73 Amateur Radio Today

JULY 1992
ISSUE #382
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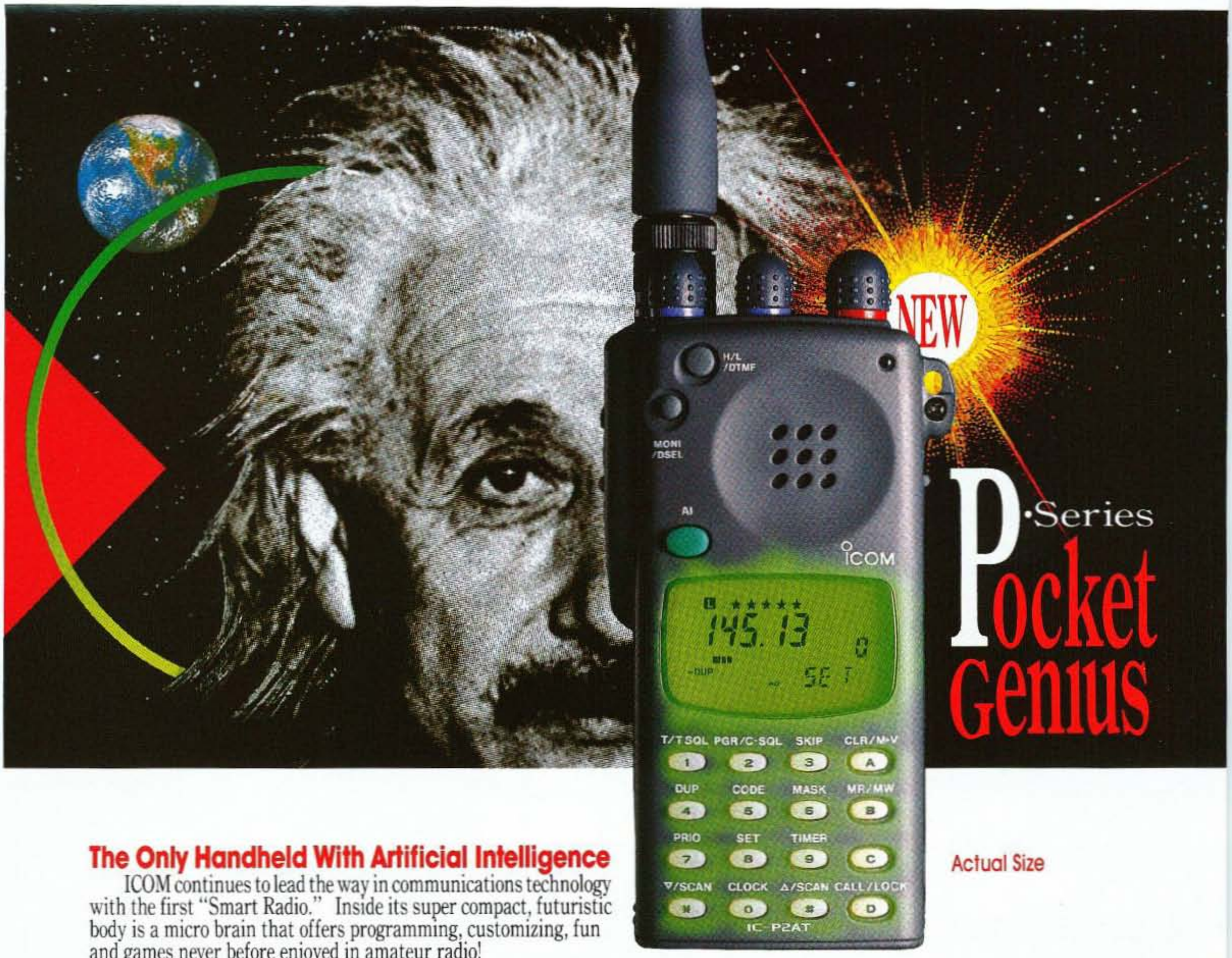

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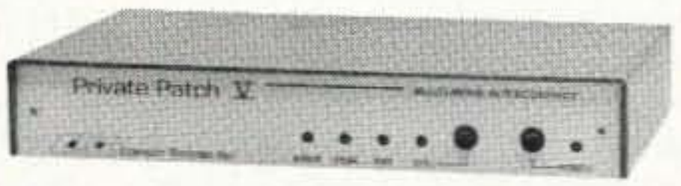

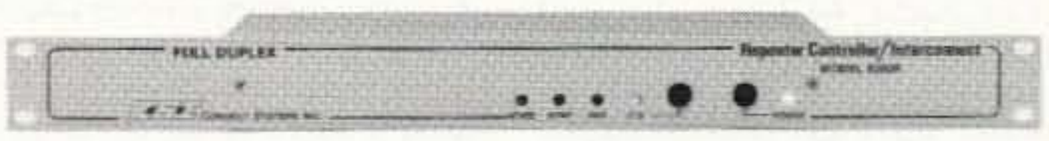

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LETTERS

Number 1 on your Feedback card

From the Hamshack

Arthur C. Erdman W8VWX, Worthington OH Part of your editorial in the January 1992 issue contained, for the first time in print, praise for the work done by myself and my shipmates. I was one of the instructors in receivers in Radio Material School (USNR-Special Assignment) who "fiendishly" put in bad components to be found by the students. I taught at Navy Pier, Chicago, from 1945 to 1946. At college, they looked down their noses at my experience in Navy electronics.

You hit the nail on the head by saying much of college was not interesting nor to the point. Only in my fifth year did I get anything really interesting. It was the detailed study of TV receivers.

I've retired from electronics and now am helping my oldest son in his financial business (CPA). With three computer systems, he can do much more work in a shorter time period. Ham radio is not the only group with old fogies—some CPAs absolutely refuse to learn how to operate the computer systems. They are being left behind.

Keep blasting hams to "shape up—ship out."

Joseph P. Esposito N2NSO, Bronx NY I really enjoy reading *73 Magazine*. I look forward to the next issue each month. I am responding to WA5BMN's comments *["Letters," January 1992]* about contesting on the amateur bands, especially 10 meters.

I am a Tech and my phone privileges, as you know, are a small spectrum of the amateur bands. I am a radio warrior on the weekends and look forward to working DX. But when I get home on Friday night from work, fire up the radio, and I hear "CQ contest," I shut down and I work my 2 meter radio.

I have to agree with WA5BMN: I do like using my radio equipment on the weekends; HF, that is.

Bill Strickland KC4CUM, Huntsville AL I have been reading your magazine for several years and think it is by far the best that I have ever seen. Your ideas and proposals about radio, morals, and enthusiasm are always refreshing and uplifting.

It was only recently that I discovered that you were a member of the silent service and on the *USS Drum*. I have fond memories of a favorite uncle Roy B. Hester who was on several of the old pig boats and later made 13 patrols on the USS Nautilus as Chief Electrician's Mate, including the Battle of the Coral Sea and Midway.

Thanks for the influence you continue to have on your readers.

Dick Melcher WA6MDI You talk about the 14.313 mess. Well, I ran into the same kind of thing when I moved into the Rogue Valley 18 months ago. I was interested in having a 440 MHz input and a 2m output remote base. Some of the local "powers" got wind of this and started bad-mouthing me. At the local radio club I was asked, "Who do you think you are, coming up here from California and doing this in *our* valley?" Seems that a group feels that 2m is for rag-chewing and that packet, repeaters and, most of all, autopatchers, have no use on *their* band. So I put up a 440 MHz repeater to control an ICOM 735 with an Ultra-Com Shack 64 and an AT-150 auto antenna tuner. I've already got a half dozen users, including a blind man and some users in retirement manors where outside antennas are not allowed.

Anyone else doing this? This is a great service for hams in poor locations and I'd like to see more like this. Dick, if we lose amateur radio, it'll be your grousing retrograde neighbor hams who have killed the hobby, not you . . . Wayne

Garry Neill K4FRL, Acworth GA I met you about 20 or 25 years ago in the hospitality room at the Atlanta Radio Club Hamfest. I knew that you were a "maverick" from what I had been told. But, I found that I liked what you said. I have since agreed with your philosophy and your ideals. Please, keep prodding me (hams) and the other groups that you are working with.

I haven't followed your exhortations to the extent that I should, but I enjoy your continuing to encourage me on to greater accomplishments. You have my backing for any idea or project that you have. I can say that, based on my reading your writings for the past 20+ years, you have been "right on target." Keep up the good work.

Jim Travis AC4JI, Nashville TN Agreeable or disagreeable, your editorials are provocative, more often on target than off. Practical or not, you generate volumes of ideas. Ideas are the lifeblood of creativity. What makes you uncommon is that you act on your ideas and often succeed. When others act on your ideas, good things can happen.

For more than 20 years my ham license, WB4HNS, was rarely used. In the mid-'60s some excellent Army instructors at Fort Dix, NJ, taught me code. These guys could strap on a leg key and bat code back and forth and never take a note. It was made clear that if you didn't learn, you would be backpacking in the snow on the other side of the post—the Army's answer to incentive licensing, I guess.

Near the end of Army service, two sergeants at Ft. Polk, one an ex-Western Union telegrapher, introduced me to ham radio at the MARS station to which I'd just been assigned. They administered the Novice exam. Picture yourself as a Novice sitting before a Collins S-line console, courtesy of Uncle Sam, with beams, an inverted-V, a long dipole, most of the operating time you could want, and a couple of fine operators right there to learn from. Few Novices are ever so lucky.

After Army service I upgraded to General class, used a 75 watt crystal CW rig for awhile, then all but quit the hobby. Excuses: apartments and a condo with no antenna space, career demands, family expenses, no decent equipment, never hearing much on 2 meters for which I DID have gear.

The license would be renewed, ham magazines read, a few projects built. I would call on 2 meter FM but get little out of it. Computers became a serious hobby.

The old Eico CW rig gathered attic dust beside a Heath SB-300 receiver, its crystals removed and employed in a home-brew shortwave converter for the car.

A few years ago I began paying attention to your jarring editorials. Your message to me was and still is: Got a license? Use it or lose it. Same goes for valuable chunks of radio spectrum.

One day colleagues at work invited me under their 1990 Field Day tent. That day the fire was lit and refused to go out. Soon I found an affordable used HF rig, some Hustler coils and a modern 2m HT, figuring if I can't put up an antenna where I live, I'll go mobile.

One hundred ten countries, 50 states, a thousand QSOs and two quick upgrades later I am still mobile. In front of me are two prized original cards that arrived today from mobile contacts with Jordan and Antarctica. Am I enjoying the heck out of this? You bet.

Last year I signed on with Army MARS, the local radio club, and QCWA—met some great people, contribute as work permits, proselytize a lot about ham radio but itch for more. Satellites and the upper spectrum have yet to be explored. If there is a way to work those mobile, believe me I will find it.

This hobby is, as Robert Louis Stevenson put it, "so full of things we should all be happy as Kings." There is no end to the challenges, no limit on our frontier.

Had you not been such a nag all these years, Wayne, I would not be writing to thank you.

There are, in fact, many to thank, beginning with the two sergeants whose names and calls I wish I could track down. They must now be close to retirement.

Above all, I will remember a young 11-year-old worked in a contest over a year ago. In a few short months he had gone from no license to Advanced. With his father's obviously able help he was preparing to march on Extra. If HE could do it, so could a 49-year-old. A few months later I walked out of a VE session as /AE awaiting a new call.

Our hobby faces serious problems and challenges. Perhaps the new people enticed by no-code licensing will show the way. We need the new blood. Most no-coders I run across will be credits to the hobby. Most already are at work on upgrades, some with remarkable dedication.

What is nice to know as I meet people on the bands is that this rejuvenated interest is NOT unique. Many have followed similar paths. Invariably we regret the time away from ham radio. We are glad to be back.

I hope more of us read and re-read David Cassidy's February 1992 piece on how to generate a QSO conversation. It is important. As a journalist, an interviewer who enjoys extended QSOs with the interesting people of our hobby, be assured the techniques work. David's article could be Lesson 2 in any operating manual, Lesson 1 being how to tune up quietly.

The points he makes were driven home for the first time by a ham visiting here from Kentucky, a minister, active on 2 meters. This gentleman never really said much in his QSOs on a local repeater. He didn't have to. He asked questions, made observations. He drew people out. Many interesting experiences and a few life stories were told in those QSOs. He was absolutely the best and brought out the best in his contacts.

Keep those editorials, fine columns and concise construction articles coming. Most of all, thank you for your prodding. Don't ever let up.

John Seginski N7NV, Reno NV Wayne, first of all, I think you're crazy. Or mighty eccentric to say the least. And that is no insult, believe me. I've been reading your editorials since way back when you first started *73 Magazine*.

I'm glad you're crazy. That's why you've accomplished so much in your life. I don't think "normal" humdrum people accomplish anything, especially in the technical fields.

The reason I'm writing is because I think you're too hard on some of the old modes of operating, like CW and AM. I've recently got back on 10 meter AM (popular AM window, 29.0 to 29.2 MHz) using a Johnson Ranger and a Collins 75A4 and have been having a really good time. I can call CQ and meet a lot of new friends, and we talk for hours about the technical aspects of the old rigs. Sort of reminds me of the fellows I know at the classic car club when they get together to discuss the pros and cons of whether a straight 6 engine is any better than a V8, or vice versa, in their old cars. In the classic car club we never talk against the guys who own and drive the old cars.

And I'll bet when you were in your Porsche club you didn't talk against the fellows who owned and drove the old Speedsters, did you? You probably talked with them about the characteristics of their old cars even though they weren't state of the art. Why can't you afford the same courtesy to the hams who enjoy the old modes of communication? Remember: Ham radio is supposed to be fun, regardless of what mode is being used.

You won't find many hello/good-bye QSOs on 10 meter AM phone. Some of the guys (old and young) can literally talk your ears off. They don't use VOX and when they are talking, they have the podium.

Take a listen. I think you'll be pleasantly surprised, and get yourself that old boat anchor rig you dreamed about when you were young, but couldn't afford, and get on the air. I'd like QSOing with you.

Using old classic modes like CW and AM does not detract from the modern modes of operation. I still love SSB, packet, FM, TV, etc., but I do stay off VHF and UHF because every time I get on, all I hear is people clicking their HT transmit buttons and invariably someone will come on and say, "Could you stop transmitting? You're tying up the frequency." That's not the type of ham radio operation I care for.

And CW. If you run high power, I agree it could be detrimental to your health. But you really don't need much power when the band you're using is open. There's nothing more relaxing than clicking away on the old Vibroplex on Saturday mornings on good old 40 CW.

We should all enjoy all the great aspects of ham radio. All modes and all bands. They all have their advantages and disadvantages, and they are all fun.

So lighten up Wayne. Have fun, and I hope to see you on good old 10 meter AM. 73

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July 1992
Issue #382

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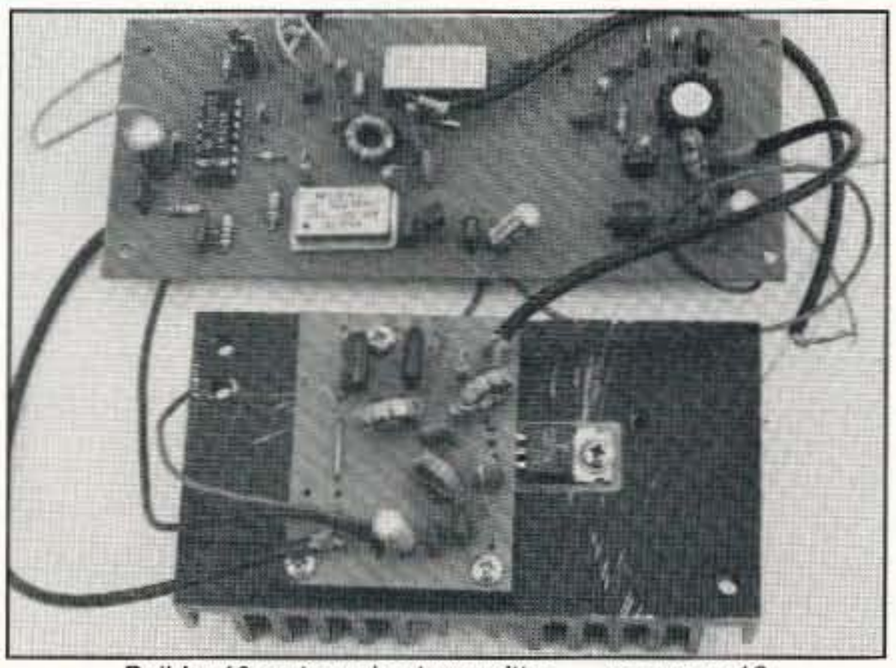

Build a 10 meter voice transmitter . . . see page 18.

FEATURES

REVIEWS

Cover: QRP and camping . . . a great summertime combination! See our review of MFJ's new QRP rig on page 36. Cover photo by David Cassidy N1GPH.

DEPARTMENTS

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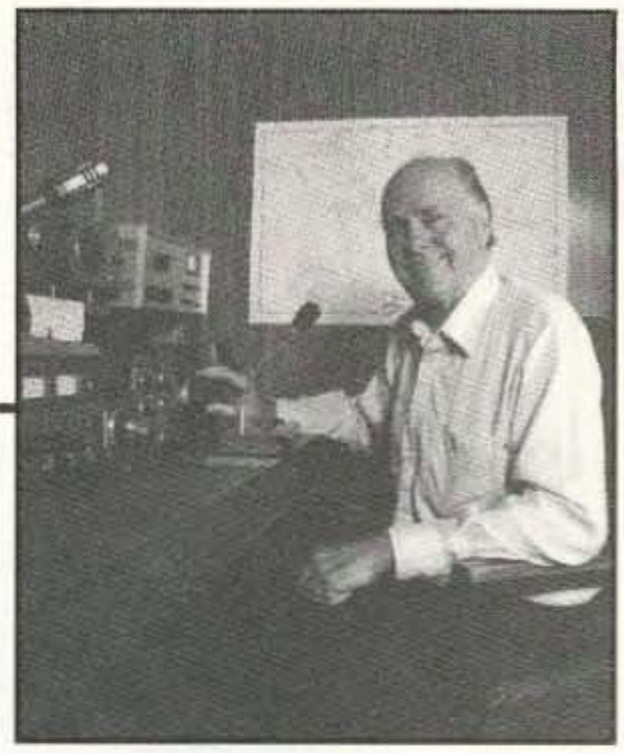

Flea Markets

The great cry from builders has to do with finding parts. You can't build much if you have to rely on Radio Shack for all your parts. And you're limited if you have to depend entirely on equipment that's available in parts kits. So how can you find the parts you want? Well, they're all there by the zillions in the larger flea markets. The only problems are (a) getting to a big enough flea market to find what you need, (b) actually finding your needs in a reasonable length of time, and at the price you want, and (c) getting the parts when you need them and not six months before or after.

Even the humongous flea market at the Dayton Hamvention doesn't help you if you get the bug to build in June or September. How can you even guess in April that you're going to want to build something in September?

The logical answer to this is to get the flea market exhibitors to advertise their stuff somewhere in a magazine or catalog. Just why hundreds upon hundreds of flea market exhibitors are so blind to the wonders of mail order is a puzzle. I love mail order.

Heck, I started my first mail order business when I was 12 years old and did well at it. That was the Elm Stamp Company. I ran across some of my old ads in a scrapbook recently.

Mail order makes it so you can reach people anywhere in the country and let them know what you've got. Yes, you have to learn about advertising and you have to be merciless in keeping track of which ads and publications pull best for which products. But it sure is nice to see those post office buckets of mail coming in every day, all with checks and charge card info in them. And it's great to have your phone ringing with orders day and night.

I'm selling CDs by mail order through Music/NH. We're also selling book and code tapes through Uncle Wayne's Bookshelf. My wife sells how-to-dance videos and her phone rings with orders day, night and on weekends. Does this bother me? Nope, when she's not around I write down the orders for her and she has them shipped the next day. I love mail order.

I started my Radio Bookshop back in 1958, selling books to hams. It's still going, now called Uncle Wayne's. Lordy, that's 34 years!

If you have any ideas on how to get the hundreds of flea market vendors to get into mail order, please let me know. I'd love to be able to buy things from them the next time the building bug bites. By the time I get to Dayton I'm too busy networking with manufacturers and talking to readers to properly shop the flea market. There's just too much to do in two and a half days.

Perhaps a special advertising section in *73* would help. We might be able to do that two or three times a year to see how it works. How about a "Ham Radio Marketplace" supplement a couple times a year that we send only to subscribers? Heck, we could include it for our *Radio Fun* subscribers too. That would give it a very good circulation.

Let me know if this is something you'd like to see.

Helping Kids

There's a lot of handwriting about the sad state of our youngsters. They're not getting interested in science and math— they're not reading—heck, they can't even talk very well, like. Yes, I agree that our educational system is at fault. It's been shown to be one of the worst in the developed countries. And yes, I have a bunch of ideas on ways to get it turned around.

My proposals for change are radical. They have to be, because all of the efforts to just improve education have failed. In the almost 10 years since the *A Nation At Risk* report billions have been spent trying to improve the system. What they've found is that the system doesn't need fixing, it needs re-inventing.

Now, my question is this. How interested are you in helping to do something about this mess? I've done a lot of homework and have come up with some proposals for a completely new educational system—one I think you're going to like. But just proposing the changes means little—the tough part is getting them implemented. That's going to take some work and clout. Are you into work? Have you any clout? Connections?

Starting From the Beginning

After a good deal of research, plus some thinking, the whole miserable picture of how badly we've been messing up our children finally dawned on me. Oh, I suspected, but I figured I must be wrong. We wouldn't do *that* to our kids! Well we have and are—and it's going to continue unless you and I are able to stop it.

First, I hope you took the time a couple of years ago to watch a PBS movie called "7-14-21-28." It was a film showing interviews with seven-year-old British kids. They asked them what they thought they might do in life. Then they interviewed them again at 14 to see how their lives had progressed by the time they were in their teens. Again they discussed their plans and interests. The third set of interviews with the kids was when they were 21. Now we could really begin to see how firmly their lives had been set when they were seven. The last interviews were when they were 28. This showed even more clearly how well established lifetime patterns are set by seven years old. The film will be shown again soon, complete with interviews at 35 years of age. Don't miss it.

Now we can see that those psychologists have been right who have been claiming that by the time children get into school their minds are already closed to reading and intelligent speech. It makes sense if you know anything about how living things develop. If you interfere at any one stage of development, the whole organism is thrown out of kilter and can never really recover.

With babies we know that without adequate stimulation at the right time the brain fails to build the neuron networks needed to speak, read, and even think very well. Enter Big Bird, who turns out to be a much greater ogre than ever imagined. Yep, "Sesame Street" comes on a villain. Both day care centers and parents have been using "Sesame Street" to keep children sedated. Well, it's great for that. It hypnotizes them with flashing lights and constant action, but it doesn't provide the stimulation children need to build the neuron network in their brains which is involved with dealing with language and thinking. The result is kids that schools are unable to reach—kids without brains developed enough to handle reading, kids with short attention spans who are used to instant gratification, kids who get bored easily and have few enthusiasms or even much of an interest in learning.

The really awful part of this is that once the time has passed for the child's brain to develop during this part of the normal growth cycle, there is no way to completely repair the damage. Children grow their minds and bodies step by step. When a step is skipped or mangled, it's mangled permanently. And that's what's happening when we should be reading to our children. We fared better a couple of generations ago when we listened to the radio. That called for building pictures in our minds—our brains got some work to do and were not fed visual pap, with nothing lasting more than a few minutes. Is it any wonder kids have such short attention spans and find books boring?

Parents who are just too busy to read to their children should at least invest in some children's stories on tape—and I don't mean Dr. Seuss either. My mother read to me while I ate lunch every day. As soon as I learned to read I was hard at it, reading and re-reading the Oz books. I also loved the poetry of Robert Louis Stevenson and Eugene Field, and could recite much of it.

By 10 years old I'd read all the Tom Swift and Tarzan books, Booth Tarkington, Mark Twain, books on flying, and I even loved what few space travel books there were. So when's the last time you read to your children or grandchildren? If they've been poisoned by "Sesame Street" it's probably too late. I've been planning on making some tapes of me reading the Oz books, but maybe I'm ahead of my time again.

If we want kids to get interested in science and amateur radio, they're going to have to be able to read and think. They're going to have to be able to set goals and achieve them. We need these kids as amateurs to carry on for the next generation. We need them to keep our hobby from being blown away by commercial

interests. But most of all we need them as potential high-tech career scientists. engineers and technicians to help protect our quality of life in the next century.

Let's say that you're not being your usual contentious self and, for a change, you're agreeing with me. The logical question then is, what can I do about the situation? Heck, I'm just one person. Yep, you're one person—and so am I—and so are a hundred thousand other *73* readers.

Continued on page 76

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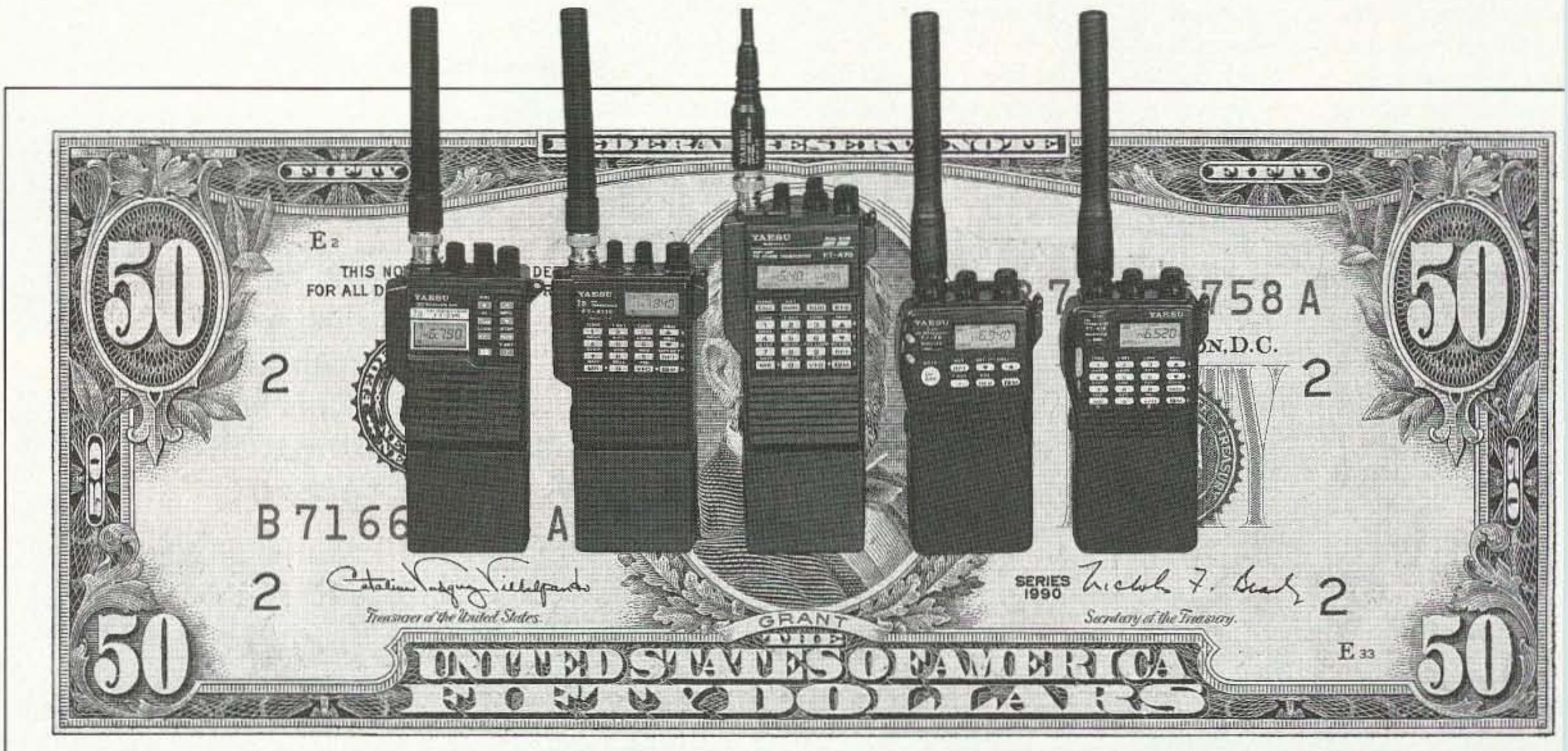

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Father Moran, 9N1MM, Silent Key

Marshall Moran SJ, better know to the amateur community as Father Moran 9N1MM, passed away in New Delhi, India, on April 15, 1992, of heart problems. He was 86 years old.

Father Moran's amateur radio career spanned the history of the hobby, from his first crystal radio in 1918 to his daily appearances on 20 meters (even within days of his death). Although he never held a U.S. amateur license, he was active on the bands from Chicago in the 1920s.

In 1951, Father Moran moved to Nepal to establish the St. Xavier School in an abandoned maharajah's summer palace. He remained there for 40 years. In 1960, he asked for and received the first amateur radio license in Nepal, 9N1MM.

Father Moran made almost 300,000 contacts from Nepal and assisted essentially every visiting ham to get on the air. *[Ed. Note: Father Moran holds a special place in my DXing memories; my first DX contact was with 9N1MM - WB8ELK]*

While not on the air, Father Moran ran the St. Xavier school with its 260 students. He held morning sick call, despite his lack of formal medical training, and he worked tirelessly to improve the education and spiritual well-being of two generations of Nepalese.

Rest in Peace, 9N1 Mickey Mouse. *TNX to the DX Bulletin, April 24, 1992.*

FCC Begins License Revocation Proceedings

The FCC has targeted the amateur Extra class operator licenses of Sandra V. Crane N6TFO (Marina Del Rey, California) and Charles P. Pascal WB6CIY (Culver City, California) for suspension and has begun revocation proceedings. Crane and Pascal were the operators of the California Amateur Radio School in Los Angeles.

Charles Pascal was previously separated from the W5YI-VEC testing program in 1986 when there was a question as to whether his PNP Amateur Radio School might be a profit-making venture. The policy of the W5YI-VEC—which every VE must agree to—is that none of its volunteer examiners may be in the amateur radio business, defined as charging amounts above out-of-pocket expenses. This differs from FCC conflict-of-interest rule 97.515(b) which precludes examiners from manufacturing, preparing or distributing amateur equipment or license preparation material.

Pascal's request to become a VEC in 1988 was denied by the Commission.

Sandra Crane N6TFO was disaccredited as a volunteer examiner in May 1991 after it was concluded that the $150 tuition charged by the California Amateur Radio School for a four-hour amateur radio training course conflicted with W5YI-VEC policy. On April 24, the FCC designated both Crane's and Pascal's operator license for suspension and ordered them to show cause why their station license should not be revoked.

"If either respondent requests a hearing or submits a written statement concerning the suspension, that respondent's suspension will be held in abeyance until the matter is decided. If either respondent does not request a hearing or submit a written statement, that respondent's suspension will take effect 30 days after his or her receipt of this order."

The "Show Cause" order states that the matter will be decided on six issues:

(1.) whether the respondents assisted other persons to obtain amateur operator licenses by fraudulent means;

(2.) whether Sandra Crane improperly examined her daughter for amateur radio licenses;

(3.) whether Charles Pascal improperly participated in the examination of Sandra Crane's daughter on November 12, 1990;

(4.) whether the respondents are qualified to remain a Commission licensee;

(5.) whether one or both station licenses should be revoked; and,

(6.) whether suspension of one or both operator licenses should be affirmed, modified or dismissed.

It has not yet been determined what FCC action will be taken against the volunteer examiners who may have been involved. *TNX W5YI Report, Volume 14,Issue #10, May 15, 1992.*

KV4FZ: Guilty of Telephone Toll Fraud

St. Croix ham operator Herbert L. "Herb" Schoenbohm KV4FZ has been found guilty in federal court of knowingly defrauding a Virgin Islands long-distance telephone service reseller. He was convicted April 24th of possessing and using up to 15 unauthorized telephone access devices in interstate and foreign commerce nearly five years ago.

The stolen long distance telephone access codes belonged to the Caribbean Automated Long Lines Service, Inc. (CALLS) of St. Thomas, U.S. Virgin Islands. Schoenbohm was found to have made more than $1,000 in unauthorized telephone calls—although the prosecution said he was responsible for far more.

According to the *Virgin Islands Daily News,* Schoenbohm, who is also the St. Croix Police Chief of Communications, showed no emotion when he was pronounced guilty of the charges by a 12 member jury in U.S. District Court in Christiansted. The case was heard by visiting District Judge Anne Thompson.

Neither Schoenbohm nor his defense attorney, Julio Brady, would comment on the verdict. The jury deliberated about seven hours. The sentencing, which has been set for June 26, 1992, will be handled by another visiting judge not familiar with the case.

Schoenbohm, who is Vice Chairman of the V.I. Republican Committee, has been released pending sentencing, although his bail was increased from $5,000 to $25,000. While he could receive a maximum of 10 years on each count, Assistant U.S. Attorney Alphonse Andrews said Schoenbohm probably will spend no more than eight months in prison since all three counts are similar and will be merged.

Much of the evidence on the four-day trial involved people who received unauthorized telephone calls from KV4FZ during a 1987 period recorded by the CALLS computer. Since the incident took place more than five years ago, many could not pinpoint the exact date of the telephone calls.

The prosecution produced 20 witnesses from various U.S. locations,including agents from the Secret Service, the U.S. Marshal's Service, Treasury Dept. and Federal Communications Commission. In addition, ham operators testified for the prosecution.

Schoenbohm was portrayed as a criminal who had defrauded CALLS out of hundreds of thousands of dollars. Schoenbohm admitted using the service as a paying customer, said it did not work and that he terminated the service and never used it again. He feels that there was much political pressure to get him tried and convicted since he had been writing unfavorable articles about Representative DeLugo, a non-voting delegate to Congress from the Virgin Islands, including his writing of 106 bad checks during the recent rubbergate scandal.

Most, but not all, of the ham operators in attendance were totally opposed to KV4FZ. Bob Sherrin W4ASX, from Miami, attended the trial as a defense character witness. Sherrin told us that he felt the conviction would be overturned on appeal and that Schoenbohm got a raw deal. "They actually only proved that he made $50 in unauthorized calls but the jury was made to believe it was $1,000."

Schoenbohm's attorney asked for a continuance due to newly discovered evidence but that was denied. There also is a question as to whether the jury could even understand the technology involved. "Even his own lawyer couldn't understand it, and prepared an inept case," Sherrin said. "I think he was railroaded. They were out to get him. There were a lot of [ham] net members there and they were all anti-Herb Schoenbohm. The only people who appeared normal and neutral were the FCC. The trial probably cost them a million dollars. All his enemies joined to bring home this verdict."

Schoenbohm had been suspended with pay from his police department job since being indicted by the St. Croix Grand Jury. His status will be changed to suspension without pay if there is an appeal. Termination will be automatic if the conviction is upheld. Schoenbohm's wife was recently laid off from her job at Pan Am when the airline closed down. Financially, it could be very difficult for KV4FZ to organize an appeal with no money coming in.

The day after the KV4FZ conviction Schoenbohm, who is the Republican Committee vice chairman, was named at a territorial convention as one of eight delegates to attend the GOP national convention in Houston this August. He was nominated at the caucus even though his felony conviction was known to everyone. Schoenbohm had even withdrawn his name from consideration since he was now a convicted felon.

The *Virgin Island Daily News* later reported that Schoenbohm will not be attending the GOP national convention. "Schoenbohm said he `came to the conclusion that my remaining energies must be spent in putting my life back together and doing what I can to restore my reputation. I also felt that any publicity in association with my selection may be used by critics against the positive efforts of the Virgin Islands delegation.'"

Schoenbohm has been very controversial and vocal on the ham bands. Some ham operators now want his amateur radio license pulled—and have made certain that the Commission is very much aware of his conviction. *TNX W5YI Report, Vol. 14, Issue #10, May 15, 1992.* 73

An Indoor or Window-Mounted Vertical Dipole

A floor-to-ceiling antenna for 10-20m.

by Robert H. Johns W3JIP

With a spring-loaded center insulator and rubber tips at the ends, this antenna is held by friction against the floor and ceiling, and is self-supporting. Its parts are less than three feet long and the coils fold up, so it stores nicely. You can also mount it temporarily on a window frame or railing and operate it outdoors.

When set up in a room with an 8-foot ceiling, the antenna is a full half wave on 10 meters, with end capacity hats making up for the lack of vertical length. On lower frequency bands, part of the large split loading coil shown in Photo B is connected into the antenna with an alligator clip. This coil resonates the antenna from 12 to 20m.

Construction Details

Only one loading coil? Yes. This means that the antenna is fed off-center. Even though the coaxial connector is in the middle of the vertical section, the element with the coil in it is electrically longer. The feed point impedance is also higher as a result of the off-center feed. This is convenient, since the impedance of a loaded antenna is often too low for a good match to 50 ohm coax. The two effects nicely balance here, giving this short antenna a low SWR on all bands so that no tuner is needed. Off-center feed is a useful trick for short-loaded antennas.

Since the coils for an indoor antenna are not exposed to the weather like an outdoor antenna, or to the wind load like a mobile whip, it's possible to get much greater Q and efficiency by making the coils big. This is a chance to reclaim some of the losses inherent in indoor operation!

The coils in the photos are approximately 8" in diameter, made from #8 aluminum wire. If you are wondering how in the world you might wind such monsters, have no concern. You can purchase the wire already wound to the proper diameter. Aluminum ground wire (Radio Shack #15-035) comes in 40-foot lengths, and coiled to this diameter. Building the coil requires preparing the PVC insulating ribs and cutting off the proper number of turns of aluminum wire, and then bolting the ribs around the turns of the coils.

This same wire is also used for the capacity hat rods at the ends of the antenna. All of the parts of the antenna are either hardware store or Radio Shack items.

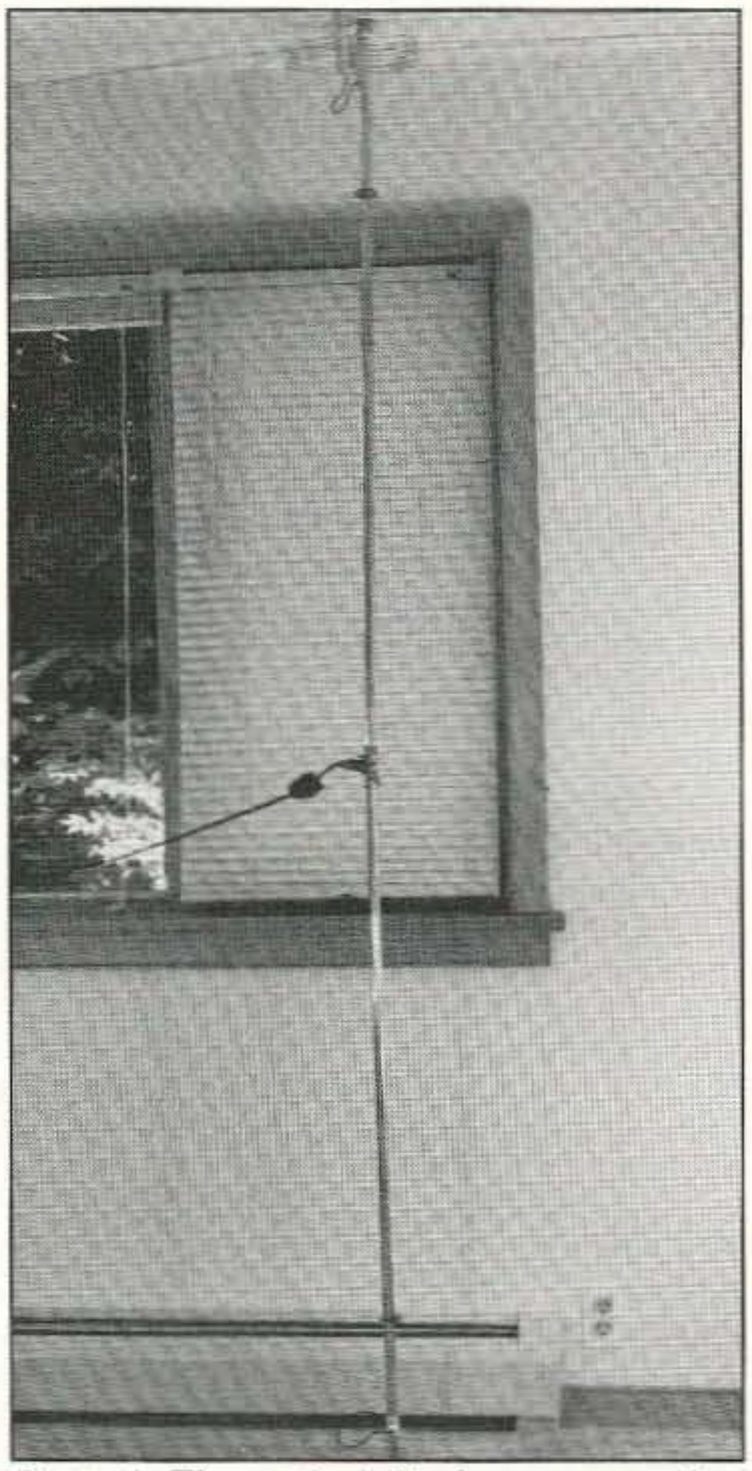

Photo A. The vertical dipole presses against the floor and ceiling to stay in position.

The folding feature comes about because there are only two ribs or supports for the turns, on opposite sides of the coil. They allow the coil wire to twist relative to the plastic ribs when the coil is flattened, as shown in Photo C. However, there is still enough grip on the wire to support the turns in a horizontal position out from the antenna when the coil is opened out again.

The outer end of the aluminum coil is connected to the antenna element via a short length of flexible wire to a ring terminal on its mounting bolt. This short wire connects to the coil by another ring terminal which is bolted to the end of the coil.

The capacity hat rods are three feet long and are attached to the antenna by inserting them into holes (#30 drill) 1/4" apart, through the end of the aluminum tubing element, as shown in Photo B and Figure 1. The rods are held in place by a 5/16" nut that slides over the two rods and then is threaded onto them to tighten them, as shown in Photo B.

Use two lengths of tubing that telescope to make each element adjustable in length. The antenna will fit against ceilings about 7.5 to 12 feet high. The larger center segments are 3/4" in diameter with a 0.048" wall, three feet long. This size of aluminum tubing is available from hardware departments. The thinner end segments are 5/8" in diameter, also three feet long. Some hardware stores carry this size, but not many. An alternate source is aluminum clothesline poles, from hardware or home building supply stores. These are 5/8" in diameter with a thinner tubing wall, about 0.030". The antenna in the photos uses this material.

One end of each 3/4" segment is slotted and tightened around a 5/8" segment by a hose clamp.

A 3.5" length of the 5/8" aluminum tubing at the tip of each element is separated from the rest of the element. This insulates the capacity hats from the elements. The insulator is a 1/2" CPVC (not PVC) pipe coupling, which is a tapered snug fit around the 5/8" tubing. Gently hammer the two tubes into the coupling and secure them with #8 x 1/2"-long sheet metal screws, as shown in Figure 1. A clip lead about 12" long is attached to the inner element tubing by a 6-32 x 1" bolt and nut. This alligator clip is the adjustable connection to the loading coil, or to the C-hat when no coil is in the antenna.

The center insulator is a 5/8" hardwood dowel, 8" long (see Figure 1 and Photo D). The SO-239 coax connector is mounted by means of 1"-long 6-32 steel bolts. Drill out two of the holes in the connector with a 9/64" bit to provide clearance for the bolts, then solder a 4"-long wire to the center terminal of the SO-239. This will pass through a hole in the dowel and connect to one of the elements by a 6-32 bolt securing the 3/4" aluminum tube to the center insulator, as shown in Photo D.

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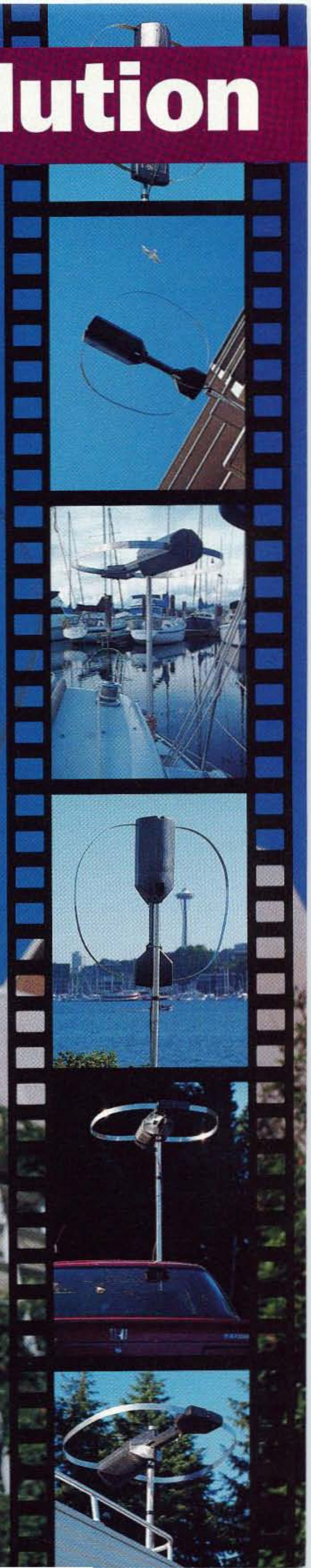

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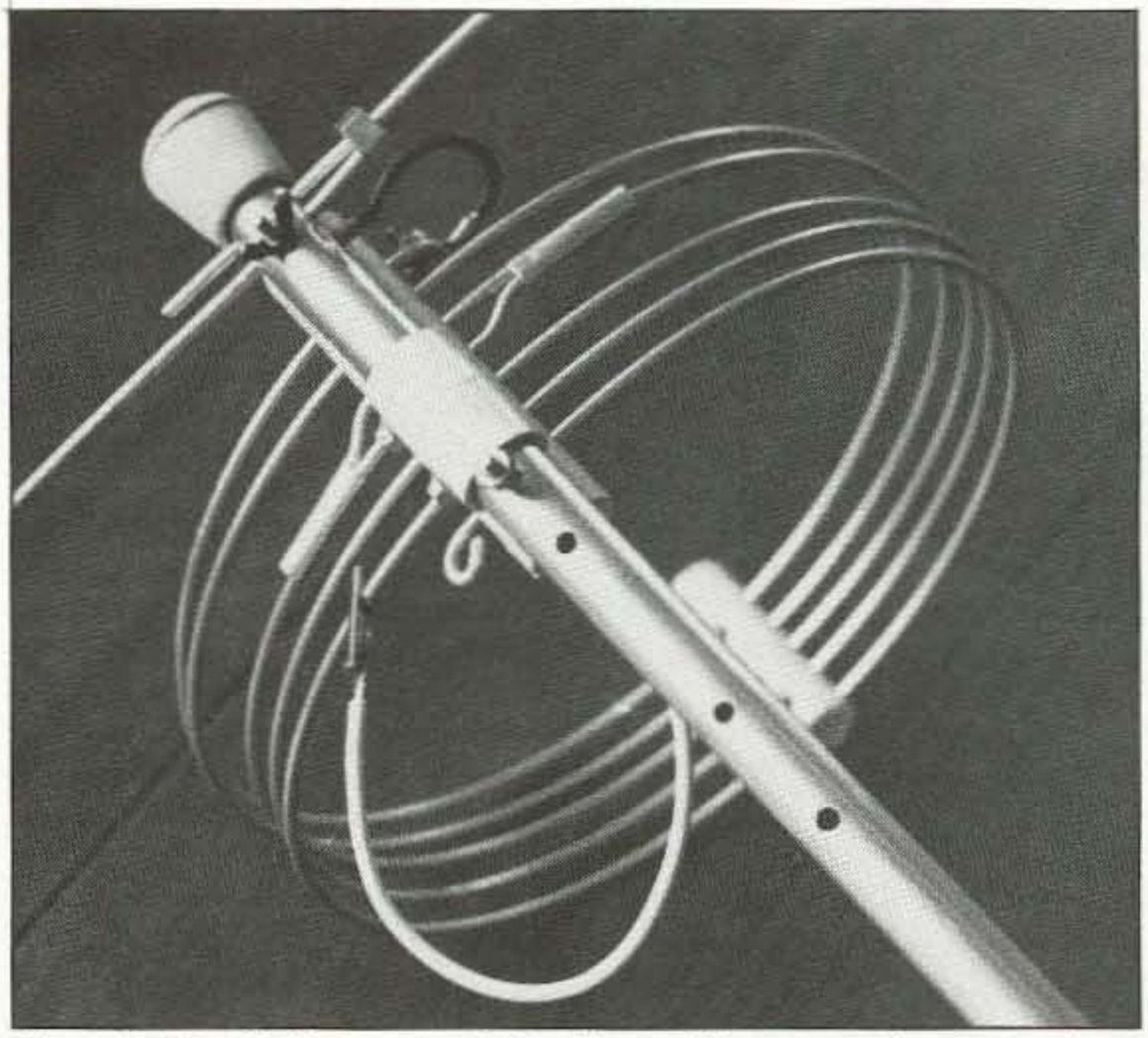

Photo B. The 8" diameter split loading coil has spaced turns so that a clip lead can tap into any point in the coil. The capacity hat rods are each 3 feet long. They are held in place by the large nut around them located near the tip of the element.

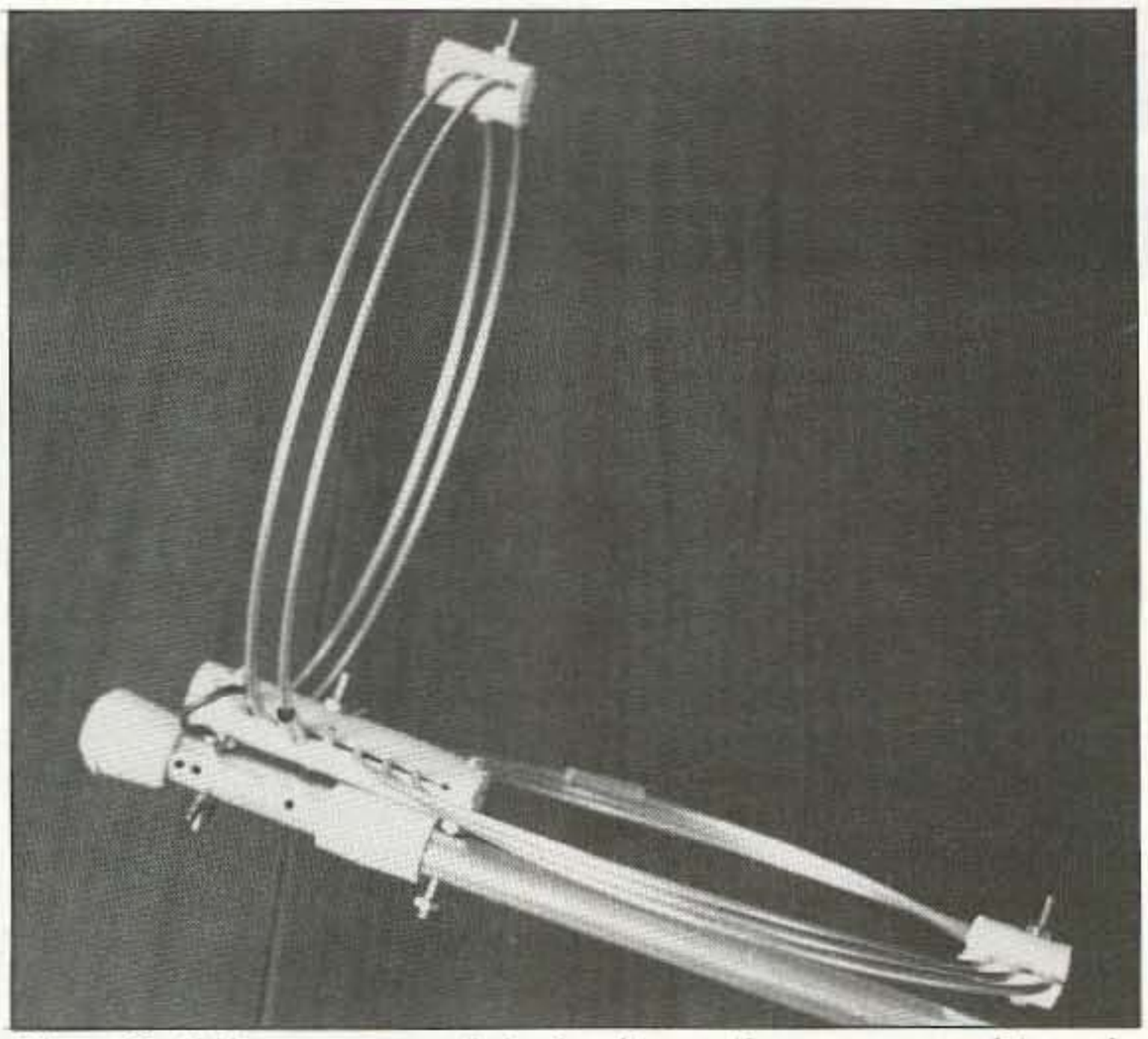

Photo C. Only two turns of the loading coil are connected into the antenna. Three turns are disconnected by sliding away the sleeves that are visible in Figure 2, and the three turns are folded down beside the element. Both coils fold for easy storage.

Corp., in a hardware store spring assortment) is a loose fit around the 5/8" dowel. This spring needs to be stretched so that the turns are spaced apart, as shown in Figure 1-b, and cut with a file or grinding wheel. It is threaded around one of the bolts that supports the coax connector so that it stays in place on the center insulator. With this compression spring in place, electrical contact to the second element of the antenna is made when the tubing is pressed against the spring.

All of the coil supports are made from 1/2" PVC Schedule 40 pipe. The turns of the aluminum coil are held in place by slots in the ribs made by drilling holes (9/64") on 3/8" centers into the pipe, and then sawing the pipe lengthwise through these holes. When the two halves of the pipe are bolted together again, with one turn of the coil in each slot, the coil turns are spaced properly and gripped by the rib. Figure 1 shows side views of coil ribs and the 6-32 x 2" bolts used to mount the coils to the antenna. You also need to drill 9/64" holes for these bolts in both the ribs and the aluminum tubing they mount to.

The 5-turn coil for 12-20m is made in two separate pieces that can be spliced together. The 2-turn coil is used for 12 and 15 meters with the 3-turn coil disconnected and folded down, as shown in Photo C. For 17 and 20 meters, the 3-turn coil is pulled up beside the 2-turn coil and they are spliced together by aluminum sleeves made from 1/4" o.d., 7/32" i.d. tubing, available from hobby stores. These two splices are visible in Photo B, which also shows the ends of the coils bent to bring them next to the adjacent coil.

To assemble a coil, bolt two rib halves together loosely at one end. Slide the aluminum sleeves onto the coils, and then put the aluminum wire between the half-ribs, with one turn in each slot. Hand-tighten the nut to keep the coil turns in the slots and add the remaining bolts to clamp the rib together. Use wing nuts to attach the coils to the elements. Connect the free eyelet of the solder lug at the top (as shown in Figure 1-a) to the outside end of the 2-turn aluminum coil. Bend the #8 wire into a tight loop that will allow a 6-32 x 1/2"-long brass screw to pass through. A #6 brass or stainless steel finishing washer will take a good bite into the aluminum wire and also wrap around it. Bolt the eyelet, the end of the aluminum wire, and the finishing washer together.

Operation

To set the antenna up between floor and ceiling, the length of the vertical section is adjusted with the hose clamps on the telescoping sections. The antenna is made about 1/2" to 3/4" too long, so that it tilts when held against the floor and ceiling. Then push down on the top section to compress the spring and bring it to a vertical position. The

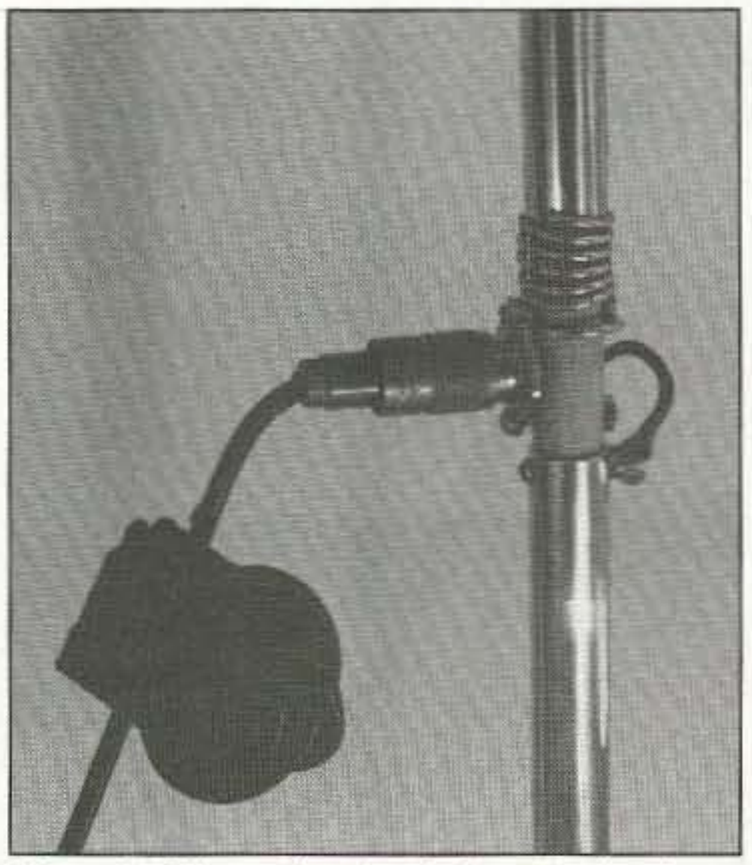

Photo D. The spring-loaded center insulator. Use a current balun (RF choke) at each end of the coaxial cable. The one shown has 5 turns of RG-58 coax wound on ferrite cores (Radio Shack 273-104).

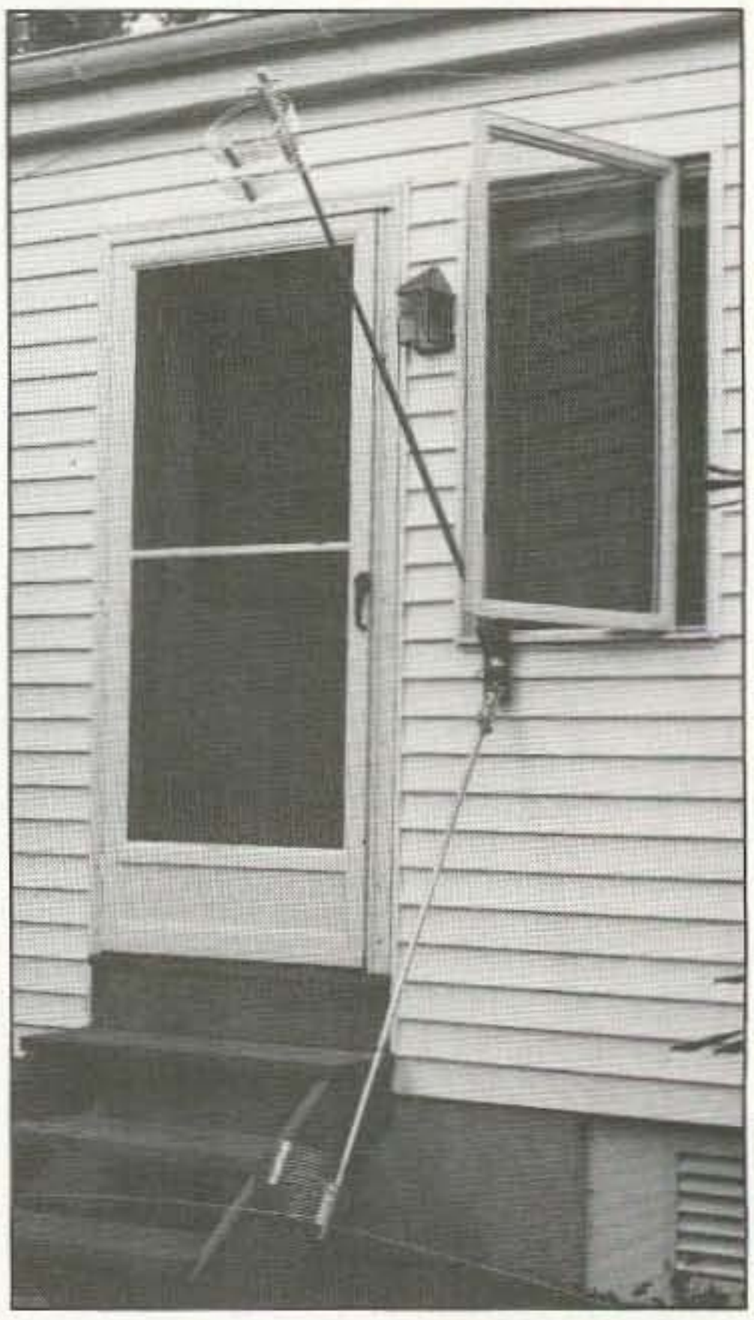

Photo E. The indoor vertical dipole can be window-mounted for better performance. A first-floor window was used for the photo, but the antenna should be as high and clear as possible. Extra coils with 5 turns (top) and 10 turns (bottom) may be added to the antenna, as shown here, for operation on 30 and 40 meters.

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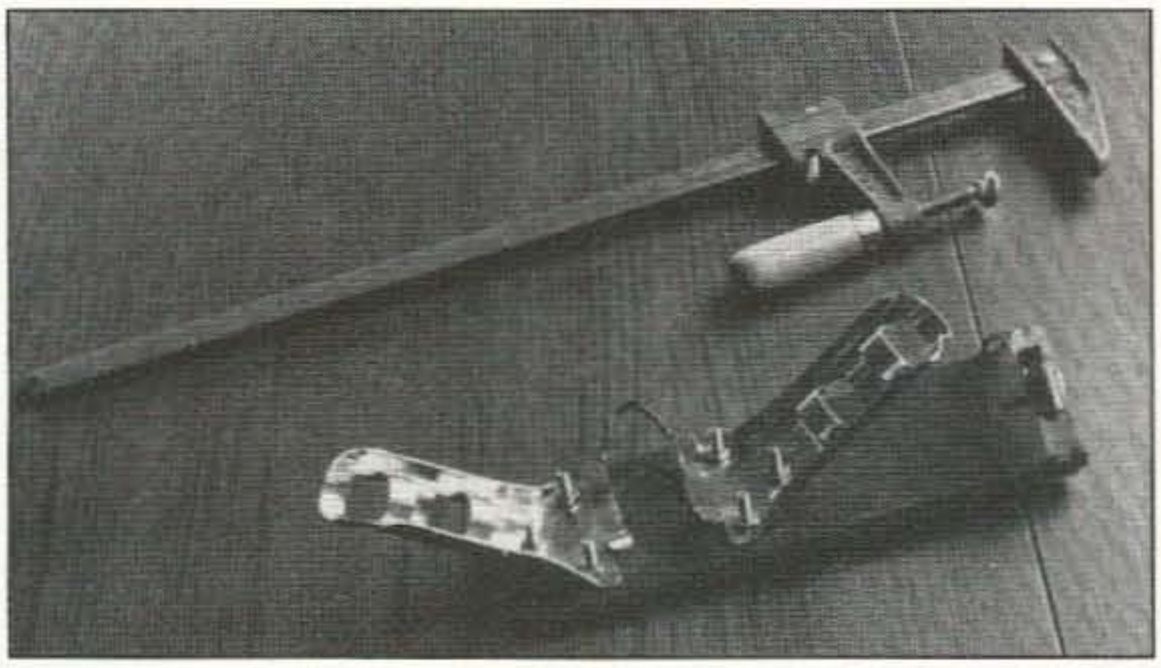

Photo F. The mounting hardware consists of 3/4" flagpole brackets on a board, and an 18" C-clamp that attaches to the board with a large hose clamp.

5/8" rubber furniture tips (not plastic) will hold it securely and not mark the floor or ceiling. Frequency changes are easier to make if the end with the coil is placed near the floor.

Table 1 gives the approximate number of turns to use for each band. These will vary, depending on how much metal in the building is close to the antenna, and on the height of the ceiling. The small increase in the number of turns from 15 to 17m is because the 3-turn coil must be connected and placed next to the 2-turn coil. This adds inductance from the mutual coupling.

When trying out the antenna for the first time or setting up in a new location, check the SWR across a band. This will tell you if an adjustment is needed. If the SWR is lowest at the low edge of a band, the antenna is too low in frequency. Remove some coil from the antenna by moving the tap (clip lead). If the SWR is best at the high end, add more coil. You are aiming to have minimum SWR where you operate in a band.

On 10 meters where no coil is used, the clip lead must connect the element to the outer tip in order to have the C-hats in the antenna. If the 10 meter frequency is too low, raise it by pushing in the C-hat rods so that they overlap and don't extend out as far.

An important part of this antenna system is a good RF choke, or current balun, to isolate the antenna from feedline currents. Especially with off-center feed, the coax will become part of the antenna if you connect it directly to the antenna without a choke. This will be seen as SWR and resonant frequencies that change with cable location, RF feedback (shocks from the radio knobs and squeals from its speaker), and inconsistent results. Use a ferrite-bead coax-shield choke (as reviewed by John Belrose in "Transforming the Balun," *QST*, June 1991, pp. 30-33) or an RF choke formed by winding the coax on ferrite cores as in Photo D.

Outdoor Operation

There are many options for portable operation of this antenna. If you bolt the removable element to the center insulator so that it contacts the spring, you can use the antenna as a horizontal dipole or hang it from a tree as a vertical dipole. You can also put the dipole outside for better efficiency, mounted on a windowsill or railing, as shown in photos E and G.

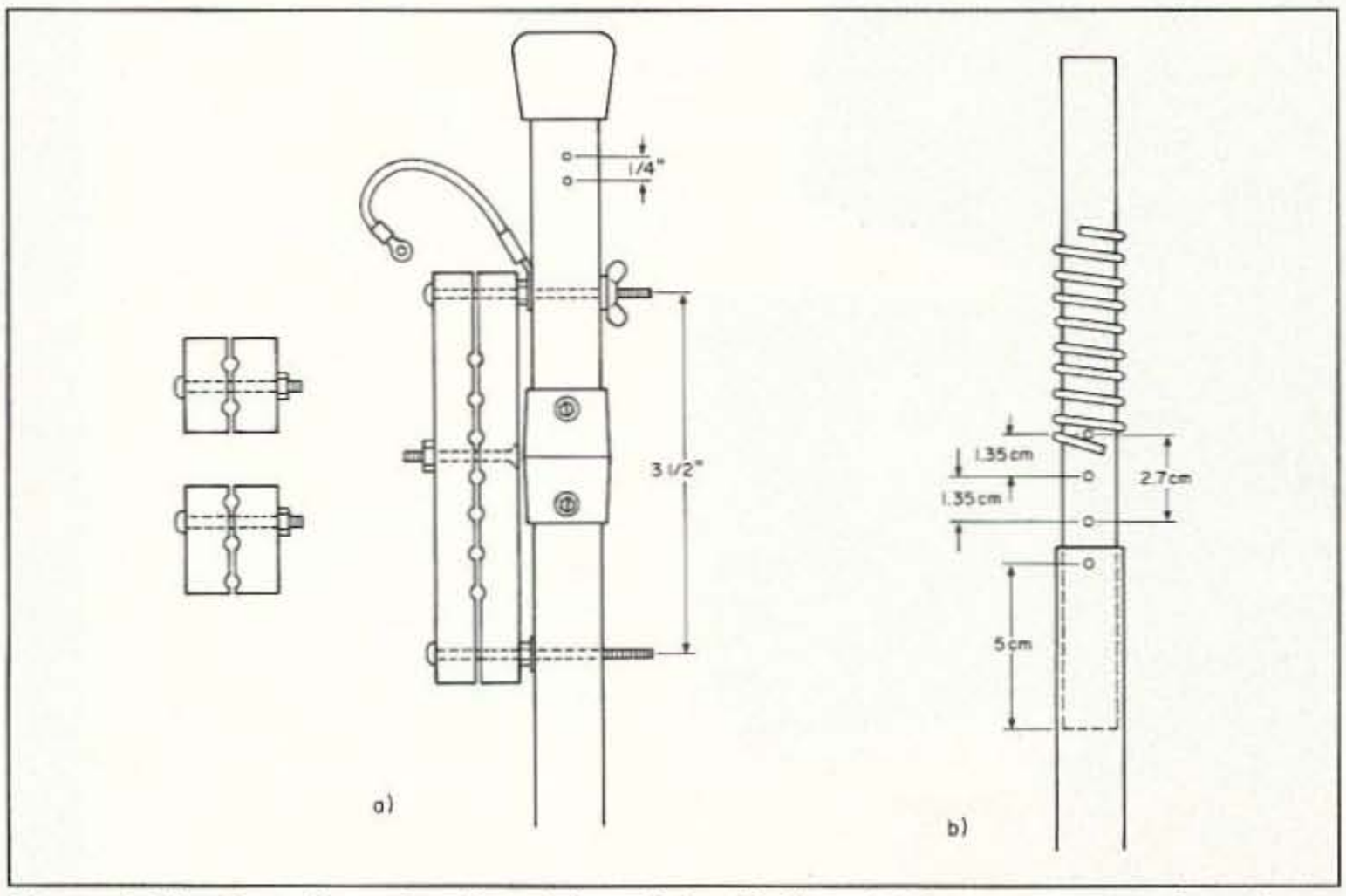

Figure 1. Sketch a) shows the ribs of the coil for 12 through 20 meters, mounted on the antenna. The slots that grip the turns of the coil are made by drilling 9/64" holes in the plastic pipe and then sawing the pipe in two, through the holes. All the bolts are 6-32, preferably brass. The longer ones are 2" and the shorter ones 1". The holes for the bolts are also 9/64". Sketch b) shows the holes to be drilled in the center insulator. These are for mounting the SO-239 connector and for bolting one element to the center insulator.

Photo G. A closer view of the window mount in operation. Notice that the indoor dipole's coax connector and center insulator are used here also. The compression spring fits into the mounting bracket and is the electrical connector to one element of the dipole.

The two elements, held in a 3/4" flagpole bracket switch, are mounted on a base and clamped to a window or railing with a large carpenter's clamp (see Photos F and G). These are all hardware items. The base can be wood (1" x 3" x 12") or a rigid plastic such as PVC or Plexiglas (1/2" x 3" x 12"). With your flagpole brackets as guides, drill the mounting holes shown in Figure 2, and countersink them so that flathead mounting bolts (3/16" x 1") won't scratch the window frame. The 1/4"-wide, 1"-long slot in the mounting base is for the spine of the long clamp. When the spine is in the slot and a large hose clamp is tightened around the clamp head and the board, they are held securely together.

There are four 3/16" holes for each bracket, even though a bracket mounts with only three. The extra one lets you mount the bracket at right angles to the way they are shown in the photos. This can be used for a horizontal mounting of the elements (first floor apartment) or to clamp the mounting base to the side of the window frame. The antenna can also be clamped to a post or a small tree, as well as a railing. The carpenter clamp and flagpole brackets make a very versatile

Continued on page 64

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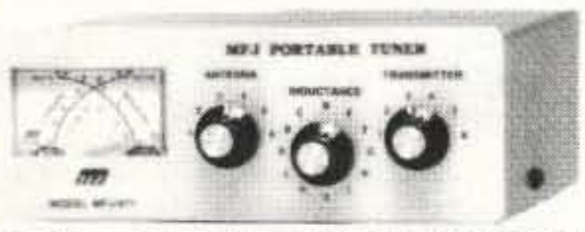

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Six-Band Linear Trap Antenna

Multiband operation without coils or capacitors.

by J. Frank Brumbaugh KB4ZGC

Trap dipoles using L/C traps require careful choice of components and adjustment before use. Traps must be waterproofed, and they add extra weight and wind resistance to the flat-top dipole. Components used to construct the traps are an added expense. They also make the antenna more visible where it might be best not to advertise the existence of an antenna.

The linear trap dipole described here is constructed entirely of wire—no coils or capacitors are needed. Any adjustment needed can be done with a pair of diagonal cutters. From a slight distance it is no more noticeable than a single-wire dipole. Less than 175 feet of wire are required, and it provides an isolated half-wave dipole on 40, 20, 17, 15, 12 and 10 meters.

Theory of Operation

The flat-top is a half-wave 40 meter dipole. At five measured points along each half of this dipole single insulated wires, each a quarter-wave long on 10, 12, 15, 17 and 20 meters, are soldered. After trimming to the desired portion of each band, these insulated wires are bundled along the 40 meter dipole with the free ends towards the central feed point. The assembly is then held together neatly with nylon wire ties.

These quarter-wavelength wires, along with the part of the 40 meter dipole along which they extend, become quarter-wave stubs. Because the end of the stub soldered to the main dipole is shorted, the impedance transfer presents a very high impedance at the open end, thus isolating the remainder of the outer ends of the dipole at the position of the open end of the stub. Thus, a half-wave dipole on each band is provided.

Construction

Figure 1 illustrates the layout of one half of the 40 meter dipole. For clarity, the quarter-wave insulated wires are shown expanded. Dimensions are given calculated for the low frequency edge of each band.

The points on the flat-top, identified as A through E, are where the insulated wire stubs are attached and soldered.

Table 1 gives the length of each of the quarter-wave wires, also identified as A through E. Each is connected to the dipole at the point identified by the same letter. There are two insulated wires for each lettered point, one for each half of the 40 meter dipole.

Cut and strip one end of a pair of insulated wires—the wire gauge is not important—of length A from Table 1. Solder the stripped end of each wire to the two points marked A.

Continue as just described until you have connected the proper insulated wire pairs to points B through D on each half of the dipole. *Do not attach wires to point E at this time.*

The wires at point E will be attached only after the 40 meter dipole has been adjusted to length, so at this time use tape or string to bundle the insulated wires temporarily to each side of the dipole with the open ends extending towards the central feed point.

Adjustment

Step 1. Feed the antenna with a small amount of RF through an SWR meter at some frequency in the 40 meter band where you usually operate. The SWR will probably not be 1:1.

Step 2. Shorten each end of the 40 meter dipole by the same amount, an inch or two, and recheck the SWR.

Step 3. Continue repeating this step until the SWR is as close to 1:1 as possible.

Step 4. Check SWR across the band to determine the 2:1 SWR bandwidth.

Step 5. Attach insulated wires at point E at each end of the 40 meter dipole, and solder. Bring this wire along the flat-top towards the feed point. Use nylon wire ties to bundle all wires neatly against the flat-top.

Step 6. Feed the antenna as described in Step 1 in the 20 meter band.

Step 7. Remove the RF and shorten the open ends of both point E wires an inch or two, and repeat Step 6, for the lowest SWR.

8. Continue repeating Steps 6 and 7 until the SWR is as close to 1:1 as possible.

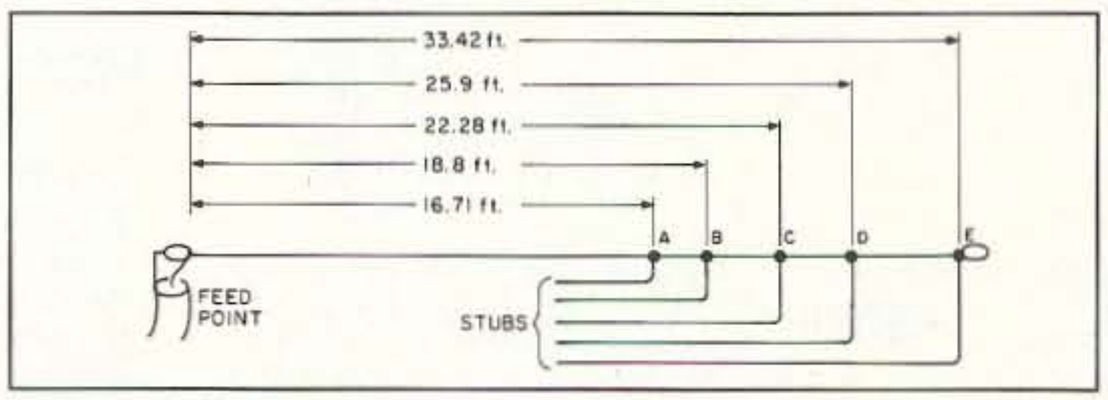

Figure 1. Stub attachment points on one-half a 40 meter dipole.

9. Check across the 20 meter band to determine the 2:1 SWR bandwidth.

10. Repeat Steps 1, 7, 8 and 9 in the 17 meter band, carefully shortening both wires connected to point D.

11. Repeat Step 10 in the 15 meter band, shortening both wires connected to point C.

12. Repeat Step 10 in the 12 meter band, carefully shortening both wires connected to point B.

13. Repeat Step 10 in the 10 meter band, carefully shortening both wires connected to point A.

This completes construction of the linear trap dipole.

Installation

As long as you remember the truism "higher is better," this antenna can be installed as a flat-top, a sloper or an inverted "V." Although it is somewhat more broadband than a trap antenna using L/C traps, the 2:1 SWR bandwidth may shift somewhat up or down in frequency when the antenna is installed in its permanent position. It is unlikely to require further trimming of the quarter-wave wires.

For the purist, attachment points A through D can be moved slightly closer to the feed point during adjustment to further reduce the SWR, although without this refinement the SWR should be below 1.5:1 over a fairly wide range on each band.

Although this antenna is designed to cover the bands from 40 through 10 meters, it is not possible to include the 30 meter band. Each half of the lowest frequency dipole must be at least one half-wave long at the next highest band, so the 30 meter band can be included only if this antenna is expanded to cover 80 meters.

If there is insufficient space for the full flat-top length, the ends of the dipole can be dropped down vertically or at right angles to the horizontal portion with very little loss of capability. Both ends should be dropped the same amount, of course.

For those hams who have space for a long-wire antenna, this linear trap design can be applied at one end of the long wire. Constructed in this manner, a long-wire antenna will be fed at a low impedance point on each band since it will effectively be fed one quarter-wavelength

Table 1. Stub Lengths

Point	Length (feet)
A	8.37
B	9.40
C	11.14
D	12.95
E	16.72

from one end, thus eliminating the need for an antenna tuner.

For those hams using rigs incorporating automatic tuners, an SWR of 1:1 is possible with this antenna on all bands covered, with the possible exception of the very wide 10 meter band.

However, if carefully adjusted as described herein, no antenna tuner should be needed, although one can be used if desired to achieve a broader bandwidth at low SWR. It is also probable that an antenna tuner will match this antenna in the 30 meter band, although this has not been attempted here.

Conclusion

With three insulators, a feedline, less than 175 feet of wire and some minor clipping of wire ends with diagonal cutters, you can have an effective isolated dipole on six of the best DX bands. It does not require an antenna tuner and it is probably the simplest and cheapest multiband antenna which can be constructed by any ham. 73

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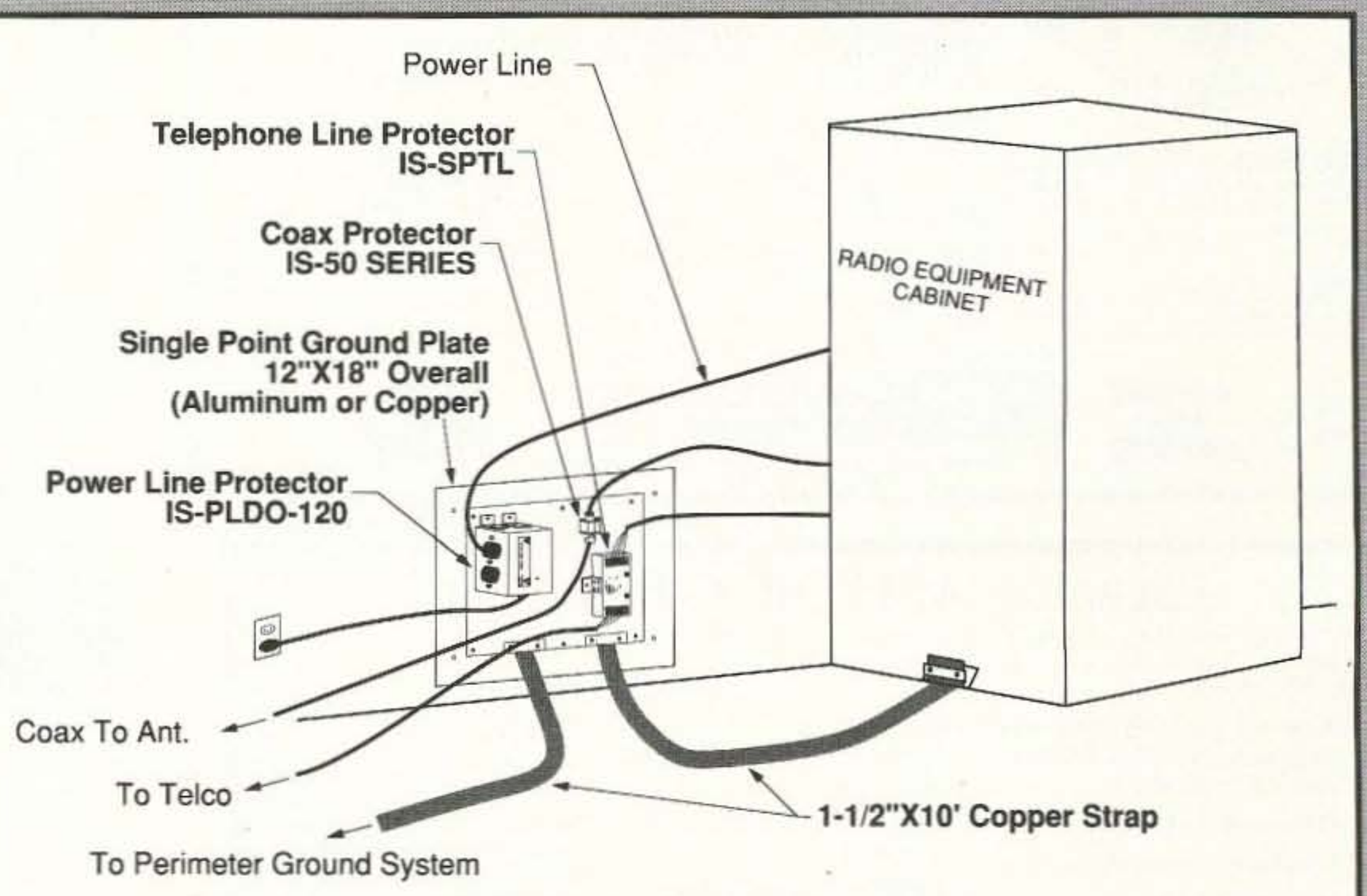

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10 Meter DSB Transmitter

Easy to build and no tuning required.

by Carl Lyster WA4ADG

Here is an ideal construction project: a no-tune, 1-watt output, CW/double-sideband transmitter which is a breeze to build, and low cost to boot! The heart of this unit is a small precision oscillator that is used as a 28.322 MHz clock on computer video cards, and is available at a cost of only a few dollars. How convenient!

Bill Brown WB8ELK alerted me to the availability of this jewel and asked if I could come up with a simple DSB transmitter. Never being one to turn down an interesting challenge, I decided to design a simple but versatile unit that could be used in DSB as well as CW modes. In order to keep cost to a minimum, I chose to use readily available parts and incorporate some of the latest technology components in the design, along with a whopping $1.50 final transistor! The total cost, including commercially made PC board, is about $25.

I hope a large number of experimenters take this project to heart and that the frequency of 28.322 MHz becomes a new breeding ground for tinkering-minded hams. *[Ed. Note: Other frequencies can be custom ordered - see the Parts List for details.]*

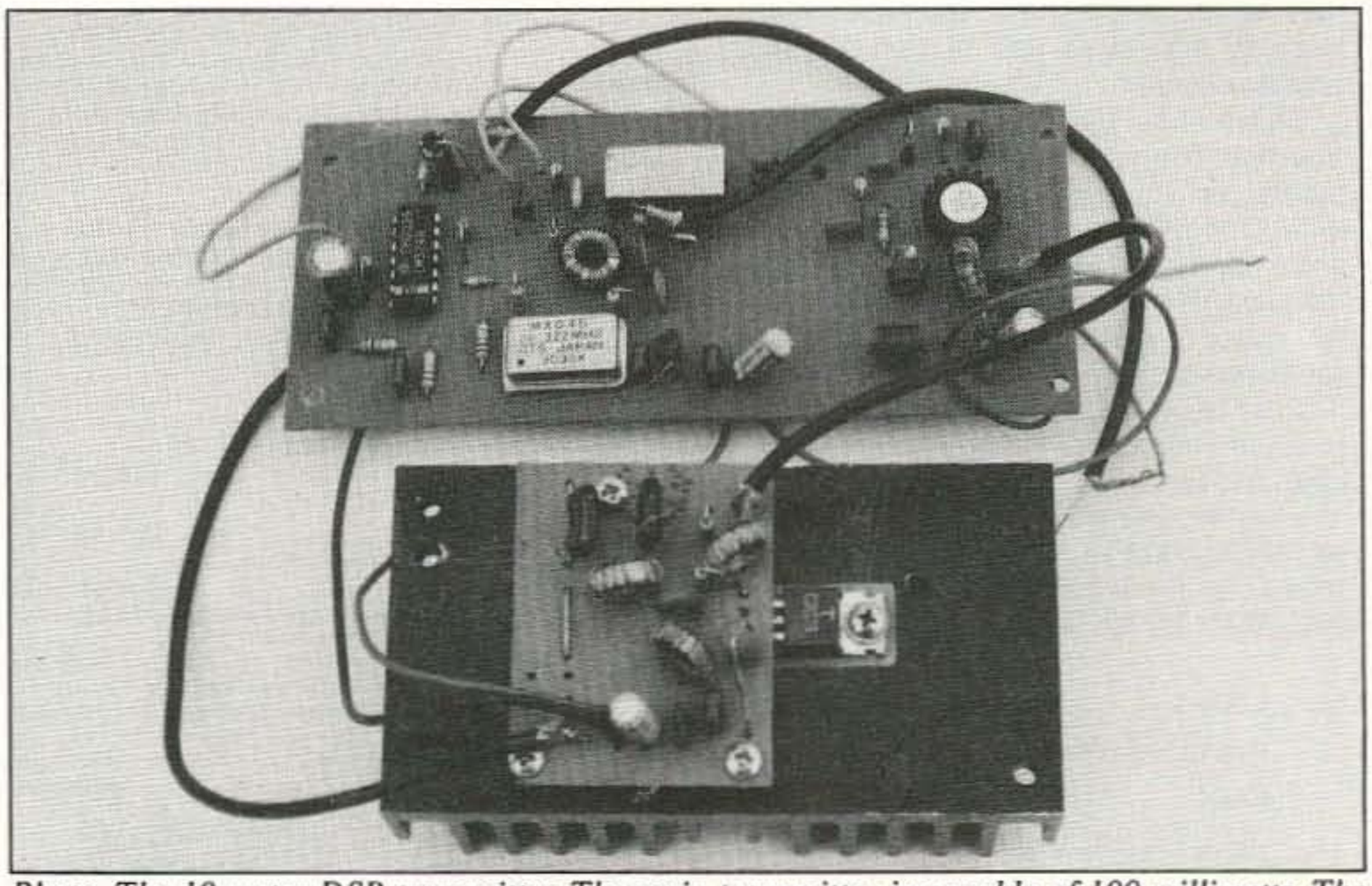

Photo. The 10 meter DSB transmitter. The main transmitter is capable of 100 milliwatts. The small amplifier board will provide you with a 1-watt output.

Why Double-Sideband Suppressed Carrier?

This question is all a matter of dollars and sense. The traditional SSB transmitter requires some form of expensive filter to remove the undesired modulation sideband and pass the desired one on to the remaining electronics. Of course there are ways to produce an SSB signal that does not require a crystal filter. I have seen articles on "rolling your own" filters from cheap surplus crystals, but all of these methods are well beyond the capability of the beginner. The old adage "Keep it simple stupid" certainly applies here; we don't want people getting "Pink Tickets" from the FCC because their home-brew transmitters are contaminating the air waves.

It is true that double-sideband modulation consumes extra spectrum space. I would not even consider building a DSB transmitter for any frequency below the 10m band. DSB modulation has several advantages that make it the ideal choice for this project. First, a DSB signal can be received by all who own DSB or SSB receivers. I have read that a direct conversion receiver will not receive DSB signals, but this is a minor concern. Second, a DSB suppressed carrier signal is more efficient than simple AM modulation. Third, and most important, a DSB signal is very easy to generate! *[Ed.note: Please note that you need at least a General class license to operate DSB.]*

DSB Suppressed Carrier Modulation

To understand DSB suppressed carrier modulation, a quick review of its close cousin, AM modulation, will help. In AM, a carrier is modulated by varying the amplitude of the RF signal at an audio rate; this can be accomplished by the use of a modulation transformer or by modulating the DC power applied to a low level amplifier stage in the transmit chain. The resultant signal is a mixture of the original RF frequency plus (the sum of the RF frequency and the audio frequency) and (the subtraction of the RF frequency and the audio frequency). These sums and differences are referred to as the upper and lower sidebands, respectively. They contain all of the intelligence associated with the AM signal; the presence of the carrier is simply wasted energy. It would be much more efficient to eliminate the carrier and devote the entire transmitter power to the sidebands. This is precisely what is achieved with DSB suppressed carrier modulation. Due to the fact that both sidebands are mirror images of each other, they contain the same information. For even greater efficiency, we could eliminate one of the sidebands by the use of an expensive crystal filter, and transmit a single sideband signal. However, for our simple transmitter we shall be content with a low-cost DSB signal.

Circuit Operation

It would be easy to breeze through this section with only a cursory description of the circuit functions, however I would feel like I was cheating you if you did not fully understand the operation of what you were building. Part of the appeal of ham radio is learning the innermost secrets of the equipment that you are operating, so I shall endeavor to explain the purpose of each and every component in this device! See Figure 1 for the schematic.

The Oscillator Section

The oscillator module produces a 4-volt peak-to-peak square wave at 28.322 MHz, which is the carrier frequency. The output of the oscillator is capacitively coupled to transformer T1 by capacitor C1. Only a small portion of the 4-volt signal is needed, so resistor R1 reduces the level applied to T1. T1 serves an unusual function in this circuit. It is used to convert the square-wave output of the oscillator into a sine wave. This is accomplished by the resonant action of T1's primary and capacitor C3. The sharp

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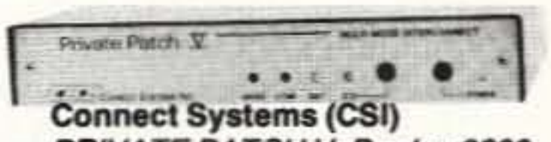

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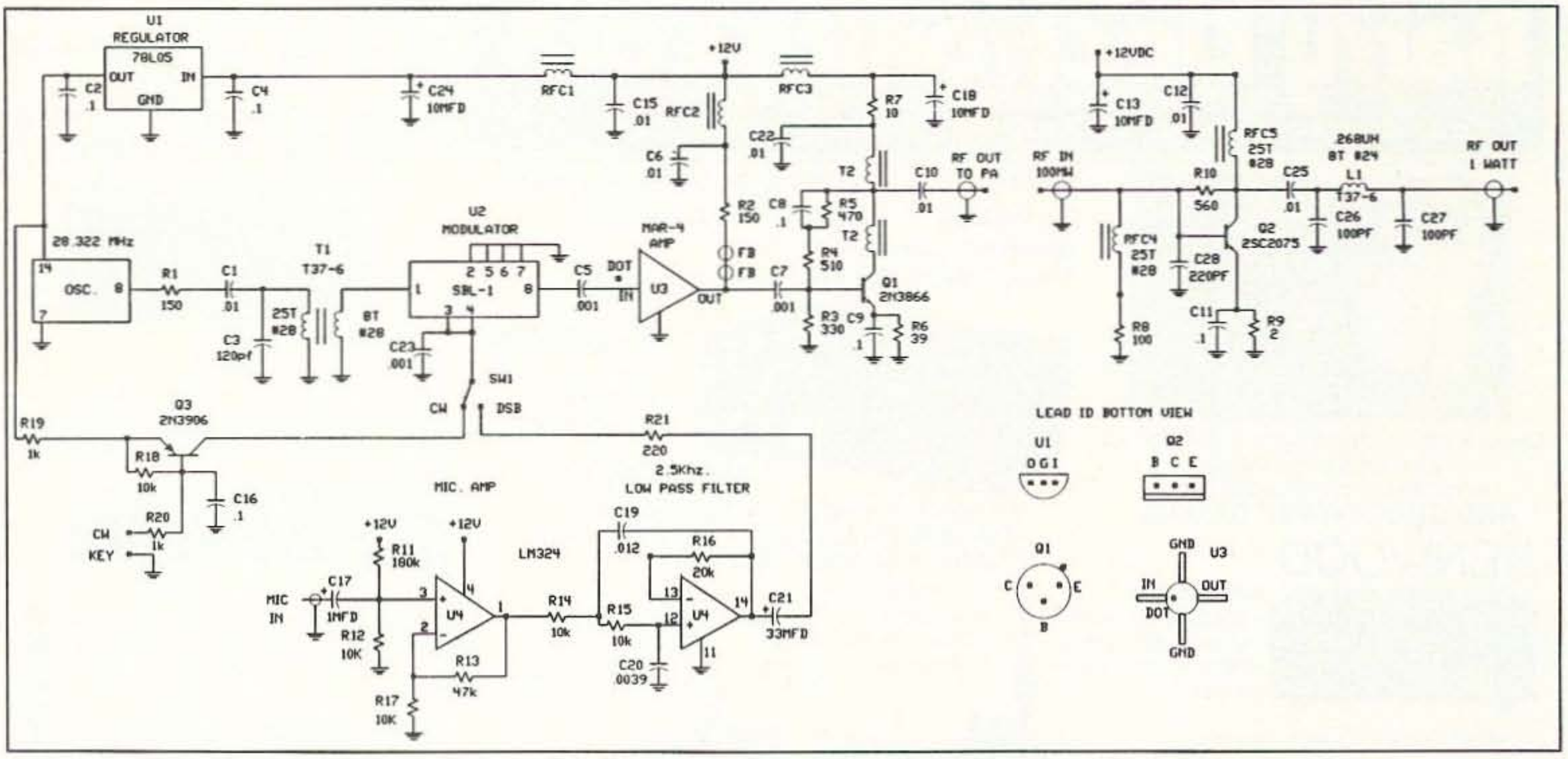

Figure 1. Schematic diagram of the 10 meter DSB exciter board and the optional 1-watt power amplifier.

spikes which occur at each half cycle of the square wave, coupled into T1 by C1, excite the primary and store energy in the toroid core. The resonant properties of T1's primary and capacitor C3 convert the stored energy into a very respectable sine wave which is coupled out of T1 by the 8-turn secondary.

I actually built a transmitter without this square-to-sine-wave converter and it performed very well. However, I was able to detect an increase in carrier suppression with the converter in place. These three parts are a small price to pay for increased performance.

The Mixer Section

Across the secondary of T1 is approximately 0.6 Vp-p, which is applied to the double-balanced mixer module U2. The mixer is one of the "high-tech" devices used in this design. It replaces a handful of transformers and matched diodes with a small package, pretested and guaranteed to meet published minimum specs. From the mouth of experience I can tell you that trying to "roll your own" double-balanced mixer is no fun! These devices are true marvels and have many different uses.

I have exploited two different properties of double-balanced mixers in this circuit: the traditional use as a mixer for the generation of DSB, and as a controlled attenuator for the generation of CW. Switch S1 selects the signal source that is fed into the IF port of the mixer.

The IF port is connected to the diodes which form the active portion of the mixer. In DSB mode, audio is directed into the mixer diodes from the audio amp and filter composed of IC U4. With no audio voltage present at the diodes, the mixer does not pass the carrier energy on to the remaining stages. When audio drive is applied to the diodes, they begin to conduct and perform their function as a balanced mixer.

The amplitude of the sideband energy output is proportional to the audio drive input. The carrier is removed by the action of the mixer; only the sidebands are contained in the output.

The term "carrier suppression" is a ratio of the energy output of the mixer with full audio drive applied, and the output of the mixer with no audio drive applied. Carrier suppression is expressed in dB and can be considered as a "quality factor" in comparing the performance of various types of mixers. This transmitter has attained a measured carrier suppression of 45 dB, which is a very impressive performance for such an inexpensive circuit. I have spent long hours improving this circuit to achieve such a level, one

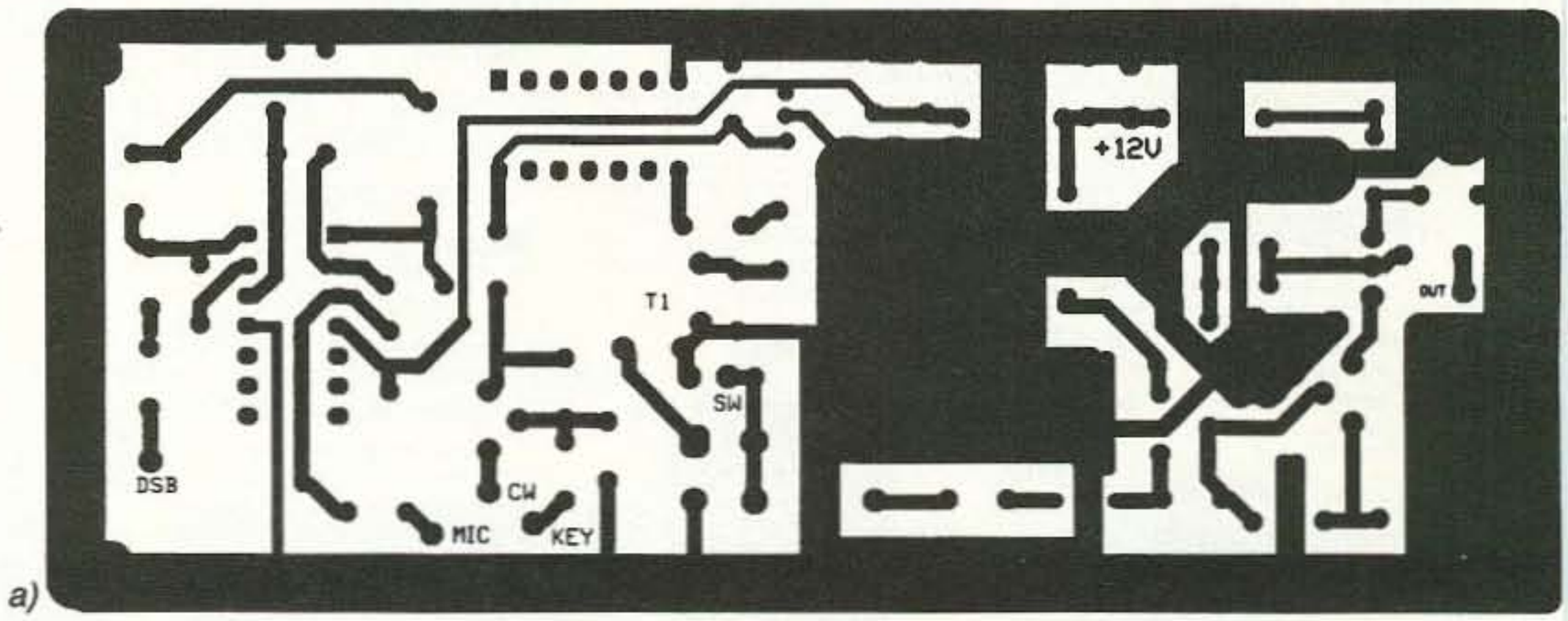

Figure 2. (a). PC board foil pattern for the main DSB exciter. (b). Parts placement.

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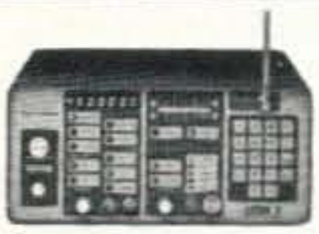

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CT-125 9 DIGIT 1.2 GHz

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CT-70	20 Hz–550 MHz	<50 mV to 150 MHz	7	1 Hz, 10 Hz, 100 Hz	$139.95
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
PS10B Prescaler	10 MHz–1.5 GHz, divide by 1000	<50 mV	Convert your existing counter to 1.5 GHz		$89.95

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$89.95 complete kit
SG-7

New low-cost microwave Doppler radar kit "clocks" cars, planes, boats, horses, bikes or any large moving object. Operates at 2.6 GHz with up to 1/4 mile range. LED digital readout displays speed in miles per hour, kilometers per hour or feet per second! Earphone output allows for listening to actual doppler shift. Uses two 1-lb coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is PC stripline. ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.

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TR-1, RF sensed T-R relay kit $11.95

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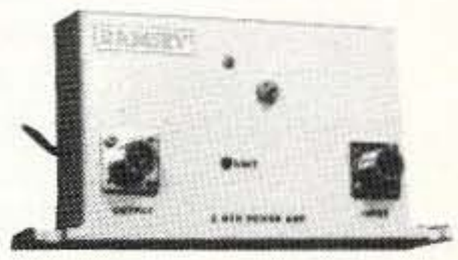

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AA-7 Kit $24.95
Matching case & knob set, CAA $12.95

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Matching case set for SRI, CSR $12.95
Matching case set for SCI,CSC $12.95

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that exceeds many commercially manufactured pieces of equipment.

CW Mode

In CW mode, transistor Q3 is keyed on and off by a CW key closure to ground. Q3 is held turned off by R18. When the key is closed R20 passes current to ground and lowers the voltage at the base of Q3, which places the base at a lower plus potential than the emitter. Q3 then turns on and supplies about 5 mA of current, limited by R19, to the diodes of the mixer. The double-balanced mixer now functions as a variable attenuator with its output proportional to the applied current. The chosen current level of 5 mA turns the mixer/attenuator fully on—a higher current level will damage the mixer diodes.

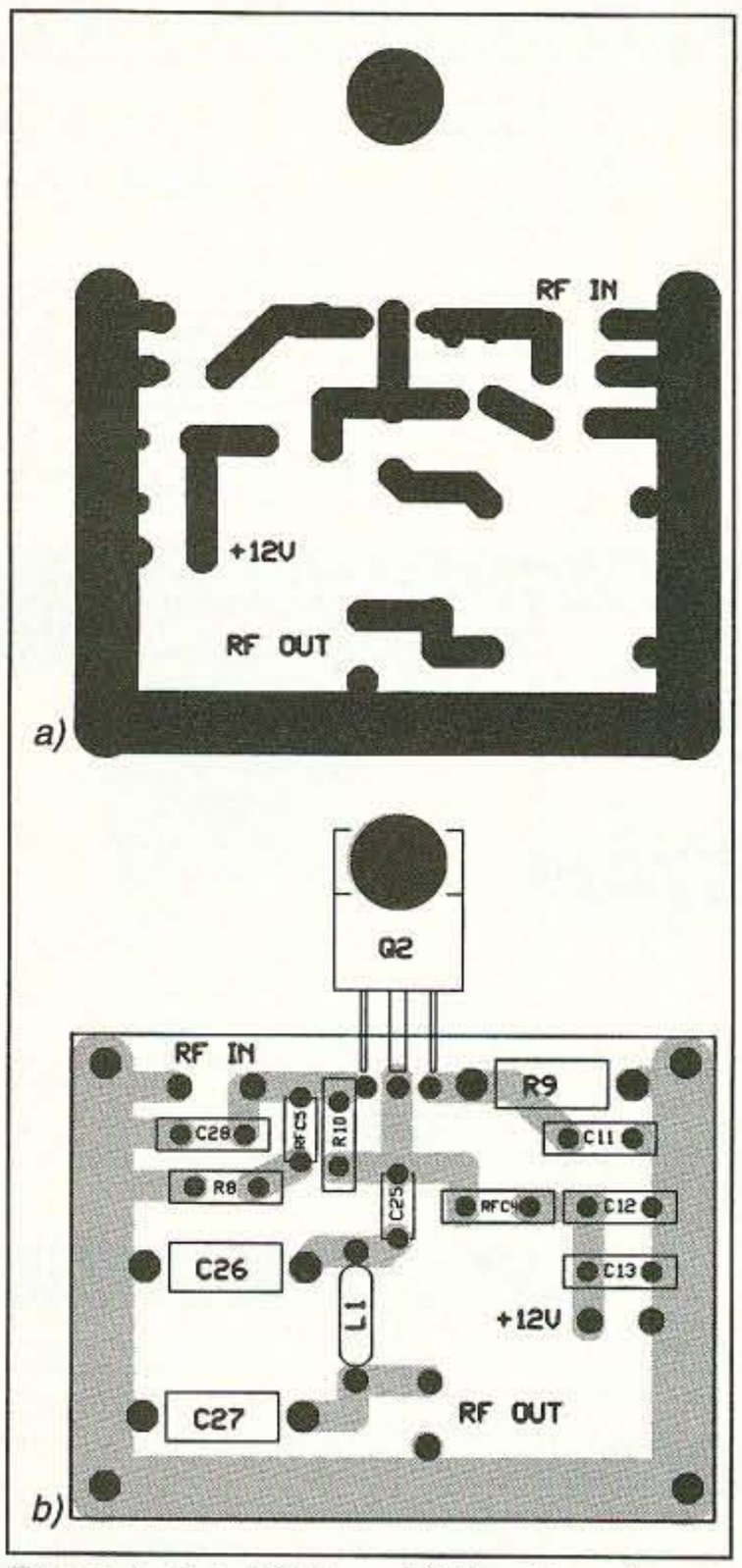

Figure 3. (a). PC board foil pattern for the 1-watt power amplifier board. (b). Parts placement.

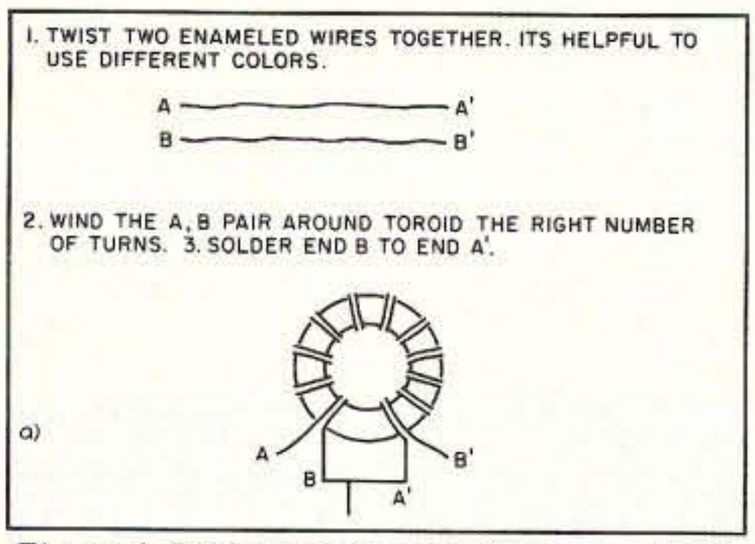

Figure 4. Bifilar winding details for toroid T2.

One modification I considered, but did not show on the schematic, is the installation of a 10k pot in series with R19. This pot would function as a drive control. I added this pot to my prototype and it performed very nicely; the power control was smooth and provided excellent control of the generated CW signal. C16 functions as a key click filter for transistor Q3, and capacitor C23 was added to bypass any carrier energy to ground that may appear at pins 3 and 4 of the mixer. Only audio in DSB or DC in CW mode should be present at this point. The addition of C23 made a noticeable improvement in the carrier suppression on my test models. This is another one of the parts which is not necessary for operation, but its presence improves the performance as measured with expensive test equipment.

The Audio Amplifier

The audio input from an electret microphone is amplified in the first section of IC U4 by a factor of five. Resistors R13, R17 and R12 set the gain to 5, while R11 and R12 form a voltage divider that applies a DC offset of 0.63 volts to the input of the op amp. About 100 mVp-p of audio from the microphone is capacitively coupled by C17 into the op amp. The gain of 5 amplifies the audio as well as the DC offset from the voltage divider, and results in an output at pin 1 of 0.5 Vp-p audio with a DC offset of about 3.15 VDC. This offset is necessary in order to use a single voltage supply op amp. By biasing the output of the op amp at one fourth of its DC operating potential, the required audio level of 500 mV is guaranteed to be free of distortion that might be caused by clipping of the audio signal if it were to approach one of the supply rails.

The second section of U4, used as a low-pass filter to limit the bandwidth of the generated DSB signal, is dependent upon the highest modulating frequency applied to the mixer. In human male voices, maximum energy is contained in the 300 Hz region of the audio spectrum, while for female voices, maximum energy is contained at about 3000 Hz. Since the DSB signal already consumes twice the precious spectrum space of a typical SSB station, a compromise must be struck on the maximum allowable audio frequency passed to the DSB mixer. I have chosen this limit to be 2500 Hz, which will provide excellent reproduction of the male voice and still provide faithful rendition of female voices. The driving concern here is to maintain a manageable bandwidth in the DSB signal that will cause a minimum of interference with others operating SSB equipment. Resistors R14, R15 and R16, in conjunction with capacitors C19 and C20, form a second order low-pass filter with a 12 dB per octave rolloff, starting at 2500 Hz. C21 is a DC-blocking capacitor which passes the audio from the amp/filter to the mixer via SW1. R21 reduces the 500 mV of audio drive to about 300 mVp-p for injection into the mixer.

MMIC Stage

Capacitor C5 is a DC-blocking capacitor which couples the DSB or CW signal from the output of the mixer to the input of IC U3, a monolithic microwave integrated circuit, or MMIC for short. This amplifier is one of a series of ICs sold by Mini-Circuits, who also manufactures the double-balanced mixer. The MAR-4 MMIC used here is rated at about 10 dB of gain and an output power of 10 mW. It replaces a small handful of parts at a cost of only $2, all contained in a package the size of a pencil point! The body of this part contains a yellow dot over the input lead, while the opposite lead is the output and the two adjacent leads are both ground. Devices such as the MAR-4 MMIC are going to play an ever-increasing role in future ham construction projects. I have purposefully used one here to introduce the new hobbyist to this class of devices. They require care in handling and soldering due to their small size, but I have found them to be tougher both physically and electrically than one might expect.

The output of the MAR-4 is also the DC input pin, and this is accomplished by the RF choke feed composed of two ferrite beads in series with the current limiting resistor R2. Ample use of bypass capacitors is used throughout the transmitter on the power supply lines to insure that no stray RF is coupled from stage to stage by these lines. Bypass caps C4 and C2 are placed on the input and output pins of the 5-volt regulator U1 to prevent internal oscillations in the regulator chip. The +5-volt supply is used by the oscillator module, and is also used to supply the switched DC current to the mixer diodes in CW mode. Capacitors C18, C6, C13, C22, C24, C15 and C12 all function as supply line bypass capacitors. Their assortment of values insures that all frequencies from audio to RF on the supply lines will be effectively bypassed to ground. Several RF chokes are used throughout the transmitter to help isolate the supply lines of the different stages. This provides further protection from stray coupling that could lead to self-oscillation in the amplifier chain, and a certain "pink ticket"!

The Class-A Broadband Amplifier

Capacitor C7 couples the amplified signal from the MAR-4 to the base of transistor Q1, a low level class-A broadband amplifier. The stage gain of Q1 is set to about 13 dB by feedback action of C8 and R5, while R3, R4, and R6 set the bias to insure class-A operation. Transformer T2 is a broadband coupling device used to provide a coarse match to the final amplifier transistor Q2. R7 is a current limiting resistor, and C9 serves as the emitter bypass cap. The output level of Q1 is about 100 mW and is coupled to Q2 via C10. *[Ed. Note: You can operate quite effectively at this power level if band conditions are good. Use of the optional 1-watt amplifier will allow you to work just about anyone. Don't expect to break through DX pile-ups, however.]*

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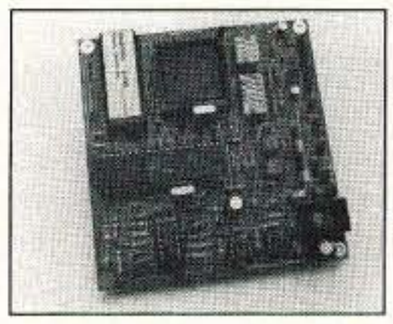

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The Final Amplifier

The optional final amplifier is also operated class-A to insure linearity. This results in a substantial amount of heat dissipation by the transistor; therefore, Q2 is fitted with a heat sink. The power amplifier is built on a separate PC board to allow easy attachment to whatever form of heat sink you wish to use, such as a chassis box or plate of aluminum. The tab of Q2 must be insulated from the heat sink due to the fact that the tab is internally connected to the collector. Resistors R10, R8 and R9 set the stage bias, while C11 is the emitter bypass cap. Choke RFC4 provides a DC path for the bias current, but acts as a high impedance to the input RF. RFC5 supplies the DC feed to Q2 and isolates the RF from the power bus. The gain of the final stage is about 10 dB, which results in an output power of 1 watt PEP. The CW output is slightly higher at about 1.5 watts RMS. C25 is the DC blocking cap for Q2, and passes the RF to a pi-network composed of C26, L1, and C27, which helps with harmonic attenuation. This completes the circuit description. I cannot claim credit for the basic design of the last two amplifier stages. These are patterned after ones in the *Solid State Handbook* from the ARRL.

Construction

Assembly of the exciter (see Figure 2) should be done a stage at a time, starting with the oscillator and progressing through to the amp Q1. It will be helpful to monitor your progress by the use of a SSB receiver, tuned to 28.322 MHz, as you assemble each stage. Remember that the oscillator module is generating a hefty 40 mW by itself and may give a significant signal to the receiver. Switch S1 can be mounted on the front of the mini-box which you house the transmitter in, along with a jack for connecting the microphone. I used a garden variety electret microphone which contains two wires: one black wire to ground, and a red wire connected to C17, also in series with a 10k resistor to +12 volts. Electrets contain an on-chip amplifier and must have a source of DC to power them. Alternately, you could supply a source of 100 mVp-p signal from an audio amp into C17. Some provision must be made to switch the +12 volt supply on and off to the transmitter. This could be a simple toggle switch on the front panel, or a PTT relay, activated by a button on the mike. Remember, you must turn off the transmitter in order to receive! No provisions have been made for a drive control in DSB mode, but a pot connected to the mike input could be used to set the maximum modulation level. With a little practice monitoring your own signal you will have no trouble finding a voice level which gives clear, undistorted audio that is less than 100% modulation.

In case of trouble, the following voltage checks should help you out. With a good quality scope you should read 0.6 Vp-p RF at pin 1 of the mixer, 0.6 Vp-p RF at the output of U3, 7 Vp-p RF at the collector of Q1, and 20 Vp-p RF at the collector of Q2. These measurements are made in CW mode. The mike amp should deliver 0.3 Vp-p of audio to pins 3,4 of the mixer with 100 mVp-p of audio input to the mike jack. You can operate with just the exciter by hooking the antenna directly to the output of the exciter PC board. For an additional boost, just run a short run of RG-174 coax between the exciter and the power amplifier board (see Figure 3) and hook up your antenna to the PA output.

This simple, low-cost transmitter can be put to a variety of uses, such as a backpacking rig, or even a 10m DSB transmitter for balloon flights. By utilizing a common frequency, this unit can create a breeding ground for experimenters, and keep you in touch with like-minded others.

I hope to start work on a companion receiver soon! 73

Parts List

R1,R2	150 ohm resistor
R3	330 ohm resistor
R4,R10	510 ohm resistor
R5	470 ohm resistor
R6	39 ohm resistor
R7	10 ohm resistor
R8	100 ohm resistor
R9	2 ohm, 1/2-watt carbon resistor
R11	180k carbon resistor
R12,R14,R15,R17,R18	10k resistor
R13	47k resistor
R16	20k resistor
R19,R20	1k resistor
R21	220 ohm resistors
C1,C6,C10,C12,C15,C25,C22	0.01 µF 100-volt ceramic cap
C2,C4,C8,C9,C11,C16	0.1 µF 50-volt monolithic cap
C3	120 pF 50-volt ceramic cap
C5,C7,C23	0.001 µF 50-volt ceramic cap
C13,C18,C24	10 µF 16-volt electronic cap
C14	not used
C17	1 µF 16-volt electrolytic cap
C19	0.012 µF 50-volt monolithic cap
C20	0.0039 µF 50-volt monolithic cap
C21	33 µF 16-volt electrolytic cap
C26,C27	100 pF 100-volt silver mica cap
C28	220 pF 100-volt ceramic cap
RFC1,RFC2,RFC3	25 turns #28 wire on a 100k 1/4-watt resistor
RFC4,RFC5	25 turns #28 on T37-6 core
T1	25T primary 8T secondary #28 on T37-6
T2	13T bifilar #28 wire on T37-6 core (see Figure 4)
L1	8T #24 wire on T37-6 core
Q1	2N3866 transistor
Q2	2SC2075 transistor (available from RF Parts)
Q3	2N3906 transistor
U1	78L05 +5-volt regulator
U2	SBL-1 mixer, Mini Circuits
U3	MAR-1 amp, Mini Circuits
U4	LM324 op amp
OSC	28.322 MHz clock oscillator, Digi-Key# CTX-128 (see Note 2).
FB	ferrite bead, Amidon Associates

Note 1: Etched and drilled PC boards are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118. The main transmitter board is available for $5 and the final amplifier for $3. You can order both boards for a combo price of $6. Add $1.50 per order for postage/handling.

Note 2: Oscillator modules on custom frequencies are available for $12.80 from Cal Crystal Labs, Inc., 1142 N. Gilbert, Anaheim CA 92801; (714) 991-1580. The part number is CCO-100A-xx.xxxMHz (replace the x's with your desired frequency).

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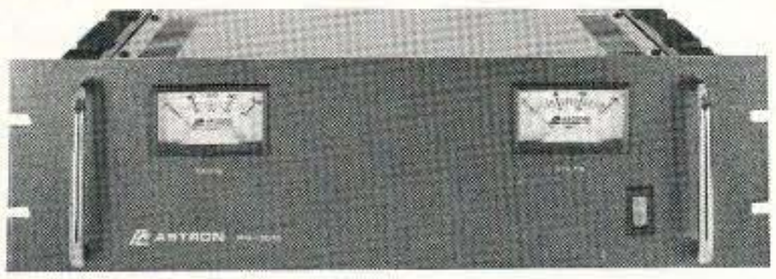
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES

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

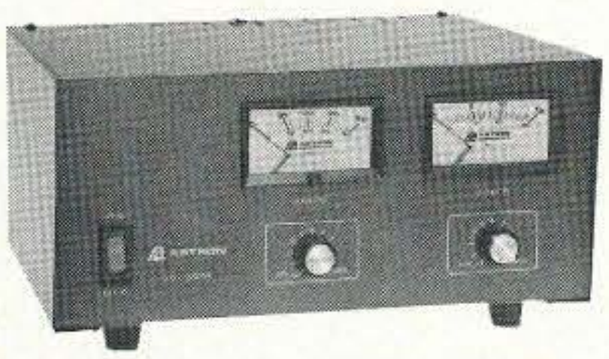
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 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

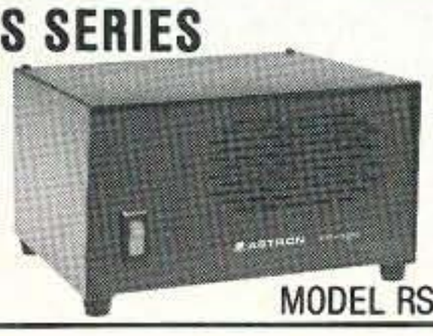


MODEL VS-35M

• 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)

CIRCLE 16 ON READER SERVICE CARD

Calibrated Signal Generator

An accurate RF source from 400 kHz to 33 MHz at the twist of a dial.

by John Pivnichny N2DCH

An accurately calibrated signal generator is a worthwhile instrument to have around the shack for equipment checkout. If you like to experiment with circuits or build your own equipment, you will often need a source of RF signals. This generator can produce a signal anywhere from 400 kHz to 33 MHz at the twist of its linearly calibrated dial. Output level is adjustable from zero to over 200 mV RMS.

Calibration

The most important part in the whole generator is the tuning capacitor. This is what permits a linearly calibrated dial. Fair Radio Sales sells a beautiful surplus worm-gear-driven 25-220 pF unit which was appropriately enough removed from a signal generator. Its rotor plates have the unusual shape shown in Figure 1. For this project the arc indicated is the only portion used. My preliminary measurements showed that linear frequency operation is possible with a 1.2:1 frequency ratio in exactly 30 turns of the worm gear drive shaft. I have no idea what the rest of this unusually shaped rotor was intended for.

I then determined the actual frequency deviation from a straight line dial by taking frequency counter readings to the nearest kHz at every turn of the capacitor drive shaft. See Figure 2 for the results. A positive error means the frequency is higher than expected at that turn of the shaft. The tuning range is 15 to 18 MHz.

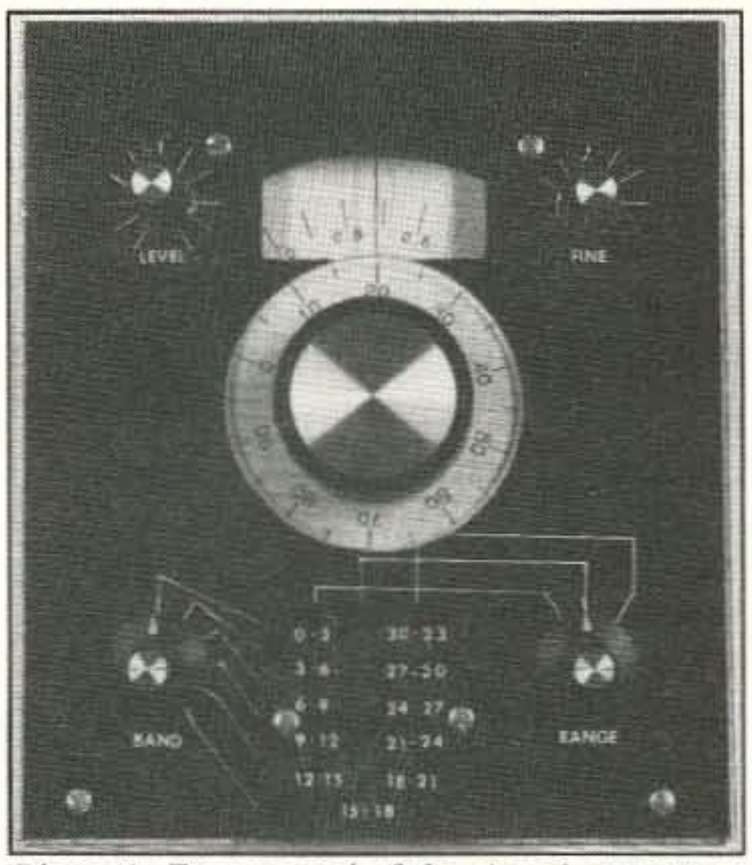


Photo A. Front panel of the signal generator.

All errors—capacitor plate shape, worm gear, circuit stray reactances, and the author's ability to position the shaft angle—are included. The net result is that the capacitor produces a straight line frequency tuning with less than 9 kHz maximum error from 15 to 18 MHz.

The oscillator circuit uses a CA3028 integrated circuit from RCA. Calibration is done by setting the low frequency end of the dial to exactly 15 MHz with the tuning slug in the variable inductor L1. Then tune the dial to the top and bring the frequency to exactly 18 MHz with the variable capacitor, then go back to the bottom and re-set to 15 MHz with the inductor, etc..

Although there is interaction between the two settings, this procedure of using the inductor at the low end and the capacitor at the high end will converge. Less adjustment will be required at each step, except the first one, until both ends of the dial line up at exactly 15 and 18 MHz. It is possible to cover this range in exactly 30 turns of the shaft and with less than 9 kHz of error at any point in the whole range.

Dial Construction

The main tuning knob covers 100 kHz per turn. A clear plastic skirt 2.5" in diameter with a paper dial divides this up into markings every 5 kHz. I used a 1.75" diameter knob and glued the skirt onto the back of the knob with plastic pipe cement, then fastened the paper dial to the back of the skirt with Scotch tape.

A large plastic pulley 4.5" in diameter is used to hold the main dial, which has 31 evenly spaced graduations marked in tenths from 0 to 3.0. A full-size pattern of both this dial and the knob skirt dial is reproduced in Figure 3. These can be repro-

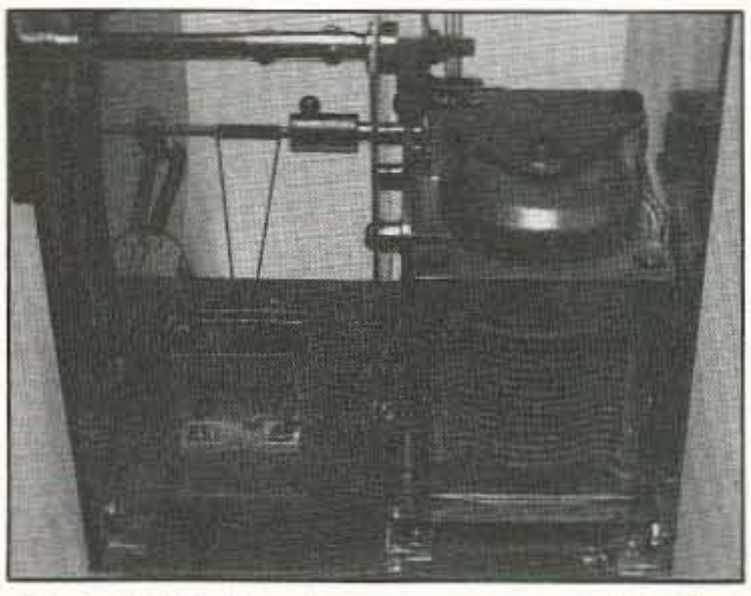


Photo B. Dial cord arrangement, right side.

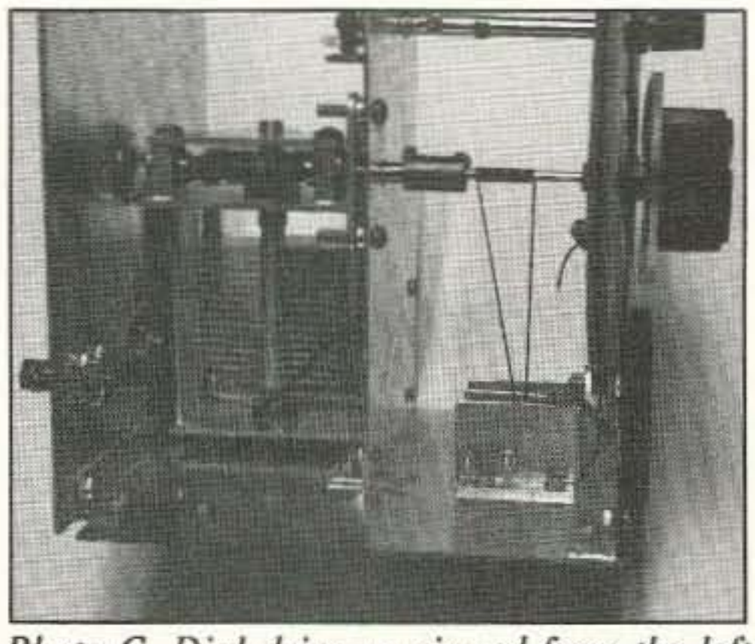


Photo C. Dial drive as viewed from the left side.

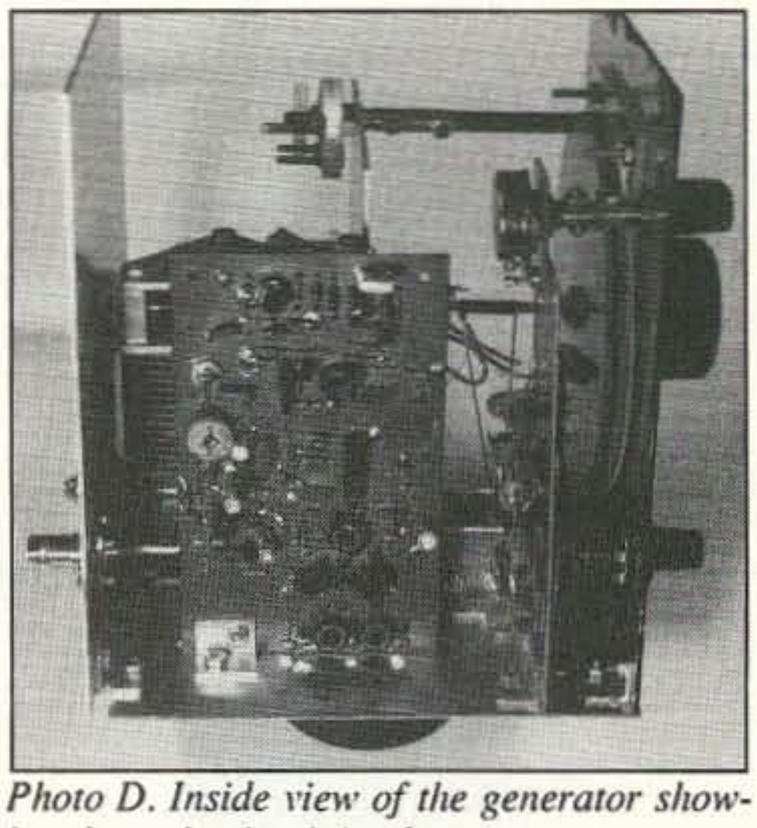


Photo D. Inside view of the generator showing the main circuit in place.

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Excludes 823.9875-849.0125 and 868.9875-894.0125 MHz.

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77116-B Midland CB with VHF weather & antenna	$66.95
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77913-B Midland CB portable with VHF weather	$79.95
76300-B Midland CB base station	$92.95
NPD-B Uniden National Police Directory	$19.95
FBE-B Frequency Directory for Eastern U.S.A.	$14.95
FBW-B Frequency Directory for Western U.S.A.	$14.95
RFD1-B MI, IL, IN, KY, OH, WI Frequency Directory	$14.95
RFD2-B CT, ME, MA, NH, RI, VT Directory	$14.95
RFD3-B DE, DC, MD, NJ, NY, PA, VA, WV Directory	$14.95
RFD4 AL, AR, FL, GA, LA, MS, NC, PR, SC, TN, VI	$14.95
RFD5 AK, ID, IA, MN, MT, NE, ND, OR, SD, WA, WY	$14.95
RFD6 CA, NV, UT, AZ, HI, GU Frequency Directory	$14.95
RFD7-B CO, KS, MO, NM, OK, TX Freq. Directory	$14.95
PWB-B Passport to World Band Radio	$16.95
ASD-B Airplane Scanner Directory	$14.95
TSG-B "Top Secret" Registry of U.S. Govt. Freq.	$16.95
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A60-B Magnet mount mobile scanner antenna	$39.95
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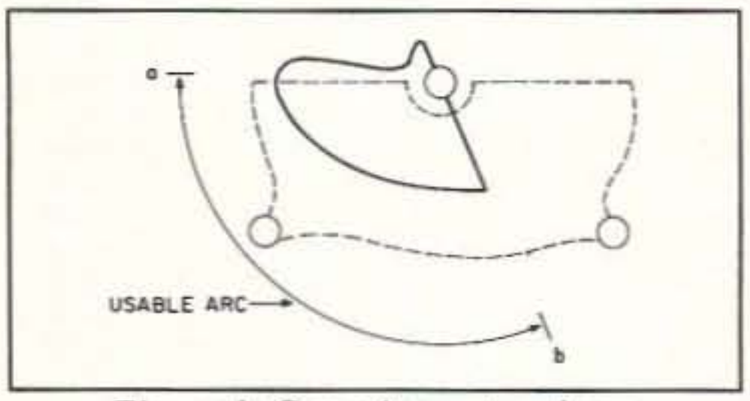


Figure 1. Capacitor rotor shape.

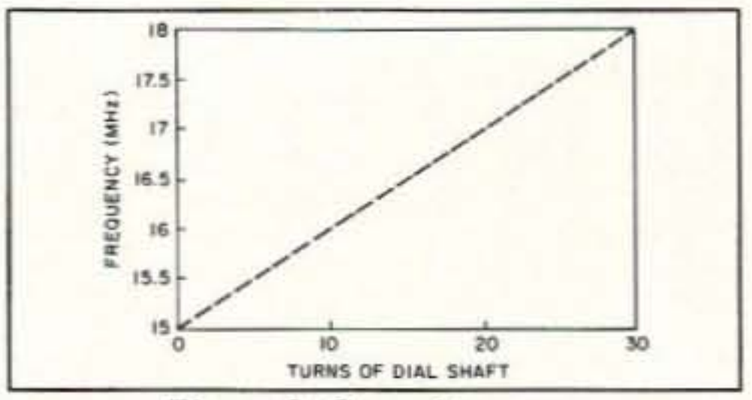


Figure 2. Capacitor error.

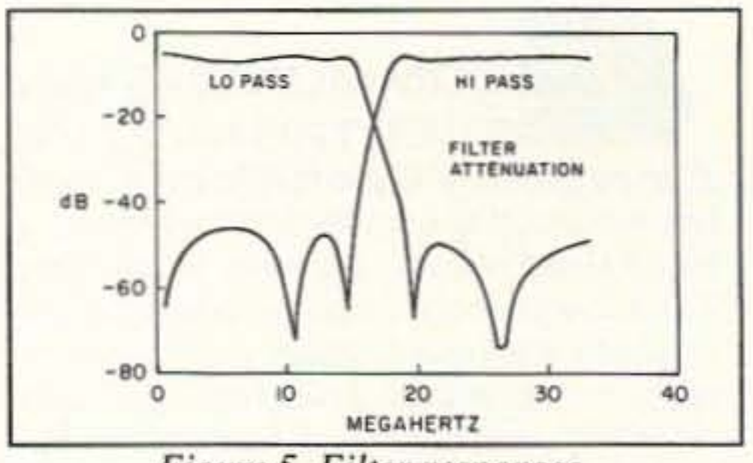
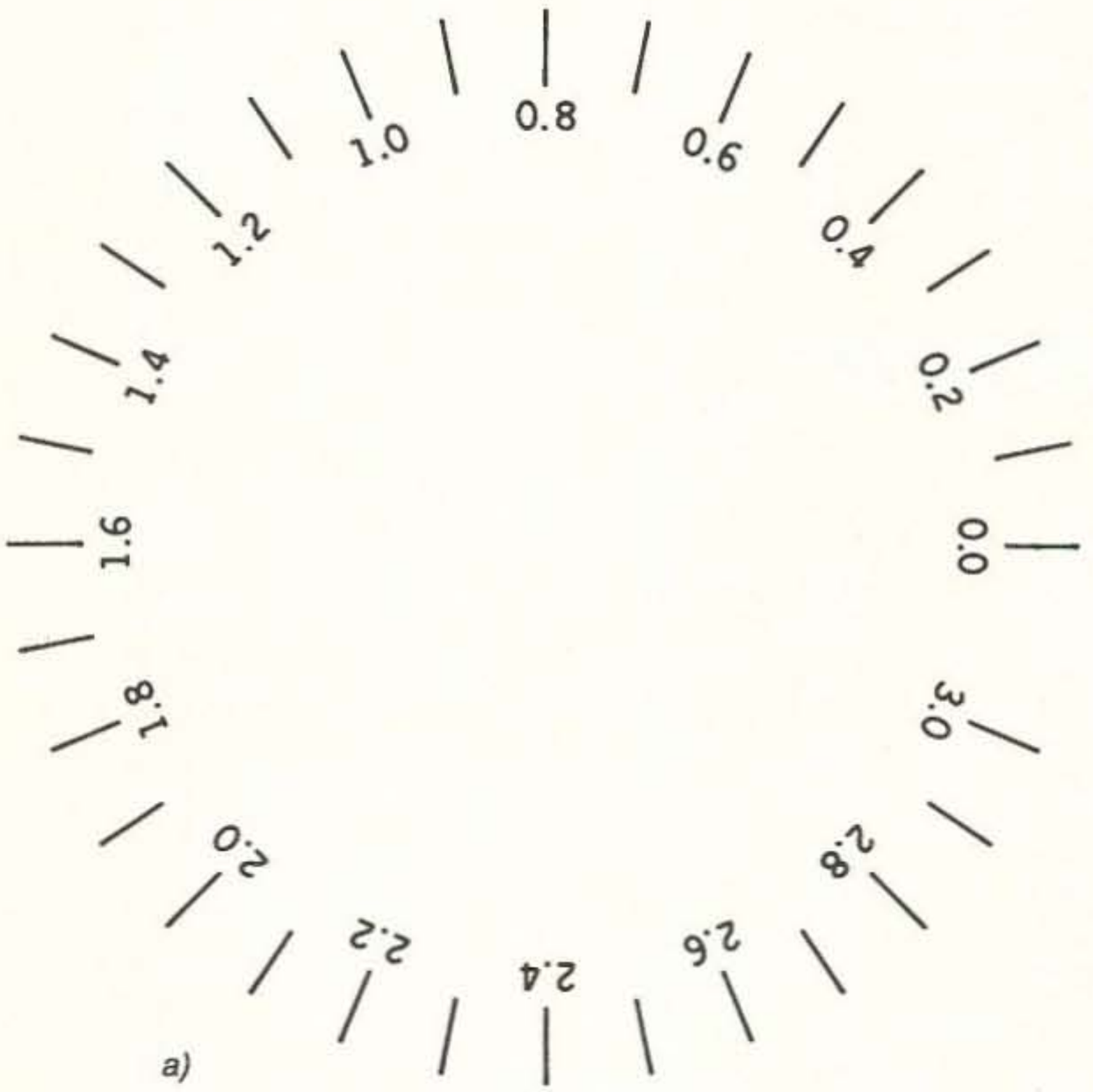
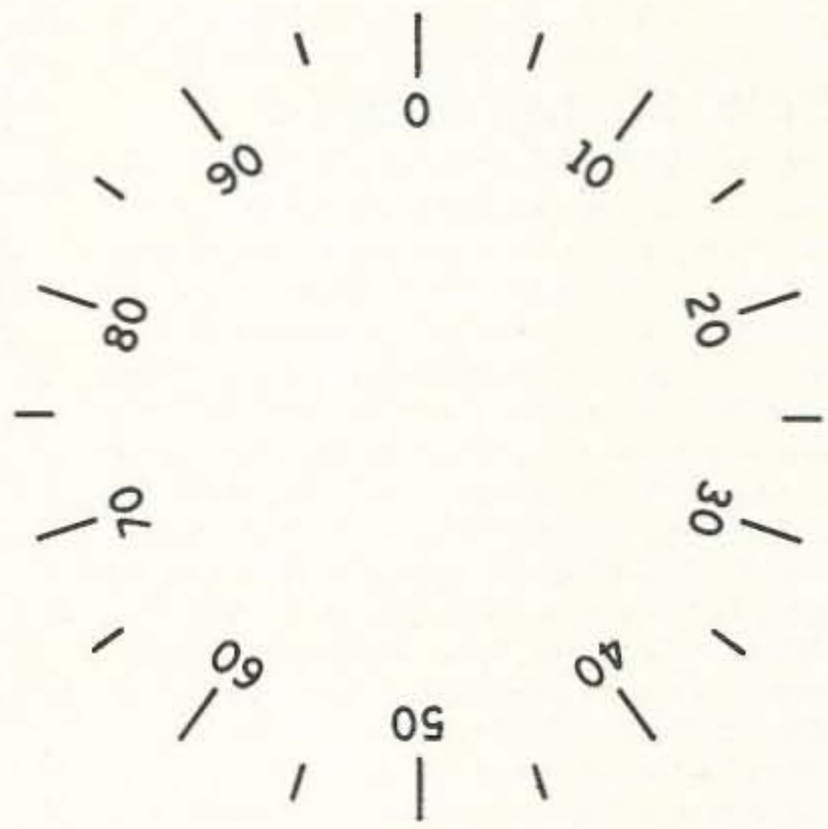


Figure 5. Filter responses.



a)



b)

Figure 3a and 3b. Frequency dials, full size.

duced on a copy machine for use in building the signal generator. A frequency in the 15 to 18 MHz range is set by adding the main dial reading in MHz to 15, then reading the kHz from the knob skirt.

The main dial pulley is driven by a string arrangement as shown in Figure 4, with 30 turns around a 1/8" shaft wound from back to front as the tuning range is covered. Two 1"-diameter plastic pulleys feed the cord up and across two small brass guide pulleys and onto the large dial.

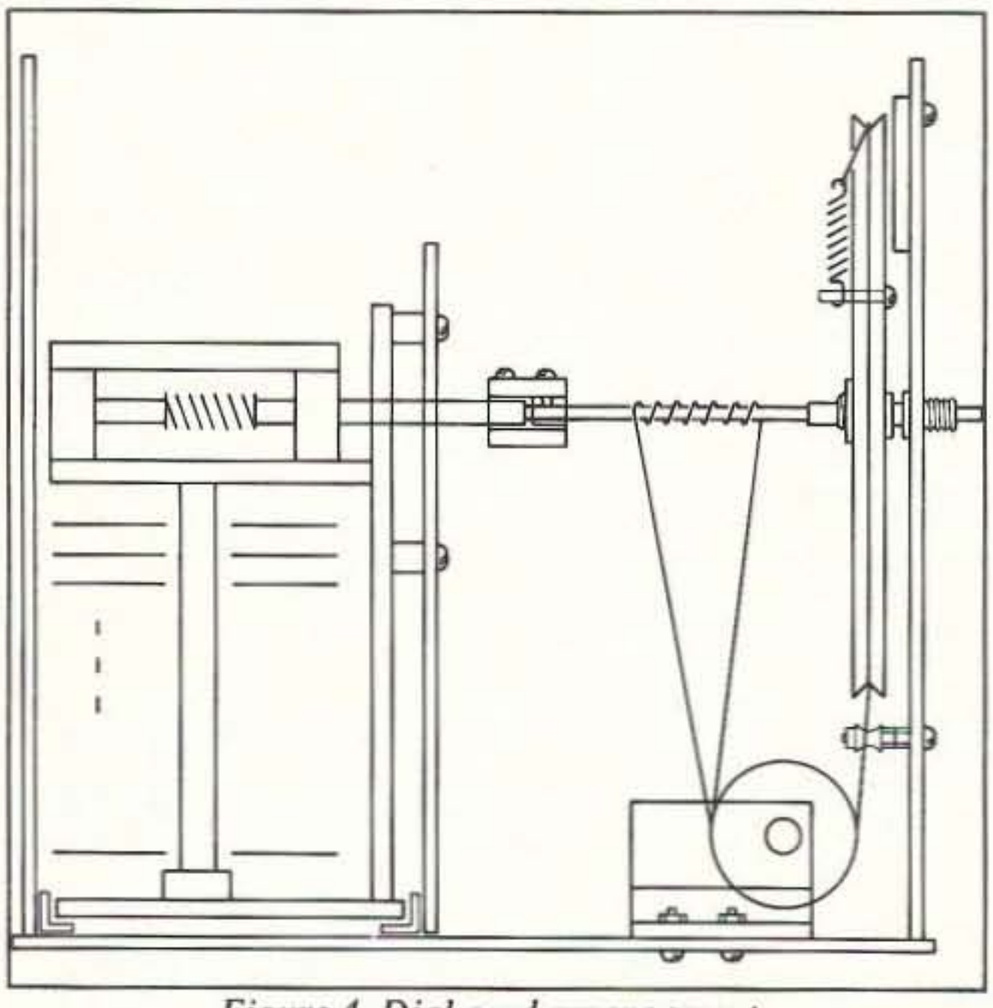


Figure 4. Dial cord arrangement.

Frequency Mixing

The remainder of the high frequencies from 0.4 to 33 MHz is covered by mixing this 15 to 18 MHz base range with a switched fixed frequency oscillator in 10 additional bands of 3 MHz each. Each fixed frequency provides two bands, one above and one below the base range. For example, mixing the base range with a 6 MHz oscillator signal produces 9 to 12 and 21 to 24 MHz ranges. The upper or lower band is selected by switching in either a high-pass or low-pass filter, described later in this article. Only five fixed frequencies are required: 3, 6, 9, 12, and 15 MHz.

An MPF102 FET transistor circuit is used with five separate slug-tuned tank circuits to generate the fixed frequencies.

The five tank circuits can be built and checked with your dipper before soldering into place on a piece of single-sided circuit board mounted behind the six-position band switch.

Final setting is done after the cover is in place by adjusting the slugs through holes drilled in the left side of the cover.

See the parts list for suggested tank circuit information. However, you can use practically any coil forms in your junk box by winding a trial set of turns for a particular capacitor, checking the frequency on your dipper, and then removing turns or rewinding with additional turns to get to the proper frequency.

In addition to the desired sum and difference frequencies just described, other unwanted signals may be produced in a mixer circuit. My use of the MC1496 doubly balanced mixer greatly eliminates both fundamentals, the fixed frequency and the 15-18 MHz adjustable one. Even harmonics of both are also balanced out. In addition, signal input levels to the mixer are properly controlled to keep them below 60 mV in order to minimize third order mixing products.

The mixer is unbalanced by shifting the DC bias of one carrier input when the 15-18 MHz band is selected in order to let that signal come through without mixing. Power to the fixed oscillator circuit is turned off, and the filters are bypassed when selecting this base range.

Filters

After mixing, either the sum or difference frequency is selected by filter FL1 or FL2. These are each five-pole elliptic designs with 40 dB attenuation of the unwanted signal. The designs are not critical and allow for normal component tolerances. The filter responses are shown in Figure 5 and the corresponding schematics in Figure 6.

Standard value ceramic capacitors are used. Inductors are wound on T37-2 (red) powdered iron torroids with #26 enamel wire for the low pass and #30 for the high pass. No alignment is necessary.

Amplifier and Level Control

After mixing and passing through the filters, the signal needs to be boosted in amplitude for some applications. The MC1350 circuit provides up to 40 dB of gain when used in a push-pull arrange-

Parts Availability Table

C1	25-220 pF variable, Fair Radio Sales #C9/SG-15
C2	8-20 pF trimmer, Fair Radio Sales #074-050J-2
C3	5-12 pF trimmer
C4	16 pF
C5	300 pF
C6,C10,C13,C15,C16,C17,C19,C20, C21,C22,C23,C24	0.01 µF
C7,C8,C11	47 pF
C9	470 pF
C12	68 pF
C14	0.047 µF
C18	0.22 µF
C25	0.022 µF
R1	2k resistor
R2	3.9k
R3	4.7k
R4,R5	15k
R6	1.8k
R7	2.4k
R8,R13,R15,R17,R19,R20,R25,R32,R35	1k
R9	100k
R10,R36	270 ohm
R11,R12	470 ohm
R14,R18,R26,R37	510 ohm
R16	820 ohm
R21,R29,R34	10k
R23	300 ohm
R24	100 ohm
R27	1.5k
R28	680 ohm
R30	1k potentiometer
R31	1.2k
R33	51k
R37	150 ohm
L1	5T #22 wire on 1/4" slug tuned form
T1,T2	trifilar 10T #26 wire on Fair Rite #2643002401 torroid, Amidon FT37-43 also usable
U1	Harris/RCA CA3028 RF amplifier/oscillator, Jameco, also available as ECG724
U2	Motorola MC1496 balanced mixer, Jameco
U3	Motorola MC1350 if amplifier, Jameco, also available as NTE746 or ECG746
MPF102	Radio Shack 276-2062
2N2222	Radio Shack 276-1617
S1	2-pole, 6-position rotary switch, Radio Shack
S2	4-pole, 3-position rotary switch, Radio Shack
knobs	Caltronics Filter inductor (all wound on Amidon T37-2 torroid cores):
3 uH	27T #26
4.6 uH	34T #26
5 uH	36T #30
7.6 uH	44T #30 Fixed frequency tank circuits:
3 MHz	70T #33 on 9/32" form with 100 pF capacitor
6 MHz	27T #30 on 9/32" form with 100 pF
9 MHz	21T #26 on 1/4" form with 100 pF
12 MHz	18T #26 on 7/32" form with 100pF
15 MHz	11T #26 on 7/32" form with 100 pF

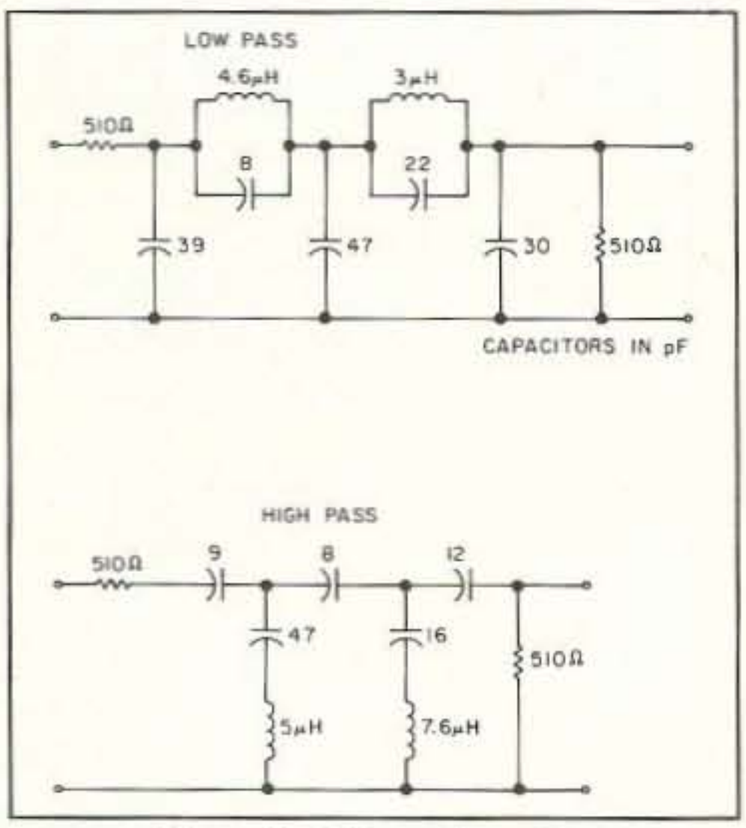


Figure 6. Filter schematics.

ment as shown. A broadband transformer using a ferrite torroid from Fair-Rite Products, terminated in a 1k ohm resistor, does a nice job over the entire high frequency spectrum.

Level control comes from adjusting the AGC input voltage between 5 and 9 volts with a 1k ohm front panel potentiometer. Maximum gain occurs at 5 volts with an over-60-dB drop in signal at 9 volts. A cathode follower circuit then isolates the amplifier and drives the output BNC jack with over 200 mV at a 270 ohm source impedance.

Power

I recommend a regulated 12-volt supply for this generator. I installed an RCA phono jack on the rear panel and use an external bench supply. There is ample room, however, inside the home-brew 6" x 7" x 6" box to accommodate a battery- or line-operated supply if you want to build one in.

Construction Details

The overall schematic is shown in Figure 7. Plastic pulleys are easily turned with an electric drill and file (see J. Pivnichny, "A Homebrew Tuning Dial," *Ham Radio*, December 1988, p.75). The small brass pulleys are made from 1/4" brass spacers, also using the electric drill and file for turning. I included a small APC trimmer capacitor as a fine-tuning control. This is ideal for tuning through the skirts of crystal filters. One of the nice things about home-brew gear is that you can include features like this if you do crystal filter experimenting.

The 7" x 6" front panel has a 1" x 2" window cut out and backed with a 1-1/2" x 3" x 1/8" sheet of clear plastic. A vertical line is scribed on the plastic and filled with black magic marker to serve as the cursor. White dry transfer letters are used on a dark gray paint. Additional lines are put on using a drawing pen and white drawing ink. A final lacquer spray before mounting the controls protects the lettering.

All components except the panel controls and tank circuits are mounted on the foil side of a 3" x 5" piece of single-sided epoxy glass circuit board. The foil serves as a ground plane. Component leads pass through counter-sunk holes and are interconnected on the back side. See the photographs for placement of the circuit boards inside the box.

Final Words

I've used the generator along with my sensitive RF voltmeter (see J. Pivnichny, "A Sensitive RF Voltmeter," *Ham Radio*, July 1989, p. 62) for lots of measurements around the shack. Most measurements can be made with the signal provided at the BNC jack. For very sensitive work, remember that unwanted signals (although 40 or more dB down) are still present so additional external filtering may be desirable.

Good luck with building your own laboratory-style signal generator. 73

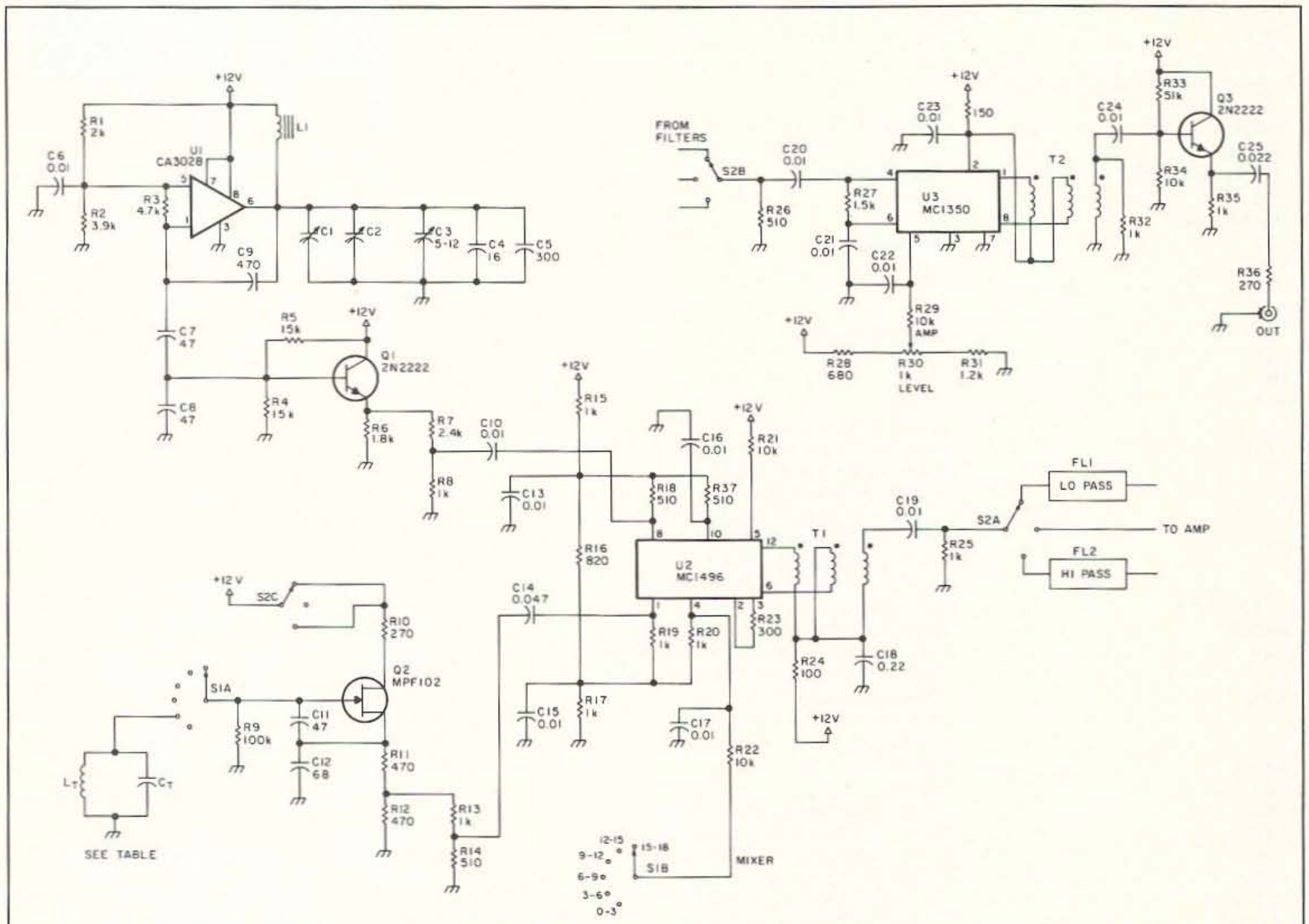


Figure 7. Overall schematic of signal generator.

A Receive Converter Adapter for 2 Meter Transceivers

Monitor 6 meters or 220 MHz with this unique circuit.

by J. Robert Witmer W3RW

Curious about 6 meter or 220 MHz activity in your area but not ready to spend the money for a dual-band or extra transceiver to find out? The receive converter adapter approach may be just the way to solve this problem.

OK, what's a receive converter adapter? A receive converter adapter is an interface device that provides a way to add receive coverage of an additional ham band by the use of an external converter, while still allowing normal operation of a 2 meter transceiver. This article describes how to build and use the receive converter adapter and offers some approaches to putting together converters to use with it.

Many of the latest model 2 meter FM transceivers have extended receive coverage and a large number of memory channels. With the converter adapter you can interface a converter covering an additional band such as 220 or 6 meters to the 2 meter transceiver without impacting normal 2 meter operation, and put some of those extra memory channels to use.

The only catch in this approach is that the frequency range you plan to use for the output of the receive converter (the IF)—say 142 MHz to 144 MHz—must be relatively free of on-the-air signals in your area. If it isn't, because of how the converter adapter works, you will receive both the normal 2 meter signals and the converted signals simultaneously—which, depending on your operation, may not be a disadvantage, either. Figure 1 shows how this works.

How it Works

A Wilkinson Hybrid ("Wilkinson Hybrids," *Ham Radio*, January 1982) forms the basis for the receive converter adapter design (see Figure 2 for the schematic). A similar technique is used to feed stacked beams for improved antenna gain. The Wilkinson Hybrid is shown by the shaded area in Figure 2. In receive operation the Hybrid acts as a combiner to couple two inputs to the receiver with minimal insertion loss, maintain isolation between the inputs and provide impedance matching. During receive the converter adapter works essentially this way—it couples the output of the converter and the 2 meter antenna to the 2 meter rig.

During transmit, without the circuitry outside the shaded area, the Wilkinson Hybrid would act as a splitter dividing the transmitter output approximately equally between the two ports. This is clearly not desirable—the effective output power to the antenna would be cut in half and the receive converter would probably be blown away on the first transmission. In the converter adapter, diodes D1 and D2 short during transmit, which protects the output of the converter and electrically disconnects the quarter-wave section of coax $\pi 2$ from the 2 meter connection port of the adapter. This action prevents the Wilkinson Hybrid in the converter adapter from acting as a splitter.

To provide impedance matching for the transmitter, the additional coax section $\pi 3$ is inserted, otherwise the transmitter would see a greater than 2:1 VSWR. Sections $\pi 1$ and $\pi 3$ are shown separately in the figure for explanation purposes but in the actual adapter they are combined into one continuous length of coax resulting in a half-wavelength section. The addition of section $\pi 3$ does have a disadvantage on receive because it interferes with the normal operation of the Wilkinson as a combiner by presenting a mismatch to the output of the converter. (Nothing is ever as easy as it first seems!) This causes an effective loss in the coupled output of the converter of approximately 3 dB. In actual operation this is not usually noticeable because of the gain of most converters and the strength of typical FM signals. The low-pass filter consisting of C1, C2 and L1 suppresses the low level harmonics generated by D1 and D2 and provides additional rejection of out-of-band interference.

The Receive Converter Adapter can be used with a scanner as well (see Figure 3 for the scanner configuration). During receive, the signal from the antenna is split approximately in half to the scanner and 2 meter rig ports. The electrical disconnection of coax section $\pi 2$, described above during transmit, permits the 2-meter rig to be electrically connected directly to the antenna with minimum interaction and transmit loss due to $\pi 2$. The only other difference is that the lowpass filter consisting of C1, C2 and L1 is moved to the antenna port. The low-pass filter will have an effect on scanner performance as you go higher in frequency from 2 meters.

Using the Converter Adapter

I use the converter adapter to add 6 meter receive capability to my Kenwood 4100A dual-band transceiver. I use the 142 MHz to 144 MHz section of the band as my receive IF. Where I live, approximately 15 miles north of Philadelphia, there is very little strong FM signal activity in the 142 to 144 frequency segment. Check the band for a similar "quiet" segment in your area before selecting an IF band. I've also used the converter adapter approach to monitor 220 MHz activity using the 146 to 148 MHz range as an IF but I've encountered some interference from in-band 2 meter signals. Converters for use with the converter adapter can be constructed using basic building block circuit elements. Figures 4, 5 and 6 show typical configurations that can be used for each band. A brief discussion of each follows.

Six meter converter adapter operation: The 6 meter converter and hook-up are shown in Figure 4. The preamplifier section of my converter consists of the RF amplifier from an RCA 1000 commercial rig, but any 6 meter preamp such as those available from Hamtronics or shown in the *ARRL Handbook* ("Dual-Gate MOSFET Preamplifiers for 28, 50, 144, and 220 MHz", the *1990 ARRL Handbook*, Chapter 31, pages 31-1 to 31-2) should also work well. The local oscillator is a Butler type (R. Campbell, "A Clean, Low-Cost Microwave Local Oscillator," *QST*, July 1989, pages 15-21.) with a 90 MHz 5th overtone crystal (see Figures 7, 8a and 8b).The capability of the circuit to ``free" oscillate with a 47k resistor in place of the crystal and L2 can be used to get the oscillator L1 and C1 components on frequency to insure crystal oscillation. Use a frequency counter or FM broadcast receiver to check the operating frequency. L1 is non-critical—the best approach is to make a coil like that specified, try it, and if it doesn't give you the desired frequency oscillation range with C1, adjust its size. If you have an approximately similar variable slug-tuned coil, try that. The same approach was used for L2, the crystal frequency trimming inductor. Once the oscillator free-runs in the right range remove the 47k resistor and install the crystal and L2. Monitor the current to the oscillator and adjust C1 for a peak in current drain, indicating that oscillation is occurring. Adjust L2 for on-frequency operation and re-peak C1 for maximum

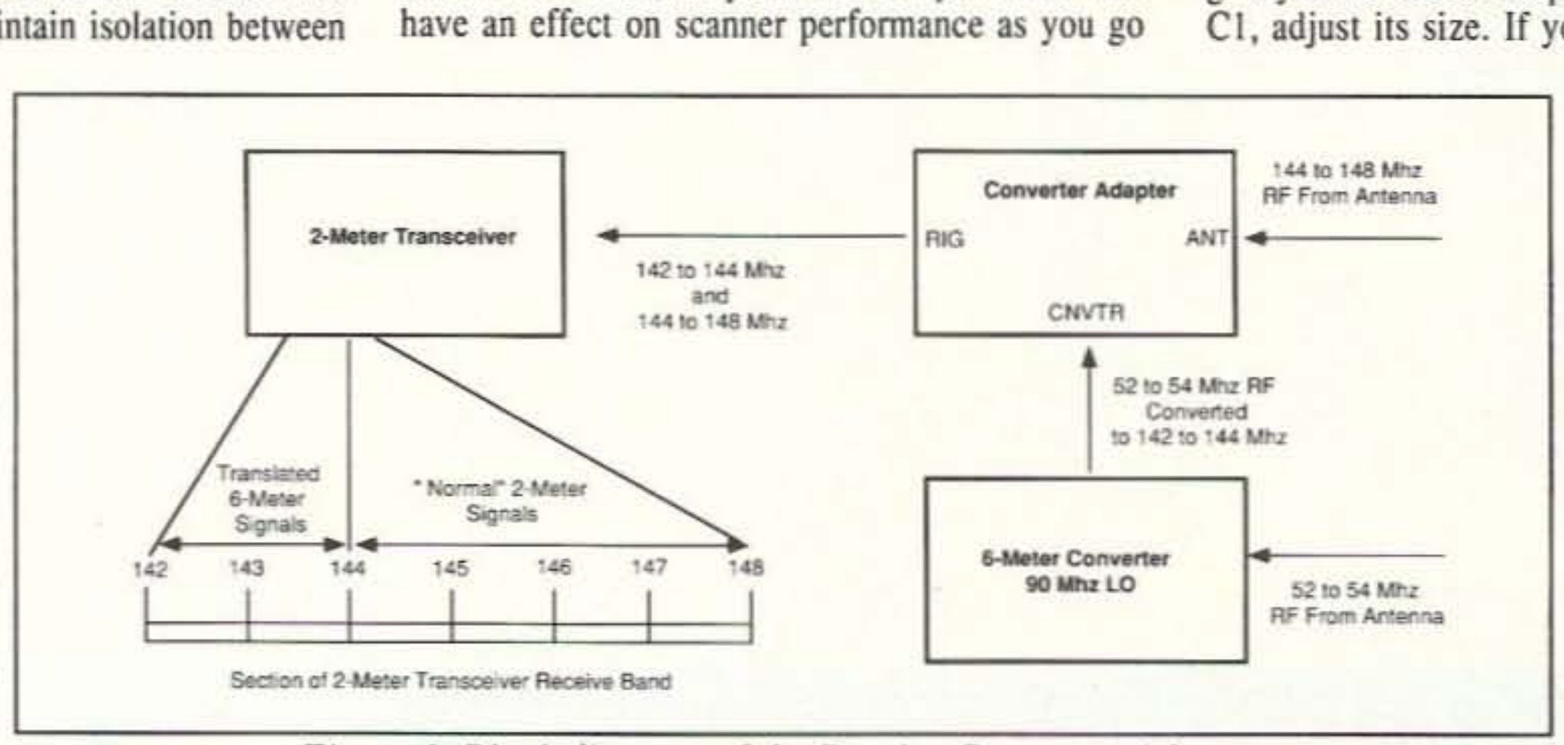


Figure 1. Block diagram of the Receive Converter Adapter.

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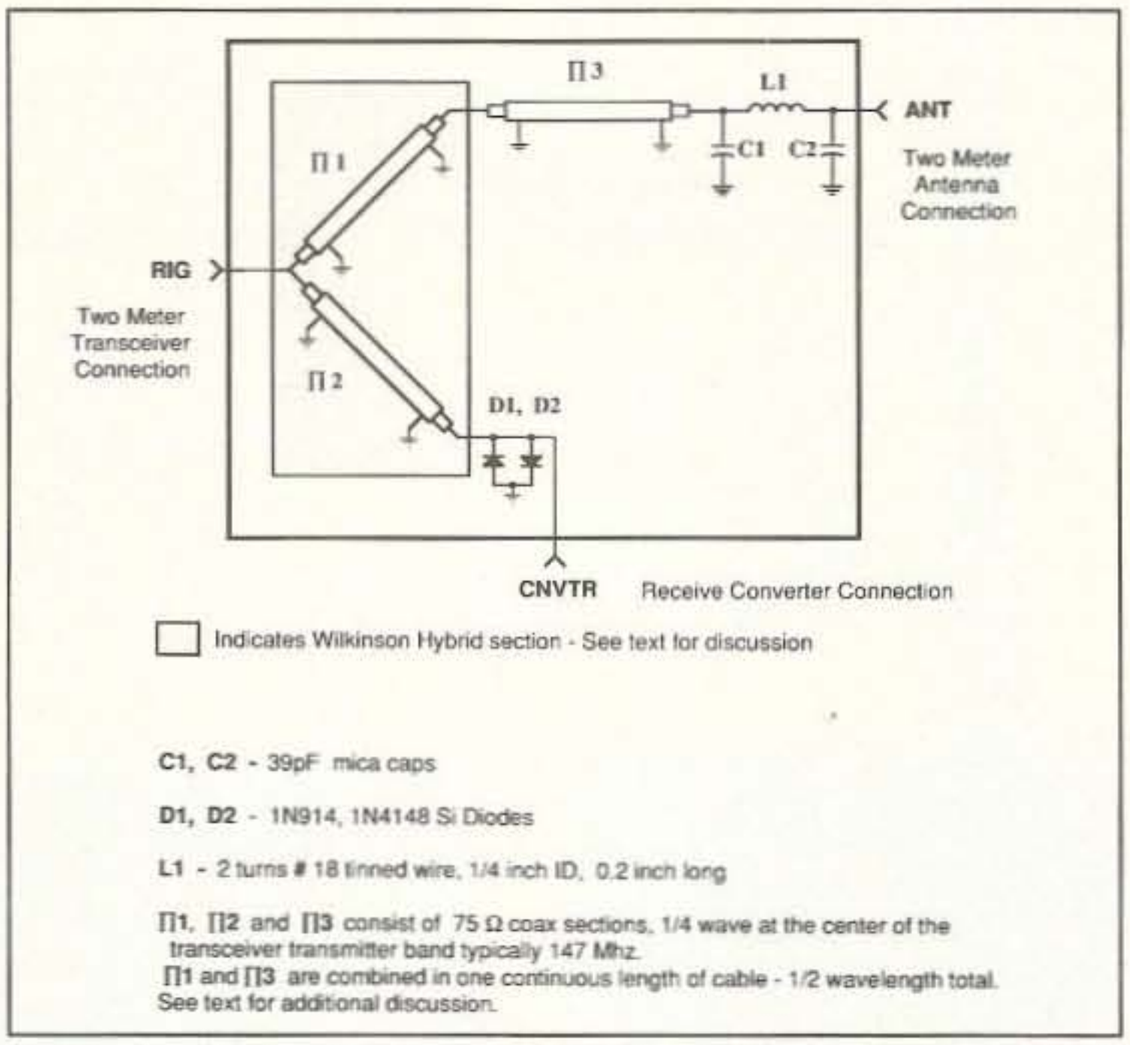


Figure 2. Schematic diagram of the Receive Converter Adapter as used with a 2 meter transceiver.

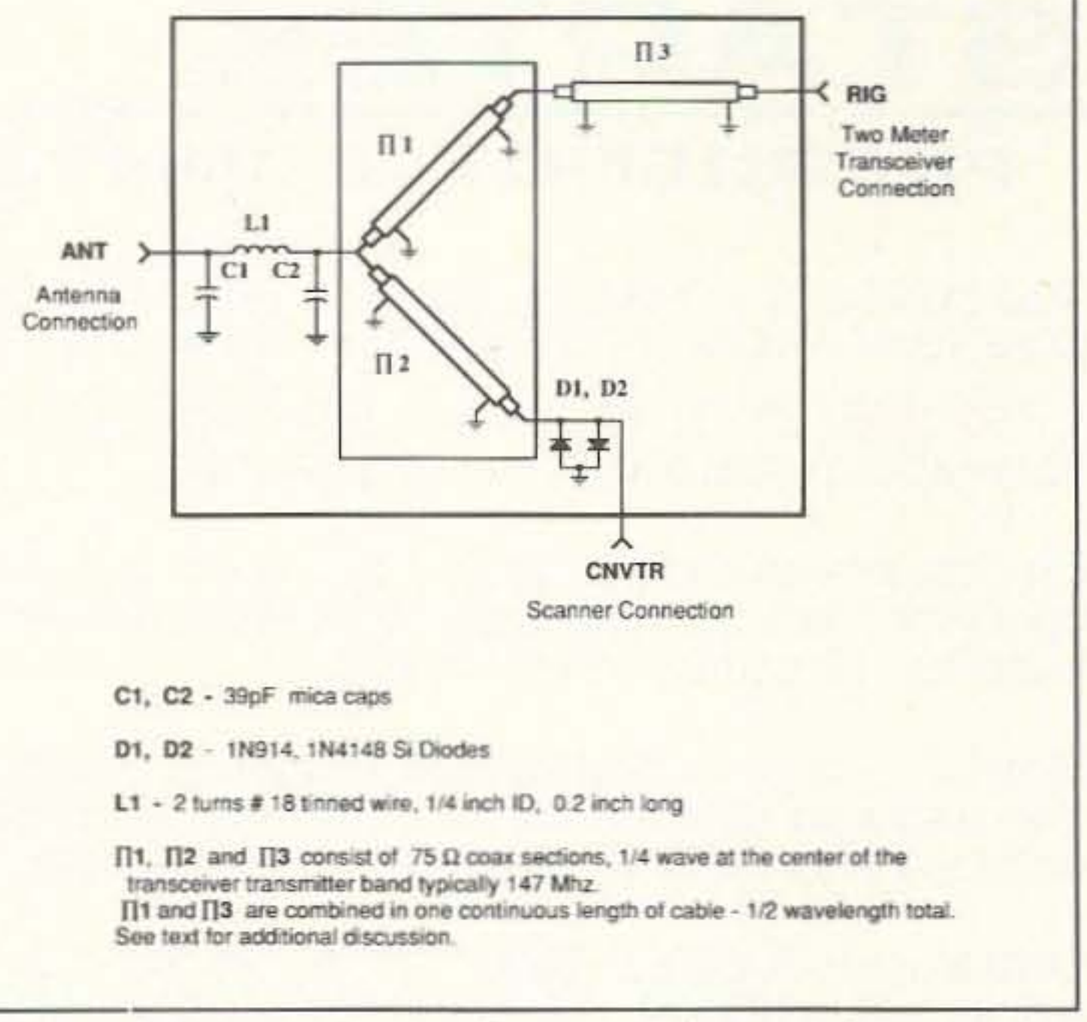


Figure 3. Using the Receive Converter Adapter with a scanner.

current—there is some interaction between these adjustments. Between the output of the oscillator (Q1 and Q2) and the MMIC (U2) is a low-pass filter consisting of L4, C16 and C17.

The mixer is a Mini-Circuits Labs SBL-1 DBM or equivalent. With the 90 MHz LO, 6 meter signals from 52 to 54 MHz are translated to 142 MHz to 144 MHz, which provides for ease of readout.

220 MHz converter adapter operation: Two 220 MHz converter configurations are shown in Figures 5 and 6. The converter in Figure 5 translates 223-225 MHz to 146-148 MHz which results in some interference between on-the-air 2 meter signals and the translated 220 signals, an example to possibly avoid depending on the activity in your area.

I've also used a 220 converter similar to the 6 meter converter just described (see Figure 6) except it used an 80 MHz LO. With an 80 MHz LO, signals from 223 to 225 MHz are translated to 143 MHz to 145 MHz, which again provides for simplified frequency translation.

Construction

My converter adapter was constructed in a small aluminum chassis using a mixture of UHF and BNC connectors to match the cables I had. RG-59/U 75 ohm coax was used. Be careful that diodes D1 and D2 are soldered directly across the converter connector (CNVTR) with minimum lead length. If the diodes are accidentally placed across either of the other connectors, a high SWR will be presented to your rig on transmit. Installation of the diodes is best done after the coax sections are soldered to minimize excess heating. An ohmmeter check of the coax sections after installation is a good idea to make sure no inadvertent shorts were created during soldering. A two-lug terminal strip was soldered to the base of the antenna port connector SO-239 and supports the input (coax) end of L1 and C1. The output side of L1 connects directly to the center conductor of the antenna port connector to which C2 is soldered.

Trim the coax to approximately the length needed—remember to include the velocity factor of the coax. For RG-59/U this is usually 0.66, which means a quarter-wavelength of cable at 147 MHz should be approximately [(246/147) x 0.66] feet long, which comes to approximately 1.1 feet, using the formulas from Chapter 16 of the *ARRL Handbook*. The half-wave section is simply twice this long. (If you are going to use the grid dip oscillator (GDO) technique for fine tuning the sections, cut them a little long to begin with.)

Oscillator Construction: The local oscillators for the 6 meter and 220 MHz converters were constructed using a technique I've used for several years for RF circuits. Using a 2-1/4" by 3-3/4" piece of double-sided G-10 circuit board material as the base, I glued small pieces of single-sided board material, cut to the size required for the particular pads, to the main board. Feedthrough bypass capacitors are used where possible for bypass requirements. With this approach, the DC power distribution is done on the opposite side of the circuit board from the RF components. Grounding is accomplished by soldering directly to the ground plane—keeping the RF circuit ground leads as short as possible. If a change is required you can pry the desired pad loose and glue it in the new location. Figures 8A and 8B show the approximate part layouts of my 90 MHz local oscillator. Try to use small components when possible; it will simplify construction and minimize problems associated with layout. L1 and L2 must be mounted perpendicular to each other. L1 is mounted horizon-

Continued on page 59

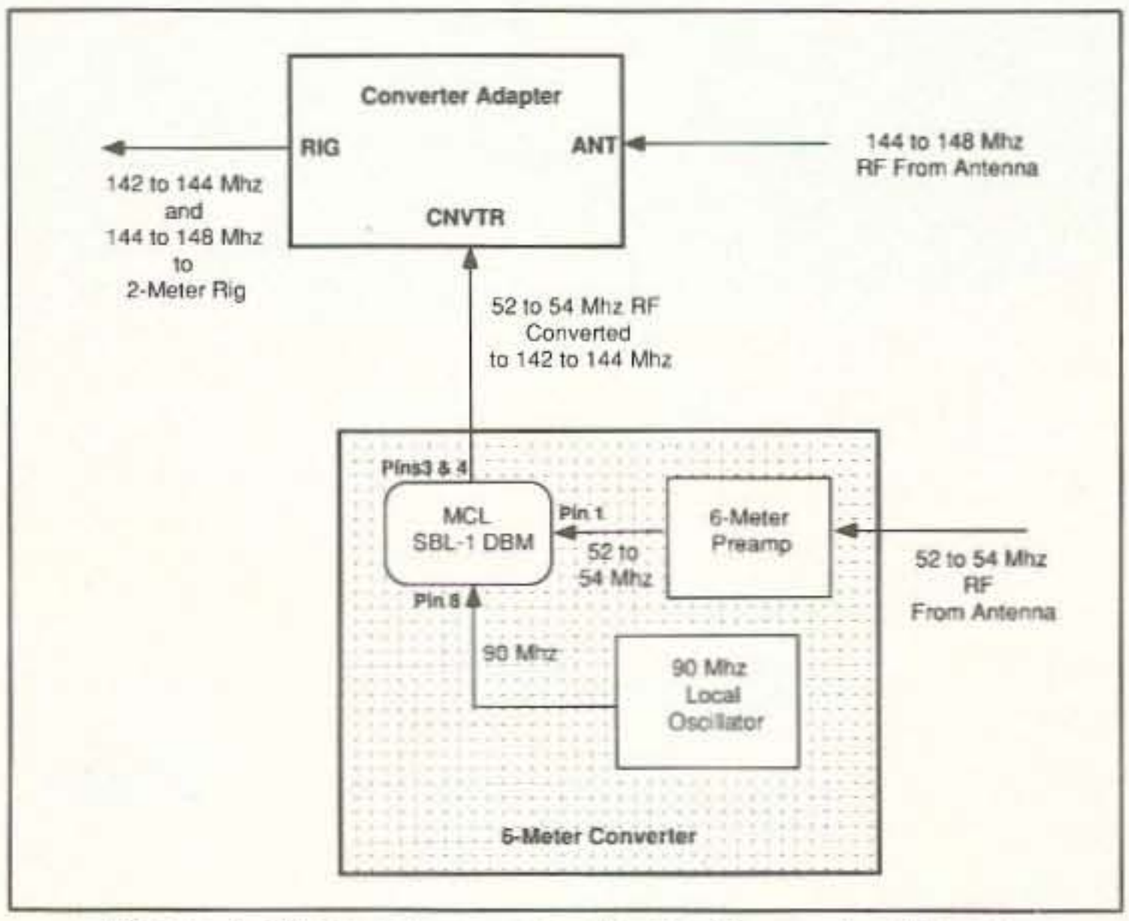


Figure 4. Six meter converter for the Converter Adapter.

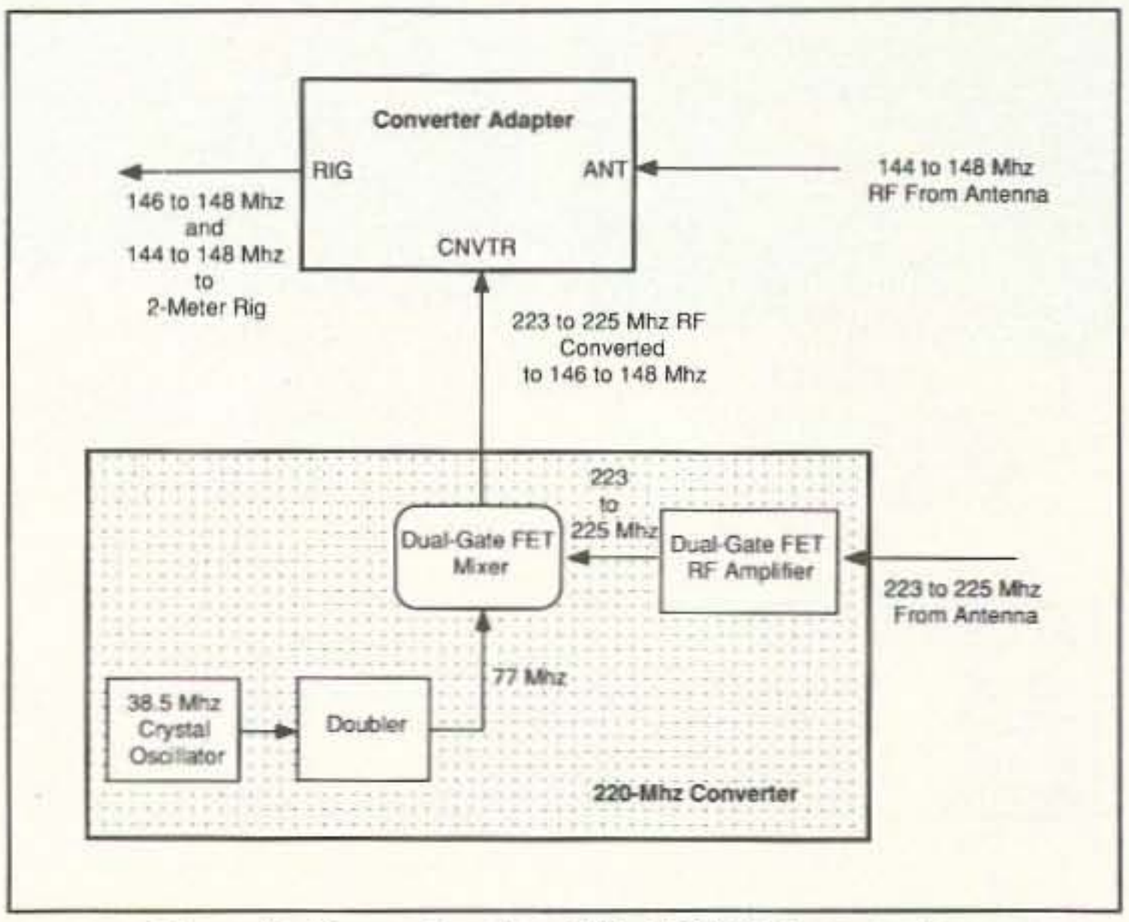
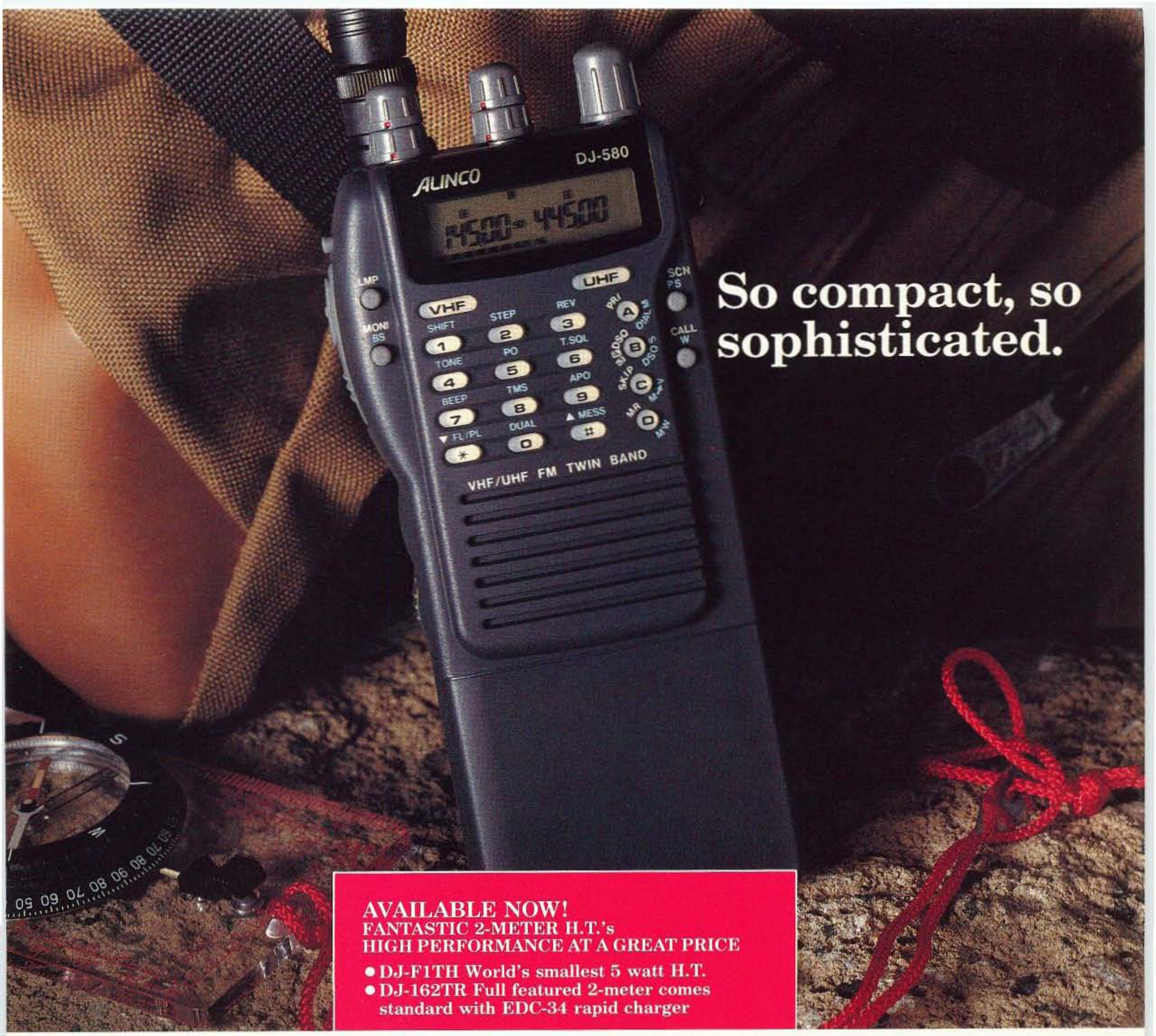


Figure 5. Converter circuit for 220 MHz operation.



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73 Review

by Michael Bryce WB8VGE

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20 meter antenna), $329.80.

Mention MFJ and visions of antenna tuners and ham accessories pop into your head. Until recently, QRP rigs weren't in the line-up. The MFJ-9020 will alter your thinking from now on.

The MFJ-9020 is a 20 meter QRP (low-power) transceiver designed by Rick Littlefield K1BQT. It covers 14.000 to 14.075 MHz of the 20 meter CW band. The MFJ-9020 is a CW-only transceiver; it will not transmit SSB nor receive SSB.

First Impressions

After opening the box, what really impressed me was the "feel" of the rig. It's constructed of 1/16-inch aluminum throughout. The speaker is top-mounted. There are but three controls on the front panel: volume, VFO tuning and RIT. Two LEDs give the operator visual verification of power on and off as well as transmit.

The back panel sports the usual power connections, which fit a 5.5mm o.d. coaxial plug. The center pin is positive. For keying the radio, you have two choices. First, you may plug in a straight key, output from a keyer or even an old bug in the key jack. The key jack requires a 3.5mm mono plug. Or, you may install the optional keyer and then use the keyer's jack, which requires a 3.5mm stereo plug.

There's an additional switch for the optional CW audio filter. In the review unit, both the keyer and the audio filter are in place. Both the switch to select the audio filter and the keyer speed are mounted on the back panel.

A real surprise for a QRP transceiver is finding an SO-239 antenna connector instead of the common RCA jack many QRP builders use for RF connections.

Of course I had to open the case for a look inside. I'm impressed! The entire transceiver is built on one double-sided board with plated-through holes. There are but three wires in the entire radio: two wires for the speaker and one from the PC board to the antenna connector. Everything else is mounted on the PC board. And I mean *everything* is mounted on the PC board, including all the pots, LEDs and all the

Photo A. The MFJ-9020 20 meter CW transceiver.

Photo B. The MFJ integrated CW station includes the transceiver, a portable antenna tuner, a portable power pack and a 20 meter folded dipole.

input/output jacks. Not only does this make for a very reliable unit, but it also reduces labor cost during construction. The PA transistor, an MRF 476, is bolted to the side of the chassis. The MFJ-9020 easily passed the number five crane test. That's a drop of three feet onto a solid surface.

The PC board is well labeled with all the adjustment pots clearly marked as to what they do. All the ICs are in sockets for easy replacement if and when replacement is needed. If you've ever worked on a double-sided board with plated holes, you'll instantly know the advantages of IC sockets. There are no "Do Not Touch" areas on the board. The circuit is simple and well thought out.

The Manual

A very detailed manual comes with the MFJ-9020. They even include all the Radio Shack stock numbers for the required plugs used for power and keyer. By the way, don't use molded adapters as they may damage the input/output sockets on the PC board.

Both a block diagram and full schematic have been included. This is a real nice touch for repairing the MFJ-9020 should the need arrive. If nothing else, it's nice to read how it works and why.

There are many tips for setting up the MFJ-9020 and getting it on the air. Included in the manual are several examples of simple 20 meter antennas. Several pages of field alignment procedures, as well as some general troubleshooting, may also be found in the manual.

The Insides

The MFJ-9020 is sensitive. A side-by-side comparison between my Argosy II and the MFJ-9020 showed very little difference between the two. If I could hear a station on the Argosy II, I could hear it on the MFJ-9020. The receiver is a superhet—NOT A DIRECT CONVERSION RECEIVER! You get single-signal reception with the MFJ-9020, thanks in part to the 8-pole crystal filter. The crystal filter is about 750 Hz at -6 dB. With the optional audio CW filter, you have some very powerful QRM-fighting tools.

Receiver signals are preselected by a 4-pole bandpass filter before the signal is routed to the NE602 receiver mixer. A 78L05 keeps the VCC regulated at 5 volts to ensure a voltage-stable VFO. A varactor RIT circuit provides VFO shift on receive only. A MC1350 IF amplifier is coupled to a second NE602 used as a product detector. This comprises the IF stage. Audio from the product detector goes to an LM386. The LM386 operates at full-loop gain and the volume level is set by an adjustable attenuator. Receiver AGC is provided by the LM386. AGC delay seems to be just about right for CW use.

On the transmit side, a third NE602 mixer

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b) **Some manufacturers state they have high capacity batteries but they neglect to tell you that their case size is considerably LONGER than the original case size (DON'T BE SURPRISED, THE ABOVE SHOULD BE STATED).**

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couples signal from the VFO with its 10 MHz transmit oscillator to produce 14 MHz CW. After two stages of amplifiers/buffers, the resulting signal is applied to the PA transistor. The MRF 476 produces 5 watts at 13.8 volts, consuming 1.2 amps of current.

Keying is semi-QSK with an antenna relay. There is an automatic 700 Hz transmit offset, just like the big rigs. During transmit, a sidetone is injected into the audio line.

Performance

Enough of this techno talk. How well does the MFJ-9020 work? In a word, great!

With only three controls to worry about, putting the MFJ-9020 on the air is about as simple as you can make it. You'll need a power supply running 13.8 volts at one amp or better. Any power source of one amp or so at 13.8 volts will work. A battery will work fine, but we'll talk more about battery operation later.

There is no reverse polarity protection built into the MFJ-9020. If you hook it up backwards, you'll be sending it back to the factory. Although the pin-out of the coaxial plug is shown in the manual, it's not silk-screened on the back of the radio. I can see in the heat of a contest someone hooking the MFJ-9020 up backwards. In the next run, MFJ will add a zener diode and fuse for full over-voltage and polarity protection. A new silk-screen will be cut for the back panel showing the pin out for the power jack.

With a 13.8 volt supply into a 50 ohm dummy load, the MFJ-9020 produces 5 watts right on the money. Current from the supply was 1.02 amps. Running the transceiver from a fully-charged battery (12.6 volts) produced 2.7 watts. As you can see, operation from a battery will produce a significant drop in RF output power. Keep this in mind for Field Day. However, at the 13.8-volt supply, the MFJ-9020 barely falls under the power level of the QRP ARCI. It's a QRO QRP rig! You may reduce power levels down to under a watt by adjusting the VFO trimpot. You can reduce the power right down to zero output if you wish.

I operate by the hunt-and-pounce method. Listening for CQs, I call the other stations. The tuning is very smooth and I was surprised to find how well the VFO tracked from one end of the dial to the other. It's not an IC-781, but dial calibration is a hundred times better than any HW-8 I've ever seen. I simply center the desired signal in the bandpass of the receiver and call. I use the RIT feature to fine-tune the signal into the bandpass when I turn on the audio filter. The RIT is very smooth from one end of its range to the other. You have about 1.5 kHz worth of RIT at your control. But, there is one drawback with the RIT: You can't shut it off. It would be nice to have a way to shut the RIT off or a center detent pot to allow you to center the RIT control. I talked with Rick Littlefield K1BQT about this, and he told me that MFJ will put in a center detent RIT control as soon as they can source the part.

The semi-QSK keying works without flaw. The antenna relay is a bit loud, but won't break any windows. The sidetone is a very pleasant sine wave instead of the usual QRP square wave noise makers.

I used both the internal Curtis keyer and my old Ten-Tec KR5 keyer. The internal keyer is nice, but if I had to choose between the filter and the keyer, the keyer would have to go in favor of the filter.

I found that the receiver's audio level was low. Although the LM386 is rated at only 600 mW, the MFJ-9020 produces barely enough audio to fill a very tiny, very quiet room. The receiver generates very little internal noise, so it sounded as though the rig was dead when I first powered it up. Even with headphones, the audio gain control must be run fully into the stops. Since you can't adjust the sidetone level, I had to turn the volume control down when transmitting to prevent the sidetone from killing my ears. *[Ed. Note: All current production units have been changed to greatly improve the audio output as described below.]*

This time Rick Littlefield came through with a suggestion and a fix. Low audio is due to gain reduction caused by lowering the output of the LM317 from 12 to 10.5 volts to accommodate battery operation. Rick says he's working on a modification to run the LM386 from an unregulated Vcc. MFJ will include the modification on the next production run and they will also supply information to those who already purchased the MFJ-9020. As a fix, I simply adjusted the regulator up to 12 volts. It seems that if I set it higher, the sidetone would begin to distort. That extra several volts made a marked improvement in audio output.

With 5 watts, I felt like king of the hill. If I could hear 'em I could work 'em. I worked many stateside contacts, as well as a dozen or so DX stations.

The keying is very good and there are no signs of clicks, chirps or buzzes on the signal. The keying sounds "big rig" instead of the sometimes classic "QRP whoop de woop."

The Complete Portable Station

There are three more accessories that make the 9020 a fully portable setup.

The 4114 power supply/charger, the 971 antenna tuner and a 20 meter folded dipole is available.

I used the model 4114 portable rechargeable power pack during this review. This is a self-contained power system for the MFJ-9020. A large wall transformer supplies AC to the 4114. Inside a simple 7812 regulator circuit provides 13.8 volts at 1.2 amps. An LM317 is configured as a constant current source set at 100 mA for charging 12 D-size NiCd batteries. As with everything else in life, batteries are not included.

I'm not much of a D-size NiCd fan. Most of the 1200 mA D-size NiCds are nothing more than C cells on steroids. The C cells are rated at 1200 mA also. If you wanted to spend the extra money, then the high capacity NiCds would be a better way to go. Personally, I would swap out the NiCds in favor of two 6-volt 4 amp/hour gel/cells. They would easily fit inside the 4114s case. A second thought would be to use two 7.2 volt NiCd racing batteries. These would give you 1.2 amp/hours at 14.4 volts. The 4114 power pack is attractively styled to match the MFJ-9020. Since the 4114 is fused internally, shorting the output means a trip inside. It would have been nice to see a panel-mounted fuse holder instead.

The wall transformer plugs into the back of the 4114 using a header. Since the cord is very stiff, I'm concerned that it may eventually mess up the header's pins after repeated plugging and unplugging.

You can't recharge the batteries while you operate the radio. Pressing the charge switch does light up the LED, but no charging will be performed. You could easily get confused unless you unplug the transformer from the supply.

This way, the LEDs are dark, telling you you're on battery power.

The Portable Tuner

The 971 portable antenna tuner is a mobile tuner that has been updated to include balanced line and random wire antennas. Most importantly, the cross-needle SWR/power meter has QRP sensitivity. The meters will display 6 watts forward and 0.2 watts reverse. No "zero" or "sensitivity" adjustment is required with cross-needle SWR displays. The meter may be illuminated if desired.

There are three different power ranges. On the high end, 300 watts forward, 60 watts reflected; middle range, 30 watts forward and 6 watts reflected; QRP range, from 6 watts forward to 1.2 watts reflected. You have a choice of any two at a time. You can switch out one range from a rear-mounted switch. Normally, these are the 300-watt and 30-watt positions. By changing two jumpers on the main circuit board in the 971, you can select whether you want the 300-watt scale or the 6-watt scale. From the factory, the normal setting is 300 watts. I think this is rather odd, seeing the tuner is a match for the 9020.

The tuner works. There's nothing fancy inside but all of the components are heavy-duty. I was able to tune out the reactance of my triband beam quite easily with the 971.

Using the MFJ 20 meter folded dipole with the tuner was very easy. In fact, the folded dipole came out with a rather low SWR to begin with. I do wish the 971 tuner had a bypass position to remove the tuner from the line.

Since the 4114 power supply and the 971 tuner are both styled to match the MFJ-9020, the trio is an attractive QRP setup.

If you're one to go in the woods to operate, you can quickly set up a portable station with the MFJ QRP combo along with the MFJ folded dipole. If you're sitting at home, then the 9020 will be happy running off of your big rig's power supply.

Even though the MFJ-9020 is a simple radio using basic off-the-shelf parts, it is capable of worldwide communications thanks to its good basic design. It is so easy to operate that a beginner can make contacts as soon as the box is opened and power applied. The "have-done-it-all" ham will have a ball with this radio. The MFJ-9020 puts back into ham radio something long ago lost—FUN! The MFJ-9020 may be the best value going in a ready-to-play ham transceiver. 73

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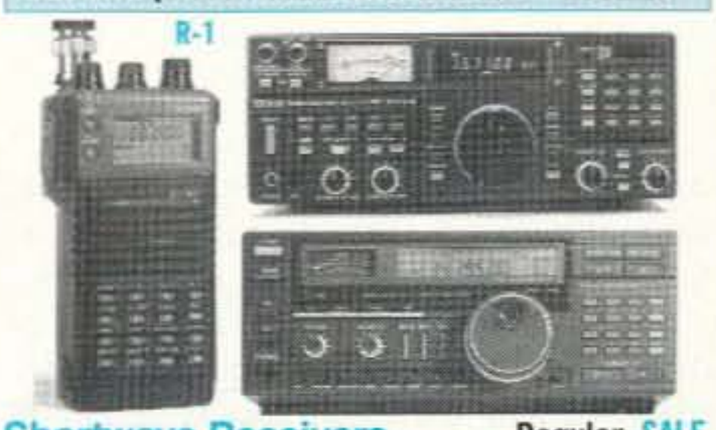

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An Eight-Channel A-to-D Converter for Your Computer

Sample the analog world with this easy interface.

by Mike Gray N8KDD

Judging by the letters I received regarding the article "High Speed Data Acquisition" in the August 1991 issue of *73*, a lot of hams are using their personal computers to acquire climatalogical and seismic information, then share it via radio. Among the comments I received were requests for more input channels. I had already added a multiplexer to the old design, but quickly abandoned that idea because the thing kept getting more complicated. A few hours looking through the data books convinced me to try a whole new approach to the problem.

This latest interface connects to the printer port of any "clone" computer, desktop or portable. Only six wires connect the computer to the interface because the A-D chip transfers data to the computer in serial rather than parallel form.

The A-D converter has an 8-channel multiplexer that is controlled using only one wire from the computer. The data is transferred through another wire, which makes for a very simple circuit but complex software. I prefer it that way because software is a lot easier to modify than hardware, and it never wears out.

The interface needs a 9-volt battery to power the A-D chip and regulator. I had planned to use a line on the printer port to drive the interface, but the voltage available at the printer port varies among brands. The interface doesn't need to be powered up between samples, though, so I included a new surface-mount regulator with an integral switch that can be enabled using one line from the computer. The computer switches the interface on just before a sample, and turns it off after the data has been transferred. The battery lasts a lot longer that way. The regulator draws 1.8 mA even in the "sleep" mode, so I included a toggle switch on the front panel so you can shut the whole thing down. When the battery voltage drops to about 7 (replacement time), the LED will glow faintly in the sleep mode,

Photo A. The ADC in use.

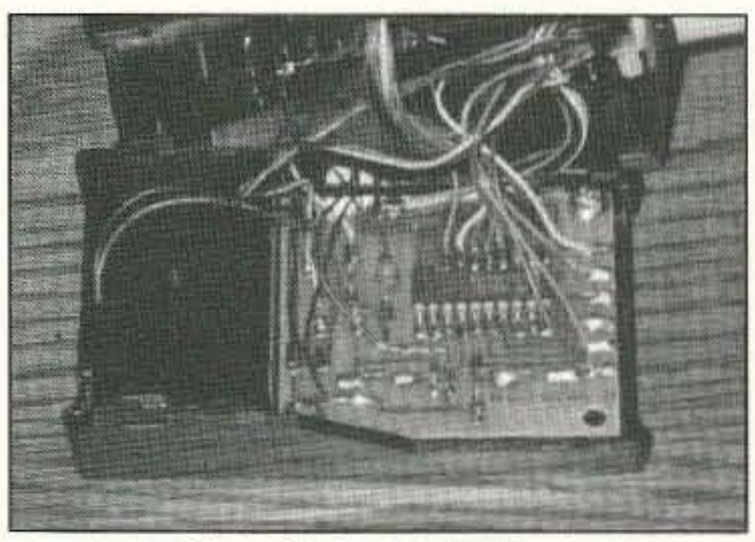

Photo B. Inside the box.

and will light up brightly while the computer takes a sample. While the battery voltage is greater than 7, the LED will remain on, whether the A-D is awake or asleep. An alkaline battery will last over 20 hours if the computer samples once per second.

ADC Operation

The A-D converter (ADC) requires some complex programming to make it work, but that's a fair trade-off for the simple hardware. The operation of the chip is described in exhaustive detail in the *National Semiconductor Linear Databook, Volume 2*. You can write your own custom programs in your favorite language, but I've found that most folks can use my M-LOG.EXE program for their purposes. Software should be easy to use without having to refer to documentation. It should graph the data as it is collected, and store it on diskette. M-LOG.EXE has these features, and mouse support too. The program listed in the sidebar is the minimum required to make the ADC work. Everything else is frosting.

Before a conversion can be performed, the chip select (CS) line must be asserted low. Then the ADC needs a clock signal (CLK), and a bit stream on the data-in (DI) line to get set up for a sample. Once it receives the set-up stream, it performs an A-D conversion on the assigned channel.

The next eight clock signals cause the conversion result to appear on the data-out (DO) line, starting with the most significant bit (MSB).

The CLK line must be asserted high before starting a conversion on the next channel.

There are three addresses assigned to the printer port. The base address is pins 2-9 and these normally transmit data to the printer. The base address of LPT1 on most computers is 888 decimal, but some are 956. LPT2 is usually 632. M-LOG.EXE allows you to select between those three possibilities. The next address at the printer port is the base address plus 1, and it is assigned to pins 10,11,12,13 and 15. These five pins are used for input only. I like to use pin 11 and tie the others to ground.

The third address at the printer port is the base address plus two. It is assigned to pins 1,14,16 and 17; these are used for output only. I use pin 1 for the CLK line.

The ADC has a high input impedance which makes it susceptible to noise. That's the reason for the 1 meg shunt resistors on the input channels.

You can leave the resistor network out if you like, but you MUST make sure you provide appropriate filtering in order to protect the ADC and get accurate data. This article barely skims the surface of the science of

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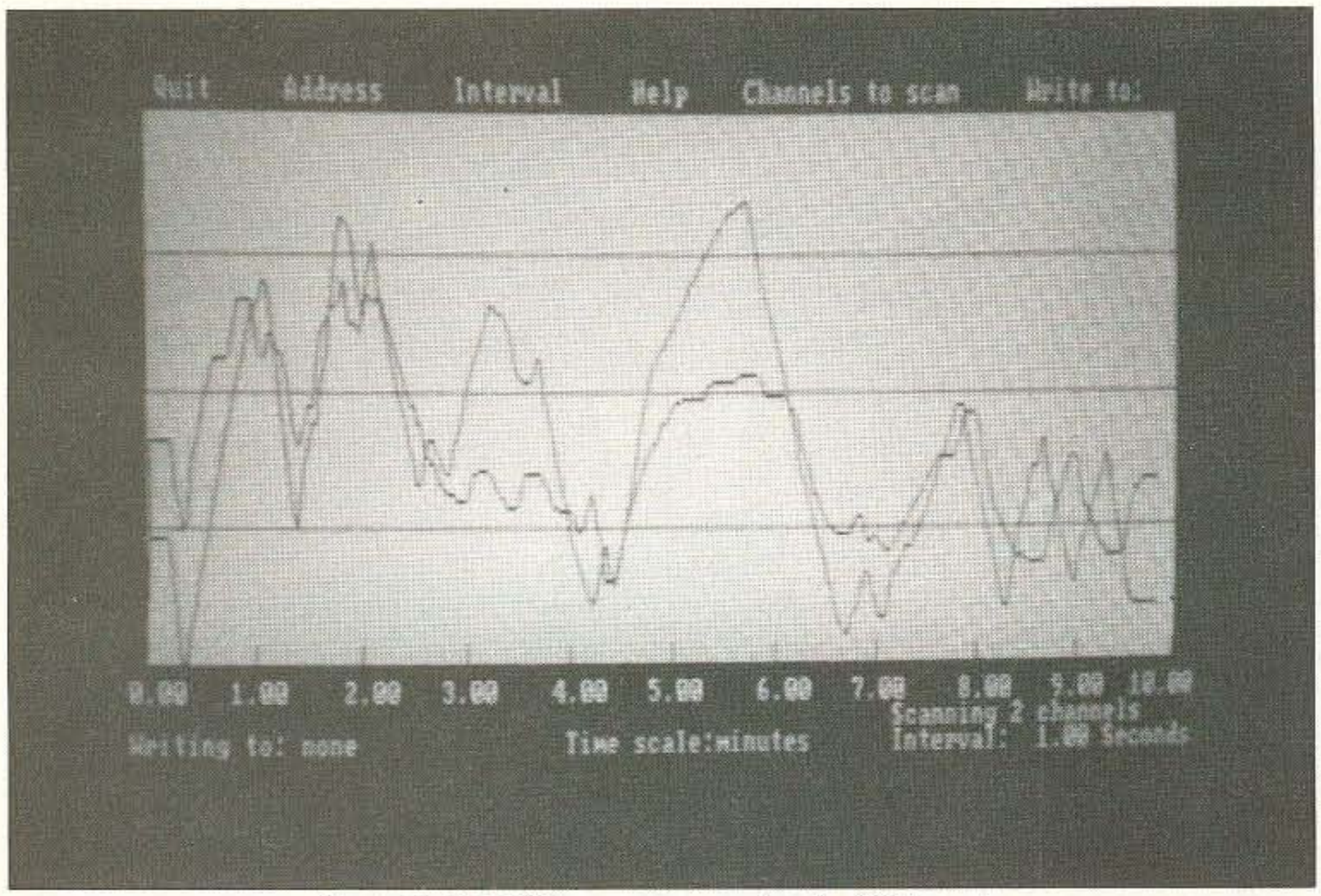

Photo C. M-LOG program running in CGA mode.

data acquisition. For more information on data aliasing, consult the *ARRL Handbook*.

Most laboratory transducers are scaled so that the output is 0 to 5 volts over their full sensing range. An input greater than 5 volts may damage the ADC, so be careful to scale all your transducers for this range. It's best to do the voltage dividing or amplifying near the transducer if you can.

Some transducers need external excitation. For instance, if you want to measure rotary position, you could use a 25k potentiometer with 5 volts applied to it. It would be wasteful to keep a power supply running, except during a measurement, so I included four terminal blocks which supply a regulated 5 volts when the computer wakes the ADC for a conversion. Using this 5-volt supply with resistive transducers will simplify things.

Construction

The hardware is reduced to a fairly simple form, so I chose to surface mount everything. You will have to bend the legs on the A-D chip so you can solder it to the board. The best way to do this is to push the chip onto progressively larger tubing until the legs are nearly horizontal.

Then finish the job by gently pushing it against a hard, slippery surface like a plastic-laminated counter top. If that seems too risky, bend the legs on an IC socket instead, and insert the A-D chip in the conventional manner.

Clean the circuit board by scrubbing it with a pencil eraser, to remove anything that might impede the flow of the solder. Trim one lead of a resistor and bend it so that the resistor will fit between the solder pads on the board. Tin one solder pad, then use the untrimmed lead as a "handle" and position the resistor on the solder pad. Touch a hot iron to the pad until the solder melts around the bent lead. With one end soldered tight, it will be easy to cut and bend the other lead to

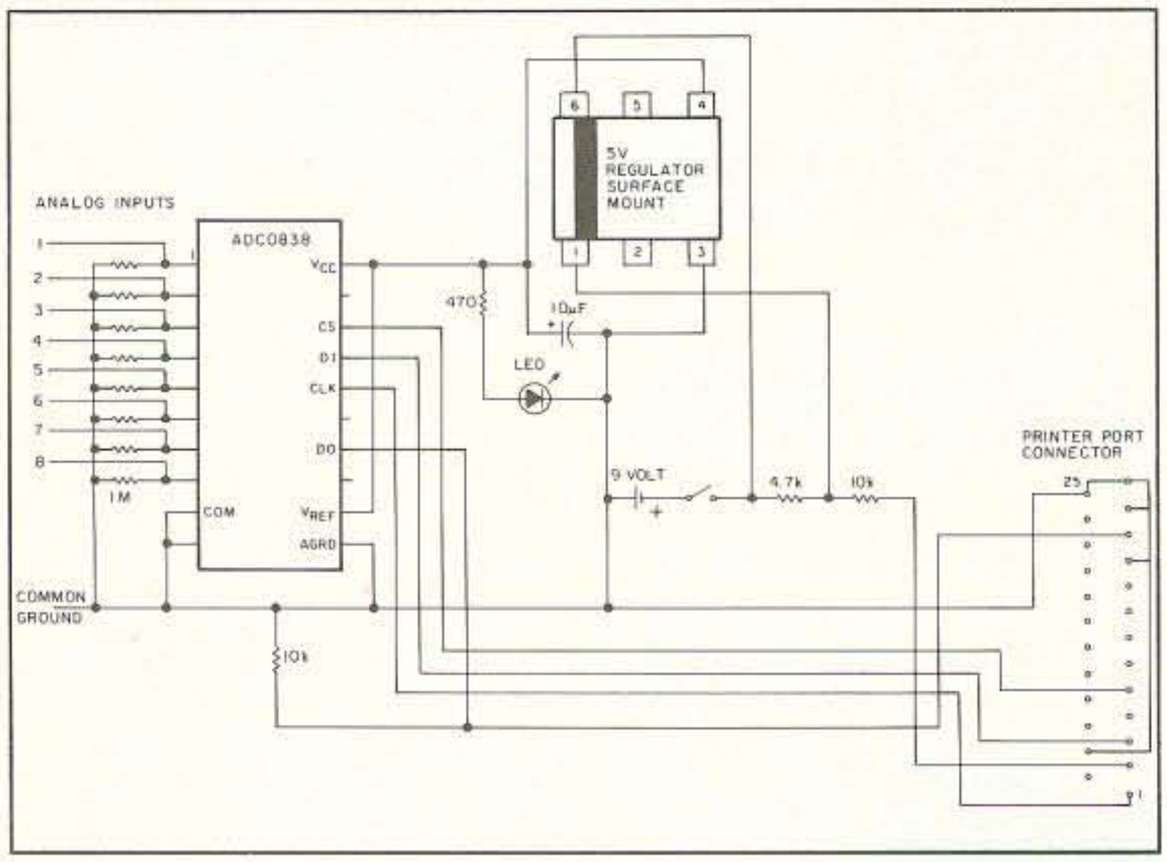

Figure 1. Schematic diagram of the A-to-D converter.

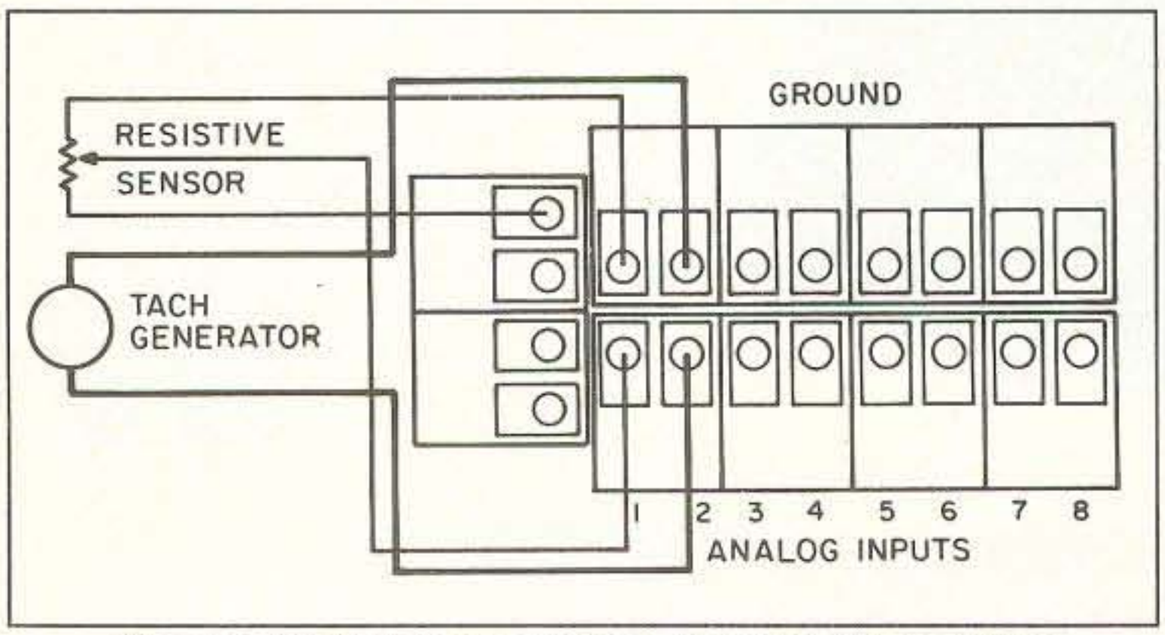

Figure 2. Typical connections for a variety of transducers.

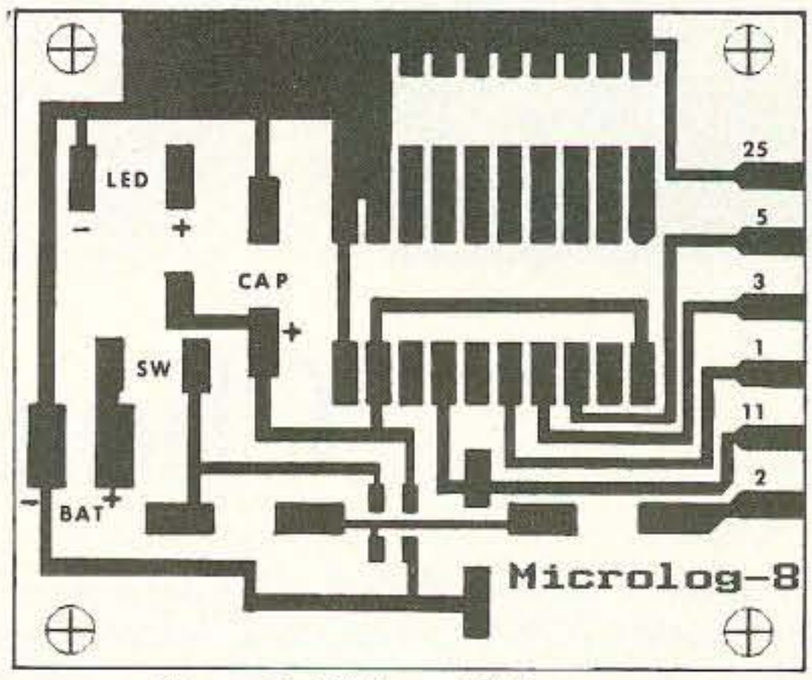

Figure 3. PC board foil pattern.

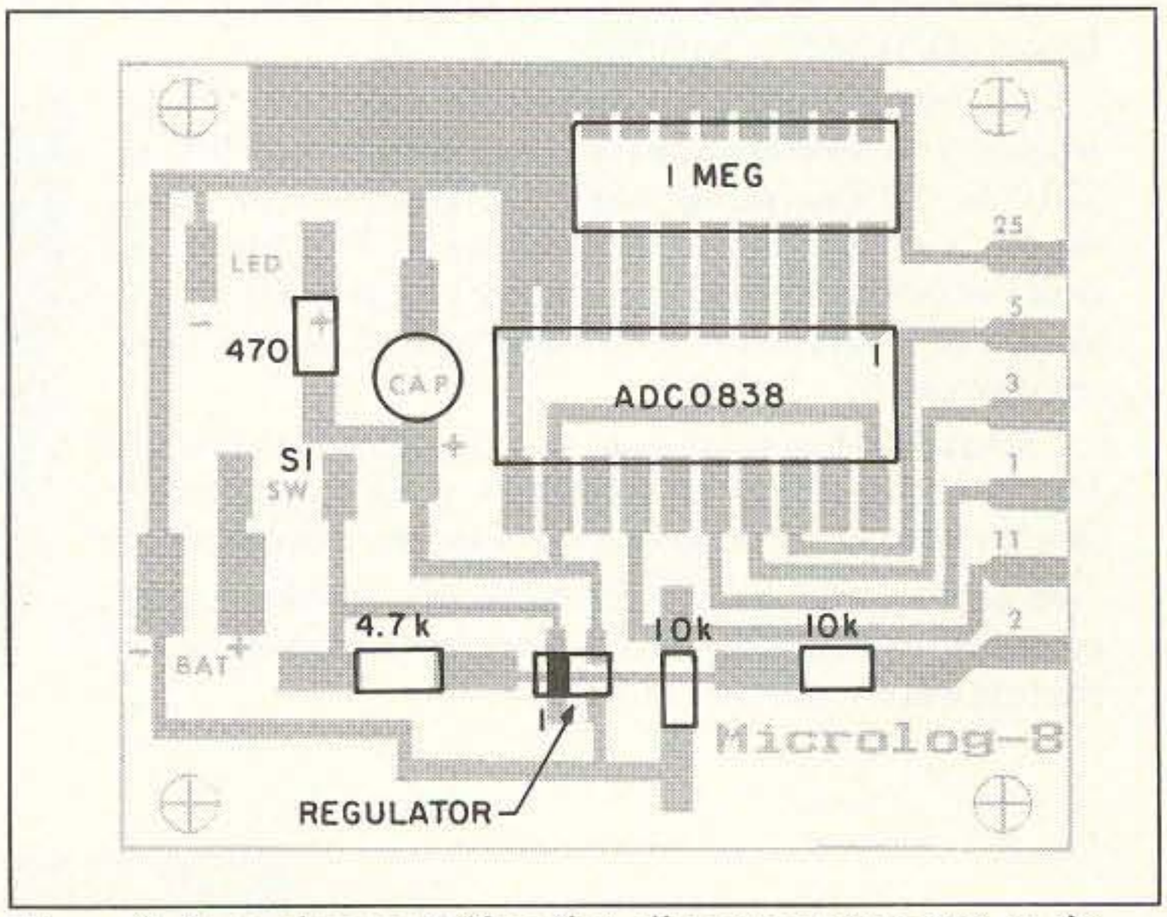

Figure 4. Parts placement. Note that all components mount on the foil side of the PC board.

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The following program causes the A-D converter to perform eight sequential conversions and display the result. It's written in Turbo BASIC/Power BASIC source code, but it will run under the GW-BASIC interpreter if you replace the delay statements with FOR/NEXT loops, and add line numbers as shown in the second listing. These programs are available on the 73 BBS under the filenames ADC Turbo.BAS and ADCGW.BAS.

```
INITIALIZE:  'remarks follow the apostrophe
   screen 0                              'text mode 80 columns
   color 14,0                            'yellow on blue
   cls                                   'clear the screen
   clear                                 'clear all variables
   toggle%=2                             'initialize variables
   oddsign%=0

MINORLOOP:
   while not instat                      'keep going until a key is pressed
     out 888,1                           'regulator line high
   delay 1                               wait 1 second before next sample
     out 888,0                           'light up the regulator
     delay .054                          'wait 54 milliseconds to stabilize
   for ch%=0 to 7                        'scan 8 channels
     out 888,8                           'CS high pin 5
     out 888,0                           'CS low
     out 888,2                           'start bit is always high DI line
     out 890,0                           'clock high pin 1 of DB 25 printer
       for slow%=0 to 1:next slow%       'stretches clock pulse
     out 890,1                           'clock low
     out 888,2                           '8 single ended measurements selected
     out 890,0                           'clock high
       for slow%=0 to 1:next slow%       'stretches clock pulse
     out 890,1                           'clock low
     out 888,oddsign%                    'part of the channel selection string
     swap oddsign%,toggle%               'toggles between high and low
     out 890,0                           'clock high
       for slow%=0 to 1:next slow%       'stretches clock pulse
     out 890,1                           'clock low
     out 888,select1%                    'part of the channel selection string
     out 890,0                           'clock high
        for slow%=0 to 1:next slow%      'stretches clock pulse
     out 890,1                           'clock low
     out 888,select0%                    'part of the channel selection string
     out 890,0                           'clock high
        for slow%=0 to 1:next slow%      'stretches clock pulse
   out 890,1                             'clock low
READBITS:
     for bit%=7 to 0 step -1             'MSB is first out
     out 890,0                           'clock high
        for slow%=0 to 1:next slow%      stretches clock pulse
     out 890,1                           'clock low
     ad%=inp(889)                        'port 889 pin 10  7-low135-high
     if ad%<120 then byte%=byte%+(2^bit%)
     next bit%
     if ch%=0  then  select1%=0 : select0%=0 : ch0volts=byte%/51
     if ch%=1  then  select1%=0 : select0%=2 : ch1volts=byte%/51
     if ch%=2  then  select1%=0 : select0%=2 : ch2volts=byte%/51
     if ch%=3  then  select1%=2 : select0%=0 : ch3volts=byte%/51
     if ch%=4  then  select1%=2 : select0%=0 : ch4volts=byte%/51
     if ch%=5  then  select1%=2 : select0%=2 : ch5volts=byte%/51
     if ch%=6  then  select1%=2 : select0%=2 : ch6volts=byte%/51
     if ch%=7  then  select1%=0 : select0%=0 : ch7volts=byte%/51
     byte%=0
    next ch%
   print using
   "##.#";ch0volts, ch1volts, ch2volts,ch3colts,ch4volts,ch5volts,ch6volts,ch7volts
    wend
```

GWBASIC Version

```
10 '  The following program causes the A-D converter to perform eight
20 '  sequential conversions and display the result.
30 SCREEN 0                              'text mode 80 columns
40 COLOR 14,0                            'yellow on blue
50 CLS                                   'clear the screen
60 CLEAR                                 'clear all variables
70 TOGGLE%=2                             'initialize variables
80 ODDSIGN%=0
90 IF INKEY$< >"" THEN END               'keep going until a key is pressed
100 OUT 888,1                            'regulator line high
110 OUT 888,0                            'light up the regulator
120 FOR W%=0 TO 500:NEXT W%              'wait 54 mseconds to stabilize
130 FOR CH%=0 TO 7                       'scan 8 channels
140 OUT 888,8                            'CS high  pin 5
150 OUT 888,0                            'CS low
160 OUT 888,2                            'start bit is always high DI line
170 OUT 890,0                            'clock high pin 1 of DB 25 printer
180 FOR SLOW%=0 TO 1:NEXT SLOW%          'stretches clock pulse
190 OUT 890,1                            'clock low
200 OUT 888,2                            '8 single ended measurements selected
210 OUT 890,0                            'clock high
220 FOR SLOW%=0 TO 1:NEXT SLOW%          'stretches clock pulse
230 OUT 890,1                            'clock low
240 OUT 888,ODDSIGN%                      'part of the channel selection string
250 SWAP ODDSIGN%,TOGGLE%                'toggles between high and low
260 OUT 890,0                            'clock high
270 FOR SLOW%=0 TO 1:NEXT SLOW%          'stretches clock pulse
280 OUT 890,1                            'clock low
290 OUT 888,SELECT1%                     'part of the channel selection string
300 OUT 890,0                            'clock high
310 FOR SLOW%=0 TO 1:NEXT SLOW%          'stretches clock pulse
320 OUT 890,1                            'clock low
330 OUT 888,SELECT0%                     'part of the channel selection string
340 OUT 890,0                            'clock high
350 FOR SLOW%=0 TO 1:NEXT SLOW%          'stretches clock pulse
360 OUT 890,1                            'clock low
370 REM                                  'read output bits
380 FOR BIT%=7 TO 0 STEP -1               'MSB is first out
390 OUT 890,0                            'clock high
400 FOR SLOW%=0 TO 1:NEXT SLOW%          if ad%'stretches clock pulse
410 OUT 890,1                            'clock low
420 AD%=INP(889)                         'port 889 pin 10  7-low  135-high
430 IF AD%<120 THEN BYTE%=BYTE%+(2^BIT%)
440 NEXT BIT%
450 IF  CH%=0   THEN   SELECT1%=0 : SELECT0%=0 : CH0VOLTS=BYTE%/51
460 IF  CH%=1   THEN   SELECT1%=0 : SELECT0%=2 : CH1VOLTS=BYTE%/51
470 IF  CH%=2   THEN   SELECT1%=0 : SELECT0%=2 : CH2VOLTS=BYTE%/51
480 IF  CH%=3   THEN   SELECT1%=2 : SELECT0%=0 : CH3VOLTS=BYTE%/51
490 IF  CH%=4   THEN   SELECT1%=2 : SELECT0%=0 : CH4VOLTS=BYTE%/51
500 IF  CH%=5   THEN   SELECT1%=2 : SELECT0%=2 : CH5VOLTS=BYTE%/51
510IF  CH%=6   THEN   SELECT1%=2 : SELECT0%=2 : CH6VOLTS=BYTE%/51
520IF  CH%=7   THEN   SELECT1%=0 : SELECT0%=0 : CH7VOLTS=BYTE%/51
530 BYTE%=0
540 next ch%
550 PRINT USING"##.#";CH0VOLTS, CH1VOLTS, CH2VOLTS,CH3COLTS,
    CH4VOLTS,CH5VOLTS,CH6VOLTS,CH7VOLTS
```

fit the other pad. Do the same with the remaining components.

Position the chips on their respective solder pads just to make sure that the legs are bent properly. Make any corrections, then remove the chip and tin the pad for pin 1. Position the chip again and hold it in place under light pressure. Melt the solder on the pad until the leg is settled into the solder. Perform the same operation on pin 11, then the remainder can be soldered without applying any pressure.

Position the surface-mount regulator carefully on the pads and hold it under light pressure with a pencil eraser. Put a glob of solder on a clean iron and touch it to a pad until the solder flows around the regulator leg. There are six legs on the regulator, but legs 2 and 5 are not used.

The Sky's the Limit

Given the simple nature and small form factor of this project, it lends itself well to aerial telemetry. DTMF encoders and decoders use 5-volt logic levels too, so it seems possible to use a computer on the ground to communicate with an ADC aboard a balloon or kite, using two low power VHF transceivers and some heavy-duty programming.

A group of local youngsters want to build and fly a huge kite. I suggested they make a science project out of it by attaching some data recording equipment and a camera. We may monitor wind speed, temperature, altitude, solar radiation, force on the string, and a few other things not yet defined. We should be able to aim and fire the camera using a computer on the ground too. 73

Contact Mike Gray N8KDD at 465 W. Maple Rd., Milford MI 48381.

Specifications

Input impedance: 30k ohms
Power consumption:
Sleep: 9 milliwatts
Wake: 100 milliwatts
Analog input: 0-5 volts
Temperature limits: 0 degrees-C

Parts List

1	A-D converter National ADC0838CCN or ADC0838CCJ
1	1 meg resistor block (contains 8 resistors)
1	Toko surface mount regulator, 5 volts
2	10k 1/8-watt resistors
1	4.7k 1/8-watt resistor
1	10 uF capacitor
1	9-volt battery clip
1	SPST toggle switch
1	470 ohm resistor
1	Low power LED
1	ABS enclosure with battery compartment
1	DB-25 connector (male)
1	DB-25 connector shell
1	6-conductor cable
10	Screw terminal blocks

Note: The following kits are available from the author: M-LOG programs and a circuit board only, $25; M-LOG programs, circuit board, and components, $60; enclosure kit (box, switch, LED, terminal blocks, graphics), $30. Add $3 shipping. Write to Mike Gray N8KDD at 465 W. Maple Rd., Milford MI 48381.

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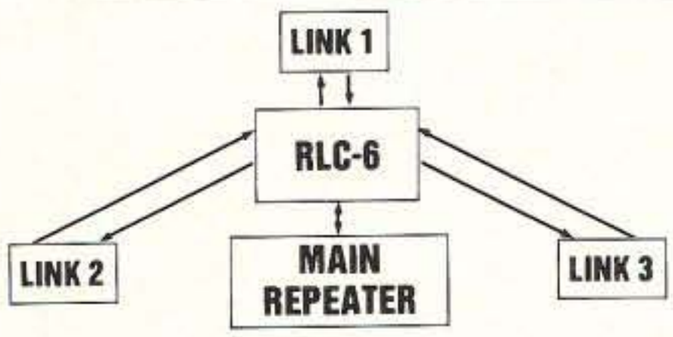

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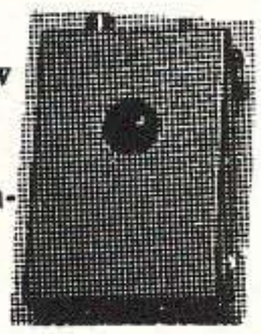

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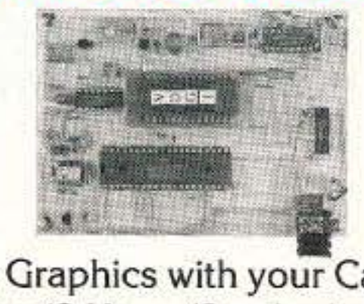

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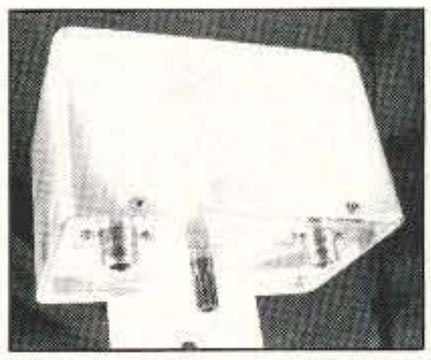

Model 146
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Model 146OS
$184
Model 440
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Model 146 160W 2 Meters 19db Gain .75db Nf
Model 146OS 160W 2 Meters 19db Gain .75db Nf
Model 440 70cm 100W 16db Gain .75db Nf

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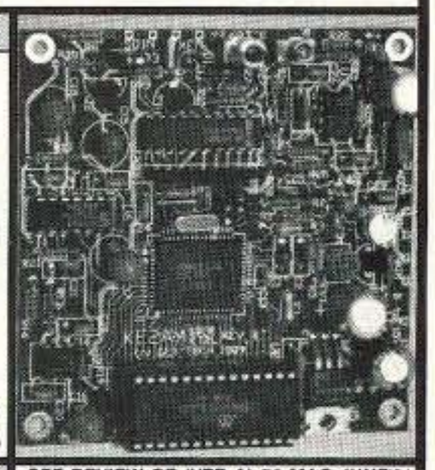

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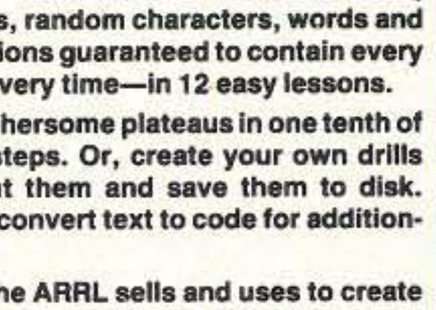

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CIRCLE 193 ON READER SERVICE CARD

73 Review

by Michael Jay Geier KB1UM

The Yaesu FT-415 Handheld

A full-featured 2m mini-HT.

Yaesu USA
17210 Edwards Rd.
Cerritos CA 90701
(310) 404-2700
Price class: $409

Yaesu's new FT-415 is an interesting melding of the FT-26 and the FT-411. It incorporates nearly all of the FT-411's features, along with the DTMF paging and squelch of the FT-26. It is styled like the '26, with a slightly thicker case than the 411's, but reduced size in the other dimensions. It is sculpted and rounded, so it feels comfortable.

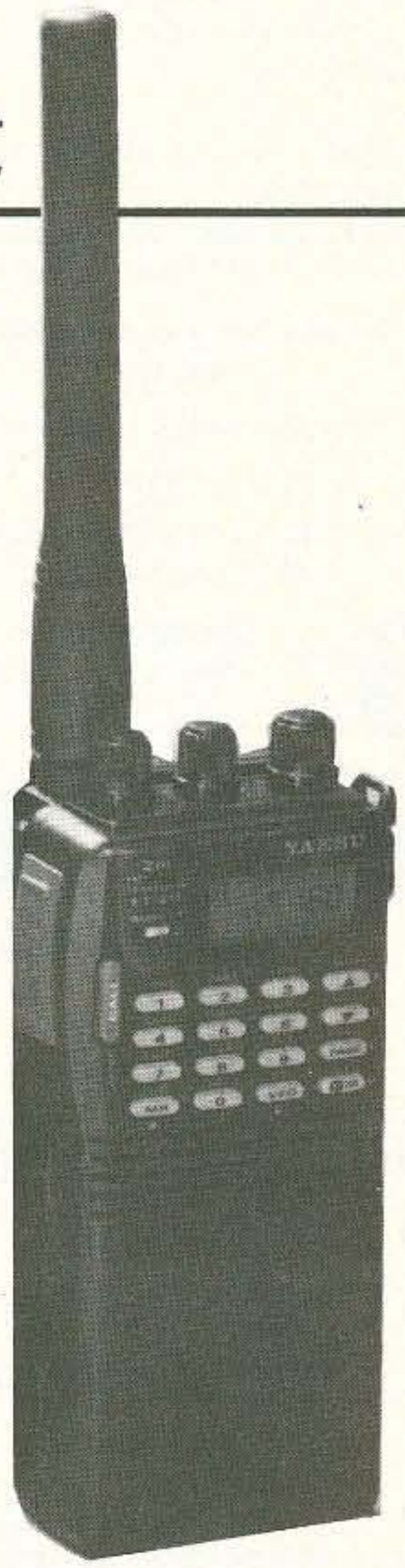
Basics

This is a full-featured radio. It includes all of the goodies we've come to expect from today's high-tech rigs, along with a few brand-new ones. Receive coverage is Yaesu's now-standard 130-174 MHz, and transmit is 140-150 MHz. Power output with the standard battery is 2 watts on high. There are 41 memories, each capable of holding independent TX/RX frequencies, CTCSS tone and configuration, etc. DTMF paging is included.

Although CTCSS is listed in the manual as an option, it comes installed on all USA/Canada rigs, as it always has on the FT-411 (but not on the FT-26).

The radio is noticeably smaller than the FT-411, except for its slightly increased thickness. The PTT switch area does not stick out as far, and the rubber PTT, Monitor and Lamp switches are curved for better ergonomics. It looks much nicer, but I'm not sure that it really works; I found the '411's PTT less fatiguing to press than the new version. Also, I sometimes find myself turning the lamp on when I press the PTT. The 16-button keypad controls almost everything; there are no hidden switches on the back. The "call" button, which selects your favorite frequency at the touch of one button, is on the front, near the PTT switch area, and is easier to get at than the '411's was. On top, next to the mike and earphone jacks, is a coaxial jack for direct DC input. The rig can operate on 5.5 to 16 volts, so you can power it from your car. At 12 volts, output is 5 watts. The rig is fairly weather-proofed, with a rubber cover over the jacks and a grommet around the antenna jack. The manual says it is ruggedized and I believe it; this thing feels solid as a rock.

The antenna is the same as the one on the FT-26: way too stiff. Also, its cover is not securely attached and turns freely, making antenna removal difficult. It seems that most walkie manufacturers like to change their ducks' styles every now and then. Yaesu might want to rethink this one.



The Yaesu FT-415 HT.

The included 600 mAh NiCd battery pack also is the same kind as used on the FT-26. It can be charged with the standard wall charger in about 15 hours, or with the optional quick charger in about an hour. Along with several sizes of rechargeable packs, there's an optional AA cell holder, which can be mighty handy in public service work or when you travel and don't want to bring a charger along. By the way, this new battery style does not fit on the FT-411 and previous units.

It Does It

This radio has every feature you could want, and then some. Anything you want it to do, it does it. It has all the usual scan and priority modes, along with a programmable battery saver and automatic power-off timer. The battery saver has the new feature also included on the FT-26: It can analyze your operating habits and typical channel activity and set itself for optimum operation with the least intrusive characteristics. If you don't want it to do that, you can set it to one of five fixed on/off ratios or turn it off altogether for packet operation. When you select the saver ratio, the time between "wake ups" is displayed in seconds. It's pretty slick. There are four RF output power levels, but only three are available at the normal 7.2 volts supplied by the standard battery. Still, that's one more than you usually get. To save even more power, you can elect to disable the front-panel "busy" LED. I don't understand why an LED is even used; this function could be shown on the LCD with no added power drain. But, it's nice to be able to save the 5 mA or so the LED eats.

Frequencies may be entered with the keypad or by using the top-mounted rotary tuning control. This configuration has pretty much become standard these days, and it works well. The rotary tuning knob can shift the frequency by either the nominal step you have selected (such as 5 kHz) or by 1 MHz in conjunction with the MHz function available on the keypad. When you enter frequencies directly from the keypad, you must enter all the digits, including the leading "1." There's even an option which lets you enter "splinter" channels (in between the normal 5 kHz channels) without changing the basic tuning step.

Like the FT-411, the '415 has two VFOs, and any memory can be used as a VFO as well. Pressing one button converts whatever memory channel you are on into a tunable memory, which is no different at all from a VFO. If you wish to replace the memory contents with the new frequency you have found, you may do so. You also may put the new frequency into a different memory without disturbing the memory from which it came. Finally, you may simply ignore the new frequency and return to the original memory with no harm done.

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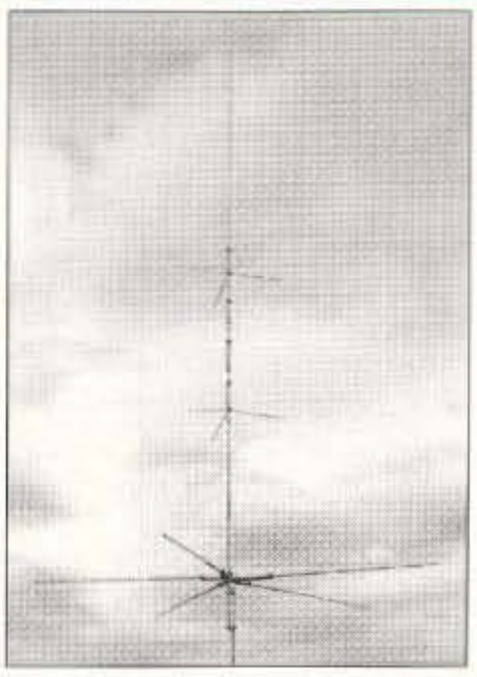

Ideal where space is limited. This easy to assemble HF vertical antenna features stainless steel hardware and a trap design at an attractive price. It can be assembled with the radials to one side for mounting close to a wall.

- Stainless steel hardware
- Ground plane design mounts at any height
- Max. Input: 500W SSB, 250W CW
  3.5 MHz - 200W SSB
- Height: 20'
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- Connector: SO239 Jack

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HSVK5JR	297.00	5 Band HF Vertical Antenna	17.5 lbs.

6 OR 10 METER HORIZONTAL BEAM

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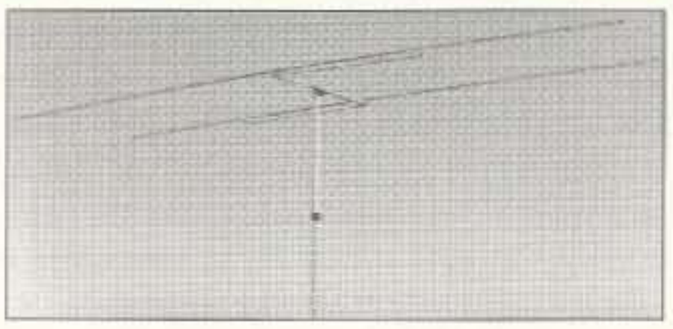

Dual driven elements at an affordable price. These high quality 6 and 10 meter antennas have an outstanding design that has gained wide acceptance for being dependable as well as compact.

50HS2HB – 6 Meter
- Max. Input: 500W (SSB), 250W (FM)
- Gain: Better than 6.0 dB
- FBR: Better than 16 dB
- Element Length: 116" (2,970 mm)
- Boom Length: 31" (780 mm)
- Connector: SO239 Jack

28HS2HB – 10 Meter
- Max. Input: 500W (SSB), 250W (FM)
- Gain: Better than 6.0 dB
- FBR: Better than 16 dB
- Element Length: 212" (5,400 mm)
- Boom Length: 53" (1,340 mm)
- Connector: SO239 Jack

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28HS2HB	99.50	28MHz, 10 Meter Horizontal Beam	7.8 lbs.
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AH212

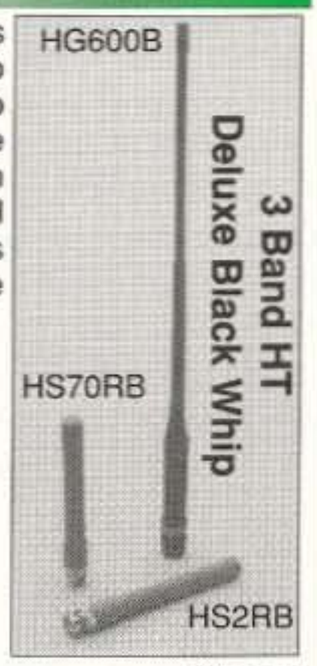
Features
- Freq.: 144/440/1200MHz
- Gain: U 144MHz
  3.0dB 440MHz
  5.5dB 1200MHz
- Max. Input: 20W (FM)
- Length: 14" (350 mm)
- Connector: BNC Male

HG600B

Features
- Freq.: 144/440/900MHz
- Gain: U 144MHz
  1.9dB 440MHz
  3.6dB 900MHz
- Max. Input: 10W (FM)
- Length: 12.5" (320 mm)
- Connector: BNC Male

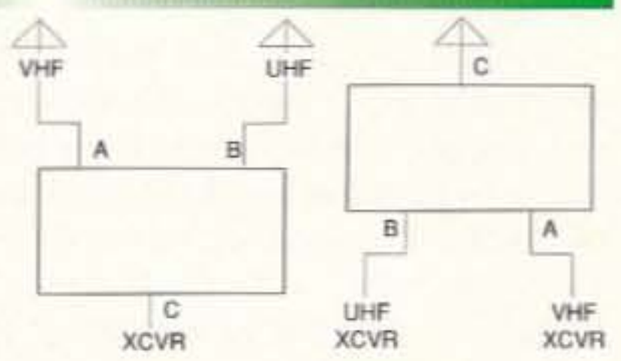
HS2RB, HS70RB

Features
- Material: Silicone Rubber
- Max. Input: 5W (FM)
- Length: 4.33" (110 mm)
- Connector: BNC Male



Order #	Price	Description	Weight
AH212	44.80	144/440/1200MHz Whip Antenna	4 oz.
HG600B	37.80	144/440/900MHz Whip Antenna	4 oz.
HS2RB	12.80	144MHz Whip Antenna	8 oz.
HS70RB	12.80	440MHz Whip Antenna	8 oz.

LOW-LOSS DUPLEXERS



- **Frequency:** Port A – 1.6 to 150MHz
  Port B – 410 to 460MHz
  Port C – Common
- **Insertion Loss:** Port A-C – 0.15dB
  Port B-C – 0.25dB
- **Isolation:** Port A-B>60dB
- **VSWR:** <1.2
- **Size (HxWxD):** 1.2" x 2.5" x 1.9"
  (Excluding Connectors)
- **Power:** 1.6 to 30MHz Max. 500W (FM)
  50 to 150MHz Max. 300W (FM)
  410 to 461MHz Max. 300W (FM)

Connectors:	A	B	C
HS790D	UHFm	UHFm	UHFf
HS790DN	UHFm	Nm	UHFf
HS790WP	UHFf	UHFf	UHFf

m=male, f= female

- **Weather Proof Model:** HS790WP comes with mounting bracket and stainless steel clamp

Order #	Price	Description	Weight
HS790D	47.50	Direct Link Duplexer	9 oz.
HS790DN	47.50	Direct Link Duplexer	9 oz.
HS790WP	58.00	Direct Link Duplexer, Weather Proof	14 oz.

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HSP7000	37.00	2.75" Fixed Cone Speaker	8W	13 oz.

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CIRCLE 9 ON READER SERVICE CARD

The front-mounted LCD shows operating frequency, memory channel number, VFO A or B, and other functions such as CTCSS status. It appears identical to the display on the '26, and is very nice. It shows the full frequency, including the final zero or five, and I like that. The display can be backlit by pressing the lamp button just below the PTT switch. The keypad lights up at the same time, making night operation very convenient. Green LEDs are used for both the keypad and the LCD; gone is the incandescent lamp on the '411. The lighting can be set to stay on for five seconds after the last key press, or to stay on until you press the lamp button again, which is nice for nighttime mobile operation from car DC power. For normal battery operation, the five-second time-out is especially handy. Of course, you can turn the lights off any time you want simply by pressing the lamp button.

The rig can scan the band, a selected portion of the band, or the memories. Scanning the band, or a portion of it, from the VFO is very fast. Memory scan, however, is only about half the speed of the '411. Still, it's as fast as most rigs; the '411 was exceptional in that regard.

Memories can be locked out in two ways. SKIP hides the memory channel from the scan, but you can still get to it via the tuning knob or by entering the channel number from the keypad. It's great for the NOAA weather channel or other busy frequencies. HIDE erases a memory completely, except that you can "unhide" it later and get it back. I find this feature to be especially useful for travel. If you often visit different cities, you'll love it. But, as on previous Yaesu walkies, each memory channel must be hidden and retrieved separately. It would have been nice if there were some way to manipulate whole ranges (such as 20-29) at a time, but it still beats having to re-enter all those frequencies. There's an improvement over previous rigs, though. It used to be that when you hid a memory, the rig dropped back to memory number 1 after each HIDE operation. It was a real pain to hide an entire range because you had to enter each memory number and essentially start over for each one. The new rig simply drops back to the first unhidden previous memory. So, if you hide channel 5, it drops back to channel 4, assuming that one is unhidden. This makes it much easier to get rid of an entire range, especially if you start at the highest number and work backward.

The memory management scheme of this new radio is essentially identical to the time-proven, easy-to-use design of the FT-411. It will even scan up or down the band from the memory. After scanning to a new frequency, you can store it in any memory channel or a VFO, or simply return to your original memory channel, disturbing nothing. It's all very easy to do and easy to remember.

The FT-415 has some new features, including DTMF paging, four power level choices, an automatic battery saver, lighting options, selectable two-second TX hang time during DTMF dialing, CTCSS scanning (it'll decode and display incoming tones!), and lots more. In order to accommodate these new capabilities, a new SET mode, similar to the one used on ICOM walkies, is included. Many of the infrequently used set-up commands are grouped in this mode, keeping them out of your way until needed. The key presses seem straightforward enough, but you probably will need to refer to the manual for the ones you don't use very often.

Like the FT-411, this new rig has a 10-number DTMF autodialer. Each number can have up to 15 digits, and sending them is as easy as touching one button while you're transmitting. (Some rigs make you press as many as four buttons, negating the whole point of an autodialer.) The procedure for entering the numbers is the same cryptic system found on the '411, and I think it could be made easier. Once you get the hang of it, though, it's not too bad, and it's definitely worth it. Naturally, you also may send numbers manually, without entering them into memory first.

Documentation

The manual is first-rate. Like other recent Yaesu booklets, it's written in clear English. I wish other manufacturers would put this much effort into their instructions. A full set of schematics is provided, and there's a lovely wallet-sized cheat sheet. This sheet, unfortunately, doesn't show some of the SET functions, but it has all of the operations you're likely to want out in the field. It's made of a coated paper which seems designed to last a long time.

Using It

Transmitted audio sounds clear. The receiver is very sensitive, even outside the ham bands. It's a definite improvement over the '411s. Selectivity is very good, but doesn't seem quite as sharp as the older rig. Still, it's better than on many other walkies, and more than good enough. Unlike most walkies the 415's front end filters are varactor controlled by the PLL tuning voltage, so they are always tuned to the operating frequency. This Advanced Tracked Tuning technique keeps the sensitivity high and helps avoid intermod problems.Overall, the receiver seems excellent. I tried the rig on packet using the Poor Man's Packet modem I built up for my '411, and it worked great. Naturally, I turned the battery saver off first!

Not Perfect

Each generation of walkies gets better than the last. This rig is really great, but it does have a few quirks and annoyances. Here are some I found.

There's one bug that's a carry-over from the '411: When you are in the CALL memory, if you turn the dial knob, it transfers the contents of the memory into the last-used VFO, trashing whatever was there. It can be a real pain when you inadvertently lose a stored frequency that way.

The rig is touted to have improved receive audio by virtue of a better speaker. It's true. Despite the small grille area, the speaker reproduces bass frequencies much better, making most voices (especially men's) sound richer and clearer. The audio obviously is better than on previous models.

The DTMF squelch and paging features use the now-standard three- and six-tone sequences, with the numbers being limited to 0-9. Unfortunately, most repeater controllers won't pass DTMF tones unless they're prefaced by some codes containing the * and #, which you can't send. This limitation makes the features fairly useless, especially in the big cities where you'd most like to use them. This problem isn't limited to Yaesu, though; all the DTMF-squelched rigs use the same system. Of course, it's nice for simplex and hamfest use.

The same blinking battery icon that was on the '411 is present on the new rig. Like the old one, it doesn't give you much warning when your battery is about to die. A voltage monitor would be far preferable. Even though NiCd batteries don't change voltage much over their discharge period, there's enough change near the end to give you more warning than the icon does.

The rig gives you the option to substitute DTMF tones for the annoying musical keypad beeper. It's an improvement, but still not great. It would be nice if there were an option to change the beeper into a single short tone, like it used to be on older walkies, perhaps with a double tone for those functions whose status is announced via the beeper.

The NC-42 Quick Charger

Along with the review rig Yaesu sent the NC-42 quick charger. This small, light unit sits on a desktop. It has no on/off switch; it turns itself on when you insert the battery. It begins in the quick mode and brings the battery to a nearly full charge in about one hour. It then switches to the trickle mode, topping off the charge. Two LEDs announce the charge mode. It works well and is very convenient, but it suffers from one problem: It throws the worst TVI I've ever seen! I have some Sony miniature switching power supplies which have the same problem, but they're not nearly this pronounced. This thing puts garbage on any TV screen in the house, including my set which is hooked up to the outdoor antenna via coax. Some shielding is in order here! Wouldn't it be ironic to get complaints from your neighbors about your *battery charger* instead of about your transmitter? *[Ed. Note: Yaesu is currently looking into this.]*

Conclusion

This radio represents the state of the art in miniature single-band walkies. No, it isn't the very smallest available, but it's certainly small enough! It works well and has more features than you'll probably ever use. Considering the wealth of functions, the user interface is very reasonable and unintimidating. This rig's a beaut! 73

Protected AC Outlet for the Workbench

Avoid a shocking experience.

by Michael A. Covington N4TMI

My most-used test bench accessory is a switched AC outlet with a ground-fault circuit interrupter (GFCI) and a precision 0.1-ohm resistor.

Photo A shows what it looks like. The GFCI is a standard model from a hardware store, mounted in a not-too-precisely-cut hole in the enclosure. It serves three purposes: to help keep me from getting shocked; to detect potentially unsafe equipment; and to let me know whether any piece of equipment is going to trip a GFCI, even for harmless reasons.

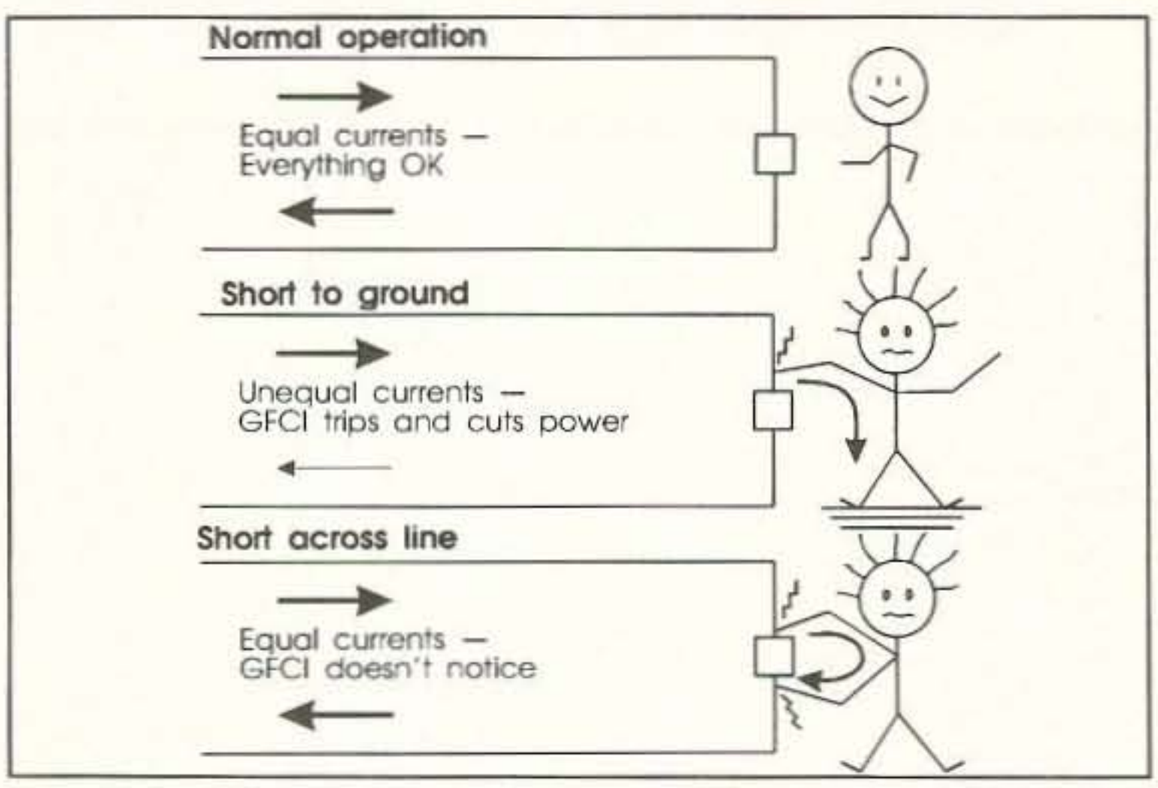

Figure 1. The ground-fault circuit interrupter (GFCI) senses mismatched currents in "live" and "neutral" wires and cuts off power. This doesn't prevent all electric shocks—only those involving a short to ground (middle example).

Figure 1 shows what a GFCI does: It checks whether the currents in the "live" and "neutral" wires are equal, and, if not, cuts off the current. This doesn't prevent all electric shocks, but it does prevent or shorten those that involve an accidental connection to ground.

The circuit is shown in Figure 2. Ahead of the GFCI are a switch and a 0.1-ohm resistor. The switch, naturally, cuts power on and off. It should be rated for as many amps as your load will ever draw (typically 10 or so).

The resistor lets you measure AC current accurately—just connect a voltmeter across it and read each volt as 10 amps. An 0.1-ohm, 10-watt resistor may be a bit hard to find; the easiest solution is to use five 0.47-ohm, 5-watt resistors (Radio Shack 271-130) in parallel.

You'll also need two pin jacks for the voltmeter. Remember that both sides of the resistor are "hot" with respect to ground; *don't* use any kind of jack that could make accidental contact with something or someone outside. Binding posts are not suitable. The Radio Shack 274-725 banana jacks are *barely* acceptable if clearly marked with a warning label; jacks with much smaller holes are preferable, and can be found at hamfests or on junked test equipment. Or you could make something of your own that mounts behind tiny holes drilled in the plastic panel.

The GFCI can come from any hardware store. It's essential not to mix up the live ("hot"), neutral, and ground wires in the power cord and on the GFCI. In most power cords the black wire is the "hot" lead, the white wire is the neutral and the green wire is the ground. The switch *must* be in the live ("hot") wire. Also, be sure to distinguish the input ("line") side of the GFCI from the output ("load"). Across the load side of my GFCI I wired a neon indicator lamp so that I can see at a glance whether power is on. 73

Contact Michael A. Covington N4TMI, 285 Saint George Drive, Athens GA 30606.

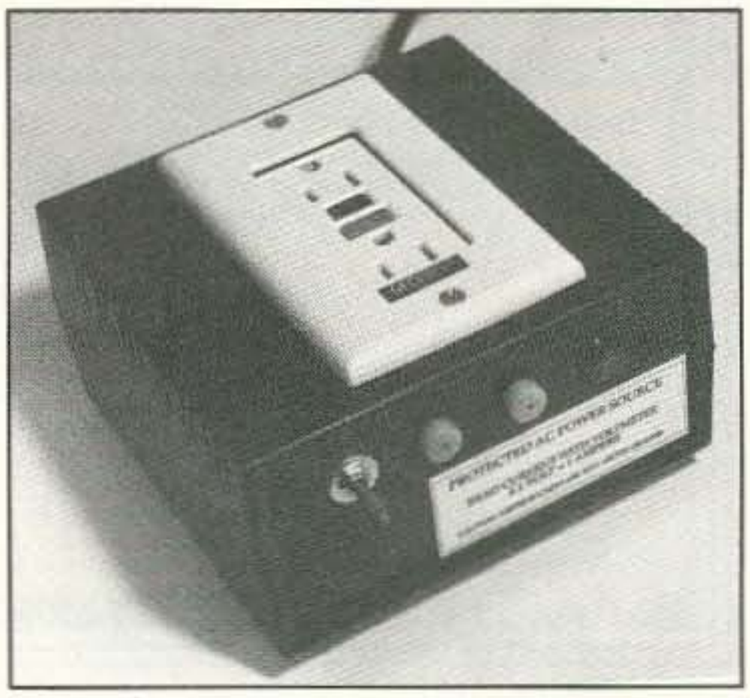

Photo A. This device consists of a GFCI (ground-fault circuit interrupter) in a convenient enclosure with a switch.

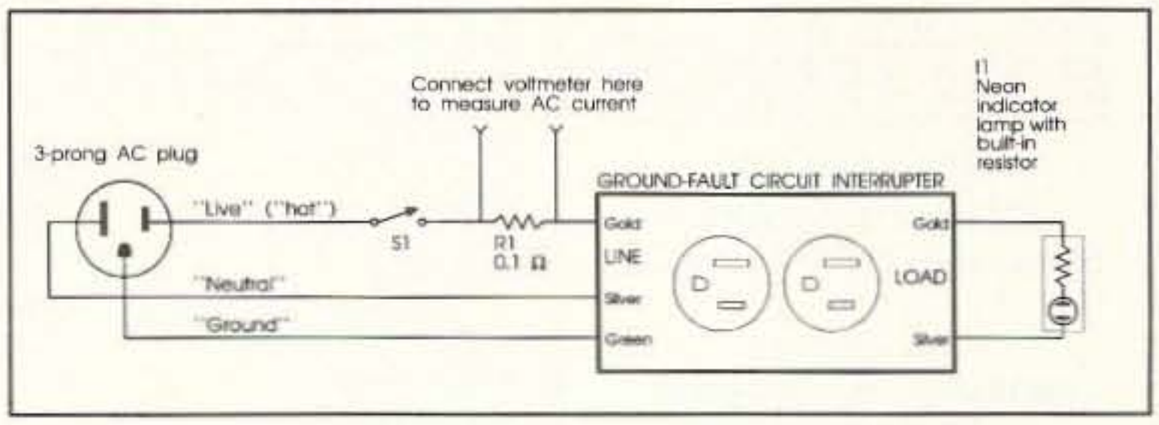

Figure 2. The protected outlet box consists of a GFCI, a switch, a 0.1 ohm resistor for measuring current, and a pilot lamp. Correct identification of live, neutral, and ground wires is VERY important. Most power cords use the black wire for the "hot" live lead; the white wire is the neutral and the green wire is the ground.

Parts List

S1	SPST switch, rated for 125V AC, 10 amperes (Radio Shack 275-324 or equivalent)
R1	0.1-ohm, 10 watt resistors (actually five 0.47 ohm, 5-watt resistors in parallel, Radio Shack 271-130)
I1	Neon lamp "power on" indicator with built-in resistor (Radio Shack 272-712 or equivalent)
GFCI	Ground fault circuit interrupter (from hardware store or electrical supply house)

Pin jacks for voltmeter connections (see text)
Enclosure

3-prong AC plug and line cord

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- GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

**Specify tuning range: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, 400-500 MHz.*

LNS-(*) IN-LINE PREAMP

ONLY **$89** kit, **$119** wired/tested

- GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W. Tower mounting brackets incl.

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GaAs FET preamps with 3 or 4 section helical resonators **reduce intermod & cross-band interference** in critical applications. **MODEL HRG-(*),** $80 vhf, $110 uhf. **Specify tuning range: 142-150, 150-162, 162-174, 213-233, 420-470 MHz.*

RECEIVING CONVERTERS

Low noise converters to **receive vhf and uhf bands on a 10M receiver**. Choice of kit with case & BNC jacks, kit less case $49, kit w/case $74, w/t in case $99. *Request catalog for complete listings.*

- **VHF input ranges avail:** 136-138, 144-146, 145-147, 146-148 MHz.
- **UHF input ranges avail:** 432-434, 435-437, 435.5-437.5 MHz.

TRANSMITTING CONVERTERS

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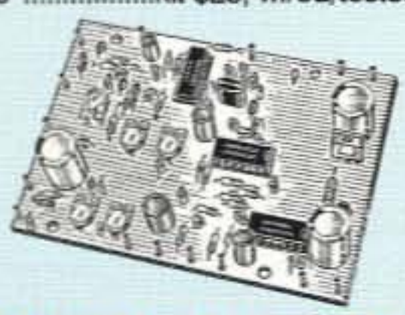
ACCESSORIES

TD-3 SUBAUDIBLE TONE DECODER/ENCODER. Adjustable for any tone. Designed **especially for repeaters,** with remote control activate/deactivate provisions .....kit $29, wired/tested $69



COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier .....kit $49

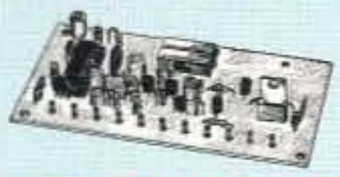
CWID. Diode programmed any time in the field, adjustable tone, speed, and timer, to go with COR-3 .....kit $59

COR-4 kit. Complete COR and CWID all on one board for easy construction. CMOS logic for low power consumption. Many new features. EPROM programmed; specify call kit $99 , w/t $159

TD-2 TOUCH-TONE DECODER/CONTROLLER kit. Full 16 digits, with toll-call restrictor, programmable. Can turn 5 functions on/off. Great for selective calling, too! .....kit $89, wired/tested $149

AP-3 AUTOPATCH kit. Use with above for repeater autopatch. Reverse patch and phone line remote control are std .....kit $89, wired/tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board kit. Use with above for simplex operation using a transceiver .....kit $39



MO-202 FSK DATA MODULATOR kit. Run up to 1200 baud digital signals through any fm transmitter with full handshakes. Radio link computers, telemetry gear, etc. .....kit $49, w/t $79

DE-202 FSK DEMODULATOR kit. For receive end of link. .....kit $49, w/t $79

9600 BAUD DIGITAL RF LINKS. **Low-cost** packet networking system, consisting of new MO-96 Modem and special versions of our 220 or 450 mHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W.

If you always thought a microprocessor-controlled repeater had to be expensive, LOOK AGAIN! You could easily spend this much just for a controller.

REP-200 REPEATER

A premium repeater with autopatch and many versatile dtmf control features at *less than many charge for a bare-bones repeater!*
We don't skimp on rf modules, either! Check the features on R144 Receiver, for instance: GaAs FET front-end, helical resonators, sharp crystal filters, hysteresis squelch.

Kit $1095; w/t only $1295!

Other models available:

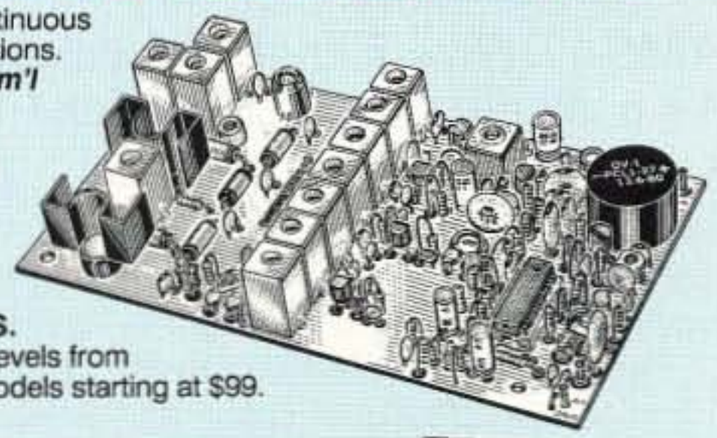
REP-200V Economy Repeater Kit. As above, except uses COR-4 Controller without DTMF control or autopatch. **Kit only $795.**

REP-200N Repeater with no controller. For use with external controller, such as those made by ACC. **Kit only $695, w/t $995.**

- Available for the 143-174, 213-233, 420-475, 902-928 MHz bands. ***FCC type accepted for commercial service** (vhf and uhf).*
- **Rugged exciter and PA**, designed for continuous duty.
- Power out 15W (25W option)143-174 MHz; 15W 213-233; 10W uhf or 902-928MHz.
- Accessory add-on PA's available with **power levels up to 100W**.
- **Six courtesy beep types**, including two pleasant, sequential, multi-tone bursts.
- **AUTOPATCH**: either **open or closed** access, **toll-call restrict**, auto-disconnect.
- **Reverse Autopatch:** two types, auto-answer or ring tone on the air.
- Pulse (rotary) dial option available.
- **DTMF CONTROL**: over 45 functions can be controlled by touch-tone. Separate 4-digit control code for each function, plus extra **4-digit owner password**.
- **Owner can inhibit** autopatch or repeater, enable either open- or closed-access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr, and other options, including two auxiliary external circuits.
- The cwid message, dtmf command codes, and owner-specified default parameters for cor and cwid timers and tones are burned into the eprom at the factory.
- Cw speed and tone, courtesy beep and tail timers, and courtesy beep type **can all be changed at any time** by owner-password-protected dtmf commands.
- **Auxiliary receiver input** for independent control or **cross linking repeaters**.
- Many **built-in diagnostic** & testing functions using microprocessor.
- Color coded led's **indicate status** of all major functions.
- **Welded partitions** for exciter, pa, receiver, and controller. PEM nuts hold covers.
- 3-1/2 inch aluminum rack panel, finished in eggshell white and black.

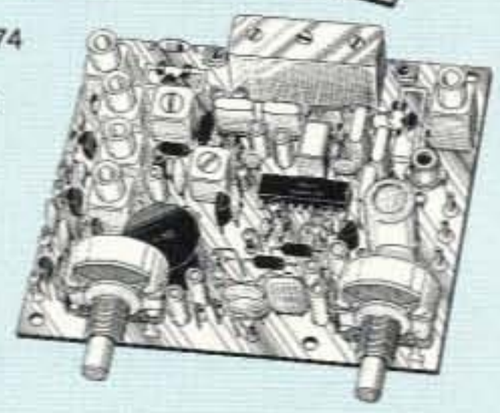
HIGH PERFORMANCE XMTRS & RCVRS FOR REPEATERS, AF & DIGITAL LINKS, TELEMETRY, ETC.

FM EXCITERS: 2W continuous duty. TCXO & xtal oven options. ***FCC type accepted for com'l high band & uhf.***



- **TA51**: 143-174, 213-233 MHz ...kit $109, w/t $189.
- **TA451**: 420-475 MHz ...kit $109, w/t $189.
- **TA901**: 902-928 MHz, (0.5W out); w/t $219.
- **VHF & UHF AMPLIFIERS.** For fm, ssb, atv. Output levels from 10W to 100W. Several models starting at $99.

FM RECEIVERS:



- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **GaAs FET** front end, 0.15uV sensitivity! Both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; afc tracks drift. ...kit $149, w/t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. ...kit $149, w/t $219.
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion, GaAs FET front end. ...$169, w/t $249.
- **R76 ECONOMY FM RCVR** for 28-30, 50-54, 73-76, 143-174, 213-233 MHz, w/o helical res or afc. ...Kits $129, w/t $219.
- **R137 WEATHER SATELLITE RCVR** for 137 MHz. Kit $129, w/t $219.

- **For complete info, call or write for free catalog.**
  Send $2 for overseas air mail.
  For casual interest (U.S. only), check reader service; allow 3-4 weeks.
- **Order by mail, fax, or phone** (9-12, 1-5 eastern time).
- **Min. $5 S&H charge** for first pound plus add'l weight & insurance.
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CIRCLE 57 ON READER SERVICE CARD

Number 13 on your Feedback card

HAM HELP

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 (81/2" 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 1 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.

Needed: Manual for Heath Kit LG-1 generator; also schematic/manual for a Lafayette LA-950 stereo amp. Copies are fine. I will pay. *Buz Chadwick N4GTX, PO Box 1381, Palatine IL 60078. Tel. (708) 358-3603.*

I am trying to locate either owners manual or schematic for Regency HR-2A 2 meter transceiver. I will pay to copy, or will copy and return. *Ted Webb AC4CS, 118 Seabury Dr., Greenville SC 29615.*

I need information on replacement parts for a Heath IM-28 VTVM that was modified to a TRVM. The Heath part numbers are: 150-57 TR1002 SS diode which is a replacement for a 6AL5, and 150-58 TR1119 SS triode which replaces a 12AU7. These are called FETRONS or HINS. Any help in locating these parts, or specification sheets on any FETRONS would be appreciated. The other FETRONS I have are TR1006, TR1008, TR1010, TR1157, and TR1126A. *Bob Juranek, 11469 Haggerty, Plymouth MI 48170-4455.* Tel. *(313) 459-7718.*

I would like to get in touch with hams who have experience with Yaesu CAT programming, particularly with the FIF-232 connected to an FT-757GXII and using some form of BASIC language on an IBM PC compatible machine. *Bill Schwiegeraht N8KSG, 1576 Karahill Drive, Cincinnati OH 45240. (513) 247-4561 days; (513) 851-9698 eves., collect; FAX (513) 247-4561, or e-mail for Prodigy user ID # BHKD13A.*

I would like to contact former students of Nathaniel Narbonne High School (ex WB6RTO) in Harbor City CA, who got their novice license between 1965 and 1976. We are going to have a reunion! *Marv Fagenson K6HCJ, 2100 Sawtelle Blvd. Ste. 202, Los Angeles CA 90025. Tel. (310) 478-1777.* Thank you.

Wanted: Genuine Hayes Modem 1200, model with 10 dip switches. Please write to *William Petrisko, PO Box 42376, Tucson AZ 85733 or e-mail petrisko@evax2. engr.arizona.edu.* Thanks.

HAMSATS

Number 14 on your Feedback card

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston TX 77083

Korean Star Rising

In late July a new amateur-radio satellite is scheduled for launch from Kourou, French Guiana. If all goes well, the satellite, KITSAT-A, will become an OSCAR (Orbiting Satellite Carrying Amateur Radio). The satellite builders in England have announced further payload details since the brief system description presented in the April 1992 "Hamsats" column.

The University of Surrey in England teamed up with the Korean Advanced Institute of Technology (KAIST) in 1990 to begin a joint educational effort to build a satellite adhering to the IARU (International Amateur Radio Union) definition of an amateur-radio satellite. The project has progressed rapidly through the cooperative efforts of the experienced UoSAT engineers and the KAIST student-engineers. KITSAT offers all the qualities built into UoSAT-OSCAR-14 and 22, but with some new and exciting features.

Current Technology

KITSAT-A carries a packet communications system with a digital store-and-forward unit like its predecessors, but with 13 megabytes of memory. Due to the availability of mature high-speed communications software, KITSAT will go to orbit ready for operation by any station currently active via U-O-22. Over the more populated parts of the world, U-O-22 has been full to capacity with user file transfers. The 9600 bps (bits-per-second) format of U-O-22 activity has performed very well and will be continued with the new satellite.

U-O-22's Earth Imaging System has proved quite functional and popular. Pictures of the Persian Gulf area during the Kuwait war clearly showed plumes of smoke from the burning oil-well fires. KITSAT carries a similar camera system. The basic CCD (charge-coupled device) unit has a resolution of four kilometers.

KITSAT Advances

Higher data speeds are possible with KITSAT. Although the main system is designed for 9600 bps, experiments are planned using digital signal processing up to 38,400 bps. KITSAT Project Manager Jeff Ward GØ/K8KA is enthusiastic about the incorporation of very-high-speed data communications through an amateur satellite, but is most intrigued by the new imaging equipment.

One of the most exciting additions to KITSAT is a second CCD camera with a telephoto lens assembly. It provides up to a 400 meter resolution. This level of definition allows identification of man-made structures from space. The wide-angle camera can be used to spot areas of interest while the telephoto system can zoom in on the target area.

The cameras are just one part of the complete Earth Imaging System (EIS). Both CCD units are connected to a Transputer Image Processing Experiment (TIPE). Manipulation of the image data can be performed in orbit prior to transmission to earth without heavy reliance on other computing resources on the spacecraft.

KITSAT carries a Digital Signal Processing Experiment to be used for speech synthesis, store-and-forward voice messages, and high-speed data modulation and demodulation.

Hamsat satellite telemetry has been sent by voice synthesizers listing numeric sequences for over a decade, beginning with UoSAT-OSCAR-9. Simple words and phrases have also been possible. The KITSAT system is capable of multilingual messages. The speech system is limited only by the imagination of the programmers.

The Korean Amateur Radio League is working in conjunction with KAIST to develop simple, dedicated hand-held receivers for KITSAT reception. Plans are to distribute these inexpensive 70cm units to schools. Messages of all types will be loaded into the satellite's memory for broadcast to amateur radio operators, experimenters and educational institutes.

Other experiments with the voice message forwarding potential of the system have not been defined but will begin when the satellite is in orbit. Real-time conversion of a digital uplink signal to an FM voice downlink for repeater style operation is a possibility.

AMSAT-OSCAR-10 and Fuji-OSCAR-12 were both severely affected by radiation damage. Amateur-radio satellite designers are increasingly interested in studies of the effects of radiation on all types on electronic circuits. Radiation detection experiments have been flown on previous amateur satellites, but at low altitudes.

KITSAT carries a Cosmic Ray Experiment (CRE) to measure total radiation dose encountered by the spacecraft and to detect highly-energetic cosmic rays. All the satellite's onboard systems, including the computers, power systems, memories and solar cells, will be monitored.

Phase-3-D, the current high-orbit satellite under construction, will encounter radiation levels similar to those seen by KITSAT. Information obtained from the KITSAT measurements will be extremely useful to Phase-3-D designers. Data formats will be available from the KARL, KAIST and the University of Surrey via AMSAT-UK.

The primary payload traveling with KITSAT is an oceanographic satellite, *Topex/Poseidon*. A microsatellite, S80-T, will also go up on the same late-July flight of *Ariane V-52*. The anticipated orbit is circular with an altitude of 1330 kilometers and a 66-degree inclination. No other OSCAR has been placed in such an orbit.

The inclination, or angle of the orbital plane with respect to the equatorial plane (equator), for KITSAT is not as high as other low-earth-orbit hamsats. Most are in polar orbits with inclinations of at least 80 degrees (90 degrees would be directly over the poles). KITSAT's inclination is also not as low as a high-inclination shuttle orbit (typically 57 degrees). The result of the 66-degree inclination will be noticed by those in high latitudes since the orbit will have characteristics similar to the shuttle, but at a much higher elevation.

An altitude of 1330 kilometers is similar to that of AMSAT-OSCAR-7, which is currently circling the earth near 1460 kilometers. For those who were active via A-O-7 in the '70s, antenna pointing was relatively easy and passes lasted long enough to make several contacts. DX was even possible from south Texas to parts of Western Europe. RS-10/11 is near 1,000 kilometers, while the current microsats and UoSAT-OSCAR-11 are even lower. KITSAT's orbit will provide users with longer access times and slower apparent Doppler-shift-to-signal frequencies.

Communications Via KITSAT

Operation via KITSAT will be easy for those already on U-O-22. The satellite's frequencies are shown in Table 1. KITSAT transmits and receives 9600 bps FSK using the AX.25 protocol. The programs currently available of U-O-22 access will allow telemetry files, experiment data, picture files from the cameras and user-uploaded files and messages to be downloaded.

Sources at the University of Surrey anticipate that 95 percent of the satellite's operating time will be devoted to normal 9600 bps communications. The rest of the time will be used for experiments with voice, higher-speed data and other DSP activities.

KAIST earth station HLØENJ in South Korea will manage KITSAT's activities, while the University of Surrey in England will provide advice as needed. Current plans focus on operating KITSAT as a satellite dedicated to the amateur radio satellite service. Exciting times are on the horizon for the first hamsat sponsored by South Korea. 73

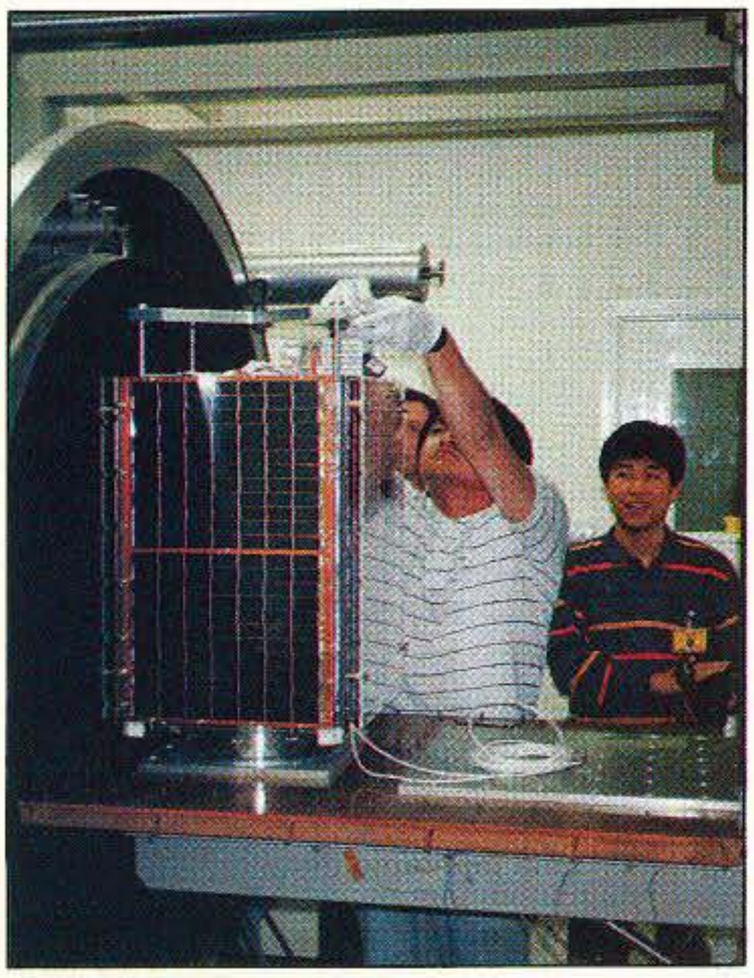

Photo A. The KITSAT-A microsatellite enters thermal-vacuum testing (5/11/1992). H.S. Chang removes the lifting frame as H.S. Kim looks on. Photo by J.W. Ward GØ/K8KA.

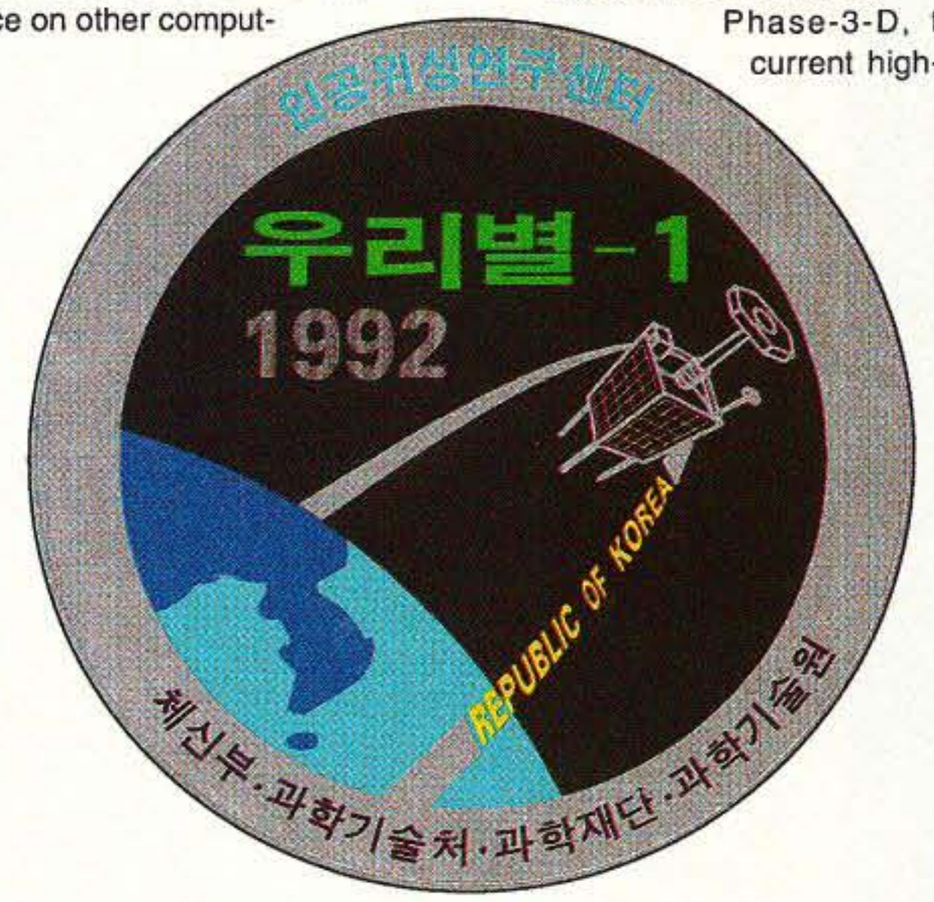

Photo B. The KITSAT-A logo.

Table 1. KITSAT-A Frequency Chart

UPLINKS:	145.850 MHz	Primary access channel
	145.900 MHz	Secondary access channel
DOWNLINK:	435.175 MHz	

HOMING IN

Number 15 on your Feedback card

Radio Direction Finding

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

RDF Opportunities Abroad and at Home

Enhancing international good will and advancing communications and technical skills are two of the five purposes of amateur radio. We all know that because it says so in the beginning of FCC Part 97. Radio Direction Finding (RDF) competitions are a perfect way for hams to do both and have a barrel of fun at the same time.

As I write this, it has been a month since this column broke the news of an invitation for U.S. foxhunters to participate in the Ukrainian RDF Championships in September (see "Homing In" for April 1992). I am astonished at the small response so far.

John Douglas NØISL, Technical Director of the Foundation for Amateur International Radio Services (FAIRS), reports only a trickle of inquiries so far. One of the respondents is of Ukrainian descent, intrigued with the program mostly because of the opportunity to visit his homeland.

Why haven't hams jumped at the chance to take part in an adventure like this? John suspects that some may fear the political situation in that part of the world. He points out that unrest is severe in Armenia, Georgia, Moldavia, and Azerbaijan, but not in the Ukraine and central Russia. Besides, your hosts will be taking good care of you.

"It was almost amusing the way we were guarded and herded on our last trip," John says. "There's always the risk of some sleazy guy sliding up to you on the street and saying, `Do you want to buy some rubles?' But you can see him coming half a block away. As one would start to approach, about six very loud Russian hams would be between me and him, and he would be gone." Instead of the tourist hotels, RDFers are invited to stay in Ukrainian hams' homes. You won't be sampling night life in the evening. Instead, you will probably be at someone's ham station, working the world.

"Lvov is a very European city, 40 miles from the Polish border," John says. "The best way to get there is to fly to Moscow, then take the overnight train for the 700-mile trip to Lvov. Travel on the train is an absolute joy. You see the countryside from European style coaches with tables and a matronly old lady who insists that you drink all the tea you can. The people are as warm and sharing as any I have ever known."

Soviet hams are just as innovative as hams anywhere else, but they lack many of the resources we take for granted. If you think getting parts for your do-it-yourself ham gizmos is hard, imagine the plight of hams in former iron-curtain countries.

John tells of his experiences on the train, meeting foxhunt organizer Igor Shewchuk UB5SBD. "He brought some hand-built foxes that he was working on, which also did the scoring and offloaded via 2 meters all of the competitors' check-in times (Photo A). It had an optical reader and he was hand-manufacturing all the little optical cards. He wanted me to look at it, suggest some changes and see if I could get him some parts." Time is getting short to make arrangements for this event. UB5SBD says, "You Americans don't have to send your champions. We'd love to show it to anyone who is interested."

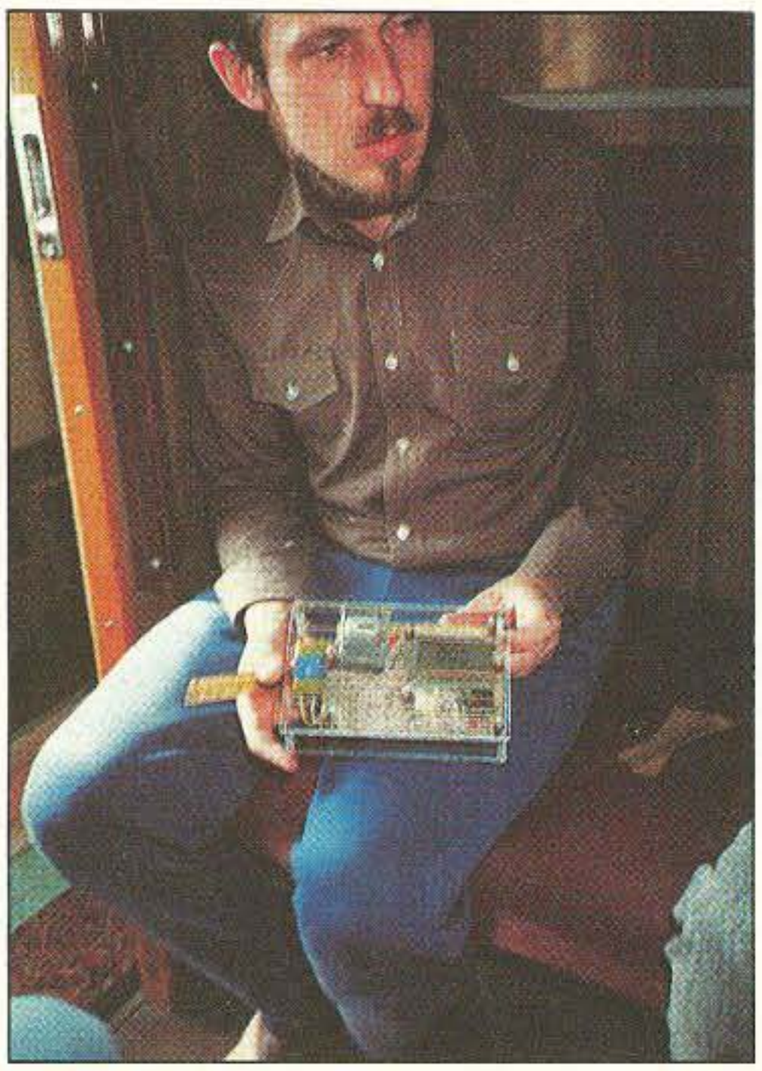

Photo A. Igor Shewchuk UB5SBD shows off his computer-controlled fox-box on the train ride to Lvov. Hunters check in by inserting an optical card into a reader, which records competitors' times and transmits this data via radio link to the judges. (Photo by NØISL)

If you think you're ready for a world-class foxhunt, and you think you would make a good ham ambassador, write to NØISL at 19164-147th Street NW, Elk River MN 55330.

Photo B. Radio foxhunting has long been a popular children's sport in Europe and Asia, but nowhere more than in the former Soviet Union, where it was sponsored by the military and taught in the schools.

East and West—Different Styles

It is clear to me that there would be more interest in the Lvov opportunity if there were more similarity between RDF contesting in the USA and foxhunting in the rest of the world. European and Asian hunts are all on foot, with multiple transmitters on a course that covers several kilometers. Unless you are in great physical condition, you're doomed to an embarrassing rear-guard finish in these sprints.

While there are several age categories, international foxhunting is primarily a sport for young boys and girls (Photo B). The primary purpose is to teach and reward physical conditioning and orienteering skills, with radio/electronics proficiency as a secondary aspect. The vast majority of European contestants are not licensed hams.

Here in the USA, hams don't think of transmitter chasing as a body building activity. We go T-hunting for a social experience or for a technical challenge. Unlike elsewhere in the world, we have the additional freedom to use our RDF skills for self-policing or to aid in volunteer search and rescue. It is an activity for ham clubs, not youth groups.

By not having the opportunity to participate in radiosports, young people in the USA are missing out on a good thing. Over the years, other international sports (like soccer) have found their way into our schools, so why not foxhunting?

Perhaps some of you readers are in a position to help make this happen. If you are a teacher who is including ham radio in your curriculum (Bless you!), consider adding foxhunting to the activities. No more classroom time available? How about putting it into your school's physical education program? I would have enjoyed foxhunting more than any other activity we did in phys. ed. when I was a kid.

Are you into orienteering? There are so many similarities that orienteers should feel right at home on a foxhunt course. I'd like to hear from people who can tell me how to get orienteers and foxhunters together.

NØISL would like to see two-way exchanges with UA-land foxhunters. "We could invite a young Russian or Ukrainian here with his RDF gear and have him teach it to clubs or interested groups," he says. "If three ham clubs picked up the cost of getting one here, and split the housing for a couple of days each, we're talking about a very small budget.

What are your thoughts? Write me at the address above. I try to answer the mail promptly. (Hint: Letters including self-addressed stamped envelopes go to the top of the pile.) You can also catch me on CompuServe (75236,2165) or Internet (JoeMoell @cup.portal.com).

Turning to Technical Topics . . .

At the end of a mobile T-hunt, you often have to get out of your car and beat the bushes. That part of the hunt is called the "sniff." Sniffing your way to a concealed 146 MHz transmitter is tricky if all you have is a 2 meter handheld rig.

The "body shield" sniffing technique loses its effectiveness as you approach a high-powered T because you can't attenuate the signal enough to determine direction and level changes. You can try tuning 5 or 10 kHz off frequency to knock down the signal, but the effectiveness of that ploy depends greatly on the modulation characteristics of the fox's signal.

You can build special sniffing gear, such as field-strength meters and du-

Photo C. Quads for 440 MHz are compact and highly directional. This is a commercial model made by Alabama Amateur Electronics, modified for mast connection at the center of gravity, with a ferrite balun added.

al-antenna RDF sets. But the handheld would be good enough if you could just get the hider to reduce power by 60 dB as you get within striking range. If you have a dual-band (2 meter and 70 centimeter) HT, you can get the same effect by sniffing the third harmonic.

FCC rule 97.307(e) limits the allowable harmonic power of 2 meter transmitters. If the hidden T runs less than 25 watts, each harmonic may not exceed 25 microwatts. If you think that's too puny for sniffing, think again.

"Every 2 meter transmitter I've hunted has put out enough third harmonic to make it sniffable once I'm in walking range," says Martin Hasa KB6MAH, who has used this trick for some time.

Not only does switching to the third harmonic give you instant attenuation, it also allows you to use a smaller, highly directional antenna for the sniff. Elements on a 70cm quad are only 6-1/2 inches on a side. The quad shown in Photo C has a boom length of 21 inches. You can carry it with the attached mast as shown, or eliminate the mast and just hold it by the rear of the boom.

Many scanners receive the 70cm band, but most don't have S-meters, so it's harder to get good bearings with them. A dual-band HT modified for extended receiver frequency range (to go below 440 MHz when the T-hunt is on 146.665 or below) is ideal.

(Here is an "electronic countermeasures" hint for hiders: If you think hunters will be sniffing on your third harmonic, use the maximum legal level of deviation. If you run +/- 5 kHz deviation on 2 meters, your 70cm harmonic will deviate +/- 15 kHz, exceeding the passband width of most UHF receivers. They will still be able to hunt you, but it will be more difficult.)

Pattern Perfection

Quads for 70cm are an easy homebrew project, or you can buy one ready to go. Not only are they fine for harmonic sniffing, but they are used in my area for mobile hunts on 446 MHz FM.

Note in the photo the non-metallic (PVC pipe) mast and tee couplings I use to preserve the quad's directional pattern. There are two tee fittings fastened to the boom, one for vertical polarization and the other for horizontal. The hider is allowed to use either polarization, so quick changing is important.

The directional pattern of a quad is never perfect. Unwanted side lobes and back lobes can show up for a number of reasons. One common cause is signal pickup by the shield of the feed line. A balun at the feed point eliminates the problem, but typical sleeve baluns, called "bazookas," are frequency-sensitive and their dimensions are critical at UHF.

I solved a pesky sidelobe problem on this quad by using ferrite beads as a choke balun. It takes two dozen beads (4-1/2 inch balun) to insure that all outside shield RF currents are attenuated to insignificant levels. You can use this trick on any VHF or UHF beam, but be sure to pick the right ferrite material.

At 2 meters, #43 beads (part number FB-43-2401) are optimum. That mix is usable from 6 meters well into the UHF range. A better material for use above 400 MHz would be #64, but #64 beads of this size are not available.

Cut the coax jacket back and slip the beads over the shield braid before installing the end connector. The inner diameter of the beads (0.197 inch) is too small to put them over the jacket. Put tape or shrink sleeving over the whole balun if you like, but don't worry about shorting anything with the beads. Ferrites for these frequencies are non-conductive.

My source for beads is Amidon Associates, PO Box 956, Torrance CA 90508; (310) 763-5770. The cost is $4.50 per dozen or $16 per hundred. There is no minimum order quantity, but Amidon charges at least $4 per order for shipping and handling. 73

ATV

Number 16 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Monster ATV Rockets

Just north of Edwards Air Force Base in the Mojave Desert, I cruised along the edge of a large dry lake bed. At the end of a little-travelled dirt road, I drove past the liquid fuel rocket engine test stand and parked next to a Quonset hut where a number of folks were assembling the solid fuel rocket.

A NASA experiment in progress? Nope . . . I had just arrived at the "Missile Test Area" for the Reaction Research Society. This group consists of a number of experimental rocketeers who meet periodically in the desert to test out their new creations. We're definitely not talking about your typical hobby store variety of model rocket—some of their rockets are what I would consider full-scale!

The ATV Rocket

Inside the Quonset hut, Bruce Markle of San Diego was busy assembling his 6-foot-tall solid-fuel rocket. Bruce's rocket had a very intriguing tail-fin assembly. To stabilize the rocket from rolling during the flight, he had "rollerons" mounted in two of the fins. Similar to the devices used in Sidewinder missiles, each rolleron consisted of a 2-3/4" milling wheel (available from machine tool shops) which was mounted vertically within a hinged surface in two of the tail fins. The edge of each wheel is grooved in much the same way as a water wheel. This allowed Bruce to spin up each rolleron with compressed air to several thousand RPM before liftoff. In addition, the rollerons would continue spinning as the rocket flew through the air at high speeds. During flight, if the rocket attempted to roll, the rolleron-fitted fin would compensate due to gyroscopic action.

In addition, Bruce could move the other two fins (acting as one surface) via R/C control to actually steer the rocket during the flight.

Since Bruce's rocket was over 4" in diameter with a large payload compartment, and since it was so incredibly stable, it seemed to be the logical vehicle for some live ATV experiments!

Mike Henkoski KC6CCC teamed up with Bruce and built a very compact 6-watt ATV transmitter/camera package designed to fit snugly within the rocket. The payload consisted of a PC Electronics ATVM-70 micro-ATV transmitter (see the July '91 issue of *73*, page 9), a 6-watt amplifier brick and a miniature B/W TV camera (similar to the Micro Video Products CX-102 or the GBC CCD-100). Mike mounted everything in a Bud box and PC board material reinforced with brass strips. Mike's package was so well made, it looked like you could drive a truck over it with no ill effects!

Just outside of the camera porthole, a small mirror was epoxied in place to direct the camera view towards the ground to see the spectacular lifoff. Right above the mirror, a half-wave dipole was mounted for the 434 MHz ATV downlink. The "V" shape of the dipole helped make it more aerodynamic and also improved the impedance match.

A Spectacular Liftoff

Just prior to liftoff, two jets of compressed air spun up the rollerons to several thousand RPM. As we all kept our distance, the fire command was issued and, in an impressive display of smoke and flame, the rocket raced for the sky. Inside the hut, we could all ride along with the rocket by watching the ATV downlink. With the high-power ATV transmitter we received absolutely P-5 snow-free images throughout the flight. The rocket made it up to about 1200 feet in just a few seconds. The rollerons worked amazingly well, absolutely NO spinning was observed in the video downlink, just a beautifully stable view of the desert floor disappearing below.

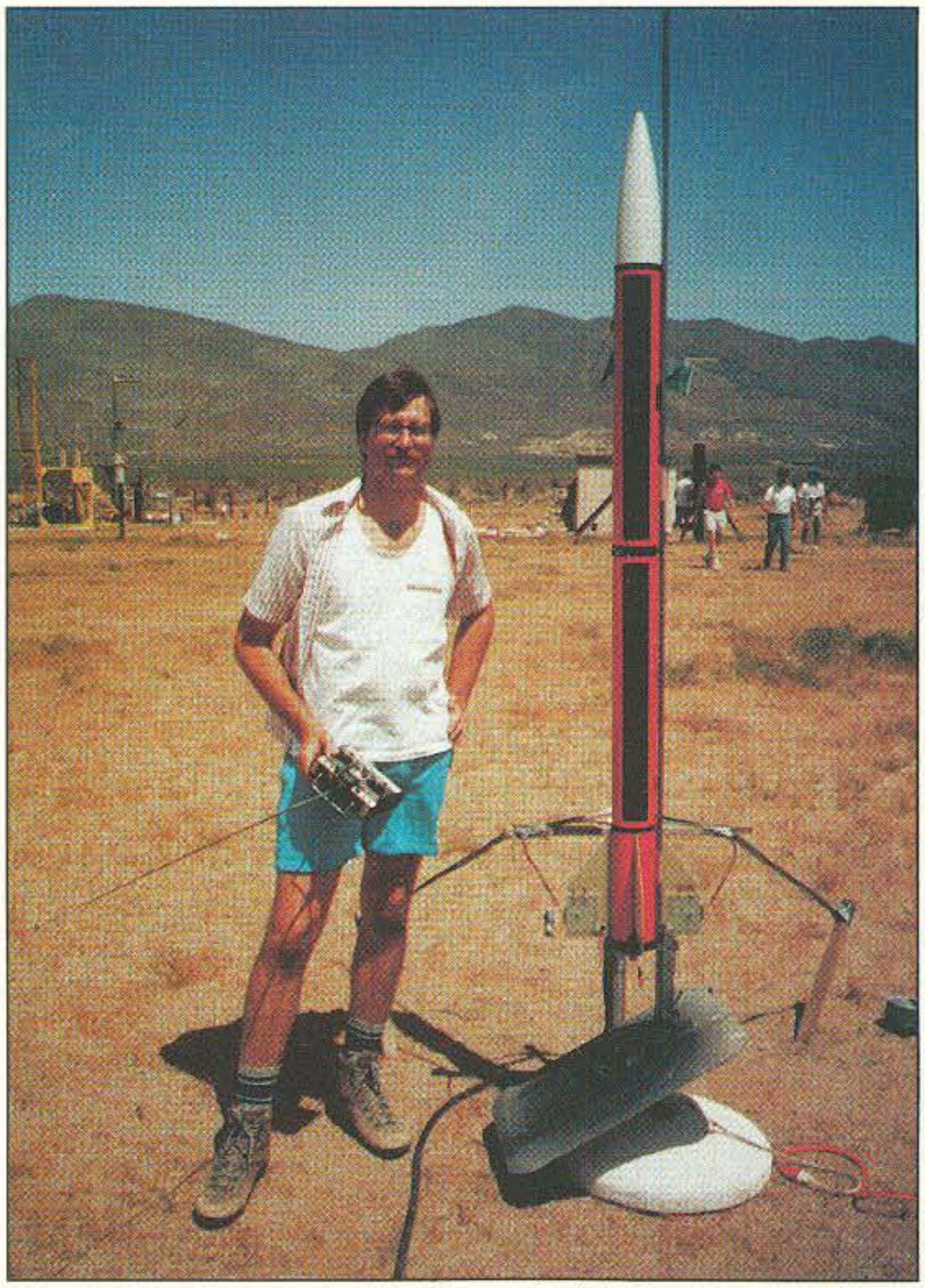

Photo A. Bruce Markle readies his R/C-controlled, ATV model rocket for flight.

Splat!

As the parachute ejected, disaster struck! The elastic shock chord con-

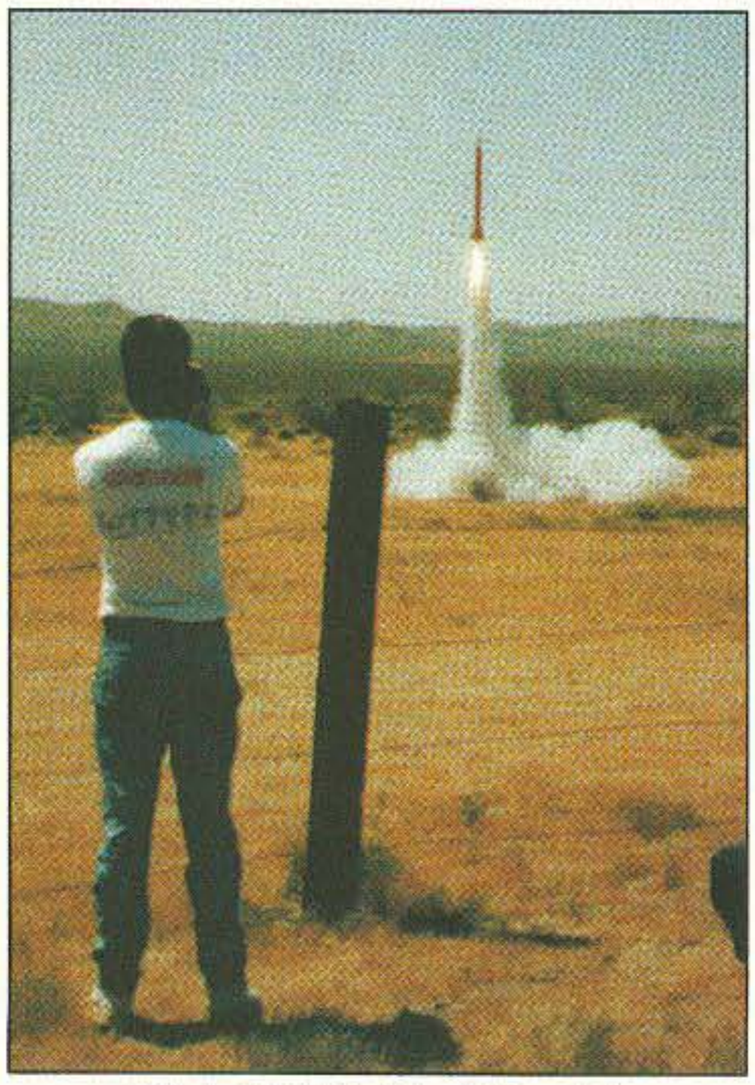

Photo B. Liftoff of the ATV rocket.

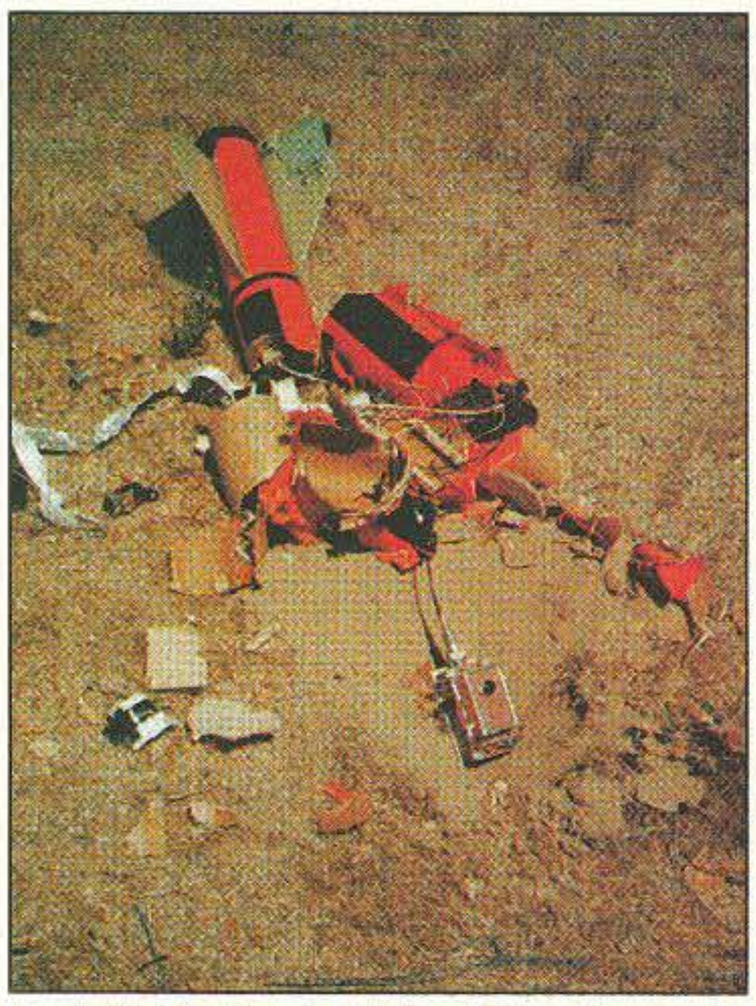

Photo C. The "landing." The ATV package miracously survives the impact amidst the remains of the rocket.

Photo D. Mike Henkoski KC6CCC (designer of the ATV package) pulls the ATV payload out of the rubble and is amazed to find it in perfect working order!

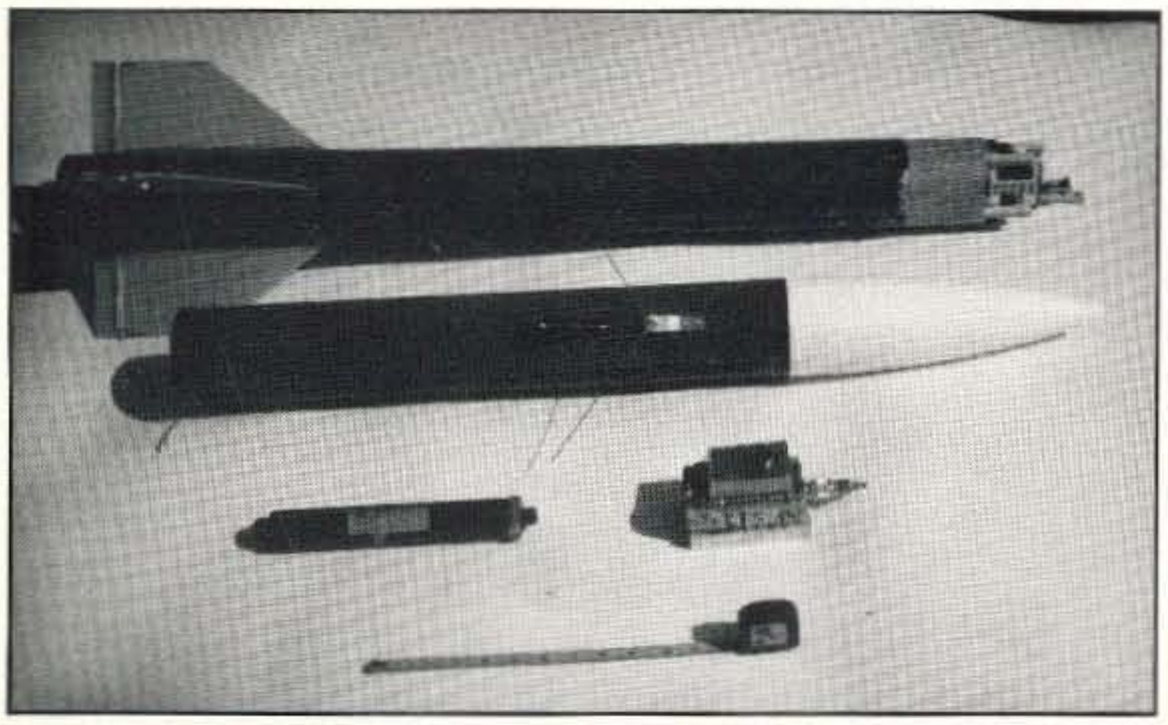

Photo E. Individual rocket sections. The ATV package (shown in the foreground next to the rocket engine) was mounted just below the nose cone section.

necting the parachute to the body of the rocket snapped in two and the rocket (with ATV payload) plummeted rapidly to the ground below. We all watched in stunned silence as the rocket hit the ground with a sickening "whump" just 100 feet from the hut.

As the dust settled, all that remained of the rocket was the tail-fin assembly and a large pile of twisted

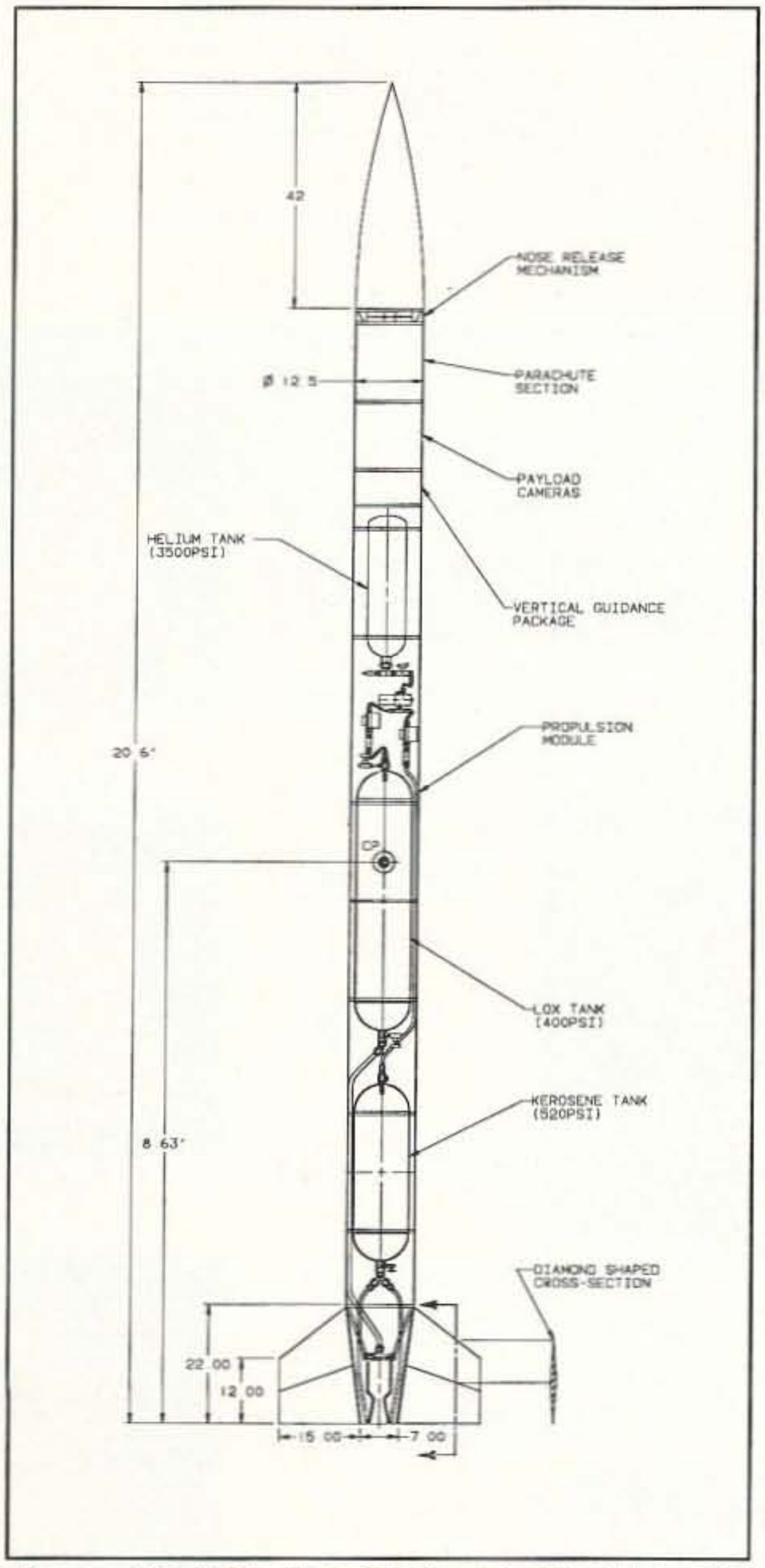

Figure 1. Diagram of David Crisalli's liquid fuel rocket which will take ATV to over 200,000 feet this fall.

Photo F. Close-up view of the small mirror which directed the camera view towards the ground. The ATV transmit antenna consisted of an inverted-V style dipole located just above the mirror.

rubble. We all wondered if any recognizable pieces of the ATV payload could be found. After digging around a bit, we found a few shards of electronic components: a bit of a resistor, a partial capacitor and a couple of rubber buttons. It turned out to be all that was left of a Radio Shack timer. At the bottom of the pile we were astonished to find the slightly bent, but completely intact ATV package. We were even more amazed when Mike KC6CCC applied power to the transmitter and we were treated with a perfect picture. It takes a REAL licking and keeps on ticking! We estimated that the rocket had hit the ground going over 150 mph and produced over 1000 Gs on the package during the impact.

Future Flights

Bruce Markle's rocket was a scale model of a liquid-fueled rocket that David Crisalli is currently building. In fact, this flight was a test to see how the guidance system and the ATV payload performed in order to prepare for the mega-flight later this fall.

David Crisalli's liquid fuel rocket will stand just under 20 feet high, will be 12.5" in diameter, and will weigh in at 380 pounds (see Figure 1). Using a mixture of kerosene and liquid oxygen, the engine can produce 1,000 pounds of thrust for upwards of 45 seconds. David hopes to reach a top altitude of over 200,000 feet with this flight (currently scheduled for early fall). He is hoping to gain permission to fly out of the White Sands, New Mexico, area.

This rocket will have a fairly large payload area. Current plans are to fly the 6-watt ATV package with a B/W camera (and possibly a color camcorder) and a 2 meter telemetry downlink. The line-of-sight range at this altitude will exceed 550 miles. David has room for some additional payloads and would be happy to fly other packages as space permits.

This flight should provide us with some very spectacular ATV footage during its trip to the very edge of space.

Join in the Fun

If you would like more information about the Reaction Research Society's activities, you can write to them at the following address (they also offer a newsletter): Reaction Research Society, P.O. Box 90306, World Way Postal Center, Los Angeles CA 90009. For more information about the liquid fuel rocket you can contact David Crisalli, 3439 Hamlin Ave, Simi Valley CA 93063. To learn more about the scale model version shown in this column you can write to Bruce Markle, 5944 Portobelo Court, San Diego CA 92124.

For those of you interested in building large rockets, there is a publication called "High-Power Rocketry" put out by the Tripoli Rocketry Association, Inc., P.O. Box 40475, St. Petersburg FL 37743-0475. 73

UPDATES

Number 30 on your Feedback card

8,000 Channels for the Ramsey FX-146

See the above article in the June '92 issue of *73*, page 10. Although the PC board foil pattern and the parts placement diagram are correct as shown, the schematic diagram (Figure 1) has three errors. The ``+RPT" and the ``-RPT" lines are reversed in the schematic and the value of the capacitor attached to the Vcc lead on the bottom EPROM should be changed from a 0.1 µF value to 10 µF. In addition, the program to determine the EPROM frequency select data is missing the ``divide by" symbols in lines 70 and 90. Also, the values in lines 100, 110 and 120 have been changed in the new version. See the figure for the correct program. This program is also available from the *73 BBS* at (603) 924-9343 under the filename ``FX146MOD.BAS." *Cecil A. Moore KG7BK*

Ask Kaboom

In the June '92 "Ask Kaboom" column the following sentence was inadvertantly changed: ``*Instead of sending the same byte over and over, the delta modulator simply sends it once: analog with a code telling the demodulator how many times it is to repeat." The sentence should read: ``Instead of sending the same byte over and over, the delta modulator simply sends it once, along with a code telling the demodulator how many times it is to repeat."*
Michael Geier KB1UM

The BASIC program for obtaining the HEX address and HEX memory contents for the two EPROMs is listed below:

```
10 FOR N% = 7000 TO 9000
20 F = (20*N%)
30 FF=(F-140000!)/10:FFF%=FF
40 UFF%=FFF% MOD 10:FFF%=FFF%\10
50 TFF%=FFF% MOD 10:FFF%=FFF%\10
60 HFF%=FFF% MOD 10:FFF%=FFF%\10
70 ADR%=UFF%\2+TFF%*8+HFF%*128+FFF%*2048
80 PLDATA%=N% MOD 256
90 PHDATA%=N%\256
100 IF F>=145100! THEN IF F<145500! THEN PHDATA%=PHDATA%+128
110 IF F>=146600! THEN IF F<147000! THEN PHDATA%=PHDATA%+128
120 IF F>=147000! THEN IF F<147400! THEN PHDATA%=PHDATA%+64
130 PRINT "FREQ", "NUMBER", "PROM ADR", "HIGH BYTE", "LOW BYTE"
140 PRINT F,N%*4,HEX$(ADR%)"H",HEX$(PHDATA%)"H",HEX$(PLDATA%)"H":PRINT
150 IF INKEY$="" THEN GOTO 150
160 NEXT N%
170 END
```

Figure. The updated program to determine EPROM frequency select data for the RAMSEY FX-146 modification.

Receive Converter Adapter *Continued from page 34*

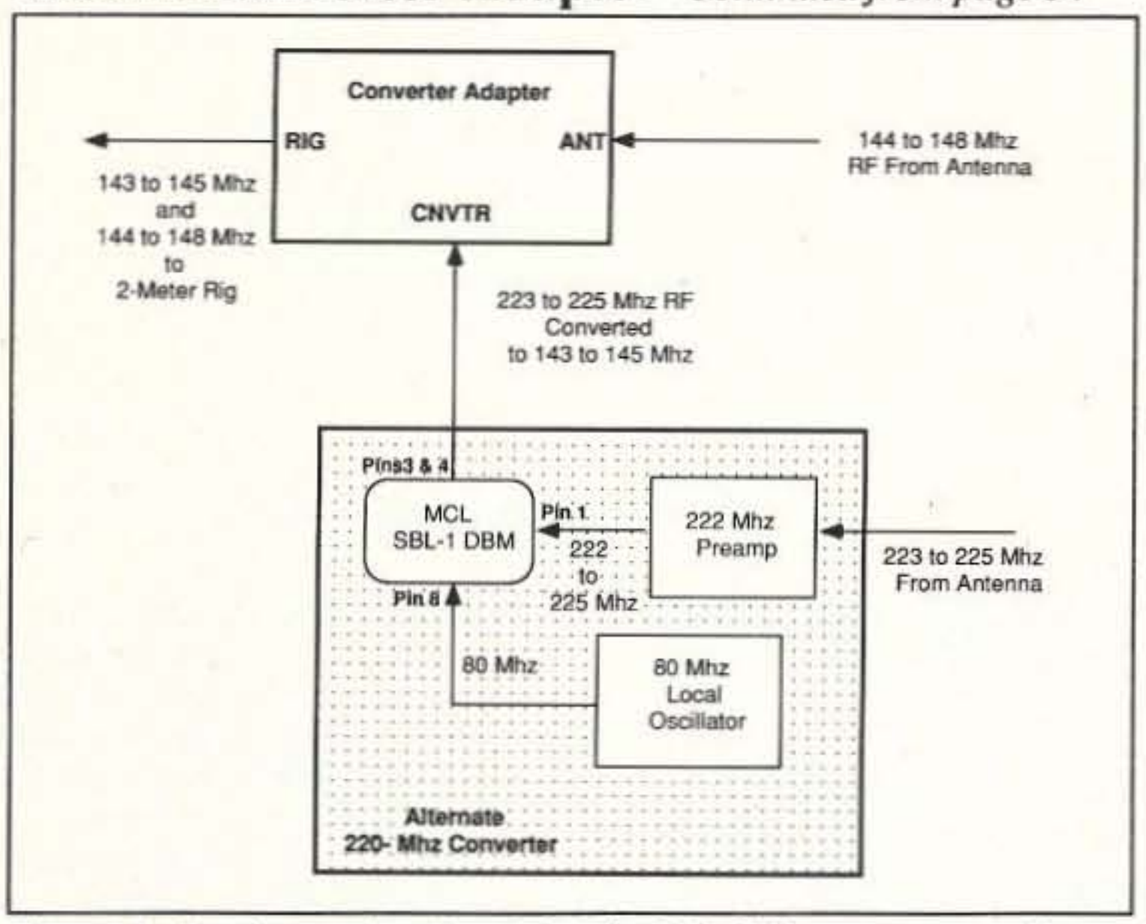

Figure 6. An alternative circuit for the 220 MHz converter using an 80 MHz local oscillator.

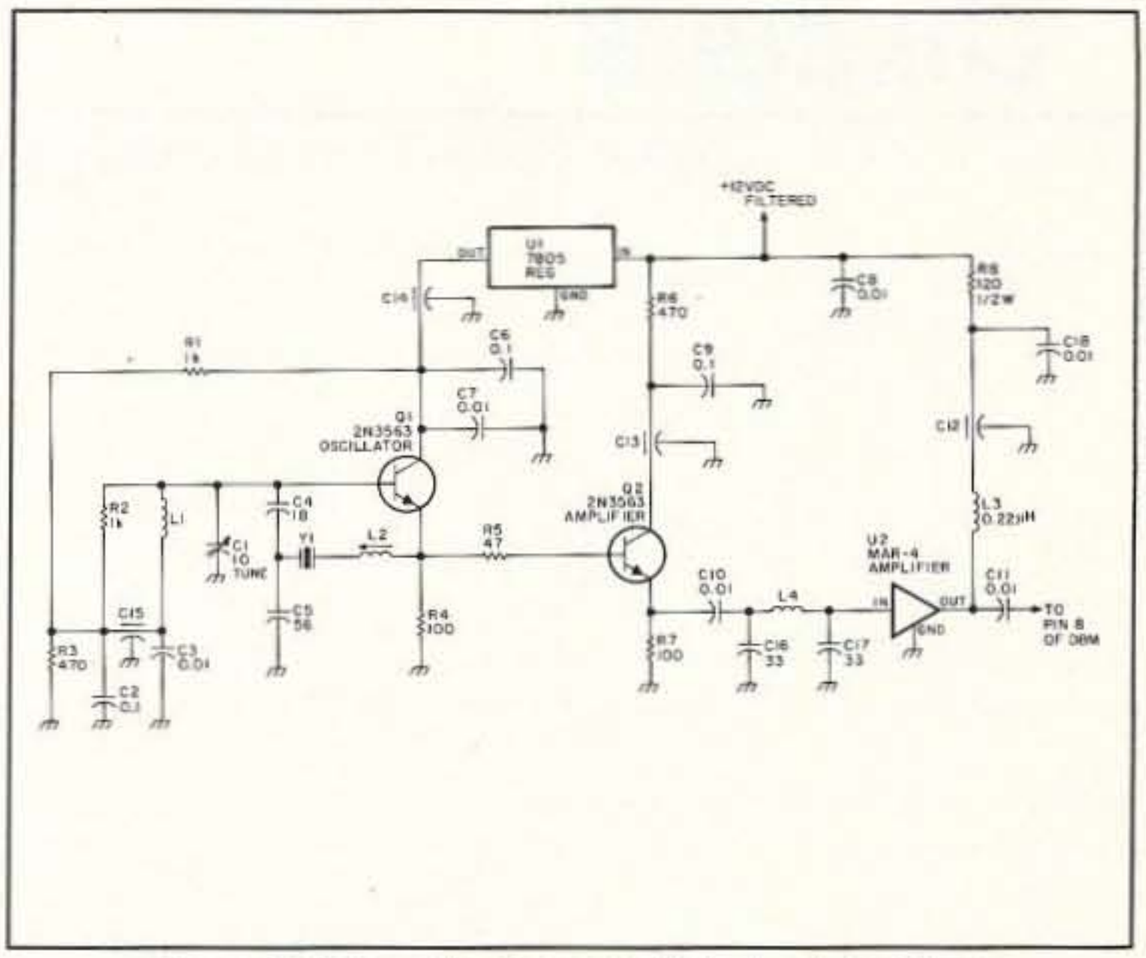

Figure 7. Schematic diagram of the local oscillator.

tally and L2 is mounted vertically in Figure 8A—though this could be reversed if you adjust the spacing and positioning of the mounting pads. The completed oscillator, preamp and mixer can be mounted in the same chassis with the Receive Converter Adapter or in a separate housing. I use threaded stand-offs to mount the modules in their enclosure.

Coax Section Trimming with a Grid-Dip Oscillator (GDO)

A Grid-Dip Oscillator (GDO), or solid-state equivalent, can be used to fine-tune the quarter- and half-wave coax sections. (Remember when most electronic devices had grids?) The first step is to create a small loop between the coax center conductor and shield at one end of the coax. Leave the other end of the coax open. Using a GDO coil selected to cover a range lower than the expected frequency, couple to the coax section loop and tune the GDO for a dip to indicate the resonant frequency of the line—moving higher in frequency until a dip is found. This is important in finding the true resonant frequency and avoiding false peaks. Trim the line by small cuts to obtain the desired resonant frequency. The same procedure can be used if you want to use the half-wave coax section, but the dip indicted will be at half the desired frequency. As an example, a properly trimmed half-wave coax section at 147 MHz will present a "dip" to the GDO at 147/2, or 73.5 MHz.

Checkout

With everything connected to the proper connectors on the converter adapter, start with your transceiver in the low power position. (It is important that the converter or another 50 ohm load is connected to the converter port during receive to minimize losses due to the reduction in signal which would result from the unterminated quarter-wave section of coax π2.) If possible, perform the initial checkout with a 50 ohm load to minimize the effects of an antenna SWR. Leaving the low-pass filter out during checkout may also be helpful. Transmit operation should be normal, with minimal differences noted from operation with the converter adapter out of the line to the antenna or dummy load. If abnormal operation such as reduced power out is indicated, check for correct converter adapter cable connections and check for coax section shorts. That's all there is to it!

Operational Considerations

Power capability: The converter adapter has been used with transmitter outputs up to the 40-45 watts level. The RG-59/U cable can handle this power with no problem and the diodes have stood up well. At the other extreme, even operation at 100 mW should provide enough RF at the diodes to cause them to operate properly in this circuit.

Receive converter protection: Diodes D1 and D2 provide protection to the receive converter during transmit. Even with the diodes conducting, some RF is present at the converter port. Rough measurements with an RF probe-VTVM combination have shown the RF level to be over 1 volt. This should not bother the output of most converters, especially not the DBM types described, but it is something to be aware of before trying this approach. 73

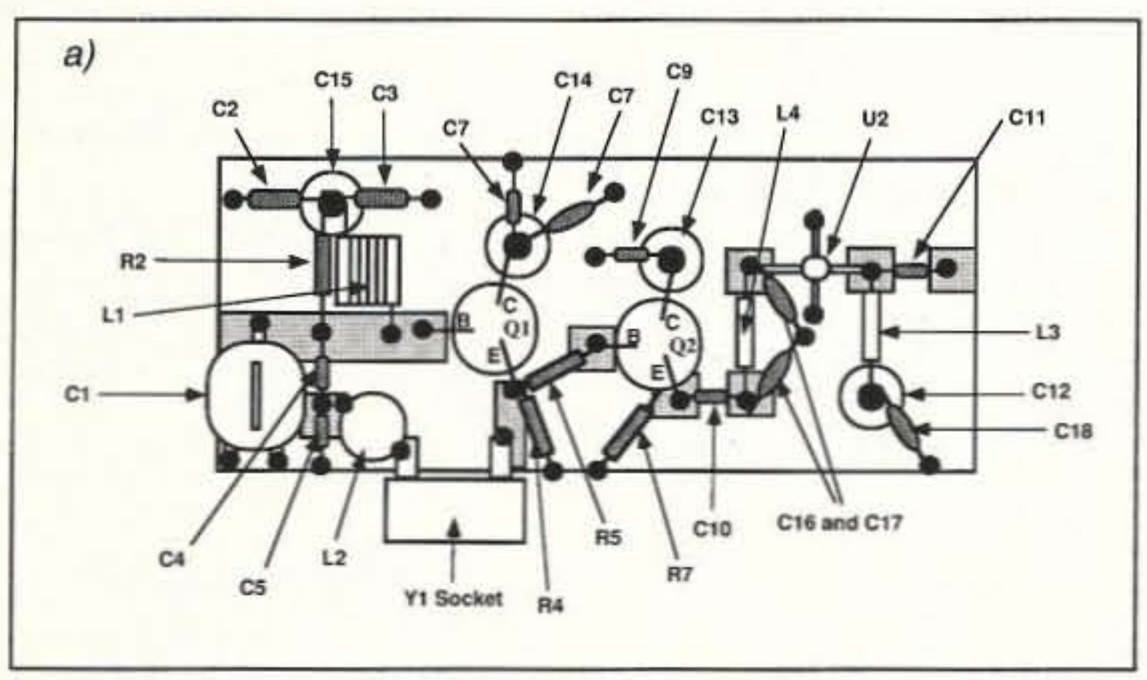

Figure 8 (a). Front side parts placement for the local oscillator. (b). Reverse side parts placement.

Parts List

C1	10 pF ceramic trimmer or equivalent
C2, C6	0.1 µF disc ceramic capacitor, 16-20 volts
C3, C7, C8, C9, C10, C11	0.01 µF disc ceramic capacitor, 16-20 volts
C4	18 pF NPO ceramic capacitor, 16-20 volts
C5	56 pF NPO ceramic capacitor, 16-20 volts
C12, C13, C14, C15	0.001 µF feedthrough bypass capacitor, 16-20 volts
L1	5 turns no. 28 enameled wire, 0.1" i.d., 0.2" long
L2	8 turns no. 28 enameled wire, 0.1" i.d., 0.2" long on a slug-tuned form.
L3	0.22 to 1.6 µH miniature RF choke
L4	0.10 µH miniature RF choke
R1, R2	1,000 ohm 1/4 watt carbon film resistor
R3, R6	470 ohm 1/4 watt carbon film resistor
R4, R7	100 ohm 1/4 watt carbon film resistor
R5	47 ohm 1/4 watt carbon film resistor
R8	120 ohm 1/2 watt carbon film resistor
Q1, Q2	2N3563 NPN transistor or equivalent
U1	7805 or equivalent 5-volt regulator
U2	Mini-Circuits Lab MAR-4 MMIC amplifier
Y1	5th overtone, series-resonant crystal 90 MHz, 77 MHz, or 80 MHz (see text)
	DBM SBL-1 double-balanced mixer (Mini-Circuits Labs)

CIRCUITS

Great Ideas From Our Readers

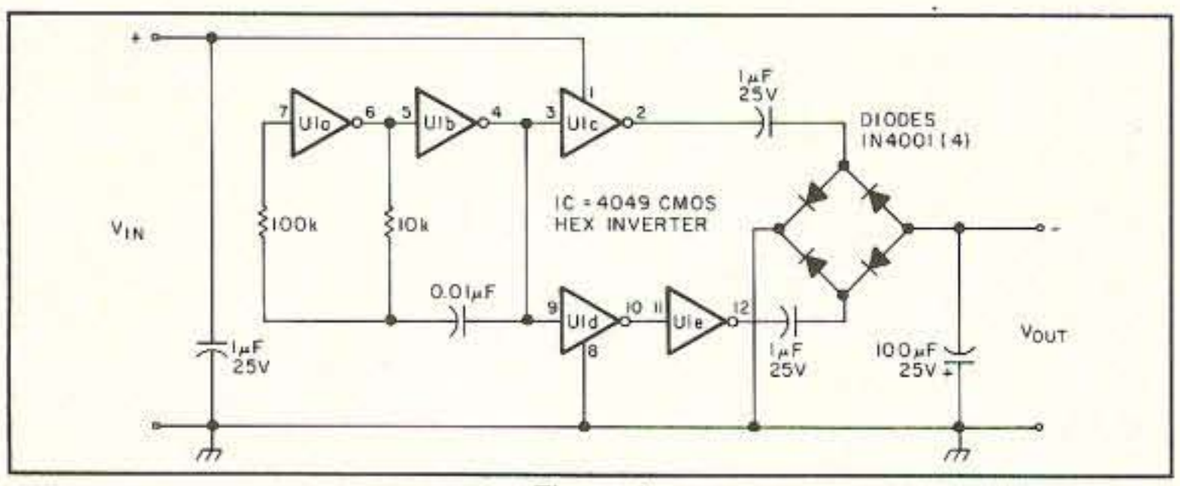

Figure 1.

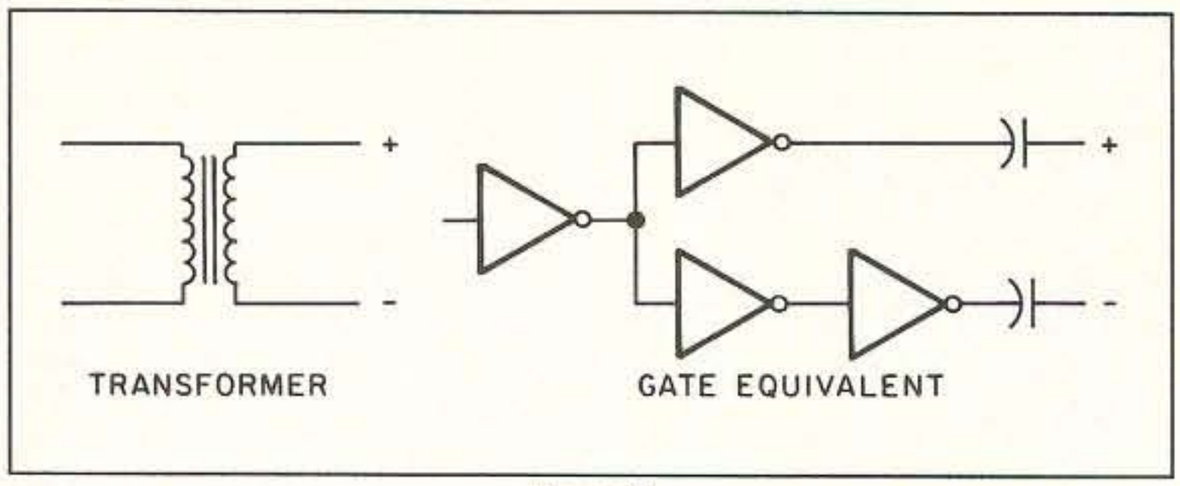

Figure 2.

Inverting Power Supply

How many times have you needed a low-current negative voltage for that op amp or RS-232 circuit? Figure 1 is a circuit I came up with to do the job. I used a 4049 CMOS hex inverter in this application since this IC is capable of more output current than the typical CMOS IC.

U1A and U1B form a standard CMOS oscillator. With the R/C values shown, the unit oscillates at 4200 Hz. U1C and U1D buffer the output of the oscillator, and U1E inverts the output to the diode bridge with respect to the output of U1C. The outputs of U1C and U1E are AC coupled to the diode bridge, then full-wave rectifies the AC signal and gives you the final negative voltage output.

Figure 2 shows how you can make a transformer equivalent circuit out of some gates. In both cases you are AC coupled. And in both cases the outputs are 180 degrees out of phase with each other.

This circuit works well with low currents. With no load, the negative output is within 0.6 volts of the positive input. With 10 milliamps of load current, the negative output will be about 3 volts less than the positive input. The output is completely ripple-free with the 100 uF filter capacitor shown. Of course, at the 4200 Hz frequency the capacitor is almost equivalent to a 10,000 uF capacitor at 60 Hz.

Depending on current drain, this circuit is useful from 5 to 15 volts. Don't apply more than 15 volts input as you'll exceed the voltage rating of the 4049!

Phil Salas AD5X
Richardson TX

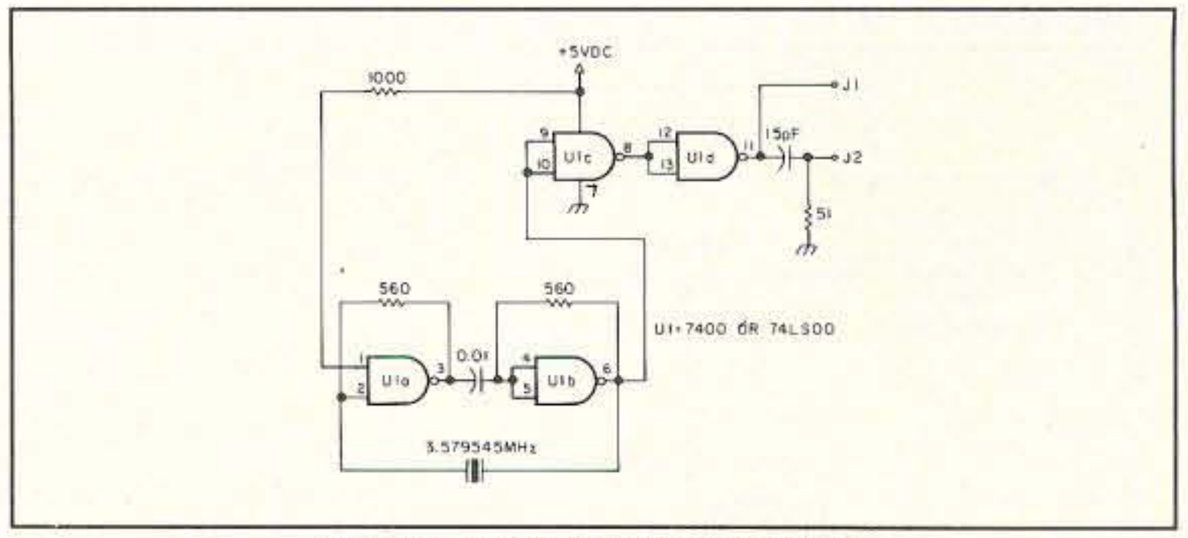

Figure 3. Wide-range crystal oscillator.

Wide-Range Crystal Oscillator for Receiver Sensitivity Testing

Here's a simple single-chip crystal oscillator which can use any crystal between 1 and 13 MHz and will produce very strong harmonics. When a color-burst crystal (3.579545 MHz) is installed, it will produce strong harmonics in or very near every HF band from 80 through 10 meters. These produce *known* ``on-the-air'' signals ideal for checking receiver sensitivity, noting the S-meter indication. If sensitivity is checked every six months any deviation will be readily evident, a warning that something in the RF path has deteriorated and should be investigated to maintain sensitivity within the manufacturer's specifications.

The crystal will oscillate in its series resonant mode in this circuit, a bit higher in frequency than that marked on the crystal. As an indication of the result to be expected, harmonics *calculated* from the marked frequency of the crystal, and the distance outside those ham bands not in exact harmonic relationship to the crystal fundamental frequency, are listed below, rounded off to the nearest kilohertz.

Whether the harmonic is in or slightly out of the band, sensitivity of the receiver will be the same because none of the out-of-band harmonics are more than a few parts per million from the nearest band edge. This is a very small percentage, even in the worst case condition of 30 meters where the third harmonic is 0.059% high.

No direct connection to the receiver is required. If desired, the output can be connected through a step attenuator of 50 ohms impedance to the receiver antenna connector. However, unless this oscillator is completely shielded it will radiate strong harmonics to the station antenna.

As an example, feeding the output directly to the antenna connector on my Kenwood TS-440S/AT, the 8th harmonic on 10 meters registered S9 + 40 dB. Radiated about 50 feet to the nearest end of my 40 meter dipole, the 10 meter harmonic registered a little over S9.

Either a 7400 or 74LS00 chip can be used. There is approximately 3V peak-to-peak square wave riding on +1 VDC at J1. J2 provides a differentiated square wave—positive and negative pulses containing all harmonics—of about 0.25V peak-to-peak at 50 ohms impedance. A short ``antenna'' can be connected to J1 if desired to radiate the harmonics to your antenna.

All parts are available from Radio Shack as well as from most mail order parts dealers. The resistors are 1/4W, 5%; the capacitors are disc ceramic. The total cost will not exceed $3.00, including the color burst crystal.

J. Frank Brumbaugh KB4ZGC
Bradenton FL

Band	Frequency	Deviation
80	3.580	
40	7.160	
30	10.740	590 kHz high
20	14.320	
17	17.900	168 kHz low
15	21.480	30 kHz high
12	25.060	61 kHz high
10	28.640	

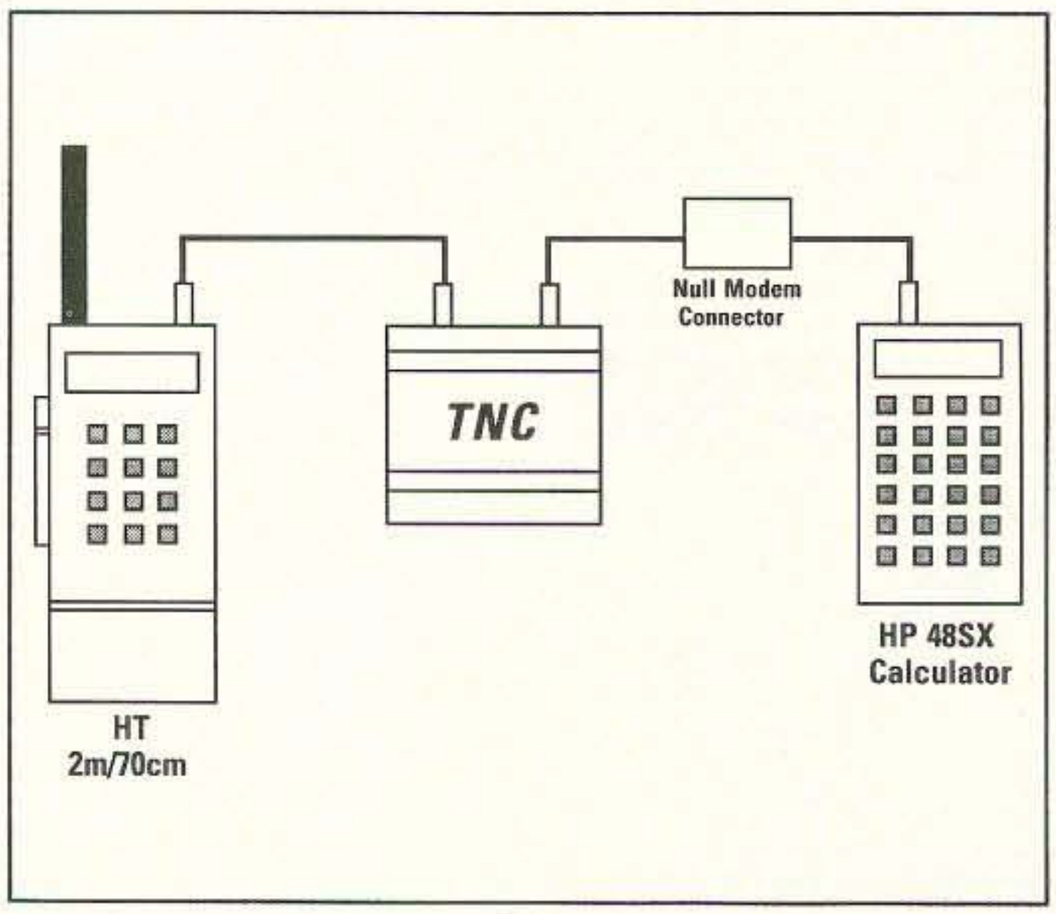

Figure 4.

Hand-Held Packet Station

This is one method of putting the HP48SX calculator to good use in the world of ham radio.

Here is the configuration I used for my packet station on Field Day, 22 June 1991. The HP48SX calculator runs a terminal emulation program, and is connected via its serial port to a TNC at 9600 baud. The HP48SX uses three ``triple A'' batteries, and I'm still using the batteries that came with the calculator (November 1990). The HP48SX has a 64 x 131 pixel display, and does quite well at displaying the data.

There are easier ways to enjoy packet radio, but I think this is the first time it has been done with a calculator.

It is fun, different, and very portable.

John Bachelor N8LIJ
Columbus OH

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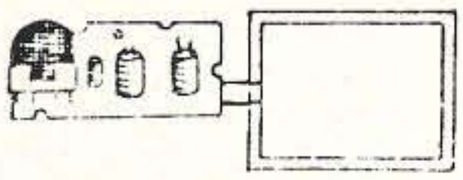

At last! A low cost electroluminescent glow strip and inverter. These brand-new units were designed to backlight small LCD TVs made by the Citizen Watch company. The inverter circuit changes 3 or 6 Vdc to approximately 100 Vac, the voltage required to light the glowstrip. Luminescent surface area is 1.7" X 2.25". The strip is a salmon color in its off state, and glows white when energized. The circuit board is 2.2" X 1". Glow strip and circuitry can be removed easily from plastic housing. Ideal for special lighting effects ant backlighting. Citizen# 92TA operates on 3-6 Vdc.

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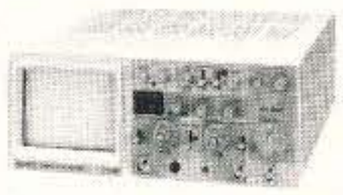

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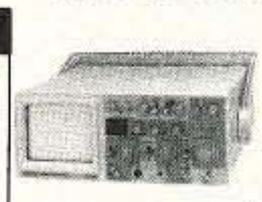

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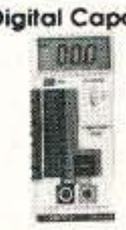

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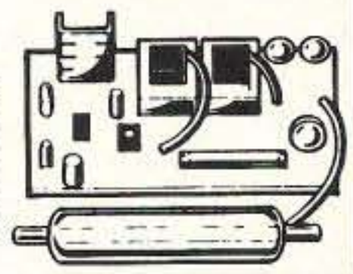
Laser tube size	1.125" dia x 5.75" long



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PMTs and Lasers

Now that you have PUFF well under your belt from the previous columns, I hope you have as much fun with it as I have had. Writing explanations helped me better understand PUFF and become more familiar with its commands, and I hope that covering it in this way will remove any start-up difficulties you might encounter. PUFF is a very complex program and there are still many different applications that need to be further explored. The booklet that comes with it gives examples of those applications, and in future columns I will cover some of these other aspects. If you come up with any interesting applications please drop me a note describing them and I will be glad to share them in this column. I am sure that some questions will surface regarding PUFF operation and I will try to cover them in the column as they come up.

Laser Operation

This month I would like to describe some new developments concerning laser operation. Quite some time ago I was involved in the construction of a system using HeNe (Helium-Neon) for a laser communication system. This was primarily due to the large number of HeNe laser tubes becoming available on the surplus market at low prices. In addition to the HeNe laser, I acquired quite a few different types of detectors for evaluation in our system receiver. I tried some very expensive solid-state pin photodetectors and the good old surplus photomultiplier tubes. Not being optics-savvy at first, I was surprised that the photomultipliers showed the highest system gains. Being an amateur, I first naturally selected the (PMT) photomultiplier for use in our top-end receiver. Its surplus cost was low.

Several amateurs helped me obtain different PMTs for test evaluation. There were various types, with all different sensiometric sensitivities. Specific PMTs are sensitive to different frequencies of light. It is very difficult to get a PMT with peak sensitivity to our laser (HeNe), which peaks at 632.8 nanometers, or 6328 angstroms, the frequency of red light. Most PMTs' sensitivity to the frequency gave about 10 to 20 percent efficiency. Even at this low percentage, operation sensitivity was remarkably high.

A little perspective on laser transmitters and receivers might be in order. The detector in a laser system can be a pin diode or a (PMT) photomultiplier. These two types are very sensitive. A solar cell could be used, but it gives poor sensitivity in contrast to the pin diode or the PMT. This detector is used to detect the laser beam and recover the modulation that is impressed on the beam. There will be no output listening to a laser beam that is continuous (CW) mode.

The laser beam must be modulated for the detector to recover intelligence. Normally, a laser is modulated by a simple 12-volt muffin fan such as is found in many of the IBM type computer power supplies. This DC fan is mounted in such a way that the continuous beam from the laser is passed through the rotating blades of the fan. The rate with which the fan blades "chop" the laser beam is the same audio rate that is transmitted. Code is transmitted by use of a shutter or your hand forming CW code on the beam's modulated rate (three long openings of the shutter and you have sent the letter "O").

This modulation rate (1 kHz) is easily detected and amplified by low frequency audio amplifiers. The prime key to success in this amplifier is the first stage. The amplifier should have high gain and very good low frequency noise response (that's a good low noise audio transistor). Additionally, it should have some form of feedback in the stage that maximizes gain at the audio frequency of interest. This feedback circuit prevents gain at other frequencies and accentuates the frequency of interest about 1 kHz, providing maximum gain there. See this column in the May, June and July 1991 issues of *73 Amateur Radio Today* for more on the laser topics and on power supply construction in general.

Power Supply

Let's get into some application details for a proposed low current power supply driver that can power PMT's. When the circuit is fully developed I will cover final test results for evaluation.

A new power supply system might not seem very important, even for portable photomultiplier tubes. However, battery conservation is quite important when operating from field locations. We not only reduce the weight of extra batteries but most likely increase the time we can operate from our existing battery. The problem with PMT tubes is that they require a high-voltage source of 1,000 to 1,250 volts DC distributed through a voltage divider made up of resistors across the dynodes (tube elements). This voltage divider traditionally was constructed with 100k to 470k ohm resistors in a series string of 10 or more resistors (see Figure 3). The actual number of resistors used depends on the number of tube elements (dynodes) for your particular PMT.

With a high voltage supply of 1,250 volts DC this usually means a current requirement of several milliamperes (0.001 to 0.003 mA) flowing through the network. Most of the current is used up in the resistor network as the tube current requirement is nil, or microamperes (almost nothing). Now, at first glance this doesn't seem like much but consider that 3 mA at 1,250 volts DC is almost 4 watts of power. Quite a bit, with almost 90 percent of it going to nothing more than heating the resistor string.

Enter the Cockroft Walton circuit to solve this power-hogging problem. The circuit is basically a voltage doubler that is stacked on end in an arrangement of capacitors and diodes. It has seen use in laser power supplies, multiplying its 1,500 to 2,000 volts (necessary to sustain a HeNe laser) to a starting voltage of around 10 Kv to ionize (start/ignite) a laser. See Figure 1, the laser starting circuit. This circuit can be adapted to the photomultiplier tube because the tube does not draw an appreciable amount of current from the multiplier assembly. (This multiplier arrangement cannot support much current demand from the PMT load.)

This is where the two circuits, laser and photomultiplier, differ. The laser requires a 10 kV high starting voltage to ionize the gas in the HeNe laser tube and when it ignites it draws a large amount of current: 5 to 30 mA, depending on the tube type. The starting circuit disconnects on high current at this point. It's still there but, due to the small value of the capacitors used, it cannot maintain the multiplication operation. The diodes are still in the circuit but are now just series pass elements and are, for the most part, invisible.

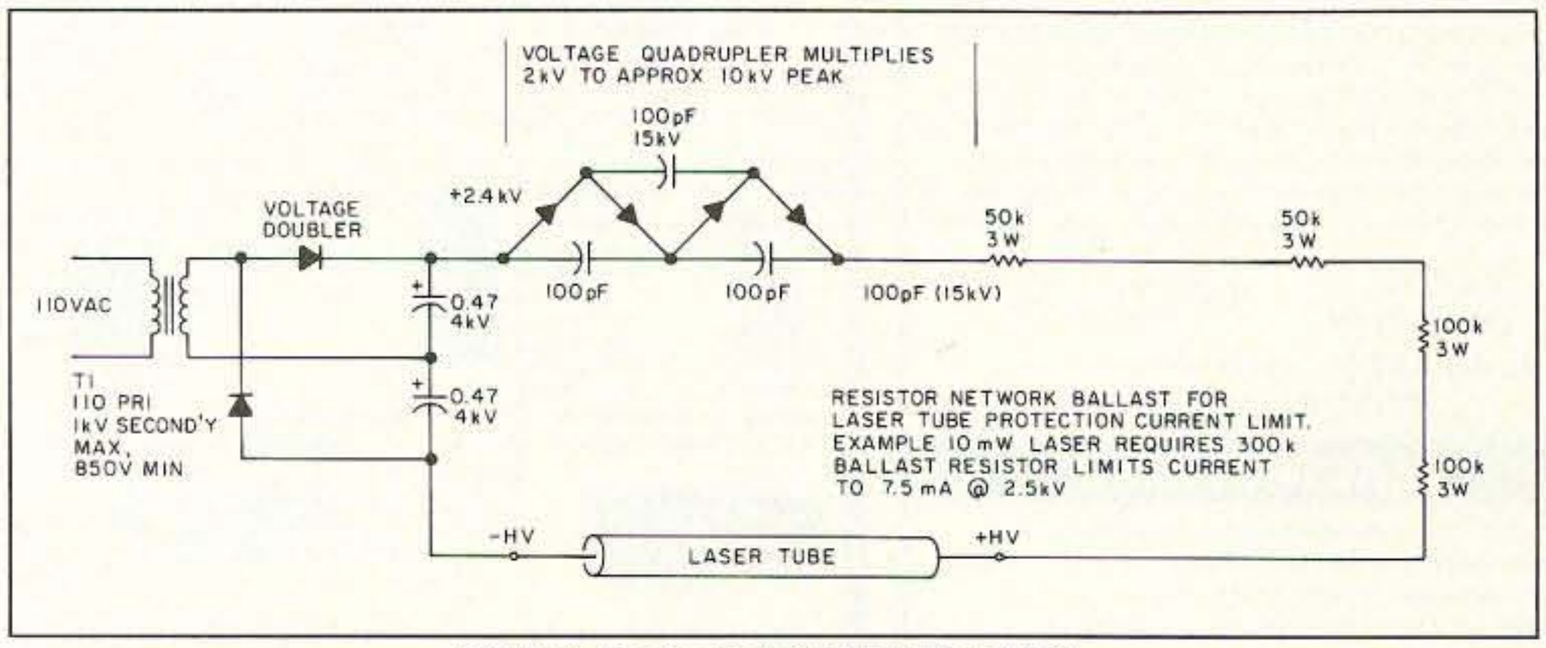

Figure 1. Laser power supply starting circuit.

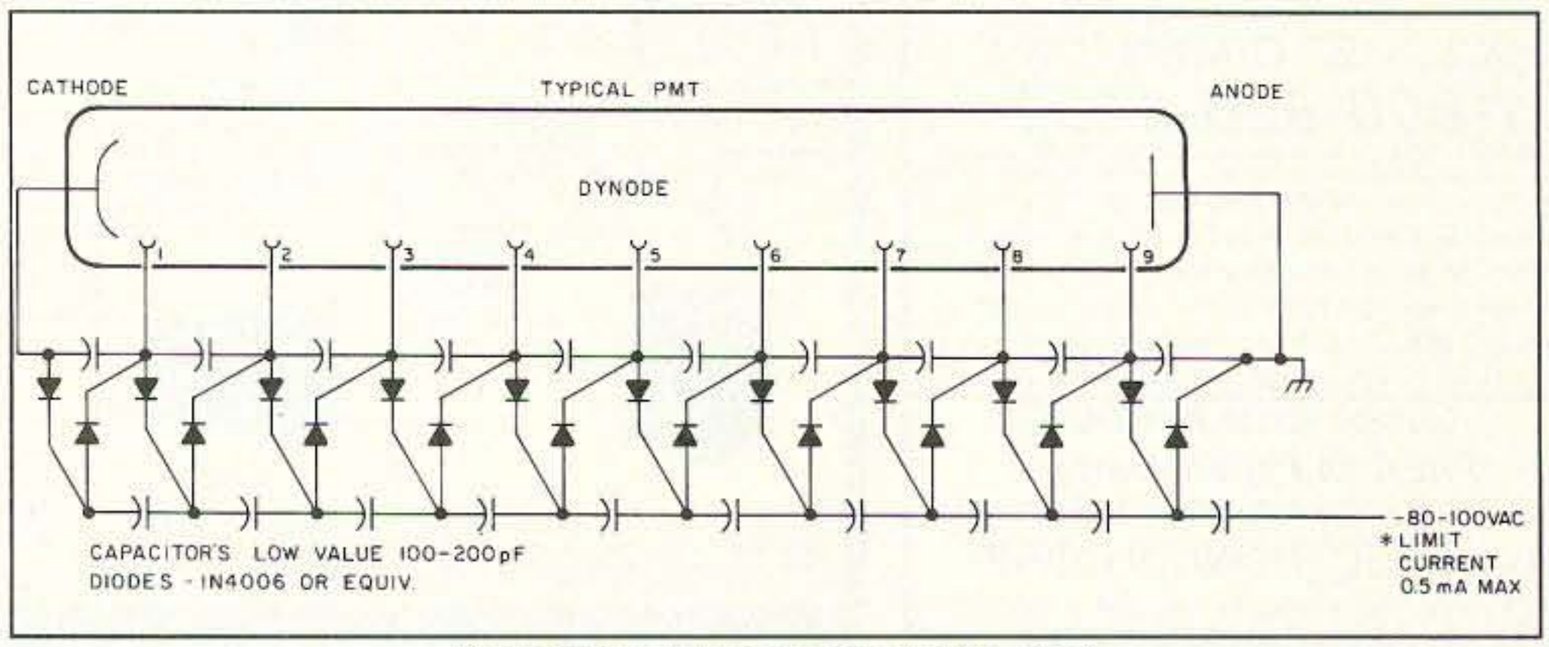

Figure 2. New PMT power supply drive circuit.

With a photomultiplier tube the current requirements are very minimal, near static values, so the multiplier approach can be tried. I haven't had time to construct a full working model of this method but I thought you might like to see what it's all about. See Figure 2 for the circuit details. Notably, the circuit is an extension of the circuit shown in Figure 1. The resistors have been eliminated and a large capacitor diode network is used in their place. The beauty of this circuit is that power dissipation is minimal and it can be constructed using low voltage components, in contrast to the high voltage components used in the laser power supply (there you must use components in the 5 to 10 kV range). In the new circuit, low voltage diodes and capacitors with low PIV voltage can be used. This makes construction right out of the junk box quite practical and inexpensive compared to a conventional high voltage power supply.

The values I would select for a first test could be 1N4006 or similar, with a 600 PIV rating (overkill on my part). The capacitors can be anything handy, from 100 to 200 pF or so. I plan to use 100 pF capacitors as I have a large quantity of disc ceramic 1 kV types on hand. Matter of fact, if you need capacitors, I will be glad to mail you a handful for postage costs, about $2. The power supply multiplier circuit is driven from a stepped-up AC source. This is where I plan to construct a simple switching driver, possibly a 555 driving a transistor pair with a small toroid transformer stepping up voltage from 12 volts DC to about 40 to 80 volts AC to drive the multiplier. Current limiting must be used between the multiplier and power supply to prevent the tube from trying to draw abnormally high current from the diode stack, unlike the old resistor type circuit which is naturally inhibited. The total current should be kept below 1/2 mA.

As I get more time I will present the final circuit as it develops. I am very anxious to use something like this for portable PMTs. In past laser systems, the PMT power supply gobbled as much of the battery consumption as did the laser (6 watts at 12 volts = 1/2 amp battery current for the PMT). This circuit promises to decrease battery drain, making portable operation on batteries easier. I apologize for not fully developing the circuit right now—I have many other microwave operation projects in the works right now, like getting ready for Field Day and the 10 GHz ARRL contest weekends in September/August.

Column Credits

There are many different people that help with ideas and suggestions, not to mention some of them lending me their circuits to publish. I could not do this work without their help. I also have to rely on many members of the San Diego Microwave Group to furnish ideas and methods, circuits and such to present here. I could not do this column without them, or without you for that matter. All contributions are appreciated.

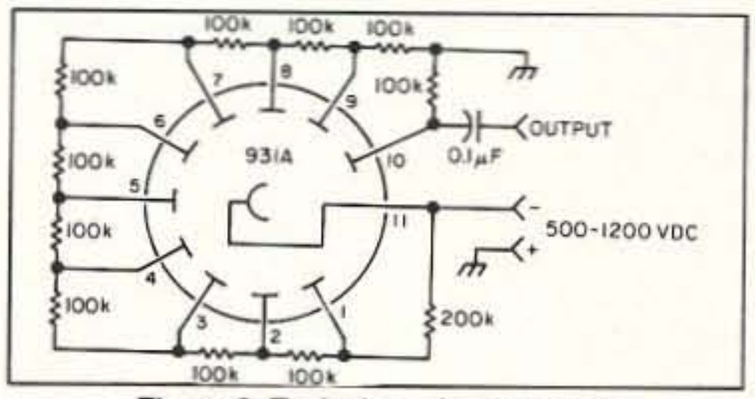

Figure 3. Typical surplus 931 PMT.

Good Surplus Supplier

For your information, I discovered a good supplier of surplus material called Halted Specialties (3500 Ryder St., Santa Clara CA 95051; phone (800) 442-5833 to order). They specialize in surplus materials and are putting together a new catalog. At present they have a 2 mW HeNe laser tube for $15, and a 24-volt input supply available to power the HeNe's for about $40. Also available are 12-volt power supplies, but they are more expensive. I thought you might be able to find something you are looking for as materials can be hard to obtain sometimes. I just ordered some material from them and their service was very prompt—I received the material in three days via UPS.

New Projects

Let me know what you are working on and I will be glad to make it part of the column. As far as new items are concerned, I should be receiving a 5.6 GHz mixer circuit in the mail soon and I plan to construct several PC boards for development. I'll publish the artwork in this column when tests are complete on the mixer. Kerry N6IZW is working on a frequency synthesizer with a quite novel approach. It can be adapted to stabilize almost anything, even a HP-608 Hewlett Packard signal generator. The heart of the system is a microprocessor that measures the period of input signal and uses this period to stabilize the circuit. I am watching the development and it's quite an interesting circuit. Also, we built a stabilizer for the phase-locked brick type oscillators and will present that in an upcoming column.

Mail Box

Roy Wilmer K7YWF writes that he has been active since 1959, mainly on the VHF bands and that I, through this column, have got his interest up in exploring the microwave bands. He has been gathering parts and pieces. Recently Roy received a commercial wideband FM transmitter and receiver for 4.7 GHz. This equipment was all solid-state, with a Fairchild brick oscillator in the receiver. Roy is currently looking at the possibilities of making modifications to the equipment to put it on the 5.6 GHz microwave band.

In his junk box Roy also has two Ma-Com Gunnplexers™ for use in mountain-topping on 10 GHz microwave as soon as IF systems can be constructed for these units. Roy is looking forward to mountain-topping in the Utah/Las Vegas area.

The IF board Roy plans to construct is based on the TDA-7000 design I presented from Signetics. However, I am having trouble getting a source of new chips as my distributor and his factory are out of stock at present. *[Ed Note: The TDA-7000 chip is currently available from DC Electronics, P.O. Box 3203, Scottsdale AZ 85271; (800) 423-0070 or (602) 945-7736.]* If this persists I will redesign the board and use a Motorola chip that is a lot easier to obtain, the MC-3357. This chip is quite similar to the "TDA-7000" in operation but has several unique features. It is made to operate as a 10.7 MHz IF system, making a converter ahead of it necessary. By the way, many different HTs use this chip, including some of ICOM's products.

Fred Spinner KA9VAW of Terre Haute, Indiana, writes that he is much closer to graduating (in electronics). He is having quite a time experimenting with MMIC amplifiers, and states that they're great. He included some information on WEFAX picture format information for 1691 MHz. The specs are as follows: modulation FM, deviation +/- 9 kHz; ground signal level, -134 dB; video mode, APT (automatic picture transmission); video subcarrier, 2400 Hz; video modulation, AM; line rate, 4 Hz or 240 lines/minute; scan left to right, top to bottom.

Fred inquired about my WEFAX system, which is not active at present. I constructed a system using an 8-foot dish and appropriate feed, coupled to a surplus amplifier that gave about 35 dB gain and had a 2 dB noise figure. I used a friend's 137 MHz receiver for downconverting and the lash up, while not really permanent, did work. It would take additional effort to mount the dish permanently focused, but my wife objects to it so it came down after the test. Right now I am copying the WEFAX charts from a re-transmission station in the Stockton, California, area on 6.453 MHz. Signal strength is quite good and the charts are also very good quality. Once in awhile (daily) they re-transmit actual satellite pictures, and on a VGA monitor they're very good. At other times they broadcast surface analysis, sea temps, and satellite imagery. Great stuff! Besides, you don't need to have a dish in the yard. Note: A good low-noise preamp for the 1691 comes from the innards of a junked Ku band "LNB."

Glenn Baumgartner KAØESA from Springfield, Virginia, is planning to construct a stable beacon from a Frequency West brick, using it as a "set-and-forget" source for a beacon. He is planning to set it near the 10.265 MHz frequency, halfway between the standard wideband FM frequencies of 10.280 and 10.250 MHz.

Ralph Herzler WA8WBP acquired a couple of Solfan wideband FM alarm units and wants to know how to bring them down to the ham bands. Of the two units he has, one draws normal current (about 150 mA) and will set off radar detectors when activated. The other just draws current and does not appear to function, compared to the first unit. Additionally, the units have an RC network tied to the receive diode to receive wideband FM with some kind of FM strip. Should this network be removed, how is the connection made to the receiver? What diodes are suitable for receiving?

Well Ralph, let's take the questions one at a time. First frequency adjustment of the cavity. The tuning screw is lowered into the cavity about three turns to bring typical units from their normal frequency of 10.525 MHz to something near 10.250 MHz. This screw (10/32) is fixed on top of the cavity with a lock nut. Looking inside the cavity (with the unit off), its pointed screw is in the middle of the cavity. Removing the screw from the cavity increases frequency. You need a wavemeter or frequency counter to set frequency accurately.

An alternative method is to find someone who is known to be on frequency and set up a work bench test adjustment. With an IF of 30 MHz you will be either high or low by 30 MHz, but in the band and operational. Concerning the defective unit: If current is in the normal range (140 mA) for a 10 mW power device, the trouble could lie in adjustment of the iris screw (cavity opening, 4/40 screw and lock nut). Don't confuse this screw with the 4/40 screw on the horn antenna. The iris screw is the other one (not on the horn antenna).

The Solfan units came with a combination RC network on the detector diode (1N23 type), and this should be removed. Leave the RFC if it's still there as it provides a DC return for diode current. If you do not have an RFC on the diode to ground, you will suffer from poor sensitivity. Diode current is adjusted for something near 1/2 to 1 mA, as measured from diode to ground (in series with RFC). The diode (1N23) 10 GHz device is coupled out with a small value capacitor to any preamp or converter input of 0.001 μF or less. The 1N23 devices look just like 1N21 devices (same package). However, 1N21 devices are only rated for 6 GHz (6,000 MHz). I have trouble with that statement as to me it should be CYCLES, not HERTZ. It's the same trouble with the metric system, but then we all have lots of rethinking to do.

Well that's it for this month. As always I will be glad to answer questions on VHF and related subjects, for a prompt reply please enclose an SASE. 73 Chuck WB6IGP. 73

Indoor or Window-Mounted Dipole *Continued from page 12*

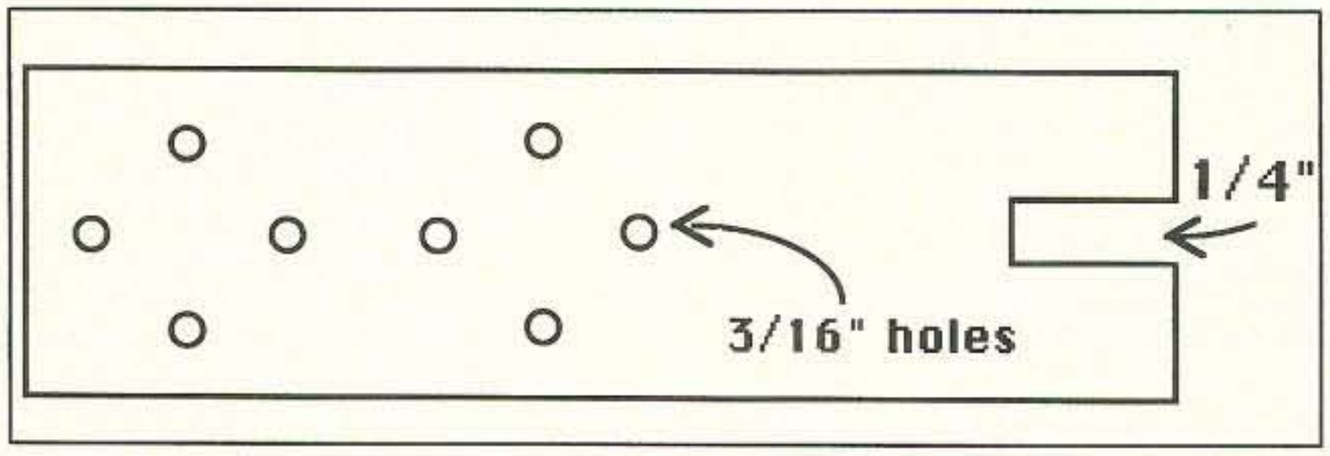

Figure 2. Approximate locations of the bracket mounting holes and the slot for the C-clamp in the mounting board.

mount. However, the type of clamp shown in the photos will rust if it is left outdoors.

The element with the center insulator, coax connector, and spring attached to it should be inserted into the bracket pointing upwards, not as shown in Photo G. The spring will fit into the bracket more securely if you open up the outer end of the bracket a bit wider so that the spring fits inside it. This can be done by flattening the side of the bracket in a vise, as shown in Figure 3.

The two mounting brackets must be connected together. Use a short wire with ring terminals that fit over the mounting bolts for the brackets.

Safety

Never operate the antenna so that anyone could come in contact with it. Shocks and RF burns are a real possibility with an indoor antenna. Also give attention to hazards of electromagnetic radiation from this antenna, and place it as far as possible from you, your family, and your neighbors. *[Ed. Note: Use the minimum power that is necessary for communications when operating the antenna indoors.]*

When considering possible outdoor locations, never place the antenna where it could possibly fall on someone. Since it is likely that you will eventually drop part of the antenna, attach a safety cord to each element before putting it out the window to mount it, and tie the other end to a heavy piece of furniture.

A patent application is pending on these coils, but amateurs are welcome to build this antenna for their own use. Coil ribs and antennas are available from Urban Antennas, Inc., P.O. Box 662, Bryn Athyn PA 19009; (215) 947-0235. 73

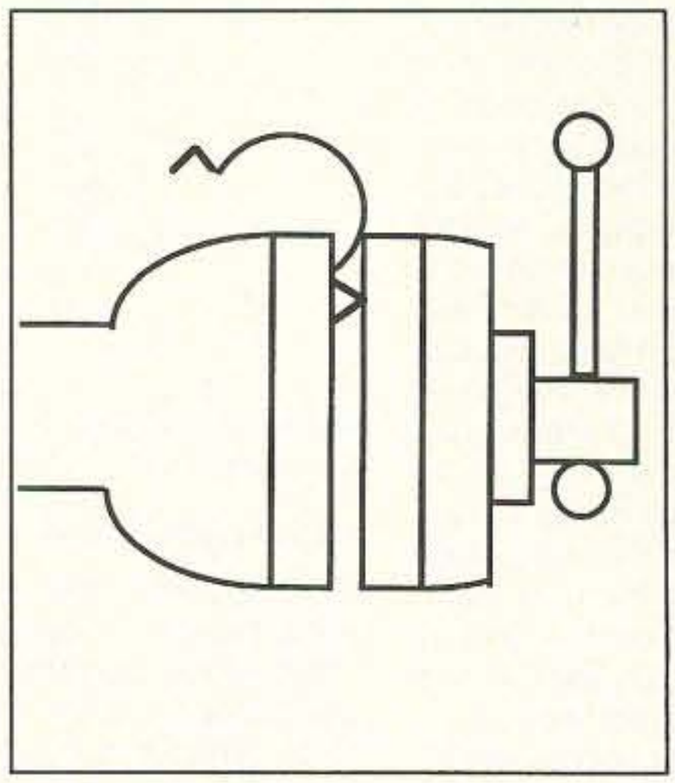

Figure 3. Using a vise to flatten the edges of a flagpole bracket to make the end half-ring a little larger so that the spring will fit in.

Table I

Loading Coil Dimensions

Band	Turns for 8' antenna length
12m	1.0
15m	2.0
17m	2.3
20m	4.0

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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. Check /The Special Events Message Area #4 on our BBS, (603) 924-9343, for listings that were too late to get into publication.

JUL 10-11

MAPLEWOOD, MN *Amateur Fair '92* will be held at the Aldrich Arena, 1850 White Bear Ave. Fri. schedule: Outside Flea Market from 6PM-9:30 PM; Commercial Exhibits from 6 PM-10 PM. Sat. schedule: Outside Flea Market 6 AM-3 PM; Commercial Exhibits 8 AM-3 PM; Grand Prize drawing 2:30 PM. The event is hobby oriented, catering to amateur radio operators, electronics hobbyists, and PC users. Admission is $6. Children under 6 free when accompanied by an adult. Free parking. Ticket holders may sell from the Giant Outdoor Flea Market at no additional cost (no electricity). For info contact ***Amateur Fair, PO Box 26331, St. Paul MN 55126; (612) 653-9999.*** Computer users can call ***HAM-LINK*** at ***(612) 426-0000 (300-9600 baud).***

JUL 10-12

U.S.A./CANADIAN BORDER North Dakota and Manitoba's International Ham Fest will be held at the Peace Garden. Registration will begin on the afternoon of the 10th. The Fest will end at noon on the 12th. Flea Market. Transmitter Hunts. Sunday morning Breakfast for all. The Peace Garden is located just a few miles north of Dunseth ND, or a few miles south of Boissevain, Manitoba. Contact ***Dave Snydal, 25 Queens Crescent, Brandon, Manitoba, Canada R7B-1G1.***

JUL 11

NORTH CHARLESTON, SC The Charleston II Summer Hamfest/Computer Expo will be held from 8 AM-3 PM at the Chas. Southern Univ. Field House, North Charleston SC. Exit-205 I-26, US-78 East. Free parking. Advance tickets: $6 family admission (2+), plus 5 prize tickets. At-the-gate tickets: $5 single admission plus 1 prize ticket. Additional prize tickets: $1/ea.; 6/$5. Auction after 2 PM. Inside Flea Market Tables 1/$10, Addt'l/$7.50 ea.; Dealer Tables (wall space and elec.) 3/$39, 5/$55, addit'l tables $8/ea. Outside vender space and tailgaters: 1st 8' space $3; $8 each addt'l space. Dealer and Flea Market contact: ***Roy Morrow N4ARA, (803) 871-5914 (H); (803) 851-0600 (W).*** Tailgate/Outside Vendor, tour and reservation help, contact: ***John Simons KC4UCP, (803) 875-3135(H).*** Talk-in on 147.27+/224.64-/443.80+.

PETOSKEY, MI The Straits Area ARC will sponsor a hamfest from 8 AM-1 PM at the 4-H Bldg., Emmet County Fairgrounds, 2 blocks W of US 31/131 intersection. VE Exams, Flea Market. Admission $3. 8' tables $3. Talk-in on 146.08/.68 and 146.52. Contact ***Tom Romanauski N8KHE, (616) 436-5033.***

SUMMERVILLE (CHARLESTON), SC The Trident ARC will sponsor *Charleston II—Summer Hamfest & Computer Expo* at the Charleston Southern U. Fieldhouse, I-26 (Exit 205) and US-78 East, from 0800Z-1500Z. Radio, Computer and Software dealers. Set-up at 0600. Wheelchair access. Free parking. Campground and motels nearby. Advance tickets $6 per family; $5 each at the gate. Tailgate $3. Tables $10. Dealers (call). True-Auction at 1400 hrs. Talk-in on 147.27+, 224.64-, 443.80+. Mini-vacation planning assistance. Atlantic Ocean beaches 25 miles. Contact ***Chairman: Bubba Johnson N4CII, 5 Shoo Fly Cir., Givhans SC 29472; (803) 821-8100 (recorder),*** or ***(803) 871-7741.***

JUL 11-12

BILLINGS, MT The Yellowstone RC, Inc., will hold a Hamfair at the Yellowstone County Fair Grounds, Metra Park Turf Club. Shuttle service from Billings Logan Internat'l Airport. Set-up will be all day Fri., Jul 10th. RV parking $9.50 per day, or $22.50 for 3 days, w/electrical hookups. Hotel room discounts are available at the Airport Metra Inn (only $28 per night). Registration fee is $35. Advance tickets $5, $6 at the door (deadline June 30th). Swap Tables: Admission plus $10 each; $5 for half table. Talk-in on 147.200+ MHz, 147.360+ MHz, 3900 kHz. Send check or money order for advance package to ***Yellowstone Radio Club K7EFA, Eileen C. Jones K7BFJ, Club Sec., 1544 Foothill Dr., Billings MT 59105.*** Please SASE. Get more info from ***Vince KB7ADL, (406) 252-8029, eves.; Eileen K7BFJ, (406) 252-2045, eves.;*** or ***Verlon K7AEZ, (406) 245-3930, days.***

JUL 12

OLD WESTBURY, NY The Long Island Mobile ARC will sponsor a Hamfest at the New York Institute of Technology, Route 25A, Old Westbury NY, from 9 AM-4 PM. VHF tune-up clinic. No advance, $5 at the gate. Exhibitors $10. Talk-in on 146.25/.85. Contact ***Neil Hartman WE2V, (516) 462-5549,*** or ***Mark Nadel NK2T, (516) 796-2366.***

AUGUSTA, NJ The Sussex County ARC will hold a Hamfest at the Sussex County Fairgrounds, Plains Rd., off Route 206, starting at 8 AM. Free parking. Admission $4 (XYLs and harmonics free). Tailgate $6. Indoor Flea Market $8 per space (limited supply of tables). Talk-in on 147.90/.30, 222.90/224.50, 146.52. Contact ***Don Stickle K2OX, 185 Weldon Rd., Lake Hopatcong NJ 07849; (201) 663-0677.***

BOWLING GREEN, OH The Wood County ARC will sponsor its 1992 Ham A-Rama at the Wood County Fairgrounds on Poe Rd., in northwest Bowling Green,

Say you saw it in 73!

starting at 8 AM. Free admission and parking. VE Exams. Trunk sales $5. Inside tables $10. Talk-in on 147.78/.18. Contact ***Wood County ARC, PO Box 534, Bowling Green OH 43402; (419) 352-3260.***

PITTSBURGH, PA The North Hills ARC will hold its 7th annual Hamfest from 8 AM-3 PM at the Northland Public Library, 300 Cumberland Rd. (10 miles north of Pittsburgh on Rt. 19N or McKnight Rd. From I-79 or the Pennsylvania Turnpike, take Rt. 19S through Wexford, turn left onto Cumberland Rd. at the second traffic light after Chunky Cheese. Talk-in will be on 147.09 (the W3BIS Allegheny County Public Service rptr). Limited indoor tables $10 each. Free admission and parking. One free automobile-sized space per tailgater; each additional space $5. Wheelchair accessible. Contact ***Don Jackson N3LAZ, 8 Dale Ave., Bradford Woods PA 15015; (412) 935-3343.***

DOWNERS GROVE, IL The DuPage ARC will sponsor their 10th annual Hamfest/Computer Mart, beginning at 8 AM at the American Legion Post 80, 4000 Saratoga Ave., Downers Grove IL. Post 80 is located about 20 miles west of Chicago, one block north of Ogden Ave. (Rte 34), and one block west of Main St. From I-88 exit at Highland Ave. south to Ogden, west on Ogden one block to Saratoga, one block north on Saratoga to the American Legion Post 80. Flea Market. Tailgating. Free Parking. VE Exams for all classes; please bring your license, copy of license, photo ID and certificate of successful completion, if appropriate. Tickets $3 in advance, $4 at the gate. Talk-in on 146.52 MHz simplex and 145.25 MHz -600, (CTCSS 107.2 Hz). For tickets, tables or info, SASE, or call ***Edwin Weinstein WD9AYR, DARC Hamfest Chairman, 7511 Walnut Ave., Woodridge IL 60517. Ham line (708) 985-9256.***

JUL 17-19

ESSEX, MT The 58th Annual Glacier-Waterton Internat'l Peacepark Hamfest will be held at the Three Forks Campground, Essex MT. Advance tickets (before July 3) are $8.50; $20.50 after July 3. VE Exams. For registration write to ***Ethel Ferree KA7HEX, Box 75, Wolf Creek MT 59648,*** or call ***Pete KF7R, (406) 222-2601.*** All are welcome. Talk-in on 146.52. For info contact ***Sheila Devitte VE6NOW, (403) 282-2171.***

JUL 18

SALISBURY, NC The North Carolina Chapter of the Triple States RAC, will sponsor a "Firecracker Hamfest" at the Salisbury Civic Center from 9 AM-5 PM. Admission, $3 in advance (with SASE), $4 at the door. No additional charge for Flea Market. Tables in air conditioned area, $5. Set-up at 3 PM-9 PM Fri., 7 AM Sat. FCC Exams by W5YI. ARRL Forum at 10 AM. VEC Exams at 1:30 PM. Pre-registration required with form 610, copy of license, and $5.25 fee. Send to ***Isabell Ledford, PO Box 826, Coolemee NC 27014.*** Talk-in on 146.73 or 146.655. Directions: From Interstate #85, take Hwy. #52 west/East Innes St. Turn left on South Boundary St., the Fest is on the left. For info and pre-registration contact ***Walter Bastow N4KVF, 3045 High Rock Rd., Gold Hill NC 28071.***

ABILENE, KS The Smoky Valley RC will sponsor a Hamfest from 9 AM-4 PM at Eisenhower Park. VE Exams. Talk-in on 146.88 or 145.33. Contact ***Bill Fenton WØOIN, 315 S. Washington, Junction City KS 66441; (913) 238-7817.***

JUL 19

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club, will co-sponsor a TAILGATE Electronics/Computer/Amateur Radio Flea Market from 9 AM-2 PM at Albany and Main Streets. Admission $2. Free off-street parking. Sellers $8 per space at the gate, $5 in advance (includes 1 admission). Set-up at 7 AM. Call ***(617) 253-3776*** for reservations and info. Mail checks before the 5th to ***W1GSL, PO Box 82 MIT BR., Cambridge MA 02139.*** Talk-in on 146.52 and 449.725/444.725 - pl 2A - W1XM/rptr.

WASHINGTON, MO The Zero Beaters ARC will hold its 30th annual Hamfest at the Bernie H. Hillerman Park (Washington Fairgrounds), from 6 AM-3 PM. Flea Market parking $4 a space. VE Exams (walk-ins, starting at 10 AM—bring original license and a photocopy). Free parking. Free admission. Talk-in on 147.24 and 444.90 rptrs. Contact ***Craig Brune NØMFD, PO Box 24, Dutzow MO 63342; (314) 239-0060 days; (314) 281-2784 eve. and weekends.***

FLINT, MI The 4th annual Swap and Shop, sponsored by the Genesee County RC, will be held at Dom Polski Hall on North Linden Rd., 1 mile west of I-75 and 1/4 mile south of Pierson Rd., 8 AM-1:30 PM. Advance tickets $3, $4 at the door. Talk-in on 147.340/.940, 146.52 simplex or 444.200. Send checks or inquiries along with an SASE to ***Swap Committee, GCRC, PO Box 485, Flint MI 48501,*** or call ***Tom N8DYN, (313) 743-3980*** for more info.

JUL 25

NORTH BEND, OR The Coos County RC will host the 2nd annual Southern Oregon Coast Hamfest at the North Bend Jr. High School from 9 AM-5 PM. Free parking. Free RV parking all weekend. VE Exams. Advance tickets $4, $5 at the door. Tables $15. Large shopping mall within walking distance. Contact ***R. Lyon N7SBF, Coos County Radio Club, PO Box 3494, Coos Bay OR 97420. Tel. (503) 888-2317.*** Talk-in on 146.01/.61 K7CCH rptr.

LANCASTER, PA The Red Rose Repeater Assn. will sponsor a Computer Fest at the McCaskey High School from 9 AM-3 PM. Set-up at 7 AM. Admission $4; children under 14 free with paying adult. Vendor contact: ***Wade Mackey, 5 Sunrise Terr., Millersville PA 17551; (717) 872-5328.***

JUL 25-26

OKLAHOMA CITY, OK The 19th annual Ham Holiday and State ARRL Convention, sponsored by Central Oklahoma Radio Amateurs, Inc., will be held at the Made in Oklahoma Bldg., Oklahoma State Fair Park. Doors open at 8 AM both days. Giant Flea Market, new and used equipment, VE Exams on Sat., RF Foxhunt, packet, computer, AMSAT, etc. Dinner Sat. eve.; QCWA Breakfast Sun. morning. Advance tickets $6, $8 at the door. Tables $5 in advance, $7 at the door. Talk-in on 147.03/.63. Contact ***Ham Holiday 1992, PO Box 95942, Oklahoma City OK 73143-5942.***

JUL 26

MILFORD, CT The Coastline Amateur ARA will hold VE Exams for all classes at the Fowler Bldg., 145 Bridgport Ave., at 12 noon. Walk-ins. Contact ***Gary NB1M, (203) 933-5125,*** or ***Dick WA1YQE, (203) 874-1014.***

TIMONIUM, MD The BRATS Maryland Hamfest/Computer Fest will be held at the Maryland State (Timonium) Fairgrounds on York Rd., off I-83 and I-695, from 6 AM-3 PM. Admission $5 per adult; children under 12 free. 8' tables in the Main Exhibit Hall are $50 each (includes AC power and one admission ticket). 8' tables in the Home Arts Bldg. are $25 each, no AC power; admission is additional. Set-up at 2 PM Sat. Tailgate area set-up 2 PM Sat., $5 per vehicle space. Buyers, please note: This is *not* a 2-day hamfest. Sat. PM access is for dealer and tailgating set-up *only*. VE Exams Sun. at 10 AM in Administration Bldg.; mail your completed Form 610 to ***John Creel WB3GXW, 3208 Kilkenny St., Silver Spring MD 20904.*** For tables, info, write to ***BRATS Hamfest, PO Box 5915, Baltimore MD 21208*** or call Table Chairman ***Franz Niedermeyer N3HFS, (410) 583-9147*** anytime.

AUG 1

COLUMBUS, OH The Voice of Aladdin ARC will host a Hamfest from 8 AM-5 PM at Aladdin Shrine Temple, Morse Rd. and I-270 Juction on the east side of Columbus. Advance tickets $3, $4 at the door. Flea Market/Trunk sales $2 per vehicle. Tables $5 in advance, $6 at the door. Advance registration preferred. Make checks payable to ***Voice of Aladdin ARC*** and mail with requests and SASE to ***James C. Caines KB8KME, 1056 Erickson Ave., Columbus OH 43227-1241.*** Walk-in VE Exams.

AUG 8

HUNTINGTON, WV The Tri-State ARA will sponsor Hamfest '92 & Computer Show starting at 8 AM at the Huntington Civic Center. Set-up at 6 AM. Walk-in W5YI testing for all license classes. Wheelchair accessible. YL and XYL activities. Close to all accommodations and restaurants. Donation, adults $5, children 12 and under, free. For more info, call ***Bill KF8QK, (304) 522-1933,*** or ***Alan N8LNS, (304) 736-9303,*** anytime.

AUG 14-16

PARK CITY, UT WIMU '92 and the ARRL Rocky Mountain Div. Convention will be at the Olympia Hotel. Phone ***1-800-234-9003*** for reservations; mention WIMU '92 for special rates. VE Exams Fri. at 6 PM; call ***NV7V, (801) 465-3983*** to register. UARC is sponsoring a Steak Fry Sat. at 6 PM; $12 per person. Swap meet starts Sat. at 8 AM, no charge for tables. Sun. at 8 AM, an All-You-Can-Eat Buffet, $6.95 per person. Preregister before Aug. 1, $10; after Aug 1 and at the door, $15. Children under 12 may register at any time for $4. Send registration requests and checks to ***WIMU '92, PO Box 67, Bountiful UT 84011-0067.*** You *must* be registered to attend these events.

SPECIAL EVENT STATIONS

JUN 28-AUG 13

SEQUOIA NATIONAL FOREST, CA Radio Station N6PZA will be operating portable from Boy Scout Camp Whitsett, on a when-time-permits basis. Camp Whitsett is located in the southern portion of the Sierra-Nevada Mountain Range, 32 mi. north of Kernville CA. Operation will be in the 40 and 17M bands Mon.-Fri. during 2100-2400 UTC; and 17 and 20m Mon.-Thurs., 0100-0400 UTC, with occasional operation on 10m. Send inquires to ***Chuck Smith N6PZA, PO Box 1867, Lake Isabella CA 93240-1867.*** We would like to establish a possible Scout/Summer Camp Net with all Boy or Girl Scouts, Scout leaders, or Ham Radio licensed Camp Staff members who work at Boy or Girl Scout or other Youth Camps during the summer. Listen for Camp Whitsett on the General portions of the Ham Bands (especially 17, 20 and 40m) during the day.

JUL 2-12

CALGARY, ALTA. CANADA Station CJ6CEXS will operate from the Calgary Stampede, to celebrate the 125th anniversary of Canada. There will be a 8 x 10 full color poster award for $5 U.S. funds. Any contact on any mode/band qualifies. Special QSL cards will be sent out. Talk-in on 146.850 -600 VE6RYC rptr. On the grounds, use 146.520 simplex. ***QSL via VE6NAO.***

JUL 4

DELTAVILLE, VA The Middlesex AR Group will operate AC4OG, 1230-2030 UTC to commemorate Deltaville's 4th of July Celebration. Operation will be in the General portion of the 80, 40 and 20m bands. For certificate, send QSL and SASE to ***Pat Muller AC4OG, M.A.R.G., PO Box 148, Locust Hill VA 23092.***

NEILLSVILLE, WI Station N9MCH will be operated by the Clark County ARES, from the Highground Veterans Memorial Park located 2 1/2 miles west of Neillsville, in southern Clark County, just off US Hwy. 10. The station will operate from 1700Z-0500Z (12 PM noon CDST to 12 AM midnight CDST). Frequencies: The bottom portion of the General 80m, 40m, 15m, and 10m phone subbands. For a Certificate, send your QSL and a 9 x 12 SASE to ***The Highground, PO Box 457, Neillsville WI 54456.***

PISCATAWAY, NJ N2HOQ will operate the first 326 minutes (0000-0526Z) to celebrate the 326th Anniversary of the town. RTTY only on various HF bands. For certificate, send QSL and 9 x 12 SASE to ***Geoff Malta, PO Box 312, Piscataway NJ 08855.***

STAUNTON, VA The Valley ARA will operate Station WB8GIF in conjunction with the Statler Bros. Happy Birthday USA. Operations will take place in the General portion of 80, 40, 20 and 15m CW and phone bands, and the Novice 10m band. For special glossy Certificate, send 9 x 12 SASE to ***VARA, PO Box 666, Staunton VA 24401.***

JUL 4-5

BUFFALO, NY/FT. ERIE, ONT. CANADA The South Towns ARC will operate Station WB2ELW and Niagara South ARC will operate Station VE3NKH, to commemorate the 65th Anniversary of the opening of the Peace Bridge over the Niagara River (connecting Buffalo NY and Ft. Erie Ont.). They are also celebrating the annual Friendship Festival commemorating 180 years of friendship between the U.S. and Canada. Operation will be in the lower 25 kHz of the General phone subbands, the Novice 10m phone subband, the CW General subbands, 10m Novice CW subband, the WB2ELW rptr., 147.09 MHz (+600 kHz transmitt) and the VE3NKH rptr., 147.165 (+600 kHz transmitt). For certificate: US amateurs send QSL and SASE to ***John Leiten WB2ELW, 6120 McKinley Pkwy., Hamburg NY 14075.*** Canadian amateurs, send QSL and SASE to ***John Gilmour VE3NKH, 158 High St., Fort Erie, Ont. Canada L2A 3R1.***

JUL 10-11

PEACE GARDEN, NORTH DAKOTA/ MANITOBA BORDER In conjunction with their 29th North Dakota/Manitoba International Hamfest, VE4IHF/Ø will be in operation as a Special Event Station. Operation will be from 9 AM-5 PM. Frequencies: 3.937, 7.255, 14.255, 21.355 and 28.355, plus or minus.

JUL 11-12

U.S./CANADA Amateurs affiliated with the American Sunbathing Assn., The Naturist Society, and Federation of Canadian Naturists will sponsor operation of as many as 12 SE stations (40-2 meters; 10 AM-3 PM local time) to celebrate National Nude Weekend. For certificate, indicating all sites worked, send QSL(s) and 9 x 12 SASE to ***AE3D, PO Box 5407, Laurel MD 20707-5407.***

NORWOOD, NY The St. Lawrence County 10m Assn. will operate WN2R to celebrate the annual "Norwood Regatta" at Norwood NY. Operation will be on the General portion of 40m and 20m and the Novice portion of 10m from 12 noon-7 PM, EDT. For a special QSL, send QSL and SASE to ***Regatta, General Delivery, Norwood NY 13668.***

JUL 15

ATKIN, MN The Barton Amateur Radio Family will operate KØPVB from 1800Z-2400Z to commemorate their 40th annual visit to Sunset Bay on Cedar Lake. Operation will be in the 40, 20, 15 and 10m bands. For a certificate and honorary membership in B.A.R.F., send QSL and SASE to ***B.A.R.F., c/o KAØWOW, 1441 West 41st St., Davenport IA 52806.*** SWLers encouraged to respond.

JUL 11-12

FULTON, NY The Oswego County Amateur Radio Emergency Service will operate KY2F from 1200Z-2100Z each day, from the Central New York Internat'l Air Show at the Oswego County Airport. Frequencies: The middle of the General 80, 40, 20, 15, and 10m phone bands; Novice portion of 10m, 147.75/.15 MHz., and packet on 145.05 MHz. For certificate, send your QSL card and a large SASE to ***Fred Swiatlowski KY2F, PO Box 5227, Oswego NY 13126.***

JUL 11-19

WOOSTER, OH The Wayne AR Technical Soc. will operate N8CEY 1200Z for 15 hours Jul. 11-19 to celebrate the Ohio Agricultural Research and Development Center, "A Century of Science" at Wooster. CW: 3.550, 7.050, 10.125, 14.050, 21.050, 24.920, 28.150; Phone: 3.900, 7.275, 14.275, 21.350, 24.960, 28.350. For certificate, send QSL and a SASE to ***OARDC, Mike Brugger N8CEY, 1680 Madison Ave., Wooster OH 44691.***

JUL 12

LA GRANGE PARK, IL The Six Meter Club of Chicago will operate K9ONA 1400Z-2359Z to commemorate the centennial of La Grange Park. Frequencies: Novice portion of 10m, and 146.37/.97 K9ONA rptr. For QSL, send SASE; for certificate, send 9 x 12 SASE to ***K9ONA, Karl Weisshappel, 802 Barnsdale Rd, La Grange Park IL 60525.***

JUL 18

DENVER, CO The Rocky Mountain Radio League will launch a high altitude balloon carrying a cross-band rptr. with the ID of NØFVG BALLOON REPEATER, at 1400Z. The input frequency will be 446.000, with the output of 147.555. The expected max. altitude will be close to 100,000 feet. Stations 500 miles from Denver should be able to check in. Flight duration will be about 4 hours. There will be a conducted net on this rptr. All stations that check in will be sent a commemorative QSL card. Send your QSL card with an SASE to ***Warren Gretz NØFVG, 3664 E. Lake Dr., Littleton CO 80121.***

JUL 18-19

STATEN ISLAND, NY The Staten Island ARA will operate W2CWW from Sat. at 1200Z-1500Z Sun., to celebrate their 70th Anniversary with the ARRL. Operation will be in the lower 25 kHz of the General 80, 40, 20 and 15m phone subbands, and the Novice portion of the 10m phone subband. Also 445.325 -5 156.7pl club rptr. For a Certificate suitable for framing, send your QSL with a 9 x 12 SASE to ***Staten Island ARA, PO Box 140495, Staten Island NY 10314-0018.***

TALLADEGA, AL The Talladega RAC will operate Station AA4UF from the Third Annual Induction of the International Motor Sports Hall of Fame, Jul. 18 from 1300Z-0500Z, and Jul. 19 from 1300Z-2300Z on 14.270 MHz (+/- QRM), in the 20m phone band and the middle of the 10m Novice phone band. For a Certificate, send QSL and two units of postage to ***TRAC, PO Box 626, Talladega AL 35160.***

JUL 24-AUG 8

MONTREAL, QUEBEC, CANADA Station CI2M will operate daily, Jul. 24-Aug. 8, from 1300-0100 UTC, to commemorate the 350th Anniversary of Montreal. Frequencies: SSB: 3.875, 7.250, 14.250, 21.350, 28.350 +/- QRM. SSTV: 14.230; Packet: 145.03; ATV: 439.25; VHF: 50.135, 147.045. A special QSL card will be available. Please QSL with SASE, or via VE2 bureau to ***CI2M via VE2CUA, Concordia University ARC, c/o CUSA H-637, 1455 DeMaisonneuve West, Montreal, Quebec, Canada H3G 1M8.***

JUL 27-AUG 2

CANTON, OH The Canton ARC will operate Station W8AL from 2200-0200 UTC Jul. 27-Jul. 31; and from 1700-2300 UTC Aug. 1-2, to celebrate the Pro Football Hall of Fame Greatest Weekend. Frequencies: SSB: 28.350, 21.350, 14.270, and 7.270; CW: 28.150, 21.060, 14.060, and 7.060. There will also be RTTY, Packet, Amtor, and 2m FM operation. SWLs welcome. For an unfolded Certificate, send your QSL and a 9 x 12 SASE, with two units of first class postage. For a QSL or a folded certificate, send your QSL and a #10 (business size) SASE to ***Randy Phelps KD8JN, 1226 Delverne Ave. SW, Canton OH 44710-1306.***

JUL 31-AUG 2

DARMSTADT, GERMANY The Wiesbaden ARC will operate DA1WA/P from Frankenstein Castle, on all bands 80-10m, CW, SSB, Packet, and digital modes. A special QSL card has been printed especially for this event. QSL to ***DJØPU,*** SAE with 2 or 3 IRCs or "greensamps." For more info, contact ***Rob Kipp DJØPU, Huegelstr. 25, D-W-6070 Langen, Germany.***

AUG 1-16

LEWISTOWN, PA The Juniata Valley ARC will operate Station K3DNA in celebration of the 25th Anniversary of the US Canoe Assn. Nat'l Championships. Frequencies: The General portion of the SSB band as well as on CW. Most operation will be during the week of Aug 1-8. For a special Certificate, send an SASE to ***K3DNA, PO Box 73, Yeagertown PA 17099.***

Number 20 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202-N
Peterborough NH 03458

More Digits

Last month, we were discussing digital technology. Let's continue.

Abracadabra

There are various ways to convert an analog signal to digital form and back again. The analog-to-digital converter, or ADC, has evolved over the years, with various types suited to differing tasks. One common type of ADC, the successive approximation register (SAR), works in an iterative fashion. It makes a rough guess of the correct digital value of the sample and then reconverts its guess to analog form. Then, it subtracts the reconverted voltage from the original signal in a differencing amplifier. What's left is the difference between them, which corresponds to the error in the ADC's guess. It then makes another approximation in an attempt to accurately digitize the error. With each guess, the digital representation of the signal gets closer and closer to being correct. Finally, all the error is cancelled out and the conversion is complete. This technique works remarkably well, but it takes time, due to the repetitive nature of the process. SAR converters are fine for low-frequency measurements and some audio work, but they just aren't fast enough for video or other high-frequency applications.

There's a much faster type of converter, called a flash converter, which is especially useful for video, because of its speed. This converter takes only one "pass" to completely convert its input sample. It uses a large array of voltage comparators to detect the sample's voltage. The outputs of the comparators are converted into a digital word with some logic gates. It doesn't get much simpler than that! So why not do all A/D conversion this way? Well, when you get up to more than a few bits of resolution, the number of comparators and logic gates gets to be unwieldy. Putting 65,000 comparators and thousands of gates on one chip ain't easy, especially since each comparator requires a precision, laser-trimmed resistor to provide its voltage reference. As you might imagine, flash converters are expensive.

There are other kinds of ADCs, but the objective is always the same: to sample the input waveform at discrete intervals and convert each sample into a digital number, with as little error as possible.

Hold It Right There

No matter what digitizing technique is used, the conversion process takes time. Unfortunately, the incoming signal may change during the conversion period, introducing serious errors in the measurement. For that reason, a sample and hold circuit, which does exactly what the name implies, is used to freeze the voltage being measured until the measurement is complete. In older systems, the sample and hold circuitry was separate from the ADC, but most modern ADCs include it right on the chip, making circuit design simpler.

Give It Back!

The process of reconverting a digital signal into its original analog form is easier than the reverse. A set of gates whose outputs are summed by a network of precision resistors makes a perfectly decent digital-to-analog converter, or DAC. Thanks to CDs, though, various new techniques for ultra-clean D/A conversion have evolved. In pursuit of ever more perfect sound, designers have developed such things as oversampling and bit interpolation, which actually synthesize data values in between the existing ones in order to make the resultant waveform smoother and easier to filter. Such things, however, are overkill for voice-grade networks; a simple resistive DAC will do fine.

We've seen how we can digitize an audio signal and the benefits and costs of doing so. Is it practical to send digitized information over the air and recover it at the receiving end? Well, maybe. The broadcast industry is experimenting right now with sending it over UHF, with the intent of providing compact-disc-quality audio directly to your home. Eventually, they plan to do away with traditional AM and FM altogether, though I expect it will be phased out over many years. So, don't go hauling your stereo gear to the hamfest just yet! Initial tests indicate that it takes far less power, compared to FM, to get the digital data across, despite the required higher bandwidth. I, for one, look forward to the time when we all aren't drenched with megawatts of RF, 24 hours a day. Of course, TV broadcasting, especially on the UHF channels, contributes most to the RF soup in which we all live. But who knows, maybe that too will be digital one day.

What About Us?

Could we hams use digital voice links? Sure, why not? For local work, digital would be excellent, perhaps providing far greater coverage from our walkies and repeaters, and perhaps making multiple-user single-channel repeaters a reality. For HF, though, it's another story. The fading, static and QRM, at least as they exist today, would likely make data recovery very difficult. Also, high-speed, noise-tolerant modems would have to be developed at prices we could afford. If it could be done, though, we might fit far more QSOs on each band, with no audible interference from adjacent stations. It may happen, but I doubt it will be soon.

Psst . . . DSP

More likely, digital techniques will be showing up more and more in applications which help conventional analog systems work better than they ever have before. Already, we're seeing signal processors employing the powerful new technology of digital signal processing. Based on a high-speed, dedicated microprocessor system, DSP devices can filter audio in ways undreamed of before. For instance, you can buy a DSP notch filter which not only removes heterodynes in the conventional manner, it also finds them automatically. Even more amazing, the filter can remove several tuner-uppers at the same time! And the notch is far deeper and narrower than you can get with any analog filter; the whistles really disappear, and the desired speech signal is essentially undamaged.

Also currently available is an audio filter which can remove much of the interference caused by adjacent voice stations, along with static. This DSP filter actually analyzes the incoming waveform, looking for patterns related to normal speech. When it detects elements which don't belong there, it removes them, leaving the speech untouched. I haven't actually used such a filter, but a friend of mine has, and he says that the result is truly spectacular. Even 20m SSB can be pleasant to listen to! As the chips become more affordable, we may begin to see such filters incorporated into new radios. Even today's best rigs will sound very unsatisfying next to the DSP-equipped ones. There's a big future in DSP audio filtering technology.

Made to Order

Another area in which DSP shines is the modeling of hardware in software. In other words, a piece of hardware, such as a modem, can be emulated in the DSP chip's software. Why do it? Because you can get the same or better result with far fewer parts. Perhaps as important, you can change the circuit's characteristics simply by changing the software, with no other modifications necessary. So, as modem speeds increase through the use of more sophisticated modulation techniques, the new designs can be implemented merely by swapping a chip! Already, some multimode data controllers are using this technique, making the products nearly obsolescence-proof.

The Ultimate

If you can model an audio channel in software, thus doing away with most of the hardware, why not do the same thing for an entire receiver or transmitter? Well, in theory, there's no reason why not! Imagine it: The antenna leads to a front end amplifier which feeds an ADC. The digital data goes into a DSP chip and out comes audio. AM, FM, SSB, you name it, the DSP can demodulate it. Tuning, of course, is handled by changing some numbers in the DSP routines. Filtering is accomplished the same way, and it can be tremendously sharper than anything we can make out of crystals or ceramics now. A rig small enough to fit into a pocket, or even be worn on your wrist, might have all the features and quality of a full-sized HF rig, and there'd be absolutely no variation from unit to unit within a given model—they'd all perform exactly the same. Wow, that's some nifty radio. No IF coils, no mixers, nothing. So why aren't we doing it?

The answer is simple: speed. It takes a DSP running at 20 MHz or more just to do audio. Imagine what it would take to process signals which are themselves in the megahertz range. Today's DSPs aren't even in the ballpark of being fast enough. But make no mistake about it, as integrated circuit manufacturing techniques advance, it will be done. To our grandchildren, and perhaps even to our children, IF coils, ceramic filters and analog receiver circuitry will seem as silly as spark transmitters do to us today. Heck, even you and I may QSO on DSP sets before our silent key notices grace the pages of history. Hey, by then we may even have settled the no-code debate! Of course, that may be asking a bit much.

Well, that about covers it in the digital domain. Now, let's look at a letter:

Dear Kaboom,

*I am in need of an amplifier that will put out a couple of watts in the VHF range. Will your "Cassette Box Special" (*73 Amateur Radio*, April 1990) amp do it at those frequencies? What's the difference between HF and VHF amps anyway?*

Signed,
Watt Pusher

Dear Pusher,

I seriously doubt the Cassette Box amp will do it for you! In basic concept, an amp is an amp, and they should all work at any frequency. But it just doesn't work out that way. RF amplifiers must deal with circuit reactance, especially component capacitances. If you try the Cassette Box amp at VHF, it probably will show *loss*, not gain, as it was designed to work at about 1/40 the frequency you have in mind. To get gain at VHF, you need to use the right transistor and certain low-reactance construction techniques. In particular, it is easiest to use a tuned amplifier, which permits component reactances to be used to advantage, in contrast to the wideband designs commonly used at HF.

73 and see you all next month. 73

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NEW PRODUCTS

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EEB

Lowe receivers are now available in the U.S. and Canada. The new compact, go-anywhere HF150 is rugged, portable and performs like a giant. It covers 30 kHz to 30 MHz, AM, AMN, USB and LSB, plus four AM synchro detection modes. It also includes 60 memories, a large LCD readout, 10-15 VDC, 150 mA operations. Available options: keypad, NiCds (8-AA), whip antenna, 120 VAC adapter. This unit is a great companion for a QRP field operation. It's just 7.3" x 3.2" x 6.3", weighs 2.9 pounds, and comes in a rugged metal alloy case.

For the price and more information on the Lowe HF150, contact *EEB, 323 Mill Street N.E., Vienna VA 22180; (703) 938-3350, (800) 368-3270, Fax: (703) 938-6911.* Or circle Reader Service No. 201.

PERIPHEX

Periphex has announced longer operating time, higher capacity, lower cost batteries for popular ICOM, Kenwood and Yaesu handhelds. For ICOM models, the BP-112S (7.2 volts, 800 mAh) offers a 15% increase in operating time at low power; the BP-114S (7.2 volts, 1700 mAh) offers a 45% increase at low power; and the BP-115S (12 volts, 800 mAh) offers a 100% increase at 5 watts output. The BP-112S is $45; the BP-114S and the BP-115S are $79 each. For Kenwood models, the PB-13S (7.2 volts, 1200 mAh) offers a 60% increase in operating time at low power, while the PB-14S (12 volts, 400 mAh) offers a 33% increase at 5 watts output. The PB-13S is priced at $49.75 and the PB-14S is $60. For Yaesu models, the FNB-26S (7.2 volts, 1400 mAh) offers a 40% increase in operating time at low power, while the FNB-27S (12 volts, 800 mAh) offers a 33% increase at 5 watts output. Both Yaesu batteries are priced at $65 and are 3.75 inches tall.

All battery packs include overcharge over-temperature and short circuit protection, and a one-year warranty. They are completely compatible with appropriate chargers. For more information, contact *Periphex, Inc., 115-1B Hurley Road, Oxford CT 06478; (203) 264-3985, (800) 634-8132, Fax: (203) 262-6943.* Or circle Reader Service No. 202.

SGC

The SG-2000 HF SSB from SGC is an American-made, remote-control head, full-coverage transceiver providing global HF communications on voice and data. The SG-2000 features scanning capability, a large LCD frequency display and ARQ/FEC capabilities. The Model SG-2000 is a solid commercial HF SSB transceiver which incorporates unique features appealing to the commercial, military, marine and amateur markets. It produces 150 watts and operates on the 1.8 to 30 MHz frequency bands. It is operational in voice and data transmission, has CW with sidetone, and is remote ready. The unit has all functions built in for HF SSB operation, including remote capability (up to 8 remote stations) through telephone lines. It can be controlled by an IBM or compatible computer without its removable front panel. Designed with a direct entry VFO and 644 ITU channels, plus 100 user-defined memories, the SG-2000 will operate on all marine, commercial and ham frequencies and includes receive capabilities for broadcast, shortwave broadcast and weatherfax frequencies. A unique suction cup mount system allows the SG-2000 control head to be installed on a vehicle dashboard without drilling holes.

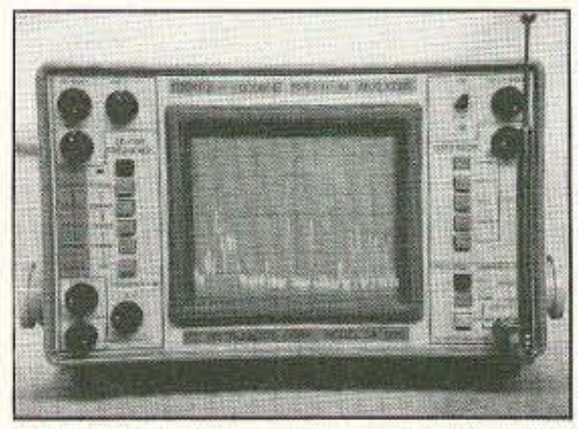
The retail price for the SG-2000 HF SSB radiotelephone is $1995. For more information, contact *SGC Inc., SGC Building, 13737 S.E. 26th St., Bellevue WA 98005; (206) 746-6310, Fax: (206) 746-6384.* Or circle Reader Service No. 203.

LINK PLUS

Link Plus Corporation has announced that, for the first time, its unique and powerful Link-Plus® signal processing technology will be made available to amateur radio operators in a new product called the MULE™. The MULE, or Multi-Use-Link-Enhancer, is a rugged, stand-alone unit that can be connected quickly and easily to any amateur radio with external cables. It is designed to allow amateur radio operators to quickly upgrade the voice quality of their radio systems without changing existing radio equipment, and without having to upgrade power and antenna systems.

The Link-Plus technology that is the heart of the MULE is an advanced, compact and cost-effective version of the linked compressor and expander technology originally developed by the telephone industry to improve the quality of high frequency radiotelephone communications. The MULE greatly improves the "quality" of voice communications in the 2-30 MHz frequency range by eliminating all interference, channel noise and signal fade from the radio link and by significantly boosting the effective strength of the radio signal. The MULE's technology has been extensively tested and has been incorporated into both international and U.S. government HF radio performance standards.

For the price and more information, contact *Link Plus Corporation, 9052 Old Annapolis Road, Columbia MD 21045; (301) 982-1585, Fax: (410) 997-3485.* Or circle Reader Service No. 204.



ITC INSTRUMENTS

The SA1000 1000 MHz analyzer from Instruments Technology Corp. is a stand-alone, full-function 1 GHz spectrum analyzer with a dynamic input range greater than 115 dB. The SA1000 has a three-step 40 dB attenuator, a baseline clipper, and a push-button frequency selector for excellent center frequency accuracy. A DC to 50 MHz per division push-button dispersion control gives you a full 80 dB on-screen dynamic range from DC to 50 MHz dispersion settings with no degradation in the on-screen dynamic range.

The suggested retail price is $1695. For more information, contact *ITC Instruments, 3678 Mt. Ariane Dr., San Diego CA 92111; (619) 277-4619, (800) 232-3501.* Or circle Reader Service No. 205.

POLYPHASER

The newly formatted 1992/1993 PolyPhaser product catalog of lightning arrestors and grounding devices is now available. This edition contains new products and a revised "Lightning Protection Information" appendix. Pricing is included. To request a copy, contact *PolyPhaser Corporation, Customer Service Department, P.O. Box 9000, Minden NV 89423-9000; (800) 325-7170.* Or circle Reader Service No. 206.

PLANNED PRODUCTS

Planned Products has introduced a new version of the popular 2200 Circuit Works Conductive Pen. The new Micro Tip Circuit Works Conductive Pen incorporates an improved tip design and enhanced silver conductor for drawing fine-line silver traces with increased precision and control.

The new pen is used primarily to repair conventional and surface-mount circuit boards and is well suited for use on membrane and flexible circuit technologies. The improved Micro Tip design uses an easy-flow, no-clog tip for drawing precise conductive silver traces in electronic design, prototype and repair applications, including trace repair, circuit modification and component shielding.

It uses an improved silver conductor featuring the better conductivity and adhesion required by demanding design, prototype and repair applications. The silver conductor dries in five to ten minutes at room temperature and reaches maximum air dry conductivity in 20 minutes. Repairing a typical damaged circuit trace requires 15 minutes and shows resistance of 0.01 ohms or less after the repair. Maximum conductivity and adhesion occur after a heat cure of between 250-300°F (121-149°C) for five minutes. Heat-cured silver conductor can be soldered at temperatures below 350°F (177°C) using tin, lead or silver solder. The new silver conductor is safe for circuit plastics and metals including copper, solder and solder mask.

The suggested retail price is $10.95. For more information, contact *Planned Products, 303 Potrero Sreet, Suite 53, Santa Cruz CA 95060; (408) 459-8088, Fax: (408) 459-0426.* Or circle Reader Service No. 207.

NEVER SAY DIE

Continued from page 4

person—and so am I—and so are a hundred thousand other *73* readers. One thing I think you do recognize: If a hundred thousand people decide they're going to do something, the chances are pretty good they're going to get something done. And if you'll take the time and effort to convince just one other person, that's two hundred thousand—and we have a movement.

"Do It Yourself" Reviews

The next time you buy a piece of ham equipment, how about keeping notes on your experience and sharing it with the *73* readers? I'd like to know what your experience is when you get something new. I'd like to know what problems you have with it—what fun you've had—how you've solved the problems—how difficult or easy it was to get going—what information sources you've found to help—what accessories—you know, all the things you'd tell a friend.

What kind of equipment? My interests are the same as yours—I want to know about anything you buy—a transceiver, an HT, a packet unit—heck, even information resources. Before I make a buying decision on something I'd like to know a little more than I can find in the ads, or even equipment reviews. With so many competing products, I'd like to have the benefit of other people's experience.

I've just started a new publication in the music field which is based primarily on the readers sending in their reviews of the CDs they've bought. I want to know when a reader finds a CD which they think is great—and when they are disappointed. In the past reviews have always been written by music professionals. Unfortunately, this has tended to result in pedantic exercises, aimed more at exhibiting the profound knowledge of the reviewer than in help for potential buyers.

Yes, this is likely to result in a lot of much less educated evaluations. Well, I'll take that into consideration when I read 'em—and I'll be looking for more than one review on newly released CDs. I don't go to the movies just on the advice of Siskel. I also pay attention to Ebert, Medved, Lyons, and other reviewers.

So if one opinionated user review of a new HT is thumbs down and another is thumbs up, I'll want to read more and find out what it was that influenced each of the reviewers. How much is a particular reviewer blowing things out of proportion? And if the equipment is something I've had experience with, I'll want to write and set the record straight.

The end result of all this should be to help us all buy new equipment with greater confidence. When I read about a chap who's just bought a 6 meter rig and is having a ball, I'm going to want to get one too. Ditto 2 meter SSB. But suppose we start seeing complaints about a new rig—should we sweep these under the table and hide them? I think the industry as well as the *73* readers will be much better off if complaints are aired. I know I'll have more confidence in what I'm reading as well as in the company which faces up to and solves problems.

So the next time you buy some ham gear keep notes on your experience and send me a letter telling me how it worked out. If you have problems, be honest about them. Let's not get into histrionics. Yes, of course I'll be in touch with the manufacturer to try and help resolve problems. So don't get mad; let's instead try to find out what went wrong and why, and get it fixed. Address your letters to Vox Pop, *73 Magazine*, 70 Route 202 North, Peterborough NH 03458.

I'll be much more influenced in my buying by a few letters telling me how great something is than by a formal equipment review. It's fun to buy something new and get on the air with it. The main thing holding me back is a lack of information. So, when you find something that's particular fun, start writing so you can share it with all of us.

An ARRL Proposal

The ARRL and W5YI have proposed that the volunteer examiners take over all Novice exams as well as those for higher license grades. Well, sure, why not, right? So what are the benefits? And what are the drawbacks?

The benefits are easy to see. The VECs will about double their take. It's more difficult to see any benefits to prospective Novices. So difficult that, even with my legendary imagination, I'm stumped. Of course, since no VEC is really interested in the fees, their main goal being to provide a service, doubling their business would just be a nuisance.

This system would make it far more difficult for Novices to get examined. The present arrangement makes it so any radio club can handle this. So let's scuttle this proposal. Please let the FCC know you think this is a bad idea.

KV4FZ Convicted!

Will Herb's conviction of phone call theft cool the mess on 14.313? Herb, the Chief of Police Communications on St. Croix, has been convicted of stealing and using telephone access codes while making over $1,000 in long distance calls. Many of these calls, it turns out, were devoted to Herb's special amateur radio interest of trying to destroy our hobby. He and his group of mentally defective deviates must be congratulated on a bang-up job of trashing our 20 meter band.

The problem we have is that while it's pathetically easy for people to get ham licenses, it takes almost an act of Congress to take one away. There's something wrong with that whole concept. I don't think the founding fathers put anything in the Constitution guaranteeing us the right to a ham license. It's a privilege, not a right. Well, there are responsibilities that go along with privileges and the rest of us are hurting because we have no way to protect our privileges from being trashed.

Granted, there's not a lot that we as individual amateurs can do, and that adds greatly to our frustration level when we hear the crap we have to put up with. The thought that comes to my mind when I hear all this nonsense—when I hear the bad language and racial taunts on 75m—when I hear dirty jokes—is why isn't our only national amateur radio organization working with the FCC to do something about this? Well, I've been watching carefully, hoping to see some signs of even a faint interest in the problem. Nothing visible yet.

I keep wondering how many amateurs have asked their ARRL directors to take some action on the growing messes we are hearing on our bands. The directors are presumably visiting your clubs and are there for you to demand action. If there's been one single case anywhere in the whole country where one single amateur has stood up at a club meeting and asked a director to take action I have not seen it reported in any club newsletters, nor have I had letter one from anyone claiming to have asked. I can only surmise that no one really gives a damn. Oh, I hear hams bitching and kvetching about it, and many letters grumble to me about it, but I have yet to hear of any time anyone has actually done anything. So much for a sense of personal responsibility.

So what can be done? Well, keeping in mind that a ham ticket is a privilege, how about getting the FCC to institute a simple system for de-licensing offenders—something which doesn't require hiring lawyers and going to court? Let's make it easy to rescind the privilege and stop considering the license as a right.

We need a system which we can run ourselves, without having to bring the FCC into the action. The less money we cost the FCC, the longer we'll be around. We know how to find hams causing intentional interference. We know how to tape the offenders. So let's empower our ham clubs to not only issue Novice licenses, but also to take away licenses.

We've been able to establish repeater councils and handle our own channel allocations, so why not set up a defrocking system? I'd suggest we establish area ham club councils to deal with this kind of mischief. If we let individual clubs have full say, we could run into problems with renegade clubs. Indeed, there are so many ham idiots in Southern California they probably could form several clubs. I don't think the bad guys outnumber the good guys yet—even there.

As you can see, when there are civil problems I tend to turn to the people for solutions, not to government or officials. The best rules we've had in amateur radio have been those we cooked up. The worst have been those from the FCC. I don't see any signs of that changing. And yes, the most disastrous of all, by a wide margin, have been promulgated by our own ARRL bureaucrats—like the 1963 Incentive Licensing disaster.

My apologies to any subliminally brainwashed ARRL members who find their bowels in an uproar over my admittedly rare mentions of that esteemed organization. The League has always promoted the concept that only League members have a right to criticize the League. Well, I've got my 50-year ARRL membership plaque, so I have every right, within the ARRL framework, to make suggestions and carp. 73

QSL of the Month

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

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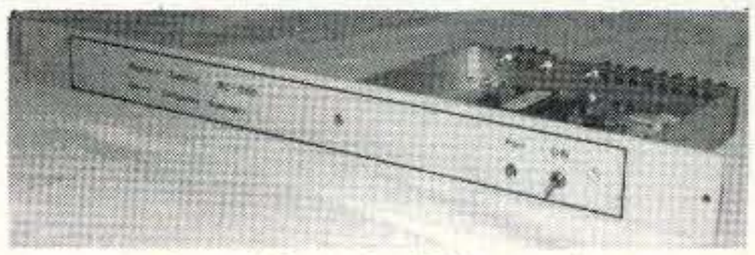

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The Radio From Hell

I'm a beaten man. Yup! I'm not one to give up, but after a week and a half, you can stick a fork in me. I'm done! The reason for all of this is a simple direct conversion receiver slated for 10 MHz. Nothing really complex, just an NE602 and some 741 op amps. As it turned out, I created the radio from hell. On this project, I'm not a happy camper. Learn from my mistakes.

The problem started with the VFO. Using a MPF102 in a Colpitts oscillator seemed like a good idea at first. The output of my Colpitts oscillator feeds the NE602 mixer with more than enough output. Excessive injection can cause all manner of critters to come out of the NE602. A small value capacitor couples some of the VFO energy to the NE602. A T50-6 core and several small-value caps comprise the tuned circuit for the VFO. Now, I'm not one for re-inventing the wheel, so I used as my starting point the VFO from one of the projects in "W1FB's QRP Notebook." Using the values listed for 30 meters, I began winding coils and heating up the soldering iron. I built the VFO first on a small piece of perfboard. Try as I might, I could not get the VFO to oscillate. Zero! Zip!

The silly thing would not even oscillator on the wrong frequency, let alone on the desired one. Out came the frequency counter and the oscilloscope. Try as I might, the oscillator still wouldn't fly.

The circuit is drawing current, so something had to be running. I checked the voltage on the drain of the MPF102 and, sure enough, I had the regulated voltage from the 7.5-volt zener diode. Yes, all the grounds were grounded and all seemed right with the world; but alas, no go.

A bad MPF102 must be the trouble. I replaced the MPF102 six different times. I gave up on number six as the chance of getting half a dozen bad FETs is a bit high. So, I started to replace the capacitors in the circuit. Again, nothing I did seemed to bring any life to the circuit. A desperate man, I scraped out the toroid and its capacitors from the circuit and in its place I installed a crystal cut for 10.106 MHz, one that should oscillate like mad.

Nothing but six zeroes on the counter. It was a little after three in the morning. The final score: VFO three, Mike zero.

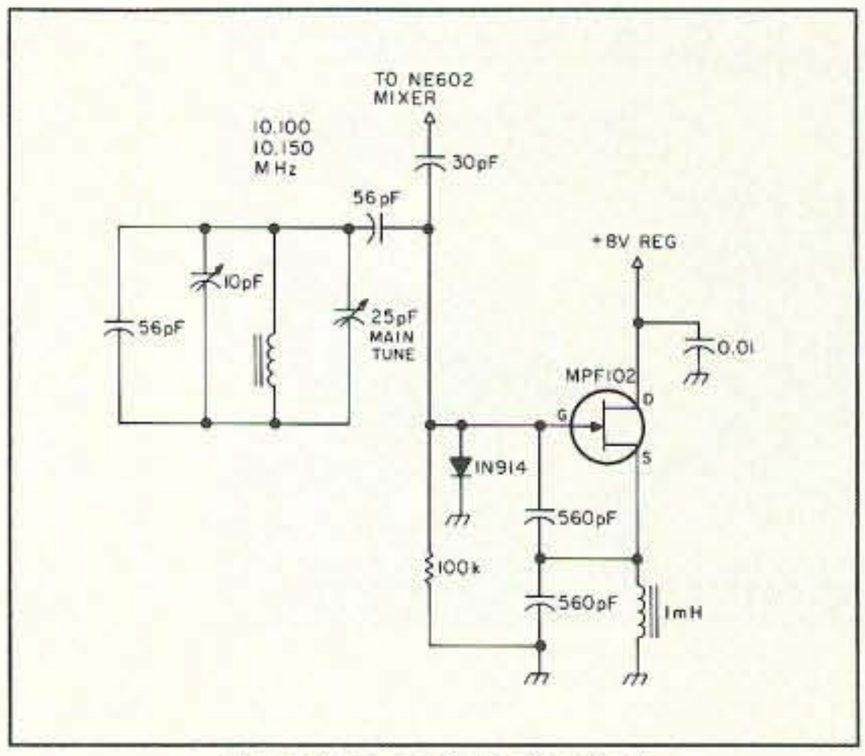

Figure. The oscillator from hell.

The Next Attempt

The next night (good thing I work 3-11 most of the time) I was back in the saddle again. All day long at work I had been working on the problem in my mind. And, as many have said, there is nothing up there to get in the way of an idea. I was out for blood, and the victim was the VFO.

My usual cut-and-try method was simply not cutting it (ouch)! I needed to get serious with Mr. Calculator. Out came the books, piles of books. If nothing else, perhaps I'd scare the oscillator into working. Look at the schematic in Figure 1. This is the beast I have been working on. The values listed are the ones I started out with.

Since I did not know the value of either the variable capacitor I was using, or the size of wire I wound the toroid with, Mr. Calculator was of little help. The variable capacitor looked as if it should be about 50 pF or so, and the wire looked close to #24 or #26 gauge.

It would seem to me that even if the component values were way off, the thing should still oscillate somewhere; but it didn't. So I started to remove components from the receiver. Perhaps I'd gotten a bad NE602? A shorted IC socket perhaps? I replaced the coupling capacitor several times thinking it might be bad. I also changed the values of the coupling capacitor. After awhile, I just removed it altogether and let the output of the VFO dangle there with my frequency counter probe attached.

Back using the cut-and-try method, I found (by changing out either C2 or C3 or both to 330 pF) I had a working VFO. The frequency oscillated from 9.500 MHz to 11.900 MHz. I could change the working frequency of the VFO slightly by spreading or compressing the turns on the toroid core.

Even though the VFO was operating, it was not a working unit. No matter what I did, I could not get smooth linear tuning from the VFO's main tuning capacitor. I could tune all the way from 9 MHz to over 12 MHz! This was all being done with a small 50 pF capacitor. The score for this evening: VFO four, Mike one.

I also found out that if I changed the values of C2 and C3 up or down ever so slightly, the oscillator would stop. One would think the frequency would either be raised (by using smaller value capacitors), or be lowered (by using larger capacitors). I found out that such is not the case with this circuit.

One More Try

Really drawing for straws, I decided that the main VFO capacitor must be way off its marked value. Nope, I don't own (yet) a capacitance checker, so I started to pull out the rotor plates, one at a time. This would lower the overall capacitance of the tuning capacitor and thus give me more band spread. Maybe instead of 50 pF the capacitor was really 500 pF. When I got down to the last rotor plates, that theory went out the window: I had a variable capacitor with one rotor plate and still the frequency went from 9.98 MHz to over 11 MHz.

So I re-wound the toroid core by adding thicker wire and five fewer turns than I had before. I removed the small 10 pF trimmer capacitor in parallel with the main tuning capacitor—perhaps too much capacitance was causing the problem with the band spread. Well, that idea was way off base too. I had a VFO all right, but still not where I wanted it to oscillate. So, I tried padding down the tuned circuits by adding small capacitors in place of the trimmer. Using 10 pF caps, I kept adding them to lower the frequency of the VFO. Now instead of running at 9 MHz something to over 12 MHz something, I had it tuned between 6.8 and 7.7 MHz. Could it be I had it beaten? Well, Kenwood has their DSP, Ten-Tec their QSK and Yaesu their CAT system. I just developed VBFC, that's Variable Band Frequency Control. Yes Sir! All you have to do is start on the high end and turn her on. In no time you'll cover the entire 40 meter band in 50 Hz steps.

I connected the VFO to the NE602 and while I'm sitting here typing this, I'm listening to all of 40 meters all at the same time. Whoa! There goes CHU Canada. Sure wish they were on long enough so I could set the station clock. Perhaps during the next sweep I can set the clock.

So there you have it, two weeks down the tubes working on a VFO. Final score: VFO eight, Mike three. But as Arnold Schwarzenegger likes to say, "I'll

RTTY LOOP

Number 23 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
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Baltimore MD 21208

Thanks To and From our Readers

I will start off this month by recognizing an anniversary. This column marks the start of the sixteenth year of "RTTY Loop." I don't know for sure, but I think this ranks up there with Wayne's "Never Say Die" column for longevity. All I can say about that is "thanks." Thanks to you, the readership, for your support and letters. Thanks to the crew at *73* for all their support and encouragement. Thanks to my family, for their understanding of this crazy hobby.

First of all, some follow-up on the column on America Online. When I checked, in late April 1992, the Kenwood file shown is available. Just look in the amateur radio files for the IBM PC compatibles. Also, I continue to be happy to forward your name to the service for starter software. Users of Macintosh or Apple II systems, please so indicate. Users of PC compatibles will need an EGA screen or better, mouse, and hard drive. Let me know the floppy disk size (5" or 3") you use.

Now, a message from Terry Stader KA8SCP/1, the America Online Ham Shack Host. He says, "It was nice to see the America Online's MS-DOS Ham Library graphic in the March 1992 issue of *73 Amateur Radio Today* ! Thanks for picking us out of the rest (Delphi and CompuServe) as one of the best bets. I think that the ham shack area is on the move with more and more personable interaction with the users than all of the other services combined! Our libraries are growing every day! Recently, a quick survey showed that many of our hams are interested in RTTY. Many of them know nothing about it . . . other than it is a mode that is available on the multimode TNC!"

Another member of America Online, Willie WD9FHA, passes along "a short note to let you know how much I enjoy `RTTY Loop.' I read it every month. I am not on RTTY or packet yet. I have a Kenwood 7400A for 2 meters and a TS520S for HF. I am not sure the 520S would do very well on packet, but I may try 2 meters soon. I have a 286 clone so that will help." It's good to hear from both of these folks, and it points out how broad-based amateur radio communication has become. On and off the radio, we do get around!

Help Out a Hamsoft User

Now, turning from some of the latest communication to an orphaned machine, I have a letter here from Charlie Anderson KG5SX, of Hattiesburg, Mississippi. Charlie wonders if we have addressed the Kantronics Hamsoft cartridge for a Texas Instruments TI-99/4A computer.

He relates, "I have used one of these for several years now, and it performs well and fills my bill for RTTY operation as I use a Heath HW-101 for 60 wpm RTTY and occasionally 100 wpm. My old Heath would not have the fast turnaround time required for AMTOR, so I am content to stay in the slow lane.

"Now I have a problem that I hope someone can help me with. It seems that I made a mistake in the shack one day and got 120 volts AC on the ground buss of my computer. Before the fuse blew the computer did, and took out part of the Hamsoft cartridge as well. The computer was easily enough replaced but I am having trouble locating another Hamsoft module. The cartridge may be OK, but [I am] not sure, as it locks up the computer when I try to use it. Sounds hopeless, but there is a chip in the cartridge that I do not have the number for, as the top of it is gone, and this chip appears to have taken the brunt of the shock. It is an SN74??? series chip. These are the only numbers readable on it and it is tied into the TMS9901 chip on the board. The ROM chip, which is marked HN482764, appears OK visually, but I know it may be permanently damaged.

"I called Kantronics and they said that they had nothing left on this device. No parts list. No schematic. They referred me to Dentronics and I called them and got the same reply. I have tried to locate a used cartridge via the 1-800 numbers, but have been unsuccessful so far. I really want to get this thing fixed or replaced, as it was on loan to me and I hate to tell my friend, `Sorry about that, ole buddy!' I know it is a long shot, but hopefully the only thing wrong is the 14-pin DIP chip . . . and maybe the TMS9901, which I know where to locate. [Hopefully someone] can look inside [a Hamsoft cartridge] and tell me what the chip number in question is. Or perhaps there is someone out there who can clone me another ROM chip, as mine is QRT."

Well, the reader base of this column is one of the most complete in the RTTY universe, Charlie. So, if anyone has the information, please forward it here, or directly to Charlie. We all thank you!

By the way, reversing the AC line hot and ground wires can be more than damaging to computers; it can kill you. If you touch a chassis that you think is grounded, but is really at full line potential, while touching a real ground, the result could be a real silent key. One simple device which can help is a $5.95 Grounded Outlet Analyze, available at your local Radio Shack (stock number 22-101). This handy little plug-in device has color-coded lamps to indicate whether or not the outlet is correctly wired. No, it may not be the equivalent of industrial testers costing hundreds of dollars, but it doesn't cost hundreds of dollars, either!

Packet Without a TNC

Interest in TNC-less packet is well articulated by many of you, with a common set of questions. David L. Ringo, M.D., N6UVF of Portola Valley, California, is one such interested party. Just finishing his psychiatry residency, Dr. David finds interest and intrigue in the different digital modes. "The possibility of putting together a very compact laptop/2 meter HT packet system is very attractive, but a number of questions come to mind. As I understand it, the BayCom and PMP *['Poor Man's Packet,' August 1991, 73]* systems differ in that one uses the serial port and the other the printer port, so that one's modem would be incompatible with the other's software. What's the real scoop on TNC-less systems? Are they as effective as a TNC, and if not, what exactly are the trade-offs? Are there significant differences between the German and A & A BayCom modems? Do you have any recommendations as to suitable laptops? I would think that RFI from the computer would be a significant issue, but I haven't seen anyone address that."

First of all, I agree that a serial and parallel data flow are incompatible. This is not to say it has not been done, just that I don't think one modem will suffice for both systems. The TNC is, after all, a dedicated computer that performs all the functions necessary for packet communication. Your personal computer can do the same, but the overhead for managing local operations, video, disk access, printing, and the like, would all cut into packet time slices. I would say that for routine, straightforward packet work, the TNC-less systems may well be all the typical amateur needs. For more demanding work, to set up a digipeater or bulletin board, the efficiency of a dedicated TNC would be a requirement. As to the differences between BayCom modems, I can't say. I would invite users' comments, though, on the various implementations, and will pass them along in future columns.

Suitability of laptops hinges on several factors, but FCC Class B certification, attesting to the lower RFI levels for home computing, is an ABSOLUTE! Other than that, the best bet would be to stick with one of the national brands, and even with a local dealer who will allow you to return or exchange the machine if RFI is a problem. I don't yet own a laptop, or I would share my own experiences. Don't fret, though, my history of candor is that when I do pick up a new piece of hardware, I share the information with a few of my most trusted friends: YOU.

Next month, more from here and there, you and me. The one story I won't tell you is how a squirrel brought down my antenna (unless you really want to hear it). I continue to look forward to your input, both by mail and Email, via CompuServe (ppn 75036,2501), Delphi (username MarcWA3AJR) and America Online (screen name MarcWA3AJR). 73

Number 24 on your Feedback card

HAMS WITH CLASS

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

Invention Versus Innovation

If, as a teacher, you were given the following background information about one of your new students, what assumptions would you make about his abilities to be successful at anything?

"The doctor said he had brain fever at birth—having an extra large head. In fact, three brothers and sisters died at birth. Relatives and neighbors thought he was abnormal, but his mother said no. His teachers thought he was abnormal too, so his mother taught him at home. He was a firebug, setting a fire in the barn just to see what it would do. He had only three months of formal schooling."

As any good teacher can tell you, it's not a good idea to make any assumptions about any child's ability to succeed until you've had a chance to work with the student yourself. The fact is that the young man described above is Thomas Edison!

We who are teachers or instructors must be careful not to pre-judge anyone who sits before us. It is a truism of education that given the right environment and motivation, everyone is capable of doing at least a little better than his own expectations. I've been working with young people for almost 20 years, and *I* certainly believe that.

Those of us who are working hard to promote growth and quality in amateur radio know the value of encouraging newcomers to explore and experiment with different modes of communication. We who are in the classroom are in the position of being mentors who can actually teach children not to be afraid to take risks; not to be afraid to ask questions and to be curious; and most importantly, not to be afraid to fail.

While it is true that we're not all going to have a Thomas Edison in our classes, we are all at least going to have some youngsters with the potential for being creative and innovative, if only given the chance. When you tap into someone's creative psyche and give them the tools they require to take a chance, you never know what great ideas, inventions or innovations you may be setting into motion.

The History of Invention and Innovation

Firstly, the children should understand the difference between invention and innovation. An *invention* is a brand-new and unique idea or discovery. An *innovation* is a concept that builds on a previous idea, invention or discovery, providing a new or perhaps improved solution.

Many thousands of years ago our ancestors found that daily living was a pretty rough experience. The caveman had only his hands to use for hunting, fishing, and gathering plants and roots. He had to find creative ways to protect himself and his family from the elements (the weather and the wild animals). Early man was forced by circumstances to use his brain and his hands to make things that would make his life easier and more pleasant. He invented tools for fishing, hunting and building. At first the tools were just sharpened stones. He soon discovered that fire was good for keeping warm and that water had many practical uses. The fur from wild animals proved to be valuable for warmth, so clothing was invented. Most likely it was a rolling rock or a cross section of a tree trunk that began to slide and roll which gave someone the idea for a wheel. One invention led to another. Many men thinking and inventing over a long period of time led to some of the inventions and innovations we have come to rely on today.

In prehistoric times there were no chairs. Our ancestors probably leaned against the cave wall or sat on a rock or a ledge. At some later date, the chair was invented. Since that time, thousands of different kinds of chairs have been designed. Today there are all kinds of chairs: folding chairs, rocking chairs, lounge chairs, couches, beach chairs, etc.; all these different kinds of chairs are innovations. They each meet a different need based on the original invention of the chair.

Teaching Techniques

A good activity to use in the classroom is to have students make a list of commonly used devices. Then have a discussion about which category each item belongs in—invention or innovation. A good follow-up to this is to divide the class into groups and have them brainstorm about one particular invention. It's sometimes helpful to have children work together in a group to get started with this kind of creative process. After they've researched all the background on a particular invention; like who the inventor was, why it was invented, what needs it met, when it was invented, etc.; they can make a list of possible innovations for the future. Children tend to be less inhibited with the creative work when working as a team. Besides, working as a team member is an important skill to master. Many inventions and innovations that are made nowadays are made by employees in large institutions who are part of a research team.

One year we turned an entire complex of rooms in our school into a living time line. Each room represented a different era of time in history. When a visitor walked into a particular room he was transported into a time warp. The children wore costumes of the time, served food of that period, and exhibited inventions of that era. What a fabulous activity this can be in a school! There were so many subtle lessons learned—like the fact that there were certain periods of time that were more conducive to the spirit of "inventing" than others. Why? The Time Line Fair lasted only three days, but the preparation for it took weeks, and the follow-up discussions and lessons went on all term. I strongly recommend that you include a living time line activity in your curriculum.

Another good activity to encourage creative thinking is to have the youngsters keep a diary over a period of time of all the needs and problems that they encounter.

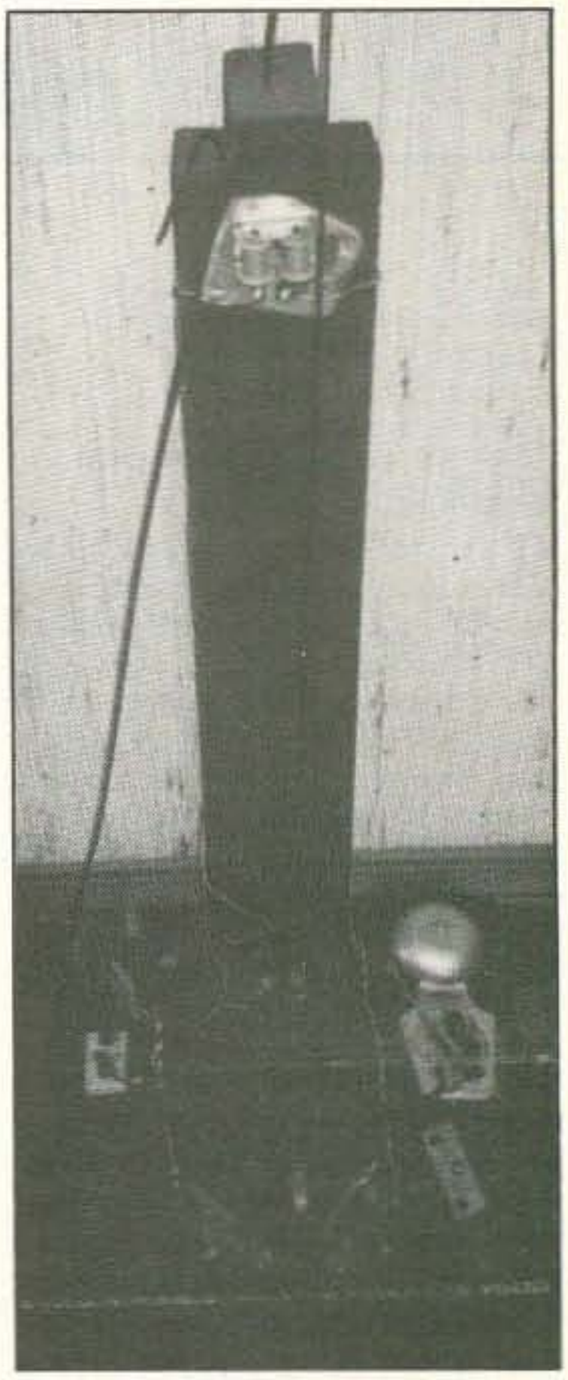

Photo B. This is the replica of the fire alarm W2SLP invented as a young boy.

Most inventions and innovations come about from a need or a necessity for change. Let each child pick a need or problem and lead a brainstorming session to see what kinds of solutions the rest of the class can come up with. You will be amazed at how productive these sessions can be. I even tape-record some of the more sophisticated topics so the children can refer back to the things that were discussed.

I'm a strong believer in bringing in experts who are good speakers to meet with the children in person. After you've laid the groundwork for the class's involvement with their own inventions, you might want to invite a patent attorney to visit

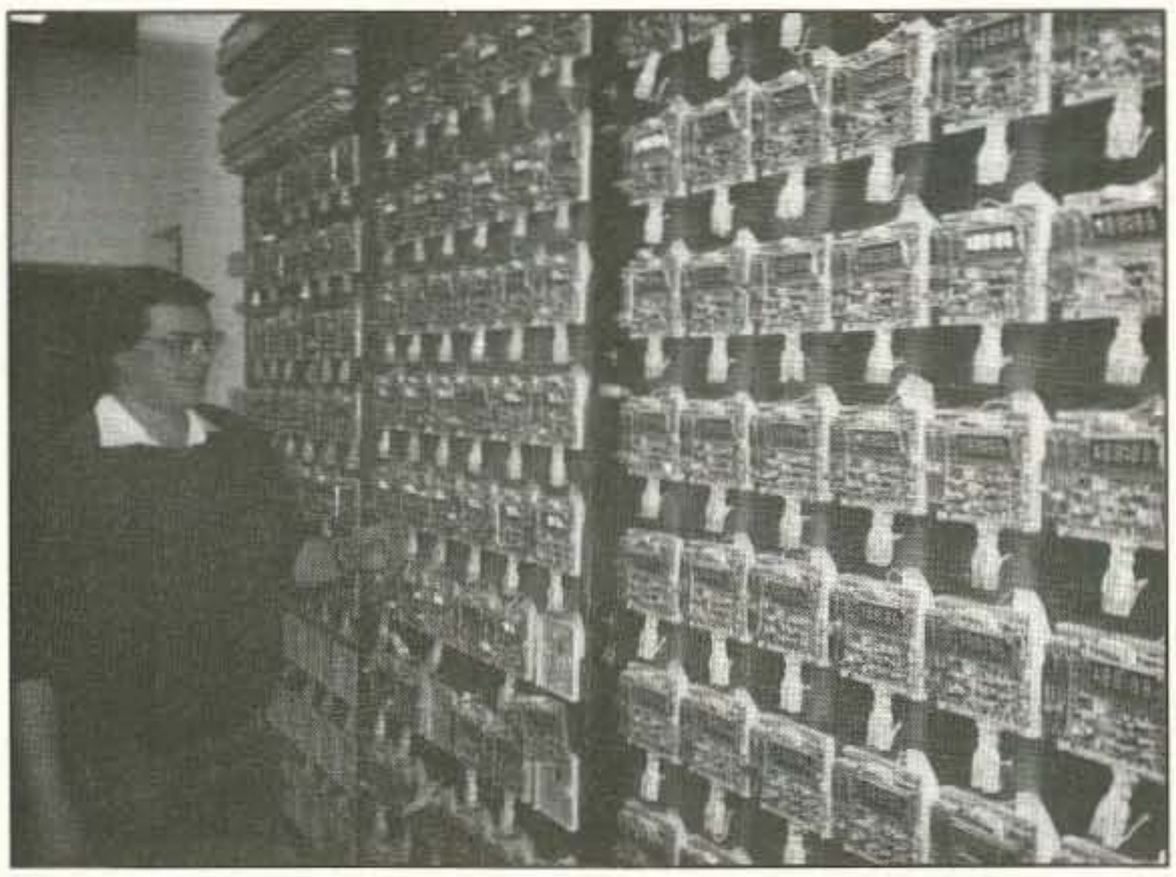

Photo A. Roger W2SLP testing circuit boards for a digital clock thermostat he invented.

Photo C. Frank KB2MID "invented" a remote-controlled shuttle to fly around his space station. Carole WB2MGP encourages her students to be creative with their projects.

your school. Once the children get caught up in the spirit of "inventing" they will have a million questions for this kind of expert about what they can do next with their inventions.

Bring in Your Ham Friends

Think through your list of ham friends and you'll probably come up with someone who has tinkered with a new kind of gadget, invented a new gizmo or discovered a better process for doing something or other. Bring them in to speak with the kids. Let them share their thinking, their methodology, and most importantly, their enthusiasm with your students.

I'm lucky enough to know several hams who fit this bill. My good friend Roger Isaacs W2SLP owns an electronics manufacturing company on Staten Island. He is the inventor and patent holder of several terrific products, including an electronic clock thermostat, a wireless car alarm, and various versions of fire and burglar alarm systems for stores and houses.

Roger once took the time to recreate a project he created as a child for my class to see. As a youngster he thought up his own version of a simple fire alarm by building a "Rube Goldberg" kind of device. When you light a match under one of the wires, it releases a magnet which drops down to close a circuit which then enables the bell to ring. The kids love it!

Don't forget to include enrichment activities from the social studies curriculum. Many inventions greatly influenced the course of history. Doing research on inventors throughout history is a valuable lesson. It can lead to discussions about how our lives might be different today without the work of people such as Guglielmo Marconi, Jonas Salk, Charles Goodyear, Louis Pasteur, Robert Goddard, Johann Gutenberg, or George Washington Carver, just to name a few.

Several months ago on our CQ All Schools Net, Jay Apt N5QWL, a NASA astronaut, was speaking with some 6th grade ham radio students of mine. He asked a youngster to go to the chalkboard and make a list of all the things the class thought should be part of the astronaut's spacesuit. This naturally triggered off all kinds of terrific discussions and research projects for weeks about space travel and astronauts and communications devices. What Jay was doing was setting the stage for this creative thinking we've been talking about.

My advice is to approach every class as though you believed there must be a future Thomas Edison amongst the children, who would emerge if only you could create the right atmosphere for him or her to flourish in. Amateur radio in the classroom makes this not only easy, but fun as well. Good luck, and let me know what your kids and you "discover."

A good resource to write to for more classroom ideas about inventing is "Invent America," 510 King Street, Suite 420, Alexandria VA 22314; or call (703) 684-1836. 73

Number 25 on your Feedback card

73 INTERNATIONAL

Arnie Johnson N1BAC
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N. Swanzey NH 03431

Notes from FN42

I have just come home from a very satisfying experience, seeing 38 non-hams show up for a meeting that was the start of a Novice/Technician class in Keene, New Hampshire. It was wonderful to see people of all ages, from the young to the more mature (we're never old, are we), male and female. My sons might have used the expression "AWESOME"!

There were also more than 10 licensed hams at the meeting, all willing to take time away from their families and friends to help in any way that they could to give a boost to the ham population in the Keene area. The syllabus has been laid out and many hams will take part in the teaching, not just one or two.

Something else that is very important is the location, the place where all the training will take place. One of the local hams is a member of the Army Reserve and he asked the powers that be if we could use the facilities of the local reserve unit for the ham training. We received approval from the local commander and things started happening.

How many of you have done the same thing in your area? How many of you have given something back to the hobby you love? How many of you have become an "elmer" to another person, a prospective ham? How many of you have read the Silent Key column in your favorite ham magazine or newsletter, shook your head, but have done nothing to replace the lost one with at least one more?

If your answer or answers to the previous questions lead in the direction of "Let someone else do it," or "I can't do it," you are now part of a very common problem: apathy—lack of feeling, emotion, excitement; indifference [courtesy of Webster's Dictionary]. *How about becoming a part of the solution to the decreasing ham population by getting involved locally in starting ham classes, either in the evenings at some convenient location or at some of your local schools? Many teachers/hams are doing it in schools in a very big way and doing it very well. It is a natural thing to do. We in the United States have been advised that our education system is sadly lacking in mathematics and science, and that we are last or almost last in that knowledge worldwide. Ham radio involves much more than just chatting on the radio waves. It includes many things: science, math, language, etc. What better way to help our young people learn than to get involved with them! Maybe we will learn something from them also. Let us* **ALL** *become part of the solution to the problem!*

Hopefully all of you are now aware of the movement of the 73 offices back into Peterborough, New Hampshire. There is a new address and also new phone and FAX numbers. I'm sure that if you have sent something to the Hancock address it will make it to the new "digs."

As I am finishing this column I am in a hurry because I still have to pack my station wagon with all of the "treasures" that I am taking to the Deerfield Hosstraders Ham Fleamarket. The usual starting time is 4 p.m. on Friday, and the event usually ends about the same time on Saturday. As of 8 a.m. this Friday morning there are already people willing to pay a premium amount to enter the fairgrounds to get a good location. This is out in the open, under the trees. There are buildings available but usually only the dealers will rent space in them to set up their wares. I guess it is what you call a "happening"."

Hopefully, many of you around the world have the same chance to attend such a happening. It is always great fun to see people that you haven't seen since the last one or meet a person for the first time that you have been talking to on the air for many years.

Maybe you will be an elmer to some new ham and help that person in choosing a first rig. Do you remember your excitement with your first rig? I certainly do, and it is now time for all of us to see the delight in others' eyes as they carry it (drag it?) back to their car. As I mentioned before, become part of the solution to the dwindling numbers of hams in the world, ***GET INVOLVED!****—Arnie N1BAC*

Roundup

Netherlands Just received is the first edition of "On Target," a free publication designed to inform listeners about what is happening to the English language programs from Radio Netherlands. This newsletter is sent twice a year to listeners who have registered on the mailing list. Radio Netherlands is making a lot of changes to the format of its transmissions, bringing the presentation in line with a new style for the 1990s.

If you wish to receive this free publication send your name and address to: "On Target," Radio Netherlands, P.O. Box 222, 1200 JG Hilversum, The Netherlands; FAX: +31 35 724 352. If you have signal reports you wish to send, address them to Monitoring Panel OTR, Radio Netherlands Frequency and Monitoring Department, at the same address.

Scotland From John "Paddy" McGill GM3MTH: The Scottish Tourist Board (Radio Amateur) Expedition Group event for July is GB2SMC at the Scottish Museum of Communication, Bo'ness, July 18/19. *[Check the May issue for frequencies and times.—Arnie]*

United States/Nepal Information received on the packet system from Bob K1RB, 16 April 92, 0100Z: "Gary Olson KA9RLJ has confirmed that Father Marshall O. Moran 9N1MM passed away early today, at a hospital in Katmandu, Nepal. The sad news followed word that Father Moran was hospitalized by what was believed to be congestive heart failure several days ago. Father Moran was often on the `256' net until recently. A member of the Jesuit order, Father Moran had friends all over the globe. From his station in Nepal he communicated with amateur radio stations worldwide. He made many trips to the United States, attending numerous amateur radio gatherings." *[Father Moran will be sadly missed by all hams around the world.—Arnie]*

United States/Ukraine From Mark Olesnicky N2DQS: On September 2, 1991, I made contact with a strange callsign in what was at that time still part of the Soviet Union. The callsign was RY75BL.

I inquired of the station, and found out that this was a Special Event Station in the Ukraine commemorating the 75th anniversary of battles between the Ukrainian Sitch Army and the Tsarist Imperial Armies held at the site of this station atop the hill Lyson near the city of Berezhany in the Ukraine (Zone 16, Oblast 076).

Although they spoke English well, I switched to the Ukrainian tongue and had a wonderful QSO with the organizers of this Radioexpedition to the hill Lyson. It was organized by the Club Station UB4BYU, a group of young students at the local technical school. The club trains and inspires youngsters in the art of amateur radio and invites other groups such as Scouts, known as "PLAST" in the Ukraine, to participate. They slept in tents, ate food supplied by a field kitchen, and transmitted from transceivers powered by batteries or generators. This Field Day atmosphere inspired great camaraderie and a sense of pride and accomplishment for this group of young Ukrainians. As you may recall, the Ukraine had just announced its independence a short time before.

As one of the leaders, Ihor Hrycyszyn UB5BBN explained to me that the emphasis of this expedition to Lyson was on youth, their pride of national origin, and the hope of being recognized by their international peers. From August 30 to September 4, 1991, they had 4,500 QSOs with 92 countries.

To confirm and commemorate this QSO and event I received a beautiful diploma and several QSL cards, as well as personal letters and copies of newspaper articles describing the event.

Today I received a letter from Ihor UB5BBN informing me that Special Event Station US76BL will be on the air from 0000UTC on August 28 through 2359 UTC September 2, 1992. The call stands for Ukraine Sovereign 76 Berezhany Lyson. The number 76 is for Oblast 076.

The organizers of this Special Event Station request that I notify anyone who could make it a resounding success. Operation will be on all bands and will include CW, SSB, RTTY, and SSTV. To receive a QSL and certificate of the event (Diploma), one must complete a successful QSO with US76BL and send a QSL card along with 5 IRCs to: Ukraine, 283150, Berezhany, Ternopilska Obl., p/s 12 UB4BYU. *[Mark T. Olesnicky, M.D., N2DQS, 9 Driftway, Florham Park, NJ 07932.]* 73

While tuning around the band, Bill found it was not hard to hold the children's interest during the demonstration.

Number 26 on your Feedback card

BARTER 'N' BUY

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 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 August classifieds is June 11, 1992.

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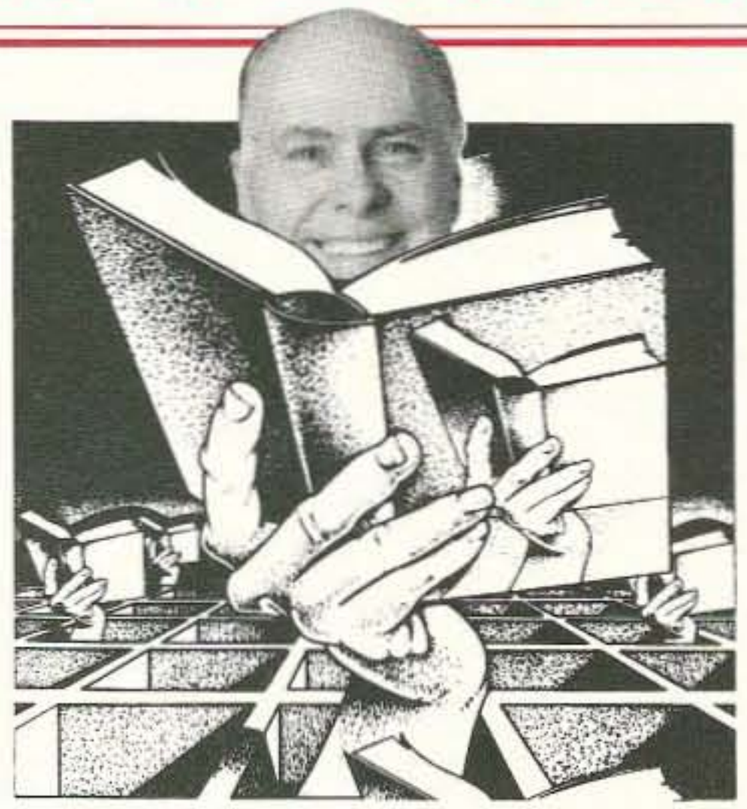

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RANDOM OUTPUT

David Cassidy N1GPH

If It Ain't Broke . . .

The ARRL and Fred Maia W5YI have, for reasons we will try to fathom, decided to fix something that isn't broken–Novice licensing. This is business as usual for the ARRL in their goal of total dictatorship over American amateur radio, but I haven't a clue what deal W5YI was promised in order to garner his support for this absolutely unnecessary and regressive proposal.

Tens of thousands of hams, including yours truly, were introduced to amateur radio through the current form of Novice testing. In my case, it was a high school amateur radio club. I attended after-school license classes for a couple of weeks, and when the club advisor thought we were ready, he and another ham-teacher administered the Novice exam to us. No trips to the FCC office in Boston (this was pre-VEC days), no unfamiliar surroundings or strange and different sounding Morse code test. My "elmer" guided me through the learning process, and he had the reward of seeing his efforts result in many proud young Novices.

The ARRL and W5YI would like to change all that. They have proposed to the FCC that all Novice testing be incorporated under the VEC program, and we must let the FCC know in no uncertain terms that the amateur radio population sees this for what it is: another blatant and self-serving power grab.

The ARRL and W5YI offer that their proposal would cut down on incorrect Novice license applications, thereby saving the FCC the time and expense of processing these forms. Boy. . .doesn't that sound peachy? All they want to do is help out the FCC, thereby saving time and money. How could anyone disagree with that?

Who said there was an unusually large amount of time and money being spent to deal with faulty Novice exams? Where is the research to back up the claim that this is a problem? If there is a problem, why hasn't the FCC ever mentioned it?

For sure, a certain number of Novice exams are bound to be submitted with examiner errors. Does the number of examiner errors justify eliminating a program that has been instrumental in gently introducing two generations of young people (not to mention the thousands of older hams) to amateur radio? The Novice test and license application is not quantum physics. It doesn't take a rocket scientist to correctly administer and submit a Novice exam. Could clearer instructions take care of the problem (if one *does* exist) of examiner mistakes?

Another reason given for adopting this proposal is to cut down on fraudulent Novice testing. I wasn't aware that there *was* any great amount of Novice testing fraud. Boy, I'm sure glad the ARRL and W5YI, who obviously consider themselves more honest than you or me, are going to save us from the hoards of illegally tested Novices. Oh. . .you mean you weren't aware of the thousands of fraudulent Novice licenses granted every year? Gee, now that you mention it, this is the first I've heard of it, too. (Let us not forget that the only testing fraud in recent in memory was perpetrated by duly authorized VEs.)

If no problem exists, then it follows that the ARRL and W5YI must have some other motive behind this nonsense. I haven't a clue why W5YI would support this proposal, unless it's part of some deal that is yet to be disclosed between Maia and the ARRL. I admit that this is pure speculation on my part, but I can think of no other reason why an otherwise intelligent guy like Fred Maia would back such an idiotic proposal.

The ARRL's motives are more apparent. They are the same motives that guided the ARRL when they wanted to control all licensing by being the *only* authorized VEC (luckily, the FCC kept that from happening). They are the same motives that made the ARRL suggest that they handle all special callsign allocation. When the FCC said they wouldn't mind having a program like the VEC system handle special callsign requests, but that the ARRL was not going to get a monopoly, the League backed off and made the FCC look like the bad guys. Once again last fall, the ARRL's motives became clear when—without notifying their members, or the entire population of American hams they *say* they represent—they had wording added to an FCC funding bill that would give them exclusive power to assign special callsigns to radio clubs. (Coincidentally, it was W5YI who blew the whistle on the ARRL's sneakiness. Hmmm. . .that might lead some to wonder if we'll be seeing a joint ARRL/W5YI callsign allocation proposal in the near future.)

Can anyone question what the ARRL's prime objective is in proposing to get Novice testing out of the hands of your average ham? Don't you see a pattern here, folks? For the last 25 years, the ARRL has consistently and systematically tried to become the sole governing and regulatory authority for American amateur radio. If the ARRL was capable of acting in the interests of amateur radio, I'd be the first in line to give them more power and authority. But the League has proven time and again, by their own actions, that they are not concerned as much with the hobby of amateur radio and the concerns of the average ham as they are with their own self-serving agenda and self-perpetuation.

I urge you to write to the FCC in Washington and voice your opposition to this proposal. While you're at it, why not drop a line to the boys in Newington and let them know that the majority of American hams are happy with the way the Novice license test is administered.

Instead of creating a transparently obvious paper tiger out of Novice testing, why doesn't the ARRL spend some of it s sizeable bank account to help educate the country—especially youngsters—on what amateur radio is, how much fun it is, and how to get involved? Until they do, the majority of hams in this country won't have anything to do with them.

This Novice testing proposal is just another piece in a long line of evidence that shows the ARRL is more concerned with what is good for the ARRL than with what is good for amateur radio. 73

Number 29 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

In general, you can expect July to be a month of reasonably good conditions on the HF bands, with minor disturbances centered around the 9th, 17th, 22nd and 25th. . .leading to Fair or Good-to-Fair conditions. You can expect considerable short-skip opportunities during the daytime hours on bands between 20 and 10 meters. DX this month will experience the usual summertime slump, although most HF DX bands will be open during daylight hours, and usually until dark, with the highest frequencies dying first, followed by 20 meters last. Then, during hours of darkness, the bands between 160 and 30 meters will tend to come alive. The "top" band (160 meters) will be best between local midnight and 6 a.m. for DX contacts and contacts around the U.S.A. Eighty, 40 and 30 meters will be best in evening and early morning hours. Notice that we don't anticipate any "Poor" conditions in July. Thunderstorms, typical of July, will cause considerable crash-static interference on the bands below 20 meters. . . some of which will be unstable during stormy periods. You can expect thunderstorm QRN to block out signals when the storms are located between your QTH and that of the station you are trying to work.

"Sporadic E" propagation via "floating" ion clouds in the E-layer of the ionosphere will provide extremely strong signals from time to time during the month on the frequencies between about 20 meters and 10 meters. . .possibly even 6 meter openings. . .on some Good days during the month. Sporadic E results in contacts of up to 1,000 miles or so, and is characterized by signals that last from a few minutes to as much as half an hour or so, with almost instantaneous fade-out.

Watch the charts for the best times, bands and directions for your DX efforts, and also look for WWV reports on current conditions and trends at 18 minutes after any hour. July should be a Good month in General–as summertime conditions go–but of course can't be compared with spring and fall conditions. Enjoy this generally quiet and uneventful month for portable and mobile operation, too. It's a winner. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	—	—	—	—	—	—	20	—	—	—	—	—
ARGENTINA	20	20	20	40D	40D	—	—	—	—	—	10	15
AUSTRALIA	—	—	—	20	20	40D	20D	20D	—	—	—	—
CANAL ZONE	15	20	20	—	—	—	20	20	20	—	10D	15
ENGLAND	20	—	40/80	40/80	—	—	—	—	—	20	20	20
HAWAII	15D	20	20	20	40D	40D	—	—	—	—	—	15D
INDIA	20D	20D	—	—	—	—	—	—	—	—	—	—
JAPAN	—	—	—	—	—	—	20	—	—	—	—	—
MEXICO	15	20	20	—	—	—	20	20	20	—	10D	15
PHILIPPINES	—	—	—	—	—	—	20D	—	—	—	—	—
PUERTO RICO	15	20	20	—	—	—	20	20	20	—	10D	15
SOUTH AFRICA	—	40	40	20D	20D	—	—	—	—	—	20D	20D
U.S.S.R.	20	20/40	20/40	—	—	—	—	—	—	—	20	20
WEST COAST	40	80	—	—	—	—	—	20	20	20	15	40

CENTRAL UNITED STATES TO:

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

WESTERN UNITED STATES TO:

ALASKA	—	—	—	20	20	20D	40D	20D	20D	—	—	—
ARGENTINA	15	20D	20	20	—	—	—	20D	—	—	—	15
AUSTRALIA	15	15	15	20	20	20/40	40	20/40	—	—	—	—
CANAL ZONE	10D	15	20	20	40D	40D	—	20	20	—	15	10D
ENGLAND	20	20	20D	—	—	—	—	20D	—	—	—	20D
HAWAII	15	15	15/20	20	20	20/40	40/80	—	20	—	15D	15
INDIA	—	—	20D	20D	—	—	—	20D	20D	—	—	—
JAPAN	—	—	—	20	20	20D	40D	20D	20D	—	—	—
MEXICO	10D	15	20	20	40D	40D	—	20	20	—	15	10D
PHILIPPINES	—	—	—	20D	20D	—	—	20D	20D	—	—	—
PUERTO RICO	10D	15	20	20	40D	40D	—	20	20	—	15	10D
SOUTH AFRICA	—	—	—	20D	20D	—	—	—	—	—	—	—
U.S.S.R.	20D	20D	20D	—	—	—	—	20D	—	—	—	—
EAST COAST	40	80	—	—	—	—	—	20	20	20	15	40

Note that a (D) will indicate a difficult path. Try on days when the geomagnetic field is quiet (G) and when solar flux is 100 and greater.

JULY 1992

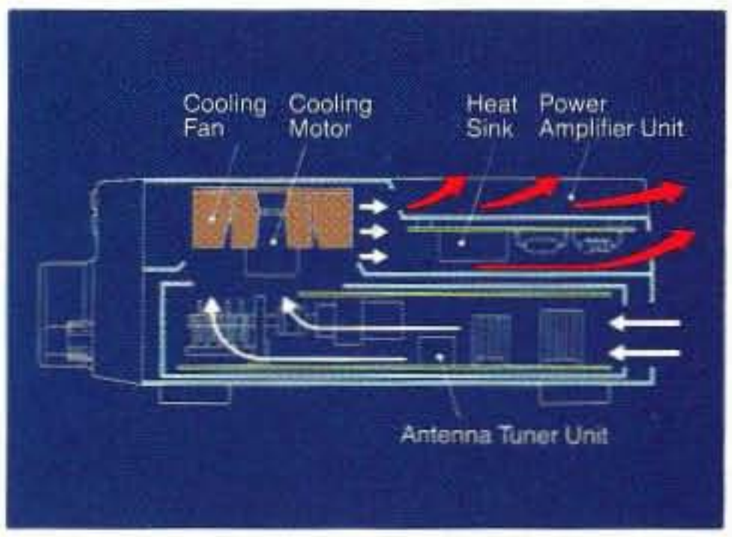
SUN	MON	TUE	WED	THU	FRI	SAT
			1 G	2 G	3 G	4 G
5 G	6 G	7 G–F	8 G–F	9 G–F	10 F–G	11 G
12 G	13 G	14 G	15 G–F	16 G–F	17 F–G	18 G
19 G	20 G	21 G	22 G–F	23 G–F	24 G–F	25 F
26 F	27 F	28 F–G	29 G	30 G	31 G	

FT-890AT...Light Years Ahead.

World's Smallest With Built-in Antenna Tuner

Rear Panel: Seldom used controls are located on rear panel allowing clean uncluttered front panel design.

Mobile Installation: The compact design and built-in antenna tuner makes the FT-890 a great mobile companion, using the optional mounting bracket kit (MMB-20).



DFCS (Duct Flow Cooling System): This unique system allows 100% duty cycle on FM and RTTY for up to 30 minutes of continuous transmission.

Antenna Tuner: High speed with 31 memories automatically stores most recent antenna matching settings for instant recall while changing operating frequencies.

Superior Performance

The FT-890 is an extraordinary achievement, featuring DLT (Digital Linear-phase Tuning) for silky smooth tuning. Including the advanced RF Front End design of the FT-1000 for superior receiving performance. Compare the advantages for yourself, it's ready to go when you are! Call your nearest Yaesu dealer for one of the best DX-pedition radios ever.

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Specifications subject to change without notice.
Specifications guaranteed only within amateur bands.
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KENWOOD

New Handheld Horizons

TH-28A/TH-48A

- Dual receive with single band HT

  TH-28A - RX 118-173.995 MHz (main) 438-449.995 (sub)
  TX 144-147.995 MHz
  TH-48A - RX 438-449.995 MHz (main) 136-173.995 (sub)
  TX 438-449.995 MHz

- TH-28A: 2.5W, TH-48A: 2W. Both models 5W output with PB-14, PB-17, or ext. 12VDC
- 40 Full function memory channels, expandable to 240 with optional ME-1

TH-78A

- Dual frequency receive in any combination. VHF+UHF, or VHF+VHF, or UHF+UHF
- RX 118-173.995 MHz, 438-449.995 MHz
  TX 144-147.995 MHz, 438-449.995 MHz
- VHF 2.5W, UHF 2W, or 5W output with PB-14, PB-17, or ext. 12VDC
- 50 Full function memory channels, expandable to 250 with optional ME-1
- Full duplex cross-band (telephone-style) operation

Additional Features: TH-28A/TH-48A/TH-78A

- Alpha numeric memory channel display. Specify memories by call sign, name, etc.
- Alpha numeric message paging
- CTCSS Encode/Decode built-in
- Ten 15 digit DTMF autodial memories. A,B,C,D,*,# can also be memorized
- Direct keyboard or rotary knob frequency entry
- Remote control speaker microphone - SM-33 (optional)
- Clock/Timer with alarm

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