solution, comprised of digital cellular, voice mail, paging and Nextel Direct ConnectSM, we're reaching over 85% of the nation's population and redefining digital communications.

Explore **www.nexteljobs.com** to learn more about current opportunities, including the ones listed below, in cities across the US:

- SYSTEMS PERFORMANCE ENGINEERS
- RF ENGINEERS
- PROJECT MANAGERS
- DISPATCH ENGINEERS
- SOFTWARE DEVELOPERS
- DATABASE/NETWORK ADMINISTRATORS
- MOBILE DATA SYSTEMS ENGINEERS & TECHNICIANS
- PROGRAMMER ANALYSTS
- SWITCH ENGINEERS
- iDEN ENGINEERS
- SS7 ENGINEERS
- PLANNING ENGINEERS

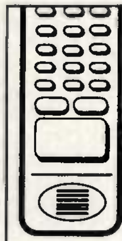
Looking to employ your engineering talent with a proven winner? Go to **www.nexteljobs.com** and check out the hundreds of cutting-edge engineering opportunities currently available with our all-digital, wireless network.

NEXTEL®

How business gets done.SM

Learn more about all the career opportunities Nextel has available, visit:

www.nexteljobs.com



...YOUR CAREER

General Manager: Three hundred million dollar RFIC GaAs MMIC company has n for a GM to lead them into a IPO startup company. Individual must possess exp ences leading a multi billion dollar effort to spin off RFIC business into a separ company. Candidate must possess an aggressive, energetic, positive personal management and technical understanding of RFIC business practices.

Director of Engineering: You will lead the effort to develop active component des competency and development strategy. You will be key in identifying the capital a human resources and the organizational structure to support the goal of best in cl active components capabilities. You will assist the business in developing the asso ated procurement and manufacturing infrastructure to support realization of th products.

RF Test Engineer: You will develop automated test software and procedures for RF/analog circuits. Ex rience using cellular test equipment. GPIB (HP VEE/labVIEW) programming and CDMA/AMPS knowle a plus. Will consider highly motivated entry-level RF Engineers with BSEE.

Sr. MMIC Design: Design highly integrated GaAs MMICs for advanced cellular products. Circuits to designed include: power amplifiers, LNAs, mixers, IF amplifiers, buffer amplifiers. RF frequencies are 9 and 1800 MHz.

Filter Design Engineer: Development of microwave high "Q" coaxial cavity and machine filter designs PCS base stations. BS/MS familiar with simulation and modeling tools, three plus years filter design ex rience with direct "Q" designs (6-8000 Q's).

Applications Engineers: SiGe RF/Analog circuits, application notes, data sheets, customer and field su port and training. Will also be responsible for the build and characterization of evaluation boards as w as the build and characterization of system application boards using RF/Analog products.

Account Manager This position will work closely with key customers to implement standard prod design-ins and custom IC development projects. Individual will manage all phases of project develo ment: schedules, forecasts, resources, and technical goals.

Regional Sales Manager High visibility role at the world's fastest growing manufacturer of RF integra circuits. Positions require knowledge of RF technology and the ability to develop and maintain relatio ships with a customer's RF design, management, and purchasing organizations. Have responsibility winning new design-ins, maintaining customer satisfaction, and training/managing the Sales Represen tive Network.

Principal Design Engineer RF IC design in the Wireless Communications and/or Broadband techno gies. Experience in designing on multiple technologies such as HBT GaAs, SiGe, BiCMOS, Bipolar, highly desirable.

RF Design Engineer Design of RF transceivers used in digital radios in the 2-6G frequency range. BSEE minimum, MSEE preferred. 3+ years of board-level RF a analog circuit design experience. Experience with amplifiers, filters, mixers, PL and their integration into radio transceivers.

MICRO COMMUNICATIONS EXECUTIVE SEARCH

We specialize in the placement of wireless, RF, microwave communications nationally.

FOR THESE AND OTHER OPENINGS
CALL COLLECT: TEL: 978-685-2272

800 Turnpike St. • North Andover, MA 01845
E-mail: micsearch@aol.com FAX: 978-794-5627

REACH NEARLY 40,000 READERS EVERY MONTH
Advertise in RF Design!

RF design Buyers' Source

ANTENNAS

VISIT OUR WEBSITE FOR MORE DETAILS

M² ANTENNAS 1.6 - 3000 MHz
Positioners & Pedestals
Standard & Custom Designs
We Specialize in High Gain Arrays
7560 N. DEL MAR AVE., FRESNO, CA 93711 (559) 432-8873
Fax:432-3059 Email:m2sales@aol.com Website: m2inc.com

CONSULTANTS/CONSULTANT SERVICES

ANALYSIS - SIMULATIONS

Fab - Test - Consulting
High Freq. Simulations (MOM, FEM)
Nonlinear Simulations (LIBRA)
RF to MM-Wave
www.kandctech.com

CONSULTANTS/CONSULTANT SERVICES

Electronic Design Consultants Inc.
Solutions at Work!
Specialists in RF and Analog Design

Call EDC today with your toughest challenges.

Electronic Design Consultants Inc.
8342 Bishop Rd SE
Aumsville OR 97325
(503) 749-3444
Fax: (503) 749-3055
Email: edc@cyberis.net

www.rfdesign.com

DISCRETE COMPONENTS

CAPACITORS

Mica High Power

SURCOM ASSOCIATES, INC.
2215 Faraday Avenue, Suite A, Carlsbad, CA 92008
Phone: (760) 438-4420 Fax: (760) 438-4759
E-mail: link@surcom.com Web: www.surcom.com

Vacuum

SURCOM ASSOCIATES, INC.
2215 Faraday Avenue, Suite A, Carlsbad, CA 92008
Phone: (760) 438-4420 Fax: (760) 438-4759
E-mail: link@surcom.com Web: www.surcom.com

RFdesign RFdesign RFdes

RF design Buyers' Source

DISCRETE COMPONENTS
PACITORS

Variable

SURCOM ASSOCIATES, INC.

215 Faraday Avenue, Suite A, Carlsbad, CA 92008
hone: (760) 438-4420 Fax: (760) 438-4759
mail: link@surcom.com Web: www.surcom.com

DISCRETE COMPONENTS
RYSTALS/OSCILLATORS

Crystals Oscillators Filters
TCXOs VCTCXOs VCXOs

FILTRONETICS INC
FREQUENCY PRODUCTS
6010 Parretta Drive • Kansas City, MO 64120
(816) 231-7375 • FAX:(816) 241-0368
www.filtro.net filtro@filtro.net

ELECTRICAL EYELETS

Miniature Eyelets and Setting Tools

IEI

800-333-9353 FAX: 760-598-2962
760-598-4007 www.intl-eyelets.com

MODEL/SIMULATION DEVELOPMENT

wTc
Walls Technology Co., Inc
RF/Microwave Product Design
Model/Simulation Development
Ph: (256)828-6728 Fax: (256)829-0328
http://www.wallstechnology.com

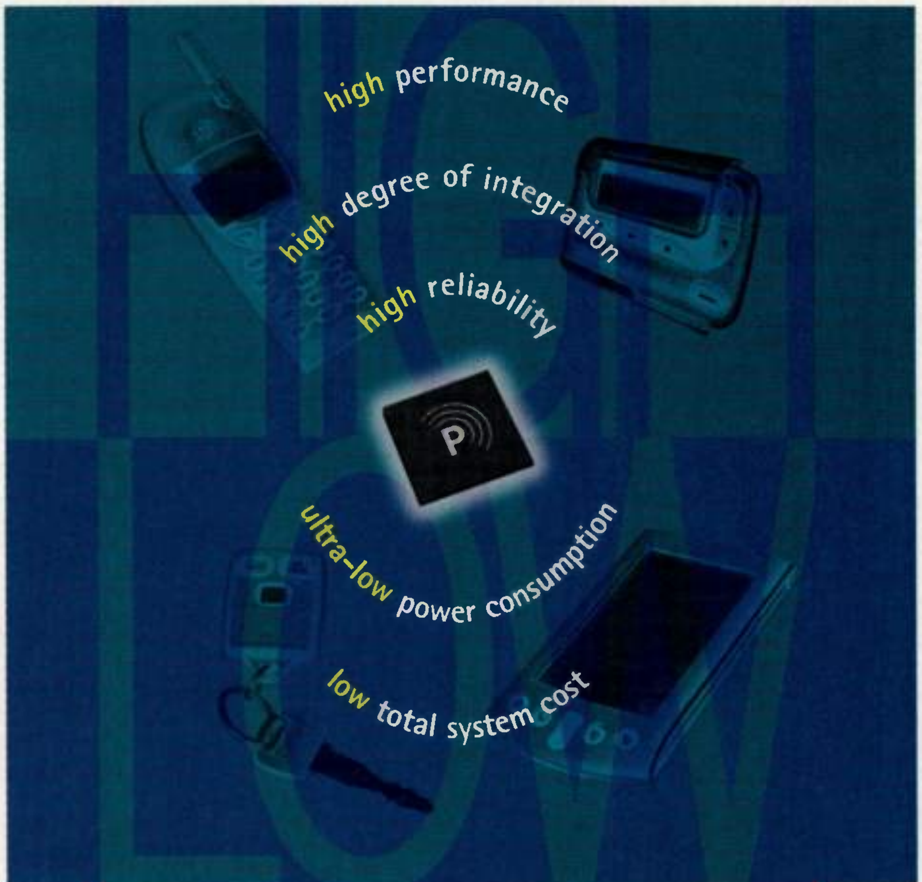
RF TRANSMISSION COMPONENTS
IDUCTORS AND CHOKES

FCC

- Lightning Supressors
- D.C.-26GHz Coaxial
- Powerline • Digital

ISCHER CUSTOM COMMUNICATIONS, INC.
2917 W. Lomita Blvd., Torrance, CA 90505

Phone: (310) 891-0635
Fax: (310) 891-0644
E-mail: sales@fischercc.com



Philsar's ultra-low-power radio ICs are taking personal wireless connectivity to a new high.

You can search high and low – but you won't find better IC solutions for personal wireless connectivity applications. Our solutions are used in high data rate products such as cell phones and PDAs, and low data rate products such as keyless entry systems. Philsar leverages its advanced architecture, radio IC design techniques and silicon technology to enable its customers to develop wireless communications devices that support standards such as Bluetooth. This results in products that are high on performance, integration and reliability, and low on power consumption and total system cost. Want more of the lowdown on Philsar's role as catalyst in the wireless revolution? Then it's high time you checked us out!

PHILSAR SEMICONDUCTOR
Helping to build a wireless world

www.philsar.com

Bluetooth.

MATERIALS/HARDWARE/PACKAGING
SHIELDING MATERIALS

EMI/RFI Shielding Tapes
Conductive Adhesives & Tapes
Foils/Fiber/Fabric/Gasketing/Laminating

Venture Tape Corp.
30 Commerce Road, Rockland, MA 02370
Tel: (800) 343-1076 Fax: (781) 871-0065
Visit us at: www.venturetape.com

MODULAR COMPONENTS
OSCILLATORS

WA
Wenzel Associates
"Quietly the Best"

- Standard and Ultra Low Noise Crystal Oscillators
- New Low Noise RF Modules
- Ultra Low Noise Frequency Standards

PH 512-450-1400 Fax 512-450-1490 www.wenzel.com

REACH NEARLY 40,000 READERS EVERY MONTH
Call Dawn at (888) 234-0448 for deadlines and rates.

The Hindenburg of the 21st century

by Ernest Worthman

I recently came across a bit of news that I find rather interesting. Good ol' Craig McCaw now has a grand scheme to salvage the hundreds of money pits circulating the earth in low orbit.

Well, I'm still smarting from the dumb decision I made to purchase Iridium stock just before the bankruptcy, gambling that Motorola would step up to the plate and make the system fly. But I lost. As we all know, Motorola let Iridium slip into bankruptcy and basically walked away. Of late, there has been some money pumped into Iridium, but only to avoid liquidation deadlines.

They're not the only one. ICO, who hasn't even got any hardware up, is also in bankruptcy and Teledesic isn't healthy either.

From a purely business perspective, I can't really blame Motorola for wanting to walk away, but it isn't that simple.

But then I have a bit of animosity towards them (that goes back 10 odd years) simply because they took an arrogant approach to the Iridium project from the start. They were seriously thinking that the public was going to buy $3,000 phones and pay up to $7 per minute to be able to communicate from the top of Mount Everest, but not from an underground parking structure (when it worked at all). I have to wonder what they were thinking.

Well, perhaps Motorola isn't going to just walk away. The latest scoop is that the court overlooking the bankruptcy is going to give Motorola an alternative. Either they come up with a credible buyer and a solid plan (read Craig McCaw), or they will be forced to bring the satellites out of orbit.

Now, I have been following the adventures of Craig McCaw since his vision of a nationwide ESMR network came upon the scene about 10 years ago (which, of course, never came about). Then, I followed his grand plan to create Nextel (which may yet, someday, become profitable). Then he bought ICO. Now he has his eyes on Teledesic, too. He is on a mission to buy these systems for pennies on the dollar and merge Iridium, ICO and perhaps Teledesic into the next super ISP (or maybe just eliminate the competition).

Challenging, but Craig has his work cut out for him (and I still can't understand why everyone continues to throw money at him).

Actually, the idea sounds great on paper. There is a real mess out there with ISPs. Modem connections are dinosaurs. Long ago, I gave up trying to download anything more than a few kB of e-mail using a dial-up connection. DSL comes in a number of flavors but to get any real speed, you gotta pay. Cable is so load sensitive that, I suspect, once they get any real numbers on line, cable modem constipation is only a click away. Plus, everyone's got their own proprietary hardware and software. And, realistically, neither cable or DSL is widely available yet. Also, projected penetration numbers are lower than expected to date and hidden costs can be surprising.

So, in theory, if Craig McCaw could pull this off, I'd be the first in line. I think that these LEO satellites are a golden goose for this application (if the price is right). Even though these LEO satellites have a weak spot when it comes to in-building penetration, that issue is easily solved in a couple of ways.

First, most residences aren't buried in steel and concrete, and they aren't mobile. I suspect most homes will be able to receive a direct signal from a LEO ISP satellite without much positioning. Second, if the signal is too weak for direct reception...well, the DBS systems have already solved th one. Direct TV/PC simply puts a on meter dish on the building (single o multi-unit) and distributes the signal.

The interface issue is simple as wel All you do is stall a PCI card (ISA be ter be dead by then) in your comput with a connector to which you conne either an antenna, or a cable.

The one "gotcha" that I worry abou is the lack of reliability of the constellations. But data is much more forgiv ing than voice, and much more err tolerant.

On the other hand, if McCaw back ers finally sense that whatever h touches turns into debt, well, lets go f plan B.

It turns out that plan B goes som thing like this: Instead of forcin Motorola to plummet the satellites t earth, let's round up a bunch of thes latest Internet-related IPO instant mi lionaires and give them a shot at som adrenaline pumping action. Le Motorola buy one of those Russia MIGs for next to nothing. Then the can offer to rent this plane to thes money-to-burn guys. Next, for, say $ million per shot, these guys get to go u and try to blast one of the satellites ou of the sky on its way to self-emolation.

Not a bad idea if you ask me. I would give 66 (plus spares) young bored millionaires something reall exciting to talk about. It would also ne Motorola about $66 million, and mayb some of us dumb investors will get few of our investment bucks back. Th rest could be used by Motorola to pay "what was I thinking?" fine.

Oh, the insanity...

GaAs SWITCHES

DC-2.5GHz Immediate Delivery

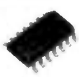
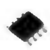
now from only $1.95 ea. (qty.1000)

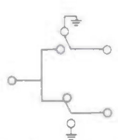
Finally! ***SPDT absorptive, reflective, and transfer switches*** that appeal to your technical side, and business side as well! It's Mini-Circuits GaAs switches...providing outstanding performance features such as very high isolation (up to 60dB), superfast 3nsec switching speed, and excellent compatibility with surface mount soldering techniques. Additionally, these switches are built extremely tough and are immediately available from stock with a guarantee to ship within 1 week. From only $2.45 ea. (qty.10), this top-of-the-line value is priced with your bottom line in mind! To order, contact Mini-Circuits with your requirements today.

Mini-Circuits...we're redefining what VALUE is all about!

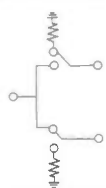
Model	Freq. (GHz)	Insertion Loss* dB (Max.)	1dB Comp* dBm (typ)	In-Out Isol.* dB (typ)	Price $ea. (qty.10)
RSW-2-25P (Reflective)	DC-2.5	1.1	+29	49	3.95
MSW-2-20 (Reflective)	DC-2.0	1.0	+24	34	2.45
MSWA-2-20 (Absorptive)	DC-2.0	1.3	+27	40	2.45
MSWT-4-20 (Transfer)	DC-2.0	1.8 TX** 2.0 RX***	+28 TX** +20 RX***	30	3.45

*Midband, 500MHz-1000MHz. **Transmit. ***Receive.

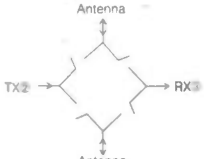
Package:
RSW in SOIC 14 pin,  **MSW** in SOIC 8 pin 



SPDT REFLECTIVE



SPDT ABSORPTIVE



TRANSFER

Mini-Circuits®

US 48 INT'L 49
CIRCLE READER SERVICE CARD

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

Yoni™ The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: http://www.minicircuits.com

ISO 9001 CERTIFIED

F 174 Rev E

New NEC Bipolar Transistors

Higher f_Ts, Lower 1/f

New, Smaller Packages

- **Flat Lead** design reduces parasitics and improves electrical performance
- **Low Profile** package is ideal for PCMCIA and other space-constrained designs

Oscillators & Buffer Amps

With the best *1/f* performance available, these devices help you achieve the phase noise your design demands. They're also available in Twin Transistors.

Part Number	Corner Freq*	V_{CE}	I_C	Package
NE856M03	3 KHz	3 V	30 mA	**M03**
NE685M03	5 KHz	3 V	5 mA	**M03**

**Review Application Note AN1026 on our website for more information on 1/f noise characteristics and corner frequency calculation.*

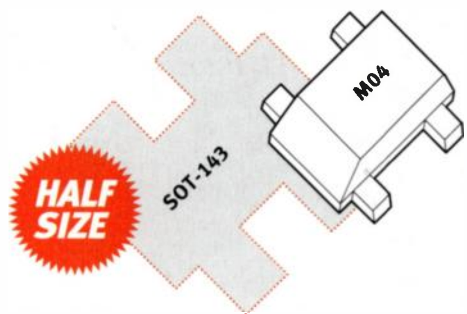
New M03

Half the footprint area of a SOT-323

LNAs

Need low noise and high gain in an ultraminiature package for your hand-held wireless products? These new high frequency NPN transistors deliver!

Part Number	Description	NF	Gain	Freq	Package
NE687M03	11 GHz f_T LNA	1.2 dB	13 dB	1 GHz	**M03**
NE661M04	25 GHz f_T LNA	1.2 dB	22 dB	2 GHz	**M04**
NE662M04	23 GHz f_T LNA	1.1 dB	20 dB	2 GHz	**M04**

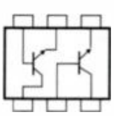


New M04

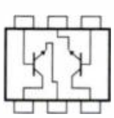
Half the footprint area of a SOT-143

Twin Transistor Devices

Cascode LNAs, cascade LNAs and oscillator/buffer combinations are just three possible uses of these versatile devices. *Matched Die* versions pair two adjacent die from the wafer to help simplify your design, while *Mixed Die* versions — an NEC exclusive — let you optimize oscillator performance while achieving the buffer amp output power you need. 40 different combinations available.



Part Number	Description	Q1 Spec	Q2 Spec
UPA810TC	Matched Die/Cascade LNA	NE856	NE856
UPA814TC	Matched Die/Cascade LNA	NE688	NE688



Part Number	Description	Q1 Spec	Q2 Spec
UPA826TC	Matched Die/Osc-Buffer Amp	NE685	NE685
UPA840TC	Mixed Die/Osc-Buffer Amp	NE685	NE681

New TC Twin Transistors

Half the footprint area of a SOT-363

Visit us at Booth 417 – Wireless Data Sheets and Application Notes are available at **www.cel.com**

CEL California Eastern Laboratories

NEC

Santa Clara, California ▪ **408 988-3500** ▪ **Fax-on-Demand 800-390-3232** (US & CANADA)

DISTRIBUTORS: Arrow (800) 525-6666 **Repton Electronics** (888) REPTRON

Mouser Electronics (800) 346-6873 **Electro Sonic** (800) 567-6642 (CANADA)

INFO/CARD 57