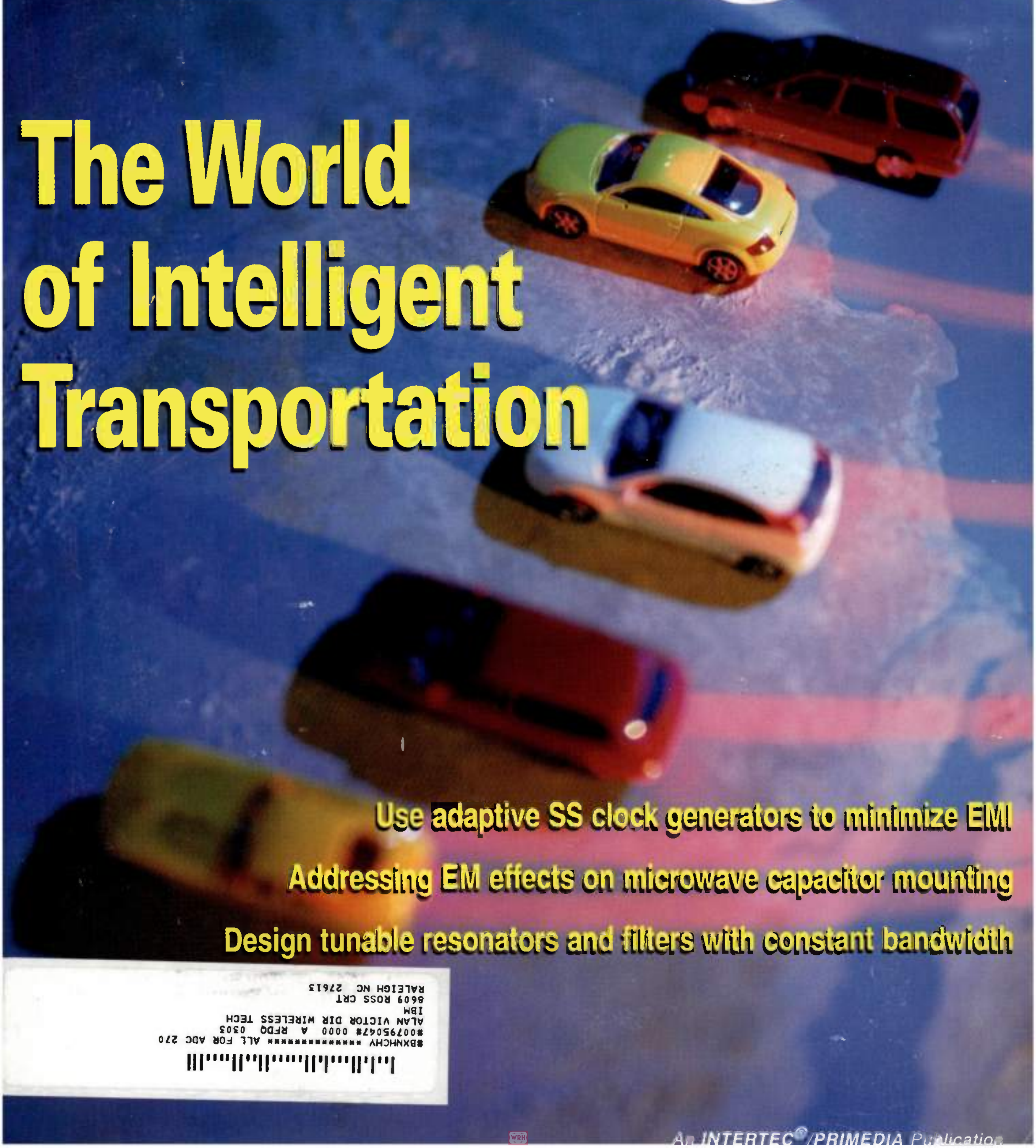
August 2001

RF design®

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

www.rfdesign.com



The World of Intelligent Transportation

Use adaptive SS clock generators to minimize EMI

Addressing EM effects on microwave capacitor mounting

Design tunable resonators and filters with constant bandwidth

An INTERTEC®/PRIMEDIA Publication

WORLD'S WIDEST SELECTION

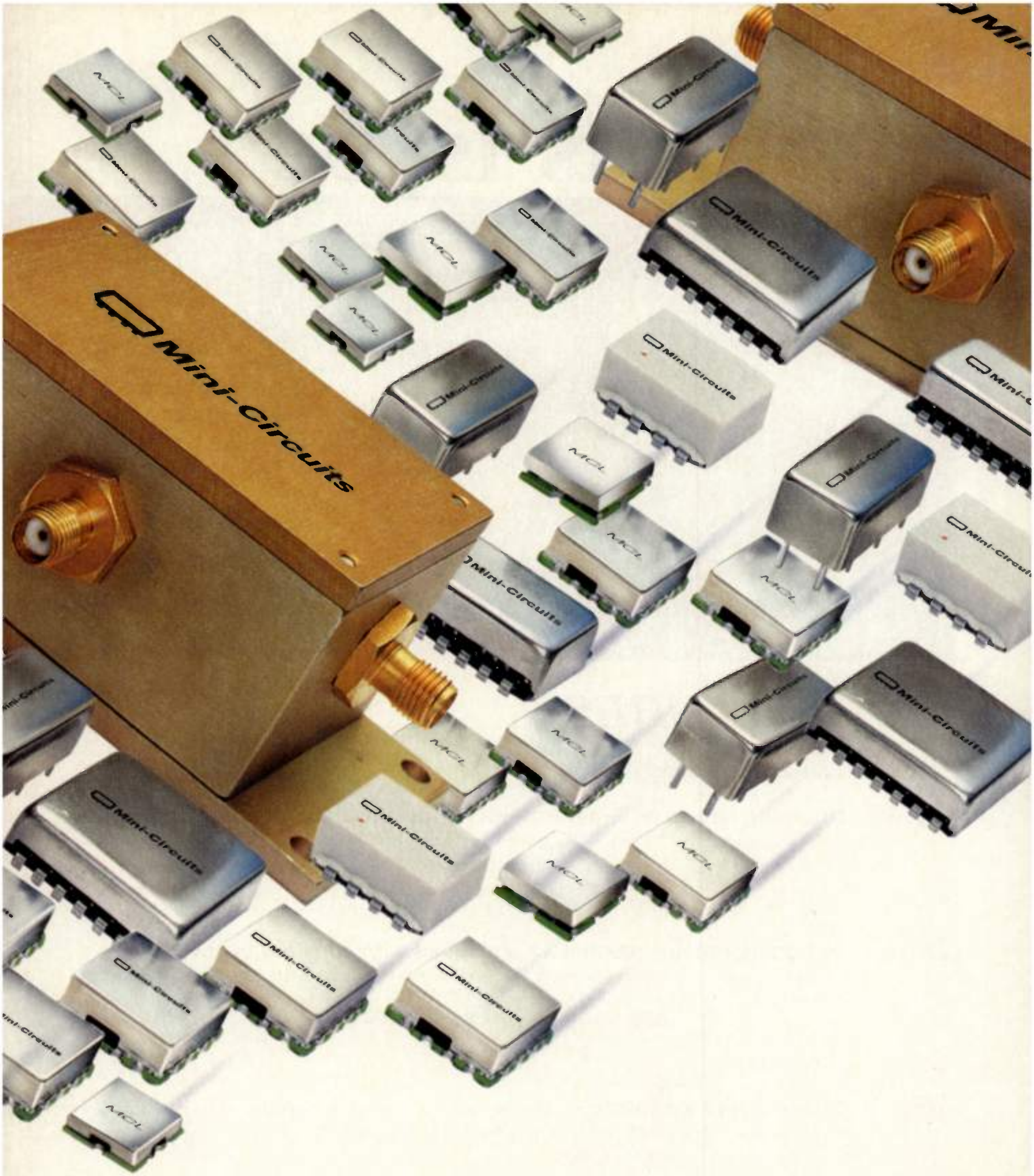
VCOs

12.5 to 3500MHz from $11.95 ea. (qty. 5)

Want a miniature surface mount, shielded plug-in, or rugged coaxial voltage controlled oscillator with the right stuff for your project? Contact Mini-Circuits! From custom designs to standard catalog models ***always in stock***, we'll supply extra robust, 100% tested VCO solutions you need at a price you can afford. Choose from narrow to broad to octave band widths. Select linear tuning, low phase noise, and 5V models optimized for PLLs and synthesizers. And pick from an innovative array of miniature SM packages as small as 0.370" square for a variety of designs and applications. You can quickly find the model you need using "The YONI Search Engine" at the Mini-Circuits web site. Just enter your specs...click...and immediately start evaluating suggested VCO solutions using the *actual measured performance data* displayed. But perhaps you need a custom design. Not a problem! Contact us for our lightning fast response, low prices, and quick turnaround. Give the competition *real competition*...specify Mini-Circuits VCOs!

New 2001 VCO Handbook...FREE!

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



Mini-Circuits®

US 27 INT'L 28
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

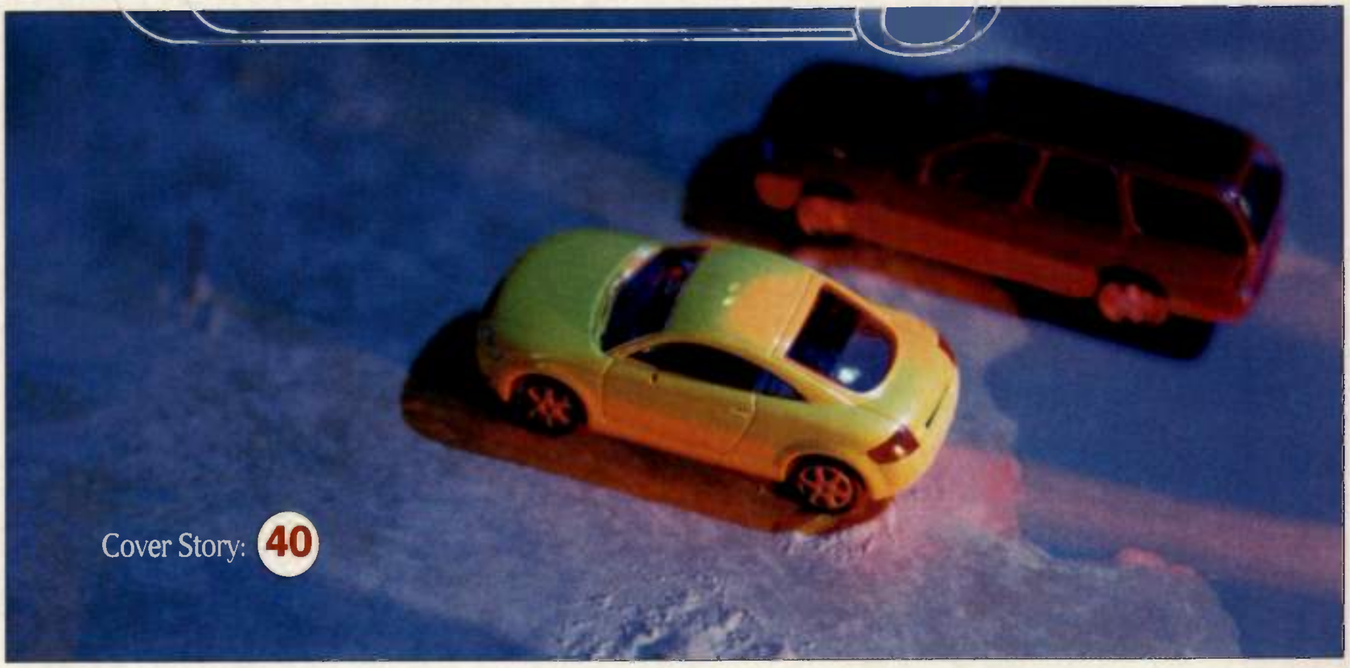
YONI™ *The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At:* ***http://www.minicircuits.com***

ISO 9001 CERTIFIED

F 341 Rev Org

August 2001

IN THIS ISSUE

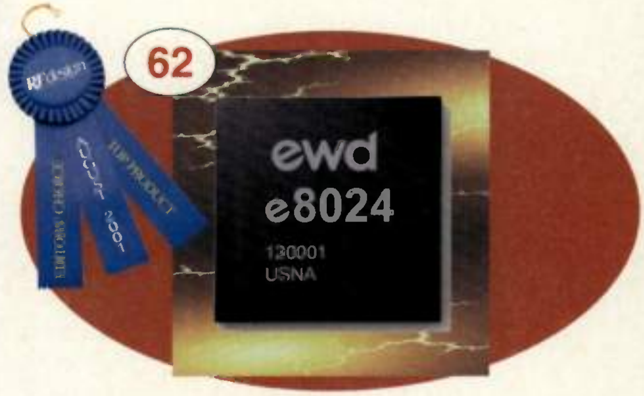


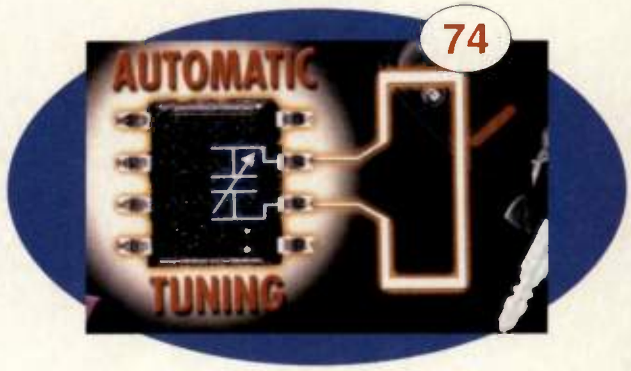
FEATURES

RFdesign online! www.rfdesign.com

IN THIS ISSUE

DEPARTMENTS





ON THE WEB

Check out the additions to *RF Design* online:

- Improved online supplier directory
- Improved monthly manufacturer's links pages
- Online survey
- Exclusive online articles

And there is more on the way!

RFdesign online! www.rfdesign.com

RF DESIGN (ISSN 0163-321X USPS: 453-490) is published monthly. August 2001, Vol. 24, No. 8. *RF Design* is a registered trademark of Intertec Publishing, A PRIMEDIA Company. Copyright 2001 by Intertec Publishing, 9800 Metcalf Ave., Overland Park, KS 66212-2215. Editorial and advertising offices at 5680 Greenwood Plaza Blvd., Suite 100, Greenwood Village, 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, $6? (surface mail) or $10? (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/2001 $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 Reprint Management Services at 717-399-1900. **SUBSCRIPTION INQUIRIES: 800-441-0294.** POSTMASTER & SUBSCRIBERS: Please send address changes to RF Design, P.O. Box 12960, Overland Park, KS 66282-2907.

SPIRENT
Communications

CDMA Gets Wide!

Extend your product's performance with **3G CDMA test solutions** from Spirent Communications

3GPDP

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.

SPIRENT has brought together Adtech, DLS, GSS, SmartBits, and TAS to create the world's leading communication test and measurement company
1-800-927-2660

www.spirentcom.com

INFO/CARD 2

RF editorial

Save us from drivers with cellphones

By Don Bishop
EditorDirector
dbishop@intertec.com

There it is. Splattered across your windshield like a big, black bug. A state law against using a hand-held cellular phone while you're driving.

In New York, the cost of making a wireless phone call has gone up to $100 each. That's the fine that goes into effect on Dec. 1.

I've heard all of the arguments.

"People who drive while using their cellular phones are as likely to be involved in a collision as someone who's drunk."

"If you're going to tell people they can't use their cellphones while driving, what about outlawing shaving while driving, or applying makeup?" (Do I have to say "men shaving" and "women applying makeup"? I hope not.)

Look, I'm not sure that New York's law will change driving habits all that much. I hope it does, but realistically, will it?

"We already have laws on the books about inattentive driving, careless driving and reckless driving. Why do we need another one specifically about using cellphones? That's already covered!"

I know; I know.

The problem is, I can't help but take it personally. I've been rear-ended three times during the past four years. Each time, there I was, thinking pleasant RF thoughts, my car immobile at an intersection while I waited for the light to change. Wham!

The first time, the sudden icing of the road made it too slippery for a driver to bring his car to a halt. The driver? A real gentleman. A 90-year-old farmer in Norfolk, Nebraska. Offered me $20 on the spot for damage to my bumper. (Shop estimate: $390.)

The second time, a 40-ish driver using his cellphone and giving thought to changing lanes (according to his statement in the police report) blasted me on a hot summer Kansas day in the cool shade of a freeway overpass. Offered to call anyone I wanted on his cellphone. (Damage: $6,000.)

The third time, the other driver, maybe in her mid-50s, told the police and me that she was distracted by something in the passenger seat. She said it looked as though it would fall on the floor as she braked, and she took her eyes off the road as her car slowed. She didn't stop soon enough, and crunch! (Light damage; didn't get an estimate.)

So I've heard the arguments on both sides. And I've had personal experience with drivers whose motoring skills were affected by road conditions and by distractions both wireless and non-wireless.

Even taking all of that into consideration, I still think it's a good idea to put it into law that motorists shouldn't use hand-held cellphones while they drive. OK, they're still going to fuss with beverage cups, cigarettes, razors, makeup cases, dashboard controls, passengers (real and imagined), their own weird thoughts and God knows what else.

But maybe the moment's thought it may give to some New York drivers is that they shouldn't allow themselves the distraction — The distraction of holding the phone to an ear while driving with one hand and listening to bad news. It begins in New York. California, you should be next.

Wyoming? Not a chance. Kansas? Maybe.

AMPS
CDMA
CDPD
DAMPS
DCS1800
ECM
EDGE
EW
GEO
GPRS
GPS
GSM900
HFC
IFF
LEO
LMDS
LMR
MMDS
NPCS
PCS
PCS1900
RADAR
RFID
RLL
SMR
TDMA
TETRA
UMTS
WAP
WBA
WCDMA
WLAN
WLL
WWAN

As demand in the wireless telecommunications industry nears 3G protocols, precision engineering and manufacturing become essential to the success of RF design engineers. We offer a variety of precision commercial VCOs, PLLs, and RF Passive Components designed to meet the stringent needs of today's and tomorrow's wireless applications.

To find out how Vari-L can "have a part in your future," please visit our website or send us an email at sales@vari-l.com.

VARIL

We Have A Part In Your Future

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

OUR PRODUCTS INCLUDE:

- PLL Synthesizer Modules
- Wideband RF Transformers
- Couplers
- Voltage Controlled Oscillators
- Power Dividers/Combiners

PROUDLY MADE IN THE USA | ISO9001 Certified

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

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

RF design

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

Established 1978

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

Editor .... Roger Lesser
Technology Editor .... Ernest Worthman
Senior Associate Editor .... Nikki Chandler
Associate Editor .... Megan Alderton
Art Director .... Maurice Lydick
Editorial Director .... Don Bishop, 913-967-1741

Group Publisher .... Mercy Contreras
Marketing Director .... Patricia Kowalczewski
Advertising Services Manager .... Karen Clark
Sr. Classified Ad Coord. .... Annette Hulsey, 913-967-1746
Ad Production Coord. .... Jason Brooks, 312-840-8440
Circulation Manager .... Sonja Radar

Directories Issues Manager .... Deborah Dickson
Reprints Manager/List Rental Manager .... Marcia Jungles, 913-967-1326

Customer Service 800-441-0294

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

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

Chief Executive Officer .... Timothy M. Andrews
President .... Ron Wall
Vice President—Communications Division .... Larry Lannon
Vice President—Production .... Tom Fogarty
Director Advertising Services .... Nancy Hupp
Corporate Creative Director .... Doug Coonrod
Corporate Circulation Director .... Sheri Gronli

PRIMEDIA Business-to-Business Group
President/CEO .... David G. Ferm
Chief Creative Officer .... Craig Reiss

PRIMEDIA Inc.
Chairmen and CEO .... Tom Rogers
President .... Charles McCurdy
Vice Chairman .... Beverly C. Chell

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 are 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.

PHIL COOK
Marketing Manager- West
2121 Alton Parkway, Suite 200 • Irvine, CA 92606
Tel. 949-838-2165 • Fax: 949-252-0556
e-mail: *phil_cook@intertec.com*

CORY BUDAJ
Marketing Manager- Central
5680 Greenwood Plaza Blvd., Suite 100 • Greenwood Village, CO 80111
Tel. 720-489-3201 • Fax: 720-489-3253
e-mail: *cory_budaj@intertec.com*

DAVID JEANS
Marketing Manager- East
5680 Greenwood Plaza Blvd., Suite 100 • Greenwood Village, CO 80111
Tel. 720-489-3108 • Fax: 720-489-3253
e-mail: *david_jeans@intertec.com*

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*

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*


The one constant
Change

RF calendar

AUGUST

13–17 **IEEE-EMC Symposium** – *Montreal* – Information: Web site: **www.ieee.org.**

19–24 **ITCom and Opticomm 2001** – *Denver* – Information: Web site: **www.spie.org/info/itcom**

27–30 **Intel Developer Forum** – *San Jose* – Information: Web site: **http://developer.intel.com/idf/camera**

SEPTEMBER

4–7 **Embedded Systems Conference** – *Boston* – Information: Web site: **www.embedded.com/esc**

10–13 **CTIA Wireless I.T. and Internet 2001** – *San Diego* – Information: Web site: **www.wirelessIT.com**

24–26 **EDA: Front-To-Back** – *Santa Clara* – Information: Penton Media. Tel. 1.888.947.3734.

24–28 **European Microwave Week** – *London* – Information: Web site: **www.eumw.com**

OCTOBER

1–3 **34th Annual Connector and Interconnection Technology Symposium** – *Anaheim* – Information: Web site: **www.ec-central.org**

1–4 **Communications Design Conference** – *San Jose* – Information: Web site: **www.CommDesignConference.com**

2–4 **Sensors Expo Fall** – Philadelphia – Information: Web site: **www.sensorsexpo.com**

8–11 **Bluetooth Summit 5** – *Vienna, Austria* – Information: Web site: **www.iir-conferences.com/a.cfm?id=382>**

23–25 **Cleveland 2001 Advanced Productivity Exhibition** – *Cleveland* – Information: SME Customer Service. Tel. 800.733.4763. Web site: **www.sme.org/cleveland**

DECEMBER

3–6 **Internet World Wireless West 2001** – *San Jose* – Information: Web site: **www.ccievents.com**

11–13 **Bluetooth Developer's Conference 2001** – *San Francisco* – Information: Web site: **www.key3media.com/bluetooth/**

11–14 **International Radar Symposium India** – *Bangalore* – Information: Web site: **www.irsi2001.com**

RF courses

AGILENT TECHNOLOGIES – *RF and Microwave Fundamentals* – Aug. 29–31, Dec. 4–6; *Network Analysis Measurements* – Oct. 16–17; *Spectrum Analysis Measurements* – Oct. 18–19. Information: Tracey Bull, Eskdale Rd., Winnersh Triangle, Wokingham, UK; Tel. +44.118.927.6741; Fax: +44.118.927.6862; e-mail: *tracey_bull@agilent.com*

ALEXANDER RESOURCES – *3G Wireless: Promises & Realities* – Sept. 24-25, Dallas, Oct. 29-30, Washington DC; *Making Money in the U.S. Wireless Internet Market* – Sept. 5-6, San Jose, Oct. 1-2, Dallas. Information: Jeff Stone, Alexander Resources,15851 N. Dallas Pkwy, Addison,TX 75001; Tel. 972.818.8225; Fax: 972.818.6366; e-mail: *jstone@alexanderresources.com*.

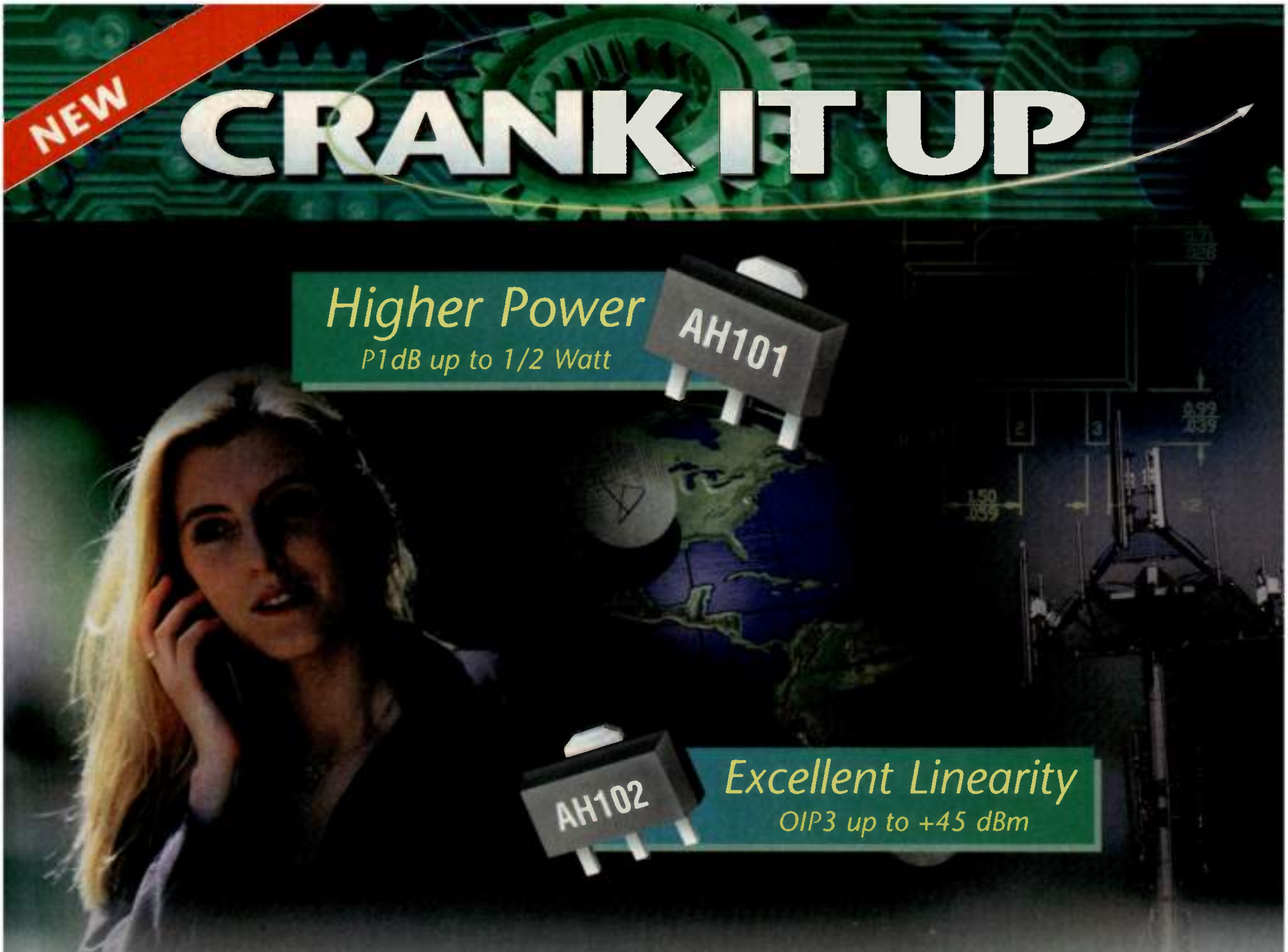
BESSER ASSOCIATES – *RF and Wireless Made Simple* – Oct. 22-23 ; *Fiber Optics Made Simple* – Oct. 30–31, Mountain View, CA. Information: Besser Associates, 201 San Antonio Circle Building E, Suite 280, Mountain View, CA 94040; Tel. 650-949-3300; Fax: 650-949-4400; e-mail: *info@bessercourse.com*; Web site: **www.bessercourse.com**

GEORGIA INSTITUTE OF TECHNOLOGY – *Infrared / Visible Signature Suppression* – Aug. 28–31; *Infrared Countermeasures* – Nov. 6–8, Atlanta; Information: Continuing Education, Georgia Institute of Technology, Tel. 404.385.3502; e-mail: *conted@gatech.edu;* Web site: **www.conted.gatech.edu**

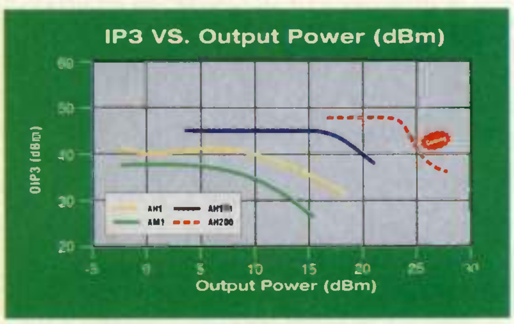
R.A. WOOD ASSOCIATES – *Introductory RF and Microwaves* – Sept. 20–21; *RF and Microwave Receiver Design* – Sept. 24–26; *RF Power Amplifiers, Classes A–S: How Circuits Operate, How to Design Them, and When to Use Each* – Sept. 27–28, Lake George, NY. Information: R.A. Wood Associates, 1001 Broad St. Ste. 450, Utica, NY 13501; Tel. 315.735.4217; Fax 315.735.4328; e-mail: *RAWood@rawood.com;* Web site: **www.rawood.com**

UCLA – *Digital Signal Processing: Theory, Algorithms, and Implementation* – Aug. 13–17; *Bluetooth: Technology, Applications, and Performance* – Aug. 20–22, Los Angeles. Information: Information Systems and Technical Management Short Courses. Tel. 310.825.3344; e-mail: *mhenness@unex.ucla.edu*; Web site: **www.uclaextenstion.org/shortcourses**

UNIVERSITY OF MISSOURI-ROLLA – *Circuit Board Layout to Reduce Noise Emission and Susceptibility* – Sept. 19, Denver. Information: Web site: **www.umr.edu/-conted>**



For higher power and excellent linearity, use WJ's AH101 and AH102 amplifiers.



WJ High Dynamic Range Amplifiers

Product	Frequency (MHz)	IP3 (dBm)	P1dB (dBm)	Bias current (mA)
AH101 (New)	50-1500	45	27	200
AH102 (New)	350-3000	45	27	200
AH1	250-3000	41	21	150
AM1	250-3000	37	18	75
AH200 (Coming Soon)	250-6000	47	30	360

WJ's got the POWER! Our new AH101 and AH102, 50 ohm unconditionally stable amplifiers have **higher power** up to 1/2 Watt. The AH101 and AH102 provide **excellent linearity** up to 47 dBm in a **low cost** surface mount package (SOT-89). The AH101 and AH102 have a Linear Figure of Merit (LFOM) of 12 dB, while maintaining WJ's high standard of reliability.

LFOM Defined: $\text{LFOM (dB)} = \dfrac{\text{OIP3 (dBm)}}{\text{DC Power (dBm)}}$

For more details, call our toll free number, fax us at 408-577-6620 or e-mail us at sales@wj.com. Data sheets are available in PDF download files by visiting our web site at www.wj.com.

The Communications Edge

ISO 9001 WJ COMMUNICATIONS

Visit us on the web at www.wj.com

1-800-WJ1-4401

wj communications

INFO/CARD 67

2.4 GHz , spread spectrum and the FCC Rules Part 15

by Delaney M. DiStefano

The FCC recently announced that it was proposing rule changes in Part 15 with regard to 2.4 GHz spread-spectrum devices. This is big news because the rule changes will allow more flexibility for spread-spectrum systems, while also allowing the development of new devices similar to spread-spectrum systems.

Part 15 regulates the operation of unlicensed devices. These devices must operate with minimal or harmless interference, while they must also accept any interference that they may receive.

Last year, the commission changed its rules to allow for some frequency-hopping, spread-spectrum systems in the 2.4 GHz band that operate with a bandwidth greater than1 MHz, but less than or equal to 5 MHz to use a minimum of 15 hopping frequencies. Previously, the systems were required to use 75 non-overlapping hopping frequencies, as long as the total span of the hopping channels was at least 75 MHz. Those frequency-hopping systems that use as much as 1 MHz of spectrum are required to use at least 75 non-overlapping hopping frequencies.

Ramifications of frequency-hopping spread spectrum

After the rule change, many companies requested additional clarification. Therefore, the commission has decided to revisit the issue by issuing a Further Notice of Proposed Rule Making and Order requesting comment on some new proposed rule changes.

The FCC has proposed to further amend Rule Section 15.247 to allow a minimum of 15 hopping frequencies regardless of the bandwidth being used in the 2.4 GHz band. The only caveat is that the output power cannot exceed 125 mW and the new device must use adaptive hopping techniques. However, it appears from the NPRM that the FCC is not committed to making the use of adaptive hopping techniques mandatory in this instance. In fact, it invites comment on that particular point. As a result, we could see more change in frequency-hopping, spread-spectrum rules before the final order.

Ramifications of direct-sequence processing gain

The FCC also proposed last year to change the method for which the processing gain of direct-sequence spread-spectrum is tested. Currently, the rules require that the processing gain be tested by the continuous wave (CW) jamming margin test. The FCC suggested that the CW jamming margin test, "may not measure the true processing gain for certain types of direct-sequence, spread-spectrum systems where a portion of the information signal is embedded in the spreading code." The solution proposed by the FCC was the use of a Gaussian noise signal in the jamming margin test because it is more like a real-world environment.

Alas, this too met with opposition by commenters, so the FCC now proposes to eliminate the processing gain requirement for direct-sequence, spread-spectrum systems altogether because there is no consensus or standard method for testing the processing gain.

Ramifications of digital transmission systems

Finally, the FCC noted in the Notice of Proposed Rule Making (NPRM) that its own rules may stand in the way of new technology being developed. To address this important revelation, the FCC is proposing, and inviting comments on, whether digital transmission systems should be allowed to operate at the same power levels as direct-sequence, spread-spectrum systems.

The commission noted that digital transmission systems are similar to spread-spectrum systems and will be required to meet the same rule criteria as spread-spectrum devices, so much so that digital transmission systems will be addressed within Section 15.247 and not in a new rule section. However, digital transmission systems are most similar to direct-sequence, spread-spectrum systems. Accordingly, the FCC proposes that the allowable output power levels for digital transmission systems be the same as for direct-sequence spread spectrum. But the FCC also seeks comment on whether this might cause too much interference to other devices, and therefore should be given a reduced permitted power level.

This is an important NPRM because the FCC is directly addressing and responding to the concerns of manufacturers. The FCC is making it clear that it wants companies to have the flexibility to develop new technology, while protecting existing uses by being fairly conservative in its proposals.

RF

About the author

Delaney M. DeStefano is a senior associate with the law firm of Schwaninger & Associates, P.C. DeStefano is a member of the New York State and District of Columbia Bars and a member of the FCC Bar Association. DeStefano's primary practice is in wireless telecommunications. She is a veteran of several FCC auctions.

Introducing our NEW 10 Million Cycle Switch

The ideal solution for your demanding switch requirements.

ISO-9001

CE Certified

2-Year Warranty

CCM-33S10 SPDT Switch

- 10 Million Cycle Life
- DC – 18 GHz
- Latching or Failsafe
- Actuator Voltage: +12 or +28 VDC
- 10 msec Switching Time
- Indicator Circuits and TTL Options

TELEDYNE WIRELESS

A Teledyne Technologies Company

INFO/CARD 62

Teledyne Wireless, 1274 Terra Bella Avenue, Mountain View, CA 94043, Phone: 800.832.6869, Fax: 650.962.6845

For Faster Information e-mail: switches@teledyne.com

www.teledynewireless.com

Opinions from a common man

By Roger Lesser
Editor
rlesser@intertec.com

Everyone is good for an opinion. I'm no exception. So, here are a few for your consideration:

Go see "Finding Forrester" and "Moulin Rouge." Both are good flicks.

The best written TV show is "Sex and the City." Maybe it's just the topic.

The best book to read over the summer is Clive Cussler's "Atlantis Found." Bet you can't put it down.

The New York Yankees will find a way to win the World Series again. It's maddening, but it's true.

The best blues song is "Crossroads." Love Eric Clapton's version(s).

I say again, the telecom market will rebound by the end of the year. I'm a believer.

The next killer app for communications will be coming to a highway near you. ITS is it, and it should be.

At the crossroads

ITS is the killer app everyone is looking for. That's my opinion, and I don't think I'm wrong (Dennis Miller I'm not.) As you read this month's cover story on ITS, consider this: What is the one area of technology that everyone seems bent on having happen sooner or later? If you said convergence, you are right in my opinion. Now ask yourself where this is going to happen first. In the home? Wrong opinion. In the car, plane, train and anything else that moves people? Right on. And it's happening.

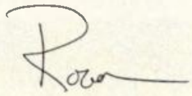
From GM to Mercedes Benz, auto manufacturers are scrambling to be the first on the block to have wireless connectivity. GM's OnStar has been out for some time, and Mercedes Benz has demonstrated an onboard computer system that can do everything a home computer can do. And now Ford is installing the CellPort wireless handset capability into its cars.

And that is just the beginning. The applications for safety, security and just plain fun are too numerous to write about in this column. From Internet connectivity to hands-free communications and GPS applications, convergence is happening. (In my opinion, of course.)

Speaking of GPS

I love seeing unique applications of any technology. Have you heard about geocaching? The concept is to find hidden "treasure" buried at a predetermined location. The object of the game is to find the treasure using a GPS handset. Players are given coordinates and must then go on the hunt. This high-tech scavenger hunt was started by **www.geocaching.com**.

I've got an opinion about this too if you care to hear it.



Worldwide network client market to reach $5.5 billion

The worldwide network client market (including network interface cards (NICs), LAN on motherboard silicon, embedded LAN connections such as those in home gateways, and mini-PCI connections) will grow from $3.1 billion in 2001 to $5.5 billion in 2005, according to Cahners In-Stat Group, Scottsdale, AZ. This growth will be spurred by emerging technologies such as gigabit Ethernet.

Wireless connectivity will also be a growth driver in the network client market, Cahners said. The strong desire for wireless LAN connections on both laptops and new form-factor devices such as residential gateways will result in robust volume shipments for technologies such as 802.11b and newer technologies in the WLAN space such as 802.11a.

Another important trend in the network client market is the continued integration of basic LAN connectivity into both business and consumer PCs, Cahners said. Both fast Ethernet LAN on motherboard connections, as well as continued integration of Ethernet functionality into the core PC chipsets will mean most PCs shipped in the future will come "pre-wired" for networking.

Internet, cellular use creates demand for wireless WANs

The international Internet craze and the growing popularity of cell phones in countries without a wireline infrastructure is expected to increase demand for wireless wide area network (W-WAN) equipment, according to research firm Frost and Sullivan, San Jose.

New analysis from the company, *World Wireless Wide Area Network Markets*, reveals that this industry generated revenues of $4.59 billion in 2000 and projects it to increase to $15.62 billion by 2007.

While global Internet use is growing, many countries struggle to provide basic telephone service. With the challenge of laying cable through new territory, providers are relying on wireless network technology to supply a less-expensive, easy-to-install alternative to a wireline base.

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

BUSINESS BRIEFS

Agere Systems, RF Micro Devices team — Agere Systems, Allentown, PA, and RF Micro Devices, Greensboro, NC, have signed definitive agreements to form a strategic alliance to develop, design and manufacture high-performance chips for next-generation, data-capable digital cellular phones and other communications products.

AWR announces worldwide licensing agreement with Ericsson Microwave Systems AB — Applied Wave Research, El Segundo, CA, announces the signing of a worldwide software licensing agreement with Ericsson. The agreement with Ericsson Microwave Systems AB provides all of Ericsson and its affiliates worldwide with a pre-negotiated licensing agreement for all of Applied Wave Research's products, including Microwave Office.

Testmart named authorized Fluke distributor — Testmart, San Bruno, CA announces that it has been named an authorized distributor for Fluke, Everett, WA. Under the terms of the contract, TestMart will resell and maintain an inventory of Fluke industrial products ranging from Fluke's hand-held oscilloscopes to multimeters. Effective immediately, these Fluke offerings are in TestMart's database, and are available for customer order and immediate shipment.

Neolinear announces $3.8 million DARPA technology investment agreement — Neolinear, Pittsburgh, announces that it has entered into a $3.8 million Defense Advanced Research Project Agency (DARPA) technology investment agreement for the development of a next-generation analog/mixed-signal synthesis system for ultra-high frequency integrated circuit design. Neolinear is being funded by DARPA in response to Department of Defense (DoD) and industry needs to rapidly design sophisticated analog and mixed-signal circuits using system-on-chip (SoC) technology.

Peregrine Semiconductor signs process technology contract with U.S. Defense Microelectronics Activity — San Diego-based Peregrine Semiconductor's high-performance communications integrated circuit technology has been selected by the U.S. Defense Microelectronics Activity (DMEA) to supply advanced process technology for radiation hardened integrated circuits. Under the terms of the $4.8 million contract, DMEA officials are asking Peregrine to develop, implement, and demonstrate a sub-micron radiation-hardened ultra-thin silicon on sapphire semiconductor manufacturing process for use within the DMEA Flexible Foundry in Sacramento.

Xemics, Conexant team on Bluetooth device — Xemics, Neuchâtel, Switzerland, a fabless semiconductor company specializing in ultra-low-power, short-range wireless connectivity solutions, announces that it has selected Conexant's, Mountain View, CA, Bluetooth radio as the preferred radio device to implement its ultra-low power Bluetooth solution. The Conexant radio device CX72303, in combination with the XEMICS Bluetooth"! baseband XE1431 and the XEMICS CODEC XE3006 allow for a complete wireless headset, from microphone to speaker, consuming less than 35mW during continuous operation (HV3 Bluetooth profile).

HOT WEB SITE

Site offers career placement, advice

National Engineering Search's (NES) Web site is dedicated to placing engineers and managers with companies ranging from Fortune 500s to technology start-ups. With more than 400 affiliates throughout the United States, NES concentrates on the software, hardware, RF, optical and mechanical engineering disciplines.

The site offers an online **job-search database** that offers access to more than 5,000 engineering jobs and technical management opportunities. Current search assignments range from junior engineer to CEO. Other features of the site include:

- **Salary Calculator** — Current salary survey data and compensation trends based on industry, skills and geographical location.
- **Career Advice** — How to present experience and strengths in an interview to writing a resignation letter.
- **Resume Wizard** — Assists in putting together a powerful resume for use in a search, offers printing and submit features.
- **Career Watch** — NES will keep you informed about career opportunities that match the criteria defined.

www.nesnet.com


muRata
Innovator in Electronics
MURATA's RF and wireless innovations open the door to design freedom
Murata PN:
MM8430-2600
Description: RF Switch Connector. One of the most exciting microwave products to come along in years. This low cost test switch has virtually universal RF and microwave design appeal. It solves many design and production test problems at a low cost. Applicable to all RF applications under 3GHz (3000MHz). Test probes: Works with Lab test probe MXGM76RL1000 and mass production test probe MM126030. Reel size/Stock quantity: 1000 pcs. 1 reel. Order PN: MM8430-2600TB1
Murata PN:
LFSN25N19C2450B
New Global PN:
LFB322G45SN1A504
Description: 2450MHz Band Pass Filter, Miniature (3.3 x 2.5mm) ultra low cost Ceramic LC Chip type BPF. This low cost BPF makes an ideal interstage filter. Small enough and low cost enough to be used in several positions on the same board! Reel size/Stock quantity: 2000 pcs. 1 reel. Order PN: LFSN25N19C2450B
Murata PN:
MQE920-2450
Description: 2450MHz miniature (7.8 x 6mm) surface mount VCO. For use in all 2.4GHz Wireless LAN applications. Low cost. Reel size/Stock quantity: 3000 pcs. 1 reel. Order PN: MQE920-2450-T7
Murata PN:
DFC21R57P002HHA
New Global PN:
DFCB21G57LDJAB
Description: 1.57GHz Band Pass Filter (BPF) for GPS applications. Ceramic Monoblock miniature low cost surface mount. Used as the primary RF filter by the USA's leading manufacturers of commercial GPS receivers, this filter has performance and low cost in a standard miniature package. Ceramic BPFs like this form the backbone of Murata's Microwave product line. Since 1950, ceramic electronic components have been Murata's key focus. Reel size/Stock quantity: 2000 pcs. 1 reel. Order PN: DFC21R57P002HHA-TA2120
SPECIAL OFFER
Visit our website and register for your FREE MM8430-2600 and LFSN25N19C2450B (New Global PN: LFB322G45SN1A504) samples
www.FutureElectronics.com/Murata
1-800-FUTURE-1 ext.2436
INFO/CARD 37
With advanced e-commerce supply chain solutions, state-of-the-art design centers, technical support teams of qualified engineers all around the world and a partner like Murata, the experts at Future Electronics give you the freedom to go further.
FUTURE ELECTRONICS
THE LARGEST "AVAILABLE-TO-SELL" INVENTORY
FUTURE
ELECTRONICS

DARING

INNOVATION

Facing a ferocious marketplace?

Let RFMD tame your challenges.

We **dare** to be different by providing **highly integrated solutions** that help meet **stringent system requirements** and **reduce your bill of materials**.

RFMD employs **innovation** to develop **next-generation** processes, circuits, architectures, standards and packaging **in advance of the marketplace**.

Our **deep design resources** and **extensive manufacturing capacity** enable us to design a wide range of **best-in-class components** for all your RFIC needs.

Because true success has no competition.

DARING innovation – 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 336.931.7454

Mention daring when contacting us.

www.rfmd.com

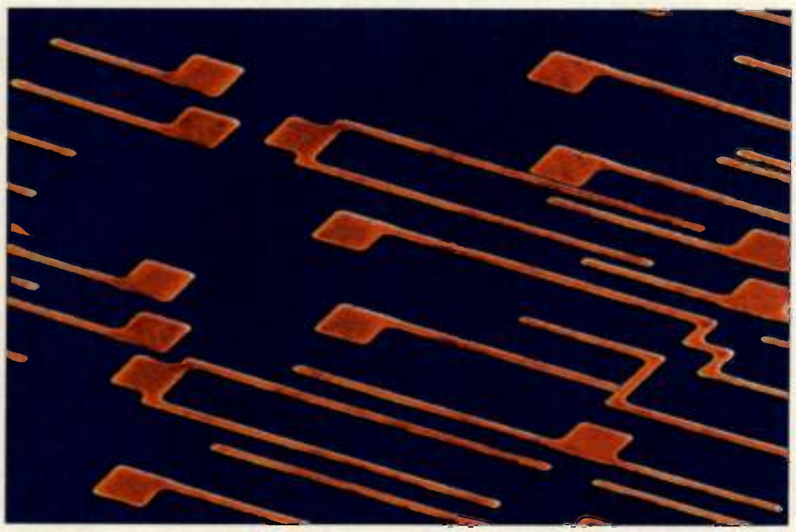
INFO/CARD 49

Mounting effects on S-parameters for multilayer microwave capacitors

Obtaining accurate results using SRF / S parameters requires consideration of the external electromagnetic effects. Here's why.

By Edward Schoepke

S-parameters, as reported by a capacitor manufacturer's typical software package, can be significantly different from the S-parameters component yields in an actual application. This is mainly because of mounting differences in the actual application, which vary according to how the capacitor was mounted in the test fixture during measurement at the manufacturer.



In the lab – analytical measurements

The capacitors are first analytically measured in a calibrated test fixture (in this case it is an SMD fixture) connected to a vector network analyzer (VNA). Then the data are mathematically de-embedded to represent the capacitor alone, as reported by the software. This de-embedded data can be used as a starting point. They are then modified using the techniques described below to yield S-parameters that represent a specific in-circuit mounting situation more accurately.

How we measure – techniques

The actual measurement is made in a series mounting configuration with a 50Ω microstrip environment where the width of the microstripline is nearly identical to the width of the capacitor. This 50Ω microstrip environment is on an Alumina substrate used during modified through-reflect-line (TRL) calibration. It is also used for launching to and from the device under test (DUT), except for directly under the DUT where the substrate is air. During measurement on the test fixture, the capacitor is de-embedded to its terminations, causing the capacitor's physical length to be included in the S_{21} phase (as opposed to the mathematically de-embedded S-parameters presented in a typical software package). After de-embedding, the physical length of the capacitor under test, as well as the small capacitances from the capacitor body to the ground, are included in the measured S-parameters.

Mounting, software, and impedance

As discussed previously, the method for mounting the capacitor in the user's circuit can alter the impedance and cause the "software reported" S-parameters to differ significantly from those created in a particular application. Some of the variables affecting S-parameters include mounting configuration (series or shunt), transmission line width, substrate (PCB) dielectric constant and solder fillet geometry/quality.

At high frequencies (greater than about 1 GHz), the capacitor, its mounting and the PCB material make up a "network" that defines the (SRF). The SRF for capacitors is the series-resonant frequency, which is also called the self-resonant frequency. Therefore, the SRF of the capacitor, absent of external effects, has no meaningful definition for microwave frequencies.

SRF and a DUT – an example

To illustrate, for a 20pF DUT, the SRF increased about 20% (as indicated by the S_{11} magnitude dip) when the PCB material was changed from FR-4 to Alumina (when the capacitor is measured in a series-thru configuration). Furthermore, mounting in a shunt configuration (SRF= S_{21} dip) could decrease the SRF by about 40% from that measured when in a series configuration.

These effects can be closely simulated in a microwave CAD program (such as ADS, Eagleware, Compact) by using the S-parameters taken from the software, and then

INNOVATIVE MIXERS

·smaller size ·better performance ·lower cost 50kHz to 4200MHz

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, patented package with a profile as low as 0.082 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.100). 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	10-1500	+7	6.6	40••	15	3.45
ADE-13	2	50-1600	+7	8.1	40••	11	3.10
ADE-11X	3	5-2000	+7	7.1	36••	9	1.99▲
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".
**Protected by U.S. patent 6133525.* ••Specified midband. ▲*100 piece price.*

Mini-Circuits®

US 74 INT'L 75
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 267 Rev L

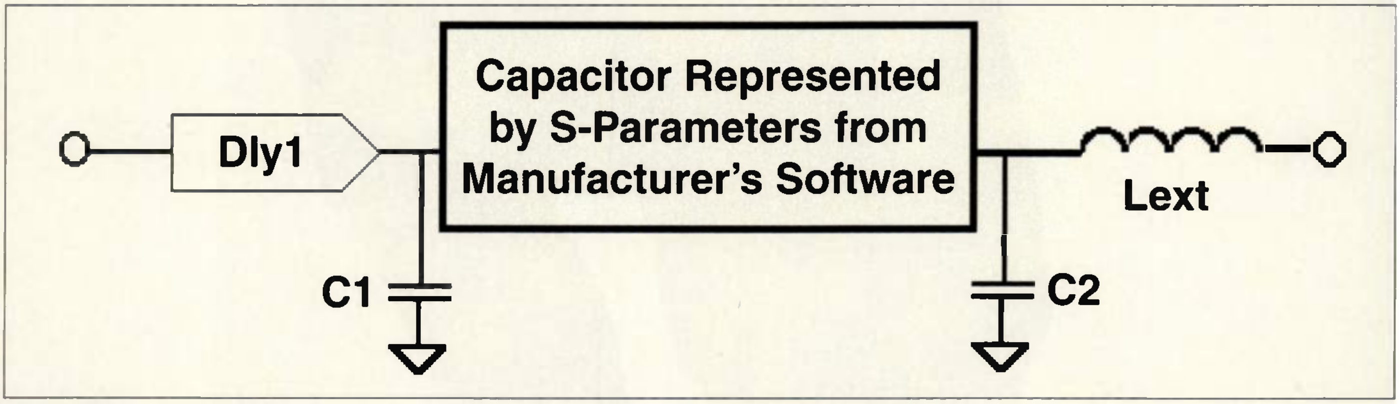


Figure 1. Schematic of circuit layout.

adding values for C_1, C_2, L_{ext} and D_{ly1} as shown in Figure 1.

The layout

C_1 and C_2 represent the capacitance as it varies with the dielectric constant of the PCB material used. L_{ext} represents the reduced SRF that occurs when shunt mounting is used. D_{ly1} represents the delay caused by the physical length of the capacitor (typical S-parameter software presents the data de-embedded to the center of the capacitor).

The scenarios

Four common mounting scenarios were examined:

- Mounting 1) Series mounted over air as in a manufacturer's software (for comparison).
- Mounting 2) Series mounting on 0.025 thick FR-4 with an opposing ground plane.
- Mounting 3) Series mounting on 0.025 thick Alumina with an opposing ground plane.
- Mounting 4.) Shunt mounting on 0.025 thick Alumina with an opposing ground plane.

The values

The values of C_1, C_2, L_{ext} and D_{ly1} were determined by the following method. First, actual S-parameter measurements were made in the lab on capacitors mounted in the configurations outlined above. Next, the S-parameters were downloaded from the S-parameter software into the microwave simulation software. Then C_1, C_2, L_{ext} and D_{ly1} were varied in the simulation software until the S-parameters displayed were as close as possible to the measured values obtained in the first step.

The results

The values obtained are as follows.:

- Mounting 1): For C_1 & C_2 and L_{ext}: N/A (all 0.00).
- Mounting 2): C_1 ~ 0.03pF, C_2 ~ 0.03pF, L_{ext}=0.0nH (modeled in series mode in CAD).
- Mounting 3): C_1 ~ 0.07pF, C_2 ~ 0.07pF, L_{ext}=0.0nH (modeled in series mode in CAD).
- Mounting 4): C_1 ~ 0.07pF, C_2 ~ 0.07pF, L_{ext}=0.5nH (modeled in shunt mode in CAD).

In each case the various delay parameters were as listed below.

- 0402 Size: D_{ly1} ~ 15 pS (applies to all mounting situations shown above).
- 0403 Size: D_{ly1} ~ 15 pS (applies to all mounting situations shown above).
- 0504 Size: D_{ly1} ~ 20 pS (applies to all mounting situations shown above).
- 0603 Size: D_{ly1} ~ 25 pS (applies to all mounting situations shown above).
- 0805 Size: D_{ly1} ~ 32 pS (applies to all mounting situations shown above).
- 1210 Size: D_{ly1} ~ 45 pS (applies to all mounting situations shown above).

The values of C_1 and C_2 will affect the SRF(S_{11} dip), but the parallel-resonant frequency (PRF= S_{21} dip) will be unaffected when it is mounted in the series-mounted configuration. The values of C_1 and C_2 will affect the PRF(S_{11} dip), but the SRF(S_{21} dip) will be unaffected when it is mounted in the shunt-mounted configuration.

Final analysis

Use of this method will produce S-parameters that are close to actual in-circuit performance. Nevertheless, the in-circuit device performance is subject to other less-serious variables that may not be addressed by this method.

RF

About the author

Edward Schoepke received his B.S.E.E. from New Jersey Institute of Technology in 1978, and has been working in the RF/microwave field since then. He has been employed at Johanson Technology in Camarillo, CA as an applications engineer for four years, and he was the pivotal engineer in the development of MLCSoft, Johanson Technology's capacitor modeling software. He can be contacted at: Johanson Technology, Inc. 931 Via Alondra Camarillo, California 93012 Voice: (805)389-1166, extension: 257 FAX : (805)389-1821; e-mail: *e_schoepke@johanson-caps.com*
www.johansontechnology.com

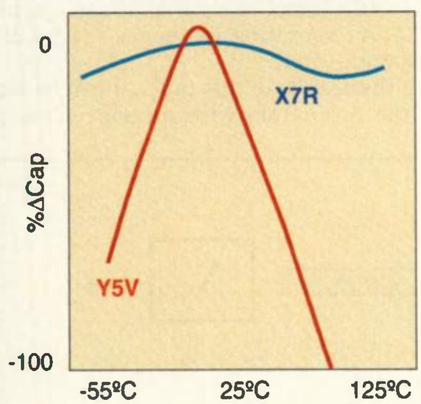
Only PRESIDIO can

make ANY Y5V

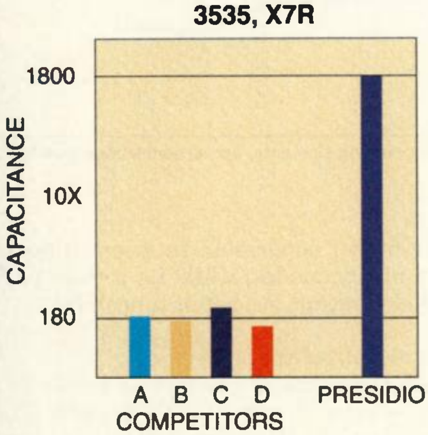
SINGLE LAYER CAPACITOR

in TRUE X7R

Temperature Stability

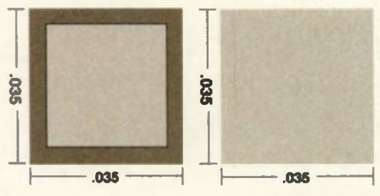


3535, X7R



Presidio Components Inc. is the choice of filter bypass application design engineers who know the vastly superior performance numbers that X7R capacitors deliver compared to parts built with Y5V.

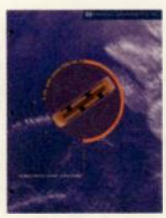
As an integral part of our proprietary single layer capacitor product line, we use ***true*** X7R to produce what our competitors can only make using Y5V or Z5U. Presidio Components' X7R capacitors offer clear advantages in virtually every possible performance test against any other material. Our parts deliver measurably better temperature stability and high frequency performance. You can also have your choice of higher Q, up to 10 times the capacitance, or a much smaller size. We have the flexibility to produce parts that will meet your most demanding requirements.



Call today for a free sample, and prove to yourself the superior performance of Presidio Components' X7R single layer capacitors.

Call us today at 858 578-9390 for our latest free catalog, or visit our website.

www.presidiocomponents.com/rfd



INFO/CARD 60

PRESIDIO COMPONENTS, INC.

Designing tunable resonators and filters with constant bandwidth

Implementing step-impedance planar structures to increase performance in L- and T- types of coupling sections.

By Boris Kapilevich and Roman Lukjanets

As the number of wireless communications devices continues to increase logarithmically, a natural by-product is a crowded spectrum. One method of addressing this crowded spectrum integrates tunable filters in systems.

Tunable filters can provide surprising benefits, especially for multimode portable terminals and tunable transceivers. However, tuneability causes undesirable changes in other important characteristics such as deviation of insertion loss, bandwidth and matching conditions. Implementing tuning elements (varactors for instance) may lead to a drastic degradation of the circuit's Q, for example.

This article presents the theory and application of stepped-impedance planar resonators and filters with L and T - coupling sections. It will also introduce an active device for loss compensation.

Step-impedance tuned resonator topology

Tuned resonators and filters can be realized through a number of methods 1, 6. The topology used below is based on step impedance sections and varactor diodes in series or parallel (see Figure 1). It consists of the two lines with different impedances, Z1 and Z2 and electrical lengths q1 and q2, respectively. A varactor diode used as a tuning element is placed in the center of the resonator. Reactive coupling elements Xc are used at the input/output of the resonator.

The analysis of resonance conditions for the configurations shown in Figure 1 can be carried out on a transmission matrix approach, similar to one described in [2]. More detailed analysis demonstrates that frequency tuning range and mode separation depend on parameter $\zeta = \theta_1/(\theta_1 + \theta_2)$, as well as a type of coupling element — capacitive or inductive.

The best results are observed for the parameter $\theta = 0.75 - 0.8$. These are illustrated in Table 1. The following parameters of the resonator are assumed: $Z_1 = 20\Omega$ $Z_2 = 80\Omega$; limits of a varactor capacitance $C_v = 0.5 - 2.5$ pF; operating frequency – 1.8 GHz, system impedance – 50 Ω.

Comparing the results of this table, it can be concluded that the resonators with a series varactor demonstrate higher separation between principal and nearest higher modes, while its counterpart, with a parallel varactor, has better tuneability.

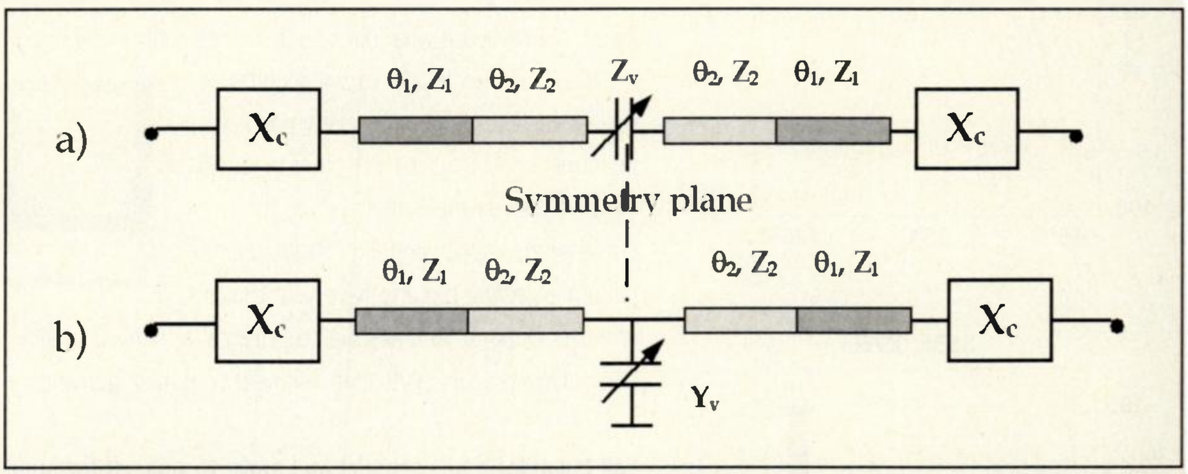


Figure 1. Step impedance configuration of the varactor tuned resonators with reactive coupling elements, Xc: a) series configuration b) parallel configuration.

Bandwidth stabilization

The major drawback of tuned resonators is a change of bandwidth in the tuning process. This issue is caused by the frequency behavior of reactances of coupling elements. For illustration purposes, Figure 2 shows this effect for a step-imped-

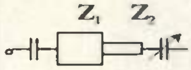
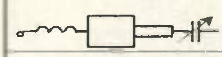
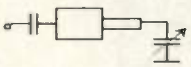
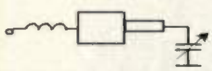
Comparison of characteristics of step impedance resonators		
The configuration of a resonator	*Absolute frequency separation between 1-st and 2-nd modes* $s = \lvert f_{02} - f_{01} \rvert$ *MHz*	*Tuning range* $\Delta = 2(f_0^{0.5} - f_0^{2.5})/(f_0^{0.5} + f_0^{2.5}) \cdot 100\%$
 Z_1 Z_2 ζ_{opt}=0.76	823	44
 Z_1 Z_2 ζ_{opt}=0.76	830	45
 Z_1 Z_2 ζ_{opt}=0.8	1208	32
 Z_1 Z_2 ζ_{opt}=0.8	1170	35

Table 1. Comparison of step-impedance resonator characteristics.

ance resonator with a varactor in series. An approximated a 50% widening in bandwidth has taken place from 20 MHz to 32 MHz.

The following resonator parameters are assumed: Z_1 = 20Ω; Z_2 = 80Ω; limits of a varactor capacitance C_v = 0.5 – 2.5 pF; operating frequency – 1.5 GHz; system impedance – 50Ω; coupling capacitor – 0.5 pF. The resonator is designed on the basis of microstrip line with substrate ε_r = 2.6, h = 2 mm, and loss tangent $tg\delta$ = 0.001.

The first step in stabilizing bandwidth uses proper reactive coupling elements to compensate for bandwidth change. One such element is the L-section[3]. Among eight available configurations, the capacitor-based L-section is preferable when taking into account fabricating facilities. Table 2 and Figure 3 present the effects of bandwidth stabilization when L-type coupling elements are used instead of a single capacitor. Bandwidth stabilizing factor is about 50.

To verify the bandwidth stabilization effect, the experimental version of the step-impedance resonator was fabricated with specifications shown in Table 3.

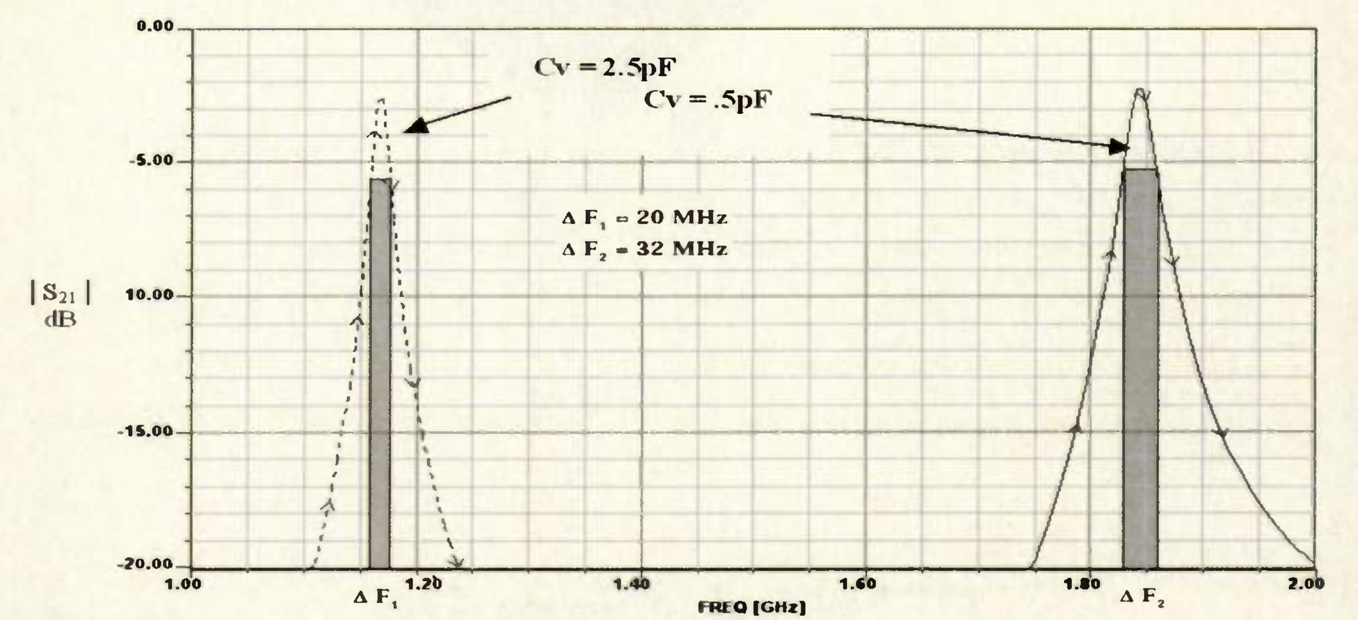
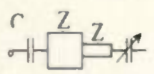
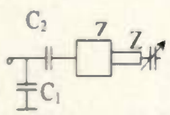


Figure 2. Illustration of changing bandwidth in a tuning process.

The configuration of a resonator	Characteristics of step impedance resonators								$\Delta f_{1,2}$ [MHz]	Δ[%]	δ [%]
	Z_1	θ_1	Z_2	θ_2	C [pF]	C_1 [pF]	C_2 [pF]	ΔC [pF]			
	20	1.35	80	0.85	0.5	-	-	0.5--2.5	1050	45	60
	20	1.35	80	0.85	-	2.4	1.2	0.5--2.5	1000	44.6	1.2

$\Delta f_{1,2}$ - absolute frequency separation between 1st and 2nd modes;

Δf - tuning range; δ[%] - bandwidth changing

Table 2. Changing bandwidth comparison.

The comparison of the calculated and measured transmission coefficients, S_{21}, are presented in Figure 4. Taking into account the biasing circuit, an agreement between calculated and measured data is observed.

Bandwidth stabilization with L-type capacitor coupling elements at input/output of the step impedance resonator.

Passively coupled resonators

The same approach can be applied to the design of passively coupled tuned resonators with constant bandwidth. In this case, choose both the external and internal coupling elements to compensate for a change of coupling coefficients in the process of tuning. Figure 5 demonstrates the transformation of a single resonator to its coupled counterpart based on capacitive L-type sections. As a result, the coupling element between resonators can be formed using a T-type capacitive section. The configuration of a tuned step-impedance filter of the second order is shown in Figure 6.

Optimization, based on the simplex search technique, finds a specification of the T-section providing constant bandwidth of the second-order tuned filter. Table 4 demonstrates characteristics of such a filter before and after internal coupling elements are optimized. The frequency response of the tuned second-order filter is shown in Figure 7. The bandwidth stabilization factor is 12, but the insertion loss has increased to 10 dB. Thus, a measurement must be undertaken for loss compensation.

An experiment was carried out with the microstrip second-order tuned filter. Its specifications are given in Table 5. A comparison of calculated and measured filter performance is depicted in Figure 8, which takes biasing circuits into account.

Active tuned filter

Having chosen the topology of uncoupled and coupled tuned resonators with near-constant bandwidth, a proper filter of higher order can be built up. However, insertion losses are increased drastically. As a result, special measures for their compensation must be suggested in a practice.

One way to do this is to transform a passive tuned filter to its active counterpart by adding an active device. A variety of microwave active filter configurations are available for practice[4]. Recently, an idea based on actively coupled resonators was presented[5]. Such resonators are almost non-interactive because of the use of a transistor as a coupling element between resonators. Therefore, the circuit sensitivity to fabricating tolerances is reduced by applying them in a cascade arrangement.

Different combinations of resonators can then be applied to achieve the desired filter characteristic. The two passively coupled resonators are actively coupled in a cascade configuration shown in Figure 9 to form the equivalent active filter of the fourth order. The bandwidth is almost constant, but insertion loss is increased about 5 dB when the filter is tuned toward higher frequencies. Therefore, an active device must provide a gain of 9 dB at low, and 14 dB at high frequencies of the tuning

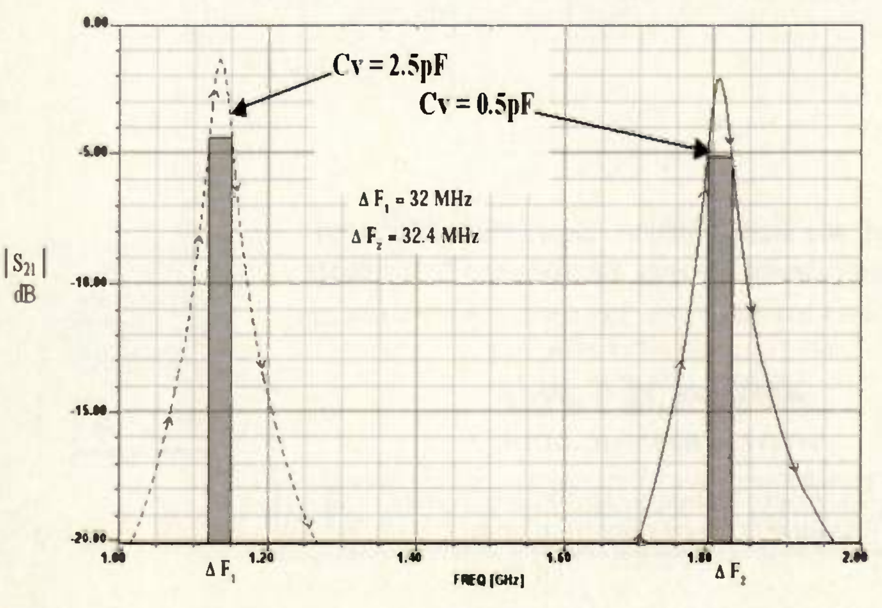


Figure 3. Bandwidth stabilization with L-type capacitor coupling elements at input/output of the step-impedance resonator.

LOWEST COST 3 & 5 OUTPUT xDSL AND CABLE MODEM POWER SUPPLIES

High-Efficiency Step-Down Controller Plus Multiple LDO Controllers on a Single IC

Use the MAX1864 and MAX1865 power supply controller ICs to build the lowest cost xDSL and cable modem consumer premises equipment (CPE) power supplies. They integrate a high-efficiency step-down DC-DC controller and 2 to 4 linear regulator controllers to provide all the required voltages for CPE equipment. The current-mode step-down controller uses an external dual N-channel MOSFET to provide low-cost synchronous rectification for high efficiency and lower heat. To further save cost, no external current-sense resistor is required. Switching frequencies of 100kHz and 200kHz permit the use of low-cost magnetics and aluminum electrolytic capacitors. The linear regulator controllers drive inexpensive external bipolar junction transistors (BJTs).

MAX1864

- Step-Down Controller
- 2 Positive LDO Controllers
- 16-Pin QSOP Package

MAX1865

- Step-Down Controller
- 3 Positive LDO Controllers
- 1 Negative LDO Controller
- 20-Pin QSOP Package

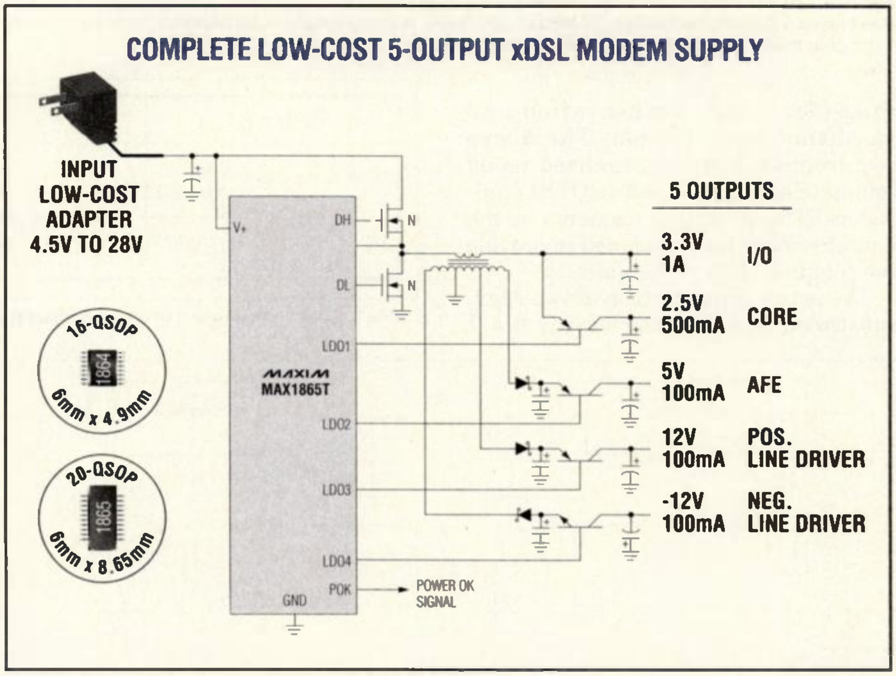
No Current Sense Resistors Means Less Cost

Step-Down Output: 1.25V to 5.5V

LDO Outputs: ±1.25V to ±15V

Power-OK Checks All Outputs

EV Kit Available to Speed Designs



In an xDSL modem application, the MAX1865 provides low-cost supplies for the I/O, core, analog front end (AFE), and positive and negative line drivers. It fits in a small 20-pin QSOP package. All outputs can be adjusted with feedback voltage dividers.

FREE Power Supplies Design Guide—Sent Within 24 Hours!
Includes: Reply Cards for Free Samples and Data Sheets

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

MAXIM

www.maxim-ic.com

2001 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/Dallas Direct!, Arrow, Avnet Electronics Marketing, CAM RPC, Digi-Key, Elmo, Nu Horizons, and Zeus.
Distributed in Canada by Arrow and Avnet Electronics Marketing.

INFO/CARD 44

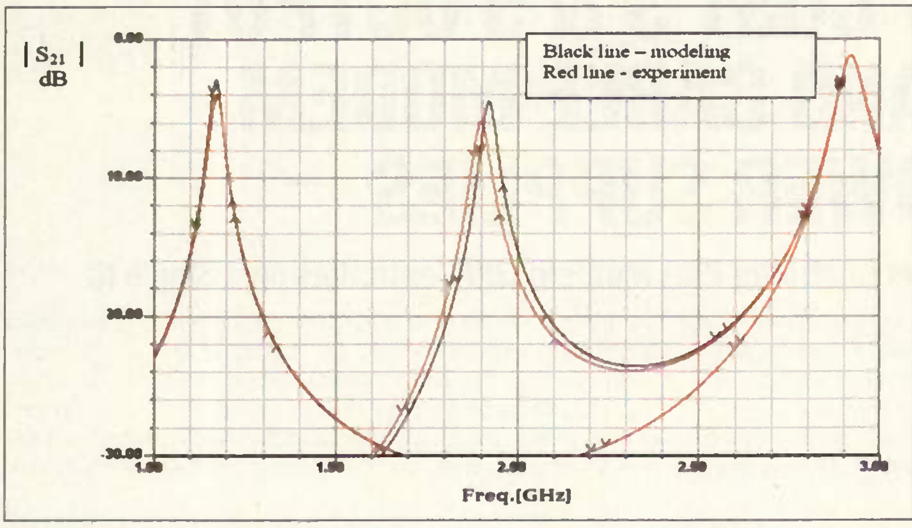


Figure 4. Calculated and measured results for the step impedance resonator. Tuning range: 48%; insertion losses 4 to 6 dB; bandwidth: 50 MHz at 3dB level; minimum separation between principal and nearest higher mode: 1010 MHz; bandwidth changing: 2.3%

tuned. This drawback can be eliminated by more careful design of the matching elements of the active device.

Conclusion

When designing tunable resonators and filters with constant bandwidth, implement L-and T-types of coupling elements to achieve the stabilization of bandwidth in the tuning process. An active device with predicted slope of the gain can be used for a loss compensation. The final active filter layout and performance has been verified in experiments carried out with fourth-order filter in a cascade configuration.

RF

range for a loss compensation and amplitude equalization. The above requirement has been realized using commercial, off-the-shelf (COTS) transistors. The matching elements of the amplifier have been designed to provide the required slope of the gain.

The active filter consists of two Al_2O_3 substrates 48 x 60 mm², having h = 1 mm, $\varepsilon_r = 9.6$. Each is used for arranging passively coupled resonators and matching circuits of the active device on its input and output. The active device is placed between them. Figure 10 demonstrates the final performance of the active tuned filter of the fourth order with the constant bandwidth.

By implementing an active device, the full compensation of the insertion loss is achieved. However, the change of return loss takes place when the filter is

Substrate			Basic resonator's elements							
tg δ	ε_{eff}	h [мкм]	ζ	Z_1 [Ω]	Z_2 [Ω]	C_1 [pF]	C_2 [pF]	C_3 [pF]	varactor	K_c
10^{-3}	2.6±0.2	2000	0.7	20	80	1.6	1.2	1.6	D-610B	5:1

Table 3. The characteristics of an experimental step-impedance resonator.

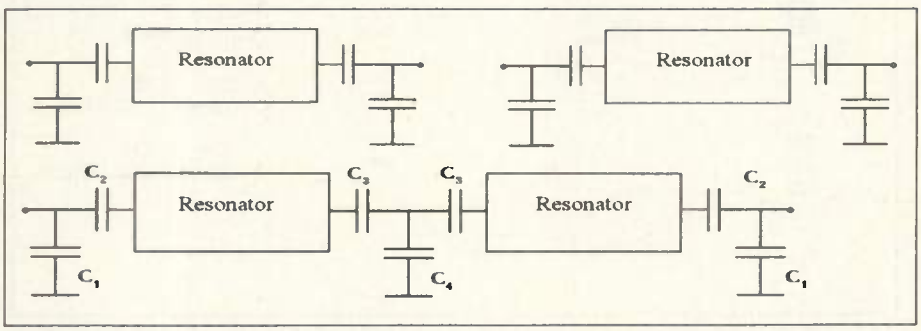


Figure 5. Transformation of L-type section of uncoupled resonator into T-section of coupled counterpart.

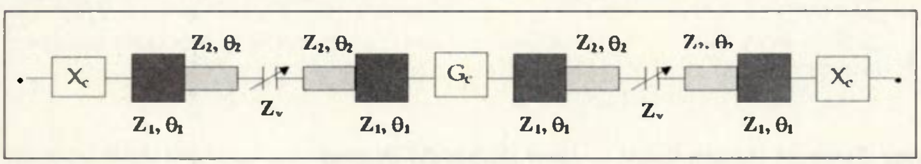


Figure 6. Configuration of the tuned step-impedance 2nd order filter.

Acknowledgment

This work has been supported by EC INTAS Project 96-0851, and the authors would like to thank the project coordinators Prof. B. Jarry (I.R.C.O.M., France) and Prof. M.Guflielmi (ESA ESTEC, The Netherlands) for their useful advice and discussions of some problems associated with the topics considered, as well as engineer V. Smirnoff (SibSUTI, Russia) for his help in experiments.

References

[1] F.E. Van Vliet, "Modern Very Narrow Band MMIC Filters and Tuning Methods", Paris EuMW'2000 - Workshop (WS8) - "New Techniques and New Technologies for RF and Microwave Filters"

The configuration of a filter	Basic components							ε	Δf [MHz]	δ [%]
	C_c [pF]	C_{cc} [pF]	C_1 [pF]	C_2 [pF]	C_3 [pF]	C_4 [pF]	ΔC_v [pF]	$\Delta f_{1,2}$ [MHz]	Δ[%]	
R1 R2	0.9	0.8	–	–	–	–	0.5- -2.5	1.69 1280	645 43	18.4
R1 R2	–	–	2.2	4.4	1.2	1.2	0.5- -2.5	1.62 1120	635 42.3	1.5

Table 4. The coupled resonator components before and after optimization.

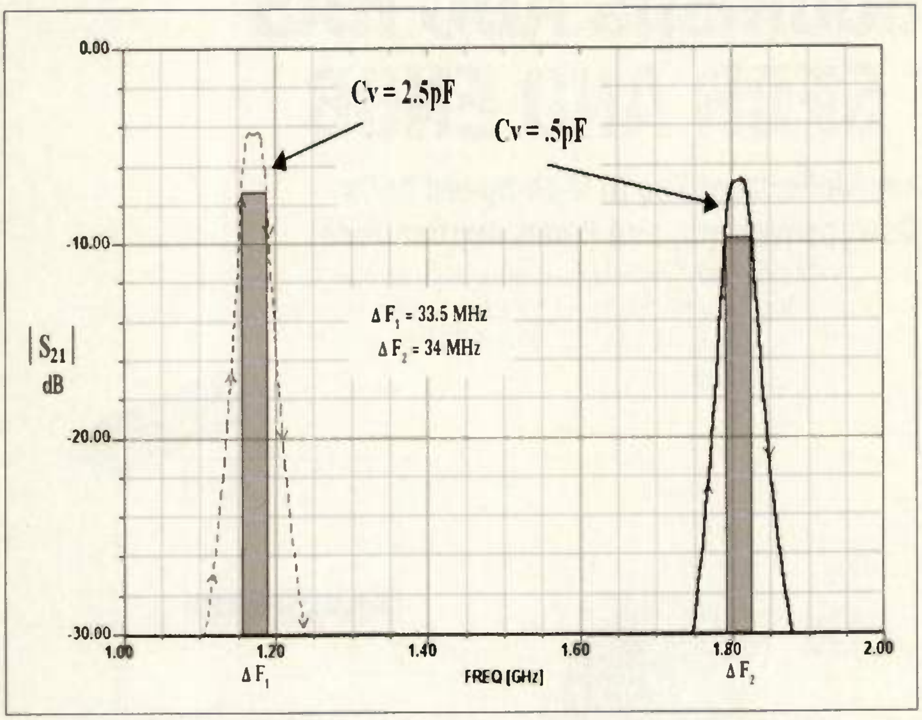


Figure 7. The frequency response of the tuned step-impedance filter of the second order with near-constant bandwidth.

[2] B.Kapilevich, R.Lukyanets, "B. Kapilevich, R.Lukyanets, "Modeling Varactor Tunable Microstrip Resonators for Wireless Applications," *Applied Microwave & Wireless*, Vol.10, no.7, September 1998, pp.32 - 44; Vol. 13, no. 5, May 2001, pp. 54-64.

[3] P.H.Smith, "Electronic Applications of the Smith Chart in Waveguide, Circuits and Component Analysis", McGraw Hill Book Co., 1969.

[4] B. Kapilevich, "Microwave Active Filters for Wireless Applications", Paris EuMW'2000 - Workshop (WS8) - "New Techniques and New Technologies for RF and Microwave Filters."

[5] F. Sabouri-S, C.Christensen, T.Larsen, "A Single-Chip GaAs MMIC Image-Rejection Front-End for Digital European Cordless Telecommunications", IEEE Trans. on MTT, vol.48, no.8, August, 2000, pp.1318 - 1325.

[6] K. Jeganathan, "Design of Simple Tunable/Switchable Bandpass Filter" *Applied Microwave & Wireless*, March 2000, pp.32 - 40.

INFO/CARD 11

Substrate			Basic filter's elements								
tg δ	ε_{eff}	h [мкм]	ζ	Z_1 [Ω]	Z_2 [Ω]	C_1 [Ω]	C_2 [Ω]	C_3 [pF]	C_4 [pF]	varactor	K_c
10^{-3}	2.6±0.2	2000	0.7	20	80	4.4	2.2	1.8	1.2	D-610C	3:1

Table 5. The specifications of microstrip second-order filter.

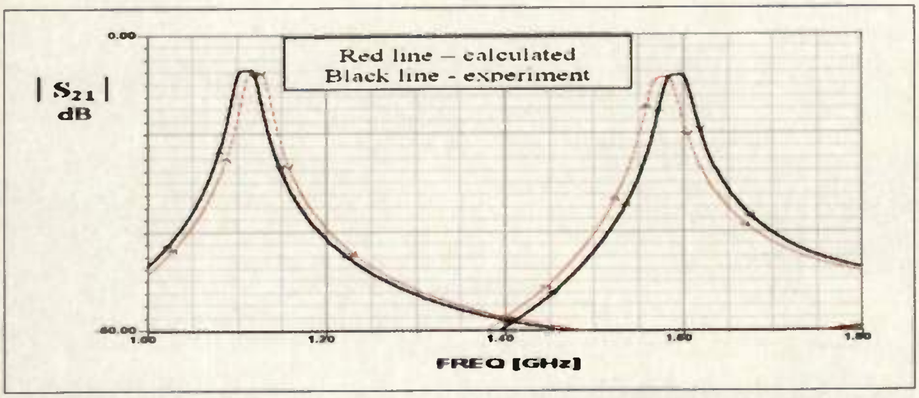


Figure 8. Calculated and measured results for the step-impedance coupled resonator: Tuning range: 33%; insertion losses: 7 to 8 dB; bandwidth: 30 MHz at 3 dB level; minimum separation between principal and nearest higher mode: 695 MHz; bandwidth changing; 3%.

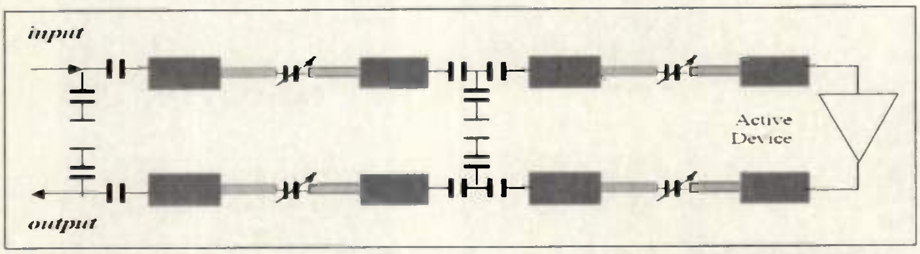


Figure 9. Configuration of actively coupled resonators forming the equivalent active filter of fourth order.

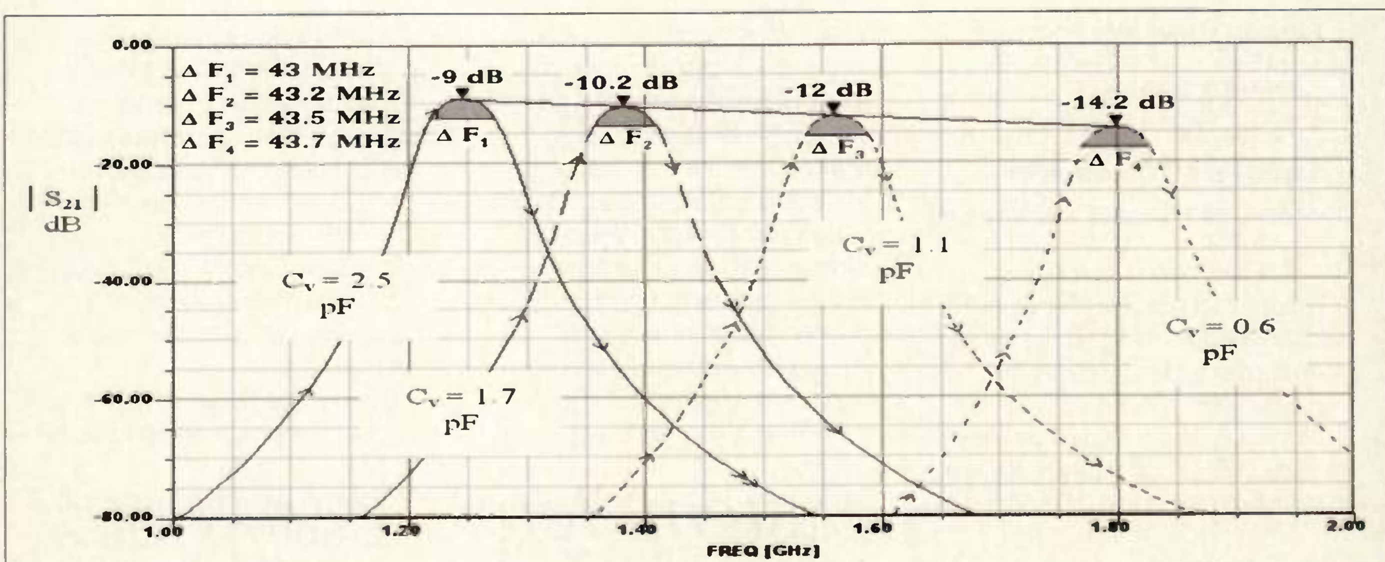


Figure 10. The calculated performance of passively coupled resonators shown in Figure 9.

About the authors

Boris Kapilevich is a professor at Siberia State University of Telecommunication & Informatics, Novosibirsk, Russia. He received his M.S. degree from Tomsk State University in 1961, a Ph.D. in 1969 from Novosibirsk State Technical University and a Dr.Sc.(technol.) in 1986 from Moscow Power Energy University. He has more than 30 years of experience in analysis and design of various microwave/RF components and devices for the communications industry. His teaching and research interests are in areas of microwave and RF components for mobile and space communications. He can be reached at his office by tel.: +007-3832-660943, by fax: +007-3832-222581 or by e-mail: *boris@neic.nsk.su* .

Roman Lukjanets is a Ph.D. student at Siberia State University of Telecommunication & Informatics, Novosibirsk, Russia. He received his M.S. degree from Siberia State University of Telecommunication & Informatics in 1996. His research interests are focused in microwave and RF components for mobile communications, including microwave active filter. Contact the authors at: Siberia State University of Telecommunications and Informatics 86 Kirova str., Novosibirsk, Russia – 630102.


Would you like to cut the VSWR on that?
Wireless Solutions For....
BASE STATIONS
HANDHELDS
TDMA/CDMA
BLUETOOTH
3G/BROADBAND
CELLULAR/PCS/DCS
AMPS/GSM/EGSM
UMPTS/ELINT
L-BAND/Ka-BAND
SATCOM/VSAT/GPS
LMDS/MMDS/WLL/LAN
INTERNET
PMR/CPE
RFID
CATV
It's So Shiny... it's brilliant.
Wireless...
Embedded With?
Stylishly Wireless
Components
Embedded Antennas
Filters
GPS Time & Frequency
COMPONENTS
CIRCULATOR
ISOLATOR
MIXER
VCO
POWER SPLITTER
COMBINER
COUPLER
HYBRID
I/Q CIRCUIT
PHASE SHIFTER
ATTENUATOR
LOAD
MULTIPLEXER
FILTERS
CERAMIC
CAVITY
TUBULAR
LC
DELAY LINE
DIPLEXER
DUPLEXER
TRAK com
ORDER CONFIRMATION
100,000..........ISOLATORS
50,000......EMBEDDED ANTENNAS
200,000..........CERAMIC FILTERS
TO GO..........
INTEGRATED MICROWAVE
OSCILLATOR
MULTIPLIER
COMB GENERATOR
SYNTHESIZER
INTEGRATED MICROWAVE ASSY.
ANTENNAS
EMBEDDED ANTENNA
DIRECTIONAL ANTENNA
OMNIDIRECTIONAL ANTENNA
ANTENNA POSITIONER/ROTATOR
GPS TIME & FREQUENCY
CUSTOM MODULAR SYSTEM
REFERENCE/DISTRIBUTION SYSTEM
OEM GPS TIMING BOARD
TRAK COM COMPANIES
TRAK MICROWAVE CORP
TRAK MICROWAVE LTD.
TECOM INDUSTRIES INC
Have It Your Way with TRAK Mass Customization!
Contact TRAK Com today. Let's talk about solutions !
888.283.8444 • 813.806.3000
We are experienced.
www.trak.com
INFO/CARD 61
TRAK com

Telematics of the future

The integration of wireless technologies will set the stage for a future of advanced telematics and intelligent transportation systems.

By Kerry Greer

Considering all the technological achievements of the 20th century, wireless communications devices are still in their infancy in terms of market development. New consumer devices come to market each month. Each has its benefits, and some have notable shortcomings; not all will be widely adopted. Still, the wireless market is growing profoundly, and market projections promise more than 500 million wireless devices selling worldwide each year in the near future. This translates to one out of every 10 people on the planet buying some kind of wireless device every year.

In contrast, automobiles have been around for almost all of the past century. Their penetration rates have leveled off, with most households in North America and Europe owning at least one car. But, as the next century begins, these two seemingly different consumer products are integrating in a way that will bring new value to the consumer.

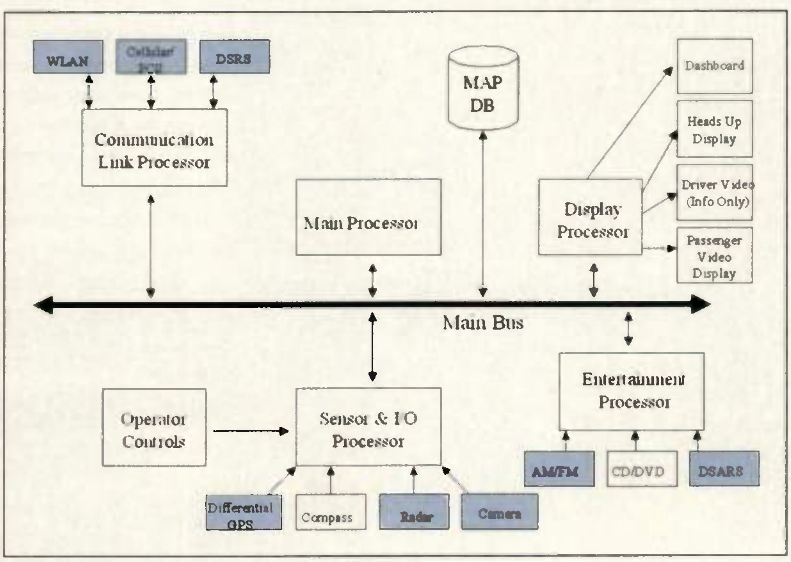


Figure 1. Future automotive telematics block diagram.

Telematics, the common thread

The term for the new wireless systems being installed in automobiles is *telematics*. But what exactly is telematics? While not yet available in Merriam-Webster's online Collegiate Dictionary, the term has generally been defined as "automotive communications technology that combines wireless voice and data to provide location-specific security, information, productivity, and in-vehicle entertainment services to drivers and their passengers.[1]" This definition identifies wireless as the key enabling technology to provide these advanced services.

Automobiles and wireless technology

Automotive systems engineers have begun evaluating different types of advanced wireless technologies for inclusion in their future models. Driven by the profound success of cellular and personal communications systems (PCS), information access is the key to providing new consumer value. And wireless is the only way to get it in an automobile. In the coming years, expect to see some, or perhaps, all, of the technologies listed in Table 1.

While this list is daunting, all have one thing in common: wireless communications links. So, expect RF and optical engineers, wireless system designers, and wireless communications experts to play important roles in the development and integration of these applications into future vehicles.

Autos — The ultimate mobile apps platform

A car is an ideal platform for wireless, as it embodies the very definition of a "mobile device." Of course the marriage of the auto and wireless industries is not a new idea. Radio was the original wireless automotive application, with AM being standard since the 1950s.

The first citizens band (CB) radios were introduced in the 1970s. They were popular as aftermarket additions to automobiles, but today their use has been supplanted by cellular/PCS.

The first mobile cellular-radio systems were developed in the early 1980s, with the transceiver designed to fit "neatly in the trunk of your car." These radios now come in sizes that fit neatly in your jacket pocket. More recently, OnStar systems, using cellular and global positioning systems (GPS) originally introduced in Cadillacs, have been available on other high-end products for the last five years. And most recently, collision avoidance radar and infrared imaging systems have become options in some high-end production models.

However, wireless applications (other than radio) have been slow in becoming standard original equipment in automotive models. This is partly due to the fast-paced (relative to the auto industry) set of wireless standards, which seems to continually evolve. The slowness is also due to a lack of perceived desire by automobile customers as to its value.

The bottom line is: "Where *is* the market for all this new technology?" As every former employee of

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 63 INT'L 64

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.

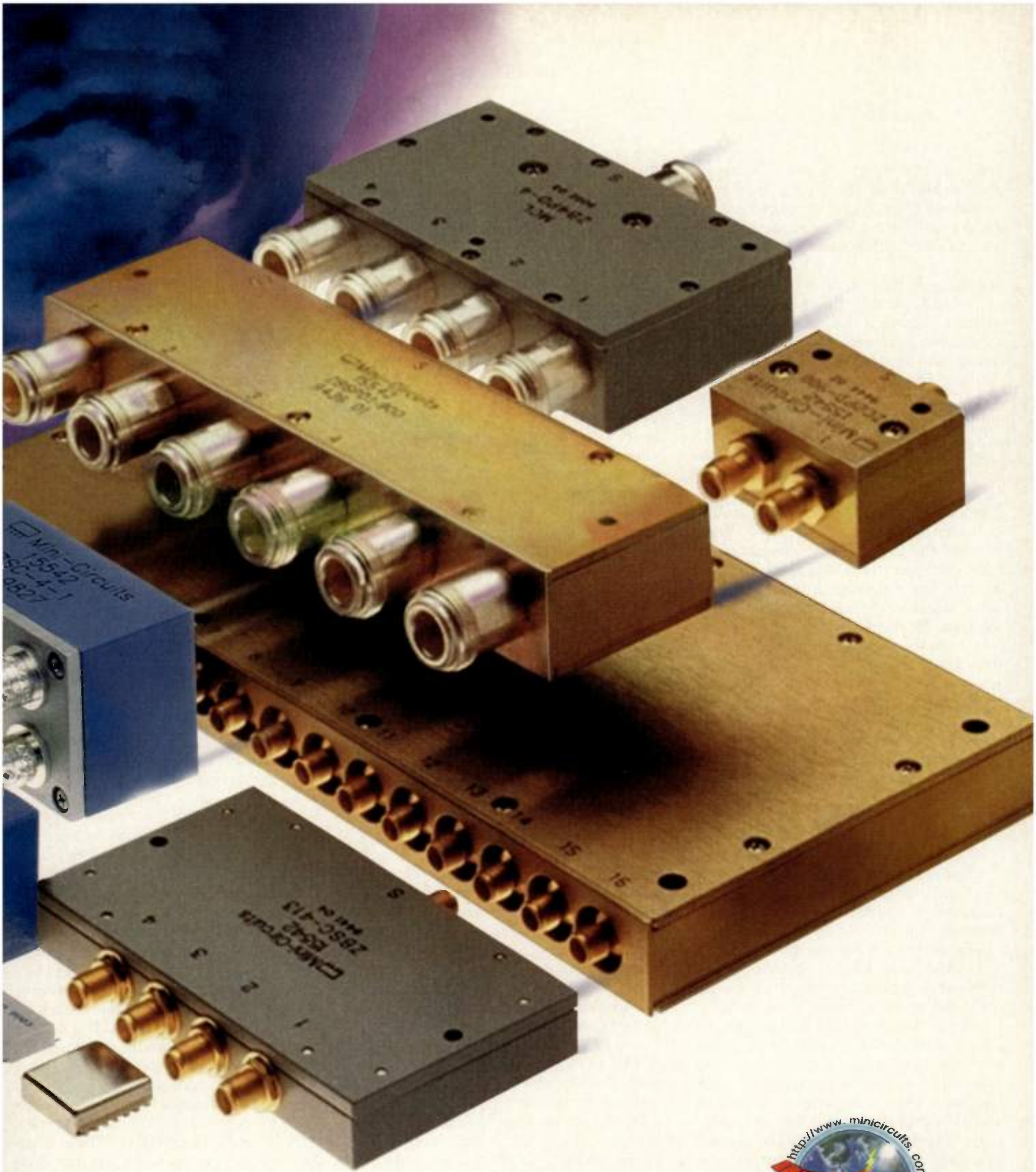
THE WORLD'S LARGEST SELECTION

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®

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

US 15 INT'L 16
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 194 Rev B

a failed dot-com knows, you will only be as successful as the strength of your business plan. That strength comes from customers and revenue, not just technological achievement.

It's all about change

Going forward, the slow market is about to change. The market for OEM telematics-equipped autos is now developing, and customers are beginning to realize the added value to their purchase. This is chiefly driven by two factors.

- *Safety concerns regarding same-time driving and talking*: With the proliferation of mobile phones in the United States being a growing public concern, in June 2001 New York became the first state in the nation to ban citizens from using handheld phones while driving a car. About 40 other states are considering similar legislation. (More than 20 countries also have similar bans.) But the NY law does permit drivers to use "hands-free" phones, which in theory allows the driver to keep his/her hands on the steering wheel. This public sentiment provides the catalyst needed for OEMs to design cellular and PCS phones into their cars as standard equipment.

- *Value-added support services such as roadside assistance and navigation/travel mapping*: The success of the OnStar system is testament to the fact that automobile consumers want a measure of security with their car as they take the on open road.

The American Automobile Association (AAA) has made a glowing business out of providing emergency towing and road service. Seeing this, automotive manufacturers have suddenly realized that they can now get additional revenue long after a car leaves the sales lot. This results in extending their top line – that is, signing up buyers to annual agreements and either receiving a direct payment from the service provider, or sharing in the future revenue stream. OEMs realize that consumers are willing to pay $20/month for mobile security and Internet connectivity. The promise of location-based advertising could also provide additional revenue.

Applications

The wireless communications links detailed in Table 1 can generally be divided into three types of applications: safety, information and entertainment.

Automobile safety is the primary concern of both government regulators and automotive manufacturers. Even in advance of industry requirements, OEMs are eager to develop new wireless safety features that could lead to additional revenue. Since the advent of cellular phones, consumers have identified them as a roadside safety necessity. Many phones were in fact purchased with the guise that they be "left in the glove box and only used for emergency." While their usage has broadened from that, auto OEMs now view this basic mobile voice link as an integral part of roadside safety. They are all working on integrated, hands-free phone models for introduction in upcoming cars.

Ford recently announced that a hands-free kit will be optional equipment available in 2002 models. But hands-free kits are still seen as an interim step toward full cellular-radio integration into the car. However, new impending legislation in many states will accelerate this development.

GM and Delphi-Delco, in cooperation with the government, have begun field-testing real-time collision warning (CW) systems. Such systems combine forward-looking collision avoidance radar, forward visible optical sensors, and a GPS mapping database as part of the first stages of advanced driver control systems. This particular prototype vehicle integrates these sensors into the adaptive cruise control (ACC) function of the test vehicle. The goal is to save lives by improving performance of ACC systems using wireless sensors.

Separately, forward-looking infrared sensors are now being offered as optional equipment on some models. These systems sense heat, and can aid in nighttime identification of animals and people ahead in dark and/or inclement weather.

While not necessarily a safety application, the U.S. Department of Transportation (DOT) also recognizes a benefit to the public good in telematics-equipped automobiles that provide traffic information. It is currently in the process of developing a public-use system called Intelligent Transportation Systems (ITS).

ITS is being targeted to help reduce traffic congestion and increase safety on our major roadways. ITS includes benefits such as the use of automated highway message signs, video cameras mounted along busy commuter roads, smart traffic-signal systems, and automated toll booths. A nationwide 511 call-in number is being established to allow motorists to retrieve the latest local traffic information quickly via cellular/PCS in every city. It only takes a little bit of imagination to foresee that commuters will come to rely on wireless phone service (to make a 511 call), GPS reception (to display alternative route maps), and dedicated short range services (DSRS) to pay tolls and/or automatically upload road safety info in their daily commutes.

GPS has tremendous automotive information application potential by itself. In addition to the obvious road-mapping capabilities, advertising executives would gladly pay for localized advertising specifically for consumers. One can imagine a vehicle passenger querying an on-board computer for a "list of all Italian restaurants within 10 miles of my present position." At the same time, a special coupon from Mama's Pizza pops up as the phone number and street address is displayed. This type of time/location-specific advertising medium is not currently available to ad agencies, except possibly in drive-by billboards.

Data networking the "killer" app?

The other big information application for telematics is in data networking. A simple example is the emerging Bluetooth standard, touted as a low-cost, low-power consumer networking standard. Natural Bluetooth vehicular applications would include keyless remote entry systems; integrated garage door openers; and consumer point-of-sale payment systems, such as automated credit card billing at gas pumps and drive-through restaurants. For Internet access, auto OEMs have already announced ongoing trials with wide area networks (WAN) standards such as general packet radio service (GPRS) and cdma2000 1x. These standards are upgrades to the current digital PCS standards and are referred to as 2.5G, reflecting a transition period before the eventual future evolution to third-generation WAN systems. These 2.5G links are being deployed today in the PCS frequency bands, and will be capable of delivering packet-switched data in an always-on configuration.

Beyond these initial applications, consumers may desire high data-rate

capability for information retrieval. Existing WLAN standards include IEEE 802.11b/a and HiperLAN 2, providing from 2 to 54 Mb/s, depending on distance between network nodes.

That's entertainment

The final application for telematics is of course entertainment. Let's face it, car travel is sometimes long and boring. Radio is still the primary means of entertainment, but other systems are being conceived. Some new car models today come with separate radio tuners for front and rear passengers, allowing two different stations to be played (headphones required). Digital satellite audio radio system (DSARS) is a new type of pay-per-listen radio system, with initial subscription service available for commercial-free listening.

The next entertainment system to be integrated is video. But, in-car video presents a number of issues, with safety being foremost. In most all states, televisions and video screens cannot be mounted in a place visible to the driver. Chevrolet has announced its new Looney Tunes mini-van. But the video display is mounted behind the driver, viewable only from the rear seats. As for video entertainment content, VHF and UHF receivers are also available, although clear reception is limited to strong signal areas around urban areas, so their usage is limited. Pre-recorded VCR tapes today and DVDs tomorrow will be the primary source for content in video entertainment systems.

Technical challenges still abound

Besides marketability issues, some technical issues must still be overcome before telematics is truly a standard option on OEM models. The most significant of these is cost.

OEMs must weigh costs when considering which telematics systems to integrate. While the future applications discussed earlier sound appealing, they will never be implemented if they greatly increase the price of the car. But, the price of silicon continues to come down. And as it does, these systems will be added incrementally where feasible, especially when the size of the chips gets small enough to be integrated in existing automotive electronics assemblies.

Multiple antennas/systems issues

Another problem specific to wireless telematics integration is the number of antennas and cable assemblies needed to implement these systems. Figure 1 outlines one possible implementation of all these communications links, sensor links, and entertainment systems into an automotive telematics block diagram (associated antennas not shown).

The wireless components are shown in blue. For example, if OEMs were to install all the wireless communications links, sensors and entertainment systems shown, they would also need eight antennas using today's technology. While marketing may try to spin this idea into something unique ("introducing the new VW Porcupine?"), in reality, new multimode, multifunction antenna systems are required to make this integration work.

Tough Environment. Top Performance.

Stanford Microdevices has expanded its industry-leading silicon-germanium (SiGe) amplifier line with two new power devices ideally suited for driver-amplifier functions in wireless equipment operating in the most demanding signal environments.

SOT-89 Package

Offering the wireless system designer typical GaAs linearity at silicon prices, these cost-effective heterojunction bipolar transistor (HBT) units produce high output IP3 performance across the DC-3000 MHz frequency band. SGA power devices are excellent choices for wireless infrastructure driver amplifiers, CATV amplifiers, as well as wireless-data and wireless-local-loop amplifiers. Stanford Microdevices delivers the power you need for your toughest operating environment.

For more information, visit us at stanfordmicro.com.

Part Number	Frequency Range (MHz)	Device Voltage (V)	Id (mA)	P1dB (dBm)	IP3 (dBm)	Gain @ 1 GHz (dB)	Gain @ 2 GHz (dB))	NF @ 1 GHz (dB)
SGA-9189	DC-3000	5	180	26	39	18	12	2.5
		3	165	22.5	35	18	12	2.2
SGA-9289	DC-3000	5	270	28	41	18	11	2.9
		3	315	26	39	17	11	2.6

*Data at 2 GHz unless otherwise noted

STANFORD MICRODEVICES

www.stanfordmicro.com • 800.764.6642

INFO/CARD 54

For example, a wideband antenna that would work from 800 MHz to 6 GHz would encompass five of the eight antennas needed today. Antenna manufacturers are rising to the challenge, however. One example is the new telematics antenna recently announced, which operates from 800 MHz to 2500 MHz.

Of course, integrating the antenna now creates a systems problem; it is not possible to simply connect dissimilar devices such as GPS, PCS, wireless local area networks) WLAN, and DSRS together at the antenna. Feedback, grounding, isolation between systems, different power levels, and different transmit-and-receive schemes need to be coordinated. So the need for a well-thought-out, high-performance, multifunction antenna system must be considered upfront. This would not only eliminate the multiple antennas and the associated systems issues, but multiple cable assemblies, connectors, multiple vendors, number of parts handled during installation, and the labor associated with installing all these systems as well.

Phone number please

One significant technical issue facing cellular/PCS integration, and the telecom industry in general, is phone number portability. Presently, 1G and 2G systems do not have the capability to assign the same number to more than one mobile phone. As a result, the driver could not have the same number for his/her handheld phone and for the integrated car phone. Also, because phone numbers are assigned in blocks to each carrier, they cannot presently be transferred from one carrier to the next when the consumer switches service providers.

Automatic call forwarding (to a different number) circumvents this issue presently, but true portability remains an active research issue for the mobile and landline phone companies. One can envision in the near future that there will be just one phone number for home, handheld and car phone; and it will follow you wherever you are at any given time.

Voice-commanded automation

Another active research issue is in the field of voice recognition.

It cannot be overemphasized that safety in automobiles is paramount. Even before the current ban on handheld phones, driver distraction is a leading cause of accidents today. This comes from the driver taking his/her eyes off the wheel, albeit for only a moment. A good, robust voice command system is required. Cellular/PCS integration will lead the way to the system, as some handheld models already offer these features today. But in the new automotive realm, voice commands will be generalized to include other systems as well.

Again, this is not an easy problem to solve with such issues as background noise and multiple/generic (vs. specific individual) speaker recognition being problematic. Robustness is also an issue. Non safety-critical systems could possibly tolerate misinterpreted commands, but other systems, such as the auto-

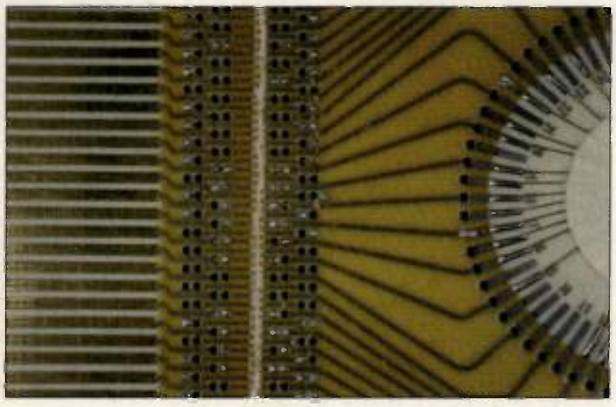
Continued on page 90

An adaptive spread-spectrum clock generator

Using a simple set of ROM codes in designing a spread-spectrum clock generator to minimize EMI.

By I–Teh Sha, Kuang–Yu Chen, Albert Chen and Jeff Keip

Engineers want an adaptive spread-spectrum clock generator (ASSCG) that uses a single set of read-only memory (ROM) codes, that requires no adjustment, and that can provide optimal peak electromagnetic interference (EMI) reduction[1] over a wide range of continuous frequencies (50 MHz-150 MHz). This can only be achieved using an automatic gain control (AGC) voltage-controlled oscillator (VCO) with a nonlinear relationship between input voltage and output frequency. Basically, a single set of ROM codes is optimized only for a particular combination of frequency and gain. When a selected VCO frequency is lower (or higher) than the optimized frequency, the gain of the VCO must be automatically adjusted down (or up) to use a single set of ROM codes.



Conventional spread-spectrum clock generator

A conventional spread-spectrum clock generator with a constant gain is optimized for a particular frequency. To get the best EMI reduction, every applied frequency needs its own unique set of ROM codes. The shape of the modulation profile is critical in maximizing EMI reduction. The optimal modulation profile that provides the greatest reduction in peak EMI is patented by Lexmark (see Figure 1)[2].

Other modulation profiles do not spread the emitted energy evenly across the full spectral band, resulting in significantly less EMI reduction. A full range of applied frequencies can be from 50 MHz to 150 MHz until one starts to factor in the requirement to follow the ideal modulation profile. To adequately cover the full range using conventional spread-spectrum clock generator techniques, at least five ROM code tables are required. Each of the devices is configured to provide optimal performance over a portion of the full range. Without multiple sets of ROM codes, the effectiveness of spread-spectrum modulation is compromised as the frequency changes.

Modulation, degradation and frequency

In Figures 2(a) through 2(d), oscilloscope traces illustrate degradation of the spread-spectrum modulation signal at various output frequencies. As the frequency of the output signal is altered, the profile varies from the ideal "designed for" average reference frequency of 80 MHz with –2.5% spread output (see Figure 2(b)) to Figure 2(a), which illustrates the changes in the modulation profile resulting from too much VCO gain when the reference signal is 50 MHz. Modulation waveforms degrade to be near triangular and sinusoidal as shown in 2(c) and 2(d) when the mean frequency of the reference signal increases to 108 MHz and 150 MHz. These degraded modulation waveforms do not spread the EMI evenly, providing much less peak EMI reduction.

The measurements for 2(a), 2(c) and 2(d) are still using the ROM code optimized for 80 MHz as shown in 2(b). The results show that the modulation profile is not maintained when the device is not operated at optimal frequency when the VCO gain is constant.

PLL spread-spectrum modeling

The block diagram of an ASSCG is shown in Figure 3. The unknowns ($x_1(n)$, $x_2(n)$ and $x_3(_n)$), the reference input ($u_1(n)$), the feedback divider (FBD(n)) and the output frequency ($y(n)$) are all time-varying functions. The VCO gain $K_{vco}(y(n))$ is a frequency-dependent function that is determined algorithmically. C_1, C_2, and R_1 compose the loop filter. The phase-locked loop is a class-of-control system that uses feedback to accomplish closed-loop control. Therefore, a time-varying PLL model can be defined by discrete equations as shown in (1) and (2), where $A(n+1)$ is a 3 x 3 time-varying matrix.

$$\begin{bmatrix} x_1(n+1) \\ x_2(n+1) \\ x_3(n+1) \end{bmatrix} = A(n+1)\bullet \begin{bmatrix} x_1(n) \\ x_2(n) \\ x_3(n) \end{bmatrix} \bullet \Delta t(n+1) + B \bullet \begin{bmatrix} u_1(n) \\ 0 \\ 0 \end{bmatrix} \bullet A(n+1) + \begin{bmatrix} x_1(n) \\ x_2(n) \\ x_3(n) \end{bmatrix} \quad (1)$$

2W & 5W DC to 18GHz ATTENUATORS

from **$29.95** ea. (1-49)

Rugged Stainless Steel Construction, High Repeatability, Miniature Size, Low Cost, and Off-The-Shelf Availability are some of the features that make Mini-Circuits "BW" family of precision fixed attenuators stand above the crowd! This extremely broad band DC to 18GHz series is available in 5 watt Type-N and 2&5 watt SMA coaxial designs, each containing 15 models with nominal attenuation values from 1 to 40dB. Built tough to handle 125 watts maximum peak power, these high performance attenuators exhibit excellent temperature stability, 1.15:1 VSWR typical, and cover a wealth of applications including impedance matching, reducing power levels when testing higher power amplifiers, wide band matching during intermodulation measurements, and providing a 2W or 5W termination load for power amplifiers. Call Mini-Circuits today and capture this next generation of performance and value!

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

MODELS (Add Prefix BW-)

2W SMA	5W SMA	5W Type-N	Attenuation (dB)	
$29.95	$44.95	$54.95	Nominal	Accuracy•
S1W2	S1W5	N1W5	1	±0.40
S2W2	S2W5	N2W5	2	±0.40
S3W2	S3W5	N3W5	3	±0.40
S4W2	S4W5	N4W5	4	±0.40
S5W2	S5W5	N5W5	5	±0.40
S6W2	S6W5	N6W5	6	±0.40
S7W2	S7W5	N7W5	7	±0.60
S8W2	S8W5	N8W5	8	±0.60
S9W2	S9W5	N9W5	9	±0.60
S10W2	S10W5	N10W5	10	±0.60
S12W2	S12W5	N12W5	12	±0.60
S15W2	S15W5	N15W5	15	±0.60
S20W2	S20W5	N20W5	20	±0.60
S30W2	S30W5	N30W5	30	±0.85
S40W2	S40W5	N40W5	40	±0.85

•At 25°C includes power and frequency variations up to 12.4GHz. Above 12.4GHz add 0.5dB typ. to accuracy.

ALL MODELS IN STOCK

Mini-Circuits®

US 58 INT'L 59
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:* ***www.minicircuits.com***

ISO 9001 CERTIFIED

F 331 Rev Orig.

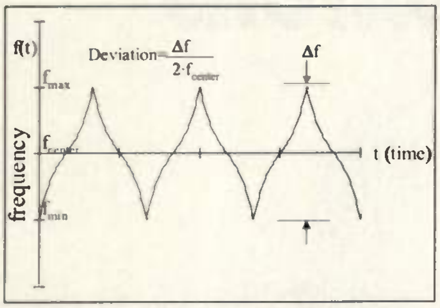


Figure 1. Lexmark Modulation Waveform Profile.

$$y(n+1) = [0 \; k_{vco} \; 0] \bullet \begin{bmatrix} x_1(n+1) \\ x_2(n+1) \\ x_3(n+1) \end{bmatrix} \quad (2)$$

$$M_{in} \left\{ \frac{\int_{t(n)}^{t(n+1)} \left[y(t) - f(t) \right]^2 dt}{\Delta t(n+1)} \right\} \to 0 \quad (3)$$

In the above equations, $\Delta_t(n+1)$ represents the interval of time between the current and next phase-frequency detector (PFD) update event. Equation (3) uses a least-square approximation [3] that provides the PLL with the best-fit SS ROM code for the ideal modulation profile ($f(t)$) in Figure 1). To solve this equation, an initial state is postulated based on the PLL parameters and initial values, then different feedback dividers are used to predetermine the complete set of next possible states. All possible variables of $x(n+1)$ are defined by equation (1). An optimal modulated frequency $y(n+1)$ can be defined by solving equations (1) and (2) to satisfy equation (3). This procedure is repeated until the modulation profile is optimized. The optimal dividers, FBD(n+1) are stored in the SS ROM.

These optimal ROM codes for feedback dividers are only good for discrete spread-spectrum PLLs running at a mean of $y(n)$ frequency. If these codes are used for lower frequencies than the mean of $y(n)$ (because the VCO's gain is too high), the gain of VCO, $K_{vco}(y(n))$ needs to be adjusted automatically in conjunction with the frequency of the output signal. Adding AGC accomplishes this.

The function $K_{vco}(y(n))$ is determined by the algorithm in Figure 4. Typically, 10 modulation cycles are simulated by using equations (1) through (3). First, an initial guess of $K_{vco\,(min)}$ is used as a trial value for existing ROM codes. After the number of modulation cycles

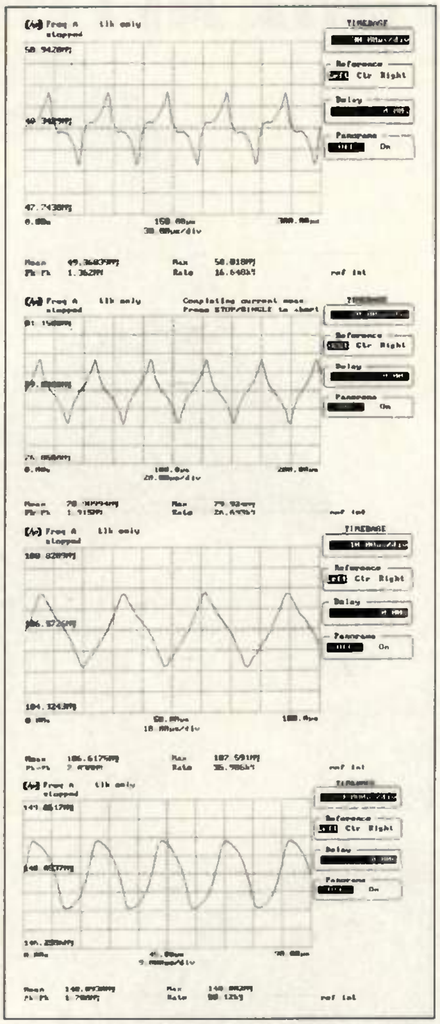


Figure 2. Modulation profile from conventional spread-spectrum PLL at frequency (a) 50 MHz (b) 80 MHz (c) 108 MHz (d) 150 MHz.

has been simulated, an accumulated error deviation at a specific frequency of $y(n)$, from an ideal modulation profile, can be calculated. This process is iterated by incrementing ΔK_{vco} until it reaches $K_{vco\,(max)}$. Then the smallest deviation error that is produced by $K_{vco}(y(n))$ is found.

The next quantum step in frequency is then calculated, and the process is repeated until the maximum frequency is reached. Eventually, the optimal $K_{vco}(y(n+1))$ is found. After all the values of $K_{vco}(y(n))$ have been determined, the spread-spectrum profile can be optimized for all of the running frequencies $y(n)$.

Circuitry and characteristics

The conventional VCO used in discrete spread-spectrum designs has resistance characteristics that provide a linear relationship between the VCO's frequency and its input voltage. The VCO circuitry shown in Figure 5(a) (where C_1=70 pF, C_2=394 pF, R =22.83 kΩ and R_i=5.62 kΩ) provides linear gain. By applying CP_{up}=3.15 μA, CP_{down}=3.2 μA and the loop filter parameters into the algorithm, the required K_{vco} is 59.18 MHz/v at 50 MHz and 274.27 MHz/v at 150 MHz. The frequency-dependent gain $K_{vco}(f)$ has parabolic or higher-order polynomial characteristics.

To implement the ASSCG, a negative metal-oxide semiconductor (NMOS) transistor is used with conventional VCO circuitry, providing the desired nonlinear resistance characteristics when it operates in an active region. The input of the NMOS transistor is connected to the VCO input voltage and uses the information from the VCO operating frequency to adjust the total resistance values, (including Ri).

Figure 5(b) shows the schematic with the automatic-gain adjusted circuitry. The aspect ratio of the NMOS transistor determines the shape of the nonlinear

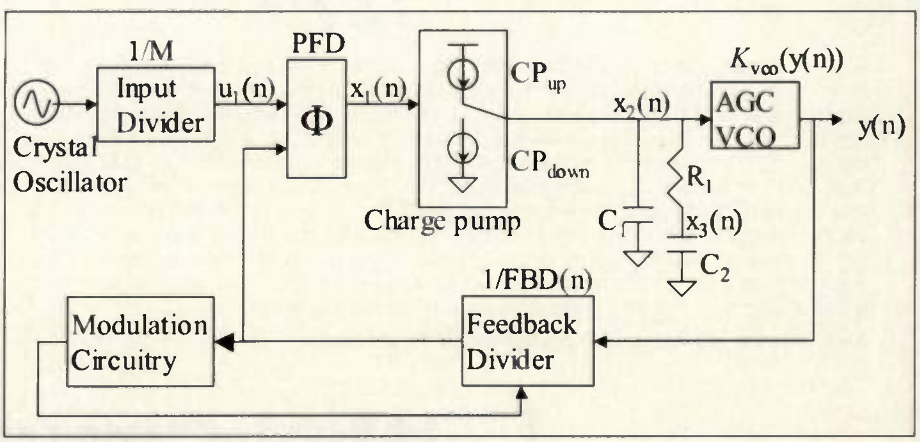
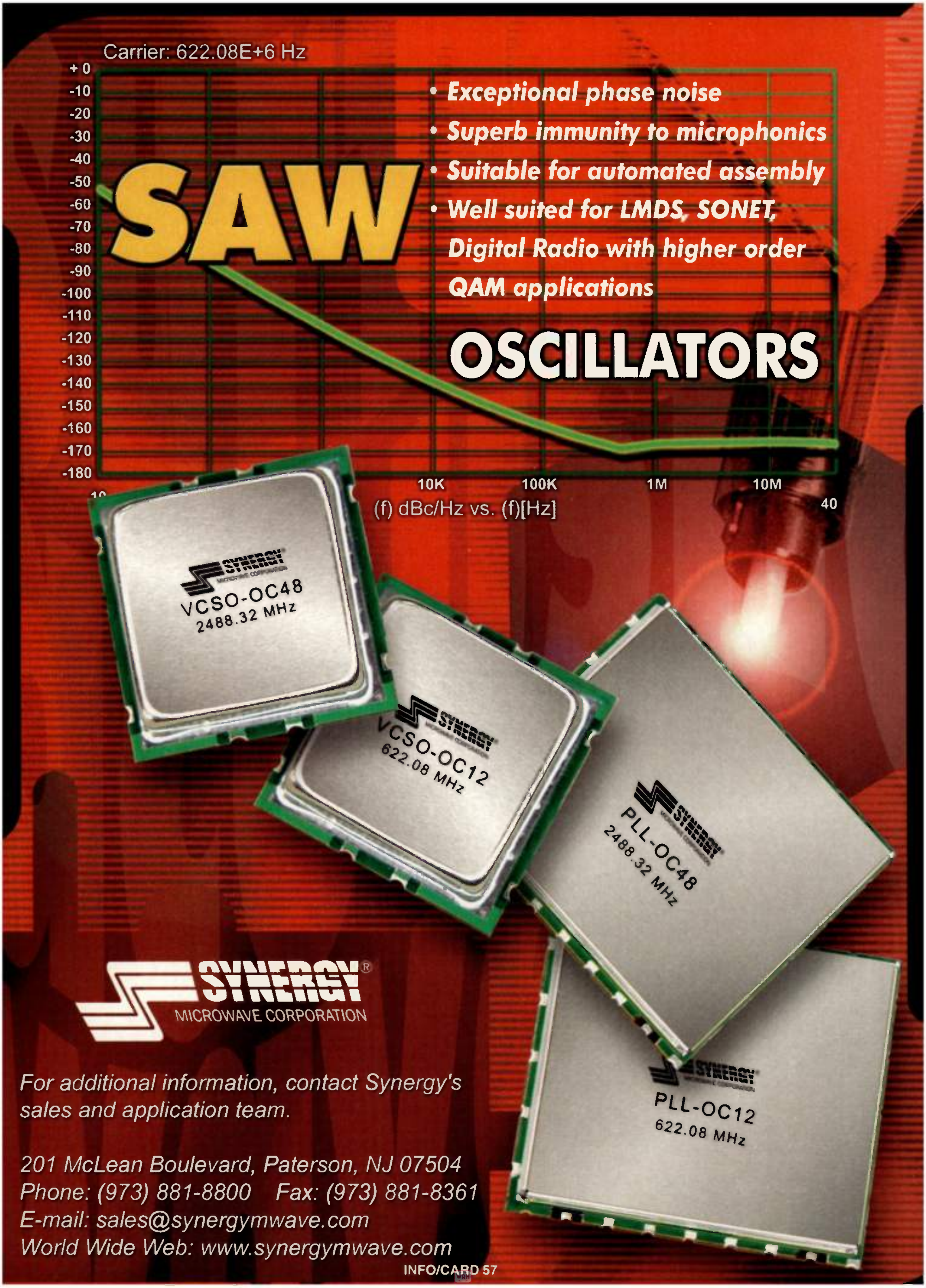


Figure 3. Adaptive spread-spectrum clock generator.


Carrier: 622.08E+6 Hz
+0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
10K
100K
1M
10M
40
(f) dBc/Hz vs. (f)[Hz]
SAW
• Exceptional phase noise
• Superb immunity to microphonics
• Suitable for automated assembly
• Well suited for LMDS, SONET, Digital Radio with higher order QAM applications
OSCILLATORS
SYNERGY
VCSO-OC48
2488.32 MHz
SYNERGY
VCSO-OC12
622.08 MHz
SYNERGY
PLL-OC48
2488.32 MHz
SYNERGY
PLL-OC12
622.08 MHz
SYNERGY®
MICROWAVE CORPORATION
For additional information, contact Synergy's sales and application team.
201 McLean Boulevard, Paterson, NJ 07504
Phone: (973) 881-8800 Fax: (973) 881-8361
E-mail: sales@synergymwave.com
World Wide Web: www.synergymwave.com
INFO/CARD 57

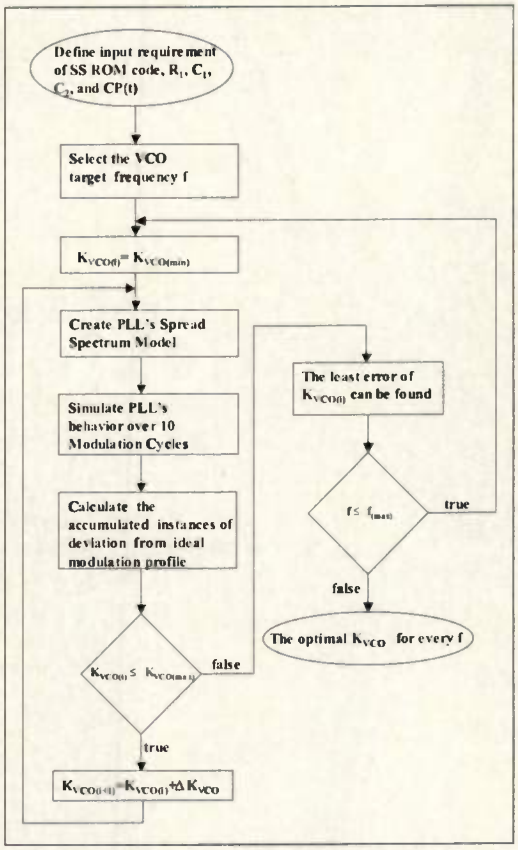


Figure 4. Algorithm for calculating required VCO gain.

gain of the VCO. This parameter can be used for curve fitting to approximate the

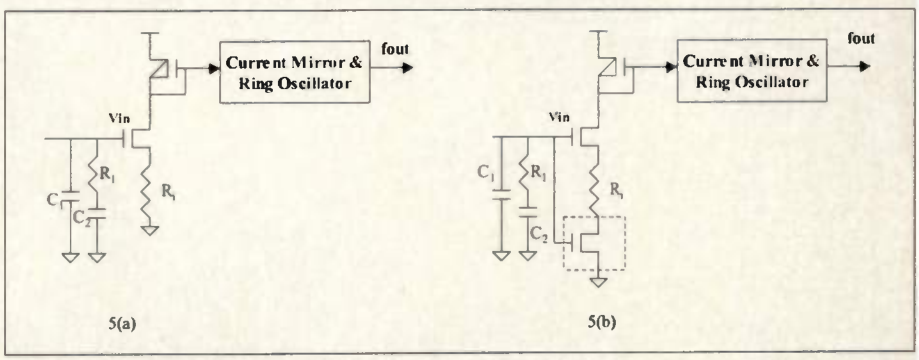


Figure 5. Schematic of loop filter and (a) VCO with linear gain (b) VCO with nonlinear gain.

curve generated by the algorithm.

The results of the device measurement for VCO frequencies and voltage-in are listed in table 1. In the conventional silicon VCO measurement, the maximum running frequency peaks at 216.88 MHz at 3 VDC input. The VCO's gain is near-linear from 63 MHz/V to 80 MHz/V when it operates between 1 and 2.6 VDC. The automatic gain-control $K_{vco}(f)$ has a fast-rising gain between 90 MHz/V to 180 MHz/V

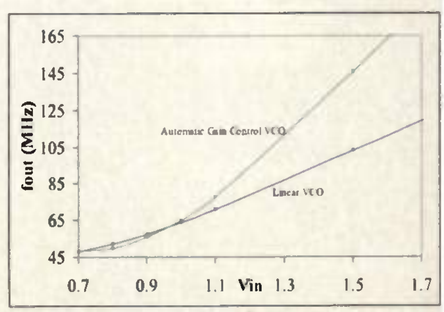


Figure 6. Frequency vs. voltage curves.

for voltages between 1 and 1.8 VDC. Figure 6 plots the frequency vs. voltage of conventional and automatic gain control VCOs. When the NMOS transistor gets into its saturation region, its resistance becomes fixed and the VCO gain will be constant.

Adaptive spread spectrum

In Figures 7(a) to 7(d), the measurements from an adaptive spread-spectrum PLL show the frequencies of a modulated clock in a different operating range. The ROM code of stored (FBD(n)) is optimized for a 95 MHz clock frequency. The best performance for EMI reduction is from 60 MHz to 135 MHz. In figures 7(b) and 7(c), the modulation profiles look similar to the ideal modulation waveform for frequencies of 80 MHz and 108 MHz. In Figures 7(a) and 7(d) the same ROM codes as 7(b) are used; the limitations of the NMOS transistor's active region prevent the VCO gain from reaching low or high enough values when the clock frequencies are running at 50 MHz and 150 MHz. Although these two waveform shapes are not as good as the profile shapes in Figures 7(b) and 7(c), comparatively, they maintain a


MITEQ
FROM COMPONENTS TO SYSTEMS
AMPLIFIERS TO 60 GHz
• Octave to ultra-broadband
• Noise figures from 0.35 dB
• Power to 10 watts
• Temperature compensated
• Cryogenic
MIXERS TO 60 GHz
• Single-, double-, and triple-balanced
• Image rejection and I/Q
• Single-sideband, BPSK and QPSK modulators
• High dynamic range
• Active and passive frequency multipliers
INTEGRATED SUBASSEMBLIES TO 60 GHz
• Integrated up/downconverters
• Monopulse receiver front ends
• PIN diode switches
• Ultra-miniature switch matrices
• Missile receiver front ends
• Switched amplifier/filter assemblies
FREQUENCY SOURCES TO 40 GHz
• Free-running VCOs/DROs
• Phase-locked cavity oscillators
• Phase-locked coaxial resonators
• Synthesizers for SATCOM
• Fast-tuning communication synthesizers
IF AND VIDEO SIGNAL PROCESSING
• Logarithmic amplifiers
• Constant phase-limiting amplifiers
• Frequency discriminators
• AGC/VGC amplifiers
• I/Q processors
• Digital DLVAs
SATCOM EARTH STATION EQUIPMENT TO Ka-BAND
• Synthesized up/downconverters
• Test translators
• LNA systems
• 1:N redundancy units
• INMARSAT products
• FM modems
MITEQ
TEL: (631) 436-7400
FAX: (631) 436-7430
100 Davids Drive, Hauppauge, NY 11788
www.miteq.com
INFO/CARD 50

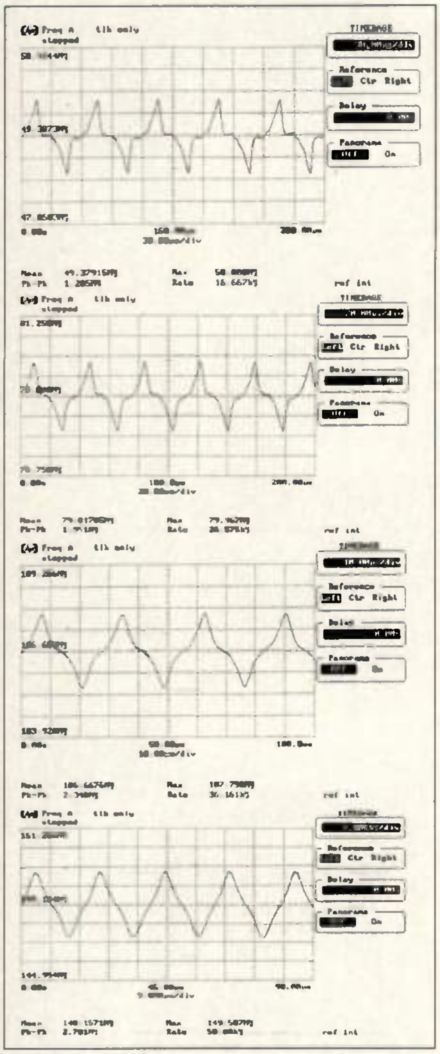


Figure 7. Modulation profile from adaptive spread-spectrum PLL at down spread frequency of (a) 50 MHz (b) 80 MHz (c) 108 MHz (d) 150 MHz.

good shape when compared to the conventional spread-spectrum PLLs shown in Figures 2(a) and 2(d). These results prove the adaptive feature gives the greatest EMI reduction over a wider clock frequency range.

Linear VCO		ACG VCO
V_{in} (volts)	f_{out} (MHz)	f_{out} (MHz)
0.6	45.163	48.621
0.7	48.122	48.872
0.8	52.484	50.311
0.9	57.566	55.995
1.0	63.94	65.06
1.1	71.28	77.96
1.5	103.18	145.71
1.8	127.41	199.74
2.0	143.36	233.93
2.2	158.87	266.44
2.4	174.04	297.55
2.5	181.47	312.68
2.7	196.00	340.72
3.0	216.88	378.16

Table 1. VCO output frequencies vs. V_{in}.

Conclusion

The adaptive spread-spectrum device is implemented using an AGC VCO with a nonlinear VCO gain calculated by the computer algorithm.

Measurements show the parabolic characteristics of the VCO gain required for adaptive spread spectrum are provided by the nonlinear resistance characteristics' NMOS transistor operating in the active region. Adaptive spread spectrum is a successful and cost-effective design to support a wide range of frequencies while maintaining the optimal modulation profile. The adaptive feature of the spread-spectrum device not only spreads all frequencies in one device, it also modulates the frequency in a continuous range and provides the best EMI reduction.

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, pp227-231.

[3] Richard, L. Burden., J. Douglas Faires., "Numerical Analysis," 4th ed., PWS-KENT, 1989.

About the authors

I-Teh Sha is a staff design engineer at the Timing Technology Division of Cypress Semiconductor. He has Ph.D. in electrical engineering from the University of Missouri-Columbia. He has previously worked in the field of two-Dimensional device physics by Finite Element and Finite Difference.

Albert Chen has an MS.E.E. from the University of Missouri-Columbia. He is employed at the Timing Technology Division at Cypress Semiconductor as a design manager.

Kuang-Yu Chen has an MS.E.E. from San Jose State University. He is employed at the Timing Technology Division of Cypress Semiconductor as a design vice president.

Jeff Keip earned his B.S.E.E from the University of California at Davis. He is a product marketing manager for the Timing Technology Division of Cypress Semiconductor.

RF POWER FOR 3G NETWORKS

UltraRF

LDMOS

Your wireless networks can't wait to move to 3rd generation technology. But retrofitting and enhancing your existing infrastructure presents some serious challenges.

UltraRF has the high power LDMOS solutions. With the highest power density available, combined with high efficiency and linearity, you can now meet the stringent demands of the emerging 3G air interface standards within both power and cost budgets.

And UltraRF is shipping gold LDMOS and bipolar transistors for all current cellular bands and standards at power levels from 5 to 1000W in both industry standard packages and highly integrated ceramic based power amplifier modules.

For an UltraRF databook or to speak with an UltraRF design engineer about LDMOS solutions for your 3G infrastructure call 877-206-5657, email info@ultrarf.com, or **www.ultrarf.com**

UltraRF.

160 Gibraltar Court
Sunnyvale, CA 94089-1319 USA
Phone: 408 745 5700
Fax: 408 541 0139

England +44 (0) 118 934 3838
Finland +358 (0) 8 551 4435
Stockholm +46 (0) 8 471 8400
Gothenburg +46 (0) 31 726 8353
Uddevalla +46 (0) 522 641 400
Norway +47 (9) 333 86271

INFO/CARD 56

Catalog features power products

IFR Systems announces the Kikusui 2001 product catalog, a resource for users of AC and DC power supplies, electronic loads, power controllers, battery testers and general test and measurement instruments. The catalog highlights new products and provides both images and model numbers for ease of ordering. With more than 200 pages, the catalog contains comprehensive information about Kikusui's selection of AC and DC power supplies, electronic loads, battery testers, power supply controller/GPIB programmers, rack assemblies for power supplies, oscilloscopes, signal generators, electrical safety testers, jitter meters and other general test and measurement instruments. From AC and DC power supplies to general test and measurement instruments, Kikusui offers ISO 9001-compliant products that enable customers to produce high-quality test equipment.

IFR Systems
INFO/CARD 115

Bulletin showcases surface-mount varactor diodes

A new 12-page brochure from Sprague-Goodman Electronics describes the company's surface-mount varactor diodes. *Bulletin SG-950* provides detailed descriptions of 11 device series that provide designers with a selection of capacitance vs. voltage characteristics (super hyperabrupt, wideband hyperabrupt, microwave hyperabrupt, high Q abrupt and microwave abrupt). The diodes are offered in three classes of package configurations (plastic SOT-23, surface-mount low parasitic, and surface-mount monolithic), giving the designer a choice of models from which to select the diode most suitable for a desired frequency range and performance criteria. The listings include common cathode models. Product descriptions include features, specifications, outline drawings, applications and C-V curves.

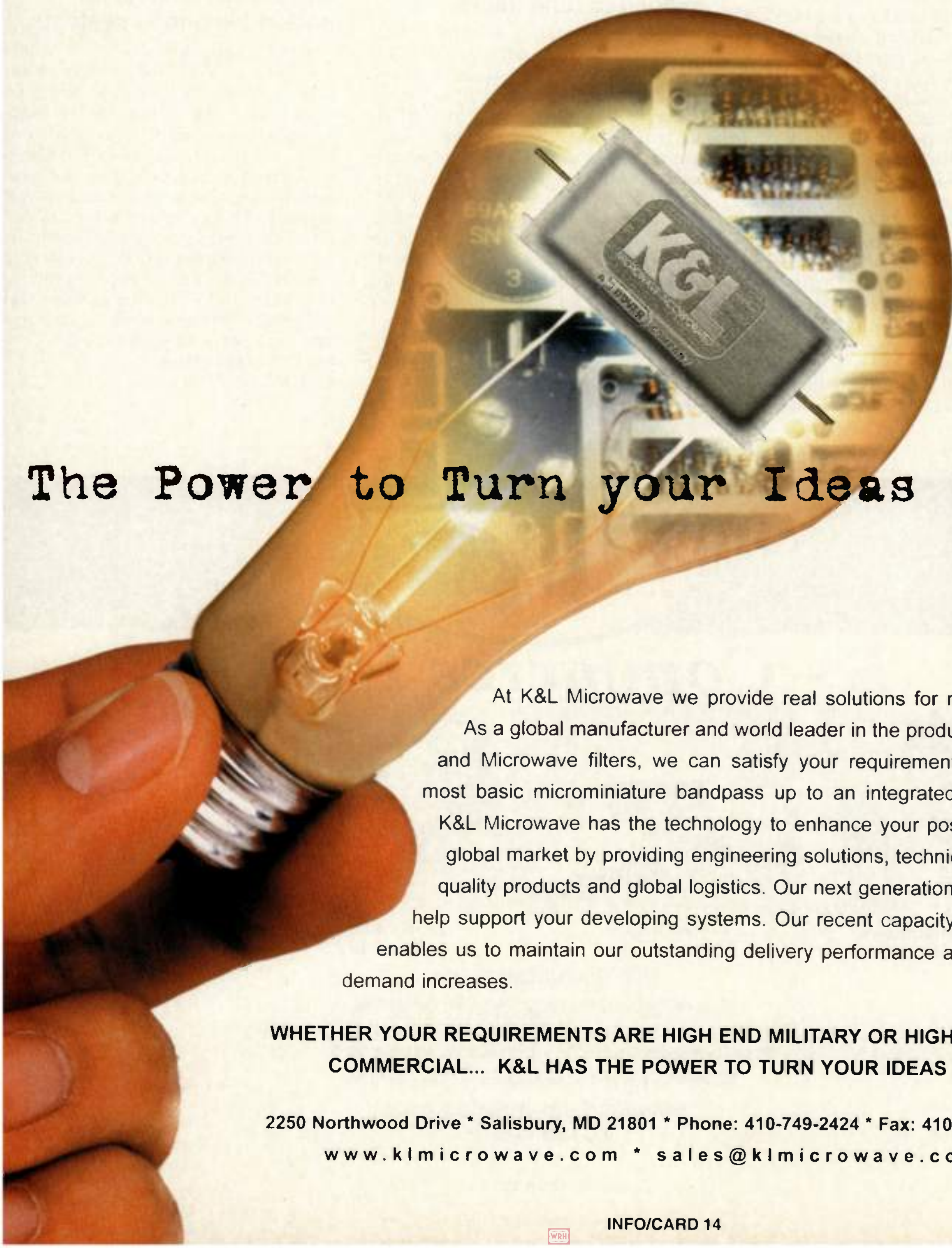
Sprague-Goodman Electronics
INFO/CARD 116

Technical library released on CD-ROM

Microchip Technology announces the revised *Technical Library CD-ROM 1st Edition 2001,* a complete compilation of technical documentation on Microchip's PICmicro microcontrollers and associated development tools, KeeLoq secure data products, non-volatile memory devices and related microperipheral products including analog/interface products and RFID. The CD-ROM features an expanded line of products, including a broad spectrum of high-performance linear and mixed-signal, power management and thermal management devices. Extensive information regarding Microchip product specifications, application notes and related source codes, software support for embedded control applications, programming specifications, and development system users' guides are also provided. The CD-ROM is color-coded for easy reference.

Microchip Technology
INFO/CARD 117

K&L
MICROWAVE INCORPORATED
A DOVER COMPANY



The Power to Turn your Ideas On

At K&L Microwave we provide real solutions for real people. As a global manufacturer and world leader in the production of RF and Microwave filters, we can satisfy your requirements from the most basic microminiature bandpass up to an integrated assembly. K&L Microwave has the technology to enhance your position in the global market by providing engineering solutions, technical support, quality products and global logistics. Our next generation design will help support your developing systems. Our recent capacity expansion enables us to maintain our outstanding delivery performance as customer demand increases.

WHETHER YOUR REQUIREMENTS ARE HIGH END MILITARY OR HIGH VOLUME COMMERCIAL... K&L HAS THE POWER TO TURN YOUR IDEAS ON.

2250 Northwood Drive * Salisbury, MD 21801 * Phone: 410-749-2424 * Fax: 410-749-5725
www.klmicrowave.com * sales@klmicrowave.com

INFO/CARD 14

ERDAS Imagine 8.5 offers feature enhancements

ERDAS Imagine V8.5 — offers a number of feature enhancements including upgrades to the mosaicking tool, advanced 3D visualization and scene creation capabilities, and MrSID's (Lizardtech) space-saving compressor. With an easier-to-use mosaicking tool, users can create seamless output images using specialized color-balancing procedures that remove "hot spots" from aerial photography and other off-nadir imagery. Additional highlights of the expanded mosaicking tool include a preview feature, a cropping feature and support for off-line imagery. Other new features in ERDAS Imagine 8.5 include the addition of license administration flexibility, more import and export utilities, greater mobility for fieldwork, the ability to preserve pixel location and boundaries, an enhanced ability to create and edit ESRI Shapefiles, military grid reference system (MGRS) support, and extensions to the Imagine Developers Toolkit.

ERDAS
INFO/CARD 118

Software cuts time, training needed to tune filters

Agilent Technologies introduces a software tool that reduces the time and skill required to tune the coupled-resonator bandpass filters used in wireless base stations. The Agilent N4261A filter-tuning software allows manufacturers of RF and microwave filters to achieve greater production throughput by reducing a filter tuner's training time from more than six weeks to less than one day. In addition, manufacturers can consistently tune each filter to a higher specified level of performance. The software tool runs under the Windows 2000 or Windows NT 4.0 operating system and operates in conjunction with Agilent's new PNA Series of RF network analyzers, as well as the Agilent 8753 and 8720 family of network analyzers.

Agilent Technologies
INFO/CARD 119

VoP Software suite for packet telephony systems

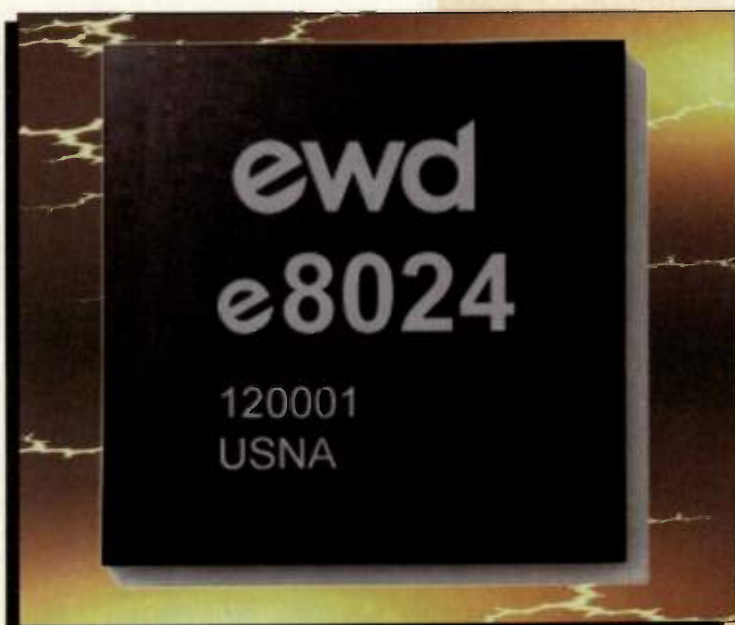
3DSP Corporation offers a voice-over-packet (VoP) software suite for DSPs in next-generation packet telephony. The new VoP Software Suite complements 3DSP's portfolio of DSP and peripheral cores for developing SoC solutions appropriate for a wide range of products in the VoP market. The software is optimized for 3DSP's proprietary DSP architecture and supports all DSP processing requirements from customer-premise equipment (CPE) and residential gateways through media gateways and next-generation switches.

3DSP Corporation
INFO/CARD 120

EWD E8024/9024 PROCESSORS

Embedded Wireless Devices introduces the e8024 voice and data broadband wireless gateway processor and the e9024 voice and data wireless local area network (LAN) processor. The processors can concurrently support the IEEE 802.11a, operating at 5.7 GHz, as well as industry-standard wireless protocols such as IEEE 802.11b, BluetoothTM, HomeRF and HiperLAN 2. Designed for residential and enterprise broadband wireless gateways and wireless LANs, these new products eliminate quality of service (QoS), interference and performance problems that occur when the IEEE 802.11b protocol coexists on a wireless network with the other 5 GHz spectrum and 2.4 GHz industry standards. The processors provide additional bandwidth and multiple basebands to support simultaneous data and voice at both the broadband and premise-side distribution interfaces. They are designed for next-generation systems using the 5 GHz spectrum to address these interference and performance issues. By allocating a broad 200 MHz band (vs. 85 MHz for 802.11b), the 5 GHz spectrum enables higher data throughput and eliminates interference from 2.4 GHz-based appliances such as microwave ovens and cordless telephones. The processors offer both high-quality voice and data processing, aid in the interference and bandwidth issues of today's wireless networks, and the ability to handle multiple wireless networking protocols with a single chip. Based on the ewdC20 core containing 32-bit CPU and DSP, the e8024 and e9024 processors combine multiple on-chip basebands to support high-bandwidth data gateway applications. Under the management of a 40/60 MHz 32-bit RISC processor, multiple 120 MHz function-specific processors are dedicated to controlling each of the two basebands and I/O functions such as USB slave-mode interface plus MAC 1 10 Mbit and MAC 2 10/100 Mbit broadband inputs. In addition to sophisticated power management, the eMOS embedded multitasking operating system efficiently handles the fast context switching between basebands to provide seamless voice and data communications. Each of the two configurable basebands can be programmed to support virtually any combination of industry-standard wireless protocols, including IEEE 802.11a and IEEE 802.11b, on the same chip, or 802.11a and Bluetooth, simultaneously supporting both 5.7 GHz and 2.4 GHz standards.

Embedded Wireless Devices
INFO/CARD 121



Multi-band 802.11b, 802.11a, and Bluetooth processors

SiGe HBT direct-quadrature modulator

Stanford Microdevices introduces a family of silicon germanium (SiGe) direct-quadrature modulators suited to 2.5G, 3G, WLAN and fixed wireless infrastructure applications between 400 MHz and 4 GHz. The STQ-1016 targets frequencies in the range of 400 to 1200 MHz, while the STQ-3016 covers 2500 to 4000 MHz. Both ICs are packaged in industry-standard, 16-pin, exposed-pad TSSOP plastic packages. The 1016 provides carrier feedthrough typically better than −40 dBm, with amplitude and phase error of the modulation inputs (typically <0.2 dB and <2 degrees, respectively). The 3016 exhibits carrier feedthrough better than −35 dBm with amplitude and phase-error performance (< 0.2dB and 2.5 degrees, respectively). Both offer a low noise floor performance (typically better than −150 dBm/Hz and −147 dBm/Hz).

Stanford Microdevices
INFO/CARD 122

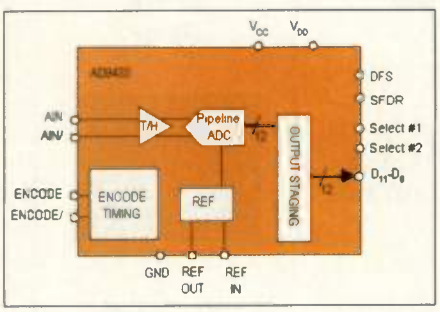
Integrated IF receiver, baseband interface

Zarlink Semiconductor announces an integrated RF chipset for cellular handsets operating in dual-mode TDMA/AMPS networks in North America. The MGCM02 and MGCT04 devices offer handset manufacturers a complete IF receiver, baseband interface and transmitter in a two-chip solution that reduces board area by 60% and cuts costs by 30% The MGCM02 is an IF receiver and baseband interface chip. The device incorporates the existing MGCR01 IF receiver and MGCM01 baseband interface chips into a single 49-pin BGA package measuring 7 x 7 mm. The MGCT04 transmit circuit provides the transmit function in dual-band, dual-mode TDMA/AMPS and CDMA/AMPS mobile telephones. The chip is designed into a 5 x 5 mm MLF package. The MGCM02, when combined with the MGCT04, provides IF receiver, baseband interface and transmitter functionality in 75 mm^2 of board space.

Zarlink
INFO/CARD 123

Fast ADC offers on-chip track-and-hold circuit

Analog Devices announces the AD9433 12-bit ADC, with a sampling rate of 125 Ms/s, capable of IF sampling



input frequencies as high as 350 MHz. The device uses a 3 VDC (2.7 to 3.6 VDC) voltage supply for IF sampling as high as 100 MHz in small or portable applications such as pico-cell, cellular base stations. It offers an on-chip track-and-hold circuit optimized for maximum dynamic performance in wideband and high IF carrier applications such as GSM cellular base stations. The device requires only a 5 VDC supply and a differential encode clock. No external reference or driver components are required for many applications. In addition, the part is pin-compatible with the AD9432 12-bit ADC for simple system upgrades. A user-selectable, on-chip proprietary circuit optimizes SFDR vs. SINAD ratio performance for different input signal frequencies, providing as much as 85dBc SFDR performance over the dc to 125 MHz band. The encode clock supports either differential or single-ended input and is PECL compatible.

Analog Devices
INFO/CARD 124

CDMA RF single-chip synthesizer

Silicon Laboratories debuts the Si4135 CDMA RF synthesizer. The single-chip Si4135 meets the stringent phase-noise performance requirements of the IS-95 and AMPS cellular standards. The device eliminates the need for more than 40 external components, including RF VCOs, decreasing required board space by up to 90%. The device is designed for single-band, dual-band, dual-mode and tri-mode CDMA/AMPS handsets and other IS-95 wireless data applications in the United States and Korea.

Specifications at a glance:

- Synthesizes U.S. 1.719 to 1.780 GHz and 954 to 980 MHz RF
- Synthesizes Korean 1.620 to 1.650 GHz RF

Silicon Laboratories
INFO/CARD 125

Programmable SOC supports portable apps

The AT94K10 field-programmable system-level IC provides system-level integration of microcontroller, programmable logic, control, memory and I/O functions, while consuming less than 50 μA in standby and 2 to 3 mA/MHz during operation. The IC's high level of integration and low power drain make it suitable for such low-power applications as personal digital assistants and their peripherals, cellphone add-on equipment, GPS portable test equipment, point-of-sale equipment, security systems or wireless

Specifications at a glance:

- 50 μA standby current
- 2 to 3 mA/MHz during operation
- integrates a 20+ MIPS AVR RISC
- 10,000 gates of SRAM-based programmable logic

INFO/CARD 84

Internet appliances. The device integrates a 20+ MIPS AVR RISC microcontroller with hardware multiplier, 10,000 gates of SRAM-based programmable logic, 36 kB of SRMA, an industry-standard, two-wire serial interface, two UARTs, three timer/counters, and a watchdog timer.

Atmel
INFO CARD 126

Four-channel A/D converter

DATEL introduces the CPCI-51 OP for analog signal processing applications, packaged on a diminutive 4" by 6.25" board. The 3U format board is suitable for wide-bandwidth signal storage to network, huge memory or disk. The front end uses four 14-bit NDs with 0 to +5 VDC or ±2.5 VDC user-selectable, full-scale input ranges. The ND-per-channel architecture allows all four channels to be captured exactly in parallel. This enables capable phase-coherent sensor arrays such as accelerometers, sonar and Doppler studies and multiple simultaneous radar channels. Each channel may sample as much as 2.5 MHz in parallel or 3 MHz per channel in single-channel mode. Applications include high-end DSP and FFTs. Using a combination of a DATEL-written device driver and on-board PCI bus mastering with a DMA controller, the board can temporarily take control of the bus, all without requiring slow CPU clock cycles to transfer each sample.

Datel
INFO/CARD 127

INFO/CARD 102

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

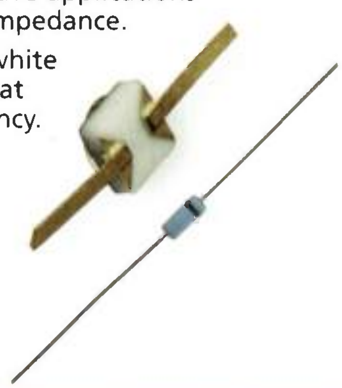
Broadband Calibrated Millimeter-wave Noise Sources

- 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!

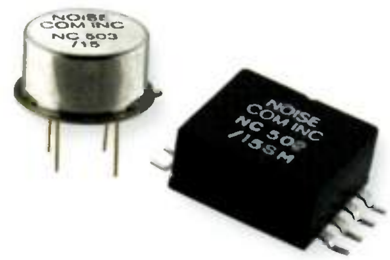
DESIGNERS' GUIDE TO BROADBAND NOISE PRODUCTS

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

NOISE/COM

BITE Modules

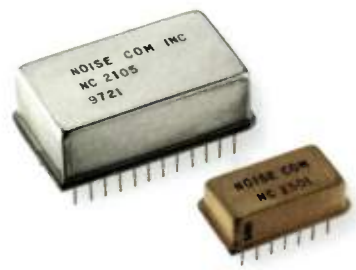
- Designed as an economical solution for built-in test requirements.
- Contain complete biasing networks; need no external components.
- Available in TO-8 cans and flat packs.



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.



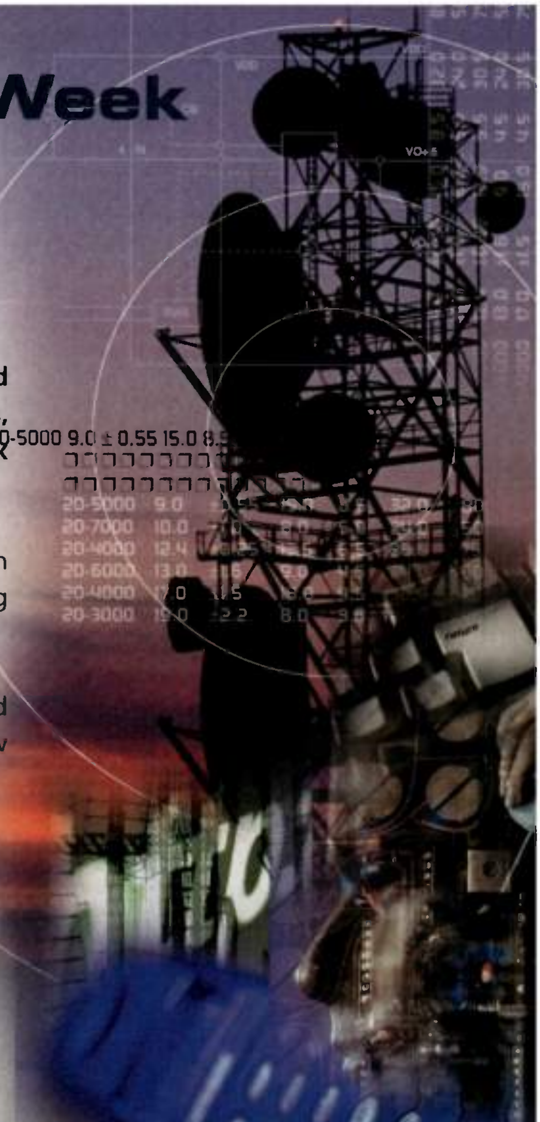
NC2000 SERIES Standard Models		
MODEL	FREQUENCY RANGE	OUTPUT
NC2101	100 Hz – 20 kHz	0.15 Vrms
NC2105	500 Hz – 10 MHz	0.15 Vrms
NC2201	1 MHz – 100 MHz	+5 dBm
NC2601	1 MHz – 2 GHz	-5 dBm

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 POWER
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

European Microwave Week comes to London in 2001...



From high frequency semiconductor materials, to components and sub-systems, through to complete systems for wireless communications, automotive and radar applications, European Microwave Week encompasses the complete wireless & microwave market.

☐ Three conferences featuring over 700 presentations make European Microwave Week the most comprehensive conference-based learning event in the world.

☐ Your chance to see all the latest technological developments first-hand at the international European Microwave Week exhibition. Register now for your free exhibition entrance ticket.

How to Register (exhibition & conferences).

☐ Register Online at: www.eumw.com

☐ Telephone our hotline for a registration form on: +44 (0)870 429 4300

Sponsored by

Platinum Sponsors

Agilent Technologies

Gold Sponsors

Anritsu

united monolithic semiconductors

For Conference & General Enquiries:

Nicola Jedrej, Event Manager
Tel: +44 (0)20 7861 6391
Email: njedrej@cmp-europe.com

EuMA European Microwave Association

MICROWAVE ENGINEERING EUROPE

EUROPEAN MICROWAVE WEEK
EXCEL, DOCKLANDS LONDON, ENGLAND 24-28 SEPTEMBER 2001
WWW.EUMW.COM

venue: excel london
date: 25.09.01-27.09.01
time: 09.30 hours

31ST EUROPEAN MICROWAVE CONFERENCE 2001 — The 31st European Microwave Conference (31st EuMC)

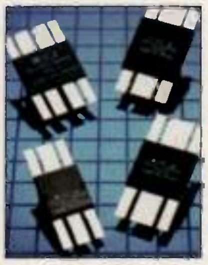
GAAS®2001 — The European Gallium Arsenide and other semiconductors Application Symposium (GAAS 2001)

WIRELESS TECHNOLOGIES 2001 — The European Conference on Wireless Technology (ECWT 2001)

CMP Electronics Group

INFO/CARD 10

Product Showcase



The DE-Series RF Power MOSFETs feature a low-profile surface-mount package with very low insertion inductance and a thermal dissipation as high as 750 W, providing exceptionally fast switching speeds combined with high power handling capability. The MOSFETs are targeted for a number of applications, including RF plasma generators.

DIRECTED ENERGY
www.directedenergy.com

Ansoft Designer is the first entry into this new world of communications design software. Experience innovation with solver-on-demand technology, a new interface, design automation features and the latest in Windows-based technologies.

ANSOFT CORPORATION
www.ansoft.com

Trimmer Capacitors
Fixed and Variable Inductors
Fixed and Variable Transformers
Tuning Varactors
Microwave Tuning Elements
Insulated Tuning Tools

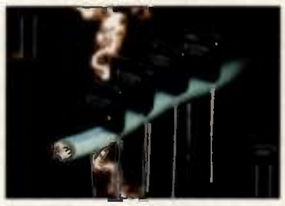
SPRAGUE GOODMAN
www.spraguegoodman.com

Noise Com's NC 302L is a member of our diode family and a building block of all noise systems. The NC302L is designed for specific microwave applications in which 50-ohm impedance is required. Typical small impedance of the NC302L is 10-20 ohms when a diode is turned on.

NOISE COM
www.noisecom.com

The PE412x incorporates patented Ultra-Thin-Silicon (UTSi) CMOS technology for best-of-class linearity performance. Targeted for wireless base station receivers for PCS/3G, Cellular/GSM800 and DCS1800, Peregrine's family of FET Quad mixers eliminates disparate baluns, and integrates RF and LO matching networks.

PEREGRINE SEMICONDUCTOR
www.peregrine-semi.com



With as much as 3700 amps peak current and 9 amps continuous current, CDE mica capacitors are the choice for snubber and resonant-power applications. They have 75% lower impedance at resonance than ceramic disks and twice the dV/dt capability of the best polypropylene capacitors.

CORNELL DUBILIER
www.cornell-dubilier.com

The model 506052E embedded antenna supports a 2.400 - 2.485 GHz frequency range, has VSWR of 2.0:1, impedance at 50 ohms, weight at .006, and linear polarization. Available at low cost and high volume, with four-week cycles from design to production on the Covant series of embedded antennas.

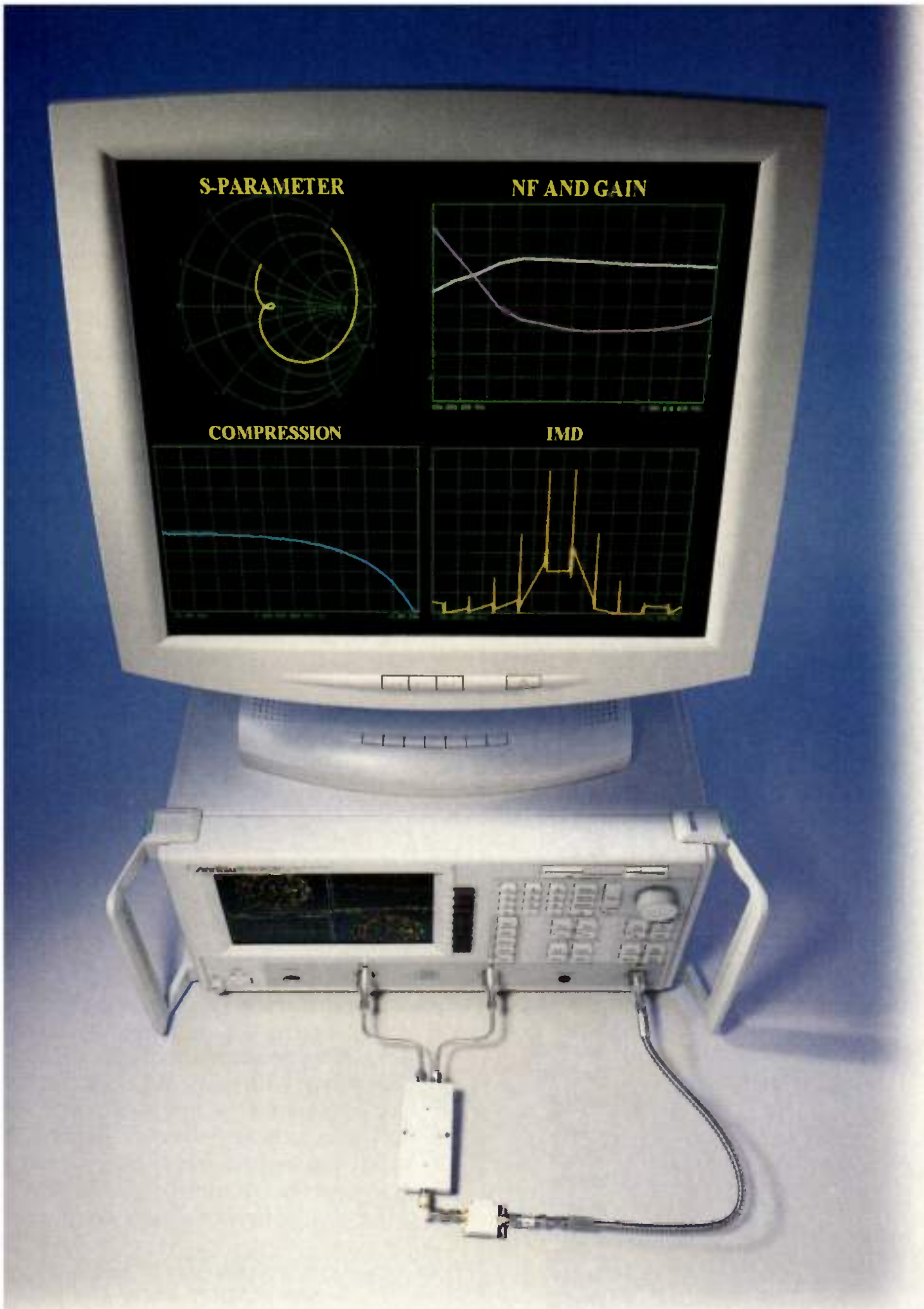
TRAK
www.trak.com

Hittite Microwave introduces a low-noise, divide-by-4 static prescaler with InGaP GaAs HBT technology in an 8-lead surface-mount plastic package. The HMC365S8G features a wide operating input window and low additive SSB phase noise of -151 dBc/Hz at 100 kHz offset.

HITTITE
www.hittite.com

Dual-band Tri-mode CDMA Front-End Module - RF Micro Devices introduces the RF3404, a fully integrated dual-band front-end module for tri-mode CDMA applications. This SiGe HBT 8mmx8mm receive module, reduces board area by 70% and decreases bill of materials component count by 22 components.

RF MICRO DEVICES
www.rfmd.com



See The True Performance Of Your Low Noise Amplifier.

Scorpion®..You Only Need One!

Anritsu's MS4623B Scorpion Vector Network Measurement System (VNMS) offers a complete single connection RF solution for the wireless market. This amazingly accurate and easy to use instrument reveals the true performance of your LNA. And it does so with the speed you need to meet today's faster time-to-market demands. The VNMS single connection solution saves you time with simple calibrations and built-in LNA measurements.

The MS4623B, offering as high as +5 dBm input power to your LNA, can measure these key LNA parameters with a single connection.

Parameter	MS4623B Measures
Noise Figure	Less than 0.5 dB out to 6 GHz
Third Order Intercept	Up to +40 dBm
Gain Compression	As high as +16 dBm
S-Parameters	+/- 0.1 dB Accuracy

When it comes to wireless R & D or manufacturing you only need one Scorpion to increase your throughput. Find out for yourself. Call us today at 1-800-ANRITSU to set up a single connection LNA demo. Or visit us at www.us.anritsu.com/adsmailers/MS4623B.asp. Anritsu's Scorpion MS4623B. Now, you too, can see your LNA's true performance.

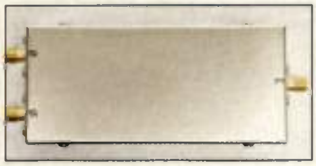
Anritsu

Discover What's Possible™

MS4623B Scorpion Vector Network Measurement System

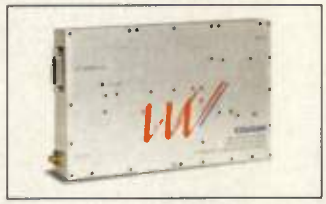
INFO/CARD 3

Product Showcase



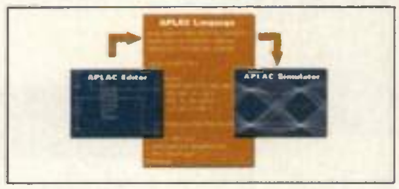
The latest 1x2 reactive power divider/combiner from JFW Industries, model 50PD-304, offers a bandwidth of 800-4000 MHz. Available with SMA connectors; it maintains a port-to-port isolation of 20 dB (minimum) and an insertion loss of 1 dB (maximum, above the 3dB split) across the band.

JFW INDUSTRIES
www.jfwindustries.com



Built for use in third-generation (3G) network infrastructures, the Cougar's (2100 MHz [3G] SCPA 15W) high efficiency, low ACPR, lightweight and small size provides customers with a cost-effective and reliable solution for their 3G infrastructure needs. The Cougar can also be customized to meet a unique specification.

UNITY WIRELESS
www.unitywireless.com

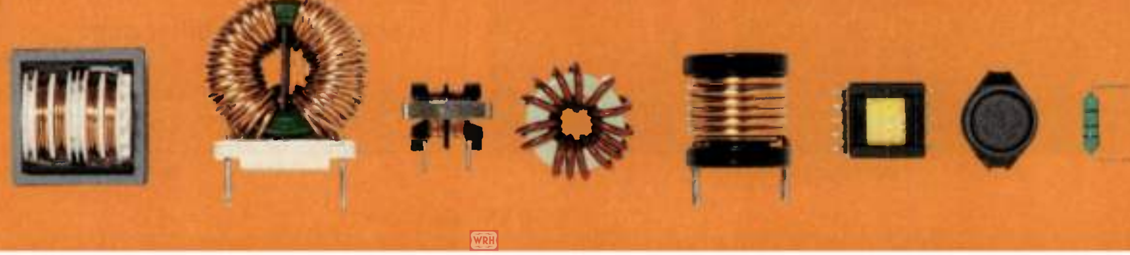


Major corporations, as well as small design entrepreneurs, use APLAC to create cutting-edge products with a cost-efficient budget and the shortest time-to-market. APLAC technology covers applications ranging from ICs to board- and system-level simulations, from DC to RF and microwave frequencies.

APLAC
www.aplac.com

Pole/Zero announces the latest breakthrough in reduced prices for readily available, digitally tunable RF Filters with the introduction of its new MINI-Hybrid Series (est. $199 each in quantity). This bandpass filter provides excellent RF power handling and selectivity at 251 tune positions in VHF/UHF frequency bands.

POLE/ZERO
www.polezero.com



Spirent's C2K-ATS is a comprehensive, integrated, easy-to-use solution for evaluating cdma2000 mobile devices. C2K-ATS answers cdma2000 test requirements, with pre-defined suites for industry-standard tests defined by TIA, 3GPP2, CDG, and ARIB.

SPIRENT
www.spirent.com

Mini-Circuits offers high-performance POSA-960 plug-in voltage controlled oscillators. The devices have 800 to 960 MHz linear tuning and low -112 dBc/Hz (typ) SSB noise at 10 kHz offset. Applications include cellular and UHF transmitters. Available from stock for $49.95 each (qty 1-9).

MINI-CIRCUITS
www.minicircuits.com

GORE-SHIELD SMT EMI Gaskets

W.L. Gore introduces GORE-SHIELD SMT EMI gaskets, high performance EMI shielding gaskets that can also be used as an RF grounding pad or interconnect. The parts come in several different sizes and are shipped to the customer in standard tape-and-reel configurations that are compatible with surface mount pick-and-place machinery. For more information, contact W. L. Gore & Associates. at 800/445-4673, +1/302-292-5100, +49/91 44 6010.

W.L. GORE & ASSOCIATES
www.gore.com/electronics

RF/Microwave Chip Capacitors to 1000 Volts

Cornell Dubilier's MC mica chips have twice the voltage and capacitance of the 100B and Q over 3,000 at 1 MHz! These chips are an excellent lower cost alternative to "cubic" porcelain ceramic capacitors. The CDE mica chip has no cracking, a high resistance to soldering temperatures and offers capacitance values from 0.5 pf to 2000 pf. Sample kits priced from $50. Available case sizes MC08, MC12, MC18, MC22, tolerance ±0.1 pf to ±5%. For more information please visit our website at: **www.cornell-dubilier.com**

CDE CORNELL DUBILIER
Your Source For Capacitor Solutions

Joe Gracia, Product Manager
(508) 996-8564 / fax: (508) 996-3830
Email: cdenb@cornell-dubilier.com

INFO/CARD 53

Want to know the secret of success in the land of Linux and Nokia? It's APLAC. An industrial-strength simulation technology that combines the functionality of Spice with the utility of an advanced RF simulator. APLAC, and only APLAC, provides the accurate IC- and board-level models and precise methods to analyze non-linear circuit behavior demanded by top RF and analog designers. The only approach up to the complex design challenges ahead: 3G, Bluetooth, and beyond.

APLAC gives you something unique - the freedom to do things right. All you do is supply the three ingredients mentioned above.

APLAC

APLAC Solutions Inc
320 Decker Dr, Suite 100, Irving, TX 75062
tel. 972-719-2562
www.aplac.com e-mail: sales@aplac.com

APLAC Solutions Corporation
Atomitie 5 C, FIN-00370 HELSINKI, Finland
tel. +358-9-540 450 00
www.aplac.com e-mail: sales@aplac.com

The Freedom To Do Things Right.

INFO/CARD 12

Single-chip transmitter for 300 MHz to 470 MHz ISM band

An integrated, single-chip, amplitude-shift-keyed (ASK) RF transmitter designed for low-cost loop antenna transmitters is available from Micrel Semiconductor. The MICRF102 QwikRadio transmitter complements Micrel's existing family of QwikRadio single-chip receivers. Highly integrated in SOIC-8 packaging, the transmitter requires only five external components. It incorporates transmit power control and unique automatic antenna tuning. Automatic tuning of the antenna eliminates the need for manual tuning in production, making it more reliable and easier to manufacture. The power-control function ensures consistent output power across varying operating conditions and over the lifetime of a battery. Included within the power control function is the ability to set the transmit power by controlling the voltage on a power-control pin. The device operates from a 5 VDC supply, consumes 7.5 mA (mark) and 4 mA (space) supply current and has a shutdown pin to further conserve power.

Micrel
INFO/CARD 128

Specifications at a glance:
- 300 to 470 MHz transmit frequency
- 20 kb/s maximum data rate
- Automatic antenna tuning
- Closed-loop power control
- ASK modulation
- 5 VDC supply
- SOIC-8 package

PASSIVES

RFID low-profile transponder coils

Coilcraft introduces a family of high-performance antenna coils designed for RFID. These low-profile transponder coils have an extended length that allows longer read ranges and higher Q. Overall dimensions are 11.8 x 3.6 x 3.1 mm. The coil is constructed of ferrite laminated onto a ceramic base for a rugged, impact-resistant device. The 4308TC series includes 11 models with inductance values from 0.4 to 8.1 mH. Coilcraft can also design coils with different inductance values or for operation at frequencies other than 125 kHz. These transponder coils come packaged in tape and reel with an encapsulated top that ensures reliable pick-and-place operations.

Coilcraft
INFO/CARD 129

Varactor tuning diodes in new substrate package

Sprague-Goodman offers several new ceramic substrate packages for its series of abrupt, hyperabrupt and super hyperabrupt varactors. The substrate packages have lower parasitics than the SOD and SOT plastic packages often used for commercial surface-mount fabrication, and are designated SMLP, for surface-mount low parasitic. The GVD90000, GVD91300 and GVD92100 series are available in five different sizes of the two terminal SMLP types (from a 0604 size to a 2010 size), and include models designed to fit the pad layouts for the plastic SOD-323 and SOD-i 23 packages. Because of the lower parasitics, and because the construction is more consistent than the standard plastic packages, higher frequency performance (up to 8 GHz) is possible for surface-mount technology (SMT) designs. The SMLPs have an operating temperature range of −65°C to +125°C.

Specifications at a glance:
- Up to 8 GHz frequency response
- SMT designs
- −65°C to +125°C operating temp

Sprague-Goodman
INFO/CARD 130

Leadless surface-mount unit offers 0.3 dB amplitude

Mini-Circuits introduces the TC16-1T RF transformer. The device offers a 16:1 impedance ratio in the 20 to 300 MHz band. Referenced to midband loss of 1 dB typical, the device guarantees a maximum of 3 dB insertion loss bandwide, 2 dB loss in the 30 to 200 MHz impedance range, and 1 dB loss from 50 to 150 MHz. This leadless surface-mount unit also features 0.3 dB ampli-

NEW PRODUCTS

NO. 84

RF/IF MICROWAVE COMPONENTS

10dB "DO-IT-YOURSELF" COUPLER DELIVERS COST SAVINGS

Designed to lower costs through automated manufacturing, the TCD-10-1W from Mini-Circuits needs only a commercially available 50 ohm external chip resister, and a complete 10 to 750MHz directional coupler is realized. Electrically, this rugged 50 ohm coupler provides 10.3dB±0.5dB normal coupling with ±0.8dB (max.) flatness. Midband, typical mainline loss is 1.2dB and directivity is 18dB (typ.) The 50/75 ohm "Do-It-Yourself" TCD family contains 9 units with 9 to 20dB coupling for 5 to 1000MHz.

4950 TO 5900MHz MIXERS HAVE HIGH IP3 AND LOW HEIGHT

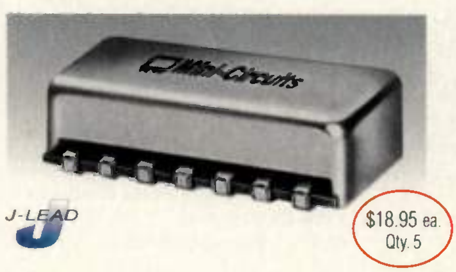
Mini-Circuits temperature stable MBA-591L BlueCell™ mixers are a low 0.070" profile solution for today's compact 4950 to 5900MHz wireless products. Typically at midband, these patented level 4 (LO) mixers offer high 15dBm IP3 to help suppress intermodulation products, 7.0dB conversion loss, and high 35dB L-R, 26dB L-I isolation bandwide. High repeatability is achieved using state-of-the-art automated manufacturing. Applications include ISM, satellite, and PCMCIA.

DC TO 6000MHz FIXED ATTENUATOR SERIES IS COST EFFECTIVE

The VAT family is a very low cost, wide band DC to 6000MHz fixed attenuator series from Mini-Circuits delivering nominal attenuation from 1 to 10dB in 1dB steps, plus 12, 15, 20, and 30dB. Equipped with SMA Type Male/Female connectors, the rugged unibody construction measures only 1.42" long (.370" diameter) and can handle 0.5 watt power (at 70°C ambient). Ideal for impedance matching and signal level adjustment applications. Designer's kits available.

5V VCO HAS LOW PHASE NOISE 400 TO 850MHz

Mini-Circuits has introduced a 400 to 850MHz wide band surface mount voltage controlled oscillator that operates from a 5V (nominal) power supply. Typically, the JTOS-850VW operates with 0.5 to 18V (min. to max.) tuning voltage, and features low -96dBc/Hz SSB phase noise at 10kHz offset, 15-80 MHz/V tuning sensitivity, and high +8.0dBm power output suitable for LO drive to mixers. Solder plated J leads provide superior mechanical integrity over temperature.



DC TO 4GHz MMIC AMPLIFIER HAS HIGH RELIABILITY

Mini-Circuits has unveiled the GAL-55, a newly developed MMIC amplifier for DC to 4GHZ, and usable to 6GHz. When operated at 2GHz/25°C, the unit delivers high 18.5dB gain (±1.7dB typ flat DC-2GHz), maximum output power of 15.0dBm (typ, at 1dB comp.), and high 28.5dBm (typ) IP3. These 50 ohm amplifiers are housed in a small SOT-89 package with exposed metal bottom for excellent heat dissipation, and display low 100°C/W (typ, θjc) thermal resistance. Uses include cellular and PCS.

WORLD'S SMALLEST 2WAY-0° SPLITTERS 5-1000MHz

Micro-miniature SBTC-2-10 power splitters from Mini-Circuits measure only 0.15"x0.15" square, making them the smallest 2way-0° power splitters on the market for the 5 to 1000MHz band. Incorporating patent pending Blue Cell™ technology, these high performance 50 ohm units typically display low 0.5dB insertion loss (above 3.0dB), excellent 0.2dB amplitude, 1.0 degree phase unbalance, and exhibit excellent temperature stability. Leads are solder plated.

Mini-Circuits

US 76 INT'L 77
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: www.minicircuits.com

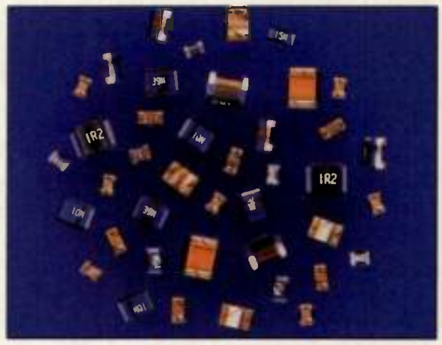
ISO 9001 CERTIFIED

F 358 Rev. Org.

tude and 4° phase unbalance typical in 1 dB bandwidth. The maximum RF power rating is 250 mW.
Mini-Circuits
INFO/CARD 131

Miniature RF chip inductors

Venkel introduces a line of miniature RF chip inductors (MRFI). These inductors offer an inductance range of 1 nH to 3.3 mH and an operating tempera-

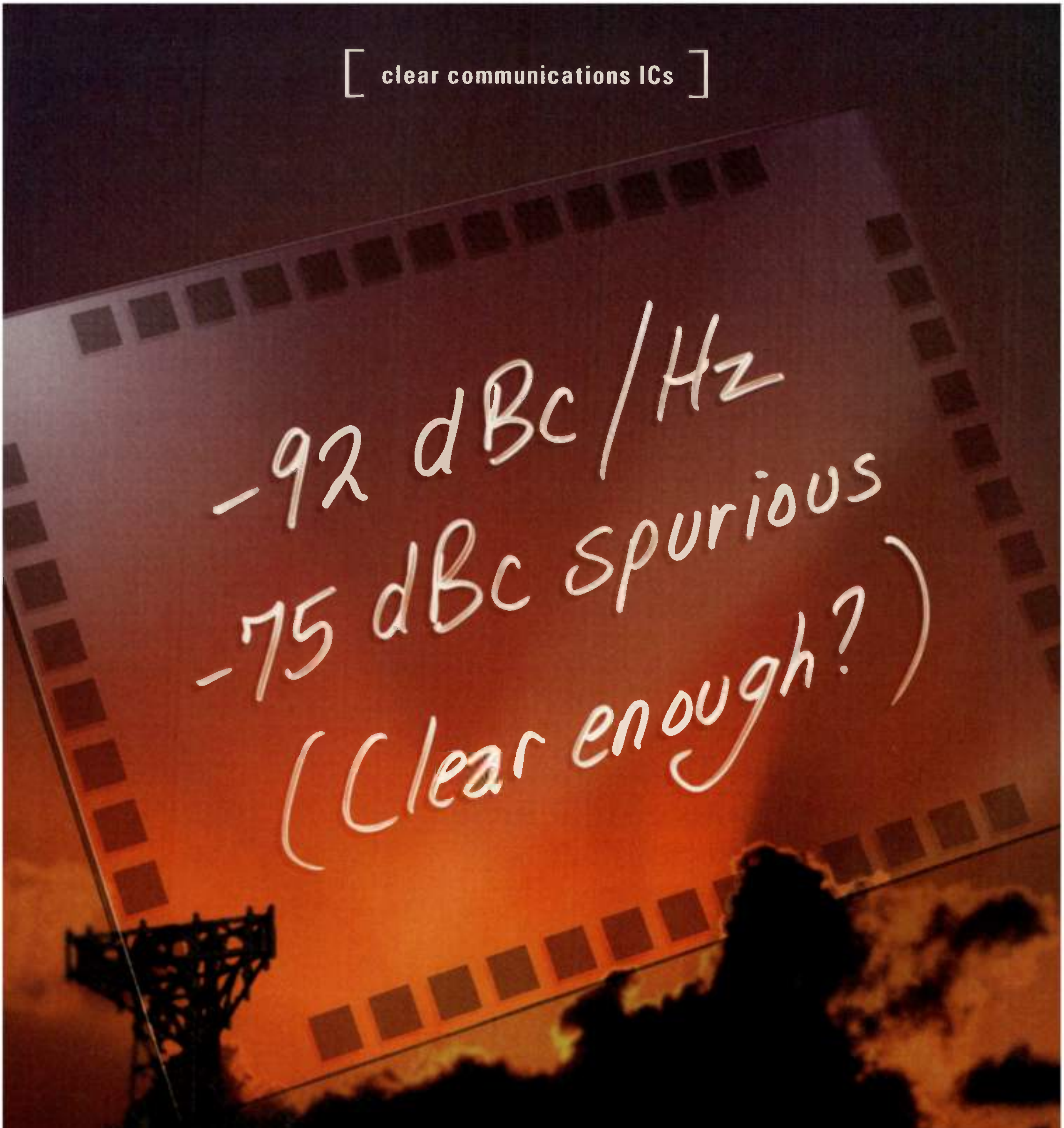


ture range of –30 to +125° C. The inductors are a compact, wire-wound type that provide excellent Q values at high frequencies and higher SRFs, giving them a stable performance. The inductors have good reliability and are used in a wide variety of applications, including communications applications such as cellular phones, pagers, radios, TV tuners and numerous other electronic devices. All styles are offered in standard EIA sizes, making them useable in surface-mount assemblies. Surface-mount engineering kits are available on request.
Venkel
INFO/CARD 132

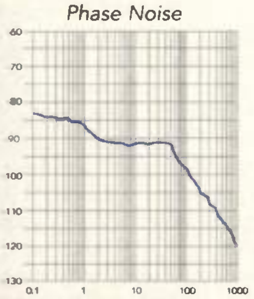
Small-footprint SMT power inductors

Pulse announces its lowest-profile 1.8 mm-high surface-mount (SMT) power inductor for use with micro power and handheld devices. In addition to being ultra-low profile, the micro power induc-

Specifications at a glance:
- 1.8 mm height
- closed magnetic field design
- 1 to 47 mH range
- 1 kHz to 2 MHz frequency range



Typical PE3236
Phase Noise



Get maximum signal clarity with our new ultra-low phase noise PLL synthesizers: the 2.2-GHz Integer-N family for demanding LMDS, MMDS, WLL and other base station systems, and our dual 1.8/.550-GHz Fractional-N family for handheld and mobile wireless devices. Our PLLs will enable outstanding phase noise performance levels that will let you achieve an optimum system performance that you just can't get without Sapphire CMOS technology. For details, visit our web site or call 858-455-0660.

PLLs

1.8/.550-GHz Fractional-N [PE3293]

2.2-GHz Integer-N [PE3236]

PEREGRINE
SEMICONDUCTOR
www.peregrine-semi.com

Distributed by Richardson Electronics

INFO/CARD 78

tors feature an extremely small footprint and a closed magnetic field because of their toroidal construction, which ensures low electromagnetic interference. The series ranges from 1μH to 47 μH, with saturation currents of 2.1 to 0.31 amps. Applicable frequency ranges are 1 kHz to 2 MHz.
Pulse
INFO/CARD 133

AMPLIFIERS

GaAs HBT amplifiers

Mitsubishi Electric & Electronics introduces two RF amplifiers for the PCS market. The chipset offers increased performances over the previous model, with a 25% reduction in idle current and a 35% reduction in overall size. The BA01202 is designed for the 1.9 GHz CDMA band and is complemented by the BA01203, designed for the 800 MHz CDMA band. The chipset features an I_{dq} of 60mA, 3.2 VDC operation, 25 dB gain, 6 x 6 module package, no negative voltage generator requirement and 50Ω input and output matched.
Mitsubishi Electronics
INFO/CARD 134

> Specifications at a glance:
> - $1I_{dq}$ of 60mA
> - 3.2 VDC operation
> - 5 dB gain
> - 50W input and output

LNA with integrated bypass switch

Motorola introduces an SiGe:C LNA with an on-chip bypass switch. The SiGe:C technology requires the addition of only one masking step into a mainstream process. The on-chip bypass switch improves the dynamic range with low insertion loss for receiver designs. The integrated bypass switch helps conserve board space and reduce system and manufacturing costs. This device also includes high gain, high-input IP3, low noise figure, selectable current settings, and a standby mode to turn the device completely off. Input and output matching is performed externally to allow maximum design flexibility. The IC can operate from 400 to 2400 MHz. Applications include PCS 1900 MHz cellular telephones, as well as 900 and 2400 MHz ISM band designs. The MBC13720 is packaged in an ultra-small SOT-363 surface-mount package and is available in tape and reel.
Motorola
INFO/CARD 135

New InGaP iHBT CDMA/TDMA PAs

M/A-COM announces two power amplifiers for cellular and PCS TDMA/CDMA wireless handsets. The MAAPSS0003 and MAAPSS0006 two-stage power amplifiers incorporate advanced GaAs iHBT power transistors, drive, and bias control circuitry elements in a compact, 3 x 3 or 4 x 4 mm FQFP-N package. The devices offer better performance over temperature to simplify power control networks. Other implementations require thermistors to monitor PA temperatures so the bias can be adjusted at cold, low-power conditions to keep the AlGaAs HBT transistors from shutting down. Efficient operation is from a single 3 to 3.5 V supply. The iHBT process employs InGaP instead of AlGaAs and offers improved manufacturability using selective etch chemistry.
M/A-COM
INFO/CARD 136

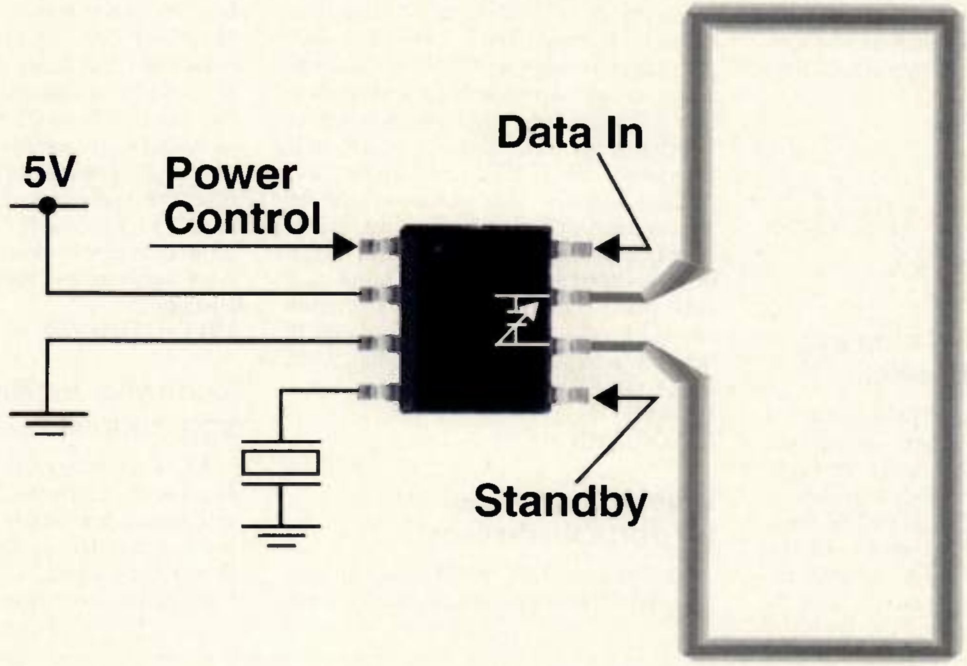
DIGITAL HARDWARE

Fast IC for military digital broadband applications

TRW has developed a high-speed, direct digital frequency synthesizer using indium phosphide (InP). The chip contains more than 3,000 InP heterojunction bipolar transistors. The chip operates at 7 GHz, more than three times faster than any previous direct digital frequency synthesizer. It was developed under contract to the U.S. Navy's Office of Naval Research. Direct digital frequency synthesizers provide greater control over the frequency and

300-470MHz Transmitter IC

Automatically Tunes Antenna



Key Specifications

- 300MHz–470MHz
- -2dBm transmit power
- 5.75mA mean operating current
- 1μA standby current

The Good Stuff

- Easy to manufacture
  - Automatic antenna tuning
  - Low component count
- Closed-loop power control
- SOIC-8 Packaging
- QwikRadio family also includes receivers

The MICRF102 QwikRadio™ transmitter is an easy to use, easy to manufacture transmitter designed for use with a low-cost PCB-trace antenna.

Conventional loop-antenna transmitters require manual tuning of the antenna in production. The MICRF102 automatically tunes itself.

Conventional loop antenna transmitters easily de-tune. Even a users' hand close to the antenna will alter impedance and de-tune the resonant circuit. The MICRF102 dynamically adapts to changes in antenna impedance to ensure correct tuning at all times.

The MICRF102 supports ASK (Amplitude-Shift Keyed) modulation. It has closed-loop power control, a standby function, all in a SOIC-8 package.

MICREL

The Infinite Bandwidth Company™

QwikRadio™ is a trademark of Micrel Semiconductor. The QwikRadio™ ICs were developed under a partnership agreement with AIT or Orlando, FL USA

Contact us for more information — bookmark our website for updates!

www.qwikradio.com

Literature: (800) 401-9572 Factory: 1 (408) 944-0800
Stocking Distributors: Arrow (800) 777-2776• Future (800) 388-8731
Newark (800) 463-9275 • Nu Horizons (888) 747-6046

INFO/CARD 46

phase of the signal than do conventional analog synthesizers. The added control aids in accurate rapid frequency and phase changes required by future military electronic systems. Direct digital synthesis lowers phase noise in the system, also heightening system sensitivity.
TRW
INFO/CARD 137

BLUETOOTH/HOME-RF/IEEE 802.XX

Broadband WLAN chip set uses OFDM technology

Intersil introduces PRISM Indigo, a broadband WLAN chip set. The system can deliver 54 Mb/s data rates for high-speed wireless connectivity in the enterprise and home. It employs OFDM technology and is designed to comply with the IEEE 802.11a 5 GHz standard. Furthermore, PRISM Indigo is engineered to meet WECA's 5 GHz interoperability guidelines. It couples best-in-class radio performance with low power consumption, enabling a WLAN adapter card bill-of-material (BOM) cost of about $60 based on a chipset price of $35. The complete suite includes an FCC-compliant reference design, developer's kit and application software. Intersil is also developing firmware for PRISM Indigo that will incorporate the IEEE's new security and quality-of-service (QoS) enhancements for deployment of video streaming, voice-over-Internet protocol (VoIP) and multimedia-related services for the home and enterprise. The enhancements provide several levels of performance tailored to take advantage of all available data rates from 6 to 54 Mb/s.
Intersil
INFO/CARD 138

Bluetooth module for portable devices

Philips and WIDCOMM announce the joint development of a commercially available Bluetooth CompactFlash card module for the Windows CE operating system platform. This card allows PC OEMs and electronics manufacturers to implement a Bluetooth plug-and-play solution and add Bluetooth connectivity to their PDAs, handhelds and other devices running on Microsoft's handheld OS. The module enables OEMs to offer end-users a complete and interoperable platform for PDAs and PCs, and for embedded Bluetooth products such as mobile phones. These modules are easily customized and include complete reference designs, hardware, software and user interfaces.
Philips
INFO/CARD 139

Controller for Bluetooth applications

KC Technology announces the µPAX Bluetooth Controller KC2680, a highly integrated, low-power protocol processor for hosted Bluetooth applications. Powered by an eight-bit CPU, the µPAX reduces the cost, gate count, power con-

Get all the building blocks you need for your wireless design solutions.

When you're creating new wireless products, contact Hitachi.

Take advantage of our wide range of hot technologies; innovative, advanced semiconductor products; and superb manufacturing capabilities that deliver quality devices and modules in high volume.

For more information, visit the URL below.

http://www.hitachi.com/semiconductor/wireless

RF & Wireless Components™

HITACHI
Semiconductor

INFO/CARD 72

sumption and memory requirements of traditional Bluetooth designs. With integrated RAM and ROM, μPAX supports the entire Bluetooth stack up to the HCI interface and can support multiple third-party radios, making it a suitable component of flexible system integration. The controller is designed to provide all key elements of a Bluetooth system.

KC Technology
INFO/CARD 140

DATA/SIGNAL TRANSMISSION

Prime focus antenna feeds

Seavey Engineering Associates has developed a line of broadband dual-polarization feeds. These interchangeable prime-focus feeds are pre-focused and aligned and have common mounting interfaces. They are environmentally sealed with a radome. The quad-ridged/scalar antenna feeds operate over the 1.0 to 18.0 GHz frequency range. They were designed for use in part of a transportable satellite tracking system.

Specifications at a glance:

- 1 to 18 GHz frequency range
- 20 dB min isolation
- 2.0:1 maximum VSWR
- Orthogonal linear polarization

SEA
INFO/CARD 141

Power monitoring bi-directional coupler

Mini-Circuits has developed a bi-directional coupler capable of monitoring forward and reverse power. The ZABDC10-25HP coaxial (SMA-Female) bi-directional coupler offers 10 dB ±1dB nominal coupling value, (±0.5 dB flatness) 50Ω impedance, typical 0.55 dB insertion loss, high (26 dB) directivity, and 1.1:1 VSWR. It is operational in –20° C to + 85° C temperature environments for communications applications.

Specifications at a glance:

- 50Ω impedance
- 0.55 dB insertion loss
- –20° C to + 85° C temperature
- 1.1:1 VSWR

Mini-Circuits
INFO/CARD 142

SIGNAL SOURCES

Miniature, low-power PLL

Elcom Technologies introduces a series of 0.5 to 26 GHz phase-locked oscillators. These oscillators employ a unique technique to phase-lock

Continued on page 88

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 card and mail it today.

Or go to our new home at www.telecomclick.com.
Click on the RF Design icon and go to the manufacturer's links.

ADVERTISERS

COMPANY NAME	PAGE NO.	READER SVC. NO.
Agilent Technologies	13	7
Anritsu	69	3
Ansoft	61	5
Aplac Solutions	73	12
AVX	49	13
Bomar Crystal	76	6
California Eastern Labs	BC	9
CMP Europe	67	10
Coilcraft	3	26
Comm & Energy	80	20
Communication Concepts	56	17
Cornell Dublier	72	53
Directed Energy	66	102
Elanix Inc	37	11
Future Electronics	21	37
WL Gore	IFC	18
Hermetic Technology	89	36
Hitachi Metals	78	104
Hitiachi Semi	81	72
Hittite Microwave	63	19
JFW	60	21
Johanson Technology	66	84
JW Miller	71	23
K&L Microwave	59	14
Labtech	80	25
Leader Tech	58	24
Matrix Systems	82	33,38
Maxim Integrated	31,33,35	43,44,45
Micrel Semi	79	46
Mini Circuits	4-5, 7, 19,	27, 28, 34, 35, 30, 31,
	25, 29, 41,	74, 75, 47,48, 63, 64,
	42-43, 51,	15, 16, 58, 59,
	65, 75, IBC	41, 42, 76, 77, 39, 40
MITEQ	55	50
Nemal Electronics	89	29
Noise.com	-	1
Peregrine Semi	77	78
Pole Zero	36	55
Presidio Components	27	60
RF Micro Devices	22-23	49
Rockwell Collins	76	32
Sawtek Inc.	45	52
Spirent Comm	9	2
Sprague-Goodman	10, 54	8, 51
Stanford Microdevices	47	54
Surcom	89	110
Synergy	53	57
Tecdia	82	112
Teledyne Wireless	17	62
Trak Communications	39	61
Truetime	48	22
Ultra RF	57	56
Unity Wireless	72	65
Vari-L	11	4
Venkel	46	66
Voltronics International	70	69
WJ Communications	15	67

EDITORIAL

Company	Page	Reader Svc.
3DSP Corporation	60	120
Agilent Technologies	60	119
	88	145
Analog Devices	64	124
Andrew	89	149
Atmel	66	126
Coilcraft	74	129
Compel	89	148
Datel	66	127
Elcom	88	143
Embedded Wireless Devices	62	121
ERDAS	60	118
IFR Systems	58	115
	89	147
Intersil	80	138
KC Technology	82	140
M/A-COM	78	136
Micrel	74	128
Microchip Technology	58	117
Mini-Circuits	76	131
	82	142
Mitsubishi Electronics	78	134
Motorola	78	135
Philips	80	139
Pulse	78	133
SEA	82	141
Silicon Laboratories	64	125
Spirent Communications	88	146
Sprague-Goodman	58	116
	74	130
Stanford Microdevices	64	122
TRW	80	137
Valpey Fisher	88	144
Venkel	76	132
Zarlink	64	123

microwave DROs to a crystal reference (10 to 800 MHz range). The models in the MPDRO series require only a single loop for phase locking, minimizing size, power consumption and cost. The units feature ultra-low phase noise, low DC power consumption (<200 mA) and a wide operating temperature range of –45° to +75° C. The device is packaged in a 2.25" x 4.1" x 1.2" housing. They are designed for use in military communications, digital radios, SATCOM and instrumentation applications.
Elcom
INFO/CARD 143

Stratum 3E clock operates from 5 VDC

VF Technologies, a division of Valpey Fisher, introduces the Stratum 3E Clock. The 3E clock meets or exceeds all Bellcore GR-1244-CORE requirements. It features less than 10 ppb total frequency change in holdover mode for a period of 24 hours, with the following criterion: ±4ppb over operating temperature range (–40 to +80 °C max); and ± 0.5 ppb aging over 24 hours. Other features of the new Stratum 3E Clock include: warm-up time of less than two minutes; power consumption of less than 0.5 W at 25° C; HCMOS/TTL compatible output (sinewave optional); and operation from a 5 VDC (12V optional) supply voltage. It is available in either 1.4" x 1.0" x 0.5" or 1.0" x 1.0" x 0.5" industry-standard PCB mount packages.
Valpey Fisher
INFO/CARD 144

Specifications at a glance:
- Better than10 ppb stability
- –40 to +80° C temp range
- <0.5 W power consumption

TEST AND MEASUREMENT

Logic analyzers for digital designers

Agilent Technologies introduces the 1680 and 1690 series of Windows-based logic analyzers in standalone and PC-hosted models. The series powers up in the waveform display and is "ready to use." The instruments minimize the learning curve by providing a single-screen home base that allows designers access to the instrument's most commonly used features through familiar Windows icons. Advanced features are easily accessible through a pull-down menu from the main menu bar. Three modes of triggering are available: quick, simple and advanced. The series' features include: 200 MHz state analysis; up to 800 MHz timing analysis; 200 MHz transitional timing; offline analysis of captured measurement; filtering, find, and unlimited markers for measurement analysis; and inverse assembly support of industry-leading processors. Sixteen models offer a variety of channel counts and memory depths. Customers can choose either the benchtop or PC-hosted form factor to match their needs. The 1680 benchtop series has a 12.1-inch color display and a built-in CD-ROM. Convenient placement of hot keys and knobs enable quick adjustments and navigation of waveform.
Agilent Technologies
INFO/CARD 145

Specifications at a glance:
- 200 MHz state analysis
- 800 MHz (max) timing analysis
- multiple trigger modes
- Offline analysis capability

Cdma2000 automatic mobile test system

Spirent Communications debuts the C2K-ATS cdma2000 mobile test system. It is an automatic cdma2000 performance-analysis system that aids mobile device manufacturers and service providers in the development and deployment of products and services. The system features ultra-low phase noise interference sources, control and diagnostic analysis of the mobile DUT dynamic system configuration optimizes test execution and test coverage, and a calibration wizard automates calibration for all system components. The system consists of the TASKIT/C2K test application software, the universal diagnostic monitor software, the TAS4500 FLEX5 RF channel emulator, the TAS CIL cdma2000 interference lab, and the TAS5048 test configuration unit. This suite of Spirent equipment works with an Agilent base station emulator and spectrum analyzer to provide a complete solution for all phases of CDMA mobile device design, development and deployment.
Spirent Communications
INFO/CARD 146

RF digitizer for flexible signal processing

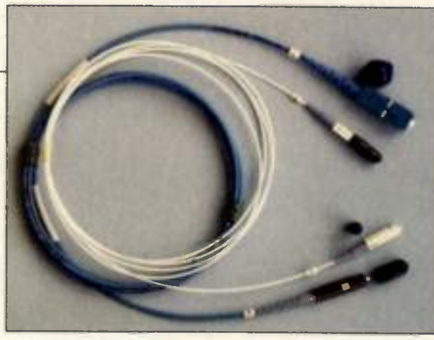
IFR Systems has launched the 2319E, the first in a series of new signal analysis instruments from IFR. The 2319E is an RF digitizer for 2G, 2.5G and 3G digital cellular testing. It offers conversion of broadband radio frequency (RF) signals into high-quality, digitized data for external processing in a personal computer. When combined with an optional high-power digital signal processing (DSP) card and IFR software, the unit can be used as a substitute base station receiver during early research and development phases of new mobile phones. It can also be used in RF communications research and development. In later product releases, the 2319E will add production test capabilities. The unit operates across a wide frequency range and provides a generous 20 MHz digitization bandwidth sufficient to capture four UMTS radio channels. The output data are made available through a variety of interfaces for external processing in a PC using application software developed by IFR, the customer or by a third-party developer. The choice of output interface is determined by the bandwidth requirements of the application, selected from low, medium or high-speed options. Data may be transferred in real time directly from the digitizer or captured into internal memory and output in bursts at a

slower rate. In either case, data can be represented as a digital IF (intermediate frequency), or digital IQ (in phase & quadrature phase).
IFR
INFO/CARD 147

INTERCONNECT/ INTERFACE

Fiber optic interconnect

Compel Electronics announces a fiber optic SC and FC connector and cable assembly series available in both single-mode and multimode versions for use in long-haul TLC and subscriber networks. Features include high return and insertion loss, compact design, ease-of-assembly, Zirconium oxide ferrule and a reliable clamping mechanism. All connectors conform to NTT specifications.
Compel
INFO/CARD 148



SUBSYSTEMS

Broadband wireless systems for MMDS

Andrew Corporation offers the SkyPath entry-level integrated broadband wireless system. Designed for quick set up, the SkyPath entry-level, turnkey system package includes highest quality RF and IP components, precision system configuration, and staging and site implementation services for deploying a base station capable of supporting 1,000 subscribers. An entry-level SkyPath system can serve as many as 1,000 customers and will typically include: base station antennas, 5 W transmitters, receivers, and frequency converters packaged into a single integrated rack with either a Hybrid or VYYO modem termination system. The system can be easily upgraded for more power and coverage and additional customers. A maximum of 28 upstream channels and two 6 MHz downstream channels can be added to the base package chassis.
Andrew
INFO/CARD 149

mated cruise control, would have a standard to maintain.

Conclusion

Engineers are actively working on solving the problems above. They are not insurmountable, and advanced telematics are starting to become available as optional equipment in automobiles. Within the next five years, many of these systems will transition from optional to standard features. It will be at that point that telematics will reach significant market penetration, and a significant portion of these systems will rely on wireless integration and the RF engineer.

RF

[1] Motorola definition obtained from http://www.motorola.com/ies/telematics/html/faq.html, 7/16/01.

About the author

Kerry Greer is director of marketing at SkyCross, head- quartered in Melbourne, FL. His primary role is business and new market development, leading the definition of SkyCross' antenna products in many wireless markets. Greer holds a Bachelor of Science in electrical engineering from Purdue University, a Master of Science in electrical engineering from the University of Florida, as well as an MBA from the University of Florida. He can be reached by e-mail at: *kerry.greer@skycross.com*.

For additional information, please see:

- **www.skycross.com,**
- **www.its.dot.gov**
- **www.itsa.org**
- **www.wi-fi.com**
- **www.bluetooth.com**
- **www.onstar.com**
- **www.nhtsa.dot.gov**
- **www.motorola.com/telematics.**

Name	Frequency	Description	Comments
AM/FM radio	540 – 1680 kHz (AM) 88 – 108 MHz (FM) Worldwide	Broadcast audio. AM primarily for talk and live sporting events. FM for in-car music	AM radio was the original "wireless" application, and will always be standard equipment
Analog cellular	824 – 89 MHz USA	AMPS is the original analog cellular standard. Used today as a backup system where PCS is not available.	With roadside safety being a consumer demand, OEMs consider AMPS as basic minimum coverage
Digital cellular	890 – 960 MHz Europe	GSM is the main mobile phone standard in Europe today	Will be the minimum for European telematics-equipped cars.
GPS	1.575 GHz Worldwide (Rx only)	Satellite-based position locations system that provides real-time vehicle latitude, longitude altitude and speed	Fundamental to any location-based auto safety service or navigation/mapping service.
Digital PCS/3G	1.850 – 1.990 GHz (North American PCS) 1.885 – 2.025 GHz (Japanese and European 3G)	CDMA, TDMA, and GSM are the three main N. American Standards. W-CDMA and cdma2000 will be the worldwide 3G standard.	PCS and European GSM referred to as 2G. Now implementing 2.5G for current digital data phone service. First 3G services will begin in Japan in the fall of 2001.
DSARS	2.32 – 2.345 GHz (Rx) U.S.	DSARS is a new radio system based on a satellite link. It will provide nationwide service by subscription	Modeled after Pay-per-view TV. $10/month subscription for nationwide, commercial-free radio.
WLANs	2.4 – 2.497 GHz Worldwide	Bluetooth and 802.11b are the two main standards for WLANs.	Bluetooth could be used for low data rate applications such as keyless remote entry. 802.11b would be used for high data rate connections to on-board computers.
High data rate WLANs	5.15 – 5.35 GHz, 5.725 – 5.875 GHz' Worldwide	802.11b is the new WLAN standard in the UNII 5 GHz frequency band. HiperLAN 2 is the approved European standard.	Capable of providing up to 54 MB/s, it is a high data rate extension to the 2.4 GHz standard
DSRS	5.85 – 5.925 GHz U.S.	Developed by the Department of Transportation, DSRC will be part of the DOT's I1TS network.	Will be used for such applications as real-time traffic congestion information as well as wireless toll booth collection.
Collision avoidance systems	76 – 77 GHz Worldwide	A low-power RADAR system capable of detecting and tracking objects and other vehicles.	Warns drivers of hidden objects in close proximity when backing the vehicle. Also being integrated into adaptive cruise control systems.
Forward imaging sensors	Infrared (IR) and visible light. Worldwide (Rx only)	Separate sensors provide both visible and infrared image sensing capability.	IR systems allow for faster nighttime recognition of people and animals in the vehicles path. Visible systems detect/track travel lanes. Also integrated into adaptive cruise control systems.

Table 1. Current and potential telematics wireless communicaitions links.

RF marketplace

career opportunities

career opportunities

www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com
www.rfdesign.com

The hottest spot on the web to connect...

RF DESIGN

ELECTROMAGNETIC COMPATIBILITY (EMC) ENGINEER

The Johns Hopkins University Applied Physics Laboratory (APL), a national leader in scientific research and development located midway between Baltimore and Washington, DC, is seeking an Electromagnetic Compatibility (EMC) Engineer with an RF design background to join our world-renowned Space Sciences department.

As part of an integral team, you will provide guidance in EMC design and analysis, and will work with lead engineers to prescribe corrective measures and write specifications for the electromagnetic compatibility of spacecraft electronic systems at the unit, subsystem and system levels.

Requires a BS or MS in electrical engineering, or equivalent, with an emphasis on RF engineering, and a minimum of 5-7 years' experience in RF design (S, X Bands), specifying EMC requirements and performing EMC tests. Experience in the use of modeling to diagnose EMC problems and to develop solutions, and with the development of RF units for spacecraft, is highly desirable.

Flexible work hours will be required when performing EMC tests, especially at the spacecraft level.

US citizenship is necessary in order to process the required government security clearance.

APL offers a comprehensive benefits package that includes a matching retirement program, educational assistance and salary commensurate with qualifications and experience. To apply, please send your resume to: e-mail: Recruiter21@jhuapl.edu; FAX: (240) 228-0112; mail: The Johns Hopkins University Applied Physics Laboratory, Mail Stop 7-115, 11100 Johns Hopkins Road, Laurel, MD 20723.

For more information on APL, please visit our Web site at www.jhuapl.edu

EOE, M/F/D/V.

The Johns Hopkins University
Applied Physics Laboratory

RF buyers' source

CONSULTANT SERVICES

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 DESIGN Classified's 913-967-1861

Wireless technology – sometimes NOT for the better

by Ernest Worthman
technology editor
eworthman@intertec.com

Every now and then something comes along that fires my passion or scares the heck out of me. In this case, it's the latter. The something I'm talking about is the recent action by Acme Rent-a-Car. The company used GPS technology to track a renter's driving habits and added a "dangerous driving" charge, ($450) because the GPS system indicated he exceeded the legal speed limit. If this sticks in its present form, this will have a far-reaching, and likely detrimental, effect on all of us. And we can thank wireless technology for it. Of course, we cannot blame wireless technology for this abuse — that's like blaming the cheese fries for the heart attack — but we certainly can question the motives of the provider.

Big Brother is watching — Ever since my experiences in Nam, I haven't had much confidence in the government. But I've resigned myself to the fact that, until we have found a way for everyone to be reasonable and respectful to one another, I have to go along (to a limited degree) with the need for covert and sometimes invasive government actions. However, I temper that by adding that it has for the most part been my experience that if you are a law-abiding citizen in this country, you're generally left alone.

Whose right is it anyway? — But I have to draw the line at private companies taking police or government authority into their own hands — especially using stealthy methods, such as wireless technology —to do so.

My real concern here is not that the company used GPS technology to track the driver's behavior. Rather, what I find offensive is that, without any due process or verifiable proof, the company assumed the customer guilty of a criminal offense and blatantly assessed a penalty — something that only the justice system has a right to do. If Acme gets away with it, I'm concerned that this will open the flood gates for any and all of those who come to use wireless and computer technology to monitor our activities — and far beyond any reasonable threat to life and limb. Does this mean that if I sign up for cellular service and they find out I'm talking in New York City without a hands-free device they can charge me a fine?

OK, Acme has a point — I can, empirically, understand Acme's concern. It costs them when a vehicle is abused or if the driver is acting dangerously, and they have a right to be compensated. But assessing a charge based upon a GPS report, even if such a clause is included in the contract, allows for too many variables. And now that Acme is trying to charge according to driving habits, does this mean they (or the cellular provider, or whomever) will refund me any money if I follow all the rules?

A far better approach for car rental companies would be for them to tie the GPS system into a warning system. In this case, if the GPS detected a speeding violation, the vehicle could be programmed to issue a voice warning to the driver that they are exceeding the legal limit. And, if the driver continues to ignore the warnings, the vehicle can be disabled, or the authorities (who CAN ticket) can be notified — all with wireless technology.

But if it sticks — One of the major concerns of this type of covert action by a private player is how far private industry can take it. It is quite possible that wireless technology can literally monitor everything we do without our knowledge (recall the flap about the government covertly monitoring e-mail for key subversive terms?).

Of late, there is movement to put GPS capability into cellular phones. I like the idea, but I have to express some concerns as to what opportunities this may have for Acme-type abuse.

What if I'm in a restaurant and want to order an expensive bottle of wine? Could the restaurant, through some covert method, check my credit card balances to see if I can really afford it? And, what if I don't leave a tip? Will the restaurant be able to bill my account without my knowledge?

Universal concerns — On a more global platform, my personal concern is that, in an attempt to get wireless ubiquity up to speed, we don't lose sight of the objective. That objective is convenience, not control.

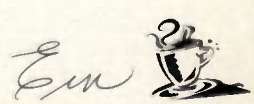
It is important that there are rules in place that prevent abuse —whether it is illegal (or questionable) billing practices, or invasion of privacy, or something in-between.

Also, I want to reiterate that the ability to prosecute or fine for illegal activities can, under no circumstances, be extended to the private sector. We have developed a justice system over the last 300 years that is designed to protect our rights and determine guilt or innocence based on strict policy and procedure. It is absurd to think a private company can simply strip away these rights, regardless of how the contract is written.

Now, there isn't really enough room in this column to discuss all of the peripheral issues. I will be more than happy to debate privately, via e-mail or telephone, related issues that readers may find pertinent.

But, now I find a new challenge (or opportunity) for the wireless industry. I'd be the first in line to buy some "anti-wireless technology." That is technology that the populous can use to defeat the unscrupulous Acmes of the world.

And finally, I wonder if it isn't time to worry about private industry, rather than Big Brother.



IMPROVE Your PCS Receiver's PERFORMANCE With NEC's New, Miniature Low Cost FETs

Need a high performance first stage LNA for your PCS, GPS, or WLAN receiver? Our NE34018 GaAs HEMT delivers! You get low noise and high output IP_3 all in a low cost, superminiature SOT-343 plastic package. Nearly half the size of a conventional SOT-143 device, the NE34018 can help miniaturize your handheld wireless receiver design — while maximizing its performance. The NE34018 is just one in a family of miniature plastic transistors from NEC.

Want more information? Visit our website or call our 24-hour automated Fax Hotline. We'll get you data in minutes!

NE34018 HEMT FETs: Great Performance, New Low Price...

- *+23dBm Output IP_3 @ 2GHz*
- *0.7dB NF, 15dB Gain @ 2GHz*
- *Ultraminiature SOT-343 package*
- *70¢ in 100K quantities*

Housed in SOT-343 packages (right), these NEC HEMTs are nearly half the size of conventional SOT-143 devices.

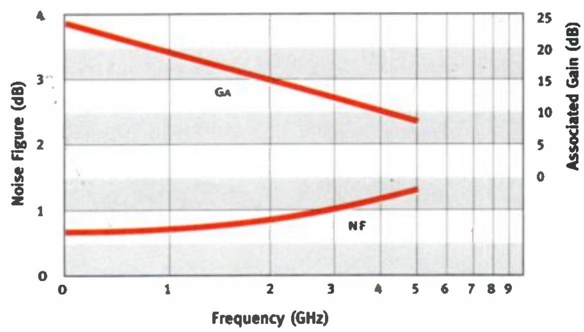
Versatile NE76118 MESFETs:

- *0.8dB Noise Figure @ 2GHz*
- *13.5dB Associated Gain @ 2GHz*
- *Use as an oscillator, 2nd stage LNA, or buffer amp*
- *61¢ in 100K quantities*

Super Low Noise NE334S01 HJ FETs:

- *0.25dB Noise Figure @ 4GHz*
- *16dB Associated Gain @ 4GHz*
- *Miniature plastic four pin package*
- *99¢ in 100K quantities*

NE34018 Noise and Gain Performance



For instant Product Data visit us at:

www.cel.com

Or call our 24-hour Fax Hotline at 800-390-3232 and request Document #144

(U.S. and Canada)

NEC

CEL California Eastern Laboratories

4590 Patrick Henry Drive ▪ Santa Clara, CA 95054 ▪ 408 988-3500 ▪ www.cel.com

DISTRIBUTORS: Arrow (800) 525-6666 Reptron Electronics (888) REPTRON

Mouser Electronics (800) 346-6873 Electro Sonic (800) 567-6642 (CANADA)

INFO/CARD 9