SPREAD SPECTRUM SCENE

The Wireless, PCS and Advanced Digital Communications Monthly News Magazette

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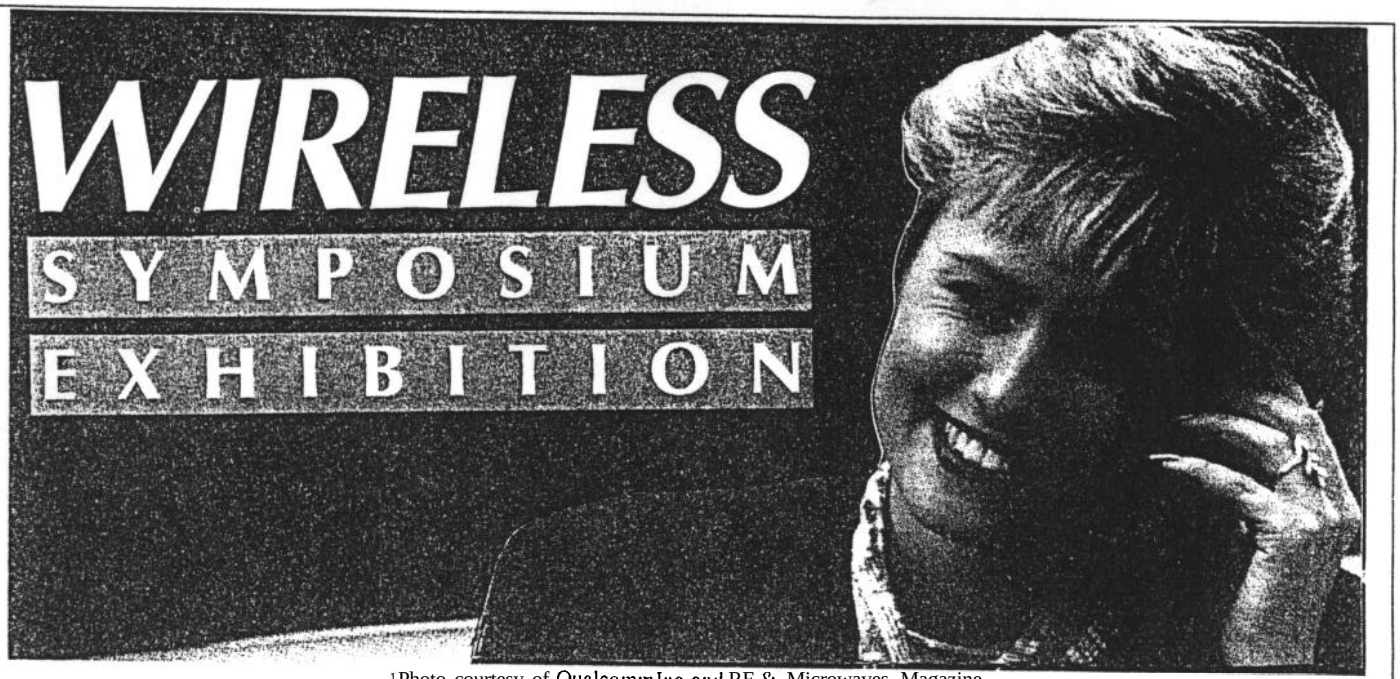
Happy New Year! 1993 The Year For SS?



]Photo courtesy of QualcommInc.and RF & Microwaves Magazine

SSS Plans for 1993

We hope 1993 will be an exciting and eventful year for the Spread Spectrum community. In our editorial this month, on page 4, we make a few predictions and prognostications about what may happen in our business this year.

We have some interesting plans for both RF/SS (our consulting arm) and SSS for this new year. We share some of these plans with you in the "SSS Plans for 1993" article on page 7.

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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

● Cirrus Logic Inc., Fremont, CA acquired Pacific Communication Sciences Inc. (PCSI) of San Diego, last month. PCSI, another M/A-Comm Linkabit spinoff, is a leading high tech supplier of European DECT and CT- 1,2 and 3 cordless/cellular telephones. PCSI has long been known as a 'sleeper" in the SS business and a force to be reckoned with. They have many capabilities that parallel Qualcomm's and their main engineering staff was also trained on the military projects that Linkabit pioneered. Cirrus /PCSI exhibited at the Wireless Expo -- but their booth was seldom manned. What gives?

● Nippondenso of Carlsbad, CA did not have a booth at the Wireless Expo, but they left flyers around the registration area listing more than a half dozen openings for engineers and managers. ND did you know that you-can reach these folks directly through the pages of SSS at no cost?

● Heard a good rumor -- want to "leak" some info to your competition -- call our 800 number and we may print it!

Decipherings

EDUCATION IS WHAT SURVIVES WHEN WHAT HAS BEEN LEARNED HAS BEEN FORGOTTEN.

- B. F. Skinner -

EDITORIAL
1993 Predictions and Prognostications

1993 should be a great year for the SS community/industry. After several years of more or less lackluster growth, economic meandering and vendor shake-out, 1993 looks to be a very promising year. The new President will appoint a new FCC Chairperson and two other commissioners. We will have a new focus in the executive and legislative branches of government and with just a little luck we may even start to turn around this recession.

With this background I will look into my crystal ball and make a few prdictions about what is to come in this business in 1993:

(1) Look for several key SS hardware vendors (no names, or I'll probably be sued) to run into financial difficulties if they insist on selling SS equipment that cannot meet today's FCC part 15.247 rules.

(2) Look for more confusion, politicking and total lack of direction from Congress on legislation required to enable the PCN-/PCS business in this country.

(3) Look for the battle between RBOCS (regional Bell operating companies or "Baby Bells") and the cable companies to heat up in the US. Both sides will try to jump into the PCN/PCS business in some way.

(4) The FCC may start experimental licensing of un-used UHF TV channels to entities that want

to try new technologies out on the public. This prediction requires the FCC to proceed rapidly with HDTV standard setting, itself a rather risky business.

(5) I predict that the new wireless PDAs from Apple, EO and others will hit the market this year and go over like lead balloons.

(6) I predict the appearance of several new innovative SS wireless products on the market, that are targeted for the Industrial Segment of this marketplace. They will not only meet current FCC rules, they will be reasonably priced, widely available and fully functional when announced.

(7) I further predict that smoke, mirrors, FM and advertising hype will continue in this business for some time. The users and buyers of SS hardware don't want it -- but, just like the computer and software sides of our high tech biz, this stuff is almost unavoidable.

(8) Finally, I predict that a showdown and shakeout will start to form between those that hawk cellular telephone technology (like Motorola's ARDIS) and others who provide SS equipment and services. I feel that pay by the minute or by the byte technology is a consumer deadend when SS is what our customers want and need. To make SS the technology of choice will require more than setting up groups like WinForum. It will take baptism by fire in the marketplace and Congressional/FCC action. Will we see it in 1993 -- who knows?

The Wireless Symposium and Exhibition Report

We attended the Wireless Symposium and Exposition, January 12 through 15 at the San Jose Convention Center. It was the first show concerning the wireless area to be held by RF and Microwaves magazine, part of Penton Publishing.

The show was a great success -- with something like 2500 paid attendees. I was a session chairman at the Friday morning PCS session of five papers and attended every day of the show. RF & Microwaves magazine and Mr. Jack Brown kindly made available a display area for our seven foot by two foot SSS banner and allowed us to hand out sample issues and subscription flyers. More than 1500 people picked up on SSS. Thank you one and all -- now let's get those subscriptions and advertisements in!

Seriously, with over 100 vendor display booths and some 50 or 60 technical papers this was the wireless show of 1993, in our opinion. This show will be hard to beat by any conference trying to cover wireless, PCS or LAN/MAN/WAN happenings this year. Jack Brown did a great job the first time out with this effort!

The conference digest will be published soon and should be available for purchase. Our next issue will summarize the most interesting papers.

Randy Roberts

The Aerial

by Peter Onnigian, P.E., W6QEU

In last months column we covered antenna construction and performance. This month we'll discuss the installation of Spread Spectrum and other high frequency antennas, their supporting structures and coaxial transmission lines to connect to the electronics. A good installation, done properly will insure long term operation and prevent damage to the equipment. When it meets local building codes, it will help you in defending your firm against damage suits in court!

Antenna Supports - Outdoors

Not all antenna support installations are identical. Only typical planning considerations can be outlined here. Perhaps the easiest method of mounting is to put up a galvanized steel pipe or aluminum tube, to which the antenna is mounted. Nearly all antennas for SS applications will easily mount to pipes whose diameter varies from 3/4 to 1-1/2 inches.

Suitable pipe masts may be obtained from Radio Shack or from Rohn Mfg, Peoria, IL. Rohn supplies 30, 40, and 50 foot telescopic galvanized masts, complete with base plates, braces, guy wire assemblies, roof anchors, etc.

The antenna should be located with two important criteria in mind. First, it should be placed so as to have line of sight conditions to the other station with which communications are to be established. Secondly, the antenna must not have a very long coaxial transmission line run. This may be necessary in which event, larger size coaxial cable must be used to keep

the RF efficiency high.

Indoor Installations

For LAN or for short range, say less than five miles, between the LAN and the central station, the antenna may be placed indoors. A rather simple antenna installation is possible. Indoor installations have advantages such as lower cost and faster erection time. Such antennas can be placed between drop ceilings and the next floor. Existing vertical straps, pipe or even drop ceiling wires maybe used to hold the antenna in place and pointed in the right direction. Tests should be made as to the best Yagi pointing direction, as local reflections may be very strong.

Outdoor Installations

For outdoor locations, the roof is probably the best location. Before installing, it must be determined that a line of sight condition exists to the station to which communication is to be maintained.

Modern buildings have many suitable objects such as air conditioning, window washing, exhaust fan housings, which may be used to hold these Yagis. Some are good, while others are not. Don't attach anything on the roof until you have received permission, preferably in writing, to install the antenna? its support and coaxial transmission line. Working with the building manager is a must.

Installing Coax Cable

After the exact location of the antenna has been determined, its time to run the coaxial transmission line from the antenna to the electronics.

There is a correct way and an in-correct way of uncoiling and or Pulling coaxial cable. Nearly all cable will be at least four tenths of an inch in diameter. The cable must be reeled out. The reel must be turned on its axis as the cable is reeled out. It should not be played out so that the cable is twisted 360" each time one turn is removed from the reel.

Don't run the cable on the roof unprotected. Run it through conduits. Use cheap PVC to protect the cable from mechanical abuse and from being under foot. The building manager will probably require you to run the cable in conduit. Because of the very small voltage [14.15 volts RMS] any sort of pipe or wood grating maybe used, and will meet the UBC, NEC,, and other codes.

Cable running vertically should also be protected and supported by tying with plastic ties every two feet of height. Don't over tighten these, so as to dent the outer cable jacket.

Entry into the roof requires special precautions. Check with the building maintenance people or with a roofer, on the best way to accomplish this. Don't ever drop the cable on the outside of the building and make entry on the proper floor through a window!

Running coax inside the building is an art, not a science. The electrical, telephone, or air conditioning duct work may be used. In this event, you'll have to have coax which is flameproof, and meets fire codes. Beldon and others carry flame proof plenum cable in the popular sizes, such as 9913, which is excellent electrically as well as meeting this fire requirement.

Connectors

Either Type N or BNC cable connectors can be used. They can be mixed, that is a N at the antenna, and BNC at the radio end. If couplings must be made in the cable, type N males on the cables can mate to a common N female barrel to make the splice.

Environmental Considerations

Due to the maximum of four watts maximum radiated power, there is no known non-ionization hazard.

All outdoor exposed hardware should be of the stainless steel type. Some antenna firms use all stainless steel hardware while others do not in order to cut costs. For a truly professional installation plated outdoor hardware on the antenna, or supporting structure, should be used.

In areas where icing occurs, the antenna wind load push plus ice coating increase must be taken into consideration. The last thing you or your firm would like to hear is that your antenna blew down, and caused damage to personnel on the ground, or damage to property. Outdoor antenna installations are not places for in-experienced installation people. The support, guying and/or mounting must be done in. a good workmanlike manner.

When in doubt, especially on high rise buildings, consult a structural engineer and go over your plans with them. A couple of hundred dollars spent with structural people is wisely spent, when considering the alternative in our litigious times.

The writer has had experience with this sort of thing, which took over four years to legally resolve, cost thousands of manhours in hearings and depositions, and many thousands of dollars in legal fees. Be careful out there!

Send your antenna questions to Peter Onnigian, c/o SSS

SSS Plans for 1993

RF/SS and SSS have some new plans for 1993. RF/SS will be making some strategic alliances with one or more Bay Area engineering firms to further our product development and consulting practice. These alliances will allow RF/SS to more aggressively market our products and services. It may also allow some of RF/SS' associates to become a little busier than they are today. SSS plans to grow in coverage, monthly page count, technical content and readership.

Effective February 1, 1993 the domestic subscription price for SSS will increase to $49.95. The Foreign Air Mail rate will also increase to $70.00 (US funds). These rate increases are necessary to offset the costs of printing, postage, handling and administration. SSS will still not make any real money until (or if) we secure a steady stream of advertisers.

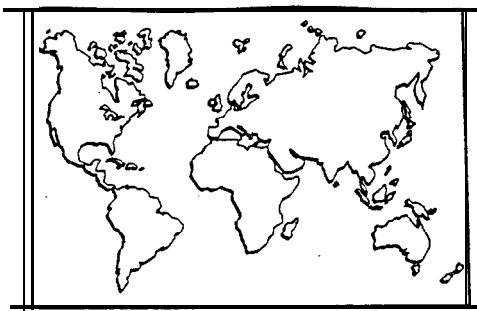
SSS will be starting two new columns in the February issue:

(1) Ham Radio Happenings

(2) Consultant's Corner

We have located a columnconductor for the second column but still need someone to take on the "Ham" column -- anyone out there interested? If you are just give me a call or drop me a notr

Finally, we plan to add part time Editor and Associate Publisher, as well as someone to help with advertising sales and other administrative chores. Again if you're interested, call write or FAX.



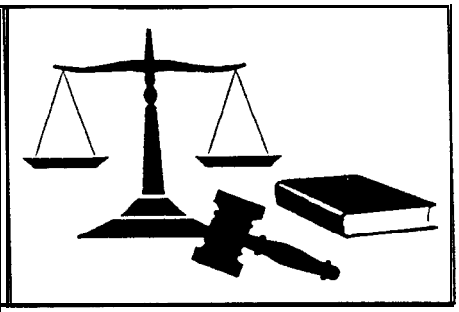
International Scene

- Mitsui Trading Company, Kinzoku and a new Los Angeles startup have announced the availability of a group of SAW (Surface Acoustic Wave) convolvers designed for SS applications. These devices and radios using them were shown at the Wireless Symposium and Exposition in San Jose.

- Science News recently announced the discovery of the 32nd Mersenne prime number, the largest prime yet discovered. Mersenne primes have mathematical properties that make them interesting for PN code generation among other things.

- SRI International is sponsoring yet another January Conference on subjects related to "wireless" and SS technology. To be held January 19-20 at the San Francisco Hilton, the "Portable Intelligence Expo" will feature exhibits by more than 50 companies and Dr. Tom Stanley, FCC Chief Engineer will give the Keynote address. Call Mark Cummings at 415-326-6200 or FAX him at 415-326-5512 for more information.

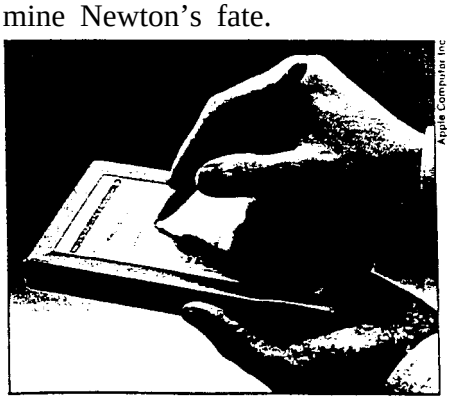
- Look for a report from Rusty Rushton, VE6TL, next month in SSS on the progress of the Calgary ham SS group.



Washington Scene

Apple Computer Inc.'s Newton Personal Digital Assistant continues to stir up the press. Apple has now signed partnership agreements with R. R. Donnelley to provide travel-based applications using GeoSystem street maps and travel data; Motorola to provide a radio for Newton; and America Online to provide technology for future enhancements to Apple's AppleLink on-line information service. We think it's wonderful -- Apple continues to provide employment for misguided children who need little toys.

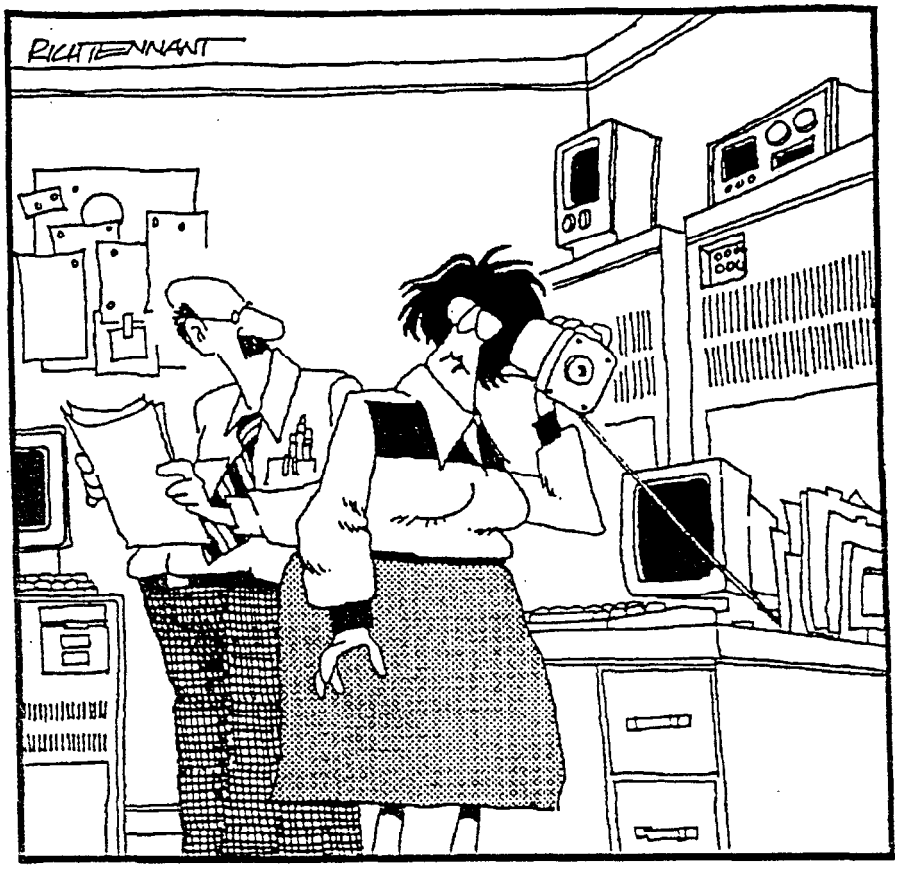
Seriously, and in all fairness to Apple, the Newton seems to be coming of age. Will anybody buy it? Will anybody use it? Will anybody care about Newton (beyond the press)? We don't think so -- but we could be wrong. You the readers, the consumers and the competition Apple will face will largely determine Newton's fate.



Apple Computer Inc.3 Newton Personal Digital Assistant is capable of wired or wireless communications

Equipment Corner

by Chris Kilgus



"I don't think our newesf network configuration is going to work. All of our transmissions from Ohio seem to be coming in over my electric pencil sharpener."

Electrical Engineers and Technicians have always used a variety of resources to obtain the parts for their projects. I started with ham radio at a young age in rural Kentucky. My link to the electronic parts world was tearing up old TVs and my Allied Radio catalog. I was always looking for the mailman. A local Radio Shack is a resource that is unappreciated by anyone who hasn't had to live without them. They are like 7-11 stores, you wouldn't do your grocery shopping there, but what would we do without them.

I have always been frustrated by distributors and reps who have their $50 minimums and an unwillingness to provide small quantities for prototyping. I think that more and more, engineers are being required to locate their own parts. Every call to a distributer starts with the question about where you are calling from. After a wait, someone comes on the line and asks you where you are calling from. Ten minutes later you find they have the part but can't sell less than a tube of 62 or that they have a $100 minimum. There has got to be a better way. There are some changes taking place and one of the best is Digi-Key Corporation (800-344-4539). They are aggressively providing a service to everyone who has struggled to find parts. They are the one stop shop for SMD parts, in small quantities. They are fast, have knowledgeable operators, and no minimum. There is a reasonable $5 handling charge on orders less than $25.

You can't beat the surplus stores for a bargain, if you have the time. Nuts and Volts has many listings. The best surplus store I've seen is Haltek in Mountain View, CA. (415-969-05 10). Right next door to them is a great place to get reconditioned test equipment. Test Lab Co. (800-442-5835) has racks and racks of prime HP and TEK equipment. One of the guys there, Bill Pollard, will also locate hard to find stuff. My company picked up a HP8656A RF Generator (.1- 990 MHz w/ HPIB) for $3400. Anybody who has looked into a synthesized generator will know what a good deal that is. I think Test Lab has a few more.

Designer kits are how you really increase your productivity in the lab. Nothing wastes more time than digging around in a box of resistors looking for a certain value and settling on something that is "close enough." Digi-Key has the kits and I recommend everyone get a 1/8 watt resistor kit and a disc capacitor kit. Inductors are more subtle, but I have found an excellent kit from 3L Global Electronics (813-343-2679). For about $40 they provide 64 values from .1uH to 1000 uH, ten coils

per value. For SMD coils there is no way to beat the Cl00 Kit from Coilcraft (800-322-COIL). They have even supplied me with refills at no cost.

MY advice to all electronic component manufactures would be to provide designer's kits to engineers. That is the most effective way to get your parts designed into equipment.

While I am on my vender bandwagon, I would like to make a pitch for one more company, JAN Crystals (800-JAN-XTAL). They can provide you with crystals shipped the next working day for only $15 extra per crystal. I have also used their $7 deal where they ship in 3 working days. That service has kept many of my projects on schedule. Add this cost to their typical unit price of $12, and you have a Blue Ribbon Vendor.

Any SSS reader that would like to give a vendor the recognition they deserve (positive or negative) send it along to me, cio sss.

Have you been to a good electronics trade show lately? I can't say I have. There was a large turn out at Wescon in LA a couple months ago, but I didn't come away excited. Many of the Exhibitors are interested in just "running your card, so we can send you more information." Well, sure enough, the information arrives months later by 3rd class mail. By that time, I can't remember why I was interested in the first place. The most effective approach to getting a product out there is to offer samples. I think they are wasting their money on monogrammed golf tees and key chains. Advice to salespeople, if you hand out a catalog make sure it has your business card attached to it.

I will be attending the Wireless Symposium Exhibition at the San Jose Convention Center this month and I am hoping that this event breaks the chain of boring shows. After all, RF is one of the few areas of electronic technology that is offering something new. I am taking a workshop by Richard Webb, "System and Receiver Design." Included with the course is a software package of analysis programs. I will review the course and software in an upcoming issue. They are also having a workshop by the renown expert on spread-spectrum systems, Dr. Jack Holtzman. Unfortunately, both workshops were scheduled for the same time slot and I could only attend one.

I will continue next month with more practical information that I hope you find useful.

A 16 kbs Full Duplex Spreaci Spectrum RF Data Link -- Part 3

by Dan Doberstein, President
DKD Instruments

Data Demod and Audio Circuitry

Last month we covered the code lock circuitry. This month we examine the data demodulator and the audio reconstruction using the CVSD demodulator.

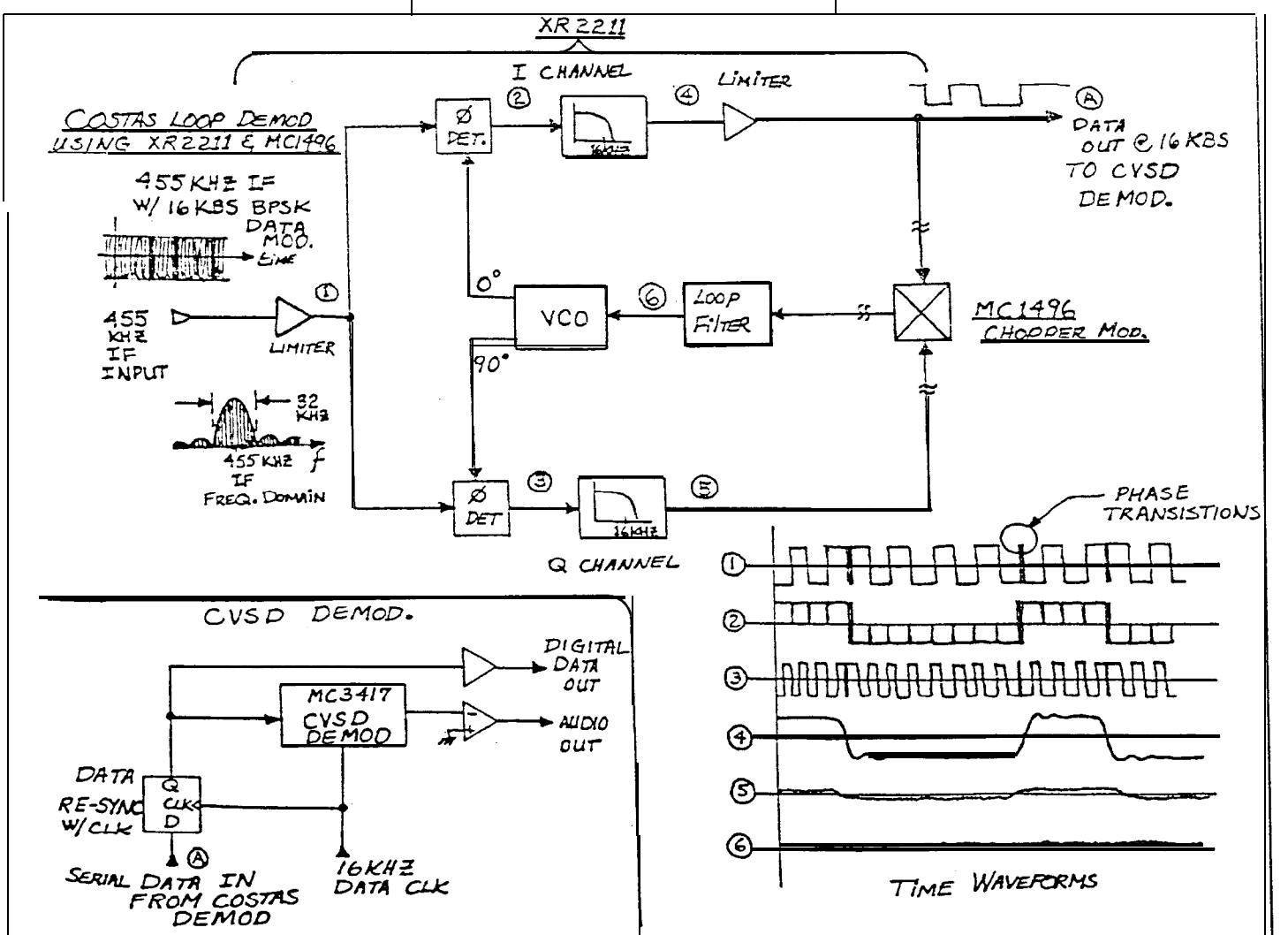
A Costas Loop demodulator is used to recover the data from the 455 Khz IF. Of course we must have code lock before an IF would be present. Assuming code lock the 455 KHz carrier has just the data modulation on it, the remaining dither modulation being negligible. The incoming carrier is first limited to remove any amplitude variation. Since the information is carried in the PHASE of the carrier this operation does not destroy any data information. After limiting it is split and sent to two identical phase detectors. Classic Costas loop demodulators use three, four quadrant, multipliers. This design approximates these multipliers with two phase detectors and one double balanced modulator. The Exar part XR22 11 contains two phase detectors, a VCO with 0 and 90 degree outputs, Input limiter and the Inphase limiter. The MC1496 does the chopper/modulator function. The two phase detectors compare the phase of the carrier with the VCO output, one at 0 degrees, the other at 90 degrees. Two channels are now present, the I or Inphase, and the Q or Quadrature. The Inphase channel carries the recovered data as shown in the timing diagrams.

The output of the phase detectors are lowpassed with the bandwidth approximately equal to the data rate. The inphase channel is now limited and sent to the MC1496. This limited signal is used to switch the output of the MC1496 from invert to noninvert state. Hence the chopper designation. To achieve this the MC1496 is used in its Double sideband, Suppressed carrier mode Essentially the Inphase channel affects only the SIGN of the MC 1496 output not its magnitude. The MC1496 output

is then lowpased by the Loop filter and passed to the VCO control point. The loop filter serves exactly the same function as the loop filter in a standard PLL. The Loop, Inphase and Quadrature filters are all single pole RC types. The Loop filter should have a time constant of about 2 to 10 msec.

The timing waveforms show operation assuming the loop has acquired the carrier, in other words the frequency error between the VCO and the IF is zero and the phase error is small. If there is any frequency offset between the free running VCO frequency and the IF (there always is!) a small DC bias level will exist at the output of the Loop filter to correct out this constant frequency error. If this offset is to large, or changes with time i.e doppler shift caused by excessive receiver or transmitter relative movement, carrier acquisition will not be obtained or ,in the changing case, maintained. This "bias" is illustrated in waveform 6.

The CVSD demodulator is fed from the re-synced data and reconstructs the audio signal from the serial bit stream. The 16 kHz clock is only valid when the we have code lock condition. Without code lock the 15 kHz clock will not be synchronous with the transmitted data clock. One of the primary advantages to coherent Direct sequence systems is that data clock synchronism is achieved simultaneously with code lock. The MC3417 Continuously Variable Slope Demodulator/Modulator converts the audio signal efficiently to and from a low bit rate serial data streams. It also does another important job by insuring a changing bit stream during "quiet" periods. Excessively long strings of all ones or zeros can create problems in receiver operation. Next month we finish up this design article with some thoughts on microprocessor interface for code selection, a serial data interface and using the Fujitsu dual PLL MB 15 19 instead of the Motorola MC145168, as well as a "hints and kinks" section for those of you brave enough to n-y out some of these ideas.



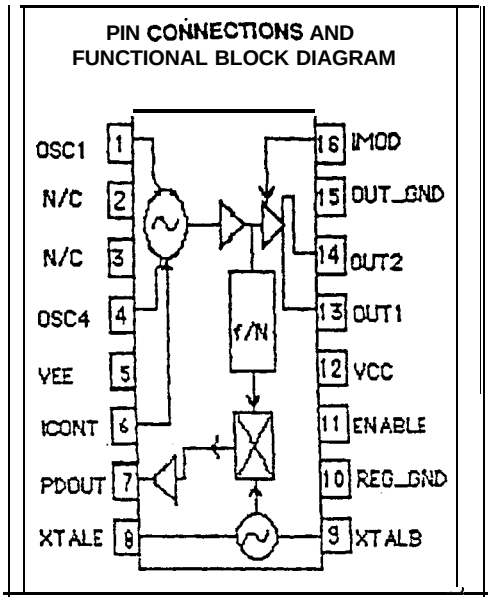
A Tale of Two Chips

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

My apologies to Charles Dickens for the play on words in the title -- but, this article will describe two radically different chips that can be very useful in SS equipment designed for the 915 MHz, FCC Part 15, ISM band. In this the first part of this article I will describe the Motorola MC13 176D IC. In the second half of the article (to appear next month) I will describe the Pacific Monolithics PM-TR1 **00** 1 Gallium Arsenide cellular telephone transceiver chip.

The Motorola MC13176D Silicon IC is finally here! The chip's pinout and block diagram is shown in the figure to the right. I've waited for it for nearly two years. You may have trouble getting a hold of production quantities of the chip (it's very popular) but samples should be obtainable, easily.

The MC13176D is described by Motorola as a "UHE FM/AM Transmitter" IC. I have used only the surface mounted plastic packaged "D" suffix parts. In quantity these little guys sell for under $2.00 -- a real buy! A sister part, the MC 13 175, is also available. The only real difference between the two parts is the internal frequency divider ratio used to compare the internal UHF VCO to the reference frequency. The '175 uses a divide by 8, while the '176 uses a divide by 32. I favor the '176 for use at 915 MHz because you can use inexpensive, nominally 30 MHz overtone crystals as the frequency reference.



Motorola MC13175/6 Pinout and Block Diagram.

This nifty chip is very useful for low power transmitters, receiver local oscillators, low power test signal sources and a host of other uses. The chip can be both amplitude and frequency modulated, internally. Just add an outboard doubly balanced mixer and you can apply BPSK PN modulation for direct sequence. Use a DDS or frequency synthesizer for the reference instead of a crystal and you've got a frequency hopper -- need I say more?

Motorola supplies a little development board designed to get you on the air quickly with this chip -- call them, they are there to help!

RF/SS has designed this chip into several recent applications. Our customers love the chip and it's highly simplified support circuitry. This chip truly makes possible a variety of low power, low cost applications that were heretofore impossible.

In a typical application at 3.3 to 3.6 VDC, the chip draws only about 35 milliamperes when active, and can be powered down in standby to next to nothing. You can easily get a few milliwatts of RF power output at 915 MHz, more at lower frequencies.

I think switched crystals are possible with a small modification to this design, so that a ftill function transmitter exciter/receiver local oscillator can be done with only a handful of parts. We are using this chip in a variety of Part 15 devices, without any amplification for both transmit and receive and almost sware by it's reliable, repeatable performance.

Motorola supplies a 32 page application note (Rev. C -- dated 9/18/91) for this part -- be sure you ask them for a copy of it! It will help overcome any doubts you may have about this part. It will also show several other example circuits using the device that you may find interesting.

The schematic on the next page is a typical application circuit that we came up with after studying Motorola's literature. The circuit is a straightforward application of the chip in FM mode using a 30 MHz, third overtone crystal reference. The circuit easily deviates 10 kHz peak at audio rates at 915 MHz. Remember you are modulating outside the PLL's loop bandwidth in this application -- so limit the low frequency end of your modulation, otherwise you may unlock the PLL!

I have run several experiments, and blown up a few parts, trying to power the chip down and trying to AM it -- be careful! The chip works on microampere levels of control current -- I'm not used to that!

The schematic below is built on a two sided PCB, with both "ground" and Vcc "ground planes." Motorola's application note uses the same technique. This microstrip construction seems to work well with these small SMT parts at 900 MHz. No other special precautions are needed to use the MC13176D. Use good quality chip caps, resistors and the L3 coil. Coil L1 is hand wound of 24 or 26 gauge, silver plated solid copper wire, air core, wide spaced. The only RF tuning required is to squeeze or stretch L1 to achieve a reliable lock with chip's on-board VCO.

Good luck using this part! Please send us any feedback you may have. More next month on PM's GaAs chip alternative.

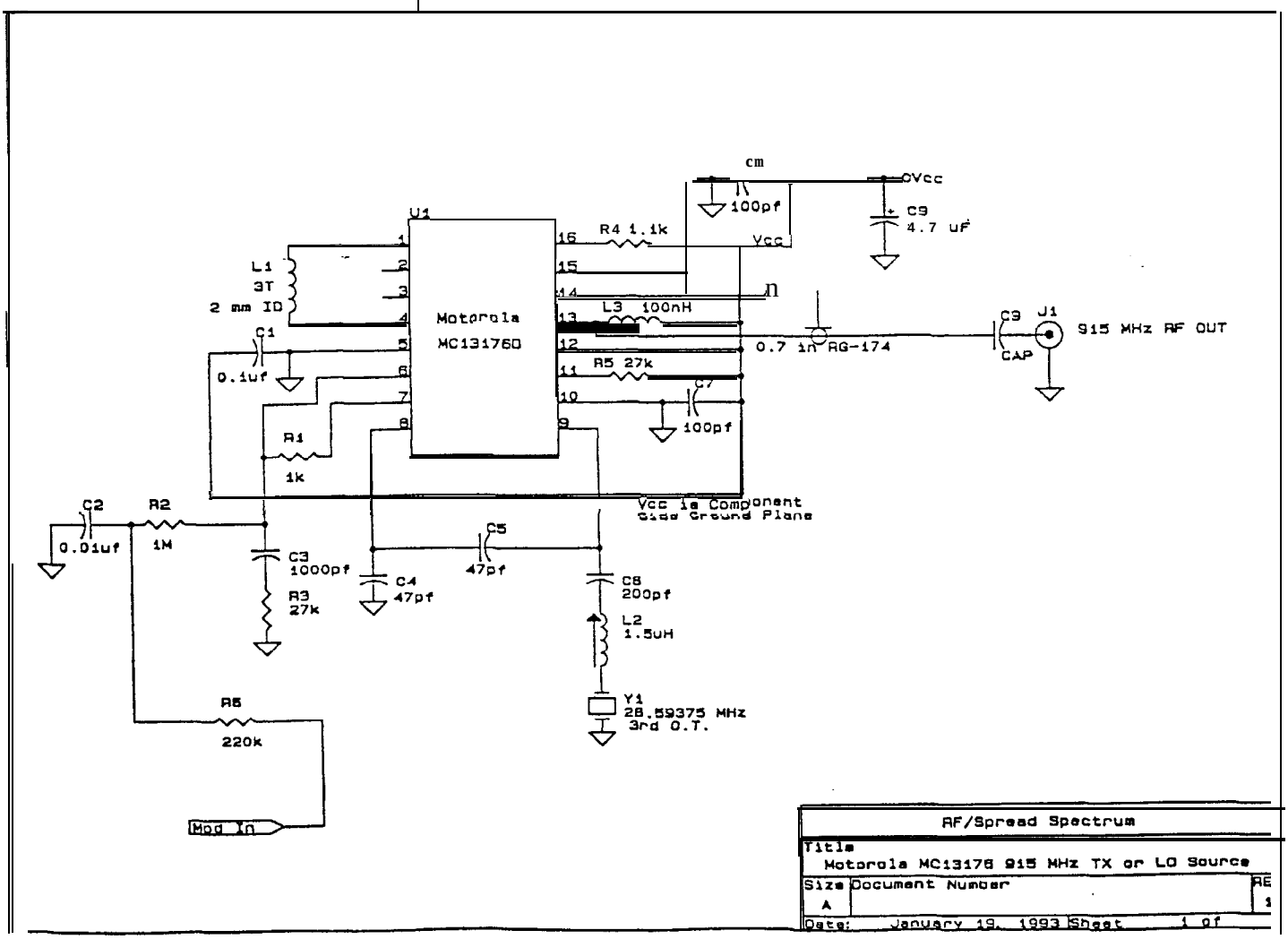
February Preview

Second Half: "A Tale of two Chips," highlights Pacific Monolithic's **PM-TR** 1001 **GaAs** cellular phone chip.

Interesting: More on DSP, HDTV, The Aerial and our other regular features.

Tutorial: Finally, the long awaited continuation of Technical Tricks -- this time with the scoop on correlators.

News: Latest news on Spread Spectrum regulatory, new products and reports on the latest wireless symposiums.



ENGINEERS

Are you interested in a new and challenging career working for a company that develops products for the emerging wireless communications markets such as Digital Cellular, WLAN, PCS, PCN, and GPS?

ESI currently has the following opportunities available:

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