SPREAD SPECTRUM SCENE

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The Wireless, PCS and Advanced Diiital Communications Monthly News Magazette

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2.4 GHz Band is Latest SS Target! *Wireless Expo Conclusion* *--page* 4.

Wireless in 1923 ...

The RF/SS 1923 Atwater Kent Model 1 OB "Breadboard" TRF Radio

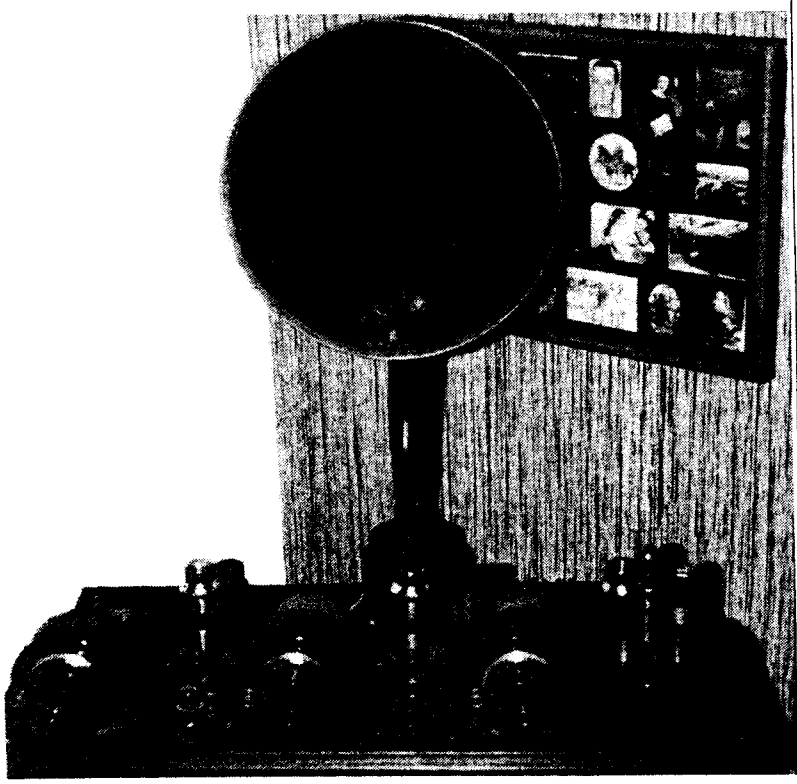

Photo by Randy Roberts, RF/SS

Wireless in 1993!

See what 70 years hath wrought (more on page 4)

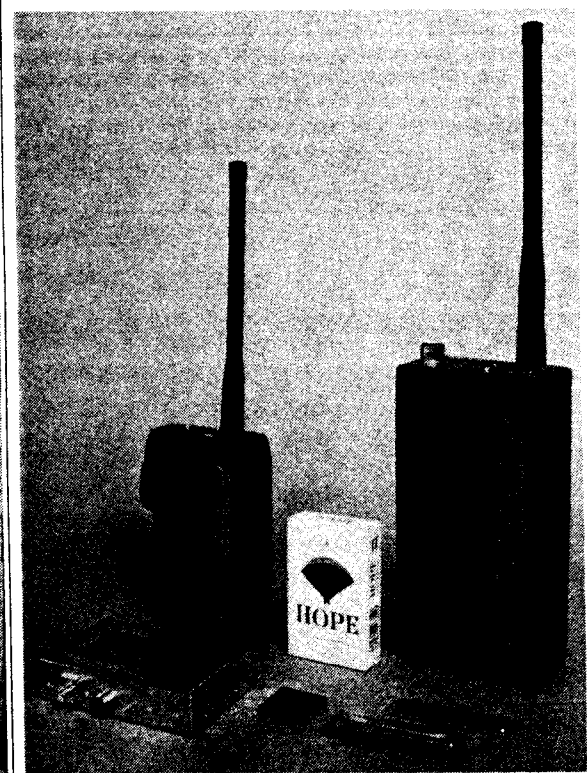

Photo courtesy of Yamada International Corporation

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Highlights

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SPREAD SPECTRUM SCENE is dedicated to the Spread Spectrum professional and is committed to being the primary source for the latest news and information about the growth, regulation, and opportunities in this emerging science.

SSS provides a forum for publication of technical information, advertising, editorials, opinions, and news relating to the emerging fields of our coverage and emphasis. SSS is a targeted circulation publication. We have chosen a distinguished cadre of the most important decision makers in this new industry to be the readers of SSS. SSS is sent by first class mail to this important cadre of industry "movers and shakers" each month. SSS can present your advertising message to the key designers, equipment developers, programmers, system integrators and end users in this new industry. Call our 800 number Hotline to request a Media Kit.

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Rumors & Ramblings

- Ardis (or Motorola/Ardis) is planning something big! They are holding a special press announcement breakfast on Tuesday morning, February 16, at the Mobile 93 conference in San Jose. It seems that Ardis' president and CEO Frank Wapole and William A. Hipp, president of RadioMail, will be pitching their new joint venture.

- Go Corporation along with partners AT&T and EO, Inc. are also planning something for the Mobile 93 show. We got a hand written, pen-based "wireless originated" FAX from them exhorting us to stop by their booth, #2 16. Go shipped its latest application, GO Fax, on January 8 and sent its PenPoint 2.0 Japanese out in mid-December.

- The latest marketing study done by BIS Strategic Decisions, Norwell, MA, shows the exciting and profitable potential of PDAs and other consumer oriented personal computing devices. The report cites work being done by Casio, Tandy, Toshiba, TI, Sharp, Apple and AT&T aimed at this burgeoning market.

Decipherings

Whatever you can do,
or dream you can, begin it.
Boldness has genius,
power and magic in it.

- Goethe -

Don't miss an issue of Spread Spectrum Scene. Subscribe now!

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Think Spread Spectrum!

March Preview

- Conclusion of Dan Doberstein's GPSS Transceiver idea article.
- Mobile 93 Conference report.
- Hint's for more uses of the MC13176 chip.
- Highlights and reviews of RF Micro Devices new chips.
- New Products, columns, SS news and other features galore.

Michael Runzler
Director

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(415) 394-3042

PACIFIC TELESIS Group

January 21, 1992

Mr. Bandy Roberts
Spread Spectrum Scene
P.O. Box 2199
El Granada, CA 94018-2199

Dear Bandy:

please allow us to set the record straight regarding Pacific Telesis' upcoming spinoff of its wireless businesses. Your article in the November-December issue contained several errors of fact.

First, Pacific Telesis is not also known as Pacific Telephone and **Pac** Bell. Pacific Telephone ceased to exist in 1984 following the breakup of American Telephone **&** Telegraph. Pacific Bell succeeded it, providing local telephone service to most of California. Pacific Telesis is the holding company that owns Pacific Bell, as well as several other subsidiaries.

Second, we have no plans to offer long-distance service in a deal with MCI.

Third, we'd love to have 33 million cellular customers, as you stated. The actual number is approximately 722,000. Your figure is based on the population of the regions where we provide service.

Fourth, the separation in no way reduces the authority of either the state Public Utilities Commission or Judge Harold Greene over Pacific Bell. In fact, the PUC retains **regulatory** authority over Pacific Bell as well as **over** the California operations of PacTel Cellular and PacTel Paging. The spinoff will remove the remaining divestiture-imposed restriction8 from PacTel Cellular and our international operations. Those restrictions, however, will remain in place against Pacific Bell.

Finally, this move does not "flaunt any old regulations." The plan enhances shareholder value by creating separate, publicly traded companies that can react quickly and responsively in a rapidly changing telecommunications market.

Sincerely,

Michael Runzler

***SSS** regrets **any confusion** we **may have** caused, **concerning** this **subject.** Our original sources for this piece were incorrect. We will publish the full PacTel press release on this subject in a future issue. Thanks, Michael for straightening us out!*

EDITORIAL

Pseudo Random Tidbits

Magazine deadlines are humbling events! In our January issue, I incorrectly credited the cover picture of the lovely lady to Qualcomm and some non-existent magazine. The magazine due the credit is *Microwaves and RF* magazine -- sorry Jack & John. Unfortunately this same mistake was carried into the article on the Wireless Symposium & Exhibition, also. All I can say is: sorry guys.

We also need to learn how to use our spelling checker a little better -- in our editorial, on page 2, we were unable to spell predictions! Oh well, we're still maturing and will probably always need a little more proof-reading than time allows.

While we are talking about our goofs in January, let me correct the ad on page 13 for John Kratz -- his phone numbers are reversed, in case you didn't notice when you tried to call/FAX him. Very sorry John.

Another Wireless Newsletter

WCCN Publishing has stat-ted an interesting new newsletter, covering mostly the application side of IDP (Interactive Data Processing) and wireless PDA (Personal Digital Assistant) type devices. Not really a competitor (it's not highly technical in nature) WCCN is interesting reading, if you can afford its steep price. Call or FAX Mr. Thomas A. Polizzi, President of WCCN Publishing for information or a sample.

WCCN™

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Wireless Exposition Wrap

The Move to 2.4 GHz

As our cover headline states, our main conclusion from the January Wireless show was that everyone wants to move to the 2.4 GHz ISM band. HK microwave showed an FM TV link at this frequency that worked very well. HP and Triquint had new chips for this band. British giant GEC-Marconi demonstrated a really neat GaAs transceiver chip for this band. RF Associates, the local GEC-Marconi rep assures us that samples will be available for $500 each in March -- with production prices coming down under $20 per chip this year. The session that I chaired at the show on Friday featured a technical paper on this chip. It packs a lot of functionality into a small slice of GaAs! Look into this chip if you want to jump into the 2.4 GHz waters. However, beware of the capricious British industrial policies and economy -- I've been burned more than once using Plessy parts!

What 70 Years Hath Wrought

Cover Feature

Did we get your attention with my old 1923 Atwater Kent, model 10 breadboard radio? What a contrast, huh? 70 years does make a difference in technology -- doesn't it'.' Wireless in 1923 was the latest craze -- much like "Wireless" is today. But yesterday's wireless became radio by the thirties, the nation entered a severe depression and the more than 2000 radio manufacturers that had sprung up to answer the magic of "wireless" mostly went away. I think history does repeat itself! Today wireless while little like yesterday's, is ripe for feast or famine.

The contrasting photo on our front cover shows some of Yamada's prototypes which use a SAW (Surface Acoustic Wave) convolver to rapidly synchronize SS signals at 900 MHz graphically shows how technology has advanced in 70 years. But in the broadest sense have we learned any lessons -- have we improved mankind's lot'! I think not!

Spread Spectrum devices **can help mankind** if we put our minds to it! Let's come up with some educational, health care or baby monitoring applications -- not just more burglar alarms!

Randy Roberts

The Aerial

by Peter Onnigian, P.E., W6QEU

ELECTROMAGNETIC RADIATION

Wireless data transmission utilizes electromagnetics. Just what is this'! The phenomena that are represented by the broad term electromagnetic radiation are amazingly diverse and far reaching. They are all characterized by interaction between objects, the radiation source and the radiation receiver. The emitter (transmitter) may be widely separated in a vacuum, in air. in interstellar space, buildings, walls. trees, or what have you, from the receiver.

Examples ofelectromagnetic radiation are the warming of your body by sun light, perception of a star by the eye, or reception of a RF signal from Voyager, millions of miles away! Human tissue and bone is illuminated from an X-ray source transmitted thru tissue to the X-Ray film (receiver). These are only a few examples of electro-magnetic radiation, which we take for granted.

The change in the receiver occurs after a time interval that is consistent with the understanding that something has traveled from the emitter to the receiver with the speed of light. The speed depends on the velocity factor of the medium.

In a configuration of conductors and dielectrics (antenna) current flow will produce electromagnetic fields and electrostatic charges.

We have all heard of Maxwell's equations and their relationship to electromagnetic currents and voltage charges. Maybe you've forgotten much of it though, since taking Electromagnetics 10 1, say thirty years ago. Maxwell was a genius who explained this type of radiation with math equations. One of his equations worthwhile recalling is that radiation decreases about 6 dB every time you double the distance between transmitter and receiver.

Perhaps it's best to leave the theory of electromagnetics at this point, without getting into the Dirac delta function free space Green's function, or scaler and vector potentials. It's a very complicated subject, taking about two years to cover at most specialty universities.

It's very important to remember electromagnetic radiation contains both electric and magnetic fields. Their relationship is very complicated, but nevertheless they exist together.

We have all heard of Maxwell's equations and their relationship to electromagnetic currents and voltage charges.

Now in antennas used for RF data transmission, electrons (current) are forced to oscillate in sync. Such oscillation is limited to the finite time during which the transmitter is active, causing current to oscillate at the carrier frequency if it is unmodulated. The current flow oscillates by changing flow direction twice each cycle. It's this current flow that causes magnetic fields, which causes radio frequency radiation, the good stuff we need for information transmission from point A to Point B!

Basic Radiation

There are two inseparable fields associated with the transmitted signal, an electric field due to voltage and a magnetic field due to current flow. The oscillations of current and voltage occur at twice the RF frequency. These fields are at right angles to each other and to the direction of propagation.

The electric field is measured by the potential per unit distance. This value is referred to as the field strength.

Polarization

By convention, the direction of the electric lines of force define the direction of polarization of radio waves. Horizontal dipoles (parallel with the earth) radiate horizontally polarized radiation. And vertical dipoles propagate vertically polarized waves.

In free space, very remote from ground effects and the earth's atmosphere, these senses remain constant. A suitably aligned receiving antenna would respond best to the whole of the incident field properly aligned.

Send your antenna questions to Peter Onnigian.

Consultant's Corner

By Gary Mitchell

This month marks the beginning of a new monthly feature in SSS. tentatively titled Consultant's Corner. This column is for those readers who, by choice or not, are in the process of becoming consultants rather than full-time employees.

An Introduction: As an introduction, I thought I would say a few words about myself. I have been an engineer for about 14 years now, most of that time as an employee, usually of large companies.

In 1990, after two successive layoffs, I decided that it was time to take charge of my own career, rather than leave it in the hands of some company. That's when I started consulting. It's been a slow start, and it definitely is not a way to get rich quick, but to me it's a lot better than being an employee.

I doubt that there is anyone who hasn't noticed that we have undergone a very painful economic restructuring the past couple of years. Partly as a result of this painful restructuring, the US (and Canada) are now poised to be the low cost producers of electronic equipment.

When you consider the downsizing of companies, the low interest rates and the pent-up consumer demand, it's obvious that we are ready for a big change. I think that we are going to see a resurgence of manufacturing, but you won't see it in the big-name companies that you think of when you think about the electronics industry.

The new growth will be in small companies (and individuals) that recognize the singular opportunity that now presents itself. We RF engineers can (and must) be a big part of that. Manufacturing is where the high-paying jobs are, not just for us, but for the rest of the country as well, and we hold the "keys to the kingdom," the ability to make things happen with hardware. When you consider that, and all of the new telecommunications that is happening now (most involving RF), you realize that it's up to us, there simply is no one else to do the job. So let's get to it!

Getting Started: I want this column to be an interactive, two-way forum. Please write to me or call me with questions, suggestions, complaints or just about anything -- I like talking to RF people about most anything. My address and phone number are printed at the end of this column and I would like to hear from you. You can write to me if you wish, but I would rather talk on the phone. Call me during the day, leave a message. and I'll get back to you in the evening.

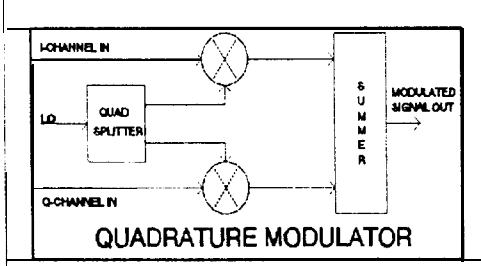
One of the first things I would like to hear is a better name for this column. We are calling it Consultant's Corner right now, but we would like to have a better-sounding name, and it's up to you.

Product Review: As I will discuss in future columns, one of the most importaut things we have going for us as consultants is an encyclopedic knowledge of the parts available to do the job at hand. To facilitate this, I will frequently review new RF products.

This month's product is a quadrature modulator, the RF2402, from RF Micro-Devices. The chip, shown below, is a complete quadrature modulator in one inexpensive monolithic package.

This single component replaces a quadrature phase splitter. two mixers and a summer with one inexpensive package. The device operates over a frequency range of below 100 to above 1000 MHz.

So how might you use this device'.' Well, suppose you had a chance at a job that required a QPSK modulator at 222 MHz for a mobile data service. You could use a conventional approach. with mixers, splitters and combiners, moduulating at a low IF and then up-converting.



QUADRATURE MODULATOR

Or you could use RF Micro-Devices quadrature modulator chip that makes it possible to do the same job using just a synthesizer at the final output frequency and the quadrature modulator chip (with some appropriate filtering added). We'll be talking about inexpensive synthesizer chips in the near future.

All of this simplicity comes at a cost of only $12.32 per device, in quantities of 100. You really can't afford not to use this device, and if you call Chris Fisher at RF Micro-Devices, I bet he'll be happy to send you a sample or two. (Help Randy, tell Chris that you heard about the part in Spread Spectrum Scene). They also make a companion &modulator chip and we'll talk about it next month.

One more thing. There is nothing as aggravating to me as reading a data sheet or product review and finding everything except a price. It's like they don't think price is an important design parameter! So I promise you, any product reviewed in my column will include a price, or it won't be in the column at all!

Next Month: The future topics of this column depend to a great extent on what you want to hear about. I have some ideas, but if you write or call me, I'll try to get to what is on your mind.

RF Micro Devices can be reached at:
7341-D W. Friendly Ave.
Greensboro, NC 27410
(Y 19)855-8085

I can be reached at:

Equipment Corner

by Chris Kilgus

EQUIPMENT CORNER

I promised to do a review of the receiver design workshop by Richard Webb at the Wireless Symposium in San Jose last month. However, Mr. Webb is a little late mailing out his software -- maybe next month.

The San Jose Convention Center, where the Wireless Symposium and Exhibition was held, is a beautiful facility. RF Expo is coming March 17-19. I think it will be a real challenge for them to out do the Wireless Symposium.

Why do people, like Crystal Filter vendors, list all their standard products in a catalog, and then are unable to offer a sample or small quantities for prototyping in less than 10-12 weeks? A 10.7 MHz crystal filter for example, can only have a few standard varieties, can't it? Two or four pole, with four different bandwidths. That is only eight crystals, yet it took me months to obtain a few for evaluation. They should be off the shelf.

Nicad's are improving. Smart chargers and better chemistry have helped, but we have all had bad experiences with them. Did you know that it is accepted engineering practice to float charge alkaline batteries? Yes, there are warning labels on the batteries, "Do Not Recharge", etc. That is to prevent gross charging currents. It is perfectly okay to replenish an alkaline battery with a 1\100 to 1\200 capacity charge. Try it on your next low power design project.

The latest media blitz about EM Fields causing brain cancer has made everyone think about what we are doing. Apparently the brain and eyeball resonate at about 1 GHz. Some Japanese scientists observed the greatest temperature rise at that frequency. The eyes have the greatest vulnerability, since they are essentially unprotected. Cataracts can be the result. The ham operator running 1500 watts into a beam only 20 feet away certainly is at risk. If there is in fact a danger, we only have to look at how long cigarettes were considered a non health hazard to possibly estimate the time before the truth is known.

To design an unlicensed radio system, one almost has to jump immediately to 900 MHz to find a modicum of spectrum to work with. It is disgusting the pittance of spectrum that is allocated for personal unlicensed operation. There are only a few possibilities below 900, the 80 KHz from 49.82 - 49.90 MHz is one. The non-critical RF circuits and readily available IC's make life easy here. The problem is that you will be sharing the band with radio controlled toys and cordless telephones. Unless you want to try working with the 160 - 190 KHz band, that's about it. There are other bands, but the power and duty cycle limitations make them rather useless except for remote control. I hope that the FCC will take a better look at how our spectrum is being utilized. The various commercial spectrum users should all tighten their specs and move closer together -- or join the 20th century and use efficient digital modulations! How about that sacred cow of the Hams, 6 meters? Right there in the middle of it all (SO - 54 MHz) is prime spectrum that is almost unused. Use it or loose it!

I appreciate the comments that I have received from various readers in the last few months -- keep those cards and letters coming. Until next month.

Ham Radio Happenings

by Harry Ham, NX6X

Welcome to this new column! We plan to cover a variety of topics of interest to amateur radio operators, students and advanced experimenters in this column. We welcome material for use in this column --just send us anything that we might use, if it really belongs here, we'll use it and acknowledge the source.

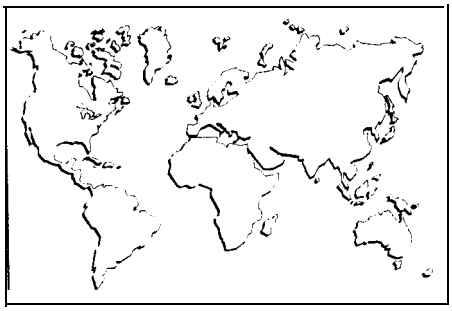
First off, I'd like to share some information we received from Rusty Rushton, VE6TL, of Calgary, Alberta, Canada. Rusty says that they have formed an Experimental Group within the Calgary Amateur Radio Club. The group is currently focused on the completion of the conversion of a number of low priced, surplus cellular rigs to the 900 MHz band. The rigs present an opportunity to not only run voice, but also high speed digital across town. Plans are in the works for a local repeater also.

Other Experimental Group interests involve DSP and Spread Spectrum. These two interests are currently on the back burner until the cellular conversion project is finished. Rusty expressed continuing interest in our SS kit and wanted further details. If some more of you are interested, we may still resurrect our SS kit idea -- let us know.

Other items: the pictures below are from the January meeting of the High Tech Experimenters Group (formerly PPRS, for Peninsula Packet Radio Society). This meeting was attended by some 30 "high tech" bay area hams and featured demonstrations of working RDF (radio direction finding) equipment by some industrious Bay Area hams. If you have interesting photos or stories from your experimentally inclined ham club -- send them along!

Finally, Gerd Schrick, WB8IFM of Dayton is sending us his club's newsletter titled: *Anomalous Propagation.* Very interesting, the group is The Midwest VHF-UHF Society and its annual membership is only $6.00. The publication shows a real experimental flavor in the groups activities and interests -- my kind of club. The newsletter reminds us that the Dayton HAMVENTION is April 23, 24 and 25 this year.

Tune in to Spread Spectrum Scene!

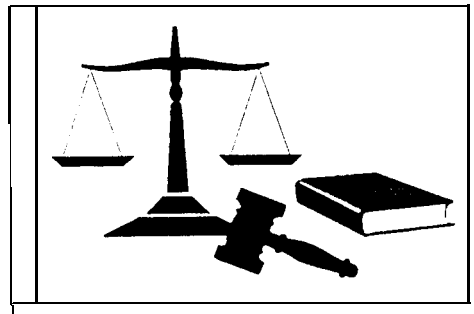


International Scene

- One of the best articles I have seen on the subject of the European Digital Cellular Market was published in the January issue of ***Microwave Journal.*** The article, by Guy Daniels, a Contributing International Editor, is noteworthy for its clarity, coverage and completeness. SSS can make copies available for this article if you have trouble finding it. It's recommended reading.

- L. M. Ericson, Stockholm, Sweden and Hewlett-Packard, Palo Alto, CA have formed a joint venture to provide telecommunications operators worldwide with systems that combine network management and administrative/customer support. The new venture will be based in Stockholm and will have facilities throughout Europe.

- Inmarsat Project 21 {a poorly defined, worldwide low-earth-orbit (LEO) mobile satellite phone service is still giving Motorola fits. Motorola's Iridium system, which could cost them and their partners up to $3.4 billion, is certainly a competitor of whatever happens with Project 21. Motorola and on-again, off again partner Lockheed Corporation, Missile and Space Divis ion, are once again looking for investors. Can Inmarsat one-up Motorola/Lockheed?



Washington Scene

- Three regional telephone comppanies have asked the Federal Communications Commission to investigate the proposed merger of American Telephone & Telegraph Co. and McCaw Cellular Communication. Bell Atlantic charged that the proposed merger "raises competitive and public interest concerns of the most fundamental kind," in a petition filed with the FCC in conjunction with NYNEX and Southwestern Bell. The proposal would combine the company that dominates the long -distance market with the nation's largest provider of wireless services.

- Under pressure because of the recent scare over possible links between cellular phones and brain cancer, FCC officials last week proposed to change a longstanding guideline on allowable EMF exposures -- an action that could slow development of next- generation wireless technologies. The new standard would reduce the limit for the power radiating from current cellular phones to one-tenth the value of that allowed under the old standard and would require next-generatiion systems to operate at half the power of existing ones. The commission plans to replace an Amercan National Standards Institute standard adopted in 1985 with one published by the Institute of Electrical and Electronics Engineers ('IEEE).

- QUALCOMM Inc. and partner Telesis Technologies Laboratory (TTL), subsidiary of Pacific Telesis, are jointly testing a PCS system in San Diego. The system is expected to operate in the 1850 to 1990 MHz band using QUALCOMM's code division multiple access (CDMA) digital transmission technology. The FCC granted QUALCOMM an experimental license to conduct PCS field trials last year. According to the FCC's notice of proposed rulemaking, published in July 1992, the advent of PCS could have a great impact on the future development and configuration of all telecommunications networks. The 1.25 MHz, CDMA channel operating in the 1800 MHz frequency is considered narrow enough to allow spectrum sharing, while road enough to offer all the advantages that can be gained from a CDMA-based PCS system.

- NASA's Jet Propulsion Laboratory (Pasadena, CA) has awarded a contract to the Pacific Advanced Communications Consortium (PACC) to examine the use of satellites in personal communications networks (PCNs) for rural users. The PACC is comprised of several Oregon and Washington communications companies, universities, and government agencies. For the JPL study, the PACC will evaluate the role of satellites in remote and rural PCNs, focusing on users in the Pacific Northwest.

Technical Tricks

All About Correlators

by R. H. Roberts, Director
RF/Spread Spectrum

The real "art" or trade secret technology of Spread Spectrum is in the acquisition and tracking of code phase, carrier frequency and data clock. The only "magic" involved is a practical knowledge of how to do it with cot-relators. Cot-relators come in various types:

Analog
- SAW correlator
- SAW convolver
- CCD delay line
- Doubly balanced mixer

Digital
- Full parallel
- Sliding
- Hybrid
- DSP algorithm based
- AI "smart" correlator

There are plenty of references on cot-relators and lots of theoretical analysis of how they are supposed to work. However, in the real world it is best to have a favorite circuit or two that has worked well for you in the past and then adapt or modify it for a new application. I will present a few such circuit ideas here.

First, the simplest and quickest cot-relator to get up and running, by far, is the simple serial, sliding cot-relator with either two (Tau Dither) or three (Delay Lock/Early-Late) channels, each containing EXOR's or DBM (doubly balanced mixer) cot-relators. In this approach, one channel is devoted to "on-time" or data channel correlation. In the Tau-Dither, two channel system, the second channel is time shared between a slightly "early" and a slightly "late" timing offset channel used to form a "discriminator" function for code tracking put-poses. In the three channel system one timing channel is always "early," while the other is always "late." Again a discriminator-like error function is generated to enable code tracking.

To better understand the strategy behind the sliding correlator, assume that the receiver has no knowledge of the code phase or frequency to be received, at all. The simplest strategy is just to sequentially try each possible code position, until correlation is found. The "data" channel, mentioned above, is used to detect "code lock," since the signal instantly de-spreads and a narrow band carrier (possibly with data modulation) magically appears when code lock is achieved.

Sliding correlators are simple, reliable and slow! A hybrid, serial/parallel or "pipelined" approach can speed up this type of correlator by a factor of N^2, where N is the number of separate, parallel pipelined channels. Thus a 3 way pipelined hybrid sliding cot-relator, where each parallel pipelined section examines a different section of the code, can acquire sync about 9 times faster than the simple sequential, sliding correlator. A great return for a nominal addition of circuitry. Today's PLD (Programmable Logic Device)

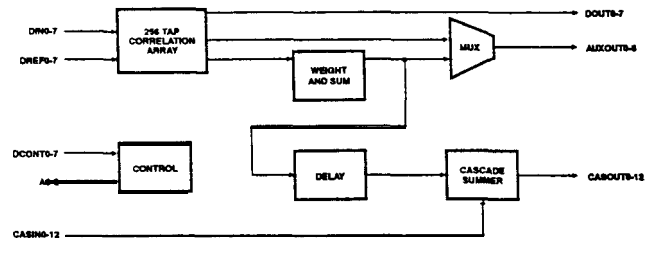
HARRIS SEMICONDUCTOR

HSP45256

August 1992

Binary Correlator

Block Diagram



TMC2023

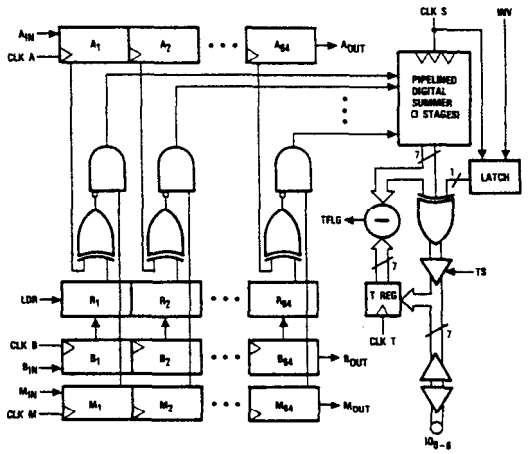
Advance Information

TRW

CMOS Digital Output Correlator

14-Bit, 30MHz

Functional Block Diagram



technology makes it easy to implement hybrid sliding correlators up to near the complexity of a full parallel digital correlator.

However, the fastest correlators are fully parallel devices – they search the entire code epoch length all at once. These devices can use CCDs, SAW (Surface Acoustic Wave) or digital LSI/ASIC technology. SAW convolvers can designed to be programmable for any code -- but, the most useful and general purpose parallel correlator is the all digital device. The chip block diagrams at left and below show some of the available ASIC offerings from Harris, TRW and Zilog. Actually Zilog has licensed the SS technology developed by Stanford telecommunications, Inc. for consumer scale commercial development.

The chips shown here are just a sampling of what's available from these and other vendors out there. All three chips shown perform superbly in a correctly interfaced SS system. There is an art to using any of these chips, however. It seems that to even read the data sheets of these chips you need a PhD in microprocessors and silicon BiCMOS technology. Each vendor does make available a certain level of application support -- Stanford Telecom sells evaluation boards and complete development/simulation circuit board subsystems. My recommendation is to select a chip based on the performance you need, build up a simple all digital test circuit first, then proceed slowly, in small steps, to integrate your new correlator into your SS system. This way you will learn some of the idiosyncracies of the chip at each step of your design/integration project.

Many companies have spent hundreds of thousands or millions of dollars developing their own full parallel digital correlators. Save your company and your project (as well a your reputation) the time, trouble and expense -- use an existing LSI / ASIC parallel digital correlator chip.

Parallel correlators can sync up in as little as one code epoch (the code repeat time interval). However, noise and statistics usually enter the picture by forcing certain P_{FA} and P_D requirements on you. It is thus typical that all digital parallel correlators synch in perhaps 3 to 5 PN code epochs (data bit times). Even this speed is blazingly fast compared to the sliding correlator which syncs up, at best, in the code length's number of data bits.

The use of digital circuitry for correlation provides interesting challenges to the SS innovator -- first it forces him to include analog and digital circuitry both in his design. Next, he must learn something of the rudiments of Digital Signal Processing, if he is to succeed in his efforts. Finally he must learn, by trial of fire and smoke, that SS design is field for those brave, persevering few, who can master multiple technologies and disciplines.

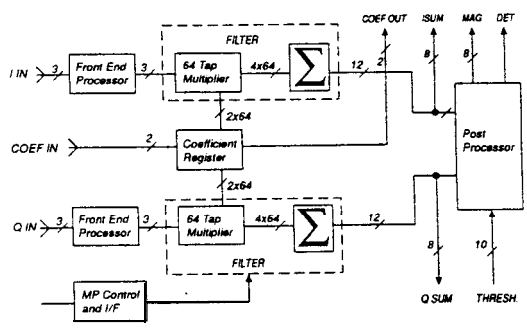
Next month we will give complete block diagrams and circuit descriptiions for both the simple sliding and the hybrid correlator designs.

ZILOG

PRELIMINARY
PRODUCT SPECIFICATION

23340
DUAL 64-TAP, 11MCPS
DIGITAL MATCHED FILTER

GENERAL DESCRIPTION (Continued)



Z3340 Simplified Block Diagram

RESOURCES:

U. S. Headquarters -- Harris Semiconductor, 1301 Woody Burke Road, Melbourne, FL 32902, TEL: 407-724-3000

ASIC and Custam Products Grnup -- Stanford Telecom, 2421 Mission College Blvd., Santa Clara, CA 95054-1298, TEL: 408-980-5684, FAX: 408-980-1066

TRW LSI Products Inc. -- 4243 Campus Point Court, San Diego, CA 92121, TEL: 619-457-1000, FAX: 619-455-6314

Zilog, Inc. -- 210 Hacienda Ave., Campbell, CA 95008-6600, TEL: 408-370-8000, FAX: 408-370-8056

A Tale of Two Chips

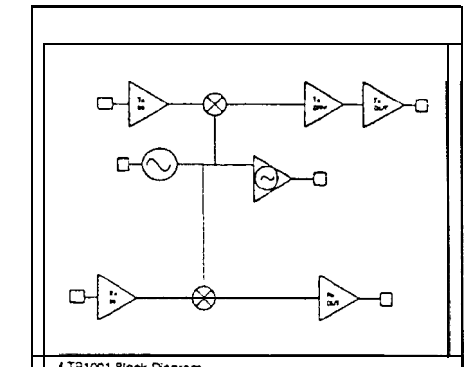
Part 2

by R. H. Roberts, Director
RF/SS & The PMI Staff

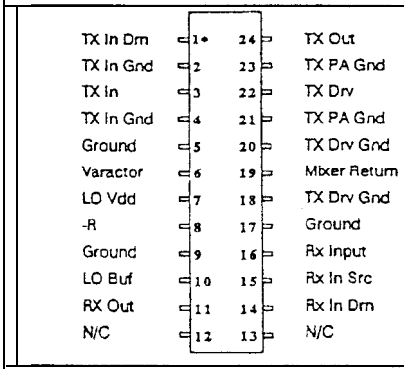
The PM TR-1001 -- A GaAs MMIC Transceiver Chip for 915 MHz

Cordless phones, PDAs, spread spectrum radios and other LAN/WAN or "Wireless" devices need RF transmit/receive front ends. The Pacific Monolithics, Inc. PM TR-100 1 provides a very interesting complete, one-chip solution for this "need."

The MMIC transceiver chip, in the figure at the right, incorporates an upconverter and

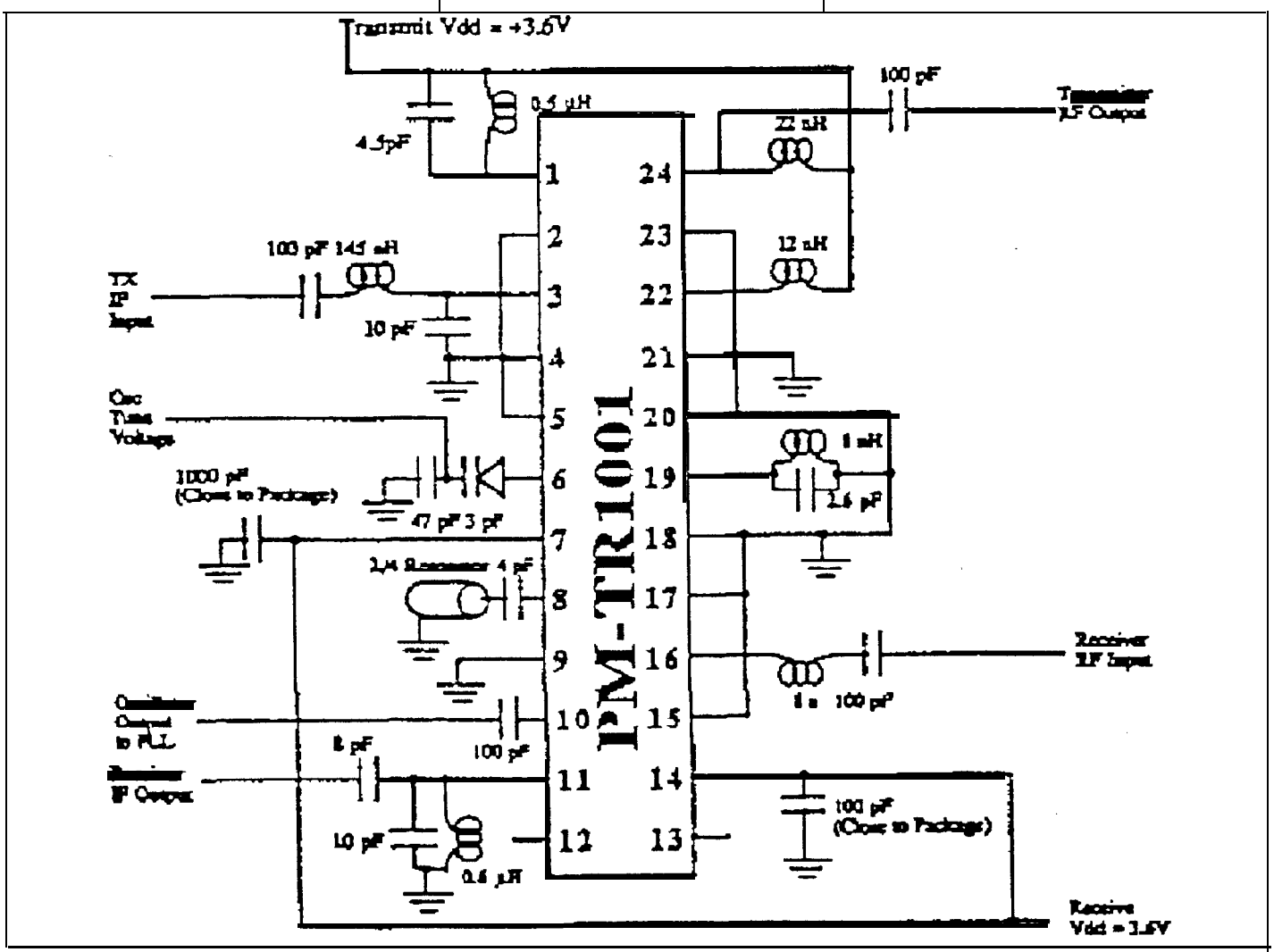


4-TR1001 Block Diagram



1 Connections - Top View

downconverter both fed by the same on-chip local oscillator. The upconverter is composed of a pre-amplifier, a single ended mixer and a post- amplifier. Output power is +15dBm into a 50 ohm load at 915 MHz with 0 dBm input at 90 MHz. The downconverter consists of a low noise RF amplifier, a single-ended mixer and an IF amplifier. Conversion gain is 25 dB with a SSB noise figure of 6 dB. The local oscillator is a capacitive source feedback design and tunes about 4 MHz using a tuning voltage of 0 to -3 volts on an off-chip varactor. The tuning bandwidth is enough to cover 160 channels with a 25 KHz channel spacing. By lowering the resonator Q, the oscillator can be tuned over a wider band-

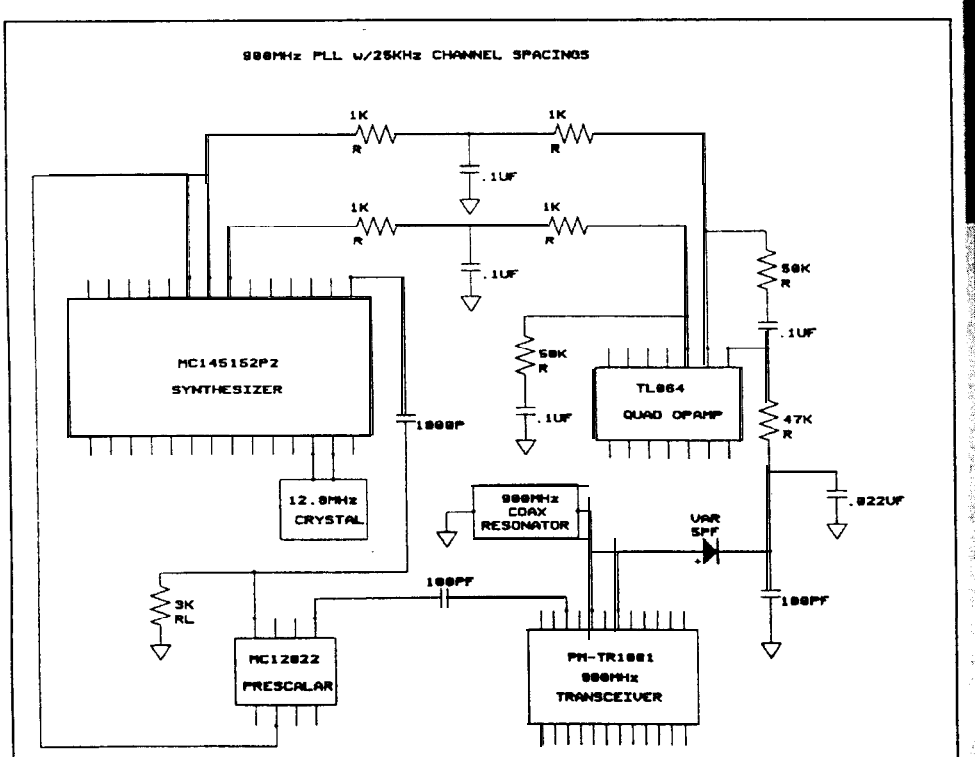


width at the expense of higher phase noise. For high volume and low cost applications, the chip is packaged in a 24 pin surface mount plastic package as shown at left. In the transmit mode, the chip draws 60 mA off a 3.6 Volt Ni-Cad battery used in many cordless phones. In the standby mode, the chip draws 15 mA.

Functionality of the GaAs MMIC chip was demonstrated by building two FM transceiver systems (see functional block diagram below). This provided a test bed for correlation of key electrical parameters (such as phase noise and output power) to audio quality and area coverage. Phase noise is one important aspect in this application, since phase noise in the 300 Hz to 3 kHz offset is directly converted to audio noise in FM systems. The GaAs oscillator with an off-chip coaxial resonator exhibits a root mean-square (rms) phase noise of 110 Hz over the range of 300 Hz to 3 kHz offset from the carrier. A comparable silicon bipolar oscillator was also designed and exhibited 60 Hz of phase noise. Although the performance of the silicon design is slightly better, the GaAs design exhibits respectable performance. A good audio signal could be heard for rms phase noise less than about 150 Hz, above which background noise becomes irritating. The line-of-sight range achieved was well over 50 meters.

This chip provides the RF heart of any communications system using the 900 MHz frequency range. A low powered SS transceiver can be designed with this chip very simply by adding the requisite spectrum spreading mixers to the IF input and output signals.

An evaluation kit is available. Contact PMI at: Pacific Monolithics, Inc., 245 Santa Ana Court, Sunnyvale, CA, 94086. Phone: (408)732-8000, FAX: (408)732-3413.



This page contained only advertising
and is now out of date!

Nibbles & Bits

● The subject of "Wireless" has finally arrived! February's BYTE magazine covers the field in 3 feature articles and a resource guide. It makes very good reading for those new to the subject or those hungry for lay levels of explanation. Pick it up, look it over -- it really isn't bad. Make sure you browse pages 146 to 177.

● Even staid *Electronic Design*, in. its February issue, covers something about our vast subject area. On pages *61* to *67*, ***Electronic Design*** presents the article "Communications Terminals Get Personal." It's pretty good reading material on the subject of PCSs, in general, and regulatory problems facing PCSs, in particular.

● Pulson Communications Inc., McLean, VA has announced its "successor" to Spread Spectrum technology. The controversial technique is known as "Impulse Radio." Using pulse-position modulation and pulses as short as 0.5 nanoseconds, the system "spreads" its information across the entire spectrum instead of just across one frequency band. The FCC has awarded Pulson a Pioneer's Preference to use the system in field trials. However, the FCC has no allocations where this goofy system may be used.

Subscribe to Spread Spectrum Scene -- today!