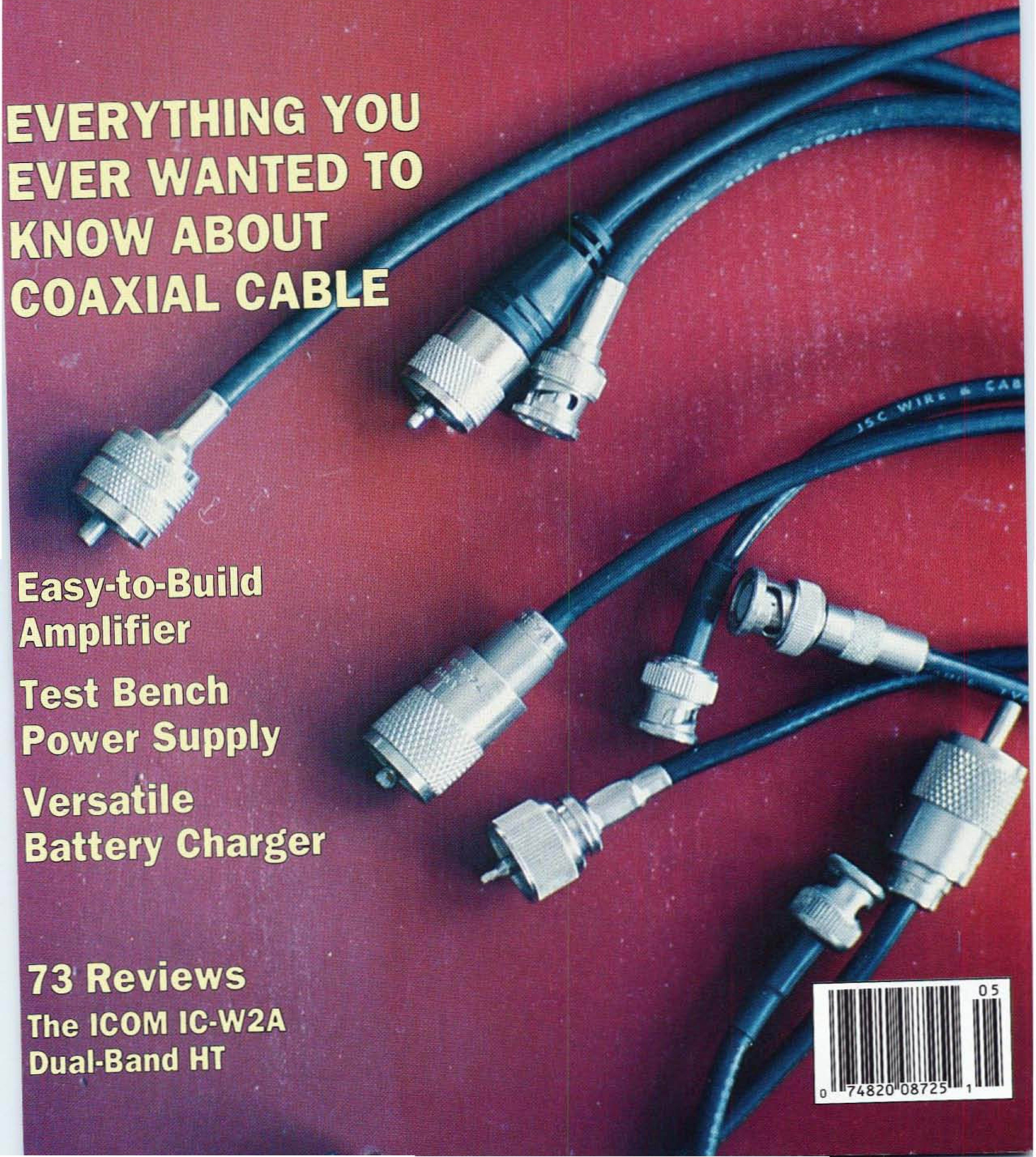
73 Amateur Radio Today

MAY 1993
ISSUE #392
USA $2.95
CAN $3.95
A WGI Publication
International Edition



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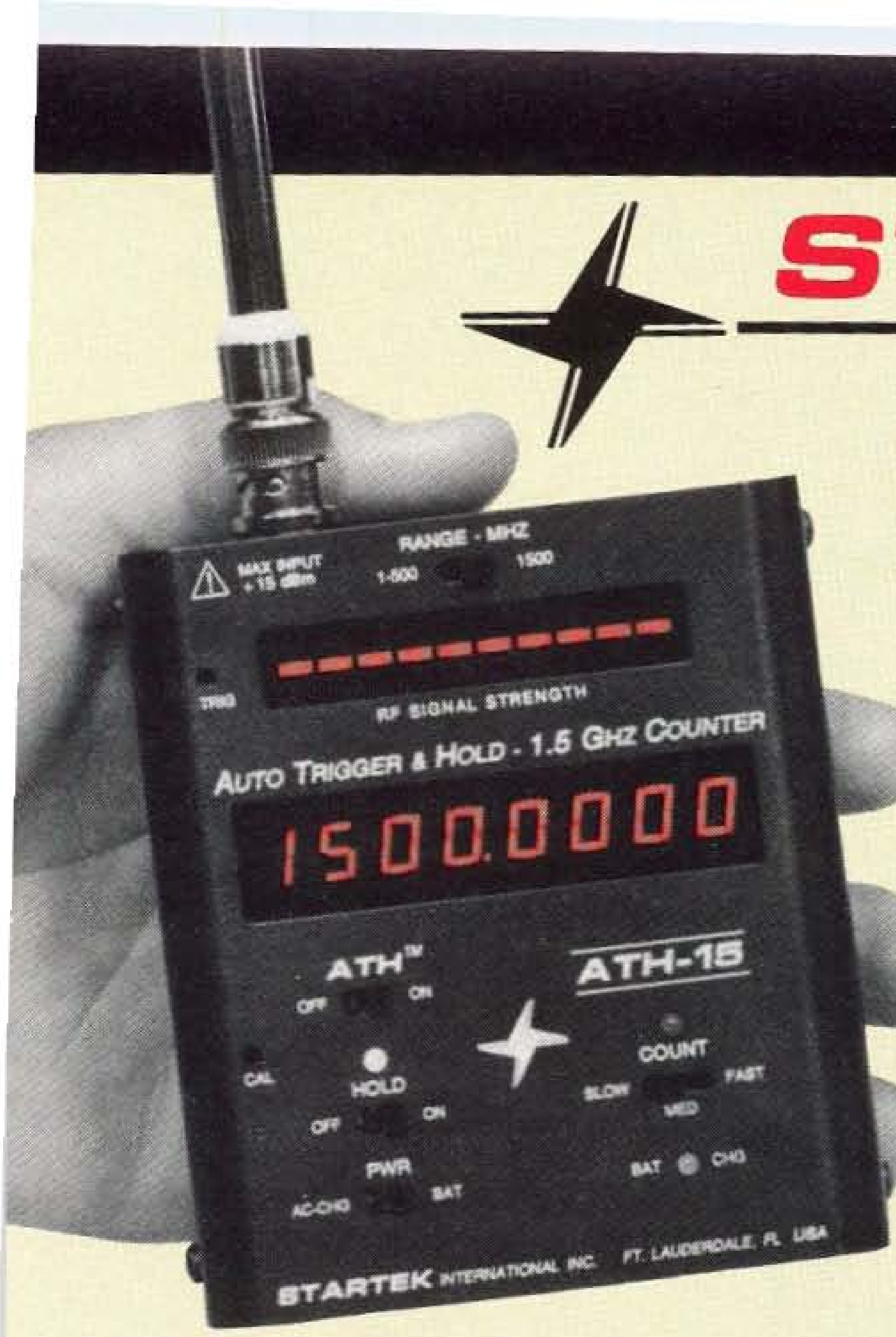

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Reprints: $3.00 per article
Back issues—$4.00 each.
Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

73 Amateur Radio Today

May 1993
Issue #392

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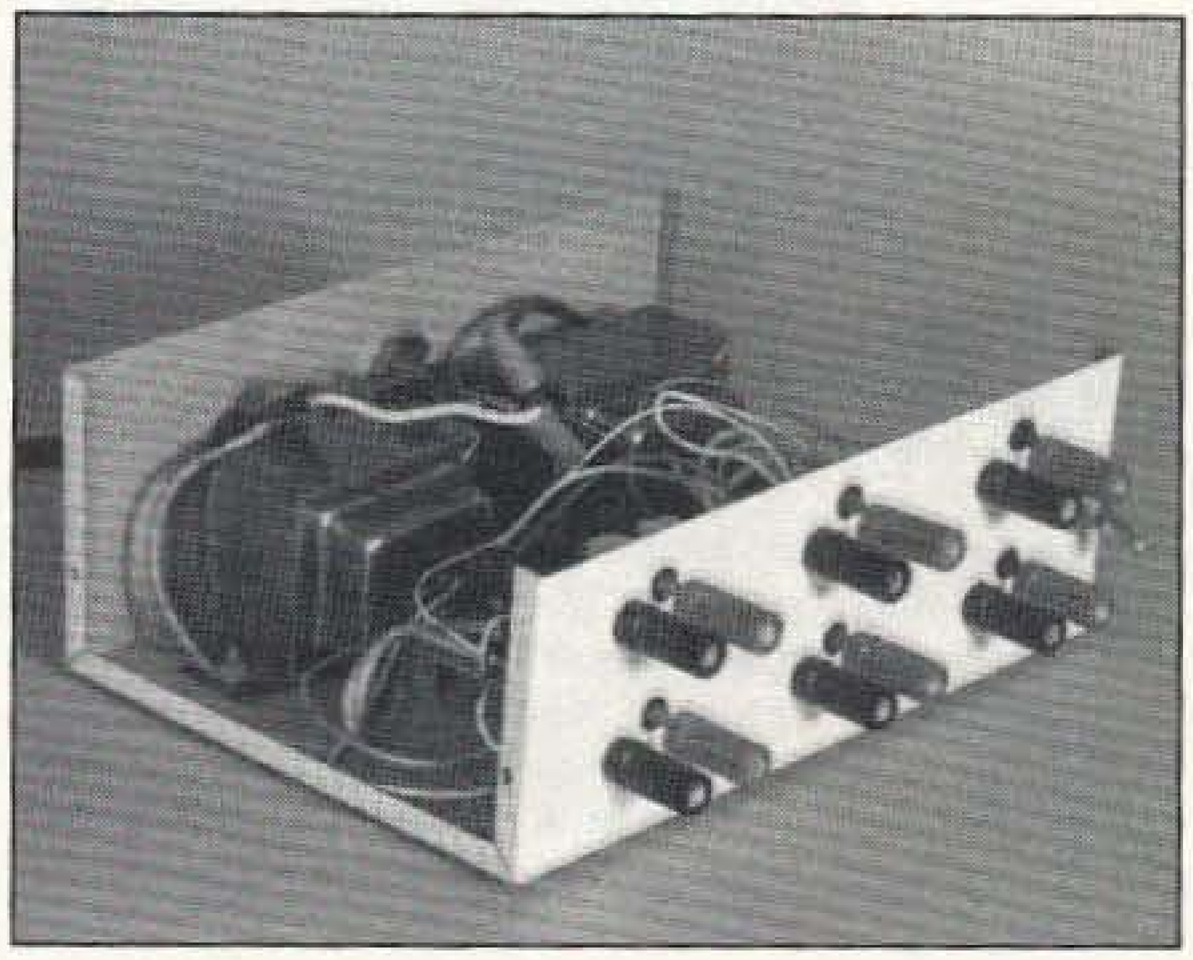

Build this multi-voltage power supply for your test bench . . . see page 30.

FEATURES

REVIEWS

Cover: Coax is the lifeline of most amateur stations. Learn about this wonder wire on page 10. Photo by David Cassidy N1GPH.

DEPARTMENTS

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Contract: When's the last time you built something? The act of reading this question has just legally bound you to an agreement with Uncle Wayne whereby you promise to build at least one project within the next 30 days. In fact, why don't you get together with a few of your buddies and all build the same circuit or antenna? If you build from a kit, go ahead and write a review and send it in. OK . . . What are you waiting for? . . . Get to work!

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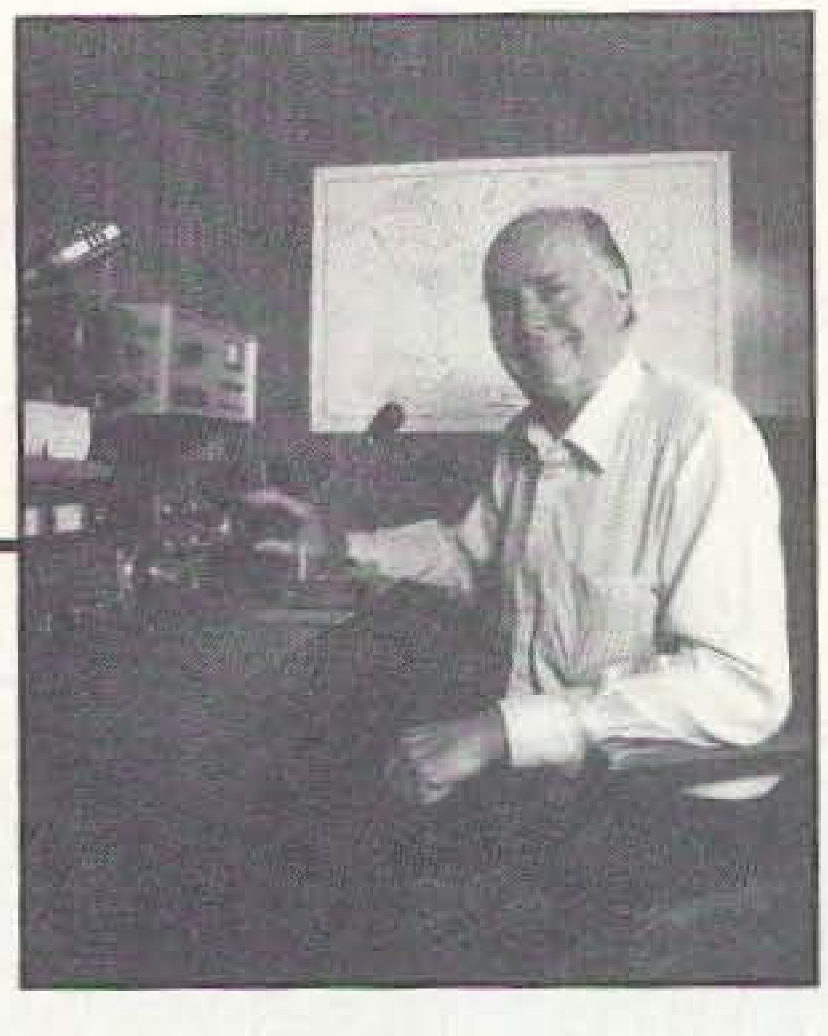

Do You Suppose? Maybe? Naw, It's Impossible No Use Even Trying

There's something that's been puzzling me for ages. Actually, now that I come to think of it, there've been several things that have been puzzling me, and which now make sense. Like how come no one has written any really creative classical music in the last 50 to 60 years? Like how come so many readers tell me they don't always agree with my editorials? Like why we Americans put up with the crooks we've been sending to Washington; our crummy post office; our dreadful schools . . .the most expensive and worst in the industrial world . . . and so on.

I've seen the same pattern in amateur radio, with an infinite tolerance for League mendacity, and of course there's this whole CW nonsense.

Yes, I admit I'm probably part of the problem in that I tend to be much too cautious about speaking my mind. Allen Turoff, the chap who invented the game of Boggle and an old car rally buddy of mine, used to call me Wishy-Washy Wayne because I was so hesitant about expressing my opinions . . . and so insecure in them, once they were pried out of me.

Suddenly several things which have been puzzling me fit together and made sense when I read a book by John Gatto. He's the New York State Teacher of the Year you've probably seen on TV, and his book, *Dumbing Us Down — The Hidden Curriculum of Compulsory Schooling*, is a corker. For the few of you who have survived our school system and actually read, I'll make copies available through Uncle Wayne's Bookshelf.

I semi-survived our public school system, but it so numbed me that it wasn't until I went through a new kind of psychotherapy when I was 28 that I was able to actually start thinking. That's when I started reading and building my library. I referred to this therapy when I described how the mind works in my October 1992 editorial. I'll eventually explain how almost anyone can help others to start thinking and stop just reacting.

John Gatto's book is the most devastating indictment of public education I've seen yet. Oh, we've known for over 10 years that we have one of the worst educational systems in the industrial world . . . which makes up for its terrible results by being one of the most expensive. But what we haven't considered, and what even John Gatto hasn't suggested, is that the end result of this lousy system has been a throttling of creativity and genius, a generally negative approach to new ideas, and a fear of opposing the system.

If you stop and think about it, not only haven't we seen any really outstanding composers in the last 60 years or so, we've also seen a drop in creativity in art, literature, poetry and so on. We've seen a deterioration of the whole country. Now I think I know what's gone wrong.

When I read a book I keep a Highlighter at hand. Well, my Gatto book is an epic in yellow swatches. Unfortunately, since you are a product of our educational system, the chances are that you find books boring, and besides, you know that there's nothing you can do to change things, so why bother. Even so I'm going to make this book available to the few of you who have escaped being totally destroyed by the system and who still have some shreds of interest in understanding what's happened to all of us. It's available from Uncle Wayne's Bookshelf. Once you read it you will want to get copies for what few friends you have who are functionally literate.

What Our Children Are Actually Being Taught

John points out that he teaches seven basic concepts. He teaches confusion by dealing with subjects out of context and not relating them. Curriculums have no coherence.

He teaches class position . . . to envy and fear better classes and have contempt for lower classes and groups. He understands that truth and schoolteaching are incompatible, as Socrates pointed out thousands of years ago.

He teaches indifference . . . that no job is worth finishing, and this is driven home by bells, which stop everything in midstream. Nothing is worth finishing, so why care?

He teaches emotional dependency. Rights do not exist inside a school . . . not even free speech . . . unless the teacher says they do . . . not even to go to the toilet.

He teaches intellectual dependency. Successful students do the thinking he assigns them, with little resistance and a show of enthusiasm. Curiosity causes trouble, so conformity is rewarded. Wait to be told what to do.

He teaches provisional self-esteem. The lesson of report cards, tests and grades is that children should not trust themselves or their parents, but should rely on the evaluation of certified officials.

He teaches that one can't hide. In school there are no private places. Children must be closely watched if you want to keep them under tight control.

He says, "It is the great triumph of compulsory government monopoly mass-schooling that among even the best of my fellow teachers, and among even the best of my students' parents, only a small number can imagine a different way to do things . . . the truth is that reading, writing, and arithmetic only take about one hundred hours to transmit as long as the audience is eager and willing to learn."

Now is it entirely a coincidence that artistic creativity dwindled as public education took hold? It was started in the mid-1800s by a group of socialists, but didn't take over completely until around 1880, when the militia finally forced parents at gunpoint to send their children to public schools. The system grew in administrative bureaucracy and control through the 1920s.

Gatto says, "When children are given whole lives instead of age-graded ones in cellblocks, they learn to read, write and do arithmetic with ease." He points out, "Out of the 168 hours in each week my children sleep 56. That leaves 112 hours a week out of which to fashion a self. Children watch 55 hours of television a week. That leaves them 57 hours a week in which to grow up. They attend school 30 hours a week, use about eight hours getting ready for it and traveling to and from school, and spend an average of seven hours a week in homework, a total of 45 hours. During that time they are under constant surveillance. That leaves them 12 hours a week out of which to create a unique consciousness. If we allot three hours a week to evening meals we arrive at a net amount of private time for each child of nine hours per week."

Gatto suggests that this develops dependent personalities and that this has a lot to do with the things that are killing us, such as narcotics, brainless competition, recreational sex, violence, gambling, alcohol, and the accumulation of things as a philosophy. This is what this brand of schooling must inevitably produce.

The results he sees are children who are indifferent to the adult world, who have almost no curiosity, who have a poor sense of the future, who have no sense of the past, are cruel to each other, are uneasy with intimacy and candor, who are materialistic, and who are dependent, passive, and timid when faced with new challenges. Is it any wonder that he says we don't need more schooling, we need less? He believes that education should make you a unique individual, not a conformist.

When I see teenagers with the knees out of their jeans I know I'm looking at conformity-driven kids who have been so brainwashed they're unable to think for themselves. When I get letters from readers who tell me they don't always agree with what I write I know I'm dealing with someone who has never learned to think. No, I don't mean everyone has to agree with everything I write. If that's your reaction, it proves you don't get it . . . and may never "get it." When someone disagrees with me I expect the honesty of them telling me what they don't agree with and what information they have to substantiate their opinion.

It is rare that I meet survivors of our school system who think positively. The normal reaction to ideas is to come up with reasons why they won't work. These are usually emotion-driven, not logic- or thought-driven.

I have to admit to being frustrated by the infinite capacity of the American people to accept the screwing the government is giving them. They may grouse a bit, but are terrified if there's a suggestion that they might be quoted. They are annoyed at the massively crooked Congress they've elected, yet they just re-elected 93% of the incumbents. They watch the exposés of graft on TV with passive frustration. They are annoyed by the $500 billion savings and loan fraud, which Congress abetted, the billions stolen from one government agency after another, the billions wasted by the military, the lousy performance of the post office, our schools, our health care system, and our inability to deal with welfare, crime, drugs, and so on. But *do* anything about it? No way!

In amateur radio we have the mindless support of CW. You're just lucky that I am so circumspect about what I think and don't come right out with my opinion. Yes, I know all the rationalizations for CW. I've been hamming for over 50 years, so you have no news for me. Yes, I know CW is fun, I never said it wasn't. And yes, I know you feel

Continued on page 80

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LETTERS

Number 2 on your Feedback card

From the Hamshack

Dan Sealy AA7OA, Astoria OR Wayne, I have been reading your editorials and responses to our letters for some time, and now I think it's time to respond.

I usually agree with you on most issues. I would, however, like to give you my two cents worth.

First, I don't agree with your constant lambasting of the ARRL. Almost every *73* issue has something bad to say about that organization. Most *QST*s don't even mention *73*. Now, I don't for a moment believe that the ARRL is fairly and equally representing the interests of amateur radio, nor do I blindly agree with much of their policy. I do think that theirs is a case of absolute power corrupted absolutely. I am a member of the ARRL not because I swallow everything the organization says and does without question, but because I at least want to have a vote in how the organization evolves. My vote may count very little in the ARRL scheme of things, but at least I have the right to complain.

For example, you frequently write of the failure of the "incentive licensing" program. I don't think that it has failed at all. I don't think that it is as much of a success as the ARRL would like everyone to believe, but the system does work. I have been a ham for just under two years. When I started, I earned my Technician with HF license. As my involvement with amateur radio grew, I came to realize that the real ticket to amateur radio was access to the HF bands (at least for now). The incentive to upgrade was real and compelling.

I have no problem with a class system for the licenses. If someone wants to be able to use a particular frequency, then work a little and get the appropriate license. It isn't that hard. You have said in many editorials that there is a great big world out there just waiting for some entrepreneur to come along and reap the harvest. I don't think that you meant that one doesn't need to work to achieve those rewards. The world today includes too many who believe that the world owes them a living, and that it isn't necessary to work for what you want.

You constantly write about the elimination of CW in favor of the modern digital modes. Why? What is wrong with CW? If it serves no other purpose than a "rite-of-passage," so be it. There isn't anything wrong with that. Almost everything we do has some form of the rite-of-passage: work, school, sports and others. Few people start out in the job market as supervisors or managers. We work for it. The old-timers usually watch the new kids do the dirty "grunt" work. We work hard to graduate from school. Along the way we might learn old, outdated material that serves no immediate purpose. The new player on the football team usually warms the bench for the more experienced players.

I have come to appreciate CW as another mode, but I don't think it is the "end-all," "be-all" of amateur radio. Sure, it's old, but so are Model T's and antique airplanes, and I know several who would pay dearly for both. It isn't fast, but it is reliable. You don't need a $500-to-$5,000 computer, TNC, and radio to make it work. You can get on the air for very, very little money, and communicate all over the world.

Finally, your statement in the February issue that amateur radio "is a government sponsored entertainment medium" is probably true, but the part about our frequencies being worth "tens of billions of dollars" is false. Sure, some of our frequencies (mainly above 6 meters) are valuable to commercial interests but, with the exception of shortwave broadcast stations, no other commercial interest would put up with the uncertainties of propagation, fading, solar flares, and other conditions which make HF only fairly reliable. Besides, as you stated, the advent of cellular telephones has made our frequencies even less valuable to commercial interests as a communication medium.

By the way, *73* is the only amateur radio magazine I subscribe to, other than receiving *QST* as part of my "membership."

Dan, your memory is in trouble. There's little connection between the 1964 Incentive Licensing debacle, when the ARRL destroyed the entire American amateur radio manufacturing industry, and the current licensing system. Your memory is also in trouble on CW, which I've never proposed eliminating. I've always been a champion of using CW for fun. You sure have a way of thinking in terms of straw men and then demolishing them. I never suggested our HF frequencies are worth billions. Millions, yes. It's our completely unused microwave allocations that are priceless, as I've emphasized many times . . . Wayne

David J. DiCenso WB1CDG I have been reading your magazine for years (since about 1978). I have been pleased at the consistency of the magazine and the enthusiasm about the hobby that is evident in the pages of *73*.

The most useful and exciting column that you have offered is Mike Bryce's "QRP" column. That column is the first one that I turn to when I pick up your magazine. Thanks to Mike Bryce's column, I have dusted off my soldering iron and have become an active builder again. His column's schematics and information are always useful and very helpful. Often when I discard old issues of *73*, I make it a point to save the "QRP" column.

Randall M. VanVoorhis KD4DWF, Killeen TX Several months ago you printed a letter of mine mentioning a questionable hard-core push for interesting newcomers in the hobby. The letter got many responses, from "Why did you go and give our club a bad rep?" to "Pretty good," and "Not bad."

Since then I have joined the Air Force and moved from Memphis to Killeen, Texas (aka Ft. Hood Army Installation). Upon my arrival in Killeen I turned on my radio and put out a call and was immediately greeted by Frank N2HNU. After speaking for a while, we exchanged 73s and QRT'd. Later that evening, having received a Poor Man's Packet modem from a friend back in Memphis, I tried to get on the air. Because I had no prior packet experience I gave Frank a quick call to ask some questions. After he spent almost an hour trying to help me over the phone, he gave me the number of the local packet guru. Both calls were toll calls.

We finally got my station up and running. After several packet contacts I ended up on voice with three "local" hams. We chatted and I got to know about them and the area and they got to know a bit about me. These contacts resulted in my getting to know some of the locals, becoming familiar with the different repeaters, and receiving an invitation to join the Temple ARC.

This is another fine example of the hospitality that makes me like to associate with hams. I still have only my No-Code Tech license. I guess I'll get your 20+ wpm tape and upgrade. It's not that far to Extra.

I am a big W2NSD fan and support you 100%. I make a point of mentioning *73* every time I contact one of your advertisers and for your new advertisers, I usually circle their Reader Service number and, of course, in any further contacts *73* is mentioned.

Your point about the audit is a very valid one and I hope the advertisers do take note of your outcome and request an audit of the other publications they may advertise in.

Being in a big state like Texas and close to several "major" cities, I was wondering if you have any plans to attend a hamfest so that I can meet you face to face and shake your hand for all of the excellent work you are doing, not only in ham radio but also in the circus ring called politics.

Randall, I hope your last letter got those cretins to stop and think about their antisocial behavior. We don't need hams like that.

Texas? I don't remember anyone asking me to come down for a hamfest recently. Oh, I don't blame 'em . . . I'm probably pretty dull these days, more interested in talking about getting our country fixed than in amateur radio minutia . . . even though a big part of my proposals entail generating a million or two new young hams . . . Wayne

Chet Smith WB2LUQ, Verona NY 13478 I want to state that I, for one, think the space utilized in *73* for your editorials is put to good use. I've gotten many a good laugh out of some of the responses to your observations. There are, naturally, some of your views that I disagree with. For instance, the idea that everyone who is anyone should have more than adequate supplies of cash to pursue any and all aspects of amateur radio. Also, your less than enthusiastic view on the issue of AM operation. Actually, I see these two points as somewhat related. When I started out, I was still in high school and cash supplies were limited, to say the least. So I went ahead and got my Novice license, and got on the air with a used rig that did have facilities for AM operation. So, not surprisingly, when I upgraded some months later I was able to, and did, get on AM. There were some local guys here who were on so we did make a go of it. No, I'm not on at present, but I do have an old Heath Apache/Mohawk combination that I fully plan to get on with good audio, as far as I can tell. And most AM stays on or near certain agreed frequencies, much like RTTY ops and other alternate mode operators. I simply think that not everybody necessarily has a couple of thousand dollars floating around to use in pursuit of their hobby. I certainly wasn't in that category when I started out, and I'm sure I wasn't the only one.

There's a lot of truth in what you've mentioned from time to time about operating from the other end, getting on from other countries. I came back from over four years in the Marshalls a few months ago, so I have been experienced in that regard. There are all kinds of different clubs on the island, but KX6BU (Kwajalein Amateur Radio Club, now V7BAX) is the oldest established club there, and had its origins soon after WWII ended.

Over the years I've had some interesting experiences operating at some other club stations' facilities. When I was in the Navy (from 1981 to 1987) I was fortunate to be able to operate from K9NBH, and later from WA4ECY. The club at K9NBH was pretty much defunct, but ECY was a pretty active group. To get back to one of your points, though, I am sure that reviving club stations at high schools and colleges would help immensely, not only in getting more hams, but also in helping us with our sad deficiency in American engineers and techs. I know that I'm not alone in saying that I would have enjoyed school a whole lot more if we could have had some sort of facility at the school. 73

QRX . . .

Unlicensed Ham Operator Heading Back to Prison

The only amateur radio operator ever to be imprisoned for illegally transmitting on ham radio is headed back to the pokey. Richard A. Burton, 48, of Harbor City, California, was sentenced to prison on Monday, February 22, for talking on his 2 meter radio without a license. He used to be WB6JAC.

Burton has a long history of repeated amateur radio violations going back more than a decade. The FCC initially revoked Burton's ham ticket in 1981, but that didn't keep him off the amateur air waves. A 1984 federal court found him guilty of transmitting on the ham bands without a license . . . and using obscene language.

The obscenity charge was later overturned but the license revocation continued. He was sentenced to a four-year federal prison sentence which was later reduced to six months, to be followed by a five-year probationary period. He served the sentence at the Lompoc (California) federal detention facility; the probation was over in 1989. In 1990, Burton was once again monitored on the 2 meter band and convicted of operating without a license. This time he was ordered to undergo therapy.

Last summer, Burton was again cited for making several illegal unidentified 2 meter ham radio transmissions after the Los Angeles FCC Office tracked his broadcasts to a Redondo Beach address. He pleaded innocent and was ordered to return to federal district court for jury trial last November.

On December 1, 1993, Richard Burton was convicted on all four counts of operating an amateur radio station without a license. This was his third conviction. He could have received up to a two-year prison sentence and a $10,000 fine.

After the prison sentence, Burton must undergo psychological counseling and perform 500 hours of community service. *Los Angeles Times* writer Bob Pool quoted Burton as saying, "I think I need to get myself another hobby." *TNX W5YI Report, Vol. 15 Issue #6, March 15 1993.*

Fake Distress Calls

As part of a plea bargain arrangement, Jorge Mestre NS3K of Fairfax, Virginia, has surrendered his amateur Extra class license and must dispose of his ham radio equipment within 60 days. Mestre pled guilty to willfully making fabricated 20 meter distress calls last summer on 14.313 MHz. The SOS supposedly involved a sinking ship located in the West Indies. Ham operators notified the Coast Guard and the FCC. The massive search and rescue effort cost the Coast Guard more than $100,000. Mestre has agreed to make $50,000 in restitution.

The prank distress calls were traced to Mestre through the efforts of the FCC's long-range direction finding network, computer analysis of tape recordings, and "signature print" comparison tests on Mestre's equipment, which was later seized on a federal search warrant. He will be sentenced on May 7th and faces six years in prison and a $250,000 fine. *TNX W5YI Report, Vol. 15 Issue #6, March 15 1993.*

TV Series Coordinated on the Ham Bands—Producers Leased Radios From Commercial Firm

During mid-February, a Fort Worth, Texas, amateur scanning the amateur 420 MHz ham band came across transmissions that didn't sound like ham radio. They sounded like unidentified business communications. He called the FCC and retransmitted the signals over a local repeater so the FCC in Dallas could hear them. An engineer was later dispatched to Fort Worth to investigate. The operation was located through close-in direction finding techniques.

It turned out that Cannon Television, Inc., of Irving, Texas, and a West-Coast-based television crew had rented 36 Motorola P-200 handheld radios to direct operations for "Walker, Texas Ranger"—a television series being produced in downtown Fort Worth, starring actor Chuck Norris. The problem was that the radios were apparently unlicensed and were programmed to operate on 443.0125 MHz and five other nearby frequencies in the 70 cm ham band.

The Dallas FCC Field Office issued a *Notice of Apparent Liability for Forfeiture* (an FCC administrative fine) in the amount of $8,000 against Cannon Television, Inc., for operating unlicensed radio stations.

The radios were apparently labeled with the proper business band channels but were programmed to operate on the ham bands in between simplex 70 cm frequencies. The television series' producer, Bob Hargrove, said he knew nothing about the legalities of "radio"—only that he routinely rents them all over the United States for shooting on location. "We had someone fly in from Houston that night to reprogram the radios," he said. "Delt Communications (the Houston company that rented out the radios) is also confused as to what went wrong. These same radios were used on two Oliver Stone movies here—and numerous other pictures. No one has had a problem." *TNX W5YI Report, Vol. 15 Issue #6, March 15 1993.*

FCC Issues $10,500 Fine for Malicious Interference

The FCC has handed a ham a record $10,500 Notice of Apparent Liability to Monetary Forfeiture. The fine was issued to Richard L. Whiten WB2OTK of Taylors, South Carolina, for what the FCC called "malicious interference to the communications of other ham radio operators." The operators the FCC says Whiten interfered with are Michael Galego KA4MUJ of Ft. Lauderdale, Florida, and Judith Duehring KA1SKV of Maynard, Massachusetts. Galego and Duehring are publicly avowed followers of the anti-service net "Better Amateur Radio Federation," headed up by convicted felon Herbert L. Schoenbohm KV4FZ.

The FCC's Kingsville, Texas, office says it monitored and recorded a conversation on the frequency of 14.314.7 MHz on September 26, 1992. According to the January 19th NAL, Whiten did not dispute making the cited transmissions but did deny that they "constituted willful and malicious interference." Whiten told the FCC that, "if [he] had truly wanted to willfully and maliciously interfere [he] could have done so to such an extent that communications between other amateur radio operators would have been impossible."

But the FCC Engineer-in-Charge Oliver K. Long, who issued the fine, looked at this as a simple case of Whiten interfering with other amateur communications, that Whiten has in writing admitted his guilt, and that he therefore is subject to the administrative penalty as prescribed. The notice says that the base amount of the fine is $7,000 but that it has been adjusted upward another $3,500 dollars because of what EIC Long says is Whiten's "repeated violation of rule 97.101(D)."

The FCC gave Whiten 30 days (from January 19) to either pay the fine or file a petition for reduction or non-imposition of the penalty. In a telephone interview on January 24th, WB2OTK told the Amateur Radio Newsline that he has no intention of paying the forfeiture and plans to hire a Washington, DC, attorney who specializes in communications law to fight the matter through the administrative appeals process, and if needed, into the federal court system. *TNX Westlink Report, Number 643, February 18, 1993.*

More Fines for Malicious Interference

The FCC has issued another Notice of Apparent Liability, this time for $2,000 against William A. Moskowitz KA3HSZ of Plano, Texas.

The FCC's Vero Beach, Florida, office issued the notice on January 14 after having monitored Moskowitz on November 26th of last year. The NAL says that during a 17-minute period, the government observed him changing operating frequency twice in the vicinity of 14.313 MHz, "in order to interfere with ongoing communications."

"The violation was willful," the FCC said.

The public notice also said that the Commission is "treating this as a minor violation." Since Moskowitz is an individual, because of the nature of the violation, and because it is a first offense, the Commission set the fine at $2,000. The FCC's base forfeiture for malicious interference is $7,000.

Moskowitz has the usual 30 days to pay the fine or appeal it. *TNX Westlink Report, Number 643, February 18, 1993; ARRL.*

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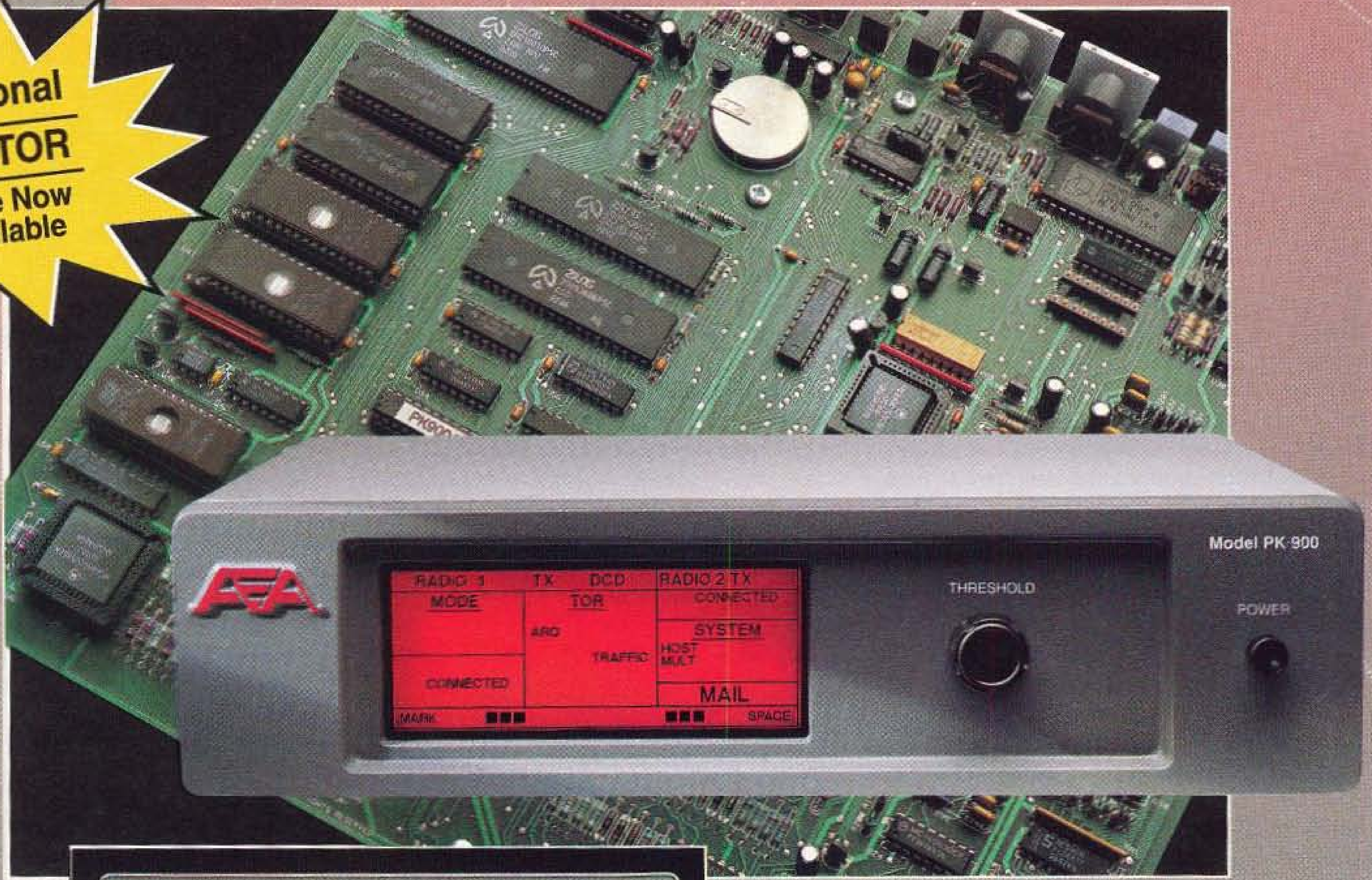

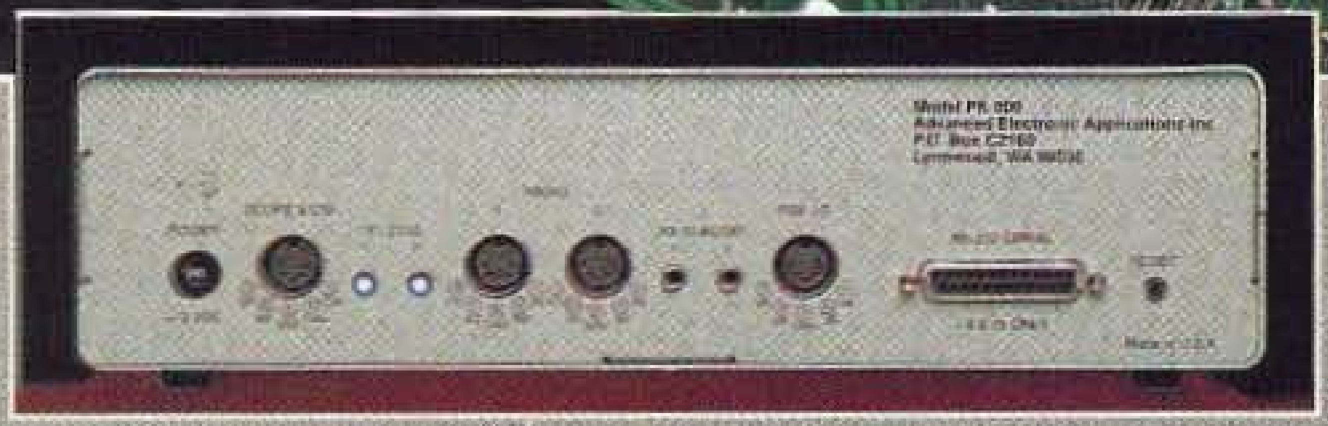

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The Hows and Whys of Coaxial Cable

How to select the most appropriate kind for your need.

by Steve Katz WB2WIK/6

Hams have used coaxial cable for transmission lines almost since its invention nearly 50 years ago, but many don't know why or how this trend started. Although much has been written on the subject, I'm frequently startled to hear so much misinformation chatted about on the ham bands, even by old-timers who should know better. Perhaps this article will help newcomers and old-timers alike clear up misconceptions and make more educated decisions regarding this important piece of station apparatus.

Why Coax?

Why do we use coax, and why is most of it 50 ohms nominal impedance?

This is the best question anyone can ask. Before there was coaxial cable, amateurs and professionals alike used primarily open-wire transmission lines, typically in the 300 to 600 ohm nominal impedance range. Sometimes they used no transmission line at all—they just directly fed antennas with a single piece of wire. In the latter arrangement, the connection wire became part of the antenna system itself, and radiated along with the antenna. The drawback to this scheme was that the connecting wire's orientation would play a critical role in antenna performance, and often a high-voltage point would appear right at the antenna connection to the transmitter, creating both RF interference and even possibly fire hazards when the wire would come in proximity to combustible materials.

Open-wire "balanced feeders" helped solve some of these problems. Because the currents in the feeder wires were balanced (assuming a well-balanced load, or antenna), feedline radiation was minimized and the RF field contained to a very small area around the wires. By orienting the feeders perpendicular to the intended antenna field, antenna radiation pattern distortion would also be minimized and antennas could be better optimized. Open-wire "balanced feeders" were also a natural for connecting vacuum-tube push-pull amplifier circuits to balanced antennas without the need for complex matching networks. Tube amplifiers are normally high-impedance devices whose output impedance is roughly equivalent to the plate voltage divided by the plate current of the output stage. Thus, a tube amplifier with 1,000 volts on the anode, drawing 500 mA anode current (this is a 500 watt stage), would have a plate load impedance of about 2,000 ohms. Matching 2,000 ohms to a 600 ohm open-wire feeder connected to a 600 ohm balanced antenna required only a transformation ratio of 2000:600, or 3.33:1, which was easily achieved by a very simple, low-loss "link output" circuit.

The problem with open-wire lines, and

> ***"Coaxial cable solves a great number of problems and that is why it is used so universally in amateur as well as non-amateur communications systems."***

"twin-lead," which is identical to open-wire except that the dielectric (spacer insulation) is a continuous strip of material (such as polyethylene), is that they are adversely affected by conducting objects in close proximity to them. They cannot be taped or otherwise directly attached to metal towers, masts or antenna booms, and even water, snow or ice laying on them dramatically increases their losses. Twin-lead and open-wire feedlines must be carefully insulated and spaced from all surrounding objects and cannot be directly buried beneath the earth. Besides all this, they still radiate to some degree, especially if terminated in any kind of unbalanced load. And, although the current in high-impedance feedline is lower than it would be in lower-impedance (coaxial) cable, making IR (ohmic) losses lower, voltages are much higher, to the point where exposure to living organisms (like people!) can be deadly hazardous. For example, if someone were running the amateur legal-limit power level of 1,500 watts PEP output and using a 600 ohm antenna and feedline, the voltage across the feedline would be 948.68 volts (calculated by the formula: $E = \sqrt{P \times R}$

This is quite a lot of voltage and is considered by all authorities to be extremely hazardous.

Coaxial cable to the rescue! Coaxial cable is self-shielding and, if well-made, does not radiate at all when properly terminated in a matched load. Since the outer conductor (shield) normally operates at ground potential, coax can be secured to all sorts of objects, including tower legs, metal masts and booms, and almost anything else that comes to mind, making its installation extremely uncritical. If the coax has the proper outer jacket material, it may be buried beneath the earth for many years without degradation. Coax is unaffected by the presence of water, snow or ice. Although the nominal impedance of coax is lower than open wire line and it therefore has higher IR (ohmic) loss, its lower impedance allows direct power transfer to low-impedance antennas (a half-wave dipole in free space, for example, looks like 70 ohms) and keeps the voltage across the feedline and antenna connection points to a safer level. A 1,500 watt PEP output transmitter connected to a 50 ohm antenna will have only 273.86 volts across the feedline—still a somewhat hazardous level, but about one-fourth that obtained using a 600 ohm system. Because coaxial cable's working voltage is quite low, its insulating dielectric material may be optimized for minimal loss, rather than maximum insulation resistance.

Why 50 Ohms?

Clearly, coaxial cable solves a great number of problems and that is why it is used so universally in amateur as well as non-amateur communications systems.

"Why is most coaxial cable 50 ohms nominal impedance?"

This can best be answered in two parts: (a) Coax isn't all 50 ohms, but commonly runs from 30 ohms to 90 ohms, and sometimes even a bit higher when called for. Impedance selection is very application-dependent. (b) 50 ohms represents an excellent compromise between the lowest possible transmission

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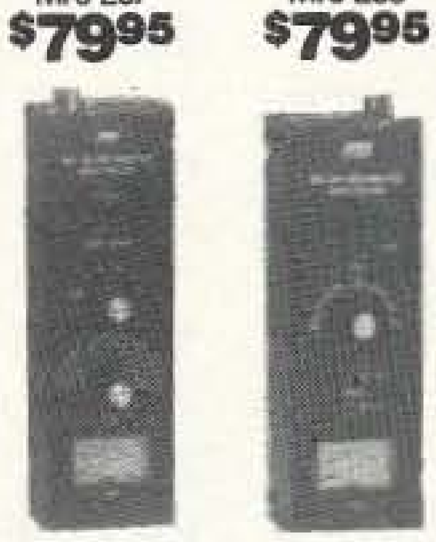

MFJ revolutionary new SWR Analyzers give you a complete picture of your antenna SWR over an entire band -- without a transmitter, SWR meter or **any** other equipment. Just plug your antenna into the coax connector, set your SWR Analyzer™ to the frequency and read SWR off the meter. You can find your antennas true resonant frequency right at your feedline -- something a noise bridge can't do. Battery operated and handheld sized -- makes it **soooo easy** to work on antennas. MFJ-207, 1.8-30 MHz; MFJ-208, 142-156 MHz. 9V battery or 110 Vac with MFJ-1312, $12.95.

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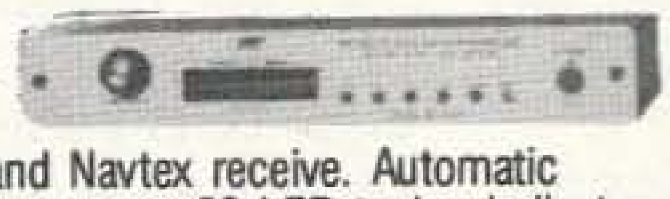

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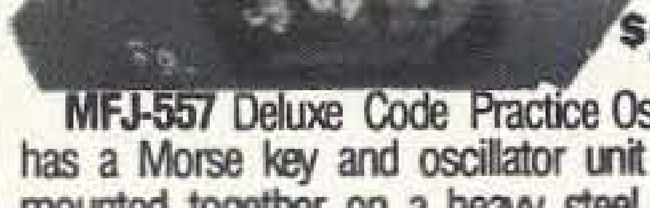

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loss, which occurs at 70 ohms nominal, and the highest possible power handling capability, which occurs at 30 ohms nominal. Because of these factors, 50 ohms was settled on as the best all-around impedance for the widest variety of applications. To this day, 70 ohm cable is used almost exclusively in receive-only applications where no power transmission is required (such as cable TV systems).

Cable Specs

If 50 ohm coax is the best thing to use, I guess I should buy a big roll of RG58/U and use it everywhere. Isn't that right?

Yes and no. RG58/U might be great stuff, but again, most choices in life are application-driven and one needs to consider the specific use before making an intelligent cable selection.

First of all, what do the "RG" numbers mean? Well, these indicate that the cable is *registered* (simply a matter of someone spending the money and filling out a few forms). Cables which are truly RG-XX-/U are also "mil-qualified," which means they are certified for lot compliance with MIL-C-17D, the general military specification for wire and cable, and manufactured in a qualified facility. The two- or three-digit number after the "RG" prefix means absolutely nothing by itself: You need to refer to MIL-C-17D to see exactly what the cable designator means. The numbers are arbitrarily assigned in numerical order, from 1 to infinity, and only tend to indicate the age of the product's registration. For example, RG8/U is a much older product than RG213/U, which is essentially identical except that RG213/U is a *QPL* (MIL-C-17D qualified) product, while the older RG8/U no longer is, having been replaced by the newer part number. Many amateur coaxial products are not mil-qualified at all, but might still be imprinted and sold as "RG" products. Usually, if these are identical to mil-spec cables but are simply not qualified, they will be labeled with the word "TYPE" after the part number: For example, Belden 9913 is "RG8 TYPE" cable but is not RG8/U. Other non-qualified products might simply leave off the "/U" suffix, such as "RG8X" or "RG8M" mini-8 cable. Admittedly, it's all a bit confusing.

How to Choose

Since most of us will be using 50 ohm cables in our stations, the most important parameters to consider in making product choices include: (a) transmission loss; (b) power handling capability; (c) flexibility; (d) availability of standard and reasonably-priced connectors; and (e) resistance to weathering and ultraviolet (UV) exposure. These parameters vary in importance and not necessarily in the order I've listed. Again, the selection is and should be application-dependent. Oh, yes—I've almost forgotten the most important parameter for many hams: COST!

In general (but not always), the larger diameter the cable is, the lower its loss will be at any given frequency. This is because the leading contributor to transmission loss is the ohmic resistance of the conductors, which are usually copper, and the larger the cross-section the conductors have, the lower their resistance will be. But if loss were based on conductor size and ohmic (DC) resistance alone, coaxial cable would have the same loss for a given length at all operating frequencies, from DC to microwaves. That is *not* the case.

There are two other factors that enter into the RF loss equation (and they do not apply to DC circuits). One is a property called "skin effect," which assumes that AC (and RF) currents will flow only in the outermost surface of any conductor and therefore conductors could be hollow (with no center core at all) and be just as effective as solid conductors for any given diameter. The other is dielectric (the spacing insulation between the center and outer conductor) loss, which increases directly with operating frequency for most commonly used dielectric materials. The "skin depth" of a conductor becomes more and more shallow as the RF frequency is increased, meaning that a more and more shallow region of the conductor is used as we work our way up the spectrum. This means that a given conductor will have loss that increases with frequency, as less and less of the conductor is actually used.

"It pays to select coaxial cable which has commonly-available, reasonably-priced connectors that will fit."

There is a third factor that applies mostly to *flexible* coaxial cables (the most-used kinds in ham stations), and that is radiation loss, which also increases directly with frequency as the outer conductor, which is made of braided materials to add flexibility, becomes a less effective shield for containment of RF energy. Solid outer-conductor cables (semi-rigid, rigid, "hardline," etc.) typically don't suffer radiation losses.

The bigger the cable is in diameter, the more power it can usually handle, since the conductors will have less loss and thus dissipate less power (generating less heat) and the insulating materials tend to be thicker, too, sustaining higher operating voltages. An exception to this general rule are the Teflon dielectric cables, which have great power handling ability even when small in overall diameter. This is because Teflon can withstand much greater heating than normally-used insulating materials, like polyethylene, and it has a higher dielectric withstanding voltage for a given thickness. This is *not* to say that Teflon cables are superior to standard polyethylene ones—they are not, except as regarding power handling for a given diameter. In general, Teflon cables are actually *inferior* to standard polyethylene-insulated coax in almost all other respects because Teflon has a high dielectric constant, creating the need for smaller center conductor size (for a given nominal impedance) and increasing dielectric losses. An example of Teflon coax is RG400/U, which is about the same size as RG58/U but will withstand more than 10 times the power; however, RG400/U actually has *more* transmission loss than standard RG58/U and costs about 10 times as much!

Throughout the HF spectrum, hams use "UHF" or "PL259" type connectors almost exclusively because commercially-made gear is already fitted with their mating receptacles (SO239) and they are good, high-power, inexpensive fittings that are very useful through 144 MHz or so. However, on 220 MHz and above, the connector of choice is the Type "N," which has a variety of military designators, mostly UG21D/U. The Type "N" connector surely costs more than the "UHF" PL259 type, but is actually easier to install and is a far superior connector throughout the VHF/UHF/SHF spectrum. In fact, some Type "N" fittings work well through 12 GHz (12,000 MHz)! For smaller cables, both PL259's with appropriate "reducers" (type UG175/U and UG176/U for RG58/U and RG8X types), Type "N" and "BNCs" are commonly used. BNCs are very good fittings through the UHF and SHF spectrum and, when properly installed, have no measurable loss at 1 GHz. However, because of their mechanical frailty they are best used with small-diameter cables like RG58/U, RG174/U and so forth.

In any case, it pays to select coaxial cable which has commonly-available, reasonably-priced connectors that will fit, or you may find yourself with $5 worth of cable that will require $200 worth of connectors to attach to anything. The "standard" ham coaxial lines (RG58, RG8, RG213, even RG217 and RG17 for those with the budget and need for giant-sized cables) all have readily-available and reasonably-priced fittings. Probably the only caveats in the market are "surplus" cables which cannot be readily identified and "hardline" cables, which do require special connectors that can sometimes cost a small fortune.

Beware of double-shielded coaxial cables! These are often found on the surplus market and, while they might be wonderful in many respects, they can be difficult to use, to flex, and to find connectors which fit. For example, the double-shielded version of RG213/U is RG214/U. These two cables have exactly the same electrical properties, the same transmission loss, and so forth, but the double-shielded type will *not* fit a conventional connector which is intended for single-shielded cable. Why would anyone want double-shielded cable? For very specific and demanding applications, where a few dB of additional shielding is very important. Connections within full-duplex repeater systems come to mind as a good application. If you don't own a repeater, there's no reason I can think of to use double-shielded cable. It's generally more trouble than it's worth.

CIRCLE 191 ON READER SERVICE CARD

Specific Questions

After contemplating all of this confusing information, what in the world should I use to feed my 40 meter dipole?

Great question! That's getting down to specifics. Unless you intend to run the legal power limit (1500 watts PEP output), I'd usually recommend RG58C/U (for runs up to 50' long and power levels below 400 watts PEP) or RG8X (for runs up to 150' long and power levels below 1000 watts PEP). These are both very flexible, lightweight cables which will exhibit very low loss on 40 meters in the lengths I've specified, and their only restriction will be power handling. For legal-limit power, I'd recommend RG213/U, which is heavier and less flexible, but will withstand 1,500 watts all day long.

What about feeding my 2 meter beam?

Another great, specific question. The only question I'd ask in reply is, "How long will your feedline need to be?"

For lengths less than 50 feet, RG8X is a good, general-purpose cable for 2 meter use. A 50-foot run will have about 2 dB loss, which is not too much for most applications (like working FM repeaters and such), but might be excessive for demanding applications like SSB/CW weak-signal work where every dB counts. For lengths up to about 100 feet, RG213/U is a great choice. It will lose about 2.4 dB or so in a 100' run. For lengths beyond 100 feet, or for more demanding applications, I'd recommend Belden 9913, which is the same o.d. (outside diameter) as RG213/U but has somewhat lower loss, about 1.3 dB per 100 feet at 144 MHz. The drawback to the 9913 is that it is far less flexible than RG213/U and does not fit a standard Type "N" connector; however, special connectors for 9913 are available and don't cost much more than the standard ones. For very long runs, or highly demanding applications like EME (moonbounce, where every tenth of a dB starts to count) or full-duplex repeater installations, 1/2" or larger "hardline" or Heliax is most commonly used.

I'd like to use a single feedline to connect my 146, 222 and 440 MHz FM antennas at home, using a "duplexer" at each end of the line to separate the signals. Any problems with that? What should I use?

There's no problem doing this, as long as you use high-quality "duplexers" (I'd prefer to call them signal-splitters, which is what they really are) on both ends, and remember to make the topside one, which will be exposed to weather, very waterproof. There are some multiband signal-splitters on the market which have almost immeasurably low loss (less than 0.5 dB) and will handle 150 watts or so. Since you intend to use the coax on 440 MHz, where losses will be the highest, I'd recommend RG213/U for short runs up to 50 feet or so, then Belden 9913 up to 100 feet, then commercial "hardline" or Heliax for runs longer than 100 feet. Bear in mind that the "hardline" types cannot take repeated flexing, are quite inflexible to begin with, and require specialized, costly connectors. But properly used, it's great stuff.

I have a 10-15-20 meter triband beam on a 70-foot tower located 150 feet behind my house. What do you recommend for coax to feed this system?

I'd probably recommend RG217/U or RG17/U in this case, and I'd bury it underground to get to the base of the tower. It will have minimal loss and is very high quality cable. Connectors are readily available (although they have a larger back end than connectors for RG8-sized cables and are not interchangeable), at least for Type N, and adapters can be used to mate with UHF fittings if necessary. Of course, you could save a lot of money by using standard RG213/U, but since you'll need nearly 250 feet of it, this stuff will begin to get lossy at 28 MHz. It's a matter of balancing your appetite for performance against your budget and trying to make the most educated decision possible.

"Properly-installed coaxial connectors have losses too low to measure if they are used in the spectrum for which they were intended.

I've heard that coax connectors all have loss, and every time you use one, you're giving up a dB or so. Is this true?

Not at all! Where in the world did you hear this gibberish? While everything has *some* loss in this imperfect world, properly-installed coaxial connectors have losses too low to measure, even with the world's most sophisticated laboratory equipment, if they are used in the spectrum for which they were intended.

A "UHF" connector, say type PL259ST, which implies a silver-plated connector with a Teflon dielectric (the best kind to use because they solder so easily and resist soldering heat so well), used at 28 MHz will have less than 0.01 dB insertion loss when mated to an equivalent receptacle. Similarly, a UG21D/U Type "N" connector, properly installed and mated to its equivalent receptacle, will exhibit less than 0.05 dB loss at *500 MHz!* This a whale of a lot less than 1 dB loss. The problem is, many amateurs don't know how to install connectors properly, and probably do end up with more loss than there should be. But 1 dB is an awful lot to lose, especially at the lower frequencies, where simply twisting the coax conductors together in a "mid-air" splice and using no connectors at all will usually result in far less than 1 dB loss.

Probably the worst misapplication of RF connectors is when hams try to use "UHF" PL259 types at 440 MHz. Most of them don't work very well at this frequency, and losses may be as high as 0.5 dB per connector or so if you're not careful. At 440 MHz and above stick with the time-proven, constant-impedance Type N fittings.

My 220 MHz "mag mount" whip antenna came with RG174/U coax installed, about 10 feet of it. Is this lossy? Should I replace it?

At 222 MHz, 10 feet or RG174/U will lose about 1.3 dB or so. Replacing it with an identical length of RG8X will only lose 0.5 dB, so you'd pick up about 0.8 dB by making the change.

What about the coax sold by Radio Shack and similar retail outlets? Is it any good?

It can be, but it might not be. I don't mean to disparage Radio Shack or anyone else, but the problem with commercial, non-military cables is the lack of *consistent* quality. Since their cables are manufactured in non-qualified facilities and each lot does not undergo the rigors of considerable Quality Conformance Inspections, many times these products are less than desirable, especially for long-term installations. I'd not hesitate to use their stuff for patch cables around the shack, or for mobile installations and other non-critical applications where the cable can easily be replaced. But for more demanding applications or installations where replacement might be very difficult, I'd stick with the real mil-spec products, or at least try to find the highest quality commercial products available. Shop around a bit, looking not only at the price, but also at the product itself. Is the braid coverage very good (at least 95% of the dielectric should be covered by the braid, with no visible "holes" between the strands)? Is the outer jacket "UV stabilized" (that is, will it withstand continued ultraviolet radiation from the sun without contaminating the cable)? Is the run you intend to use free of splices under the jacket (usually visible as a small bump in the cable diameter)? If everything looks great, use it! If not, look elsewhere.

What about "foam" cables versus "non-foam?" What's the difference?

"Foam" cables use this term to refer to the dielectric material; it is cellular polyethylene, which looks a bit like foam rubber, and is softer and spongier than solid-dielectrics. The "foam" stuff is usually very white in color (although it needn't be) and you can permanently indent it with your fingernail. Foam cables tend to be a bit more flexible than those with solid dielectrics, and their transmission losses will be slightly lower for a given cable type and diameter. However, there are drawbacks. The cellular foam melts easily at a relatively low temperature, and once melted, it is permanently damaged. Because of this, foam cables are really intended for "crimp-on" connectors, not the solder-on kind, which obviously will expose the dielectric to very high temperatures during the soldering operation. Also, the nature of the foam dielectric is to absorb water easily, making the cable quicker to contaminate if the jacket is pierced or if a terminating connector leaks a bit of water. Solid dielectric cables are more robust and will withstand soldering heat better, and are also less prone to the absorption of moisture. Because

of the operating temperature restrictions, no "foam" cable is mil-qualified. However, throughout this article I have recommended RG8X for some applications, and RG8X *is* a "foam" cable type. Use it carefully.

Why does "foam" cable have less loss?

Two reasons. One, the cellular polyethylene has a lower dielectric constant than solid, so dielectric losses are somewhat lower. Two, because of this same fact, the center conductor will be larger in diameter (for the same outside conductor diameter) to maintain 50 ohms impedance. (The nominal impedance is a function of the inner conductor diameter as related to the outer conductor diameter, and the constant of the dielectric used between them.) With a slightly larger diameter center conductor, ohmic losses (and skin-effect losses at RF) will be somewhat reduced, without impacting the overall diameter of the cable. Whether or not you'll really notice the difference in loss will depend on the length of cable you use.

What about "9913?" Is it as good as they say it is?

"9913" is excellent with respect to transmission loss and power handling ability. It is often called "poor man's hardline" because it might be nearly as good as hardline, while costing far less. "9913" is really just an extension of "foam" dielectric cable. Instead of using cellular polyethylene, Belden (the inventor of 9913) uses a thin spiral of polyethylene dielectric material as a spacer to hold the center conductor in place, and a lot of the dielectric is really the air between the spiral turns. Picture the dielectric in 9913 as a long spring, with lots of coils and air in the spaces between. As a result, the dielectric constant is even lower than in "foam" cables, the center conductor is even larger and has less resistance, and everybody is happy as a clam. Of course, braided outer conductors for 9913 would never work, as there'd be nothing rigid enough to hold the cable together. So the manufacturers use a very thin wall of polyethylene, covered with aluminum foil to make the outer coaxial conductor. Since you can't really solder to aluminum foil, they cover that with some tinned copper braid material. The braid serves no particular purpose other than giving you something to solder to (for a PL259) or clamp to (for a type N).

The problem (and there's always a problem with anything that seems too perfect) is that 9913 is far less flexible than conventional cables, will not withstand repeated bending (due mostly to that big, fat, solid center conductor and the fragile aluminum shield), is easily contaminated by the very first droplet of water that might enter in past a connector, and is too fragile to rigidly clamp to a tower leg or other solid support. If you use proper precautions, 9913 is great stuff. If you don't you'll wind up replacing it frequently. Belden will be glad to provide you with an applications note on how to use 9913 correctly. It was really intended for crimp-type connectors, not solder-on ones, so be *extra* careful.

I've heard that a solid center conductor in coax is better than a stranded one. Is that true? If so, why?

No, this really isn't true. Since the RF currents flow only on the perimeter of any conductor, only the outside diameter of the center conductor is of consequence in determining attenuation. (The same is true for the *inside* diameter of the outer conductor, because that's where the current flows there.) To maintain a constant and desired impedance, the ratio of the o.d. of the inner conductor to the i.d. of the outer conductor must be a fixed, predetermined quantity for any given dielectric material. It doesn't really matter if the inner conductor is solid or stranded, as long as its o.d. (outside diameter) is correct to maintain the desired nominal impedance. Solid conductors are generally used in cables that will not be exposed to repeated flexing, like 9913 and hardline, while stranded center conductors are used in cables intended for flexing and smaller-radius bends because the stranded conductors are far more flexible. For this reason, I'd always recommend cables with a stranded center conductor for routing in tight spaces, around rotators, in mobile installations, as "patch" cables for use around the shack and in other applications where flexibility is required. For example, rather than using RG58/U or RG58A/U, I'd recommend RG58C/U in almost all applications for small-diameter cable. The RG58C/U has a stranded center conductor while RG58/U and RG58A/U do not. A perfect example of the resilience of the stranded conductor cable is when it is used to attach a mobile "mag mount" antenna, where the car door may be repeatedly slammed against the cable. RG58/U might withstand this abuse only a few times before it finally breaks, while RG58C/U will withstand similar abuse hundreds of times because it is so much more flexible. (It's still not a great idea to slam a car door against the coax, but I know it's done, and will be done for years to come.)

"In amateur installations, the factors that detract from the operating life of coaxial cable are typically abrasion, moisture, and UV radiation."

I've heard that coax's ability to withstand UV radiation has something to do with the cable's suffix designator, like A/U, B/U, C/U, etc. What's the story on this?

Cables will last nearly forever if they're never exposed to excessive temperatures (hot or cold), weather, or ultraviolet radiation. Unfortunately, that means we really can't use them. In the real world, cables are exposed to all these things which impact operating life. In amateur installations, the factors that detract from the operating life of coaxial cable are typically abrasion, moisture, and UV radiation. UV radiation, which gives us such great tans in the summer, can cause the plasticizers in the jacket materials of coax to "migrate" and flow through the braid and into the dielectric material. When this happens, the dielectric becomes contaminated and the cable's attenuation increases. To avoid this occurrence, manufacturers—especially mil-qualified ones—began using "UV stabilized" jacket materials (usually polyvinylchloride, or "PVC") which will withstand UV radiation under normal conditions without migration. Unless you intend to use all your coax indoors, where it will never be exposed to the sun's rays, it certainly pays to use coax cable that has a "UV stabilized" jacket material. This material is commonly called "Type IIA," an industry buzz-word for the enhanced properties discussed here. Old-fashioned RG8/U was not Type IIA; RG8A/U supposedly was, and replaced RG8/U on the military QPL (Qualified Products List) for MIL-C-17D years ago. Because of the confusion created by two such similar part numbers, RG8/U and A/U were dropped from the QPL entirely and have been replaced with RG213/U, which should automatically have a UV stabilized jacket, if it is real mil-spec coax. A similar story exists for RG58/U: The old number was not Type IIA, but RG58A/U, B/U and C/U. This is a bit confusing, so it pays when purchasing cable to find out for sure if the product has a Type IIA jacket material. All the newer mil-spec products do, but many commercial products don't. RG8X, which is a purely commercial product (and is not mil-spec in any form) is made by a variety of manufacturers using different materials; some are UV stable and some are not. RG8X and other commercial cables are often available with a white-colored jacket material, which may be desirable for those wishing to "hide" the coax against the side of a light-colored building or interior walls. Whether the white jacket material is UV stable or not, it will reflect the sun's rays better than a black jacket and run cooler and absorb less UV radiation than black-jacketed coax. The white-colored stuff is often used in marine applications, where UV exposure is the norm.

I used RG58/U to feed my 2 meter antenna for years, and its VSWR was always 1.2:1. I just replaced the feedline with brand-new RG213/U of the same length and now the antenna VSWR measures almost 2:1. Why is the new coax so bad?

Congratulations! You've actually improved your whole system by a large factor, and your new VSWR measurement is far more accurate. You're obviously measuring the SWR down at the rig, and not up at the antenna feed point, which is where it *should* be measured. Since VSWR is a ratio of feedline to load impedance (*not* rig to antenna!), a "flat" (1:1) SWR will only exist when the antenna impedance is exactly the same as the feedline's. If there's any mismatch at all, some reflected power will result. When you used RG58/U, a large amount of that reflected power was absorbed by the coax because

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it had lots of loss. The reflected power just created some cable heating and never made it down to your VSWR bridge at the "rig" end of the line. Now that you're using less lossy cable, more of the reflected power is actually being conducted back to your bridge, and your rig, and less is being absorbed by the coax. This is a very normal condition. The new coax isn't "bad," it is probably far better than the old coax was. If you take the trouble to measure VSWR right at the antenna itself, you should find it will be the same with any 50 ohm feedline you connect to it. The best thing to do is re-tune the antenna, using a bridge connected directly to it (up on the roof, tower, or whatever) and try to optimize this match to 1:1 at the frequency of interest. If you can do this, there will be no standing waves on the feedline and the SWR will measure the same at the antenna, the rig, or anywhere in between. By the way, *all* the reflected power will eventually be absorbed by the feedline regardless of how much there is. This is an interesting subject on which much has been written, and there's insufficient space to cover it completely here.

How can I keep water out of my feedline?

A few simple precautions will prevent moisture from entering coax in most situations. The first is, when measuring, cutting and handling the cable, be careful not to create abrasion of the jacket. While some cables are nearly impervious to rough handling (like the ITT Impervion cables) because they are "self-healing," most are really quite fragile. Don't drag your coax across the pavement or roofing materials, and don't yank it through the legs of your tower. Treat it as though it were expensive silk fabric that could be easily damaged—because it can.

The second thing is, install the exposed connector (the one that attaches to your antenna) in a precise, proper and professional manner. Make sure the jacket ends *inside* the RF connector, and that no braid is exposed after the connector is installed. Then, weatherproof the connector as well as possible. "Coax Seal" weatherproof putty works well, if its directions are followed carefully. This stuff molds itself around the connector and the coax near the connector and is very weather resistant. Lacking "Coax Seal" or something similar, you can try spraying the connector and a few inches down the coax with Krylon "Klear Kote", then wrapping with overlapping layers of high-quality vinyl tape like 3M "Scotch 88" electrical tape, then spraying over the tape with another coating of "Klear Kote." It is not impossible to make an exposed RF connector totally weather resistant, it just takes some practice and some patience. Then, *don't* pull the coax straight away from the antenna connector and run it down a mast, boom or tower leg: Make a "drainage loop" in the coax, maybe 6" or so in diameter, by forming a 360-degree coil in the coax before routing toward the shack. Make this "loop" very close to the coax connector, preferably an inch or two away. Tape the loop in place so it will hold its form, and then carefully route the coax towards the shack, never pulling hard on it. When installing the "drainage loop," make sure the loop itself is all *below* the antenna connector, with the turn of the loop facing down towards the ground. This will help prevent any moisture that happens to enter the connector from "wicking" down the coax and contaminating the whole length, so if you do have a water problem in the future it will be confined to the first few inches near the antenna connector. If this *does* happen, at least you'll have enough coax left up there to cut off the old connector and the few inches of contaminated coax, install a new connector and reattach it to the antenna. You won't have to replace the whole line.

How can I tell if my surplus coax is any good? I got a real bargain on it, but am afraid to use it until I test it somehow.

First, cut a few inches off each end of the coax to get a "fresh end" exposed. Then, cut away the outer jacket to expose the braid. Is the braid shiny? (It may be pure copper, tinned copper or silver-plated copper, but in all cases it should have a shiny, new finish and not be discolored, green or black.) Now, pull back the braid and look at the dielectric material. Does it have a new-looking, consistent color? (It may be white, off-white, transluscent or nearly any color, but it should not be stained or discolored by the braid oxides or jacket plasticizers.) Now, cut back some of the dielectric and look at the center conductor. Is it shiny and new looking? (It may be pure copper, copper-plated, tinned, or silver-plated, but it should look shiny and new and not be oxidized.) If the answer to all these questions is, "Yes," then the cable is probably fine. But you may want to make an electrical measurement just to be sure.

> ***"When measuring, cutting and handling the cable, be careful not to create abrasion of the jacket."***

If you have a good VSWR bridge or directional coupler of high quality, you can make two simple measurements. First, install connectors on both ends of the coaxial line. Next, connect your VSWR bridge at the transmitter end of the line with a short "jumper" and connect the TX end of the bridge to your transmitter. Then, install a "dead short" circuit across the far-end connector, which would normally go to the antenna. You can make a good short circuit that will be effective up to 144 MHz or so by using a piece of #12 copper wire and soldering it between the center and outer conductors of a mating receptacle. Keep the wire very short, under one-fourth of an inch long. (At frequencies above 144 MHz, a commercial short-circuit RF termination, usually type N, will work better. These are available inexpensively via surplus outlets.)

Now transmit, using the lowest possible power to obtain a reasonable reading on your VSWR bridge or wattmeter. Switch the bridge back and forth between forward and reflected ranges. The VSWR should read infinity, or close to it: Forward and reflected power will both be the same if the cable has minimal loss. The *difference* between forward and reflected power indications is the power lost in the cable, but remember this will be the power lost by the signal traveling both up and down the cable (to the short-circuit termination and back to the transmitter), so the attenuation in just *one* direction is one-half the difference between forward and reflected power readings.

For example, if you transmit with 5 watts of power and measure a reflected power of 2.5 watts, a total of 3 dB is lost by the cable when the signal travels to the termination and back again. The single-trip loss (signal traveling from transmitter to termination only) will be one-half this amount, or 1.5 dB. The dB loss is calculated as follows:

$$\text{Attenuation (dB)} = 10 \log_{10} \frac{P1}{P2}$$

Where P1 is the transmitter forward power (5W), P2 is the reflected power (2.5 W) and the attenuation is for a "round-trip" in the cable; the one-way attenuation, which is a more relevant parameter, is one-half this amount.

If you'd prefer not to intentionally transmit into a short-circuit (and some solid-state rigs won't let you, due to their internal VSWR protection circuitry), you can make a similar analysis by taking a few extra steps and using a good 50 ohm "dummy" load, as follows:

Connect your wattmeter to your transmitter using a short "patch" cable, and terminate the far end of the coax line with a high-quality 50 ohm (non-reactive) dummy load. Connect the TX end of the coax to the antenna port of the wattmeter, and transmit with as much power as possible to achieve a high-scale reading on the meter. Read this indication and write it down. Then, disconnect the wattmeter from the transmitter, connect the coax directly to the transmitter, and re-install the wattmeter at the far end of the coax, right next to the dummy load. Transmit again using the same power as before and record this reading. Subtract the lower reading (which should be the second one) from the higher reading, and calculate the one-way cable loss using the same attenuation formula as before (10 times the log of the power ratio). Using this method should yield exactly the same results as using the "return loss" method described earlier.

In the example set forth, where the cable has 1.5 dB loss, you might measure 25 watts at the transmitter and 17.7 watts at the far end of the line. The loss of 7.3 watts in this case is exactly 1.5 dB.

I tend to use the "return loss" method, with a very high-quality short-circuit termination, for most of my cable evaluations because it is simpler, and does not require installing the meter at each end of the line. But I also usually use a signal generator running very low power (like 10 milliwatts, which is +10 dBm) and a very good directional coupler in my system, so I'm not relying on transmitters and high-powered wattmeters. Attenuation in any cable is a fixed number at a given test frequency and will not vary with power applied, so my system yields very accurate results and is a quick way to check lots of cable.

As discussed throughout this article, there is more to know about coaxial cable than just how much loss it has. Its overall quality of materials and construction, resistance to the effects of weathering and UV radiation, flexibility, ease of use and other factors can be equally, if not more, important. Yet, attenuation (or loss) is probably the most important criteria for the majority of users and applications, especially if the load cannot, for some reason, be matched to the line and a high SWR results.

One last note on this subject: Do not be misled into thinking that SWR, or the match between your feedline and its terminating load, is any indication of *efficiency*. The two parameters—SWR and efficiency—are mutually exclusive. It can be proven that if your feedline loss is *zero*, it won't matter what the SWR is because 100% of all the power generated by your transmitter will be coupled to the antenna and *no* power will be lost.

Table 1. Coaxial Cable Data

Cable Type	Z_0 Ohms	o.d. (in.V.F.)		Attenuation dB/100'					Dielectric
				50	144	222	440	1260	
RG58C/U	52	.195	66%	3.1	5.7	7.5	11	L9	PE
RG141A/U	50	.190	69.5%	2.1	4.0	5.2	7.6	16	TFE
RG59/U	73	.242	66%	2.4	4.2	5.4	7.8	14	PE
RG8X*	50	.242	78%	2.3	4.3	5.7	8.5	15	FPE
RG213/U	52	.405	66%	1.5	2.4	3.3	5.0	10.5	PE
RG11/U	75	.405	66%	1.3	2.4	3.2	4.9	9.5	PE
8214 Belden*	50	.405	78%	1.2	2.3	3.0	4.8	9.5	FPE
FM8 Times*	50	.405	80%	1.2	2.1	2.5	3.5	6.5	FPE
9913 Belden*	50	.405	84%	0.64	1.3	1.8	2.8	5.4	Air/PE
RG331/U*	50	.500	78%	0.60	1.1	1.5	2.4	4.0	FPE
RG17/U	52	.870	66%	0.50	1.0	1.3	2.3	4.4	PE
RG332/U*	50	.875	78%	0.35	0.65	0.80	1.3	2.5	FPE

Notes:

Cables denoted by an asterisk (*) are commercial cables and not qualified to any military specification.

V.F. = Velocity Factor of propagation. Not an important parameter unless cable is used in a tuned circuit, stub, trap or filter application or used as a precision phasing line.

Attenuation figures are plotted for 50 MHz through 1260 MHz only, as most cables have very little loss per 100 feet at frequencies below 30 MHz.

Dielectric type codes: PE = Polyethylene; TFE = Teflon; FPE = foam (cellular) polyethylene; Air/PE = helical dielectric of polyethylene and air.

Data taken by WB2WIK using 1000' lengths of each cable listed, measuring actual loss by "return loss" method, and dividing measured loss by 10 to calculate loss per 100 feet.

RG331/U and RG332/U are standard aluminum outer conductor "hardline" types which require specialized connectors. Used mostly for reference.

In my next article, I'll discuss the proper installation of coaxial connectors. To whet your appetite, I'll state now that *no* coaxial connector will take more than 90 seconds to install exactly right if you're armed with the proper tools and knowledge.

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Change from 7 MHz to 225 MHz with no bandswitching or tuning!

by John Cunningham AA4AW

There are times when you need more power to get into a repeater or to be heard across the country. People who operate handhelds or QRP sometimes find that they have a hard time communicating with such limited power at their disposal. However, buying an amplifier for 10 meters, another for 6 meters, another for 2 meters, and still another for 1.25 meters can get expensive. Wouldn't it be nice to have an amplifier that took care of all these bands?

The amplifier described here meets these requirements. It is broadbanded from 7 to 225 MHz—the range of 10 amateur bands (40, 30, 20, 17, 15, 12, 10, 6, 2, and 1.25 meters). It will operate on CW, SSB, AM, and FM—or any other mode that is used on these frequencies. It can be fed with an input of 1/10 to 24 watts (though there is not much gain above 12 watts input) and can deliver an output of more than 200 watts. It can be operated over a voltage range of 12 to 28 volts.

Field-effect transistors are more immune to damage from high SWR and thermal runaway than bipolar transistors. They also have higher gain, greater efficiency, and lower noise. They can be operated over a greater voltage and power range than bipolar transistors.

The MRF175GV is a Gemini twin which means it is two balanced transistors in one package. The amplifier designed here will not work unless the transistors are balanced.

Field-effect transistors have a few drawbacks. They are more prone to static damage, and care must be exercised during handling until they are soldered onto the board. They easily go into oscillation, owing to their high gain. Be careful not to drive them too hard and destroy the gates. If there is a chance of this happening a limiting circuit should be installed at the input of the amplifier.

Collecting the Parts

The MRF175GV field-effect transistor can be ordered from RF Parts (telephone: 1-800-737-2787 or 619-744-0700). The transformers, chip caps, and copper heat spreader are available from Communication Concepts, Inc. (hereafter referred to as CCI) at 508 Millstone Drive, Xenia, Ohio 45385 (telephone: 513-426-8600). Experimenters who plan to use a similar design in future projects should purchase the coax needed to make the transformers instead of buying them fully assembled. CCI will not send less than five feet of the coax in any one shipment. Five feet is enough to build five output transformers and almost 10 input transformers. However, once you go this route you must also buy the ferrite beads that accompany the transformers.

The total cost of this project is about $362, but that doesn't seem so high when you consider that many of the parts must be ordered in more quantity than is necessary for this project, and the excess can be used on future ventures. The copper heat spreader, for instance, can be cut into three pieces and used in two other projects. Also remember that a high percentage of the cost is in the transistor at $154. If this sounds expensive, consider that to get 200 watts from commercially-built amplifiers you usually pay more than $200, and most of these amplifiers are single-band! Multiply $200 by the 10 amateur bands that this amplifier covers and you get a whopping $2,000—far more than the cost of this amplifier. Maybe you will not work all 10 of the amateur bands which this amplifier will handle, but if you are an experimenter you probably will.

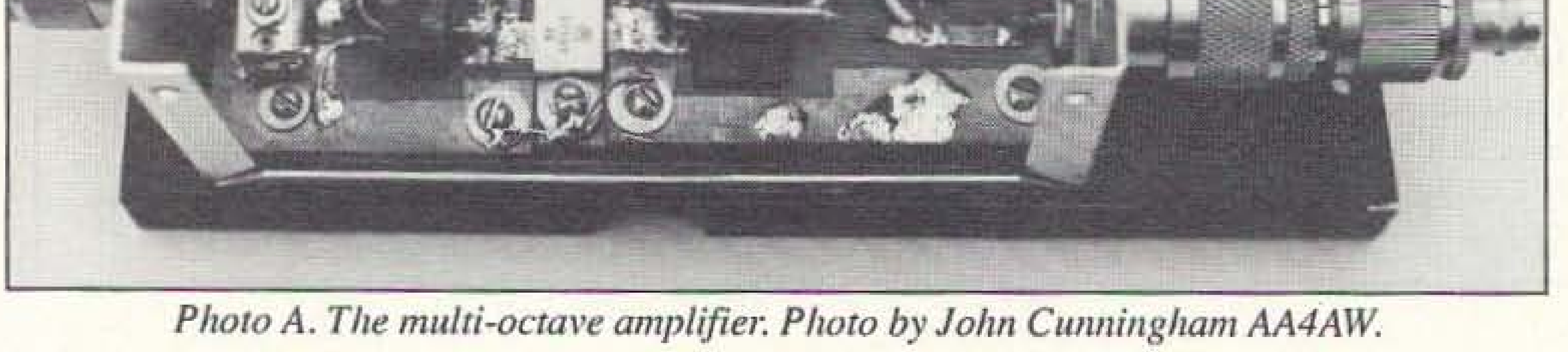

Photo A. The multi-octave amplifier. Photo by John Cunningham AA4AW.

Construction

I used a Radio Shack 276-1499 circuit board and cut it to the proper size. A single Radio Shack card will build two of these amplifiers. This design consists of two separate cards: one for the input and one for the output. The cards are cut to a size that will enable them to fit into a Radio Shack aluminum box (no. 270-238) 5-1/4" x 3" x 2-1/8". The output card should be cut to 2-3/4" x 2-11/16". The size of the input card should be 2-11/16" x 1-3/4". (Custom pre-etched circuit boards for this project are available for $7 a set plus $1.50 S & H from FAR Circuits, 18N640 Field Court, Dundee IL 60118.)

A copper heat spreader is cut to a size that will allow it to fit into the box and enable the lid of the box to fit over it: 5-1/16" x 2-11/16" will make the proper fit.

You will need to drill holes into the boards, box, heat spreader, and heat sink to mount the hardware that holds these devices together. These holes must be lined up with the holes drilled for the circuit board, except that the rectangular holes will not be made in the heat spreader, box, or heat sink. You will also need to drill holes for the bolts that hold the transistor in place. See Figures 2 and 6.

In addition, you will need to make inserts in the circuit boards and the heat spreader (See Figures 2, and 6). I used a grindstone to make the inserts. Without the inserts, the connectors will not fit on the sides of the box.

Holes should be drilled on the output board to bond the ground on the component side of the board. (See Figure 2.) Once the holes are drilled, a lead from a resistor or other component can be placed in the holes and soldered to both sides of the board.

I used Radio Shack 276-1435 etchant, according to the instructions printed on the etchant bottle. Only one side of the board will be etched, except for a little on the lower side of the output board where the power transistor will be. See Figure 2. I drew the pattern with a felt pencil which left the copper to be etched exposed. The unetched copper was further protected by duct tape. All components are located and soldered on one side of the board, similar to a ground-plane configuration—the difference being that some etching is done. This design makes for improved grounding and ease of troubleshooting, repair, and modification.

Once the circuit boards are etched, components can be soldered in place. The component layout is not critical, except that capacitors C5 and C6 must be soldered before transformers T1 and T2 are put on the boards. I recommend that you don't place these transformers on the boards until the boards are bolted inside the box and the ferrite beads are put in place. Otherwise, the parts placement is according to Figure 3. I recommend using only chip caps because the leads from other types of capacitors may pick up stray RF and make the amplifier inoperable.

The most difficult part is assembling the transformers. If you order from CCI specify that you want a low-impedance input transformer and a high-impedance output transformer with a 1:9 ratio. CCI does not sell low-impedance input transformers with a 4:1 ratio as called for in this design, but you can order a 9:1 impedance input transformer and convert it to a 4:1 transformer by removing one of the windings. Otherwise, assemble the transformers according to Figures 3 and 4. If you order the coax to build the transformers yourself, specify that you want both input and output coax; they are not the same.

For use at frequencies below 100 MHz, ferrite beads must be put on the input and output transformers to control parasitic oscillations, thereby increasing stability. See Photo A and Figure 4. These oscillations can get so bad that they destroy the transistor in-

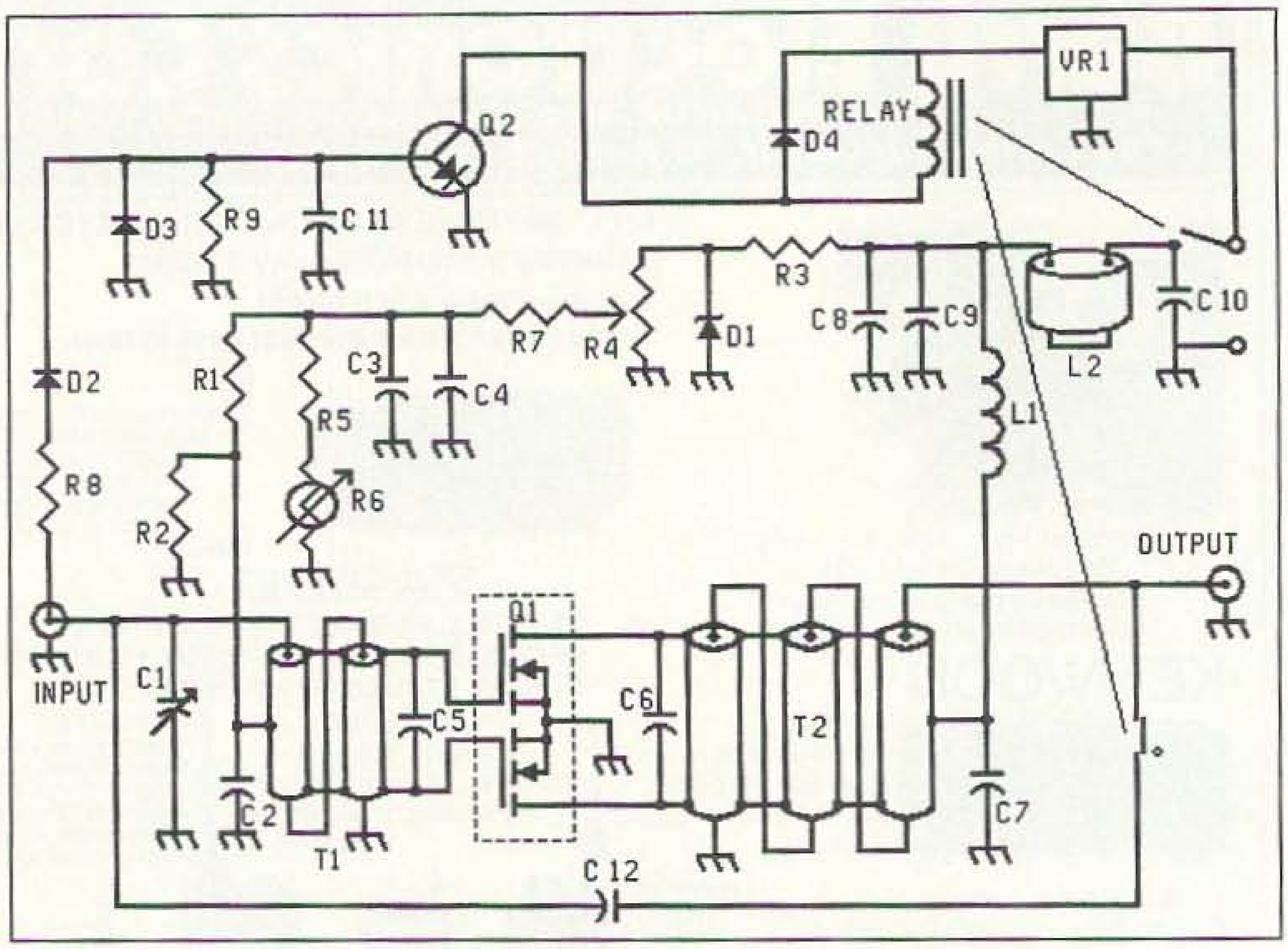

Figure 1. Schematic for the MRF175GV amplifier.

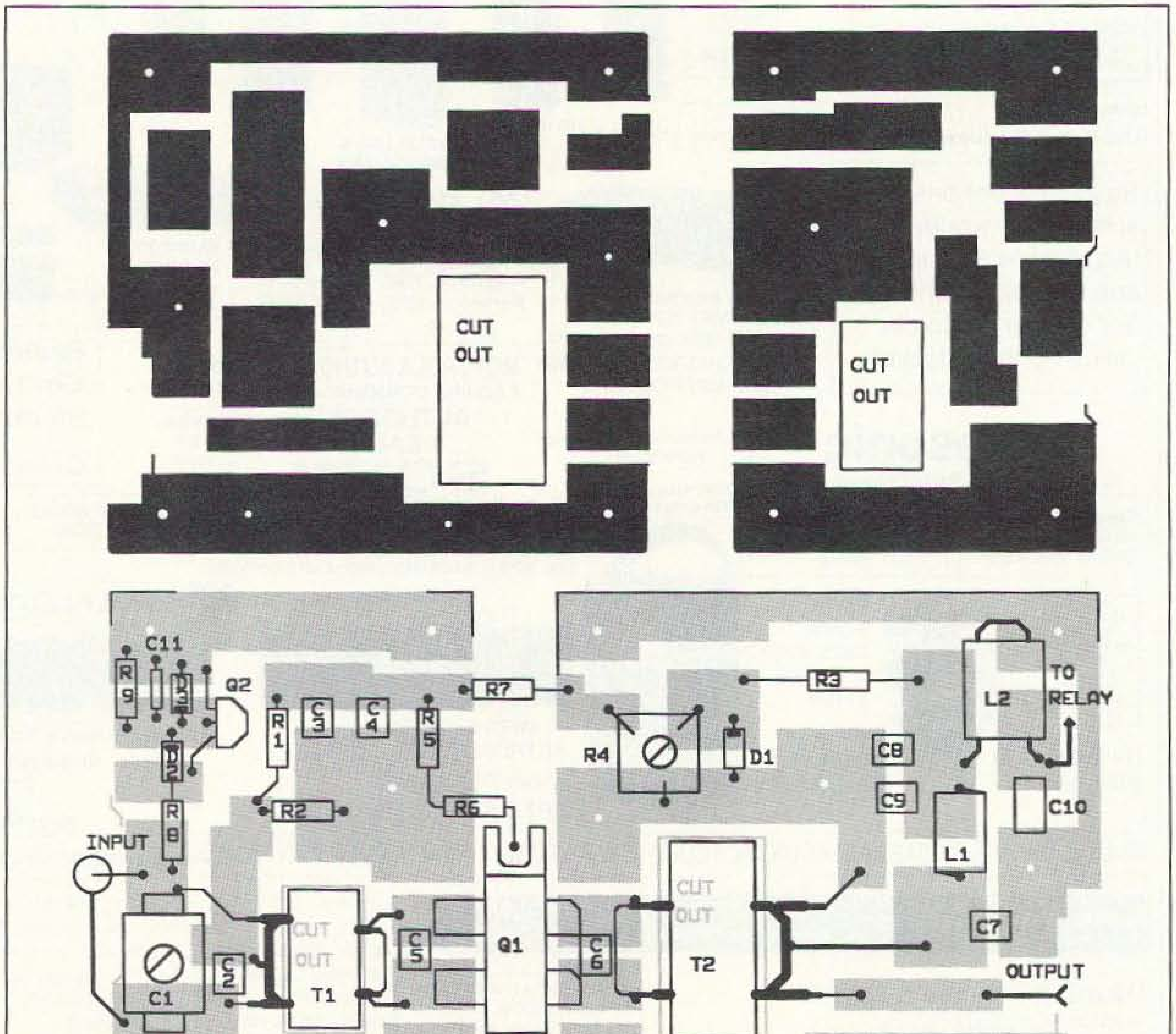

Figure 2. Circuit board.

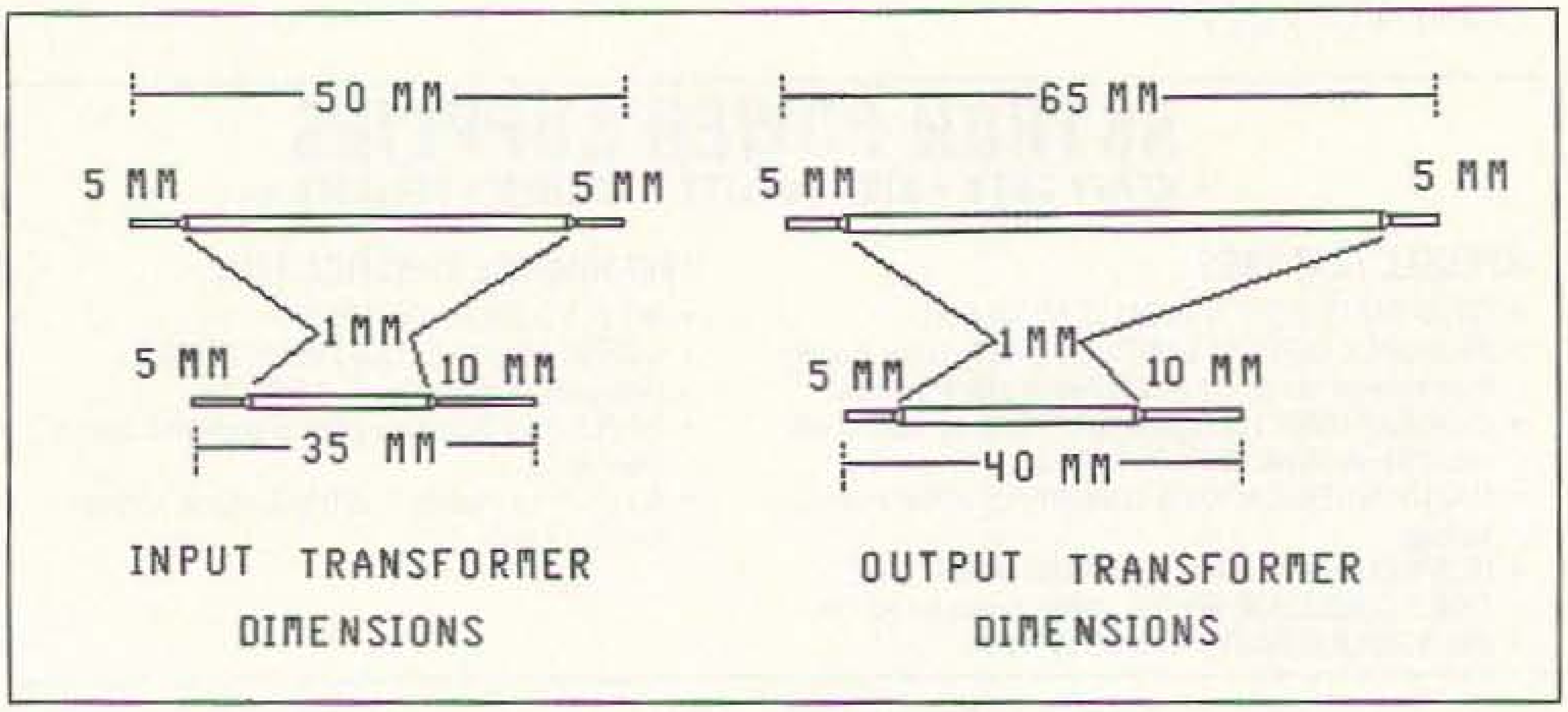

Figure 3. Preparation of the transformer coax. Cut the transformers to the lengths shown, and strip the outer conductors. The inner leads that are to be 5mm should have their outer conductors stripped 6mm and the leads that are to be 10 mm should be stripped 11mm. Then strip the insulator that goes between the inner and outer conductors, leaving 1mm of insulator as shown, which will leave the inner conductors bare at the proper lengths.

stantly—especially when operated with more than 20 volts on the drain. If you intend to use the amplifier exclusively above 100 MHz, the beads can be left off the output transformer to get greater efficiency. In addition to stabilizing the amplifier, these beads can also aid in heat dissipation—something that is critical if the amplifier is to be operated at its maximum power. As for putting beads at the input transformer for use above 100 MHz, they should be installed if the amplifier will be operated at more than 20 volts. For operation below 20 volts, generally more power is obtained from the amplifier if they are left off—especially at frequencies above 200 MHz. However, the amplifier is more broadband if the input beads are left on.

Instructions for installing the beads are included if you order them from CCI. I used only a weak kind of glue, such as a little dab of silicone rubber, to hold the E ferrite beads to the I beads because I anticipated taking them off. The input E bead ordered from CCI fits the 9:1 transformer they sell but is a bit large for a 4:1 transformer. Therefore, I filed down the E bead until it made a tight fit. The I beads need to be glued to the heat spreader after the circuit boards are installed, but before the transformers are soldered to the circuit boards.

A rectangular hole needs to be made in the output side of the box for the relay. If you do not have the tools to cut a square hole you can drill several small holes inside the area of the opening. Then use a hacksaw to further cut the area into straight sides. I deliberately made the cutout smaller than the dimensions shown because I did not want the relay socket to fit too loosely. In order to have a tight fit, I used a file to gradually increase the opening to the dimensions necessary for the relay socket. See Figure 5 for the positioning of the relay and the input and output connections.

When the box and circuit board have been properly prepared you are ready to assemble the amplifier. The heat sink, box, and heat spreader fit flush together; they should be sanded to eliminate burrs. Thermal heat sink compound should be applied between these parts as they are placed together. I used Radio Shack 276-1372 compound for this project. However, no thermal compound should be put on the circuit boards, which are raised above the heat spreader by means of washers (see Figure 6). The leads of the power transistor will need to be bent sharply upward—especially the output (drain) leads. Separating the boards from the heat spreader reduces heat on the components on the boards. It also makes the transformers fit flat on the boards when ferrite coils are used, instead of being elevated above the boards as they would be if the circuit boards were not elevated from the heat spreader.

The heat sink, box, heat spreader, and circuit boards are bolted together, using five bolts for each board. See Figures 2 and 6. I recommend that you don't tighten the bolts holding the boards in place until the transistor is bolted securely.

The power transistor should be placed on the board next. Use care in handling a field-effect transistor as these devices are subject to being destroyed by static buildup. When handling FETs, pick them up only by their sources. It is a good idea to wear a grounded wrist strap and to work on a static-free table using a grounded soldering iron. Once the device is soldered in place the danger from static buildup is minimized.

The transistor is mounted between the two circuit boards on the copper heat spreader. Thermal heat sink compound must be used when mounting the transistor. Be careful not to mount the transistor backwards—that's easy to do. The two flanges that have one of their corners cut are the drains; the other two are the gates. The leads on the output side of the transistor are bent sharply upward, but be careful not to break them. Also, there is a chance of the output leads shorting to the unused side of the board. One way to prevent

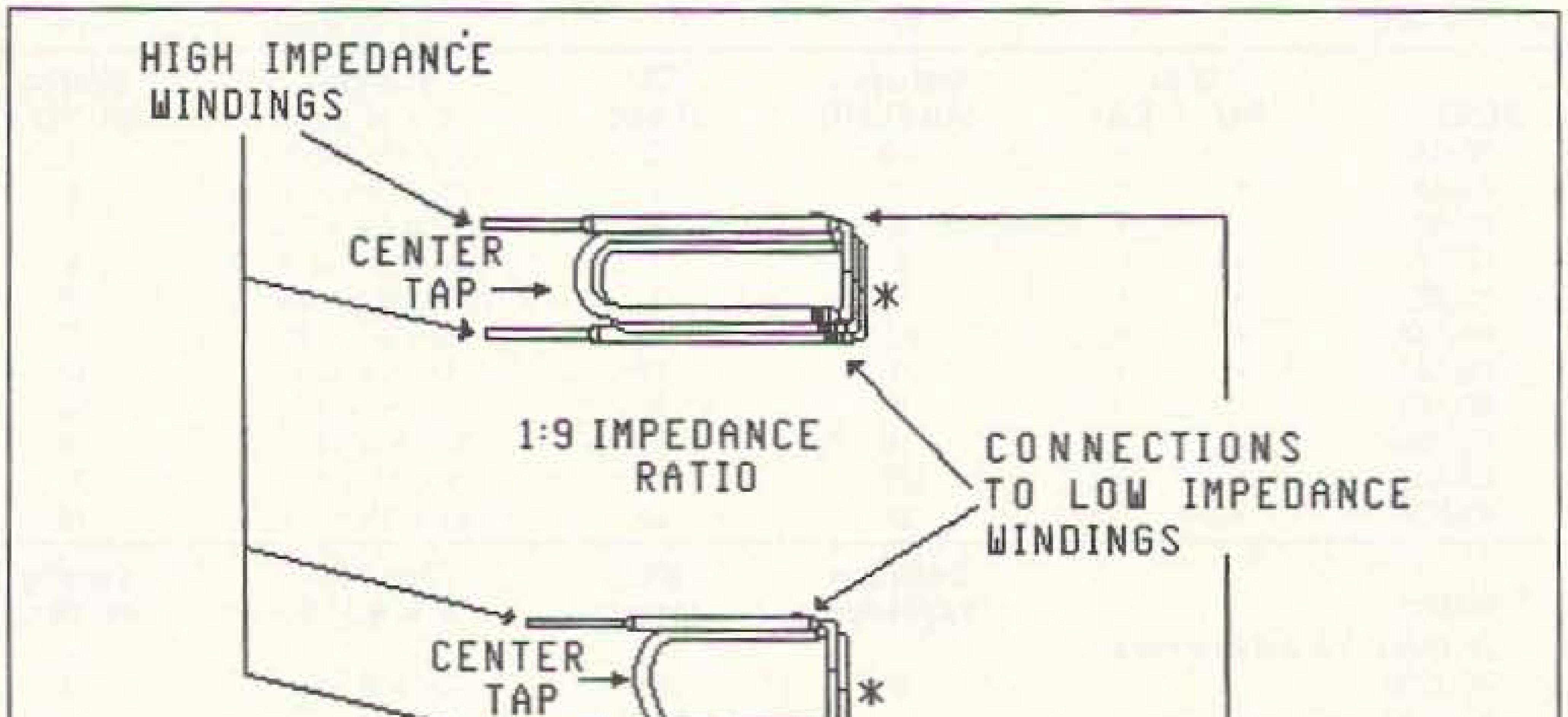

Figure 4. Preparation of the transformers. The leads between the transformer windings should be as short as possible. Bend the coax and bend the leads till they touch tip to tip, and solder the tips together. When properly assembled, an ohmmeter check will show a closed circuit between the two ends of the transformer leads and an open circuit between the inner and outer conductors. The mistake made on the bottom right drawing is easily made by persons assembling the transformers themselves. Nothing feels worse than getting the transformer assembled and having to redo it.

this is to etch away a small part of the output board near the transistor. See Figures 2 and 6.

Once the transistor and circuit boards are mounted and their bolts tightened, solder the flanges to the transistors. The transformers can be positioned now and soldered, completing the installation of the circuit boards. Then the last of the components can be soldered in place—VR1 and C12—as well as the connective wires for the receive circuit and the wire that provides the power for Q2. See Figure 5.

Before applying voltage, it is a good idea to do a few continuity checks. See if there is zero resistance from the voltage input to the drain of the transistor. Then check for shorts between the drain and ground and between the gate and ground. If you find shorts, do not proceed until the trouble is corrected. Both the input and output, however, should have a short to ground.

Parts List

C1	Arco 404 mica trimmer, 8-60 pF or equivalent	Available from CCI.
C2, C3, C7, C8	1000 pF chip	CCI no. C1210C NPO 200V
C4, C9	0.1 mF chip	CCI no. C1813 BX 100V
C5	200 pF chip	ATC 100B 300V
C6	In parallel: 100 pF chip 130 pF chip	CCI no.C1210C NPO 50V ATC 100B 500V
C10	.47 mF chip	CCI no. C2225 BX 100V
C11, C12	.001 mF PC mount capacitor	Radio Shack 272-126 (or equivalent)
D1	8.2 volt zener	1N5923A or 1N756A, available from CCI.
D2, D3, D4	1N4148 high-speed switching diodes or equivalent	Radio Shack 276-1112 (for 10 diodes) or 276-1620 (for 50 diodes)
L1	10 turns AWG # 16 enamel wire, close wound, 1/4" i.d.	
L2	CCI VK 20/4B RF choke or ferrite beads of suitable material for 1.5—2 mH total inductance.	
Q1	Motorola MRF175GV	
Q2	2N4401 NPN transistor or equivalent	
R1	1k 1/2 watt	
R2	10k 1/2 watt	
R3	330 ohm 2 watt	
R4	1k variable trim resistor	CCI 3386P-102 or equivalent
R5	6.8K 1/4 watt	
R6	10k (25C)-2.5K (75C) thermistor	
R7	2k 1/2 watt	
R8	100 ohm 2 watt	
R9	10k 1/4 watt	
Relay	12 volt DPDT, 15 amp contacts	Radio Shack 275-218 and 275-220 relay socket.
T1	4:1 impedance ratio RF transformer. Can be made of 25 ohm semirigid coax, 47-52 millimeters outside diameter.	
T2	1:9 impedance ratio RF transformer. Can be made of 15-18 ohm semirigid coax, 62-90 millimeters outside diameter.	

NOTE: Both T1 and T2 are available from CCI. If you don't buy the transformers fully assembled you will need magnetic cores for the transformers. For T1 use Fair-Rite Products Corp. #9461012002/9361021002 E (or type 75-26 E and I Micrometals powdered iron core). For T2 use type 100-8 E and I Micrometals powdered iron core). See text.

VR1	12 volt regulator	Radio Shack 276-1771
Connectors	Type N chassis mount female	Radio Shack 278-152 (or equivalent)
Optional	Radio Shack auto cigarette lighter power cord	#276-021

Circuit boards for this project are available for $7 plus $1.50 S & H from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

Checking It Out

When the resistance checks are made, you are ready to test the amplifier. Connect the input to a handie-talkie or other low-power transmitter and the output to a dummy load that has some kind of power indicator. If you have a spectrum analyzer, so much the better. A dummy load wattmeter will do—so will a dummy load with an SWR and relative power indicator placed between the amplifier and the dummy load. Be sure the dummy load is capable of handling more than 200 watts.

When applying voltage, put no more than 12 volts to the amplifier at first. Once voltage is applied, quickly check the voltage on the gates. This voltage will vary, depending on the adjustment of R3. For now, adjust R3 until the gate voltage reads approximately 2 volts. The gate voltage should not exceed 6 volts.

If you wish, you can check out the amplifier portion of the project before you check out the receive portion. To do this, do not connect one side of R10. However, once the amplifier is tested and R10 is reinstalled, it will have to be realigned.

Once the voltage on the gate is 2 volts, apply a 0.5 or 1 watt RF signal to the input of the amplifier. The relay should click on. If it does not, adjust C1 until it does. If the relay still does not come on, there is either a component breakdown or an error in construction. Once the relay has engaged, see if there is any output indication. Adjust capacitor C1 and R3 for maximum output. One good feature of this amplifier is that there are only two adjustments to be made: C1 and R3.

All this sounds simple, and it usually is. However, these amplifiers have a tendency to go into oscillation. Turn off the exciter, and see if you still get a power indication on the wattmeter. If so, the amplifier is oscillating. Back off from R3 until the oscillation stops. C1 may also be adjusted. The trick is to get the maximum power out of the amplifier without it going into oscillation and remaining in that state after the drive has stopped.

When properly adjusted, the amplifier should give out more than 30 watts at 12 volts with 1 watt drive. At this point, you can increase the power of the amplifier by gradually applying more voltage to the drains. Never exceed 28 volts on the drains, and never let the voltage on the gates exceed 6 volts—if even that much.

If you are content to use only 14 volts (the power available in most automobile electrical systems), the amplifier can be used for continuous duty operation on all modes. At this voltage the transistor can withstand infinite SWR and any other conceivable abuse (except overdriving) and should easily outlast its owner. Notice that the amplifier gets warm after only a few minutes—even at this power level.

A word of caution: Some late-model automobiles are equipped with computers that will break down if a transmitter putting out more than 10 watts is used. This can stop the engine and lead to a thousand-dollar repair bill. Check your automobile owner's manual.

Once the transmitter is functioning, you are ready to test the receive circuits. Since the receive circuit consists of nothing more than a relay and capacitor C12, there should

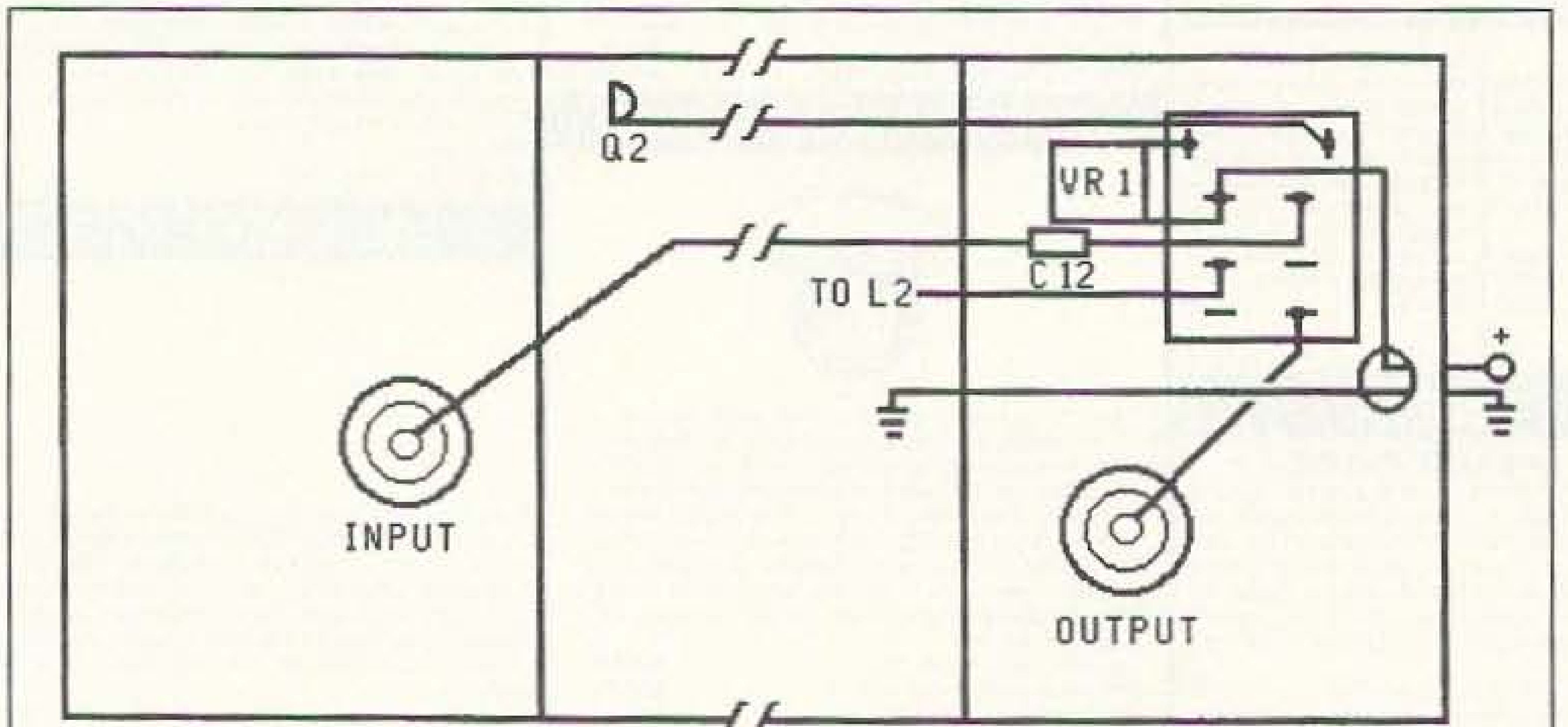

Figure 5. The front and back sides of the box, showing the relay mounting and relay connections. The hole near the relay which allows DC into the box should be approximately 1/4" diameter. The rectangular opening for the relay should be 1" by 7/8". The holes for the "n" connectors should be 9/16".

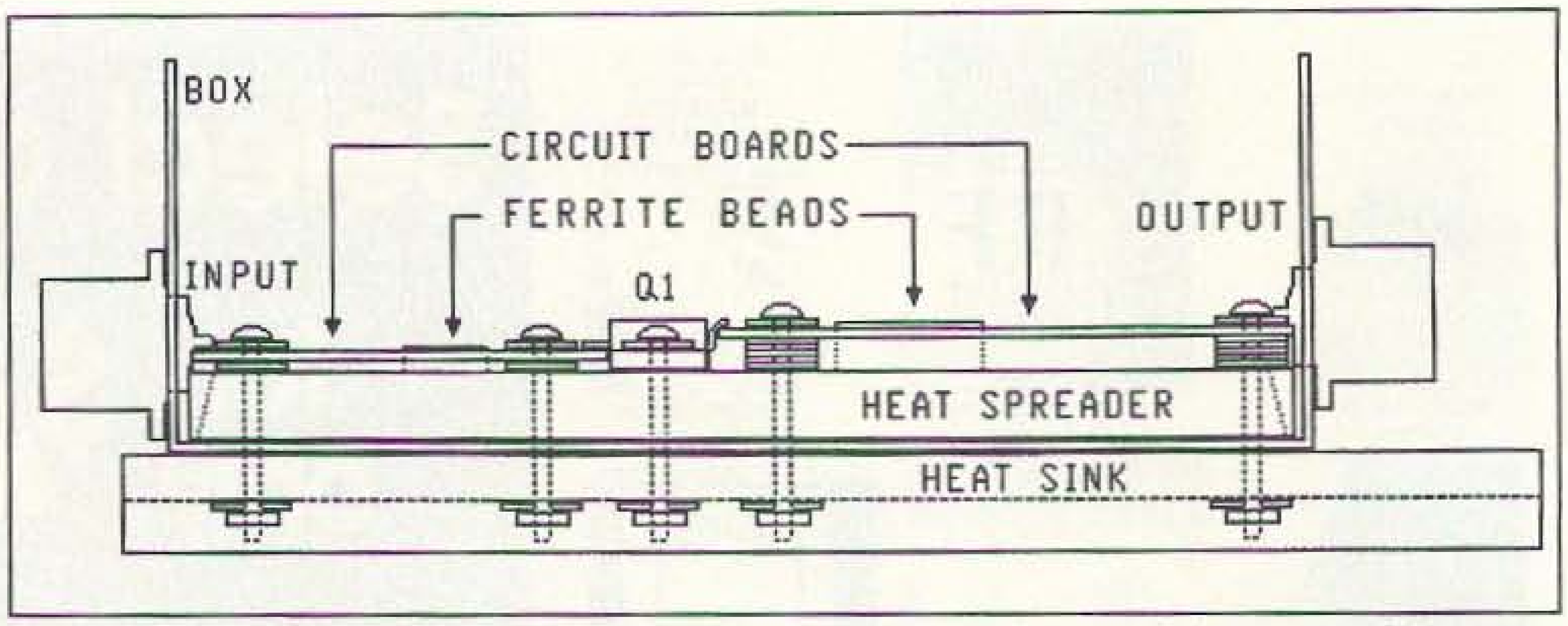

Figure 6. Bolting the amplifier parts together. Note that the flanges of the output of the power transistor have to be bent upward. The output of the transistor can short to the bottom of the circuit board unless a small part of the bottom of the board is etched. See Figure 2.

Be careful to make the input and output connectors touch on the circuit board, or the amplifier may not work at 225 MHz. Solder the inputs and outputs directly to the foil of the board without using lead lengths. A BNC connector could be used in place of the type N connector used in this experiment.

be no problem if everything was installed correctly.

How It Works

When an RF signal is put into the amplifier, a small portion of it flows through R12 and D2 (see Figure 1), which turns on Q2. This action causes the relay to engage, thereby disconnecting the receive circuit and allowing voltage from the power supply to enter the amplifier.

Resistors R1 through R7 supply the proper bias voltage to the gates of Q1. The power supply voltage goes to the drains through the T2 center tap.

The transformers are wound in such a way that they match the 50 ohm impedances of the input and output over a range of several octaves. The transformers' ratios are the ratios of the square of their turns. For instance, one turn would give a 1:1 ratio, two turns a 1:4 ratio, three turns a 1:9 ratio, and four turns a 1:16 ratio.

Continued on page 42

Number 9 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 8 1/2" x 11" sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS 73 MAG Message Area #4. (2400 baud, 8 data bits, no parity, 1 stop bit. (603) 924-9343). 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/schematic, or copy, for Zenith Color Monitor, Model ZVM131, Service No. CD13MVRC05. *Ed Reichert N2BGE, 462 Timberline Dr., Mt. Laurel NJ 08054.*

I am in need of the schematic and/or SAMS Photofacts for the HyGain II CB transceiver. Photofacts preferred. I will pay for copy and postage. *Brent Putnam N8UBD, 12110 Mayfield Rd. #6, Cleveland OH 44106. E-mail on college internet bwp2@po.cwru.edu.*

Needed: Schematics, Parts/Track Maps and Component Location Diagrams for Genave Alpha/500 Nav/Com. I want to use the receiver for 121.5 MHz ELT locator. I will pay reasonable costs. Thank you. *Lewis Moore N4DRJ, P.O. Box 52, Cornelia GA 30531. (706) 778-4716.*

Wanted: Information on satellite operation: How to get started, uplink/downlink frequencies, telemetry info, equipment needed, antennas, etc. Can anyone suggest a good up-to-date reference source that can give me complete information? Also, I am interested in contacting hams who are vegetarians (for recipes and ideas). Contact me on the local Spokane WA 147.20 rptr, or write to: *Doug Cole N7BFS, P.O. Box 72, Spokane WA 99210.*

An Experimenter's Power Supply

An adaptable multi-voltage supply.

by Fred Reimers KF9GX and Mark Reimers

After you have built a special project and want to power it up, you connect the completed project to your power supply. But what do you do when the project requires special voltages, different from the normal 12 VDC power supply, like +9 and +5 and -5 and -9 VDC? You say to yourself, "I need a multi-voltage power supply that also has negative voltages, and I have to be able to set the voltages to accommodate different projects."

Switching Supplies vs. Standard Transformer Power Supplies

There have been a number of articles on power supplies over the past years. Most of these have been single- or dual-voltage.

Switching power supplies have a lot to offer. They provide higher efficiency at higher currents than transformer supplies. Switching supplies are smaller and weigh much less than transformer supplies. An 8-amp transformer supply could weigh six to 10 pounds, while a switching supply could be as light as two pounds. Switching supplies are easier to filter and offer better regulation.

Why haven't there been published construction articles on switching power supplies? Because switching power supplies are much harder to design and it's difficult to keep the radiation down. Without a large amount of RFI filtering and shielding, you could never operate a radio near a switching power supply.

Switching power supplies are not as reliable as conventional transformer power supplies, though the commercial supplies are becoming as reliable as their transformer counterparts. The weakest links in switching supplies are the switching devices (transistors or FETs), due to the Di/Dt transients under load conditions. The biggest reason why standard transformer power supplies are still popular with us builders and experimenters is the availability of parts and the ease of building a supply. With the availability of transformers, regulator ICs (ie. the 723, 78xx series and 317/337 devices), and capacitors, it is easy to build a transformer power supply.

We wanted to make a supply that was simple, yet versatile enough to fit all low power multi-voltage applications. The supply we came up with has six outputs that can be independently adjusted. We set the outputs to +12, +9, +5, -5, -9, and -12 VDC.

"The biggest reason why standard transformer power supplies are still popular with us builders and experimenters is the availability of parts and the ease of building a supply."

Circuit Description

The power supply is made up of two independent circuits, the positive and the negative voltage sections. Diodes D1-4 and D5-8 rectify the AC voltage and C1 and C2 filter the DC voltage for the positive and negative sections. Capacitors C3, 5, 7, 9, 11, and 14 are placed at the input of each of the regulator ICs for regulator stability; C4, 6, 8, 10, 12, and 13 are placed at the output of each regulator for improved transient response, i.e. to improve the output voltage overshoot and undershoot response when a load is applied or removed from the output. The negative and positive sections are divided into three separate regulator circuits. The LM317T and LM337T regulator ICs, chosen because of their availability, require only two external parts, can be configured as variable regulators, and are rated at 1.5 amps (with proper heat-sinking). The voltage adjust resistor was chosen as 5k, but lower values could be used to increase the adjustment sensitivity and to lower the maximum adjusted output voltage.

The data book (Note 1) gives the equation for the output voltage as:

$$V_{out} = V_{ref}\,(1 + R2/R1) + I_{adj}\,R2$$

V_{ref} is a constant 1.25 volt that is maintained between the output and adjust terminals by the regulator. Thus, the lowest voltage that can be achieved from the LM300 series regulators is 1.25 volts. Using the above equation, the adjustable resistor value is 2,244 ohms for a 13.8 volt output. Using a 1k pot would yield an output voltage range of 1.25 to 6.8 volts. Depending on where the output voltage of the individual regulator is set, the LED current-limiting resistor should be adjusted to keep the LED current in a safe operating range, as specified by the LED manufacturer. We like to keep the LED current between 10 and 20 milliamps.

To calculate the LED current for the output voltage setting you want, use the formula:

$$R_{LED} = (V_{out} - 0.7) / 0.015$$

The 0.7 is the LED voltage drop and 0.015 is the LED current of 15 milliamperes. For example, for V_{out} of 12 volts, the current-

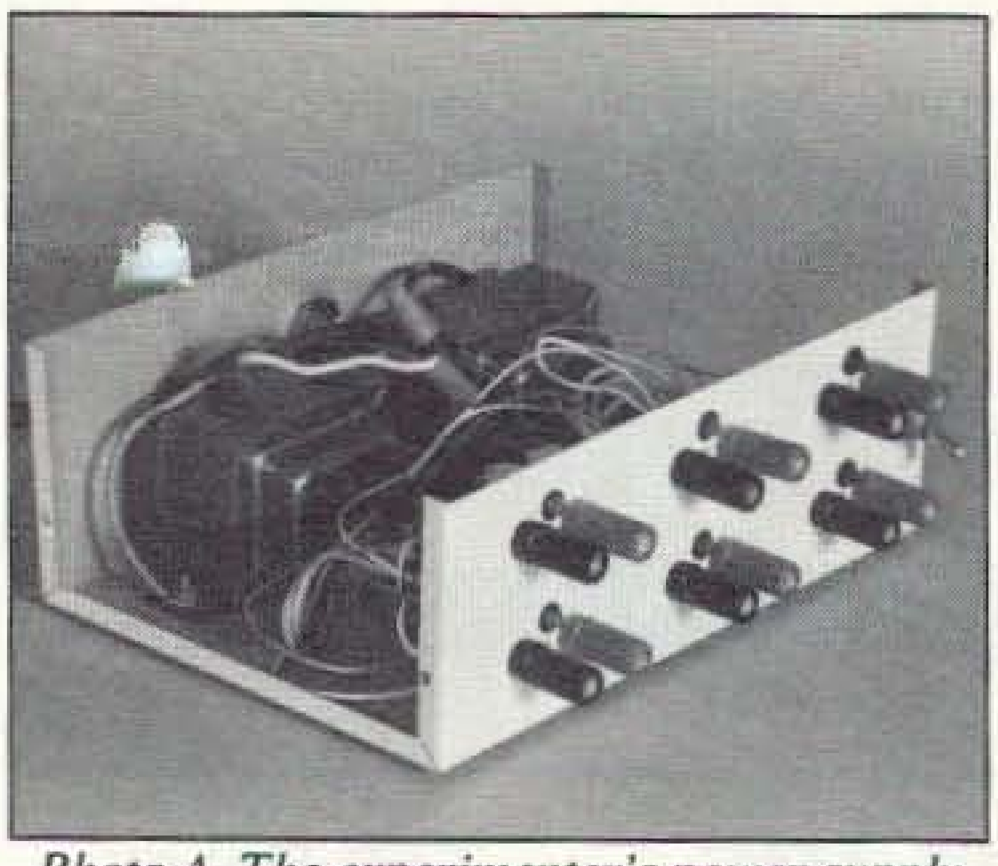

Photo A. The experimenter's power supply.

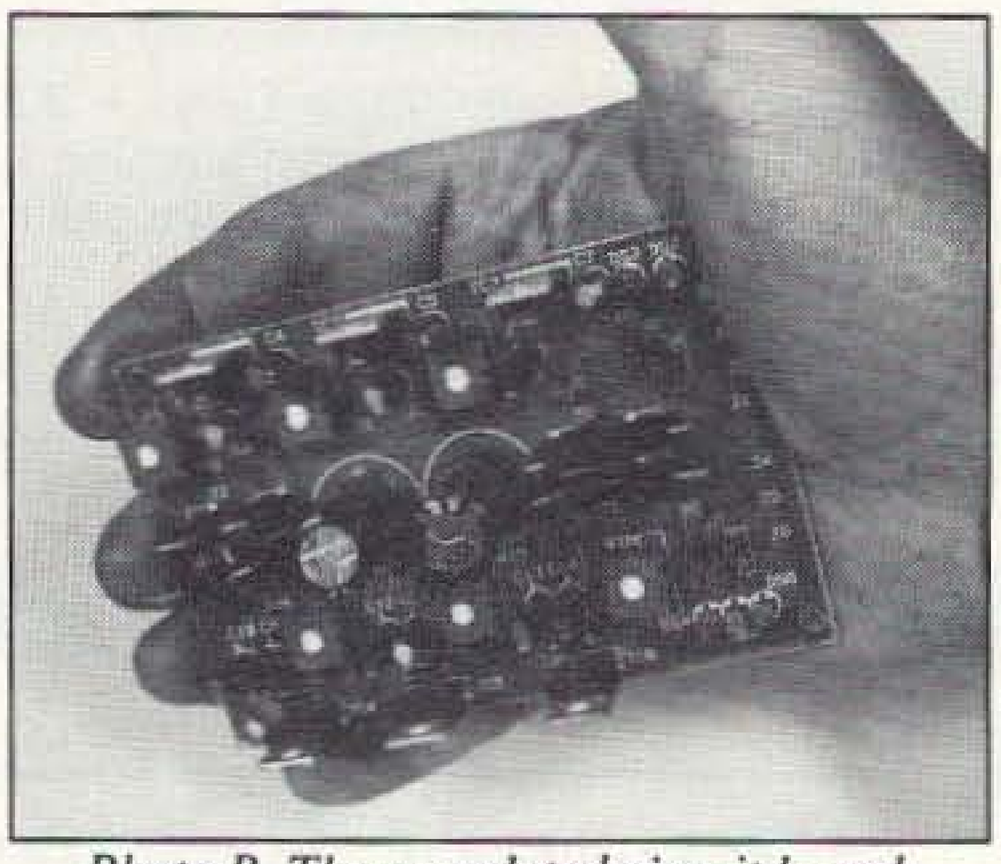

Photo B. The completed circuit board.

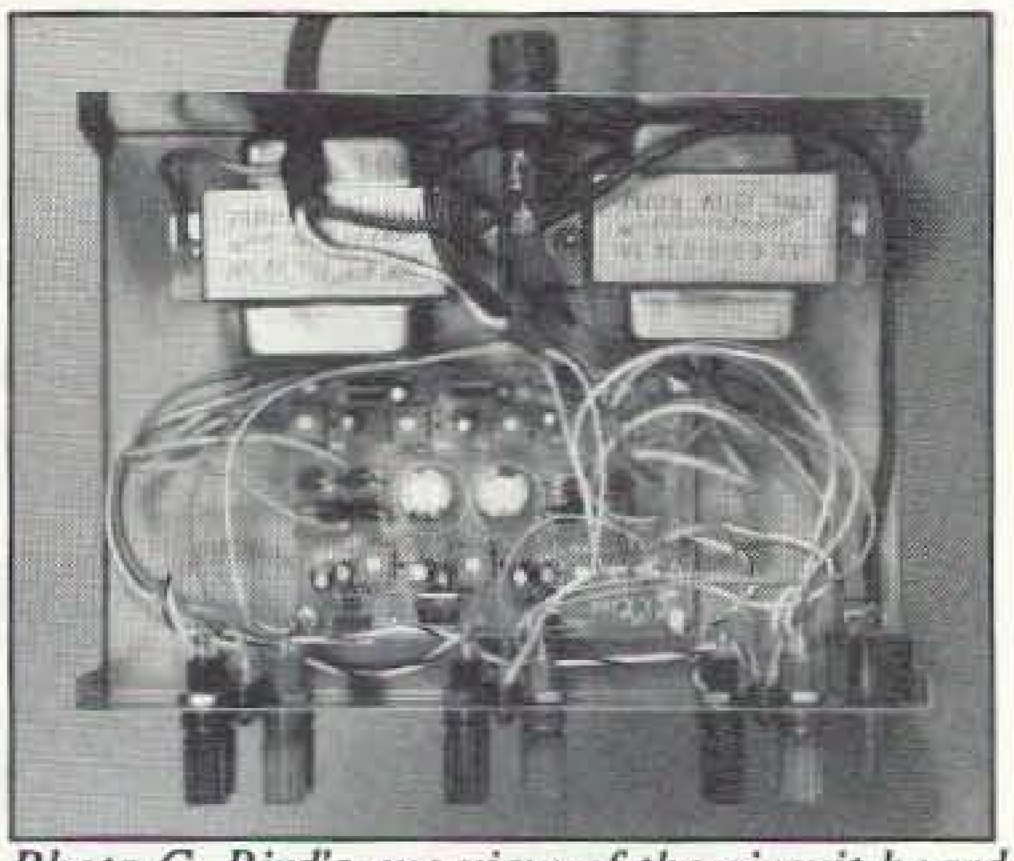

Photo C. Bird's-eye view of the circuit board and transformer placement.

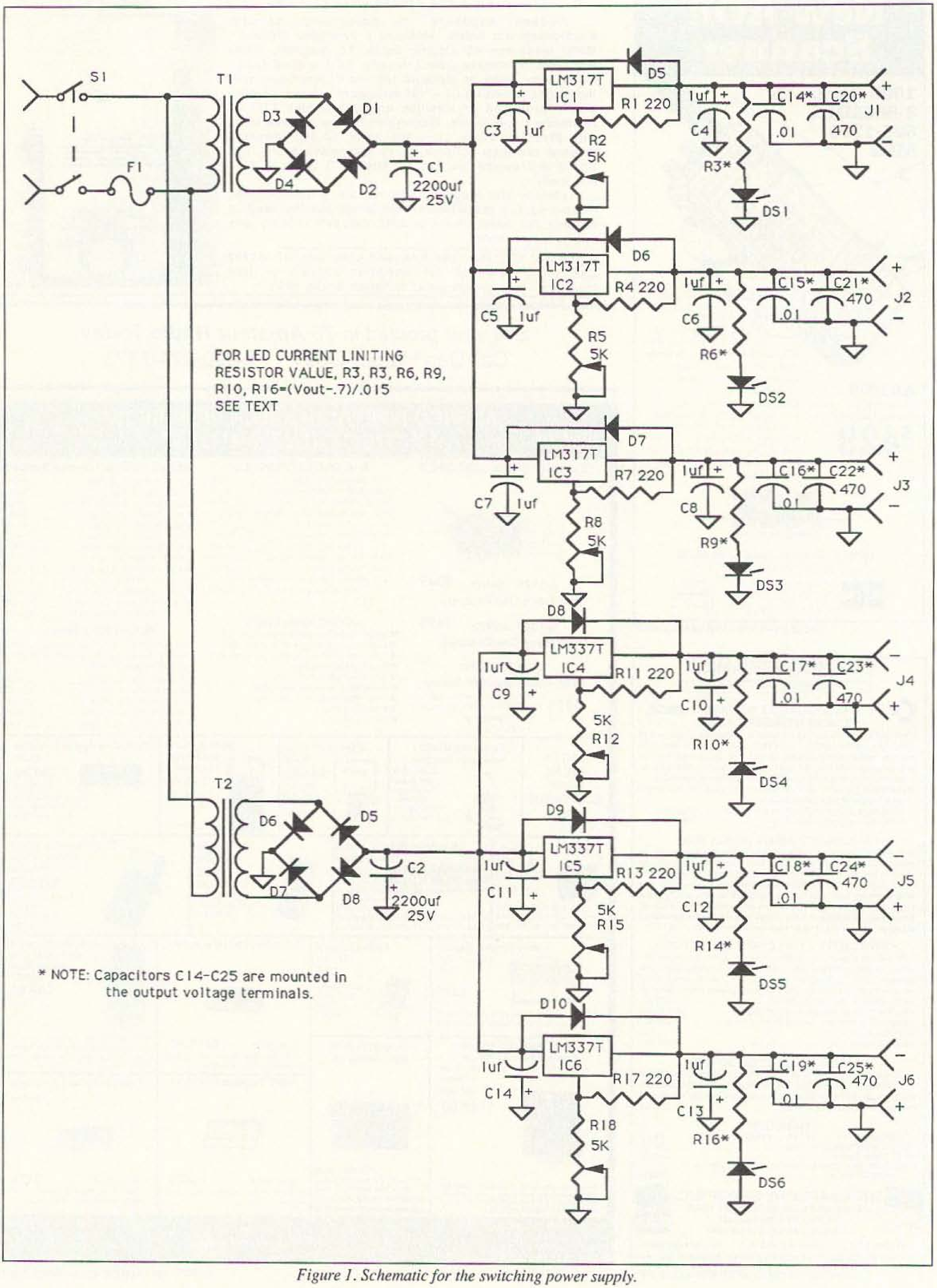

Figure 1. Schematic for the switching power supply.

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HF LINEAR AMPLIFIER

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limiting resistor should be 750 ohms. A 680 or 820 would also work, keeping the current in the 13.78 to 16.6 milliamperes range. For a lower value of V_{out} of 5V, a 270 or 330 ohm resistor will do the job. We used a 680 ohm LED current-limiting resistor. This kept the LEDs in a safe operating limit at the higher voltages and still allowed the LED to light dimly when the output voltage was adjusted to 5 volts.

We chose a 3 amp transformer because of its availability and current rating. The available 3 amp source current is divided between the three regulator circuits. Two separate transformers were used for the AC to keep the positive and negative voltages isolated. We mounted the transformers off the PC board.

A Word About RFI

All active regulated power supplies work great until you use them to power up the transmitter project you just finished. Have you ever wondered why the voltage drops or increases drastically when you key the transmitter? This is due to RF getting back into the regulator of the power supply. To prevent this, put 0.01 and 560 pF or 470 pF capacitors across the voltage output terminals.

A word of caution: The LM317s and LM337s like to have a load on them at all times. If the LEDs are not installed, and with no load on the regulator, the output voltage could float up to the input unregulated voltage. The LED current is sufficient to keep the output voltage from floating up.

Construction

The project is assembled in a Radio Shack box #270-250. A bigger box may be required if heat sinks and/or front panel adjustments are used. The AC power switch should be a DPDT type which disconnects both sides of the line when the power supply is turned off. The fuse should be in the high side of the power line and use a three-prong AC plug on the end of the power cord. The regulator ICs are rated at 1.5 amperes but will require heat sinks for the lower voltage applications that draw more current. For example, if the output is adjusted to 5V and the load current is 0.75 milliamps, there will be almost 10 watts of power dissipated into heat in that regulator IC. We did not show the heat sink in the power supply pictured in this article. When adding the heat sink, remember that the tabs on the LM337Ts are connected to the input voltage and the tab on the LM317T is connected to the output voltage. Mica insulating hardware (such as Digi-Key 4671K-ND or 4672K-ND, or Newark 46F7847 with insulating shoulder washers) must be used to isolate the tabs of the regulators from each other. The power supply is assembled on a nice 4" x 2.75" PC board with a screened legend for easy assembly. The board is available from FAR Circuits (Note 3). The transformer is external to the board and connects to the T1 and T2 points on the board.

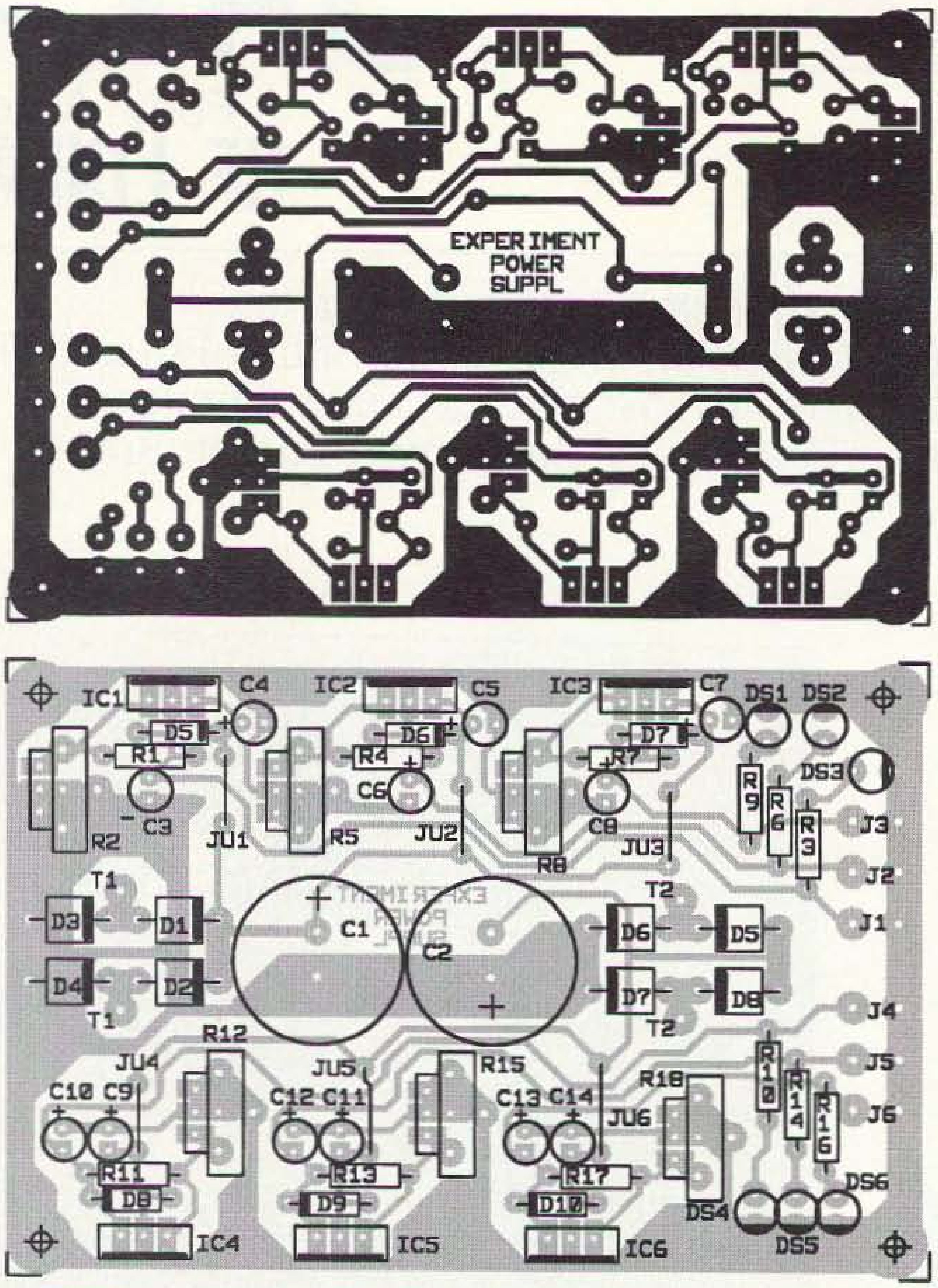

Figure 2. PC board pattern and parts placement for the switching power supply.

Parts List

IC1-IC3	LM317T (RS276-1778, All Electronics, Mouser #595-SG317P or 511-LM317T)
IC4-IC6	LM337T (All Electronics, Mouser #595-SG337AP or 511-LM337SP)
C1, C2	2200µF 25V (All Electronics, Mouser #140-LLR25V2200)
C3-C13	1µF 35µF Tantalums (RS272-1434, All Electronics, Mouser #540-0.1m35)
C14-C19	0.01µF disc capacitor (RS272-131)
C20-C25	470 pF disc capacitor (RS272-125)
D1-D8	1N5402s (RS276-1143, All Electronics, Mouser #333PG5402 or 333-PG5402)
D5-D10	1N4001 diode (RS276-1101, All Electronics, Mouser)
DS1-DS6	Red LED T3/4 (RS276-041, All Electronics LED-10, Mouser)
T1, T2	12.6V CT 3.OA Transformer (RS273-1511, All Electronics TX-123, Mouser #41 ILG030)
S1	Toggle switch 3A 125 VAC, DPDT (RS275-666) or DPST (All Electronics STS-14, Mouser #10TE002)
J1-J6	Binding post, red and black, (RS274-661 set of six, All Electronics 5-BP-B and 5-BP-R, Mouser)
F1	Fuse Holder (All Electronics FHPM-6, Mouser #504-HJM)
R1, R4, R7, R11, R13, R17	220 1/4 watt
R2, R5, R8, R12, R15, R18	5k pot (RS271-217, All Electronics STOP5K, Mouser #320-1510-5K)
R3, R6, R9, R10, R14, R16	See text
Box	Radio Shack #270-250 or Mouser #40UB103

The above part numbers are only suggestions and are not the only part that the listed companies have available that will work in the circuit. All Electronics: 800-826-5432; Mouser: 800-346-6873

Note 1. *Motorola Linear and Interface Integrated Circuits*, DL128, Rev 2.

Note 2. *Fred Reimers Storehouse of Knowledge*, 1946 Ed.

Note 3. A drilled and etched PC board is available for $6.00 plus $1.50 S & H per order from FAR Circuits, 18N640 Field Ct., Dundee IL 60118.

Number 7 on your Feedback card

73 Review

by T.S. Rowinski KA1MDA

The ICOM IC-W2A Dual-Band Handheld

ICOM America, Inc.
2380 116th Ave. N.E.
Bellevue WA 98004
Telephone: (800) 999-9877
Price Class: $500

Two radios in one!

It never failed. No matter which rig I happened to have at any given moment, all the action seemed to be on another band! If I had my 2 meter HT, I would miss my normal commuting skeds on 440 MHz. Yet whenever I had my 440 MHz HT with me, I would always find some need to get on the more heavily populated 2 meter band. The thought of carrying around the extra weight of two full-size handie-talkies and a couple of heavy-duty battery packs was not an appealing one.

There was only one solution: It was time to upgrade to one of those new, compact, dual-band handhelds! Having had excellent results (with both performance and service) with my older ICOM HTs, I selected the ICOM IC-W2A.

The ICOM IC-W2A is a full-featured dual-band handheld measuring only 6.7" high, 2.1" wide, and 1.4" thick. The rig weighs in at only 1.2 lbs. As delivered, frequency coverage is 140-150 MHz and 440-450 MHz transmit, 136-174 MHz and 440-450 MHz receive. Despite its small size, the W2A offers a full 5 watts output (at 13 volts) on both bands, four scanning modes, 60 memories (30 per band), simultaneous receive on both bands, full crossband duplex operation, and a host of other functions. Unlike many other HTs, the W2A comes equipped with a heavy-duty 7.2 volt, 1,000 mAH battery pack and a multifunction PL encoder/decoder as standard features. Other noteworthy features include a 24-hour clock, power on/off timer, two power-saver modes, four 15-digit autodialer memories, and a pager mode.

Although I had seen photos and dimensions of the HT prior to ordering the rig, they still did not prepare me for the surprise I experienced when I opened the box. How could ICOM fit all those features into such a small package? Although the W2A may sound large due to its 6.7" height, the heavy-duty BP-84 battery pack takes up three of those inches; the actual radio itself is only 3.7" long! The antenna connector, speaker and mike jacks, external power jack, rotary tuning knob, and dual concentric volume/squelch knobs are placed on top of the transceiver. An LCD display shares the front panel with the internal speaker/mike, an RX/TX status indicator LED, and no less than 22 individual buttons—no small feat considering the W2A's 6.5-square-inch front panel. The function and PTT switches are located on the left side of the case. The lower two-thirds of both sides of the case are contoured for an easy and comfortable grip.

The first thing I noticed about the W2A is how naturally it fits in the palm of the hand. After using this HT for a few hours, going back to my trusty 02AT/04AT suddenly felt as if I were holding a brick! Although the W2A is compact, it does not feel cheap. The rig has a slightly heavy (for its size) feel, and the metal back provides structural rigidity while serving as a heat sink for the output modules. Squeezing the rig, even hard, caused none of the squeaking, popping, or snapping sounds common to many plastic-cased radios. The W2A felt like a quality, high-grade piece of electronic gear.

Features

The ICOM W2A is chock-full of useful features. There are 30 memories, plus a VFO memory, call channel memory, and two band-scan memories for each band. Each of these is capable of storing not only frequency and offset, but custom offset, PL encode mode and frequency, PL squelch mode, and channel scanning lockout information as well. Unused memories can be masked. Memory backup is handled by an internal rechargeable battery, although ICOM provides no information as to how long memory contents can be retained with no external power.

There are five different scan modes available. The simplest is VFO scan mode. Enter a frequency into the VFO memory, and hit the scan up or scan down key. This has the same effect as tuning a receiver across its tuning range. Programmed scan mode allows the user to enter two frequencies into scan memory, and the radio then scans continuously between these two limits. This is similar to what scanner manufacturers call search scan. Memory scan mode scans all 30 memories, regardless of their lockout or "skip" settings. Memory skip mode scans only those memories which have not been assigned lock-out status. Finally, frequency skip mode allows the user to enter up to 20 frequencies in memory, and perform a VFO or programmed band scan. The rig will then ignore these frequencies while scanning. If this weren't enough, all these modes have two resume modes: timer and pause. Timer resume

stops the receiver when a signal is received, pauses for five seconds, and resumes scanning. Pause resume mode stops the receiver when a signal is received, and will not resume scanning until two seconds after the signal ceases.

The ICOM W2A also comes equipped with a multifunction PL board which allows full PL encode/decode functions. The PL unit can be used not only as an encoder to access closed

repeaters, but also as a subaudible tone squelch which will keep the receiver squelched regardless of channel activity until the unit receives the proper PL tone. When the right tone is received, the W2A can be set to either open the squelch and receive the signal, or to emit a series of pager-like beeps for 20 seconds. Pushing the PTT button cancels the PL alarm mode and returns the rig to PL tone squelch mode, allowing reception of the desired signal.

When setting PL tones, the actual tone frequencies are displayed on the LCD, instead of the archaic two-digit alpha-numeric codes used on some older rigs. Since the PL board is actually two units in one, it's possible to transmit with a PL tone on one band and activate the PL squelch on the other band using a different PL tone. It is also possible to operate both receivers in PL squelch mode using different tones on each band. Although the PL tone squelch functions during crossband repeat mode, the PL encoder does not.

The W2A also sports a pager/code squelch mode which is activated by a sequence of DTMF touch-tones. This mode allows for all call, group call, and individual call modes, which allow a single transmission to trigger all receivers, a subgroup of receivers, or a single receiver, respectively. The pager tone sequences, as well as the pager decoder codes, are entered into five memory positions reserved for this function.

Other nice touches include tuning increments which can be set at 5, 10, 12.5, 15, 20, 25, 30, and 50 kHz steps for both VFO and scan modes. In addition to these, 100 kHz and 1 MHz steps are available when using the tuning knob at the top of the radio. Frequencies can also be input directly from the keypad. Transmit offset frequency is programmable in 5 kHz steps from 5 kHz to 10 MHz. The IC-W2A also features a keyboard lock function which locks out all keys except the dial light and high/low power switch, and a PTT lock which makes it impossible to key the transmitters.

A number of features specifically address power consumption and battery life. Transmitter power output is selected from four steps rather than the more common hi/low setting. "Auto off" mode shuts off the radio if no transmissions or key strokes are made within a specified time period. Prior to shutting down, the rig emits a number of beeps to warn the user of its intentions. "Power saver" mode puts the W2A into standby mode after five seconds of inactivity. The unit will then turn on every few seconds and check for a received signal. If the channel is quiet, the W2A goes back to sleep and the cycle repeats. If the channel is busy, the radio will remain on until activity ceases, then resume power saver mode. The "on/off" duty cycle is selectable between a 1:4 and a 1:16 ratio. "Power saver" works only when monitoring a channel—it does not function when using any of the scan modes.

Ironically, some of the W2A's biggest features are those which ICOM does not mention in the owners manual: extended wideband receive and crossband repeat. Both of these features are accessed through simple keyboard sequences without the need to open the radio or perform any hardware modifications.

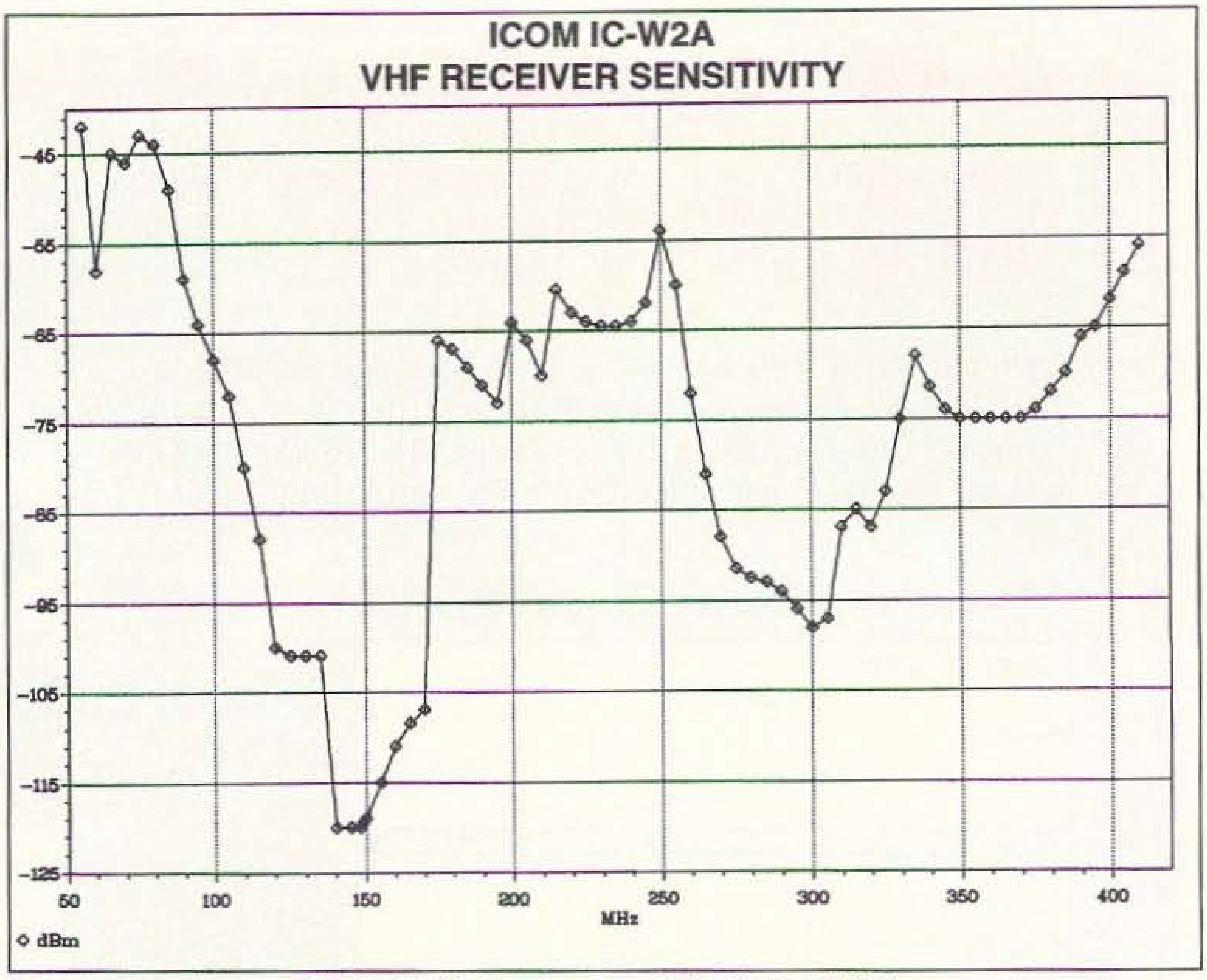

Figure 1. VHF receiver sensitivity (55-420 MHz).

Modifications and Operation

To open the coverage range of the receiver, turn the radio off. Then turn the radio on while simultaneously pushing the [LIGHT], [B], and [#] keys. After I performed this procedure, the receiver tuned from 55-410 MHz (including AM aircraft) on the VHF band. The UHF receiver covered 350-525 MHz and 725-1026 MHz (FM only)! *Warning: Please remember that it is illegal to monitor cellular phone conversations!* As expected, receiver sensitivity varied widely across these ranges. Due to high-pass filtering on the VHF band for image rejection purposes, don't expect to hear much below 118 MHz. Figures 1-3 show receiver sensitivity in dBm for a 20 dB quiet-

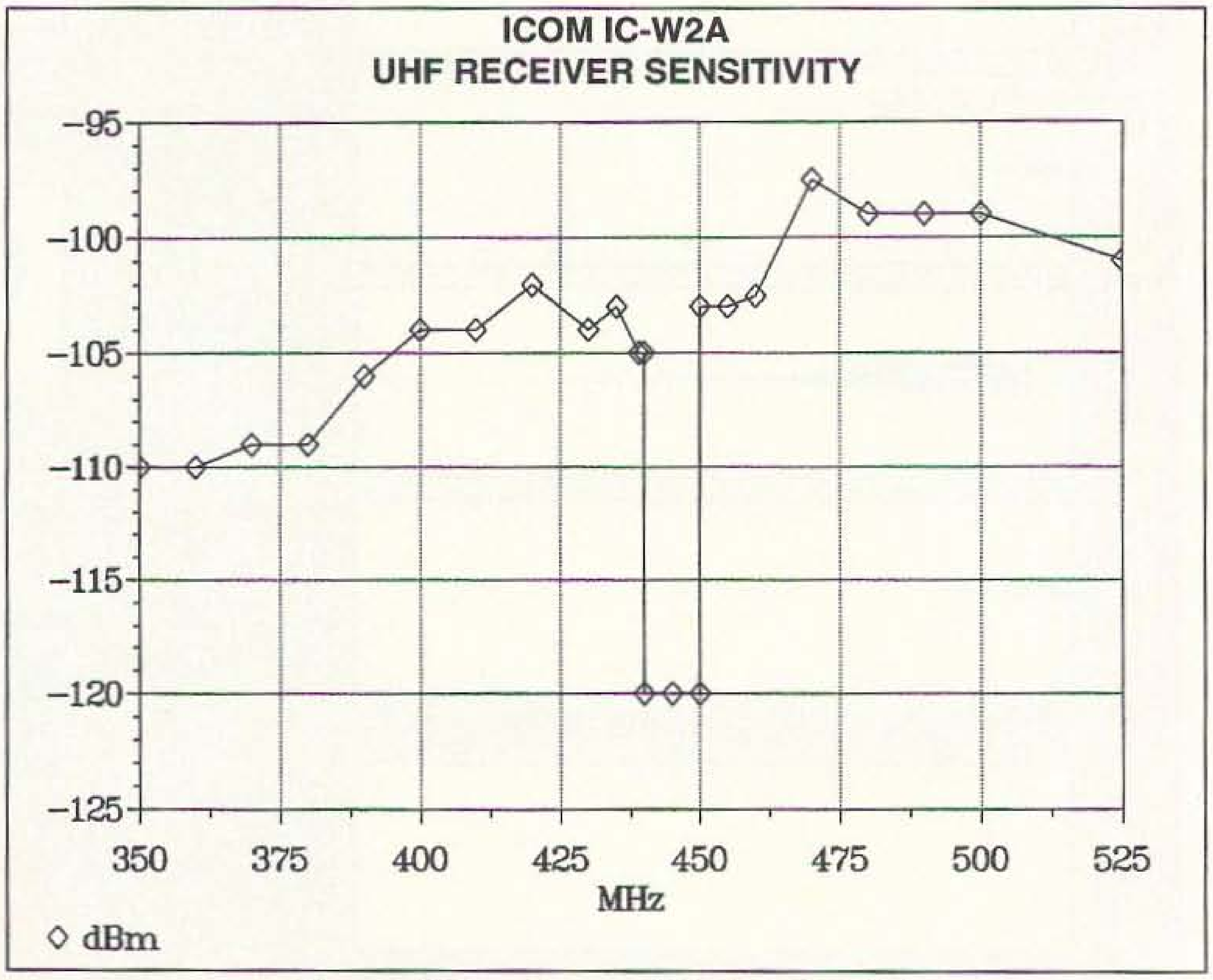

Figure 2. UHF receiver sensitivity (350-525 MHz).

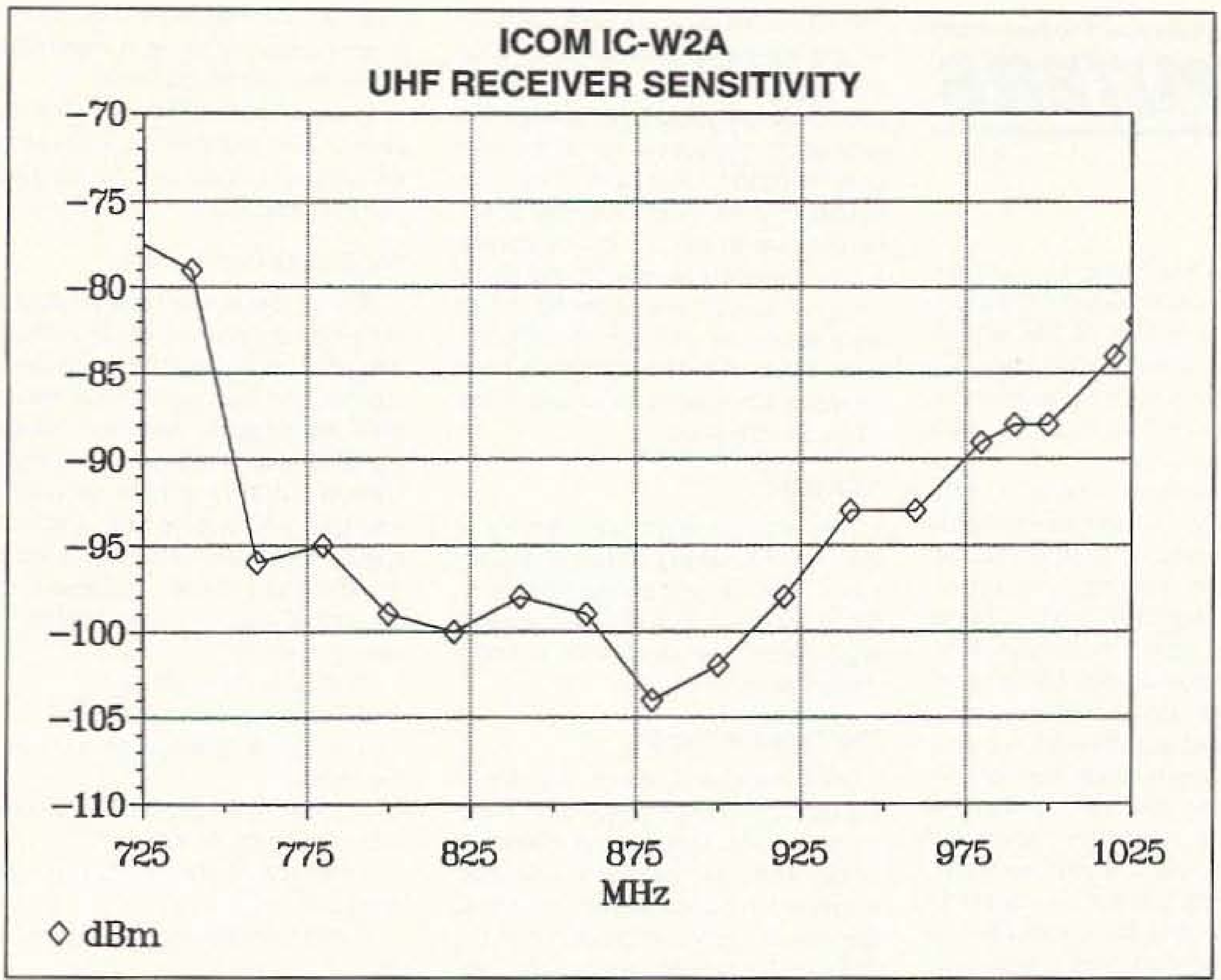

Figure 3. UHF receiver sensitivity (725-1025 MHz).

ing figure. For those not familiar with dBm, the sidebar table cross-references selected dBm levels to microvolts. Although the LCD display goes from 0-1300 MHz, these figures represent actual receive band limits as confirmed with a signal generator.

After completing this modification, access the radio's setup menu as per the instruction manual. Step through the options with the [UP] or [DN] keys and you will find a new parameter not listed in the ICOM manual, called PL. This sets the highest MHz place which can be programmed by the direct keyboard entry mode, selectable between 1 MHz, 10 MHz, and 100 MHz. Turn the tuning knob to set the PL parameter to 100, then press either the PTT or [CLR] to exit the setup menu. The VFO can now be tuned to any frequency within its extended receive range by simply entering the numbers from the keypad. For example, say the VFO is set at 440 MHz and you want to tune to 903.525. Simply enter: [#] [9] [0] [3] [5] [2] [5].

To enable the crossband repeater function, the above wideband receiver modification must be performed first. To activate the repeater, enter the desired frequencies and modes (simplex or duplex) and push the [VMAIN] key. While holding down the [FUNCTION] key, press the [2] key and then the [ENTER] key. The keylock [L] symbol will now flash on the LCD display, indicating that the unit is in repeat mode. To cancel repeat mode, push the [FUNCTION] and [ENTER] keys simultaneously.

Lab tests were performed using a Hewlett-Packard 8654A signal generator and 403B AC voltmeter, a DigiMax D-1200 frequency counter, a Measurements 920 peak deviation meter, a Daiwa wattmeter, a Heathkit Cantenna dummy load and SM-5258 THD analyzer, a B&K 1630 DC power supply, and a Fluke 95 scope-meter. For frequencies above the H-P 8054's 535 MHz limit, the signal generator's second harmonic was used. This harmonic was measured and found to be 30 dB down from the fundamental. Then 30 dB was subtracted from the signal level settings. All graphs and/or charts show the corrected figures.

The ICOM IC-W2A utilizes dual-conversion receivers with a 30.85 MHz 1st IF (35.80 MHz on UHF) and 455 kHz 2nd IF. Receiver sensitivity measured 0.12 µV for a 12 dB SINAD on both 2 meters and 70 centimeters. The 20 dB quieting level measured 0.22 µV. Receiver sensitivity was essentially flat across both ham bands, and varied widely across the extended receive range, as shown in Figures 1-3. Image rejection measured 72 dB on 2 meters and 77 dB on 70 centimeters. Audio output measured 150 mW with 3% THD. Maximum audio output using ICOM's 10% THD reference was 220 mW.

dBm Versus Microvolts

dBm	uV	Volts
0	220,000	0.22
10	70,000	0.07
20	22,000	0.022
30	7,000	0.007
40	2,200	0.0022
50	700	0.0007
60	220	0.00022
70	70	0.00007
80	22	0.000022
90	7	0.000007
100	2.2	0.0000022
110	0.7	0.0000007
120	0.22	0.00000022

On the transmit side of things, peak deviation measured 5 kHz for voice and 2.5 kHz for DTMF tones. Transmit frequency was 20 Hz low on 2 meters and 40 Hz low on 70 centimeters. Maximum RF power output measured 6 watts at 13.8 volts and 1.5 watts when using the supplied BP-84 battery pack.

Power consumption measurements were taken at 7.2 volts to simulate realistic current drain on the battery pack during typical portable operation. Where different readings were obtained depending on band, the first value is for the VHF unit and the second value (in parenthesis) is for the UHF unit. Unless otherwise noted, measurements were taken with only one band in operation. The receiver drew 50 (70) mA during no-signal squelched state, 150 (170) mA for full audio output, and averaged 13 (18) mA in power saver mode. With both receivers on, power consumption measured 117 mA during standby, 220 mA for full audio output, and 21 mA in power saver mode. Activating the backlight added 15 mA to the battery load. Transmit current measured 410 (625) mA at the lowest power setting and 780 (970) mA at the highest power level. At 13.8 volts, transmit current measured 1.5 (1.7) amps at maximum RF output.

Real-world use tests were conducted over a six-week period during which the W2A was used in base, portable, and mobile environments. Audio output was ample for base and portable operations, but a little light for mobile use in a noisy vehicle. The LCD display was easy to read from a wide range of angles. The dual LED backlight provided sufficient light to read the display at night. Very few intermod products and virtually no birdies were noted on either band, even when operating in areas of high RF clutter around Springfield, Massachusetts. Those that did occur were usually well outside both ham bands in the W2A's extended receive range. The operator's manual was relatively clear and easy to understand, with only a few confusing sections.

Although it was easy to inadvertently hit a key on the crowded keyboard and QSY to another frequency or send the rig into scan mode, the keylock feature proved extremely useful for preventing such accidents during mobile operation by locking out all keys except PTT, power, light, and hi/low RF power. The PTT lockout feature proved handy when leaving the rig in the presence of co-workers and other non-hams, and could be a real plus for hams with children. The W2A's small size and light weight also made for comfortable, extended-duration QSOs while commuting to work. Although the metal rear cover became fairly warm during long-winded QSOs, it never became uncomfortable to the touch. The W2A's mechanical construction also appeared quite durable; it survived a few accidental drops of two to four feet (definitely not recommended)!

The W2A's lack of sufficient low-battery warning was annoying. The radio would operate flawlessly right until the battery went

Continued on page 42

Number 8 on your Feedback card

PACKET & COMPUTERS

Jeffrey Sloman N1EWO
75 Herriott Street
Franklin IN 46131

Async Comms, Part 2 (Finally)

Whoops! The flurry of paper, bits, and phone calls here at N1EWO Central Control sucked up this second half (continued from the March 1993 "Packet & Computers" column) of our async primer and spit out the first half of a different series. For those of you who got confused, it wasn't your fault—it was mine. So, the result is that we will have interleaved multipart columns for this and next month.

When we last left our data, it was timing itself—allowing us to communicate asynchronously. Let's review a little. The term asynchronous (async) means "without the same time." It comes from the Latin roots "a," for without; "syn," for the same; and "chronos" for time. As you can see, it's a strange sort of word. It sets up a complicated idea and then adds "not." What this whole mess means to digital communications is that the data on an async link does not depend on a common "clock"—regulating signal—to figure out each bit as it goes by.

Before I completely confuse you, let's take a step back. Why is time important at all? OK, binary communications (that use only two states—on and off, high or low, etc.) depend upon time to create combinations that can be interpreted as characters. The "canvas" upon which the character is "painted" is time. In contrast, printed communications use space as their medium. As you look at written communications, you are concerned with how the marks or the paper (or display) relate to the space they occupy. The terminal's space is time. It concerns itself with the relationships that the bits form in time to figure out their content. This makes time the medium upon which the data is written. Don't worry if you don't get this, it is not critical to understanding this stuff. If you do get it, though, it will help you understand.

So, we are dealing with something that happens over time. The receiving station has to know when a bit (the smallest unit of data—a binary 1 or 0) has gone by. You'll get a better feel for this if you think of a data stream that has, say, seven 1's in a row. Without some sort of timing, the receiving station would have no way of telling that this was not just one big 1, since the signal will not change for the duration of the seven 1 bits. The obvious solution is to have one side be in charge of the timing. This is called synchronous communications. In this scheme we send a standard clock signal along with the data, and the data stream is interpreted by this timing. In our seven 1's example, seven ticks of the clock would count off the seven bits as they went by. This works fine, but while it is conceptually simpler, it is more complicated to implement on a real data channel.

The alternative scheme is our subject—asynchronous communications. The name, async, is a bit confusing. While it implies that time is not important, this is not true. What it really means is that there is no master clock. The data is self-timing. Each async character has what are called "framing" bits. These are the start and stop bits that you are probably familiar with from setting in your communications software, or even from using dip switches inside a dumb terminal. These framing bits let the receiving station know that the character has started and stopped. This makes each async character its own clock. Well, at least to a point. You still need to know at what speed the data is being sent. It isn't a free-for-all. The framing bits let the receiver sync(hronize) to the bit sequence. There are standard data rates that must match.

Back to Earth

So, what's the practical upshot of this academic stuff? For those with a nuts-and-bolts bent, it means that for the TNC and computer to successfully communicate they must be set to the same data parameters. The most common setting, and the first to try if you don't know what is the right combination, is 7E1. 7E1 is shorthand for 7 data bits, Even Parity, 1 Stop bit. Let's break that down.

7 Data Bits

This means that the characters are made up of 7 bits. This is fine for the standard ASCII (American Standard Code for Information Interchange) character set. Seven bits allows for 128 different combinations—in this case characters. This is fine for most communications, but for graphics characters (which are in the extended ASCII set) or binary file transfer, which uses all 255 combinations that the 8 bits of a byte allow. (Note: Binary file transfer using 7 bits is possible, but it requires special software to encode and decode the information on each end.) Seven bits is the de facto standard because it is usually all that is needed, but 8 bits is a possible value as well.

Even Parity

The parity bit is used for error detection. You are unlikely to actually find software that does anything with it other than report an error. In other words, it is not used for error *correction*. In any case, it works likes this: The bits in the data are added together and the parity bit is set to a value that will make the result either even or odd, depending upon the setting. For example, in the case of an "e" the data bits, "1100101," add up to four. This means that for even parity the parity bit gets set to zero. This is because four is an even number. If the parity were set to odd, the parity bit in this case would be one—which added to four makes the odd five. Your main concern with parity is to set it the same on both ends.

1 Stop Bit

The stop bit is the complement of the start bit. Every async character has a start bit and at least one stop bit. You *can* set stop bits to 2, though. Again, your main concern is to match the two ends.

The Speed of Things

As I mentioned before, the rate of the data transmission must also match on both ends. Data rate is measured in bps (bits per second). It is also measured in bauds (named for J.M.E. Baudot, a French engineer from the 1800s). These two can be—but are not necessarily—the same. A baud is a state change or transition—say from on to off. A baud can transmit one *or more* bits. In the simplest case, bps = bauds because one bit is sent for each transition. This will be the case for the connection between your terminal and TNC. As soon as we start to discuss modems with data rates higher than 1200 bps, the picture changes.

Because modems work by changing data to audio and back again, the bandwidth (frequency range) with which they have to work puts a limit on how many bauds (transitions per second) they can transmit. Most modems are designed to work on voice channels which offer a bandwidth of about 3000 Hz. So to get around the relatively narrow bandwidth, high-speed modems use a technique that combines the frequency information of the signal (FSK—Frequency Shift Keying), and the phase information (PSK—phase shift keying). This scheme is called trellis encoding. It uses combinations of frequency and phase in a table that resembles a trellis, hence the name. This approach allows more than one bit of information to be encoded into each transition—or greater than one bit/baud.

Practically speaking, you need to make sure that each end of the data link is set to the same speed. What should this be? My general purpose recommendation is 9600 baud. A good question is, "If the on-the-air data is only going 1200, why set the comm link at 9600?" Well, if the only data that was sent over the link was from the on-the-air link, that might make sense. But the TNC sends status messages, mail, and other traffic to the terminal. It is much more pleasant to work with the TNC at the higher data rate. On the other hand, it is not a requirement. While you might experience difficulties—like buffer overflow—if you set the link below 1200 baud, it is not necessary to set it higher than 1200—it will work fine there.

The next part of this series will appear in two months. I will cover the software side of this confusing but vital part of packet radio.

The Survey Continues!

A few months ago I started publishing a set of survey questions which I thought I would run for a couple of months and then publish the results. Well, the response has been increasing rather than decreasing so I thought I would put them in here once again and give you another chance to respond. It's not too late, but this will be the last time I ask for responses. You can use E-mail or paper mail to answer the survey.

1. What is your callsign?
2. What is your license class?
3. What computer(s) do you use in the shack?
4. What operating system/environment version(s) do you use?
5. Which digital modes are you *equipped* for?
6. Which digital modes are you *active* in?
7. Which of these columns (month, year) has been your favorite (if any)?
8. What has been your biggest problem with computers in ham radio?
9. What would *you* like to see in this column?
10. *Any* comments:

You don't need to copy the questions, just put the number before your answer. Answer all the questions, or just the ones you want. Make the responses wordy or brief. I really want your feedback to make this column something you look forward to each month. Thanks so much for your participation.

Electronic Addresses

Packet: N1EWO@NICENI/0ARY

(Note: I'd love to hear from you on packet—but not about the survey! This survey is the business of this magazine, and we can't do that on ham radio. A personal note or test message is just fine.)

Internet: jsloman@mcimail.com

(This is my preferred address.)

MCI Mail: jsloman

(This is the same as above, but direct.)

CompuServe: 71221,1143

(This is my least favorite place to get mail, but it is OK.)

Even if you don't answer any survey questions, I am very interested in anything you have to say. I can't answer every message—though E-mail has a *much* better chance. Many of you have written asking for help. You have not been forgotten; I am planning a "mail bag" column for the near future where I can answer the many similar questions that come in. For those of you who have written saying that you enjoy the column, thanks. For those of you who would like to see additions/changes, please write to me—it's the only way I have of knowing what you need and want. 'Til next month, 73 de N1EWO. 73

ICOM IC-W2A

Continued from page 39

dead, giving virtually no warning whatsoever. When the battery finally did run down, the only warning was a howling or oscillation in receive mode or a transmitter which cycled on and off if the PTT key was pressed. Once either of these events occurred, there wasn't enough juice left in the battery to even sign off! On two occasions I was unable to shut off the radio with the power button (which ties into the CPU and is not a hard-wired power switch). The only way to get the unit to stop howling or keying was to remove the battery pack. It would have been nice had ICOM used the front panel status LED to warn of an imminent dead battery condition a minute or so before the rig actually goes dead, as was done in the IC-2/3/4AT series of handhelds.

My biggest disappointment with the ICOM IC-W2A was its limited transmit frequency coverage on the 70 cm band. The W2A transmits between 440 and 450 MHz only. With its full crossband duplex modes, this HT would have made an excellent basis for a portable OSCAR AO-21 platform, had not the 435 MHz FM uplink frequency been locked out of the transmit range. A call to ICOM's tech line confirmed that there was a mod available to open the transmit range, but ICOM would not reveal the mod, stating that it was a "dealer mod." A call to two dealers proved fruitless, while a third dealer offered to perform the modification for a fee, but only if a MARS or CAP license was presented. ICOM would do well to provide a simple mod or upgrade the programming to enable transmit in the 430 to 440 MHz range. With an HT this advanced, they have truly limited its potential and missed a golden opportunity to introduce users to satellite communications.

Other drawbacks were minor, but equally irritating. These included an oddball DC power connector, the likes of which I have never seen anywhere other than on the pages of an ICOM accessory catalog. Although the battery packs are interchangeable between the W2A and the 24AT, forget the speaker mike or headset units. If you've ever charged an ICOM BP-4 in a BC-30 charger, you'll be as surprised as I was to discover that the W2A's BP-90 battery cases cannot be recharged in a drop-in charger. Finally, the shape of the belt clip made it virtually impossible to hook the radio on a back pocket with one hand. Attempting to do so was an exercise in aggravation. The shape of the clip caused it to prefer plowing through material rather than sliding over it. The only way to engage the clip was to use one hand to pull on the pocket and place the material under tension, and use the other hand to force the clip down over the pocket lip.

A Bargain

All things taken into consideration, the best way to sum up the ICOM W2A is to call it a bargain. Although $500 is not cheap for an HT, one must remember that the W2A is basically two completely independent single-band radios sharing a single case, and is capable of doing anything two separate HTs could do, except transmit on both bands simultaneously. The BP-84 heavy-duty battery and the included PL encode/decode board make the radio quite an attractive value. Toss in the wideband receive modification, and it's like getting a portable scanner for free!

The ICOM W2A is not for everybody. With so many features packed into such a small package, plan on spending at least four or five hours with the owner's manual learning what all those double and triple function buttons do. It took me about a week to learn my way around all the features and extras packed into this little HT. For those willing to take the time to read and understand the manual, the W2A is an exceptional rig.

Rating this HT on a scale of one to 10 was difficult. Receiver sensitivity, frequency coverage, features, ease of use, layout, appearance, and performance all deserved a solid 10. However, I could not overlook the unit's inability to transmit on legitimate 430 MHz satellite FM uplink frequencies, nor the difficulty experienced in trying to get it to do so. The incompatibility of some accessories between the W2 and 24AT, along with the weird power connector and lack of any advanced low-battery warning also pulled down the overall rating. On a scale of 1 to 10, I would rate the ICOM IC-W2A at 8-1/2. 73

An Everything Amplifier

Continued from page 28

Results

At 223 MHz the amplifier will put out more power than is legal for Novice operators. However, this power can be backed up to the legal 25 watts by adjusting R3. I tested this amplifier with my 1.25 meter handie-talkie, 2 meter handie-talkie, 6 meter transceiver, 10 meter mobile rig, a 10 MHz home-brew transmitter, and an HF rig at 3.5, 7, 10, 14, 17, 21, 24, and 28 MHz. The amp does not work well at 3.5 MHz, but it does at the other frequencies tested. At HF frequencies with only 13 volts from the power supply, 1 watt input gives a little more than 30 watts out. One point cannot be emphasized enough: Do not put more than 25 watts into this amplifier—so be careful if you test this amplifier with a transmitter that is capable of putting out more power than that.

If the amp is used for SSB, the relay may not want to stay engaged. It may be necessary to manually key the relay if you're going to use the amp on SSB or to design a circuit that will delay the relay from opening once it closes.

As the power supply voltage is changed, the bias will sometimes have to be adjusted. Furthermore, bias sometimes has to be changed if you go from one band to one of a much different frequency. The power gain of a broadband amplifier will go up at the lower frequencies, and if you switch to a lower frequency with no adjustment, the amp may go into oscillation.

Receive sensitivity is slightly reduced—especially at the higher frequencies. If you want to get the receive sensitivity back up to the level it would be without the amplifier, consider installing a broadband preamp.

Remember that FCC regulations, common courtesy, and good operating practice require the use of minimum power when operating on the airwaves. Also remember that experimentation is one of the main reasons for our hobby.

My thanks to the XYL, Carolyn KC4NBE, who encouraged me in the project and proofread the manuscript. Also thanks to Will Payne N4YWK, who worked with me on the project and gave me tips that enabled the amplifier to work. 73

Bibliography: Motorola Semiconductor Products, Inc., *RF Device Data*, Vols. 1 and 2, 1990.

Approximate Metric to English Conversions

	List:65mm 2-19/32"
50mm	1-63/64"
40mm	1-19/32"
35mm	1-25/64"
11mm	7/32"
6mm	15/64"
5mm	13/64"
1mm	Less than 3/64" or more than 1/32"

Electronic Project Panel Labels

Let your computer help.

by Marion D. Kitchens K4GOK

After finishing the electronics on your latest project, the next matter at hand is a suitable enclosure, followed immediately by the problem of labeling. How do you make your electronic marvel look like a professional piece of work? There are a number of different ways to accomplish that task, all with various degrees of difficulty and varying qualities of results. Many hams resolve this problem with rub-on lettering, stick-on tape labels, etc.

With the advent of desktop publishing on personal computers, there is another way that is quick and easy, and produces top quality results. The desktop publishing technique has several advantages over other methods. It allows you to design the panel electronically, so changes are easy to make without the hassle of physically changing things. This way you can get the layout exactly the way you want it, before "cutting metal." The only limit to the degree of detail and complexity is your imagination: You can put whatever you want on the panel, including graphic images. If you can do it on the computer, you can put it on a panel.

As a practical matter, a printed copy of the panel layout can be used as a template for drilling holes and making cutouts on the physical panel. This assures proper alignment and location of switches, jacks, indicator lights, etc.

This article describes the desktop publishing method and the resolution of the pitfalls the author encountered. Hams who build electronics projects are encouraged to "dress them up" with professional-looking panels and labeling.

Making a Panel

I recommend making an initial rough pencil layout of the panel. Make sure that you plan for all the switches, control functions and the like that the project either does have, or may have in the future. Leave room for additions or embellishments to your project. See Photo D for an example of a rear panel showing jacks for just such future embellishments.

Use your favorite desktop publishing software to make a full-size layout of the panel.

Photo A. The "CONSTANT CURRENT," panel made with a 9-pin dot matrix printer.

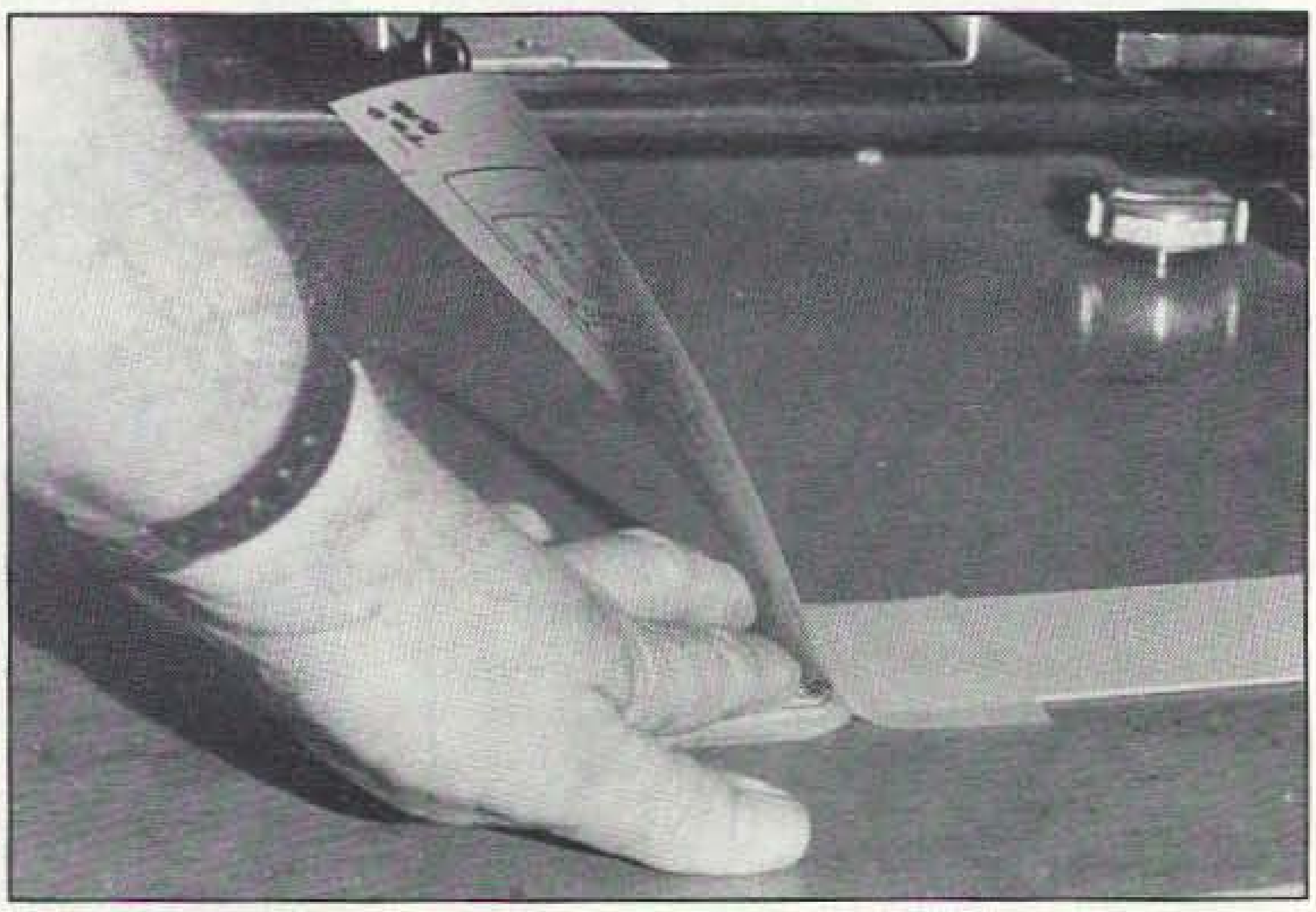
Photo C. The "roll on" technique recommended for application of the film.

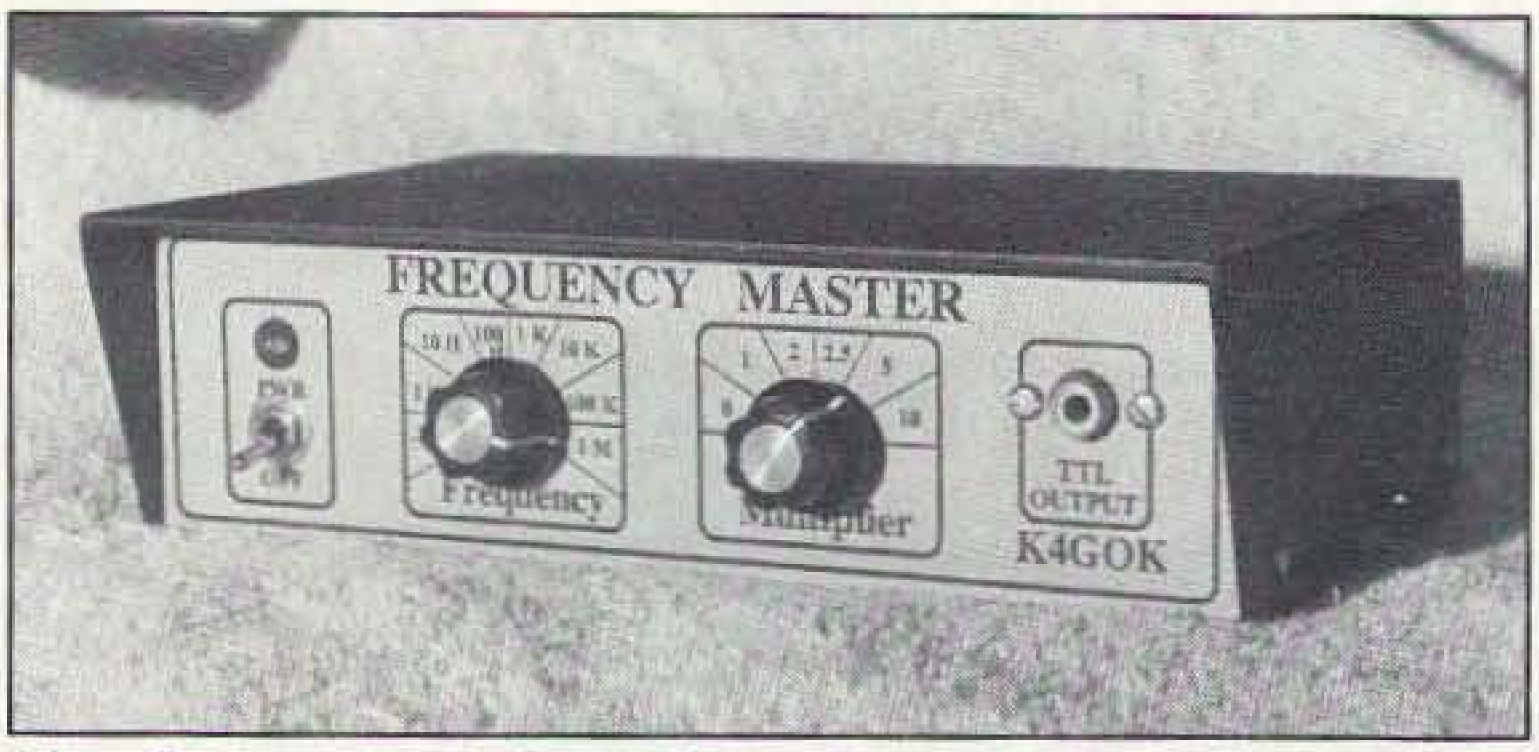

Photo B. Front panel of "FREQUENCY MASTER," showing the computer-generated panel layout.

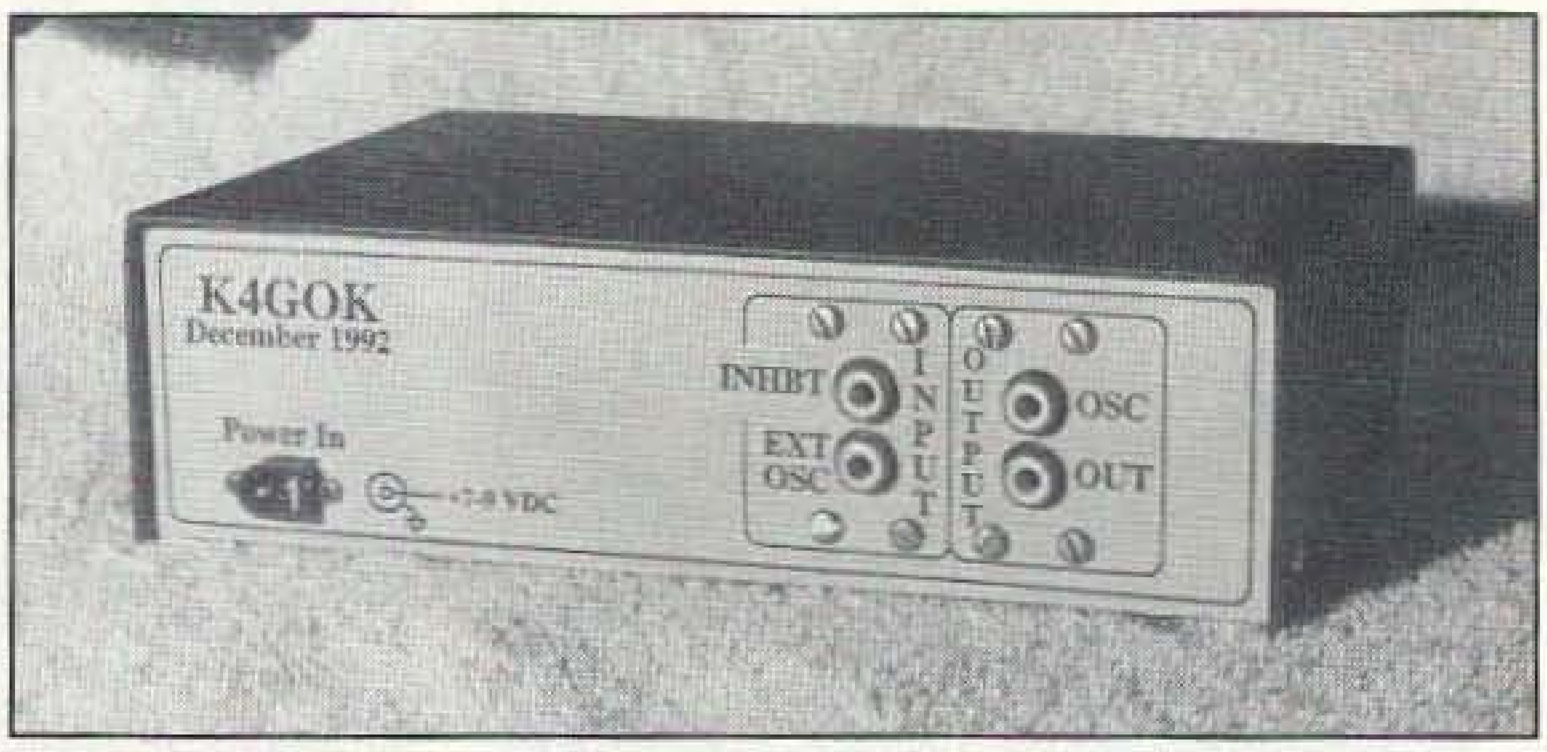

Photo D. The rear panel, showing provisions for "embellishments" as mentioned in the text.

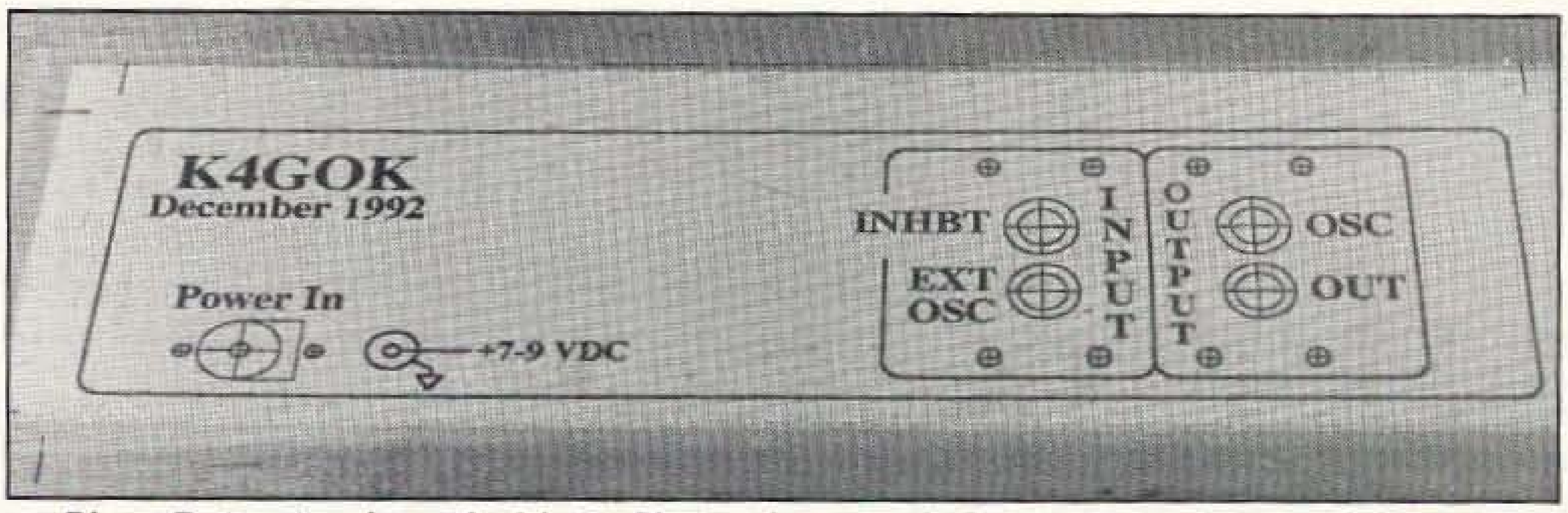

Photo E. A painted panel with the film in place, ready for cutting to shape and drilling.

Make sure you have it the way you want it: The finished product will be exactly like that in the computer. Print out a copy of the finished layout to be sure it is OK. For best results, I recommend a laser printer, but 9-pin dot matrix printers can also produce quite good products. The "CONSTANT CURRENT" panel shown in Photo A was done with a 9-pin dot matrix printer.

Take your final artwork to your local copy shop. Make a copy on paper, and a copy on transparent stick-on film. The film used for making the "FREQUENCY MASTER" panel shown in Photo B was called Graphic Applique Film. It was the brand offered by my local copy shop, and should be available widely. It works well, without stretching or distortion during application.

I recommend completing all the metal work and painting before applying the film. This results in the best-looking panel, but it also requires careful alignment of the film before sticking it in place. The film sticks tightly and can pull the paint off if it is lifted for realignment. Use the paper copy for drilling and cutting the panel. Rubber cement works great for sticking the paper copy to the metal panel. I found out the hard way that "100%" size on most copy machines is not actually 100%. But if you use the paper copy, it will be the same size as the film you will be applying later. When cutting the panel from the material you use (I used double-clad PCB here), leave a small tab on one end. I left about 3/4" on the end of the "FREQUENCY MASTER" panel (Photo B). This tab serves as a place to stick the film down while aligning it with the panel. Cut off the tab after applying the film.

Alternatively, the film can be applied before drilling and cutting the panel. If you use this technique, sharp drills and cutting tools must be used to prevent damaging the film during that operation.

Apply the film by aligning it carefully and sticking it down to the tab. Bend the film so that the stiff backing will "unroll," and rub the film down with your finger as it is comes in contact with the painted panel. See Photo C. Apply only a small area at a time. Make sure all the small air bubbles are rubbed out as you go. Any trapped air will not come out later. It is important that the air be rubbed out as the film is applied.

The edges of the film can either be rolled around the edges of the panel and stuck to the backside, or trimmed neatly to the panel edges with a sharp X-acto knife. I recommend putting a thin bead of white glue around the trimmed edges to prevent clumsy handling from lifting the film during use.

The film needs no protection for normal handling—the lettering seems to be durable. Once the film is applied to the painted panel it is ready for use.

Using the desktop publishing technique produces craftsman-quality labeling for home-brew electronic projects. The results are comparable with rub-on lettering and India ink, and can be achieved with considerably less time and effort. I recommend this technique for all who enjoy building electronic projects.

Number 11 on your Feedback card

CARR'S CORNER

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Home-Brewing Your Own RF Filters

Radio frequency filters are inductor-capacitor networks that pass one band of frequencies, while rejecting all other frequencies. Hams use RF filters in a wide variety of applications: keeping harmonics at the transmitter, preventing out-of-band signals from getting into the receiver, etc. There are four basic types: low-pass filters (LPF), high-pass filters (HPF), band-pass filters (BPF) and rejection filters (called notch filters when the rejection band is narrow, and bandstop filters when the rejection band is wider).

The LPF and HPF frequency responses are shown in Figures 1A and 1B, respectively. In the LPF (Figure 1A), all signals from DC to some cut-off frequency (Fc) are passed, but above Fc the response falls off to the point where there is little signal passing. The cut-off frequency is usually defined as the point where the frequency response falls off -3 dB from the in-band response. The HPF characteristic is shown in Figure 1B, and is exactly the opposite of the LPF: It rejects all frequencies below its cut-off frequency, while passing all frequencies above Fc. Note that these curves are a bit idealized; real RF filters are not so smooth either in the passband or outside it.

If you start "raw" and design your own filter, then the task is daunting indeed. But if you use tables of values for "normalized" generic filters, then the job becomes a lot easier . . . and certainly falls into the "easily do-able" category. I recently tried my hand at a number of RF filters for different purposes, only some of which are related to ham radio, but all of which illustrate the principles involved. You can also use the same method to design filters for your own purposes.

"The filter projects turned out so well that I am convinced it is another case of ' . . . the contriving of contrivances is a game for all.' "

I had several projects in mind when I built some filters. First, I needed both HPF and LPF designs with overlapping cut-off frequencies of 3,000 kHz or so (the exact frequency was not critical). Second, I needed an 8,000 kHz LPF for a small 40 meter 1.5-watt power oscillator that I was building. Finally, I needed an LPF that would reject the AM broadcast band, while passing LF/VLF signals. For these projects I turned to the *ARRL Handbook* for the normalized tables. The circuits are found on page 2-51 in the 1993 edition, while the tables are found on pages 2-51 and 2-52. Figure 2 shows the basic LPF circuit, while Figure 3 shows the HPF case (both use the part designations found in the *ARRL Handbook).*

The tables give the values for the normalized case where Fc = 1 MHz; the inductances are given in microhenrys (µH) and the capacitances in picofarads (pF).

Table 1.

No. Elements	Ripple (dB)	C1	C2	L1	L2	L3
5	1	3473.1	3473.1	16.99	23.88	16.99
5	0.1	4364.7	4364.7	9.126	15.72	9.126
5	0.01	4153.7	4153.7	6.019	12.55	6.019

Example: The Low-Pass Case

In this example let's look at my 3,000 kHz LPF. It was used in a sweep signal generator that I designed for the AM broadcast band, and for common AM IF frequencies (e.g. 455 kHz). I needed it to facilitate a project that I am working on: a super AM DXer's receiver (sorry, no details as yet). A portion of the normalized 1 MHz data from Table 20, p. 2-52, is shown in Table 1.

The number of elements in the complete table varied from three to nine (odd numbers), but because this filter has two capacitors and three inductors, only the five-element data is reproduced (see the book for the complete table, as well as those for the HPF and other designs). The ripple data refers to the maximum ripple in the passband of the filter, and is expressed in decibels (dB). I selected the 0.1 dB figures.

The table data are normalized to 1 MHz, so to find the values of inductance and capacitance needed for the actual filter divide the values in the data table by the frequency in megahertz (MHz). To find the values for my 3,000 kHz (i.e. 3 MHz), 0.1 dB ripple LPF I divided the *ARRL Handbook* values by three:

C1 = C2 = 4364.7/3 = 1454.9 pF; L1 = L3 = 9.126/3 = 3.04 µH; L2 = 5.24 µH.

C1:	1454.9 pF
C2:	1454.9 pF
L1:	3.04 µH
L2:	5.24 µH
L3:	3.04 µH

The coils are relatively easy to come by: Wind them on Amidon Associates [2216 East Gladwick Street, Dominguez Hills CA 90220; phones: (voice) 213-763-5770, (Fax) 213-763-2250] coil forms. The T-50-2 (RED) cores have an AL value of 49, and op-

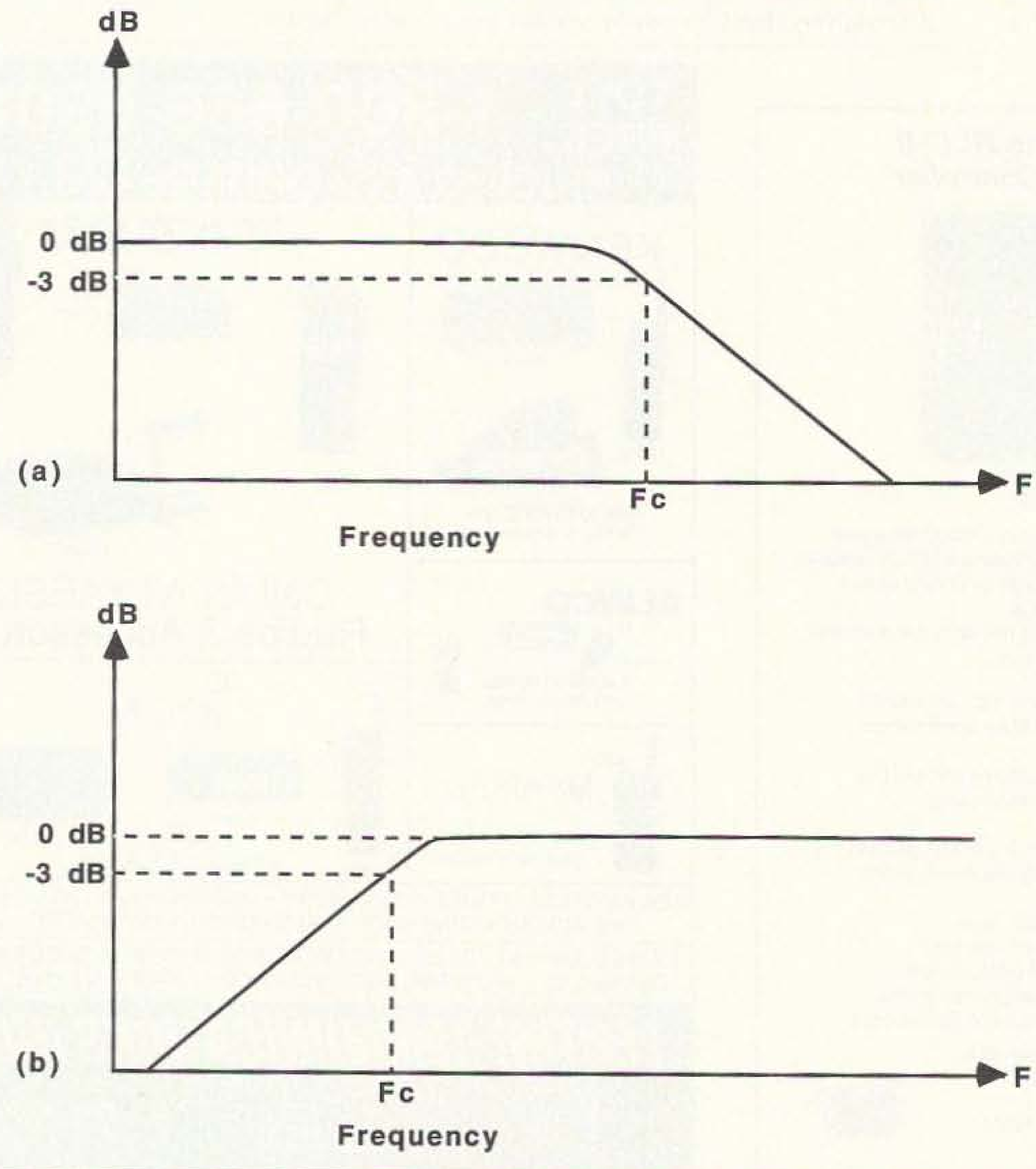

Figure 1. A) LPF frequency response; B) HPF frequency response.

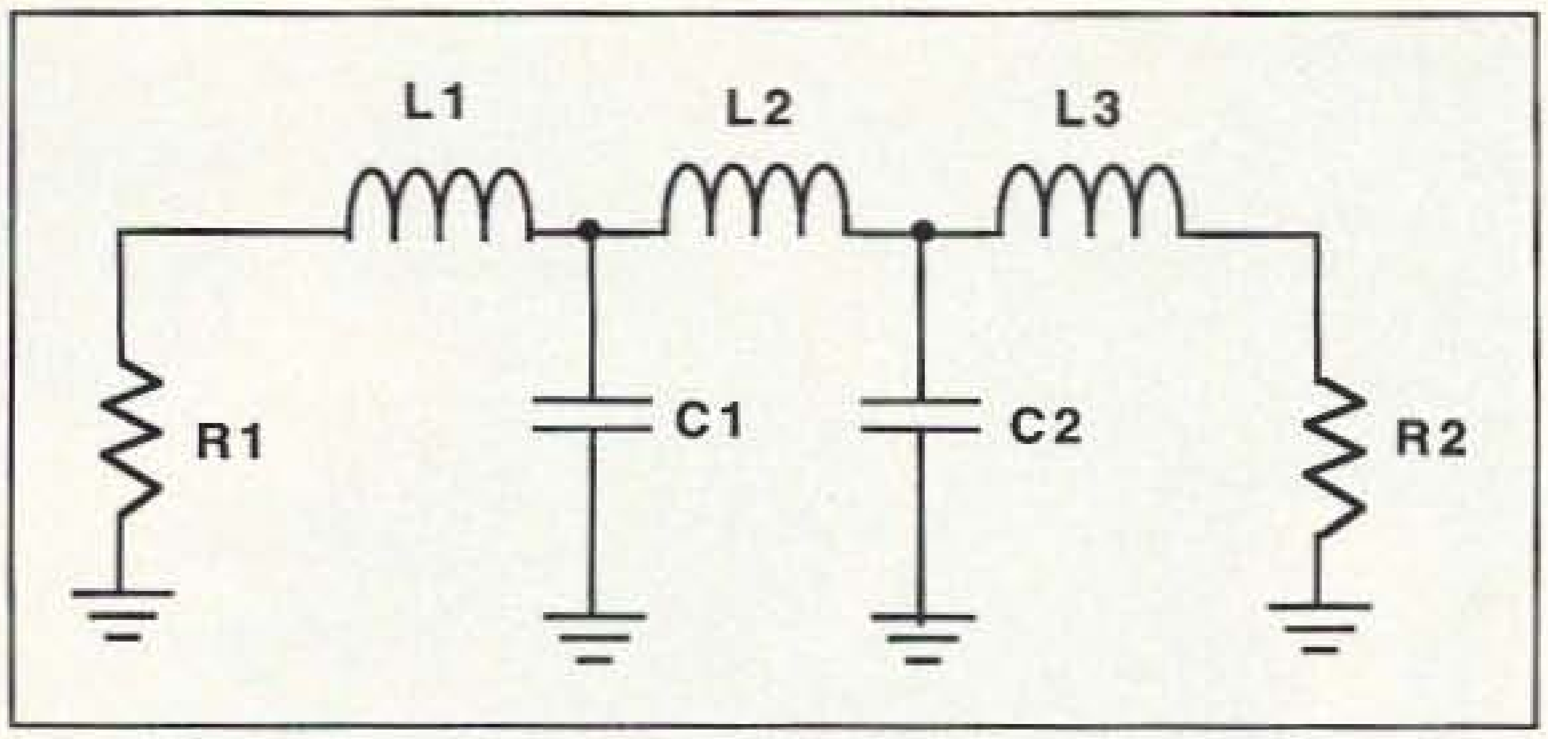

Figure 2. LPF circuit.

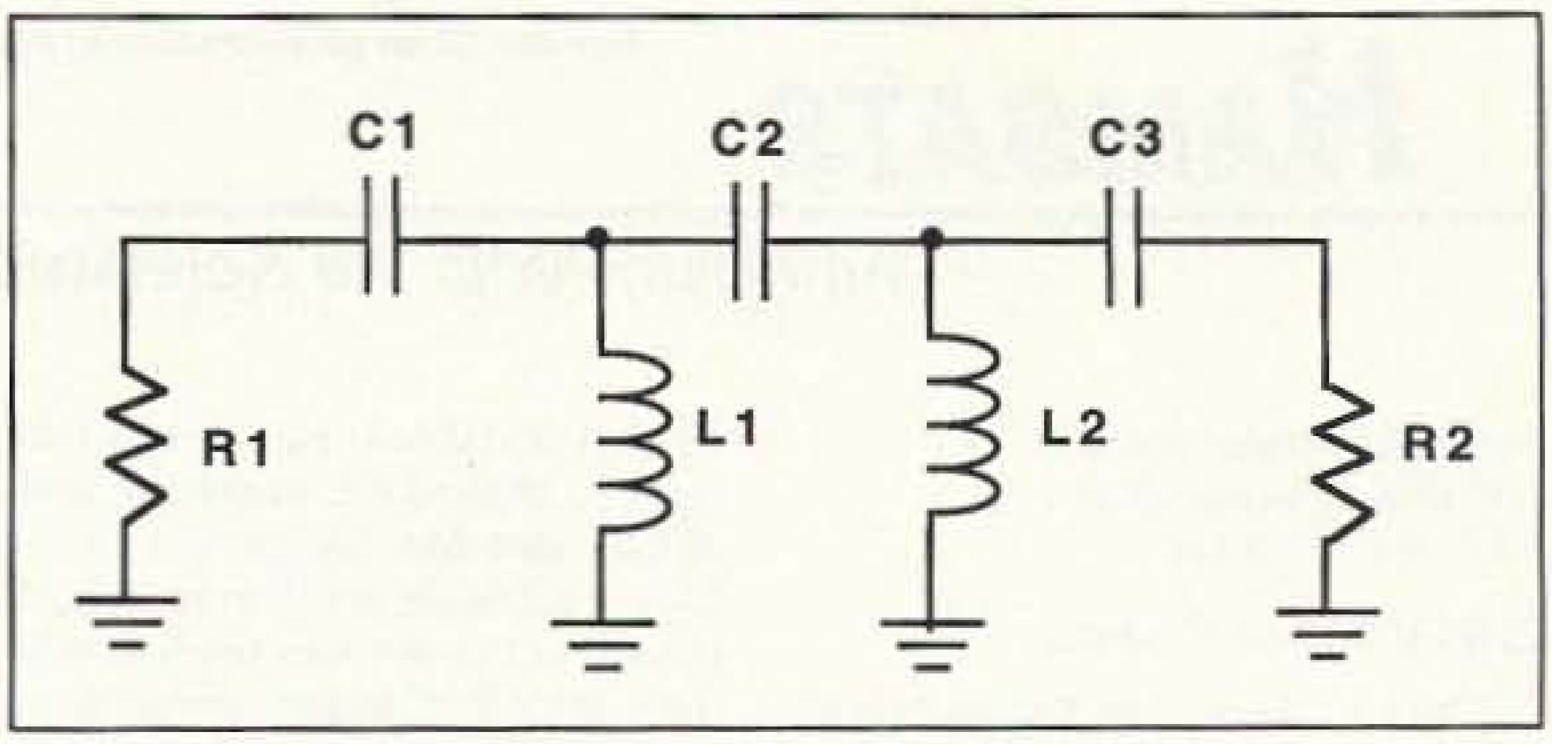

Figure 3. HPF circuit.

erate from 2 to 30 MHz, while the T-50-15 (RED/WHT) have an AL of 135 and operate over 0.1 to 2 MHz. In practice, I found that 3 MHz was not unreasonable for the -15 cores, so I opted to use them. Applying the formula below gave the number of turns:

$$N = \sqrt{L_{\mu H} / A_L}$$

L1, L3: 3.04 µH, 15 turns, T-50-15 (RED/WHT)
L2: 5.24 µH, 20 turns, T-50-15 (RED/WHT)

The capacitors are another matter. Where in blazes do you get a 1454.9 pF capacitor? Well, one solution is to use a 0.0015 µF (1,500 pF) and live with the slight frequency error. I did this and found that the filter had a cutoff frequency only slightly lower than 3,000 kHz, and it was acceptable. Otherwise, it is possible to select standard value capacitors that in some series or parallel combination total 1454.9 pF, or something close to it. For example, 75 pF, 560 pF, and 820 pF add up to 1455 pF, and all are easily available values.

The capacitors used in the filter should be NPO disk ceramic, silvered mica, or polyethelene. I bought several dozen of all types recently from Ocean State Electronics [P.O. Box 1458, 6 Industrial Drive, Westerly RI 02891; phones: 1-800-866-6626 (orders), 401-596-3080 (inside RI), or 401-596-3590 (Fax)]. Ask them for their catalog . . . you'll find a lot of ham building parts that you thought were "history" because other parts distributors no longer carry them.

Another approach is to use a combination of fixed-value and trimmer capacitors in the filter. This is a viable approach if you have a sweep generator and oscilloscope to align the filter, but can be a "bear" if you don't. A procedure for alignment of such filters is given in Hayward and DeMaw's *Solid-State Design for the Radio Amateur* (an ARRL publication).

The filter projects turned out so well that I am convinced it is another case of " . . . the contriving of contrivances is a game for all."

Book Note

One of my publishers has moved, and has also added an "800" number for credit card orders. HighText Publications is owned by Harry Helms and Carol Lewis. Their address is: 125 North Acacia Avenue, Suite 110, Solana Beach CA 92075; phones 619-793-4141 and 4142. Credit card orders are handled by IPG at 1-800-888-4741. They publish my *Receiving Antenna Handbook* and *The Art of Science*, as well as Harry Helms' books *All About Ham Radio* and *Shortwave Listening Guidebook*.

They now claim to be the biggest technical publisher west of Pacific Coast Highway (or, is that the only publisher west of . . . ?), and to have sales greater than the combined profits of IBM and General Motors. Helms, you're dangerous.

HAMSATS

Number 12 on your Feedback card

Amateur Radio Via Satellites

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SSTV From Space

Only 10 days after the launch of AMSAT-OSCAR-6 in October 1972, Don Miller W9NTP wrote a letter to the editor of the *AMSAT Newsletter* describing his efforts with WA9UHV to send slow-scan television images via the new satellite.

In his letter Don described systems that included equipment that might be found in a ham radio museum today, but 20 years ago represented state-of-the-art gear. HF transmitters with transverters and home-brew video samplers and modulators provided uplink signals, while more home-brew equipment was used to view the black-and-white images sent through the Mode "A" (2 meters up and 10 meters down) transponder. These pioneering efforts have provided inspiration for today's video experiments and some exceptional possibilities for later this decade.

In his mid-seventies book, *OSCAR Amateur Radio Satellites,* Stratis Caramanolis recounted efforts by DL8AT and OE3KMA to send SSTV pictures via the Mode "B" (70 cm up and 2 meters down) transponder on AMSAT-OSCAR-7. The year was 1976 and eight-second, black-and-white pictures were still the standard. These efforts led to additional image transfer techniques including facsimile (FAX) transmissions by DLØVB and others.

During the 1980s emphasis was placed on the purely digital modes like AX.25 packet. Today we have several digital-only satellites in orbit, capable of providing worldwide store-and-forward services. Sending image files via these electronic bulletin boards in the sky has become common. Real-time image exchange via satellite declined, but thanks to advances in inexpensive digital interface techniques and individual efforts, SSTV operation is again gaining popularity.

SAREX and SSTV

Dr. Tony England WØORE took the Shuttle Amateur Radio Experiment (SAREX) equipment to orbit on the shuttle *Challenger* in August 1985. Part of the ham gear included a modified ROBOT 1200C scan converter for SSTV. The image-control software on the shuttle supplied automatic sequencing, providing two red-filtered frames (8 sec.), one green and one blue; a low-resolution color frame (12 sec.); and a high-resolution color image (36 sec.). Many stations monitored the signals using home-brew SSTV systems or new and expensive ROBOT equipment. Others simply recorded the warbling tones in hopes of someday decoding the cryptic sounds and viewing the pictures.

Further experiments with SSTV from the shuttle continued on missions STS-37 and STS-50. The equipment will be carried on STS-56 and other future flights.

In addition to sending pictures earthward, the shuttle apparatus can also receive and display images sent from earth-bound hams. During Tony England's flight, a picture of the astronauts' wives was sent up to space and displayed on one of the monitors located in the Aft Crew Station. The picture was stored and sent back to earth a few minutes later. During STS-50, schools with suitable SSTV gear sent pictures of the students up to Dick Richards KB5SIW and the other ham crew members on board the *Columbia.*

Photo A. A 36-second ROBOT color image of Tony England WØORE on the Space Shuttle Challenger*—August 1985.*

There are advantages and disadvantages to shuttle-based SSTV operation. On the plus side, the signals are sent via 2 meter FM transceivers. Signals are strong and color errors caused by frequency shift experienced using SSB are not a problem. The greatest disadvantage is the length of time available for picture exchange. Shuttle passes are usually very short, 10-15 minutes. The ROBOT equipment is capable of a 72-second mode, but images are usually sent in the 36-second mode to allow the exchange of as many pictures as possible. The ROBOT gear is also limited to those ROBOT modes hard-coded in the scan converter.

SSTV and the PC

PC-SSTV interfaces have lagged behind those for other machines like the Amiga, and only a few dedicated hams have been able to buy a ROBOT 1200C at over $1,000 for computer-less operation. Although the Amiga computer and appropriate interface cost less than a ROBOT, those already heavily invested in PC-compatible machines (most of us) don't consider either a viable alternative.

Early attempts to provide SSTV support on PCs required the use of the cassette port to input the tones. Rough, blocky, black-and-white pictures could be seen from the eight-second format frames on monochrome monitors. The software was crude and the results poor. Better interfaces, faster machines

Photo B. A 36-second ROBOT color image of Ken Bowersox, Carl Meade and Dick Richards KB5SIW on board the Space Shuttle Columbia *(STS-50)—June 1992.*

Photo C. Dave WB6LLO poses for a 72-second ROBOT color picture sent via AMSAT-OSCAR-13.

and improved video were needed. Recent offerings have certainly helped.

For the satellite enthusiast looking to get results without a significant investment, there are two inexpensive PC-SSTV interfaces available.

The first is the Viewport VGA from A & A Engineering. This unit was described in a construction article by J. R. Montalbano KA2PYJ in the August 1992 issue of *73*. A complete kit from A & A Engineering (telephone: 714-952-2114) sells for $169. This unit transmits all the ROBOT modes through 72-second color and receives ROBOT plus Scottie and Martin formats. Recent modifications also allow operation with a new FAX mode defined by Ralph Taggart WB8DQT in the February 1993 issue of *QST*. The Viewport VGA is an external interface box that connects to the PC through the printer port.

The second recent offering for PC owners looking for a way to do SSTV is the Pasokon-TV interface card and software. The card uses a slot in the PC (286 or better) and provides full transceive operation with all of the popular SSTV modes, including ROBOT, Scottie, Martin and others. The kit costs $200 and is available from John Langner WB2OSZ at (508) 256-6907.

Hamsat SSTV

Most SSTV operation via satellite is currently on AMSAT-OSCAR-13 using ROBOT 72-second color. Activity is usually heard during times when the satellite signals are strongest. This is when the satellite's antennas favor the earth. Dave WB6LLO promotes an informal SSTV net for weekend activity via modes B and J (2 meters up and 70 cm down). The "B" downlink is 145.960 MHz and the "J" downlink is 435.980 MHz.

"The advantage of satellite SSTV is the lack of interference. While coverage is worldwide, the congestion is much easier to take than on HF."

The advantage of satellite SSTV is the lack of interference. While coverage is worldwide, the congestion is much easier to take than on HF. The odds of a station ruining a good picture by tuning up or talking over it are very small. Unlike the shortwave bands where everyone cannot hear each other on a particular frequency, via satellite the problem of "skip" is not present. In fact, due to the nature of full duplex satellite activity, you can monitor your own signal as it is being heard by other ground stations. The only disadvantage to SSTV via A-O-13 is the noise. Many stations do not have antenna systems for noise-free copy of SSTV, and since SSTV is a 100 percent duty cycle mode and should not be run at full power on the transmit side, signals are not like the blockbusters sometimes heard on 20 meters. Consistency of the signals and lack of interference balance the equation.

A-O-13 is not the only satellite passing SSTV signals in the sky. RS-12 is as well. Rick VE4AMU and WA2KUK have been trying ROBOT 36-second color via the mode "K" (15 meters up and 10 meters down) transponder. The biggest problems encountered are the effects of Doppler shift, causing color changes as frequencies shift, and interference from 15 meter stations not aware of the satellite operation. SSTV gear used by both stations has included the AEA AVT Master Amiga Video Terminal with Commodore Amiga computers. Although superior results might be possible with newer SSTV modes, the short passes have yielded more pictures with the 36-second ROBOT format.

Full-Motion Video

Standard fast-scan television (FSTV) operation via satellite is not currently being considered. The bandwidth required exceeds that available on most bands allocated for amateur radio satellite use. The FSTV experiments to uplink video to the Space Shuttle require FCC permission for the participating stations to send 6-MHz-wide signals to space. The 70 cm uplink band is normally only 3 MHz wide.

For now SSTV is the best way to get images across without using the digital store-and-forward satellites. In the future, work on video-compression techniques will allow nearly full-motion video via hamsat using special modems and digital data at 9,600 to 56,000 bps. 73

RTTY LOOP

Number 13 on your Feedback card

Amateur Radio Teletype

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Having been involved in radioteletype for many years, it's easy to lose sight of the simple questions with complex answers posed by the newcomer. To wit: Timothy S. Kraus KC4ZGP, of Warner Robins, Georgia, writes that "Lately, I've been watching hams converse in 60 wpm Baudot TTY. I got to thinking, I'd like to talk to folks out there. Do you know where I can find a surplus TTY keyboard? I have the receive side—my Microdec MD-100—I just need a keyboard. I don't have a computer and I hope I won't have to buy one because RTTY keyboards are getting rare."

Well, Tim, there are at least three ways you can go with this. First off, let's define a "RTTY keyboard." The keyboard attached to classic teleprinters such as Model 15s, Model 19s, and Model 32s, is an electromechanical conglomeration of levers, gears, and contacts. It runs both off the electrical circuit built into the machine and via a gear driven by the motor which powers the unit. The rotation of this gear is critical both to move the levers and to provide the timing needed for the pulses. Thus, an isolated keyboard, without a machine, is relatively useless.

Next up the scale would be a self-contained Baudot keyboard. Using a Programmable Read Only Memory (PROM) or a diode matrix to encode the five level pulses, such a keyboard is a reasonable do-it-yourself project. Over the past 10 years this magazine has carried any number of such construction projects. A search of the *73* indices should turn up a few that you might look at. Trouble is, the blank keyboard used in such projects is becoming a scarce animal. James Electronics, among others, used to have one that was easy to use. Radio Shack used to, but no longer does, to my knowledge. You may be in trouble here in terms of obtaining the needed parts.

The third solution is the one you dread, getting a computer. I know, it seems like overkill. But a small computer, such as a used VIC-20, C-64, or Radio Shack Color Computer, should be available used for well under, *well under*, a hundred dollars. With suitable programming, any of them would do just fine.

The bottom line is to look around, see what's out there in your area, and go for it. Whatever you do, why not write it up and share it with the readers of this column, and this magazine? We look forward to hearing from you.

Another letter arrived from Martha Nelson N3MHD, in Milton, Pennsylvania. She tells us that she has been "playing for about 10 months at a packeteering computer. For fun, I bought a 128K Tandy (color computer) . . . I use a Packard Bell (and) KAM for my communications. However, I would love to hear about your experience with the CoCo."

It really hurts me to say this, but you've bought an orphan. An orphan I have loved, an orphan with great potential, a very capable orphan, but an orphan nonetheless. You see, when the first CoCo came out, I was right there in the store, plunking down my cash almost before they unloaded the truck. I had my CoCo 2 running an 80 x 24 display, multiple disk drives, modem, and even multitasking under OS9. When Tandy Radio Shack introduced the CoCo 3, with more memory and better capabilities, we thought, at first, that this was to be an exciting new line. But as they emphasized the PC-compatible line they first neglected, then orphaned, the CoCo.

There are still support groups around, and there are an awful lot of these machines in users' hands. A very active SIG (special interest group) may be found on the Delphi computer network. There may be files elsewhere as well; I just can't find them. Personally, I would use the CoCo as a dedicated terminal in front of a multimode controller, or use one of the available programs to run it in simple RTTY or packet mode. It is usable; it's just going to take some work. I do wish you luck, and I look forward to hearing about your progress.

Several of you have asked for circuits to power your teleprinters. The power supply used supplies a constant current in a loop, normally 60 mA or 20 mA, depending on the machine. At any rate, Figure 1 is an example of one such RTTY loop, which uses transistors as current-controlling devices. This is a good place to start, neither too simple nor too complicated. Maybe next month we will a look at another circuit.

We've kept things basic this month, but that is not always the case. I look forward to hearing from you, each and every one of you, to let me know what you want to read about in "RTTY Loop." Reach me by mail, at the above address, or through E-mail on CompuServe (ppn 75036,2501), Delphi (username MarcWA3AJR), or America Online (screen name MarcWA3AJR). The software disks, RTTY and archiving, remain available as well. Each collection, two of RTTY programs and one of archiving programs, may be yours by sending me a high density disk sufficient for 1.3 Mb each, $2 per disk sent, and a self-addressed stamped disk mailer. Be sure to indicate which collection you would like. ■

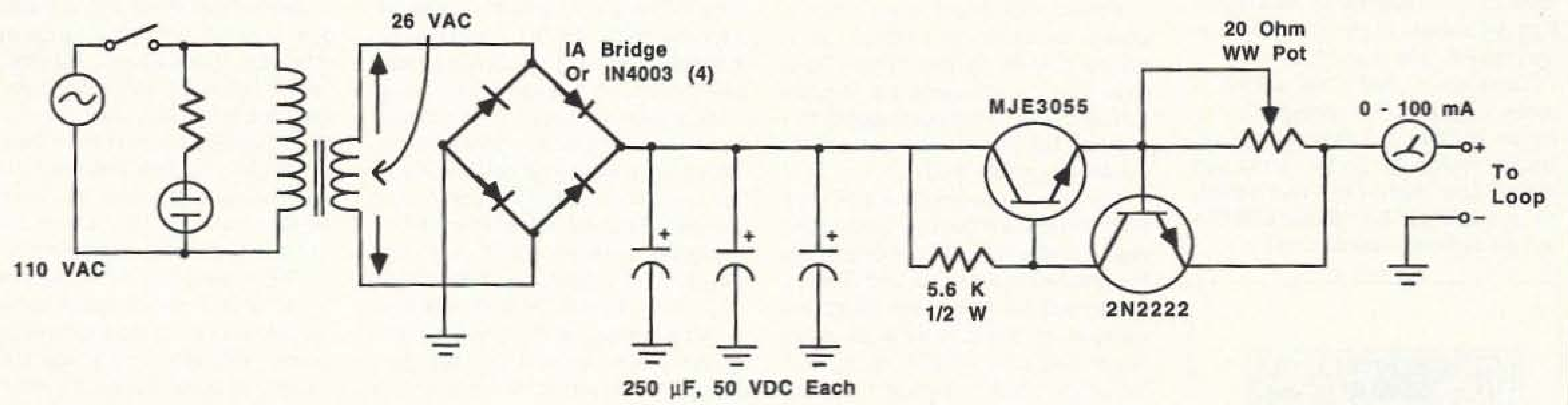

Figure 1. A circuit to power a teleprinter, using transistors as current-controlling devices. The power supply used provideds a constant current in a loop, normally 60 mA or 20 mA, depending on the machine.

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Teeny-Weeny T's

Newcomers to amateur radio direction finding contests often ask what special transmitters they must obtain to get in on the fun. Actually, the "fox" in a foxhunt or T-hunt, as these events are called, has it easy from an equipment standpoint. Most times, a handie-talkie or a mobile transceiver is all it takes. With enough battery power to last through the event and a source of audio (your voice or some sort of tone box), you're ready to set out in search of a hiding spot.

But the creativity of ambitious hiders sometimes demands special equipment. Last year in Albuquerque, New Mexico, T-hunters puzzled for a long time before they figured out that the hidden T was inside a cola can on a picnic table. On other hunts, this micro-T has been hidden in a hole in the bottom of a fireplace log, buried under a plant, and secreted in a cream cheese container under a rock.

Usefulness of a subminiature transmitter is not limited to competitive foxhunts. Almost every month I receive requests for tiny radio beacons for unusual purposes, ranging from keeping track of coon hounds to motorcycle theft deterrence. Some of these ideas are practical, others aren't.

There have been a few articles in hobby magazines with designs for flyweight emitters, but they usually are lacking in stability, performance, and ruggedness. That's why I was delighted to encounter Ken Bauer KB6TTS and his radio retrieval devices.

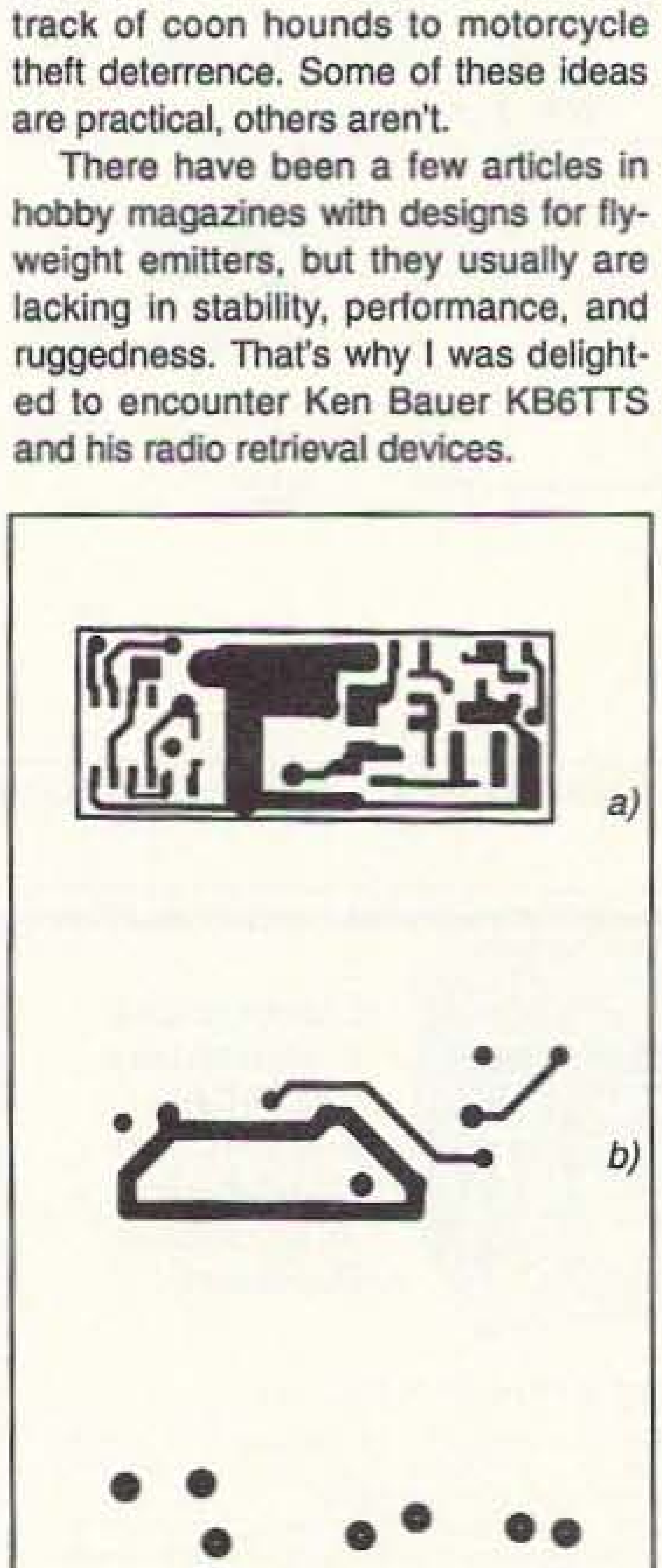

Figure 1. Parts side etch (a), rear side etch (b), and feed-through hole locations (c).

Where's My Glider?

KB6TTS is an RF engineer at a Southern California aerospace company, with 10 years of experience working with transmitter and receiver circuits. In his spare time, he flies model gliders in the nearby deserts. These 7-foot wingspan craft can travel up to five miles in a typical flight if there are good "thermals" in the air.

Locating his models when they land out of visual range is a frequent and potentially expensive problem, so in the early 1980s Ken started experimenting with radio beacons for recovery.

In the model glider world, every additional gram of weight and ounce of drag is undesirable. Ken's latest glider beacon weighs only 2 grams, not counting the antenna and battery (Photo A). That's about a quarter of an ounce! With a 2-gram 3-volt lithium coin cell (#1225), it puts out a couple of milliwatts peak for about 48 hours. With a larger coin cell (#2032), it can achieve up to 8 milliwatts and transmit for a week.

This long battery life is due in large part to the low transmit duty cycle. A CMOS timer keys the transmitter for 100 milliseconds each second, giving short beeps in Ken's BFO-equipped receiver.

For more RF output power, which is usually desirable on T-hunts, use a standard 9-volt alkaline battery. This gives 25 to 50 milliwatts, but requires different biasing resistor values. The alkaline battery will last a week or more in the pulsed mode.

For glider recovery, the 222 MHz (125 centimeter) ham band is better than 2 meters. High gain beams for the receiver are smaller and there is less broadband noise from Santa Ana winds in the desert to mask the weak signal. Ken's transmitter can be built for either band by proper choice of crystal and tuned circuits.

The KB6TTS beacon board measures only 1.25" by 0.5", small enough for two to fit side by side on an Elvis stamp. Figures 1a and 1b are etch patterns. Front and rear etch are connected together at hole locations shown in Figure 1c. Figure 2 shows the parts placement.

Figure 3 is the schematic of the RF and pulsing circuits. Component values are for 2 meters. For the 1-1/4 meter band, change C2 to 47 pF, C4 to 22 pF, and C6 to 10 pF. Y1 will be 74 to 75 MHz. For operation with a 9-volt supply, change R1 to 10k, R2 to 5.1k, and R4 to 22k.

Ken's design is straightforward and reproducible. "Very hot RF transistors are needed for the unit to work well at low voltage and provide plenty of energy at the third harmonic of the oscillator," he says. "The Motorola MMBR951L is a good choice because it's inexpensive and has gain up to 8000 MHz." "Q1 forms a Colpitts oscillator with the crystal, C1, and C2," he continues. "The crystal sees the combined capacitance of C1 and C2 as its 20 pF load and itself looks inductive as these elements form the main frequency control tank. L2 prevents the circuit from oscillating on the fundamental frequency of the crystal and keeps it in the overtone mode. The trick is that the oscillator will work only on frequencies where its emitter sees capacitance to ground. The combination of L2 and C2 must be such that they look capacitive at the overtone frequency but inductive at the lower fundamental frequency, thus preventing oscillation there."

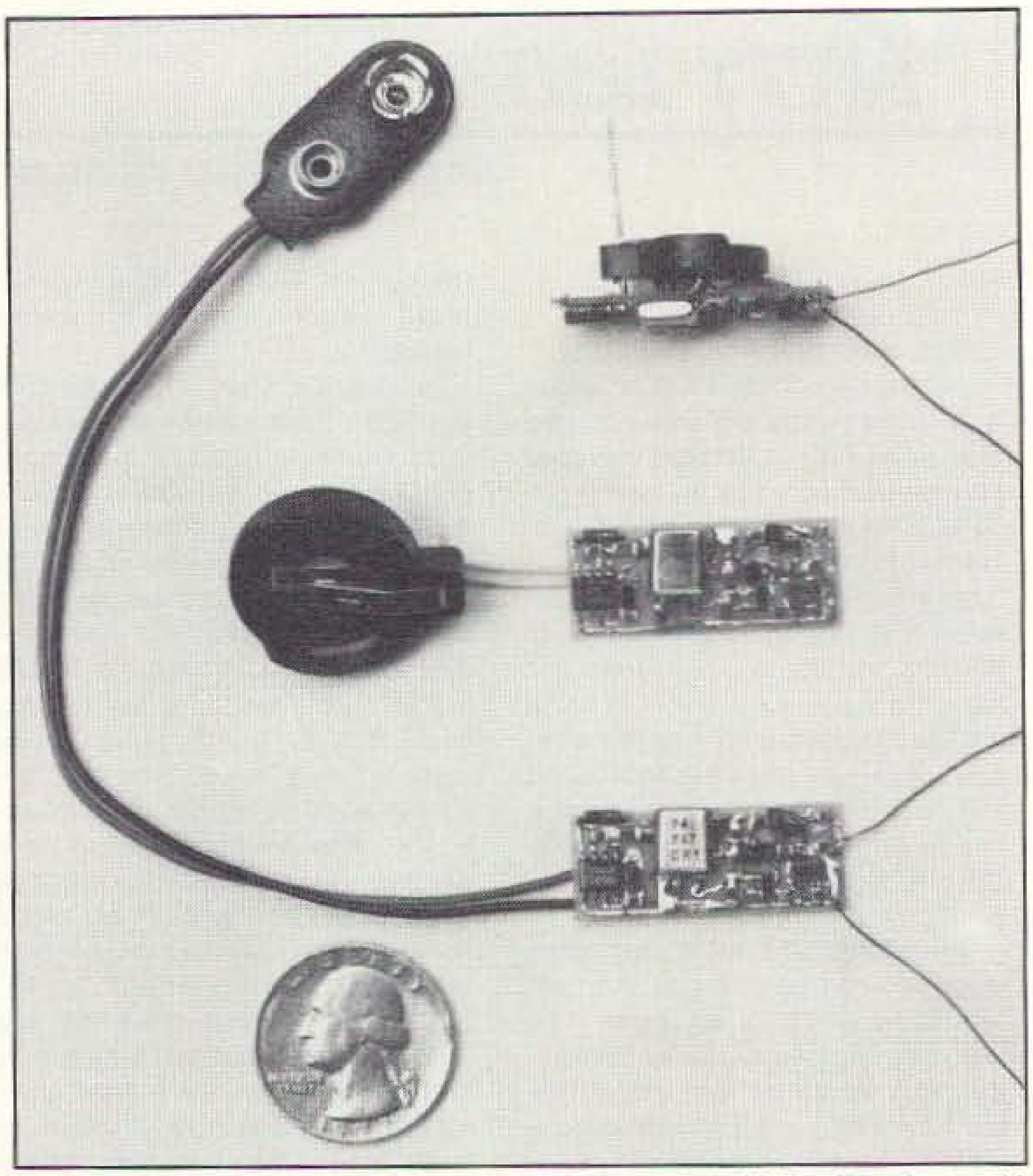

Photo A. It's not hard to find hiding places for these little hidden T's, shown with three options for battery power. Digi-Key stocks the battery holders. Use quarter-wavelength wires as antenna and radial.

Tank circuit L1/C4 is tuned to the transmitter output frequency, making Q1 an oscillator/tripler stage. Q2 is a buffer that amplifies the oscillator output and isolates it from load variations at the antenna. U1 pulses the Vcc supply to Q1 and Q2 with on and off time periods set by R5, R6, and C8. Change these components as you wish to give the right pulsing rate and duration for your application. It is important to use the CMOS version of the 555 timer to maximize battery life.

The crystal is a third overtone type at 2 meters and fifth overtone at 1-1/4 meters. It should be specified for 20 pF load capacitance, series resistance not more than 60 ohms, and frequency tolerance of 25 parts per million or better. Ken gets his from International Crystal Manufacturing (ICM), Oklahoma City, Oklahoma.

Pinhead-Size Parts

If your idea of project-building is dropping component leads through holes in a nice big circuit board and fastening them down with a soldering gun, you will need to change your ways for this project. Making an "Agent 007 size" transmitter calls for the same technology used to make today's pocket-size dual-band handie-talkies. All capacitors and resistors are chip components except R5, which is 1/8-watt carbon. The transistors and IC are in surface-mount packages.

This is definitely not a beginner's project. If you have successfully built a few circuit boards and know your way around VHF RF circuits, you should be able to build and adjust this little rig. Otherwise, seek help from a local technically-inclined ham.

Surface-mount construction may seem a bit scary, but it just means acquiring a few new skills. Set your soldering gun aside and use a fine-tipped iron, 18 to 25 watts. You will also need steady hands, a strong light, a low-power magnifying lens, and a pair of fine-point tweezers.

Once you get the hang of it, soldering a component onto the board is not difficult. Pick up the part with tweezers and "wet" one terminal using the soldering iron and a tiny amount of solder. Use the tweezers to hold the part down on the board in its place, then momentarily touch the iron to the pre-tinned pad to flow the solder and secure the component. Then tack down its other leads, being careful not to overheat the part so that it shifts position on the board.

Bare circuit boards are available for

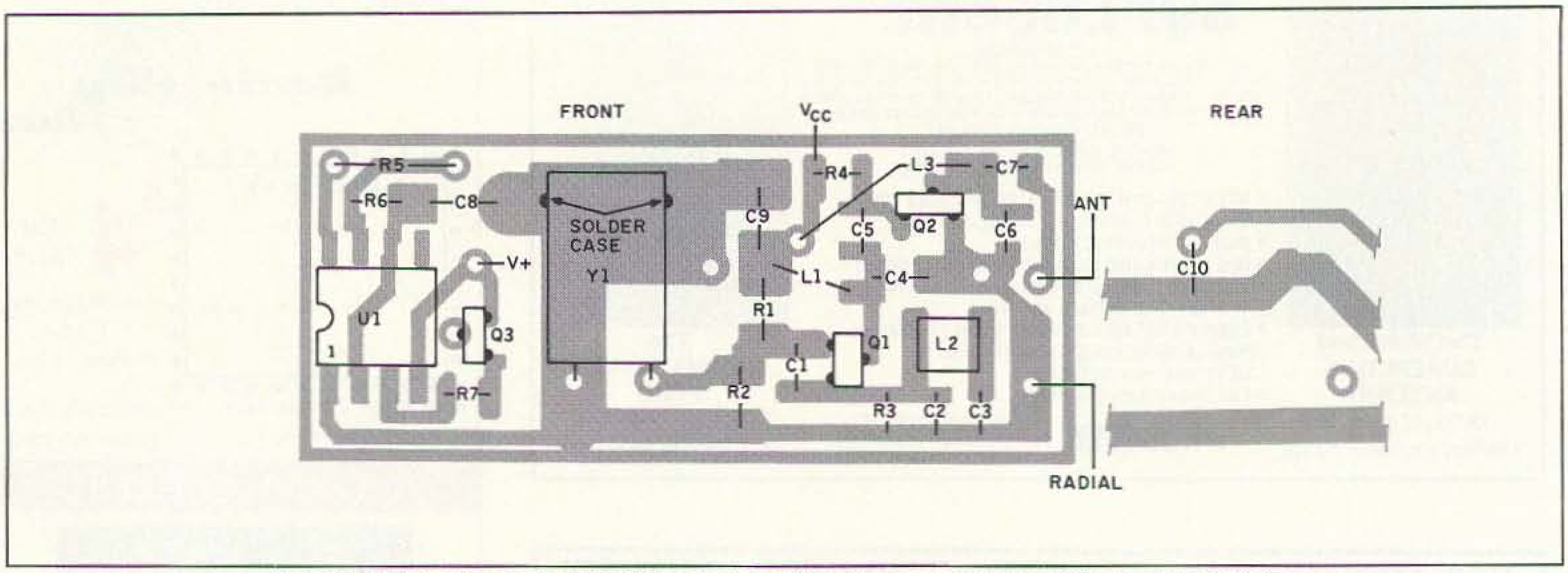

Figure 2. Parts locations for the KB6TTS beacon transmitter. All components except C10 are on the front side.

$10 each from KB6TTS. Ken is not selling parts kits, but he will build complete transmitters to order as his spare time allows. For information and prices, send a self-addressed stamped envelope to Airtek, 2306 Turquoise Circle, Chino Hills, CA 91709. If you're into flying models, ask for his info sheet that gives tips on aircraft transmitter mounting and retrieval techniques. As usual, here's the disclaimer: These offers are not warranteed by *73 Amateur Radio Today* or by me.

Q1 and Q2 are available from Motorola distributors. One that sells to individuals is Newark Electronics. Newark has over 200 branch offices across the USA and Canada. Call the main office in Chicago at (312) 784-5100 to obtain a catalog and get the phone number of the nearest branch.

To order a crystal from ICM, call (800) 426-9825. Specify the crystal frequency (transmitter output frequency divided by 3) and part number 471393 for 2 meters or 472393 for 1-1/4 meters. These ICM part numbers determine the mode, load, series resistance, tolerance, case, and leads.

The remainder of the parts are available from Digi-Key Corporation, PO Box 777, Thief River Falls, MN 56701, phone (800) 344-4539. The resistors are Panasonic thick-film, 1/10-watt, series 0805. The capacitors are Panasonic multilayer ceramic. C3, C8, and C9 are type X7R, and the remainder are type NPO, for low drift. L2 is Toko type 32CS.

L1 and L3 are made from AWG 32 enameled wire, wound over a 0.06" diameter drill bit, then slipped off and soldered onto the board. Start with the turns close spaced. You will spread the turns as necessary to tune each stage.

Keep Our Spectrum Clean

The primary goal of tune-up is to peak up output on the transmit frequency and minimize output on the fundamental and all other harmonics of the crystal. A spectrum analyzer is the ideal tune-up instrument, but most of us don't have one at home.

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50 MHz					
0503G	1-5	10-50	6	15/0.6	LPA
0508G	1	170	28	15/0.6	Standard
0508R	1	170	28	–/–	Repeater
0510G	10	170	25	15/0.6	Standard
0510R	10	170	25	–/–	Repeater
0550G	5-10	375	60	15/0.6	HPA
0550RH	5-10	375	60	–/–	Repeater HPA
0552G	25-40	375	55	15/0.6	HPA
0552RH	25-40	375	55	–/–	Repeater HPA
144 MHz					
1403G	1-5	10-50	6	15/0.6	LPA
1406G	25	100	12	15/0.6	Standard
1409G	2	150	25	15/0.6	Standard
1409R	2	150	24	–/–	Repeater
1410G	10	160	25	15/0.6	Standard
1410R	10	160	24	–/–	Repeater
1412G	25-45	160	20	15/0.6	Standard
1412R	25-45	160	19	–/–	Repeater
1450G	5	350	56	15/0.6	HPA
1450RH	5	350	56	–/–	Repeater HPA
1452G	25	350	50	15/0.6	HPA
1452RH	25	350	50	–/–	Repeater HPA
1454G	50-100	350	40	15/0.6	HPA
1454RH	50-100	350	40	–/–	Repeater HPA
220 MHz					
2203G	1-5	10-40	6	14/0.7	LPA
2210G	10	130	20	14/0.7	Standard
2210R	10	130	19	–/–	Repeater
2212G	30	130	16	14/0.7	Standard
2212R	30	130	15	–/–	Repeater
2250G	5	220	40	14/0.7	HPA
2250RH	5	250	40	–/–	Repeater HPA
2252G	25	220	36	14/0.7	HPA
2252RH	25	250	36	–/–	Repeater HPA
2254G	75	220	32	14/07	HPA
2254RH	75	250	32	–/–	Repeater HPA
440 MHz					
4403G	1-5	7-25	4	12/1.1	LPA
4410G	10	100	19	12/1.1	Standard
4410R	10	100	18	–/–	Repeater
4412G	20-30	100	19	12/1.1	Standard
4412R	20-30	100	18	–/–	Repeater
4448G	5	100	22	12/1.1	HPA
4448R	5	100	22	–/–	Repeater HPA
4450G	5-10	175	34	12/1.1	HPA
4450RE	5-10	175	34	–/–	Repeater HPA
4452G	25	175	29	12/1.1	HPA
4452RE	25	175	29	–/–	Repeater HPA
4454G	75	175	25	12/1.1	HPA
4454RE	75	175	25	–/–	Repeater HPA

MODEL 1410G
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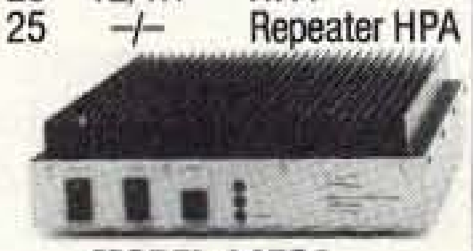

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RX Preamplifiers

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50 MHz	0520N	.5	25	N
144 MHz	1420B	.5	24	BNC
144 MHz	1420N	.5	24	N
220 MHz	2220B	.5	22	BNC
220 MHz	2220N	.5	22	N
440 MHz	4420B	.5	18	GNC
440 MHz	4420N	.5	18	N
1.2 GHz	1020B	.9	14	BNC
1.2 GHz	1020N	.9	14	N

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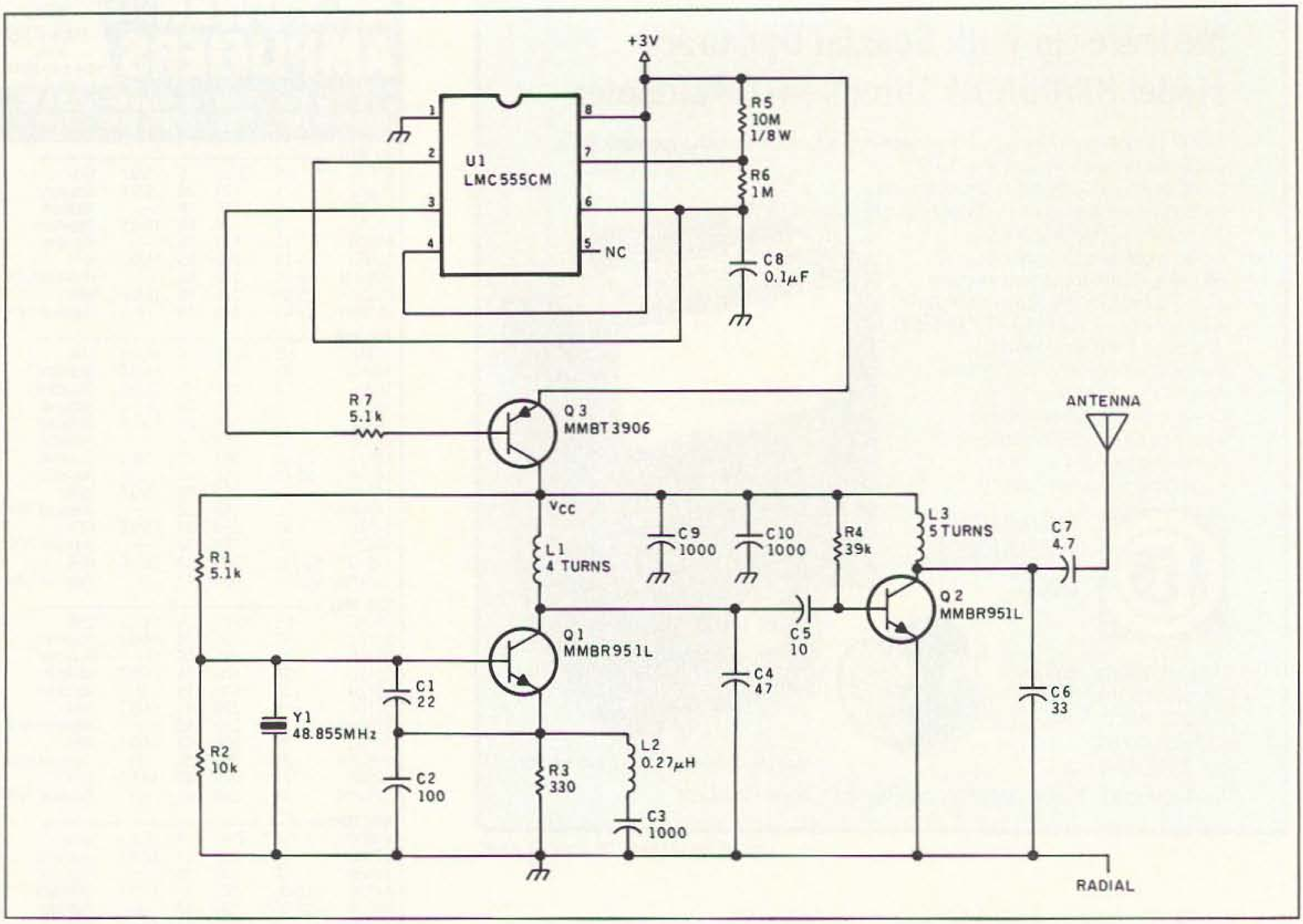

Figure 3. Schematic of the tiny transmitter as built for 146.565 MHz, the Southern California T-hunt frequency. Unless otherwise specified, capacitances are in picofarads. See the text for component changes for the 222 MHz band and for 9V power supply.

With a bit of patience, you can substitute the S-meter of a wide-range receiver.

As an example, the output of a 146.565 MHz unit should be checked at 48.855, 97.710, 195.420, 244.275, and so forth, tuning to minimize all spurs and maximize the 2 meter signal. Tune-up is easiest with continuous output, so jumper the collector and emitter of Q3 during this process. Whether you use an analyzer or receiver, connect the mini-T's output to the indicating instrument through a resistive step attenuator, so you are measuring the true output instead of direct radiation from the stages.

Ken's board has no provisions for ID or modulation. You will want to add these as appropriate for your application. Many CW keying circuits have been published, and they can readily be adapted to key the Vcc line of this rig. ■

Number 15 on your Feedback card

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
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Peterborough NH 03458

Various Gripes

This month, I'd like to address various small topics which keep cropping up, but none of which warrants an entire column by itself.

Those Darned Batteries

First of all, nickel-cadmium batteries. I've written a fair amount about them, and I've seen various contradictory articles. Frankly, I'm getting sick of the whole thing. Some say the "memory" effect exists, some say it doesn't. Some say that dischargers are a bad idea, others like them. My opinion, once and for all: It may be memory, it may be something else, but whatever you want to call it, NiCd packs don't work very well for very long. After six months or a year, you almost inevitably wind up with one or more weak or shorted cells. Just tonight I had to crack open two $100 laptop computer packs, each manufactured about two years ago and bought and used only about eight months ago. In both of them, there were a few shorted cells alongside others which were fully charged. That has happened to just about all the NiCd packs I've ever owned, and I follow all the rules. I suspect that the true cause of the failures is charge imbalance.

What seems to happen is this: Because no two cells can be absolutely identical, some discharge faster than others, especially when sitting idle on the shelf. When the pack appears to need recharging, it really has some cells which are only partially discharged. When you charge it up, their higher resistance prevents the weaker ones from getting a full charge. Next cycle, it gets even worse because the weaker ones die even faster due to their having only a partial charge to begin with. Eventually, the weaker ones wind up getting reverse-charged by the stronger ones (during the discharge cycle) and they short out. End of pack. I've had some success with zapping them, but it requires opening the pack, and it doesn't always last.

I've never seen any literature regarding whether you should keep your packs charged or discharged between uses. In light of the above, it might make sense to leave them discharged. That way, they can't slowly sink down to uneven levels while sitting on the shelf; they're all pretty low anyway. I can't verify the wisdom of this approach, but it's a strong hunch. Perhaps that's why they ship them discharged from the factory.

As for dischargers: Many people pooh-pooh them, but they may be wrong. Did you know that Sony is now offering, for their video equipment, optional chargers which include automatic dischargers? Apparently, even *they* are admitting there's a problem with NiCds. I haven't tried a discharger, so I can't say for sure whether they actually work. Even if they can't fix a bad pack, at least they let you charge up your pack whenever you want to, ending the frustration of having only half a charge because you're afraid to charge up a partially charged pack.

I don't want to write about NiCds anymore. As I've said before, the only ones which have worked fairly well for me are those made by Sanyo. They seem to hold a charge much longer while sitting idle, and that may have something to do with it. Hopefully, the new nickel-metal-hydride cells or some other new kind of battery technology, such as the up-and-coming rechargeable lithium cells, will obsolete the old stuff once and for all. End of topic. Please.

Open Wide

If you've ever spent any time on the 20 meter band, you've heard squabbles arising over somebody with excessive bandwidth. Just yesterday I heard one such argument, including (and this is a direct quote), "I don't think my 50 watts could be that wide." Folks, your bandwidth has *nothing* whatever to do with how much power you are putting out. You could be running 100 milliwatts and still be 10 kHz wide!

We're all supposed to be no more than 3 kHz wide, unless we're running AM or FM. On AM, we can be 6 kHz wide, and on FM even wider. That's why FM is not allowed below 10 meters. Ten's a big band, so there's room for wider stations. The lower bands are just too small.

AM

There are some people who run AM on 20 meters. In fact, there's an entire net of them. Personally, I find the idea inconsiderate but, hey, they are allowed to do it, so until the rules change, we'll all have to live with it. Luckily, they tend to stick to one frequency, so it really isn't all that big a deal.

The problem is that most AM transmitters are far wider than 6 kHz! To stay within that limit, the audio response must go no higher than 3 kHz, just like on any other mode. Compounding the circumstance that most of these transmitters are very old, and have no filtering to prevent them from being too wide, is the fact that many users go out of their way to get microphones with what they call "broadcast quality" sound. In other words, lots of high frequency response! Many AMers take a great deal of pride in sounding hi-fi (and say so on the air), while conveniently ignoring, and sometimes denying, the resulting bandwidths of their signals. Folks, you can't have the crisp, commercial-quality highs without the bandwidth.

SSB

But before it sounds too much like I have it in for AMers, which I really don't, let me say that plenty of SSBers also are too wide. There are several reasons, but the most common one is the over-adjustment of speech processors. Lots of hams, and especially DXers, turn them up to the point of pain. I've probably done it myself a few times, but it isn't hard to avoid. If you have an IF monitor button on your rig, plug in a pair of headphones and listen to what you're putting out. If it sounds overly peaky and distorted, back it down a little! If you don't have a monitor, have a friend listen up and down the band to see if you're within proper bandwidth limits. This works best from the range of a few miles, rather than from across the country. But even that is better than nothing. Above all, though, if people complain that you're wide, don't get defensive. Check it out; they may be right.

The reason high power is associated with excessive bandwidth is that it is really easy to overdrive a linear amplifier and cause signal-widening distortion. Using the amp's ALC line can help prevent it, but not completely. Some amps just aren't all that linear to begin with. But, a good clean amp with the right drive will be no wider than the signal driving it. And even a QRP rig can have excessive bandwidth if you let it.

There's another reason for SSB rigs' being too wide, and this one is no fault of the operator. While it is true that today's rigs have audio filters which roll off above 3 kHz, they don't have terribly steep skirts. In other words, some of the higher frequencies do get through. Most of the filtering action occurs at the SSB filter in the transmit IF stage.

SSB rigs have two adjustments, one for each sideband, which set the frequency of the carrier before it is suppressed in the balanced modulator. These frequencies are chosen to coincide with the filter skirts such that no opposite sideband or residual carrier energy get through the filter. Typically, the adjustments are trimcaps connected to crystals in fixed crystal oscillators. In older rigs which did not have IF shift or variable bandwidth tuning functions, adjusting the oscillators caused the entire rig to shift in frequency. Many newer radios shift the first local oscillator to track the carrier oscillator. (And you don't need digital synthesis to do it; heck, my old TS-120 did it with a PLL circuit, even though it had an analog VFO.) Doing that has the effect of changing the passband without detuning the radio, which is exactly what you want when you turn your IF shift or VBT control. What most people don't realize, though, is that it can happen in transmit as well as in receive.

Obviously, the IF shift control disappears in transmit. But what if the oscillator is off to begin with? If it is set too far toward the low end of the filter's response, the radio may radiate carrier or opposite sideband. If it is set too high in the response, there'll be lots of audio highs and the RF signal will be too wide.

Over time, these oscillators drift. If your rig is on frequency but the sound quality differs markedly between USB and LSB, you may have this problem. It doesn't take much more than 50 Hz drift to do it! Correcting it requires a frequency counter. If you have a sharp ear, you can make it better just by matching the sounds of the two sidebands while listening to background static. Don't expect them to be identical, though; the two carriers are coming at the filter from opposite sides of its passband, and no filter is perfectly symmetrical. By the way, the by-ear approach works best when only one sideband is obviously off. If they're both off, you have no way to know where they belong.

There are some people who deliberately set the carrier oscillators to make their rigs sound "punchy" and "hot." What they're doing, of course, is reducing the bass and increasing the highs. If you do it, you will annoy other amateurs and violate FCC rules with your wide-as-a-barn-door signal. It is far better to have the carriers set properly and then use a punchier microphone or a little speech processing to get the sound you want. It is possible to sound crisp and punchy within 3 kHz. Up to a point, anyway.

SSTV

SSTVers take a lot of flack from voice operators. Some lids go as far as causing deliberate QRM to those exchanging pictures. Often, I've heard cracks about "all that splattering noise interfering with us." In truth, SSTV tends to be a bit *narrower* than the allowed 3 kHz. The audio frequencies used to modulate the transmitter are carefully controlled, and they're sine waves. All in all, a much cleaner signal than what comes from our vocal cords. I can tighten the slope tuning on my TS-940 to the point where voice signals are hard to understand, without affecting SSTV reception. So how about giving these folks a little slack, OK?

Well, I guess I've griped enough for one session. Next month, something positive, I promise! 73

Number 16 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

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

MAY 1

GLEN ELLEN, CA The Valley of the Moon ARC (WB6DWY) will hold its semi-annual Hamfest at the Sonoma Developmental Center, 15000 Arnold Dr., at McDougal Cottage, next to the fire station. Swapmeet, VE Exams, Ham and Egg Breakfast, SE Station, and more. Talk-in on 147.47 simplex and the 145.35 (-600) Rptr. For info call *Darrel WD6BOR, (707) 996-4494.*

MAY 2

SOUTH BEND, IN A Hamfest Swap & Shop will be held in PARKING GARAGE Downtown on U.S. 33 ONEWAY North by the Society Bank Bldg. and Century Center, across the street from Winter Hamfest. Talk-in on 52-52, 99-39, 69-09, 34-94, 145,29. Contact *Wayne Werts K9IXU, 1889 Riverside Dr., South Bend IN 46616. Tel. (219) 233-5307.*

MAY 3

ROCK SPRINGS, GA WCARS/VEC Exams will be held at Walker County (GA) Civic Center, US 27 Hwy., beginning at 7 PM. Pre-register with *Alan Painter WA4QCH, (404) 866-1200,* or *Dale Harwood N4VFF, (404) 937-5680.*

MAY 8

MANITOWOC, WI The Mancorad RC will hold its annual Hamfest beginning at 8 AM at the Manitowoc County Expo Ctr., intersection of Hwys. 42-151 and I-43 on Co. Hwy. R. Flea Market. VE Exams. Pre-register with SASE to *Moncorad RC, P.O. Box 204, Manitowoc WI 54221-0204.* For info, call *Red, (414) 684-9097 days,* or *Ron, (414) 793-4733 eves.*

MIDDLESBORO, KY Stop in at the Middlesboro City Library for WCARS/VEC Exams at 10 AM. To pre-register, contact *Andrew A. Pitt WB8WEZ, (606) 248-0046,* or *James E. Dyke KZ8A, (615) 869-4453.*

MURFREESBORO, TN The Middle Tenn. DX ARC will sponsor the Murfreesboro TN Hamfest from 8 AM-4 PM, indoors at the Rutherford County Agriculture Center, Old Fort Pkwy. (HWY 96); one mile east of I-24 Exit 78. ARRL sanctioned. Contact *Jerry Sartain KC4ALG, President MTDXARC. Tel. (615) 890-9358.*

MAY 8-9

AMARILLO, TX The Panhandle ARC will sponsor the Golden Spread Hamfest 8 AM-6 PM Sat., and 8 AM-2 PM Sun., at the Amarillo Civic Center, 3rd and Buchanan. Talk-in on 146.67 (-600). Contact *Lettie Hahn, (806) 358-7115.*

MAY 9

ATHENS, OH The Athens County ARA will hold its 14th annual Hamfest from 8 AM-3 PM at the City Rec. Center. To register in advance, contact *John Biddle WD8JLM, 80 Wonder Hills Dr., Athens OH 45701. Tel. (614) 594-8901 after 6 PM.* Talk-in on club repeater at 145.15+ MHz. For general info, write to *Carl J. Denbow KA8JXG, 63 Morris Ave., Athens OH 45701-1939.*

MAY 14-16

TULSA, OK The 1993 Green Country Hamfest and ARRL Oklahoma Section Convention will be held at the Maxwell Convention Center, W. 7th St., between Denver and Houston Aves. VE Exams. Talk-in on 146.28/.88. Call *(918) 272-3081,* or write *P.O. Box 470132, Tulsa OK 74147-0132,* for info. Sponsored by Green Country Hamfest Inc.

MAY 15

AMENIA, NY A Hamfest sponsored by the Southern Berkshire ARC will be held from 8 AM-2 PM at the Amenia Firehouse on Mechanic St. Talk-in on 147.285+. Contact *WB1CEI, (203) 364-5266* or *N1GIS, (203) 364-5976.*

CADILLAC, MI The Wexaukee ARC will hold its annual Swap 'N Shop and Eyeball QSO at the Cadillac Middle School starting at 8 AM. Talk-in on 146.98 Rptr. Contact *Wexaukee ARC, P.O. Box 163, Cadillac MI 49601,* or call *Dan Schmidt KE8KU, (616) 775-0998.*

COLORADO SPRINGS, CO A Ham Radio/Computer Swapfest will be held by the Pikes Peak RAS, from 8 AM-4 PM at the City Auditorium, 221 E. Kiowa at the corner of Weber St. Talk-in on 146.97/.52. For general info, call *Doug Paris N4TGO, (719) 495-9346.* VE Testing 9 AM-1 PM; call *Rick Brown KD0SU, (719) 531-9423* for details. To reserve tables, contact *Dennis Ochs N7OGL, 850 Santa Fe St., Colorado Springs CO 80903. Tel. (719) 630-0704.*

CROSSETT, AR A Hamfest & Crafts show will be held from 8 AM-4 PM at the Nat'l Guard Armory on Bus Route 133, Florida St. Sponsored by the Southeast Arkansas ARC. VE Exams at 10 AM. Talk-in on 146.04/.64. Contact *Ray Haney, 1707 S. Louisiana, Crossett AR 71635. Tel. (501) 364-5957 eves.*

N. SMITHFIELD, RI The R.I. Amateur FM Rptr. Serv., Inc., will hold their annual Spring Auction & Flea Market starting at 8 AM at the VFW Post 6342, Main St., in Forestdale. The Auction will be from 11 AM-3 PM. Talk-in on 146.76. Contact *Rick Fairweather K1KYI, 106 Chaplin St., Pawtucket RI 02861. Tel. (401) 725-7507 between 7-8 PM.*

ROANOKE, VA There will be WCARS/VEC Exams for upgrades only, beginning at 9 AM. Pre-register with *Fred L. Horton KZ4Y, (703) 366-6266* or *Ben Giavaden N4BG, Route 7, Roanoke VA 24022.*

SELAH, WA A Hamfest will be held by the Yakima ARC (W7AQ), at the Selah Middle School Gym from 8 AM-5 PM. Talk-in on 146.66, 444.800 and 146.52 simplex. The 2nd Northwest Packet Forum will be held at 9 AM. VE Exams at 10 AM. Potluck Picnic Sun. at Noon. Contact *KF7ZS, (509) 697-8080 (non fax)*, or *N7HHU via packet at YKM.*

MAY 16

CAMBRIDGE, MA A Tailgate Electronics/Computer/Amateur Radio Flea Market will be held from 9 AM-2 PM at Albany & Main Sts. Talk-in on 146.52 and 449.725/444.725 pl 2A (W1XM) Rptr. Sponsored by the MIT Radio Soc. and the Harvard Wireless Club. Reservation deadline May 4th. Contact *(617) 253-3776.*

HAGERSTOWN, MD The 1993 Great Hagerstown Hamfest, sponsored by Antietam Radio Assn. (W3CWC), will be held from 8:30 AM-3:30 PM at Hagerstown Jr. College Athletic & Rec. Center. For reservations contact *Fred Bailey N3HTN, Hamfest Chairman, (301) 416-8079.* VE Exams may be given by the Mountain ARC-VEC; for info call *(304) 289-3576 or (301) 724-0674.* Talk-in on the Hagerstown 146.34/.94 Rptr.

OLD WESTBURY, NY The L.I. Mobile ARC will hold an outdoors Hamfest at the New York Inst. of Tech., Route 25A. VHF Tune-up Clinic. Talk-in on 146.25/.85. Contact *Neil Hartman WE2V, (516) 462-5549.*

WHEELING, WV The Triple States RAC will sponsor the 1993 TSRAC Wheeling Hamfest/Computer Show from 8 AM-3 PM at the White Palace, Wheeling Park. ATV demos. Seminars. Talk-in on 146.91. Contact *The Triple States RAC, Box 240, RD #1, Adena OH 43901. Tel. (614) 546-3930.*

MAY 20-22

RACINE, WI The Racine Hamfest and Big Boy's Toy Show, sponsored by Racine Megacycle Club (W9UDU), will be held in downtown Racine, On the Lake, Hwy. 20 East from I-94. Time: Fri. May 20th, 5 PM-9 PM; Sat. May 21st, 8 AM-7 PM; Sun. May 22nd, 8 AM-5 PM. Vendors call *Rory or Kelly, (414) 636-9271.* ARRL/VEC Exams Sat. 9 AM-11 AM. Talk-in on Lakeshore Rptr. 147.27.

MAY 21

ELIZABETHTON, TN Western Carolina AR Society/VEC, Inc. will sponsor VE Exams at Moody Aviation-Carter County Airport at 7 PM. Pre-registration only. Contact *Joe Hopkins K4BKI, (615) 543-4022* or *Jon Christiansen AB4NN, (615) 543-7155.*

MAY 21-22

SO. SIOUX CITY, NE The 3900 Club and the Sooland ARA will sponsor Hamboree 15 at the Marina Inn. Flea Market. Convention. Bus Tour. QCWA Luncheon. MARS, and more. Flea Market contact: *Al Smith W0PEX, 3529 Douglas, Sioux City IA 51104. Tel. (712) 258-7475.* Convention/Banquet contact: *Dick Pitner W0FZO, 2931 Pierce St., Sioux City IA 51104. Tel. (712) 258-1520.*

MAY 22

EPHRATA, PA Lancaster County Hamfest sponsored by the Ephrata Area Rptr. Soc., Inc., will be held at the Ephrata Sr. High School, 803 Oak Blvd., starting at 8 AM. VE Exams at 9 AM. Contact *Tom Youngberg K3RZF, (215) 267-2514 after 6 PM,* or write to *E.A.R.S., 906 Clearview Ave., Ephrata PA 17522.* Talk-in on 145.45 and 444.650 MHz.

GRAND RAPIDS, MI The Independent Rptr. Assn. will hold its 13th Annual Hamfest at Wyoming Nat'l Guard Armory, 44th St.; 1/2 mile west of the 131 x-way. Hours: 8 AM-4 PM. Talk-in on 147.160 Link System. Contact *Tom or Kathy Werkema KA8YSM/KB8KZH, (616) 698-6627.*

MINNEAPOLIS, MN There will be a Tailgate Swapfest from 7 AM-2 PM at the Honeywell Ridgway plant parking lot, 2600 Ridgway Pkwy., Stinson Blvd. Contact *Bill Brisley N0BSN, 18025 Cynthia Dr., Minnetonka MN 55343. Tel. (612) 474-0118.* Sponsored by TwinsLAN ARC.

PADUCAH, KY Come to the Noble Park Civic Center to enjoy a Hamfest sponsored by the Paducah ARA. Time: 8 AM-2 PM. Talk-in on 147.06/.66. VE Exams. Contact *David Fraser KQ4IU, 5715 Blandville Rd., Paducah KY 42001. Tel. (502) 554-7999* or *Paul Smith N4FFO, 229 Nickello Hts., Paducah KY 42001. Tel. (502) 898-6834. Packet address @W4NJA KY.USA.NA.*

MAY 23

CANFIELD, OH The Twenty over Nine Radio Club will hold its 9th Annual Computer/Electronic Hamfest from 8 AM-3 PM at the Canfield Fairgrounds on Fairgrounds Blvd. Flea Market. Talk-in on 147.315+, 443.225+ or 223.5 simplex. Contact *Don Stoddard, 42 South Whitney Ave., Youngstown OH 44509.*

MAY 28-30

EDMONTON, ALBERTA, CANADA Northern Alberta Hamfest 93, sponsored by the Northern Alberta RC, will be held at Shakers Acres RV Park, 21530 - 103 Ave. Contact*Jim Steene VE6JDS, 9319 - 95 St., Edmonton, Alberta T6C 3X1 Canada. Tel. (403) 469-2595.*

MAY 30

CHICAGO, IL The Chicago ARC Hamfest will be held from 8 AM-3 PM at DeVry Inst. of Tech., 3300 N. Campbell. Flea Market. Walk-in VE Exams by Great Lakes VEC. Talk-in on 147.255+ 107.2, 444.825+. For info call *(312) 666-1606* or *(312) 545-*

3622. Make reservations with *CARC, c/o Dean Woodman NB9Z, 1501 Ashland, Evanston IL 60201-4001* or *W9CAF packet on 144.930.*

SOREL-TRACY, QUEBEC, CANADA "Hamfest du Quebec" will be held at the Curling Club located in Tracy. Contact *Club Radioamateur Sorel-Tracy Inc., Boite Postale 533, Sorel Quebec, J3P 5N6 Canada.*

WEST FRIENDSHIP, MD The Maryland FM Assn., Inc. will host its Memorial Day Hamfest at the Howard County Fairgrounds, Route #144, from 8 AM-3 PM. Flea Market tables by pre-registration only. Contact *Melvin Seyle WA3KZR, 15809 Pointer Ridge Dr., Bowie MD 20716. Tel. (301) 249-6147.* Talk-in on 146.16/.76, 223.16/224.76 and 449.0/444.0 WA3DZD Rptr.

JUNE 5

KITCHENER, ONT., CANADA The Central Ontario AR Fleamarket will be held at Bingeman Park. Contact *Jack Knight VE3RGY, 35 Brockville Ave., Guelph, Ont. Canada N1E 5X5. Tel. (519) 823-1358.*

KNOXVILLE, TN The RAC of Knoxville will present its 27th Annual Amateur Radio and Computer Fair at the Tenn. Valley Fair Grounds, 8 AM-4 PM. Talk-in on 147.300+, 224.500-. For VE Exams, contact *Rich Slover ND4F, (615) 539-4821.* Ticket/table contact: *Angela Crigger N4RPR, 2707 Pine Hill Dr., Knoxville TN 37932. Tel. (615) 694-9071.*

TEANECK, NJ The Bergen ARA will hold its annual Spring Hamfest from 8 AM-2 PM at Fairleigh Dickinson Univ. VEC Exams. Flea Market spaces by pre-registration only. Talk-in on 146.190/.790 and 145.620 simplex. For Hamfest info call *Jim Joyce K2ZO, (201) 664-6725.* Get VE info from *Pete Adely K2MHP, (201) 796-6622.* Please, no calls after 10 PM.

JUNE 6

BUTLER, PA The Breezeshooters of Western PA will sponsor their 39th Annual Computer/Hamfest from 8 AM-4 PM at the Butler Farm Showgrounds. Mobile Check-in on 28.495 and 146.520. Talk-in and directions available on 147.96/.36. Fly-in available at Roe Airport. Contact *Rey Whanger W3BIS, Box 8, R.D. 2, Cheswick PA 15024. Tel. (412) 828-9383.*

DAVISVILLE, NH The Contoocook Valley RC Ham Radio/Computer/Electronics Tail-Gate Flea Market will be held from 8 AM-3 PM. Talk-in on 146.895 K1BKE Rptr. Contact *John C. Moore, (603) 746-4817.*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St., beginning at 9 AM. Talk-in on 444.200 WB2ZZO Rptr., or 146.52 simplex. Call evenings only: *Charles Becker WA2JUJ, (516) 694-3955* or *Arnie Schiffman WB2YXB, (718) 343-0172.*

SPECIAL EVENT STATIONS

MAY 1

MEMPHIS, TN The Mid-South ARA will operate W4EM 1500Z-2200Z to celebrate the Memphis in May Internat'l Festival in honor of Russia. Operation will be in the lower 50 kHz of the SSB General 40m-12m, and the Novice 10m subbands. AMTOR frequencies: 21.080, 14.100, 7.080 and 3.580 MHz +/- QRM. For a certificate, send QSL and a 9" x 12" SASE to *MARA-W4EM, c/o Pat Lane, 3390 Northwood Dr., Memphis TN 38111.*

SPRINGFIELD, IL The Sangamon Valley RC will operate W9DUA 1400Z May 1-2200Z May 2, to commemorate the 5th anniversary of the dedication of the Illinois Vietnam Veterans Memorial at Oak Ridge Cemetery. Operation will be in the General portions of the 160m thru 15m bands to include the Novice 10m subband. For a special QSL card, send a letter size SASE to *W9DUA SPL EV, San-gamon Valley Radio Club, Red Cross Bldg., 1025 S. 6th, Springfield IL 62707.*

MAY 1-JUNE 30

VICTORIA, BC, CANADA The Friendship ARS of Victoria will celebrate the 1993 Friendship Radiosport Games and Hamfest by operating XO7G daily at 2100Z-0500Z in the General class subbands. QSl direct or by bureau. For details, contact *FARS-Victoria, c/o Camosun College Box 128, 3100 Foul Bay Rd., Victoria BC, V8P 5J2 Canada.* Visitors may operate a Field-Day SE Station June 26th & 27th.

MAY 6-7

KAYSVILLE, UT The Davis High School ARC will operate KG7TE 1600Z-2200Z to celebrate the beginning of summer vacation. CW: 14.050, 21.050, 28.050; Phone: 7.285, 14.285, 21.285, 28.375, 145.59. For a certificate, send SASE to *Sara Otterson KB7OTZ, 1549 N. Honeybee Circle, Farmington UT 84025.*

MAY 8

CARTHAGE, TX Carthage AR Service, Inc., will operate N5IKS 1400Z-2100Z from the Tex Ritter Museum, near the middle of the 40, 20 and 15m General level and 10m Novice bands. For a certificate, send your contact number, QSL card and business size SASE to *N5IKB, 221 Browning St., Carthage TX 75633.*

LONDON, ONT., CANADA The London ARC, in conjunction with The London Middlesex Red Cross, will operate CJ3RCL (VE3RCL) in support of World Red Cross Day. Operation will begin at 0000 UTC on 75m around 3.810 MHz, changing every 2 hrs. Frequencies: 3.810, 7.210, 14.270, 21.270, 28.270 +/- QRM. For details, write to *Canadian Red Cross, 840 Commissioners Rd. East, London Ont., Canada N6C 2V5, Attn: Joyce.*

MAY 8-9

BOSTON, MA The Massachusetts QSO Party will be conducted by the Boston ARC, under the leadership of the Council of Eastern and Western MA Radio Clubs. Time: 1500Z Sat.-2100Z Sun. Write to *Massachusetts QSO Party, Boston ARC, P.O. Box 15585 Kenmore Station, Boston MA 02215.*

LAS VEGAS, NV The Nevada QSO Party will operate 0000Z May 8-0600Z May 9, on 6 through 160 meters. Modes: CW, SSB, RTTY, SSTV, Packet. Sponsored by the Frontier ARS. Contact *Jim Frye NW7O, 4120 Oakhill Ave., Las Vegas NV 89121.*

MAY 10

PROMONTORY, UT The Ogden ARC will operate NL7JE to commemorate the driving of the Golden Spike at Promontory Summit UT. Operation will be from 0001Z-2100Z on one of the following: 3.970, 7.270, 14.280, 21.375 and 28.415 MHz. Send QSL and SASE to *Ogden ARC, P.O. Box 3353, Ogden UT 84409.*

MAY 15

FORT WALTON BEACH, FL The Playground ARC will operate W4ZBB from the Air Force Armament Museum, to give an Armed Forces Day salute to U.S. troops. Operation will be 1600Z-2200Z in the General portions of 40, 20, and 15m and in the Novice phone portion of 10m. For a certificate, send business size SASE and contact number to *PARC, P.O. Box 873, Fort Walton Beach FL 32549.*

PASADENA, MD The 149th Anniversary of the telegraph message "What Hath God Wrought," will be commemorated by the Bay Area ARS through the operation of KB3MF, 1300 UTC-2000 UTC, from the Baltimore/Washington area. CW frequencies: 7.125, 14.035, 21.145, 28.245 MHz. Send your QSL card and QSO details along with an 8 1/2" x 11" SASE, to *Ray Robley, Bay Area ARS, 211 Laurel Rd., Linthicum Hts. MD 21090,* to get a certificate.

MAY 15-16

ST. CHARLES, MO Station WB0HSI will operate 1300Z-2100Z as part of the Lewis and Clark Rendezvous commemorating the departure of the Lewis and Clark Expedition on 21 May 1804. Frequencies: 7.265, 14.265, 21.365, 28.465, 146.67. AO-13 Modes B and J, as propagation and QRM permit. For a certificate, send a 9" x 12" SASE to *St. Charles ARC, P.O. Box 1429, St. Charles MO 6332-1429.*

WALL TOWNSHIP, NJ The Ocean-Monmouth ARC will operate 1600Z May 15-1600Z May 16 to commemorate the Marconi Memorial Tower Radio Site. CW will be up 10 kHz from bottom of Novice subbands and 10.145, 14.045, 18.080 MHz and bottom of General 80-15m and Novice 10m phone subbands. For certificate send a 9" x 12" SASE (or $1 U.S.) to *OMARC, P.O. Box 75, Bradley Beach NJ 07720.*

MAY 15-17

OAK PARK, MI The 1993 Michigan QSO Party will be sponsored by the Oak Park ARC, 1800Z Sat. May 15-0300Z Sun. May 16, and from 1100Z Sun. May 16-0200Z Mon. May 17. Contact *Mark Shaw K8ED, 27600 Franklin Rd., Apt. 816, Southfield MI 48034.*

MAY 16-17

HANSKA, MN The New Ulm ARC will operate KB0IWV 1600Z-2359Z May 16th to celebrate Hanska's 9th annual Syttende Mai, and on May 17th to commemorate the anniversary date (1814) of the Constitution of Norway. Tune in on 3.875, 7.250, 14.250, 21.350, and 28.350 +/-. For a certificate, send QSL and a 9" x 12" SASE with two first class postage, or a #10 SASE for a folded certificate to *KB0IWV, NUARC, RR4, Box 14-A, New Ulm MN 56073 USA.* SWL reports welcome.

MAY 17-22

DAVIS MTNS., TX Amateur astronomers/hams representing the Southwest region of the Astronomical League, will operate K5GH at the 12th annual Texas Star Party. Frequencies: (+/- QRM): 28365, 21365, 14265 and 7265. SSTV and CW contacts on request. For an astronomical theme QSL card, send QSL/SWL report and SASE to *K5GH-TSP, 2619 Bordeaux, McKinney TX 75070.*

MAY 21-23

LIBERTY, NY The Long Island Mobile ARC's Junior Operators Committee will operate K2YEW from their QRP camping weekend at Mongap Pond Camp grounds. Frequencies: 7.040, 3.560 CW and 7.225 phone. For certificate, send SASE to *Robert Todaro N2JIX, 2218 E. 73rd St., Brooklyn NY 11234.*

MAY 22-23

SUMTER, SC The Sumter ARA will operate WA4UMU from the Swan Lake Iris Gardens, to commemorate the Sumter County Iris Festival. Operation will begin at 1700 UTC and continue for 24 hrs. on the General Portion of 80, 40, 20 and 15m; and on the Novice portion of 10m. For a Certificate, send QSL and 9" x 12" SASE to *KC4SZG* call book address.

MAY 29

DECATUR, AL Station AB4RE will be operated by the Morgan County ARC to commemorate the Alabama Jubilee Memorial Day Weekend celebration at Point Mallard Park. Time: 0900-2100 CST. Operation will be in the General portion of the 40m band and the Novice portion of the 10m band. For a Certificate, send QSL and a 9" x 12" SASE to *AB4RE, Steve Simmons KD4KTV, 1603 1st Ave. SW, Decatur AL 35601.*

MAY 29-30

LOGAN, UT Members of the Bridgerland ARC will operate N7LMO 1600Z May 29-0200Z May 30, to celebrate the Mountain Man Rendezvous commemorating the early Mountain Men and Indian fur trading rendezvous. Operation will be in the Novice 10m phone subband and in the lower 25 kHz of the General 15 and 20m phone subbands. For certificate QSL send 8 1/2" x 11" SASE with 2 oz postage to *Dean Stevens, P.O. Box 332, Millville UT 84326.*

MAY 29-31

WELLSBORO, PA Tioga County ARC will operate WO3C 1500Z May 29-1700Z May 31, to celebrate the 100th Anniversary of the Pennsylvania State Park System. Operation will be on the lower portion of the General 80, 40, 20, and 10m bands and Novice 80, 40, 20, 10m bands. For QSL and Certificate, send QSL and 9" x 12" SASE to *Darlene Rahn WO3C, R.D. #6 Box 200, Wellsboro PA 16901.*

Number 17 on your Feedback card

HAMS WITH CLASS

Let's Concentrate Now

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

Of all the skills that get taught in a classroom, concentration and following directions are most often overlooked. Perhaps with the rise of technological advances in information storage and retrieval there is a decline in emphasis on the basic memory and concentration skills. As a teacher of amateur radio in the classroom to 6th, 7th and 8th graders, I am appalled at the lack of ability of many students to focus on a task, concentrate, and to follow directions. I am forever pointing out how much time we waste redoing work that was hastily rushed through without thought.

Fortunately, amateur radio in a classroom gives the instructor ample opportunity to train youngsters (and adults as well) to improve their auditory and concentration skills. The very first time I hand out code practice oscillators to a class is when the first lesson of "listening" occurs. In an average class of 40 youngsters, the children will get 20 keys to practice on, using the "buddy system." They are literally forced to listen to just the person sitting next to them, and to block out everyone else's tones. I smile to myself as they inevitably get very frustrated and try to convince me that it's impossible to hear only their neighbor with so much other "noise" going on all around them. I keep reassuring them that with total concentration they will definitely be able to hear each other.

Of course, as their auditory and concentration skills improve during the term, most of the children become quite good at being able to distinguish particular tones. I remind them periodically about how far they've come. It's a great motivation to do better when someone realizes that with appropriate effort they can master new skills.

By the end of the term, almost every student has improved his or her ability to concentrate solely on their neighbor's messages, to the exclusion of the other children's sounds and the distractions coming from the hallway outside our room. This exercise is just one example of the "hidden" benefits the children get in a ham radio class. It doesn't matter that every student won't pass their code test; that's okay. What does matter is that in all of my 12 classes, every child will have gotten more self esteem by acquiring basic tools that are needed to be successful in all their studies.

Following Directions

Before we get to the part of the term where some of the youngsters will be filling out the FCC license application, we have an entire lesson devoted to following directions and carefully reading written instructions. (Another valuable lesson!) Because I always like the more tedious lessons to have a little "zip" to them, I make my point about the importance of following directions and reading everything carefully through a little fun activity. I believe that the lessons the children learn through a need-to-know situation or an amusing demonstration will be well learned and well retained.

The following is the "test" paper that I have waiting on everyone's desk when they enter the room. I don't say anything to them. On the board is written, "This is a timed test—you have only five minutes. Good luck!"

Photo A. Using Morse code in the classroom can improve auditory and concentration skills.

1. Read everything carefully before doing anything.
2. Smile, then sit back comfortably for the next five minutes.
3. Circle the word "everything" in instruction #1.
4. Brush away an imaginary fly. Blink four times.
5. Sign your name after instruction #1.

6. Mentally subtract 19 from 26 and extend as many fingers as there are digits in the answer.

7. If 9 is divisible by 3, touch your head while you count silently to 11.

8. Draw a rectangle around the word "doing" in instruction #1.

9. Loudly call out your name when you read this instruction.

10. On the reverse side of this paper add 8,457 and 9,063.

11. Put a circle around your answer for #10.

12. If you think you have followed directions carefully to this point, call out loudly, "I have."

13. Cross your left ankle over your right ankle. Then uncross your ankles and slap your right heel.

14. In a low whisper, count backward from 10 to 1.

15. Punch three holes in the top of this paper with your pencil.

16. If you are the first student to reach this point, call out loudly: "I am the leader in following directions."

17. Grasp your throat with both hands and open your mouth.

18. Underline all even numbers on the left side of this paper.

19. Say clearly: "I am nearly finished. I have followed directions."

20. Now that you have finished reading everything carefully, do only instructions #1 and #2.

Photo B. The "buddy system" forces each child to listen to their neighbor.

Not only is this a terrific lesson that children can have fun with and learn an invaluable lesson from, but it can be a great ice-breaker in an adult radio class as well. Whether you're a classroom teacher or an evening instructor, remember that we all learn better in a relaxed, non-threatening environment where it's okay to have fun while learning. 73

QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Space restrictions for the March 1993 "QRP" column did not allow me to include the schematic for the controller. We'll take a look at the entire project this month.

Three of the four chips used in the controller are LM324 op amps. They're easy to come by and very inexpensive. Each LM324 consists of four op amps. The LM324 operates on a single power supply, a great advantage over the 741 op amp. If you build the circuit on perf board, notice the unusual location of the VCC pin (pin #4) and ground (pin #11) of this chip. Also, don't short the output of any of the amplifiers or you may damage the chip.

In the March column I described the array detect and power supply systems, as well as the state-of-charge reference source. This time around, we'll look at the FET driver and the driver switching. A quick look at the over-temperature comparator will wind up the tour.

From the voltage divider the battery sense is buffered by U1C. The output is then run to U1B where it is compared to the SOC reference voltage. Two 22 µF capacitors connected back-to-back slowly charge and discharge, depending on the input from the battery sense line. The output, on pin #8, will slowly rise and fall along with the battery's terminal voltage. The output of this amplifier, pin #8, is then routed to two more locations. First, it goes to U3B. This amplifier and U3D compare U3B's output and also act as LED drivers. Op amp U3 controls the function of the charging and charged LEDs.

The output of U1C also goes to U2D. Op amp U2D takes the output from U1C and the SOC reference voltage and will generate a string of pulses when the two voltages are alike. If either one of them changes, the output of U2D will also change. This is how the FETs are switched on and off—by the action of U2D.

The last op amp before the gate driver is U3C. This op amp acts like a switch to provide a nice square wave to the voltage pump. When its output is low, the voltage pump is turned on. This then turns on the FETs and they conduct, passing current from the array to the battery bank.

The voltage pump is nearly identical to the one that I mentioned in the first part of this series. A 4001 CMOS chip will be used as an oscillator running about 300 kHz. The oscillator runs all the time and is never turned off. Gates C and D act as switches to couple the oscillator's energy into the voltage multiplier diodes. The output runs about +22 volts to the gates of the FETs. This is a bit over the maximum limit of the gates and therefore a 20-volt zener diode clamps the gate drive at +20 volts. This +20 volts turns on the FETs.

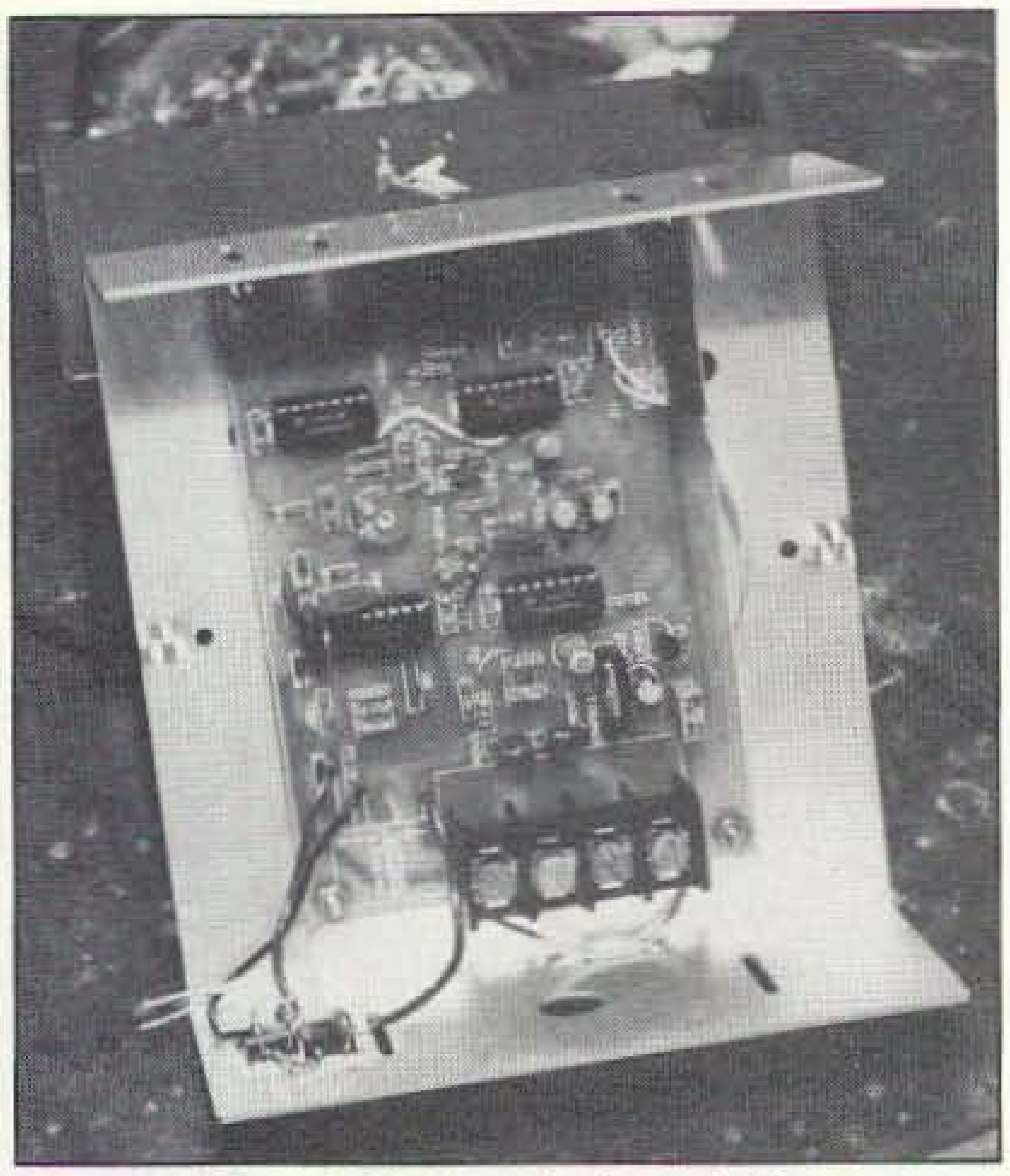

Photo A. Prototype for the controller.

Although the FETs have a very low RDS (on), they can still generate heat when passing large amounts of current. The blocking diode will generate more heat at higher currents because of the 0.3-volt drop across it. A 10k thermistor monitors the temperature of the heat sink. U2C is a simple comparator checking the thermistor's voltage drop across the other 10k resistor. When the comparator switches states, the output on pin #8 goes high. This high is fed back to the input of the chip, providing a set hysteresis. This will keep the over-temperature shutdown from oscillating at the over-temperature point. The output also goes to the LED driver. When an over-temperature condition occurs, the "charging" LED will be forced off. Also, the SOC reference on pin #13 of U2D will be forced high, turning off U2D. Pin #8 of U3C then becomes high and turns off the voltage pump. The FETs are then turned off during an over-temperature condition. Everything will stay this way until the

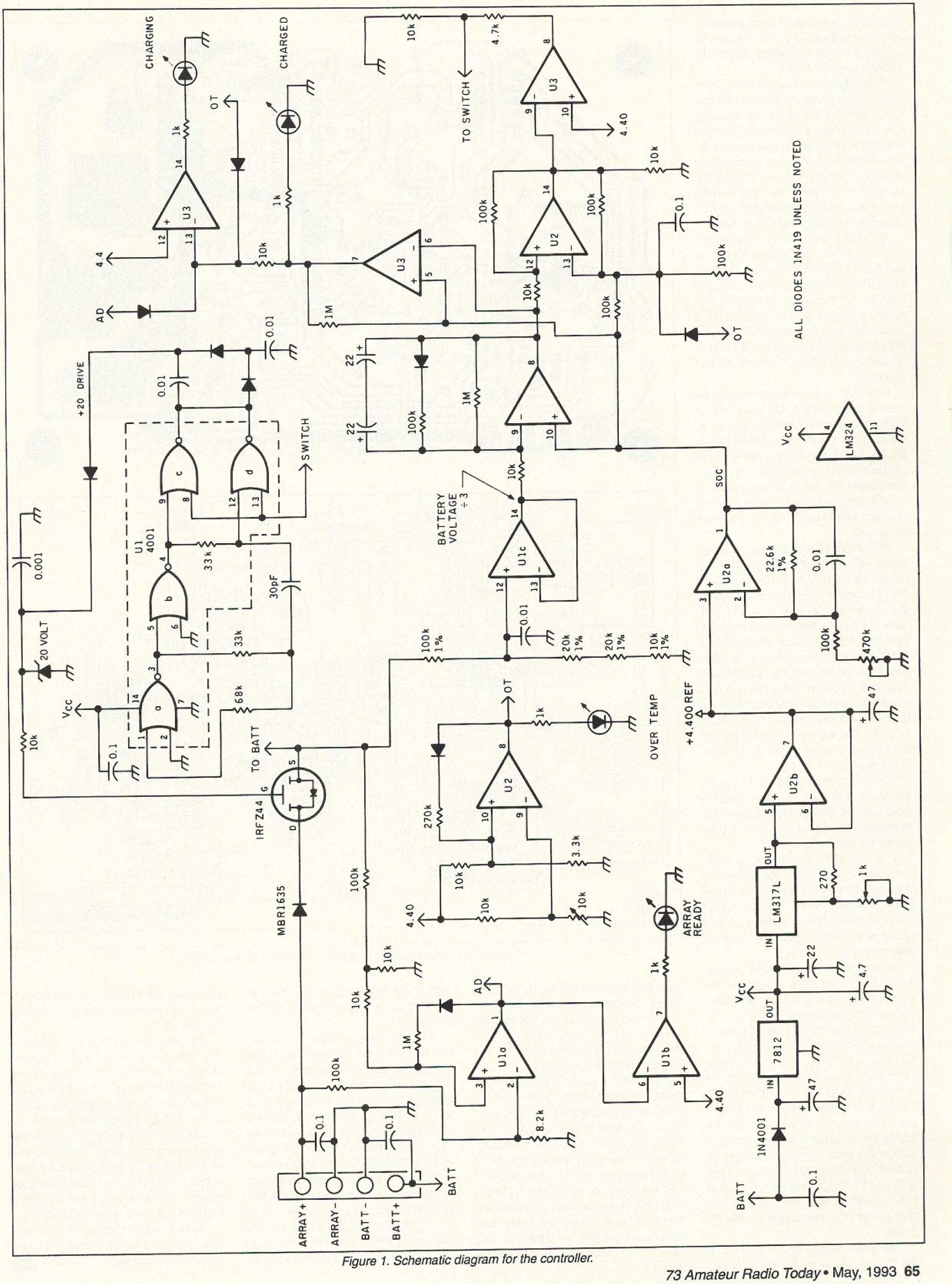

Figure 1. Schematic diagram for the controller.

heat sink's temperature drops below the reference voltage set by the 10k resistor and the 3.3k resistor voltage divider connected to pin 10 of U2C.

By changing the value of the 3.3k resistor, you can alter the turn-on temperature. Lowering the value will raise the over-temperature shutdown. Using a well-calibrated fingertip and a pot, I adjusted the pot until over-temperature shutdown occurred when I thought the heat sink got too hot. I then removed the pot, measured its resistance and installed the nearest value-fixed resistor.

Because this is a rather complex project using almost 16 IC gates, it's best to use a PC board. FAR Circuits (18N640 Field Court, Dundee IL 60118) has one available for $9 plus $1.50 shipping and handling. If you're really up to it, perf board may also be used. There are no special precautions required if it's built on perf board. Photo A shows my first prototype.

Construction is basically straightforward. Sockets for the ICs really help in troubleshooting the project. If you're really brave, solder everything in, including the ICs. Watch for correct polarity of the diodes and the electrolytic capacitors. Remember, the two 22 µF caps near U1 connect back-to-back. The circuit will not operate correctly if they are placed backwards.

The MBR1635 blocking diode as well as the FETs mount to a heat sink. In my units, I use a 6" x 4" x 1/8" aluminum sheet to hold the PC board as well as the two active devices. Because both have hot cases, they must be insulated from the heat sink. Radio Shack sells a TO-220 mounting kit for about a buck. Also note that the lead from the blocking diode and the drain of the FET are connected together. Carefully bend over the leads of both devices and solder them together. The leads are quite fragile and are easily broken off at the plastic body of the device.

The source lead connects to the PC board via a #12 gauge wire. Another length of #12 gauge wire connects the cathode of the blocking diode to the array via the terminal block.

If you're going to run over 6 amps through the controller, the PC board trace between the + battery terminal and the source lead of the FET should be strengthened. Again, a piece of #12 gauge wire soldered over the trace will take care of the problem.

Setup will require a digital VOM and a variable power supply. Connect the power supply to the battery terminals. Turn on the supply and adjust it to 14 volts. Using your VOM, check for proper voltage of +12 volts at the 7812 regulator. Check for VCC at pins 4 of each LM324 and at pin 14 on the 4001. None of the LEDs should be on at this time.

Check the voltage on pin 7 of U2A. It should be close to 4 or 5 volts. By adjusting the 1k trimmer, set the output of U2A to 4.5 volts. Verify this voltage on pins 10 of U1B, pin 13 of U2D, pin 12 of U3D, pin 10 of U3C and pin 5 of U3B. If you're missing one, then you have a wiring error or solder bridge on the PC board.

Check the voltage on pin 1 of U2. It should be around 4.5 volts. By adjusting the 470k trimmer, you should be able to increase and decrease the voltage. Set this point at 4.766 volts. That's one-third the battery voltage of 14.3 volts, our fully-charged terminal voltage.

Turn off the power supply and remove it from the battery terminal on the block. Reconnect them to the array terminals. Connect a small amp/hour battery (6.5 amp/hour is ideal) to the battery terminals. Adjust the power supply to 16 to 18 volts and turn it on. The "ARRAY" LED will come on, as will the "CHARGING" LED. If you can monitor the current from your power supply, you should see current flowing into the battery at this time. If not, check for +20 volts on the gate of the FET. Also, double-check the blocking diode and FET drain connections for errors.

As the terminal voltage of the battery hits 14.3 volts, the output of U3C will begin sending square waves to the voltage pump. This will rapidly turn the FET on and off, controlling the flow of current into the battery. An oscilloscope connected to pin 8 of U3C will show this clearly. The "CHARGING" LED will now go out and the "CHARGED" LED will come on.

During the charging process, you can try out the over-temperature shutdown by flicking your BIC on the thermistor. The "CHARGING" LED will go out and the "OVER TEMP" LED will come on. All charging will stop at this time until the thermistor cools down. When its temperature is cooled back enough, charging will resume.

By using one FET and the MBR1635, you can get up to 16 amps of current flowing, the maximum rating of the MBR1635. By using an SD51 diode and two or more FETs in parallel, you can increase current capacity up to 45 amps. One BUZ348 FET and a SD51 diode will provide about 20+ amps of current. You can add more FETs in parallel by connecting all the drain and source leads together. The gate leads will require a separate 10k resistor for each FET.

Next month I'll have some troubleshooting tips for the project and some modifications as well.

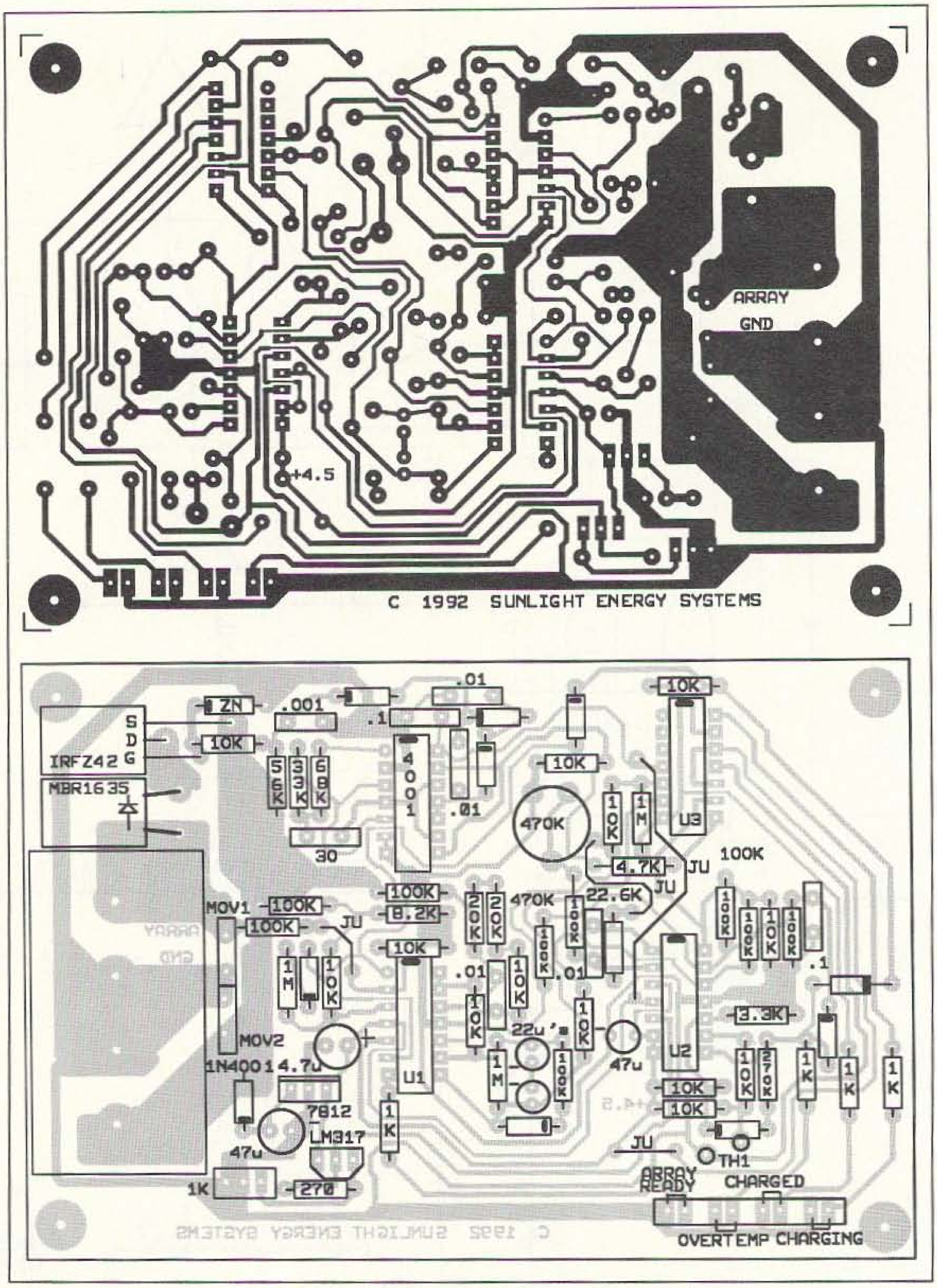

Figure 2. PC board pattern and parts placement for the controller.

A Versatile NiCd Charger

Simple to build with off-the-shelf parts.

by Ivan T. Lorenzen W4JC

With the ready availability of all kinds of chargers, you may well wonder why anybody would bother to build one. One good reason is that by adding a few things (like a timer, a latching relay, a constant current regulator, and provision for adjusting both the charging and trickle rates) you will have a truly versatile NiCd charger. It will: (1) satisfy a wide range of current requirements; (2) automatically switch over to a trickle rate at the desired time; and (3) charge any number of cells, from one cell to 18 cells, with any mAh rating from 100 mAh to 1500 mAh. And it won't go back to charging again at the end of 24 hours.

There are probably as many philosophies regarding the best way to charge NiCds as there are people who use them. Some argue that constant voltage is best, others say constant current, and still others argue the merits of pulsed DC over filtered steady-state DC. It has also been argued that, in practice, one will work about as well as another, provided that limits are observed to prevent damage to the cell(s). I have used the constant current method for years and have gotten excellent cell longevity. The original 250 mAh pack in my early Tempo S1T handheld lasted for over 12 years and faithfully delivered its full capacity all that time, until it finally died of old age.

The usual practice has been to discharge the pack until the low-battery indicator comes on. On gear that has no low-battery indicator the NiCds are not put on charge until the terminal voltage is down to 1.0 volt per cell. Instead of the commonly used charging rate of 10% of the cell's rated capacity (0.1C), NiCd life can be extended if the charger is set at 0.08C and left on for 18 to 20 hours to achieve approximately 150% of the NiCd mAh rating (1.5C). At the end of the charging period the NiCds are put on a trickle charge set at one-half the charging rate, 0.04C. The NiCds can be left on 0.04C trickle charge continuously until they are to be used, and they will retain full charge until put into service.

The circuit of this charger contains nothing new and is quite simple. See Figure 2. All components are standard, off-the-shelf parts. The parts list includes Radio Shack catalog numbers for some of the parts that may not be readily available elsewhere. The 100 ohm and 250 ohm potentiometers are available from Digikey (Telephone: 1-800-344-4539). Wiring is point-to-point, and the parts placement is not critical. Any box of adequate size to hold the parts may be used. The timer is a standard table-top type and sits alongside the charger. The polarized AC female socket supplying AC to the timer and the male polarized AC plug which plugs into the socket on the timer are from an AC extension cord, and polarities must be observed.

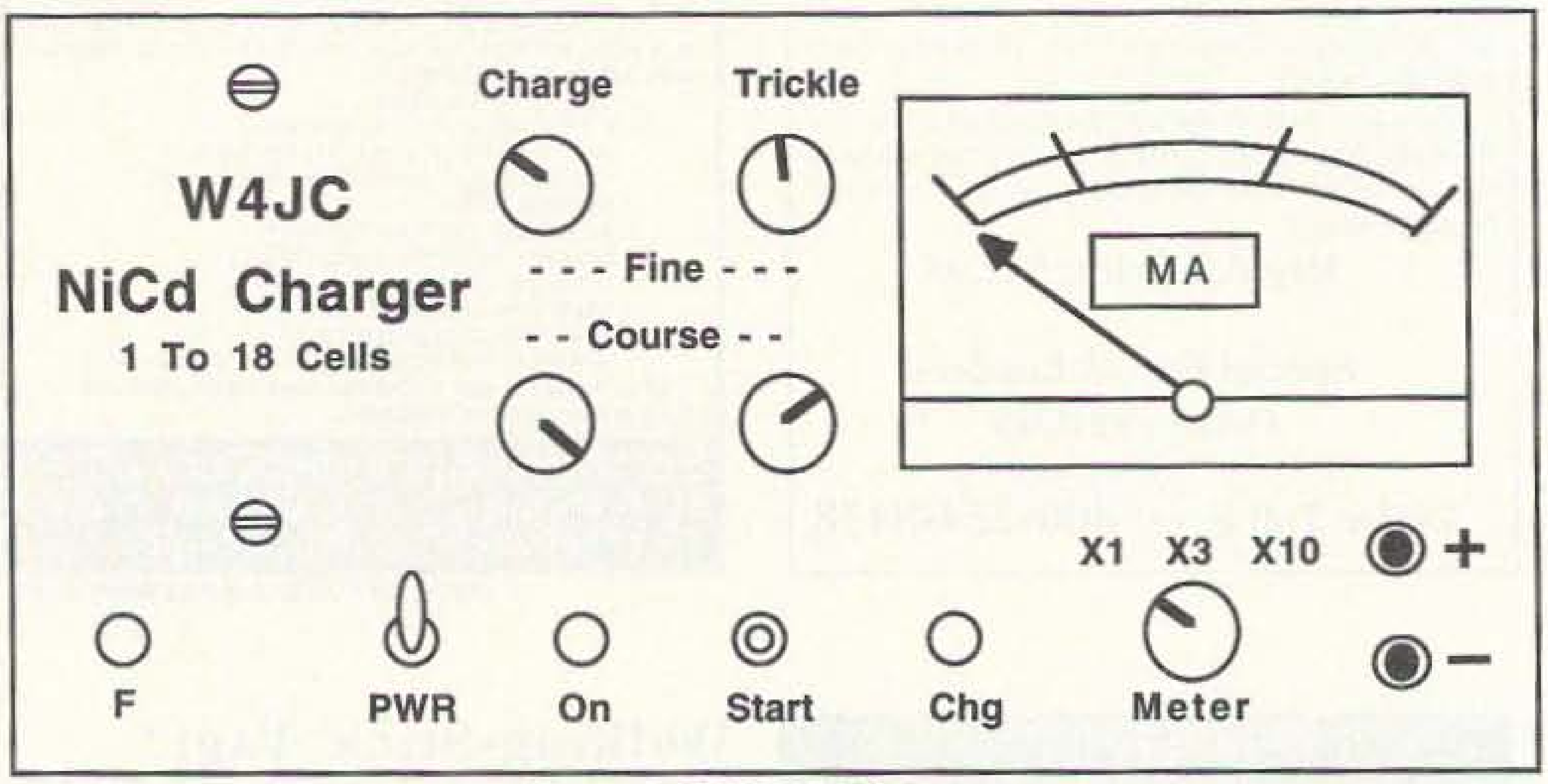

Figure 1. W4JC NiCd charger.

When SW1 is closed, AC is applied to the green pilot lamp, the timer clock, and T1. The relay is not yet energized, and its charger contacts connect the regulator output to the trickle adjustment potentiometers, so the desired trickle rate may be set immediately by adjusting R5/R6.

At this point, rotate the timer clock dial until its internal switch closes, sending AC to the "start" switch. Pushing the "start" switch lights the red pilot lamp and energizes the relay. One set of contacts holds the relay in its energized position. The other set of contacts switches the regulator output to the charge position, and the charging rate may be set by adjusting R2/R3. Since the regulator is connected as a constant current device, any number of NiCd cells from one to 18 may be connected to the charger output terminals.

When the timer clock turns its internal switch to "off," both sets of relay contacts open, and the NiCds are switched to trickle charge at the rate previously set. The charge rate will not come on again unless the "start" switch is pushed.

This charger will do what you may now be using two or three chargers to do, and it will do it better.

Construction

All parts are mounted on the panel. Remove the panel from the project box or case and temporarily position the parts to assure adequate clearance, before holes are marked and drilled.

The following parts are mounted on a 2" x 4" piece cut from unclad perf board: the relay socket, C2, C3, the bridge rectifier, and the LM317T in its heat sink. If a mounting angle bracket is not available, you can remove the center lug from a tie-point strip and bolt it to the perf board, then mount it on a meter bolt.

A tie-point strip, with one lug cut off, can be mounted on the other meter-mounting bolt and used for the junction of the meter-shunt resistors. A tie-point strip may also be fastened to one of the mounting bolts holding the transformer and used for the several connections in the AC part of the wiring.

The meter-shunt resistors are standard

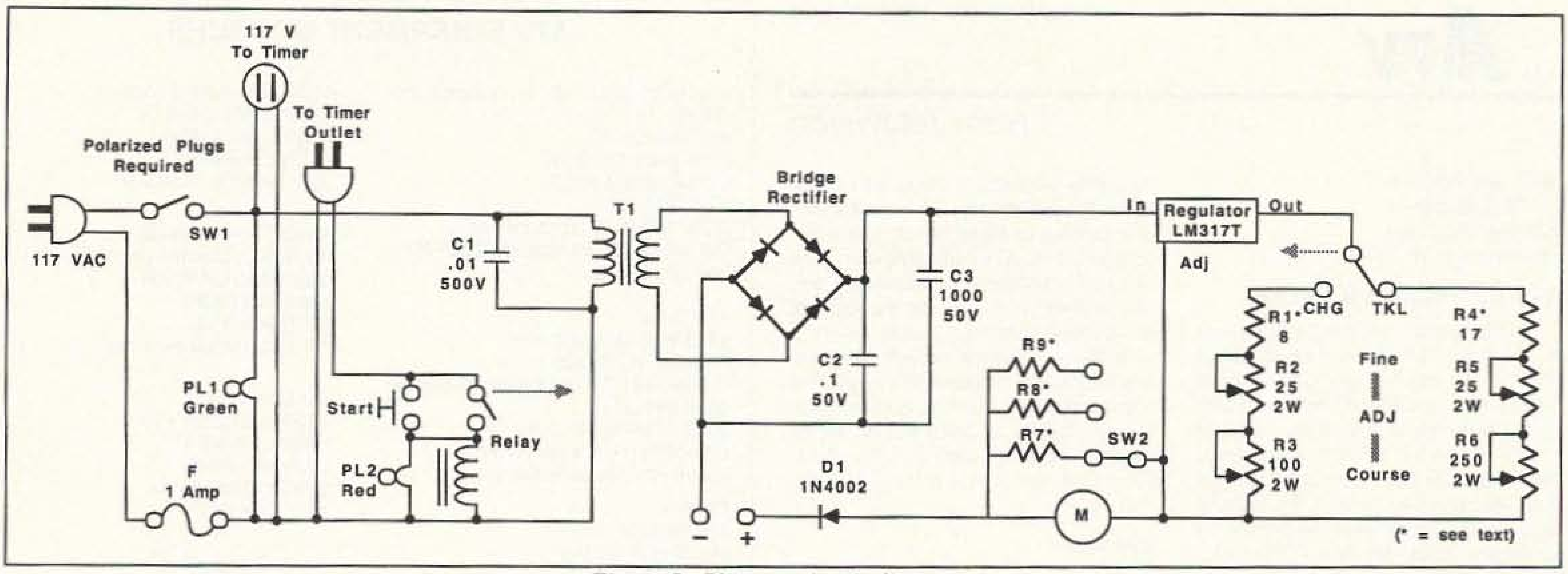

Figure 2. Charger circuit diagram.

sizes and will give readings on the meter within the accuracy of the average multimeter.

A round file can be used to make three notches in the back of the plastic box for the AC cords.

Operating Notes

Always charge cells in series, not parallel, and be sure all cells have the same mAh rating. To put the charger into charge mode, rotate the timer dial until its internal switch clicks ON, then press the "start" switch. The charge rate is adjustable from 10 mA to 150 mA. The trickle rate is adjustable from 5 mA to 75 mA.

If even a short power drop occurs, charging will be stopped. When power returns, the cells will automatically be put on trickle. All you need to do is check that the trickle rate is set at 0.05C (32 mA for 650 mAh cells), and just leave the NiCds on trickle for at least 24 hours or until voltage per cell reaches 1.35 to 1.4 volts, measured with the cell(s) removed from the charger.

To avoid NiCd memory effects, always discharge NiCds down to 1 volt per cell before putting them on charge, and don't take the cells off charge until they have received a full charge.

If you want to check the trickle rate adjustment while the charger is in charge mode, turn the power switch off momentarily. The red light will go out. Then turn the power switch back ON and adjust the trickle rate as desired. Press the "start" switch to return to charge mode.

Some NiCd battery packs have internal protective circuitry to limit charging current. In this case, the charger cannot be adjusted to force more current than the pack will allow.

Do not over-discharge a NiCd battery pack or you run the risk of polarity reversal in one or more cells. A safe discharge point is considered to be 1 volt per cell. If your equipment has a "Low Bat" indicator, don't try to get more out of it. 73

PARTS LIST

SWI	AC toggle switch	
SW2	Rotary switch, single-pole three-position, shorting type (make before break)	Radio Shack #275-1385 (All unused switch points are connected together and to the junction of R7, R8, R9 resistors.)
F	Fuse holder with 1 ampere fuse	
PL1	Green pilot lamp assembly, 120 VAC	RS#272-708
PL2	Red pilot lamp assembly, 120 VAC	RS#272-712
START	Momentary push switch, normally open	RS#275-1571
RLY	120 VAC relay, DPDT contacts, with socket	RS#275-217 and 275-220
T1	25.2V, 450 mA transformer	RS#273-1366
C1	0.01 µF, 500V disc capacitor	
C2	0.1 µF, 50V disc capacitor	
C3	1000 µF, 50V electrolytic capacitor	
D1	Diode, 1N4002 or equivalent	
Regulator	LM317T with heat sink	RS#276-1778 and #276-1363
Bridge rect.	100 PIV, 1.5A	RS#276-1152
Meter	0-1 mA movement, marked 0-15	RS#270-1754 (Discard the external 15k resistor)
R1	Two 15 ohm, 1/2W resistors in parallel	
R2, R5	25 ohm, wirewound potentiometers, 2W	#271-265
R3	100 ohm, 2W potentiometer	Digikey #53C1101-ND
R4	Two 33 ohm 1/2W resistors in parallel	
R6	250 ohm, 2W potentiometer	Digikey #53C1251-ND
R7	6 ohms, consisting of one 10 ohm, one 15 ohm and one 220 ohm, each 1/2W, resistors in parallel (Meter scale X1, range: 0-15 mA.)	
R8	1.93 ohms, consisting of five 10 ohm and one 33 ohm, 1/2W resistors in parallel (Meter scale X3, range: 0-45 mA.)	
R9	0.57 ohms, consisting of two 0.47 ohm wirewound resistors in series and then connected across a 1 ohm and a 0.47 ohm resistor in series. (Meter scale X10, range: 0-150 mA.)	
1 pr.	Insulated binding post/banana jacks	
5	Small-diameter knobs for potentiometers and rotary switch	
2	6 ft. extension cords with polarized plugs, cut and connected as shown in diagram	
1	Project box or case of adequate size to accommodate all components—no smaller than RS#270-232 (approx. 8" x 5" x 2-1/2")	
2	Insulated tie-point strips RS#274-688	
1	Prepunched, unclad perf board RS#276-1394	
1	Adaptaplug cord and set of Adaptaplugs from a no-longer-used Radio Shack AC/DC adaptor/charger, such as #273-1652	
1	Pair of solderless banana plugs	

ATV

Number 20 on your Feedback card

Ham Television

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

ATV Information Sources

The question I am most often asked is, "Where do I find out more about ATV?". Fortunately, there is a variety of publications, newsletters and books dedicated to amateur television. Another good information source is a catalog from one of the ATV manufacturers listed here. Just browsing through one of these catalogs should stir your imagination as you dream about your ideal ATV station.

ATV Publications

There are several publications that cater specifically to the ATV crowd (see the sidebar for address/order info):

ATV Quarterly. This magazine is dedicated to amateur television. It contains a large variety of ATV construction projects, reviews of the latest equipment and an activity news section.

CQ-TV. This is the journal of the British Amateur Television Club and offers a wide selection of amateur television projects. Many of the articles deal with FM ATV or video accessories and are fascinating reading.

The Spec-Com Journal. Originally called *A5 Magazine* in the early '80s and before, this publication deals with specialized modes (including ATV). There are also sections about SSTV, packet, weather satellites and OSCAR satellites.

VHF Communications. Published in Europe, this magazine offers a number of VHF and UHF projects. Quite a few ATV articles appear as well. It is available in English (see the sidebar).

ATV Today! This is a newsletter that offers some construction articles as well as a news section showing some of the latest equipment available.

ATV Equipment Manufacturers

There is a wide array of companies that carry products of particular interest to the ATV community. I've included a list of a number of these, along with a description of the ATV items they carry. You can now purchase a complete ATV station or build your own from the kits and accessories these manufacturers carry.

If you're fortunate enough to attend this year's Dayton Hamvention, you will find a number of these companies represented. There's no better way to decide which route to go than to actually observe the equipment in action at the Hamvention.

ATV Nets

There are two HF nets which meet weekly. If you live in the Midwest or on the East Coast, try listening to 3.871 MHz every Tuesday night at 9 p.m. local time (EDT). On the West Coast, there is a net every Sunday morning at 10 a.m. local time which meets on 7.243 MHz. These nets are an excellent way to meet the area ATVers, ask questions, set up skeds and generally stir up activity.

In addition, there are a number of local ATV nets which usually meet on the 2 meter band. For example, in Southern California there are nets which meet on Monday night at 7 p.m. (Mt. Wilson group) and Tuesday night at 8 p.m. (ATN). Both nets can be found on 146.43 MHz.

Calling Frequencies

The 2 meter band is usually used for establishing contact for an ATV QSO. Some groups use simplex, others use the local repeater. There are, however, a few frequencies that are commonly used for a specific region.

If you live in Southern California, try giving a call on 146.43 MHz; for the Midwest and portions of the East Coast, try 144.34 MHz (parts of Ohio use 147.45 MHz in addition to 144.34).

I hope this helps you to find other ATV activity. It only takes one other station to get things rolling! 73

ATV EQUIPMENT SOURCES

Advanced Electronic Applications, Inc. (AEA)
P.O. Box C2160
2006 196th St., S.W.
Lynnwood WA 98036
(206) 774-5554
(800) 432-8873 brochure info
Complete ATV transceiver (VSB-70) and accessories.

ATV World
3713 W. Charleston Ave.
Glendale AZ 85308
(800)-4-A-HAM-TV or (800) 424-2688 order line only
(602) 978-4348 tech line
Complete transceivers/down-converters and accessories.

Bestlink
130 Emmett Ave.
Madison TN 37115
(615) 868-4757
Complete ATV transceivers/down-converters—both AM and FM.

CCTV Corp. (GBC)
315 Hudson St.
New York NY 10013
(800) 221-2240
(212) 989-4433
(212) 463-9758 FAX
A complete line of miniature video cameras.

Comet Antennas
NCG Co.
1275 North Grove St.
Anaheim CA 92806
(714) 630-4541
(800) 962-2611
Antennas, omni-vertical gain and yagis.

Communications Concepts, Inc.
508 Millstone Dr.
Xenia OH 45385
(513) 426-8600
(513) 429-3811 FAX
ATV downconverter kits, power amps.

Down East Microwave
RR#1 Box 2310
Troy ME 04987
(207) 948-3741
(207) 948-5157 FAX
Antennas, transverters and pre-amps.

Elktronics
12536 T.R. 77
Findlay OH 45840
(419) 422-8206
Video IDs, micro TV xmtr and other kits.

Engineering Consulting
583 Candlewood St.
Brea CA 92621
(714) 671-2009
(714) 255-9984 FAX
Computer ID system for the Commodore computer.

Hi-Spec
P.O. Box 387
Jupiter FL 33468
(407) 746-5031
Tube amplifiers for ATV; 33cm and up.

International Crystal Manufacturing Co., Inc.
P.O. Box 26330
701 W. Sheridan
Oklahoma City OK 73126-0330
(405) 236-3741
(405) 235-1904 FAX
VSB filter for ATV.

Lindsay Specialty Products
50 Mary St.
Lindsay, Ontario K9V 4S7
Canada
(705) 324-2196
(705) 324-5474 FAX
Omni-horizontal ATV repeater antennas.

Micro Computer Concepts
7869 Rustic Wood Dr.
Dayton OH 45424
(513) 233-9675
ATV repeater controller.

Micro Video Products
1334 So. Shawnee Dr.
Santa Ana CA 92704
(800) 473-0538
(714) 957-9268
Miniature video cameras.

M2 Enterprises
7560 N. Del Mar Ave.
Fresno CA 93711
(209) 432-8873
(209) 432-3059 FAX
ATV antennas.

North Country Radio
Box 53-A
Wykagyl Station
New Rochelle NY 10804
(914) 235-6611
(914) 576-6051 FAX
ATV transmitter kits.

Olde Antenna Lab
4725 W. Quincy
Denver CO 80236
(303) 798-5926
Omni-directional wheel antennas.

Pauldon Associates
210 Utica St.
Tonawanda NY 14150
(716) 692-5451
Amplifiers, pre-amps, etc for UHF and ATV.

P.C. Electronics
2522-WG Paxson Ln.
Arcadia, CA 91007
(818) 447-4565
Large selection of complete ATV transmitters/downconverters/ transmitters, as well as modules, antennas and accessories.

R.P. Industries
1450 Jeffery St.
Ypsilanti MI 48198-6319
(313) 482-2670
Video overlay modules and telemetry computer systems.

Rutland Arrays
1703 Warren St.
New Cumberland PA 17070
(717) 774-5298 (7-10 p.m. EST)
FO22-ATV antenna.

Spectrum International, Inc.
P.O. Box 1084, Dept. S
Concord MA 01742
(508) 263-2145
(508) 263-7008 FAX
Transverters, antennas, passband and VSB filters, WX satellite systems.

WBØQCD Antenna Mfg.
770 Quincy Ave.
Clarence IA 52216-9368
(319) 452-3628
Alford slot antennas.

Wyman Research, Inc.
RR#1, Box 95
Waldron IN 46182
(317) 525-6452
Complete line of assembled ATV transceivers/transmitters/down-converters, including a line of FM video equipment.

ATV PUBLICATIONS

Magazines:
Amateur Television Quarterly
1545 Lee St., Suite 73
Des Plaines IL 60018
(708) 298-2269
(708) 803-8994 FAX
$18/yr.

CQ-TV
$20/yr.
VHF Communications
$25/yr.

Available from:

Wyman Research
R.R.#1 Box 95
Waldron IN 46182
(317) 525-6452

or from:

ATV Quarterly
1545 Lee. St., Suite 73
Des Plaines IL 60118
(708) 298-2269
(708) 803-8994 FAX

The Spec-Com Journal
Spec-Com Communications & Publishing Group, Ltd.
P.O. 1002
Dubuque IA 52004-1002
(319) 557-8791
(319) 583-6462 FAX
$20/yr.

Newsletter:
ATV Today!
P.O. Box 1677
Weatherford TX 76086-1677
(817) 599-7509
$15/yr.

Books:
ATV Secrets
Non-technical beginners guide to ATV.
$9.95 + $1.50 postage

TV Secrets
Technical topics and projects for novice to expert.
$24.95 + $2.90 postage

Both available from:

ATVQ
1545 Lee St., Suite 73
Des Plaines IL 60018
(708) 298-2269
(708) 803-8994 FAX

The Complete Amateur Television Workbook, 2nd Edition
QCD Publications
770 Quincy Ave.
Clarence IA 52216-9368
(319) 452-3628
$18.95 + $1.50 p/h

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ABOVE & BEYOND

UHF And Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

Wideband Test Amp and Antenna

This month I thought you would be interested in a simple project that can have multiple uses, namely the ability to observe wide ranges of frequency above 1 GHz with high gain and a low noise figure. Normally, wideband devices like a receiver or a test instrument such as a spectrum analyzer would be used, but they lack the proper sensitivity. The spectrum analyzer that I have is very good but it is 20-some years old and suffers from this same problem. It does have a large dynamic range of 80 to 90 dB, making it very useful. The problem is that its age and related noise figure must be in the 12-to-14 or greater dB range. A small improvement here would make a very big difference overall.

The problem is the same with most broadband receivers. The ICOM R-7000 is an excellent one. It is a super monitor receiver but you have to pay for all its well-thought-out options and excellent sensitivity. I would like to own one but until that day I will be putting things together (like this month's project) to compensate.

Try Surplus

This month's column assumes that you have some sort of broadband receiver or test set that is in need of a high gain, low noise preamplifier. Additionally, with this preamp an antenna is needed to cover the very large frequency band of operation to form the final part of the system. Let's start our construction of a suitable amplifier by hunting in the surplus market to see if we need to construct from scratch or if we can put to use something that has already been built.

Building from scratch usually poses problems in acquiring component parts. In this case, there is a simple solution: Look in the surplus market for something that exists in quantity. This project, the preamp, is constructed out of a surplus satellite LNA (low noise amplifier). Normally, this amp is built for operation in the 3.7 GHz to 4.2 GHz range, with 30 to 40 dB gain and a low noise figure (something near 1 to 2 dB) for most surplus units I have observed.

Surplus availability is quite good—most people are upgrading their existing systems to lower noise figure amplifiers and smaller dishes. This relegates the older (higher noise figure) amps into the surplus market. The price on the surplus swap meet market is around $5 as is, $10 for stated "good" units. Of the several LNA amplifiers of various designs that have passed through my hands, only one had a blown front end stage. All the other LNA amplifiers worked. The defective one showed signs of corrosion and water leakage into the inside of the case. Let's hope you have the same luck with the LNAs that you find.

The application I have in mind for the LNA is not just to monitor the 3.7 to 4.2 GHz band. With a small modification, Kerry N6IZW was able to increase the frequency range of the amplifier to cover from 800 MHz to about 4.2 GHz, with associated gain in the 20 to 30 dB area over bandwidth. There were gain peaks and dips, but for the most part the gain curves looked good.

Photo A. Standard 3.7 to 4.2 GHz LNA.

Photo B. Modified (cut housing) LNA.

Construction

The modification is somewhat delicate, but if you're careful it can be done easily. First, open up the LNA by removing the small screws which hold the amplifier cover onto the main aluminum cast body. Remove the cover and the PC board for the amplifier. Now the associated circuitry should be exposed. Looking at the amplifier RF circuits you can see several stubs on the input and output of each stage in the LNA. These stubs are used in the original design to peak up each stage for the best gain and noise figure in the frequency band of interest, namely 3.7 to 4.2 GHz. Using an X-acto knife, gently cut/disconnect these tuning lines (they are the thick lines) from the main transmission line that runs straight from the input to the output of each device. See Figure 1 for details.

Disconnect all such lines, being careful not to disconnect the narrow RFC lines which supply DC power and bias to the FET devices. Also, be careful to ground the work station to prevent static buildup from damaging the devices in the amplifier. When working with the X-acto knife, use a sharp blade and don't press hard on the soft Teflon PC board while disconnecting the tuning lines. Teflon is quite soft and you will go right through the board material if you're not careful. Use light pressure to cut away part of the connection to DC-isolate them. You don't have to remove the entire line, just disconnect it from the main line.

Removing these tuning stubs alters the frequency response of the amplifier gain curve. It will not be peaked up at its normal range but will now give a much broader and lower frequency range of operation. In the unit that Kerry modified, the device gave usable operation from 800 MHz to over 4 GHz.

Once that part of the operation is complete, the input circuit can be changed as we will not be using a waveguide for this amplifier anymore. The input probe in the waveguide cavity must be removed, and an isolation capacitor needs to be added to the circuit first. Locate the place where this probe is connected on the main PC board trace and cut this trace again with the X-acto knife. On this spot we are going to place a 10 pF (or so) value coupling capacitor to give DC isolation to the input of the amp. In the unit's original condition this was not necessary because the probe was isolated in the waveguide. We will remove the waveguide and replace it with an SMA connector, which requires DC isolation. After the board has been cut to accept the capacitor (a chip type), stop this part of the procedure and unsolder the probe from the PC board, which is now isolated by the cut in the PC board. Remove the probe from the PC board connection.

Now, with a bandsaw remove the waveguide flange, cutting it flush with the top of the amplifier body. Put a piece of masking tape on the open side of the amplifier to keep metal filings from contaminating the PC board area when the waveguide flange is removed. You will also be able to remove the Teflon insulator that insulated the old RF waveguide probe. It should just pop out with a little pressure. Clean the PC board hole where the removed probe was soldered and in its place put an SMA coaxial connector.

The Teflon insulator on the connector might need a little trimming, but some are exactly the right size to slip in the hole where the old Teflon insulator used to be. The center connector of the SMA connector should be long enough to fit right in the PC board hole you just cleaned.

Mark the SMA connector mounting holes and drill and tap for a couple of mounting screws to hold the SMA connector body securely to ground. Now, on the PC board remove the paper tape from the PC board cover plate area and mount the new coupling capacitor to the SMA connector tip and to the other side of the center line you cut before. This will give you DC isolation to the coax connector.

At this point, check the unit for errors. When you are ready, reapply DC power. If you used standard static protection everything should be OK. Even so, amplifiers in circuits are less susceptible to static than loose components. If you used proper care in making the modification, everything should

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be OK. Remember that different units might give varied results, but for $5 or so, why not give it a try? You don't have much to lose.

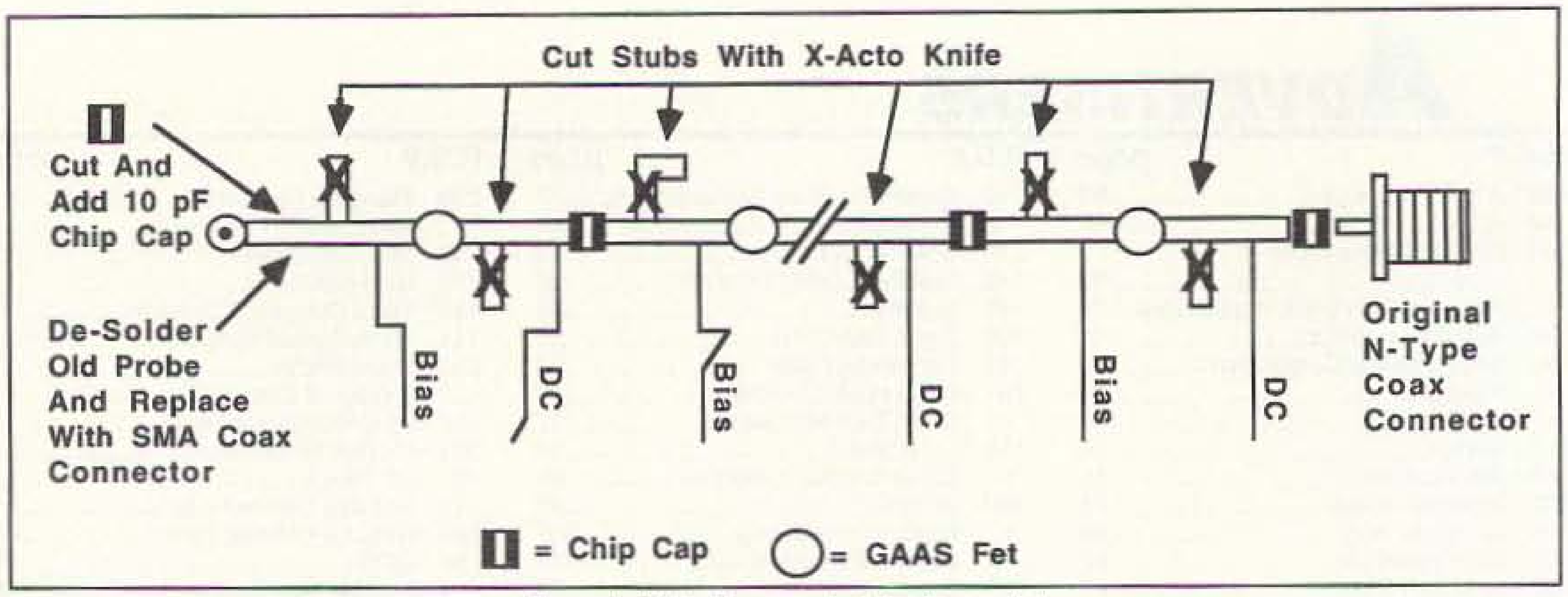


Figure 1. LNA disconnect stubs (example).

Constructing an Appropriate Antenna

Due to the broad bandwidth of the modified amplifier, we needed to construct a new antenna for bench or even outside applications. The normal antennas we had did not cover such a wide range of frequencies. Our station monitor antenna, which works from 50 MHz to over 1200 MHz, worked well but something was needed for the upper frequency ranges. We decided to construct a simple small-scale version of our low frequency monitor antenna, a discone for the 1 GHz to 4 GHz range. This antenna worked quite well over our frequency range and it is easy to duplicate.

A miniature replacement of the low frequency discone turned out to be only 3-1/2" high and less than 3" wide at the base and top hat of the antenna. This antenna is basically a funnel turned upside-down, with the bottom spout of the funnel removed. At this point a top hat or disc is electrically connected to the center of the coax cable. In our case we used 0.141 o.d. 50 ohm hardline, quite common in microwave circuits.

The bottom part of the funnel, or ice cream cone, has the coax cable protruding just 3/32" above the small end of the cone (ground portion of the coax). The portion of the 3/32" is all insulator, separating the funnel cone from the top hat. The center conductor is about 1/4" longer, sticking up above this 3/32" of insulation. Mount the top hat horizontally to this center conductor, to the top of the cone, and solder it directly to the center of the coax cable. The 3/32" space of insulation serves as an isolator between the top ring and the bottom cone. See Figure 2 for information on the discone dimensions.

Please note that the dimensions of the discone antenna are not too critical and there is room for error. Our antenna was cut out of flashing copper about 0.020" thick, and it bends (forms) quite easily. It also solders with small-wattage irons. Most of the 0.141 solid sheath coax comes with Teflon insulation, making it somewhat impervious to heat during construction.

In actual use, the antenna and amplifier functioned well, although no actual measurements were made on antenna parameters. The antenna and amp have been used in spectrum analyzer applications to observe low-level products from workbench construction projects. They can even detect some of the microwave ovens in the neighborhood. Their operation is on the low 2.2 GHz part of the spectrum. In any case, this conversion should give you increased sensitivity over quite a range of frequency, with lots of gain and a great noise figure, for a little effort and few dollars.

Be sure to keep a good stock of X-acto knives and blades available for conversions on lots of surplus items. After all, who said you can't make a silk purse out of a sow's ear?

Mailbox

The Tin Can filters for 2 meters in the November and December 1992 editions of this column caught Dick N6ISY's eye. He is quite involved with the C.A.R.E.S (Coastal Amateur Radio Emergency Services) group. They use 2 meters for primary communication and have found that when two nets were being run on 2 meters there were desense communication problems. Their problem is related to the operation of many different types of 2 meter HTs, all operating in close proximity to each other on different frequencies, causing desense to each other.

Since most of today's newer radios are quite compact and capable of operation on wide bands of frequency, this type of problem is common. Some form of frequency limiting is necessary to prevent the excellent front ends from being overloaded or saturated from nearby RF. Quite a few of my HTs suffer in varying degrees from this problem, even from commercial radio and TV frequencies when their transmitters are nearby. The problem is due to the wideband "hypersensitive" front ends that are not tuned to a specific frequency. In this case a filter would help solve the problem.

The cavity or "soup can" cavity can be placed on your antenna lead to provide the required isolation from other frequencies. The narrow passband of the cavity will provide attenuation to the other frequencies, providing the extra margin for operation. We found that the bandwidth of the Tin Can filter was quite narrow, somewhere in the 100 to 200 kHz range on 2 meters (for typical Tin Can cavities). This is dependent on the can size, construction details and coupling link placement. All this can be "jiggled" or adjusted to allow custom design after your first-cut design attempt. There are so many factors involved, however, that most work out well with some re-positioning or different can selection. You just have to try for yourself—all you have to lose is a little time and very few materials.

With small ceramic variable capacitors suitable for low power HTs, running 5 watts would be OK. As always, try out this type of filter with even lower power (100 mW on some HTs) when testing so you don't damage the HT you are using. If pre-tests can be done with something other than a rig, so much the better. I happen to be blessed with a well-stocked workbench, allowing most types of measurements to be made with test instrumentation. It proves to be very valuable to see what exactly is going on. However, lots of small projects can be constructed with a little care and no special test equipment other than an SWR meter.

The Tin Can filter is just a compact

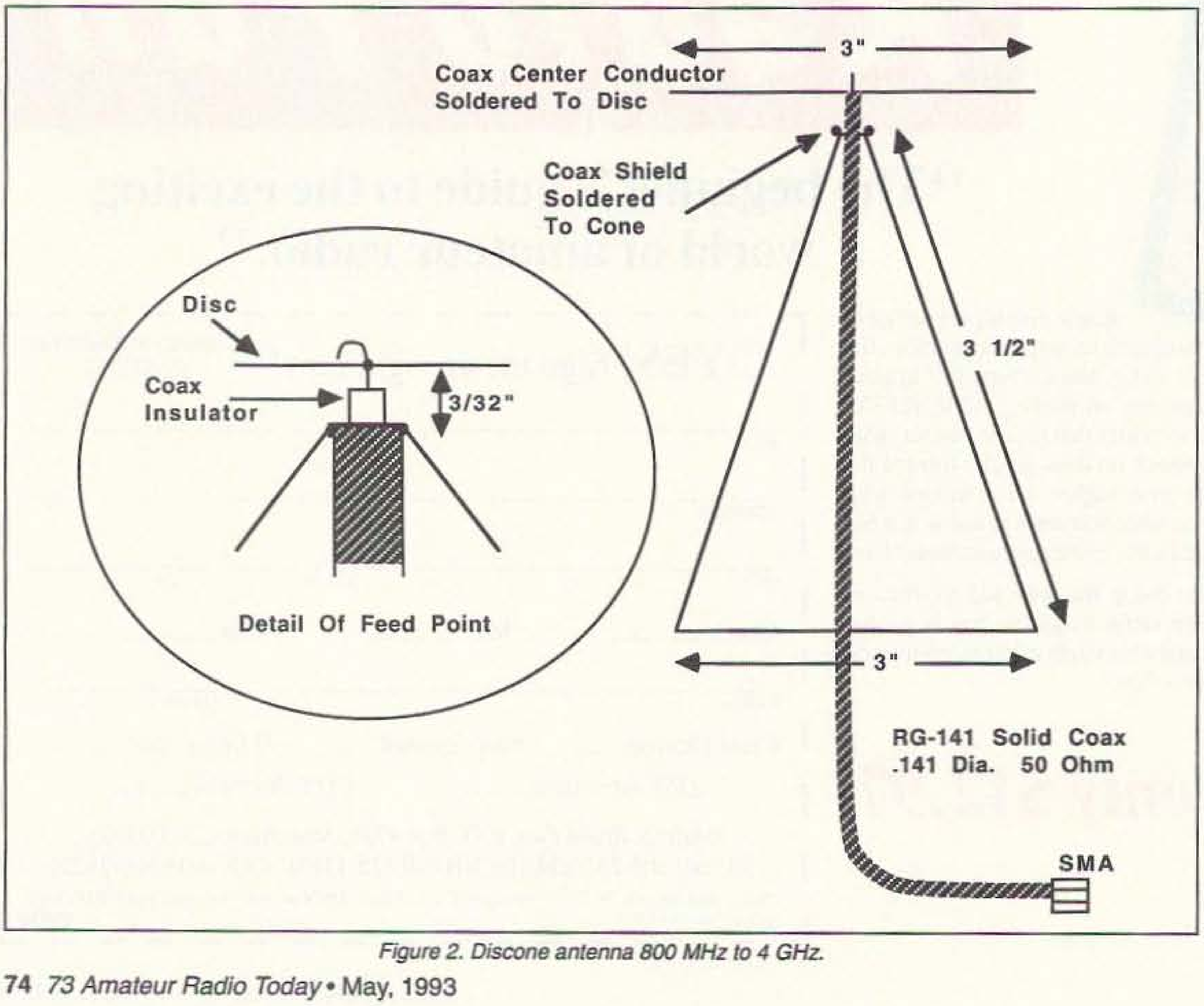


Figure 2. Discone antenna 800 MHz to 4 GHz.

cavity-high "Q" filter that can be cheaply constructed. It's sort of a poor man's cavity, and it should not cost more than a couple of bucks to construct. All that is needed is two BNC connectors, a tin can, a small ceramic 10 pF capacitor, and a short section of 3/8" to 1/4" hobby brass tube for the center element. Don't worry about the input/output links being a direct short; they are at DC but at 145 MHz they represent something in the order of 50 ohms reactance. At RF this is not a short!

A variation of the cavity is the multi-tuned circuit I covered earlier. There has been some discussion as to coupling loss for different construction types. In the case of high loss, the problem lies in poor circuit-to-circuit coupling between coils. One cure is to place a coupling link in place from one circuit to the other. This is nothing more than a short piece of large diameter insulated wire soldered to the variable capacitor on one circuit and bent near the other circuit. Try several places for positioning; test to improve coupling loss. It's a cut-and-try proposition at best but will make a difference.

As always, I will answer questions on this and related projects. For a prompt reply please send an S.A.S.E.

10 GHz EME Activity

On January 31, 1993, at 22:30, G3WDG and G4KGC made two EME QSOs on 10 GHz. This is believed to be the first made on this band from the UK. The intial QSO was with WA7CJO in Phoenix, Arizona, at 22:30. This was the second attempt. The first test on January 30 was partially successful as WA7CJO was heard at good signal strength but they could not find G3WDG's signal. This difficulty was caused by a problem in a preamp at WA7CJO's location.

The antenna in use in the UK was a 10-foot solid dish (Andrew 11 GHz version) mounted on an EL/AZ mount originally intended for satellite TV use but modified for a motor drive. The dish was scraped off from a local electronics company where G3WDG used to work. The rest of the equipment consisted of a Hughes 28 watt TWT amplifier. Many thanks to WA5VJB and KY7B for their help in acquiring this tube and refurbishing the power supply.

This is typical of some of the contacts that, with dedication and planning, can be made. I will have more detailed information about this contact and others in my next column. Congratulations for a great job done.

Update

The West Coast VHF-UHF Conference in Ventura. California, is *May 21-23*, not May 12-14th as originally reported and the ARRL book is $10 at the conference, $12 afterwards. 73

Random Output

Continued from page 88

intelligence. (Personal note to Mike Galego KA4MUJ: The word frequency is pronounced "free-kwen-see," *not* "free-ken-see." There's a "w" sound in there.)

Other than giving yours truly the chance to poke fun at these misfits, what does all of this mean? It means that the FCC is finally doing what the amateur radio community has been asking them to do for years: Clean up the mess on our bands. The rest of us are sick and tired of having our frequencies overrun by vermin. We do not care which side of the issue they are on. We want the outlaws rounded up. In fact, it doesn't have to take that long or cost that much money. If the FCC made a concerted effort, dedicating their monitoring stations to policing the ham bands for four random weeks out of the year, I bet our bands would be a lot less messy and the FCC would collect a lot more money. Once they round up all the ne'r-do-wells on 20 meters, they could spend a few nights monitoring 80 meters.

The other thing that needs to happen is we must come up with a way that repeat offenders like Dick Whiten can have their licenses yanked for good. It would be very easy to write something into Part 97 like "the FCC shall have the authority to revoke the license of any amateur radio operator upon receipt of that amateur radio operator's third Notice Of Apparent Liability, and that person shall no longer be eligible to receive an amateur radio license." This isn't exactly strict "legalese," but you all get the point. An amateur radio license is a privilege, *not* a right, and those who abuse the privilege should be banned for life. If you don't play by the rules, you can't play. Period. End of story. Maybe I ought to seriously consider writing up a rule like this and asking the FCC to consider it, all formal and legal-like. What do you think? Would you support something like this? If I hear from enough of you, I'll do it. 73

73 INTERNATIONAL

Number 23 on your Feedback card

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

Notes from FN42

When it rains, it pours! There was much news in the mail for this month! Some of it will have to wait 'til next month.

It's a small world, again! I went to Boston to have lunch with one of my sons last week, and he introduced me to a young lady who was moving into the building he lives in. She was being helped by two Chinese men and one woman. He told me later that she was from Beijing, China, so of course I asked her if she knew anything about Tsinghau University. She said "no" but the other girl she had introduced me to earlier had graduated with a chemical engineering degree from there. I wish I had known that earlier so that I could have found out if she knows Rick Hunter, our Hambassador for China, who is a student there.

One last thing before all the news. It's that time of year again: the semi-annual pilgrimage to HOSS-TRADERS. The location of the best out-of-doors ham flea market in the Northeast, maybe even in the world, has been moved from its old location in Deerfield, New Hampshire, to the Rochester Fairground in Rochester, New Hampshire. The primary date is Saturday, May 8th, but the gates will open on Friday, May 7th, at noon. VE testing facilities will be available. All proceeds above expenses go to the Shrine Hospital in Boston. The autumn date is October 16. For more information contact K1RQG @ K1RQG. ME.USA.NA on packet.

Look for me at Hosstraders. I'll be the one running around looking for bargains, with no money in his pocket, but having a great time! 73, Arnie N1BAC.

Roundup

Europe *Downloaded from packet:* Hello Clover users. I have just received a message from Fred DK4ZC saying that many EU hams would like to QSO in Clover with USA hams in order to test their setups and just to have somebody to talk to in this new mode. According to Fred, most of them operate and monitor 21.083, 21.084, 14.083, and 14.084 kHz. Let's give them a hand. Ramon KP4GE @ KP4GE.

Montserrat *Letter from Stu Stephens K8SJ:* As reported in the January 1993 issue, I was active from Montserrat in the British West Indies from February 5-17, 1993. My QSO totals were 3,071 CW and 2 SSB, over one-third of those on 40 meters. I contacted 81 countries, all continents, but no JAs (I didn't even hear any).

The equipment was an FT-767GX, 100 watts to an inverted V at 30 feet. A venerable crystal-controlled DX-20, 35 watts, did 30 QSOs when the FT-767GX fan acted up briefly. Semi-casual operating style (negotiated with the XYL and two young harmonics) was about one hour in the morning, one hour in the afternoon, and three hours late at night.

Special apologies to those I worked on February 16-17 QLF style (sending with my left foot). My arm literally blew out on me. I never knew how strenuous operating a key paddle is in the long haul! I had to relearn how to send with a different finger combination to replace the blown neurons in my thumb and arm! Next time, a memory keyer!

QSL to K8SJ, 1992 or 1993 *Callbook* address: P.O. Box 266, Girard OH 44420. Foreign hams may QSL through the USA/ARRL Bureau, "VP2MFA c/o K8SJ." Non-SASEs will be routed through the Bureaus.

The Montserrat Tourist Board and Montserrat Amateur Radio Society are very interested in encouraging ham activity and visitation of the island. We had a wonderful time with the people the beaches, and the mountains of Montserrat, "The Way the Caribbean Used To Be." It is an extraordinarily beautiful, safe, and peaceful place. The cost of a Montserrat vacation is comparable to a Florida resort stay: Travel costs are a bit higher, but living expenses and accommodations can be quite reasonable on the island. Our total expenses for two weeks were the equivalent of a week at Disney World. And VP2M has better pile-ups than W4!

For further information about Montserrat, write to: Montserrat Tourist Board, P.O. Box 7, Plymouth, Montserrat, West Indies; or Montserrat Amateur Radio Society, P.O. Box 448, Plymouth, Montserrat, West Indies. The ARRL, 225 Main St., Newington CT 06111 has reciprocal licensing info and applications. 73, Stu VP2MFA/K8SJ.

Russia *Downloaded from amsat.org, forwarded from SEDSNEWS:* The Russian solar sail Znamya experiment ended Sunday, February 7th, when the sail entered the atmosphere. Current reports indicate that initial results went well after it was deployed from the Progress TM-15 cargo craft at the MIR space station about 0400 UTC February 4th. The solar sail illuminated several areas in Europe, especially in Toulouse, France. Apparently in that southern

French city, near the Spanish border, the streets were noticeably brighter during the pass, as seen by several town people.

Shortly after it crossed the day/night terminator in Europe, the solar sail was released from the Progress. The sail then lost altitude until it re-entered the atmosphere on the 7th.

Certainly this ranks as one of the more noticed Russian/CIS space experiments in recent years. *(Glenn Chapman, Simon Fraser U., glenn@cs.sfu.ca).*

Letter from Dmitri A. Souslov: After having gotten familiar with the November '91 issue of *73* (occasionally received from my American pen pal) there appears to be a strong feeling of nostalgia for my former military speciality as I read about more and more things and problems familiar to me. I was a radio operator during my two-year military service, working as a CW communications operator and receiving high-speed air notification information (also in the CW mode). However, after being demobilized in 1988, I didn't have any opportunity to become a licenced civil amateur, first of all because of having no chance to get proper gear in my country. So, I still remain a SW DXer, my main interest being broadcast stations, but not giving up hope to start again that fascinating hobby of radio communication.

At present I am in contact with several US amateurs who are also interested in the DXing of broadcast stations, and who know about the problem of DXing the stations in CIS broadcasting in the Russian language. Many stations don't send QSLs if the report is written in a language other than Russian. So, I'd like to offer a solution to this problem.

If any of the *73* readers would like to sent their reception report to a station on the territory of the former Soviet Union, broadcasting in Russian, but don't know the language, then send your report in English to me. I'll make a qualified translation and forward it to the station you need in the CIS. US$2 or 4 IRCs fee, please. For an additional US$2 fee I could keep correspondence with the station by myself and then send you the reply translated into English. This price just covers leasing computer time to compile the reports, and the greatly increased postal tariffs in Russia.

Please send your requests to Dmitri A. Souslov. P.O. Box 96, Kazan-80, 420080 Russia.

Ukraine *Downloaded from packet from Lisa KD6BLK:* Thanks to my new packet pal in Russia I have the following information to share: Vic, UB5WPR, can receive packet messages addressed to UB5WPR @ U5WF.LVV.UKR.EU. He loves to hear from people, so if you want to explore packet DX send him a message.

The Ukrainian Amateur Radio League (UARL) informs us that since January 1992 the Central Radio Club of Russia (P.O. Box 88, Moscow) has been demanding additional payment (except postage) for QSL cards addressed to the Ukrainian radio amateurs. Nobody understands why. So, please DO NOT send any QSLs for the Ukraine via P.O. Box 88, Moscow. Use only the UARL QSL Bureau address: P.O. Box 56, Kiev, 252001, Ukraine.

The Second Conference of the UARL was held on January 30-31, 1993, in Kiev at which the following were elected as officers of UARL: President—Nick Gostry UB5UT; 1st VP—Anatoly Kucherenko UT5HP; VP—George Chiljanc UY5XE, and VP—Serge Bunin UB5UN.

For any questions please contact the UARL at: P.O. Box 57, Kiev, 25001, Ukraine, or telephone (044) 446-22-39, Fax: (044) 488-39-68, or packet UB5UT @ UT4UX.KIV.UKR.EU.

United Kingdom *Downloaded from amsat.org:* **UK Novices on OSCAR** This week's GB2RS News Bulletin reports that the 70 cm frequency allocation for UK Novice licensees has just been expanded to 432.0-440.0 MHz, i.e., it will now include the satellite subband for the first time. UK Novices will thus be able to access any satellite with a 70 cm uplink, including AO-10 and AO-13.

> ***". . . the 70 cm frequency allocation for UK Novice licensees has just been expanded to 432.0-440.0 MHz, i.e., it will now include the satellite subband for the first time."***

Of course, the Novice power limit of 3 watts output will pose a challenge, but one that can be overcome. With 3W output, forward gain of 17 dBi (typical of a 40-element cross-yagi—20 elements each way) will produce up to 150W eirp, more than enough to access AO-10 or AO-13 if conditions are good.

UK Novices have callsigns with 2*Ø and 2*1 prefixes and three-letter suffixes, where * is a geographical indicator (E = England, M = Scotland, W = Wales, I = Northern Ireland, D = Isle of Man, etc.). For example, 2EØAAA would be a Novice in England, while 2D1AAB would be located on the Isle of Man. A "Ø" in the callsign indicates that the holder has passed a code test and enjoys limited HF privileges; "1" is no-code.

Who will be the first UK Novice to make an OSCAR QSO, and who'll be the first to work one? Sorry, 2E won't count as a new country. 73, Ray Soifer (71331.1337@CompuServe.COM)

USA/Guatemala *Request from Paul Neuger WU1B via packet:* My daughter Lisa N1IAR is considering going to Quetzaltenango, Guatemala, to attend the Casa de Espanol Xelaju Spanish School. I know nothing about Guatemala, the school, or how to get a license for Guatemala. I would certainly appreciate any information you can pass one to me. Address: Paul Neuger, 286 Chandler St., Duxbury MA 02332, or via packet: WU1B @ NS1N.MA.USA.NA.

AUSTRALIA

David Horsfall VK2KFU
P.O. Box 257
Wahroonga NSW 2076
Australia

The details of the long-awaited changes to the licence structure in Australia were announced at the SEANET '93 convention, held in Darwin on August 31, 1992, and was relayed via phone patch to the various WIA Divisions for a live broadcast. However, complete details were not provided, and the changes need to be cross-checked against the existing Radiocommunications Act for consistency; add to that a forthcoming Federal election, and it will apparently be some time before the actual structure is known. When details are available I will report them.

In the meantime, the highlights are: a no-code *Limited Novice* licence allowing voice and packet radio on 2m and 70 cm; "Limited" licences (no HF privileges) may use FM (voice) on the 10m band to encourage its use (and presumably to keep the pirates out of it); amateurs holding both Novice and Limited certificates will come under an *Intermediate* category of licence; Novices will be permitted higher power outputs, to be consistent with commercially available equipment; and various restrictive rules applying to both voice repeaters and packet radio will be relaxed, permitting greater freedom for experimentation, etc.

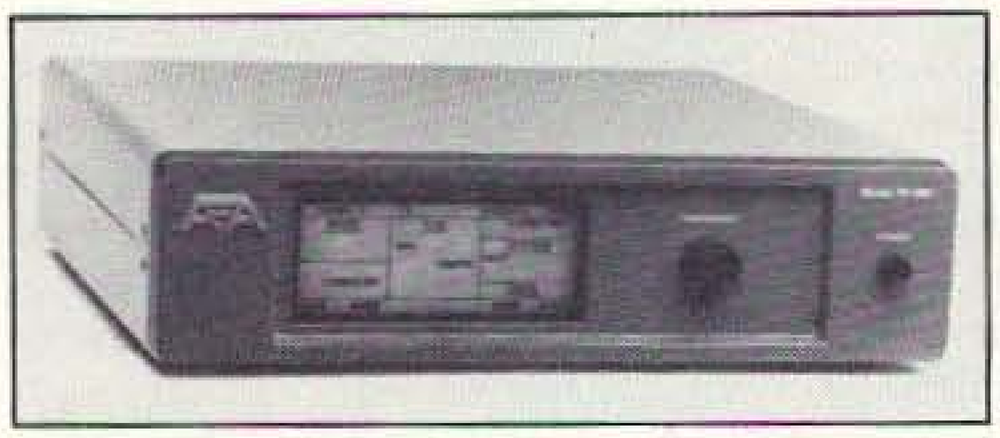
All in all, it appears that these changes will encourage many more people, especially computer "whizz-kids" to take up amateur radio. I acknowledge the Wireless Institute of Australia (WIA) as the source of this information.

The WIA has had charge of the amateur examinations for over a year now, with a team of more than 400 registered examiners. It does not appear to be the debacle that its opponents had predicted, but as usual, there are some bad apples. It appears that four examiner teams are under investigation by the DoTC for apparent irregularities in the conduct of examinations. Cheers for now. Those with access to Internet can contact me as "dave@esi.COM.AU" or packet "VK2KFU @ VK2RWI.NSW.AUS.OC." 73

Number 24 on your Feedback card

NEW PRODUCTS

Compiled by Hope Currier



AEA

AEA has introduced its newest multimode data controller, the PK-900. The PK-900 boasts a powerful triple processor system and provides all standard amateur digital modes, dual simultaneous ports, a PACTOR option, a large back-lit LCD display, a 9600 bps G3RUH/K9NG plug-in option board, a Direct Digital Synthesis AFSK tone generator, six selectable receive modem tone pairs (from 170 Hz to 1000 Hz), packet and AMTOR maildrop, 16 gray shade WEFAX (with optional software) and much more.

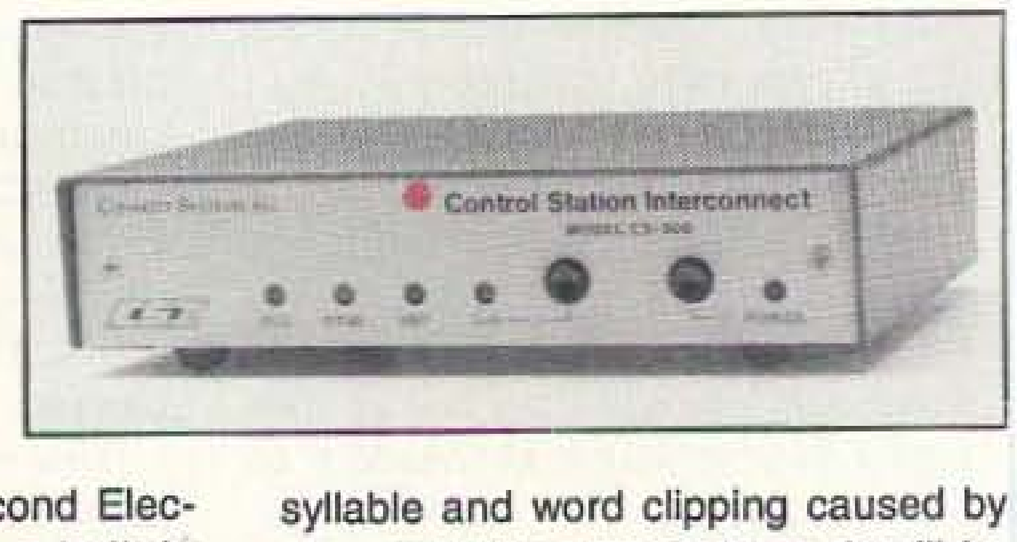
The suggested list price is $549. For a product data sheet and a list of authorized dealers, contact *Advanced Electronic Applications, Inc., P.O. Box C2160/2006 196th St. SW, Lynnwood WA 98036; (800) 432-8873, (206) 774-5554.* Or circle Reader Service No. 201.

TIMEWAVE TECHNOLOGY INC.

The DSP-59 noise filter from Timewave Technology Inc. reduces and filters noise and interference to improve radio reception, reducing QRM and QRN on speech, RTTY and CW signals. It uses digital signal processing technology to provide optimum filters for five basic functions: random noise reduction, tone noise reduction, high-pass filtering, low-pass filtering, and bandpass filtering. The five functions are combined to make five switch-selectable modes.

For prices and more information, contact *Timewave Technology Inc., 2401 Pilot Knob Road, St. Paul MN 55120; (612) 452-5939, Fax: (612) 452-4571.* Or circle Reader Service No. 204.

CONNECT SYSTEMS INC.



The new CS-900 from Connect Systems Inc. is the first low cost VOX (voice-activated) simplex phone patch to incorporate powerful standard features such as a half-second Electronic Voice Delay (EVD), a built-in programming keyboard with digital display, a 90-memory speed-dialer, last number redial, call progress tone detection, a user-programmable CW ID, and more. The CS-900 is totally VOX operated and does not use sampling. There are no sampling noises or interruptions—just smooth natural audio. The built-in EVD completely prevents syllable and word clipping caused by slow switching transceivers. It will interface with virtually any transceiver. The only connections required are to the mike and speaker jacks.

For the price and more information, contact *Connect Systems Inc., 2064 Eastman Ave. #113, Ventura CA 93003; (805) 642-7184, Fax: (805) 642-7271.* Or circle Reader Service No. 202.

CM TECHNOLOGIES

CM Technologies has introduced a new packet radio software program for the Macintosh called *Savant*. Building on their previous success with *Virtuoso*, they have added a number of useful new features that make AX.25 packet operation on the Mac fast, easy and flexible. *Savant* offers a true Macintosh user interface, including scroll bars in session windows; an edit menu with undo, cut, copy and paste commands; and saving and printing of all or part of any session window. It also has a split window interface with both panes resizeable. Animated icons and text fields in the session windows report the status of the connection: number of packets sent and outstanding, signal round-trip time, and number of retires. Multiple simultaneous connections are supported, each having its own window. *Virtuoso* has full-function digipeating capability and the option to assign an "alias" to your callsign.

For the price and more information, contact *CM Technologies, RR1 Box 83A, Kelley IA 50134; (515) 597-2051, CompuServe: 71574,421.* Or circle Reader Service No. 203.

BARTER & 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, Judy Walker, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the June classified ad section is April 8, 1993.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $7.95 each, ppd USA. Send to Dept. S, P.O. Box 22366, San Diego, CA 92192. BNB200

FUN! EASY! COMPUTER BUSS ANALYZER. Plans, schematics, Theory of Operation: $19.00 plus $3.00 S&H. **CV ENTERPRISES,** P.O. BOX 2001, Stillwater OK 74076. BNB210

QUALITY IBM SOFTWARE- $1.50 per disk! Many great programs: Ham, science, education, modem, gifs, games, much more! Free catalog ($3 overseas): **R&B SOFTWARE,** Box 1428, Idaho Falls ID 83403. BNB215

SOLID OAK CLOCK 12 or 24 hour. Beautiful addition to any shack or decor. Display your license (both sizes) and call sign (letters are changeable). Warranty. (616)677-3706. **MIDWEST WOOD,** 16141 24th Ave., Coopersville MI 49404. BNB216

SUPERFAST MORSE CODE SUPEREASY. Subliminal cassette. $10. LEARN MORSE CODE IN 1 HOUR. Amazing supereasy technique. $10. Both $17. Moneyback guarantee. Free catalog: SASE. **BAHR-T1,** 150 Greenfield, Bloomingdale IL 60108. BNB221

QSL CARDBOXES & INDEX DIVIDERS. Send SASE. 7-Mike **HAMSTUFF,** P.O. Box 14455, Scottsdale AZ 85267-4455. BNB224

RADIOS! RECONDITIONED WITH WARRANTY. Drake, ICOM, Kenwood, Yaesu. SASE for list or call (800)296-4261. Buy, sell, trade, or consignments. **R.R.I.,** P.O. Box 1041, Linwood PA 19061. BNB228

BACK ISSUES: *73, QST, CQ,* and more. Too numerous to mention. $1 brings list. SASE. **J.K. BACH,** P.O. Box 96, Walden NY 12586. BNB240

FINALLY HEAR THOSE UNREADABLE SIGNALS buried in noise, hetrodynes, tuner-uppers. **REVOLUTIONARY** JPS Audio Filter, NIR-10, Digital Signal Processing. **DEEP DISCOUNTED: $329.95 DELIVERED** continental U.S.! (elsewhere $350). Also, NF-60 DSP Notch Filter **ELIMINATES MULTIPLE NOISE TONES,** discounted at $139.50 delivered!, see 3/92 *73 Mag.* DON'T SETTLE FOR JPS CLONES! Authorized Dealer. DACRON ROPE, Mil Type, black, strong, high UV/stretch resistant. **DAVIS RF CO.,** POB 230-SR, Carlisle MA 01741. **24-HOUR ORDERS:** 1(800)484-4002, CODE: 1356. FAX: (508)369-1738. BNB254

MOST complete and comprehensive-resistor color code identification chart-coil winding data chart-L, C, F nomagraph- capacitor decipher chart. Stop mystery of componet identification. Post charts at work bench for quick component identification. Specify required chart, each chart $3.00 all for $10.00. Send payment to **TMS ELECTRO-DATA INC.,** 4906 S.E. Mills, Lawton OK 73501. BNB255

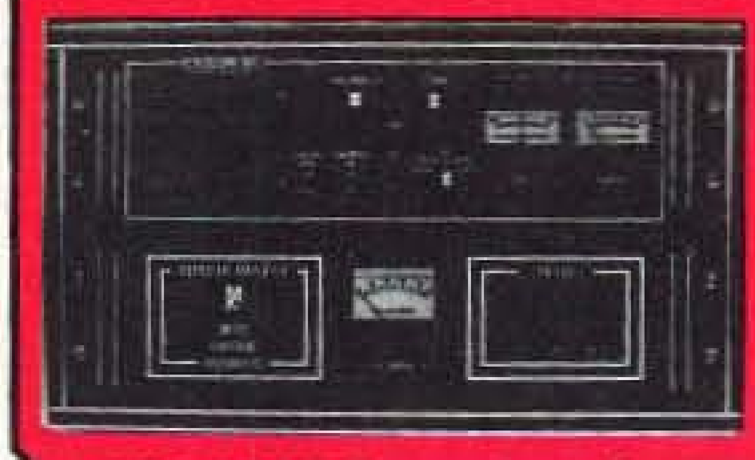
FREE LIST of Homebrew Radio Projects. SASE. WB2EUF, PO Box 708, East Hampton NY 11937. BNB264

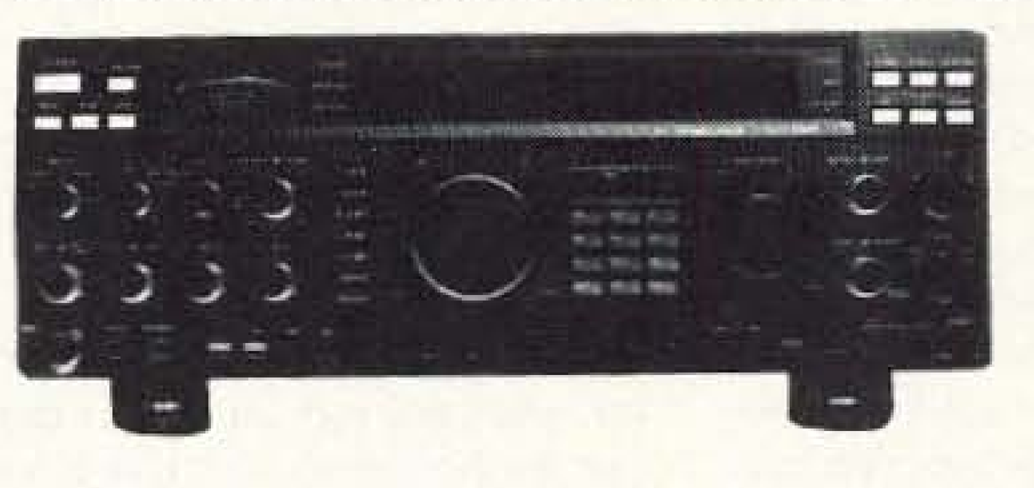
LOW COST ANTENNAS, GADGETS, & GILHICKIES for the beginning ham. SASE or call **TYRO HAM SUPPLIES,** 5 Glendale Rd., Thornhill, Ontario, Canada L3T 6X4. (416)731-3135. BNB270

EXPERIMENT WITH STATIC ELECTRICITY, VLF radio reception and VLF lightning detection with our VLF Sensor Module. Model LA5000. Easy to use 4-pin device with full instructions. Send $29.95 to **MCCALLIE MFG. CORP.** P.O. Box 77, Brownsboro AL 35741-0077. (205)776-2633. BNB280

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLOGIES AMATEUR RADIO,** 10715 SW 190th Street #9, Miami FL 33157. (305)238-3327. BNB295

Continued on page 81





NEVER SAY DIE

Continued from page 4

really comfortable with the government treating you like a slave and telling you what you have to do.

If The Schools Are So Bad, What Can Be Done?

I've covered my recommendations for a totally new kind of educational system in my book, *Declare War*, so I won't go into the gory details here. Briefly, I recommend school be made non-compulsory; that tests and grades be eliminated; teachers be replaced by team leaders; schools be open year around; ed schools be closed; teacher certification ended; radio, computer and other high-tech clubs be encouraged; and so on. Probably nothing you'd be interested in.

If you do want to learn more about education you can access a list of the books I've read on the subject on the *73* BBS (603-924-9343).

My, How Things Have Changed! And Not for the Better!

Us old-timers have noticed the way "the world has changed." More crime, drugs, riots, poverty, divorce, homelessness, and porno. Family life is less like the Nelsons and more like the Simpsons these days.

You don't suppose there could be any connection between all this and our educational system, do you? Isn't what we're seeing happening exactly what you'd expect from the education John Gatto was forced to provide? And which he got awards for providing?

But, other than sit around and wring our hands, what can we *do* about it? The educational establishment has our hands tied. Let's say that you're the one parent in a hundred (or thousand) who actually takes a look at the stupid books your kids are using for texts and you get angry enough to want to at least get the kids better books from which to learn. You'll soon find out what you're up against.

The books are selected by the local school board. You talk with them and find they know little about the books. They just use the recommended book list. So why not run for the school board so you can start changing things?

Two years later you've made it. Then you find that getting better books onto the list, even if there are any, is a multi-year project. It seems that the state textbook commission reviews the books for any specific course once every five years. And here you'll find yourself up against a well-healed sales force from the bigger publishers.

You're up against institutionalized mediocrity. The books are lousy. Many teachers are bad. The classrooms and bells are bad. The curriculum stinks. Our educational system doesn't need a patch job, it needs re-inventing. Patching will be fought at every level by the entrenched system . . . teachers, administrators, unions, textbook publishers, school boards, and a host of government agencies dependent on the status quo.

Is the situation really hopeless? They got us when we were kids and did us in. They're doing the same thing to our children and grandchildren. Is there no way to stop this institutionalized massacre of our kids minds? Not unless you get mad enough to break through the wall of apathy the system has built for you. Not unless you really want something better for your children and your country.

A good educational system can make all the difference. It can end poverty. It's the *only* way to end poverty. Just taking money away from those who worked hard for it and giving it to those who haven't bothered to get an education because the system defeated them isn't a good answer. We've tried that and it hasn't worked.

A good educational system will cost much less than the bloated bureaucracy we have now. It'll prepare our kids to be competitive in the 21st century with the other industrial nations. It'll give them a happier, better quality of life. It'll bring back inventiveness and creativity. It'll greatly reduce crime and drug dependency. It'll end welfare, cut down on teenage suicide, reduce divorces, improve our health, and perhaps even get us interested enough in government so we'll end the corruption in Washington.

None of this is going to happen with the school system we have now. These miseries are artifacts of the system. If people paid a fraction of the attention to fixing our educational system that they do to ball games, we'd be richer, happier, and healthier. Can it happen? You tell me.

Basis & Purpose Circa 1994

The original basis and purpose for the amateur radio service, as set out in 97.1, and enacted by Congress almost 60 years ago, back in 1934, is so totally out of date that it's about time for the Commission to consider rewriting our charter. A lot of water has gone over the bridge since then.

One of the basic reasons for allocating big gobs of the radio spectrum for amateurs was so that in case of war we'd be able to provide a pool of trained Morse code skilled operators, plus technically skilled personnel to maintain communications equipment. These reasons bore splendid fruit when WWII came along and 80% of our licensed amateurs went to war. I was one of the technicians, so I can attest to the validity of this purpose.

Further, the government bought our receivers from us for war use, so we provided an extra benefit. My Hallicrafters SX-24 was sent to Brazil to help provide communications for the government's Rubber Development Corporation, a project to try and grow rubber trees in the Amazon River area to make up for our loss of rubber from Malaysia, after it had been taken over by the Japanese. I wonder whatever happened to that wartime project . . . I've never seen it written up anywhere. My old SX-24 may still be sitting somewhere in the Amazon rain forest in an abandoned building.

Another stated purpose for our "service" was for us to help pioneer new communications modes and technologies. Plus, we were supposed to provide emergency communications to help build international friendships.

My, how things have changed in only 60 years! The military has as much use for CW today as smoke signals. And modern equipment servicing is done by exchanging modules, not by electronic technicians and test equipment. Military equipment is so specialized today that 99.9% of us would be unable to help fix it. Heck, what percentage of today's hams can fix their own digitally synthesized transceivers? The military have no further use for hams, even if we were young enough to be of interest to them.

We've seen the whole concept of war change. When WWII came along we had a year or so to train people and build equipment. Now we have 100-hour wars. The military don't even need our frequencies any more . . . and they're sure not going to have much use for our ham rigs. None of these things happened during the Korean or Vietnam wars, and we have no prospect of them happening in any future conflicts we can envision. Modern military communications equipment is just too specialized.

If we're going to bring the Basis & Purpose up-to-date we need to rewrite it to fit our 1993 world.

We might start out with 97.1a, stating that the number one purpose of amateur radio is to provide entertainment for a group of largely retired middle-income older white men. A second purpose is to provide entertainment for the mentally deranged, thus keeping them from committing more heinous crimes. Better they enjoy spewing filth on 14.313, jamming traffic and emergency nets, creating pile-ups to the disgust of foreign operators, and venting their spleens over our repeaters, than molesting little girls . . . or young boys, as one of our best known pioneer repeater chaps did. Oh yes, I seem to remember a convention chairman who got caught at this too.

About the only original purpose we're still hanging in there on is emergency communications. But we're being squeezed hard on this by CB, cellular phones and other new technologies. If our emergency systems aren't capable of tying CB, our ham repeaters, cellular phones, police, fire and other emergency services together, we're not going to be needed for long. We need to clean up our act in this respect. Any volunteers to write articles to help our ham clubs get up-to-date in emergency communications?

We're so far behind in technology these days that it's unlikely we'll ever be able to do much pioneering again. We certainly did do a fine job a generation back, with our pioneering of FM, NBFM, RTTY, SSB, SSTV, meteor scatter and moonbounce communications, and repeaters. Then, 30 years ago, we dropped the ball.

A New Manifesto

My own agenda is to make our priority the attracting of new, young hams to the hobby as a way to help our country generate the high-tech work force which is going to be needed if we're going to maintain a good quality of life. If we can do that we'd be well worth the investment in the spectrum allocated to us.

If we can generate a hundred thousand school radio clubs with an average of 25 members per club, we'll have the work force we need to invent, build, sell and service the technology of the 21st century.

Next, we need to update our emergency communications systems. I'd like to keep that as one of our purposes. But none of this CW traffic net baloney. Any system which can't handle at least 9600 baud won't be of much value. This means we need to get busy developing effective HF packet systems which will give us the throughput we need. We're doing fine on the VHFs, but we still need to be able to get the traffic dependably through QRM, QRN, QSB, and so on. In my past editorials I've shown how we can establish a communication protocol which will enable us to automatically translate our messages into any language in the world and have a throughput of 25,000 words per minute.

I like the concept of building international friendships, but that's completely incompatible with the ARRL DXCC Honor Roll, so one or the other will have to go. Maybe we can get the League to curb some of their endless contests too. These are not international friendship builders.

Please let me know what you suggest in the way of a new Basis and Purpose for 97.1.

Tackling the Deficit

Let's say that you buy a house and find an old painting in the attic. You take it down to a local antique shop and they give you $100 for it. Wow! Then you read in the paper that the store has sold it for $7 million. Would you be upset? Remember, you got what you thought was a good price for it.

Well, there's this 1872 law on the books saying Uncle Sam has to sell land for $2.50 an acre. One parcel of 17,000 acres they sold for $42,500 was resold a few days later for $37 million. Did that make Uncle mad enough to change the law? Har de har. Some of the $2.50 parcels of land are near the gambling casinos in Las Vegas and have appraised values up to $47 million.

Nearer to our hearts is the incredible Uncle Sam (and that means us taxpayers, buddy) giveaway of radio frequencies. We're giving away our radio and TV channels for free, even though the users are making billions

Continued on page 82

COPPER WIRE WEAVE RF GROUND LEAD. Woven wire tubular sleeve. Three inch diameter (five inch wide flattened) radio frequency shield and/or ground lead. Bright corrosion resistant copper wire weave. $1.00 per foot. Add $3.00 shipping/handling per order. California buyers add 7% tax. Send $3.00 s&h for sample. Satisfaction guaranteed. Russ N6VVO, 1050 Sanpablo Circle, Costa Mesa CA 92626. BNB380

OFFERED PEANUTS FOR YOUR TRADE-IN RIG? I pay cash! **RADIO RECYCLERS,** 3221 W. Lincoln Avenue, Milwaukee WI 53215. (414)383-9001. BNB400

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QSL CARDS- Look good with top quality printing. Choose standard designs or fully customized cards. Request free brochure, samples (stamps appreciated) from **CHESTER QSLs,** 310 Commercial, Dept. A, Emporia KS 66801. FAX (316)342-4705. BNB434

LOW PRICED QUALITY EQUIPMENT. HP608C Sig. Gen. $50.00; Fluke 8000A D.M.M. $50.00; G.E. Mastr-Pro 250W Base's 39MHZ $50.00; 100's of Micor Drawer's prices start as low as $15.00. Much more! Call or fax for current list (909)873-1319, or write John Lansdell, 424 E. Shamrock, Rialto CA 92376. BNB455

RIG REPAIR by 20-year ham. Fast, reasonable. Skip Withrow, 5404 S. Walden Street, Aurora CO 80015. (303)693-0997. BNB702

ROSS' $$$$ NEW May (ONLY): ICOM IC-737 $1320.00, W21A $475.00, 726 $1000.00, 471H $900.00, O4AT $250.00; MFJ 949E $135.00, 9120B $270.00; 815B $55.00, 422B $120.00, KENWOOD TM-741A $620.00; TS-50S $1025.00; TM-541A $475.00, TS-450SAT $PHONE; TELEX HYGAIN; HAM-IV $357.00; CD-45II $240.00; EX-14 $400.00; YAESU FT-470 $360.00; FT-530/25-B $435.00; FT-73R $265.00, FT-26X/27B $260.00. ALL LIMITED TIME OFFERS. OVER 9,035 ham-related items in stock for immediate shipment. Mention ad. Prices cash, F.O.B. Preston. HOURS TUESDAY-FRIDAY 9:00 TO 6:00, 9:00-2:00 P.M. MONDAYS. CLOSED SATURDAY & SUNDAY. **ROSS DISTRIBUTING COMPANY,** 78 SOUTH STATE, PRESTON ID 83263. (208)852-0830. BNB707

GIANT SOLAR PANELS $44.00 EA! Excellent Prices/Solar Equipment/Accessories. Free Information/Send Stamped Envelope, Catalog $3.00. To: **QUAD ENERGY,** P.O. Box 690073, Houston TX 77269. (713)893-0313. BNB715

SIMPLEX REPEATERS $149.00! We manufacture them ourselves. **QUAD ENERGY.** (713)893-0313. BNB716

ELECTRON TUBES: All types and sizes. Transmitting, receiving, microwave . . . Large inventory = same day shipping. **DAILY ELECTRONICS,** 10914 NE 39th ST. Suite B-6, Vancouver, WA 98682. (800)346-6667 or (206)896-8856. BNB719

MINIATURE POLICE RADAR TRANSMITTER one mile range, $41 assembled, $31.00 kit, (219)489-1711. P.O. Box 80096, Fort Wayne IN 46898. BNB725

Continued on page 83

using them. Ditto cellular telephone channels, and so on. Isn't it about time we started getting a piece of the action back from these humongous industries which are using our property to make money?

If someone set up shop on your front lawn and started selling things, wouldn't you at least expect a cut of the action? When you open a store in a shopping mall you have to agree to pay a percentage of your sales to the mall in exchange for the location. Is there any reason we shouldn't ask the commercial radio and TV users to pay maybe 10% of their revenues for the use of our property? That would add a few billion to the Treasury. The estimate is that we're giving away $32 billion just for the cellular channels.

Of course, until you get Congress to change, all more revenues will mean is more spending. It won't cut our taxes one nickel. There are tons of ways for Congress to cut spending, but none of them are yet deemed necessary. What most people don't understand is that no one is actually running the government. Congress makes laws and the president handles foreign policy and is commander in chief of the military. But there's no one minding the store, so we see endless bureaucratic waste, with no easy way to curb it.

Waste? How about $4.9 billion a year for outside consultants for government bureaus? That's according to the government accounting office. How about $1.5 billion for Congressional staffs? We could cut $30 billion if we ended farm subsidies, and that doesn't count how much we'd save on lower food prices, which are now being supported. Then there are failed farm loans, where we've donated about $10 billion to the farmers. We might want to cut down on the $22 billion in food stamps too.

I'll be writing about this in more detail in my *Declare War Update* newsletter, which genuine Wayne Green-haters should consider buying, as it will give them plenty more to hate. There are some fascinating recent books which go into the gory details on how Congress is screwing us, but a warning . . . they could possibly make you mad. They could even put a strain on your 12 to 16 years of conditioning in our school system to not cause trouble and to do as you're told. I know I almost got mad. Worse, it almost made me think!

One of the most amusing books on government waste is O'Rourke's *Parliament of Whores*. P.J. shows how Congress could quickly cut $337 billion off the budget, without even getting to the small, half-billion-dollar, items. Then there's Gross' *Government Racket—Washington Waste From A to Z*. And if that doesn't hold you, check out Kelly's *Adventures In Porkland — How Washington Wastes Your Money and Why They Won't Stop*. These are just new books on the subject. There's nothing new about egregious waste in Washington. I've got stacks of books going back 10, 20 and 30 years, all describing the waste . . . and nothing has ever come of it . . . or changed.

The probability is high that nothing will change this time, except that the deficit and taxes will continue to rise.

Continuing Unemployment

I see they're extending the unemployment benefits because people aren't finding jobs. I think I know what's wrong. I've talked with some local businessmen and find they're having the same problem I am. They need more people. They're desperate for more people. But the job applicants just aren't what they need.

What's happened in New Hampshire . . . and all around the country . . . is that larger firms have been laying off their high-priced mid-management staffers. These people have been used to making $50,000 and up a year, but having worked in mid-management, they've little experience or confidence in making decisions. What the smaller businesses need are people who can start at around $20,000 and work their way up by generating sales. Someone who's geared to making $50,000 has the wrong house, car, clothes, outlook, work habits, eats at the wrong restaurants, and so forth. Worse, they're used to that and are not much interested in settling for a $20,000 lifestyle. So the job market is glutted with over-priced, under-trained people. Meanwhile, small businesses which need more help aren't able to find anybody they can hire. There just aren't many unemployed who can satisfy the needs of small businesses.

I have some great openings here . . . on *73* and *Radio Fun*, and to help start a couple new magazines, but finding people interested in actually working hasn't been easy . . . and we've been interviewing for months.

Ooops, a Typo!

Morris Blechman N9GVA was understandably upset when our data input person managed to let her subconscious alter his letter in the March issue. He ended his letter saying, "Anyway, I am going to send $ for your ranting and raving." Naturally this got changed to, "There isn't any way I am going to send $ for your ranting and raving," slightly altering the meaning. Tsk.

HAM RADIO REPAIR—Prompt service. **ROBERT HALL ELECTRONICS,** 1660 McKee Rd., Suite A, San Jose CA 95116. (408)729-8200. BNB751

DIGITAL AUTOMATIC FREQUENCY DISPLAYS. Please specify radio. Business 52 cent SASE. **GRAND,** POB 3377, Blaine WA 98230. BNB758

AMATEUR RADIO SERVICE: Complete repair facility. 15 years communications repair experience. Special service needs? No problem. Give us a call. Compassionate rates. **HAMSERVE,** 1720 Grand Ave., Waukegan IL 60085. (708)336-2064 (Dean) or Voicemail at (708)580-2034. BNB760

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WANTED; HAM EQUIPMENT AND OTHER PROPERTY. The Radio Club of Junior High School 22 NYC, Inc. is not only the Big Apple's largest Ham club but also the nations only full time, non-profit orgainzation, working to get Ham Radio into schools around the country as a theme for teaching using our EDUCOM-Education Thru Communication-program. Send your radio to school. Your donated amateur or related property, which will be picked up or shipping arranged, means a tax deduction to the full extent of the law for you as we are an IRS 501 (c) (3) charity in our thirteenth year of service. Your help will also mean a whole new world of educational opportunity for children around the country. Radios you can write off, kids you can't. Please, write-phone-or FAX the WB2JKJ "22 Crew" today: The RC of JHS 22, POB 1052, New York NY 10002. Telephone (516)674-4072 and FAX (516)674-9600. Young people, nationwide, can get high on Ham Radio with your help. Meet us on the WB2JKJ CLASSROOM NET: 7.238 MHz. 1100-1230 UTC and 21.395 MHz. 1300-1900 daily. BNB762

SOLAR POWERED HAMS! The Sunswitch is a charge controller to protect your batteries from over charge. Power MOSFETs are used, no relays! Assembled tuned and tested $39.95 plus $2.50 shipping. **SUNLIGHT ENERGY SYSTEMS,** 2225 Mayflower NW, Massillon OH 44647. BNB774

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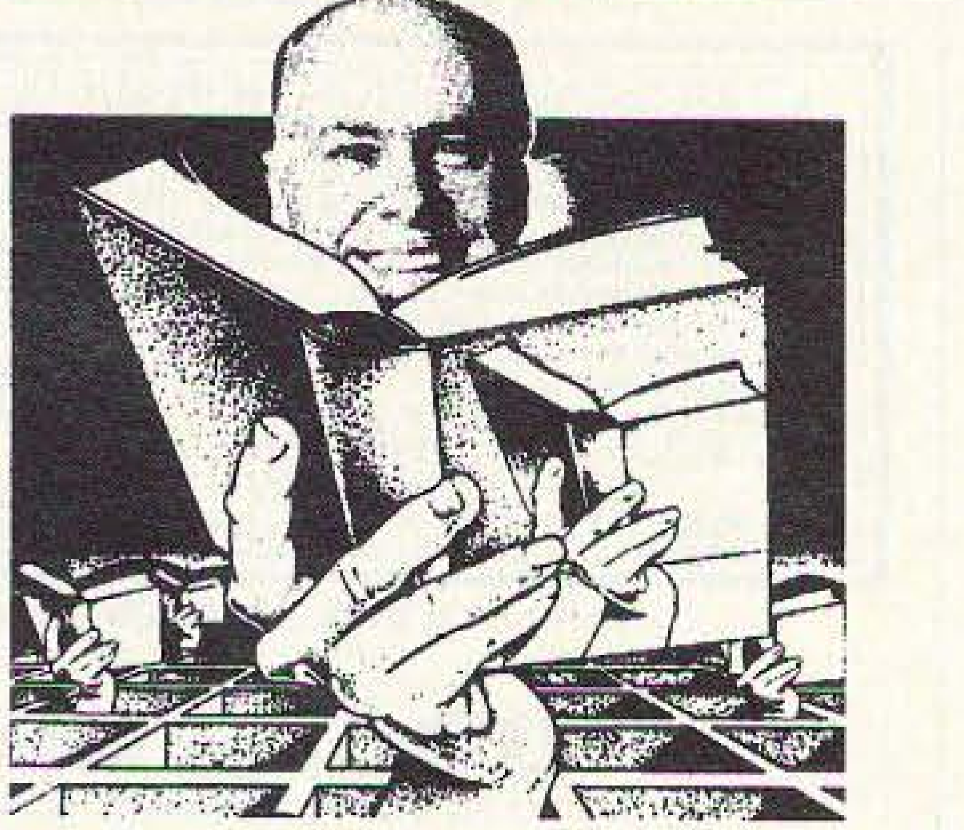

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Hams In Low Places

It appears that the FCC has finally given up on the notion that the Amateur Radio Service is self-policing, especially when it comes to the odd assortment of human flotsam and jetsam that washes up on 14.313. The FCC has finally answered the cries of the thousands of amateurs who operate legally and courteously, by stepping up their monitoring of the 14.313 cesspool and passing out some nice fat fines. Bravo, FCC! Please, keep up the good work.

When you add in all the other hams who have found themselves on the fuzzy end of the legal lollipop stick, amateur radio is starting to look more like *America's Most Wanted*. We've got illegal VE testing sessions, we've got false distress calls on the high seas, and of course there's always the illegal long distance exploits of everybody's favorite big mouth, Herbie Schoenbohm KV4FZ. It seems that Herbie, who has so far avoided an FCC Notice Of Apparent Liability (though many of us are still hoping), has also avoided any kind of serious penalty for his theft of long distance service. He was originally convicted on three counts, but an appeal got him off two of them. He was sentenced to two months of house arrest (kinda like being grounded, except it's by a judge instead of your parents), and ordered to pay a $5,000 fine. Herbie has reportedly vowed to appeal the remaining conviction, all the way to the United States Supreme Court. It always amazes me how blowhards and big mouths who get caught with their hands in the cookie jar think they can appeal their little case to the Supreme Court. Herbie should read a book or something, because I can guarantee him that the Supreme Court won't be interested in reviewing his case. Of course, it is mighty difficult to hear and learn something when your mouth is always open.

I have to admit, I am a bit biased when it comes to discussion of Mr. Shoenbohm (watch out, faithful reader, here comes the dreaded "personal anecdote"). Other than my fundamental dislike for ignorance that passes as insight because of shear volume, I have had a single personal contact with Herbie that left me less than impressed. It was the week we started sending American troops over to Saudi Arabia in Operation Desert Shield, what would eventually become Operation Desert Storm. I was driving home from work and turned on my HF mobile rig. I finished a nice chat with a fellow in Manchester, England, and was tuning up the band, when I came upon KV4FZ's afternoon speech. He and a buddy of his were operating a phoney net. They were being so ludicrous that no one would have mistaken what they were doing for anything other than a joke. I have no problem with jokes. I had a major problem with what Herbie chose as the subject of his joke. He and his buddy were acting like some kind of para-military relief net for the operations in Saudi Arabia. Even if I didn't have two relatives who had been part of the operation (which I did), and no matter how I felt about President Bush's decision to send American troops to that Godforsaken part of the world (I had mixed feelings), I still think that what Herbie and his pal were doing was in poor taste.

I sent out my callsign, was recognized, and had a short conversation with KV4FZ. I asked him if he could see how many people wouldn't find his joking about a potentially deadly situation involving American soldiers humorous. Herbie launched into some incoherent diatribe about how we had no business being over there, and how Bush was a dupe of the oil companies, blah, blah blah, yuck, yuck, yuck. I returned and told Herbie that most people didn't care about the political or corporate ramifications of Operation Desert Shield. I told him that it wasn't about Bush, or oil companies, or American-Israeli relations or any other complex matter. Once we had American men and women camped out on the sand of Saudi Arabia, it was a simple question of how many of those young Americans would die before it was all over. I guess this concept was too large to fit Herbie's narrow frame of reference. I don't think he understood what I was trying to say, so I signed off. Herbie and his buddy continued their fun and games.

While Herbie has yet to get caught in the act of pulling illegal amateur radio tricks, others have not been as lucky. William Moskowitz KA3HSZ of Plano, Texas, will soon be cutting a check to Uncle Charlie for $2,000. Billy-boy is getting off easy, because it's his first offense. The base amount for malicious interference is $7,000, but the FCC said they'd give Bill a break this first time. Mighty nice of 'em, doncha think?

The FCC wasn't as lenient with bigtime offender Richard Whiten WB2OTK of Taylors, South Carolina. Dickie will soon be "contributing" a whopping $10,500 to the national debt. The FCC stated that they were really socking it to Dick because of "repeated violation of rule 97.01(D)." Actually, I suspect that Whitten got slapped with such a stiff penalty because his defense was so lame. He didn't deny making the transmissions in question, but said that they weren't malicious interference because "if I had truly wanted to willfully and maliciously interfere, I could have done so to such an extent that communications between other amateur radio operators would have been impossible." Is that not priceless? Maybe we should call this the "Big Gun Defense."

Of course, I do have to express a little sympathy for Mr. Whiten, since the guy he was accused of maliciously interfering with was Michael Galego KA4MUJ. Mikey hasn't paid the piper yet, but like his buddy Herb Shoenbohm KV4FZ, it's just a matter of time before the FCC catches him doing something. KA4MUJ is perhaps the most frequent callsign heard on 14.313. Not only is he on the air himself at all hours of the day and night, but others make tapes of his inane ramblings and play them back over 14.313 when he's not around. When he is understandable (his words are so often slurred that it is difficult to understand what he's saying), Mikey can come up with some of the most hateful, ill-informed, anti-Semitic crapola this side of a skinhead convention. He adores Herb Shoenbohm to the point of suspicion, which is reason enough to question his

Continued on page 75

Number 27 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

The following times are given in Coordinated Universal Time (UTC), which used to be called Greenwich Mean Time (GMT). When using the band-time-country chart please note that highest possible frequency is used for the path indicated. For the WARC bands, use as follows: for 12 meters, use 10 and 15 data; for 17 meters, use 15 and 20 data; and for 30 meters, use 20 and 30 data. Sometimes a path will open on a band higher or lower than the one indicated, so be sure to check those as well.

The propagation report for May contains some days that are Very Poor or Poor. These are expected to occur on the 4th, 9th and 10th; on the 16th through the 18th; on the 21st through the 22nd; and on the 25th. You will note that there are only 12 Fair or Fair-to-Good days forecast. May will be a month of unsettled ionospheric conditions and an active-to-storm level magnetic field on the days shown as Poor or Very Poor. Also, some intense geophysical effects may be noticed on the days surrounding the 17th of the month. Quite often you will notice that the forecast conditions take place a day or two before or after the forecast date, so always check the WWV broadcasts at 18 minutes after any hour to discover the *trend* in solar flux, and the Boulder A and K indexes. Remember that the *higher* the solar flux, and the *lower* the A and K indexes, the better the propagation will be.

May is also a month for trends from spring propagation (usually quite good) to summer conditions (usually quite poor as compared with spring and fall). The reason for this is the higher-than-usual absorption during the hours after noon, particularly on the lower HF bands. The ionosphere tends to be a poor reflector during those hours. Short skip on the higher HF bands will be quite good on many days as these frequencies are less affected than the lower ones. You may have noticed that the 30, 40, 80 and 160 meter bands are always better during early morning and late afternoon and evening hours. May always brings increased thunderstorm activity in the Northern Hemisphere, so QRN will be high on many days.

Note, also, that we are now in the last few years of declining sunspot activity when the higher HF bands will suffer the most. Therefore, you will find that working DX is more difficult in general on the bands from 10 through 20 meters. So, as the farmers say, "Make hay while the sun shines," which also applies to our radio activities in the years of declining sunspots.

There will be a partial eclipse of the sun on May 21st and it will cover North America, except for the Southeast, Arctic regions, Greenland, Iceland, Northern Europe (including the northern British Isles) and the northwest portion of the former Soviet Union.

Let me know how these predictions are working out for you. I'd like the feedback. See you next month. 73

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	-	20	-	-	20	20	-	-	-	-	-	-
AGENTINA	20	-	-	-	-	-	-	-	-	10	10/15	15
AUSTRALIA	15	-	-	-	-	-	20	20	-	-	-	15
CANAL ZONE	15	20	20	40	40	-	20	20	10	10	10/15	10/15
ENGLAND	-	-	-	-	-	-	-	15	15	15	-	-
HAWAII	15	20	-	-	40	40	20	20	-	-	-	15
INDIA	-	-	-	-	-	-	20	20	-	-	-	-
JAPAN	-	20	-	-	20	20	-	-	-	-	-	-
MEXICO	15	20	20	40	40	-	20	20	10	10	10/15	10/15
PHILIPPINES	-	-	-	-	-	-	20	20	-	-	-	-
PUERTO RICO	15	20	20	40	40	-	20	20	10	10	10/15	10/15
SOUTH AFRICA	-	-	-	-	-	-	-	-	-	15	15	20
U.S.S.R.	-	-	-	-	-	-	-	-	20	20	20	-
WESTCOAST	20	80/40	80/40	80/40	-	-	-	-	15	20/15	20/15	20/15

CENTRAL UNITED STATES TO:

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

WESTERN UNITED STATES TO:

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

*80-Meters possible on good days only

MAY 1993

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

FT-5200/6200
Dual Band Mobiles

Frequency Range:
FT-5200
2M: 140-174 MHz RX
140-150 MHz TX
70 cm: 430-450 MHz RX/TX
FT-6200
70 cm: 430-450 MHz RX/TX
23 cm: 1240-1300 MHz RX/TX
- 32 Memories (16 per band)
- Odd splits on any memory
- CTCSS Encode Built-In
- Dual Receive with Balance Control
- Full Duplex Cross-Band Operation
- Built-In Antenna Duplexer
- Backlit DTMF Microphone
- Automatic 8 Level Display Dimmer
- Built-In Cross-Band Repeat
- **RF Output Power:**
2M: 50/5 watt (high/low)
70 cm: 35/5 watt (high/low)
23 cm: 10/1 watt (high/low)
- **Accessories:**

FRC-4	DTMF Paging Unit
YSK-1L	20' Trunk Mounting Kit
FTS-22	CTCSS Dual Decoder
SP-7	External Speaker
DVS-3	Digital Voice Recorder Unit
MW-1	Wireless Microphone /Controller

What weighs 5 oz., lights up, snaps off and fits in your pocket?

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With the use of the optional adjustable control panel bracket kit, you can conveniently mount the "smallest" control panel almost anyplace in your car and mount the transceiver body out of sight. When you leave your car, snap off the 5 oz. front control panel and take it with you. Now your rig's secure. For safer autopatch operation at night, you'll find another Yaesu exclusive – a back-lit DTMF mic. And there's also a built-in antenna duplexer and easy-to-read dual full-frequency liquid crystal display.

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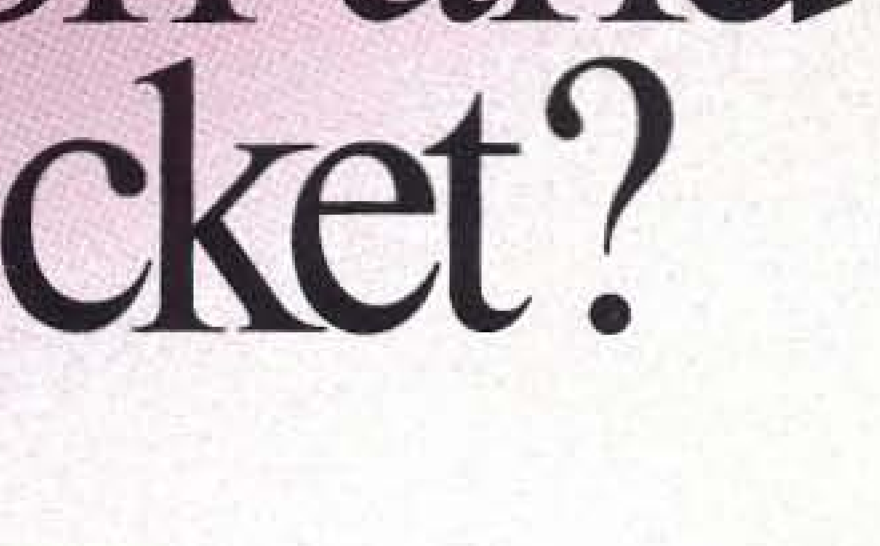
Here's another Yaesu exclusive! The MW-1 Wireless Mic with Remote Control.



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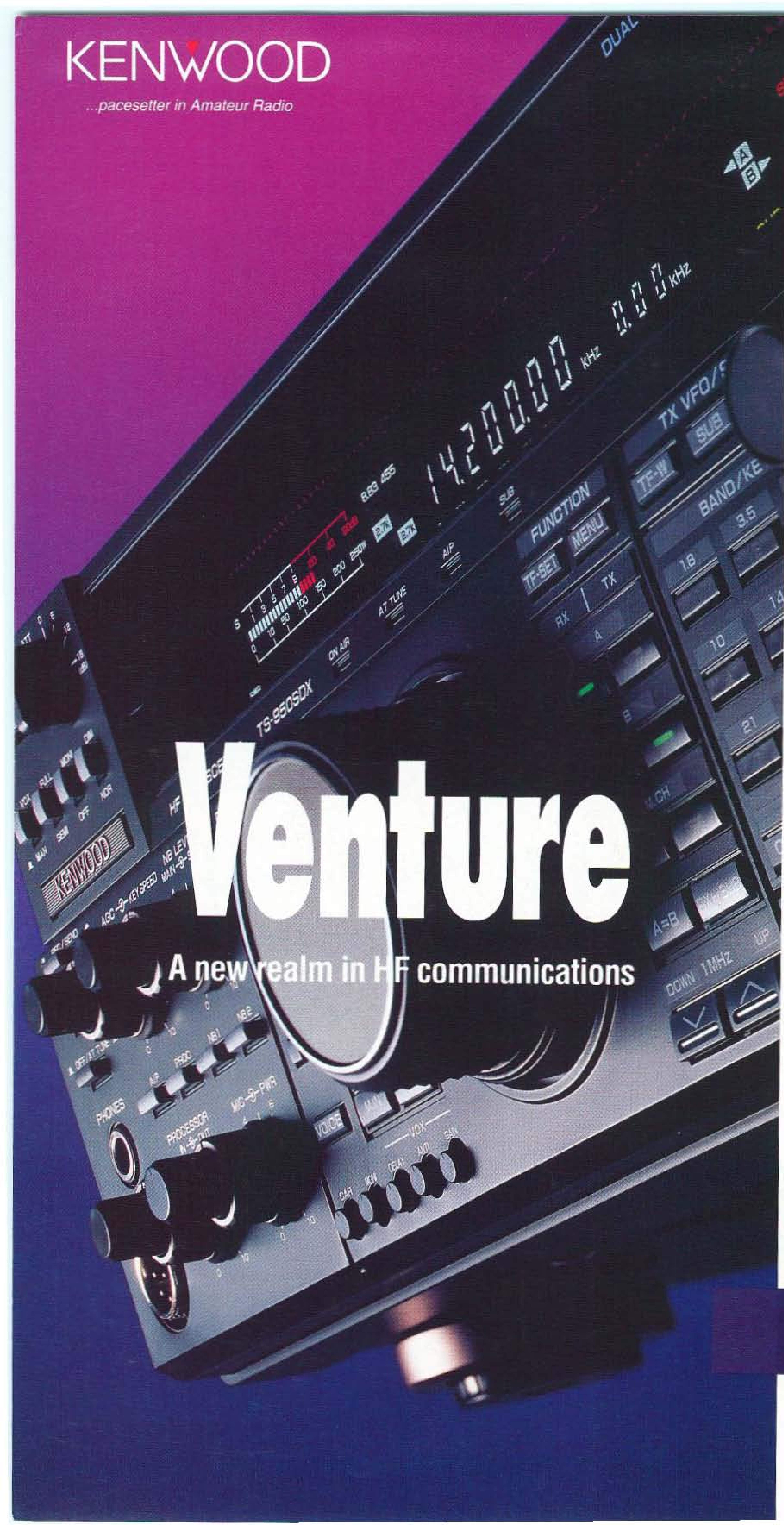
Performance without compromise.℠



Offering superb TX/RX performance plus exceptional signal purity, Kenwood's TS-950SDX establishes a new benchmark f HF communications.

- **Built-in DSP (digital signal processor)**
- **Dedicated Power MOS FET final sectio**
- **User-friendly menu system**
- **Automatic antenna tuner built-in**
- **AIP (Advanced Intercept Point) system**
- **Ultra-fine (1Hz) tuning**

- **Super stability with reliability**
The Power MOS FET final section is conservatively rated at 150W (40W in AM mode). This increases reliability and lowers distortion.
- **Wideband general coverage receiver**
The TS-950SDX covers all Amateur bands from 160 to 10 meters. The receiver covers 100kHz to 30MHz.
- **100 memory channels with multi-scan functions**
Enabling independent storage of TX and RX parameters, th 100 memory channels may be scanned with such conveniences as programmable memory channel lock-out c continuous control of scan speed.
- **Built-in DSP**
The digital signal processor replaces conventional analog circuitry for processing the TX signal in the SSB, CW, AM, FSK modes. Reception is also enhanced: digital PSN detection and digital audio filtering help to eliminate interference and improve audio quality.
- **Power MOS FET final section**
The TS-950SDX ranks as the first Amateur Radio transceiv to feature an FET final section. Superior linearity results in greatly improved TX performance.
- **Dual-frequency receive**
The TS-950SDX can simultaneously receive two frequencic within 1MHz of each other. To facilitate split-frequency operations, front panel controls include M/S (main/sub) select and an RX↔SUB key for instantly swapping the tw frequencies. A 500Hz CW filter is included in the sub receiver.

TS-950SDX
HF Transceiver

KENWOOD COMMUNICATIONS CORPORAT
AMATEUR RADIO PRODUCTS GROUP
P.O. BOX 22745, 2201 E. Dominguez Street
Long Beach, CA 90801-5745

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