73 Amateur Radio Today

NOVEMBER 1992
ISSUE #386
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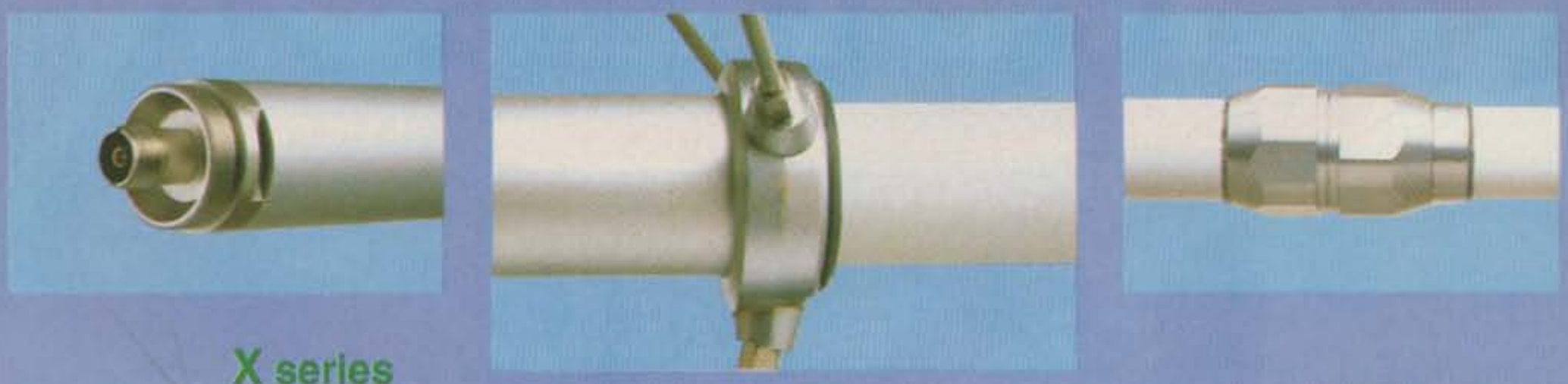

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73 Amateur Radio Today

November 1992
Issue #386

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Stephen Glowacki KC4TMT shows you how to build your own HF mobile antenna . . . see page 18.

Cover: JaMi Smith KK6CU with his mobile foxhunt array. It rotates continuously at 40 rpm and displays bearings on a storage oscilloscope. Find out more in this month's "Homing In." column on page 34. Cover photo by Joe Moell KØOV.

DEPARTMENTS

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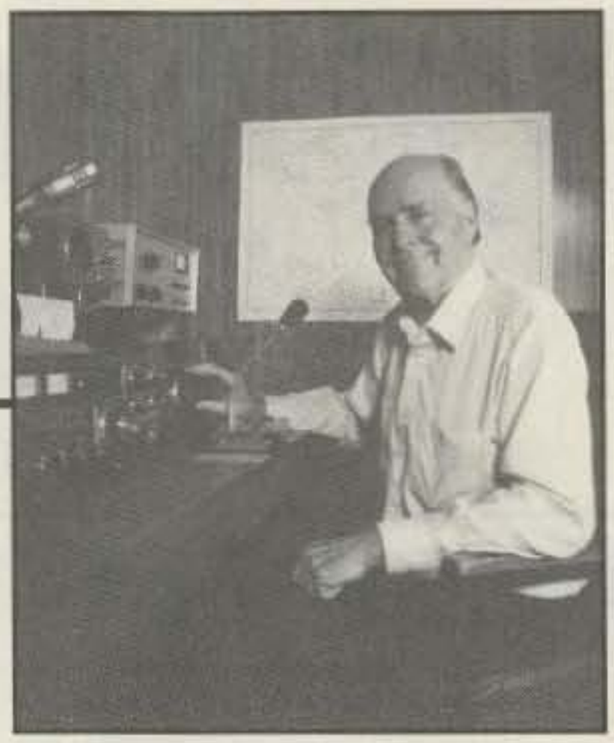

CW In 1992

A reader noted this response when he asked about the code in the military: "We don't train radiomen to copy code any more. Why would we want to train someone to copy code when we can move messages at 1,500 words per minute encrypted, download it, decrypt it, have it letter perfect and hand deliver it to the addressee? The Navy can't live with 35 wpm response times. Heck, even our tugs have high speed communications."

Sure, manual CW is fun. But it's like the fun men have driving antique cars and preserving them. Should our motor vehicle departments insist that people prove their ability to crank a Model T and drive a stick-shift in order to get a driver's license to operate today's automatic shift cars? It makes the same kind of sense.

Making a Buck

The endless whining letters from retired old-timers who are trying to make do on Social Security make me sick. The world is out there with 10-dollar bills hanging from the branches of almost every tree and these old geezers are too lazy to bother to reach up and pick 'em. Then there are the millions of people who are "out of work" and can't find a job. If you can't find a job, make one!

A chap stopped by to visit the other day. Out of work. What can he do? Well, here we are in a recession. Here we are in what looks like it's going to be a very long recession because the factors that caused it haven't been addressed by the administration or Congress yet—nor is there any ray of hope on the horizon that they'll really do anything about it. Well, one man's catastrophe is another's bonanza. When Humpty falls you get busy and make omelets, you don't stand there wringing your hands while hydrogen sulfide develops.

Where are the opportunities for starting small businesses? Everywhere! For instance, with people losing their jobs right and left, many are also losing their homes. This presents a couple opportunities. One is to start making very low income housing for people who suddenly have to live on welfare or unemployment. But my approach as an entrepreneur would be to form a building maintenance service and offer it to the banks. For a reasonable price I'd look after their repossessed houses, keeping the lawns mowed and watered, the bushes trimmed, the windows repaired, the insides clean and dusted. The house isn't going to sell if it looks ratty. I'll bet I could sign up the banks around southern New Hampshire to let me handle at least a couple hundred homes. Heck, there are several just on my little country road that have "For Sale" signs on them and are unoccupied. They all need attention.

Then there are families going on vacation. They need their homes checked, animals fed, and the junk mail taken in. All you need is to be reasonable, dependable and known to your potential customers. To be known you have to have some visibility and that means small ads in the paper, an occasional news item, perhaps a TV interview, if you can organize it. It means mailing cards to the owners of better homes. It means visits to the local banks—and more visits.

Any problem offers opportunities—it's all in how you think about it. My wife Sherry noticed how difficult it was to find good baby-sitters. So she started a baby-sitting service. She interviewed potential baby-sitters and checked their references. She ran ads and checked with the customers to see how well her sitters were doing. She helped train them. The first thing you know she had dozens of sitters and a land-office business going, with her getting a commission on every job. And that was before computers, which would make it even easier to keep track, do the billing of the customers and handle the payroll for all those independent contractor sitters.

So what services are needed in your area? I can think of a bunch more, but let's get your little gray cells perking instead of sitting there in a foop.

Fixing The Brain

It all started with an article in *Analog*. When I was young I read a lot of science fiction. The best was in *Astounding Stories*, edited by John Campbell W2ZGU. The magazine is now *Analog*.

John had an enormous influence on me. He was the first magazine editor I'd ever seen who wrote long editorials about whatever was interesting him at the time. How many magazines have you seen with interesting editorials? It's rare. I eventually got to be good friends with John. We'd get together for lunch every few weeks. Talking with him was exciting—like a mental roller coaster, with ideas on nuclear physics, cosmology, quantum physics and so on going by in rapid succession. He was interested in everything and never restrained by scientific or religious dogma. Alas, he smoked, so he died far too young.

So here I am, still an *Analog* subscriber after 58 years and still turning to their science fact article the first thing every month. They're usually outstanding.

The article they published on how the brain worked made so much sense that I bought the book on the subject. I had to know more. Since I approach all new ideas as a skeptic, I wanted to give this new concept a try and see if it really worked. The idea that painful incidents happening to a baby before it's born could influence it all through life was rejected flat out by doctors and psychiatrists, yet from a systems analysis view, it made perfect sense.

I was a radio announcer at WSPB, a radio station in Sarasota, Florida, at the time. I talked over the idea with a fellow announcer. He was skeptical, but game for us to give it a try and see what would happen. We decided to see if we could find out why he had to cough every time he was starting to announce. He'd solved the problem by installing a small switch by the microphone which would cut it off while he coughed.

So I put him into a light hypnotic state and asked him to repeat the word cough. I then asked him to go to the earliest time he had to cough and to say whatever came to mind. He said, "I've got to cough." I asked him to keep repeating that and see what else came to mind. This developed into, "Every time I get nervous I have to cough."

For about an hour I kept getting him to come up with more words and phrases. I asked him his age and he said eight. I asked if that was years. He said no, it was months. I said before or after birth. He said it was before birth. Hmmm. Sure. Well, if it might help, what's the difference, so we continued. I wrote down the stuff he was saying. The story that emerged was of his mother and father living in the back of a cold, damp factory building. His mother had a bad cough, which apparently was painful to little pre-Joe. The father said something about her staying with the family next door, the Murphys, until she felt better.

Whether this was all fantasy or reality I didn't know, but it was intriguing. Once we'd run through all this stuff a few times Joe never again had to cough when he was announcing. Something worked.

A few weeks later Joe's mother visited for a few days. I took her out to lunch, armed with my notebook. I asked her if she'd ever lived in the back of a factory. She was incredulous. Yes, not long before Joe was born. Was she sick at the time? She thought for a moment and then said she'd had a terrible cough. As far as she could remember this experience had never been mentioned after Joe was born. She'd forgotten about he whole thing until I reminded her. Then I asked if she'd stayed with some friends next door for a while. Yes! And did she remember their name? Was it Murphy? Yes, it was, and she was sure she'd never even thought of them since Joe was born.

This did a lot to convince me that this was a real experience that Joe was bringing up under hypnosis. Of course, there's always the possibility that he might somewhere have heard about all this and forgotten it, but that's a remote possibility since you don't forget things under hypnosis. It's all there.

Being a pragmatist I wasn't quite as interested in whether these were real memories or fake, as long as dredging them up and "running" them would erase the patterns causing problems in present time. I felt I had hold of something important, so I wanted to know more.

The radio station owner was impressed with my announcing and ability to ad lib morning shows. He offered to let me have a three-hour morning spot and share in the ad sales it would generate. This was an opportunity that many disk jockeys would kill for, but while I enjoyed the work, I couldn't see myself devoting my life to being a DJ. I quit to learn more about how to help repair minds. I moved to New Jersey and a research foundation. This turned out to be the wisest decision of my entire life.

In a few weeks of concentrated work I learned how to find and remove the causes of people's problems. Doctors today agree that all diseases have emotional components. What we discovered was how to find these and remove the basic causes for most illnesses. We even discovered that an amazingly high percentage of what seem like accidents have emotional causes.

My experience with Joe was repeated endlessly with other people I worked with. I've been promising my-

Continued on page 74

New MFJ *Super Loop*™ Antenna

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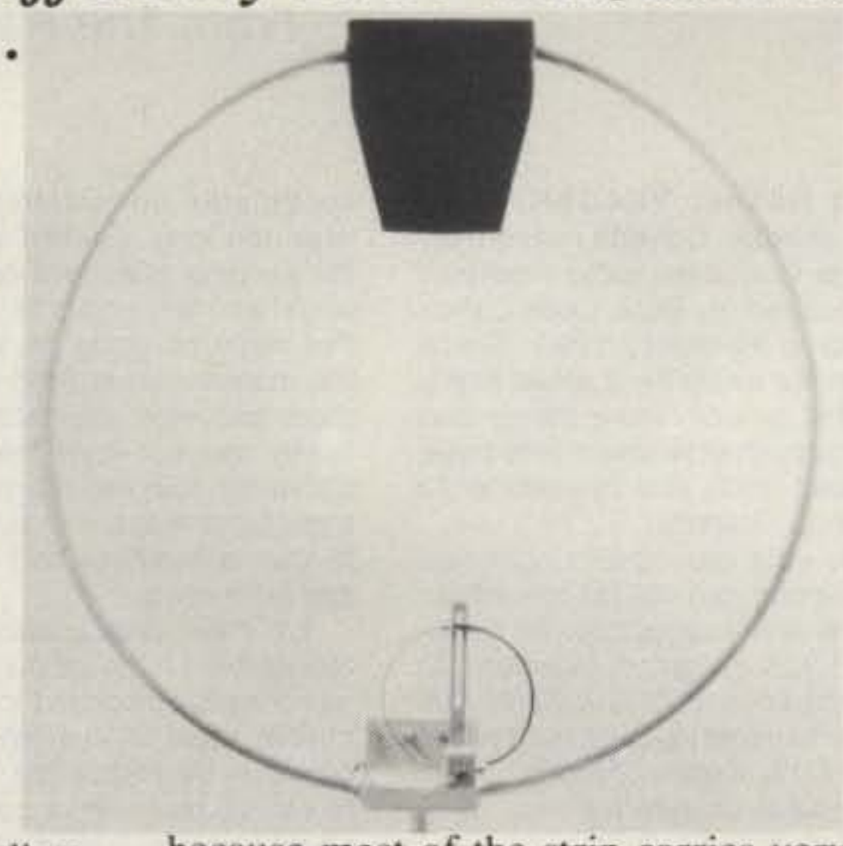

When was the last time you saw a *ally assembled* multiband HF antenna hat fits in the back of a tiny Toyota? **Only** 36 inches in diameter, the ortable MFJ *Super Loop*™ is the mallest high efficiency 10 to 30 MHz ontinuous coverage antenna ever anufactured for ham radio.

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Round conductor has less RF resistance than flat conductor

The following is quoted from *Electronic and Radio Engineering* by Frederick Terman, 4th edition, page 22: " . . . with a conductor consisting of a thin flat strip, . . . the current flows primarily along the edges, . . . the true or effective resistance will be high because most of the strip carries very little current . . . it is not the amount of conductor surface that determines the resistance to alternating current, but rather the way in which the conductor material is arranged."

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LETTERS

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From The Hamshack

David Rosner VE4DAR, Winnipeg, Manitoba, Canada I am a relatively new Canadian radio amateur, having received my Basic Qualification (no-code) in February 1992. Since getting on the air on the 2 meter band, I have tried to learn more theory and practice through discussion with more experienced hams and by reading *73* and other publications.

I enjoy your provocative editorials and remember your call for one million new hams and suggestions for learning CW. I was delighted, therefore, to win subscriptions to *73* and *Radio Fun* at my first hamfest last weekend at the Canada/U.S.A. Peace Gardens.

Please keep us thinking!

Larry J. Clark N2MOS, Princeton NJ Isn't it about time that amateur radio operators started paying their own way around here? We're facing a steadily escalating federal budget deficit, and we expect the taxpayers to pay for our hobby. Let's get real!

Free Lunch Nothing is free. If you want it, pay for it. We haven't paid a lick for what we use, but there are plenty of other people who would like more chunks of "our" spectrum . . . And they **are** willing to put up cash! If you want to use a National Park, you pay. You license your boat and you pay. If we don't pay for it, how can we claim it?

Public Service? This notion of all hams just waiting in ranks to put their radios into public service might just contain a measurable amount of bunk. What is the percentage of hams who **really** participate in meaningful drills and exercises? Most hams spend most of their time doing other radio stuff, some of it rewarding, some of it merely interesting, and (by an increasingly vocal minority) some of it downright destructive to the hobby (20 meters?).

Policing We've got a few Bozos out there. Unfortunately, they take up more than their fair share of domestic and international resources (radio frequencies). What if we decide to redefine the term "self-policing" as meaning the willingness to pay for competent enforcement by a properly staffed, equipped and trained FCC?

I believe that we should pay a fee upon initial licensing, upgrading and renewal. The fee should be sufficient to cover administrative costs during the period of the license, as well as the cost for a reasonable amount of enforcement in the amateur bands. The one exception to fees should be initial (but not renewal) for Novice class licenses. However, I think that a substantial discount for those under 18, the disabled and senior citizens would be in order . . . which, of course, would proportionately raise the fees of non-discounted hams, since we want the hobby to be pretty much self-funded.

The period between renewals will have to be determined, but somewhere in the neighborhood of every two to five years will probably work out. Annual renewal would be an unacceptable administrative burden, while too long a period wouldn't have the purging effect we need. Purging would end any bogus license counting that might be going on, and also give the manufacturers (and publishers) a more accurate estimate of what the hobby needs. I don't feel like actually shoveling gold into the pockets of the manufacturers, but I would like them to stay in business so I can buy stuff and get it fixed.

We might even consider basing the license fee on the amount of spectrum a license is authorized to use. The fair market value of VHF and UHF would probably be higher than HF, since it has more competitive commercial value and isn't as limited by international agreements and treaties.

Partial and/or full relief from fees could be provided by allowing credit to hams who participate in bona fide drills and exercises conducted by federally recognized (perhaps by FEMA?) public service agencies and organizations. This would have to amount to something more than the monthly check-in on the 2 meter net. By maintaining a data base of hams applying for fee credits, we could finally show exactly how many hams really **are** willing to support emergency service operations . . Of course, we have to be prepared for an underwhelming response as well.

A rational license fee would show that we pay our own way, are willing to pony up the bucks to support the FCC's enforcement efforts in our bands, support new and disabled hams, and offer that trained and equipped resource for emergency operations we've always talked about.

There is another advantage for those of us **in** the hobby coming up with a license fee scheme: If we don't do it, and soon, someone else (perhaps Congress) is going to ram it down our throats. Trust me . . . when these things come off the Hill they usually don't work right. The money would probably go into the general fund instead of to the FCC (perhaps an FCC Amateur Radio Trust Fund needs to be established). Congress's idea of a fee schedule could be pretty strange. And it would probably take us years to get Congress to fix things.

I think it is time to pay up.

J. G. Owen, Fort Salonga NY Greetings. I couldn't let that churlish fellow's complaint in the February 1992 issue stand unanswered. *I* like your editorials. Indeed, I have very little to do with ham radio, so probably the only reason I occasionally buy the magazine is for the editorials.

On another topic, from my non-ham viewpoint, the arguments about spectrum usage are very convincing; why *should* we give you guys all this stuff? I mean, if you want to talk to each other, can't you just use a car phone? I don't want to be harsh, but as you've pointed out again and again, hams have to appreciate how the rest of us are going to see this issue, and although I've hardly studied the thing all that much, I haven't heard any very convincing arguments on the hams' side.

Finally, one of the great things about your editorials is the broadsides you level from time to time at various offenders. It wouldn't hurt if you would occasionally go into background so we non-communicants might get the drift. For instance, I found your story in the February editorial about the various early leaders of the ARRL of considerable interest; on the other hand, I've heard a good deal about K1MAN and his nefarious activities, but never what must be obvious background (to hams) about exactly what it is he does. It's true, mostly hams read the magazine, of course, but good journalists (storytellers) should always try to be complete so none of us slower listeners get lost.

Dean Bergmann KB5UVT, Arlington TX Concerning David Cassidy's "Eventually, Morse code will be dropped from all license classes." ("Random Output," September 1992): Since international agreements are involved, it may be a long time before that is true. I suspect that in many parts of the world it is still important that CW rigs cost less; that they are simple enough for an amateur to build; that they use less bandwidth; and that they consume less power. As a newly licensed amateur, I am impressed by QRP CW rigs that can work the world with batteries that would only power a handie-talkie in other modes.

Cassidy is right about one thing: Innovation is vital. Amateur radio once led, and commerce followed. Now the reverse is true. Don't dream of copying commercial modes; dream of entirely new ones.

Dean—CW is, and always will be, a fun way to communicate. The gear is inexpensive, portable and simple to work on. The fact still remains that it is an inefficient way to transmit information and is quickly becoming a "nostalgia mode" like AM. My prediction is that the ITU treaty will drop this requirement someday—the sooner, the better . . . David N1GPH

Edwin S. Oxner, San Jose CA Wayne, you hit the nail squarely on its head—again ("Never Say Die," August 1992). Both our educational system and our prison system are a lost cause. And, none of our politicians are aware of either the problem or the cure.

As I read your column I was hoping to see comments regarding the burgeoning interest in home schooling that many families are adopting. My daughter has four youngsters receiving their education at home. It works, too. A year ago the Montana legislature planned to outlaw home schooling, but through the insistence of my daughter, who was privileged to speak to the joint houses of the Montana State Legislature, home schooling not only remained legal but was encouraged!

Another topic you covered related to corporations going "off-shore" to manufacture, thus depriving millions of Americans of their jobs. A principal cause of this exodus stems from the cross purposes between government agencies, namely the EPA under the guidance of Director Reilly. Why should our factories be forced to align themselves with the machinations of the environmentalists when foreign nations offer tax breaks, low interest loans and low-cost labor enticements? Again, do politicians understand? Obviously not. The EPA is an independent government agency within the Executive Branch, yet Bush still scratches his head wondering why joblessness remains high. Hey Bush: Look in your own back yard! (Remember, Wayne, Reagan dismantled the EPA; it was Bush himself who restored it.)

I appreciate your obvious concern for the welfare of this country; I trust you're concentrating your efforts where they'll do the most good.

Ray J. Howes G4OWY, Weymouth, Dorset, England Wayne, just thought I would drop you a short note regarding your editorial in the August '92 issue.

Suffice it to say that I agree with your incisive hypothesis; as usual it was right on the button. Yes, the British education system sucks, and as you infer it parallels what is apparently happening in America.

You won't be surprised to learn that I have written numerous letters to all those who possess governmental power, but not only that, I have actually spoken to these people in an attempt to dissuade them from their almost maniacal desire to preserve the status quo that unfortunately exists within our educational system. Trying to get these so-called elected "leaders" to see the error of their ways is akin to resurrecting the dead.

Perhaps I should mention the stranglehold the teachers union (N.U.T., quite an appropriate acronym) has on the teaching profession here in the U.K. The union bosses appear to be more interested in preserving their perks and large salaries than in eradicating the cancer that pervades their members' flawed "teaching" methodology. What a jungle.

As there are several teachers who are also hams in my immediate area, I've been expounding the virtues of re-inventing the wheel, so far as teaching is concerned, over my local repeaters, etc. Guess what? For my pains, all I hear from these supposedly "intelligent people" are pathetic excuses and irrational diatribes, instead of reasoned argument or constructive remedies. It's a monster out of control.

Hey, perhaps we need a Rupert Murdoch to do what he did to the British print unions, which were nothing more than constipated dinosaurs awaiting extinction. Murdoch went through them like a dose of salts. You would not believe the salaries "printers" were earning before Murdoch cut off the gravy train.

Don't lose heart Wayne, I'm doing my level best here in the U.K. to persuade those people who matter that education just has to undergo a transformation . . . now. 73

QRX . . .

Number 3 on your Feedback card

SAREX Flies Again on STS-47

The space shuttle *Endeavour* lifted off on September 12 at 14:22:59.974 UTC carrying two ham astronauts (Mission Specialist Dr. Jay Apt N5QWL and Payload Specialist Dr. Mamoru Mohri 7L2NJY) among its seven-member crew. This was the first on-time liftoff since 1985.

Due to the sleep and work schedule of the astronauts, most voice contacts took place over the Eastern hemisphere. Hams in the U.S. and Europe did have ample opportunity to work the shuttle via packet radio. The shuttle's packet callsign was W5RRR-1. This mission's high inclination orbit (57 degrees) put it within reach of those living in the higher latitudes.

Several schools in Australia and the U.S. were contacted directly by the shuttle and over 8000 packet and voice contacts were made during the mission.

A QSL is available if you've worked the shuttle or if you have a reception report. If you made a packet contact with the shuttle, please include your QSO number. Send a SASE (foreign stations should include at least $0 50 postage or equivalent IRCs) to Jay Apt N5QWL at 806 Shorewood Drive, Seabrook TX 77586 USA.

Earthwinds Update

The Earthwinds around-the-world manned balloon flight is now scheduled to fly any time after November 15th. Inclement weather and wind patterns prevented last year's attempt from Akron, Ohio.

This time the launch point has been moved to Stead Field near Reno, Nevada. This area near Reno has some of the most favorable wintertime ground wind conditions in the U.S. and will give the launch team more opportunities for a successful liftoff of the complicated dual-balloon system.

The amateur radio experiment will operate during the mission under pilot Larry Newman's callsign KB7JGM. Twice each hour (at 30 and 55 minutes past each hour) a digitized voice message will give the balloon's latitude, longitude and ground speed on a frequency of 28.303 MHz. Transmissions at 15 and 45 minutes past the hour are also possible. This should give anyone with modest receive capabilities the opportunity to track the balloon's progress as it flies non-stop around the world. The expected flight path should carry the balloon from Reno to Texas, the Midwest and the East Coast during the initial portion of its journey. Launch updates will be posted on the Balloon section of the *73 BBS* at (603) 924-9343.

ARRL Kills Automatic HF Packet Forwarding

At the July board meeting of the ARRL directors it was decided to accept the Digital Committee's recommendation that unattended (automatic) HF packet forwarding should not be allowed. Currently a selected number of stations automatically forward packet messages on the HF bands by permission of a STA (special temporary authority). The current STA expires at the end of the year and will essentially kill the HF packet forwarding network. This network has been in place for a number of years and successfully transfers many thousands of messages each month between packet operators and BBSs across the country and around the world. The League's recommendation is for *semi*-automatic forwarding. This means that only a station with a control operator present may initiate a contact with an unattended HF packet station.

Lyle Johnson WA7GXD has come up with an intriguing proposal in the July '92 issue of TAPR's *Packet Status Register* that would move unattended automatic HF packet operations to segments in the WARC bands (30, 17 and 24 meters) to alleviate crowding on the popular 20 and 40 meter segments currently used.

It's hoped that a reasonable compromise or alternative can come about to keep the forwarding network alive. Write to your ARRL Director with your opinion on these proposals or suggestions for a workable unattended HF packet forwarding system.

Founder of Hallicrafters Dies

William J. Halligan W9AC, founder and retired chairman of the Hallicrafters Company, died July 14 at age 93 in Miami Beach. The man who started the firm in 1933 as a supplier of amateur radio shortwave receivers, and then developed it into a major manufacturer of electronic equipment for the home, industry, the military and aerospace, resided in Bal Harbour, Florida, and formerly in Chicago, Illinois.

Halligan, a native of Boston, Massachusetts, received a radio experimenter's license while still in high school, and held the amateur radio call letters W9AC. He worked as a wireless operator on excursion ships between Boston and other coastal cities, serving in WWI as a radio operator on the battleship *Illinois*.

Halligan attended West Point, but quit the military academy to instead become a newspaper reporter in Boston, and then later in New York. He left journalism to become the sales manager for a radio supply company in Boston, then started Hallicrafters in 1933.

During WWII, Hallicrafters made shortwave radios for the military. After the war ended, the company took to production of home television receivers and peacetime radar. In the early 1960s, the company's military contracts constituted 70% of its revenues. Hallicrafters helped to develop the Air Force Quick Reaction Capability (QRC) program, and then moved into space communications.

A 1953 *Chicago Tribune* article said of Mr. Halligan that due to his prominence in the industry, he was sometimes referred to as "Wireless Willie," or "Radio's #1 Ham."

Halligan, who served as President and CEO of Hallicrafters, continued in that position even after the company was acquired by Northrop in the 1960s. He retired in 1967, and is survived by two sons, William Jr. and Jack, 10 grandchildren and 12 great-grandchildren. *TNX Chicago Tribune; W9JUV; Westlink Report #631, August 14, 1992.*

"Wayne Green's World"

Wayne Green W2NSD/1 is the latest addition to the growing list of ham radio celebrities taking to the airwaves with a radio show of his own. "Wayne Green's World" was kicked off on Thursday, August 6th, as a part of the new lineup on the revamped Let's Talk Radio Network. In his first outing, Green touched on several subjects that included national politics, the welfare system, educational travel and cooking, as well as amateur radio. According to LTRN Producer/Director Frank Collins N6TAF, the response to Green's new program was overwhelming. Collins says that he received numerous calls after the program to congratulate the organization on bringing W2NSD to the satellite radio network. "Wayne Green's World" can be heard every Thursday at 9:00 p.m. Eastern time over LTRN on GTE Spacenet III, Channel 21, 6.2 MHz audio. *TNX Westlink Report, #632, August 28, 1992.*

Instant Licenses for Aliens?

The FCC on August 6th issued a Notice of Proposed Rule Making in P.R. Docket 92-167 to provide a way in which foreign amateurs could secure 60-day operating permission while visiting the U.S. The plan would include amateurs from countries with which the United States has no reciprocal operating agreement and would have volunteer examiners handle the mechanics of the applications. The comment deadline for P.R. Docket 92-167 is October 26.

The FCC proposes to have VEs examine the foreign operator's amateur license and identification, and determine the applicant's home operating privileges, then administer a 20-question examination "on those aspects of our rules that are most applicable to the type of operation in which the visitor plans to engage while in the United States."

The FCC suggests that VEs could compile the 20-question examinations from existing question pools maintained by Volunteer Examiner Coordinators.

Upon passing the examination, the foreign applicant would receive a Certificate of Successful Completion of Examination, which would serve as proof of the foreign operator's conditional license authorizing operation in the United States, according to the FCC.

The volunteer examiners then would notify their coordinating VEC, who would add the pertinent information on the foreign applicant to a data base that is maintained and forwarded to the FCC on a regular basis. The foreign operator would be allowed one maximum 60-day operating period in the U.S. at any time within 365 days of the issuance of the CSCE. *TNX Westlink Report, #632, August 28, 1992.*

The QRP 80/40 CW Sender

QRP power and QRP cost.

by Richard Q. Marris G2BZQ

My original plan was to home-brew a simple CW transmitter for a daily, early morning, point-to-point QSO with a friend in Germany, using 3665 kHz. This was a distance of 400 miles or so. I figured that around 5 watts CW would suffice, and decided to use semi-conductors. A look at some recently published designs indicated that this would involve a printed circuit, several semi-conductors, maybe 50 or more components, plus all the components for an AC power supply.

I went back to the happy days when I, and many others, used a single 6L6 or 6V6 transmitter and worked the world. With these happy recollections in mind, things really got out of hand—one thing led to another, and the QRP 80/40 was born.

This transmitter is a personification of simplicity in circuitry, simplicity in construction, QRP in power, and QRP in cost. It covers both the 80 and 40 meter bands, and is built into an existing metal cabinet measuring about 8.6" wide x 4" high x 4.1" deep (that includes the built-in AC power supply). It uses just one tube and can be loaded to 5 watts or so. In fact, the result is less complex than so-called "simple" semi-conductor jobs. The reliable, robust 6BW6 tube can be quickly changed and the design does not require a printed circuit—all major components have solder tag connections and the smaller components can be slung between them. By all means, toil away on a printed circuit board if it will make you happy, but I have always believed that "the simplest is the bestest." In addition, 85% of the bits and pieces were in my junk box.

The circuit in Figure 1 shows a relatively conventional circuit using a 6BW6 tube (V1), crystal-controlled with a pi-output circuit which is tunable over both 80 and 40, by simply plugging in an FT-243 crystal (either 80 or 40 meter band)

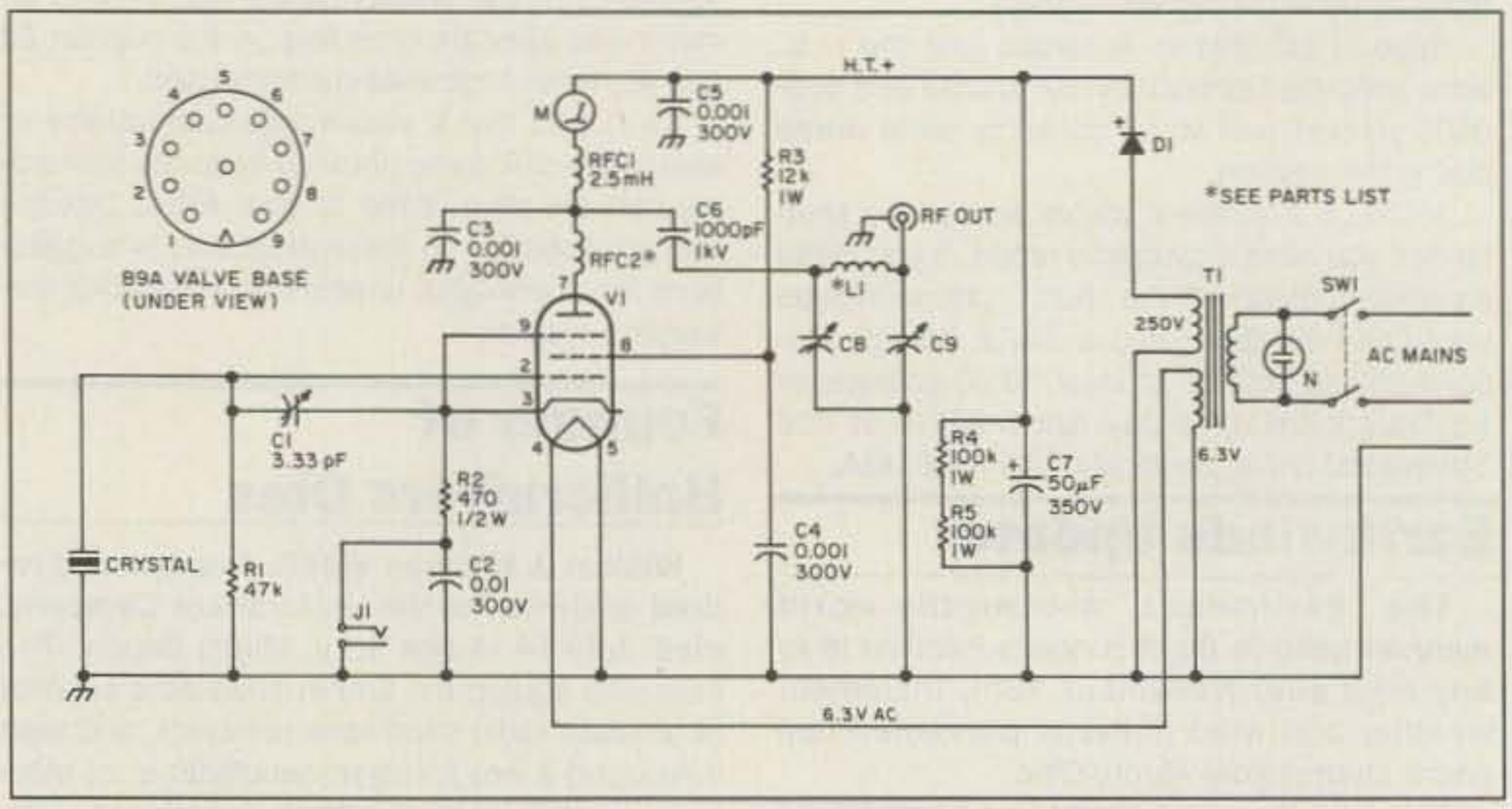

Figure 1. Schematic of the QRP 80/40 CW transmitter.

for the selected band. Do not try to double an 80 meter crystal to the 40 meter band. The purpose of C1 (3–33 pF trimmer) is to pre-set adjust for a clean CW note, which can be a problem with a single tube TX. The power of the TX could be increased by decreasing the value of R3, at the risk of a T7/T8 note.

C8 is a single-gang 365 pF air-spaced good quality receiving type variable capacitor. C9 is a similar 2-gang 365 + 365 pF variable capacitor with both sections wired in parallel to give 730 pF total capacity. Both an external LC and "T" type ATU have been used with success and no detectable harmonics.

The built-in AC power supply half-wave rectifier used was an old Westinghouse 18RA which was in the junk box, but Radio Shack/Tandy and others stock suitable low cost alternatives.

The whole TX + AC power supply is enclosed in an existing metal cabinet 8.6" wide x 4" high x 4.1" deep, onto which a new front panel was fitted. A simple ⌐¬ shape chassis was made and fitted to the panel as shown in Figure 2, which also shows the assembled layout of the main components on the front panel and chassis. The size of the cabinet/chassis is not critical and the positioning of the major components can be adjusted slightly to accommodate the actual component sizes used by individual constructors. The HT DC plate voltage with "key down" was 115 volts DC.

L1 is wound on a length of 1" diameter PVC or plastic tube using 35 turns of 24-gauge enamel copper wire spaced one turn. The L1/C8 + C9 circuit should tune to the 40 meter band near minimum capacity. However, individual coils and layouts may differ slightly. If necessary, a small number of turns can be removed from L1 to achieve 40 meters with the C8 plates about 15% enmeshed, and then the 80 meter band should resonate with C8 plates about 65% enmeshed.

To test the TX, adjust C1 and C9 to maximum capacity and plug in a 50-ohm dummy load. Next, insert an 80 meter band crystal, press the key, and tune C8 for minimum current on the meter; then increase the current by detuning to give a

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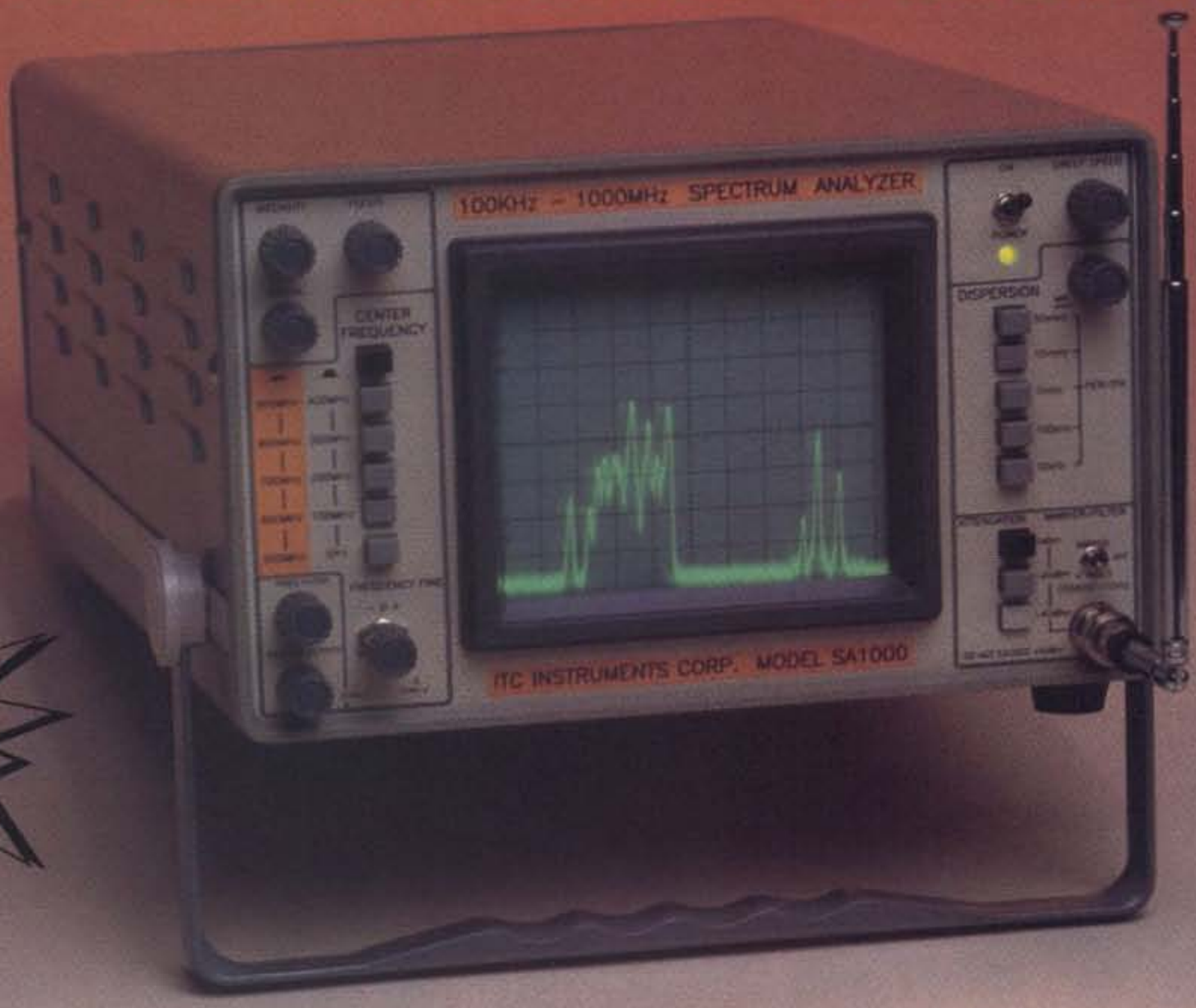

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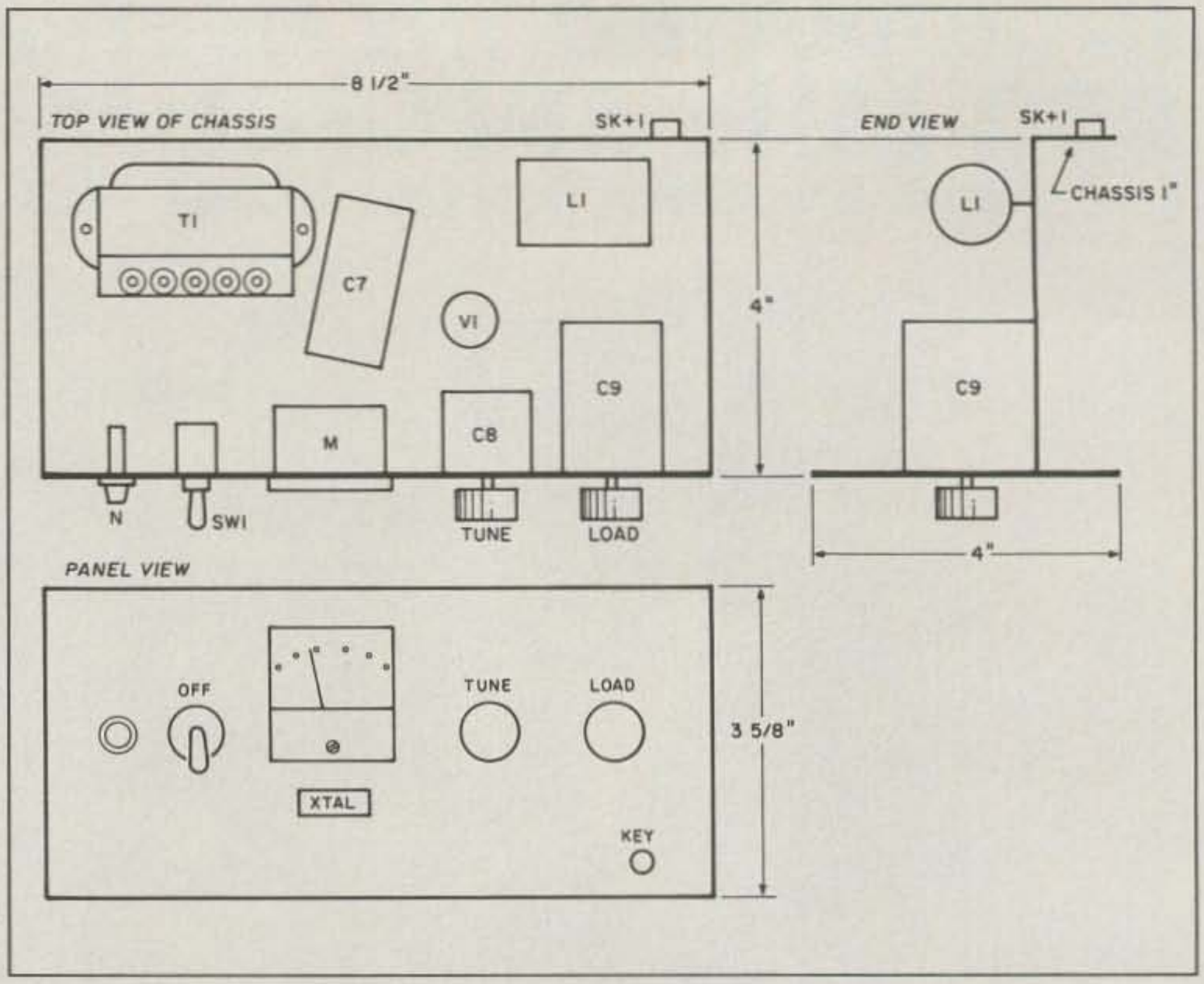

Figure 2. Panel/chassis assembly layout.

2 mA increase in current so that the crystal is oscillating smoothly. Increase the antenna load by tuning C9 for maximum current. Now listen on an RX and adjust C1 for the best keying note. Repeat all the above with an ATU and antenna in place of the dummy load. Readjust C1 for the best note. It should not be necessary to readjust C1 again unless the 6BW6 tube is replaced.

Repeat all the above with a 40 meter band crystal—*but* without any further adjustment of C1. Do not use an 80 meter crystal on 40 meters.

Remember—higher voltages are used in tube transmitters than with semi-conductors, so TAKE CARE!

With this little QRP one-tube transmitter I have been able to maintain the regular early morning QSO into Germany, and have met little difficulty in working all over Europe with an indoor antenna, providing a useful standby transmitter.

Have fun with "The QRP 80/40 Sender." 73

Parts List

R1	47k, 1/4 watt
R2	470 ohms, 1/2 watt
R3	12k, 1 watt
R4	100k, 1 watt
R5	100k, 1 watt
C1	3-33 pF trimmer
C2	0.01 µF/300V working minimum
C3,C4,C5	0.001 µF/300V
C6	1000 pF @ 1kV
C7	50 µF/350 volts electrolytic
C8	365 pF single gang airspaced variable capacitor
C9	365 + 365 pF two gang airspaced variable in parallel—730 pF
Crystal	3.5 & 7 MHz band crystals—FT243 with panel mounting socket
V1	6BW6 tube + B9A ceramic chassis mounting socket
D1	(Westinghouse 18RA used) any suitable type available
RFC1	2.5 mH RF choke
RFC2	9 turns close-wound PVC hook-up wire wound on 3/16" diameter rod, and removed
J1	Jack socket for Morse key plug
L1	35 turns 24 gauge enamel copper wire, spaced 1 turn and wound on 1" diameter PVC or plastic (paxolin in the U.K.) tube
N	Neon panel light
SW1	2-pole on/off switch
T1	Transformer—secondaries 1.) 250 VAC @ 60 mA (minimum) 2.) 6.3 VAC @ 1 amp (minimum)

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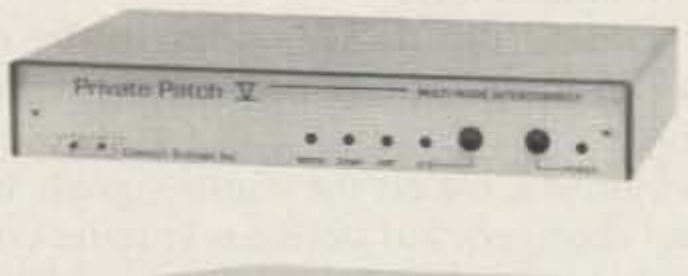

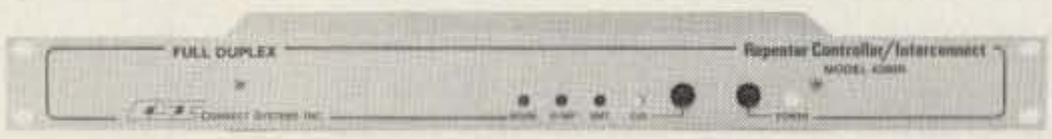

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The Noise Remover

A simple, effective way to get rid of the static.

by Gerald F. Gronson K8MKB

There have been a number of remarks as to how a really narrowband CW filter becomes useless when a lot of "static" noise is on the band. The source doesn't matter; the result is the same. The filter becomes a tone generator and the signal you are trying to copy is lost.

One solution is the noise circuit described in this article. It is adjustable from "no effect" to "no signal out," requires no special parts, and can be made small enough to be installed in an existing add-on CW or SSB filter. It can also be used in one of the new simple receivers, such as the Sudden (see the October '91 issue, p. 8), to give the receiver a bit more performance.

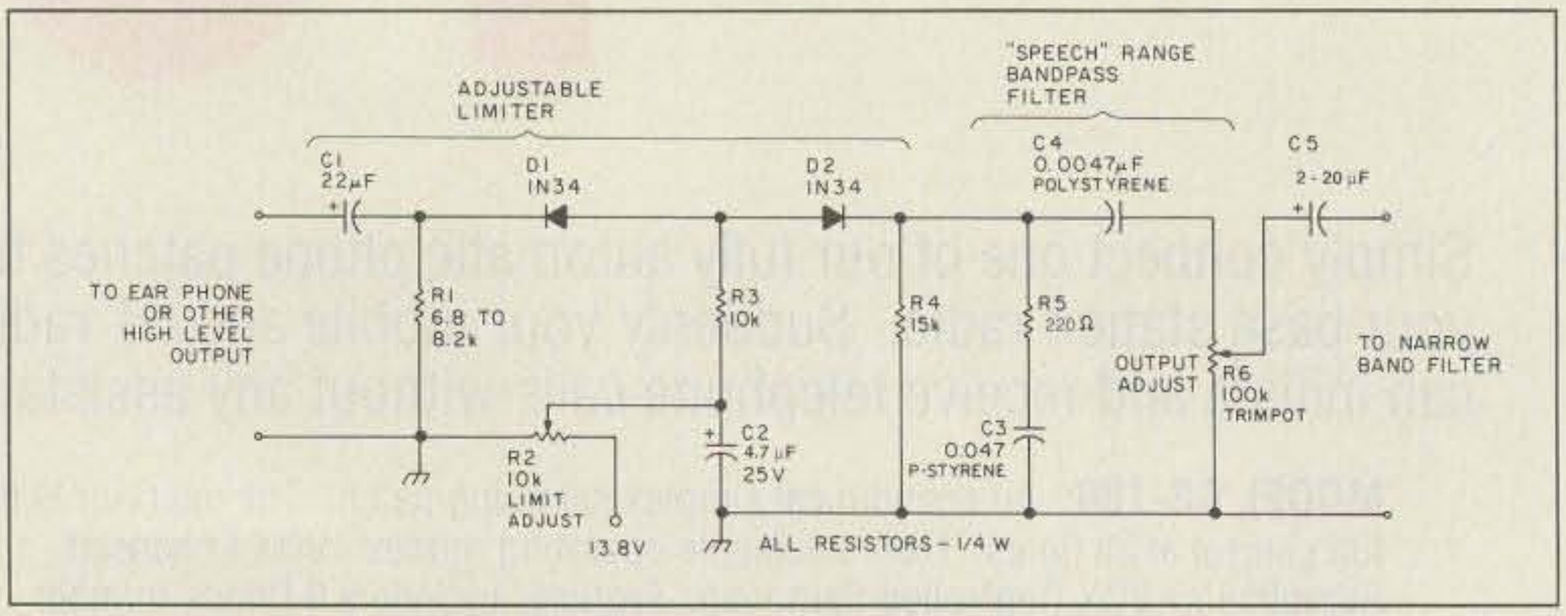

Figure 1. Noise-limiter schematic. Use this circuit if a high level signal is available and you have an "add-on" narrowband filter.

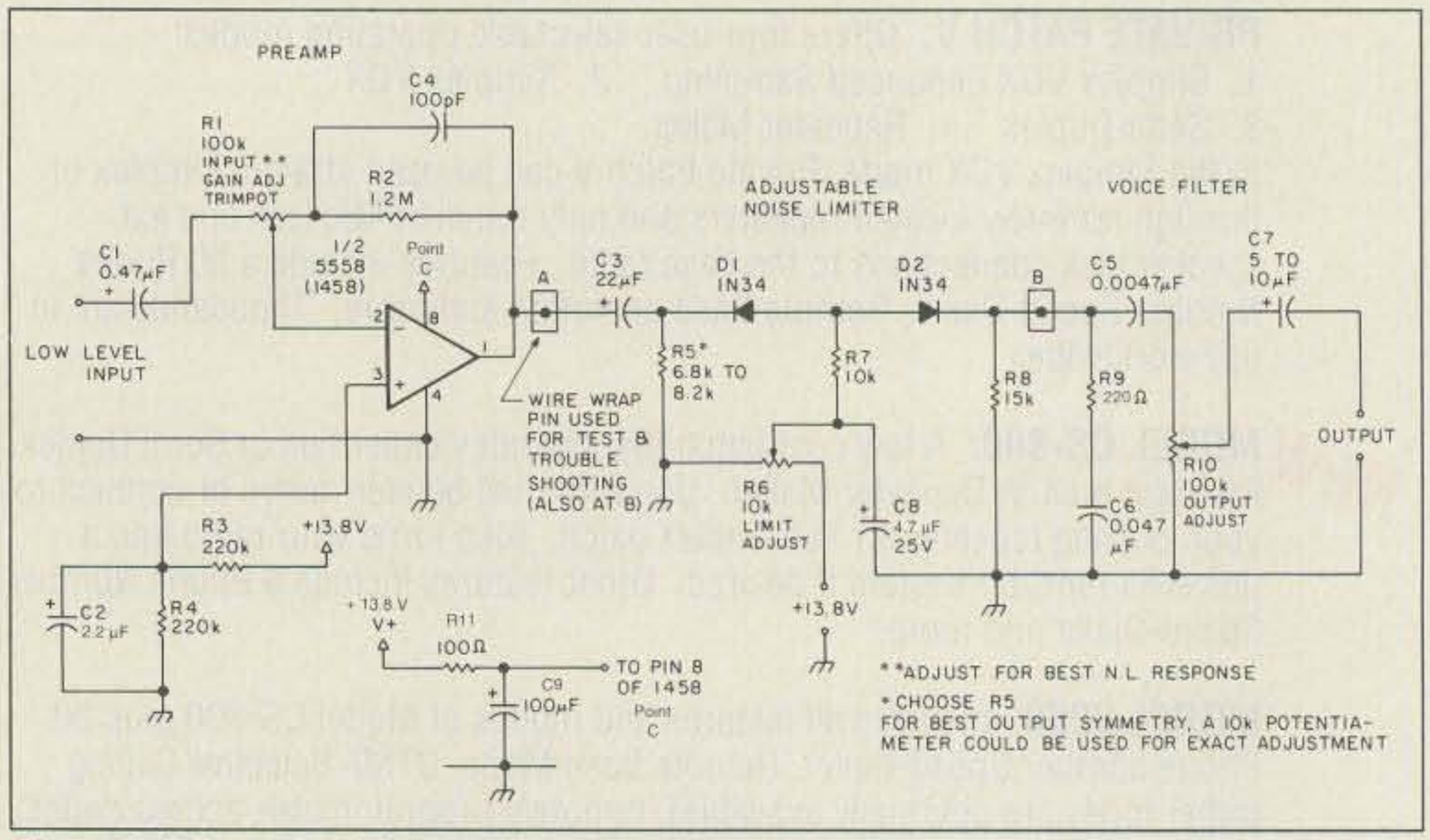

Figure 2. Schematic of the noise-limiter with a pre-amp. For a low level signal if you have an "add-on" filter such as an MFJ CW type.

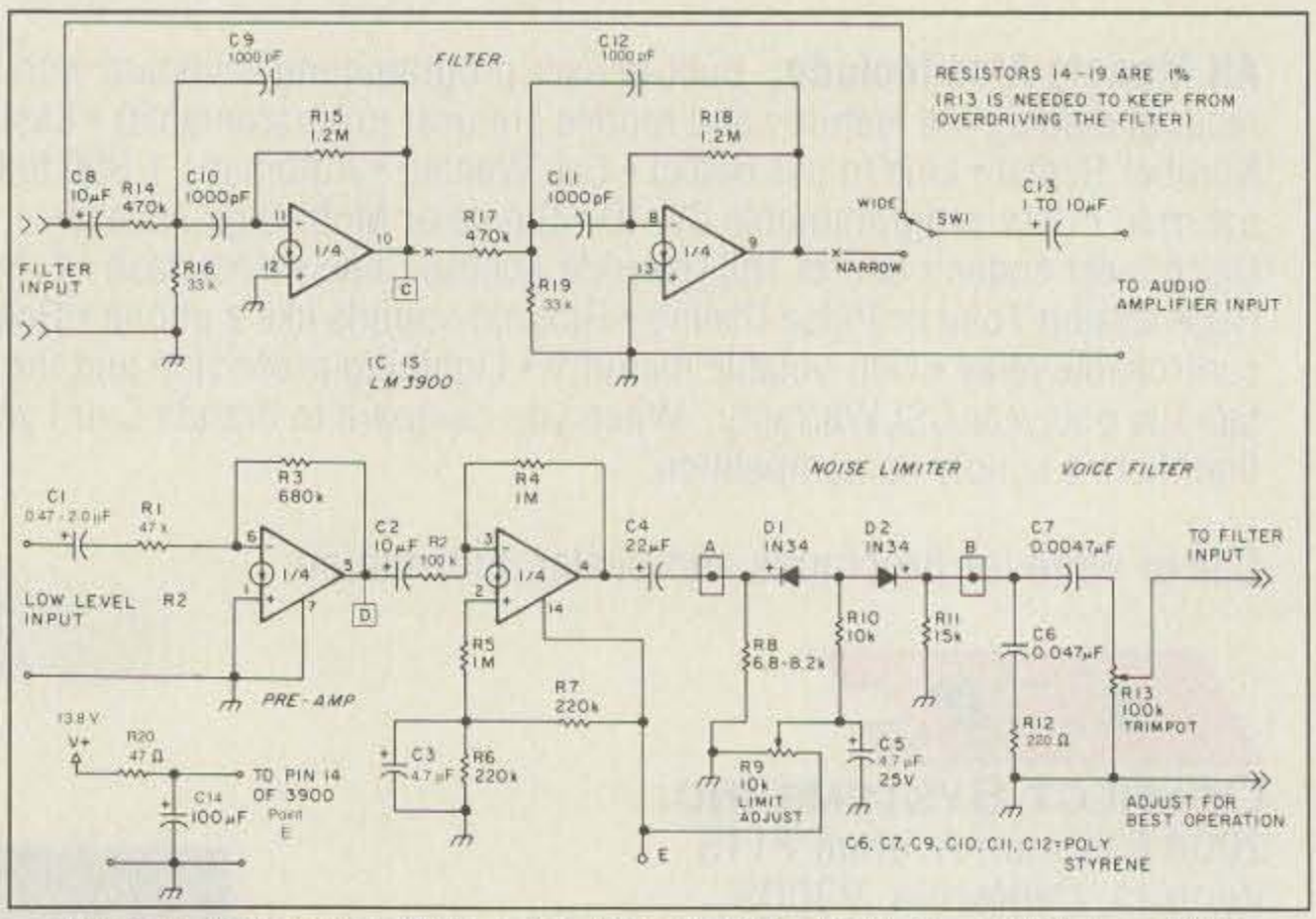

Figure 3. Schematic of the noise-limiter with a built-in amplifier and filter.

The Noise-Limiter Circuit

The circuit that does the job is shown in Figure 1. Most noise-limiter circuits are of the shunt type. This one is a series limiter. The bias on the diodes is adjusted by the 10k limit adjust pot. The resistor marked 6.8 to 8.2k (a 10k/25 turn pot can be used here) is used to adjust symmetry. The capacitor is a bias filter; the 15k resistor is the output load. The 220 ohm, 0.047 µF, and 0.0047 µF capacitors form a speech range filter. The 100k output adjust potentiometer can be a trimmer or a standard audio taper "volume control."

Putting the noise limiter in the receiver ahead of any filter makes copying a signal easier. It's like closing the window a bit on the radio signals being received, but unlike a volume control, small signals get full amplification and big signals get clipped.

Three circuits are shown. With so many different situations out there it's a hard call to make as to which circuit to recommend, but it is best to place the noise limiter ahead of any filter. In the Sudden receiver, place the noise limiter ahead of the LM386. In fact, in a simple receiver, use the circuit in Figure 3. The circuit between the X's could be omitted for first-time builders. All it does is give steeper

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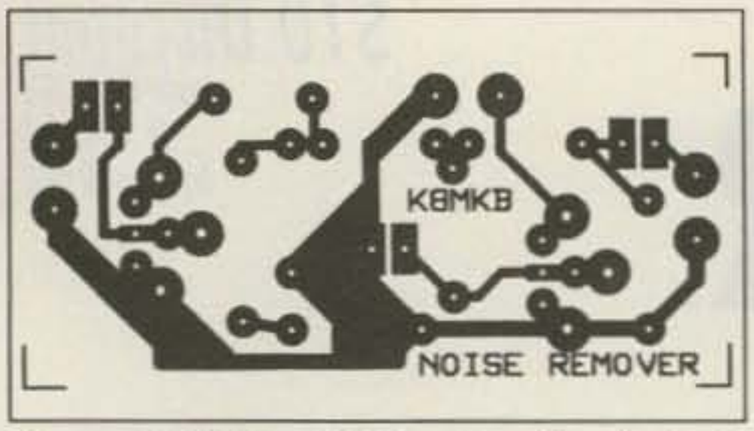

Figure 4. PC board foil pattern for the basic noise-limiter (refer to Figure 1).

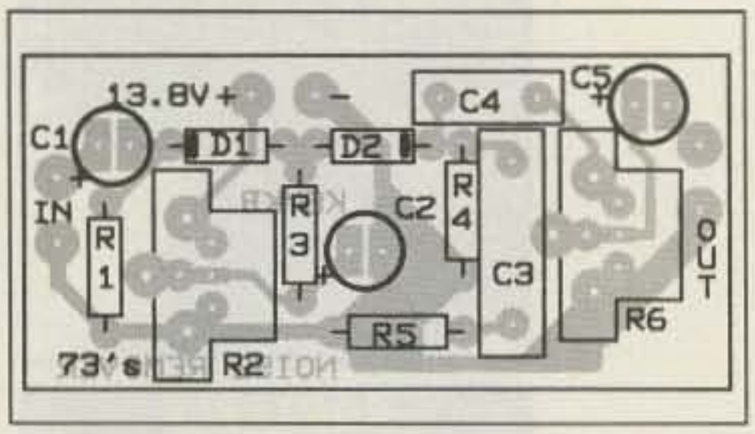

Figure 5. Parts placement for the basic noise-limiter.

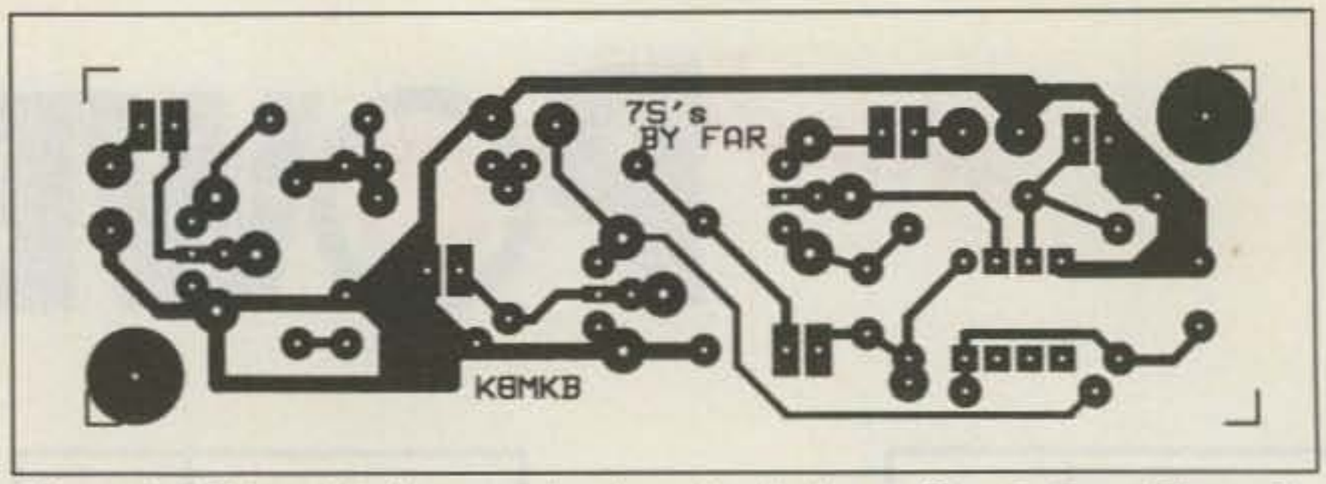

Figure 6. PC board foil pattern for the noise-limiter + filter (refer to Figure 2).

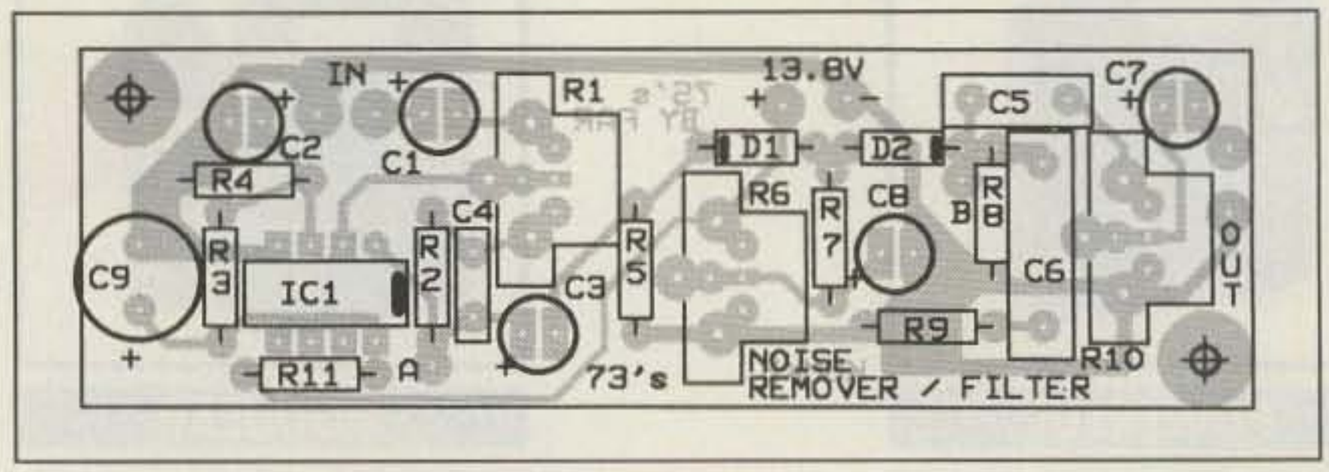

Figure 7. Parts placement for the noise-limiter + filter.

skirts to the bandpass response. It is a definite improvement, but not really necessary. The output trimpot is adjusted, in any case, to keep from overdriving the filter. Using fixed resistors that are about 35% lower in value will allow operation of the limiter on 9 volts. It could then be built into one of the existing add-on filters, such as one of the MFJ models.

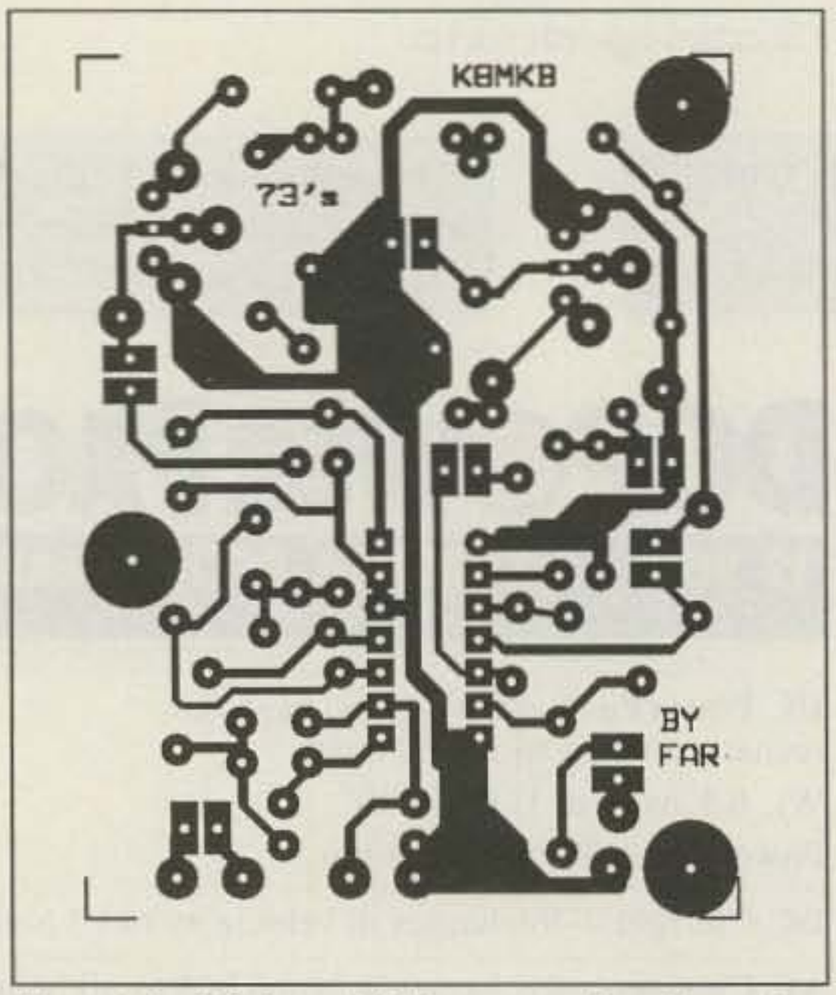

Figure 8. PC board foil pattern for the noise-limiter + filter + preamp (refer to Figure 3).

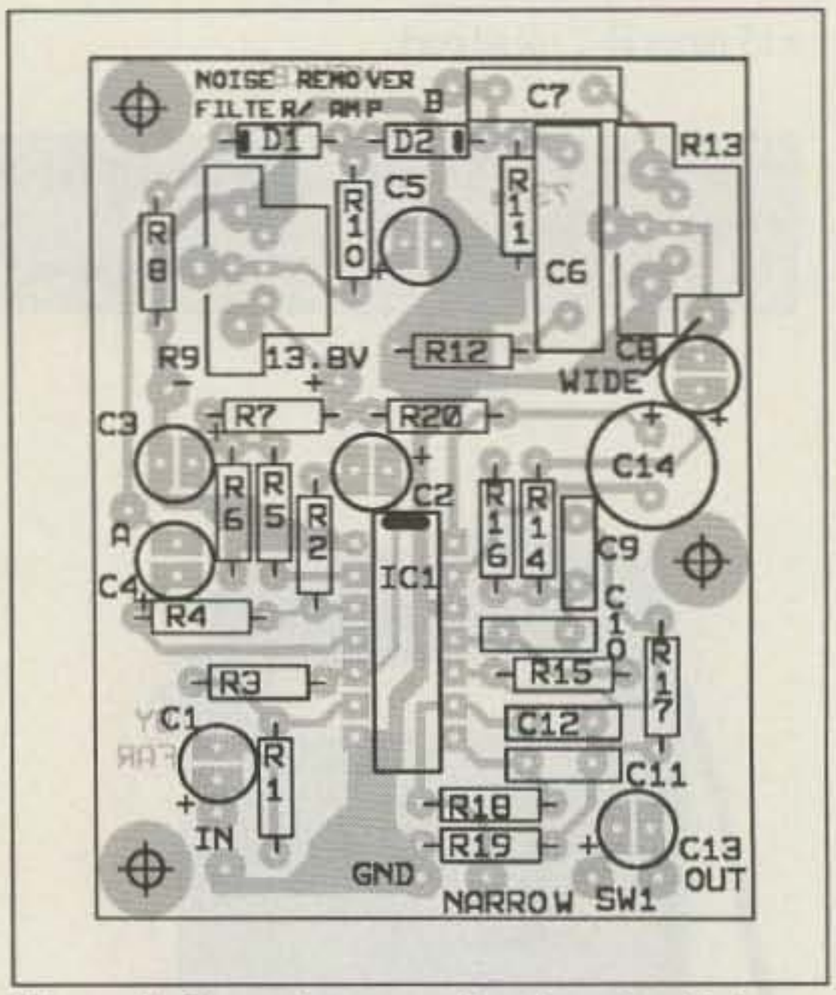

Figure 9. Parts placement for the noise-limiter + filter + preamp.

Assembly

The noise limiter can be assembled on perf board. PC boards are also available (see the parts list on page 16). Glass epoxy is preferred to paper phenolic. Use a low-watt soldering pencil, and *heat-sink the diodes*. Quarter-watt resistors are used throughout. *Poly-styrene* capacitors are used in the filter circuits, as are 1% resistors (you can get by with 5%). The squares with dots are wire wrap pins. Wire wrap pins are handy for making connections to pots, power connections, and input-output connections.

Adjustments

I used a panel mount pot for the *limit adjust* pot (R2 in Figure 1, R6 in Figure 2 and R9 in Figure 3) so I could easily adjust the noise reducer. Hook up a 10k pot in place of the resistor marked 6.8 to 8.2k (R1 in Figure 1, R5 in Figure 2 and R8 in Figure 3) for initial adjustments (you can leave the pot in place when done or measure its final value and replace it with a fixed value).

"I believe that this circuit can improve copying a CW signal in a high QRN situation by between 60-80%. Try it; you'll like it."

Tune in a signal with your receiver and set resistor R1 (marked R5 in Figure 2 and R8 in Figure 3) to 2/3 of its maximum resistance. Next, set the *limit adjust* pot (R2 in Figure 1, R6 in Figure 2 and R9 in Figure 3) to maximum. Then adjust the output pot (R6 in Figure 1, R10 in Figure 2 and R13 in Figure 3) for the optimal output level. Adjust the *limit adjust* control (R2 in Figure 1) counterclockwise until clipping occurs (listen for a definite change in the quality of the sound). Rock R1 back and forth until you hear a clean sound. From this point on you only need to adjust the *limit control* for noise reduction.

I believe that this circuit can improve copying a CW signal in a high QRN situation by between 60-80%. Try it; you'll like it. 73

See the parts list on page 16.

The Noise Remover *Continued from page 14*

Parts List.

Basic Noise-Limiter (see Figure 1).	
C1	22 µF electrolytic
C2	4.7 µF/25V electrolytic
C3,C4	0.047 µF polystyrene
C4	0.0047 µF polystyrene
C5	2 to 20 µF electrolytic
R1	6.8 to 8.2k
R2	10k potentiometer
R3	10k
R4	15k
R5	220 ohm
R6	100k trim pot
Noise-Limiter with Preamp (see Figure 2).	
C1	0.47 µF tantalum
C2	2.2 µF electrolytic
C3	22 µF electrolytic
C4	100 pF
C5	0.0047 µF polystyrene
C6	0.047 µF polystyrene
C7	4.7 to 10 µF electrolytic
C8	4.7 µF/25V electrolytic
C9	100 µF electrolytic
R1	100k trim potentiometer
R2	1.2 MEG
R3,R4	220k
R5	6.8k to 8.2k (choose for best symmetry or use 10k pot)
R6	10k potentiometer
R7	10k
R8	15k
R9	220 ohm
R11	100 ohm
R10	100k potentiometer
D1,D2	1N34 diodes
U1	1458 op-amp IC
Noise-limiter + Amplifier and Filter (see Figure 3).	
C1	0.47 to 2.0 µF electrolytic
C2	10 µF electrolytic
C3	4.7 µF electrolytic
C4	22 µF electrolytic
C5	4.7 µF electrolytic
C6	0.047 polystyrene
C7	0.0047 polystyrene
C8	10 µF electrolytic
C9,C10,C11,C12	1000 pF polystyrene
C13	1 to 10 µF electrolytic
C14	100 µF electrolytic
R1	47k (or 100k potentiometer)
R2	100k
R3	680k
R4	1 MEG
R5	1 MEG
R6,R7	220k
R8	6.8 to 8.2k
R9	10k potentiometer
R10	10k
R11	15k
R12	220 ohm
R13	100k trim potentiometer
R14	470k, 1% tolerance
R15,R18	1.2 MEG, 1%
R16,R19	33k, 1%
R17	470k, 1%
R20	47 ohm
D1,D2	1N34 diodes
U1	LM3900 IC

Note: Etched and drilled PC boards are available for each version of the Noise Limiter from FAR Circuits, 18N640 Field Court, Dundee IL 60118. The basic Noise-Limiter PC board is $3.00, the Noise Limitier + Filter is $3.75 and the Noise Limiter + Filter + Preamp is $4.00. Please add $1.50 per order for shipping/handling.

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An All-Band HF Mobile Antenna

Efficient and inexpensive.

by Stephen A. Glowacki KC4TMT

There are many reasons why we build antennas. Often we want something in particular that we either can't buy commercially or can't afford.

As the county's Emergency Coordinator I needed a good mobile multiband antenna. I initiated this design to favor materials available at local hardware stores. This tends to make repair easier and helps keep the overall cost down. The following mobile design can be constructed for about $20, with subsequent band coils costing less than $3-$5 each.

Much of the designing for this antenna was done with the aid of the *ARRL Antenna Book* and the *ARRL Handbook*.

Theory

The main idea behind an HF mobile antenna is to maintain the electrical length while shrinking the physical length to a practical size. The way to do this is to incorporate some sort of loading coil at either the base or the center. Each has its merits. Base loading has the advantage of physically placing the weight of the coil near the car. This avoids the need for guy connections.

I'll include some references to the math, but not many. If you really want the full outline of the calculation process and formulas, contact me and I'll be more than glad to QSO about it.

RF current is maximum at the point immediately above a loading coil. With a base-loading antenna, the efficiency is less because this current tapers off quickly as it goes toward the top of the antenna. However, with center loading, the radiation efficiency improves quite a bit. Optimum positioning is somewhere between 50%-70% up the total length of the antenna.

RF current varies with the cosine of the height in electrical degrees at any point in the base section. In a center-loaded antenna this characteristic results in more current being allowed to conduct higher up the antenna. This is more efficient, compared to a base-loaded antenna. The current then tapers off above the coil normally, resulting in an overall increase in the efficiency of the antenna.

Unfortunately, center loading requires a larger inductance than base loading in order to cancel out the increased capacitive reactance (X_c). (This increase is due to less antenna being available for resonance above the coil.) This larger inductance then requires a larger Q-factor (to maintain the same comparative radiation efficiency as a base-loaded antenna).

Photo A. Stephen Glowacki KC4TMT stands next to his mobile antenna.

This need for larger inductance and Q-factor forces the construction of physically larger coils. With placement of the coil being higher, wind-loading problems require the use of guy connections. (I hate to think in terms of guy wires when working with my car.)

Theoretically, if the coil is moved much beyond the two-thirds mark, the size of the coil would become impractically large and make it impossible for mobile use.

Most of the dimensions of this antenna resulted from the materials I had on hand at the time. The numbers are only internally significant and changes can be made easily with minor adjustments to the rest of the antenna, i.e. if you shorten the top antenna section, increase the number of turns on the coil; if you lower the position of the coil along the antenna, use less turns on the coil. (The opposite of these remedies is true for reversed conditions.)

To achieve optimum efficiency you need to balance all the characteristics of the antenna. The measurements given will put you in the ballpark, but fine-tuning is always required. Be patient in fine-tuning the antenna to your car. A good way to ensure a favorable outcome is to set plenty of time aside and follow consistently whatever procedure you devise to trim the coil.

The matching system listed here is only one of many. The general approach is to cause the antenna to be capacitive; that is, to have it resonate at a frequency slightly higher than what you want. This will also increase the impedance of the antenna. The increased capacitance can then be canceled by an inductance in the matching portion.

The opposite is also true. However, using an inductor seems to be easier—it's less sensitive to surrounding conditions and, thus, more predictable than an air capacitor.

The third approach is to use a combina-

Continued on page 21

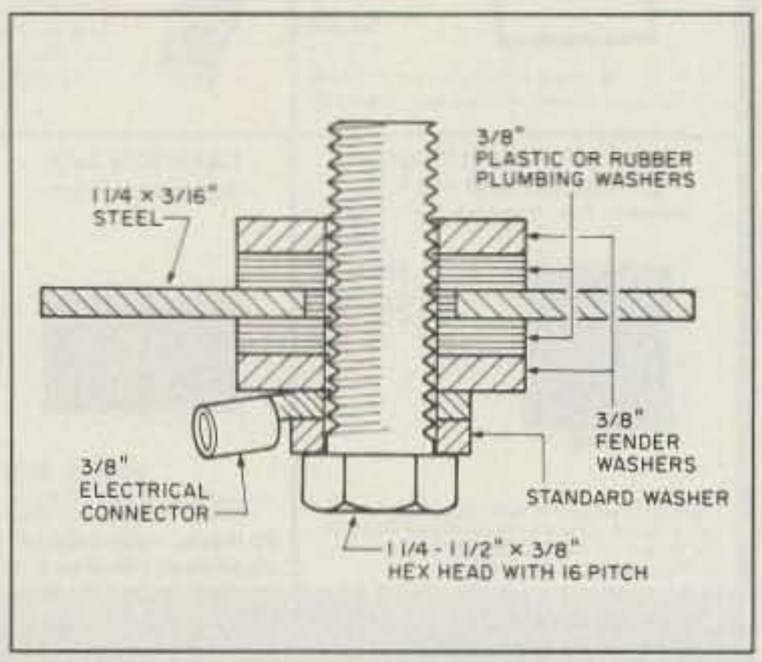

Figure 1. Antenna bracket.

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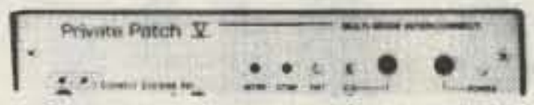

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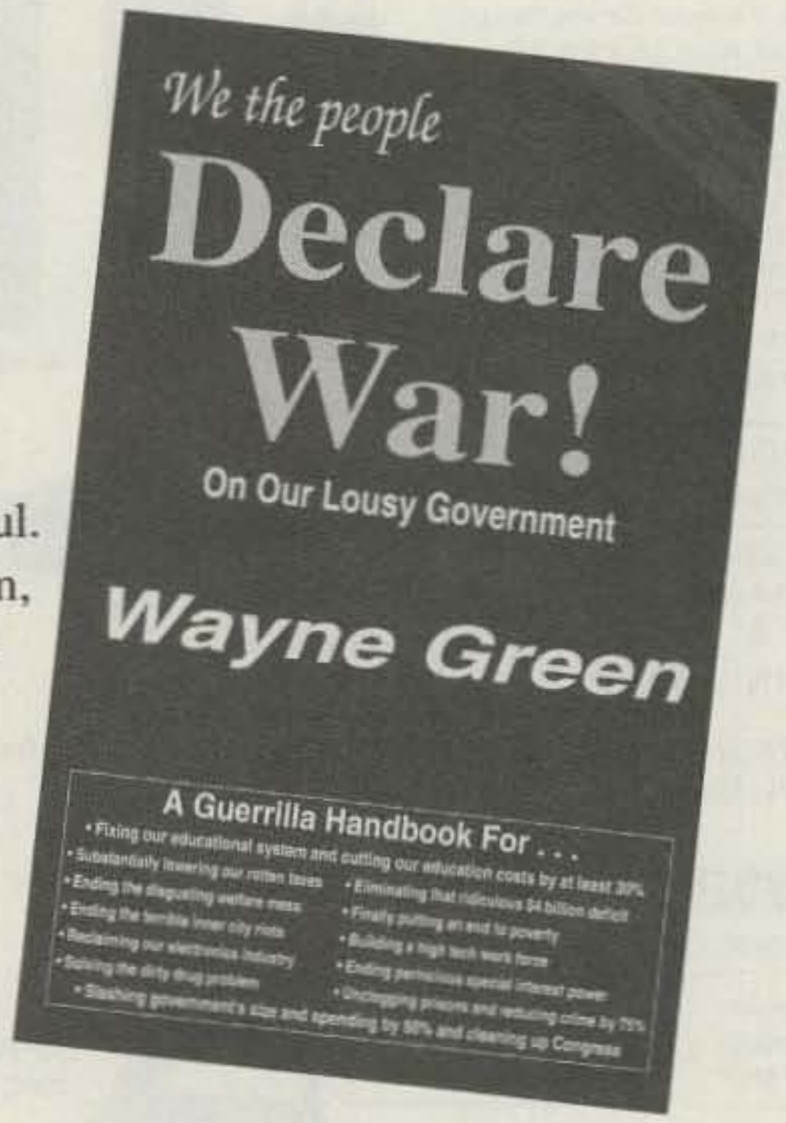

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Photo B. Close-up view of the loading coil.

tion of inductance and capacitance shunted in parallel to ground. This is most effective since it is basically a custom-made antenna tuner. I recently experimented with this design and found it to be very successful. To make this addition, simply locate a variable air cap having somewhere between 15 and 600 pF and mount it either directly on the car or on an enlarged platform able to hold both. Wire them in parallel and you're ready to go.

I've been able to tune the existing center loads across each entire band with at least a 1.2:1 SWR. Not bad for a $2 addition!

Before you begin, I'd like to note that designing and building antennas is a learning experience. We've all heard the story of the damaged antenna lying on the ground that worked better than when it was on the tower. Antenna performance is not always predictable, so watch for unusual results.

There are many opinions and approaches to what works or doesn't work. What's important to remember is that the antenna is only as good as its SWR and RSTs.

Construction

Preparation and assembly of the antenna is straightforward. First gather the materials. I strongly suggest that the lower portion of the antenna be made of at least 3/8" diameter SOLID aluminum or stainless steel rod. Thinner dimensions will tend to break under the stress of driving.

The length of this rod (62-1/2") will be an overall 63-1/2" when the couplers are attached. The upper whip section measures 50-1/2" overall. This includes the coupler, so measure appropriately. If you need to deviate slightly from these figures no recalculation will be necessary, just allow more turns on the loading coil. Later you can trim the coil to accommodate the changes.

At this point you'll need a tap and die set (see the sidebar). If you don't have one the local hardware store will usually do the work for a small fee. Or visit the local high school metal shop. The teachers are often very helpful and a donation of a few pizzas to the class can go a long way. Die cut a 3/8-16 thread around both ends of the lower solid antenna portion. (Remember to keep in mind that TWO couplers are used on this section and that the overall required length is 63-1/2".)

The top antenna whip can be purchased at most radio shops or at Radio Shack; or, you may have one lying around that will work. The majority will use a 1/4-20 thread. A coupler of the same thread will be used to attach this to the top of the loading coil.

I suggest you use dielectric for all threaded connections. About a month after I installed the antenna I began having problems while tuning up. I found that this was because the threaded portions had some minor corrosion due to weather. Periodically check these connections and, if necessary, treat them with electrical sealer or doping.

Mounting Bracket

The actual mounting bracket design will depend on where you decide to place the antenna on your car. Like many cars, mine has rubber bumpers. This forced me to design a bracket using 1-1/2" x 3/32" flat steel that would be bent to mount against the body BEHIND the rear bumper.

First bend the steel to fit as you would like it. Then measure how far out it needs to be cut to support the antenna. Ensure that the steel doesn't rub against other parts of the car—this would cause static and could effect the tuning of the antenna.

After the final placement and bending is completed, drill two 7/16" holes through the steel and body of the car. Temporarily attach the bracket and determine how far out to drill the hole for mounting the antenna. Mark this spot.

The size of hole to drill here will depend on the outside diameter of the insulating tubing you use around the mounting bolt. The tubing I used had an o.d. of 1/2". This hole should allow the insulating tubing to have a snug fit, so cut the hose to the thickness of the steel plus 1/8".

Drill a second hole (1/4") about 1-1/2" from the first, toward the car. This will be for mounting the coaxial grounding connection.

After all the bending and drilling is completed, paint the bracket with as many coats of clear enamel as necessary to protect it from the weather. Set it aside to dry.

Next, attach two electrical connectors to one end of the 16-1/2" RG-58 coax; 3/8" to the center lead and 3/16" to the shielding. I suggest soldering the ground connector as close as possible to the coax. Be careful not to melt the center lead insulation.

Once the bracket is dry, assemble the 3/8" coupler as shown in Figure 1. When you tighten the coupler the plastic washers will compress against the rubber hose and electrically insulate the bolt.

Then attach the shielded side to the bracket with a 1/4" bolt. Measure the resistance between the two connections. It should be better than 10 meg. (I measured almost 250 megohms with my DMM.)

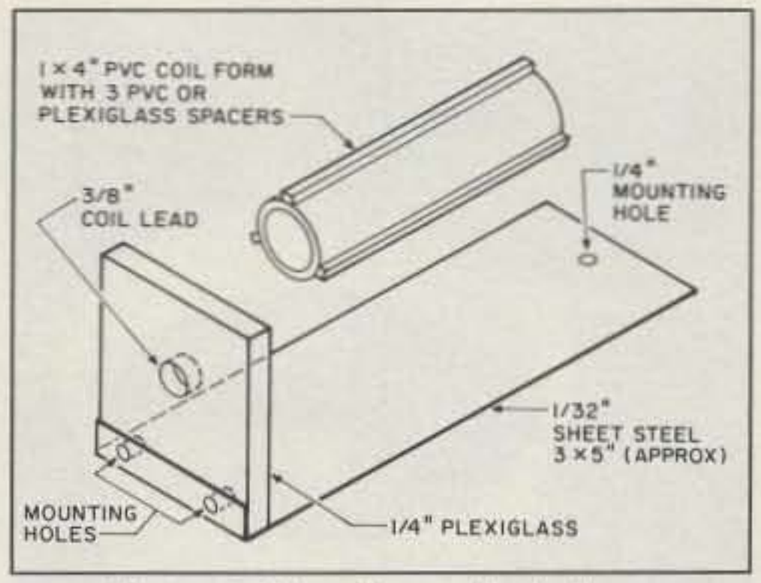

Figure 2. Matching coil platform.

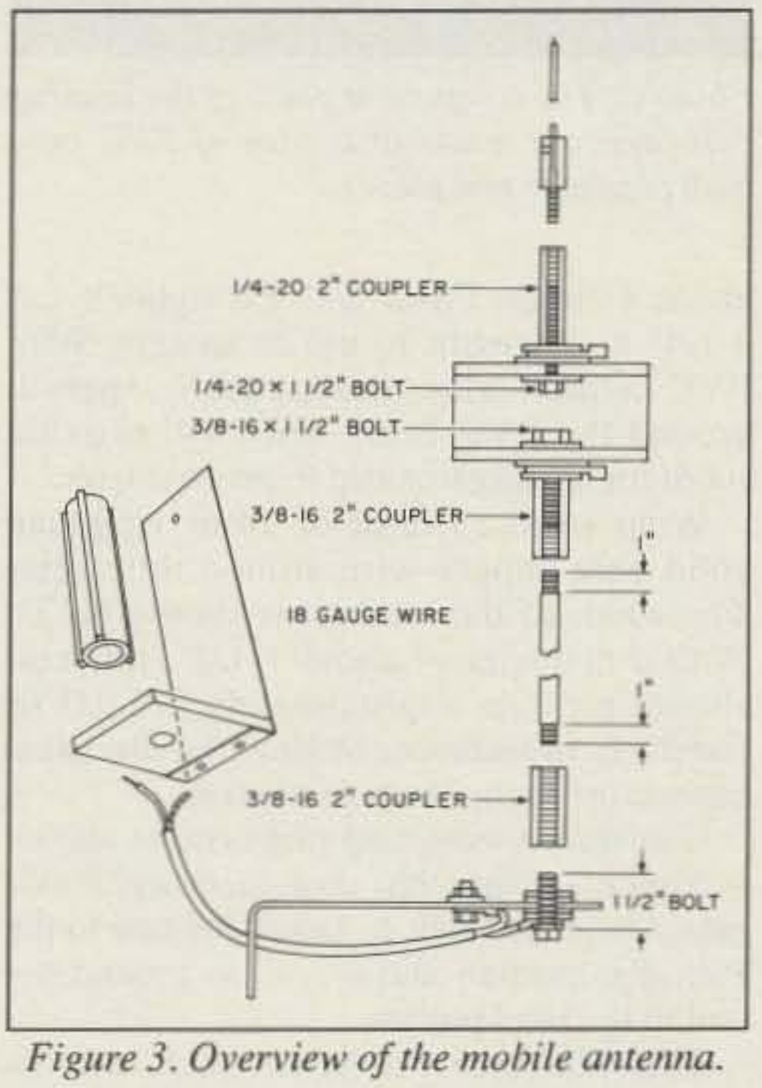

Figure 3. Overview of the mobile antenna.

Once satisfied, use electrical doping to insulate BOTH connections to stop moisture from getting into the coax and from creating a short between the two leads. This doping is commonly available at electrical supply stores.

Use 7/16" hex-head bolts and washers to mount the bracket to the body of the car. To ensure a good grounding contact, scratch off the enamel where the washers meet the bracket. Consider using Lock-tight on the bolts if excessive vibrations are a factor. These bolts should extend inside the trunk about 1" beyond the nut for attaching the grounding strap.

Finally, drill a 3/8" hole through the car body next to the bracket and install a grommet. Feed the other end of the RG-58 coax through the grommet.

This completes the mounting bracket assembly.

Matching Coil

The matching coil is designed to balance an 80 meter loading coil and higher. If you decide to use a 160 meter coil you can add more turns to the matching coil.

The coil is built around a 1" PVC pipe

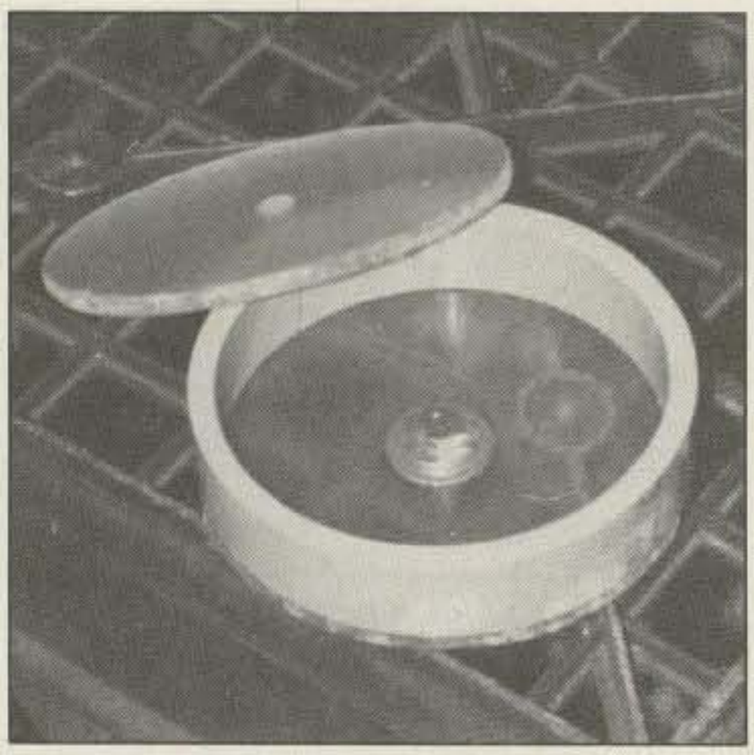

Photo C. The component parts of the loading coil form are made of a slice of PVC pipe with plexiglas end pieces.

about 4" long. From 1/4" Plexiglas™ cut 3-1/4" x 4" lengths to use as spacers. With PVC cement, glue these, equally spaced, around the PVC form. This will provide room for an alligator clip to be used later.

Wrap 14 to 15 turns of 14 or 16 gauge solid bare copper wire around this form. The width of the total turns should be 3". With a diameter of about 1-1/2", this coil should provide approximately 3.2 µH of matching inductance. Solder two electrical connectors to the leads of the coil.

Construct a mounting platform, as shown in Figure 2, using thin sheet steel and Plexiglas. Use a 3/8" bolt to attach the coil to the Plexiglas portion and a 1/4" to ground the coil to the steel portion.

This platform can be mounted almost anywhere inside your trunk provided it's within reach of the RG-58 feedline. Drill a 1/4" hole and mount this platform with a hex-head bolt. Again allow about 1" extra on the bolt length for the coil and jumper connectors.

Solder the two electrical connectors to the RG-58 antenna feed inside the trunk AFTER IT HAS BEEN FED THROUGH THE GROMMET. (7/16" for the shielding and 3/8" for the center lead.)

To make the jumper, remove the shielding from a piece of RG-58 about 6" to 7" long and solder an alligator clip to one end. Cut a length of heat shrink that will insulate all but 1/4" of this shielding and shrink it on. Slide the alligator clip's rubber cover over the heat shrink to the clip. Finally, solder a 1/4" connector to the other end of the jumper where the bare shielding extends.

Attach both the jumper and one end of the matching coil over the platform's 1/4" bolt. Attach the other end of the coil to the Plexiglas support using a 3/8" bolt (see Figure 2).

If you use 16 or 14 gauge wire for the inductor it will be able to support itself by its leads.

To finish the matching unit, cut a 6" to 7" length of RG-58 coax and connect a PL-259 connector to one end. Solder an alligator clip to the other end's center lead. Insulate the shielding with heat-shrink tubing, as before, with the jumper and attach a 7/16" electrical connector to the end. (Allow these two leads to be long enough for the center lead to extend to both sides of the matching coil when the shielding is connected to the 7/16" bracket mounting bolt.)

At this point you can add a variable capacitor. Remember to wire it in parallel and you're all set.

Photo D. The matching coil assembly mounts inside of the vehicle. Grounding and feedline alligator clips allow for fine tuning of the resonance and impedance of the antenna.

Loading Coil

Cut a piece of 4" PVC tubing into slices, referring to Table 1. Make these cuts as square as possible. This will determine the straightness of the antenna. Because bolts and washers extend toward the inside of the coil, the PVC slice should not be cut less than 1" wide.

On a sheet of 1/4" Plexiglas, outline two disks for each loading coil by using one of the slices as a guide. I've had excellent results using a saber saw with a moderate tooth blade (12/inch) under moderate pressure. This should avoid chipping but may create melting. Pliers can be used to pull off the melted excess.

Drill a 3/16" hole through both disks at the same time to help center the antenna studs. Then drill one of these to 5/16". Drill carefully to avoid chipping or cracking. For added strength, drill three holes in a triangular pattern through both disks. The holes should be about 5/8" in from the edge to provide clearance for the PVC tubing thickness (1/4"). The size of these holes depends on the size of the plastic bolts you'll be using. I strongly suggest that you tap these holes to allow the bolts to thread. Plastic bolts aren't very strong and the added benefit will be needed.

Tap the center 3/16" and 5/16" holes to 1/4"-20 and 3/8"-16 thread, respectively. Using fender washers to help disperse the pressure, thread each bolt through to ensure a clean tap. Back the bolts out about 1/4" and apply a generous amount of instant glue to the threads. Re-tighten to a snug fit.

Placing the threads outward, glue the two disks to a PVC slice with five-minute epoxy (clear type) and let them dry. An important point when gluing is to have all the pieces under moderate pressure to ensure a tight bond. To do this, thread the plastic bolts through and tighten them before the glue dries. DO NOT USE METAL BOLTS FOR THIS—they will interact with the loading coil and could distort the radiation pattern.

Once dry, solder a 1/4" electrical connector to one end of the 18 gauge enamel wire that will be used for the coil. Bolt this to the top part of the coil form using spacing washers and the 1/4" coupler.

With a flat iron tip melt a groove into the edge of the top Plexiglas disk. Press the enamel wire into the groove while it's still soft. This will stop the coil from unraveling. Wrap with an appropriate number of turns for the band you've chosen. Try and keep the turns as tight as possible and pressed together.

Use plenty of electrical tape to temporarily hold the coil wire in place. Mount the 3/8" connector to the lower side as you did with the top side, but don't solder the enamel wire—you'll need it loose for tuning later on.

Fine-Tuning

Attach an SWR meter to the matching coil's PL-259 connector. Hook up your radio as it would normally be and attach the feedline to the other side of the SWR meter. The feedline alligator clip should be attached to the ungrounded side of the matching coil where the antenna feedline is connected. The coil's grounding jumper should be unconnected. (You can clip it to the end of the PVC form.)

Assemble the antenna and attach it to the coupler on the mounting bracket. (I added a second support higher up to allow the lower antenna to stay permanently on the car.) (See Figure 3.)

File the enamel off the tip of the lower loading coil wire that isn't attached. Use an alligator clip to temporarily hold the con-

Table 1. Center Coil Dimensions

Band	Turns	Coil Length	Form Length	PVC Diameter
160	62	2.75"	2.875"	4.5"
80	23.75	1"	1.125"	4.5"
40	10.25	0.5"	1"	4.5"
20	7.50	0.5"	2.5"	2.375"
15	2.80	0.125"	2"	1.875"
10	No center coil necessary; join the two rods together with a coupler.			

nection for tuning. The clip should not have any wire attached to it.

Check for the best SWR, 100 kHz down from the center frequency you want the antenna to resonate at. Adjust by clipping one quarter turn at a time, each time checking the SWR. Don't test by shorting the loading coil—this will degrade the efficiency of the coil and give false readings.

Once you get near the null (where the SWR begins to dip) adjust to your desired frequency and continue by clipping 1/4" to 1/2" at a time. Each quarter turn should increase the resonance by about 50 kHz while half-inch snips should be 10 kHz.

Once you are satisfied, remove the coil and solder the enamel wire to the lower connector. Reassemble and check the SWR. If there are any problems you'll need to restart the fine-tuning from the beginning, and possibly rewrap the coil.

Repeat this process for each band coil. Try not to change the matching unit. The goal is for the coil to be the only necessary change to switch bands.

The matching coil alligator clips are used for within-band adjustments. These will allow for adjusting the SWR within a small range after the overall tuning is complete. The feedline clip is used to balance the matching coil, while the jumper is used to adjust the inductance. You'll need to be patient to successfully tune to different frequencies.

The results could be marked by paired colors, 1/8" jumpers could be soldered to the matching coil at these points for easier reference, or a two-pole rotary switch could be used to make band switching quick and easy.

If you choose to include the variable capacitor in the matching system you'll have more leeway. (The grounding jumper wasn't necessary when I made this addition later.)

Whatever you do, the shorter the leads are the better. Everything effects the antenna. Even the 16-1/2" feedline is part of the antenna and will effect the tuning if it is changed.

Hot glue or five-minute epoxy could be spread on the enamel wire once all tuning is complete. I haven't been able to find heat-shrink tubing big enough to fit over the coil, although this would be best. If you use 2" PVC or smaller for the loading coil form, 3" heat-shrink tubing is available from Electronic Surplus (R&D Electronics) in Cleveland, Ohio.

Finishing

The guy connection I'll leave up to you. High strength fishing line, thin rope, or mason line are all good choices. Either way, guys are necessary to avoid damage. I suggest using two support lines.

I've had many S7-9 reports within a 400-mile radius of my West Virginia QTH on the 80 and 40 meter bands. On the 15 and 20 meter bands I was able to QSO with stations in France and Germany while traveling through northern Ohio.

Although commercial designs may have a 20% improved bandwidth, the quality of this design should meet your needs.

I'm interested to hear of any changes you make to the design, including the matching system, and would appreciate hearing from you about your results. Good luck! 73s. 73

Contact Stephen A. Glowacki at Rt. #3, 205 Hickory Drive, Elkins WV 26241.

Tap and Die

If you're not familiar with the mechanics of a tap and die, no problem. The procedure is straightforward.

First locate the proper size of die. (This is what cuts the threads into a rod to make it resemble a bolt.) Using the 3/8"-16 size as an example, the first number measures the diameter of the outside of the threads, and the second number tells how many threads there are per inch. These numbers appear on the die itself, which can be purchased individually for about $2.

You need a handle to hold the die steady during the process. These cost about $8-$15, depending on the style.

If you want to save money, Sears has a 20-piece Homeowners Set for under $20, available through their catalog store. Whatever you buy, just make sure that the 3/8"-16 and 14"-20 are part of the set. These are common sizes used in amateur radio.

The technique for cutting with a die is simple. Brace the rod steady either in a vise or with Vise-Grip pliers. (I used the latter, attaching the pliers near the base of the rod and then standing on them for bracing.)

Placing the **wide** side of the die toward the rod, turn slowly but with pressure. You'll feel it cut into the aluminum almost immediately.

Make sure that the first two to three thread cuts are square so that the die remains perpendicular to the rod.

The die needs to remain square to the rod **while** it is turning. This is the most difficult part of the whole process. Once the first two to three threads are cut, the rest is easy.

Now the turning technique: Turn the handle clockwise 90 degrees, then reverse and turn back until you feel the metal filings snap. (About 30-40 degrees.) Then, turn clockwise another 90 degrees and again reverse to snap off the filings. Continue this process until the proper length is cut. I find it easier if I imagine north, east, south and west and keep to those points.

It may be necessary to turn continuously for the first thread or so to help the die take hold. Don't be afraid to back off and start again.

Once the cutting is started, have some lubricant available and apply moderately. There are certain lubricants preferred for some metals. Generally, a light oil or kerosene is good for aluminum and stainless steel.

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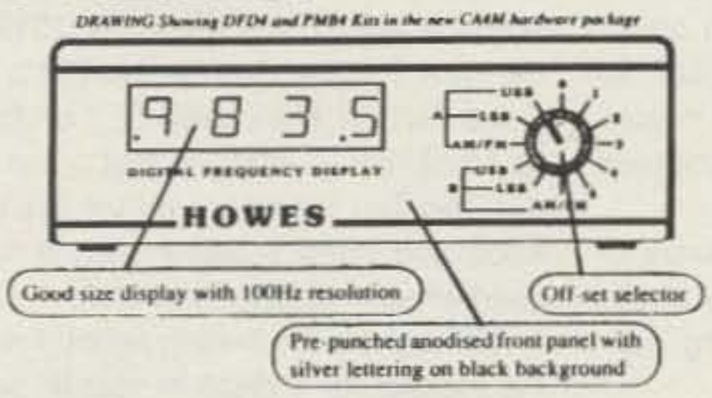

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The JRL-2000F HF MOSFET Linear Amplifier

A solid-state, no-tune kilowatt with very advanced features.

The JRL-2000F is built by the Japan Radio Co., Ltd. (JRC). It is a microprocessor-controlled solid-state no-tune HF linear amplifier capable of producing a solid 1,000 watts output.

When the 2000F arrived it was in a single box and well packaged inside same. The weight of the box was a formidable 78 lbs. and you should be forewarned not to attempt to place this amplifier on anything less than a desk or surface designed for battleship purposes. I used two heavy-duty milk crates. Due to its weight, this unit cannot be shipped by UPS. It arrived at my door via Federal Express (FEDEX).

There is nothing to assemble with the amplifier. It is ready to go as soon as it is unpacked. No tube(s) or transformer(s) to install. Strictly plug 'n go!

The 2000F comes with a remote hand control, resembling a TV remote control, which can completely operate the amplifier.

Photo A. The JRL-2000F solid-state kilowatt amplifier.

Initial Testing

For initial testing I used the JST-135 (also from JRC) transceiver. Through an interconnection cable, the 135 converses directly with the amplifier for band/frequency information and control.

The 2000F is a complex and modern device, although from the operational point of view it is about as simple as you can get. A pre-made cable (optional) is connected between the exciter and the amplifier for control (it contains a few more wires than the usual transmit relay control line) and a coax jumper for bringing the RF input to the amp.

The antenna system is connected to the four antenna ports on the back of the amp. In the case of this testing I utilized them in the following manner: 80/40 dipole, Cushcraft R5 vertical, 160 meter dipole, and 80-10 meter Windom. No external antenna tuner was placed in the line.

My first operation was on 75 meters. It took about 10 seconds for the amplifier to set itself up for the band segment being operated on. Later return to this segment required only an instant for retuning.

Signal reports were excellent. No mention was made of poor signal, low audio quality, reduced power, or distortion. A single 3-500 (1 kW output) tube-based amplifier was used for on-the-air comparison of signal reports.

Fan noise was not mentioned by anyone. Nevertheless, depending upon physical placement of the amplifier, I believe fan noise could prove to be a problem. However, the 2000F is not the only amplifier to suffer from fan noise. The problem applies to nearly all HF amateur amplifiers.

The typical efficiency of the 2000F appears to be about 60 percent. This is based upon meter readings of 22A current at 80 VDC during key-down, with an output of 1 kW.

Antenna control is done by the 2000F. Manual selection is made by pushing buttons on the front of the amplifier. Later recall of previous operation on the same (or nearby) frequency will cause the amplifier to select the originally chosen antenna automatically (this can be overridden by the manual controls).

After using the JST-135/JRL-2000F combination on several bands and enjoying the complete ease of fully automatic tune-up and antenna change, I built connector cables for use with my ICOM 751A and Corsair II. The cables must provide, in addition to the normal ALC and PTT lines, a talk-back line. The latter forces the exciter into transmit during tune-up or after QSY.

Tune-up is still super simple. For example, to change from 40 meters to 75 meters you merely push the 2000F's SET button to sample the frequency of operation (not required when using the JST-135, due to the feedback data line between the transceiver and the amplifier). In SSB mode it is necessary to say a word or two (ie: "ahhhhh!") so the amplifier can determine the operating frequency. Once the frequency is determined, the 2000F will tune itself, based on prior usage at that frequency.

Once the band segments for my favorite frequencies had been programmed into memory, I found the ICOM and Ten-Tec to be nearly as dexterous with the JRL-2000F as is the JST-135, the only difference being the requirement for pushing the SET button and announcing yourself each time you QSY.

The ease of the 2000F's automatic tuning and antenna selection brings this HF linear amplifier into the realm of the instant QSY we are all used to with solid-state transceivers. I found that when jumping from 14.300 to 3.950, the amplifier tuning and the switching of the antenna line took about three seconds when using the ICOM 751A. Just punch the new frequency into the 751's keypad and press ENTER, then press SET on the 2000F and say "ahhhhh." It really is that easy! QSYing with the Ten-Tec took slightly longer as its tuning knob and band selector switch must both be used when changing frequency.

Throughout the testing period I was always on the lookout for a glitch to rear its ugly head, yet none ever appeared. Performance was flawless.

Points of Interest

The 2000F can be used as an antenna switch; switch and tuner; or switch, tuner, and amplifier. Each section is separate in operation but they are linked operationally via microprocessor control.

Switch selections provide for power on/off, standby, tune (automatic antenna tuner), antenna selection, and set (storage/selection of current operating parameters).

Two front panel meters provide selectable monitoring of output power or VSWR and current, voltage, or ALC.

LED indicators monitor drive levels and XMIT, indicate antenna match, and show the selected

antenna. A central display indicates the frequency in use and produces coded messages in case of trouble.

The amplifier is designed for a 1 kW output and typical readings of the output show that the 2000F easily reaches this specification.

Although the 2000F is equipped with a "high-speed arrestor" for protection against lightning surge pulses, I would not trust this expensive device to the whims of nature by relying upon anything less than complete disconnect during storms.

Instruction Manual

The JRL-2000F's manual is rather stark when compared to the volumes of paper typically accompanying a modern piece of HF equipment. It is, just the same, very adequate. After all, the 2000F does nearly everything for you automatically.

Once I understood the initial connections and settings, I only found it necessary to refer back to the manual to decode alarm messages when they appeared on the LCD readout (very infrequent and always, in my case, indicative of an operator error).

Maintenance instructions for cleaning the air filters and a troubleshooting chart are part of the manual.

A publication describing JRC's design theory and operation of the 2000F is also provided. It is straightforward, easy to understand, and is not couched in technical language.

MOSFET Design

Japan Radio Company describes the 2000F as using 48 MOSFETS in the PA section, which consists of four wideband 250W power amplifiers (each has 12 MOSFETS). The PA circuits are SEPP (single ended push-pull) design, providing greater efficiency than standard bipolar transistor/transformer coupled push-pull circuits. The design of the PA focuses on ease of impedance matching for input/output and linearity.

Bias control for the MOSFET SEPP design in class AB operation requires a high gate voltage and high drain idle current. This results in low high-order IMD and a non-critical bias voltage setting. The bias of the 2000F is controlled partially by the excitation voltage to achieve extreme stability.

The cooling system for the MOSFET amplifier is based upon heat-resistant MOSFETS and temperature actuated fans. The fans are rear facing and generally quiet.

Antenna Tuning

The antenna tuner is microprocessor-controlled and consists of coils, capacitors, and relays (30 on the tuner board). Operation consists of sampling the output frequency of the exciter and checking for previous operation on the same frequency.

The 2000F has a memory matrix consisting of a possible four antennas and 455 HF subbands (70 of which are indicated as within the ham bands in the manual). What this means is that each band is split into small segments.

When operating in a particular band segment the unit will search its memory for information matching the frequency. If the unit recognizes the

particular frequency (or another within the same subband) it will set itself to the previous settings and antenna selection. If not, you will be required to enter this information before operation (takes only a few seconds and is fully automated).

Antenna selection is a part of the 2000F's tuning as the four antenna inputs are microprocessor-controlled. For example: On 14.300 MHz you always use your trusty tribander and select that antenna when tuning the amplifier. From that point, until you tell the 2000F otherwise, the tribander will always be selected when operating 14.300 MHz.

The antenna selection relays are contained in a separate shielded box on the rear panel of the amplifier's chassis.

The important band information is written into an EEPROM (a ROM chip that can be electrically rewritten) during the TUNE operation. This information will always be available and won't disappear when the power is turned off.

The data for the various operating states of the JRL-2000F (power, PA, meter settings, antenna switch settings, frequency band settings, etc.) are stored in battery-backed RAM. Memory backup is provided by a rechargeable battery which will keep the RAM fresh for a period of two weeks if the unit is unplugged from AC power. When the battery discharges your operation settings are lost; however, normal operation can be restored by using the SET procedure. Battery recharge is automatic during normal operation.

Power Supply

The power supply is designed to use 220 VAC and provide 80 VDC at 30A for the PA. Additionally, it produces 12 VDC (positive and negative) for the control circuits. By using a switching power supply, JRC claims efficiency of 90% or more. The power supply is cooled by its own fan and is professed to be capable of continuous operation at 2.4 kW.

The AC line voltage required for operation is, according to the various manuals and information sheets I received with the 2000F, ambiguous. In the written information an indication is made that AC of 50/60 Hz from 85 through 264V will operate the unit, yet attention is later drawn to reduced output power at lower input voltages (ie. 100-120 VAC for 750W). All testing at this station was done at 220 VAC line voltage, which I consider the standard for 1 kW and above amplifiers.

Specifications

Operating bands	160m
	80m
	40m
	30m
	20m
	17m
	12m*
	10m*
Input impedance	50 ohms
Output impedance	50 ohms
Output power	1 kW (SSB/CW/RTTY)
VSWR	Less than 3.0 (16.7 - 150 ohms)
Unwanted radiation	-60 dB or less (below PEP)
IMD	-35 dB or less (below PEP)
Excitation power	100W (max.)
Freq. change time	Less than 0.1 sec.
Power supply	220 VAC 50/60 Hz (see text)
Power consumption	2.5 kVA at 1 kW
Input power factor	Greater than 95% at 1 kW
Temperature range	-10 to +40 degrees C
Protection items	Excessive PA current
	PA overheat
	Excessive exciter power
	PA abnormal load
	Excessive AC voltage
	Power supply overheat
	PA failure
	Excessive VSWR
Dimensions	430 x 300 x 420 cm/
	16.8x 11.7 x 16.4 in. (WHD)
Weight	28 kg/62 lbs.

*Contact JRC in New York for further information.

Service

I was concerned about service for the 2000F since there is not a plethora of JRC dealer/service centers and the unit is very complex (i.e. not user-serviceable).

JRC informs me there is no problem in obtaining service, as the Raytheon Service Company of New York, service center for JRC's commercial and marine amplifiers, will service the JRL-2000F. This is reassuring, as the name Raytheon is recognizable and the 2000F is based upon the commercial/marine amplifiers routinely serviced by them.

My Recommendation

The 2000F is a class act that the competition will find very difficult to follow. It does its job well, appears to be solid in design and manufacture, and exemplifies the term state-of-the-art. Would I like to have a 2000F residing in my station? Yes. If I had some easily earned dollars, I would immediately purchase one!

The 2000F amplifier does operate as intended. In fact, it does it very well and includes many features not available on any other HF amplifier. Additionally, I experienced no problems whatsoever while testing it for nearly two months.

I cannot compare the design of the 2000F to that of models from competitive manufacturers, as none offer an amplifier as advanced or feature-filled as the JRC product. There are good solid-state amplifiers and auto-tune tube-type amplifiers currently available on the market, but none provide the overall features of the 2000F.

I cannot accurately say that JRC's design will provide long and trouble-free service. There is no history, yet, to base the assumption on. However, I note that the company manufactures commercial HF amplifiers of a similar design which appear to have a good service track record.

The 2000F is not an amplifier for everyone and I can only leave the choice of such an expensive purchase to the individual. I would say, however, that when contesting and/or chasing DX, the ability to instantly QSY and make antenna selections automatically could be very valuable. Furthermore, the hands-off operation is enhanced by use of the remote hand control.

Availability

The JRL-2000F is available from ham radio suppliers. The suggested list price is $4,899; however, the street price is considerably below that. 73

Spread Spectrum Primer

What is spread spectrum, anyway?

by Randy Roberts KC6YJY (ex-WA6BFN)

Spread spectrum uses wideband, noise-like signals. Because spread spectrum signals are noise-like, they are hard to detect. Spread spectrum signals are also hard to intercept or demodulate. Further, spread spectrum signals are harder to jam (interfere with) than narrowband signals. These low detectability and anti-jam features are why the military has used spread spectrum for so many years. Spread signals are intentionally made to be much wider-band than the information they are carrying to make them more noise-like.

Spread spectrum signals use fast codes that run many times the information bandwidth or data rate. These special "Spreading" codes are called "Pseudo Random" or "Pseudo Noise" codes.

Spread spectrum transmitters use the same transmit power levels as narrowband transmitters. Because spread spectrum signals are so wide, they transmit at a much lower watts-per-hertz power density than narrowband transmitters. This lower power density gives spread signals a big plus. Spread and narrowband signals can occupy the same band, with little or no interference. This capability is the main reason for all the interest in spread spectrum today.

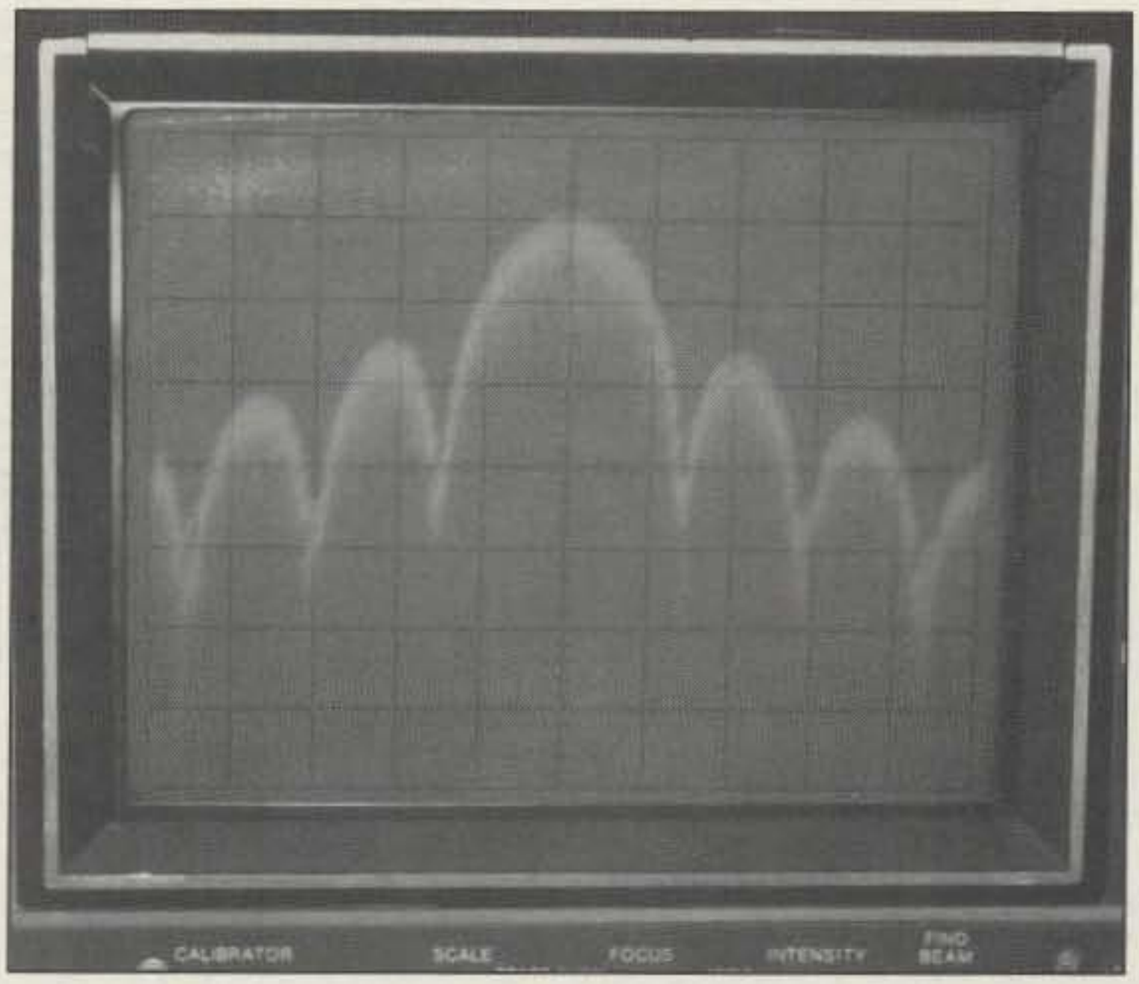

Photo A. Direct sequence spread spectrum signal (un-filtered BPSK). Note the suppressed carrier. Center freq.= 52 MHz with a 1.5 megabit/second PN (31 stage PN generator). Horiz. scale = 1 MHz/div. Vert. scale = 10 dB/div.

What's Spread Spectrum?

Spread spectrum radio communication is igniting much discussion and speculation lately. In the last few years there has been a lot of media attention, congressional interest (*IEEE Spectrum*, "Spread Spectrum Goes Commercial," August 1990, by Donald L. Schilling, Raymond L. Pickholtz and Laurence B. Milstein, pp. 40-45), FCC rulemaking, commercial product announcements and marketing hoopla about this exciting new field. Several very good articles on spread spectrum (SS) have appeared in ham radio literature and the ARRL's *Spread Spectrum Sourcebook* has been in print for several years now. With all of this activity you may still have a few questions about spread spectrum, how it applies to hams, how it works and in general what all this alphabet soup (like PCN, PCS, CDMA, TDMA and frequency hopping) is all about. See the sidebar for a definitive guide. This article is intended to gently lead you through some of the practical details of today's modern commercial (and soon to be ham) radio spread spectrum technology and help you gain a basic understanding of the principles involved in SS.

In 1983 the FCC issued a notice of proposed rule making authorizing the low power use of spread spectrum techniques on a shared frequency basis in the Industrial, Scientific and Medical (ISM) frequency bands of 900, 2400 and 5500 MHz. These bands are also shared with amateur radio operations—so we hams have a direct stake in what happens with this kind of equipment. Since 1983 the FCC has revised and clarified the rules for spread spectrum operation under Part 15 of their rules. Hams have been able to legally use spread spectrum under Part 97 rules for a number of years, also. However, the FCC rules for ham spread spectrum have been quite restrictive and have had the net effect of almost eliminating ham radio experimentation in spread spectrum techniques. Recent commercial developments with Part 15 equipment and a new FCC Special Temporary Authority (STA) (R. A. Buaas K6KGS request for STA, FCC file number 7230-A, granted April 17, 1992) provide a renewed impetus to the amateur community to make more use of spread spectrum techniques. In light of the possible awakening of a ham spread spectrum community, I hope to spur some interest in the ham builder/experimenter to put some of these ideas to practical use.

More About Spread Spectrum

Simply put, spread spectrum trades a wider transmission bandwidth for better signal-to-noise ratio and reduced transmitted power density. Two types of spread spectrum implementation are in fairly common use today: Frequency Hopped and Direct Sequence. Frequency hop (FH) and direct sequence (DS) are pretty well known, mature techniques today. Other more exotic forms of spread spectrum such as chirp, time hopping and hybrids of frequency hop and direct sequence are not in general use in low-cost Part 15 equipment and will probably remain only in the military province for several more years. The following paragraphs will describe frequency hop and direct sequence techniques in a little more detail and show that pseudo-noise code techniques provide the common thread through all spread spectrum types.

Frequency Hop

Frequency hopping can provide the easiest method of utilizing spread spectrum. Any radio with a digitally controlled frequency synthesizer can (theoretically) be converted to a frequency hopper. This conversion requires the addition of a pseudo noise code generator that is used to select the frequencies for transmission or reception. Most hopping systems utilize uniform frequency hopping over a band of frequencies. This is not absolutely necessary if both the transmitter and receiver of the system know in advance what frequencies are to be skipped. Thus, a frequency hopper in, say, 2 meters could be made that would skip over commonly used repeater input and output frequency pairs. A frequency hopped system can use analog or digital carrier modulation and can be designed using conventional narrowband radio techniques. Dehopping in the receiver is done by a synchronized PN code generator which drives the receiver's local oscillator frequency synthesizer.

Direct Sequence

The most practical, all-digital version of spread spectrum is direct sequence. A direct sequence system uses a locally generated pseudo noise code to encode digital data to be transmitted. The local code is generated at a rate of 10 to 100 times the data rate to be transmitted. Data for transmission is simply exclusive-OR'd with the faster pseudo noise code. The composite pseudo noise and data can be passed through a data scrambler to randomize the output spectrum (and thereby remove discrete spectral lines). A direct sequence modulator is then used to double sideband suppressed carrier modulate (also called Binary Phase Shift Keying—BPSK) the carrier frequency to be transmitted, resulting in a signal spectrum as shown in Photo A. Other forms of carrier modulation are possible with di-

rect sequence, however BPSK or differential phase shift keying (DPSK) are the simplest and most often used techniques.

A spread spectrum receiver uses a locally generated replica pseudo noise code along with a receiver correlator to separate out only the desired coded information or messages from all possible signals. A spread spectrum correlator can functionally be thought of as a very special matched filter—it responds only to signals that are encoded with a pseudo noise code that matches its own locally generated replica code. Thus, a spread spectrum correlator can be "tuned" to different codes simply by changing its local code. This correlator does not respond to man-made, natural or artificial noise or interference. It responds only to spread spectrum signals with identical matched signal characteristics and encoded with the identical pseudo noise code.

Why use the wideband signals—isn't narrowband CW or packet better? The use of these special codes in spread spectrum communications makes signals appear as wideband, noise-like signals on a spectrum analyzer. It is this very characteristic that inherently makes spread spectrum signals hard to detect or demodulate. In other words, spread spectrum signals are harder to detect on narrowband equipment because the signal's energy is spread over a bandwidth of maybe 100 times the information bandwidth.

The spread of energy over a wide band of frequencies makes spread spectrum signals very unlikely to interfere with narrowband co-channel or adjacent channel communications. Narrowband communications, conversely, cause little to no interference to spread spectrum communications systems because the correlation receiver effectively integrates over a very wide bandwidth to recover a spread spectrum signal. The correlator actually then "spreads" out a narrowband interferer over the receiver's total detection bandwidth and thus only the total integrated signal density or signal-to-noise ratio determines whether there will be interference or not. All spread spectrum systems have a threshold or tolerance level of interference beyond which useful communication ceases. This tolerance level or threshold is related to the spread spectrum processing gain. Processing gain is the ratio of the radio frequency (RF) bandwidth to the information bandwidth.

Typical SS anti-jam (AJ) radios have a processing gain of from 10 to 20 dB, depending on the data rate. They can tolerate total jammer power levels of from 0 to 8 or 10 dB (jamming margin) stronger than the desired signal. Yes, the system can work at negative signal-to-noise ra-

tios in the RF bandwidth (signals buried in the noise) because of the processing gain of the receiver's correlator.

Besides being hard to intercept and jam, spread spectrum signals are hard to exploit or spoof. One cannot get any useful information from a scanner tuned to a spread spectrum signal. Spread spectrum signals also are naturally more secure than narrowband radio communications. Thus, spread spectrum signals can be made to have any degree of message privacy that is desired—you can have all the private channels you want with spread spectrum. The very nature of spread spectrum allows military or intelligence levels of privacy and security, if desired, to be had with minimal complexity.

Frequency Re-Use and Multiple Access

Multiple spread spectrum signals on the same frequency or in the same frequency band can be accommodated through various techniques of multiple access or diversity. The nature of PN codes and correlators allow what is called CDMA (code division multiple access). Time division multiple access is also commonly used with spread spectrum. Frequency and space or polarization are also used to increase the number of users or network size of spread spectrum networks. Sometimes combinations of the above multiple access techniques are used to achieve special system characteristics.

Multiple access techniques can provide for frequency re-use, elimination or reduction of interference, increased system capacity, or to provide for "private" channels. The newest methods for digital cellular, micro-cell and worldwide LEO satellite mobile communications will use SS and CDMA or TDMA to efficiently utilize the frequency spectrum they will be allocated. Commercial voice and data PCNs and PCS's that operate over cordless telephone-like ranges of up to 5,000 feet between micro or nano cell sites will also use various SS multiple access techniques to achieve frequency re-use and spectral efficiency.

Finally and most importantly, the major benefit of spread spectrum communication is that data communications can be provided at data rates of 10 or 20 times normal wired or narrowband radio communications rates, with automatic protocols that virtually eliminate bit and message errors. Thus, digital voice, computer-to-computer, BBS, networking and other demanding communications can be provided error-free at a reasonable cost. This data reliability and integrity are the most important reasons for spread spectrum communications.

Now, the Catch

Sold on spread spectrum yet? Sounds great doesn't it? Note, however, that above I described how each type of spread spectrum worked when each receiver was presumed to have PN synchronization with its companion transmitter. This requirement for PN sync is what makes spread spectrum system design tough. There are three major problems in spread spectrum PN systems: acquisition, synchronization and tracking. All three problems are part of the general problem of estimation and/or tracking of PN code phase (timing) and frequency. These problems cause all the complexity that is associated with PN system operations. Sync problems are slightly different with each type of spread spectrum, but the main problem is the same. How does a receiver's PN generator rapidly, without significant loss of data, lock onto and track changes in a transmitter's PN code generator? A complete answer to this question is really beyond the scope of this introductory article; however, the secret lies in the design of the receiver correlator and its related processing. Current commercial Part 15 equipment uses both serial (sequential or trial and error) and parallel digital correlators. Many of these commercial designs use custom ASIC or LSI chips to accomplish the required PN acquisition and tracking operations.

Interfacing and Networking

The latest generation of commercial Part 15 SS radios, some soon to be available to hams (in a private correspondence with Mr. Dewayne Hendricks WA8DZP, president of Tetherless Access, Ltd., in February 1992, Dewayne stated that Tetherless radios will soon be available to hams through PacComm in Florida), are easily interfaced to any asynchronous communications equipment at data rates up to several hundred kB/sec. No special interface circuitry is required. The radio transmits and receives in half duplex mode—that is, it either transmits or receives data at any instant of time. The terminal hooked to the radio determines whether the radio is transmitting or receiving by setting the "Request to Send" line. Several options are available for hardware/software handshaking with the "Clear to Send" and "Device Carrier Detect" signal lines. To summarize the typical SS radio capability, the equipment can be thought of as a radio combined with a digital modem and a form of packet-radio-like TNC. Several of the commercially available SS radios (some of the more commonly available commercial SS radios are sold by GRE America, Symbol Technologies, Proxim, Senses Data Corporation, Cylink, O'Neil Communications and Qualcomm) include AX.25, X.25 or TCP/IP networking protocols software or firmware. At the current time these radios can use small networks that can be built up, entirely by software, with up to 32 or more network nodes, thus providing limited PCN/PCS capabilities. Typical SS radios in the network can be designated to be a digipeater (a store-and-forward, single-frequency repeater) by software. Several digipeaters can also be connected in tandem to extend network communications well beyond simple "line of sight" radio ranges.

Continued on page 77

Simple Operation
Advanced Technology

Within Budget - Without Compromise

Just when you thought great audio and tough as nails construction were luxury features available only on the most expensive models, and just when you thought simple, intuitive operation was a thing of the past, along comes the Alinco VHF-FM HT, DJ -180T.

A different offset can be stored in each memory channel, and most other functions can also be stored independently in each memory channel. CTCSS encode and decode comes standard. As most QSO's on 2- meter are done through repeaters, these special features make the DJ-180T the most practical HT to own. Alinco has once again combined high-technology with low-cost.

Check out the affordable technology of the 90's. Check out ALINCO.

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- Low battery indicator
- "Busy" channel LCD indicator
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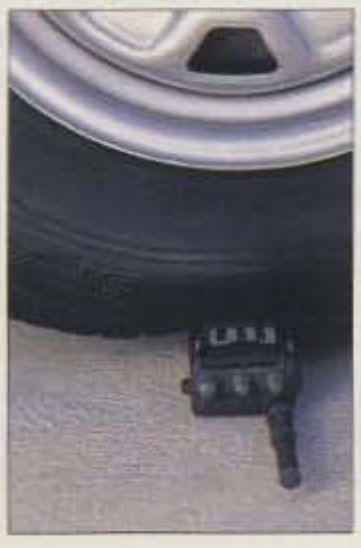
- Auto Power Off
- Instant QSY to Call channel
- Monitor button
- Scan Modes
- Battery Saver design
- Supplied with Ni-Cd battery pack EBP-26N for 2 watts output, wall charger, belthook, and strap.
- Optional accessories: EBP'28N Battery pack for 5 watts output, EDH-11 Drycell case, EDC-45 Quick charger, EMS-9 Speaker-microphone, EME-12/13 Headset with VOX/PTT. EME-15 Tie-pin microphone, EDH-12 DC Jack adaptor .EBC-6 Mobile bracket, ESC-18/19 Soft case, EJ-14U 50ch Memory unit, EJ-15U 200ch Memory unit.

Also Available
DJ-580T Dual Bander



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HOMING IN

Radio Direction Finding

Joe Moell, P.E., KØOV
PO Box 2508
Fullerton CA 92633

What's That Whirligig?

"Do you have a TV in your car?" Questions like that from passers-by are common when hams gather for hidden transmitter hunts, usually called foxhunts or T-hunts. The yagis and quads that most competitors in my area use for 2 meter radio direction finding (RDF) look a lot like television antennas, so they are big-time attention-getters. No one gets more stares than JaMi Smith KK6CU of Pasadena, California. His quad is long, tall, and continuously spinning at 40 rpm!

Last month's column showed how a display with a storage type cathode ray tube (CRT) gives far more useful RDF data than an S-meter when you're hunting with a beam. The concept, originally used on the ham bands by the late Jim Davis W6DTR, has been updated and improved by KK6CU. He motorized his antenna for continuous rotation and bearing readout.

This month you'll see how JaMi built up his system from inexpensive surplus components and read some hints to help ambitious RDFers build their own. You may not be able to make an exact duplicate but you can achieve the same results using hardware that's readily available, plus your own ingenuity.

It's Not Covert

JaMi supports his six-element quad with an A-frame almost three feet high (see Photo A). The frame sits atop a bicycle rack that is firmly attached to the rain gutter. Pillow blocks hold the 3/4-inch o.d. mast in two places, 21 inches apart, with the drive mechanism in between (see Photo B). The AC gearmotor turns at 72 rpm, coupled with a 13-inch belt to the 40 RPM mast.

Parking garage clearance? No problem. The A-frame lowers to the rear on hinges (see Photo C). The whole assembly adds only about a foot of height to the vehicle when lowered. JaMi says he's eyeing worm gear drives to automate the raise-lower function, but it's manual for now.

KK6CU's display unit is a Tektronix Model 603 medical monitor. It writes traces on the screen continuously until the ERASE button is pressed. When evaluating a storage oscilloscope for use in this application, look for external inputs on both left-right (x) and up-down (y) axes. Amplifiers for both axes must work at DC and have the same scale factors (volts per division).

JaMi uses a DC-to-AC inverter to power the CRT monitor, the motor, and a +/-15 volt DC power supply for the interface circuit. His 400-watt Tripp Lite square-wave inverter is not recommended for inductive motor loads, but the 50-watt motor and the 125-watt monitor have worked fine with it so far.

Electronic Trigonometry

A beam and receiver S-meter give signal strength information as a function of pointing direction (azimuth). This data is in "polar" form. You may remember from a math class that polar coordinates are represented by an angle (signified by the Greek letter theta) and the radius (r). The magnitude of r is proportional to signal strength.

To display polar data on an oscilloscope monitor, it must be converted to x and y axis voltages. The value of x equals r times the cosine of theta. The value of y equals r times the sine of theta. That means we need a device that outputs voltages proportional to the sine and cosine of the beam pointing angle.

Such a device exists: the sine-cosine potentiometer. You won't find one at your local parts store because they are used only in specialized applications such as servomechanisms and robotics. But try nearby surplus outlets—you might get lucky. JaMi found a good one for less than a dollar.

These pots have special windings that generate voltages proportional to the sine and cosine of the shaft angle when the pot is connected to equal positive and negative voltages. Several models are available from Servo Systems Corporation, 115 Main Road, PO Box 97, Montville NJ 07045-9299; telephone: (201) 335-1007, for a catalog. Prices range from $18.50 to $69.50 each. The minimum order is $30.

Photo A. Heads turn when JaMi Smith KK6CU goes on foxhunts with this array. It spins at 40 RPM and displays bearings on a storage oscilloscope.

If you can do so without damaging it, peek inside your sine-cosine pot to see if it is designed for rotation in a specific direction. Some units have the wiper arm configured to "pull" across the winding in one direction. If you rotate in the opposite direction, the wiper "pushes" across the winding and the pot will wear out quickly.

Use care mounting the pot on your antenna mast, particularly if it has a 1/8-inch diameter shaft. Allow a little side-to-side play so that damaging shear force is not applied to the shaft. But don't allow much rotational play, as that will cause bearing errors. JaMi supports the pot by the wiring harness, as shown in Photo D.

Figure 1 shows the polar to x-y conversion schematic. The op-amps operate near DC, so compensation is not critical. A 1458 dual op amp (RS 276-038) should work fine. JaMi used two sections of an LM324C (RS 276-1711).

Each stage inverts the S-meter output, so equal but opposite polarity "r" voltages are applied to the sine-cosine pot windings. Using two identical inverter stages assures symmetrical low impedance drive.

On the pot JaMi used, a Computer Instruments Company model 106-1, one inverter output goes to pin 1 and the other to pin 2. Sine and cosine outputs are pins 3 and 4. Two pins on this pot (5 and 6) are connected to signal ground. Yours may have only one ground pin, or it might have two separate sections, one for sine and one for cosine.

The S-meter input level and the gain of U1a are such that Jami gets full-size scope patterns with signals that barely move the receiver's S-meter. As he approaches the T and the traces go off the scope face, he adds RF attenuation between the antenna and the receiver to shrink the pattern.

A Cheap Joint

The next dilemma is getting the signal from the spinning antenna to the stationary receiver with minimum loss. Prices for coaxial rotary couplers (sometimes called "rotary joints") start at a budget-busting $450 each at specialty coax product suppliers like Pasternack Enterprises. Furthermore, they must be mounted to the bottom end of the mast, which is where the sine-cosine pot also needs to go.

KK6CU's solution was to make an in-line rotary coupler out of a two-element continuous-turning potentiometer. Two elements are needed because an insulated slip ring is required for the coax shield as well as for the center conductor. If you take the easy route and try to couple the shield through the bearing of the pot, you'll have a very noisy system.

It's simplest to convert a pot having a 1/4-inch diameter shaft. "Most continuous-turn pots, including this one, have

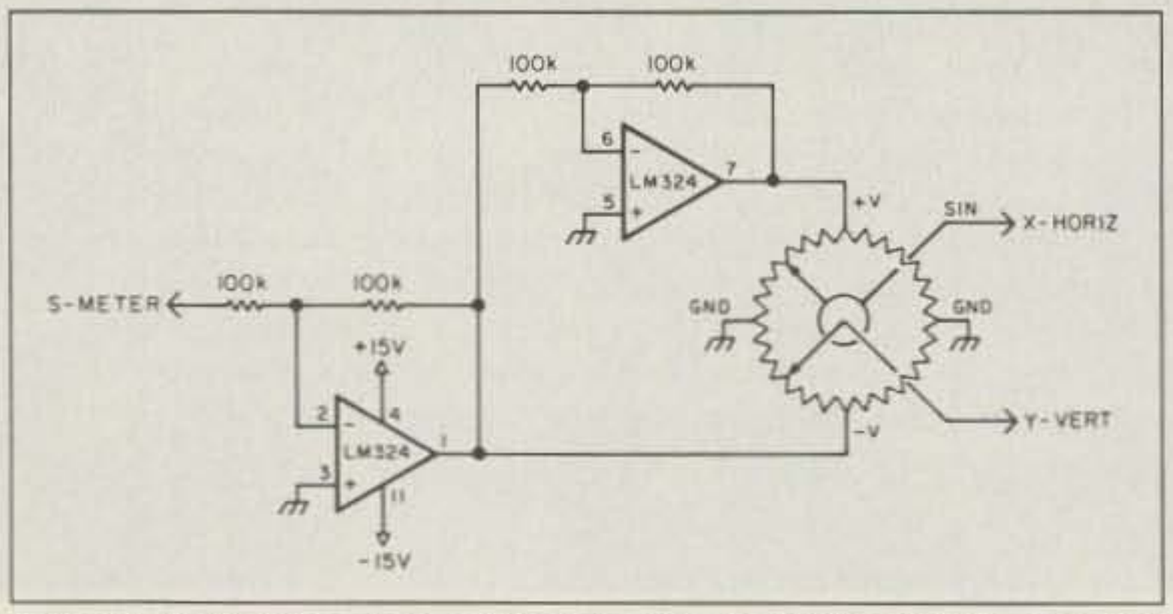

Figure 1. Basic polar-to-rectangular converter and pattern generator. The sine-cosine pot is shown as a bridge of four resistive sections and two wipers, but most units actually have a single tapped winding on a square board inside.

Catch of the day!

Have you been trawling the bounding main for a new product? We have just netted it—the TP-38 microprocessor controlled community repeater panel which provides the complete interface between the repeater receiver and transmitter. Scuttle individual tone cards, all 38 EIA standard CTCSS tones are included as well as time and hit accumulators, programmable timers, tone translation, and AC power supply at one low price of $595.00. The TP-38 is packed like a can of sardines with features, as a matter of fact the only additional option is a DTMF module for $59.95. This module allows complete offsite remote control of all TP-38 functions, including adding new customers or deleting poor paying ones, over the repeater receiver channel.

$595.00 each
$59.95 DTMF module
$149.95 Digital CTCSS module

Now available with Digital CTCSS

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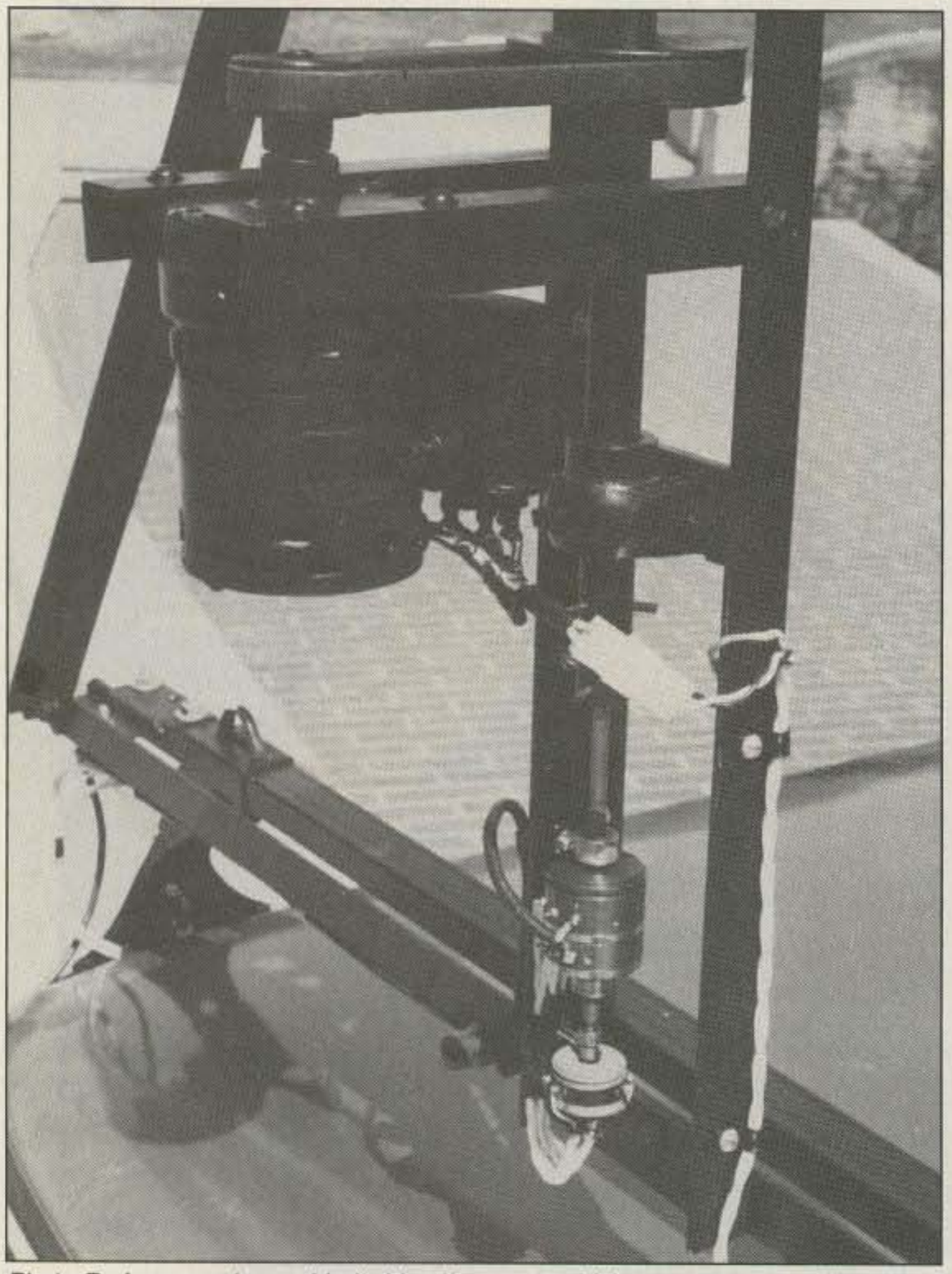


Photo B. A gearmotor and belt drive the mast, which rotates on two pillow block mounts. The antenna coax goes down the inside of the new brass shaft of the rotary coupler, located between the pulley and the sine-cosine pot.

Photo C. JaMi can fold the entire antenna assembly down on the car top for low-clearance situations.

some kind of insulated slip ring assembly bonded to the shaft," JaMi says. "I carefully disassembled it and put the shaft in a vise. Then I took a scribe and a little mallet and very gently chipped away the epoxy so that I could remove the two slip rings and their insulators intact from the shaft, which is discarded.

"I replaced the shaft with a piece of 1/4-inch o.d. hobby brass tubing, one foot long. I soldered a piece of 7/32-inch o.d. brass tubing inside the 1/4-inch tubing to reinforce it. I slid one of the slip rings on the tubing and bonded it in place; then I put the second one on, set for the same spacing as on the original shaft, and bonded it. The solderable connection points on the rings should face each other.

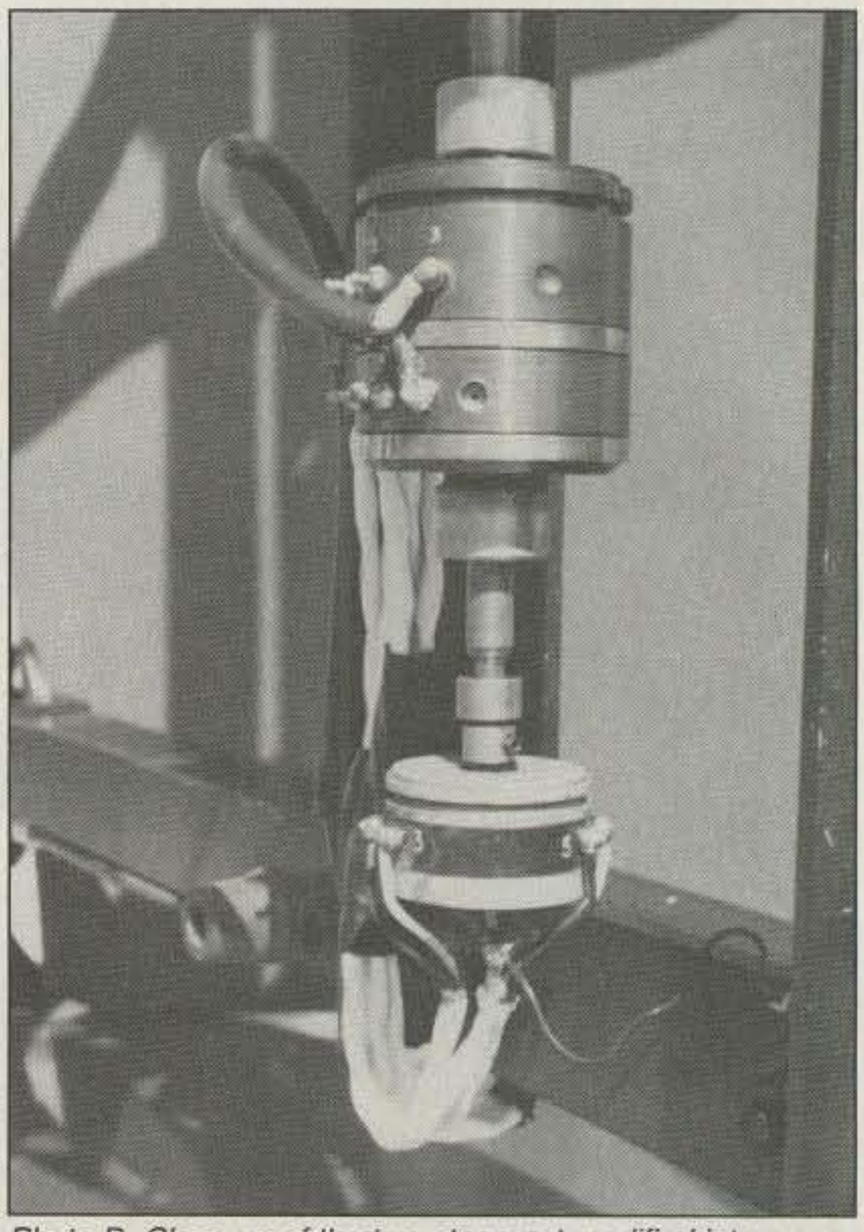


Photo D. Close-up of the two-stage pot modified into a coax rotary coupler (above) and the special sine-cosine pot (below) on the mast bottom.

"After the glue set up, I used a rat-tail file to gently make a little slot in the tubes (forming an oval) between the slip rings, then deburred it. The coax from the antenna comes down the mast, into this tube, and out to the slip rings. Despite the higher loss, I recommend RG-178 teflon-dielectric coax. You can use RG-174 if you're very careful not to overheat it.

"By cutting a square end on the coax and curling it just a tiny bit, I could feed the coax down the hollow shaft and out through the oval hole. Then I stripped the shield and center conductor in the normal manner and soldered them to the slip ring rotors.

"I removed the windings to minimize stray capacitance. Finally, I reassembled the pot, making sure that the coax pigtails didn't protrude and interfere with anything inside the enclosure. The stationary coax connections (RG-58) go to the rotor terminals of two stages, as shown in the photo."

JaMi has some additional suggestions for anyone duplicating this conversion: "The original shaft probably had one or more C-rings to hold it in place. You may have to stack washers or shims onto the hollow brass shaft to maintain proper spacing and avoid end play.

"Lubricate the wiper to prevent noise and avoid excessive wear," he adds. "You'll need to re-lube it occasionally, so drill a 1/16-inch hole in the body. You can spray tuner lube through the hole as needed. The hole should be located where it will not allow easy water entry."

Safety First

When constructing and using an RDF system like this, keep safety in mind at all times. Use extra care in designing and building your motorized antenna. Mount the beam high enough that it can't strike someone standing next to the car. Fasten the frame securely to the vehicle—suction cups aren't good enough.

Pay close attention to balance, distribution of weight, and center of gravity. An antenna that breaks up or sheds pieces on the highway could injure someone following, or cause a serious accident. JaMi says he arranged for someone to serve as a spotter, trailing his car during initial tests to watch for mechanical instability in the antenna system.

There is also potential danger in the 120 volt AC power system. Carefully ground the chassis of the storage monitor and all other equipment to the vehicle frame. Do not leave AC terminals on the motor, or any other equipment exposed. Cover or tape them up. Don't use the system in wet weather unless you have a waterproof cover for the motor and other exposed AC-operated items.

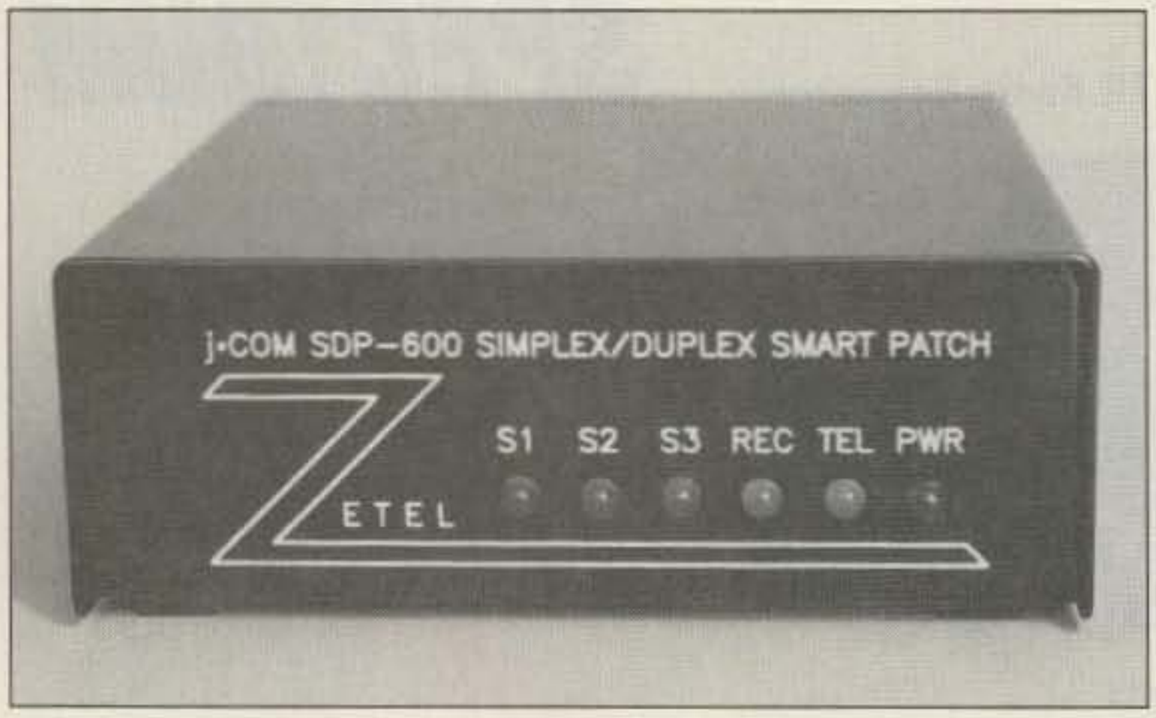
A good engineer is never content with his or her creations. KK6CU is no exception; he's trying out new bells and whistles constantly. He has incorporated the x and y outputs from a Radio Shack fluxgate compass sensor through a switch to put a "north dot" on the CRT screen. When his rotatable screen-mounted protractor is aligned with the north dot, bearings are relative to north instead of relative to vehicle heading. He is working on new offset circuits to subtract the noise floor from the scope trace.

JaMi and I welcome your letters with questions on this unusual RDF scheme, but please enclose a self-addressed stamped envelope if you want a personal reply. 73

Number 10 on your Feedback card

NEW PRODUCTS

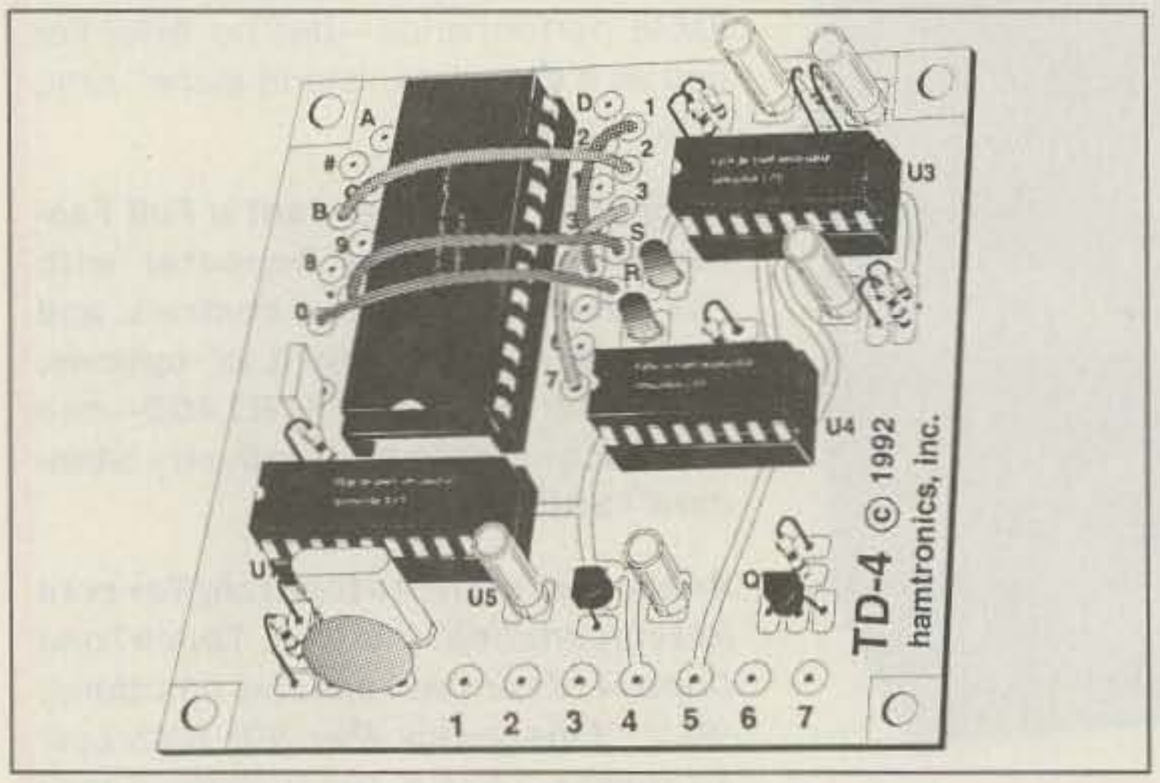
Compiled by Hope Currier



j•COM

The Model SDP-600 autopatch from j•Com is a low cost microprocessor-controlled interface between a VHF/UHF transceiver and a telephone line, allowing the user to make and receive telephone calls from any HT or mobile rig within range of the base station. Installation consists of connecting the autopatch to the rig's microphone and speaker jacks and plugging in an RJ-11 telephone jack. Control and programming of the autopatch is done by DTMF tones issued from the remote. Separate user-programmable access password codes can be set up for local and long distance dialing. And, unlike other low cost autopatches, the SDP-600 can be used in full duplex mode with a dual-band transceiver, so both parties can hear each other at the same time. Simplex mode can also be used. With the reverse patch option enabled, incoming calls will cause a short ring-out over the air and the user can then answer the call using his access password code.

The SDP-600's introductory price is $199.95. Contact *j•Com, Box 194, Ben Lomond CA 95005; (408) 335-9120; Fax: (408) 335-9121.* Or circle Reader Service No. 201.



HAMTRONICS

The TD-4 Selective Calling Module from Hamtronics is an economy touch-tone decoder with one latching output. This versatile module is primarily designed to mute the speaker of a receiver or transceiver until someone calls by sending four-digit DTMF signal, thus making it unnecessary to listen to all the activity on a channel just so someone can call you once in awhile. The TD-4 also may be used to turn on an autopatch or other device which requires a simple ground to activate it. The four-digit DTMF address is easily set in the field with wire jumpers. The 2-3/4-inch-square PC board is easily packaged for custom installations, and it operates on 12 VDC.

The TD-4 is $49 in kit form or $89 wired and tested. For more information or a complete catalog, which also includes all Hamtronics' VHF/UHF transmitters, receivers, repeaters, converters, preamps and accessories, contact *Hamtronics, Inc., 65-E Moul Rd., Hilton NY 14468-9535; (716) 392-9430, Fax: (716) 392-9420.* Or circle Reader Service No. 206.

INTERFLEX SYSTEMS

InterFlex Systems has released the KaGOLD DualPort for Kantronics TNCs, the KAM and all KPC units; and PkGOLD Enhanced for AEA TNCs. KaGOLD fully supports dual-port operation, mixed modes including AMTOR, RTTY, CW and packet. Three file transfer methods are supported, including remote send/receive as well as text files and brag files. The packet conference bridge is easy to use and supports multi-level conferences and cross-port conferences on two port units, useful for nets, emergencies and group discussions. The built-in logging feature also handles automatic exchange of name, QTH and QSL information with other GOLD users, and many more advanced features. Instead of fixed-length buffers, PkGOLD and KaGOLD support huge scrollback buffers that are dynamically allocated (memory given to activities that need it), with up to 250K of scrollback on most systems. They have fast installation and startup and run in Host Mode for high performance. The built-in Clipboard editor's cut/paste feature makes traffic handling and message storage and retrieval a snap. Both come with a 95-page bound manual, an extensive online help system for all parameters and operating modes, and a quick reference guide.

Each program is $79.95 plus shipping and handling. For more information, contact *InterFlex Systems, P.O. Box 6418, Laguna Niguel CA 92607; (714) 496-6639; Fax: (714) 496-8041.* Or circle Reader Service No. 202.

EUR-AM ELECTRONICS

EUR-AM electronics is offering an adjustable mount (up to 25 degrees) for PL or N type connector antennas (like Diamond, COMET, etc.). The mount is currently imported from WiMo (Germany) and comes with 12 feet of RG-58 coax permanently connected in either vertical (fenders) or horizontal (roof) fashion. The N type is $36; the PL type is $33. For more information, contact *EUR-AM Electronics, P.O. Box 990, Meredith NH 03253-0090; Fax: (408) 866-4311.* Or circle Reader Service No. 203.

TRIPP LITE

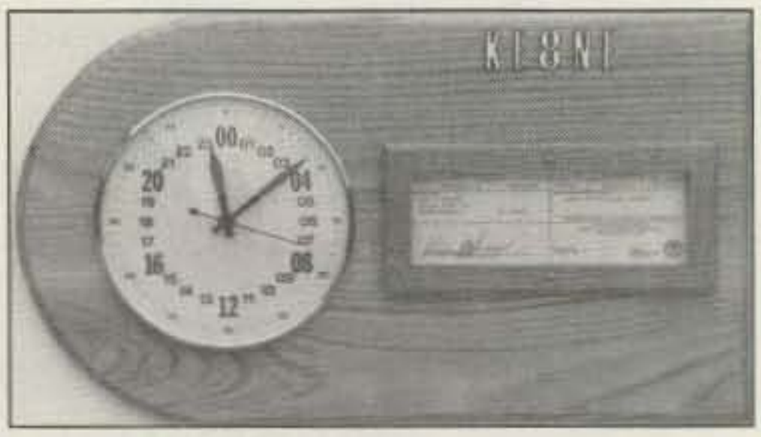
The new ISOBAR(R) Ultra surge suppressor from Tripp Lite has a revolutionary new design, featuring diagnostic indicators and a new comprehensive warranty. Using multicolored indicator lights, the ISOBAR Ultra can detect and display wiring faults, loss of power and integrity of the surge protection circuitry, alerting the user to problems *before* equipment is turned on. This series also features new Lifetime Ultimate® Insurance, which guarantees every Ultra model and the connected equipment against surge damage (including direct lightning strikes) for life, up to $25,000. If surge damage occurs, the ISOBAR Ultra and connected equipment will be repaired or replaced free.

Each ISOBAR Ultra also features exclusive isolated filter banks to prevent interference between connected components, two or three UL listings, multiple filtering components and a rugged all-metal case. They are available in 4-, 6- and 8-outlet models, with optional fax/modem protection. For prices and more information, contact *Tripp Lite, 500 N. Orleans, Chicago IL 60610-4188; (312) 329-1777, Fax: (312) 644-6505.* Or circle Reader Service No. 205.

MIDWEST WOOD PRODUCTS

Midwest Wood Products has introduced a new clock made of solid oak and measuring 10-3/4" by 19". It comes with a frame for either size U.S. license and has non-glare lenses for both the movement and display frames. The quartz movement is U.S.-made, runs on one AA battery, and is warranted by the manufacturer for six years. The wood and display frames are warranted for one year. The letters on the clock are self-adhesive and are easily changed if you upgrade or move and change your callsign—the necessary letters and numbers will be supplied for $1. The hardware is brass, including the bezel, and the clock is available with a natural finish or stained, and has a polyurethane finish.

This clock is available in a 12-hour or 24-hour version for $69.95 plus shipping. For more information and/or a complete catalog, contact *Midwest Wood Products, 16141 24th Ave., Coopersville MI 49404; (616) 677-3706.* Or circle Reader Service No. 204.



HF Equipment

		Regular	SALE
IC-781	Xcvr/ps/tuner/scope	★ $6529.00	**5298**

IC-765	Xcvr/ps/keyer/tuner	$2859.00	**2348**

IC-751A	9-band xcvr/SW rx	$1629.00	**1348**
PS-35	Internal power supply	239.00	**219.95**
IC-735	HF xcvr/SW rcvr/mic	★ 1149.00	**949.95**
PS-55	External power supply	239.00	**219.95**
AT-150	Automatic antenna tuner	469.00	**399.95**

IC-725	HF xcvr/SW rcvr/mic	$893.00	**729.95**
AH-3	Automatic antenna tuner	512.75	**449.95**
IC-728	HF xcvr/SW rcvr/mic	★1099.00	**899.95**
IC-729	HF xcvr/SW rcvr w/6m	1419.00	**1168**
AT-160	Antenna tuner	413.00	**349.95**
IC-2KL	HF solid state amp w/ps	$2119.00	**1768**
IC-4KL	HF 1 kw amp w/ps	★ 7459.00	**5998**

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$60 Off on: 728, 735, R100, R-71A, R72, R7100

$40 Off on: 2410A/AB, 901, 1201, 2SRA, 2AT, PS-70

$20 Off on: 275H, 228H, UX-19A, UX-39A, UX-49A, UX-97, UXR91A, UXS92A

$10 Off on: W2A, 24AT, 02AT/HP, 28H, 4SAT, 4SRA

ICOM

All prices subject to change without notice - check with salesperson

VHF/UHF Base Transceivers

		Regular	SALE
IC-275H	100w 2m FM/SSB/CW	★ $1589.00	**1298**
IC-475H	100w 440 FM/SSB/CW	1819.00	**1498**
IC-575A	25w 6/10m xcvr/ps	D 1455.00	**1158**
IC-575H	25w 100w 6/10m xcvr	1699.00	**1398**
IC-1275A	10w 1.2GHz FM/SSB/CW	D 1924.00	**1598**

VHF/UHF FM Transceivers

		Regular	SALE
IC-28H	45w 2m FM/TTP mic	★ $389.00	**329.95**
IC-228H	45w 2m FM/TTP mic	★ 429.00	**349.95**
IC-229A	25w 2m FM/TTP mic	439.00	**369.95**
IC-229H	50w 2m FM/TTP mic	439.00	**369.95**
IC-38A	25w 220 MHz FM xcvr	439.00	**369.95**
IC-449A	35w 440FM xcvr/TTP	529.00	**439.95**
IC-1201	10w 1.2GHz FM/SSB/CW	★ 849.00	**719.95**

Dual band FM Transceivers

		Regular	SALE
IC-2410A	25w 2m/440 FM/TTP micD	★ $889.00	**729.95**
IC-2410H	45w 2m/35w 440 FM/TTP	939.00	**769.95**
IC-3230A	25w 2m/440 FM/TTP mic	739.00	**619.95**
IC-3230H	45w 2m/ 35w 440 FM/TTP	839.00	**699.95**

Multi-band FM Transceiver

		Regular	SALE
IC-901	50w 2m/35w 440 FM xcvr	★ $1069.00	**879.95**
UX-R91A	Broad band receiver unit	★ 539.00	**449.95**
UX-19A	10w 10m unit	★ 319.00	**269.95**
UX-59A	10w 6m unit	369.00	**319.95**
UX-S92A	2m SSB/CW module.	★ 639.00	**549.95**
UX-39A	25w 220MHz unit	★ 479.00	**399.95**
UX-129A	10w 1.2GHz unit	589.00	**489.95**
UX-49A	440MHz module for IC-900	★ 369.00	**319.95**
IC-970A	25w 2m/430MHz xcvr/ps	2839.00	**2348**
IC-970H	45w 2m/430 MHz xcvr/ps	3079.00	**2548**
UX-R96	50-905 MHz receive unit	419.00	**349.95**
UX-97	1.2GHz band unit	★ 1059.00	**899.95**

VHF/UHF Mobile Antenna

		Regular	SALE
AH-32	2m/440 Dual Band mobile ant	$ 41.25	

VHF/UHF Repeaters

		Regular	SALE
RP-1520	2m 25w repeater	$2369.00	**1968**
RP-2210	220MHz 25w repeater	2009.00	**1658**
RP-4020	440MHz 25w repeater.	★ 2439.00	**1998**
RP-4020/50W	440 50w repeater	★ 2649.00	**2198**
RP-1220	1.2GHz 10w repeater	2759.00	**2298**

Handhelds

		Regular	SALE
IC-P2AT	2m HT	$419.00	**349.95**
IC-P3AT	220MHz HT	419.00	**359.95**
IC-P4AT	440 MHz HT	469.00	**389.95**
IC-2A	1.5w 2m HT • *Closeout*		**199.95**
IC-2AT	1.5w 2m HT/TTP	★ 269.00	**219.95**
IC-02AT/High Power	2m	★ 349.00	**289.95**
IC-03AT	2.5w 220 HT/TTP	329.00	**279.95**
IC-2SAT	2m/TTP	379.00	**309.95**
IC-2SRA	2m/25-905 rx.	★ 579.00	**479.95**
IC-24AT	2m/440MHz/TTP	★ 459.00	**379.95**
IC-3SAT	220MHz HT/TTP	359.00	**299.95**
IC-4SAT	440MHz HT/TTP	★ 399.00	**329.95**
IC-4SRA	440/25-905 rx..	★579.00	**489.95**
IC-2GAT	2m HT/TTP	399.00	**329.95**
IC-4GAT	440MHz/TTP	399.00	**329.95**
IC-12GAT	1.2GHz/TTP	519.00	**429.95**
IC-W2A	2m/440 HT	★ 589.00	**499.95**
IC-X2A	440/1.2 HT	749.00	**629.95**
PS-70	2A power supply for HT's	★79.00	**69.95**

Aircraft band handhelds

		Regular	SALE
A-2	5W PEP synth aircraft HT	$575.00	**429.95**
A-20	aircraft HT w/VOR	639.00	**469.95**
A-21 Navicom Plus	Aircraft HT	680.00	**499.95**

Shortwave Receivers

		Regular	SALE
R-1	100kHz-1.3GHz AM/FM pocket	$539.00	**449.95**
R-71A	100kHz-30MHz rcvr	★ 1209.00	**989.95**
RC-11	Infrared remote controller	74.75	
FL-32A	500 Hz CW filter	72.25	
FL-44A	SSB filter (2nd IF)	187.00	**169.95**
EX-257	FM unit	51.50	
EX-310	Voice synthesizer	62.00	
CR-64	High stablity oscillator xtal	83.00	
R-72	30kHz-30MHz SW rcvr	★ 1109.00	**929.95**
R-100	100kHz-1.856GHz AM/FM	★ $729.00	**599.95**
R-7000	25MHz-2GHz receiver	1439.00	**1198**
RC-12	Infrared remote controller	74.75	
EX-310	Voice synthesizer	62.00	
TV-R7000	ATV unit	184.00	**169.95**
SP-3	External speaker	68.25	
CK-70	(EX-299) 12V DC option	13.75	
R-7100	25MHz-2GHz receiver	★ 1479.00	**1228**
R-9000	100kHz-2GHz all mode rec.	★ 5859.00	**4898**

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Number 11 on your Feedback card

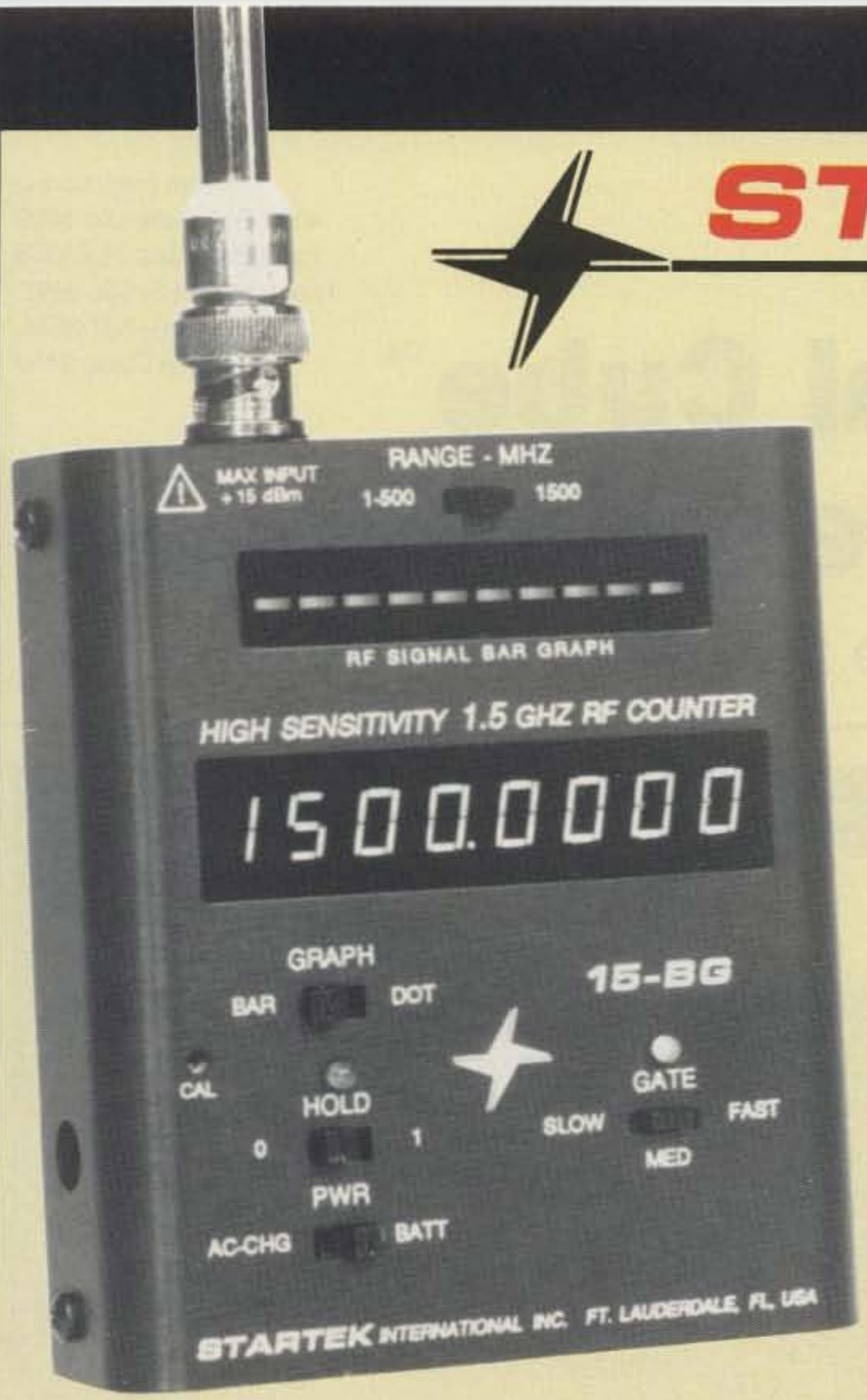
HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8-1/2" x 11") sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS Special Events Message Area #11. (2400 baud, 8 data bits, no parity, 1 stop bit. (603) 924-9343). Please indicate if it is for publication. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Bullet Electronics marketed several kits in the late '70's; among these were "Grandfathers Clock" and "Super Music Machine." Construction instructions and schematics are desperately needed. Will pay. *Jack Christilaw KO8I, 38700 Ann Arbor Trail, Livonia MI 48150.*

Wanted: Tube schematic for 3RP1 CRT. Also, schematic suggestions for building a simple o'scope using this CRT. Please send info by air mail. *David K. Hanson KBØEVM, SAUDIA, P.O. Box 167 Cost Center 956, Jeddah 21231, Saudi Arabia.*



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73 Review

by Larry R. Antonuk WB9RRT

Number 12 on your Feedback card

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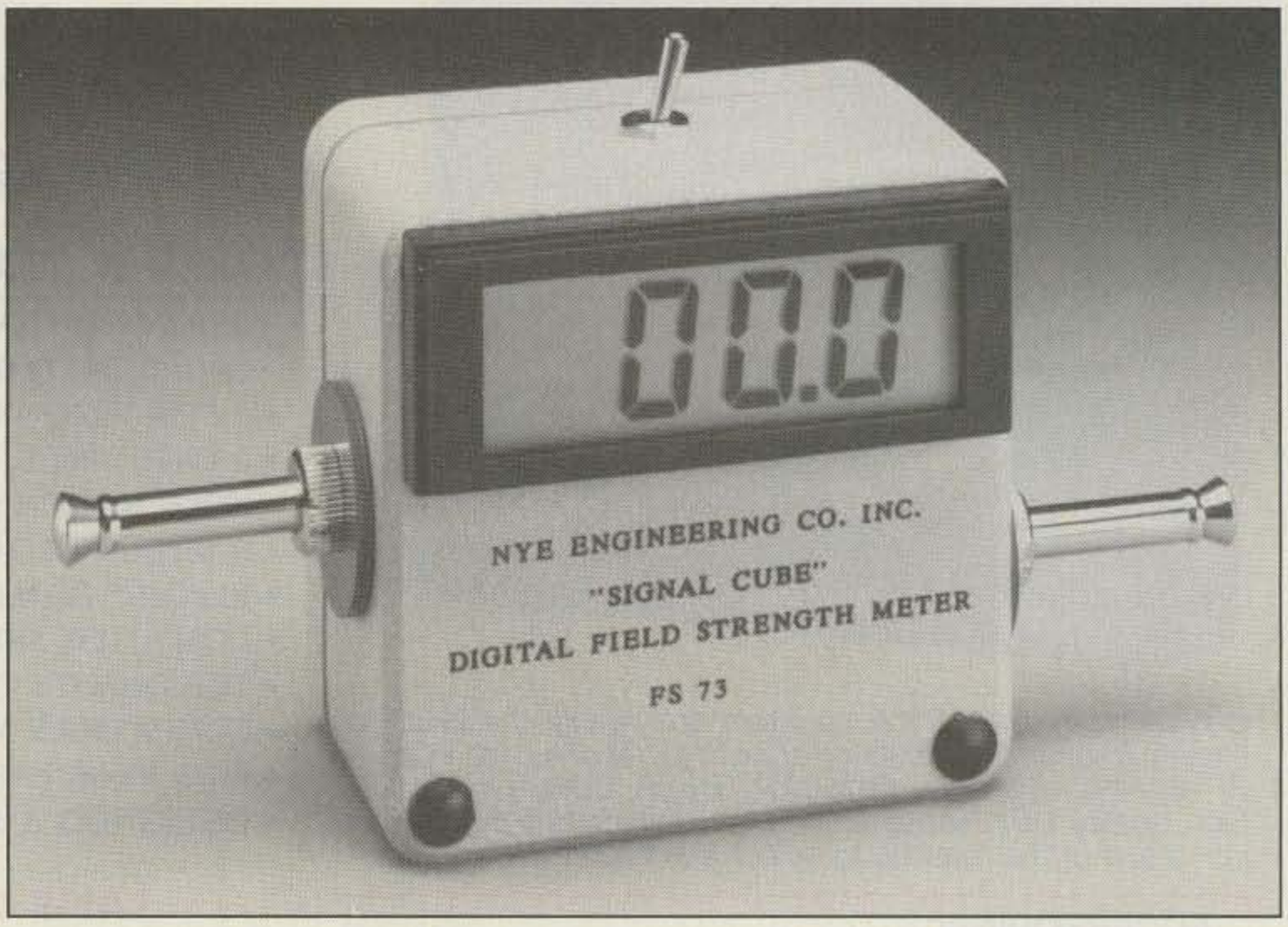
Price Class: $159

The FS 73 Signal Cube™ Digital Field Strength Meter

Measure both absolute and relative field strengths.

Forward and reflected power measured at the transmitter can tell you quite a bit, but not always the whole story. You may have a VSWR of 1.1:1, and 250 watts out, but for some reason you're just not making the trip. What's the problem? It's obvious that what's going into the coax isn't getting out of the antenna. The flat VSWR is just there to fool you—it could be caused by several different problems. You may have moisture in a connector at the antenna that just happens to approximate 50 ohms. Your receive signal may be fine, since the connector may not break down until it sees the high power transmit signal. You may have had moisture in the connector last year, and by this year the moisture has crept down the coax, causing it to become very lossy—not unlike a 50-foot-long resistor. At any rate, you begin to wonder why people no longer talk to you, even though your trusty wattmeter tells you that everything's OK.

At times like this, the tool to pull out of your bag is your field strength meter. Short of a QSL card, the only way to really measure the effectiveness of an antenna system is to measure the field strength produced by the antenna—how much signal is actually being thrown off into the ether by that tangle of wires on the roof. Basic field strength meters consist of a small antenna, a diode and capacitor to rectify the RF, and a DC meter to display the level. These meters are useful only for relative readings, and tend to be somewhat lacking in the sensitivity department. (In technical circles, they are referred to as being "deaf as a post.")



The Nye Engineering FS 73 Signal Cube digital field strength meter.

The Signal Cube

Enter the "Signal Cube" field strength meter from Nye Engineering. The Nye Engineering folks have mixed some traditional field strength meter values with some new technology, and have come up with a winner. The first traditional value you'll notice is the quality. Built into a 2.5" x 2.5" x 2"-deep cast aluminum box, the unit is as solid as a rock. Another quality feature is the unit's practicality—it makes relative as well as absolute measurements, from 100 kHz to 450 MHz. The Signal Cube is splashproof (coffee??) and has a range of 30 mV/meter to 30 V/meter. It's autoranging, and wideband—the only control available is the on/off switch. A large 3-1/2-digit display brings the device into the 20th century, making it easy-to-read and accurate, and giving it a rather high-tech look. Two collapsible antennas pull out from each side of the Cube, making a dipole that can be adjusted to different lengths to change the sensitivity of the meter.

Measurements

The addition of absolute measurements to a meter of this caliber is quite an achievement. For those unfamiliar with the concept, an absolute field strength measurement is one that is related to a given reference—in this case, the number of volts/meter, derived from the voltage impressed upon the two antennas. In actual operation of the Signal Cube, this value is calculated by taking a reading from the display, and using a chart (found on the back of the unit or on the instruction sheet) to relate the reading to the frequency of operation and the lengths of the small collapsible antennas, producing a value in volts/meter. On the other hand, a relative reading is simply one related to a previous reading. The actual value is not of interest—we only care if the second reading is better or worse than the first.

To put things in perspective, relative readings would be used to tune a transmitter. Your only concern would be to watch your voltage and current readings, and tune for a maximum indication on the Signal Cube. It wouldn't matter what the readings were, just so you got the peak reading possible on the Cube. Absolute readings would be useful to measure the performance of, say, a 2m yagi antenna you just built. You could set the unit up to transmit in the open, then take readings a fixed distance away at several points of the compass. This information could be used to plot a basic directivity graph. You could then change the design and re-measure, or perhaps compare a commercial antenna to your design. (Commercial test ranges often keep the field strength meter stationary and rotate the antenna, but building a commercial test range is beyond the scope of this article.) Closer to home, you might record readings from your HF antenna at several key spots around town while your buddy keys it up. Once a year or so you might repeat the exercise, and get a jump on things the next time you get that water in the connector!

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Other Uses

Of course, once you get your hands on the Signal Cube the uses for it multiply. In addition to the traditional applications, you can use the Cube to measure the levels of RF floating around the shack itself, perhaps caused by faulty antennas, or maybe poorly shielded equipment. The Cube can be used to tune a ground lead, artificial ground, or an antenna counterpoise. Paranoid users will find it useful at work—the high sensitivity of the Signal Cube makes it useful for ferreting out those hidden transmitters bugging your office. How much RF is coming out of your microwave oven? How about the cellular phone on your front seat? How about that color computer monitor?

These last three examples are all "out of range" of the FS 73, either below or above the 100 kHz to 450 MHz range, but they still produce usable readings on the instrument. They just can't be converted to absolute field strength readings. The readings are still useful from a relative basis, however. For instance, what's the best position of this computer monitor EMI shield, in order to reduce the amount of RF bombarding my cranium?

Operation

Operation of the Signal Cube could only be simpler if it had an auto-sensing on/off switch! You simply turn the unit on and read the display. The display blanks in the event of excessive input—simply collapse the antennas, or increase the distance to the transmitter. The two antennas form a dipole, so there is some directivity to the unit. For most situations, the Cube is just rotated to give the highest reading, which is then noted.

This directivity and the high sensitivity make the Cube of some interest to the foxhunter, especially during the end game. However, the FS 73 lacks an external antenna jack, which might be used to connect a higher-gain, more directional antenna than would be necessary in most foxhunts. In addition, the LCD readout, while quite readable, has no bar graph—it's designed mainly for measurements, rather than peaks or dips.

Most of us aren't too familiar with field strength measurements, but the sensitivity of 30 millivolts per meter is quite good. Translating this to reality, it means you can pick up a 1 watt, 440 MHz handheld at about 150 feet. Holding the Cube in your hand tends to distort the pattern, so two tapped holes are provided to attach your own non-conducting pole.

The FS 73 Signal Cube is a great tool for antenna experts, and for anyone who's interested in finding out where the invisible (and sometimes insidious) RF is in his or her life. Far from being a specialized instrument, you'll find more and more uses for it on a daily basis. 73

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High-Flying ATV in Utah

Quite a few groups have sent up ATV-equipped high-altitude balloon experiments this past year. One of the more prolific (and ambitious) groups is the Bridgerland Amateur Radio Club in Logan, Utah. Over the past year BARC has flown nine balloon experiments (two were tethered) carrying amateur radio equipment. Every payload on these flights has been successfully recovered. These initial flights carried a two-channel Radio Shack VHF receiver, a 250 milliwatt 2 meter beacon and a tone decoder that would activate a release mechanism on command from the ground. The early flights used a standard rubber weather balloon that burst immediately upon reaching maximum altitude. The seventh and eighth flight used a special *zero-pressure* balloon (made out of a plastic film) that could allow the payload to float at peak altitude for as long as a day.

These initial flights helped give the group the know-how and experience to design payloads to withstand the extremes of the upper atmosphere, launch large delicate (and expensive) balloons and the ability to successfully track down and recover the payloads wherever they landed (usually in remote and rugged terrain) using direction-finding equipment. The following is an account of their latest effort (the ninth flight), as described by Harl Goodsell W7LTH.

The Super ATV Balloon

The BARC group decided to attempt a flight using a newly designed *super-pressure* balloon donated to them by Winzen International, Inc., makers of large high-altitude balloons and recovery parachutes. A super-pressure balloon is designed to go to a fixed altitude and remain there for long periods of time. It is conceivable that it could remain at altitude for months, traveling thousands of miles in the jet streams. *[Ed. Note: Imagine an ATV (or voice) repeater at 65,000 feet periodically floating across the country! Two-way contacts over 600 miles apart could be reliably established with P5 pictures from such a system.]*

Photo A. Inflating the zero-pressure balloon for payload test flight #8. Photo by Gil Moore N7YTK.

Photo B. Liftoff of flight #7 using a zero-pressure balloon. Photo by Harl Goodsell W7LTH.

The BARC Program

One of the goals of this program is to interest high school and university students in science by flying their experiments as part of a balloon payload. This allows them to see the results in real-time as the flight progresses.

The fifth flight carried the first of these student experiments: a solar-driven motor that could be used for maintaining a device in relation to the sun. The sixth flight carried several hundred paper gliders that were released at about 2,000 feet as part of a Cub Scout event. The glider that went the farthest received a prize.

Gil Moore N7YTK, Adjunct Professor of Physics at Utah State University and a representative of the Rocky Mountain NASA Space Grant Consortium, has been the driving force behind these balloon flights. He has been able to obtain the special balloons and has also helped with many of the expenses incurred. Many of the local hams have put in long hours designing, building and testing the circuits used in the payloads.

During a conference on balloons, Gil met the folks from Winzen and showed them a videotape of the BARC experiments. He was asked if the BARC group would like to fly one of their newly designed super-pressure balloons. They even offered to come out and show them how to handle this special very thin clear nylon material. As Gil later put it, "I just couldn't say no."

The Payload

One of the goals was to have ATV on board and to have a means of sending real-time and delayed information down from the payload. Stan Wellard N7UXC took over as project coordinator and the new payload started to come together. It contained a Motorola P50 2 meter FM radio, a tone decoder board, a Campbell Scientific data-logger, a P.C. Electronics KPA-5 one-watt ATV transmitter on 434 MHz, an Olde Antenna Labs "mini-wheel," a Micro Video Products miniature black and white CCD camera and a High Technology Flight video overlay board for the callsign ID (N7YTK). A three-inch front surface mirror was mounted at a 45 degree angle in front of the TV camera and rotated by command using a one-RPM motor to allow a full 360 degree view. A PacComm UMPAD-4 micro powered TNC sent down packet telemetry on 144.290 MHz via the Motorola 2 meter FM HT. Kelly Vining KE7WI built a separate 250 milliwatt beacon transmitter that IDed for 20 seconds every three minutes on 145.550 MHz to aid in tracking the balloon.

There were sensors to measure inside and outside temperature, as well as battery condition. There was a Magellan GPS (Global Positioning System) receiver board that would give the bal-

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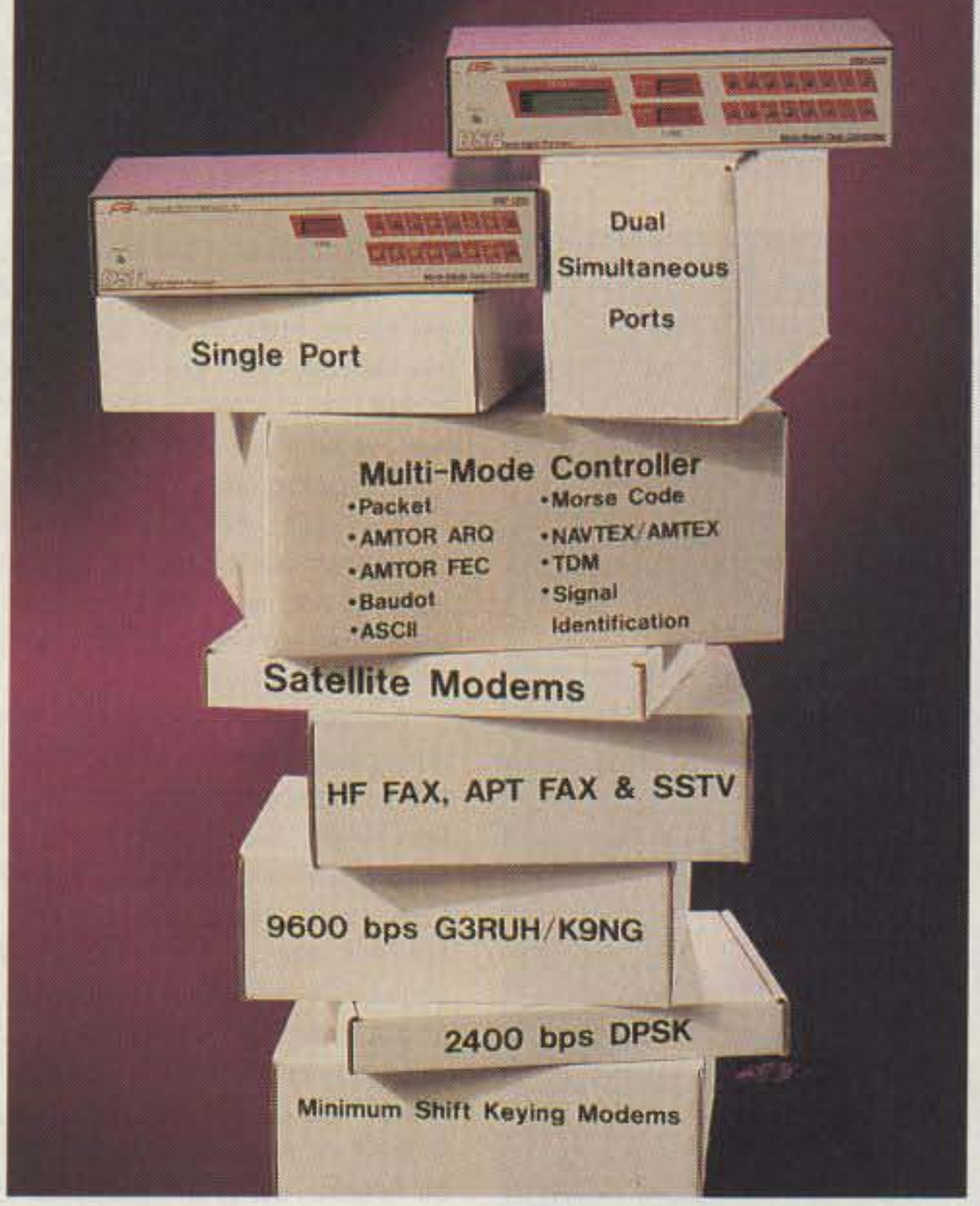

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Photo C. Stan Wellard N7UXC (r) checks out the payload for the super-pressure balloon experiment (flight #9). The rotating TV mirror system is on the left and the GPS antenna (egg-shaped) is shown sticking out on the right side of the payload. The radiometer is located inside with the rest of the electronics. Photo by Harl W7LTH.

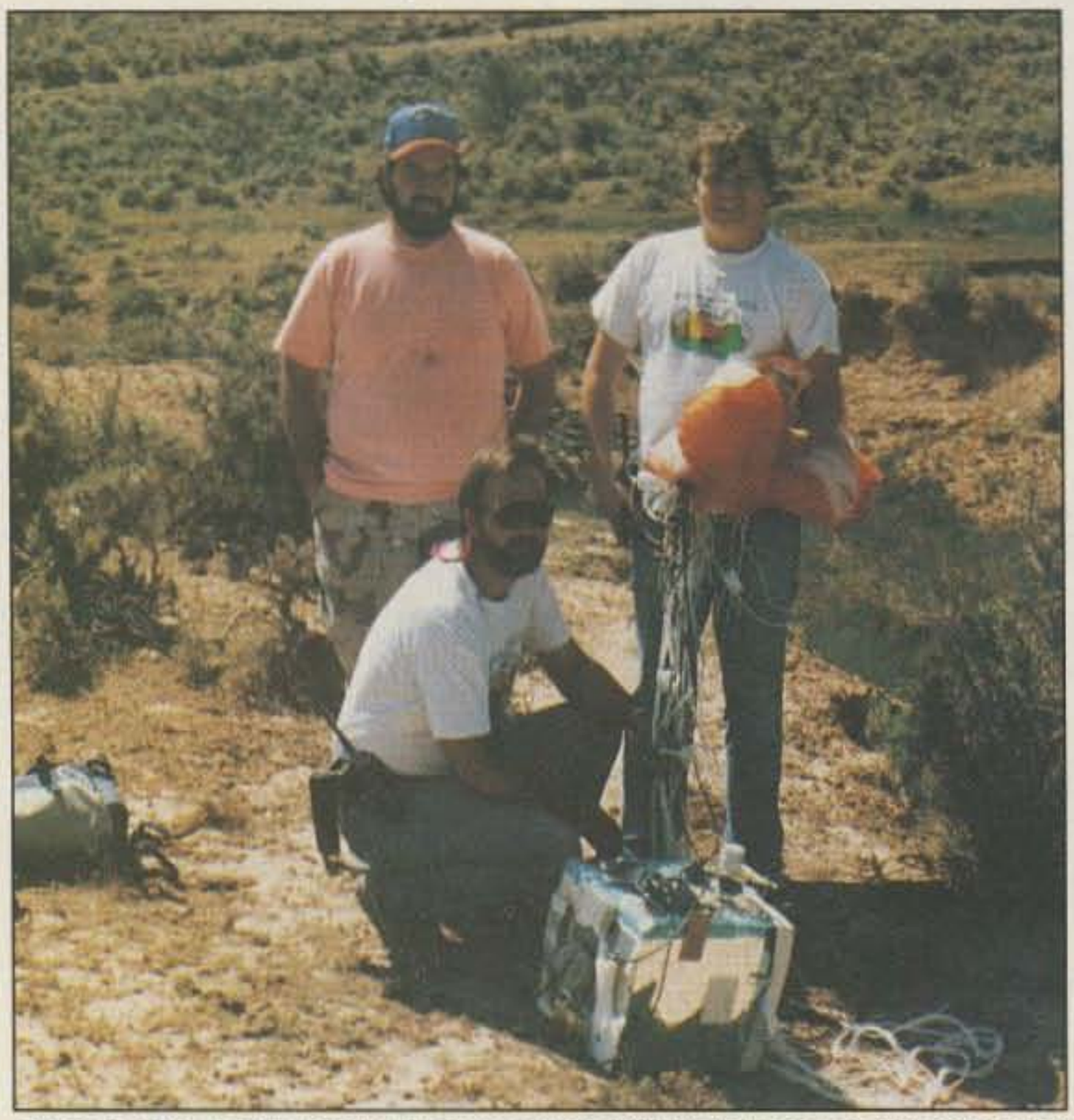

Photo D. The super-pressure balloon payload (flight #9) is found just eight miles northeast of Evanston, Wyoming. (l to r): Jeff N7UWW, Mike KG7FZ and Mark N7EVJ. Photo by N7UWX.

loon's current position to within 300 meters (latitude, longitude and the altitude). A four-channel radiometer was obtained to study the ozone layer. The data logger stored data from the radiometer, sensors and the GPS receiver and downlinked the information via packet on 144.290 MHz on command or automatically at two-minute intervals. The first three packets gave the GPS position data and the fourth packet gave the sensor data.

A cutdown system consists of two electric pyro igniters controlled via the tone decoder. On activation, it would burn a large "V" in the top of the balloon and also sever the line holding the payload with its 12-foot parachute. There was also a fail-safe timer just in case all else failed. The payload weighed in at just over 27 pounds. *[Ed. Note: A payload of this size requires a special FAA waiver (four to six pounds is the limit for free-flight balloon payloads unless a waiver is issued)].* In addition, two strobe lights were on the system since the balloon would be launched during darkness. The payload was encased in a rigid nylon framework about 12 inches square and covered with 3/4-inch styrofoam with an outside layer of metallized mylar to act as a radar reflector. There were three separate battery supplies used to power different parts of the payload.

This super-pressure balloon when fully inflated has a 26-foot diameter and a volume of 9203 cubic feet. It can carry a 30-pound payload to 64,000 feet. Once there it could stay at that altitude for weeks or months.

The Flight

Early on the morning of August 1st, Gil N7YTK called the FAA from his cellular phone and received clearance for liftoff. At exactly 4:00 a.m. local time the balloon was released. It began slowly moving to the north but was NOT rising! It turned out that the payload weight had been miscalculated and not enough helium had been pumped into the balloon. The balloon was quickly captured and brought back to the launch site for some additional helium. At 4:07 a.m. the balloon was again on its way and finally began its journey.

The launch was planned for this early hour so that the radiometer could look at the ozone layer as the sun came over the horizon. Also, one of the goals was to see how the new super-pressure balloon would react when the sun hit it and expanded the helium to stretch the balloon skin tight. ATV was used to observe the balloon as it reached its maximum tautness and to see if the cutdown system functioned properly and the parachute deployed.

All systems performed well with good data coming down on the packet downlink as reported by AC7O in Clayton and Dan KAØEOF at their portable stations. Joe N7NJR was receiving the ATV picture (with some snow) and Brian N7QAR and Dick K6KCY were busy sending commands to downlink the data and turn on and rotate the TV camera mirror. Members of the chase team, Mark N7EVJ, DeAnn KB7LLG, Mike KG7FZ (and his brother Jeff N7UWW), all headed out to the projected landing site. Kevin N7RXE and Tyler N7UWX headed for the top of an 8,000 foot pass that was halfway to the landing zone. Gil and Stan updated the aircraft map as the GPS position data came in and helped steer the crew in the right direction. At daylight Hugh N7KW took off from the Logan airport followed by a second plane piloted by Carl Howlett with Jamie N7XLH riding along as observer.

The balloon stopped at 45,000 feet and remained at that altitude. A look at it with the ATV camera revealed that it was not completely in the sunlight yet and had not fully expanded. Reception reports came in as far away as Kemmer, Wyoming. In addition, N7PQZ in Rawlins, Wyoming, had over an hour of packet hardcopy. At about 7:15 a.m. the sun shown fully on the balloon and within minutes it rose to its peak altitude of 64,000 feet and held steady. The ATV picture revealed the balloon was now fully expanded. Brian N7QAR issued the cutdown command and a cheer went up as the ATV downlink displayed the parachute blossoming out above the payload.

Recovery

After the payload landed, the chase crew closed in on the landing site near the town of Evanston, Wyoming (75 miles from the launch site). As the recovery team drove down a dirt road they came to a fence that had a sign reading "No Trespassing—Hunter Control Area. Cyanide Poison Charges Set." Since the signals were so strong, they knew the package was just over the next rise.

After a call to the local Sheriff, the recovery team was escorted through the area and quickly found the payload and parachute in good shape. The balloon envelope was even found just two miles away by Randal N7YSV and SDL employees while riding in the Space Dynamic Laboratory/USU recovery truck.

The actual landing site was within a mile of the prediction as given by Stan from updated data. The flight had lasted three hours and 50 minutes. The total time from liftoff to recovery took six hours and 47 minutes. The radiometer data is currently being analyzed and appears to valid.

Over 25 hams, and many more who were monitoring, were involved in this very successful flight. 73

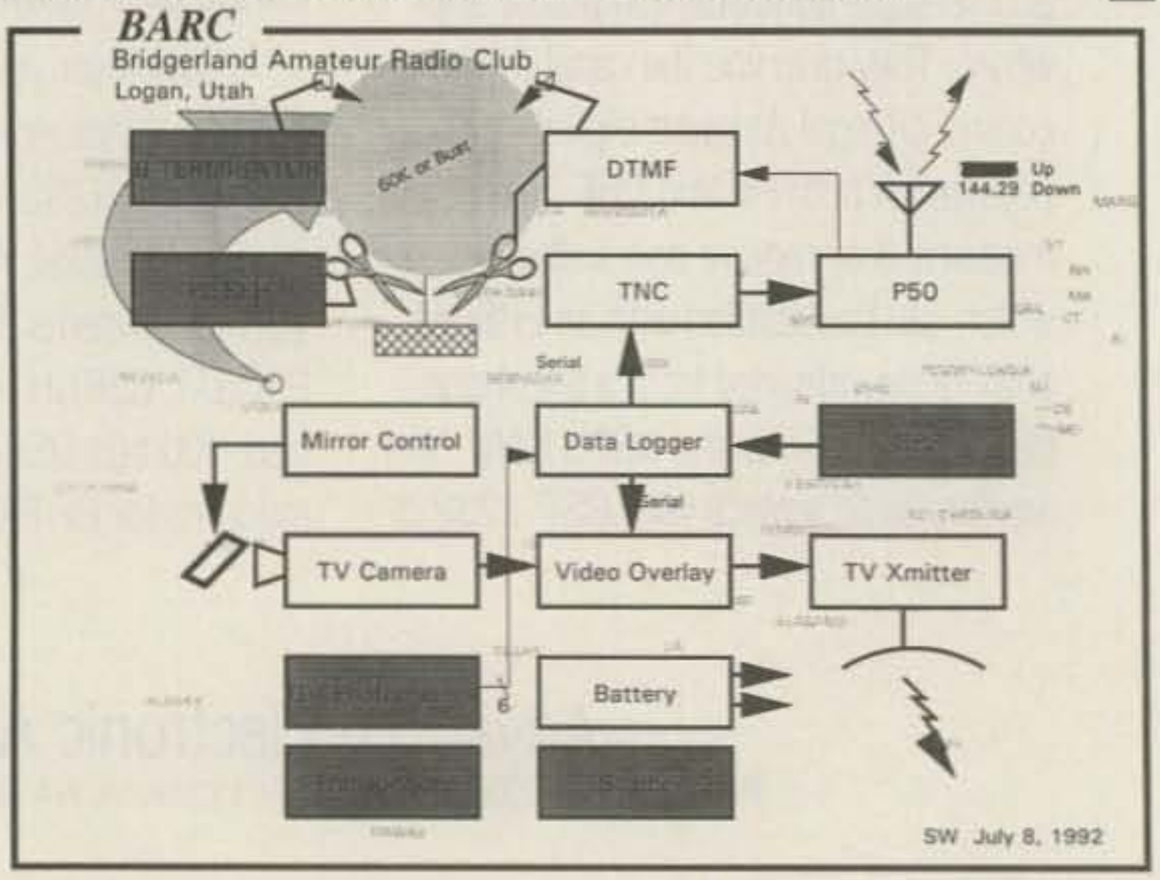

Figure 1. Block diagram of the BARC payload. Drawing by Stan Wellard N7UXC.

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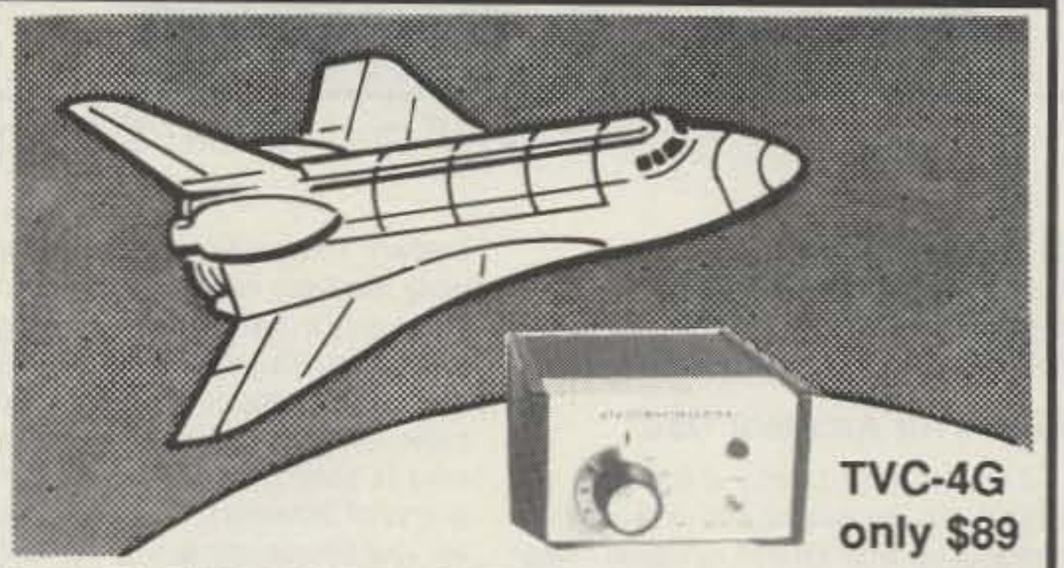

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Filters for Amateur Use

Last month I briefly discussed 10 GHz Gunn oscillators and the components used with WBFM systems. This month I would like to get into another subject altogether: different RF filters and coaxial and waveguide systems. I have accumulated questions from readers on this topic for quite a while. These questions vary from problems on very low frequencies (60 kHz) to very high up into the microwave spectrum.

I usually orient each of my columns to some of the topics brought up in letters I receive from our readers. I feel that this is the best way to present material of interest. I appreciate your feedback on these and similar topics. Most specific questions invoke a more general discussion of applications and materials that can benefit our amateur endeavors. Sharing the information has always been paramount to me.

Transmission Paths

Let's start off with a simple premise. "Why don't we move some of our radio-based systems to a closed coaxial or waveguide environment? In that way we would reduce quite a bit of interference and congestion on much of our frequency spectrum." I think this question has been asked in various ways ever since spark ran king. Why don't we use coax or waveguide to contain communications paths instead of using atmospheric-type transmission paths?

Before we get far afield, let me say that we don't use coaxial cable or waveguide for systems covering great distances because the cable losses become too large to pass signals as the distance gets greater and greater. Loss in the atmosphere is great also but nowhere near the loss encountered in coaxial systems. Antennas perform better in transmitting and receiving energy at very great distances.

Filters also entèr into a major aspect of our lives: They help to separate the multitude of signals and help prevent overload in some of the very simple systems. Additionally, filters can be used to prevent out-of-band image product signals from reaching the antenna when mixing low frequency IFs for 144 MHz or 432 MHz. Of course, we want the desired frequency signal to pass and the filter does just that.

The trend for advancement in communications has brought along a corresponding reduction in bandwidth and improvement in signal-to-noise ratios due mainly to filters. There are other advanced wide-based systems employing spread spectrum and frequency hopping; I am not going to get into them here. Before we get on to several different filter types and discuss them, let's see how they help to solve part of the problem.

First, filters to me are the doorways of modern transceivers. By comparison, early receivers were wide open, consisting of only a detector, and would receive everything. It's just like a simple crystal detector or "potato" receiver—you receive everything that is strong in your area (a potato receiver is very similar to a crystal detector). The same analogy for low frequency is true for both our VHF/UHF and microwave bands.

For example, when you take an HT to a favorite overlook or mountaintop, why does your HT seem dead? Is your HT OK or is the band dead? Well, the band is not dead and your HT is OK. What is going on is that the same problem a simple crystal receiver experiences is happening to your HT, but in a slightly different manner. The HT is being desensitized by operating near a high power transmitter. Your HT's front end is shutting down due to the high power RF that is being thrust upon it. The cure for the HT is a low-pass filter that will pass 148 MHz with low loss and provide high loss at 150 MHz and higher. This will minimize the effect on your HT and allow normal operation to be restored, as attenuation is given the higher frequency RF as presented to your first stage amp in the receiver. The same would be true for other UHF frequency bands.

On microwave the problems are the same. Filters can be used to minimize out-of-band influence and aid operation. With basic systems operating wideband FM (WBFM), the addition of filters would not be of much use but would be rather cumbersome to the basic systems. The basic systems provide enjoyment and easy contacts. While they could be modified, I feel that a point is reached where refinements do not give apportioned results for the effort put forth. When you have reached this point, as I did some time ago, the necessary switch to a reduced bandwidth and mode of transmission would yield higher efficiency of operation—for starters, reducing bandwidth improved operation several orders of magnitude. Changing from FM to single sideband with less than 3 kHz bandwidth also made improvements. Filters again play an important part in the series of improvements in circuit performance and operating practices.

Types of Filters

This month I will describe a few new types of filters and discuss some of the methods and materials used to construct them. The first filter is one that was designed by Chip Angle and presented quite a few years ago for 1296 MHz. Basically, it's a copper pipe 3" in diameter and 2-1/2" long. See Figure 1 for details. The filter is constructed with a 7/8" copper section fixed to the top lid of the cavity. Two coupling links are soldered to this 7/8" pipe section, directly to the center pipe section 0.600" up from ground. These coupling links are 180 degrees apart from each other and connected to their respective input/output coaxial connector, type "N" in this case. The bottom of the cavity, also made out of 1/8" brass like the top section, has a tuning screw that will tune the cavity and the 7/8" pipe section to resonance.

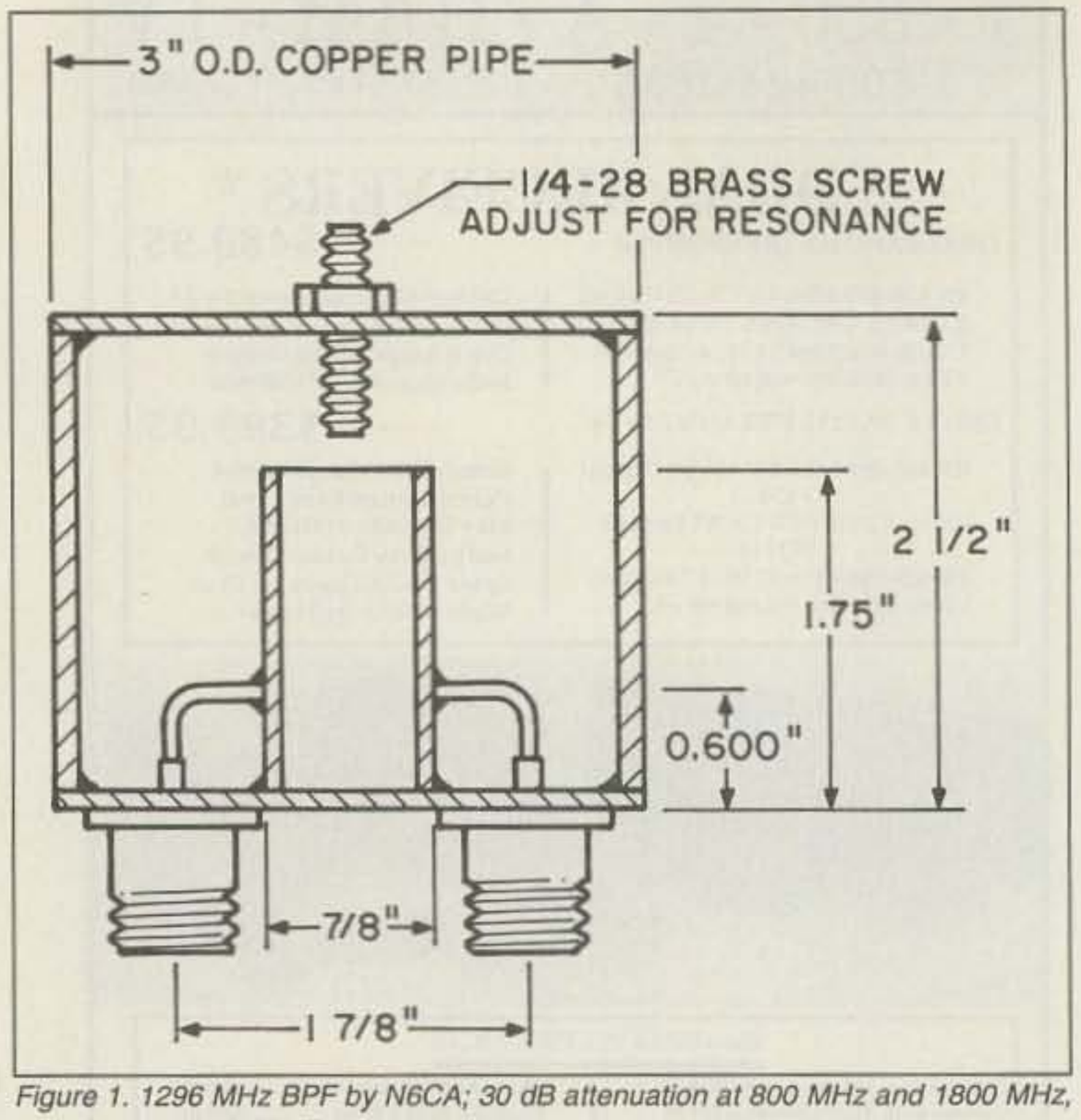

Figure 1. 1296 MHz BPF by N6CA; 30 dB attenuation at 800 MHz and 1800 MHz, insertion loss is 0.05 dB.

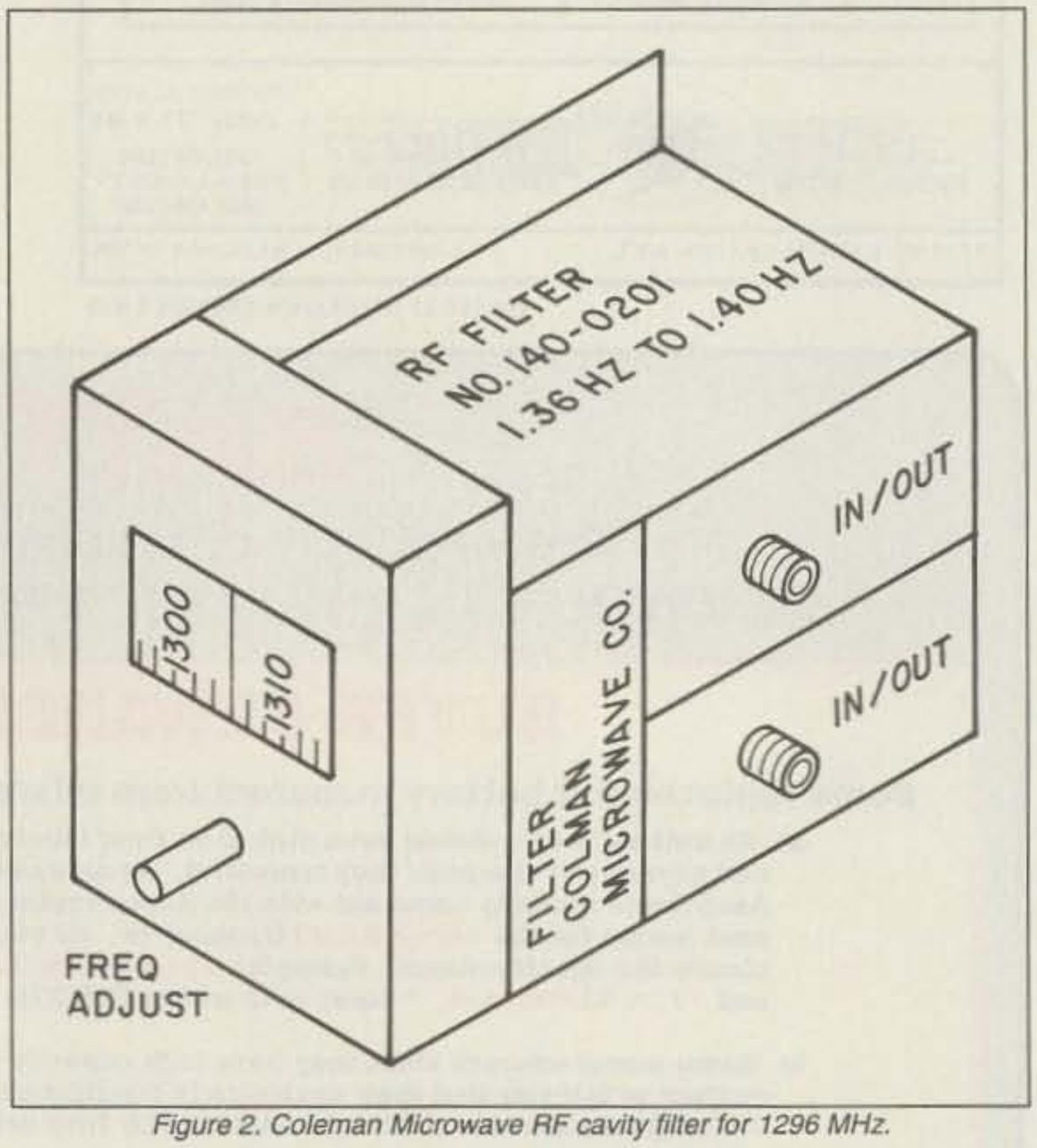

Figure 2. Coleman Microwave RF cavity filter for 1296 MHz.

The tuning screw is made out of 1/4" rod that is tapped 1/4-28 to thread into the bottom cavity plate. Provide a lock adjust to make the tuning tight but not bound up. Then, when the cavity final adjustment is made, you can lock the adjustment in. Typical specifications are 6 MHz bandpass, 30 dB isolation at 800 and 1800 MHz, insertion loss less than 0.05 dB, and return loss greater than 30 dB.

The construction of this filter is quite simple with hand tools and a little patience. Commercial filters can be obtained for this same range and one that I got came from the Coleman Microwave Co. of Lebanon, New Jersey. It's a tunable cavity adjustable from 1.3 to 1.4 GHz. I have just enough room to make 1296 MHz in its tuning range before the stops take effect. The filter has a window and film calibration setting knob controlled with 1 MHz calibration marks about 1/8" apart, with real easy frequency setting. See Figure 2, the Coleman cavity. These are available in surplus in multitudes of frequency ranges covering several hundred MHz to just about 6 GHz. Usually at the higher microwave frequencies, 12 GHz and up, the cavity designs stop and waveguide-based designs take over.

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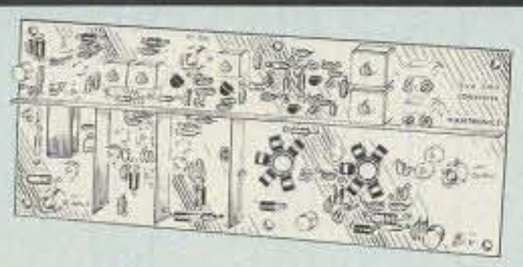

XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

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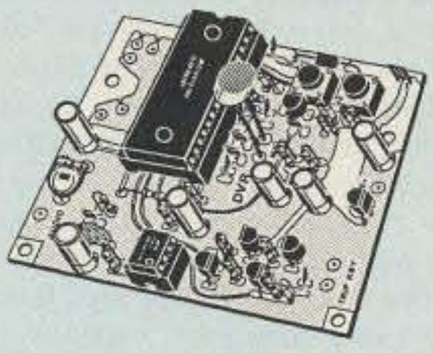

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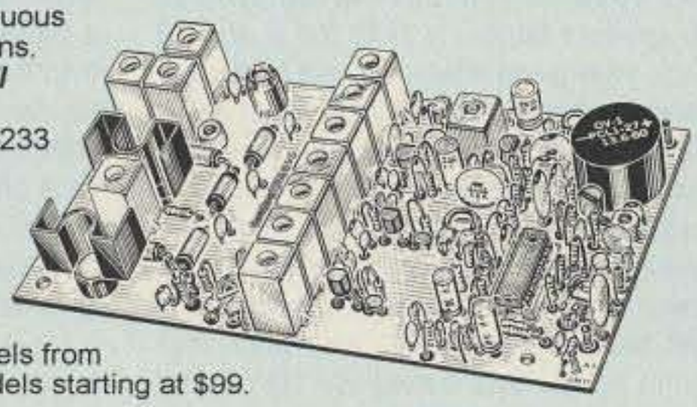
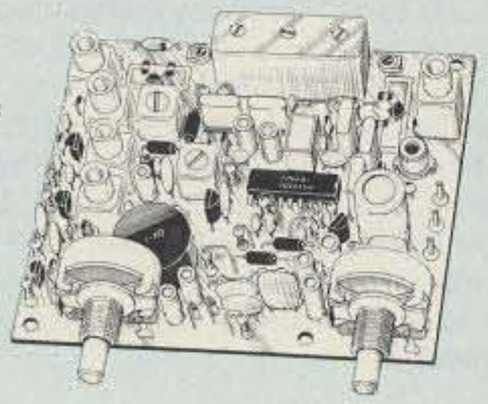


FM RECEIVERS:



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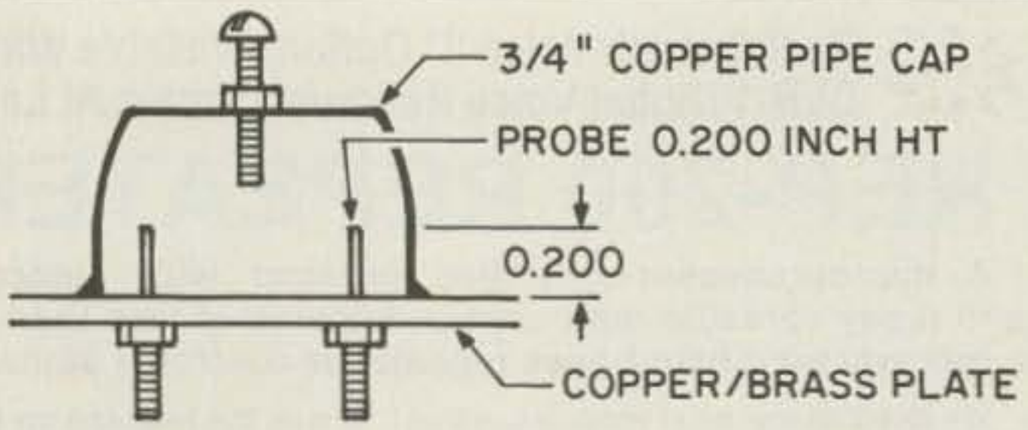

Figure 3. Pipe cap filters courtesy of WA5VJB @ North Texas Microwave Society.

Designs for filters that can be used in frequency ranges from 1296 MHz to 6 GHz can come from unusual materials. Reports of filters from Kent WA5VJB show that pipe caps for copper pipe can be selected to size and inverted and fitted with an adjust screw on the top of the cap. The cap is soldered to a copper or PC board material ground surface to which probes are added on the opposite side of the ground surface for input/output coupling. Filters of this nature have loss that is determined in part by probe length and spacing. These filters tend to exhibit a little excess loss but do work well from 2304 MHz to 6 GHz. This depends on the size of pipe cap: 3/4" for 6 GHz and 1-1/2" for 2304 MHz. See Figure 3 for details.

Waveguide Filters

Waveguide filter designs usually start at 5 GHz and work up in frequency, where they provide very high quality filters. A difficulty with them is that they require tightly controlled construction techniques because the dimensions are quite critical. I have not tried to construct one yet but when I do I will present this information and describe any troubles I encountered.

I have tried to re-adjust waveguide filters obtained from commercial sources to amateur bands. In both the 6 and 10 GHz waveguide filters I did not have very much success with retuning most filters when the designed frequency was over 500 MHz higher than where I wanted to use them. They did not have much frequency range in tuning or retuning. As they tuned downward they seemed to get balky and have high loss when lowering a 11.5 GHz waveguide filter to our 10 GHz band. I also encountered trouble in trying to lower in frequency 6 GHz filters to 5760 MHz. This did not work either. This is not to say it is all impossible, just that the filters I tried would not tune low enough to make them usable. My recommendation on waveguide filters is to stay away from them unless they are cut for your frequency or you make one yourself.

Interdigital Filters

There remain two basic types of filters to be covered: the interdigital filter and a more recent application of it, the hairpin filter. First the interdigital filter. This is the last of the "great block of metal" filters, or filters constructed out of or using substantial metal, forming a cavity. In their construction, fingers (quarter-wave sections) are interleaved and spaced with close coupling to allow the RF to flow through them, by nature of their resonance. A small adjust screw is positioned above the high impedance end of each finger to permit adjustment to the desired frequency. See Figure 4 for typical interdigital filter construction.

The size limits construction of this type filter from 400 MHz, or more typically 1300 MHz, to over 12 GHz in most commercial applications. A filter for 1300 MHz can measure 4" x 8". For 10 GHz, that equates to less than 2" long and 3/4" square for a six-element filter. These filters can be retuned quite far in frequency, namely 10% to 15%. For an 11 or 12 GHz filter it usually can be retuned to 10 GHz without too much difficulty.

The Hairpin Filter

Another type of filter that is becoming very popular is the hairpin filter. This is a printed circuit type of filter where each element of the filter, or hairpin, is a half-wavelength long. The actual length that can be constructed depends on what type of dielectric material it is constructed on, the velocity factor of the material, and what frequency you plan your filter for. Most filters of this type became very popular with the advent of the MMIC amplifier no-tune design for 1296 MHz and a variety of other frequencies. Printed circuit board fabrication of this type of filter demands that accurateness be tightly controlled or else the filter will be resonant off frequency, high or low, depending on the construction techniques. You can use math to a large degree, but be sure to add a little jiggling to make it fit your model, especially to hit a desired frequency without re-adjustment. Gremlins always seem to enter into the math stage and exact operation is not always proper. What I do with a particular PC board substrate is to have my stock "jiggling" or "fudge" factor to multiply by for each material to account for my particular construction techniques. This seems to work out OK. If you try some you will have to develop your own factor as it can vary quite a bit, depending on the board material you use.

A prime consideration when constructing these filters is what type of substrate you construct your filter on. For instance, the dielectric constant of the material has a lot to do with how large your filter will be. Low dielectric material like Teflon™ has a dielectric constant of 2.5 (E_r =2.5), and as such will produce larger filters than ceramic (E_r =10), where the filter's length will be quite a bit smaller. Well then, why did the PC board makers use G-10 epoxy when they designed these kits for their no-tune designs? Well, ceramic and Teflon PC board material is quite expensive and not a common everyday shop stock material. Board cost is quoted by the inch. However, high quality epoxy Fiberglas™ G-10 PC board material has a E_r =5 and is a good cost/performance alternative. (Note: The upper frequency for G-10 epoxy board is 3 GHz, where it gets lossy but is still reasonable.) While the Teflon and ceramic types have excellent RF loss factors and are highly recommended for microwave construction, the G-10 Fiberglas board shows good loss characteristics to 2 GHz. It gets a little bit of high loss near the top end of the frequency, but this problem is offset by the convenience of the easy availability of G-10 type PC board material. Teflon, and especially ceramic materials, are a lot more difficult to obtain. Ceramic materials at this time are out of reach of amateur construction budgets. The high dielectric constant of 10 or so makes circuitry very small when using this type of high dielectric constant (E_r =10 or greater) type ceramic board material.

Teflon dielectric PC board material, by comparison, also has excellent low loss at microwave frequencies—10 GHz and even higher, due to its lower dielectric constant, which can vary from about E_r =2.0 to E_r =2.6. This depends on who manufactured the board and how they constructed it. All Teflon board is excellent for microwave but there are distinct differences between different board materials.

Microwave circuitry constructed on Teflon material tends to be bigger when compared to the ceramic material. In either case, you can vary the material to suit your construction needs. For example, a 10 GHz type amplifier using ceramic can reach sizes of a quarter of an inch square for a push-pull commercial amplifier, while with Teflon the size nears one inch square for a single-stage circuit. The point to make here is that micro positioners and gold bonding equipment are mandated when working with some ceramic materials at 10 GHz, and standard soldering techniques are used with the Teflon board. This makes Teflon quite a bit easier to work with, at least at 10 GHz. Choose your board material carefully.

The converse is true when the frequency is reduced, say, to 1296 MHz. An amplifier constructed on G-10 (E_r = 5) and Teflon (E_r = 2.5) tends to make circuitry large, as we stated before. In this case, with G-10 material at 1296 MHz, a single stage stripline design would be two inches wide and four to five inches long. With ceramic this would be reduced to less than one inch wide and about two inches long. This is quite manageable and standard soldering can be employed. With Teflon PC board material bulk components such as adjustable capacitors and above-board inductors can make Teflon a good choice—it all comes together in one simple statement. Use what you have and make logical choices to maintain PC board circuitry, particularly stripline circuitry, small and workable to your application.

Make use of the engineering program PUFF I described in the May 1992 issue of *73 Magazine*. This program will give you some very good design information not only for amplifiers but for generating filter designs as well. I don't know what I would do without it. PUFF is a very powerful tool in engineering circuitry from stripline techniques.

Well, that's it for this month. If you felt we left out the 2 meter filter for your HT, well, we did, but I'll cover some of those designs next month. I will get into some simple effective ones and some inexpensive types that work quite well. As always, I will answer your questions concerning this and similar topics. Please send an SASE for a prompt reply. 73
Chuck WB6IGP. 73

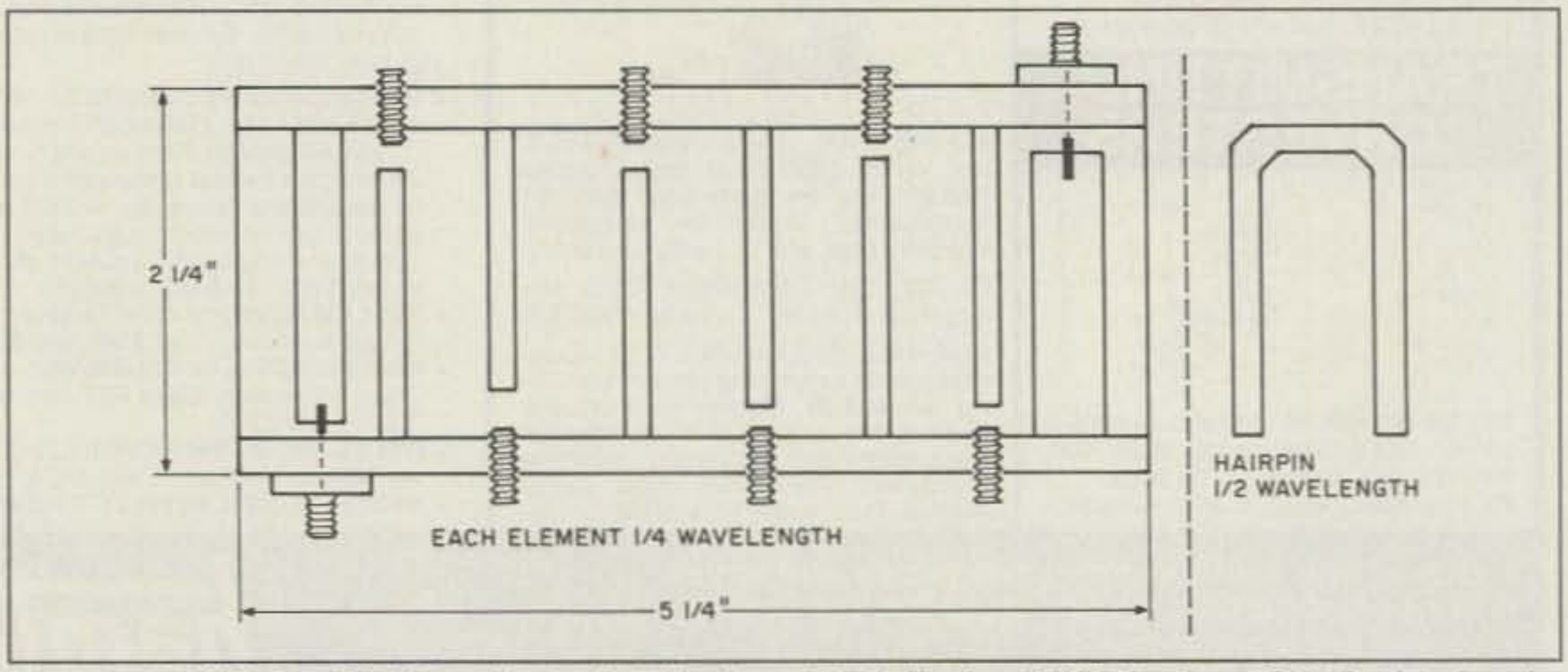

Figure 4. 1540 MHz interdigital filter with six adjustable elements. This filter has 20 MHz bandpass @ 3 dB points. Insertion loss is 0.4 dB. A 1/2 wavelength hairpin shown for comparison.

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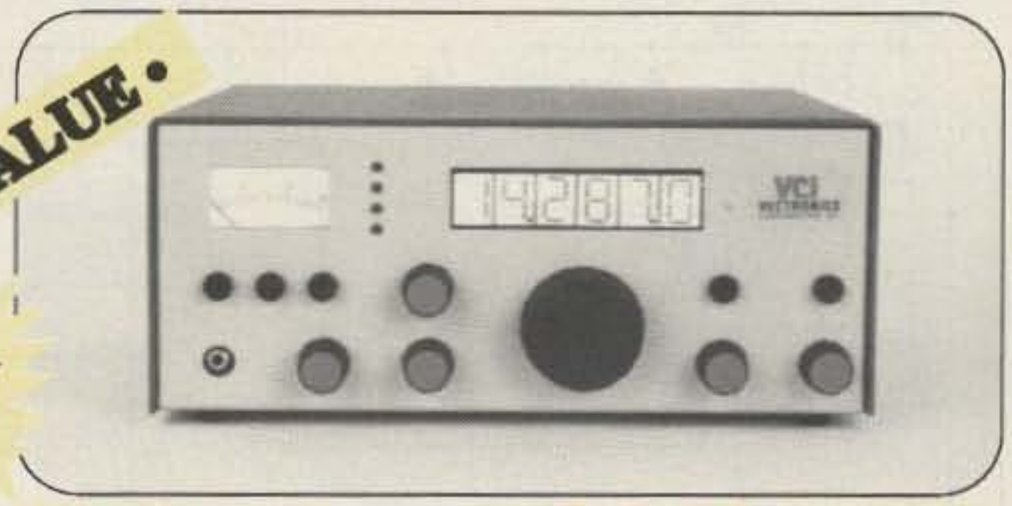

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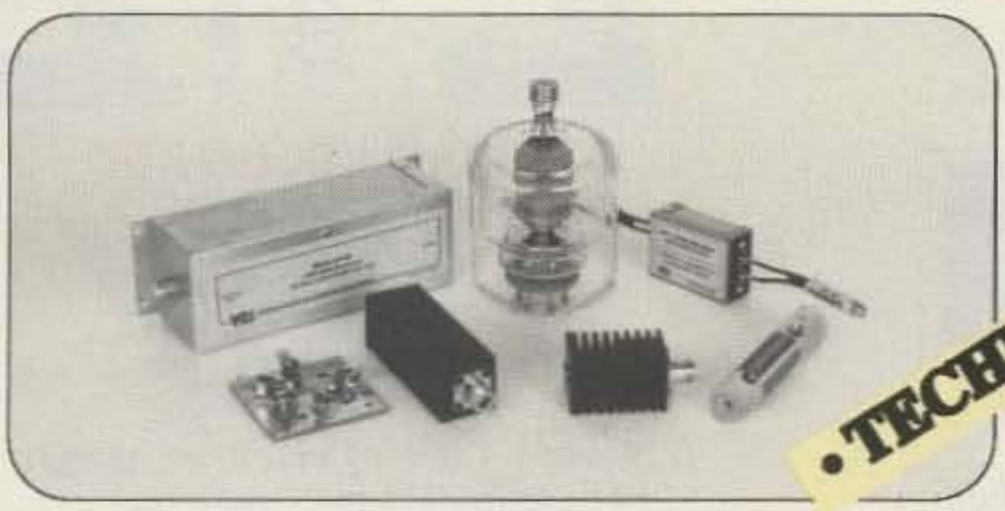

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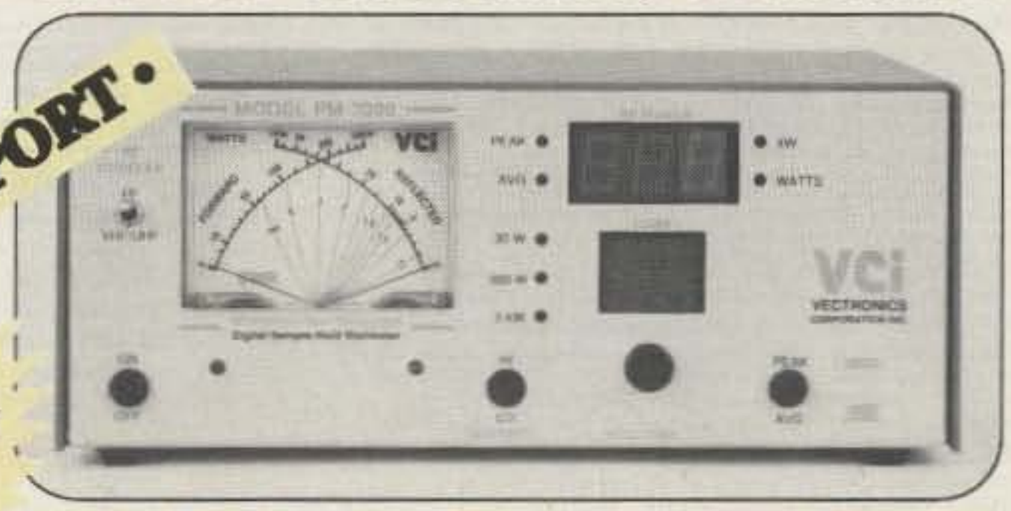

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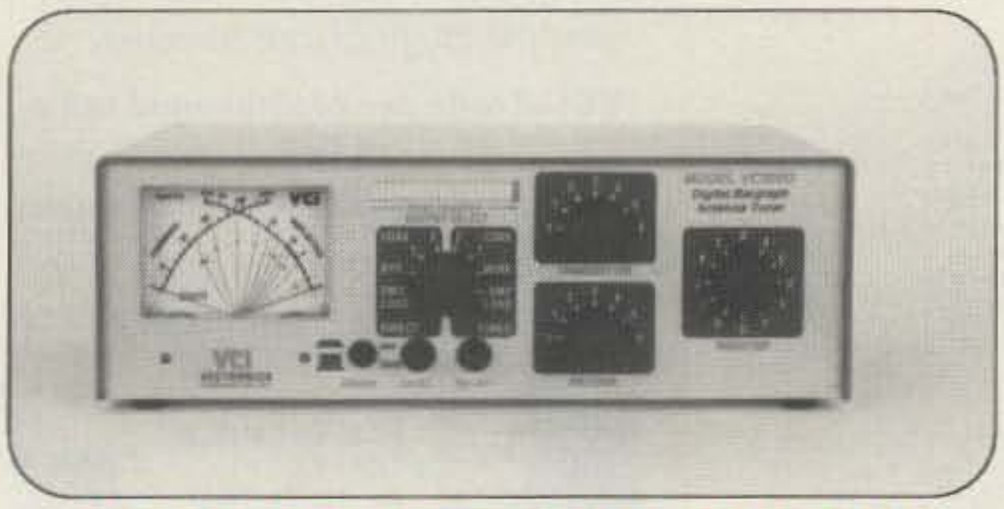

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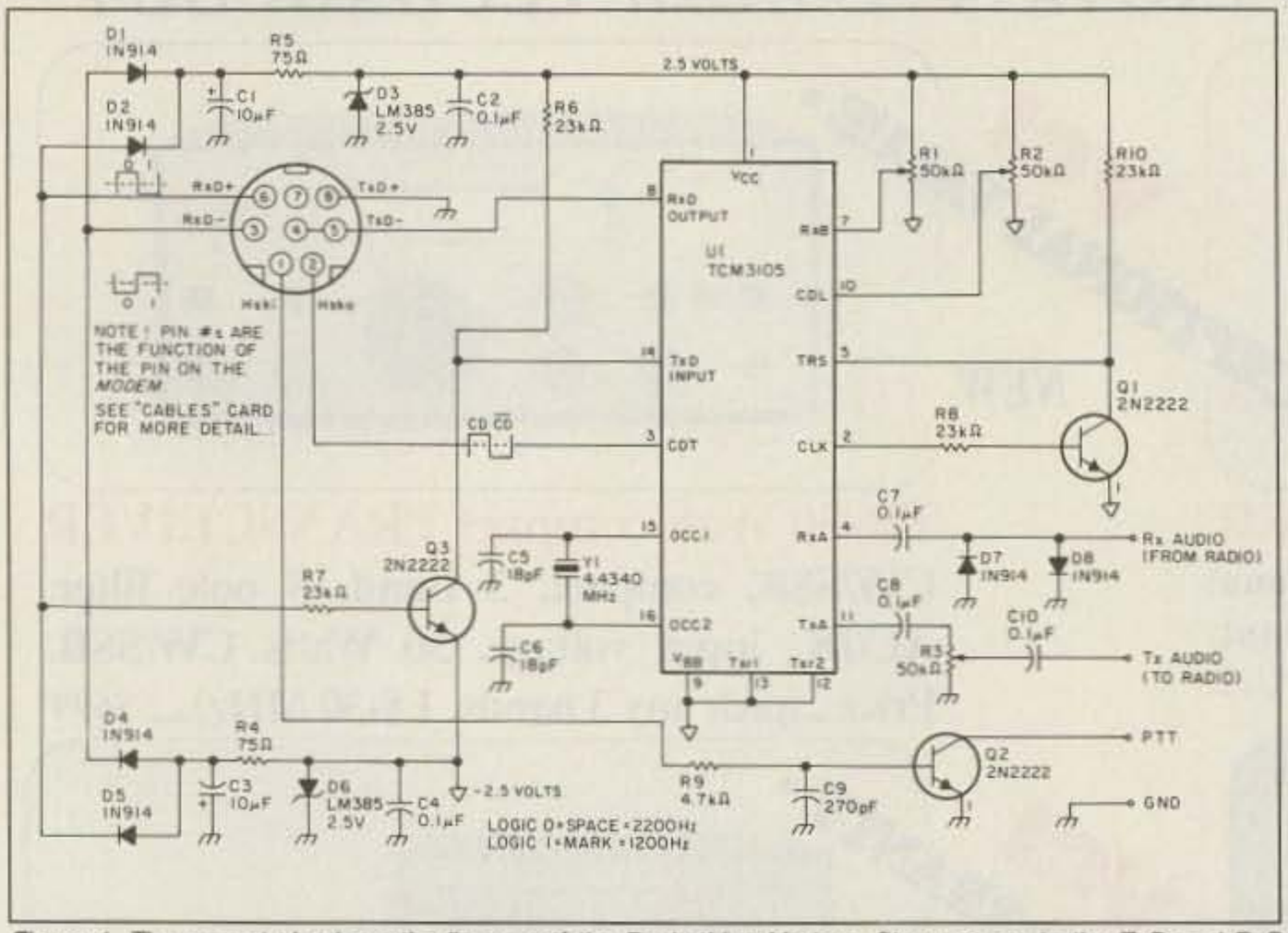

Figure 1. The corrected schematic diagram of the PacketMac Modem. Changes are to the TxD and RxD wiring, pin numbers on the connector and the -2.5 volt connections. Note, however that everything except the loopback test will work as originally wired.

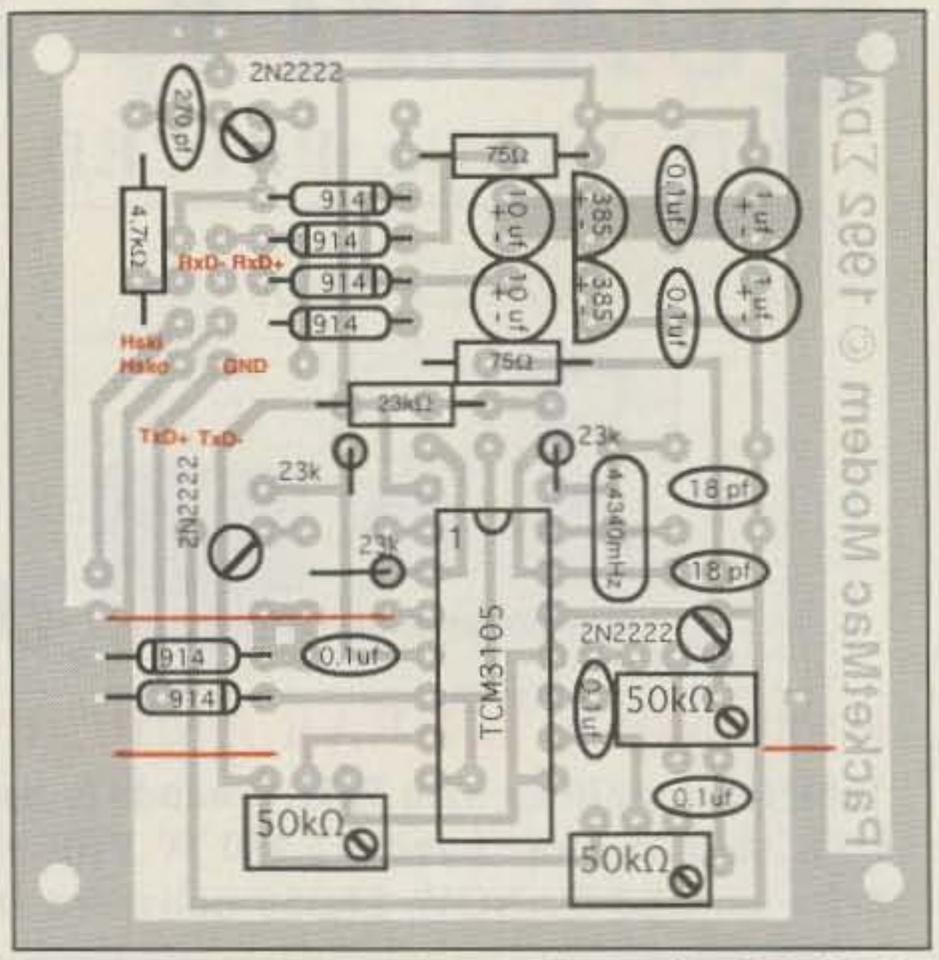

Figure 2. The corrected parts placement diagram of the PacketMac Modem showing the jumper wires as well as the new pad assignments (shown in red). Using these new pad assignments, just follow the wiring hookup chart in Figure 4 in the original article for the proper connections.

"Packet on the Mac"

Refer to the above article on page 8 of the October 1992 issue. The following corrections need to be made:

1) The jumpers were not shown on the parts placement diagram for the modem. See the corrected diagram in Figure 2.

2) The bit asserted sense of the TxD+ and TxD- lines are the same as their name, not the opposite as stated in the article.

3) See Figure 1. for the corrected schematic.

Note however, that the modem will still work fine for packet as originally wired since the NRZI encoding asserts a bit by changing state, it does not matter if the state starts high or low. The only indication that a reversal exists is that the characters received during a loopback test are the "inverts" of what was sent.

The modem can be fixed by simply swapping the wires on the mini DIN-8 Macintosh cable where it attaches to the TxD+ and TxD- pads on the modem. You could also change the modem by swapping the wires going to the RxD+ and RxD- pads.

4)Co-authors: The section on SoftKiss was written by Aaron Wohl N3LIW. Aaron can be reached at 6393 Penn Avenue #303, Pittsburg PA 15206. The section on Savant was written by Jim Van Peursem KEØPH. 73

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Korean Star in Orbit!

Just after 2300 UTC on August 10th, a new amateur radio satellite was sent to space. KITSAT-A, now known as Kitsat Oscar-23, brought another success to the hamsat community. Our congratulations to the University of Surrey team in England and the Korean Advanced Institute of Technology (KAIST). The project manager for the payload was Jeff Ward GØ/K8KA. Jeff has been extremely active with the Surrey group for several years and is now leading some of the more ambitious programs.

KITSAT-A incorporates many of the better features of UoSat-Oscar-14 and 22. The system provides a high-speed (9600 bps) packet BBS from orbit with a new and greatly improved camera system. The satellite has six computers and an array of experiments to complement the amateur radio devices. For hams, though, great pictures from the wide- and narrow-angle cameras and the incredibly strong downlink signals have been a delight. Complete details of the satellite were described in the July 1992 "Hamsats" column.

The Launch

For those with satellite TV dishes or a quality cable TV system, the NASA-Select channel covered the launch of K-O-23 and the other payloads sent to space on Arianespace flight 52. This was only the second time an Ariane 4 rocket was launched with two strap-on solid-fuel boosters. The rocket is typically configured with more external boosters for heavy communication satellite payloads to be sent to geostationary transfer orbits.

Lift-off was just after dark, from Kourou, French Guiana. Kourou is located on the northeast coast of South America just above the equator. Daytime Ariane launches are quite spectacular. While the rocket is beginning its ascent, insulation panels peel from the structure like tree leaves falling away in a strong wind. Although the panels were not as evident during the late evening launch of mission 52, the spectacular flames from the liquid and solid boosters put on quite a show.

The flawless countdown was followed by a perfect launch.

> ***"For hams, though, great pictures from the wide- and narrow-angle cameras and the incredibly strong downlink signals have been a delight."***

NASA and Pentagon representatives were present with a keen eye on the progress of the operation. Future joint ventures are expected.

The Payloads

The principal passenger, TOPEX/POSEIDON, was a Joint NASA/CNES (the French space agency) scientific payload. The satellite was built by Fairchild Space, under contract to NASA/JPL (Jet Propulsion Laboratory). It weighs 2,400 kg and has an expected life of five years. During that time it will survey ocean circulation on a global scale. The spacecraft includes sophisticated radar units, a laser retroflector array and a global positioning system receiver. The altitude of any point on the ocean can be accurately measured to within an inch.

Two auxiliary passengers were sent with TOPEX/POSEIDON. They included KITSAT-A and another small satellite almost identical in shape to Kitsat, called S80/T. The two small spacecraft were mounted on a large ring located below the main payload called the ASAP (Ariane Structure for Auxiliary Payloads). The satellites were put in place two weeks prior to launch.

S80/T was built by Matra Marconi Space for the CNES and was designed to study the use of the VHF band from 137 to 150 MHz for mobile communications. On-board power available is 26 watts, with an expected lifetime of one year.

K-O-23 weighs in at 50 kg, substantially less than TOPEX/POSEIDON. At launch, the satellite is approximately one foot by one foot, by two feet tall. The anticipated lifetime is five years. Stabilization is achieved by a gravity-gradient boom and computer-controlled mag-

Photo A. Kitsat-Oscar 23 was launched on an Ariane 4 rocket. (Photo by CSG and Arianespace.)

Photo B. The August 10, 1992, early evening launch of KO-23 from French Guiana. (Photo by CSG and Arianespace.)

netic torquer. When deployed, the boom is almost 20 feet long.

The Orbit

Due to the mission requirements of TOPEX/POSEIDON, K-O-23 is in an orbit unlike any other amateur radio satellite. Most space shuttle missions have an inclination (angle of the orbital plane relative to the equator) between 28 and 57 degrees and an altitude of less than 500 km. Most low-orbit hamsats have orbits that take them over the poles. Their inclinations are near 90 degrees and altitudes are usually less than 1,000 km. K-O-23 has a 66 degree inclination and an altitude near 1,325 km. Most Northern Hemisphere stations will find it different to track because the satellite doesn't appear to travel in a straight line. The path takes some getting used to, but the longer access times for data downloads per pass (just over 20 minutes) have been great.

Spacecraft Commissioning

Only 24 minutes after launch KITSAT-A was released into orbit and 14 hours later the KAIST ground station HLØENJ in Korea was uploading software to the satellite. Many reporters witnessed K-O-23 execute the very first command sequence sent by KAIST. Upload activities and tests continued with few problems.

During the first few days, hams noted that the K-O-23 signals were relatively weak and experienced severe fading. The satellite had not yet been stabilized and only the low-power transmitter was on. Within a week of launch the craft was completely stable with virtually no tumbling or spinning. The gravity-gradient boom was deployed and the TX1 transmitter was activated with a downlink on 435.167 MHz with 1.3 watts out (8 kHz below TX0, the low-power unit).

On August 18th, efforts began to commission the CCD camera experiment. This system includes two CCD cameras: one with a lens system capable of 4 km resolution, and another with 400 meter resolution. The cameras are connected to an 8051 microcontroller and from there to two transputers.

The first image was taken at 1740 UTC on August 19th while the satellite was over Antarctica. Satellite controllers were delighted to see an excellent picture of the edge of the earth showing cloud formations with an interesting lighting effect caused by the low sun angle. Some software bugs caused dropped frames in the transputer-to-OBC (on-board computer) path, thus corrupting later shots, but the system is currently producing excellent views with both wide- and narrow-angle cameras. Due to the orientation of the satellite, the cameras are always pointed earthward.

Working K-O-23

Kitsat's uplink (145.900 MHz) and downlink (435.167 MHz) both use AX.25 FSK at 9600 bps for normal operations. A typical earth station has 100 watts ERP (effective radiated power) on the uplink and a sensitive receiver on the downlink. Antennas range from omnidirectional turnstiles to circularly-polarized yagis. A slightly modified TNC (terminal node controller) with modem disconnect header, a 9600 bps modem and a PC-type computer running "PB" software complete the system. Any station currently active on U-O-22 can work K-O-23.

Information on the components that make up a UoSat or Kitsat-ready station can be found in the October 1991 and December 1991 "Hamsats" columns. In addition to the several devices described, a new 9600 bps modem kit has been announced by TAPR (The Tucson Amateur Packet Radio Corporation). Kits are available from TAPR for $70. Since the initial release, several bugs have been found and corrected. The July 1992 issue of the "Packet Status Register" from TAPR describes the latest modifications to the board and interface procedures for the AEA PK88, AEA PK232MBX, DRSI PC*PA and the TAPR TNC-1. The instruction manual with the kit describes the TNC-2 hook up.

Experiencing is believing. Digital communications via satellite at 9600 bps works exceptionally well. Activities that are tedious at 1200 bps flash by at 9600. Messages, programs and images can be downloaded and uploaded with ease. K-O-23 has added another fine satellite resource to the hamsat community. 73

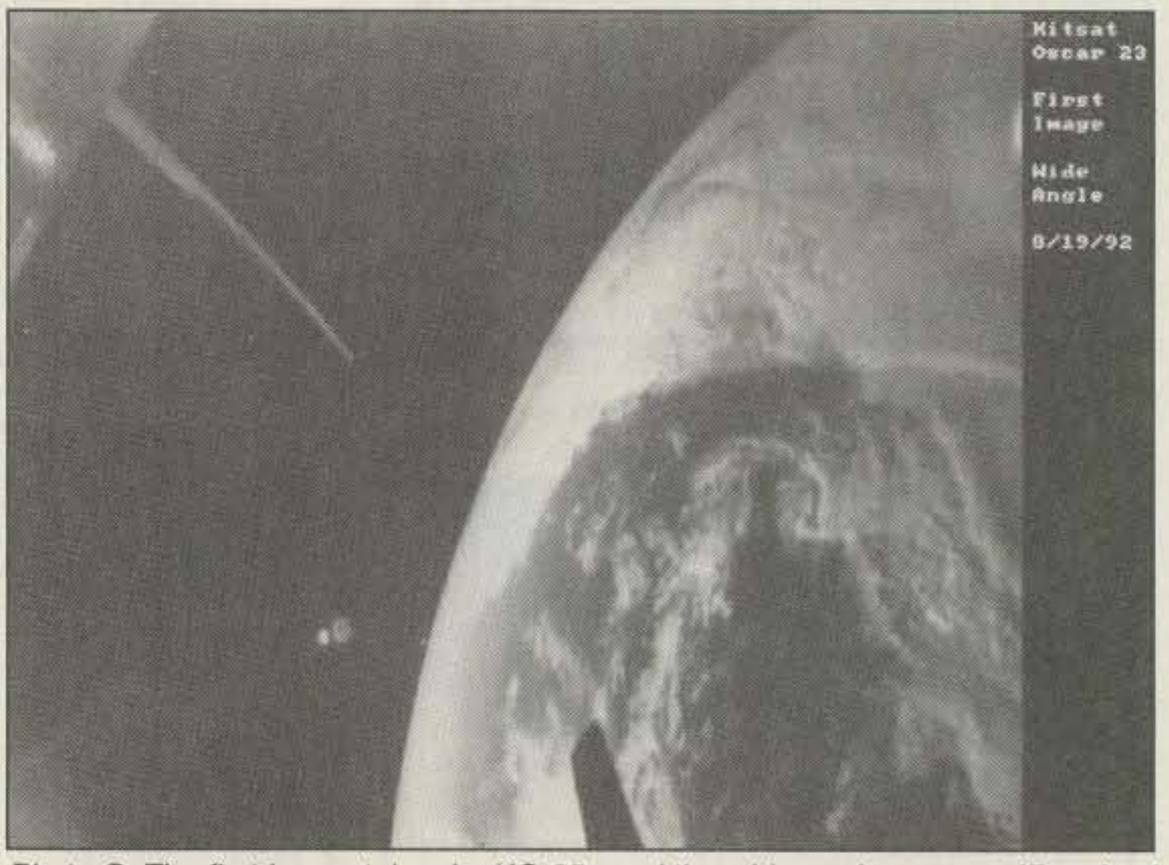

Photo C. The first image taken by KO-23 used the wide-angle camera. (Received and formatted by NK6K and plotted by KB5UST.)

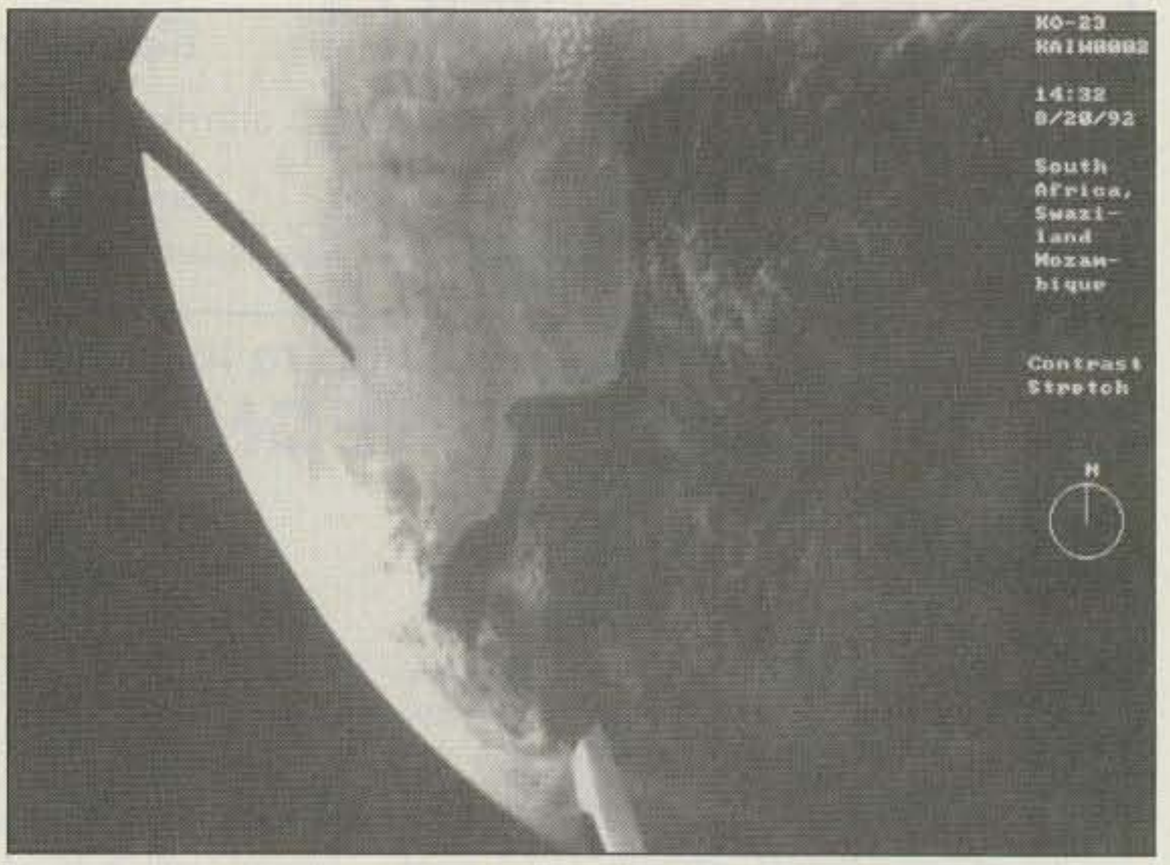

Photo D. Wide-angle view of the southern Africa coast as seen by KO-23. (Received and formatted by NK6K and plotted by KB5UST.)

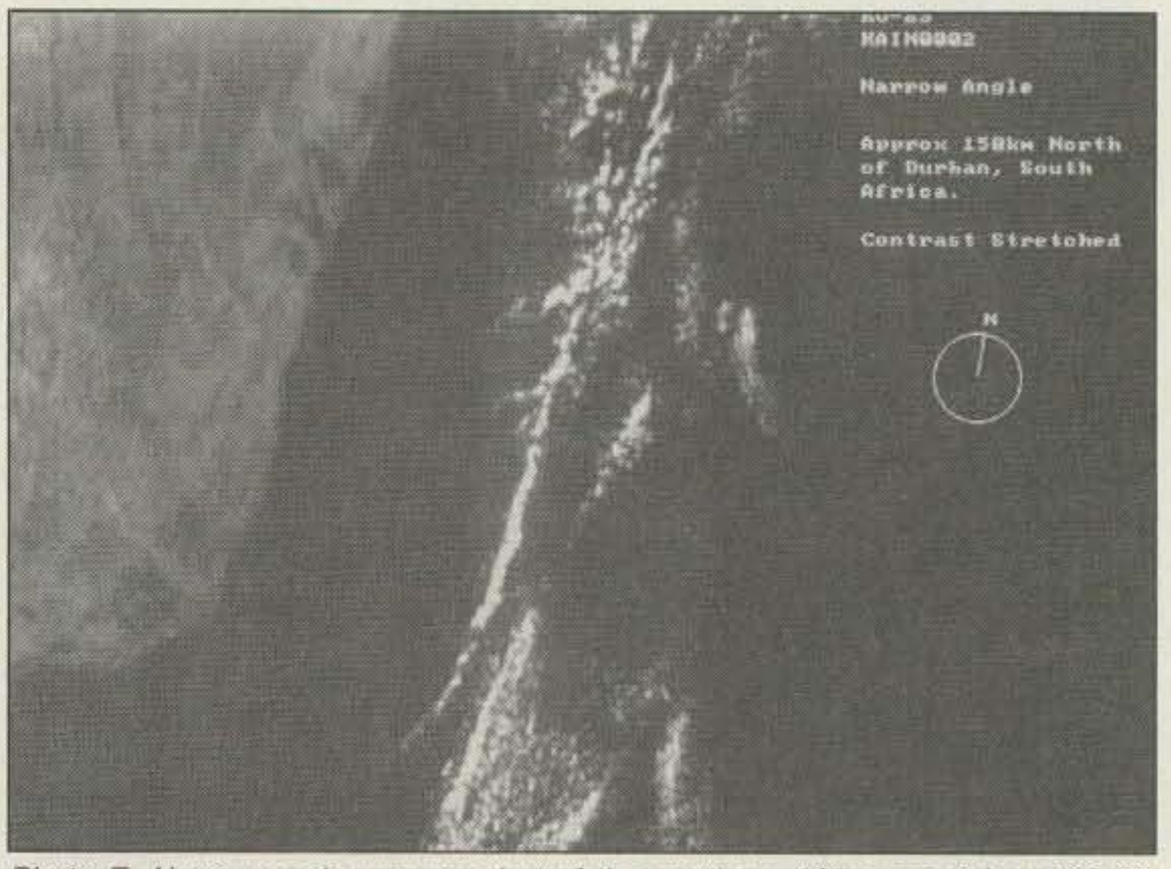

Photo E. Narrow-angle camera shot of the southern Africa coast from KO-23. (Received and formatted by NK6K and plotted by KB5UST.)

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Micro Power

This month we're going to explore micro power. No, not QRP. I'm talking about the microprocessors which are the brains of just about all of our gear these days. Sure, you know what they do for you, but how do they do it?

Just A Bit

I doubt there are very many hams out there who have no idea what a microprocessor (let's call it a "micro") is. Just about all of us have had some experience with desktop computers, and many of us have them in our shacks. And if you have a computer, you know what bits, bytes, ROM and RAM are, so I'm not going to write an entire computer primer here. But what does that mysterious little micro in your walkie or HF rig have in common with your PC clone? Well, more than just a bit.

In fact, several bits! While your desktop machine reads and writes to disks and outputs characters to its screen and printer, the micro in your rig reads the radio's knobs and buttons and writes to the display screen. It also outputs control signals to the frequency synthesizer which puts your rig on whatever frequency is shown on the display. So, how many bits does it take?

Well, desktop PCs typically use eight or more bits. Why? Because it takes at least six to represent all the upper- and lower-case characters. If you raise two (the number of possible bit states—on and off) to the power of the number of bits, that tells you how many possible combinations you can make from those bits. Two to the sixth power equals 64, so you can use six bits to cover the alphabet and numbers. But just barely. By the time you add punctuation, "control" characters (so named because they let you control the machine instead of producing anything on the screen) and perhaps some graphics blocks and such, you are way over 64 codes and you need more bits. Eight bits gives you 256 characters, which are more than enough.

So, why use more than eight bits? Well, for word processing, there's really no point. But for graphics and high-precision math, having more bits per byte lets you move more information around faster. Essentially, a computer's architecture is that of a serial device with parallel lanes, much like a multi-lane expressway. You can move just as many cars with two lanes as four, but it takes twice as long. So, many PCs now use 16 or even 32 bits.

In contrast, the micros in most radios use four or eight bits! Why so few? Well, there just aren't that many things to be coded. And speed is not an issue like it is on the PC so, if multiple bytes are needed to represent a particular piece of information, it's no big deal.

In Control

Small microprocessors with their own RAM and ROM built in are known as *microcontrollers* because they're intended to be used to control things, rather than to be the centers of large information systems. You can find microcontrollers in lots of things, from microwave ovens to VCRs, and camcorders to hard disk drives. The chip's architecture is essentially the same as that of larger systems, but the numbers are smaller. A typical microcontroller might have anywhere from 256 bytes to 2K of RAM. You sure wouldn't want to type a document into it!

The ROM, which stores the operating program, also is typically in the 2K to 4K range. Small as that sounds, it usually is enough to handle a pretty complicated radio's functions. In some cases, external ROM and RAM are used to increase the data capacity. Many HF rigs use multiple-chip systems, although some do it all on one chip. Most walkies use one or two chips.

Take It For A Spin

When you spin the tuning knob on one of today's typical HF rigs, an optical encoder (a slotted disk with an arrangement of LEDs and detectors) sends pulses to the micro. Its software reads the pulses and changes the frequency by rewriting the display and sending the proper codes to the frequency synthesizer. It may *feel* like you're tuning a VFO, but you're really just altering data! (For that matter, these days a "VFO" is nothing more than a piece of data in memory anyway.) Many other controls work the same way. Usually, the RIT, modulation mode (AM, FM, SSB, etc.), filter selection and IF shift or PBT are controlled via the micro. Some functions, like volume and squelch, are just regular old analog controls, but they too could be made to be part of the computer system and probably will be in the future. Why bother? Well, wouldn't it be nice to have the squelch "remember" its proper setting on FM but return to the wide open position on SSB?

Getting Wired

So how does a micro read a switch, anyway? Actually, it's pretty simple. Micros have "ports," which are just connections used for inputs and outputs, or "I/O," as they say. In most cases, the switch will have one end tied to ground, with the other end tied to the positive supply via a resistor of a few k ohms or more. The micro's port connects to where the resistor meets the switch. When the switch isn't being pressed, the connection point will be high. When you press the switch, it goes low (to ground). By making the micro's software examine the value of the port, the switch's state can be determined. Actually, it's almost that simple, but not quite. Switches tend to "bounce," or have rapid "ons" and "offs," for a fraction of a second when you press or release them. To avoid false readings, the software is made to wait a few milliseconds and then test the switch's state again. If the two readings match, the computer knows that a valid press or release has been made.

Hey, wait a minute, my '940 has an awful lot of buttons on it! Is there a separate port for each one? Well, probably not. That would require a *big* chip with lots of wires, and remember, hardware costs money, while software is free! To read lots of switches, an old technique, used for everything from calculator and computer keyboards to electronic telephones, is employed. It's called *multiplexing*. Here's how it works:

Drive A 4X4

Let's say you have a 16-button keypad, like the one found on most walkies. To read each switch individually requires 17 connections: one for each switch and a common ground. If instead, though, you wire them in an X/Y grid, you can do it with only eight wires. Try it on paper. Draw four rows of four boxes each. Now, connect them together horizontally and vertically. If you connect four wires at, say, the left and four at the top, no matter which button you press, you'll make a connection between a wire on the top and a wire on the side *somewhere*. Of course, multiple keys pressed at the same time can cause all kinds of confusion. The way to avoid it is to *scan* the rows and columns, looking for connections. That way, if you find more than one set, you can ignore them all. By the way, if you're trying to discern the grid pattern on a bunch of switches, keep in mind that the electrical arrangement is not necessarily related to the physical layout of the switches. Sometimes they match, but sometimes switches on unrelated areas of the rig may be connected in a grid. Ultimately, whatever costs the least will be used.

Where In The World Is Common Groundiego?

Please notice that, in the scanned arrangement, no switch has a ground! Scanning ports are specially constructed to provide a voltage pulse on one set of connections and to look for it on the other; that's how the scanning is accomplished. I've seen more than a few cases of damaged chips because someone wanted to connect a remote switch and put it between the micro and ground. If you need to connect a remote switch, you must connect it across the original one. Unfortunately, induced voltages on the remote switch's wires (such as from your transmitter) and the wires' inductance kick also can damage the micro. And you can't put a capacitor across the wires to smooth things out because it interferes with the scanning pulse, making the switch appear to be continuously pressed. If your remote switch is more than a few inches of wire away, it is best to use either a relay or a 4066 or similar type analog switch chip. Multiplexed switches can be a real pain to remote.

My Friend Flicker

By the way, the multiplexing technique works for displays as well. If you have lots and lots of LED segments to control, as you do in a frequency display, you sure don't want a wire for each one. You can multiplex them in exactly the same way, thanks to the eye's inability to see very rapid flashing. The result is that only one segment in the entire display is on at any one time, but they get scanned so fast that they all appear to be on at the same time. The technique reduces power consumption, too. Of course, the display doesn't appear as bright as it would if they were all on together, but most displays are more than bright enough anyway. LED function indicators, such as the ones used for filter and mode selections on some rigs, also may be multiplexed.

If you want to see if your display is multiplexed, try this: Turn the rig on and shut the room lights off. Now, stare at the display and move your eyes rapidly in a circle. If you see interrupted bars of light, the display is multiplexed. If all you see is a bunch of solid smears, there's no multiplexing in use. And, if you do it long enough, you may get to see Nirvana.

LCDs usually are multiplexed, too, but their inherently slow response time makes the segments stay set between scans, so they really are all on, or nearly so, at the same time.

A to D, Where Are You?

Some micros, particularly the ones in walkies, display S-meter readings in the form of LCD bargraphs. Some also show battery voltage. To do this, the analog voltage representing the received signal strength or battery voltage must be digitized and converted to bargraph steps by the micro for display. It sounds messy but, luckily, most modern microcontrollers have built-in analog-to-digital (A/D) converters, making the job very easy. There is one function, however, where the rigs cheat: All the walkies I've seen which have bargraph RF power output displays simply show a preset number of bars which depends only upon the power level you have chosen. I've never seen one that actually shows a real measurement of the power coming out of the transmitter.

Well, there's lots more to discuss, but I've run out of room. We'll continue next month. 'Til then, 73 de KB1UM. 73

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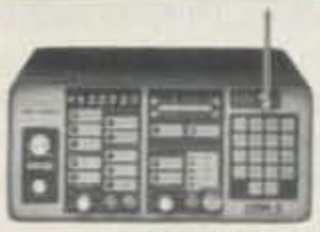

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CT-90	10 Hz–600 MHz	<10 mV to 150 MHz <150 mV to 600 MHz	9	0.1 Hz, 10 Hz, 100 Hz	$169.95
CT-125	10 Hz–1.25 GHz	<25mV to 50 MHz <15 mV to 500 MHz <100 mV to 1 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$189.95
CT-250	10 Hz–2.5 GHz typically 3.0 GHz	<25 mV to 50 MHz <10 mV to 1 GHz <50 mV to 2.5 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$249.95
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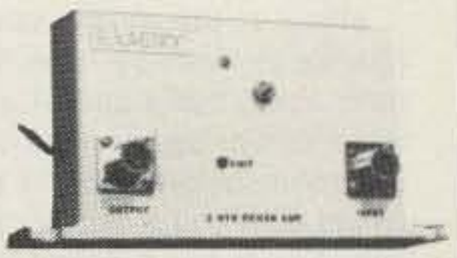

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PACKET & COMPUTERS

Jeff Sloman N1EWO
c/o 73 Amateur Radio Today
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Digital Radio Glossary

Many of the letters you've sent (thanks for writing!) have had questions about basic packet and digital radio terminology. Instead of answering them individually, I thought I would give you a digital radio glossary. This is by no means an exhaustive effort, but it answers all the questions I have received and provides related information. I hope you all find this useful, and maybe something worth saving and referring to in the future. Please let me know what you think—and of any questions you have about items discussed here. Thanks for the wonderful response to the column by US Mail, and various email. 73 de N1EWO.

AMTOR Amateur Teleprinting Over Radio is an enhanced form of RTTY, including error correction (called Mode A or ARQ for Automatic ReQuest for reception) and FEC (Mode B) modes. It is well suited to noisy HF channels and reliable, though very slow. AMTOR avoids QSB (fading) and QRM/QRN (noise) by sending very small data packets, two characters at a time, giving an AMTOR QSO its characteristic staccato sound. AMTOR Mode B is excellent for bulletins and a version called NAVTEX is used to communicate with ships at sea. See: FEC.

AX.25 Amateur X.25 is a version of the CCITT X.25 protocol with enhancements for operation over radio. It is the set of rules which is used by the packet TNC to establish, maintain, and terminate a link between two stations, and to transfer data back and forth. AX.25 defines the structure of valid data frames and the behavior of the sending and receiving stations. See: CSMA/CD; Error Detection and Correction; Frame.

Backbone A network connection among LANs. Packet radio backbones are usually used to connect LANs for PBBS message forwarding, although some allow user traffic.

Baud Named for the French engineer J.M.E. Baudot (Baw'-doe), a baud is a discrete transition of a signal which can carry information. Baud is not necessarily equal to bps (bits per second) since fancy modulation schemes—using signal phase and trellis encoding, for example—can stuff more than one bit in each baud. These schemes are common in land-line applications, but generally are not used in radio since properties like phase—on which they depend—are hard to preserve.

CRC See: Error Detection and Correction.

CSMA/CD Carrier Sense Multiple Access/Collision Detection is the access method used by the AX.25 protocol to allow simultaneous use of a single channel by multiple stations. This differs from, say, land-line modem connections where the conversation is between a pair of modems—one on each end of the line. CSMA/CD is easy to understand if you think in terms of a typical group discussion on a repeater. Each station listens to the channel and waits for the currently transmitting station to finish (carrier sense).

If one (or more—multiple access) of the listening stations wish to make a comment, they will wait for an arbitrary period of time to make sure "they've got it." They don't key up right away because others might do the same and cause a double. But, even if the stations wait to see if the channel becomes busy, two can decide to transmit at precisely the same time, causing a double anyway. When this happens, the station to whom the transmission was directed will say something like, "You guys just doubled, K9HI try it again"—collision detection.

One other access method which will also be familiar to repeater users is called Token Passing. In this scheme a "token" is passed among nodes on the net. When the node receives the token, it can use the channel—though it may not want to. It makes its transmission—or not—and then passes the token on to the next node. You may have already recognized this as the scheme used in round-table QSOs: "WN9T and the group, this is N1EWO," the token is passed.

DCD Data Carrier Detect has two meanings. It is the designation of pin 8 of the RS-232D pinout standard, and it is a function of the TNC which determines if there is incoming data—or another station on the air. Because packet radio uses CSMA/CD, it is important for the TNC to know if there is another station on the air. DCD comes in two basic types. The simplest makes no distinction between actual data and anything that opens the squelch—noise, voice, whatever. The second, called Derived DCD, actually determines if there is data present. Since this type of DCD allows the squelch control to be left open at all times, it can be advantageous for older radios and high-speed transmission where the limiting factor is the speed of the squelch circuit.

Digipeater A DIGItal rePEATER is a station which receives a packet and retransmits it. The idea is very similar to a voice repeater, but is not full duplex. AX.25 allows up to eight intervening "digis," which are specified in the connect request to the TNC. Stations seeing the digipeat request will handle the packet in the order in which the list is specified. Even if the destination can hear the originator directly, it will ignore the packet until the digis handle it. All packet stations are digipeaters by default—this function of the TNC must be explicitly turned off if it is not desired.

DSP Digital Signal Processing is a relatively new technique which uses general purpose or specialized microprocessors to do the job that analog filters normally do. Since DSP-based filters can be programmed for all sorts of different behaviors, they are extremely flexible. Multimode units based on DSP are becoming available and have the advantage of being ready for any new mode that might appear by simple reprogramming of the DSP chip.

DWAIT Digipeater Wait is an important TNC parameter which determines how long a station will wait after the last transmission before attempting to acquire the channel for its own use. Digipeaters should have smaller settings than users, since they need to be able to repeat users packets. This very simple method has not been effective for busy LANs, and has been—or should be—replaced by the Slot Time parameter, which is more random.

Error Detection and Correction Packet radio has an advantage over older digital modes like RTTY because it detects and corrects errors in transmitted data packets called frames. AX.25, the packet protocol, uses a technique called CRC (Cyclic Redundancy Check) to determine if the frame arrives intact. A CRC is a mathematical operation which is performed on all data in a frame. The result is transmitted along with the frame and must match the result the receiver gets using the same operation—a mismatch indicates a detected error. The receiver then requests a retransmission, called a retry, of the frame and the process is repeated until the data arrives without error to the retry count—the number of attempts the transmitting TNC will allow—is exceeded. The retry count is a settable TNC parameter which defaults to 10.

Ethernet Developed by Xerox at their Palo Alto Research Center (PARC), Ethernet is a networking scheme that uses 10 MHz radio transmissions on RG-58 cable. It is a CSMA/CD-based system, and is quite similar to packet radio in operation. Ethernet is used throughout the Internet.

FEC Forward Error Correction is a scheme which allows broadcast messages with very low error rates. Unlike AX.25, which uses retransmission to correct errors, FEC modes send the error-correcting data along with the original transmission. This redundant information can be used to reconstruct data that is damaged upon arrival. This method is very similar to QSZ—sending each word or group more than once—in CW traffic handling. If QSB—fading—or QRM/QRN—interference—make copying one attempt impossible, it can probably be reconstructed from the repeated version.

Frame AX.25 uses data packets called frames to transmit data and link management information. There are three basic AX.25 frames:

I Frames Information-Transmission Frames transmit user data—the text of messages and bulletins, etc.

S Frames Supervisory Frames are used to establish and maintain the link between two stations. They are responsible for ACKs (ACKnowledgements) and NAKs (rejections), in addition to establishment and termination of the link.

U Frames Unnumbered Frames are used when there is no connection to another station. They may also be used during a connection for miscellaneous housekeeping.

Hidden Transmitter Because AX.25 uses a scheme called Carrier Sense Multiple Access/CD (CSMA/CD), all stations operating in a LAN (Local Area Network) must be able to be heard by all other stations—this is the carrier sense part. If not, some stations will attempt to transmit while others are on the air. This leads to collisions—like doubling on repeaters. Though the collision detection part of CSMA/CD will reject the garbled frame and acts for a retransmission, the hidden transmitter will continue to interfere until both it and the station it is interfering with "retry out" (give up and disconnect). The only way to prevent this problem is to insure that everyone can hear all stations operating in the LAN and, since it is impractical to expect all stations to erect antennas capable of this, a repeater—almost identical to a voice

"I hope you all find this useful, and maybe something worth saving and referring to in the future. Please let me know what you think—and of any questions you have about items discussed here."

Number 19 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors, Inc.
P.O Box 131646
Staten Island NY 10313-0006

The Antique Wireless Association: A Heterodynamic Group

This past summer I had the privilege of being a guest speaker at a hamfest in Batavia, New York. My gracious host for the weekend was Tom Rosica W2GIR, a production technician in radio and television at Genesee Community College. Tom was a 25-year employee of the former GTE-Sylvania plant in upstate New York.

It was a pleasure to be taken on a tour of this most scenic area of New York state. Tom took great pride in telling me about the good works of the Genesee Radio Amateurs, who are very active in community affairs and are prepared to help out in emergencies. This region of New York is known for severe winters and blizzards that can devastate an entire region. Tom spoke of several such occasions where the communications of ham radio operators were the only thing the community had to rely on.

I had a wonderful time speaking with many of the hams and teachers who attended my forum. Visitors to this part of our state get to enjoy a special kind of hospitality. Tom kept assuring me that no visit to this community would be complete without a tour of the world-famous Antique Wireless Association Radio Museum in Bloomfield, New York. My interest was really piqued when Tom introduced me to Bruce Kelley W2ICE, the museum's curator. For the longest time, Frank Gunther W2ALS (friend and colleague of Major Edwin Armstrong) had been telling me that I must get in touch with Bruce Kelley and visit this most impressive museum. My only regret turned out to be that I didn't have more time to spend there on this visit. It is definitely on my list of places to revisit as soon as I can.

Bruce Kelley

In 1936, Bruce Kelley began collecting radio tubes and old gear while he was living in Rochester, New York. When Bruce was 34, in 1948, he set up a museum in his barn in Spencerport. Bruce, who worked for Eastman Kodak, became well known in the area for the extraordinary slide presentations and equipment displays that he brought to meetings and hamfests. After awhile, these activities took up so much of his time that, in 1952, he founded the Antique Wireless Association with George Batterson W2GB and Linc Cundall W2LC.

The AWA began to grow in membership, and Kelley and his museum moved to a new home and a new barn in Holcomb, New York. The "Old Timer's Bulletin" was founded in 1960, the AWA National Conference debuted in 1963, and in 1972 the AWA was chartered by the state of New York as a nonprofit educational institution. The AWA has gained official recognition in past years when it was invited to hold its annual historical conferences at three of the nation's leading museums: The Ford Science Museum in Dearborn, Michigan; The Benjamin Franklin Institute in Philadelphia; and The Smithsonian Institution in Washington, D.C.

By 1970, Kelley's barn was overflowing and the AWA leased half of the Bloomfield Academy Building. Following renovation of the 1837 building, the AWA museum moved in alongside the museum of the Historical Society of the Town of East Bloomfield, which occupies the other half of the former school. If you are considering visiting there, or taking a class trip to this wonderful place, you should know that the Radio Museum in East Bloomfield is about 20 miles southeast of downtown Rochester and 10 miles west of Canandaigua.

The Radio Museum is a teacher's dream. Not enough museums offer youngsters, or oldsters for that matter, the opportunity to touch, feel and even smell their exhibits. Most of the displays at this museum are out in the open to be examined and enjoyed. According to Bruce Kelley, most of their tour groups consist of school classes, Scout troops, retired folks, and antique aficionados. Admission to the museum is free.

Exposing youngsters to artifacts and relics of the past is a terrific teaching tool. The Radio Museum provides the visitor with a "feel" for what went before. This is how we come to know where we are now: by experiencing the enrichment of the things that make up our history. In this museum you will "experience" one of the largest collections of early radio apparatus—actual equipment associated with Marconi, De Forest, Armstrong, Edison and other pioneers. Much of it still works.

The AWA Museum in East Bloomfield houses more than 25,000 historical items, from early Morse telegraph keys, repeaters, relays, and other equipment, to the earliest commercial wireless apparatus (vintage 1910 and earlier) and radio receivers—which are considered to make up one of the finest collections in the United States. In addition to radio and wireless gear, the museum contains such visual equipment as the early RCA and Finch facsimile machines, and scanning disk-type television receivers.

Photo A. Operating a 1923 amateur phone station at the AWA Electronic Communication Museum, East Bloomfield, New York.

Many of the exhibits have been donated by private institutions or are on loan from owner-members. There are today more than 3,600 members in the AWA worldwide. Among them are leading scholars, statesmen, scientists and industrial leaders, and many old-time pioneers in telecommunications. According to Bruce, "Membership includes Marconi ship-to-shore operators to hundreds of amateur radio operators who earned their expertise in the days of the spark gap and the coherer. In addition, there are scores of knowing antiquarians who have saved from oblivion literally thousands of artifacts from earliest wireless days which have found a place in the AWA Electronic Communication Museum. The museum's resources include a comprehensive library of books, periodicals, photographs and documents basic to its research and the sharing of this knowledge with others."

Many of us enjoyed the recent showing of the PBS "Empire of The Air." This Ken Burns documentary covered the lives of three controversial radio pioneers: De-Forest, Armstrong, and Sarnoff. The story stayed close to the excellent Tom Lewis book of the same title. A large amount of the footage was photographed or recorded in the AWA Museum, including the signals from the Association's rotary spark transmitter.

The AWA Museum is open from May through October. I heartily recommend that you put this museum on your "must see" list when you have the time. I also recommend that you bring at least one young person along with you.

For more details about the Antique Wireless Association or the Radio Museum, write to Bruce Kelley W2ICE, Main Street, Holcomb, New York 14469. 73

Photo B. Curator Bruce L. Kelley W2ICE with a group of school children.

repeater—must be used. Unfortunately, this is still rare—due mostly to cost.

Hierarchical Addressing A scheme which allows stations that forward packet messages to easily decode the final destination of the message. A hierarchical address runs from specific (callsign) to general (continental region). We don't yet include planet in a hierarchical address.

Internet An enormous Ethernet network with tens of thousands of government, educational, and commercial computers connected. The resources of the Internet are used by amateurs running TCP/IP to create "wormholes" that route transmissions originating on radio through the land-line Internet's high capacity network. This makes it possible to connect almost instantly from the US to Australia, for example, and end up on the local Aussie AX.25 network.

KAnode A proprietary networking scheme found in Kantronics TNCs, it is similar to NetROM networking.

LAN Local Area Networks are groups of nodes—usually user terminals, like packet stations—that are connected in such a way as to directly share the network channel. In the case of packet, LAN nodes are those stations which directly participate in the CSMA/CD sharing of a frequency. This is distinct from WANs (Wide Area Networks) which are used to connect LANs together. The distinction is not necessarily tied to geography—a LAN could just as easily cover more area than a WAN—but to architecture. The interaction of LANs on a WAN is similar to the interaction of nodes on a LAN. See: Backbone.

MAXFRAME An important TNC parameter that determines the number of outstanding (unacknowledged) frames that will be allowed. This number should be lowered on busy or noisy channels; high values of MAXFRAME in these cases will cause a reduction in throughput.

Modem From MODulate-DEModulate, a modem is a piece of hardware that converts digital information into analog signals in the audio frequency range to permit their transmission over voice channels. In a TNC, the modem is the subsystem which is connected to the radio. Most TNCs are delivered with 1200 baud modems but permit the connection of other, faster modems to the digital section that handles the AX.25 protocol.

Multimode A box which can operate not only as a TNC, but also as a terminal unit (TU) for RTTY, AMTOR, FAX, etc. The exact capabilities of multimode units vary from manufacturer to manufacturer. Multimode units are—of course—considerably more expensive than simple TNCs, but are worth considering if the extra functionality is interesting to you.

NetROM An automatic networking scheme that is stored on an EPROM (Electrically Programmable Read-Only Memory)—also known as a ROM, hence the name. NetROM nodes constantly exchange information about other NetROM nodes that can be heard and worked from their location. Users connecting to NetROM nodes can get a list of reachable nodes and connect to them, avoiding the time-outs and other limitations of digipeaters.

Packet The general name given to amateur computer networking via radio, it is derived from the use of data "packets" to provide data integrity. See: AX.25; Frame.

PACLEN An important TNC parameter which determines the length—in characters—of an I Frame. Larger values will increase throughput on quiet channels by reducing overhead, but will drastically reduce efficiency on channels that require retries. The default size is usually 128.

PACTOR An experimental mode for HF digital communications, developed in Germany. It takes the best parts of packet and AMTOR and combines them into an excellent system for the conditions found on the HF bands. Its legality for use by US hams is questionable, given the ambiguity of the rules concerning digital modes. There is hope, however, that this will change.

PBBS A Packet Bulletin Board System is a computer program which allows amateurs to exchange messages and provides automatic store and forward facilities for bulletins and messages addressed to distant hams. It is similar to a land-line BBS—like FIDO and other systems that forward messages.

Protocol A set of rules that specify the structure of transmitted data and handshaking (signaling used to communicate over a data channel). A protocol is something like the rules used on voice repeaters to prevent confusion and interference, though much more formal since computer programs don't think. See AX.25; TCP/IP.

Retry A request for re-transmission of a damaged frame, or the re-transmission of the frame. See: Error Detection and Correction.

Rose Yet another networking scheme prevalent in the eastern half of the US. It has some technical merit and wide support.

RTTY Radio Teletype is the original form of digital communication via radio. In its original form it uses a simple 5-bit code called Baudot (Baw'-doe) which allows for transmission of only upper case letters and the figures 0-9. See: Baud.

Serial Port A communications port found on a computer or terminal. Serial ports and other serial devices send and receive their data as a string of bits, one after the other. This is opposed to a parallel port, which transmits two or more bits in parallel. Serial ports are the most common connections to TNCs and other communications devices.

SLOTTIME An important TNC parameter that works in conjunction with the PERSIST parameter to more thoroughly randomize attempts to acquire the channel. On busy channels, it is important that transmissions occur at highly random intervals after the channel is quiet, to avoid collisions. SLOTTIME and PERSIST work like this:

SLOTTIME specifies the amount of time the TNC will wait before generating a random number between 0 and 255, which will be used by PERSIST.

PERSIST sets the threshold (0-255) which will be checked against the random number each time SLOTTIME specifies one should be generated.

The exact settings of these values is a matter of LAN management and should be determined by a technical committee of the local packet organization.

SSID A Secondary Station Identifier is a number following the callsign that allows a station to have multiple connections active without collision of the packet address. SSIDs up to and including 15 are valid. An SSID of 15 is usually attached to a user's call when they are being heard through a network node like a NetROM node.

TCP/IP Transport Control Protocol/Internet Protocol is the protocol used on the Internet. It is the closest thing to the universal solvent of the networking world, and is being adopted by amateurs as an alternative to AX.25. While it has some distinct technical advantages, it is much more difficult to get running than a TNC-based AX.25 station. A suite of software, including Phil Karns' (KA9Q) implementation of the utilities needed to run TCP/IP, can be found on many BBSs. The best way to get started in TCP/IP is to find someone already running it.

Terminal Emulation Using a computer program to emulate a dumb terminal. Digital's VT series is the most common choice.

TheNet Another automatic networking scheme, similar to NetROM. See: NetROM.

TNC A Terminal Node Controller is a box containing a modem and the "brains" to run AX.25 protocol. Because of the intelligence built in, it needs only to have a terminal and radio connected to work. Some software implementations of TNC intelligence are available for use with inexpensive modems.

TNC Parameters Settings used by the TNC to determine how it will behave. Because of varying channel conditions, there is no single "ideal" set of values. Other things like callsign and text messages are also in the set of parameters. See: MAXFRAME; PACLEN; SLOTTIME.

WAN See: LAN.

Number 21 on your Feedback card

QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

The Argonaut II

What separates one company from another is how that company changes or improves a product, based on input from its customers. Ten-Tec is a good example. Ten-Tec began as a company producing QRP equipment and their Argonaut line has become the world standard in low power amateur radio transceivers. When Ten-Tec introduced the Argonaut II at the '91 Dayton Hamvention, there were some rough edges. The unit I initially reviewed revealed some of these rough edges and other people noticed the same things.

Most companies would have just weathered the storm and let the rain roll off their backs. Not Ten-Tec! At the '92 Dayton Hamvention I cornered Tom Salvetti KC3NF, vice president of Ten-Tec marketing. Tom mentioned that Ten-Tec made several changes in subsequent production runs, most in the summer and fall of 1991. The first dozen or so prototypes were the ones that got out as review units. A prototype was the one I received for the original review. Tom offered a second Argo II for me to review. Tom assured me the next run of Argo IIs would be from a different mold.

The New Argo II

"Give me a call after the Hamvention and I'll get a new Argo II for you for Field Day." Now, I might be a little slow on the uptake, but reviewing a radio during Field Day is asking for trouble. Field Day has to be the all-time worst place to test a new radio. You get all kinds of critters flying about on Field Day, from no antennas to weak batteries. Don't forget all the other stations all trying to be on the same band at the same time.

Well, several days before Field Day, the Argonaut II arrived. The first thing that got my attention when I opened the box was a full-blown manual with schematics for the Argonaut II. All my first unit had were some instructions for memory programming and some condensed operating instructions.

This time around, the Argonaut II seems to have a better fit and finish than the first unit I tested. The silkscreening seemed much clearer on the front panel. Gone are the Torx screws holding the covers on. In their place, Phillips screw heads. Now you can open the case without a trip to Sears for tools. On the back there is a jack for an external speaker (1/4" jack) and an 8-pin DIN jack for I/O ports. These

The Ten-Tec Argonaut II.

ports include receive audio, T/R line and transmit audio, as well as T/R line to key an external amplifier. Ten-Tec did not include the band-line outputs on the rear of the Argonaut II to automatically select the proper band on the amplifier. Remember, you purchased a QRP transceiver in the first place. Yes, QRPers do use amplifiers, just ask Randy KD8JN but hooking up an Argonaut II to your SB220 is, well, different! If you want to run 100+ watts and then use an amplifier, get the Delta. You can turn the Delta's RF power down, too.

Many of the improvements to the Argonaut II were done to the firmware controlling the CPU. There are two changes I really like. First, in the older version of the firmware, when the Argo II went into transmit the frequency was locked. You couldn't move the frequency around the band with the main tuning knob. Now this problem has been fixed. I guess it's not the best thing to do on the bands, but band swishers are a part of life. If nothing else, it's great to swish around to find the resonate point of your antenna.

Second, the first Argo II did not like operating on battery power. When the battery voltage dropped down to 12 volts, things went kinda weird. By flashing the display on and off, the new firmware lets the user know the battery voltage is too low to operate. There

were more changes done to the firmware controlling the Argo II, but these two I really think help the most.

The first Argo II I reviewed showed different amounts of transmit current for the same amount of RF output. This time around, the current for the transmitter is within a few hundred milliamperes of each other. Transmit current ranged from a low of 2.51 amps on 80 meters to a high of 2.84 amps on 17 meters. RF power was 5 watts into a 50-ohm load. No signal receive current is 832 mA on receive with the backlighting off, and 888 mA with the backlighting on.

In the past, keying the radio with a transistor-switched keyer seemed to cause some trouble. I was able to key the Argo II using anything I had in my shack. A fix? I'm not sure, but the first ones off the line had trouble with some keyers.

For the times when you want to listen to the BBC on 5875 kHz, the AM audio response rolls off at 1600 Hz (as reported by *QST*) is easily fixed. Adjust the NOTCH control so it is 100 percent out of the circuit (fully counterclockwise). The Argo II is not a Drake R8, and it was not designed to be, but it allows for good shortwave listening. Most of the QRM fighting controls, however, are offline when in AM mode.

Field Day Testing

The real acid test came during Field Day. I set the Argo II up beside our phone station. Don Wade WD8DEA was using our ICOM 735. His antenna was a G5RV. I used a center-feed Zepp and fed the antenna with a run of 300-ohm TV twin lead and some 450-ohm open ladder line. I ran out of TV lead wire. The Argo II received its power from an 80 amp/hour battery, solar-charged of course.

Our club had a CW station, too. An old Triton 4 was pressed into duty this year for the CW station. Both the phone and the CW station were running 100 watts output.

Anyone working the event this year can tell you the band conditions were the pits. Everyone started out on a different band. After a few hours went by, we all knew how bad the bands really were. Toward the late part of the night, we somehow all managed to be on the same band at the same time. The band happened to be 80 meters; Don WD8DEA on 75 meter phone, the CW station on the one end and me in the middle.

When the CW station was on, the phone station got nailed. Turning on the attenuator, I was not only able to work stations, but I was also able to nudge up as close as 5 kHz to the CW station without getting nailed. Oh yes, I could tell when the CW station was transmitting, but I could still operate! On the other hand, Don threw up his hands and headed for the food table.

I took my old Argonaut 509 with me and swapped out the pair. I never made it to the front of the radio as the CW station nailed the 509 right then. I quickly unplugged the 509 and replaced it with the Argo II. I thought the 509, having a tuned front end, versus the Argo II's broadbanded front end, might be better. I guess not. All in all, the Argo II really did super on Field Day.

Suggestions for Improvement

Are there still some rough edges? Well, nothing is perfect and yes, there are some things that I feel need to be looked at.

With the full manual, many of the finer points in setting up the Argo II are fully explained. I would like to see a drawing on the setting of the bandwidth control and adjustable filter control. This drawing should show the approximate locations for bandwidth. Put the bandwidth control here for 500 Hz wide, here for 1200 Hz, etc. As slick as the variable bandwidth control is, Ten-Tec would really have a radio if I could have the best of the digital stuff and the crystal filters from my Argosy II. Yes, the cost of all the filters would be expensive and yes, you would lose the advantage of the variable bandwidth control, but it's a thought.

I found it hard to keep a station centered in the passband of the receiver when I tightened up the filter bandwidth. I fixed this problem by myself by setting the filter control at the 11 o'clock position and then adjusting the PBT tuning control to center the station I wanted. Leaving both controls alone, I used the main tuning knob to tune the station in to my filter/PBT settings. This seemed to work the best under FD QRM.

Using the spot function to get a station properly tuned in was difficult during the FD QRM. It worked, but I had to run up the sidetone level so high to overcome the QRM, then reduce the level to save my hearing.

The goof that I am, I worked both CW and SSB during FD. Switching from SSB to CW is no big deal, only a couple of button pushes. But, I sure miss the automatic mode selection feature most modern transceivers have. Going from 75 SSB to 40 CW and not pushing the buttons caused me no end of grief. I'd key the rig, then get a sidetone but no RF. After looking for loose wires, downed antennas and everything else in between, I noticed that the radio was in the wrong mode. RATS!! It would (should) be a simple change to the firmware to have the radio switch modes as you change frequency. Going from 7.040 CW to 7.200 SSB would then be automatic. Moving from 40 meter lower sideband to 20 meter upper sideband would also be automatic. As it is, the Argo II won't do this simple task.

The Argo II has many pluses, too. With the LCD backlighting, the display did not tire out my eyes, even at 3 a.m. Shutting off the backlighting saves only about 50 mA so I just kept it on all the time.

The semi-QSK (slow QSK) worked out quite well under the QRM of Field Day. I like to work QSK with the best of them, but FD is really hard on the ears.

I have to hand it to Ten-Tec for getting many of the problems worked out of the Argonaut II. You don't see this too many times nowadays. So, next time you work a station and he tells you, "Rig here is Argo II," he has a worldclass QRP transceiver on his desk. He has an Argonaut II. 73

Number 22 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event. Call our BBS at **(603) 924-9343**, *and check* **Special Events File Area #11, EVENTS.TXT** *for listings that were too late to get into publication.*

ANNOUNCEMENT

McGREGOR, TX Amateur Radio License Exams are offered the 2nd Sat. of each month at The Community Center, 2nd and Madison, at 9 AM, for all levels. Fee $5.40. Walk-ins welcome. Contact ***Alma AB5BA, (817) 859-5374***, or ***Ed AB5CG, (817) 840-3807***.

NOV 1

LEBANON, IN The Boone & Clinton County ARCs will sponsor a Ham Fest at Boone County 4-H Fairgrounds Warm & Dry Community Bldg. from 8 AM-4 PM. Set-up at 7 AM. This location is 17 miles north of Indy, just off I-65 at exit 138. Free parking. Free Tailgating. VE Exams nearby. Flea Market. Dealers. Admission $3. Table and space $2. Talk-in on 147.105 and 443.150. For info call ***Don Jackman N9ILX, (317) 482-5211*** or ***Don Lecklitner N9GBO, (317) 654-6580***, or write to ***Boone County ARC, P.O. Box 186, Lebanon IN 46052***.

NOV 7

ENID, OK The Enid ARC will host a Ham Swap Meet at Garfield County Fairgrounds' Hoover Bldg., Oxford St. and N. 4th. Admission $1 at the door. Free tables. VE Exams at 10 AM, walk-in only. There will be technical programs throughout the day. Contact ***Fred Selfridge N5QJX, (405) 242-3551*** or ***Tom Worth N5LWT, (405) 233-8473***.

EUSTIS, FL The Lake ARA will hold their annual Hamfest/Electronics Expo at the Lake County Fairgrounds in Eustis FL, from 9 AM-5 PM. Tickets $4 in advance, $5 at the door. Tables still available @ $12.50 (includes 1 free admission). Large tailgate area, spaces $5 (does not include admission). VE Exams for all classes will start at 1 PM. Contact ***Cole A. Ruck KC4UIG, (407) 273-1624***.

MILWAUKEE, WI The Milwaukee Repeater Club will sponsor the 8th annual 6.91 Friendly Fest, rain or shine, from 8 AM-1 PM at Serb Halls 1 & 2, 51st & Oklahoma. All on the ground floor with easy access. Set-up at 7 AM. Advance tickets $3, $4 at the door. 4' Tables $4 in advance, $5 at the door. To save $1 per ticket or table, send SASE with payment to ***The Milwaukee Repeater Club, P.O. Box 2123, Milwaukee WI 53201*** before Oct. 31. VE Exams on site. Talk-in on 146.91- (The Friendly Rptr.) and on 146.52.

NOV 8

LONG ISLAND, NY The Radio Central ARC will hold their HAMEXPO at Suffolk Community College, Long Island Expwy. exit 62, Nicholls Rd./County Rd. 97 North 1 mile. All indoor Flea Market. Ham Dealers. Computer Show. Free parking. VE Exams. Admission $5 at the door. Tables $20 in advance. Send to ***Radio Central ARC, P.O. Box 680, Miller Place NY 11764***. Talk-in on 145.15-4Z or 449.525-2A. For info call ***John Mark KB2QQ, (516) 689-6336***, or ***Jo Ann Colletti N2IME, (516) 399-1877***.

NOV 14

MONTGOMERY, AL The Montgomery ARC will host the 15th annual Montgomery Hamfest in Garrett Coliseum at the South Alabama State Fairgrounds, located on Federal Dr. from 8 AM-3 PM. Free admission. Free parking. Flea Market set-up 3-8 PM Nov. 13th, and 6-8 AM Nov 14th. All indoors. No reservations required. FCC Exams on-site beginning at 8 AM—bring original and a copy of your current license, picture ID and $3.00. Talk-in on 146.24/.84 W4AP. Ragchew on 146.32/.92 (with phone patch, *up/#down), 147.78/.18,449.50/444.50. Special Hamfest rates at Days Inn, I-85 Exit #3; desk phone ***(205) 269-9611***; or (across the street from the Hamfest, ***Coliseum Motel, (205) 265-0586 or 1-800-876-6835***. For info, write to ***Hamfest Committee, c/o 111 Diane Dr., Prattville AL 36066***, or phone ***Jiggs, (205) 365-0380***, or ***Fred, (205) 270-0909***.

NOV 14

PLYMOUTH, MA The Mayflower ARC will host a Flea Market at the Plymouth Memorial Hall Bldg. in

Plymouth Center (RT3A) from 9 AM-3 PM. Admission is a $2 donation; children under 12 free. Tables $12 ea. in advance, $14 ea. at the door if available. Walk-in VE Exams. Talk-in on 446.625 and 146.55 simplex. To pay for tables, mail checks with an SASE to ***M.A.R.C., P.O. Box 766, Dept. FM, Plymouth MA 02361***. For exam info call ***Dave KA1TXO, (617) 585-1351***. For Flea Market info, call ***Jon WS1K, (508) 746-0162***, or ***Jim NM1F, (508) 747-2224 eves.***

NOV 14-15

F. WAYNE, IN The 20th annual Fort Wayne Hamfest/Computer Expo/1992 ARRL Indiana State Convention will be sponsored by AC-ARTS, and held at the County War Memorial Coliseum. Doors open Sat. 9 AM-4 PM; Sun. 8 AM-3 PM. VE Exams both days. Coliseum parking $2 per car. Flea Market. Admission $5. Commercial tables $30. Flea Market tables $15, (electricity $25 extra). Reserve tables by Nov. 6th. Talk-in on 146.88- and 443.80+. Send SASE to AC-ARTS, P.O. Box 10342, Fort Wayne IN 46851. For general info call ***Don Gagnon, (219) 484-3317***. For table info call ***John Rufner, (219) 483-6305***.

NOV 15

BENSON, NC The Johnston ARS, Inc. will hold its annual "JARS-FEST" at the American Legion Complex from 8 AM-4 PM. Tickets $4 in advance, $5 at the door. Tables $6. Tailgating $3. Set-up at 6:30 AM. Contact ***Bill Lambert AK4H, Rt 3 Box 315, Benson NC 27504. Tel. (919) 894-3352 between 7 PM-10 PM.***

BRANFORD, CT The Southcentral Conn. ARA will hold its 13th annual Flea Market at the Branford Intermediate School, at 185 Damascus Rd. Sellers 7 AM. Buyers 9 AM. Advance Tables $15, $20 at the door. Admission $4. VE Exams. Reservation deadline (in writing, no phone) Nov. 1. SASE to ***SCARA, P.O. Box 705, Branford CT 06405-9998***. For info call ***Brad, (203) 265-9983***. Talk-in on 146.01/.61.

MATTAPOISETT, MA An Amateur Radio Flea Market will be held at Knights of Columbus Hall. Admission $1. Table and space w/one admission $10. Set-up at 7:30-9 AM. Talk-in on 146.52 MHz. Please call or write if you have an interest in taking exams. Contact ***Kenneth Rapoza K1NSX, 19 Golf St., Fairhaven MA 02719. Tel. (508) 993-3993***.

NOV 21

PARK RAPIDS, MN The Smokey Hills ARC will hold a Ham Fest at the Eagles Club from 9:30 AM-3:30 PM. Tickets $3. $4 for a table and admission. Talk-in on 147.30. Contact ***Nick De Carlos, KA7VLH, Rt. 1 Box 352A, Park Rapids MN 56470***.

SUMTER, SC License Preparation Classes are being offered by the Sumter ARA. For info write ***Sumter ARA, P.O. Box 193, Sumter SC 29151***, or call ***Dan WB5SGH, (803) 773-9106***. Walk-ins okay.

NOV 22

ILFORD, CT VE Exams are scheduled for 12 noon at the Fowler Bldg., 145 Bridgeport Ave., by the Coastline Amateur ARA. Walk-ins. All classes. Contact ***Gary NB1M, (203) 933-5125***, or ***Dick WA1YQE, (203) 874-1014***.

WASHINGTON, PA The 5th annual Tri-State Hamfest/Computer Fair will be held at the Chartiers Houston High School from 8 AM-3 PM. This all indoor event is located 1.5 miles from Exit 8 off Interstate 79. Admission $3. Children under 12 free. Talk-in on 146.52 simplex. Directions on 145.49/144.89. Contact ***Bob McCloskey, c/o WACOM, P.O. Box 1386, Washington PA 15301. Tel. (412) 695-8608 after 6 PM.***

WHEATON, IL G.M.R.S. of Illinois, Inc. will host their annual "Winter Fest 92," at DuPage County Fairgrounds, 2015 W. Manchester, from 8 AM-1 PM. Set-up at 6 AM. Tickets $4 in advance, $5 at the door. Tables $10 in advance, $12 at the door. Talk-in on 146.52 direct; 462.600, PL 173.8. Contact ***G.M.R.S. of Illinois, Inc., 2077 W. Roosevelt Rd., Wheaton IL 60187***.

DEC 5

FARIBAULT, MN The annual Courage Center Handi-Ham Winter Hamfest will be held at the Eagles Club, starting with registration at 8:30 AM. There will be a Handi-Ham equipment auction. Dinner at noon and program. Talk-in on 146.19/.79. Contact ***Don Franz WØFIT, 1114 Frank Ave., Albert Lea MN 56007***.

DEC 6

HAZEL PARK, MI The Hazel Park ARC will hold their 27th annual Swap and Shop at Hazel Park High School, 23400 Hughes St, from 8 AM-2 PM. Tickets $3 in advance or at the door. Tables $12 (reservations for tables must be received

with check, no phone reservations.) Free parking. Talk-in on 146.64-(DART). For reservations and info, write to ***HPARC, Box 368, Hazel Park MI 48030***.

DEC 8

LARGO, MD To benefit Prince George's County RACES/ARES, Inc., HOLIDAYFEST 92 will be held from 8 AM-4 PM at Prince George's Community College Campus (exit 17A or 15A Capital Beltway). Donation $4. Tables $20. Symposium presentations, free VE Exams by Laurel VECs; please bring your original license/CSC or photocopy. Special CW speed challenge contest. Contact ***HOLIDAYFEST 92, P.O. Box 1037, College Park MD 20740. Tel. (301) 572-2362***.

SPECIAL EVENTS ANNOUNCEMENT

GERATOL NET Greetings Extra Radio Amateurs Tired of Operating Lately. The Geratol Net (for amateurs of all ages, from all states and the Canadian provinces) helps to assist U.S. Extra class amateurs and other operators (whose privileges allow them to use the Extra class portion of the 75 meter American phone band) to obtain the ARRL, 2-letter Extra Class SSB, WAS award. The number on the ARRL Certificate is known as the Geratol number. This net also aids those operators on the completion of the Canadian 2/80 Award offered by the Metro ARC. The Geratol net is not a DX net. For the purpose of this net, Canada is not considered DX. The Geratol net meets every night at 0100Z on or about 3.767 MHz, depending on QRM, and continues to operate until all hours, depending on band conditions and check-ins. For more info on the net, awards and endorsements, send a #10 SAE with 2 units of postage to ***WØYTZ, 300 Valley View Dr., Ord NE 68862 USA***.

NOV 1

DELAWARE The members of the Warminster ARC will conduct their 4th annual DXPedition to the rare state of Delaware and will operate Station WA4DFU/3. Frequencies: 7.275, 14.275, 21.375 and 28.375 MHz. CW contacts will be made on request. QSL with SASE to ***Warminster A.R.C., Box 113, Warminster PA 18974***.

NOV 5

CLINTON, NC The Sampson County ARS will operate Station AB4TT from 1700-2400Z for the Sampson County Expo and Pork Festival. Operation will be in the lower portion of the General bands. For a certificate, send QSL and SASE to ***SCARS, P.O. Box 64, Clinton NC 28328***.

NOV 7

SANTA ROSA ISLAND, FL The Serious Hams ARC will operate Station N4MAD from Ft. Pickens State Park (IOTA 142) from 1200Z-0000Z on 80, 40, 20, 15, and 10 meters in the code and voice portions of the bands. Contacts made to Station N4MAD will receive a special QSL card. Sorry, no certificates this time.

NOV 7-8

HONOLULU, HI Hawaii Army MARS members will operate WH6R to commemorate the 50th anniversary of the rescue of Capt. Eddie Rickenbacker. Activities are planned for all bands, all modes, including the Novice subbands. Look for us at the lower portion of each subband, Nov. 7 1900Z-1900Z Nov. 8. For QSL please send your card and SASE to ***Joe Mao, 3251 Pakahu St., Honolulu HI 96822***.

NOV 14

FT. PIERCE, FL The Ft. Pierce ARC will operate KN4RY from 1400Z-2100Z to commemorate the 7th anniversary of the UDT-SEAL Museum. Operation will be on the General portion of 40, 20, 15, and the Novice portion of the 10 meter band. For a certificate, please send a QSL and a large #10 SASE to ***Fort Pierce ARC, P.O. Box 4, Ft. Pierce FL 34954***.

NOV 28-29

PLYMOUTH, MA The Whitman ARC will commemorate Thanksgiving by operating Station WA1NPO from 1400Z-2100Z each day. Frequencies: 3.970, 7.270, 14.270, 18.140, 21.370, 24.970 and 28.370. WA1NPO will operate from historic Plimoth Plantation, overlooking Cape Cod Bay. A special QSL card will be sent to those Hams and SWLs sending an SASE. A special 8 1/2 x 11 certificate with the Mayflower II in the background, is also available for this event. Send replies to ***Whitman A.R.C, P.O. Box 48, Whitman MA 02382***.

DEC 5-6

GUANTANAMO BAY, CUBA The Guantanamo Bay ARC will operate Station KG4CA from the U.S. Naval Base at Guantanamo Bay, Cuba, from Dec. 5 0001Z-1700Z Dec. 6, to celebrate the 40th anniversary of Cuban-American Fraternity Day. Operation will be SSB and CW on 20, 15, and 10 meters. For QSL send QSL and SASE to ***Guantanamo Bay ARC, PSC 1005 Box 73, FPO AE 09593-0146 USA***.

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- SOLID STATE ELECTRONICALLY REGULATED
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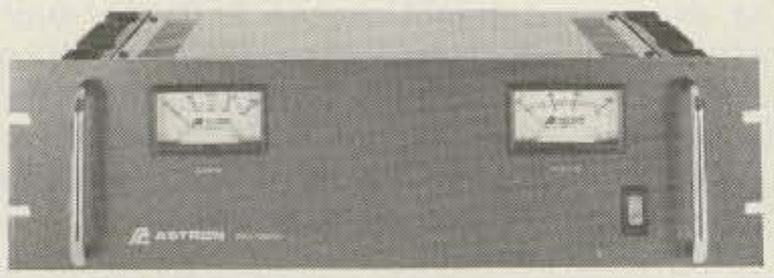
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• LOW PROFILE POWER SUPPLY						
SL-11A	•	•	7	11	2¾ x 7⅝ x 9¾	11

RS-L SERIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE				
RS-4L	3	4	3½ x 6⅛ x 7¼	6
RS-5L	4	5	3½ x 6⅛ x 7¼	7



RM SERIES

MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

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NEVER SAY DIE

Continued from page 4

self I'd write a book on how the mind works and how to fix it, complete with anecdotes on the people I helped.

At the foundation, we learned by working on each other. While the process is lightning fast in comparison to psychiatry or psychoanalysis, it's still slow enough so those working with it don't see startling changes on a day-to-day basis. Week to week, yes. In the work done for me I found myself being held down by two doctors and my parents when I was four years old. My ear was infected and they'd decided to operate on it. I was frightened as they put the ether mask over my nose and mouth.

Then there was the time I got across my 2,000 volt power supply and was thrown six feet across my hamshack. Whammo!

After a few weeks of erasing these painful memories, plus those of a lot of very painful beatings by my father, I found my awareness had improved enormously, as had my ability to think.

At this time I was faced with another career choice. Should I go back to radio work? Should I go back to being a television director? Or should I be a therapist? I tried the therapist business for a while, working on something over a hundred patients and having some amazing successes. But I found that most people preferred to live with their problems. This was frustrating. This was very frustrating. I'd meet people who stuttered, or who had other easily curable physical or emotional problems, but didn't want to do anything about them. I decided it would be better to pursue a technology-oriented career.

If we can ever get over the concept that psychiatrists, psychologists and psychoanalysts can cure mental problems, we may be ready to get to work actually repairing minds. It's easy to do. It's fast. And you don't have any relapses. I'd like to see the basic concept incorporated into a computer program which would help doctors to diagnose not just a patient's physical illness, but also isolate the root emotional (subconscious) tie-in so that can be erased. That'll resolve many physical illnesses a lot faster than pills. The whole system is routine enough so it could be made into a computer program.

We do need a lot more research so we'll know what kind of successes we can have with things like dual personalities, multiple sclerosis, cancers, alcoholism, and so on. Another aspect that needs more research is the past-life phenomenon. Many psychiatrists run into this and dismiss it. Some have had considerable success in treating past life traumas just as if they were real. I started to do some research in this field, but didn't follow through. I did find that every person, under hypnosis, can be regressed to times of great trauma in what they say are previous lives—or, more often, past deaths. Being pragmatic, I found the whole thing interesting, but I wasn't sure whether these were real, or just imaginary. I found that when I erased them, just as I would a present-life trauma, the patient would change significantly and seem no longer influenced by the events. People with a great fear of water, when regressed to find the cause, would pop instantly to a drowning death. I'd erase the trauma response and they'd no longer be afraid of the water. Oddly enough I was unable to find any water-related traumas during their present life, even during the prenatal period. Well, real or fantasy, what I was doing did the job, and that was what counted.

Many people dismiss past lives, psychics and so on as fantasy. I remain a skeptic, but one with an open mind. I've had too many instances of psychic phenomenon during my life to refuse to even consider that we may have a lot to learn about all this yet.

During one of the more traumatic moments of my life, when I was terribly distraught, the telephone rang. It was my mother, 120 miles away. She said, "What's wrong? I know something's terribly wrong." Coincidence? Hardly. This was the only time in my life she ever called like that, and she had no way of knowing I had any problems. So I'm open to know more about life, death, and other pseudo-scientific matters. I'm not a passionate believer, just a skeptic who wants to know more. I believe we still have a lot to learn. There are just too many unexplainable anomalies—too many loose ends that need tying.

Magnetic Fields

WARNING: The Electricity Around You May Be Hazardous to Your Health—by Ellen Sugarman—Simon & Schuster—$11.00.

This fascinating book tells the story of the criminal cover-up by power companies, dishonest scientists and even the White House of the death and serious health problems caused by 60 Hz power line magnetic fields. Remember, one of the leading researchers in the field is Dr. Ross Adey K6UI, who has proven in his own research the incredible power to affect cell growth of even very small magnetic fields. Power lines, pole transformers and other sources of magnetic fields are causing leukemia, brain cancer, and a whole range of other immunity-weakened health problems.

You can get the straight skinny on the extent of the cover-up via this new book. The chap who originally blew the whistle on this health hazard was Paul Brodeur, the same fellow who eventually was able to convince people about the dangers of asbestos. The government and business approach is the same with magnetic fields as it was with asbestos and cigarettes: Deny it, then produce paid scientists to deny it . . . and eventually to be forced by the public to face the situation. The power companies are still in denial and the public is paying the price through high childhood leukemia deaths, brain tumors, miscarriages, and so on.

The most critical source of these fields in the home are electric blankets, water beds, nearby pole transformers and poor house wiring. But not far behind comes ham radio amplifiers, which may help explain why hams are dying of cancer at far above the average. Have you measured how many cell-disruptive milligauss you have going through you when you operate?

Look for the book in your local book store or call Uncle Wayne's for a copy.

The Dream Station

My wife has been bugging me. She says now that I'm 70, I should be able to have the ham station of my dreams. Yes, I know, our wives usually bug us about how much we're spending on our ham gear, not how little, so perhaps I'm fortunate to have mine pushing the other way. But it's an uphill push. I'm not known as Wayne The Frugal for nothing. That NSD in my call stands for Never Spend a Dollar. Yes, I'm cheap. When haircuts got up to a dollar I bought a pair of scissors and have cut my own ever since. Lordy, they must be up to near $2 by now! Look at the money I've saved.

So I need some help. Yes, I'd like to have a great ham station, but I want to get the best bang for the buck I can, not just go out and throw money at the top of the line stuff, just because it's expensive. Sure, I wear Rolexes, but they only cost $25 in Taiwan. Oh, I had a real Rolex once—used it for years, then it got swiped when I sent it in to the Rolex people to be cleaned. A friend of mine, Jean Shepherd K2ORS, got it for me at the discount store at Shannon Airport back in 1957. It was one of those Submariners, good to 300 feet. Since I'm only good to around 200 feet I felt the margin for error was just fine. It had a movable bezel, which was handy when I had my own plane.

When the insurance money came I blew it all on one of those new digital watches. Yep, I managed to get in there and grab one before the price dropped—before Casio got into the business. I got in there early on calculators too, buying a bunch from MITS for $129 a whack just weeks before the price dropped to $12. Who wants any of those cheapo calculators, right?

This time I'd prefer to get in on the other side of the price curve. Look, if you were going to put together a dream ham station, but were faced with a seven-generation genetic need to be frugal, what would you pick? What HF rig? What amplifier? What tower? What beam? Keep in mind that I need to have a whammo signal. As it says in "December Song," I haven't got time to play the waiting game. I've got so much lined up to do and so few hours of life left in which to do it that I'd rather put a few bucks into a humongous signal that gets answered on the first call in a pile-up instead of being down there in the second or third layer and having to frustrate it out, hoping the band won't change before I'm finally heard. I've paid my dues in that department. The fact is it doesn't have to cost all that much extra to have a first layer signal and the investment is well worth it. I want to be able to get on the air, make a contact and talk without fighting the QRM endlessly—without having to keep my contacts down to a signal report, name and QTH. I've worked my 350 countries—did it long ago, so I don't have to prove anything. I want to be able to talk with my friends in Hong Kong, Sabah, New Zealand, Jordan and so on, not have to fight to get heard.

So what do you recommend? How do you like the rig you're using? What's wrong with it? What's right? I'll bet I'll need a full-sized single-band 20m beam—what do you think? Should I get a tilt-over tower so I can fix it when something goes wrong? A crank-up? I'm not sure I want to climb 100-foot towers for many more years. I've paid my dues there too.

Should I look around for a used ICOM 730 or something like that, or go bananas for a multi-kilobuck rig? I'm not into impressing anyone with the magnificence of my station, I just want one that does the job and will make it so I can talk about more interesting things—providing I can find a ham somewhere with an actual interest in talking. Perhaps I'm asking too much. I had a 730 but one of my editors left it behind when he was on St. Lucia helping out after a hurricane. I hated losing that rig.

I had a Kenwood 830 that I really liked. Alas, a *73* editor swiped it. I even had a panoramic adaptor for it so I could find empty channels a little easier. So if you had an uncle who was a noted skinflint, what would you recommend?

Iraq Retakes Kuwait

How'd you like to see that one in the headlines? I'll be surprised if it doesn't happen—and without the U.S. lifting a finger to stop it. Further, I'll be even more surprised if Iraq doesn't keep right on going on down the old Arabian peninsula, gobbling up Saudi Arabia, Bahrain, Oman and points south.

Well, we'd never put up with that sort of nonsense! We'd be right over there lobbing missiles down Baghdad chimneys again, right? Not if Saddam plays it they way I would if I were holding his hand. Ask me how I'd pull this one off.

Glad you asked. The next thing you're going to ask me is what this has to do with amateur radio. What's the matter with you, got monomania and interested in nothing but hamming? Well, I'll get to the ham relevance. Hang in there, but in the meanwhile take off your bloody blinders. Hamming is fun, but it isn't everything.

So here's how I'd go about cornering the world's oil if I were sitting in a deep bunker in Baghdad scheming. First I'd invest in a few more tank trucks so I could run more of my oil down to Aqaba via Jordan. Jordan, cut off by the other Arab countries from their old support payments, is in desperate need of the toll money for the use of their highway and port. Remember, Jordan has no natural resources or industries, so they need anything they can get from Iraq.

Instead of buying more food for my people I'd build up a little kitty to send along with some friends of mine when they visit the ex-Soviet countries. They'd be shopping for the best deal we could get on a couple of atomic bombs (also known as devices).

The next step would be to buy a small suitcase for each of the bombs and smuggle them into the U.S. I'd set up one in downtown Manhattan and the other in Washington, over near the Capitol. Then I'd announce my plans for Kuwait, explaining about the bombs and suggesting that we not hurt each other.

While much of the country might cheer the loss of Washington, which has very few redeeming values, the possible loss of the New York pimps and transvestites might act as a deterrent to our military. While we don't want to lose all that oil, we might not want to lose a couple million people in New York even more. Having lived in New York City for many years, I'd trade it off in a minute for almost anything, but I doubt if our president will know it as well as I and will thus be inclined to wimp out.

But what about Europe? What about Germany and France? England? Hey, Bush had to drag them kicking and scratching into the Gulf War last year, even though we did most of the dirty work. They seem more interested in selling Saddam plutonium processing equipment than bombing him.

Since Saddam probably isn't as unprincipled as I, I'm sure we'll never have to worry about the scenario I outlined. It's always possible that no matter how difficult things get and how hard up the ex-USSR countries are for food and cash, they'll not sell any nukes. How much would you like to bet? Hey, China has nukes too, and they seem to be willing to sell just about anything to get cash, so perhaps we ought to stop needling them about killing all those pesky students. Doesn't what they do to their people, no matter how despicable, come under the heading of an internal matter and therefore is none of our butinsky meddling business?

In view of the above, how much should we hams get involved in setting up high speed emergency communications systems? Should we breathe easily, now that international communism has been soundly defeated by capitalism? Or should we maybe plan ahead in case something goes wrong?

One more thing I'd like explained is why the Russians haven't stopped building new and bigger nuclear submarines! And why have they stepped up their intelligence operations in America? I thought they were short of cash and were begging for a whopping loan from us to tide them over. Does this mean we're about to lend them money which, in essence, will help them build bigger, better and quieter nuclear submarines? I hate to seem dense about this, so if you can explain what's going on, I'm waiting. In the meanwhile perhaps we shouldn't decommission too many of our submarines. And we might just put a little effort into building a national high speed emergency traffic system. And is this really the time to stop experimenting with unattended packet relay stations on the low bands?

I wonder if every single ham club in America will expect someone else to actually do something about this? Hey, it's just that old doom & gloom Wayne again? When was the last time he was ever right about anything?

QSL of the Month To enter your QSL, mail it in an envelope to 73, Wayne Green Inc., 70 Route 202-N, Peterborough, NH 03458. Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to 73. Entries not in envelopes cannot be accepted.

Hanging's Too Good

Please let me know when you're beginning to get fed up with hearing bad language on the air. Oh yes, you might send a copy to the ARRL, which seems to be unaware that we have an increasing number of very sick individuals exercising their freedom of speech on our ham bands. Now that stuff may be just fine for radio and television, but there are a majority of us who don't want to have to listen to that kind of . . . er . . . baloney when we're hamming.

Having spent a few years in the Navy, there aren't any combinations of words that bother me. Indeed, I use a few myself when the situation seems appropriate. But I have never used 'em over the air and it annoys me when I hear hams doing it. CB is well known for this kind of expression, yet I've heard far less bad language on CB than I have on our ham bands.

Perhaps I should remind you that there have been just two people arrested, tried, convicted and sent to prison for using bad language over the air. Yes, they were both doing this on CB. And yes, of course both were Extra class hams. Both had passed their 20 wpm code tests, the filter old-timers assure us will keep amateur radio ethnically pure.

Almost every amateur except the tiny overly vocal minority causing the trouble gets upset when faced with this filth. The knee-jerk reaction is to turn to the FCC in outrage. The anger these maggots incur causes otherwise rational amateurs to completely forget the League's endless promises to the FCC that amateur radio is self-policing. They also forget that the FCC is woefully underfunded and has no budget for policing our bands. They forget that the FCC has its hands tied by the Supreme Court when it comes to the freedom of expression. They forget that amateur radio is an expensive luxury which costs the FCC big bucks and that we are not paying one cent for this service. They forget that megabuck communications companies are pouring millions of dollars into lobbying efforts aimed at pressuring Congress and the FCC to take away our bands. They forget the success UPS had in grabbing 40% of our 220 MHz band not long ago. They forget that as a group we have contributed pathetically little to our country in the last 20 years. They forget that modern communications technology is making our slow, error-prone emergency nets of little more than historic interest. They forget that before the 1964 ARRL holocaust, which stopped our growth and killed off over 90% of our American ham industry, amateur radio was contributing new technology breakthroughs and pioneering on a regular basis. They forget that the world doesn't care what we did 30 or 50 years ago, it wants to know what we've done lately. The answer is not pretty.

A Solution

Outside of my usual hand-wringing over the fix the League has gotten us into . . . my contribution in the way of League-bashing, as it's called . . . or League truth-telling, as I see it . . . what's the answer when we hear garbage pouring out of our loudspeakers? The answer is the same one I've proposed before, but which, as far as I know, not one single ham club in the entire country has acted upon, is to get the League off its duff and off the golf links long enough to tackle the problem.

I've proposed a number of approaches the League could take to help us clean up our bands if they had the slightest interest in living up to their billing as our national society. I'll know they're taking an interest in something more than selling subscriptions to *QST* when I see they've established at least a one-person department at HQ dedicated to cleaning up our bands.

The first step I'd take if I were going to tackle the problem would be to petition the FCC for a rule change which would make it easier to unlicense offending hams. Right now it's easier to apply the death penalty than to take away a license. Somehow the concept seems to have gotten into the public conscience that a ham license is a right instead of a privilege. Wrongo.

Look, we've acquired the responsibility for issuing licenses via our VECs, so why shouldn't we have the power to take licenses away? So let's get the rules changed to give us the power to actually do the self-policing we keep telling the FCC we're doing. We aren't doing squat. Yes, we need some safeguards to protect honest, clean-living amateurs from small gangs of rascals . . . the old crooked sheriff syndrome. But losing an amateur radio license is not comparable to being thrown into prison or executed. Let's get a rule which will allow the filth repeater in Los Angeles to be cleaned out once and for all. Let's get a rule which will let us clean out the nuts ruining 20m. And let's make sure the rule has no opening whatever for lawyers to get their scum-sucking hands into the system.

We're being licensed by our peers, so let's get organized so our peers can de-license our mistakes. We don't have any test for IQ or sanity when we give a ham test, so we're going to get weirdos. We know that kids interested in amateur radio are generally considered nerds and dweebs, so we should do all we can to clean our bands of nut cases and ranting fanatics.

Do I have to work out the proposed rule change in detail, thus giving you the opportunity you're waiting for to find some aspect with which to find fault? I'd rather have you come up with what you recommend so I can have the fun of telling you how stupid you were to suggest this or that. Why should you have all the fun? As far as I know there is little perceived fun in coming up with creative, constructive suggestions and endless fun in ridiculing any perceived negatives—no matter how exaggerated.

So, if your brain hasn't already been turned to kimchee by listening to the stink on our ham bands, let's see what you can come up with. Then, let's see if you can get through to any of the ARRL old-timer directors and get their attention. I'm giving odds of 50:1 you won't get anywhere.

We've been billing ourselves as a self-policing service, so isn't it about time we paid more than lip service to the concept and started organizing ourselves to do what we say we do? And we can do it, if we have the leadership we need. Do you get the feeling that we're running just a tad short on leadership? And no, stop writing me asking me to start a new national ham organization. I've got enough aggravation in my life without geting involved with that. You just want someone else to do the work instead of you. Well, get off your butts and make the League do what they should. Get them busy cleaning up our bands. Get them into gear to help us rope more kids into our hobby so we'll have some inventors and pioneers to help us hold our bands.

Uncle Wayne Broadcasting

Yep, I'm on for an hour or so every week, coming to you by satellite radio every Thursday evening at 9 p.m. Eastern time, 6 p.m. LaLa Land time. And yep, you can even call in and give me a hard time.

What do I talk about? Anything and everything. Sure, I talk a lot about amateur radio, I talk about diving, skiing, psychology, cooking and so on. I talk about my experiences during the war in a submarine. I talk about what's gone wrong with our country and how to fix it. I talk about making money, flying, horseback riding and so on. I even talk about no-nos like religion, pro-life vs. pro-choice. I talk about Bush, Quayle, Clinton, Gore and even Perot.

I'll be talking about music and trying to get you interested in listening to some different kinds of music. I talked a bit with one listener about loudspeaker design and how I put the Karlson speaker on the market and built a million-dollar business within two and a half years, starting from scratch.

If you can tune in Spacenet III, Channel 21 (6.2 MHz subcarrier), you'll be able to keep track. And you can call in to kibitz via (310) 824-6991 during the broadcast. Hey, I'll talk about anything you want to hear.

My latest enthusiasm has to do with tying together quantum mechanics, holography, and chaos theory, if you've read up on these incredible developments. How do these tie in with a completely new perception of the real world? It'll take some explaining, but the ramifications are so enormous that it's worth learning more. Are we close to being able to eliminate all illnesses? I said all! I believe this is within our grasp, if we reach in a completely different direction.

Our health care system today is much as if we spent all our time learning how to repair people better after serious car accidents, while it never occurred to us to see what we could do to prevent the accidents in the first place. If we can stop people from getting sick we won't even need a pharmaceutical industry. Is this even worth considering?

Well, anyway, there's a lot of interesting things for me to talk about . . . and next to talking about me, talking with you over the air comes a close second. 73

Spread Spectrum Primer

Continued from page 32

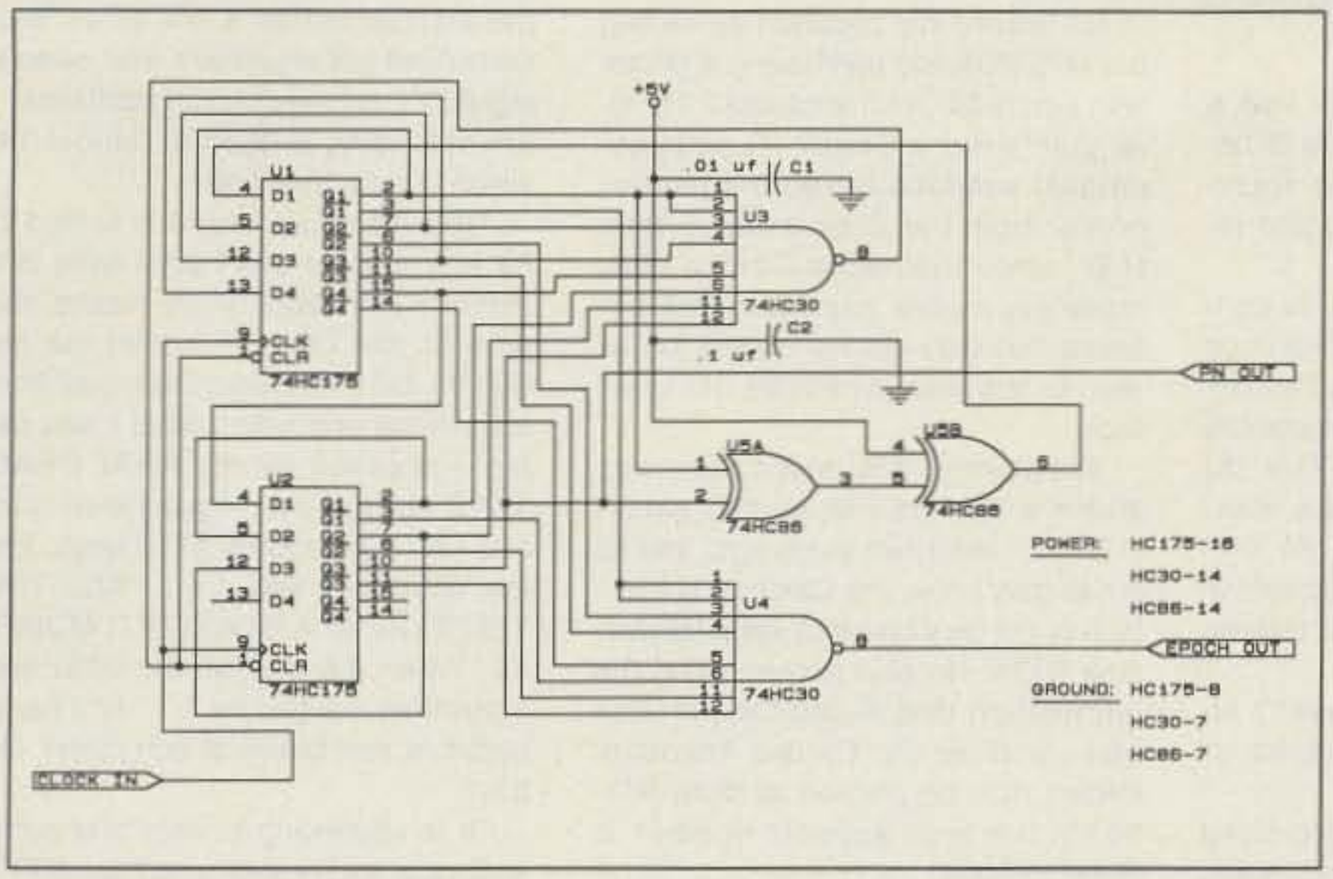

Figure 1. Simple 7-stage PN generator.

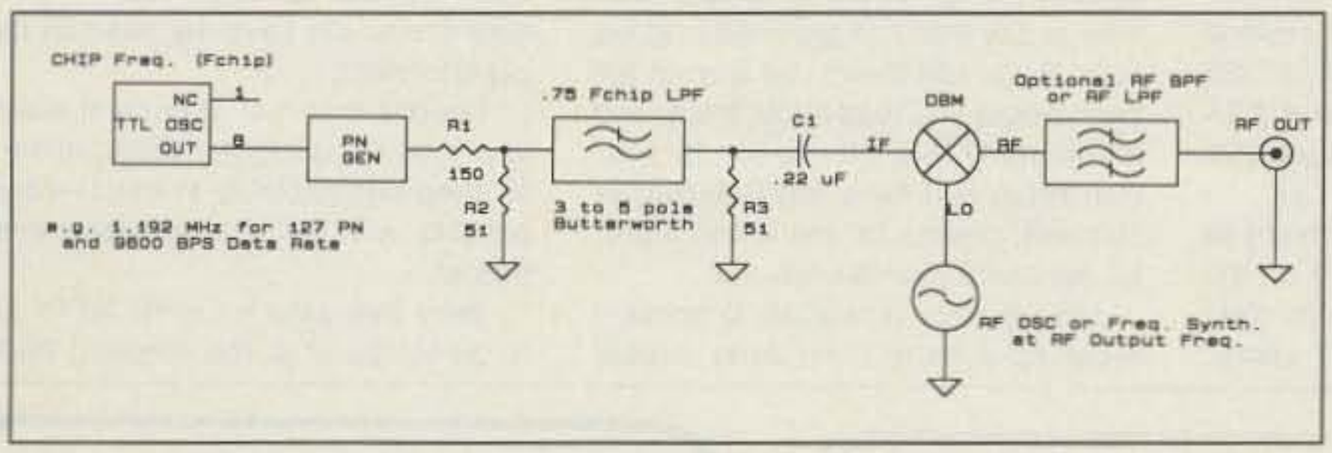

Figure 2. Filtered BPSK modulator block diagram.

Use of dedicated PCs or Macs with SS radios will be necessary until an integrated and well-defined data communication interface set of standards have been generated (commercial work along this line is being done by the IEEE 802.11 committee—hams haven't started this effort yet). The major feature that an industry standard hardware/software interface provides is a very simple and flexible way to channel (or multiplex) diverse sources and sinks of data to/from SSradio equipment. Standard PC or Mac (Appletalk) based multiple COM channel boards are being integrated into commercial SS radio host PCs and message routing software can be easily modified to handle multiple async data rates and protocols.

Are We Hams Ready for SS?

A very important part of a foreseeable nationwide spread spectrum system is the ability of the spread spectrum system to interface with other existing packet-based terrestrial and/or satellite-based or other amateur radio communications facilities. Several communication switching centers (or gateways) could be installed at various points throughout the US to handle digital voice, fax, teletype or other communications that require routing outside a national spread spectrum network or national ham radio PCN/PCS. Standard ham communications traffic and protocols could be transparently handled via these gateways. Will SS techniques have any impact on ham radio in the near future? Probably not—unless a renewed phase of ham radio experimentation takes place. Personal computers are now a fact of life in ham radio. So is packet. Will SS become old hat and used every day, like VHF/UHF SSB is? Time will tell. I think SS is one of the bigger challenges for hams—with ingenuity and dedication hams may enter the 21st century using SS and keeping most of our bands out of the hungry commercial interests' hands. 73

SPREAD SPECTRUM GLOSSARY

AJ	Anti-Jam—designed to resist interference or jamming.
BPSK	Binary Phase Shift Keying—digital DSB suppressed carrier modulation.
CDMA	Code Division Multiple Access—a way to increase channel capacity.
CHIP	The time it takes to transmit a bit or single symbol of a PN code.
CODE	A digital bit stream with noise-like characteristics.
CORRELATOR	The SS receiver component that demodulates a spread spectrum signal.
DE-SPREADING	The process used by a correlator to recover narrowband information from a spread spectrum signal.
DIVERSITY	Sharing a signal characteristic to allow more users in the same frequency band.
DPSK	Differential Phase Shift Keying—a simplified BPSK where only data transitions are transmitted.
MULTIPLE ACCESS	A method for accomodating more users in the same frequency band.
NARROWBAND	A signal whose bandwidth is on the order of its information bandwidth.
NOISE-LIKE	Having properties that cause the appearance of true random noise.
PCN	Personal Communication Network.
PCS	Personal Communication System.
PN	Pseudo Noise—a digital signal with noise-like properties.

HOW TO GENERATE A LEGAL FCC PN CODE

Here is one tried and true (almost foolproof) Pseudo Noise (PN) generator circuit that requires no EPROM or PLD programmer (or software either.) The main advantage of this design is that it generates a seven-stage, length 127 maximal length shift register sequence that is legal to use under current FCC Part 97 amateur radio rules.

Simple, short length (four- to 13-stage) maximal length shift register (MLSR) sequence generators are often used to provide simple PN code generators for SS systems. These simple generators usually perform very well when started from the correct initial conditions or when reset at power up. However, most of these simple circuits can hang up and stop generating anything (they can get stuck) when an all ones (or an all zeroes) condition occurs. Which condition that causes hang up or how it got to this condition is immaterial—the darn thing is broken when this happens! The circuit concept shown in Figure 1 solves this problem very nicely and even includes an EPOCH sync detector as well (for data timing, scope sync, or whatever).

The circuit of Figure 1 is built from two 74HC175 shift registers, one 74HC86 and two 74HC30 NAND gates. As shown, the generator uses feedback from the last shift register stage as well as from the first shift register stage, as the FCC requires. This connection, when started from the all-zeroes state, will always generate the correct MLSR sequence. The top NAND gate looks for the occurrence of an all-ones condition (an indication of being stuck) and resets the shift registers to all zeroes if this condition should ever occur. The bottom NAND gate detects the occurrence of the all zeroes condition which marks the start of a PN cycle of length 127, also known as a PN EPOCH. The EPOCH signal is coincident with the start of the code repeat cycle and is useful for sampling or synchronizing input data for Direct Sequence Spread Spectrum (DSSS) modulation.

HOW TO GENERATE A USEFUL BPSK SIGNAL

Figure 2 shows a block diagram of a BPSK modulator that is useful on the ham bands. Spectrum limiting (both pre-modulation and RF bandpass filtering) is included in this design. As the unfiltered BPSK spectrum photo shows, Spread Spectrum BPSK is a relatively wideband modulation that can splatter out of a band. Pre- or post-modulation filtering must be used for most ham applications.

The clock for the PN generator, shown in Figure 1, is derived from a TTL crystal oscillator. This furnishes the "chip" clock signal. The chip clock must be 127 times the data rate for proper operation with this PN generator. The PN generator's output drives an impedance matching circuit, then a passive LC, a three- to five-pole Butterworth low-pass filter. This filter uses a cutoff frequency approximately 0.75 times the chip clock rate. This filter is used to "round" off the sharp edges and spikes that are present on the TTL output of the PN generator. This filtered, AC-coupled signal then drives the IF (DC-coupled port) of a doubly-balanced mixer (DBM). The LO port of the mixer is driven by a crystal oscillator-multiplier chain or a frequency synthesizer to provide an RF carrier for the modulator. Finally, the mixer's RF port drives a bandpass filter to provide the modulator's output RF signal. Optionally, just an output low-pass filter that reduces transmitter harmonics can be used instead of the bandpass filter. Further amplification and frequency conversion, if needed, comes at this point in an amateur radio SS transmitter.

Number 23 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

From the Mailbag

A few months ago, I relayed the plight of Bill Barbee AA5ZR, who was having trouble getting his Commodore computer to print when receiving RTTY online. I guess sometimes it pays to clean your desk because there, buried under more stuff than I care to discuss, was an old letter which addresses a similar problem. This one, though, comes with a solution.

Written to me several years ago by Carl Moore W4MJK, it discusses a problem with printing with Commodore computers. He said that the Kantronics Hamsoft protocol is compatible with printers. The Control-P key toggles the printer on and off with this software. Similarly, Kantronics Hamtext supports a printer toggle with the F7 function key.

He also indicated that his Star 10X printer, with a Cardco +G interface, was also not working at first. After checking everything "umpteen" times and still finding nothing wrong, he began to curse at the printer, and suddenly it began to print. There was a buffer in the setup which had to fill before printing would begin. This apparently applied to both sending and receiving.

His other suggestion was to connect the printer to the user I/O port on the computer. Figure 1 details the connection of a Centronics-compatible printer to the user port. The D0 through D7 lines are the data lines, and the corresponding lines are connected to the printer. It is important to use the signal ground, not the chassis ground.

It's worth a try, if you haven't already done it. Anyway, if it works, or helps, let me know.

I am passing this information along because it is related to another letter, just received, on the same topic. R. D. Carter, an SWL in Vass, North Carolina, states that he is using the Commodore C-64 computer and Kenwood R-600 and R-5000 with the MFJ-1225 receive-only interface and the AEA SWLtext software on ROM to receive CW, Baudot, and AMTOR/SITOR.

He had the exact same problem as AA5ZR: The C-64 would print on the monitor and be saved to floppy disk, but not print on the MPS-801 printer. He contacted AEA and was told that the MPS-801, to the best of their knowledge, could not be made to print RTTY in real time, and that this cannot be changed.

He solved his problem by selling the MPS-801 and purchasing a printer with a parallel Centronics input. He also purchased a Cardco+G serial-to-parallel interface to run the parallel printer from the C-64 serial output. R.D. notes that while Cardco sells more expensive interfaces, he believes that they will not do the job as well as the less expensive +G interface.

Apparently, this information was known to AEA as well, as they did tell R.D., in a letter two years ago, that as far as they know, the Cardco +G interface is the only one that will print real-time RTTY. He also passes along the information that Supra Corporation manufactures the Cardco interface. Orders may be phoned to (503) 967-9075; the tech support number is (503) 967-9081.

This information from R.D. Carter is provided pretty much "as-is," and I can't speak about the specifics, other than to say that it is provided in good faith. If you call Supra, be sure to tell them where you read about them, and if you apply this information to your own setup and have any measure of success, please let me know! Sure, tell me about your failures, too!

Moving back in time, so to speak, I received a letter from Jerry Arnold WA6MBP of Terre Haute, Indiana, who has a long-standing love affair with RTTY. He writes that the "August column was at least partially the *most* enjoyable for quite some time due to the admission that a few of us 'old-timers' still get enjoyment from operating RTTY on *mechanical* machines. I am still using a good ol' Model 19, which is older than I am.

"Yes, it's noisy. Yes, it is limited to 60 wpm Baudot. But I don't care! In a recent RTTY QSO on 20 meters, the ham on the other end sent me his 'BRAG LIST' (no doubt dumped from a memory) and asked what I was using. I reached for my *REAL* BRAG TAPE (as punched by my own unit) and sent it out merrily at 60 wpm. The last entry on it says ' . . . AND THE TELETYPE IS A GOOD OLD MODEL 19.' When the ham on the other end responded, he said he ' . . . had never heard of that brand of computer!' Oh boy!!

"It is interesting to note that *some* software today designed for RTTY does not send a LINE FEED when a CARRIAGE RETURN is sent. That doesn't bother computer users, but it sure makes me keep my hand on the paper crank!"

I guess that last statement really is a plea for computer programmers to keep compatibility in mind—compatibility with mechanical teleprinters, that is!

Jerry also asks for some RTTY art to be included in the column. Well,

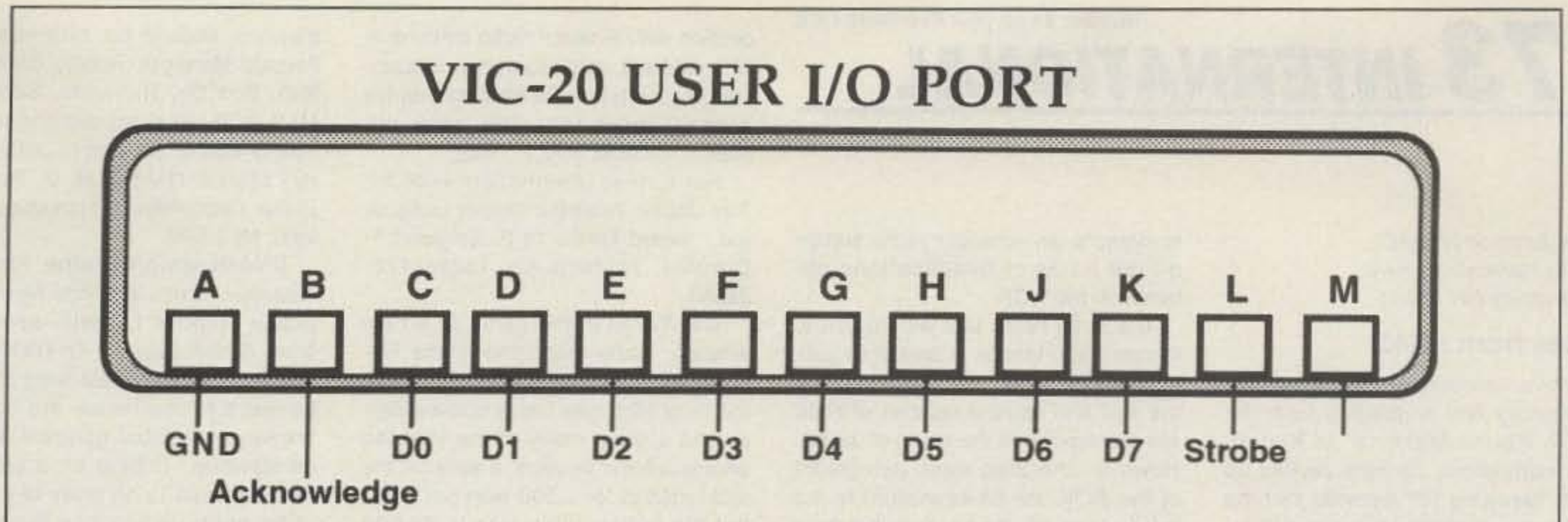

Figure 1. VIC-20 I/O port.

guys, send me some!

Stephen Coil KK6RB of Santa Ana, California, relates that he has been a subscriber to *73 Magazine* for about two years, and has gotten interested in RTTY. He wants to get onto RTTY with his computer, an Apple II+, but all he gets are blank stares and the response, "Software for that dinosaur?" Well, while he feels stuck in the Stone Age, Stephen wonders if there still exists some software for his Applesaurous.

One popular program we mentioned a few years back was MODEM MGR. Used by many hams for years, this is one of the most comprehensive and well-supported programs available for the Apple II+, IIc, IIe, or IIgs. It supports split screen operation or full screen, at speeds to over 19k baud, and will run under either ProDOS or Apple DOS 3.3.

While Apple users sometimes feel orphaned by the amateur industry, they are often reluctant to give up their machines and the sizable investments they have already made. For many, MODEM MGR speaks to that need precisely. It is available from MGR Software, Suite 101, 305 So. State College Blvd., Anaheim CA 92806. Contact them for current pricing and availability information, and be sure to mention *73*'s "RTTY Loop" when you write.

Another solution available to you would be to use any of a number of hardware solutions, such as the multimode interfaces from MFJ, Kantronics, or AEA, with a communication package. This would have the advantage of offering more modes and features, although it certainly would cost more. There are a variety of "boxes" out there, and you pays yer money and takes yer choice.

I look forward to hearing from each of you about these and related topics. Reach me by mail at the above address, on CompuServe at ppn 75036,2501, or on Delphi or America Online using the screen or user name MARCWA3AJR. And as we all sit down this month to observe the Thanksgiving holiday, let us think of those less fortunate than ourselves, whom we can help this time of year. This past few months have seen hurricanes, earthquakes, fires, and human destruction throughout the world. Maybe if each of us offered just a little kindness, we could help illuminate the darkness. 73

73 INTERNATIONAL

Number 24 on your Feedback card

Arnie Johnson N1BAC
43 Old Homestead Hwy.
N. Swanzey NH 03431

Notes from FN42

While listening to the Tri-State Emergency Net originating from the K1XR "Keene Machine" in Keene, New Hampshire, my ears perked up when "Newsline 92" reported that the FCC has established Proposed Rulemaking Document 92-167. I did not get all of the particulars noted but it appears that it addresses the ability of licensed amateur operators from other countries to operate in the United States even though we may not have reciprocal agreements with them.

It appears that those wishing to operate in the United States would contact a Volunteer Examiner group which would check licensing documentation and administer a test. Upon successful completion the applicant would receive a Certificate of Successful Completion which would allow for 60 days of operation in the U.S.

I have not really had time to think of the pros and cons of this Proposed Rulemaking but will say that anything that a country can do to assist amateurs from other countries to operate in its own is a plus. Many of us have had the good fortune to meet many nice people from other countries on the air and then in person.

It is also very noteworthy to mention the agreement between Japan and the Republic of Korea (ROK). Catch that in "Roundup" under the Japan banner.

Another interesting way to license operators from other countries was performed by three ARRL VEs by "taking the mountain to Mohammed." Be sure to read this story in "Roundup" under the USA/Russia/Ukraine banner.

Now it is time for the news from the rest of the world.—Arnie N1BAC.

Roundup

Japan *From the JARL News:* **Reciprocal Agreement Between JA-HL!** August 1, 1992, is a memorable date for both Korea and Japan because the much-talked-about and long-awaited reciprocal agreement between the two countries came into effect.

Up to now, when a ROK citizen wished to operate amateur radio in Japan he/she was obliged to obtain an operator's license in Japan, using a club station. Henceforth, however, and thanks to results emanating from the two countries' agreement, the establishment of individual stations will be acceptable. And furthermore, it also will be possible for a ROK citizen to operate an amateur radio station on the basis of qualifications obtained in the ROK.

It is to be noted that with regard to the correspondence of amateur qualifications between the two countries, the first and second classes of ROK will correspond to the same of Japan. However, the third class (telegraph) of the ROK will be equivalent to the third class of Japan and the third class (telephone) of the ROK will be equivalent to the fourth class of Japan.

And finally, congratulations to all concerned!

Worked All Squares Award JARL has introduced a new award, "WASA," which is characterized by the use of the grid square locator system that is getting more and more popular worldwide.

This system enables us to clearly determine a location both on land and at sea. Therefore, QSL cards obtained through communication with locations at sea can also be used for the Award.

Seeing that this is our first attempt at this new system, we ask for your close cooperation and look forward to receiving your applications. There are two awards: WASA-V.U.SHF (achieve communication or reception with amateur radio stations in 100 different squares on and above 50 MHz and/or an amateur satellite; sticker for each 50 above 100) and WASA-HF (achieve communication or reception with amateur radio stations in 100 different squares using frequencies on and below 28 MHz; sticker for each 50 above 100). QSL cards are valid on or after July 1, 1992.

For further information write to: The Japan Amateur Radio League, Inc., Award Desk, 14-2, Sugamo 1-Chrome, Toshima-ku, Tokyo 170, Japan.

CQ Korea is the name of a new amateur radio magazine in the Republic of Korea. This B5-sized publication of 62 pages has a colored cover and a great many of the inserted photos appear in color. It sells on the local market for 2,500 won per copy, but the subscription rate is 25,000 won for one year (including postage) for domestic (HL) readers, plus a bonus of a free copy for the first two months.

Detailed terms for overseas readers have yet to be announced but should someone wish to subscribe, he or she is asked to write directly to: *CQ Korea*, Seoul-shi, Jongro-gu, Kyeonun-dong 47-1, Kongukyu Bldg. 312-1 Ho, Republic of Korea.

Scotland From the Scottish Tourist Board (Radio Amateur) Expedition Group, John "Paddy" McGill GM3MTH: On November 30th GB6SA will be operating on St. Andrews Day, celebrating the 2nd Annual International St. Andrews Day, involving the Moscow Radio Club (MTI) and the St. Petersburg Radio Club, and the Aberdeen ARS. The callsigns appear to be GB6SA, R1SA, UA3 or RA3???, and GBØASP.

This appears to be the last of the List of Events of 1992 for the Scottish Tourist Board (Radio Amateur) Expedition Group. Correspondence for awards should be addressed to Awards Manager, Robbie GM4UQG, P.O. Box 59, Hamilton, Scotland, ML3 6QB, and correspondence to Paddy should be sent to John (Paddy) McGill GM3MTH, 9, Ramsay Place, Coatbridge, Lanarkshire, Scotland, ML5 5RE.

USA/Russia/Ukraine *From the Roanoke Times & World News, Saturday, August 1, 1992, sent to us from David Larsen KK4WW:* "In a small room in the east wing of David Larsen's hilltop house are some of the keys of global goodwill and understanding. They're on a computer that's hooked to an array of amateur radio gear. Larsen has been using those keys for more than a year to communicate with people in the former Soviet Union. Amateur radio operators in the old Soviet republics have been included in this computerized ham radio project." Larsen has developed many friends in the Ukraine since meeting Victor Goncharsky, an amateur operator, during a ham convention in the US during 1990. David and his wife Gaynell, also a ham, have visited republics in the former Soviet Union during the past three years. They and others have taken a new IBM-donated computer plus several older but serviceable PCs there as a first step in setting up an emergency radio communications network.

The development of this network will allow those republics to maintain emergency contact with each other during times of emergencies and will allow peaceful communications around the world during the rest of the time.

The transfer of these computers has been made possible by building

Photo A. Diploma Islas Canarias.

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County: Delaware

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CIRCLE 55 ON READER SERVICE CARD

Photo B. The EA8VIB QSL card.

an organization called the Foundation for Amateur International Radio Service, or FAIRS, with David Larsen as the executive director. When these computers are connected to ham transceivers, the computers can send and receive a form of radioteletype that is less affected by atmospheric conditions and is automatically error-correcting, making it highly accurate and more efficient than Morse code. The computers can also save and store messages for later retrieval. *[A phone call to David confirms AMTOR using the APLINK program connected to a BBS.—Arnie]* The Larsens were visited by Vyacheslav Sergeev and Yuri Katyutin earlier this year and if plans work out, Victor and Helen Goncharsky from the Ukraine will visit in August. Helen served as an interpreter during the Larsens' visits to Russia and Ukraine. These visits are part of an exchange agreement between Russia's Ulyanovsk Polytechnical Institute and Virginia Tech, where David teaches chemistry.

Ukrainians and Russians receive USA Amateur Licenses! The FAIRS group gave ARRL VEC exams in the Ukraine and Russia during the May 1992 visit of American FAIRS members. The ARRL VEs were David Larsen KK4WW, John Douglas NØISL, and Victor Goncharsky KC1VF. Victor's home call is UB5WE in Lviv, Ukraine, and he received the American call during a visit to the Dayton Hamvention in 1990. The exams were given to eight in the Ukraine and four in Russia, and a total of six passed the exams.

During the visit David and Ron taught workshops on instrument automation and local area networking. David also worked on university exchange agreements for VPI and SU and several institutes in Russia and the Ukraine. The group spent as much time operating from Lviv, Ukraine, and Ulyanovsk, Russia, as possible.

For more information on FAIRS and the trips, contact David or Gaynell Larsen at (703) 745-4023 or 231-6478, or write P.O. Box 341, Floyd VA 24091.

"It appears that those wishing to operate in the United States would contact a Volunteer Examiner group which would check licensing documentation and administer a test."

CANARY ISLANDS SPAIN

Woodson Gannaway EA8/N5KVB
Apartado 11
35450 Sta Madre Guia (G.C.)
Islas Canarias
Espana

[This letter was sent prior to the FAX received from Woodson in time for last month's Spanish lesson. It will hopefully clear up some of the info from last month.—Arnie] The newspaper that I read today says that in October 1992 we will have a World Amateur Radio Congress here in Las Palmas de Grand Canary! It says it will be in the Imperial Playa Hotel and will attract hundreds of hams from all over the world. The editorial continues to say that this convention hasn't been publicized either by the local or national authorities.

My one-man project to at least document the unique Canary Islands knife style (before it died a quiet death from neglect) is beginning to bear fruit after four years of gardening and mothering. After a brief preview in the yearly "Knives '92," it will be featured in an article in "Knives '93." Those of you interested in that sort of thing might enjoy reading it. To say that I've had a fine time doing it (working with an old-world master smith to learn how to make the knives so I'd know what the *@$# I was writing about) would be a real understatement. It is a comment on the sad state of our world that I don't know where I can sell an article about the human interest side of the story, by far the most interesting facet of all. Occasionally he asks me: "How long is it that you've been the shop now? What, four years? It seems like it was just the other day . . ."

I also enclose the Diploma Islas Canarias (Photo A). This diploma is awarded to amateur radio operators and SWLs in all parts of the world for having contacted different EA8 stations after April 29, 1971, on any band or any mode. The requirements are: for Spain, Portugal, Madeira—contact 60 different EA8 stations; the rest of Europe and Morocco—40; South America and the Caribbean—30; USA, Canada, and Africa—20; and Asia and Pacific—10. It is not necessary to have received QSL cards; just send a list of the EA8 stations contacted, in alphabetical order, and indicate date, band, and mode of the contact.

The request needs to be signed by two amateur radio operators, stating that they have checked the logbook of the petitioner. Send 15 IRCs with the list to: Diploma Islas Canarias, Apartado 860, Las Palmas de Gran Canaria, Islas Canarias, Espana.

Also enclosed is the QSL card sent to operators contacted during our "Expedition Around the Island" on Burros (Photo B). *[What will hams think of next?—Arnie]*

SOUTH AFRICA

Hans van de Groenendaal ZS6AKV
SA AMSAT
PO Box 13273
Northmead 1511
South Africa

IARU Station Established at National University of Lesotho. On Friday, August 21, the IARU Region One Working Group for the Promotion of Amateur Radio in Developing Countries presented a complete HF amateur radio station to the Amateur Radio Club of the National University of Lesotho as part of its programme to establish amateur radio in the developing world.

At the ceremony, which was attended by senior government representatives, university personnel, and the secretary of the Lesotho Amateur Radio Society, the IARU PADC liaison officer, Hans van de Groenendaal ZS6AKV, said the establishment of the Radio Club at the National University of Lesotho was an important step to place amateur radio on a firm footing in this African mountain kingdom and would provide the infrastructure to teach Lesotho youth amateur radio. From an educational point of view this will add a third dimension to the teaching of science and in particular electronics and communications.

"Amateur radio," he said, "provides an opportunity to get Lesotho's youth interested in electronics and pursue a career in this field. For Lesotho itself it is another step forward in training local people in this growth sector where the country is currently almost totally dependent on imported personnel." The Managing Director of the Lesotho Telecommunications Corporation, Mr. L. Mohapeloa, said that his corporation supports this new thrust to establish amateur radio on a more local footing and said that he was committed to easing regulations to make the hobby more accessible to the youth of his country. 73

Number 25 on your Feedback card

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Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, Sue Colbert, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

Deadline for the December classifieds is October 12, 1992.

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RANDOM OUTPUT

David Cassidy N1GPH

I'm bored. I've got a coupla' new antennas that I keep meaning to put up, but I never seem to get around to it. I've got a transceiver kit sitting on my desk, still in the shipping box. I can't remember the last time I turned on the 2 meter transceiver in my car. I took the HF antenna mount off my car a few months ago and haven't needed to re-install it. My multimode controller hasn't multimoded in weeks. There's a layer of dust on my HF gear that really should be wiped off.

Ho hum . . . I'm in the dreaded amateur radio rut.

I have no one to blame for this apathy but myself. After all, amateur radio isn't a single hobby, it is hundreds of specialized interests all held together by the common thread of the Amateur Radio Service. If you get bored with one, there's always something new to try.

Let's see . . . what haven't I tried yet? How about ATV? I've always wanted to put together some video presentations—sort of "mini-documentaries"—and transmit them to other hams. Wouldn't it be great fun to get together every week and show off your latest video creation to other ATVers? We could share other hobbies, careers, or even short fictional stories. With the activity on 450 MHz, everyone who has a cable-ready TV or VCR already has an ATV receiver. A low-cost transmitter, a simple antenna, maybe a preamp to boost the received signal, and I could be in business!

Something else I've always wanted to try is foxhunting. I've already got a portable beam. All I'd need to do is wire up a simple attenuator and some kind of signal strength meter, and I'd have a pretty good beginner's foxhunting rig. Make a few calls, invite some friends over for a Saturday foxhunt/barbecue. I've got a coupla' hundred acres of State Forest bordering my back yard that would make a great place to hide the fox. Now that sounds like fun!

What about QRP? Sure, I've dabbled in low-power contacts, but how about working all 50 states on a 5-watt rig I build myself? Might even be fun to get back into CW operation. I do so much traveling, I could bring a QRP rig, antenna and code key with me and get the first "Worked All States—Hotel Portable" award in the history of amateur radio! It wouldn't cost much, either. Ramsey's got a nice little transmitter/receiver combo for less than $100. There are a bunch of other advertisers in *73* with nice QRP transceiver kits for very little money.

Something else I've never done is microwave operating. I bet I could work nine or 10 states, plus a few Canadian provinces, all from the top of Mount Washington (6,300 feet) in northern New Hampshire.

Speaking of northern New Hampshire, aren't there a few rare counties up there? I already have the HF mobile gear. It would only take about 10 minutes to mount that Outbacker back onto my car. In fact, Outbacker has a new model coming out, and Douglas RF Devices has an all-band mobile antenna I'd sure like to test drive. I've never really gotten involved in county hunting, but it sure would be neat to be on the receiving end of a pile-up.

I haven't done any public service in quite awhile. With my new pilot's license, I wonder if my skills as an amateur radio operator would be valuable to the local Civil Air Patrol wing? That would be one way to combine two interests, while putting both to good use. One of the CAP's functions is to locate downed aircraft, often by radio-direction-finding the emergency locator beacon contained in most every aircraft. Talk about a foxhunt!

Satellites is yet another area of amateur radio that I have very little experience with. I hear that now it's easier than ever to get involved. I bet I already have all the gear I'd need to get started. I could download some tracking software for my Mac off of an online service, get the current orbital data off of the local packet BBS, and I could be on the air via satellite in a single afternoon.

Something else that piqued my interest recently is the possibilities of remote base operation. I met a guy at the Los Angeles hamfest who could do everything—and I mean *everything*—from his 2 meter HT. He could change frequency and band (with verbal confirmation of the change), switch between different antennas and rotate his tribander (again, with an automated voice confirming the new heading). He did all this via the tone pad on his HT. We were sitting by the hotel pool, and he was making DX contacts on 20 meters through a shirt-pocket-sized radio! I know this isn't exactly new technology, but it was the best application of remote operation I had ever witnessed. Let's see . . . my house sits at the crest of a 900-foot hill, with a clear shot to almost every direction (except when I drive behind the few higher hills and mountains). A nice high mast at the peak of my roof would get my antenna higher by almost another 100 feet. Maybe I ought to give that guy a call.

I guess I'm not really in a rut at all! In fact, I don't know what to do first.

Hams often call amateur radio "The Greatest Hobby In The World." Even though we may be a bit biased, there is a lot of validity to that immodest claim. I set out to outline the various subgroups of amateur radio activity the other day. I stopped after three single-spaced pages and probably could have come up with two or three more pages without much trouble. "Amateur" and "radio" are two simple words that we use to define literally hundreds of unique and fascinating activities. When you combine amateur radio with other areas of interest—aviation, camping, boating—I'd bet the list would grow to the thousands.

There's one more thing I've been meaning to get to, and I think I'll put it at the top of the list. My neighbor's 10-year-old son was watching me put up a 2 meter quad last weekend. Ya' know, I've been meaning to move that 80 meter dipole, and I think I'll ask him if he'd like to help me get it back into the trees. Then, when we're done, I wonder if he'd like to get a chance to say hello to someone across the ocean? I bet I know what his answer will be. 73

Number 27 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

November is a month that falls between the excellent fall propagation conditions of September/October and the relatively poor winter conditions of December/January . . . which is to say that the HF bands will be trending from Good to only Fair as a general prediction and that many days during the month are expected to be Poor.

For example, the periods between the 5th and 7th and again between the 10th and 14th are anticipated to bring not only poor inonospheric propagation but also the possibility of some severe weather in some parts of the country, and maybe even other geophysical effects as well. There are several significant planetary alignments during that period which historically have produced some very "interesting" results in the past. Look again for poor conditions around the 23rd to 25th and again around the 29th and 30th. This means about 10 days out of 30 that are forecast to be "Poor." The daily forecast will tell you what to expect.

Use the band-time-direction chart for your planned activities and DX operation. I wish I could say that the propagation will be good all month, but that just won't happen.

In general, the bands above 20 meters will close at dark or before, while those below 20 meters will become quite DX-lively. There won't be the summertime QRN to disguise weak signals, so you will be able to do very well on 30, 40, 80, and (possibly) 160 meters. As the later hours of night and the early hours of morning approach, the better the lower frequency HF bands become . . . so either get your sleep during the day or keep the coffeepot going. Finally, as dawn approaches, the higher HF bands will come alive and some excellent east-west DX and long-path DX will appear. Always use the dusk and dawn periods for "grey-line" DXing, too. I think that 20 will be the "sleeper" this month and may well be the best band of all . . . but will also provide the usual pile-ups and crowding . . . so a beam or "gain" antenna will be very helpful. You'll be able to hear the weak ones in there, and quite often the weaker stations will prove to be the real gems you need. Let me know how the month goes for you, too. I like the feedback.

By now you already know that the solar flux has consistently fallen below the 100 mark on many occasions since June and July—which is a "leading indicator" of the decline of cycle 22 and the approach of the sunspot minimum, so make hay while the sun shines. 73

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15*	20	20	20	—	—	—	—	—	—	—	15*
ARGENTINA	15	15	20	20	40	—	—	10	—	—	10	10
AUSTRALIA	10	15	20	20	—	40	20	20	—	—	—	10
CANAL ZONE	15	40*	40*	40*	40*	—	20	10	10	10	10	10
ENGLAND	20	40	40	40	—	—	20	10	10	10	15	20
HAWAII	10	15	20	20	40*	40	20	20	—	—	—	10
INDIA	20	20	—	—	—	—	—	15	—	—	—	—
JAPAN	15*	20	20	20	—	—	—	—	—	—	—	15*
MEXICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
PHILIPPINES	—	—	20	20	—	—	20	15*	15*	—	—	—
PUERTO RICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
SOUTH AFRICA	40*	20	20	20	—	—	—	—	10	10	10	15
U.S.S.R.	—	40	20	20	20	—	—	10	10	15	20	20
WEST COAST	10	15	20	20	40/40	40/40	—	—	—	10	10	10

CENTRAL UNITED STATES TO:

ALASKA	10	15	20	20	20	—	—	—	—	—	—	—
ARGENTINA	15	15	20	20	20	—	—	10	—	—	10	10
AUSTRALIA	10	15	15	20	20	40*	40	20	—	—	15	10
CANAL ZONE	15	15	20	20	—	40	40	10	10	10	10	10
ENGLAND	—	—	—	—	—	—	10	10	15	15	20	20
HAWAII	15	15	20	20	40*	40*	40	20	—	—	10	10
INDIA	—	20	—	—	—	—	—	20*	15	—	—	—
JAPAN	10	15	20	20	20	—	—	—	—	—	—	—
MEXICO	15	15	20	20	—	40	40	10	10	10	10	10
PHILIPPINES	15	—	—	—	—	—	—	20	10	10	—	—
PUERTO RICO	15	15	20	20	—	40	40	10	10	10	10	10
SOUTH AFRICA	20	20	20	—	—	—	—	—	10	10	15*	15
U.S.S.R.	—	—	20	—	—	—	20	15	15	15	20	20

WESTERN UNITED STATES TO:

ALASKA	10	15*	—	20	20	20	20	20	20	20	—	15
ARGENTINA	10	15	15	20	20	20	—	—	10	—	10	10
AUSTRALIA	10	15*	15*	20*	20	20	40	—	—	—	—	10
CANAL ZONE	10	15	15	40/(1)	40/(1)	—	—	—	15*	10	10	10
ENGLAND	—	—	—	—	—	—	—	—	15	20	15	—
HAWAII	10	10	15	20	40*	40*	40	40	15	15	—	15
INDIA	—	20/(1)	—	—	—	—	—	—	20/(1)	15*	—	—
JAPAN	10	15*	—	20	20	20	20	20	20	20	—	15
MEXICO	10	15	15	40/(1)	40/(1)	—	—	—	15*	10	10	10
PHILIPPINES	10	10	—	—	—	—	—	—	20*	15	15	—
PUERTO RICO	10	15	15	40/(1)	40/(1)	—	—	—	15*	10	10	10
SOUTH AFRICA	20	20	—	20	—	—	—	—	—	10	15	15
U.S.S.R.	—	—	—	20	20	—	—	—	15	15	20	20
EAST COAST	10	15	20	20	40/40	40/40	—	—	—	10	10	10

* Try next higher band (1) Difficult path

November 1992

SUN	MON	TUE	WED	THU	FRI	SAT
1 F-G	2 G	3 G	4 G-F	5 F-P	6 P	7 P-F
8 F	9 F-P	10 P	11 P	12 P	13 P	14 P
15 P	16 P-F	17 F-G	18 G	19 G	20 G	21 G-F
22 F-P	23 P	24 P	25 P	26 P-F	27 F-G	28 G-F
29 F	30 F-P					

"Built-in duplexer and 94 memories!"

"Great price and smallest dual band made, too!"

"Comes with a backlit DTMF Mic!"

"Yaesu did it again!"

FT-5100
Dual Band Mobile

- **Frequency Coverage:**
  2M: 130-174 MHz RX
  140-150 MHz TX
  70 cm: 430-450 MHz RX/TX
- 94 Memories (47 per band) Odd Splits In Any Memory
- Dual in-band receive (V/V, U/U or V/U Receive Operation)
- DTMF Paging and Coded Squelch Included.
- Packet Radio TNC Jack Built-In To Back of Radio
- CTCSS Encode Built-In
- Dual Receive with Balance Control
- Full Duplex Cross Band Operation
- Built-In Antenna Duplexer
- Back Lit DTMF Microphone
- Automatic 8 Level Display Dimmer
- Built-In Cross Band Repeat
- RF Output Power:
  2M: 50/5 watt (high/low)
  70 cm: 35/5 watt (high/low)
- **Accessories:**
  FTS-22 CTCSS Dual Decoder
  SP-7 External Speaker
  MW-1 Wireless Microphone/ Controller

The ultimate definition of Dual Band.

Now you can listen to two, 2 meter frequencies, or two, UHF frequencies, at the same time with In-Band Dual Receive*. Although equipped with traditional dual band, Yaesu has taken receive two steps beyond in the remarkable FT-5100. Combined in one compact mobile transceiver, it's the ultimate meaning of "dual band".

With 94 memory channels – more than any other radio in it's class – and the optional MW-1 Wireless Mic, the flexibility of the FT-5100 is matchless. But to make sure the FT-5100 is complete, and an even better value, unlike the competition, there's a backlit DTMF mic included.

Through advanced miniaturization technology you'll find practical additions like the built-in antenna duplexer – an option on similar transceivers – and equally important, DTMF paging and coded squelch. All in the smallest dual band made!

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Three Dual Receive Configurations

VHF/UHF

UHF/UHF

VHF/VHF

Dual band redefined.
And the choice is yours.

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YAESU

*Performance without compromise.*SM

*In-Band Dual Receive available only on FT-5100.

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Features include dual/triple receive, 101 memory channels per band, multiple scan modes, and a removable front panel—specially illuminated for optimum nighttime visibility.

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Another star in the fast-moving world of mobile communications is Kenwood's TM-732A. Offering 144MHz/440MHz dual-band operation with dual receive (including VHF+VHF and UHF+UHF), this compact FM transceiver comes with built-in DTSS and pager functions, automatic band change, a detachable front panel, and a multi-function microphone to facilitate on-the-move operation.

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