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JANUARY 1992
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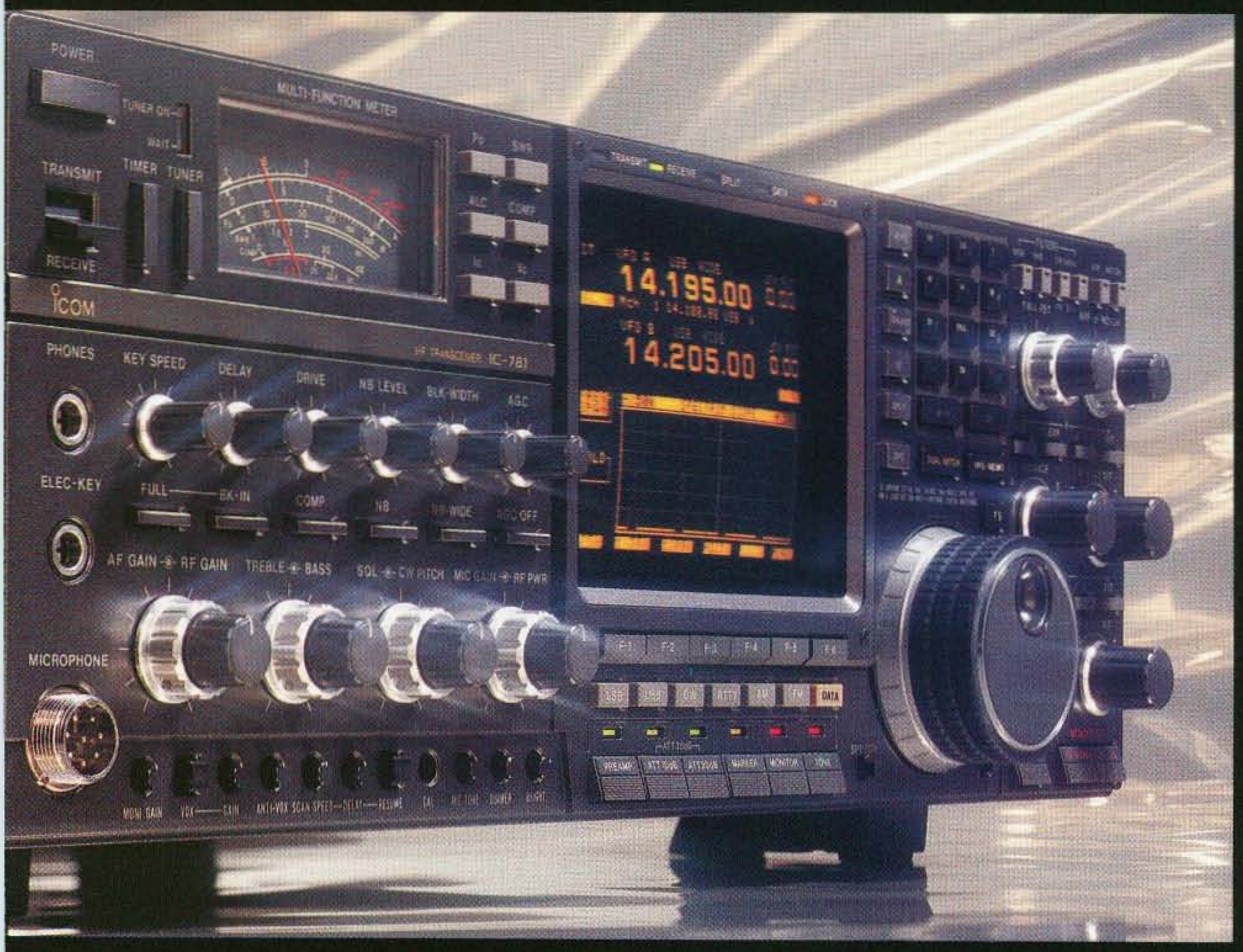

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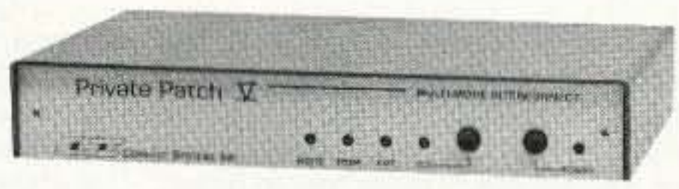

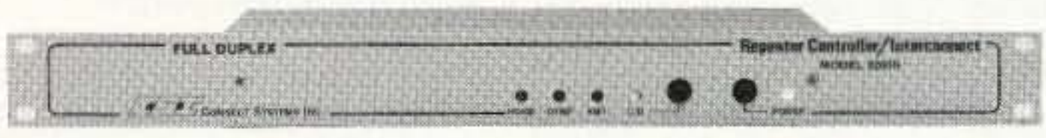

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LETTERS

From the Hamshack

Ronald Schmidt WA5QBA, Garland TX Back in 1973, I paid $73 for a lifetime subscription to *73 Magazine*. That was one of the best investments I have ever made. 'Nuff said.

Max Holland W4MEA, Hixson TN I really like hamfests. The first one I attended took place in 1955 in Dayton, Ohio, in the halls and lobby of the Biltmore Hotel. Leo Meyerson of World Radio Laboratory played the electric organ for entertainment.

I attend approximately 10 hamfests per year. Sometimes I have found some real bargains. Most of the bargains are products manufactured by the AS IS Company. As an example: At the Dayton Hamfest I brought a receiver that was clearly marked AS IS. I only paid $2.00 for it. It didn't work, and some of the components looked burned, but it was a real bargain. At another hamfest I bought an AS IS printer for $5.00. When I got home, it didn't work either. I believe I could fix most of these things if I had the technical manuals. Does anyone know the address of the AS IS Company?

Kent C. Babcock, Arcadia MI I'm still a no-call, as I'm waiting for the study materials I ordered from *73*. In the meantime, I'm listening to hams on a couple of communications receivers, and I must admit to being somewhat surprised at what I'm hearing, mostly on 14.313 MHz. I hope I can be assured that the vast majority of hams are as offended by this juvenile foolishness as I am.

This brings me to my point. As a CBer, I have never heard anything worse on 27 MHz than some of the crap I've heard from supposedly legitimate amateur radio operators. Wayne, keep that rolled-up newspaper handy and continue to swat those holier-than-thou hams who insist on calling CBers names over the back fence.

You also have my promise that when I do get my license I will do my best to uphold the standards of good amateur conduct on my part *first* and then worry about the practices of others.

Thomas E. Durfee, Jr., WI8W, Big Rapids MI I really enjoy reading *73*, and I find that Wayne Green hits it right on the head when it comes to telling it like it is. He keeps telling me to get off my duff and write something, and by God that's just what I'm gonna do. Keep up the good work.

Charlie N4TDY, Raleigh NC I decided to take some of your advice and do something new and different for a change over the past year. I have been reading *73* for about four years, and I've only been a ham for three years and four months.

My first license was the Tech, and it took me about a year and a couple of months to upgrade to Extra. Hey, would you believe I am yet to make a code contact. Bet you the old-timers hated to hear that statement.

Wayne, this is the first time I've written any known public media. I am now also taking a Spanish class, and I joined OMIK this year and went to its convention in Charleston, South Carolina. I have participated in a number of Boy Scout activities with my son, which I never took the time to do before. I have gone out and bought fishing gear, which is something I always wanted to do, and would you believe that I am writing this letter with a new computer. Three weeks ago, Wayne, I did not know what DOS was; look at me now, a 386 with the works!

Dennis D. Spreng KB0IRY, Lake Crystal MN I wrote to you several months ago about how I was dissatisfied with my job at the post office, and how your editorials had convinced me to change. For starters, I enrolled in an electronic communications course, passed my Novice exam, and started my own communications business. I am still working at the post office for now while I get things rolling.

This has not been easy for me to do. I am typing this at 3:00 a.m. after working eight hours at the post office. I have spent money to get started, but I believe it is worth it. You are exactly right about how making money means changing, and we are all basically lazy and begrudge those who do work hard. People at work give me a hard time about this, but that is their problem.

My business is just getting started. I am planning a direct mail program for later this month. I am a dealer for several antenna and radio lines. I also carry emergency vehicle products. I am even considering advertising in *73*! I am working hard at this career change, and your editorials are what got me started. I hope in a few years you can put my success story in your column.

Jerry Wetzel W3DMB, Butler PA I have read your editorials since the early 1950s, so I have a general idea of your opinions as they have evolved over the years. Do you "worry" if anyone doesn't agree with what you write? (Fat chance!) Recently, the following editorial policy appeared in the local club newsletter.

"It is very difficult for an editor to print any news if he is afraid of having someone disagree with his editorials. Therefore, in the future, any BCARA member who disagrees or is upset by anything that is in the Tell-A-Ham can bring his/her copy to the next regular meeting. The editor will have a pair of scissors and will cut out the offensive article from that person's copy of the Tell-A-Ham."

At *73*, would you rather people who disagree cancel subscriptions, write a letter, or just steam (assuming they won't change their mind)?

. . . write, giving some rational reasons for disagreeing. I do my homework before writing, so why shouldn't people who disagree do theirs, too? I'm always open to new data and able to change my opinions if the data dictates. Wayne

Clark J. Evans WA4DLL, Tampa FL *WA4DLL asks us to print the following:* Clark J. Evans, Sr., used amateur radio operators around the world to trace where the width (4'8½") of the United States train tracks came from. Clark got interested in track gauge through his father, John T. Evans, Sr., who worked for the Pennsylvania railroad for 47 years. It took over six years of research to trace where standard gauge (4'8½") came from.

The United States got the gauge from England because they built the first steam engine. England got it from the Roman chariot. The Romans got it from the Celts. The Celts got it from common horse sense. It is the width of two horse rumps standing side by side pulling a cart, wagon, or chariot. You always made the wagon, cart, or chariot a little smaller so it wouldn't get stuck in a narrow opening.

Thanks to IK8HEP (Italy), IK8DXX (Italy), IK8BQE (Italy), IK8BLM (Italy), and GW0MAW (Wales). Thanks also to Joan and Betty Ruck of Altoona, Pennsylvania.

InSuk J. Granholm KA7TAG, Monett MO You write wonderful and enthusiastic editorials! I especially enjoyed your information on Amelia Earhart. Although I have had my Novice license since 1984, I have made just one contact. I got the license because I happened to learn the code with my husband who was studying for his Novice license. Not being technically minded, much of the ham magazines do not make sense to me.

Since I started reading my husband's *73 Magazine*, your editorials have me fired up, and I intend to study and upgrade and become active. Like you, I have numerous projects going on. I have started writing and hope to be published again. I have also begun a book about my adoption and life in Korea and in America. Thank you for sharing your enthusiasm. May you live another 30 years to continue sharing it.

Stephen D. Goff N8IVX, Bellevue OH This is in reference to a letter in the November 1991 issue by Mr. Bovee about repeater coordination. First and foremost, the FCC DOES NOT assign repeater frequencies. They also DO NOT initiate nor approve band plans. They authorize amateur frequencies in blocks, and it is the responsibility of amateurs to govern themselves in this regard. In Ohio, the recognized frequency coordination organization follows the ARRL approved band plan. Not all states follow this same band plan, and unfortunately for Mr. Bovee's group, neighbors of Ohio do not follow the same band plan, which renders useless many pairs that would be otherwise available. Different geographical areas require (or desire) different uses of the available spectrum. The situation that Mr. Bovee's group has encountered is purely geographic. The thought of one pair per band per individual/club has merit, with one exception: as more special interest groups are formed and want their "own" pair, will the idea of one pair per band PER CITY/AREA crop up? The question will ultimately arise as to why one city or area needs duplicate coverage on one band. Who gets to stay, and who goes? Should we ask the FCC to sell spectrum to us so only the groups with lots of members can have repeaters?

Why DO we need so many repeaters? Is it because we can only associate ourselves with others who agree with only us, who think like we do? I believe it's time for amateurs to work together, to coexist, and to show the "newcomers" that we really are a fraternity dedicated to the continuation and extension of our unique ability to enhance goodwill, locally AND internationally. When that day comes, we will no longer have need of all the repeaters that are in existence today.

James Dillon N0KWA, Rapid City SD Could you please announce in *73* that I am trying to start a net related to astronomy where fellow hams could discuss the technical and observational aspects of astronomy? I think that such a net could help make for some interesting QSOs and teach amateur astronomers about ham radio. My packet address is N0KWA @ W0BLK.SD. My home address is 801 East Ohio Street, Rapid City SD 57701.

Larry Junstrom KN4UB, Jacksonville FL I have started a Celebrity and Entertainers Net, and the response has been quite good, but I feel it needs additional publicity. I am wondering if you could put a plug in for the net. There are quite a few hams in the entertainment business, and I would like to get them together.

The net meets on Mondays and Thursdays at 2300Z on 14.265 MHz, ±QRM. I travel quite a bit with my band, but there are other guys who will act as net control in my absence. The net is run in a civilized and gentlemanly manner so as not to invade the privacy of any truly famous personalities.

Gary N. Babcock WA5BMN In response to the letter submitted by AA9AN in the October issue of *73*, regarding contesting on the amateur radio frequencies, I find his point of view very parallel to mine. This contesting has gone to the point of making the amateur bands useless during many of these marathon QRM sessions. I have often wondered what the outcome would be if another San Francisco earthquake were to occur at the exact moment that the famous SWEEPSTAKES contest begins. I can assure you it would not be for the benefit of mankind, judging by what I have heard during contesting operation over the 30-plus years that I have been in this hobby.

In regards to the editorial response given to AA9AN not to complain to the FCC, I can assure you that contacting the contest organizers will get you nowhere fast. I have contacted many of these organizers over the years to suggest a sensible method of contesting that the general amateur population could live with, and I have been told everything from "Mind your own business" to "Don't complain to us, we aren't the problem." If the organizers are not the problem, it seems to me that some sort of FCC regulation may be necessary to correct the problem of totally obscuring the amateur frequencies with this senseless QRM. It seems that the amateur community is unable to regulate itself in this area. Perhaps the involvement of the FCC is the answer many of us are looking for. I welcome any comments from other amateurs who would like to use their radio equipment on the weekends again.

73 Amateur Radio Today

JANUARY 1992
Issue #376

TABLE OF CONTENTS

FEATURES

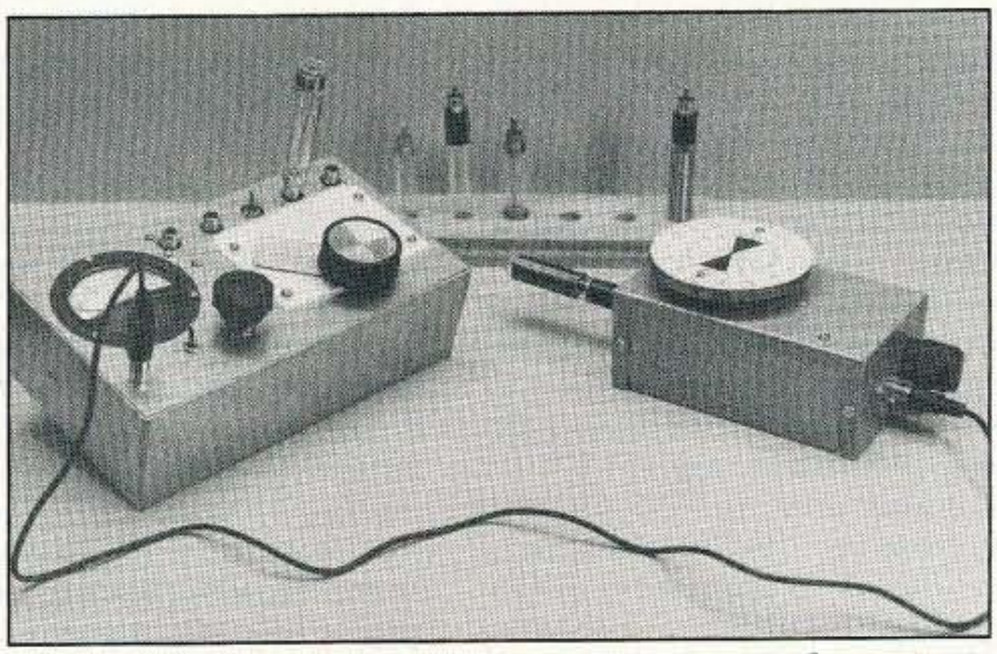
REVIEWS

BOOK REVIEW

Cover: Associate Publisher David Cassidy N1GPH destroys another perfectly good circuit board.

Cover design: David Cassidy, Larry Dunn

Cover photo: Larry Dunn



Build a field-strength/dip meter. . . see page 8.

DEPARTMENTS

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Audit Bureau of Circulations (ABC) membership applied for.

Contract: It's New Year's Resolution time, and just by reading this sentence you have become legally obligated to the staff of *73 Amateur Radio Today* to resolve to pick at least one project in this issue and build it. You'll have fun, acquire a deep sense of accomplishment and pride, and you might even learn something.

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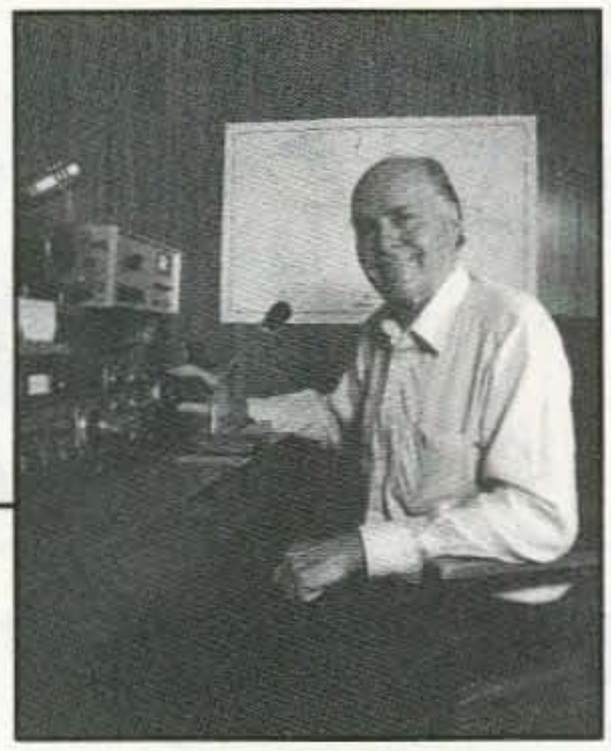
NEVER SAY DIE

Wayne Green W2NSD/1



Repeater Guides

Unless you've got moss growing on your back, you at least occasionally get away from your home town—in which case you'll want to know what repeaters are where. Well, having a list with you beats the hell out of kerchunking all possible frequency pairs to see what's around—particularly if you're driving from one repeater area to another. And let's see, are they using 15 or 20 kHz spacing between channels around here?

When I was busy in the 1970s trying to get repeaters going, I used to publish a $5 *World Repeater Atlas.* It sold well and did the job. It had a list of every known repeater with its in/outputs, plus state maps showing the transmitter locations. We also had a cross-index by frequency. By 1980 the *Atlas* ran to 274 pages.

Then the League started handing out repeater lists for free at hamfests. They weren't nearly as complete, but they almost stopped my *Atlas* sales, forcing it to be discontinued—whereupon the League started charging for theirs. It's $6 today, has only the repeater listings and no maps, and doesn't cover hundreds of repeaters in Europe, Africa, Asia and Oceana. Their list is handy if you know where all the little towns are—which you probably don't—and don't travel abroad.

This need for maps got Bill Smith N6MQS busy with his Macintosh. He's publishing a *U.S. Repeater Mapbook* (see the "New Products" section in this issue of *73*) which sells for $10. It's got the 50 state maps (plus Canada) with the repeater output frequencies shown. The larger cities have separate boxed listings. It's a good book to keep in your glove compartment, or to pack when you're flying somewhere.

I've got the cutest little quarter-wave telescoping magnetic mount antenna that I use on rental cars. Picked it up at Dayton from the folks at Cellular Security Group. It sure beats trying to use an HT in the car.

The frustrating part for travelers is the lack of response when we call in on repeaters as visitors. I joke that we appear to have finally accomplished the ultimate—one repeater for each 2m ham. The sad fact is that in many cities I'm able to raise several repeaters, but seldom able to get any answer when I ask if anyone is there. And no, it isn't that they don't want to talk with me in particular. I'd say that maybe 10% of the hams I contact ever connect my call and name with me.

As I've mentioned in the past, I find it irritating to call and get no answer, then, seconds later I hear someone call a friend to see if he's listening, just to let me know that visitors aren't welcome on this repeater. If you aren't a paid-up member, keep the hell off our channel. I guess that's the "good new" ham spirit—as differentiated from the "good old" ham spirit. Alas, I'm still stuck in the past when amateur radio used to be like a fraternity and friendliness was the rule, not the rare exception.

Speaking of friendliness, I was amused to see that one of the Los Angeles repeaters finally made the newspaper headlines for being so outstandingly awful. I'll bet I could do a good business selling tapes of our cesspool to CBers to show them how good the CB channels are compared to amateur radio these days. I've got some interesting CB tapes, but nothing approaching what we hams have been able to produce. Right now L.A. is even beating out New York for repeater obscenity, but it's by a nose.

But what about the FCC, you ask? Oh, come *on*. They've several problems—like we're supposed to be self-regulating—like the FCC is under enormous pressure from industry and lobbyists to take away our frequencies and put them to better use—like the FCC's shortage of funds for trying to cope with our seemingly unlimited supply of wackos (all excellent CW ops, by the way). The FCC seems to feel that it's our responsibility to police our bands, not theirs, so where's our national organization which should be dealing with this mess? And why do the League directors remind me so much of Congress? Well, I don't blame them for ignoring our messes. I blame you for not cleaning house at election time. We also need to do some house cleaning in Washington...and senate cleaning too. But for some reason you blindly re-elect the same do-nothing turkeys every two years.

There I go bad-word processing the League again? No, I'm putting *you* down for not cleaning up the ARRL at election time. The League is fine in what it does. It's got some fine awards—like the DX Honor Roll, which has forced most amateurs from rare countries off the air. And there's its fantastic traffic handling system which shuttles thousands of completely useless CW messages around the country, losing a few in the process and delivering the rest late. I say give credit where credit is due.

And what other national organization do we have to represent us at ITU conferences? Of course they haven't bothered to do their homework, but then it's a non-profit organization, so we can't really expect it to be very effective, right?

The part I liked the most was when the League killed off 85% of our ham stores and 95% of our American ham manufacturers, thus opening our market to Asia. It was hilarious as Hallicrafters, Hammarlund, National, Millen, Johnson, Centra Electronics, Gonset, B&W, Multi-Elmac, Thordarson, UTC, Lakeshore, Webster, SBE, World Radio and others paid the League millions while it killed their companies.

Ah, but that was a long time ago, back in the 1960s with another bunch of directors, now dead, far's I know. But the loyal ARRL members, despite anything I and other ham journalists could write explaining what was happening, supported them to the hilt, re-electing them like clockwork. A recent *Westlink* editorial called these loyalists "League Lemmings." I kinda like that.

Time Multiplex

How many years have I been suggesting (pleading?) for some ham experimenters to tackle time multiplex technology? And how about my touting digital voice communications? Well, wouldn't you know that Motorola has put the two together, calling it Time Division Multiple Access (TDMA). This will make it possible to stack up to six conversations, all on the same channel.

Well, we can do that too! The next time you hear anyone whining about QRM, just keep in mind that the main reason we have QRM is because we're 30 years behind in technology, not because we have (a) too many hams or (b) too few frequencies.

As a matter of fact, if we can change to digital voice transmissions we'll be able to go full duplex, even when we're in contact with someone on exactly the same frequency. With digitized voice and a multiplex system, six hams will be able to talk with each other in full duplex, all on one channel.

Perhaps, if we're all too old and too tired to even try to develop the equipment, we'll be able to get the Japanese to do it for us. We're not talking about anything terribly complicated here... certainly nothing a clever 14-year-old ham couldn't whip together after school.

How much would such a technology be worth if someone bothered to develop it? Something like that is all it would take for an entrepreneur to build a pretty big business. Motorola says they'll have it available commercially in another year, so in a few years we'll be able to put a dollar figure on the development. If it's worth less than a few tens of millions, I'll be surprised.

Liars Figuring Again

The Gettysburg licensing figures can be interpreted to show a huge growth in new licenses as a result of no-code. Alas, I suggest you view those who do this as charlatans...or dummies.

The no-code ticket has boosted new Tech licenses to a fairly steady average of 2,800 a month vs. a tenth that in previous years. Wow! A ten-times growth! Awesome. We're packing 'em in.

Well, sure, but when we look at what's happened to the Novice new licensees we see they've dropped an average of 500 a month. That drops our overall gains a tad.

The bottom line is that according to the FCC's figures we've gained about 7.7% in total licensees since this time last year. The eentsy problem with this is that for the last three years the FCC has stopped deleting deceaseds and non-renewals. This has given us a great-looking boost in our numbers... kinda like a Chicago election, with voting gravestones.

Thus, the apparent 7.7% growth is obviously somewhat inflated. Looking at the FCC's figures for earlier years suggests this is adding about 5% of statistical bloat. The apparent growth for the last two years was 6.1%, so we've at least progressed 1.6% due to no-coders.

I know the League Lemming hordes won't forgive me for "Trashing the League" by bringing this up, but our real growth from 1946–1963 was an amazingly steady 11% per year. That was before the ARRL's Incentive Licensing debacle almost killed the hobby...and did virtually kill the ham industry.

The no-code license has increased our growth...about doubled it from an actual 1.6% to 3.2%, and that's good stuff. But we're still creeping when we should be running. If your club hasn't set up classes for newcomers, if you don't have a team scouring the CB channels for youngsters, if you're not sending club members into

Continued on page 80

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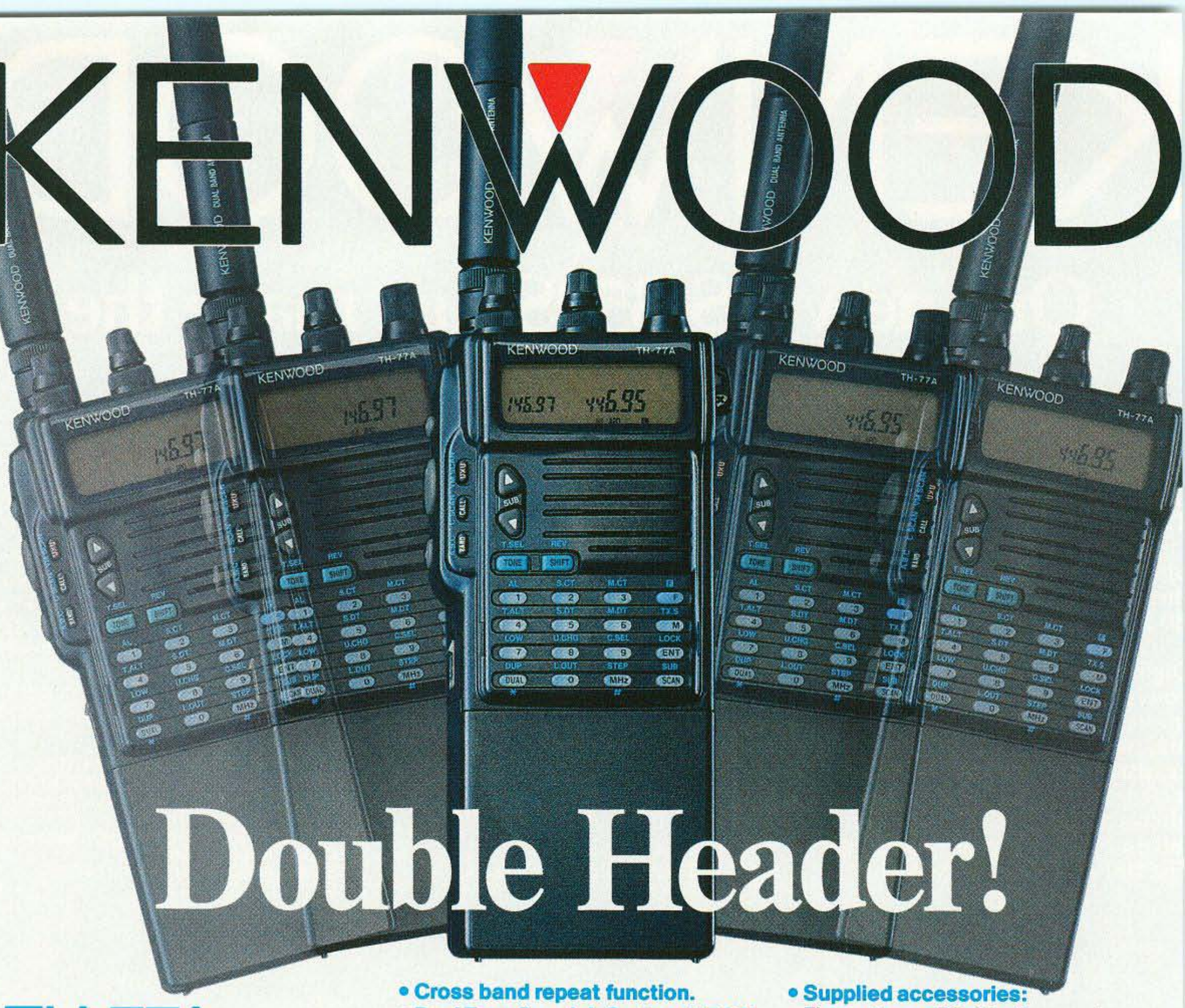

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Compact 2m/70cm Dual Band HT

Here's a radio that deserves a double-take! The TH-77A is a feature-packed dual band radio compressed into an HT package. The accessories are compatible with our TH-75, TH-25, and TH-26 Series radios. Repeater and remote base users will appreciate the DTMF memory that can store *all* of the DTMF characters (*, #, A, B, C, and D) that are usually required for repeater functions!

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QRX . . .

EDITED BY LINDA RENEAU KA1UKM

Spectrum Use Today

Private Radio Bureau Chief Haller of the FCC spoke at the Spectrum Summit for Emerging Technologies in Washington last November. The *W5YI Report* printed excerpts transcribed from on-site recordings. Haller: "The demand for spectrum is unparalleled. Since 1968, there's been over a 400% increase in the number of licensed land mobile transmitters in this country. That is a 10% annual growth rate. In the last six years alone, the total number of transmitters below 470 MHz has increased from 7.5 million to 11.5 million. And if that weren't enough, the traditional users of land mobile radio are anticipating even more advanced kinds of services. More remote control. More digital. More automation. All of these things place a heavy demand on the spectrum.

"...I don't know how to provide those additional channels without some very difficult and perhaps expensive changes in the way that we do our processes at the Commission, and the types of systems we license. It's a tough balancing act, and one that's not going to get easier for the government generally or for the FCC in particular. The tight budget under which our agency is forced to operate this fiscal year, and next fiscal year, will require us to do more with less, notwithstanding the explosive use of spectrum today.

"As a federal regulator...I think of myself as sort of an acrobat on the high wire. On the one hand, I'm charged with trying to ensure as far as possible that new technologies can come on line and have a place, a home in the spectrum. Then on the other hand, with the number of transmitters I've told you about, there is a tremendous existing investment out there. So we have to be careful that changes we implement don't, overnight, wipe out that existing investment.

"It also means letting people try, so far as possible, to bring new applications into the marketplace. Section 7 of the Communications Act requires the Commission to encourage the provision of new technologies and services to the public. One of the problems is that we have no way of knowing what those technologies are going to be. So very often our rules are way behind the industry. A new idea is presented to us, and we have to go through a lengthy rulemaking process to get that technology on the air. By the time we've gone through the process, the poor entrepreneur is bankrupt and the technology goes away, and we never see it.

"...the Commission recently adopted rules to release the 220–222 MHz band for narrowband technology. This provides for the first time a home for very spectrum-efficient narrowband voice and digital technology, using about one-fifth to one-sixth the spectrum of existing two-way services. At a time when spectrum availability is very scarce in the large metropolitan areas, we have great hopes that this new service at 220 MHz is going to provide an expansion area for systems."

Regarding Haller's speech at the ARRL National Convention in Saginaw, Michigan, reported in last month's "QRX," Haller said that he was not sure if he used the words "excess capacity," but he does not have a problem with that term. "Excess capacity means you can do something more, and still get your basic communications through. In my mind, excess capacity is not a spectrum term. It doesn't mean 'too much spectrum.' It means you have capacity enough to do the basic communications and something else." As to changing FCC Rule 97.113 on "Prohibited Transmissions": "I have serious concerns about opening up the Amateur Radio Service to such an extent that it becomes a substitute for other services. And yet, I think there are things that can be done beyond what the current rules permit that do not compromise the Amateur Radio Service." TNX *W5YI*. For more details, see Vol. 13, Issue #22 of the *W5YI Report*.

WARC-92

The FCC has released the U.S. proposals for WARC-92. Those with a possible impact on amateur radio are: *HF Broadcasting and 40M:* The FCC recommends that 1325 kHz of spectrum be reallocated from the Fixed and Mobile Service to broadcasting. The new bands would become available on June 30, 2007. By this same date, broadcasting would have to be fully converted to Reduced Carrier Single Sideband (RSSB).

In the 40m band, the Amateur Radio Service would be allocated 6.9 to 7.2 MHz worldwide. At 6.9–7.0 MHz, amateurs would share spectrum with Land Mobile, amateurs the primary users, and Land Mobile, secondary. At 7.0–7.2 MHz, amateurs would have exclusive access. Region 2 broadcasters would gain exclusive access to 7.2–7.3 MHz, worldwide. Other proposed, new HFBC allocations (worldwide, non-shared, all adjacent to existing allocations) are: 5.900–5.950, 7.300–7.525, 9.350–9.500, 11.550–11.650, 13.800–13.900, 15.600–15.700, 17.450–17.550, and 18.900–19.300 MHz.

Mobile Satellite Service: The U.S. proposes that the 137–138, 148.0–149.9, and 400.15–401.00 MHz bands be shared between low earth orbit satellite systems and other users. The LEOs and as many as three other services would all have primary status in these bands. A 150 kHz segment at each edge of the 137–138 MHz band is proposed for the Meteorological Satellite Service on a secondary basis. There had been concern among amateurs in Regions 2 and 3 that the LEO proposal for 148.0–149.9 MHz would drop below 148.0 MHz.

The FCC has withdrawn its preliminary proposal to allocate 420–421 MHz to LEO satellite systems on a secondary basis. This is welcome news to amateurs in Australia, Jamaica, the Philippines, and the U.S., who have secondary status at 420–430 MHz.

The FCC proposal would allocate 2390–2430 MHz to the Mobile Satellite Service (MSS) on a primary basis, for use as an uplink to MSS geostationary satellites. Amateurs would retain their current secondary allocation at 2300–2430 MHz in all three regions. (In Australia, Papua, and the U.S., 2310–2390 MHz is reserved for aeronautical telemetry.) The future of the amateur satellite program is limked to the continued availability of the segment 2400–2450 MHz.

Broadcasting Satellite Service: The FCC is not nearly as definitive in its proposal for allocation to digital audio broadcasting (DAB). Some spectrum would come from the 1429–1525 MHz segment. In the U.S., this would require moving aeronautical mobile test telemetry to other bands, possibly to 2310–2390 MHz. Further, the FCC proposal would allocate spectrum for DAB from the 2300–2390 MHz segment, most of which is currently dedicated to aeronautical telemetry. This proposal does not completely appeal to anyone, and further consultations are scheduled. TNX *Westlink Report, No. 613.*

SAREX STS-45 Hams

Ham astronauts Brian Duffy N5WQW, David C. Leestma N5WQC, and Dirk Frimout ON1AFD of Belgium are scheduled to fly on the STS-45 flight of the Atlantis this coming May 1992. Duffy will pilot the *Atlantis* on the seven-crew, eight-day mission. They will fly a high inclination orbit, much like those flown by Owen Garriott and Tony England (57 degrees, rather than the usual 28.5), therefore passing over most of the populated areas of the world, giving good coverage to hams on all continents. Altitude will be 160 miles. The astronaut hams will be restricted to battery powered FM voice operation on 2 meters.

As planned, this will be a CQ mission, meaning that there will be several attempts to work as many stations as possible. Some school contacts will be arranged, too. The SAREX Working Group plans to release the timetable and frequencies as soon as they are available. The mission's prime objective will be to use an Atmospheric Lab for Applications and Science that will be carried in an igloo in the payload bay. TNX *Westlink Report, No. 610,* and the *OSCAR Satellite Report, No. 232.*

The Dual-Combo Field-Strength and Source Dip Meter

Versatile test instruments for all your RF projects.

by Martin Beck WB0ESV

Most field-strength meters described in ham literature are coil-capacitor tanks with a diode and a meter. These FSMs are useful, but not sensitive enough for many jobs where the RF is not very strong. I frequently need something better, so I designed the device described here.

The most notable feature of this FSM is that instead of a DC amplifier, it uses an RF amplifier: a grounded-gate FET. After RF amplification, the signal is capacitively coupled to a diode voltage doubler whose output is fed to a 200 µA meter. For those who want the ultimate in sensitivity, a simple bipolar DC amplifier can follow the diode doubler.

More than 20 years ago I used such a system, but it was all bipolar. I took it to the annual Field Day operation of the W6LIE radio club. During a break in operation, I noted that my FSM's meter was reading up and down, but no local signal was being generated. I determined that the FSM was reading 15 meter *received* energy being reradiated from a 15 meter yagi at about 40 or 50 feet up!

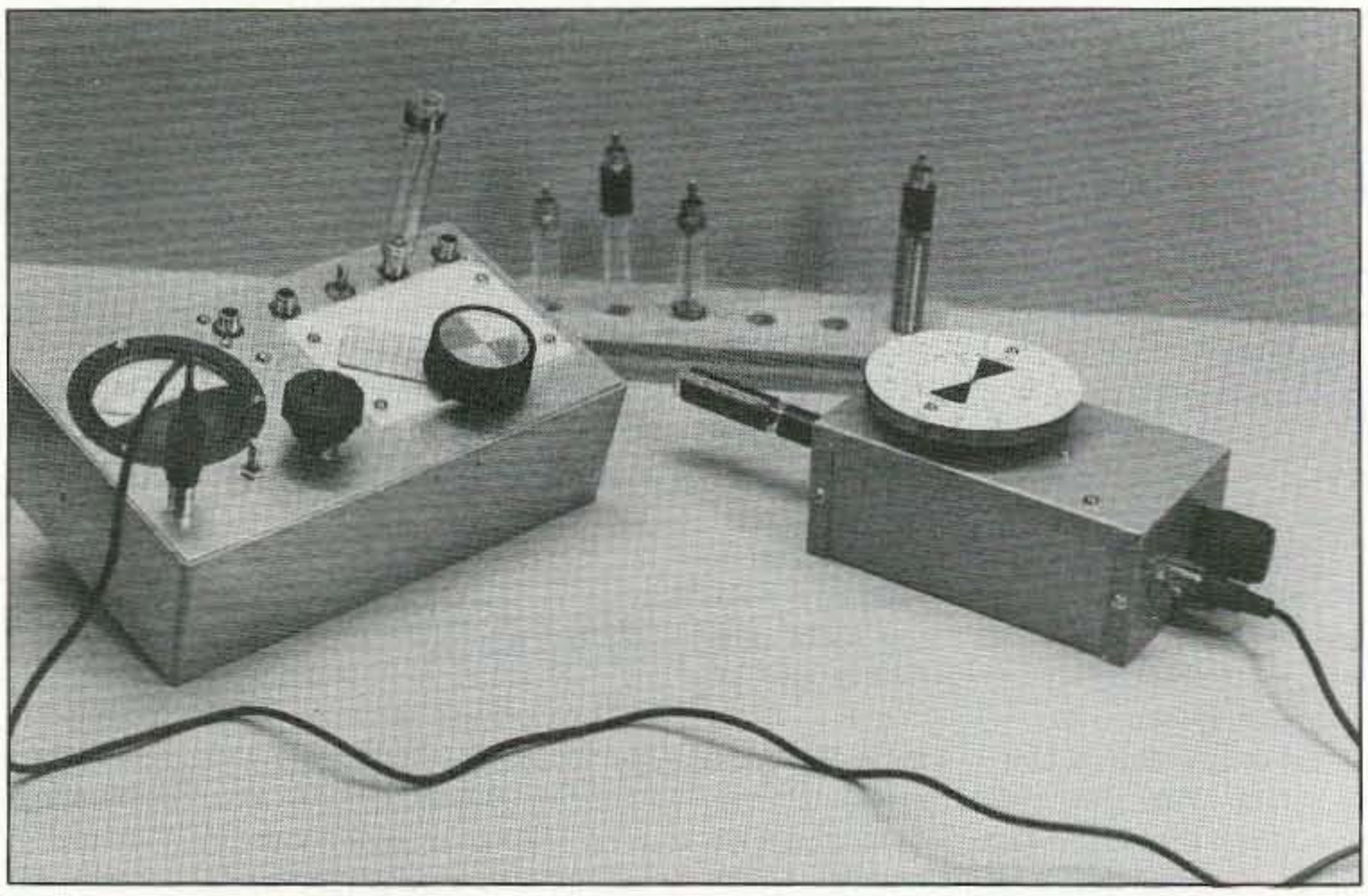

Photo A. The field-strength meter (left) and the source dip meter (right).

Construction Details

The device shown in Figure 1 uses three "tricks." First, the FSM uses the same plug-in coils as the source dipper described later in this article. Second, the dipper uses the FSM's meter. Third, switch S1 not only switches the meter from the FSM to the dipper, but also turns on the power for the FSM's FET when in the FSM meter position. The FSM uses two extra plug-in hairpin loop coils to extend its range a little bit.

Note that in Figure 1 the 365 pF air variable capacitor C1 is not shown. This was for the sake of clarity. C1 is on the opposite side of the board. Two bolts hold it to the board. Any broadcast capacitor will do (from a "junker" AM radio, for example)—just use one section. It does not have to be bolted to the board, but a short heavy lead should be run from its frame to the board. A thin brass strip ¼-inch or wider is good for this. You can often drill and tap a couple of holes for mounting it to the board.

Note that in Figure 1, J2, J3, J4, and J5, as well as S2, are mounted on a plastic strip. This is because these phono jacks must have both "sides" (i.e., both sheath and center pin) above ground. The plastic strip is bolted to the inside of the metal face plate and 0.375-inch holes are punched in the face plate to completely clear the phono jacks. The switch just went along for the ride, as it could have been mounted on the metal face plate.

Except for the meter, C1, and the RF choke, I bought all the parts at Radio Shack. The RF choke came out of an AM radio. Anything from 1 to 2.5 mH will do. The chassis box is known to Radio Shack as a "project box," and is about 7½" L x 4¼" W x 2.375" deep. A metal chassis box could also be used. The entire FSM is built on the metal face plate. Simply turn the plate upside down on the box and you will have a convenient holder while you do the work.

For a dial, I used a piece of typing paper held down by a piece of thin, clear plastic. Since the FSM uses the source dipper's plug-in coils, you need an RF source for calibrating the dial. Some signal generators will work. Other options are the use of a friend's dipper or, if you want only the amateur bands, transmit into a dummy load and hold the field-strength meter nearby. As a last resort, you can wind a second set of plug-in coils for the FSM and calibrate it with the source dipper.

Since both the source dipper and the FSM use the same meter, I opted for a 200 µA job. You can use a Radio Shack 50 µA meter (now discontinued), but it is so highly damped that its response is too slow to suit me when using it with the dipper. It does work, but a less highly damped 200 µA meter is better.

Note that most of the circuit is built using phenolic terminal strips. A printed circuit could be equally good.

In Figure 1 you can see that there are both a low band (J2 coil and J3 antenna) and a high band (J5 coil and J4 antenna). Since brass strips are used in conjunction with J4–J5, the inductance is lower, and the FSM's range can be extended. Only the two hairpin loops are used in the high band section. Either antenna can be a two-to-three-foot "spike."

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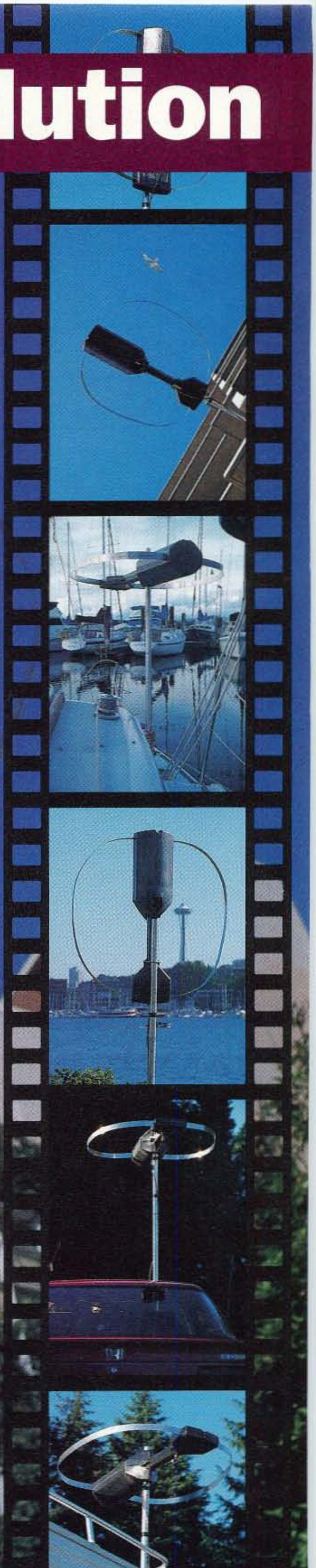

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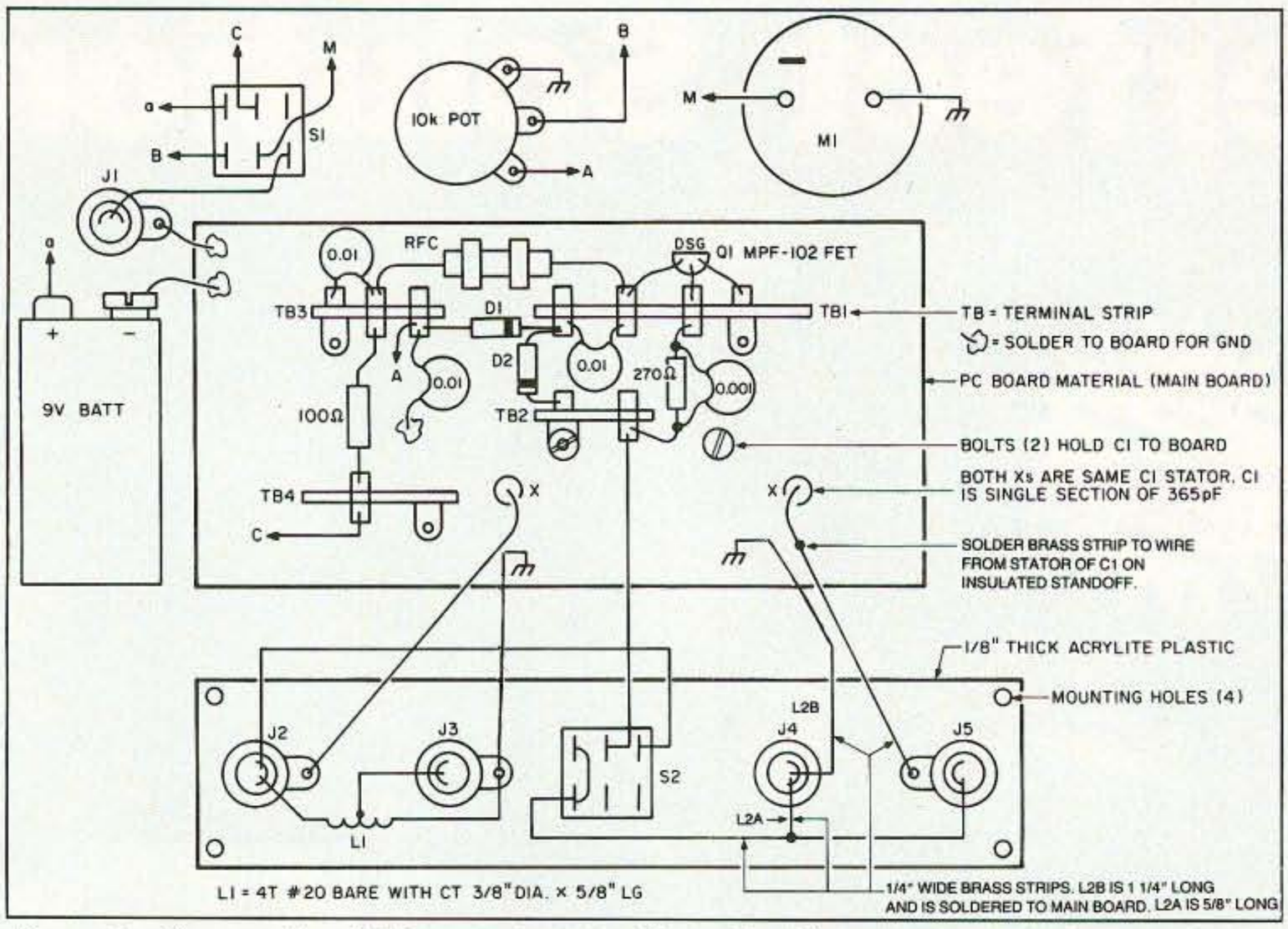

Figure 1. The sensitive field-strength meter. Note: For clarity, parts and subassemblies are shown only in approximate positions. J1 switches the meter to the source dipper. The shield lug of J3 is grounded to the main PC board as shown. Please note that the ground lead marked L2B should be a 1.25-inch-long strip of ¼-inch brass strip. L2A is ⅝" long. The points marked "X" are holes which pass insulated leads from the variable capacitor C1 stator.

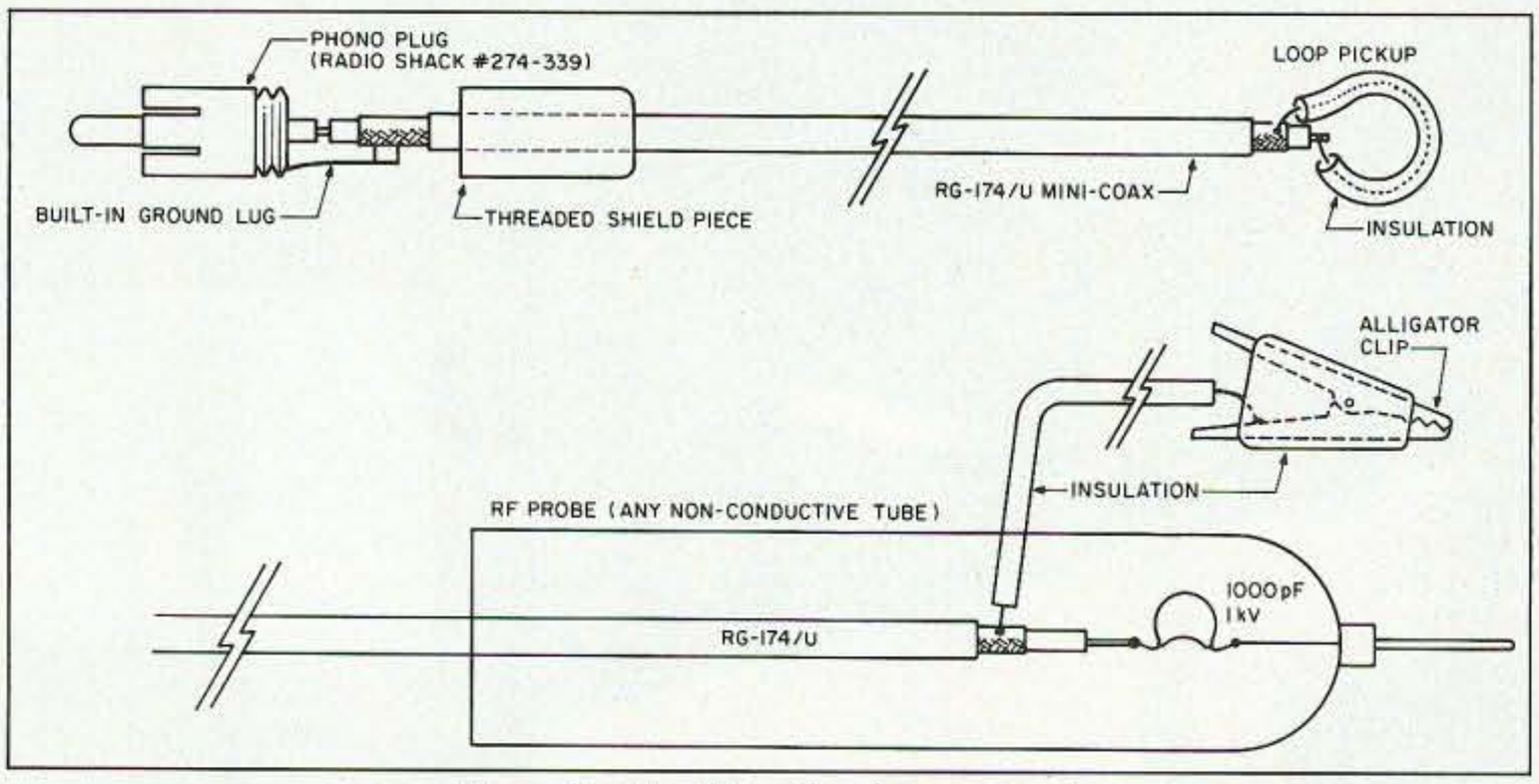

Figure 2. The RF sniffer (two options).

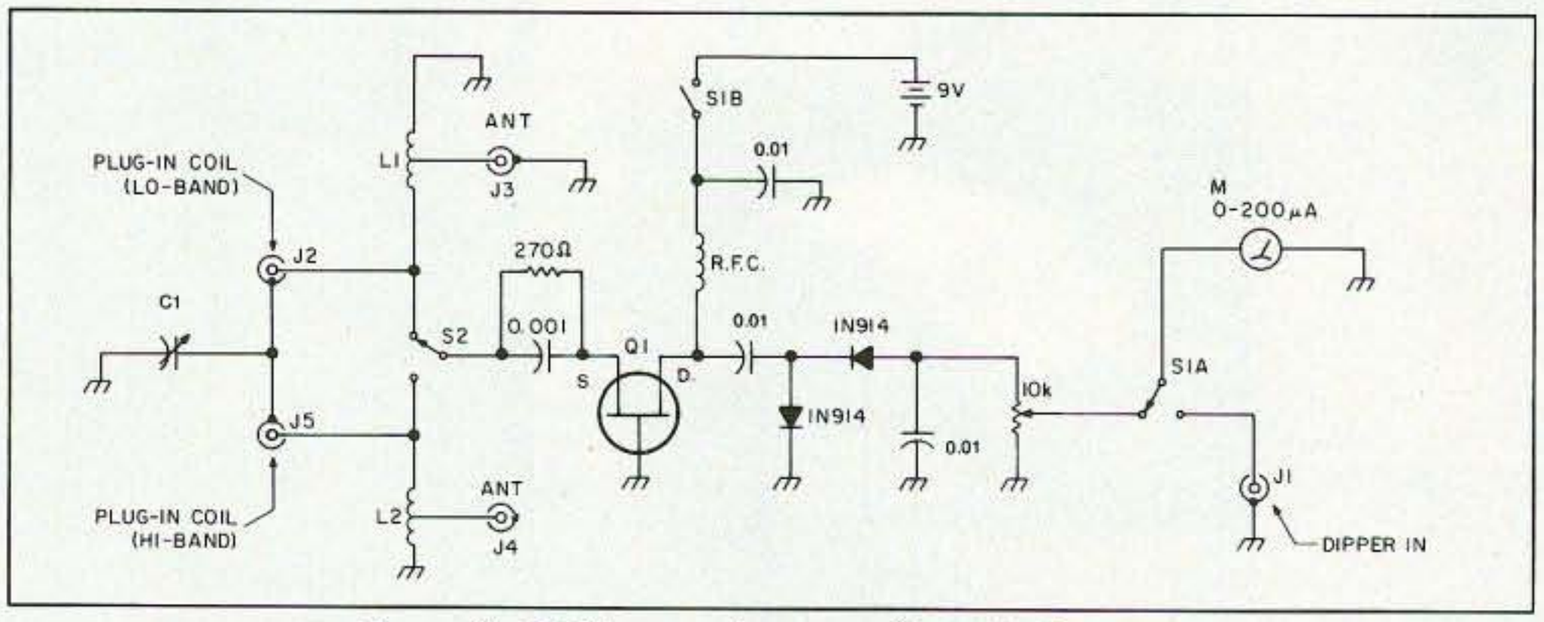

Figure 3. Field-strength meter schematic diagram.

To make a "hot-sniffer" out of the FSM, make a simple adapter, as shown in Figure 2. Using RG-174/U mini-coax, put a phono plug on one end and a small one- or two-turn loop from the center conductor to the braid on the other end. A second option here is an insulated probe that is capacitively coupled. Use a good high-voltage capacitor here! The braid should have a lead soldered to it with an alligator clip for a probe ground. Do not use a diode in the probe.

Since the meter, the 365 pF air variable, and the dial on my FSM were all "scrounged" or homemade, you will have to do the same (see the Parts List for a possible source of the capacitor). However, if you build the circuitry carefully on the plastic strip, the rest of the wiring is not the least bit critical. It is, of course, simply good practice both electrically and cosmetically to use short, direct leads whenever possible. Figure 1 does not show this, but that is because I used an exploded view for clarity. The 9-volt battery in Figure 1 is used only by the FSM; the source dipper has its own battery. Using separate batteries facilitates less switching and fewer interconnecting wires.

Make Your Tinkering Easier

Once you have the dipper and FSM built, operating, and on your workbench, you can investigate both active and passive circuitry. Large or small tank circuits can be checked with equal ease. Instead of repeatedly installing and removing a coil, you can get it right the first time with the dipper. The sensitive FSM will help you hunt down parasitics, check oscillators for output, verify that multipliers are working, sniff out RF leakage from the supposedly shielded chassis and... well—you will think of other uses, I'm sure. At any rate, this dipper and FSM combination will prevent a few gray hairs and add the most important item of all: having fun with your RF-oriented projects and/or troubleshooting!

The Source Dip Meter

A dip meter belongs on every ham's workbench. Before you install that tank circuit, the dipper will tell you what the tank's actual frequency is. A dipper will also ferret out "hidden resonances" for you. In a pinch, it can even be used as a signal generator. It can determine the frequency of antennas, and even the lengths of coax. The list goes on, making the dipper an extremely useful device.

This dipper uses a common FET as the active device and, aside from the variable capacitor and coils, it uses only one pot and six small parts. It uses the meter in the sensitive field-strength meter discussed previously, and shares its plug-in coils with the FSM. It is such a simple circuit that a beginner can easily build it. The only tools required are the usual ones: needle nose and diagonal pliers, a drill motor and a soldering iron. Except for the RF choke and the variable capacitor, all parts or suitable substitutes are available at Radio Shack.

If there is one glut on the market, it is the defunct so-called stereo, and this is where you can get the RF choke and variable capacitor. In fact, except possibly for the 10K pot, you will find all the other small parts in these old clunkers from the Orient. These little variable capacitors always have a number of tapped holes, so they are easy to mount. Just don't lose the original nuts and bolts—they are metric!

Some comments are needed regarding the variable capacitor. First, use a magnifying glass to determine whether the spacing of plates (rotors and stators) is the same on both sections. Take care because this difference in spacing will be subtle. The capacitor I used

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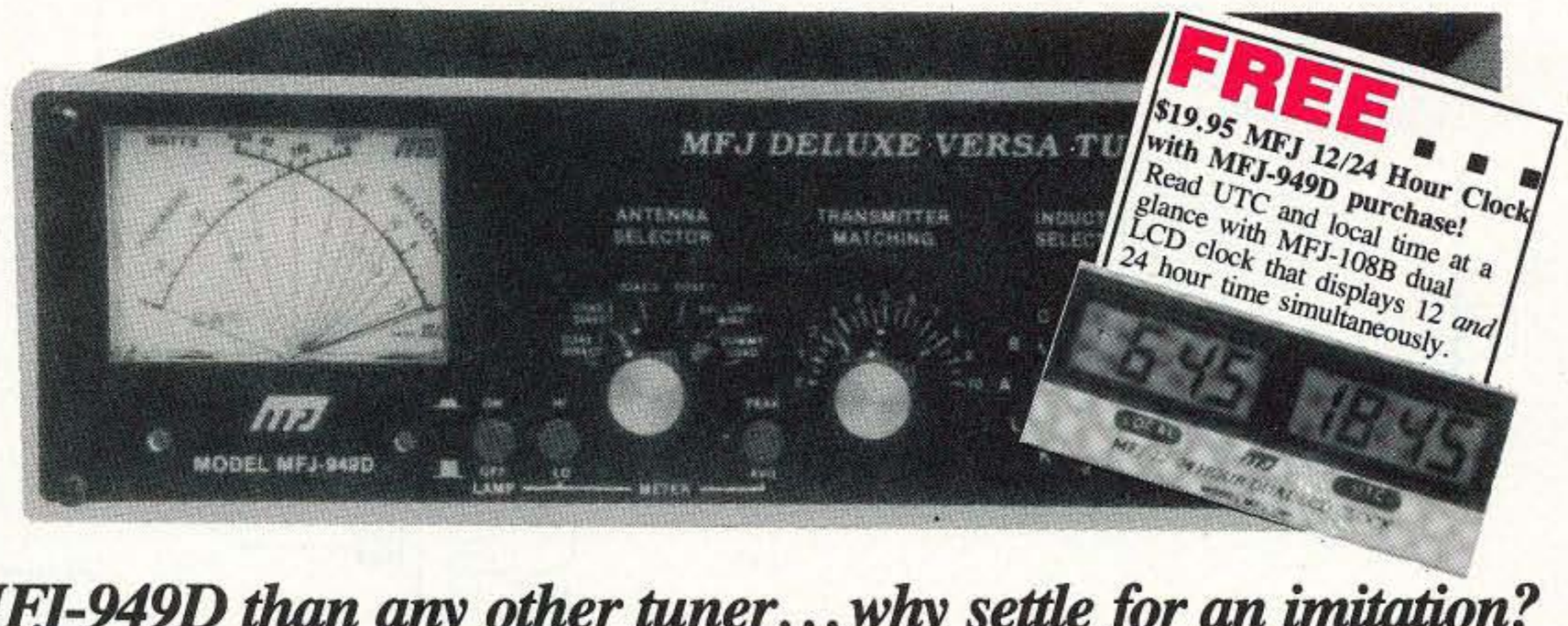

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Add $5 each shipping/handling;

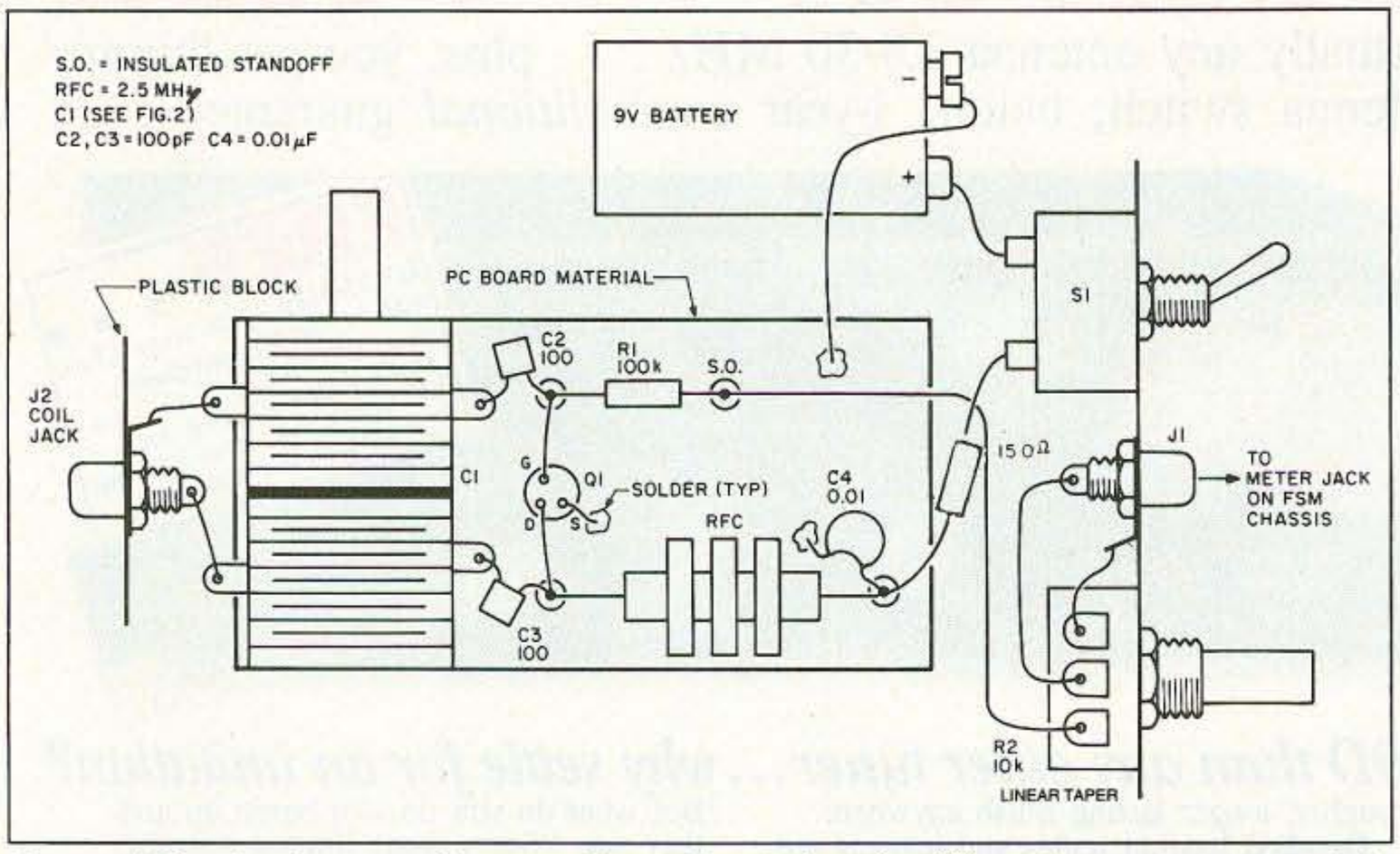

Figure 4. The simple source dip meter. Notes: For clarity, the off-board components are only in their approximate positions. The PC board is 3-9/16" L x 1-¾" W. The chassis box is 5-¼" x 3" x 2-⅛" (L.M.B. #780). J1 and J2 are Radio Shack phono types.

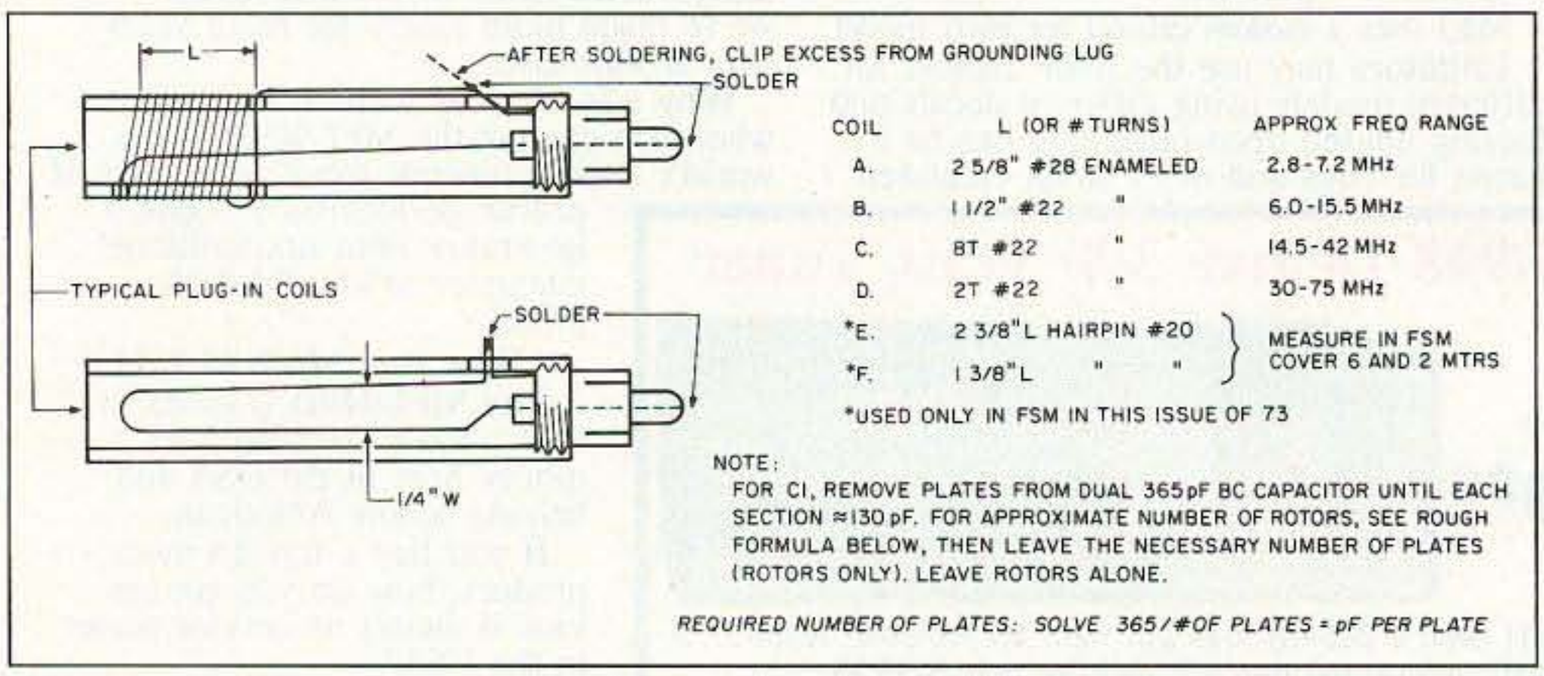

Figure 5. Dimensions of the coil forms. Note that coils E and F are used only for the field-strength meter. Use ½" o.d. Acrylite tubing (2-¾" long for coils A–E and 1-¾" long for coil F).

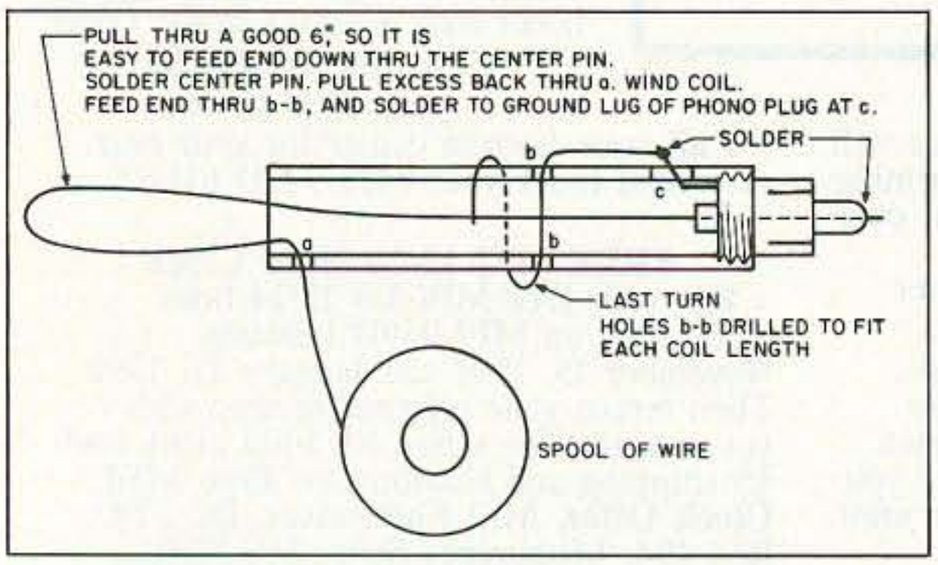

Figure 6. Winding details of the coil form.

required that only one plate be removed from the wide-spaced section, but seven plates had to be taken from the close-spaced section. The thing then becomes a dual 130 pF variable capacitor. If both sections are identical, you can use the approximate formula in the box in Figure 2. Above all, don't be concerned about hitting the 130 pF value on the nose; anything in the range of 100 to 150 or so will do just fine. *[Ed. Note: If you use the Antique Electronic Supply variable capacitor # CV-471, you need only use two of the three sections with no modifications; their model CV-240, although smaller, requires you to remove several plates in each section.]* This is because you have to calibrate your own dial, anyway. Exact ranges can be obtained by adding or removing turns on the plug-in coils. Have no fear—this is all very easy. By the way, you can remove or simply ignore the two small FM sections of these variables. I just bend their stator tabs down and solder them to the PC board as a board mounting method. If you remove those outer FM rotor plates, there is room on the front of the frame to drill and tap mounting holes (in case you did lose those metric bolts).

The plug-in coils use phono plugs, and both sides of the plug must be above ground. Therefore, I punched a 0.625-inch hole in the coil end of the mini-box to clear the phono jack. The latter is mounted on a 1½" x 1½" piece of acrylite plastic. When bolting on the plastic, be sure the phono jack is centered in the 0.625-inch hole, so the outer conductor of the jack is not grounded. Radio Shack's phono jacks come with a "grounding" lug. It is used here as a tie point for one side of the wires from the two sections of the variable capacitor, as is clearly shown in Figure 1.

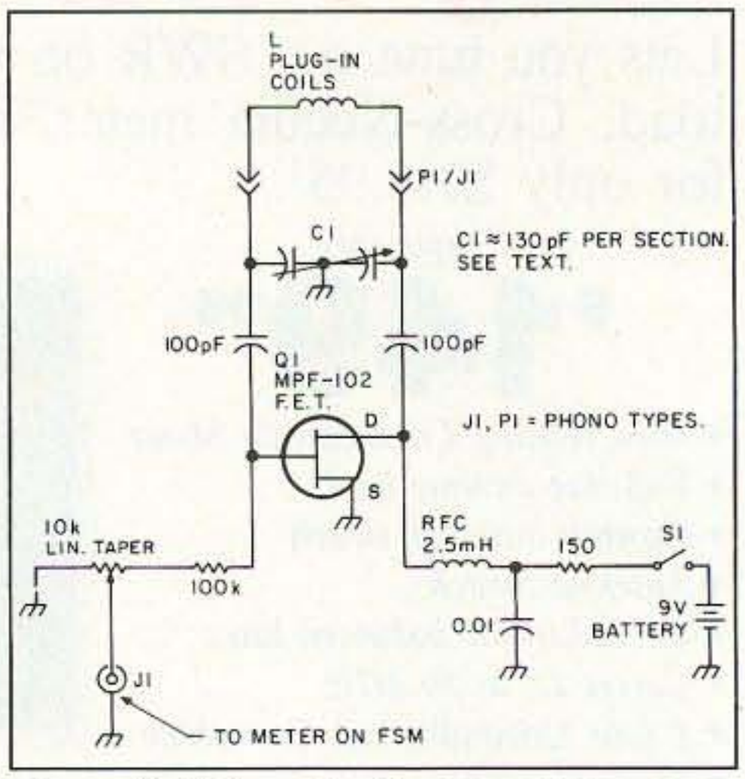

Figure 7. Schematic diagram of the source dip meter.

Wiring

For wiring the board, I used tiny insulated standoffs (phenolic terminal strips could be used as well) and a FET socket (optional). Of course, the ultimate way to go is to just etch a little printed circuit. The way I see it, you would only need six "islands," and they could even be located where my standoffs are! A small Z-shaped clip can hold the battery in place. See Figure 1 for details.

For the dial, I used a disc of ¼-inch thick acrylite clear plastic. The original knob on the capacitor had a brass insert with a setscrew, so I shattered the plastic off of the insert, then epoxied the insert into the plastic dial. No knob is used; the dial itself *is* a knob and offers superior control when tuning.

To achieve "one-hand" operation, a ¼-inch wide strip of coarse sandpaper is epoxied to the edge of the dial. The dial has a pair of 4-40 nuts and bolts 180 degrees apart on the outer rim, to hold on a piece of white poster board for the actual calibration marks. Use a friend's dipper or your own receiver to calibrate the dial. Do not try for too many numbers, i.e., 7.05, 7.06, etc. Use numbers only on every 1 to 5 MHz, and suitable marks between, for example: 7.0, 8.0, etc. Use pencil lightly for calibration. Then remove the poster board only—not the plastic dial. With the poster board removed, it is far easier to ink over the light pencil marks. If you use India ink, here's a little trick: Use black for all frequency marks except the amateur bands; use red for these bands. Then when your buddy borrows your dipper (and refuses to return it), he will find it easy and quick to use.

Winding the Coils

I used ½-inch Acrylite plastic tubing for the coil forms. See Figure 5 for dimensions for each frequency range. Note that all coils are used for the field-strength meter. However, coils E and F are not used for the dip meter. After cutting each coil form to the desired length, I drilled a 3.16-inch hole in the side of each coil form about ⅜-inch from the plug end. Now drill 1/16-inch holes at "a" and through the tube at the points marked "b," as shown in Figure 6. Holes "a" and

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"b" mark the beginning and end of the coil itself. Hole "a" is drilled about a ¼ inch from the top end of the coil form in each case. See the chart in Figure 5 for the dimensions for each coil.

Next, mount an RCA phono plug in the end of each form. Use only the Radio Shack plug (RS# 274-339) with the metal shield. Remove the shield and toss it. Next, dab some epoxy on the threads of the plug and place it securely into the end of the coil form with the ground lug sticking through the hole in the side of the form as shown in Figure 5.

After the epoxy has set up, you're ready to wind the coils according to the chart in Figure 5. First, route the wire down the center of the coil form, through the center conductor of the phono plug, and solder it in place. Figure 6 shows the winding procedure. The last turn passes through the holes marked "b" and pulled down to point "c" and soldered in place on the phono plug's shield lug. Be sure to cut off the excess grounding lug. Being careful not to short the lug to the center pin, push the lug in a bit until it is about flush with the outside of the tube. It can be pried in and out several times without breaking. Once the coil winding is adjusted to the range you want, you can slip some heat-shrink tubing over the lower (plug) end, or for that matter, over the entire coil. Once the wire is fed through holes B–B, pulled tight and bent down to the plug's ground lug, the coil will not unravel. The dipper coils are all close-wound. You should use the #28 enameled wire for the lowest band's coil, but you can substitute #22 enameled wire for the #21 I used (because I had it). Note that, except for the lowest band coil, a few extra turns should be used as it is easier to remove than add turns when adjusting frequency. Be sure that when the coils are finished, there is overlap of the ranges. For example, the lowest frequency of coil C should be lower than the highest frequency of coil B. I always try to keep all of an amateur band on one range, to avoid having to plug and unplug coils.

My dipper is stable, easy to use, and gets more use than my old 110V Millen dipper. The source dipper has its own "power supply" and can go anywhere. Once you have one, you will wonder how you ever got along without it.

One note: Make sure you use the proper size of Acrylite tubing (½" o.d.) that will mate with the phono plugs. For the location of an Acrylite distributor, you can call Cyro Industries at (800) 223–2976.

If you can't find a source of the tubing, I can supply a full set of pre-cut and drilled coil forms with phono plugs permanently installed (send to address at end of article). These forms are suitable for many other purposes than these two projects. The package includes a pre-cut and drilled acrylite plate with the coil's jack permanently installed. The set is $39.95, including postage. If you can do your own drilling and epoxying-in of the phono plugs, the set of coil form parts is $29.95, including postage. 73

Contact Martin Beck WB0ESV at 1637 Hood, Wichita KS 67203.

Field Strength Meter Parts List

Q1	MPF102 FET (RS# 276-2062)
D1,D2	1N914 diode
S1,S2	SPDT switches
R1	10k panel mount potentiometer
R2	270 ohm resistor
J1–J5	RCA phono jacks (RS# 274-346)
RFC	1 to 2.5 mH RF choke (Antique Electronic Supply #PC-1535B)
TB1,TB2,TB3	2-terminal strips
TB4	4-terminal strip
BT1	9-volt battery
L1	4 turns #20 bare wire with center tap (⅜" diameter by ⅝" length)
L2	¼" wide brass strips mounted as shown in Figure 1
M1	200 µA panel meter
C1	365 pF variable capacitor (from AM broadcast radio or Antique Electronics Supply #CV-230)
C2	0.001 disc ceramic capacitor
C3,C4,C5	0.01 disc ceramic capacitor
Misc.	Case, mounting hardware, a ⅞"W x 4⅞"L Acrylite support plate (⅛" thick) and a 2"W x 4"L piece of single-sided PC board material for mounting components

Source Dip Meter Parts List

Q1	MPF102 FET (RS# 276-2062)
RFC	2.5 mH RF choke (Antique Electronic Supply #PC-1535B)
C1	Dual section 150 pF variable capacitor (Antique Electronic Supply #CV-900 or #CV-240)
C2,C3	100 pF ceramic disc capacitor
C4	0.01 µF ceramic disc capacitor
4	insulated standoffs
J1,J2	RCA phono jacks, RS# 274-346
R1	100k resistor
R2	10k potentiometer
R3	150 ohm resistor
S1	SPST switch
BT1	9-volt battery with clip
6	RCA phono plugs (for coils), RS# 274-339
Misc.	Battery clip, PC board material for mounting components (1¾"W x 3½"L), small plastic block (1.5" x 1.5") to support J2. ½ inch diameter Acrylite tubing for the coil forms. Lengths of #28, #22 and #20 wire for the coils.
Source:	C1 and the RF choke for both the Field Strength Meter and the Source Dip Meter are available from Antique Electronic Supply, 6221 S. Maple Ave., Tempe AZ 85283. Phone (602) 820–5411.

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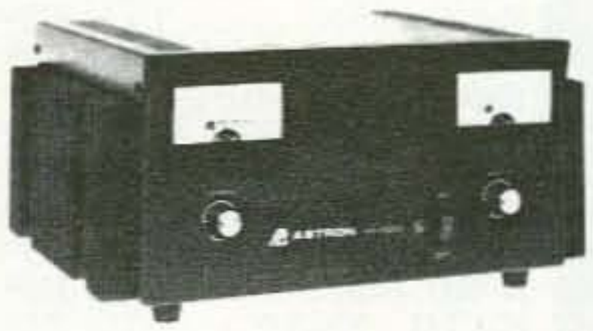

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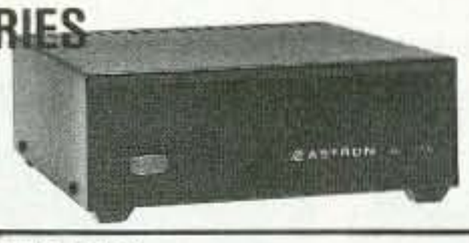

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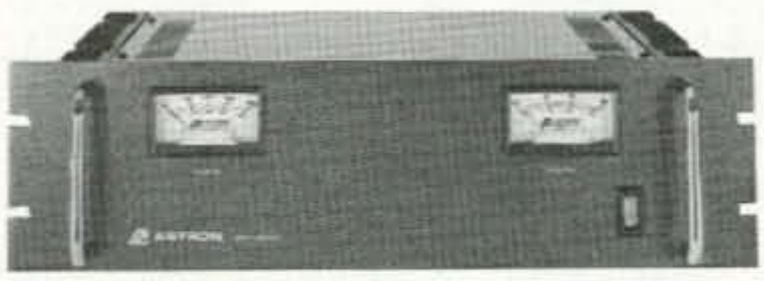

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RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

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MODEL RS-7A

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RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46

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VS-50M	37	22	10	50	6 × 13¾ × 11	46
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MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
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RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18

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

CIRCLE 16 ON READER SERVICE CARD

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. These numbers correspond to those on the feedback card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like. To show our appreciation, we draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

To save on postage, why not fill out the Product Report card and the Feedback card and put them in an envelope? Toss in a damning or praising letter to the editor while you're at it. You can also enter your QSL in our QSL of the Month contest. All for the low, low price of 29 cents!

Feedback# Title

1 Never Say Die
2 QRX
3 Letters
4 Dual-Combo Field-Strength and Source Dip Meter
5 Safety Power Breaker For The Test Bench
6 Improved Crystal Tester
7 Book Review: Secrets of RF Circuit Design
8 Review: The Standard C168A Handheld
9 Build a Function Generator
10 Review: The Ventenna
11 One Desert Storm MARS Experience
12 A Direct-Reading Linear Inductance Meter
13 Use Those Surplus Meters
14 Hams with Class
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29 Propagation

Safety Power Breaker For The Test Bench

Avoid a shocking experience.

David McLanahan WA1FHB

When setting up a test and service bench, safety often gets short shrift. Most of our equipment, both test and working, operates from potentially lethal 117-VAC. To coin a cliche, "familiarity breeds contempt." Even neglecting the hazard to life or limb, the only way to limit further damage to equipment in a memorable minority of failures is to remove all power from the circuit RIGHT NOW. Yet, many service benches are cat's cradles of power and signal connections with a maze of switches and controls—certainly not conducive to fast, effective emergency action when something unpleasant starts.

The Big Three

The most important attack on this problem is forethought. As in defensive driving, you must tinker defensively. Observe the following three rules:

1) Set up hypothetical danger situations and come up with responses to them ahead of time. "What do I really need to do fast if something happens?"

2) Know who plugs into what in a specific test setup, and how both AC and DC are fed to the various units involved.

3) Know the location of the "most definitive" OFF switch; how to reach it; and, ensure a clear path to it. Check this often, particularly when working with new, partially defective, or questionable equipment.

The Added Edge

This thinking is more valuable than any hardware, but there is a hardware device to help—a safety-wired 117-VAC relay or "contactor" whose coil is powered from its load side with several normally-closed (NC) "panic" switches in series (see figure). With this configuration, opening any one (or more) of the panic switches, even just momentarily, will turn off the current solidly, and you have to intentionally reset the system to restore power. (Of course, this will not disable such sources as batteries or big capacitors on the bench . . .)

To get the benefit from this device, be sure that it is the sole power source for all equipment on the bench, especially for any dubious units you are working on. You don't want it to serve any room lighting. All you need is to have something exciting happening with, perhaps, a small fire starting, and then find yourself in total darkness!

The panic switches can be any normally closed types, either momentary or sustained (I prefer momentary so I don't have to check them to reset), rated for 117 VAC at the coil current. Suitable examples are some nice big red-button industrial ones that sometimes show up on old equipment in junk yards.

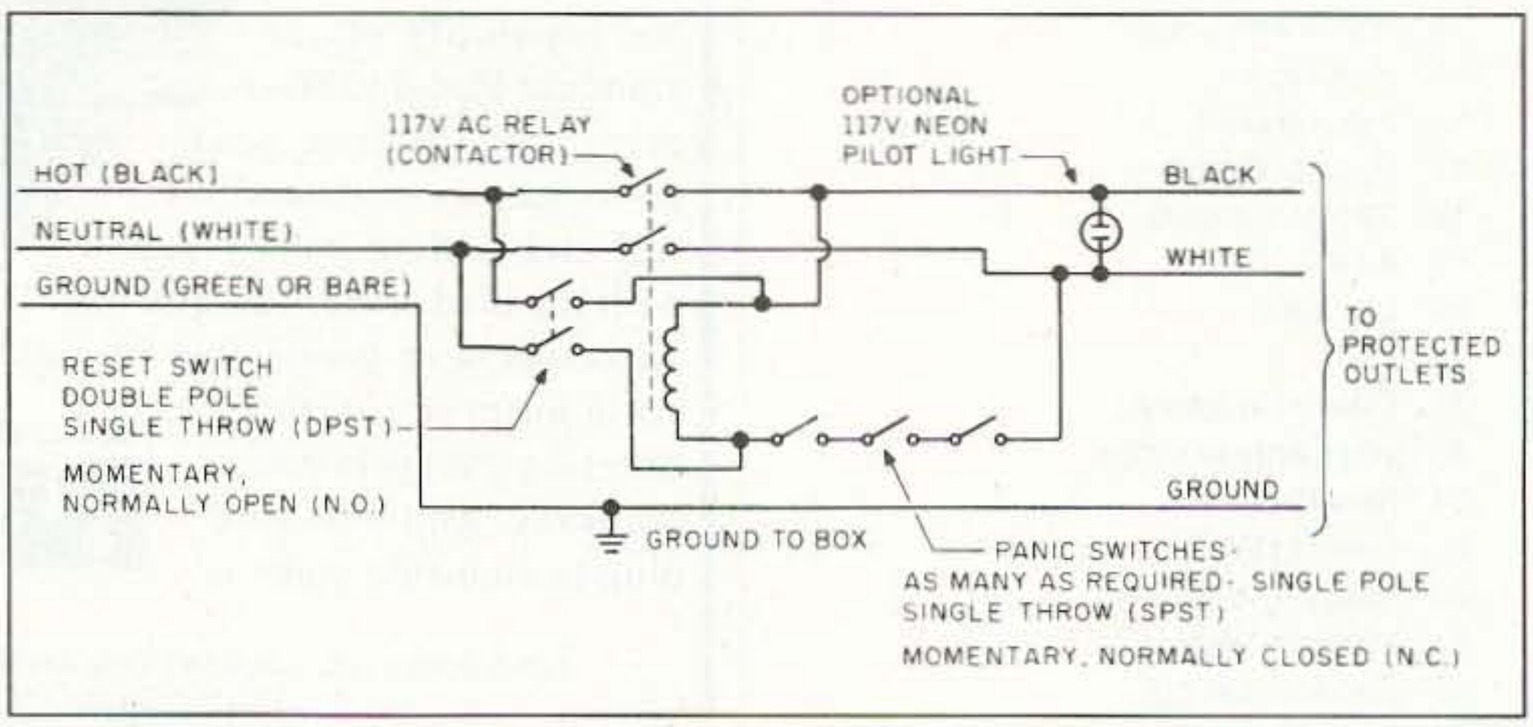
Where To Put the Switches?

Give thought to where and how to mount the switches. One or two should be easily accessible but slightly protected on the test bench. I'd put one—large, obvious, and completely unprotected—just inside each door to the room. It's also possible to have a switch on a hinged pipe "kick bar" along the length of the bench. Don't forget to explain the system to family, co-workers, or technical guests, so they can activate it if they witness a problem while you have your hands full of probes. The reset switch, on the other hand, can be in an obscure place, perhaps on the relay box, and well protected.

Because of the cost of new contactors, you may want to look for a used one at a hamfest or tag sale. There's nothing critical about it, but if you have a choice of several, energize the coil of each and pick the quietest. Some of them make quite a buzz. To determine the required current capability, add up all the loads you might ever want on-line at once and double the figure to find a reasonable minimum capacity to look for.

When you find a unit, check out the contacts for pitting, and check the coil voltage on the label. If it's not 117-VAC, you'll need a small transformer to power it. There are many nice little solid-state AC switching modules that would work nicely here. In this application, however, it's a good idea for the power circuit to be physically broken by an air gap.

Both for safety and to conform with the National Electrical Code, mount the relay in a sturdy metal box (called a "NEMA" box), available from your local electrical supply outlet. The input power can be taken from



The safety-wired 117-VAC relay or "contactor." Opening any one (or more) of the panic switches, even just momentarily, turns off the current.

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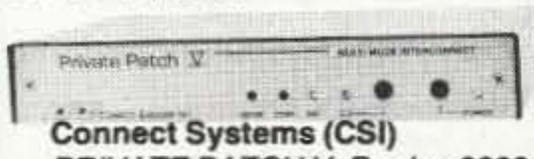

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any unswitched 117-VAC outlet (or hard-wired) and goes only to the the relay input contacts and the reset switch. Connections from the relay output contacts fan out to the protected outlet boxes and other equipment, as well as back to power the relay coil.

In doing this wiring, preserve the color code (black and white) through the relay contacts. In other words, when the relay is closed, make sure that the black wire going in connects to the black wire (and not the white) coming out. The ground wire (either bare copper or green insulation and connecting to the round ground pin on the power plugs) is never opened by the relay. It connects solidly to the relay box as well as to the ground connections to the outlet boxes.

There are several other enhancements you can provide for your power distribution system. The cheapest and simplest would be three GE Metal Oxide Varistors, MOVs, that will peak-limit damaging high-voltage transient spikes on your household power line. The next enhancement would be line filtering—reducing some of the high-frequency (but lower voltage) garbage on the line.

Another safety enhancement would be a ground fault interrupter (GFI) that would disconnect the power if it found current returning through the green or bare ground wire. The last enhancement is to fuse- or circuit breaker-protect, according to the dictates of your conscience. Fuse and breaker protecting is another whole subject, but there's a small tip I'd like to insert here: Most of the breakers available from local electrical suppliers are thermal with large ampacities, intended to prevent fire in the household wiring. Electronic and surplus sources are apt to have magnetic breakers (faster acting) in smaller ampacities. I devote an individual fuse or breaker to each major piece of equipment that normally resides on my test bench.

Unless I don't want the unexpected shutdown of a piece of equipment, I'll fuse- or breaker-protect it at about 110% of its current rating, rather than the more customary 150 to 200%. That way, in the event of a problem in the protected equipment, the fuse or breaker will pop as a warning before the smoke starts, and there may be less secondary damage.

The "self-fed" contactor scheme outlined here has one additional benefit: Most modern electric power distribution systems (electric companies) use "reclosers." These are sophisticated circuit breakers that, on experiencing an overload and opening, automatically "try again" several times, reapplying power to see if the fault might have cleared. The problem with this for us is that the repeated switching of the electricity off and on can be stressful to many kinds of electro-mechanical devices. With the self-fed contactor, your equipment will not be subjected to the retry switching; it will go off on the first failure, and stay off until you reset the contactor.

Safety may not be an interesting or exciting topic as ham radio endeavors go, but along with increasing our ranks by selling ham radio to new converts, it pays to protect the hams we already have. 73

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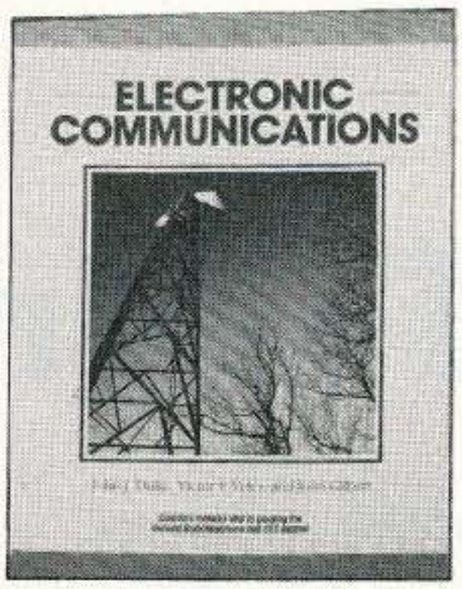

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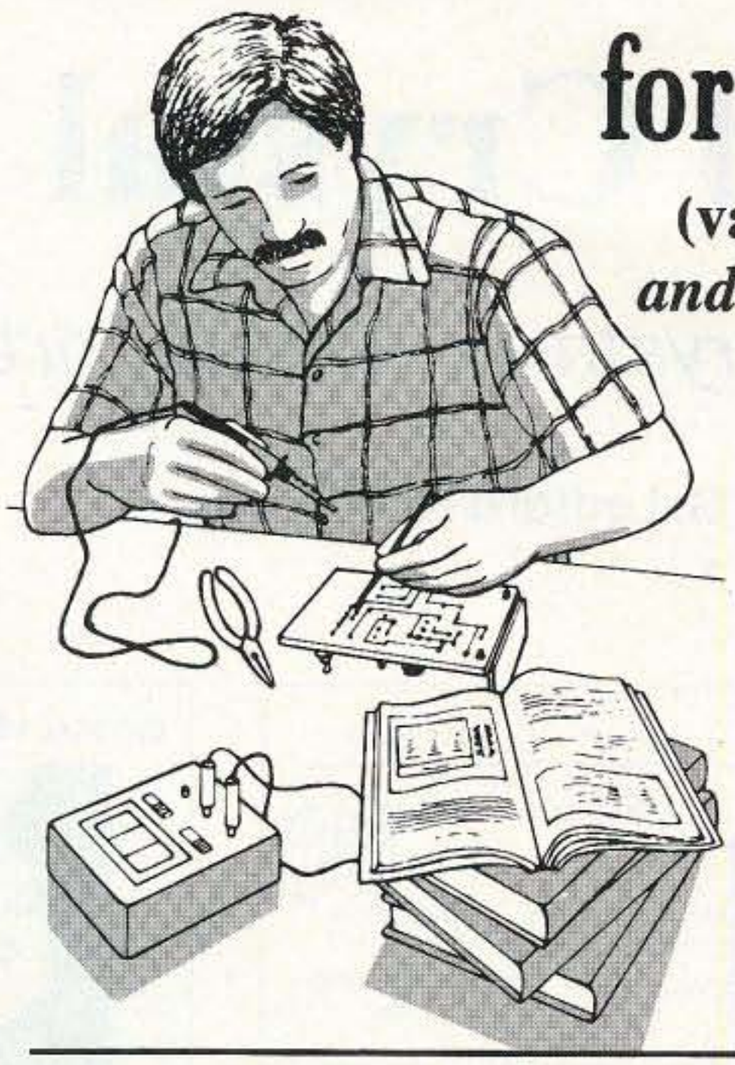

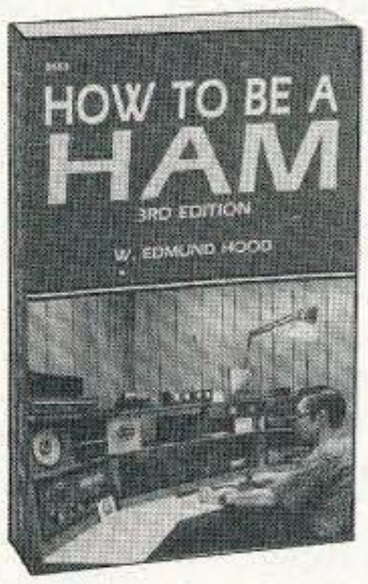

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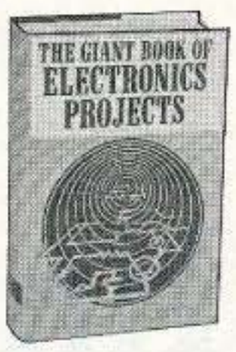

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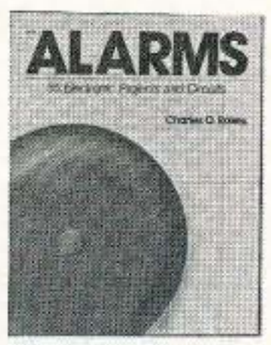

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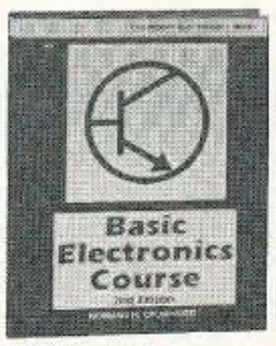

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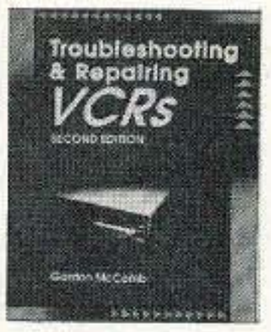

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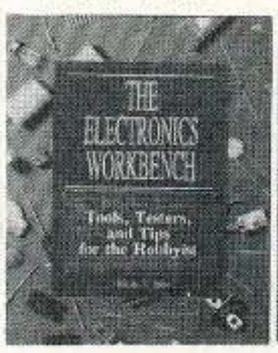

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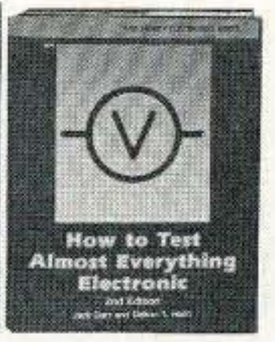

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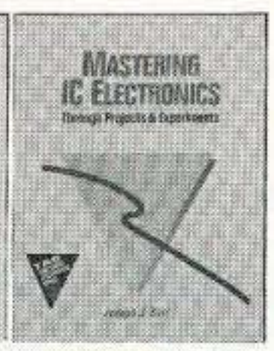

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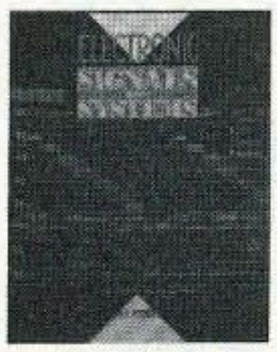

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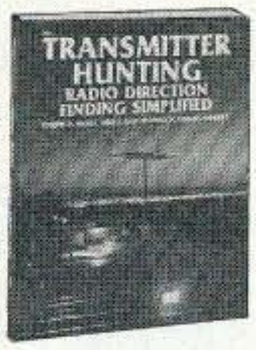

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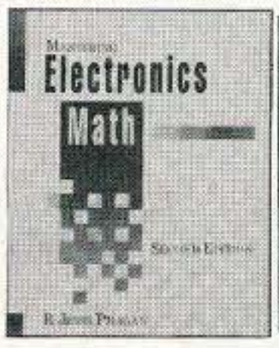

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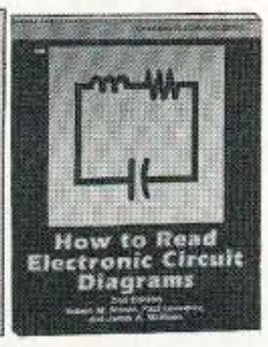

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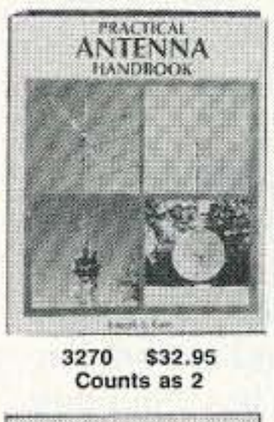

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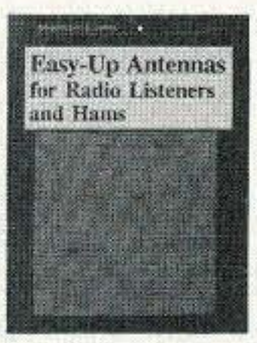

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CIRCLE 128 ON READER SERVICE CARD

An Improved Crystal Tester

Check out those surplus crystals with this portable circuit.

by Larry G. Ledford KA4J

Wayne Green's book *Practical Test Instruments You Can Build [currently out-of-print]* contains a very useful circuit for a crystal tester developed by Mike Kaufman. It's a good, simple, portable and very handy test item. But with a few modifications it can be made better.

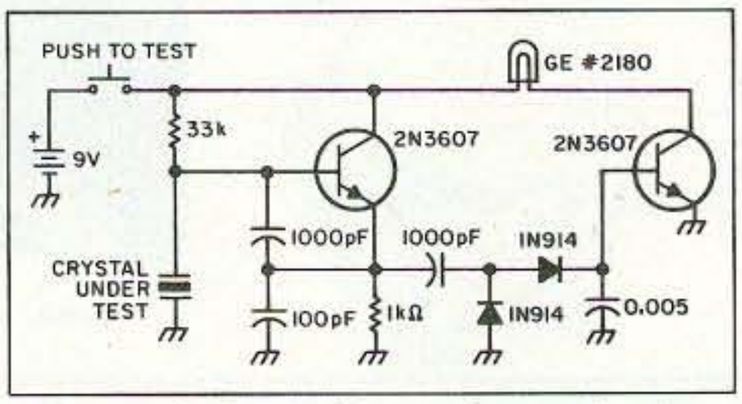

Figure 1. Original crystal tester circuit.

Modifications

See Figure 1 for the original circuit. If you are building this from scratch, be advised that plastic 2N2222s (the ten-for-a-dollar at any hamfest variety) will work very well in place of 2N3607s.

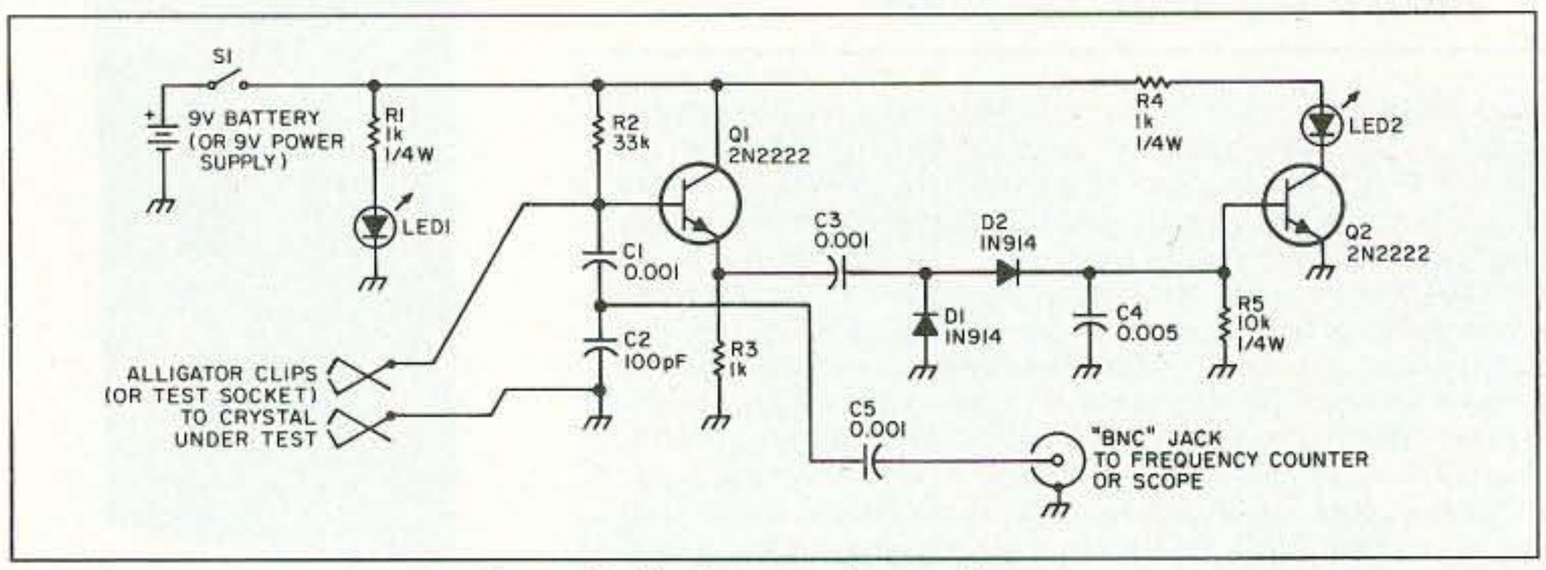

Figure 2. The improved crystal tester.

The first change is to replace the incandescent bulb used for a go/no-go indicator with a light-emitting diode and current limiting resistor. When I did this, the LED switching transistor would "latch" on so I added a 10k resistor from base to ground for a cure. Apparently the transistor had sufficient bias to turn off the higher current of a bulb, but would allow a lower current LED to stay on.

The next mod is to add another LED and resistor to act as a very simple battery indicator. If the battery were low (or dead), you'd never get a "good" crystal indication and you might discard a non-defective crystal. If the power LED lights but the crystal's "good" LED doesn't, you can assume the crystal is bad! Although you could mount several different crystal sockets on your tester, I used two alligator clips on short leads that will fit any crystal.

The last modification is to add a capacitor and BNC connector so that a counter or scope can be hooked to the oscillator for rough frequency checks. Bear in mind that this circuit will not be the same as the circuit that the crystal will be used in, so the frequency will be different. However, it will give you an idea of where you are.

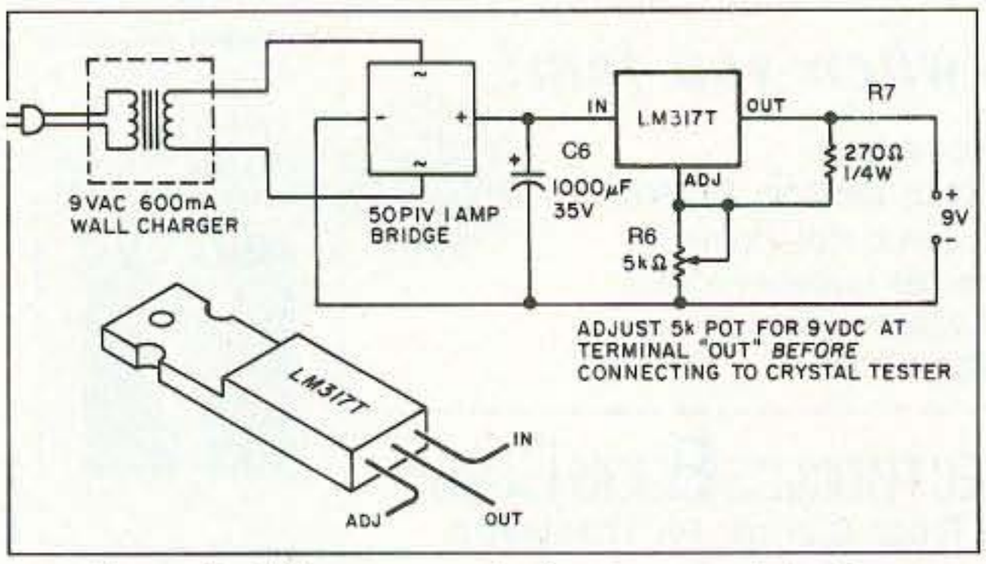

Figure 3. AC power supply for the crystal checker.

Due to the lack of any tuned circuits, third overtone crystals will oscillate on their fundamental frequency. It may take some work with pencil and paper to see exactly what frequency a receive crystal is on. You can also plug a short antenna or wire into the BNC jack to loosely couple it to your receiver.

Figure 4. PC board foil pattern.

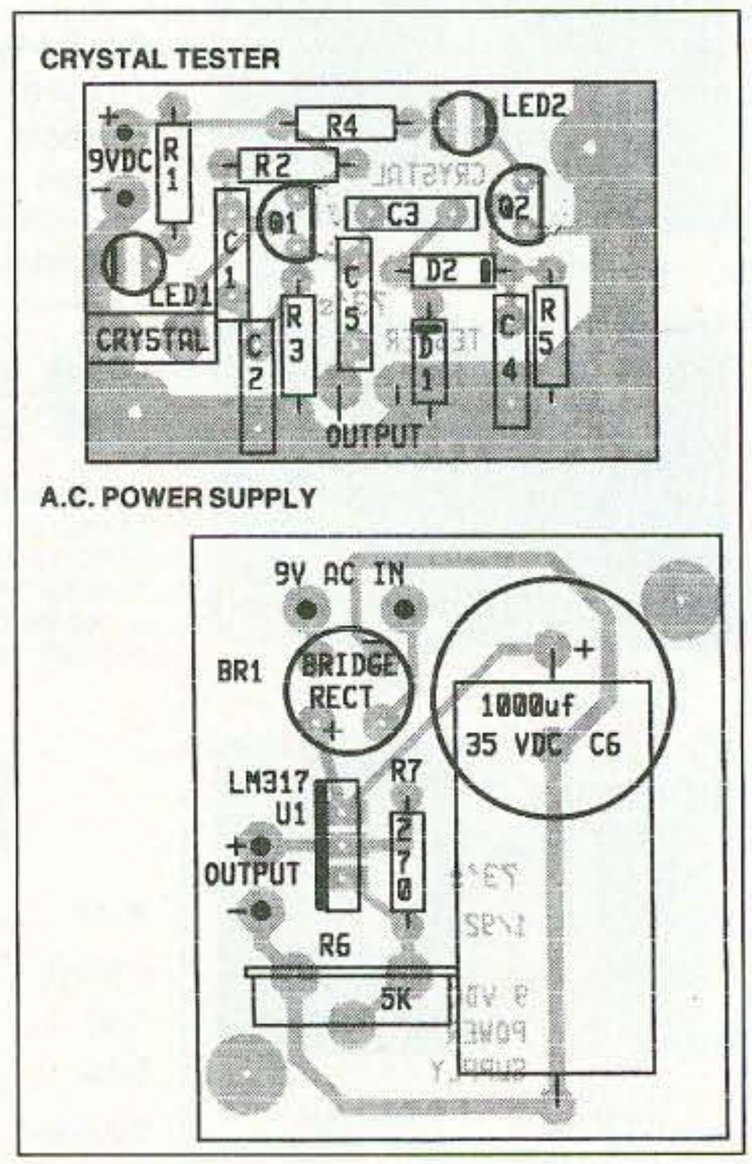

Figure 5. Parts placement.

Continued on page 26

73 Book Review

by Brian Robinson N3GDE

Secrets of RF Circuit Design

Secrets of RF Circuit Design
by Joseph J. Carr
First Edition, 1991
TAB Books
Blue Ridge Summit PA 17294-0850
Hardcover, 405 pages
Price Class: $20

The name Joseph J. Carr should be a familiar one for any frequent reader of electronics magazines. Mr. Carr has a new book out that is an excellent introduction and reference for anyone interested in radio.

Secrets of RF Design was written to remove some of the mystery from a field that has often involved a lot of "black magic." Mr. Carr has documented many of the practical design and construction practices required to make circuits work at RF frequencies. The book is full of the required theory, but it also includes many practical hints and procedures that can mean the difference between a circuit operating or not operating.

The book begins with an introduction to RF electronics, and starts with explanations of the factors that cause circuits to operate differently at RF frequencies, such as stray inductance and capacitance, the skin effect, and stray coupling. There is plenty of material on variable capacitors, varactors, and inductors, as well as design and construction information for building your own inductors and RF/IF transformers. Hams and shortwave listeners will be especially interested in the mechanical filter IF amplifier project.

There is ample information covering receiver and preselector circuits. This information is especially suited for people who want to design and build their own receivers, but it is also appropriate for anyone who wants to learn more about how receivers work, and the advantages and disadvantages of various features. As the author states, the material presented will allow you to successfully "roll your own" designs.

Not Just Circuits

The title of the book is somewhat misleading. While there is plenty of the circuit-level material as described above, there is also a lot of RF systems-level material, including chapters on propagation, interference, antenna design and construction, emergency antennas, frequency drift problems, and lots of information on test procedures and equipment. Those interested in older equipment will find several chapters on choosing and rehabilitating old receivers, transmitters, and signal generators.

There is a great deal of information oriented towards service and troubleshooting, including simple build-it-yourself signal generators and an RF noise bridge, and a whole chapter on alignment techniques.

Plenty of information is included for UHF and microwave fans. Three chapters are devoted to microwave diodes and negative resistance devices, UHF/microwave transistors, and UHF/microwave ICs.

The level of the material spans a wide range. Some of the material is presented on a very basic, introductory level, and much of the text is very straightforward and practical. However, other sections, particularly those covering negative resistance devices and propagation, are quite advanced. Readers will encounter a pleasantly wide variety of both practical and theoretical information.

Interesting historical information is presented both on its own and to illustrate various technical topics.

The book also devotes a separate chapter to the W4UCH "Poor Man's Spectrum Analyzer," and provides useful information for anyone who has or is considering one of these interesting pieces of equipment. There are also chapters on building your own time-domain reflectometer, and on a frequency counter module that the author finds especially useful.

The book presents a broad range of useful material. It is appropriate for anyone who wants to design and build his or her own radio circuits, repair and refurbish old equipment, or who just wants a better understanding of the circuits, features and systems used in radio communications.

The book includes a chapter of BASIC antenna programs for antenna design. The programs are also available on disk from the author. 73

Secrets of RF Current Design *is available from Uncle Wayne's Bookshelf.*

73 Review

by Gordon West WB6NOA

Standard Amateur Radio Products, Inc.
P.O. Box 48480, Niles IL 60648
Tel. (312) 763–0081
Price Class: $345

The 200-Channel Standard C168A Handheld

Lots of options in a small, small package.

Photo A. The Standard C168A.

Standard VHF and UHF transceivers are back. The "Standard" name may be new to you, but Standard Communications, a Division of Marantz Japan, Inc., has been building quality VHF and UHF ham, land, and marine transceivers for over 25 years.

In fact, it was 22 years ago that this author introduced the ham community to the world's first Japanese-built, 2-meter, 5-channel, crystal-controlled handie-talkie. What a weekend to remember—everybody with a Motorola HT-220 thumbing their noses at this Japanese rig. Few hams felt that the 2-meter band would ever be popular, and even fewer professional radio operators dreamed that Japan could ever produce any type of equipment comparable to good ol' U.S.A. gear.

How times have changed. Standard Communications Corporation in Salt Lake City, Utah still continues to be the leader in land mobile and marine VHF and UHF equipment, and well-known entrepreneur Roger Wayman W9TYT heads up Standard Amateur Radio Products in Niles, Illinois. The Standard line originally re-debuted under the Heath label; now Roger has brought back the VHF and UHF hand-held, mobile, and base units under the Standard label.

Just as Advertised

The Standard C168A (the "A" stands for the "American" version) 2-meter handheld is advertised as the "world's smallest full-keyboard handheld." Smaller than some of the other brand-new micro series 2-meter handhelds? Yes, it is. Yet this scaled-down size handheld still possesses all of the features found on larger equipment plus reasonably sized, rubberized keypad buttons for soft-touch commands.

The 2-meter set comes with a long-life, 700 mA battery pack, and a little overnight wall charger that lights a red LED when it's plugged into the pack. The wall charger feeds the battery direct, so if you're dealing with a reasonably full battery, you can run the unit and charge the battery at the same time. It's about "push" when it comes to getting the battery charged with the unit on, but turn the unit off and by daybreak your pack will have a full head of steam.

Controls include volume, squelch, remote mike and ear jacks, along with the BNC connector for the antenna and a frequency and channel-changing knob. They have a nice rubberized feel to them, and they're far enough apart to make knob-twirling a breeze. I also liked the recessed LED that glows red on transmit, and green with open-squelch activity. This is handy when a radio goes off at a hamfest—you can look down and see whether or not it's yours.

The LCD display on the front is small, like all other pint-sized handhelds, but it's completely readable at an oblique angle. If you hold your head just right, you can also read it with polarized sunglasses, too!

Audio, Power Usage, and Heat

Audio output was tested at 200 mW, which is okay for normal operation, and about "standard" for other small handhelds. The speaker gave us reasonable audio output, and its full fidelity made listening to the recovered audio pleasant. There are other handhelds with slightly louder audio output, but the audio tends to be a bit tinny, and at low volume not as pleasant as the Standard audio. But in a crowd, sharp, tinny audio output is sometimes desirable.

Standard has a variety of headsets and speaker microphones to take care of operating in a crowd. Two different models of headsets let you walk around in a crowd and look like a goon—but for good, solid communications, the goon-look is really one of the best ways to go to hear and be heard.

One interesting feature allows you to remote the battery via a curly cord down to your belt, and you wear the actual transceiver on your shoulder. This gets that antenna up out of your gut, and makes you look like a New York cop with great sounding audio right next to your ear. It also gives you the capabilities of complete control of your handheld at eye level.

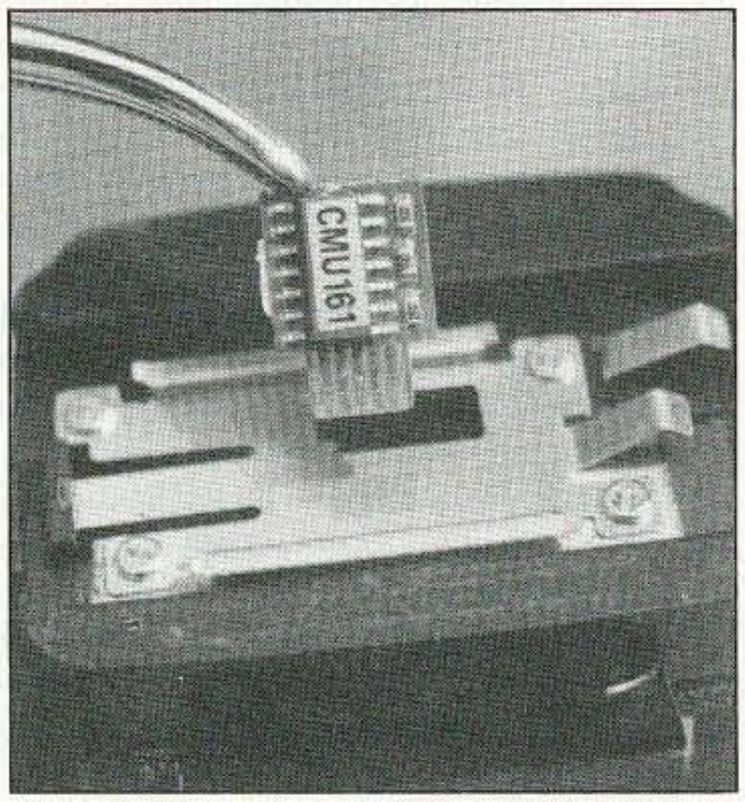

Photo B. The 40- or 200- memory-channel board simply plugs into the bottom of the HT. The memory is always retained.

If you plug your Standard C168A into 12 volts, you can get a little over 5 watts out of the antenna jack. This is a good way to boost your power for mobile use for a quick conversation. Real quick.

Anytime you run a micro-sized portable at 5 watts, it's going to get real hot fast off of 12 volts. Real hot, and real fast—after about four minutes of key-down. But Standard did its homework, and the power output begins to fold back, protecting the output transistor from thermal meltdown.

Selectivity and rejection of out-of-band pager, weather, and taxi cab calls, was judged adequate. On an outside antenna, it gave us a few more squawks than some larger handhelds with (probably) more band pass circuitry in the RF section. But with its reasonable selectivity, the Standard 2-meter handheld turns out to be a dandy AM/FM full-sensitivity scanner from the air band at 115 MHz to FM narrow band frequencies to 175 MHz. And for those of you who are members of the Civil Air Patrol, MARS, or the U.S. Coast Guard Auxiliary, word has it that modification capabilities for transmit are available WITH PROPER CREDENTIALS.

The Standard also contains all those neat bells and whistles that not many hams use, but every ham wants—such as DTMF paging, DTMF group calls, tone burst for European repeaters, and seven different types of scan,

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Emergency Operations Center

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TIC-B Techniques for Intercepting Communicatons	$14.95
EEC-B Embassy & Espionage Communications	$14.95
SMHV1-B Scanner Modification Handbook/Volume 1	$18.95
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CIRCLE 121 ON READER SERVICE CARD

with three modes of scan and multiple scan speeds. Very good news—CTCSS encode AND DECODE is "standard" with Standard. With more repeaters going over to PL, it's hard to understand why their competition would still make CTCSS an option.

Programming

Programming the Standard is unlike programming any other 2-meter handheld. With the Standard equipment, you program in layers. For example, first you punch in the repeater output, and program it into any one of 40 memory channels. Then you go back and program the offset and the PL. This is layered on top of that original simplex frequency entry, and stays in memory until you go back and change it. And you don't need to worry about accidentally erasing a memory already programmed—a unique set of keystrokes makes accidental write-over impossible; you must deliberately write over what you want to change.

Once you master the concept of layering in the information for each memory channel, it programs up just as fast as any other handheld out there. But it is different from what you might be used to, when you first start poking away at the rubberized keypads.

Memory Unlimited

But here's the neat thing with the Standard C168A—you can pull out the plug-in 4K EEPROM memory cartridge, and plug in a 16K EEPROM memory cartridge for 200-channel storage! Or, if you're like me and can't remember what you've stored in 200 channels, you could have: several sets of 4K EEPROMs for different geographic regions of the country, or plug-in EEPROMS for 40 air scanner, marine, or repeater channels in different cities. Each PROM retains its memory after you unplug it. When you travel, you can just pick the appropriate PROM and plug it in. But you have to do the initial programming yourself. No one has cloned the *ARRL Repeater Directory* yet by geographic area in the standard or 16K PROMs.

I run the 200-channel PROM and divide up my frequencies by banks of 20 for different cities. This gives me 10 different banks of 20 channels each, and if I need more, I'll simply buy another $30 200-channel EEPROM from the factory. They are readily available.

Ham radio dealers should cash in on this feature by offering preprogrammed EEPROMS. It takes a maximum of two minutes to clone from one Standard set to another. Just think, Mr. Dealer, of all the time you can save when selling that next 2-meter transceiver—you won't have to stand there for 20 minutes, programming in some popular frequencies for your particular area on this new hand-held set.

Standard has a 440 MHz UHF model, the C468 (for about $370), which I got my hands on. It's also a good performer. Like the 2-meter set, the big advantages are ultra-compact size, reasonably good audio out, out-of-band scanning capabilities, and the incredible memory expansion EEPROM capabilities.

So, welcome back, Standard. We look forward to some of that exotic equipment we see advertised in some of the Japanese magazines. The new dual-band mobiles look good, and that triband base station, along with the scanner spectrum analyzer, is also a long-awaited product here in the U.S.A. 73

The Standard C168A HT
Test Bench Report

TX power output (High, with included battery): 2.2 watts at 950 mA.
Second harmonic: −92 dB
Frequency accuracy: +094 Hz
Peak deviation: 4.8 kHz
In-band receiver sensitivity: 12 dB SINAD, 0.102 µV
Selectivity (±15 kHz): 32 dB
Selectivity (±20 kHz): 60.4 dB
Intermodulation rejection: 63 dB
Image rejection: 73 dB
Heat sink capabilities: Good, using diecast aluminum frame.
Best feature: Ability to plug in EEPROM for 200-channel capability.
Least desirable function: Must read instruction manual several times to figure out how to program a memory sequence.
Distribution: Available from leading amateur radio dealers throughout the United States.
Availability: Off-the-shelf, including 27 different accessories.

An Improved Crystal Tester

Continued from page 22

See Figure 2 for the improved circuit. If you power the tester with a 9-volt battery, it will make a very handy portable test instrument. It's especially useful when rummaging through those bins of surplus crystal at a hamfest or surplus store.

For a more permanent setup, you may wish to run the tester from 110 volts AC. I built the power supply shown in Figure 3 for mine. 73

Contact Larry G. Ledford KA4J at 553-4th Street S.E., Cleveland TN 37311.

Parts List

Q1,Q2	2N2222 transistors
D1–D4	1N914 diodes
LED 1 & 2	Red LEDs
R1,R3,R4	1k, ¼W resistor
R2	33k, ¼W resistor
R5	10k, ¼W resistor
C1,C3,C5	0.001 µF capacitors
C2	100 pF capacitor
C4	0.005 µF capacitor
S1	SPST switch

Misc: XTAL sockets (optional), 9V battery, mini alligator clips (2), PC board, case, battery clip.

A blank PC board for the XTAL tester is available for $3 + $1.50 shipping/handling per order (the optional power supply board is $3.50) from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

Build a Function Generator

An inexpensive way to generate useful waveforms.

by J. Frank Brumbaugh KB4ZGC

Function generators provide a number of different waveforms over the audio frequency range and, if you pay enough, up to about 2 MHz or more. Commercial units are priced well over $100, a very high price for what can be a very simple instrument.

Hams do not need a broad frequency range, nor do they have to spend big bucks for a perfectly adequate function generator covering the most important audio frequencies, at least 300 to 3,000 Hz or a bit higher. But they may need a number of different waveforms, depending on the tests they require.

The function generator described in this article covers from below 300 Hz to above 7,500 Hz in two ranges. It provides positive pulses, negative pulses, square waves, triangle waves, and sine waves at all frequencies within its two ranges. Best of all, it requires only a single inexpensive IC and a general purpose NPN transistor. It can be constructed for less than $5, not including an enclosure, even if all parts must be purchased new (surplus).

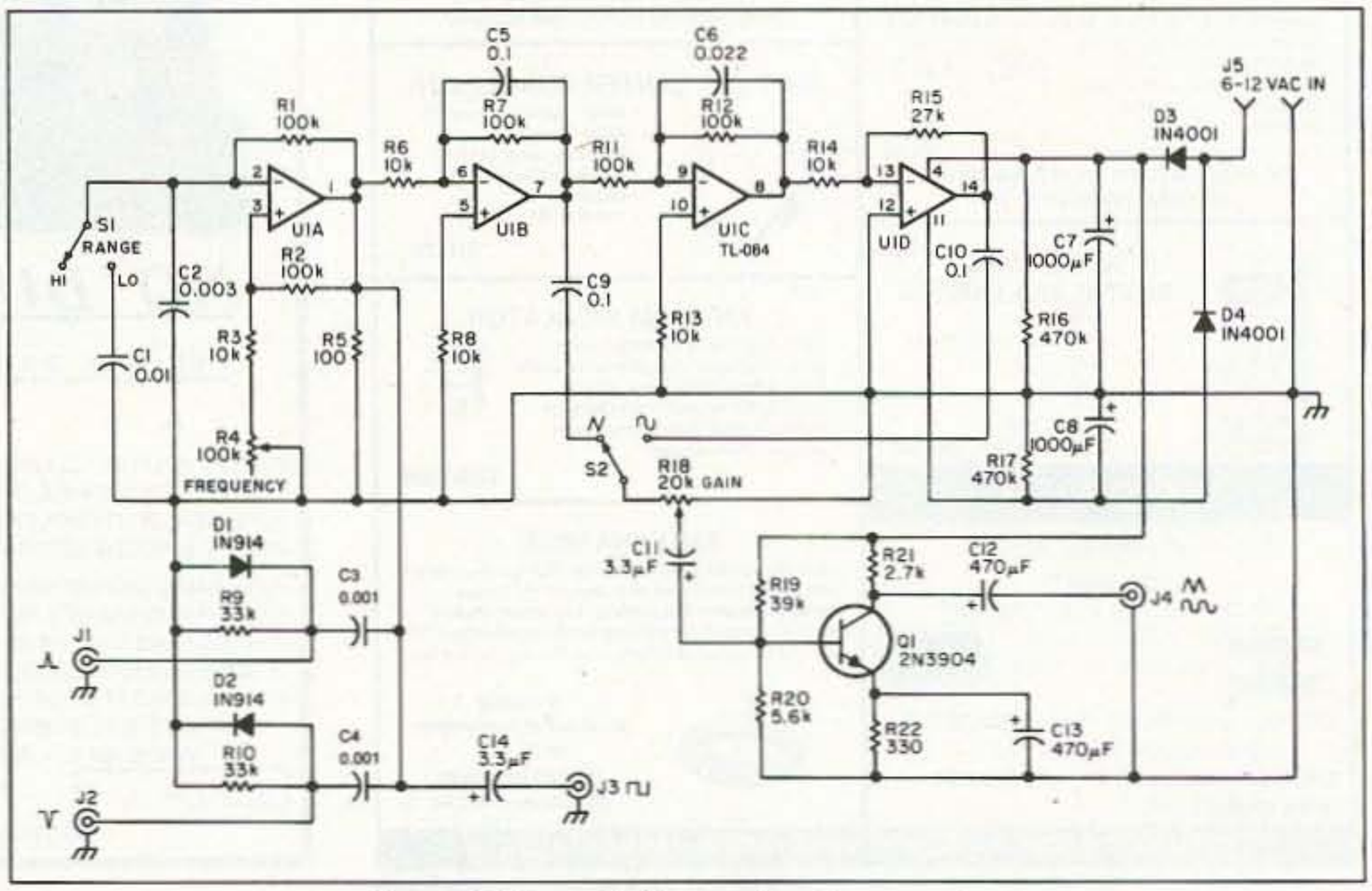

Figure 1. Schematic diagram, function generator.

The Circuit

Figure 1 shows the schematic diagram. U1 is a TL-084 quad FET op amp that is connected with external components to generate square, triangle and sine waves at frequencies controlled by *frequency* potentiometer R4. Positive and negative pulses are derived from the square waves.

There is a minor drawback resulting from trying to do so much with so little, but this is eliminated by adding Q1, a 2N3904. Triangle and sine waves generated by U1 vary inversely in amplitude as frequency is changed. Q1 amplifies sine and triangle waves with the input level controlled by *gain* potentiometer R18. Lowering the frequency reduces their amplitude; raising the frequency provides more gain. This allows you to keep these waveforms at a constant amplitude and eliminates distortion at low frequencies.

Although this circuit requires both positive and negative voltages, the total current drain is so low—a few milliamperes—that a simple voltage doubler consisting of diodes D3 and D4, electrolytic capacitors C7 and C8, and voltage equalizing resistors R16 and R17, does the job. A small wall transformer, or any small low voltage transformer with a secondary voltage between 6 and 12 volts AC, is used to power the function generator. One side of the secondary is the center tap of the voltage doubler circuit and is grounded, thus both positive and negative DC voltages referred to ground (common) are provided, eliminating the need for a complex positive and negative power supply.

Construction

I recommend a small printed circuit board, such as Radio Shack 276-150. All parts except jacks and controls are mounted on the PC board. The layout is not critical, despite the rapid rise and fall times of the square waves. You don't need any shielded wire.

The PC board can be mounted in a small metal or plastic enclosure, or one made from printed circuit board material. Both the potentiometers and the toggle switches can be mounted on the panel, along with the four waveform output jacks. The AC connector can be mounted wherever desired. It must match the low voltage AC connector from the wall transformer.

If desired, a small step-down transformer with a secondary of 6 to 12 VAC can be mounted in the enclosure if a wall transformer is not used. If you do this, an SPST toggle or slide switch should be used in series with the primary to serve as an on/off switch. If you want a pilot light, connect an LED in series with approximately 12,000 ohms, 2 watts, across the transformer primary. Two-watt resistors are scarce today. If you do not have one in your junk box you can use a pair of 27k, 1W resistors; four 47k, ½W resistors; or eight 100k, ¼W resistors, wired in parallel to substitute for the 12k, 2W resistor.

Although calibrations can be marked directly on the panel, it will look better if you use a circular calibrated dial. You can make an excellent dial using an aluminum or steel circle left over from cutting a hole for a meter or small speaker. (You *do* save these in your junk box, don't you? If not, you'll have to cut one the correct size.)

Paste white card stock to one side of the circular dial. Allow it to dry thoroughly before trimming the excess card even with the dial plate. Enlarge the center hole if neces sary so the dial will just clear the shaft of R4. Fasten the dial plate to a knob, using super glue or epoxy. Place the dial over the shaft and tighten the setscrew(s) in the knob.

All parts except the printed circuit board and transformer are available from Short Circuits, PO Box 285, Barnegat NJ 08005, at unbelievably low prices. Small inexpensive power transformers are available from Micro-Mart, 508 Central Ave., Westfield NJ 07090. (Cat. No. T-11 provides 10.6 VAC at 175 mA for $1.50.)

Calibration

A frequency counter is recommended for calibrating the frequency dial. It must be capable of measuring frequencies below 300 Hz. Some of the frequency counters which have very broad measurement ranges require use of a low-pass probe for frequencies below about 20 kHz. Figure 2 shows the schematic for a simple low-pass probe which will work with any frequency counter.

Rotate the dial (R4) fully counterclockwise to maximum resistance. Set RANGE switch S1 to LOW. Connect the square-wave output (J3), through a low-pass probe if used, to the frequency counter. Set the frequency counter to a one-second gate period. Apply power to the frequency counter and the function generator.

Note the frequency displayed. It should be a bit below 300 Hz. If the frequency displayed is higher than about 500 Hz and you are *not* using a low-pass

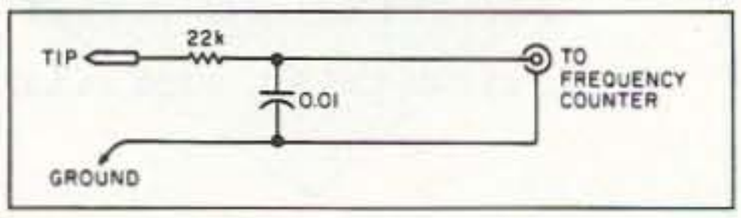

Figure 2. Low-pass probe.

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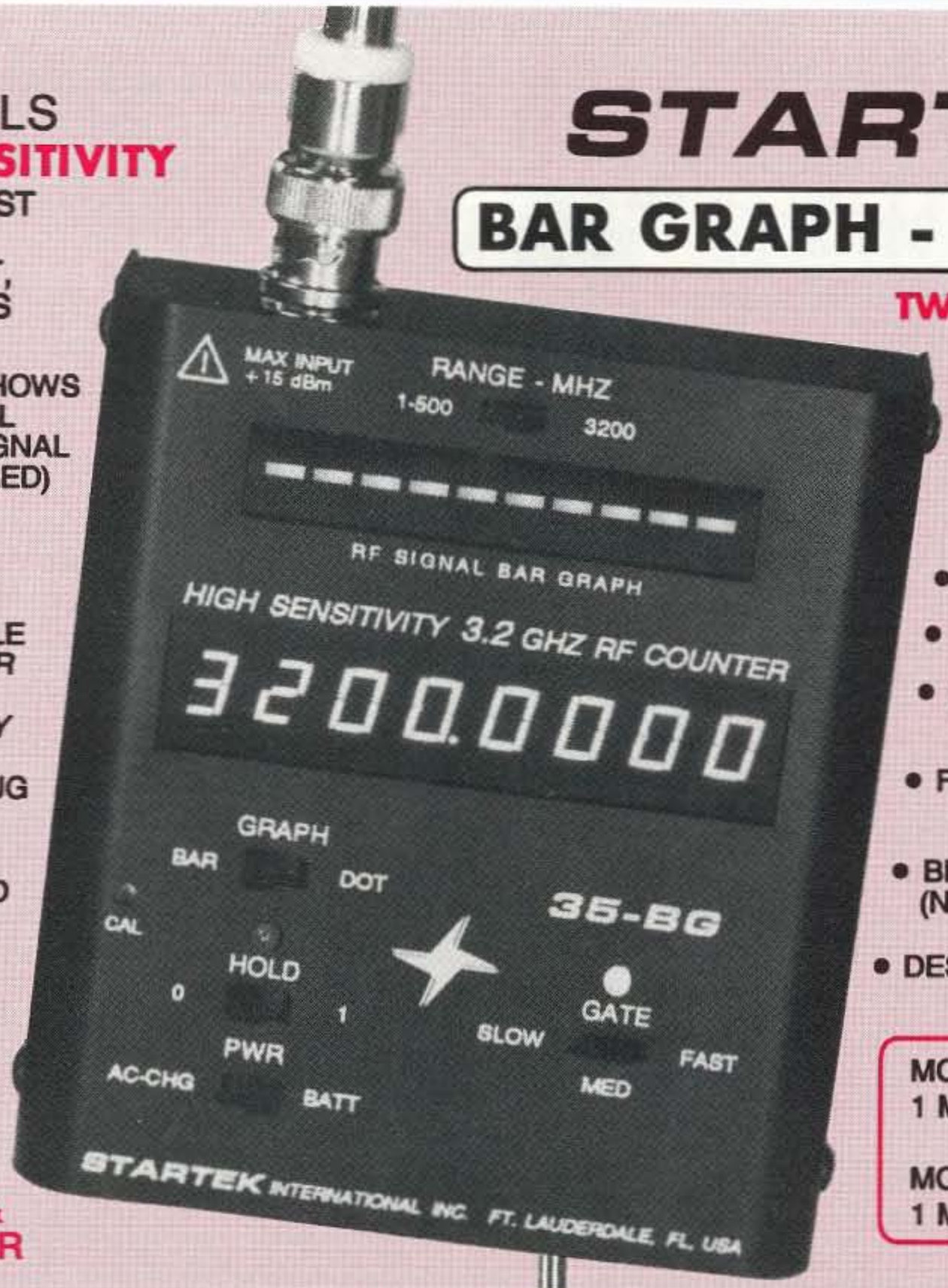

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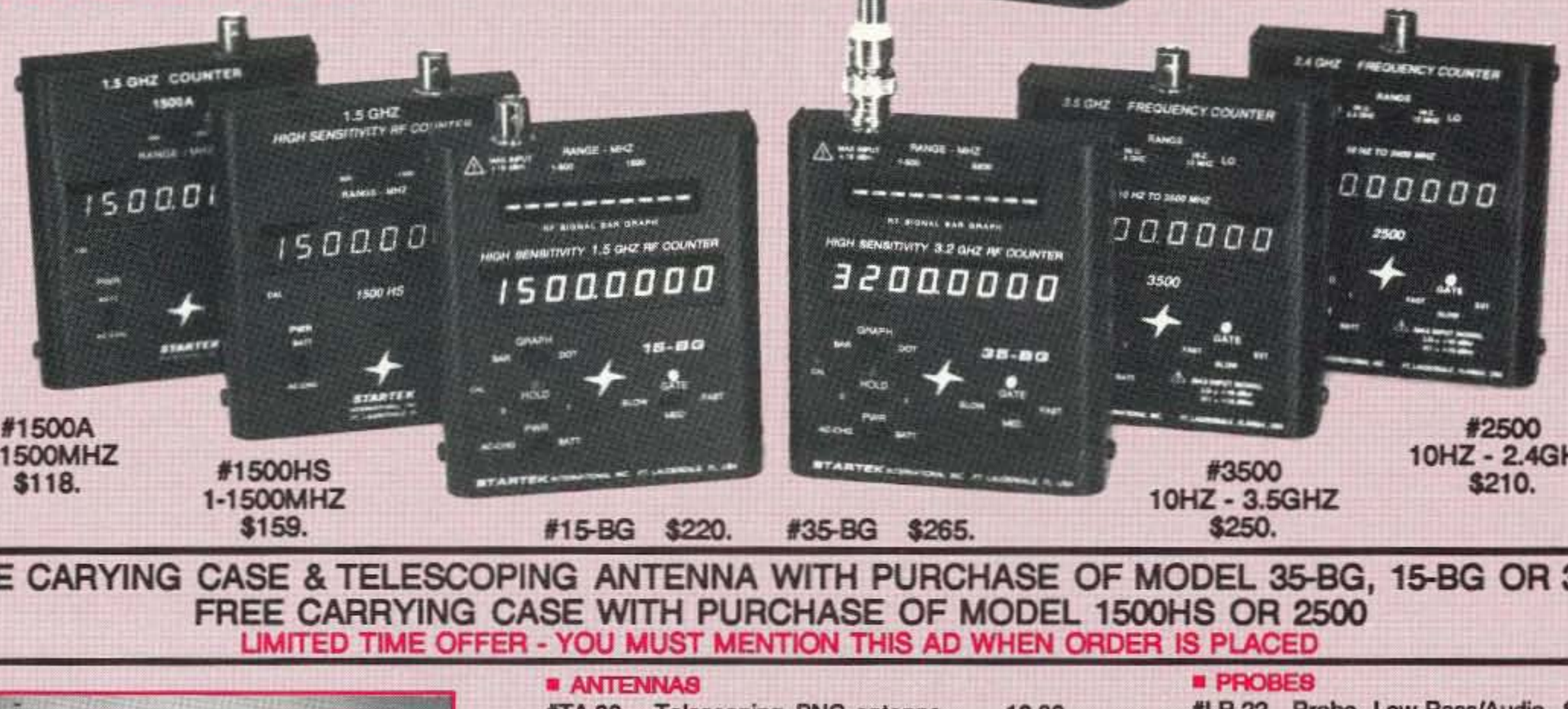

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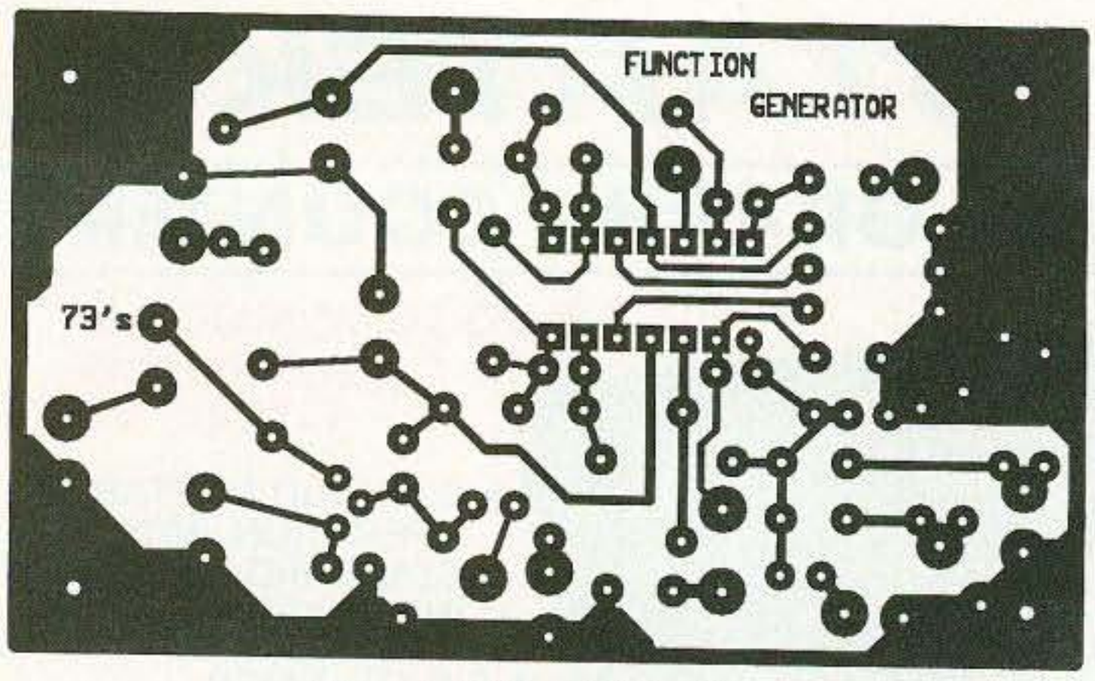

Figure 3. PC board foil pattern.

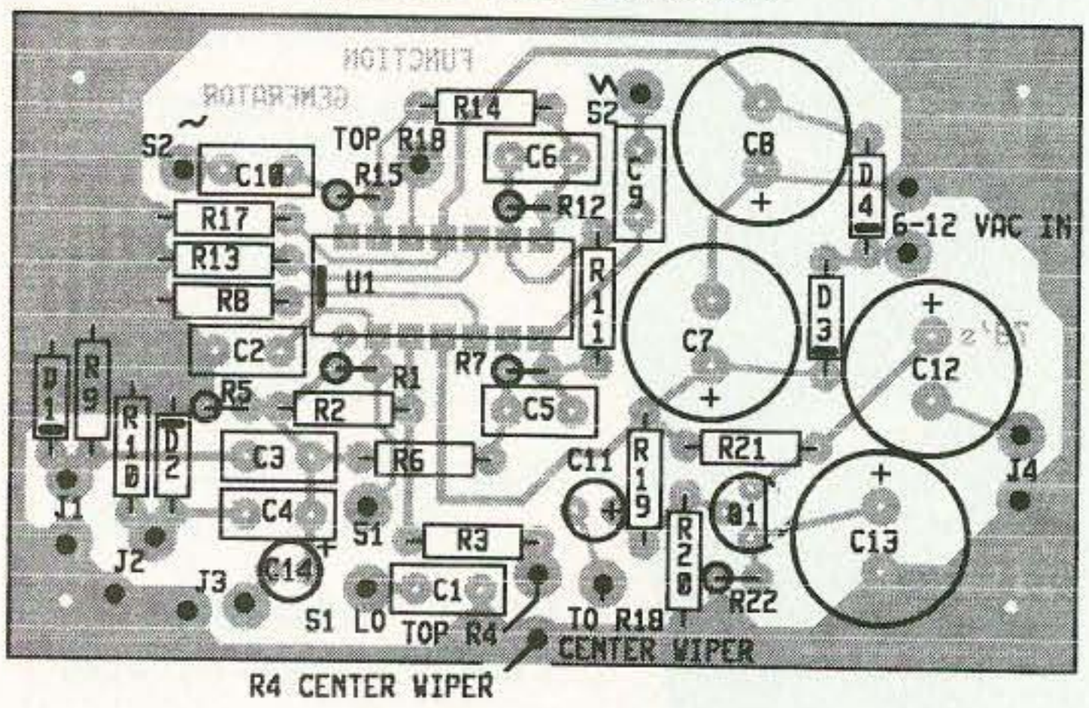

Figure 4. Parts placement.

probe, both the positive and negative edges of the square wave will be counted, displaying double the actual frequency. If this occurs, either divide by two or use a low-pass probe.

Rotate the dial until a frequency of 300 Hz is displayed. Mark the dial at this point. Continue calibrating the dial as described until the entire low range has been calibrated. Then move the range switch to HIGH and calibrate the high frequency range.

The dial will not be linear with frequency. Lower frequencies on both ranges will be spread out and high frequencies compressed. However, these ranges overlap so the compressed high frequencies on the LOW range are spread out on the low end of the HIGH range.

Operation

Apply power to the function generator. Set the dial and RANGE for the desired frequency. Pulses and square waves are available at all times. A choice of triangular or sine waves at J4 is controlled by S2, and their amplitude controlled by gain control R18. Both triangle and sine waves should be observed on an oscilloscope when setting the gain control. Too high a gain at low frequencies can result in greatly distorted waveforms.

Conclusion

The function generator is a general purpose instrument. A few of the more common uses are:

•*Pulses*: External triggering of oscilloscope. Checking electrical length of coaxial cables. Measuring carrier lifetimes of diodes.

•*Square Waves*: Checking low frequency limits of amplifiers. Vertical amplifier voltage calibration of oscilloscope. Output can be keyed into a speaker or headphones for code practice. Signal injector in receiver tests.

•*Triangle Waves*: Bi-directional sweeping of a voltage controlled oscillator.

•*Sine Waves*: Checking bandpass or bandstop characteristics of active and passive filters. Measuring frequency limits and insertion losses of active and passive filters. A known modulation source for transmitter testing.

The methods and techniques for using various waveforms for testing and evaluating circuits and equipment are explained in a number of textbooks, and detailing them here is far beyond the scope of this article. When you become familiar with the function generator you will discover many more uses for it in the shack. 73

Contact J. Frank Brumbaugh KB4ZGC at 1812 Marilyn Ave., Bradenton FL 34207-4743. Please enclose an SASE.

Parts List

C1	0.01 µF 5% mylar or polycap
C2	0.003 µF 5% mylar, polycap or monolithic
C3, C4	0.001 µF ceramic disc
C5	0.1 µF ceramic, polycap, mylar or monolithic
C6	0.0022 µF mylar, polycap or monolithic
C7, C8	1000 µF 25 VDC electrolytic
C9, C10	0.1 µF disc ceramic or monolithic
C11, C14	3.3 µF 16 VDC electrolytic
C12, C13	470 µF 25 VDC electrolytic
D1, D2	Silicon switching diode (1N914, IN4148, etc.)
D3, D4	Silicon rectifier diode 1N4001
J1, J2, J3, J4	RCA or phone jack
J5	AC connector to match wall transformer output
Q1	NPN small signal transistor (2N3904, 2N4124, etc.)
R1, R2, R7, R11, R12	100k 5% ¼W resistor
R3, R6, R8, R13, R14	10k 5% ¼W resistor
R4	100k potentiometer
R5	100 ohm 5% ¼W resistor
R9, R10	33k 5% ¼W resistor
R15	27k 5% ¼W resistor
R16, R17	470k 5% ¼W resistor
R18	20k potentiometer
R19	39k 5% ¼W resistor
R20	5.6k 5% ¼W resistor
R21	2.7k 5% ¼W resistor
R22	330 ohm 5% ¼W resistor
S1	SPST toggle or slide switch
S2	SPDT toggle or slide switch
U1	TL-084 quad FET op-amp

A blank PC board is available for $6.25 + $1.50 shipping per order from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

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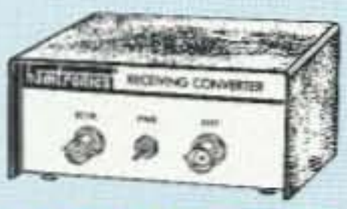

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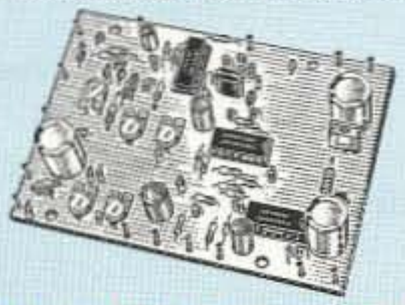

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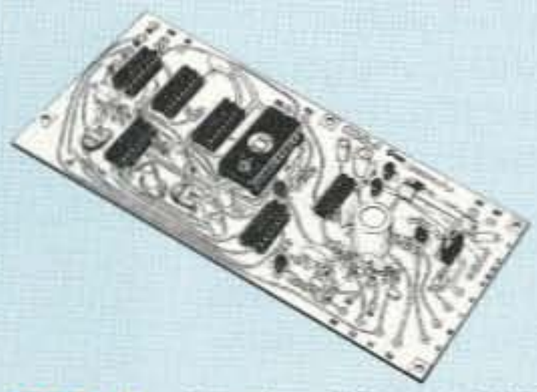

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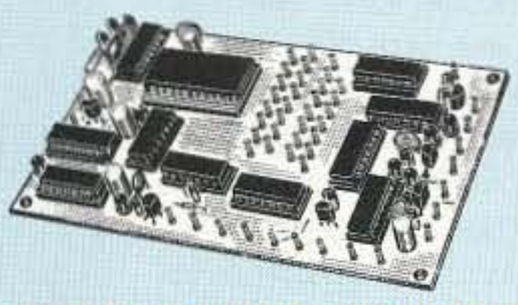

TD-2 TOUCH-TONE DECODER/CONTROLLER kit. Full 16 digits, with toll-call restrictor, programmable. Can turn 5 functions on/off. Great for selective calling, too! .....kit $89, wired/tested $149

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

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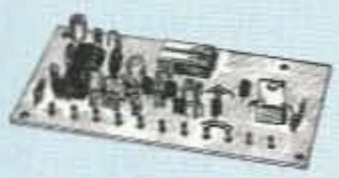

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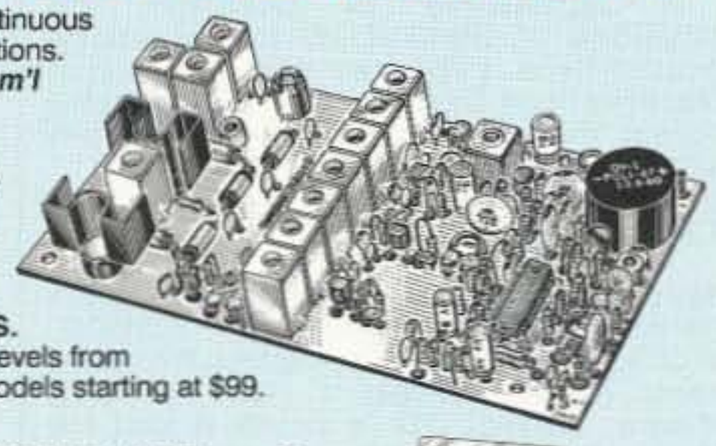

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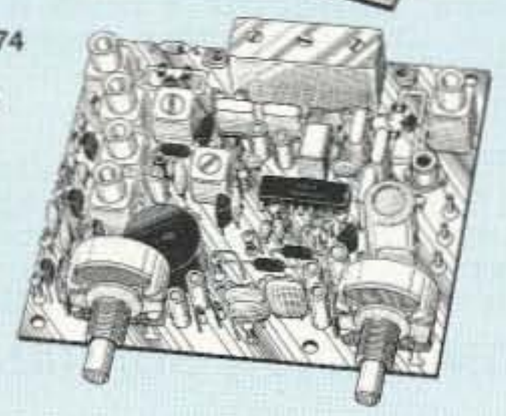

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CIRCLE 57 ON READER SERVICE CARD

73 Review *by David Cassidy N1GPH*

The Ventenna

The "no antennas" antenna.

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One of the biggest problems faced by many hams is how to operate from an apartment or condominium. There are entire communities that restrict all outside antennas, and even a simple dipole or 2 meter vertical could be a violation to restrictive zoning laws or deed covenants.

Of course, hams should check out this kind of stuff before renting or buying a home, but let's face it—amateur radio isn't always the prime factor in choosing where to live. There are thousands of amateur radio operators who find themselves with very limited options: indoor antennas (TVI problems and often poor performance), mobile operation (fun, but limiting) or going QRT (yikes!).

The Forbes Group has come up with an ingenious way for those in a "no antenna zone" to get around restrictions, and still get out a decent signal on the UHF/VHF bands. It's called the Ventenna.

What's a Ventenna?

As it comes from the manufacturer, the Ventenna is a strange looking thing—until you understand how it goes up. When you take it out of the box, what you see is about 3 feet (2 meter version) of ABS pipe with a coax tail sticking out 6 inches from the bottom.

That's what you see. What you've got is an efficient 2 meter (also available in 220 and 440 MHz versions) antenna that looks exactly like a common vent pipe. These vent pipes (or "stink pipes," as they are sometimes referred to) grace the rooftops of millions of homes all over the world—even homes that have restrictions against any outside antennas.

Installing the Ventenna

The first thing you want to do is take a walk down your street and notice what the vent pipes in your area look like. Are they "raw" ABS pipe (with the manufacturer's stenciling still showing), painted black, or are they painted to match the house or roof color? If the pipes in your neighborhood are raw ABS, you're all set, because the Ventenna comes in this form.

If the pipes in your area are painted, visit your local hardware store and buy a can of spray paint in the right shade. While you're at it, pick up a can of paint that matches the color of your roof. Are the shingles gray, brown or blue? Take a sample with you to the hardware store and try to find the best match possible.

A couple of quick coats with fast drying spraypaint should be sufficient. If you want to get really sneaky, sprinkle some sand on your freshly painted coax so it resembles the texture of your roof shingles even more. For truly cloak-and-dagger type installations (if you own your home), drill a small hole in your roof next to your vent pipe, placing the hole so that it is hidden by the pipe when viewed from the street. Run your coax into this hole and seal with a waterproof sealent.

The inside diameter of the Ventenna is slightly larger than the outside diameter of your vent pipe, so it slips right over your existing pipe. Tighten the three set-screws on the bottom of the Ventenna (a dab of matching paint helps hide the shiny screws), run your coax, and you're on the air.

On the Air

I found that this clandestine antenna gives great performance all across the 2 meter band. It is broadbanded enough to use on the packet frequencies at the low end of the band, and it can jump up for FM repeaters at the top of the band. I measured SWR less than 1.6:1 from 144–148 MHz.

The Forbes Group has come up with a very clever solution to what is becoming a bigger and bigger problem in amateur radio. If you live in a restrictive area, or if you are simply trying to keep your rooftop from turning into an antenna farm, the Ventenna could be the antenna solution for you. 73

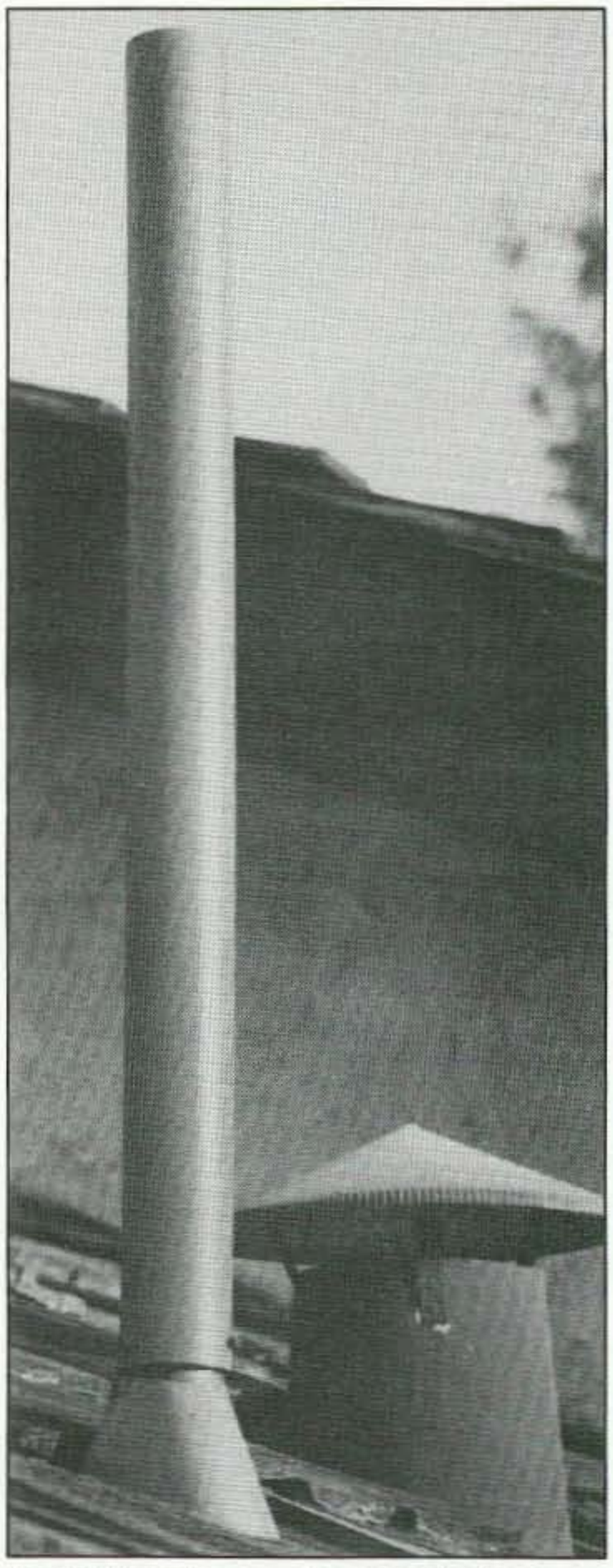

Photo. Vent pipe or antenna? Only the person who put it there knows for sure.

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MR1000 .....$109.00
MR2000 .....$129.00

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Meas. Pow. Ranges: 0-50W/0-200W CW
Input Impedance: 50Ω
Insertion Loss: Less than 0.5dB
Residual SWR: Within 1.2
145MHz (MR1000)/435MHz (MR2000)
Connector: SO239 (MR1000), N (MR2000)
Size: 2.75" x 6.22" x 4.41" (HxWxD)
Weight: 1.25 lbs.

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BM1.....$29.00
Matte Black Finish

Zinc Die-Cast
Adjustable Mounting Angle
Weight: .76 lbs.
Features: Inserts for the protection of your vehicle while mounted.

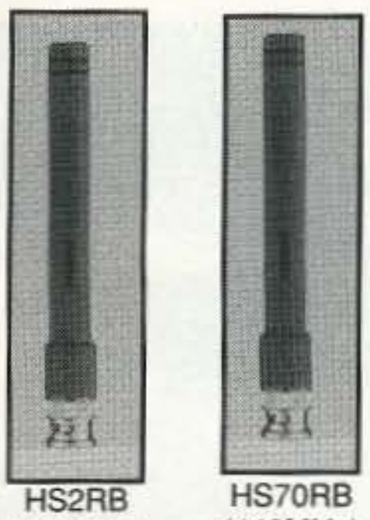
Speaker
HSP6000.....$29.00

4 Inch fixed cone speaker with high quality noise filter
Max. Input: 15W
Impedance: 8Ω
Weight: .94 lbs.
Connector: 3.5 mm plug
Size: 4.33" x 5.32" x 2.13" (HxWxD)

Speaker
HSP7000.....$37.00

2.75 Inch fixed cone speaker (high quality, deluxe magnet mount type)
Max. Input: 8W
Impedance: 8Ω
Weight: .67 lbs.
Connector: 3.5 mm plug
Size: 3.51" x 4.06" x 1.42" (HxWxD)

Handy Whip Antennas 144/440 MHz


HS2RB (144MHz) HS70RB (440MHz)

HS2RB $12.80
HS70RB ..$12.80

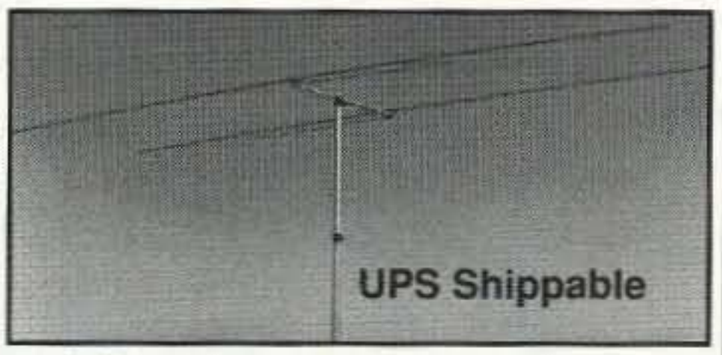
Material: Silicone Rubber
Max. Input: 5W (FM)
Length: 4.33 "/110mm
Weight: .05 lbs.
Connector: BNC- Male

3 Band HT Deluxe Black Whip

144/440/900MHz
HG600B ..$37.80

Freq.: 144/430/900MHz
Gain: - - (144MHz)
1.9dB (430MHz)
3.6dB (900MHz)
Max. Input: 10W (FM)
Length: 12.5 "/320 mm
Weight: .16 lbs.
Connector: BNC- Male

10 Meter Horizontal Beam



28 MHz
28HS2HB.....$99.50

Max. Input: 500W (SSB), 250W (FM)
Gain: Better than 6.0 dB
FBR: Better than 16 dB
Element Length: 5,400 mm/17' 8"
Boom Length: 1,340 mm/4' 5"
Shipping Weight: 7 lbs., 13 oz.
Connector: SO239 Jack

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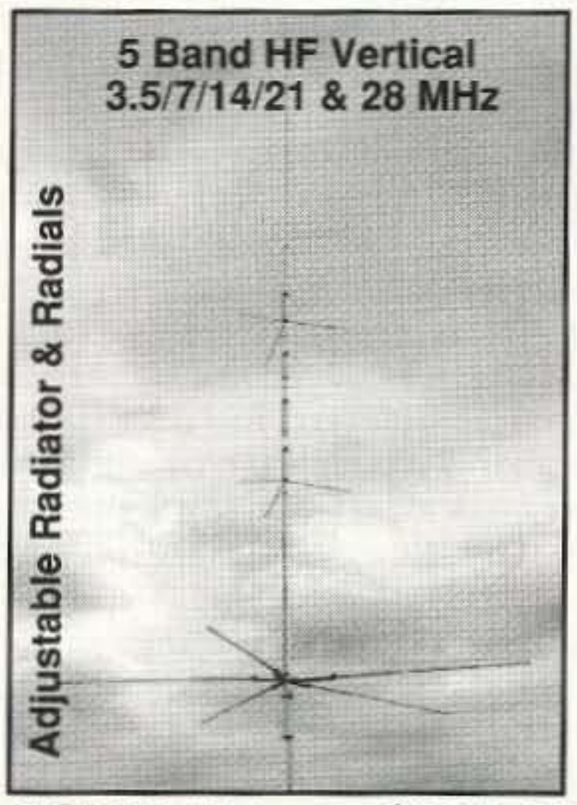

HSVK5JR.....$287.00

Max. Input: 500W SSB, 250W CW,
3.5 MHz - 200W SSB
Height: 20', Radial: 10' 2"
Shipping Weight: 17 lbs., 8 oz.
Connector: SO239 Jack
UPS Shippable

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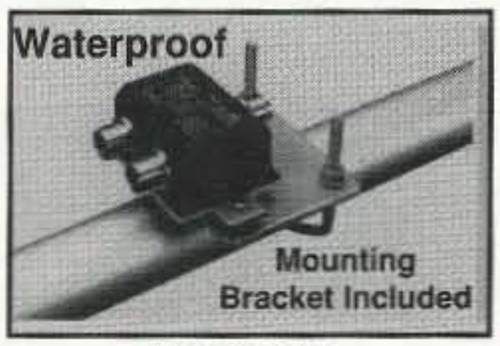
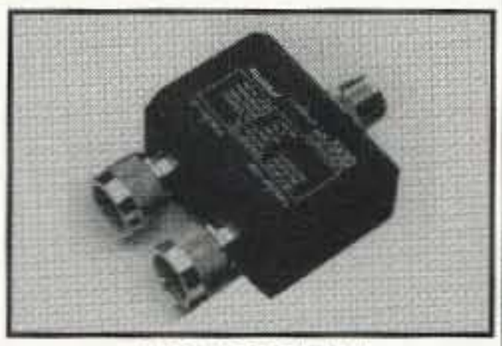


HS790WP



HS790D/DN

Frequency: 1.6-150MHz (LPF)/410-460MHz (HPF)
Power: 1.6-30MHz 500W(F3) 1kW (A3J)
30-150MHz 300W (F3) 500W(A3J)
410-460MHz 300W(F3) 500W (A3J)
Insertion Loss: 1.6-150MHz 0.15dB
410-460MHz 0.25dB
VSWR: Less than 1.2
Isolation: 60dB more
Size: 1.2" x 2.5" x 1.9" (HxWxD) (Excluding Protuberance)
Input Connectors: SO239

HS790WP...$58.00
Direct Link
Output: SO239 x 2

HS790D.....$47.50
Direct Link
Output: PL259 x 2

HS790DN ...$47.50
Direct Link
Output: PL259 x 1 , N x 1

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CIRCLE 9 ON READER SERVICE CARD

One Desert Storm MARS Experience

MARS readiness and support needed!

by Mike Warner NX7T

In November of 1990 not one community MARS (Military Affiliate Radio System) station existed in the Nuernberg Military Community. The 1st Armored Division's MARS license (Ansbach) was revoked for failure to meet the 40-hour week manning requirement. Only one active amateur club station, the Erlangen, Ferris Barracks Amateur Radio Club, DA2SF, existed in the area. It owed its existence in large part to the German amateur community and the Iron Land Amateur Radio Association (ILARA).

Enter the Gulf War, and of course, the 1st Armored Division's (1AD) deployment. There was a sudden shift of priorities. Second Brigade 1AD's new commander, Col. Montgomery Meigs, received a copy of our ILARA newsletter. It indicated our potential and willingness to be a MARS station. This time there was interest.

The newly arrived chaplain of the Division Support Command (DISCOM), Rabbi Ken Leinwand, had started several MARS stations in the past. He also had one amateur among his support battalion commanders.

Dan Pasomoto, whose German call had been expired for two years, joined forces with the rabbi. Dan is the Director of the Learning Centers for the Nuernberg Community, but with all the soldiers leaving for Desert Storm there would be little need for the usual learning center activities. Dan was able to convince the right people to divert money (27,000 DM) from the Learning Center budget to buy amateur radio equipment for the deployment, and to encourage our Community Commander, General Wesley B. Taylor Jr., to request additional equipment from the Amateur Radio Relay League (ARRL).

With letters of commitment from General Taylor and Col. Montgomery Meigs, 5th Signal Command granted two MARS licenses to the Nuernberg Community. One station was established at Monteith Barracks, and the other at the Ferris Barracks Amateur Radio Club Station. A full-time operator was committed to each. By the end of deployment more personnel were added to the Erlangen (AEM1ELN) station, and many volunteers contributed hundreds of man hours to both operations. The ARRL came through with two radios: One TS-140S and one IC-735.

Getting the Equipment

The real difficulty was spending the Learning Center money. Army Contracting was swamped, and suffered drastic loss of personnel at a very inconvenient time. When push came to shove, there was not time to order the equipment from the States. Doing so would have made the available money go much farther, as equipment is generally more expensive in Germany. But there was no time, so it had to be locally purchased.

In Germany, too, when Christmas approaches, most amateur distributors close

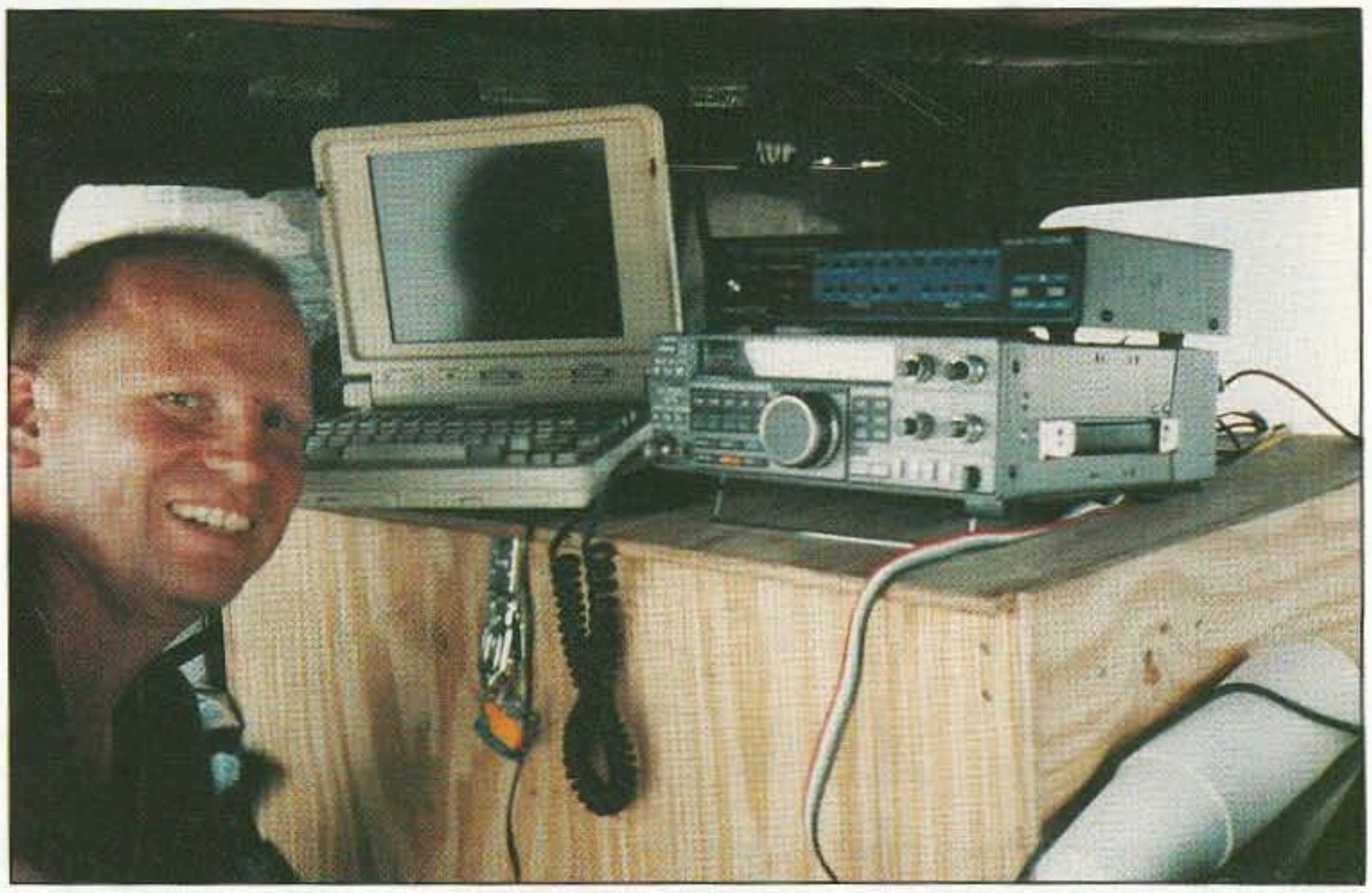

Photo A. SSG Michael R. Warner NX7T, MARS operator during Operation Desert Storm.

Photo B. A well-equipped Desert Storm mobile.

Happy Holiday's

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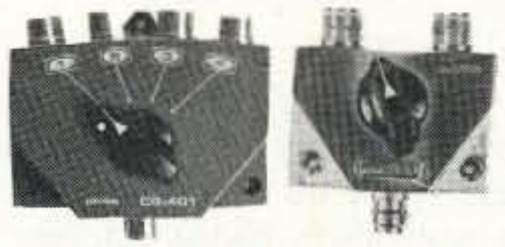

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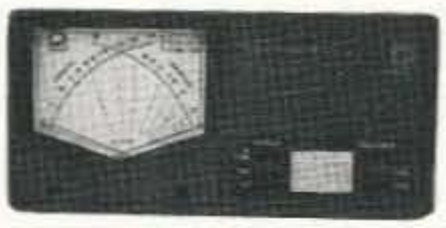

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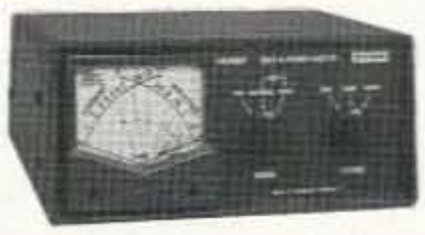

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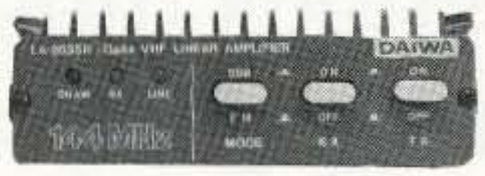

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down until the new year. Much of what we needed could not be found at any price, but we managed to obtain six TS-440Ss, a few antennas, and some hardware. Most of the ham/MARS operators spent their own money, some over $500, to help make up shortages.

Two groups from Monteith, the Non-Commissioned Officers Wives and the Officers Wives Clubs, granted an additional $1,500. These funds were added to ILARA club dues to purchase little things like microphones (that don't come with radios when you buy them in Germany), coax cable, insulators, antennas, baluns, a power supply, and other important items like phone patches.

When this equipment was combined with that sent by the ARRL, we were able to equip both the Erlangen and Monteith stations as well as four deployed stations to Saudi Arabia.

Some of the hams in the division deployed with their own personal radios as well. All of us had planned to take our own rigs. Fortunately, it was not necessary for a few of us.

The equipment was purchased just a few days prior to our departure, and we had to work out the distribution. We learned that only licensed hams were to be granted Saudi MARS licenses, and some of the units originally slated to receive equipment had no one with a license. Unit calls were later issued allowing our battalions without licensed hams to have their own MARS call. We did the best we could given the time and information available.

In addition to the two community stations, equipment was divided up among: Chaplain Ken Leinwand, 1AD DISCOM; Headquarters Second Brigade, AEM3XC, SSG Mike Warner (NX7T/DA1YH); 6-3 Air Defense Artillery (ADA), AEM3XK, CW2 Denis Puls (DA1PV); and Alpha Co 94th Field Artillery, AEM3XF, SPC Warren Fitzsimmons (DA2FI). Later 1st of the 35th Armor Battalion, Chaplain Richard Davis (KB2MAX) also obtained his MARS call, AEM3XG, and the IC-735 provided by the ARRL.

AT&T Mops Up

We had the equipment, and troops who wanted desperately to talk to home. In an adjacent sector we heard the 18th Airborne Corps and others phone patching to their loved ones in the States and to Germany. But VII Corps was under restriction. In order to operate we had to go where no troops could find us. But we could and did send message traffic.

For difficult cases commanders would transport their soldiers out to us. Sometimes phone tents were available, and you could call Germany with an AT&T card, but if you didn't have one you were out of luck. If you did have an AT&T card, your wallet was out of luck. Originally, phone calls were costing $27 for 10 minutes. I must ask you to bear in mind that the AT&T equipment at the Saudi end was set up and maintained by soldiers, not AT&T personnel.

Many soldiers will be dealing with their phone bills for months to come. The International Red Cross helped some of these soldiers with grants to help pay the bills. Still, many soldiers' combat pay and their family finances dissolved before their eyes. Some soldiers experienced bills in the order of several thousand dollars. MARS provided a free service. When permitted, we operated, and we were able to do so long before the AT&T system could arrive and long after they shut down. Often AT&T was not there at all.

For whatever reason, in the 7th Corps in general and 1st Armored Division in particular, MARS could not really operate until after the war was over! The reason given was, of course, fear of Sadam DFing us, while at the same time Air Force Liaison (ALO) and 141 Signal operated HF/SSB and teletype (key down for long periods) not only in the area of our troops, but inside our perimeter.

MARSgram Problems

One of the worst and most demoralizing logistical problems at Operation Desert Storm was the mail. Before the war, no one questioned the need to transport bulletins over mail, but nothing changed after the war! Normally MARS is a good alternative to the mail for service members overseas. Since MARS was an afterthought, the plan for delivery of MARSgrams to soldiers in the Gulf was a disaster.

The plan was for all incoming MARSgrams to be dumped in the "Military Postal System, MPS" at Daharan. Many of the messages sent to soldiers were never received. Those that made it through were often received months after being sent. A number of fixes were instituted to allow message dissemination down to unit level through the MARS system if there was a MARS station nearby. But no one really had an accurate list of where the units were, not even the Red Cross! Had there been a MARS station active in each brigade-sized unit, this could have been avoided. By the time the system really started to work, most of the soldiers and families had lost faith in it.

MARS Success, Nonetheless

Still, our MARS operators both in the Gulf and at home saved soldiers in the 7th Corps alone some $250,000 in personal and official communications costs. Had restrictions not been placed on us for operating, and had a plan been in place and working rather than thrown together, I am convinced it could have been four or five times that amount.

Stateside stations like AAR4CSS in Ocala, Florida; AAR5NSF in Minnesota; and AAR2USI at Ft. Monmouth, New Jersey, supported us throughout our deployment. They often operated 24 hours a day using only volunteers from the amateur community. We take our hats off to you! Why none of

Continued on page 59

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April 24, 25, 26, 1992

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• Asst. General Chairman, Dave Grubb, KC8CF

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• Free bus service • License exams
• Activities for the non-Ham

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Nominations are requested for " Amateur of the Year," "Special Achievement" and "Technical Excellence" awards. Refer to the Hamvention Program for nomination form or contact Hamvention Awards Chairman, Box 964, Dayton, OH 45401-0964.

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1992 Deadlines
Award Nominations: March 1
License Exams: March 23
Appointments will be mailed by April 13
Advance Registration and Banquet:
USA - April 3 Canada - March 27
Flea Market Space:
Spaces will be allocated by the Hamvention committee from all orders received prior to February 1. Express Mail *NOT* necessary! Notification of space assignment will be mailed by March 15, 1992.
Checks will not be deposited until after the selection process is complete.

Information
General Information: (513) 454-1456
FAX: (513) 890-5464 Attn: Hamvention
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Please write to **Lodging, Dayton Hamvention, Chamber Plaza, 5th & Main Streets, Dayton, OH 45402-2400** or refer to our 1991 Hamvention program for a listing of hotel/motels located in the Dayton area.

HAMVENTION is sponsored by the Dayton Amateur Radio Association Inc.

Advance Registration Form

Dayton Hamvention 1992
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Flea Market Reservation Deadline: February 1

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Flea Market (Max. 3 spaces)	_____	$30/1 space $60/2 adjacent $150/3 adjacent	$_____
Admission ticket must be ordered with flea market tickets			
		Total	**$** _____

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A Direct-Reading Linear Inductance Meter

Check out your coils with a digital voltmeter.

by Arthur C. Erdman W8VWX

The meter described here allows you to use an inexpensive digital voltmeter (DVM) to directly display inductance in microhenries. The basic principle of operation is that *the width of a pulsed voltage is directly proportional to inductance.* The DVM reads the average (direct, or DC) value. Inductor resistance degrades the linearity (stray capacity has minimal effect), but the circuit constants are such that if measurements are limited to about 250 mV (and 250 µH), the linearity is excellent.

One integrated circuit chip is used for the circuit. One 9-volt transistor radio battery and a 5-volt regulator make up the power supply. A line-powered supply could be used. There are no special construction problems.

The main component is a 14-pin integrated circuit (IC) chip, 74HC132 (the 74HC132 and the RF choke coils are available from Mouser Electronics, 2401 Highway 287 North, Mansfield TX 76063, phone (800) 346-6873). The IC consists of four two-input NAND gates. The IC also has what are called Schmitt inputs. The Schmitt circuits trigger the NAND gates at precise voltage levels.

The complete circuit for the inductance meter is shown in Figure 1. NAND 1 generates the square wave. NAND 2 is an isolation stage. NANDs 3 and 4 produce the desired output pulsed voltage. One input of each NAND is connected to +5 volts. The NANDs operate as inverters. The pulse width is equal to the time it takes the voltage across the unknown inductor to fall from 5 volts to the lower triggering level (about 1.8 volts at room temperature).

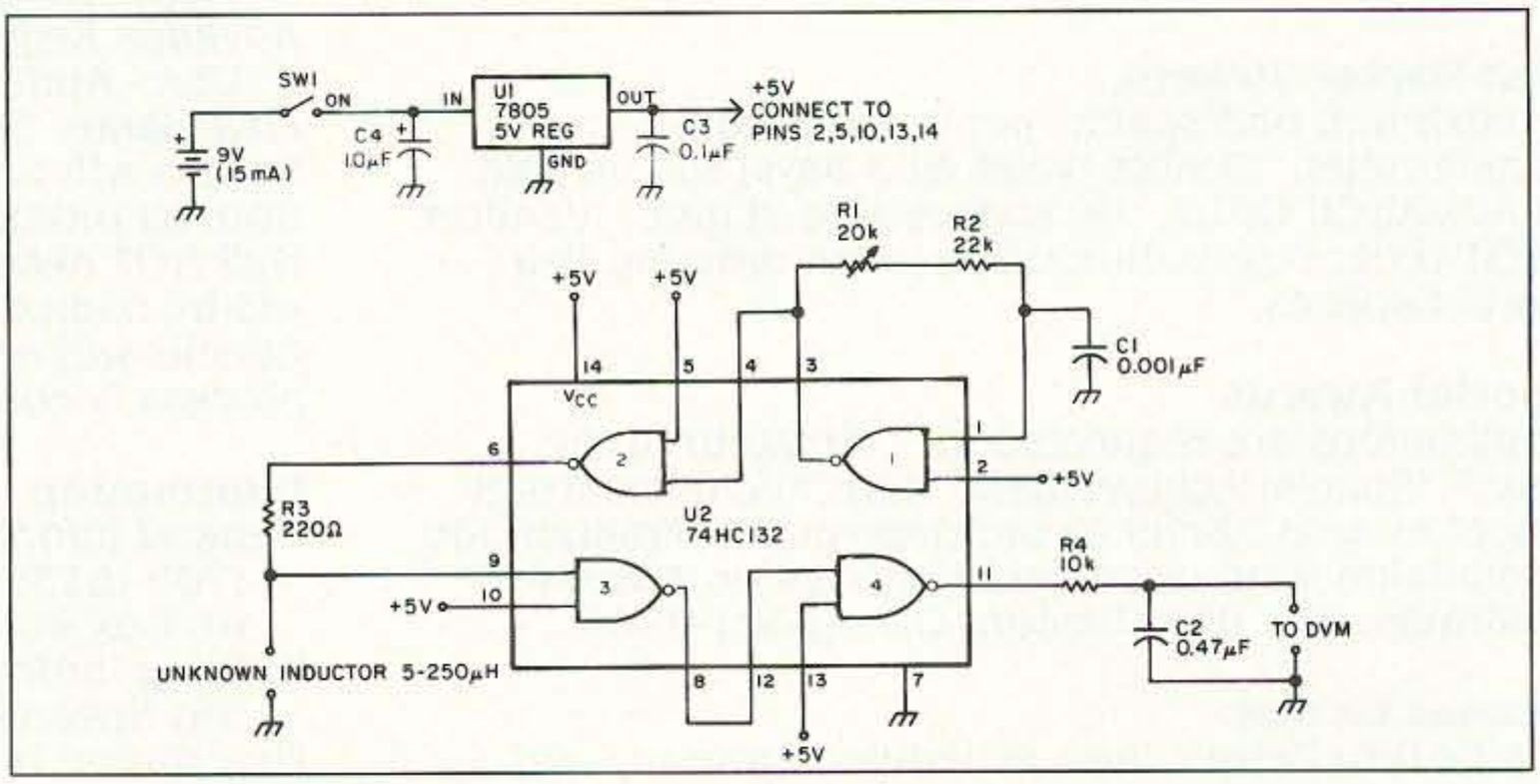

Figure 1. Direct-reading inductance meter.

Construction

The only construction caution is to try to keep the internal leads to the inductance terminals as short as possible. In my unit, the combined length of the two leads to the terminals is about four inches. I selected 5 µH as a minimum reading. These leads do not cause much unwanted inductance compared with the minimum.

Calibration

Known-value inductors (5% tolerance) are available from Mouser Electronics for about $1 each.

To calibrate, connect a known-value inductor that has a value close to 250 µH (220 µH inductors are available). If a 220 µH part is used, adjust R1 for an output reading of 220 mV. No other adjustments are needed. If you have other known-value inductors less than full-scale, check the linearity. Don't forget that your inductors have, at best, a 5% tolerance. If you have measured the inductance of an inductor using the inductor in an oscillator circuit, the error in measurement is related to the ratio of fixed external capacitance to the inductor's stray capacitance. The value found by that method is the APPARENT inductance. The value is higher than the true self-inductance. The measuring method used in our unit measures closer to the true self-inductance. (Capacitive effects are minimal.)

This unit will measure inductances from 5 µH to 250 µH. While readings greater than 250 mV are possible, the linearity becomes poor.

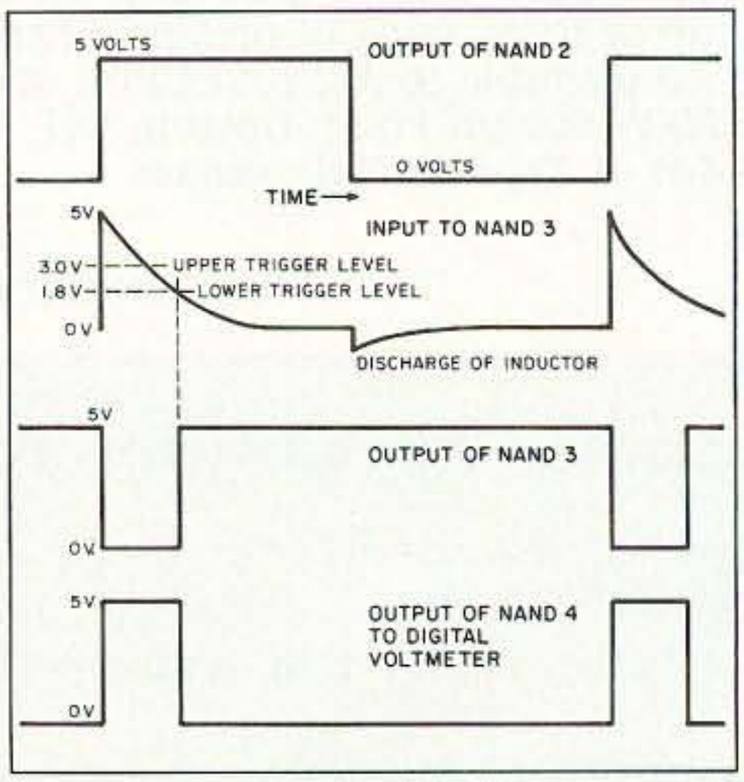

Figure 2. Voltage waveforms for the inductance meter.

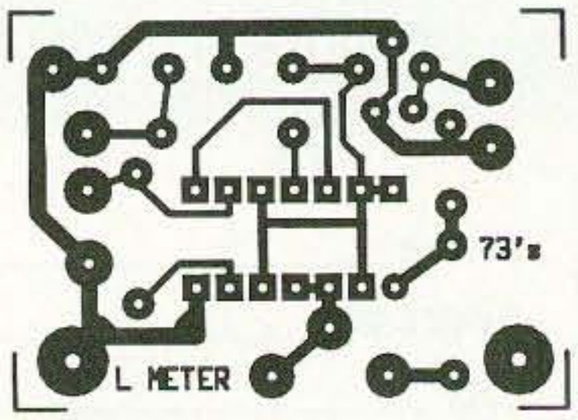

Figure 3. PC board foil pattern.

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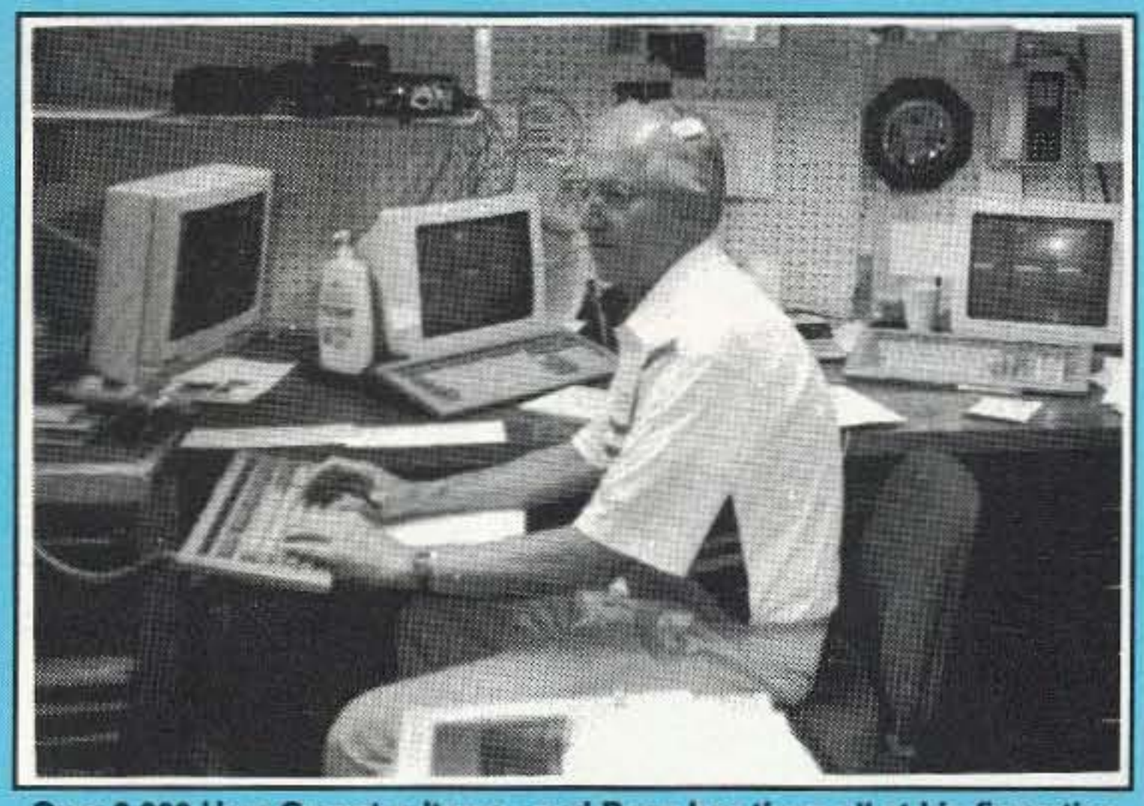

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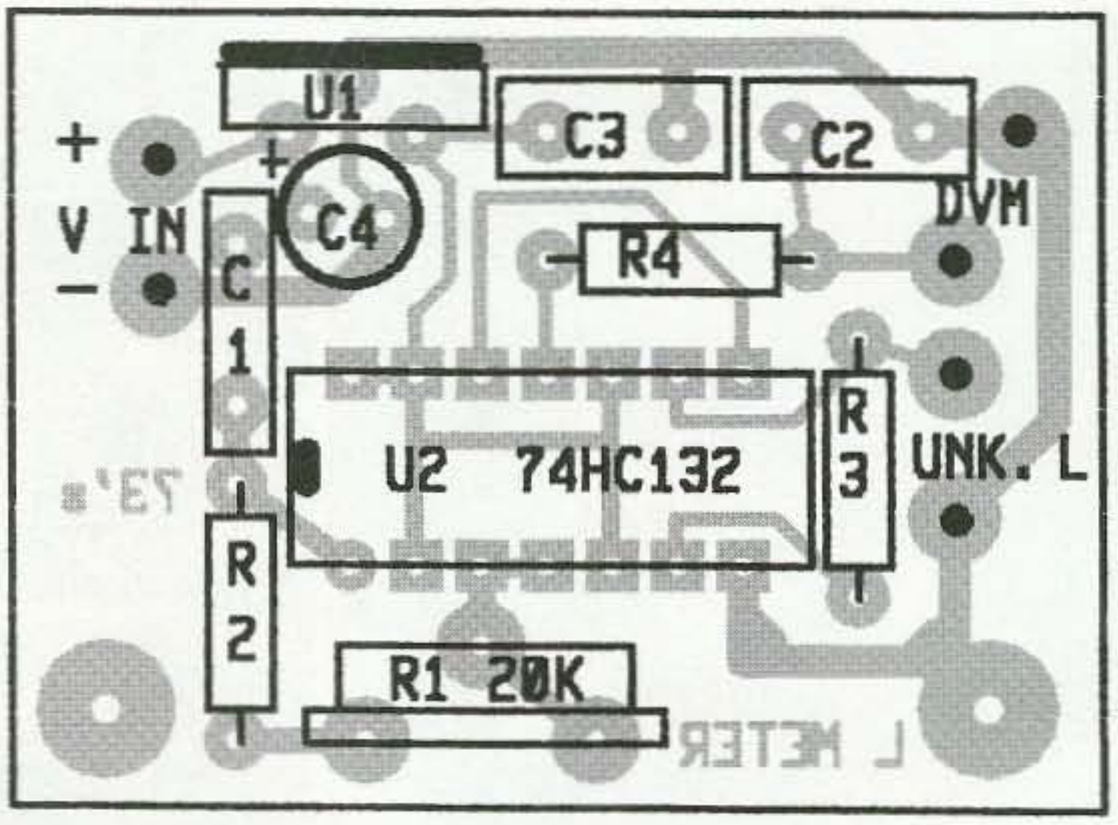

Figure 4. Parts placement.

Theory of Operation

Figure 2 indicates the waveforms of the voltages present. At the instant the input square wave goes positive (5V), so does the voltage across the inductor. The NAND trigger level is about 3 volts, therefore the NAND 3 output goes LOW (inverter action) while NAND 4 output goes HIGH. When the voltage across the inductor decays to the lower triggering level (1.8V), NAND 3 goes HIGH and NAND 4 goes LOW. In other words, an output pulse is formed. We will be show that the pulse width is directly proportional to inductance.

Examine Equation 1 and Equation 2 to see the linearity, in spite of the fact that the inductor voltage dies exponentially.

Assume no coil resistance. R = external resistance

Equation 1: $V_L = 5e^{-(RT_w)/L} = 1.8V$

T_W is the time it takes the inductor to go from 5 to 1.8 volts. Re-arrange Equation 1 and take the natural log.

Equation 2: $T_W = (L/R)\ LN\ (5/1.8)$

L is in microhenries, R is in ohms, T_W is in microseconds, and LN is the natural log 1.022.

All the terms in Equation 2 are constants. Therefore, the pulse width, T_W, is a linear function of inductance.

The equation for the average (DC) voltage of a rectangular pulse is: (T_P = time of square wave)

Equation 3: $V_{AVG} = (T_W/T_P) \cdot$ height of pulse [5V]

Equation 4: $f(MHz) = 1/T_P$
(T_P in microseconds)

Equation 5: $V_{AVG} = 5 * T_W(f)$
(T_W in microseconds, f in kHz, V_{AVG} in mV)

From Equation 5, if T_W is a linear function of inductance then average voltage is also a linear function. Experimentally (using a scope), we found that the effect of stray capacitance is greatly reduced if the resistor, R3, is about 250 ohms. Values of R3 much higher than 250 ohms prevented the inductor voltage from reaching 5 volts due to stray capacitance. As a result, linearity suffered. I used a 220 ohm for R3. If R3 is much lower than 220 ohms, the battery current is too high and linearity becomes poorer due to the longer time constant (L/R). The time constant must be short enough so that the inductor voltage falls to nearly zero every positive half cycle of the square wave. I added an RC filter on the output so that the frequency response of your particular DVM won't matter. (My DVM is a Micronta 22-188 from Radio Shack.) The DVM should have about 1 megohm input impedance.

There are many possible variations in the value of R3 and the frequency of the square wave. However, due to the wide variation in the stray capacitance and DC resistance of inductors in the mH range, linearity is seriously degraded. Consequently, no attempt was made to include readings above 250 µH.

Readers will probably determine that the same circuit, with only a few minor changes, could be used to measure capacitance. True, and I have already built one, but there are so many capacitance meters out there that I decided to drop that feature and reduce the complexity by not adding more adjustment pots and switches. 73

Parts List

C1	0.001 µF, 16V or higher
C2	0.47 µF
C3	0.1 µF capacitor
C4	1.0 µF/35V tantalum or electrolytic
R1	20k pot
R2	22k
R3	220 ohm ¼W
R4	10k ohm ¼W
R5	22k ohm ¼W
U2	74HC132 integrated circuit
U1	7805 5-volt regulator

A blank PC board is available for $3 + $1.50 shipping per order from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

Contact Arthur C. Erdman W8VWX at 224 Chaucer Court, Worthington OH 43085. Please enclose an SASE.

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CIRCLE 67 ON READER SERVICE CARD

Use Those Surplus Meters

Find out what's inside that meter, and how it can be used.

by J. Frank Brumbaugh KB4ZGC

Junk boxes all over the world hold panel meters with all kinds of scales, most of which provide no clues to the characteristics of the internal movements. If the capabilities of these meters could be determined easily, many would be dusted off and placed in useful service in power supplies and test gear. This article will describe some simple and easy methods that any ham can use to identify the electrical parameters of most types of panel meters, and show how to tailor them to his or her exact requirements.

Meter Varieties

Disregarding the oddball meters which were originally intended for use in military equipment for exotic purposes, most common panel meters are of two basic types: iron-vane and D'Arsonval. Typical of the iron-vane movement are the small, black metal-cased meters such as those manufactured by Shurite and a few other companies. The D'Arsonval movement is a moving coil movement and is used in the more expensive, and accurate, panel meters, as well as in analog VOMs and other types of electronic equipment.

The iron-vane meter is neither very sensitive nor very accurate, and in most cases its function is clearly indicated by the scale on the meter. This meter is often used on automotive battery chargers and in AC line voltage measurement.

The d'Arsonval—moving coil—movement is usually found in meters which at least look expensive, in black or white or clear plastic cases. Occasionally the case may be metal, usually painted black, and a few may be hermetically sealed. Almost every such meter can be identified and placed in service to measure either voltage or current or both (with switching) of practically any value.

Some surplus panel meters, especially those made originally for WWII and more recent military equipment, and many more removed from commercial gear and manufactured under such well-known names as Simpson, Westinghouse, Marion, etc., contain essential information on their faces. For now, ignore the main scale and look at the very small type at the bottom of the meter face, usually on one or both sides of the movement, visible through a cutout in the center. Either the DC resistance, the full-scale DC current, or both may be printed there.

The many small square and edgewise panel meters in plastic cases now available from mail order parts dealers for about $2 are usually 100 µA, 200 µA, 500 µA, or 1 mA movements. However, be aware that these ratings are nominal, not exact, and these inexpensive meters may not have a linear response, regardless of any scale printed on them. These meters are available in left- or right-handed zero and center zero. They were made originally as tuning meters in commercial AM/FM and stereo equipment for home use, and as power and S-meter service in citizen band transceivers.

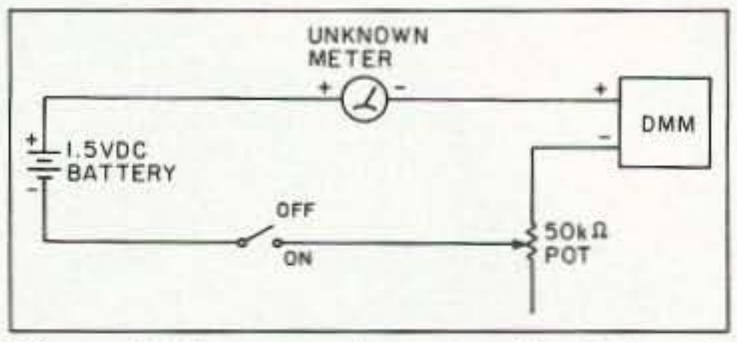

Figure 1. Test setup for measuring full-scale current.

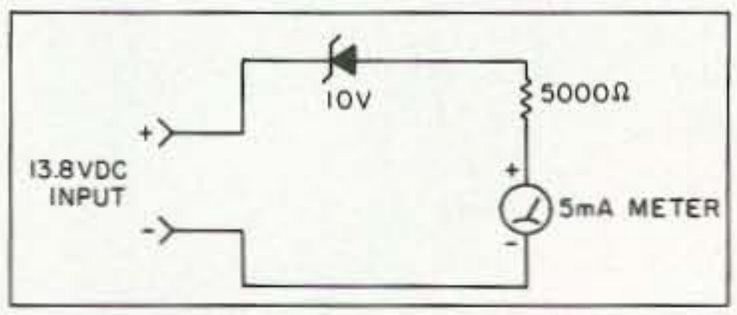

Figure 2. Suppressed zero, expanded-scale voltmeter.

Even if the DC resistance and/or full-scale current is printed on the meter face, there may be internal shunts or multiplier resistors. Therefore, I recommend that the actual full-scale current be measured before doing anything else. This is covered later in this article, as is the easy way to measure the meter's DC resistance.

Meter Disassembly

CAUTION: If you have to make any internal modifications, the meter must be partially disassembled. Use extreme care and the proper tools in taking the meter apart. Equivalent care must also be used in reassembly. Be very careful not to lose any tiny screws! Replacements may be impossible to locate.

Surplus military and commercial meters in black metal or plastic cases are usually held together by three small flathead screws around the circumference of the rear portion of the meter case, near the rear panel. Surplus commercial meters in white or clear plastic cases are usually held together with strips of cellophane tape, but a few may be cemented together with plastic adhesive. Hermetically sealed meters, easily identified by the glass-to-metal seals around the rear terminal studs, cannot be disassembled without destroying them. However, these meters are very accurate, and the printed scale(s) are indicative of their intended use. Use them as-is, or sell them at the next hamfest.

If the meter is held together with screws, use a jeweler's screwdriver of the proper size to remove them, being careful not to distort or burr the screw slots. Put the screws in a safe place so they will not be lost. With one hand, grasp the terminal posts on the rear of the meter and, holding the case firmly in the other hand, gently pull the meter movement from the case.

If the meter is in a plastic case held together with strips of tape, carefully strip the tape off and discard it.

If the meter case has been glued together it *may* be possible to break the seal by carefully cutting through the joints with a sharp knife. This may or may not work, and cutting or prying with a knife may cause the plastic case to crack or break, rendering the meter unusable. However, if you have to disassemble this type of meter, it must have been unusable as-is and thus would not be a great loss. Attempting to take this type of meter apart is not recommended, except as a last resort.

Modifying the Meter

The only internal modification that I suggest for panel meters is the elimination of shunts and series resistances so that the basic meter movement is available at the external terminals.

Shunts will be connected between the positive and negative terminals. Usually they

look like a coil of wire, a resistor, or, in some cases, a piece of printed circuit board. This latter shunt is generally found in very large DC ammeters.

Multiplier resistors may resemble ordinary resistors or small coils of wire. These normally will be connected from the positive meter terminal to an insulated tie-point near the meter coil at the base of the needle. The simplest way to eliminate the effect of the multiplier resistor is to shunt it with a fine wire (AWG 30 or finer), *very carefully* soldering this shorting wire to both ends of the multiplier resistor. If there is room to clip the resistor out, it can be replaced with a short piece of fine wire. Note: In some meters it may be necessary to remove either the meter face or the rear panel to gain access to internal components.

If the meter face must be removed, use a small jeweler's screwdriver of the proper size to extract the two tiny screws holding the meter face to the internal structure. Save these screws, and any small meter needle stops which were attached under the screw heads. Then carefully, without bending the needle, slide the meter face towards the top of the meter and off.

When a new or modified scale is to be placed on the meter to replace the original scale, removing the face first will make this modification easier.

To remove the rear panel of the meter, carefully remove the nuts from both terminal studs passing through the rear of the meter. Save these nuts and any washers or solder lugs that come off with them. Very carefully remove the rear panel from the terminal studs. Note: If you anticipate using shunts or multipliers with the meter, I suggest that you use them externally, *not* placed inside the meter case. Used externally, meter shunts and multipliers can be trimmed or changed at any time if you want to use the meter for a different function.

Meter Reassembly

If the meter face or rear panel has been removed, replace them in the reverse order to that used in removing them. Use the same hardware and tools, and be extremely careful not to bend or break anything. If needle stops were found under the face mounting screws, be sure to replace them in the same positions they had previously occupied.

Meters held together with screws must have the movement inserted into the case so the screw holes match perfectly and the meter face is positioned properly when viewed from the front through the protective glass. **Caution**: Make certain that the slot on the front of the movement slides accurately over the stud on the zero adjust, if the meter is equipped with one.

Before fastening the screws holding the meter together, hold the meter in one hand while adjusting the position of the zero adjust screw on the front of the meter. It *must* be possible to move the needle both above and below scale zero with less than 180 degrees movement of the zero adjust screw.

If the needle cannot be moved as just de-

scribed, remove the movement from the case. Look into the case from the rear and rotate the zero adjust screw to position its stud at the bottom of the case and on the vertical center line. Then, carefully align the slotted extension on the bottom front of the movement into a vertical position so it will slip properly over the zero adjust stud when the meter is again put together.

Slide the movement back into the case, making sure that the screw holes on top of both components match up when the movement is fully seated into the case *without rotating* either component in a way that will affect matching the screw holes.

Check proper seating by again rotating the zero adjust screw so the needle can be moved both above and below the scale zero. Then replace the three screws holding it together and set the needle to scale zero.

Commercial plastic-cased meters seldom have zero adjust capability, and thus are simpler to reassemble. Replace the face if it has been removed, and the rear section, as described above. Finally, use cellophane tape to hold the meter case together.

Many small, square plastic meters don't come with a means of mounting them to a panel. There is sufficient space near the lower corners of these meters to drill small holes from the front panel through the rear of the case to clear 4-40 machine screws. **Caution:** Drilling these holes will leave plastic shavings and chips inside the case. These must be removed to prevent them from lodging in the movement or under the needle and preventing the meter from operating properly. Use great care when removing these chips and shavings so the moving coil and needle are not bent or broken.

Table 1. Copper Wire Table

AWG	Ohms Per Inch
14	0.0002
16	0.0003
18	0.0005
20	0.0008
22	0.0013
24	0.0021

Table 2. Fractions of One Inch

Decimal	Linear
0.0625	1/16
0.1250	1/8
0.1875	3/16
0.2500	1/4
0.3125	5/16
0.3750	3/8
0.4375	7/16
0.5000	1/2
0.5625	9/16
0.6250	5/8
0.6875	11/16
0.7500	3/4
0.8125	13/16
0.8750	7/8
0.9375	15/16

Determining Meter Resistance

Although the methods for measuring the DC resistance of meter movements described in the *ARRL Handbook* and other publications are quite accurate, they are rather complex. The advent of the digital multimeter (DMM) has made such involved methods obsolete. With the DMM on the ohms scale, meter resistance can be safely and accurately measured directly, as simply as measuring an ordinary resistor.

Fortunately, the voltage and current available at the test prods of a DMM set to measure resistance are too low to damage even a 50 µA meter. While most DMMs will pin the needle on a 50 µA movement, the meter will not be damaged. Usually, a 100 µA meter will indicate about three-quarter scale when it is being measured with a DMM. Caution: Use only a DMM to measure meter resistance directly. An analog VOM measuring ohms can provide enough current to destroy a valuable meter.

The range of resistances to be expected will probably be between about 50 and 5,000 ohms. Higher resistances are usually, but not always, found in more sensitive meters. Resistances outside this range suggest internal components such as shunts (very low resistance) or multiplier resistors (high resistance). In these instances, first check the primary scale printed on the meter face. It may indicate the range of current or voltage for which you have an immediate or future use. If this is true, no further action is necessary.

Determining Full-Scale Current

If full-scale current in microamperes or milliamperes is not printed along the lower edge of the meter face, you will have to measure this. Because of the very fine wire used in the moving coil of d'Arsonval meters, basic movement current is limited to about 25 mA, although most surplus meters are usually 1, 5, or 10 mA. This makes these meters more valuable for use as DC voltmeters and ammeters, as well as in ham-oriented equipment of all kinds.

Refer to Figure 1, which illustrates the test setup for measuring the full-scale current of unknown meter movements. Although a DMM is preferred because of its accuracy, an analog VOM can be used for this measurement. Set the meter to indicate DC current, and the 50k ohm potentiometer to maximum resistance. Apply voltage—I suggest using a flashlight battery—and slowly decrease the resistance of the pot until the needle on the unknown meter is at full scale. Read the current on the DMM or VOM. This value is the full scale current required by the unknown meter. Note: Both the DC resistance and full-scale current should be marked on a label attached to the meter. This information will be needed when calculating shunts or multipliers.

Calculating Voltage Drop Years ago it was almost always safe to assume that any basic meter movement of the d'Arsonval type was a "50 millivolt movement." No longer.

To discover the amount of DC voltage required to produce a full-scale indication on the meter, you'll have to make a very simple Ohm's law calculation. The full-scale current and DC resistance have already been measured so you can determine the voltage drop by the formula: E = IR, where E = volts across the meter; I = full-scale current in amperes; and R = DC resistance in ohms. This value should be marked on each meter. It will be required in making shunts to allow greater current to be measured.

Voltage Multiplier Resistance

A DC current meter in series with a resistor becomes a voltmeter and the scale is calibrated in volts. It is necessary to know the full-scale current of the meter in order to choose the proper series resistance. Because the voltage drop across the basic meter movement is only a few millivolts, it can be ignored and the value of the multiplier resistor determined from the full-scale current required by the meter and the maximum voltage required to be measured. Again, a simple Ohm's law calculation will tell you what you need to know: R = E/I, where R = multiplier resistor in ohms; E = maximum voltage to be measured in volts; and I = full-scale current of the meter in amperes.

A special application is a *suppressed zero, expanded scale voltmeter*. This allows spreading a narrow voltage range over the entire meter scale, a voltage range which is referenced to a point above ground. For instance, you might want to monitor the +13.8 VDC from a regulated power supply which powers a modern transceiver. If an ordinary voltmeter, which measured from zero to, perhaps, +15 VDC were used, any voltage variation around the +13.8 volt point would hardly be visible on the normal panel meter. An expanded scale voltmeter, which would measure only the 5 volt spread between 10 and 15 volts, would enable even small variations of the +13.8 VDC to be seen.

The properties of zener diodes, available from a few to a few hundred volts, form the magic ingredient which allows such a narrow voltage range to be easily monitored. The zener diode establishes the voltage equivalent to scale zero on a low voltage meter, and the meter will not indicate a voltage lower than the conducting point of the zener diode chosen in each application.

Figure 2 illustrates a typical suppressed zero, expanded scale voltmeter which monitors only the range between +10 and +15 VDC. The values given are for a 5 mA meter and uses a 10 volt zener diode to establish the voltage at which the meter (which, with its multiplier resistance, becomes a 5 volt meter) starts to conduct. This example illustrates the simplicity of the application and you can adjust for just about any voltage monitoring application that most hams might need. **Caution**: Be sure to consider both the current-carrying capacity and power dissipation maximum of the zener diode used in any application where this type of voltmeter is to be used. If the zener diode should develop a short, it is likely that the meter movement would be damaged and the needle "wrapped around the pin."

Current Shunts

A DC current meter shunted by a small resistance becomes an ammeter capable of indicating greater current than the basic meter movement. The new scale is calibrated in amperes or milliamperes, depending on the application. A shunt to allow the meter to measure higher current is very simple both to calculate and to make from common copper wire. The voltage drop across the meter, the maximum current to be measured, and good old Ohm's law again are all that are required to calculate shunt resistance: R = E/I, where R = reputed shunt resistance in ohms; E = voltage drop across the meter, in volts; and I = maximum current measured in amperes.

Table 1 gives the value of ohms per inch of copper wire sizes from AWG 14 through AWG 24. These values have been rounded off to four decimal places. These values are very small so I suggest using a calculator to determine the length of wire in the shunt.

To determine the length of copper wire needed for the shunt, choose a wire gauge that seems reasonable for the maximum current to be measured. As a guide, remember that AWG 22 is suitable for 5 or 6 amperes, and AWG 16 is sufficient for 20 or 25 amperes. Smaller wires (higher AWG numbers) may be used for lower current values, and vice versa. Larger wire sizes make shunts self-supporting. Smaller wire sizes for shunts should be wound on forms such as 1 watt resistors.

Calculate the shunt as follows: L = RS/RW, where L = length of wire in inches and decimal fractions; RS = required shunt resistance in ohms; and RW = resistance of one inch of chosen gauge wire (from Table 1). The required length of shunt wire will seldom be in an exact number of inches. Use Table 2 to convert decimals to fractional equivalents.

As an example, assume that the meter movement has a voltage drop of 50 mV at full scale and that 20 amperes is the maximum current to be measured, the current equivalent to full-scale on the meter. In this case, AWG 16 wire will be used to make the shunt. Therefore: L = 0.0025/0.0003, so L = 8.3333 inches (8-1/3 inches).

Referring to Table 2, 0.3333 inches is closer to 5/16 than 3/8, so this is added to the eight inches, giving a total length of wire of 8-5/16 inch for the 20 ampere shunt.

Now all those meters gathering dust in junk boxes can be easily revived and given a purpose in life. Don't let them hide in dark corners. Clean them up, check them out, and put them to work in the ham shack. And, be sure to bypass the terminals of each meter with a 0.01 µF disk capacitor to prevent stray RF from causing erroneous meter indications. 73

Contact J. Frank Brumbaugh KB4ZGC at 1812 Marilyn Ave., Bradenton FL 34207-4743. Please include an SASE.

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Moonbase America

At the Dayton Hamvention, I was privileged to have then-10th-grader Lenny Mack KB8KTC speak at my Youth Forum about his participation in the famous Moonbase America project. Lenny was the command controller in charge of the entire project from his school. He spoke enthusiastically to the youngsters and adult hams in attendance at the forum.

In recognition of 1992 as the International Year of Space, Moonbase America provided students across the country with an opportunity to participate in a national educational project. Different schools had varied levels of involvement, but all the schools that participated benefited from the unique perspective on learning.

Photo A. Aerial shot above Moonbase America.

In April 1991, 84 students from the Copley-Fairlawn Middle and High School participated in a week-long simulation of a moon base. During this time, 17 Copley-Fairlawn students manned the Command Center outside of the structure. The students lived in a self-enclosed city consisting of nine geodesic domes and conducted all aspects of survival on the moon. Students from 15 local schools assisted. The project incorporated many fields of study: science, computers, electronics, math, English, history, government, restaurant management, business, physical education, communication, technology, music, library sciences, and foreign languages.

Moonbase America was developed to encourage students to actively participate in their own education. Students were asked to project themselves into the future to discover the technology and environment they need. The project was networked throughout the United States. Eighteen schools were chosen as major participants, dedicated to one critical area of the program: hydroponics, fish hatchery technology, robotics, space science experiments, and space science medicine.

These satellite schools reported directly to Moonbase America with their experimental results and solutions to planned and unplanned problems. The scope of participation was unlimited because all other interested schools followed a general coinciding curriculum and were offered the opportunity to participate in national PBS satellite broadcasts aired during the occupancy of the Moonbase.

The national curriculum was developed through the support of nationally recognized high school and college instructors. This project gave students experiences which are not available in the normal classroom setting—interacting with their peers in other states, discovering the importance of sharing ideas, designing their own courses of action, and working closely with professionals from the business community.

Through the assistance of NASA, corporate sponsors, civic organization, and national student and teacher participants, Moonbase accomplished its goal: students permanently interested in becoming involved in the sciences, space, and learning. Lenny was kind enough to forward the following write-up to me. For further information, Lenny can be contacted at 3400 Ledgewicke Circle Fairlawn OH 44333, or KB8KTC @ WB8BII . OH.USA.NA.

KB8KTC: Ham Radio Highlighted

"Houston, Tranquillity Base here, the Eagle has landed." These were the first words transmitted from the moon by Neil Armstrong on July 20, 1969. Billions of people back on earth watched the ghostly images of Armstrong take the first steps on the dusty lunar surface. Yet, by the end of 1972, the Apollo program had been terminated and no one has set foot on the moon again—until last April when 84 students from Copley, Ohio, spent one week on the lunar surface in a Moonbase. Well, not really, but we came just about as close as you can and still stay on our own planet.

The simulation Moonbase America enabled 84 students to live in a moon city for seven days. The city, consisting of a geodesic structure of nine domes, included everything needed for survival: a fish hatchery, food preparation, government, communications, and waste management, with specialists in all areas. Each student spent an entire year in a space science class, a state accredited science course, and many after school and weekend hours training for their positions for the simulation.

Photo B. Satellite tracking antennas (on the left) on top of the main dome of Moonbase. To the right is a 3-element triband HF beam on a 40-foot tower.

Our training in ham radio began early in the school year. Members of the Cuyahoga Falls Amateur Radio Club donated several hours of their time during the day to come in and teach the 84 students the fundamentals of ham radio and prepare them for the Novice code and theory tests. Sixty of the 84 students passed their tests and obtained the Novice license for use during the simulation. Some students opted to upgrade to Technician for further privileges.

Once the simulation began, amateur radio played a major role in its success. Some events involving amateur radio could have been lifesaving if we had really been on the moon.

Located inside the 50-foot dome were: a communications console consisting of a full HF station for special event operation; two dual-band 144/440 MHz base station radios for communication to ground crews; one 220 MHz base station radio for internal communications; one 1.2 GHz base station radio for communications to the ground; an ATV transceiver for video link to ground; a VHF packet station; a complete satellite tracking system, including a 386 computer running satellite tracking software; a satellite 144/440 MHz all-mode transceiver; and 10 220 MHz hand-held radios located throughout the base for internal communications.

At the command center on the ground, there was a similarly equipped station. Also, for external moonwalks, there was an ATV transmitter located on the Moonrover for live video. This entire system enabled us to keep in contact with the command center back on ground (located in the high school

Photo C. Lenny Mack KB8KTC, sitting at the communications console, is operating the special event station.

auditorium), throughout the domes, and with moonwalkers during their walks.

Some might ask, "Why amateur radio in a moonbase?" Amateur radio, as most hams know, is a reliable source of wireless communications for video, voice, computer, and other modes. One evening during the simulation, the electricity failed, and all other means of communications with it. But our 220 MHz battery powered handhelds provided a link to the ground.

Each day two students exited Moonbase for the daily moonwalks with hand-held radios and VOX headsets for communications to each other, the ground crew, and people inside Moonbase. In everyday activities, we used ham radio for internal communication between pods. Specialists in each area used the radios to keep in contact with other people throughout the base. We also used it as entertainment, talking third party to friends and relatives back on the ground.

Moonbase was a milestone in education here in the United States. It not only taught the students at Copley High many things on topics such as government, space, environment, computers, living together in a closed area with 83 other people for a week, and many other things too lengthy to list, but it also taught teachers and students abroad that education can be fun, hands-on, and rewarding for the student and teacher.

I would like to extend a special thanks to ICOM of America for the donations of equipment used during the simulation, the Cuyahoga Falls Amateur Radio Club for technical support before and during the project, with special thanks to Mike Young WB8CXO and Rich Burgan WC8J, without whom none of this would have been possible. 73

Please send write-ups on interesting classes, recruiting ideas, youth club activities, or individual children's experiences, along with photos, to Carole Perry at the above address.

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Up, Up, and Away

For the past three years, I have encouraged you to send me news of your local radio direction finding (RDF) competitions (often called foxhunts or T-hunts). Some have, but most of you are apparently too busy hunting and building to write. Luckily, I've had the chance to visit some of you and take photos. This month, "Homing In" goes T-hunting in New Mexico.

Albuquerque is probably best known for its annual Balloon Fiesta. It's hard to describe adequately: hundreds of hot air balloons in the air, all shapes and sizes, all immensely colorful. Where they will land is quite unpredictable, so each balloon's pilot needs to communicate with its chase crew.

Balloonists and crews use every possible radio service, from business band and cell-phone (legal) to marine band (illegal) and ham radio (illegal when unlicensed or commercial). The Fiesta is a scanner owner's dream and an FCC field engineer's nightmare. April and I didn't see the feds there, but there were plenty of rumors.

The morning balloon ascension was just a prelude to the afternoon's fun—an Albuquerque-style T-hunt. There is a hunt almost every Sunday afternoon on 146.565 MHz, starting from the University of New Mexico campus. Typical boundaries are determined by the Albuquerque AAA city map. To win the hunt, you must have the lowest elapsed mileage. Occasionally, time determines the winner instead.

High-Tech RDF in 5-Land

Competitive hunting is new to most Albuquerque hams, so they aren't set in their ways. They are eager to try out various RDF methods, and they don't fear failure. Some have already put a big hole in the car roof for a 2 meter quad (Photo A), or arranged another semi-permanent mounting method for a rotating gain antenna (Photo B).

Most use some sort of compass rose at the bottom of the mast to indicate direction. Jerry Boyd WB8WFK has gone a step further. He mounted a precision linear 360-degree potentiometer to the bottom of his mast (Photo C), and connected it to a meter readout atop the dash. Now he can see which way the beam is pointing without looking down.

There are endless possibilities for enhancements to this scheme. The direction indicator could be directly tied into a laptop computer for real-time triangulation. (Substituting a sine-cosine pot would probably simplify the software design.)

Correction for vehicle heading to give true (relative to north) bearings could be done by adding the output of a vehicle-mounted flux-gate compass. Who will be the first to do all this, and put the readout into a "heads-up" display? I'm waiting for your photos.

The terrain within the Albuquerque hunt area is fairly level, although there are mountains outside the boundaries that can provide some interesting signal reflections. To add an extra challenge, most hiders put their fox transmitters well away from driveable surfaces, forcing hunters to get out of their vehicles and scout around as they close in.

Fox hunters do this electronic on-foot "sniffing" with a variety of techniques, ranging from "body fades" with hand-held radios, to field-strength meters on their beams, to special homing RDF units (Photo D). The W9DUU design, which uses time-difference-of-arrival (TDOA) technology, has been well received in Albuquerque. (W9DUU's RDF unit is described in *73 Amateur Radio Today*, July 1990, page 9. More information on commercial and home-brew TDOA sniffers can be found in "Homing In" for September 1989 and November 1989, and in *Transmitter Hunting—Radio Direction Finding Simplified*, a 323-page book by KØOV and WB6UZZ, published by Tab Books, and available from Uncle Wayne's Bookstore.)

These hunters have come a long way in a short time, and are still thinking big. At the post-hunt barbecue, a (nameless for now) hunter took me aside to covertly show off a new "secret weapon" antenna system he was working on. It was temporarily hidden in the back of his vehicle. I hope he has revealed it and given it a couple of battle tests by now.

Albuquerque T-hunts have garnered some nice publicity. They were featured on a local TV news report recently. My thanks to the T-hunters of Albuquerque for a great hunt experience. The barbecue, hosted by Kevin N6QAB and Susan Kelly, was equally fun.

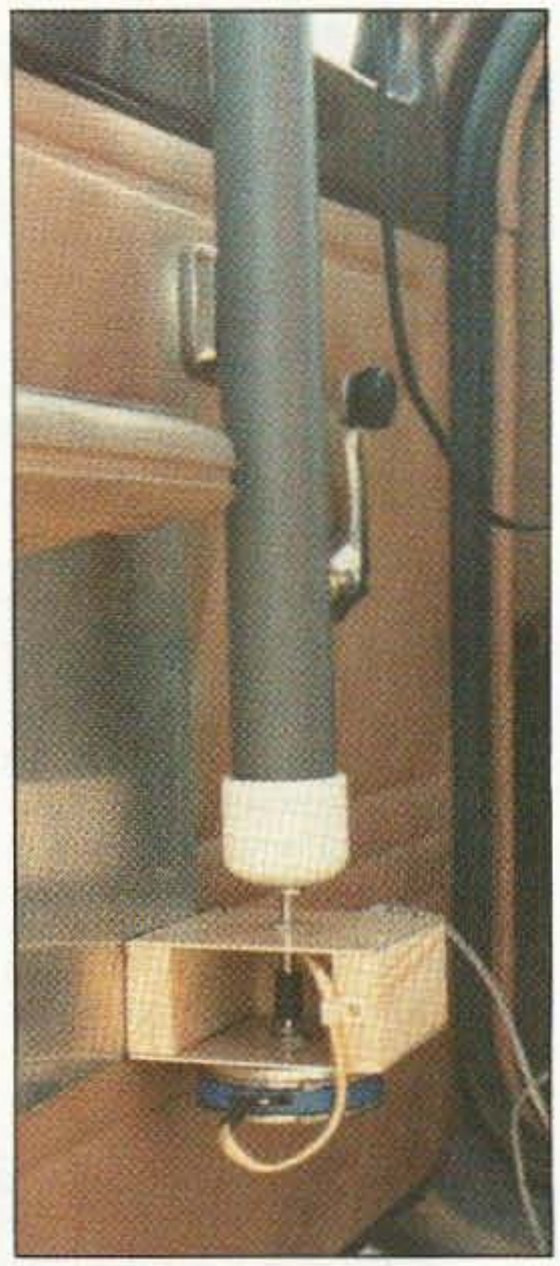

Photo C. Mount a precision 360-degree or sine-cosine potentiometer to the bottom of your antenna mast, and you can have remote indication of your mobile beam heading. Jerry Boyd WB8WFK installed his mast to the driver-side door.

Support Your Local Sheriff

Evening Shade is not just the creation of a whimsical TV writer. The name comes from a real-life town of 450 souls in northeast Arkansas, at the eastern end of the Ozark Mountains. (Actually, there are two Evening Shades in the state, but that's another story.) The hams of Evening Shade and vicinity aren't regular T-hunters (yet), but they knew enough about RDF to perform a valuable public service last September.

Monty Haley WJ5W, who broke the story, lives in Evening Shade. It all started when a strong unmodulated carrier appeared on the sheriff's 150 MHz repeater in nearby Walnut Ridge, jamming all other signals. Walnut Ridge, the county seat for Lawrence

Photo A. Bob Lindsey KF5W had little hesitation about taking a big punch to the roof of the family car. He uses a commercially available quad for his 2 meter hunting.

Photo B. Joe Riggs WAØTWG mounted a beam and mast to the driver's side of his pickup. Left-side overhang restrictions in your state's vehicle code may limit your antenna size using this method.

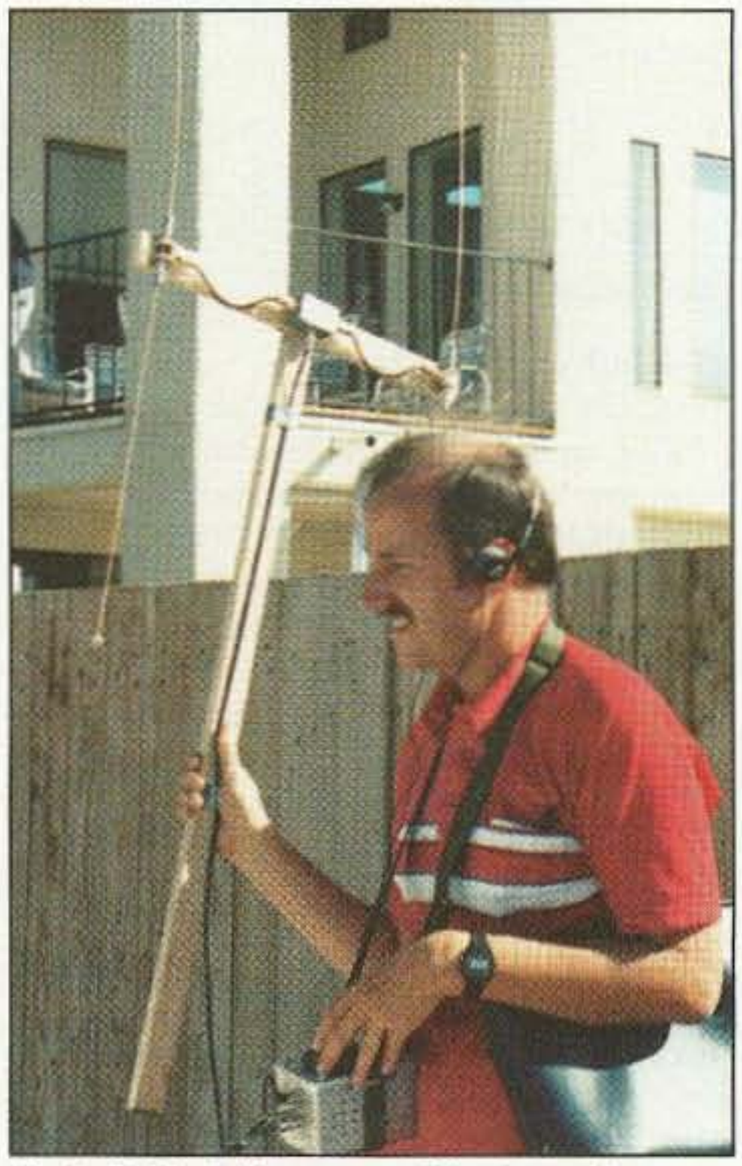

Photo D. Most Albuquerque T-hunts require an on-foot "sniff" at the end. WB8WFK says his W9DUU-design homer works great.

County, is about 35 miles east of Evening Shade.

The QRM started early Thursday morning. Communication was quite difficult for the sheriff without the repeater. "They were forced to use one of the simplex frequencies that the city of Walnut Ridge had for police use and was programmed into all the county cars," said WJ5W. "It worked, but there were a lot of dead spots."

Authorities believed the interference was malicious, and suspected a local ham. "He wants to become a police officer and has a car with lots of antennas like a police car. He told us on 2 meters that the sheriff was blaming him for this, that they were calling in the FCC from New Orleans to be there Monday morning, and that he was ordered to be at the sheriff's office when the FCC came there. As soon as I heard that, I said, 'We're going to find this,' " Monty reported.

Using extended frequency coverage on his 2 meter rig, WJ5W could hear the carrier on the sheriff's repeater input at his location. He put out a general packet message and called some hams on the phone and local repeaters to see if they could get base station beam bearings.

"It took a couple of hours to do all this," he said. "Once we got the beam headings and figured out the general area, three of us took off in our cars. It was six o'clock Saturday when we decided to do something about it, and it was just after ten that night when we found the problem."

The sheriff's personnel had checked all their own radios, but other agencies have equipment with the sheriff's repeater frequencies. "I'm a volunteer firefighter," WJ5W related. "So I'm pretty familiar with fire departments in the area and I knew that a fire radio was a likely cause of the problem. I thought it might be the mike on the seat of a fire truck keyed up.

"That was the reason I was looking for a fire station in the area. There were three of us. We were driving in the general direction—one from the west, one from the south (me) and one from the east, all going to where the beam headings converged and talking to each other on 2 meters."

Sure enough, a failed radio relay unit at the fire station in the town of Strawberry was the culprit. Monty was proud that hams' efforts resulted in some favorable PR: "The sheriff put something in the local paper thanking all the hams who had helped. The guy that they suspected earlier was prominently mentioned as being one who helped find the problem."

"In some states what we did would have been illegal due to restrictive scanner and mobile receiver laws," WJ5W pointed out. "I think if something like this happened again, they would contact us early on. Now that they know we can do it, and we know we can do it, they should be a lot more apt to get us involved from the beginning."

Congratulations to Monty and to the other participants: Larry Allen KB5ECV, Carl Duckworth KB5TI, Nelson Bailey K5TML, and Kenneth Thompson KG5KS. Are you prepared to use your RDF skills to assist agencies in your area? 73

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Flavors of Amplifiers

Continuing our discussion of gain (my, there's a lot to tell, isn't there?), we turn now to the various types of amplifiers. It might seem intuitive that an amplifier is an amplifier is an amplifier, but it just ain't so. There are many types, called "classes," of amplifiers and each has its own characteristics. Consequently, each also has unique advantages and drawbacks. Let's look at the various applications and which kinds of amps are best suited to them.

Know Your Limits

Oops, perhaps I spoke a bit too soon. Before we can do that, we must have a basic understanding of the limits of an amplifying device. These are simple: The amplifier cannot produce an output voltage lower than its lower power supply voltage (usually ground or zero volts), and the amp cannot produce a voltage higher than the voltage of the power supply system feeding it. Note that I say power supply "system" because the inductive tank circuit of a tuned amplifier can be considered part of the power supply (because it stores power), and in such an amplifier a voltage higher than the DC voltage feeding the amp can appear at its output. In essence, the tank inductance is acting like an autotransformer, converting power supply current into a higher voltage just like any step-up transformer.

Any attempt to drive an amplifier past its limits will result in "clipping," in which the output will stay at its limits as the input continues past them. If you've ever seen it on a scope, you know where the name comes from, and if you've turned your stereo up to the distortion point, you know how ugly it sounds. By the way, in transmitters we call it "flattopping," but it's the same thing: The amp just can't go any further, so the tops and bottoms of the waveform are clipped off.

Speak Into the Linear, Sonny

Audio is linear in nature. That is, it is represented by a changing voltage whose changes correspond to the fluctuations in sound pressure. Thus, what comes out of an audio amp must be a replica of what goes in. Any change in the signal will cause an untrue sound, and that is by definition distortion. Actually, there is one exception: The signal may be completely inverted without being damaged; such inversion is not readily detectable by ear, and re-inversion is easy to accomplish anyway, as no information has been lost.

I'd Give it an "A"

There are several types of linear amplifiers. The simplest, and perhaps the "cleanest," is the type A. This design biases the active amplifying element (the tube or transistor) in the middle of its linear region. In other words, the element's resting voltage is set halfway between the points of complete saturation and complete cutoff. This biasing arrangement permits the incoming audio signal to swing up and down (audio is an AC phenomenon) without forcing the amplifier out of its linear region. The amp's output will be a replica (or inverted replica, depending on the design) of the input signal, only bigger. Naturally, if the input signal gets too big, the output will slam into its limits and the amp will clip.

This works great, so why not use it for everything? Well, it has some disadvantages. First, the output is not true AC because it is not centered around zero volts. Rather, it is centered around the bias point, so it never changes polarity with respect to ground. To restore the true AC nature of the input signal, it is necessary to pass the amp's output through a capacitor or a transformer to block the DC component of the wave. That works fine but it, too, has drawbacks, including distortion and frequency-dependent actions.

Actually, there's a far greater problem with class A amplification. Because the amp is biased midway, it is always dissipating current. In fact, at any moment, it is burning half the total supply current! As the audio signal bounces up and down, the current demand follows it, but it all averages out to the same amount as the resting current, which is at the halfway point. Wow, that's a lot of heat! Not to mention the waste of power. Still, a class A amp has the lowest distortion of any type, and some ultra-hi-fi audio systems still use the design despite its serious drawbacks. Such amplifiers will have very large heat sinks for their power transistors and will have hefty power supplies as well.

B Is For Better

Although the class A amplifier reigned supreme for many years, designers were always looking for a better, more efficient way. It was reasoned that if the bias point were set to zero, then the amp would draw no resting current and would run cool. True, but it would also cut off the bottom of the input waveform (which would now be below the amp's cutoff point), turning the amplifier into a rectifier. Now that's what I call distortion! But wait a minute, what if there were another amplifier of opposite polarity hanging under the first one, so that each amp worked on one half of the input signal while the other one loafed? Son of a gun, it works. Two amplifiers connected in this way are called a class B, complementary or push-pull, amplifier. (There's a variation on this called a quasi-complementary, but the arrangement is basically the same.)

This technique has lots of advantages. It draws no resting current, so it runs much cooler than a class A and does not need as big a power supply. Also, its output is truly bipolar, so it needs no capacitor or transformer. Of course, a bipolar power supply is required for this amp.

Class B amplifiers seem perfect, don't they? Well, they would be if the amplifying elements themselves were flawless. Alas, they are not. In particular, the elements begin to exhibit nonlinearity when they are very near their cutoff and saturation points. In other words, the amount of gain changes with the signal level, causing distortion. And, unlike the class A design, which keeps the signal safely away from the cutoff point, the class B hits it each time the input signal changes polarity and shifts to the other half of the amp. The result is called crossover distortion, and it has a particularly nasty sound.

This is one area where tubes beat transistors hands down. The nonlinearity in tubes is very small, permitting class B designs to sound reasonably good. Semiconductors, on the other hand, have such poor linearity near their cutoff points that transistor class B amps are just plain horrible. In fact, this problem was the reason hi-fi purists rejected transistors in the early days. Some still do.

When Is a "B" Not a "B"?

Fortunately, there's an easy way out. If we bias each half of a class B amplifier so that it is turned on *just a little*, we can keep it away from the ugly cutoff points and the signal will remain clean. Of course, the amp will draw some resting current, but far less than would a class A, because the bias point is so low. This is called a class AB amplifier, and it is the design used in most hi-fi audio amps today.

But We're Hams

So why am I going on and on about audio amps anyway? After all, we're hams, not audio purists, right? Well, these same designs are used in RF power amps too. In fact, there's another type, the class C, employed as well. Let's look at the requirements of RF amps and how they are filled by the different types.

In radio, the type of amp chosen depends upon the signal you are trying to amplify. Yes, you could simply go with a class A or AB and call it a day. But there are drawbacks. The class A is very inefficient and wastes power. And a class AB is tricky to accomplish at very high frequencies because small differences in capacitance between the two halves can cause mistracking and distortion. Ultimately, the design used will be matched to the modulation method of the radio signal.

FM and CW

In FM, the power output is constant and the frequency of the carrier wiggles back and forth a little, in step with the modulating signal's amplitude. We all know that what goes out the antenna must be a nice, clean sine wave, but it sure doesn't have to start out that way! Because the amplitude of the carrier doesn't change, we don't have to worry about linearity at all! We can make an ugly, distorted pulse and filter it into a sine wave (by filtering out all of its harmonics) after amplification. Remember what I said would happen if you biased a class A at the cutoff point? It would amplify one half of the signal and cut the other half off like a rectifier. Well, if you don't care about that, you can make an extremely efficient, simple amplifier. If you feed it sine waves, the result will be half waves. If you drive it all the way to saturation, the output will be clipped into pulses. The amplifier will also be running about as efficiently as any could, because it will spend most of its time all the way on or all the way off, and it's the "in betweens" that waste power. Such an amplifier is called a class C, and it's the kind you will find in your walkie or mobile FM rig. It's also great for CW which, like FM, has no amplitude changes within the carrier. The output filter cleans the mess up and sends nice, shiny sine waves to the antenna.

AM

There are two ways to make AM. One is to modulate the carrier at a low level and then amplify it later. This technique, common in multimode rigs, requires a true linear amplifier because any significant distortion will ruin the modulation's amplitude changes. But there's another way. You can make pulses and amplify them via class C, the same way as in an FM rig. Then, by feeding the class C stage with DC power modulated by the audio (instead of pure DC power), you can make its output follow the modulation, creating AM. This is called high-level amplitude modulation. In the tube days, it was known as plate modulation. Most AM-only rigs, such as CBs and older transmitters, use this technique precisely because it avoids the need for linear amplification, which is much harder to do.

SSB

Single sideband is a special form of AM. But, because of the need to filter out the carrier and one sideband, it is not practical to generate SSB via high-level modulation. (If you did, you'd be generating and then discarding large amounts of power.) Thus, virtually all SSB rigs use low-level modulation and linear amplification. The amp may be class A or AB. Naturally, it won't be as efficient as a class C, but that is made up for by the nature of SSB: Large amounts of power are drawn only during voice peaks, since there's no carrier. On average, an SSB transmitter with a class AB amp is the most efficient for voice service.

Well, we're out of space. See you next month! Write to me at the above address with your questions on trouble-shooting. 73

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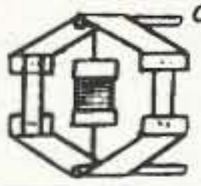

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JAN 11

MILWAUKEE, WI The West Allis RAC will hold their 20th annual Midwinter Swapfest at the Waukesha Co. Expo Center Forum from 8AM–2 PM. Directions: I-94 to Co. J, south to FT, west to Expo. Admission $3 in advance, $4 at the door. Table space: First 4 ft. $3 in advance, $4 at the door; additional 4 ft. $4 in advance, $5 at the door; electrical outlet $5, as available. Advance reservation deadline Dec. 31, 1991. Amateur exams given at Red Carpet Lanes across the street, starting at 9 AM. For tickets or info, write with SASE to ***WARAC Swapfest, PO Box 1072, Milwaukee WI 53201.***

JAN 18

MONTEREY, CA All persons are invited to participate in the free public service event, Winterfest 1992, which will be sponsored by the Naval Postgraduate School ARC at Monterey Peninsula College Armory, rain or shine. There will be an indoor Flea Market and an outdoor Tailgate Market, as well as commercial vendors. Demonstrations include Voice and CW, ATV, Slow Scan TV, Computers, Satellite, Packet, MARS and ARES. Contact ***Pat KA6IRS at (408) 649–4444, Ext. 20, days***, or ***Doug KC3RL at (408) 663–6117, eves.***

JAN 19

YONKERS, NY Metro 70cm Networks will sponsor a Giant Electronic Fleamarket at the Lincoln High School on Kneeland Ave., from 9 AM–3 PM, rain or shine. Free parking. No tailgating. Indoor Flea Market. VE Exams 10 AM–2 PM. Free frequency check. Sellers: $15 1st table, $10 each additional table. All tables 30" x 5' or bring your own table at $1.80 per ft. minimum. $10 full payment is due with registration. At the door, $20 all tables, and $2.50 per ft. No paid reservations will be held past 9 AM. No refunds unless notification of cancellation has been received 72 hours in advance of the event. Admission $4, kids under 12 free. Set-up at 7 AM. Register with ***Otto Supliski WB3SLQ, (914) 969–1053.***

JAN 25

CRYSTAL RIVER, FL The 12th annual Citrus County Hamfest, sponsored by Sky High ARC, will be held at the New National Guard Armory on Seven Rivers Dr., just off US19 south of Crystal River Airport. Admission $4 before Dec. 20th, $5 thereafter. Indoor tables $10, (wall tables $12). Outdoor Fleamarket spaces $6. ALL exhibitors and helpers MUST purchase admission tickets. Talk-in on 146.355/.955. Call ***Ed Gaudet K4BRC, (904) 746–2371,*** or write ***SHARC Hamfest, 9 S. Davis St., Beverly Hills FL 32665.***

GALLATIN, TN The Tenn Valley AR Network, Gallatin Section, will hold its 2nd annual Winter HamFestival in the National Guard Armory on Highway 25 east of Gallatin, from 7 AM–3 PM. Set-up Fri. from 12 noon–5 PM; 5:30 AM–7 AM Sat. Register for VE Exams at 8 AM, take the test at 10 AM. Tables $5. Admission $4. Talk-in on 147.30+, 443.300+, 145.31 repeaters. Buy, sell, trade. New and used gear. Contact ***Bill Ferrell N4SSB, 1120 Douglas Bd. Rd., Gallatin TN 37066. (615) 452–3962 after 5 pm.***

JAN 26

VILLA PARK, IL Wheaton Hamfest 92, sponsored by Wheaton Community Radio Amateurs, will be held at the Odeum Expo Center from 8 AM–3 PM. Tickets $5 in advance with 2 drawing stubs; $6 at the door with 1 stub. All tables reserved—free for clubs (no selling at club promo tables). Info: ***(708) 629–8006***; Flea Market ***(708) 231–2428***; Commercial vendors ***(708) 629–8889*** or FAX ***(708) 629–7098.***

MILFORD, CT The Coastline ARA, will hold VE Exams at 12 noon at the Fowler Bldg., 145 Bridgport Ave., Milford CT. All classes. Contact ***Gary NB1M, 933–5125, West Haven*** or ***Dick WA1YQE, 874–1014, Milford.*** Walk-ins welcome.

SOUTHFIELD, MI The Southfield High School ARC will sponsor their 26th annual Hamfest/Electronics/Computer Swap & Shop at the Southfield High School, 24675 Lahser, from 8 AM–3 PM. Set-up at 6 AM. Admission $4, children 12 and under free. Reserved tables $13 for each 8 foot table. Paid admission required. All profits from the Swap & Shop go toward Electronic Scholarships and to support the activities of Southfield High School's ARC. Make checks out to Southfield High School: ***Robert Younker, Southfield Senior High School, 24675 Lahser Rd., Southfield MI 48034.*** For info call ***(313) 746–8675*** or ***(313) 746–8658.***

JAN 28–30

SAN JOSE, CA The Windows&OS/2 Conference will be held at the San Jose Convention Center Jan. 28 thru 30. Tutorials will be on Jan. 27. Over 250 leading software and hardware vendors will be exhibiting their products. Contact ***Stan Politi, Show Director, CM Ventures, Inc., 5720 Hollis St., Emeryville CA 94608. (510) 601-5000.***

SPECIAL EVENT STATIONS

JAN 5

DAVENPORT, IA The Davenport RAC will sponsor the 1992 Zero District QSO Party from 1600Z–2400Z on these suggested frequencies: CW–60 kHz up from the low band edge; Phone–3.900, 7.270, 14.300, 21.350, 28.360; VHF–146.52 (no repeater QSO's); Packet–145.01. Certificates will be awarded. Mail logs by Mar. 1 to ***/W0BXR, Zero District QSO Party, 2131 Myrtle St., Davenport IA 52804.***

JAN 11–12

KIMBERLING CITY, MO The Kimberling ARC will operate Station NQ0G 1400–2000 on Jan. 11 and 12, in conjunction with the Festival of Lights of The Ozarks. Operation will be in phone 30 kHz up from the bottom of the General portions of the 15, 20 and 40 meter bands, 28.330 and in CW 30 kHz up from the bottom of the bands, plus Novice portions of the 15, 20 and 40 meter bands. For certificate, send SASE to ***The Mayor, Kimberling City MO 65686.***

JAN 28

SAN DIEGO, CA Challenger Jr. High School's Technology Club will operate Station KI6YG to commemorate the 6th Anniversary of the Challenger Space Shuttle tragedy. Operation will be 1500–2400 UTC on the Novice phone portion of the 10 meter subband. For a special commemorative QSL card, send QSL and SASE to ***Challenger JHS, 10810 Parkdale Ave., San Diego, CA 92126.***

JAN 29

SIDNEY, ME The James Bean Elementary School ARC will operate N1IFP from 1200–2100 UTC to commemorate Sidney's Bicentennial. Operation will be on 7.265, 14.265, 21.365 and 28.465 MHz. For certificate, send QSL and SASE to ***N1IFP, Bean School, RFD 3, Augusta ME 04330.***

73 INTERNATIONAL

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

Notes from FN42

As I am writing this, face-to-face communication between Israel and Palestinian representatives is taking place in Madrid, Spain. You might have noticed that I did not say that they were just talking, I said that they were communicating. Is there a difference in what the two words mean?

There very definitely is a difference! Talking means that there is one-way movement of information. It does not mean that anyone is really listening or understanding on the other end. But communicating means that there is a sender and a receiver, and if true communication takes place the receiver understands the sender and gives feedback to the sender. Of course, just because they are communicating doesn't mean that a settlement will be reached that will be acceptable to all, but this type of communication is certainly better than face-to-face looking down a rifle barrel.

During the past few months we have been watching meaningful communication take place in the Soviet Union. People are not just talking, they are also listening. Communication is taking place, just like hams have been doing for years and years! But hams also have their problems. Hams are not perfect either.

As we end 1991 and enter 1992, let us all attempt to truly communicate with each other and make 1992 the best year ever for world peace and prosperity. It's the only world we've got.—Arnie N1BAC.

Roundup

IARU Information downloaded from the US packet radio system, distributed by Clark Campbell VE3KSQ for Tom Atkins VE3CDM, Secretary, IARU Region 2.

The Union of Swiss Short Wave Amateurs (USKA) has developed many agenda items, including four that are of interest to amateurs: (1) The possible extension of the frequency spectrum allocated exclusively to broadcasting which should come from the bands allocated to the fixed service; (2) & (3) The consideration of the allocation of frequency bands to broadcasting-satellite and mobile-satellite service and the associated feeder links; and (4) To develop new recommendations and resolutions in relation to the agenda of the conference, including meteorological aids service in frequency bands below 1,000 MHz and present allocations to space services above 20 GHz.

The Radio Amateur Society of Thailand (RAST) recently met with officials of the Thai Post and Telegraph Department regarding Thai participation in WARC-92. The Thai delegation will not be represented by an amateur but by Mr. Rienchai Reowilaisuk, Director of Frequency Management at the Post and Telegraph Department. Mr. Reowilaisuk attended the April 1991 Amateur Radio Administration Course in Tokyo and will hopefully champion the amateur efforts.

Mr. Alon Bar Sela, representing the Israeli Ministry of Communications, spoke to approximately 400 members of the Israel Amateur Radio Club (IARC) at their annual general membership meeting on May 9, 1991. He gave assurances that the Israeli delegation to WARC-92 will be a staunch supporter of amateur radio and will do all it can to defend the amateur bands.

Amateur radio was well represented at the 20–21 May 1991 WARC-92 preparatory meeting of the Association of Southeast Asian Nations (ASEAN), in Kuala Lumpur. Attending at the invitation of the Director-General of Telecoms, Malaysia, were the Director of the IARU Region 3 Association, Mr. D.D. Devan 9M2DD, and the WARC-92 liaison officer from the Malaysian Amateur Radio Transmitters Society (MARTS), Mr. Sangat Singh 9M2SS. Present at the meeting were 31 representatives from Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, and Thailand.

At the request of the Telecommunications Department of Malaysia, both Devan and Singh presented a paper, "The Case for Amateur Radio in View of Possible Revision of Frequency Allocations at WARC-92," which was subsequently adopted as part of Malaysia's position and distributed to all delegates as an official document. Other amateur presentations followed. The head of the Malaysian delegation asked the meeting to take the interests of amateurs into consideration during their deliberations.

Two papers from IARU Region 1 have been presented to the European Conference of Post and Telecommunications Administrations (CEPT) Working Group "WARC-92" meeting in Sweden in mid-June 1991. One of the papers covered the 7 MHz issue. The IARU fully supports the CEPT approach, which proposes to separate the issue of harmonization of allocations in the vicinity of 7 MHz from the total HFBC package. The CCIR Report to WARC-92, Chapter 4.2, states that "the sharing of frequency bands by the amateur and the broadcasting service is undesirable and should be avoided" and is an "existing undesirable compatibility situation."

The other paper discussed the sharing arrangements that now exist between the amateur service and other services, and the proposed spectrum rearrangement. This paper offers solutions which will protect the interests of all the services involved *[too lengthy for inclusion here]*.

From IARU Region 2 News Service, Tom Atkins, VE3CDM, Secretary IARU Region 2. Address inquires to: Clark Campbell, VE3KSQ, 10-101 Kent St., London.ON.CAN N6A1L2 or VE3KSQ @VE3KSQ.ON.CAN.NA.

Israel/USA Downloaded from packet radio: An electronic issue of the *Israel Ham News* is available on the K2UK packet BBS. The issues may be secured by the REQFIL @ K2UK.NJ. USA technique. Please be SURE that you spell the file name absolutely correctly. The example Ed used was for the October 1991 issue: ISRAELNEWS1091.PT1, .PT2, .PT3, .PT4, which has 4 parts, each approximately 2K or less in length, and each part must be requested separately. If you have any questions contact Ed at K2UK @K2UK.NJ.USA.

Ukraine (USSR) The following report was received from Alex Shestakov UT5UNX: The DXpedition organized by the Karelian DX Club * Kivach * (Photo A) took place on the island of Kizhi from July 25 to August 8, 1991. The island is one of the most wonderful islands on Onega Lake. Kizhi is well known for its wooden temples, the most marvelous one being Preobrazhenskaya Church (Photo B), which was built in 1714. There are 22 aspen domes in five levels on the top of the church.

Photo A. The EK1NWB DXpedition bunch on the Island of Kizhi.

Time is very damaging to the temples, and they are getting dilapidated without proper care. But restoration requires much money. All money which was received by us from selling emblems, pictures, and photos was sent to the 18th century architecture restoration fund. Previous help was received from Finnish colleagues who were here in 1990.

This was the second DXpedition on Kizhi. The stations which participated were UA1NDR, UA1NEG, UA1NEQ, UV3VJ, UA3SDT, UA3SET, UT5UNX, 4K4QQ, and others. EK1NWB was the base station of the Karelian DX Club, working almost every day.

The Netherlands From Radio Netherlands Program Information Release, Sept.–Dec. 1991: Hi, we're back. This bulletin was suspended during some internal reorganisation at Radio Netherlands English department. This publication will continue until March 1991 when we shall replace it with a full-colour newsletter designed to improve our contact with listeners still further.

For any who are presently on or wish to be on our mailing list, please send your name and address to: Els van den Tempel, PIR List, English Department, Radio Netherlands, P.O. Box 222, 1200 JG Hilversum, The Netherlands. If you have recently moved, please send the old address and ask for it to be deleted.

Our new booklist, Edition 13—August 1991, is available. The contents are broken down into eight sections: Listening Guides, Mass Market Periodicals, Books and Pamphlets for the MW/SWL, Broadcast Related Books for the SWL, Tape Recordings, Amateur Radio, Vintage Wireless, and Specialist Addresses. If you wish a copy of the Booklist contact Jonathan Marks at the previous address, or FAX: +31 35 724352; Tel: +31 35 724211.

Photo B. The Preobrazhenskaya Church on the Island of Kizhi.

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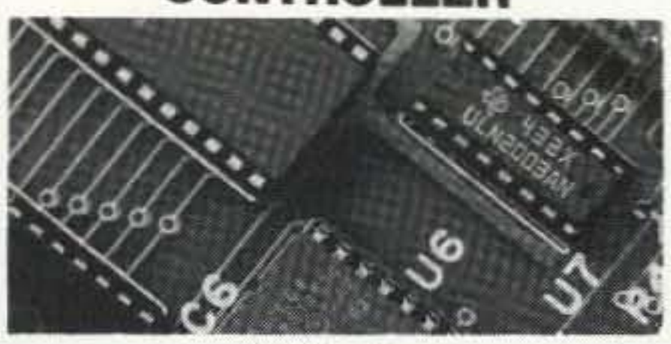

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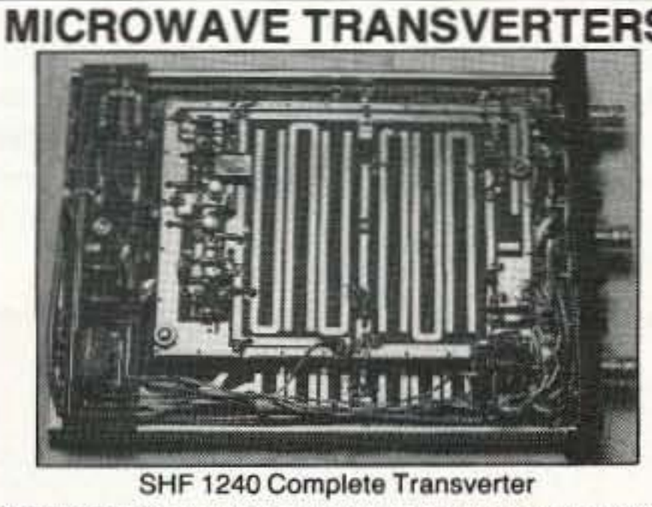

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SHF 2304K	2304-2308 MHz	10mW	Kit $205	Built $325
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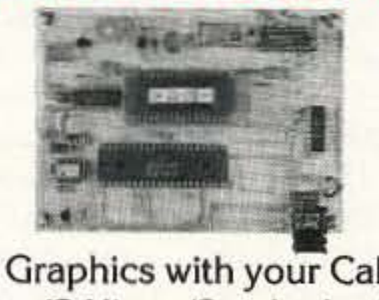

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73

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Equipment used was Soviet and foreign, including UW3KI, FT-270, UA1FA; and RTTY was produced by the Tula radio amateurs. Antennas used were 9 meter ground plane, 2-element quad for 14–21–28 MHz, and inverted Vs for 1.8 and 3.5 MHz.

We plan to do one more DXpedition to the Isle of Kizhi and other islands of the Solovetsky archipelago. You might remember that Mr. Solzhenitsin has written about some in his book, *Archipelago Gulag*. 73 from Alex A. Shestakov UT5UNX, P.O. Box 15 Kiev 91, 253091 Ukraine, USSR.

From Boris "Bob" Grebenichenko, UB5UCH: There is a Jubilee Medal available commemorating the 65th anniversary of the first radio contact between the USSR and the USA. "Radio Amateur Ivan Nikitin for the Kiev Province was the first to have taken the signals of 'WOC' American radio station from the state of Iowa and received official confirmation about it." *Radiolubitel Magazine*, July 1926.

This big ceramic medal is awarded for working 10 USSR stations and 10 USA stations. One QSO with Obl 065 and the state of Iowa must be represented. All stations in Obl 065 will use the following prefixes: UB5U, UB4U, RB5U, RB4U, and the special callsign for this celebration, URØUCH. QSO valid for any time, mode, and band. No QSL cards, only GCR list with US$5 or 15 IRCs. Send registered mail only to: UB5UCH, P.O. Box 1, Obukhov-1, 255400, Ukraine, USSR. SWLs use the same rules. USA stations should send the same information to: Bill Aspin WI8R, 188 N. Mieliens Rd., Munger MI 48747.

Taras Zima, UB5LSL has sent a letter to explain his QSL card service. His address is: P.O. Box 43, Komsomolskig, Kharkov obl., 313750 USSR. His rate is US$1 per three cards.

PORTUGAL

Mike Lazaroff KB3RG/CU3LF
PCS 76, Box 1687
APO AE 09720

Hello once again from the Azores Islands! The Azores are a group of islands located in the North Atlantic, about 2,200 miles east of New York City and about 850 miles west of Lisbon, Portugal. Their total land area is about 922 square miles. The islands range in size from seven square miles (Corvo—CU9) to 297 square miles (San Miguel—CU2).

The islands are of volcanic origin and are quite mountainous, with numerous extinct volcanic craters. There are many varied wild flowers mixed in with the vegetation, which gives the islands a very pleasant appearance.

The climate is semitropical. Summer, which extends from June through September, is very pleasant. There is little rain, and temperatures commonly range in the mid-70s F. The winter is rainy and damp; however, the temperature seldom drops below the mid-50s, so we don't worry about digging out from under massive snowstorms.

In my next column, I'll write on the history of the islands and pass along some interesting statistics. Meanwhile, I'm sure the DXers out there will find some callsign and license information interesting. There are nine major islands in the Azores, and each is a separate call district. They are: CU2—Santa Maria, CU2—San Miguel, CU3—Terceira, CU4—Graciosa, CU5—San Jorge, CU6—Pico, CU7—Faial, CU8—Flores, and CU9—Corvo. CUØ is reserved for special event and commemorative calls. I had the callsign CUØWPX during the CQ WW WPX contest last March.

Temporary 30-day reciprocal operating permits can be obtained for a small fee from offices of the CTT (the local licensing authority). They can be renewed for an additional 30 days. These permits allow you to sign the Azores prefix/your call. Local callsigns are granted to hams living here or on assignment to the air base on Terceira. That procedure is somewhat complicated and unfortunately involves a bit of red tape. I will be happy to assist anyone coming here who wants to apply for a license.

Until next time, 73 de Mike, KB3RG/CU3LF.

SPAIN

Woodson Gannaway EA8/N5KVB
Apartado 11
35450 Santa Maria de Guia
(Las Palmas de G.C.)
Islas Canarias
Espana

After receiving the September issue of *73* and seeing the photo of our clubhouse, imagine my surprise when, on my following visit, I found the clubhouse undergoing extensive changes! A second story is being added, the main meeting room enlarged, etc. Plans call for everything to be finished by the end of the next year, a tall order. But, with the prospect of a very exciting event taking place there next spring, it is worth it! And it helps keep us from getting bored.

In addition to the Spanish replicas of the *Pinta*, the *Niña*, and the *Santa Maria*, the Japanese have commissioned a copy of the *Santa Maria* which is now under sail, making the voyage that Columbus had intended to make. They left port here at Las Palmas two weeks ago *[the middle of August—Arnie]*, and expect to be in Japan in about 10 months. Curious as always, I went down to look at her. Dinky! That's the first word that comes to mind when I see those ships (there is a full-size copy in Santa Cruz de La Palma, on land). Crowds kept me from going on board this one, but my eye found a small antenna for around 2 meters, certainly for communicating with its mother ship. The mother ship, *Yaiza 2*, had plenty of antennas but I was unable to find out if there was any amateur radio activity in addition to its official ship radio communications.

Old Ben Franklin really comes to mind often; for instance, "If we don't hang together we will surely hang separately." While we were in Madeira (in the mountains, not in Funchal) a friend caught the first uncertain news about the attempted coup in the Soviet Union on his shortwave radio, in Arabic! The next day he found a fading Spanish station and we got some details. Here we were, people from half a dozen different places gathered to help celebrate the first Baha'i Summer School of Madeira, all being affected by what was taking place in the USSR! The Russian teacher at the Translators and Interpreters School speaks fluent Spanish and I enjoyed talking with her about her native Armenia, the smallest Soviet Republic. We have no business meddling, but we'd sure better learn to cooperate. It doesn't take too much imagination to see us hanging separately, and soon, if we don't.

So until next time, 73, Woodson EA8/N5KVB.

ITALY

Mario Ambrosi I2MQP
Via Stradella, 13
20129 Milano
Italy

It's been a long time since I have sent something to "73 International." I hope that what I have sent is worth the wait.

Expedition to IL4

Island hunting is becoming more and more popular. There are several awards in Europe, apart from the very popular IOTA. You can find the Italian Island Award, the French Island Award, and now the Spanish Island Award.

The best season for an expedition to an island is summer. The weather is nice, propagation is still reasonable in this period of the cycle, and it is holiday time. So, what better idea than to take a lot of radios and antennas and go somewhere with your friends.

Photo C. The group of expeditioners on Piallazza Island, with antennas and accommodations in the background.

This is what we do from time to time. Photo C is a picture taken on the trip we made to Piallazza Island, IL4.

Photo D shows the QSL card of IY1TTM, the call for Torre Marconi in Sertri Levante, about 50 km from Genova, Liguria, on the top of a hill 70 metres above the waters of the Golfo del Tigullio, Ligurian Sea. The tower, 10 metres high, was built in 1200 as a sighting point. Since 1971 it has been looked after by the radio amateurs of Sestri Levante who belong to the Italian Amateurs-Radio Association. TTM is the acronym for Tigullio-Torre-Marconi. I2DMK is the primary operator and I2MQP is the QSL manager.

Guglielmo Marconi (1874–1937) used this tower for his studies on ultrashort waves (UHF) and on the microwaves, his third discovery after the broadcasting aerial of 1895 (complex radiating earth-aerial) and the short waves for communicating over large distances. Marconi also executed tests of broadcasting studies on television and on radar at the tower.

A contact with IY1TTM is valid as a commemorating station, as required by the regulation of DGM, Diploma Guglielmo Marconi. It is fascinating to work from the very point where the "Father of Radio" executed some of his great inventions devoted to humanity. 73

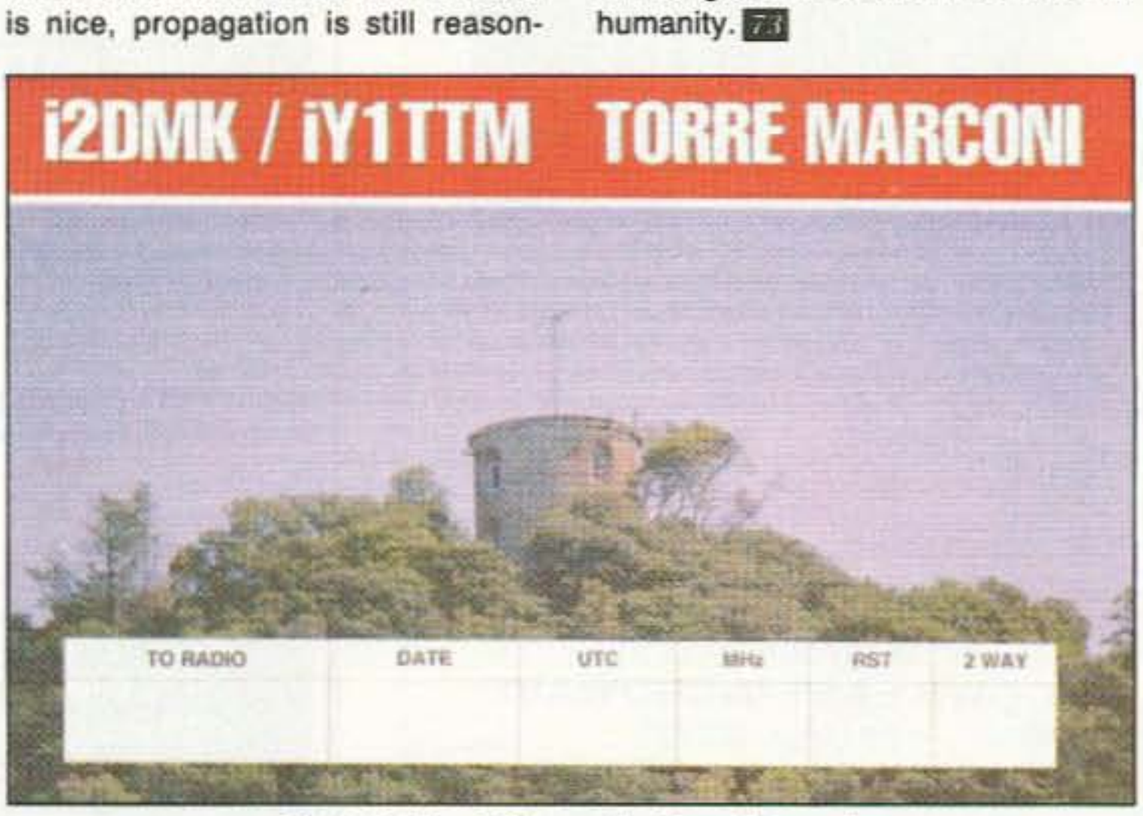


Photo D. The QSL card for Torre Marconi.

ATV

Number 19 on your Feedback card

Ham Television

Bill Brown WB8ELK
%73 Magazine
Forest Road
Hancock NH 03449

ATV Touch-Tone Controller

Last month we took a look at the ATV jet system designed by Bill Walker WB1ADF and Bill Kinton NX1D. This time we'll show you how they remotely controlled the jet's ATV transmitter by touch-tone commands via a VHF uplink.

Bill Kinton NX1D designed the touch-tone controller for this project so that it would fit neatly inside a PC Electronics TC70-1 ATV transceiver. A 44-pin card-edge connector (RS# 276-1551) was installed inside of the TC70-1 with connections to the "push-to-look" switch, the audio and the microphone inputs, as well as to the two camera inputs (see Figure 1 for edge connector pinouts). The final controller circuit, as shown in Figure 2 (see page 60), is capable of selecting between two video and audio sources and can turn the ATV transmitter on and off. In addition, the controller can key a relay to activate an external power amplifier.

The Circuit

Audio from a VHF HT is routed to both the microphone input of the TC70 and the input of the SSI202P touch-tone decoder chip. This way, ground stations can actually use this system as a remote audio repeater (2 meters or 220 MHz in—ATV audio subcarrier out). When a valid touch-tone command is decoded by the SSI202, a unique 4-bit output results. This is hooked into a 4-to-16 line decoder IC (4514) which gives you an output corresponding to the number you pressed. This is only active as long as you hold down the touch-tone pad, so a few 4013 flip-flops latch the outputs either on or off until reset. The video and audio paths from the two TV cameras are routed through a 4066 analog switch which is controlled by the output of one of the flip-flops. For example, touch-tone #3 will cause the video and audio from camera 1 to be selected. When #4 is pressed, the 4013 flip-flop (U2A) is reset, which selects camera 2.

In a similar manner, touch-tone command #1 keys the TV transmitter on, and touch-tone #2 turns it off. Commands 5 and 6 key a relay on or off to control the external power amplifier (if used). There are a number of unused outputs which can be used for additional features.

Installation

In order to fit inside the TC70 and be easily removed, Bill built the controller onto a Radio Shack protoboard (RS# 276-154). The nice thing about this particular protoboard is its built-in 44-pin edge plug. With the front panel of the TC70 facing you, mount the edge connector inside along the left panel. Referring to Figure 1, the top row of the connector is numbered from 1 to 22, and the bottom row is labelled A to Z. In addition to the four optional LEDs, mount a ⅛-inch phone jack and an RCA phono jack as shown. Wire connections to the various controls and switches inside of the TC70 also as shown in the diagram.

Once you've completed your controller board, just plug it into the connector inside of the transceiver. Hook up your video and audio inputs to the TC70 as you normally would. Attach an audio cable from your HT or VHF receiver and plug it into the new audio input jack on the side of the TC70. Adjust R14 for reliable touch-tone decoding and R15 for proper volume into the TC70 microphone input. You now have a remotely controlled ATV transmitter.

Next Month

In my next column we'll show you a complete circuit board pattern along with a parts placement for the touch-tone controller which should make assembly a real breeze. 73

Continued on page 60

Parts List

IC1,2,3	4013 CMOS flip-flop
IC4	4514 CMOS 4-to-16 line decoder
IC5	SSI202P touch-tone decoder
IC6	4066 CMOS analog switch
IC7	7805 5-volt regulator
Q1,2	2N3904 transistor
C1,2,4,7,9,11,13,15	1.0 µF tantalum
C3,8,10,12,14,16	0.01 µF
C5,6	680 pF
R1	47k
R2	3.3k
R3,4,5,6,10	4.7k
R7	10 MEG
R8,13	10k
R9	6.8k
R11,12	1k
R14,15	5k potentiometer
LED1–4	Green or red LEDs
XTAL	3.579 MHz colorburst crystal
PCB	Radio Shack protoboard with edge connections (RS# 276-154) or PC board as described in note below.
Misc	44-pin edge connector (RS# 276-1551).

Note: An etched and drilled PC board designed to fit a 44-pin edge connector is available for $9.50 + $1.50 shipping per order from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

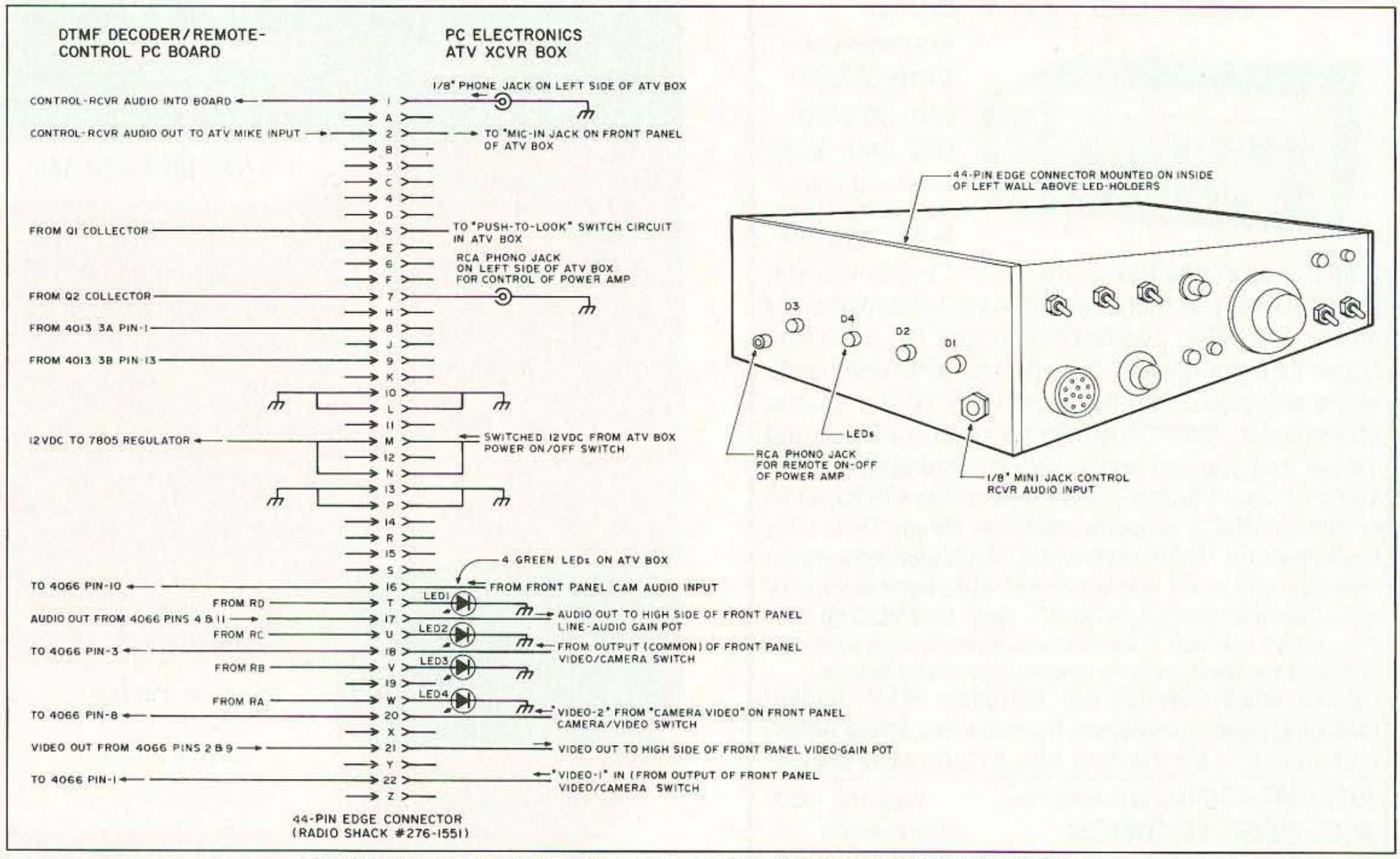


Figure 1. Edge card connections (mounted inside the PC Electronics TC70-1 ATV transceiver).

MARS Experience

Continued from page 36

the full-time post MARS stations didn't help is still a mystery.

MARS provided much more than savings. It was often the only communications our unit had to home base. Essential communications were made over MARS that would not have been accomplished without it. There is not a single battalion commander or staff section who did not use, and use frequently, the MARS system. Normal communications were so poor that even the Red Cross sent messages through MARS to get them delivered after failing through all other means.

One case in particular was very bad. A young soldier's brother had died, and the family had been attempting contact with him for over 10 days. He got his message just the day before his brother was to be buried. This was not an isolated case.

Similarly, MARS stations in Germany and the States stayed on many hours without being used. Lower level (battalion) MARS stations could have been instituted from the beginning had systems been in place. But the Army in general, and armor (tank) units in particular, seem to be very shortsighted when it comes to communications.

Our brigade and community stations are both on the verge of being shut down. We have only one last chance . . . if the new Nuernberg Community Commander, General Wilson, will agree to man it, one station may remain on the air. If not, we will not only lose the licenses but quite likely the equipment as well. Even though it was purchased with community funds, 5th Signal Command may take it away from us just as they took the entire Ansbach station only a year ago. And that equipment was purchased by the Officers Wives Club!

I should be happy . . . we went to war . . . we survived . . . we helped many soldiers . . . . So what's the problem? I don't know . . . I just have this sinking feeling that won't go away.

Many wonderful things happened on the air with MARS. Marriage proposals, experiments with antennas (have you ever had an entire desert to set up as much antenna as you wanted?), re-unions, marriages saved. All because some hams were committed to putting it all together . . . .

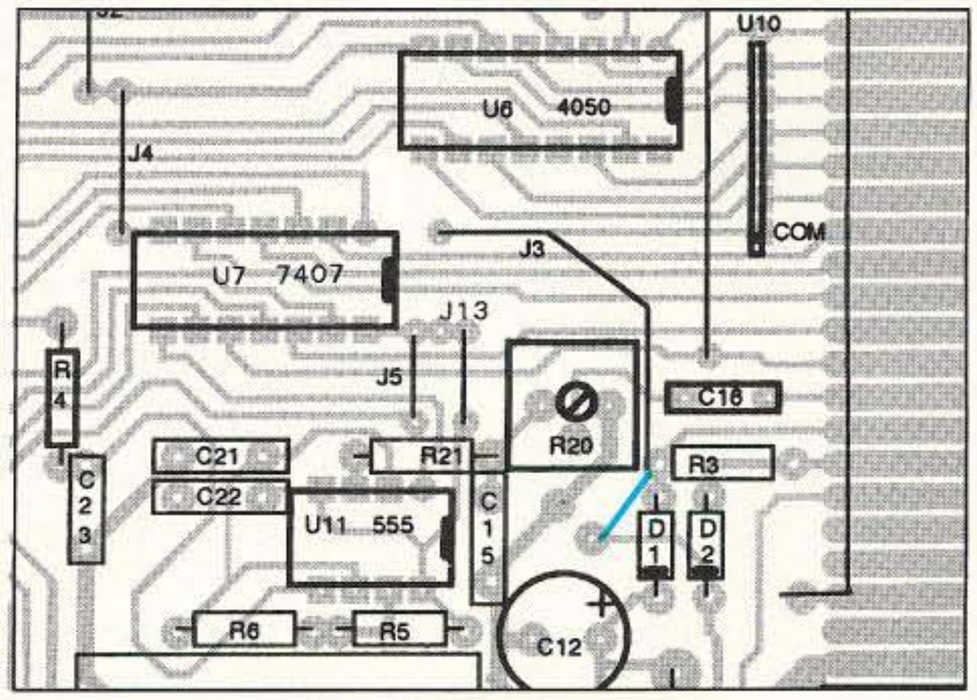
A very special thanks to those who kept the home fires burning and their end of the MARS system open: SSG Scott Hoffman DA2SC/N4SXP, without whom AEM1ELN and AEM1NBG would never have succeeded; Nancy Tilton DA1KS/KA3NDB; Don Goff DA1DD; and Helmut Boehm DL4NDK/AA7FS. Most of all thanks to my lovely wife Pat DA2WP/N4ROC/AEM1WP, who never ceases to amaze me and continues to be my inspiration day by day. We did good! 73

SSG Michael R. Warner NX7T, Box 5961, Headquarters Second Brigade, 1st Armored Division (3rd ID) APO, NY 09066.

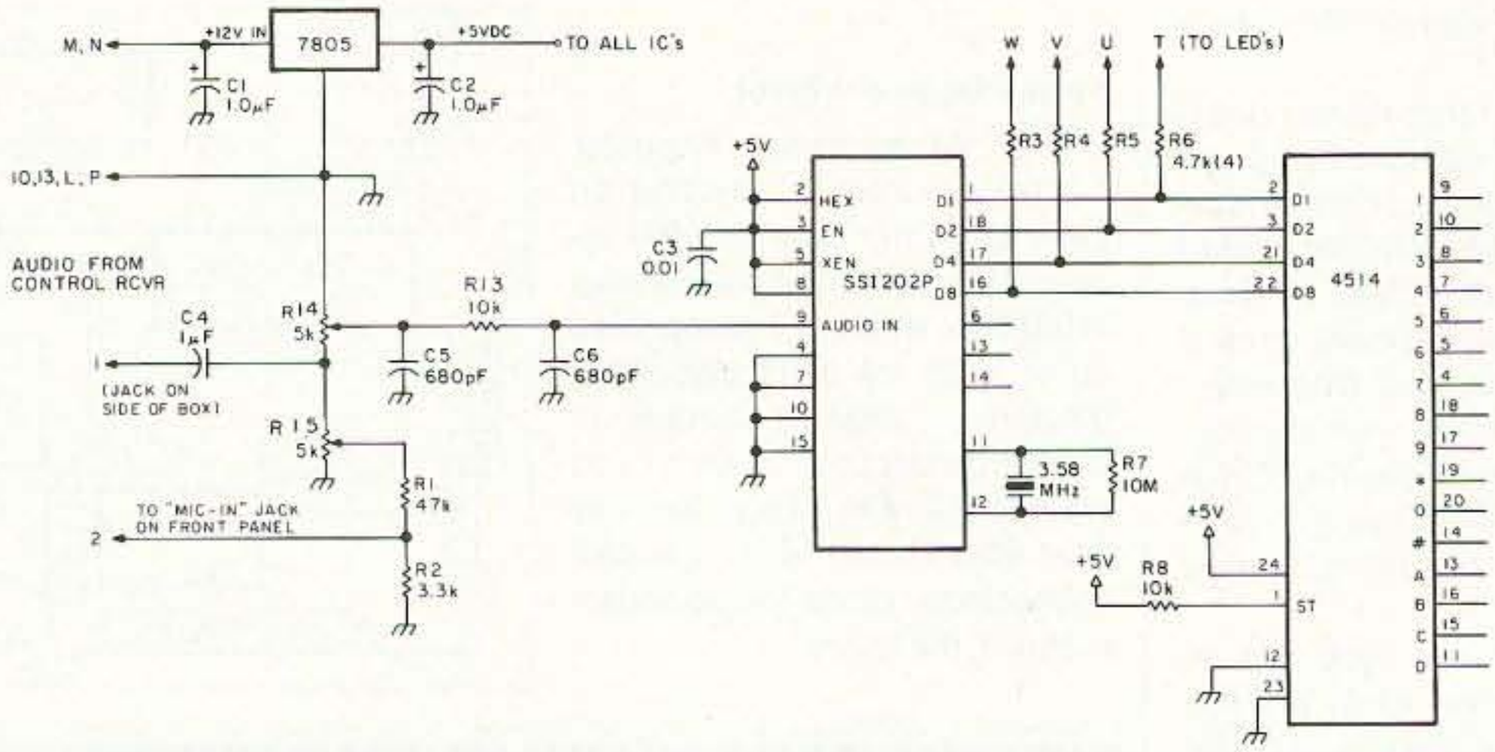
UPDATES

Parts Placement Error

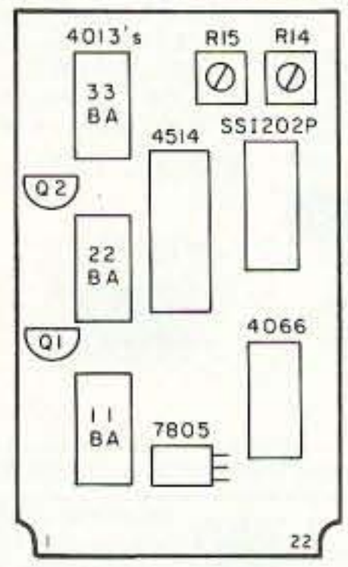
See "Microprocessor Repeater Controller, Part I," starting on page 28 of the October 1991 issue. The author, John Bednar WB3ESS, writes: "I discovered an error in the parts placement diagram on page 34. Jumper J3 should connect the common end of U10 to 12 volts. The jumper end near R20 should go to the pad connected to diode D2, as shown in blue in the figure.

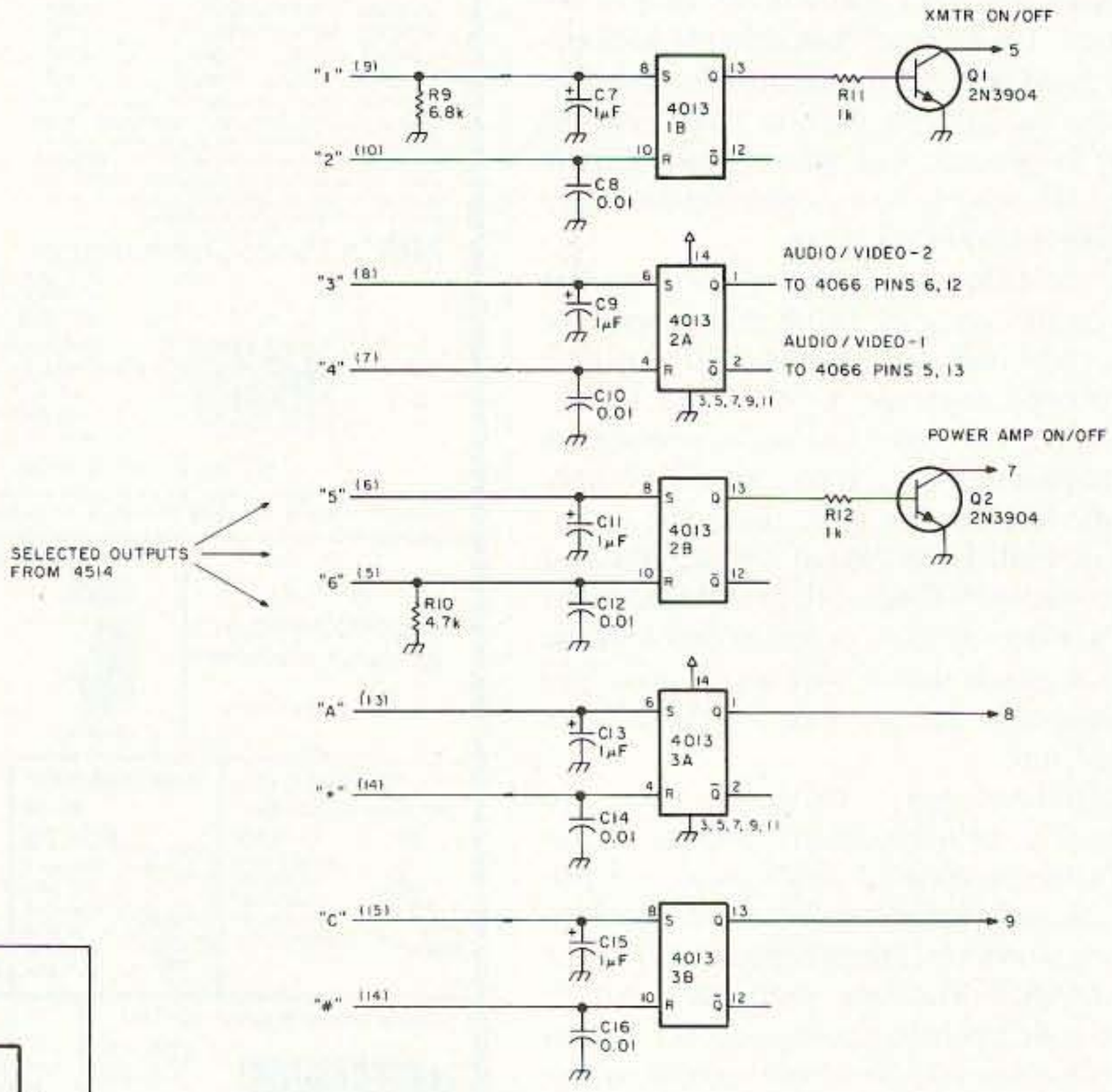


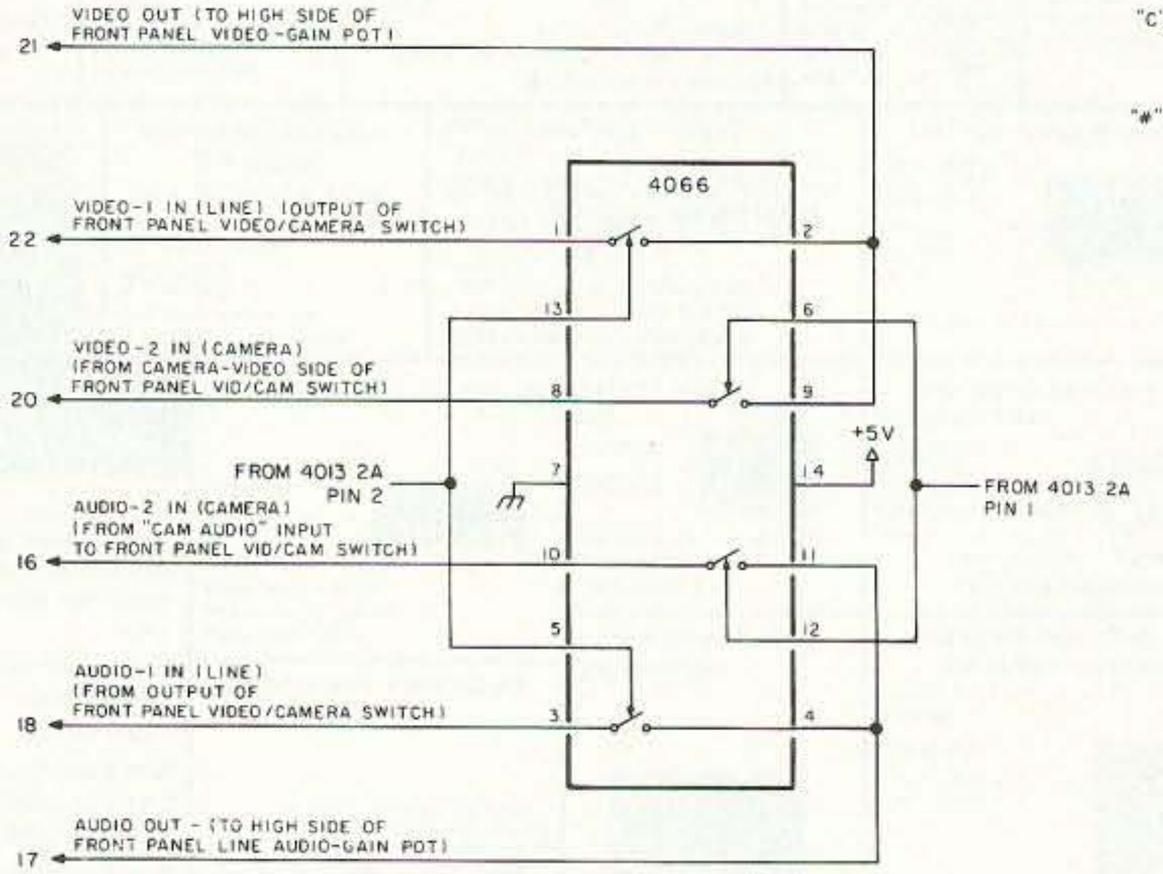
Continued from page 58



PC BOARD – PARTS LOCATION



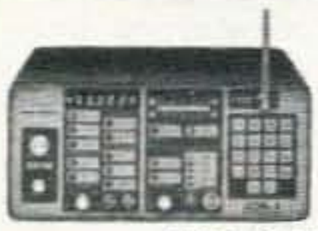




PC BOARD (RADIO SHACK #276-154) PLUGS INTO 44-PIN EDGE CONNECTOR (RADIO SHACK #276-1551), MOUNTED INTERNALLY TO LEFT WALL OF PC-ELECTRONICS ATV BOX.

Figure 2. Schematic diagram of the touch-tone controller.

RAMSEY ELECTRONICS



COM-3
$279.00

2 WAY RADIO SERVICE MONITOR

OM-3, the world's most popular low-cost service moni-r. For shops big or small, the COM-3 delivers advanced apabilities for a fantatic price—and our new lease pro-am allows you to own a COM-3 for less than $3.00 a day. eatures •Direct entry keyboard with programmable emory •Audio & transmitter frequency counter •LED bar aph frequency/error deviation display •0.1–10.000 µV utput levels •High receive sensitivity, less than 5 µV 100 kHz to 999.9995 MHz •Continuous frequency cover-ge •Transmit protection, up to 100 watts •CTS tone ncoder, 1 kHz and external modulation.

RSG-10
$249.00

SYNTHESIZED SIGNAL GENERATOR

Finally, a low-cost lab quality signal generator—a true alternative to the $7,000 generators. The RSG-10 is a hard working, but easy to use generator ideal for the lab as well as for production test. Lease it for less than $3.00 a day. Features •100 kHz to 999 MHz •100 Hz resolution to 500 MHz, 200 Hz above •−130 to +10 dBm output range •0.1 dB output resolution •AM and FM modulation •20 programmable memories •Output selection in volts, dB, dBm with instant conversion between units •RF output reverse power protected •LED display of all parameters—no analog guesswork!

FREQUENCY COUNTERS

T-70 7 DIGIT 525 MHz | **CT-90 9 DIGIT 600 MHz** | **CT-125 9 DIGIT 1.2 GHz**

amsey Electronics has been manufacturing elec-onic test gear for over 10 years and is recognized for s lab quality products at breakthrough prices. All of ur counters carry a full one-year warranty on parts nd labor. We take great pride in being the largest anufacturer of low-cost counters in the entire .S.A. Compare specifications. Our counters are full-atured, from audio to UHF, with FET high pedance input, proper wave shaping circuitry, and rable high quality epoxy glass plated-thru PC oard construction. All units are 100% manufactured the U.S.A. All counters feature 1.0 ppm accuracy.

NEW CT-250 2.5 GHZ

ACCESSORIES FOR COUNTERS

Telescopic ship antenna—BNC plug, WA-10	$11.95
High impedance probe, light loading, HP-1	$16.95
Low-pass probe, audio use, LP-1	$16.95
Direct probe, general purpose use, DC-1	$16.95
Tilt bail, elevates counter for easy viewing, TB-70	$ 9.95
Rechargeable internal battery pack, BP-4	$ 9.95
CT-90 oven timebase, 0.1 ppm accuracy, OV-1	59.95

ALL COUNTERS ARE FULLY WIRED & TESTED

MODEL	FREQ. RANGE	SENSITIVITY	DIGITS	RESOLUTION	PRICE
CT-50	20 Hz–600 MHz	<25 mV to 500 MHz	8	1 Hz, 10 Hz	$189.95
CT-70	20 Hz–550 MHz	<50 mV to 150 MHz	7	1 Hz, 10 Hz, 100 Hz	$139.95
CT-90	10 Hz–600 MHz	<10 mV to 150 MHz <150 mV to 600 MHz	9	0.1 Hz, 10 Hz, 100 Hz	$169.95
CT-125	10 Hz–1.25 GHz	<25mV to 50 MHz <15 mV to 500 MHz <100 mV to 1 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$189.95
CT-250	10 Hz–2.5 GHz typically 3.0 GHz	<25 mV to 50 MHz <10 mV to 1 GHz <50 mV to 2.5 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$239.95
PS10B Prescaler	10 MHz–1.5 GHz, divide by 1000	<50 mV	Convert your existing counter to 1.5 GHz		$89.95

SPEED RADAR
$89.95 complete kit
SG-7

w low-cost microwave Doppler lar kit "clocks" cars, planes, boats, rses, bikes or any large moving ob-t. Operates at 2.6 GHz with up to mile range. LED digital readout plays speed in miles per hour, kilo-ters per hour or feet per second! rphone output allows for listening to ual doppler shift. Uses two 1-lb cof-cans for antenna (not included) d runs on 12 VDC. Easy to build—microwave circuitry is PC stripline. includes delivery. ABS plastic case h speedy graphics for a profession-ook. A very useful and full-of-fun kit.

BROADBAND PREAMP

Boost those weak signals to your scanner, TV, shortwave radio or frequency counter. Flat 25 dB gain, 1 to 1000 MHz. 3 dB NF. BNC connectors. Runs on 12 VDC or 110 VAC.
PR-2, wired, includes AC adapter $59.95

2M POWER AMP

Easy to build power amp has 8 times power gain, 1W in, 8W out, 2W in, 16W out, 5W is for 40W out. Same amp as featured in many ham magazine articles. Complete with all parts, less case and T-R relay.
PA-1, 40W pwr amp kit $29.95
TR-1, RF sensed T-R relay kit . $ 8.95

FM WIRELESS MIKE KITS

FM-3 SHOWN

Pick the unit that's right for you. All units transmit stable signal in 88–108 MHz FM band up to 300' except for hi power FM-4 that goes up to ½ mile.
FM-1, basic unit ..... $ 5.95
FM-2, as above but with added mike preamp ..... $ 7.95
FM-4, long range, high power with very sensitive audio section, picks up voices 10' away $14.95
FM-3, complete unit includes case, battery, switch, antenna, and built-in condensor mike. Excellent fidelity, very small, kit $16.95
FM-3WT, as above, but fully wired and tested $19.95
SMC, miniature sensitive mike cartridge for FM-1, 2, 4 ..... $ 2.95

CROWAVE TRUSION ALARM

real microwave Doppler nsor that will detect a hu-n as far as 10 feet away. erates on 1.3 GHz, and is affected by heat, light, or rations. Drives up to 100 output, normally open or sed, runs on 12 VDC. mplete kit MD-3 . $16.95

MUSIC MACHINE

Neat kit that will produce 25 different classical and popular tunes, plus 3 doorchime sounds. Lots of fun for doorbells, shop, or store entrances, car horn, music boxes, etc. Runs on 9V battery or wall transformer. Excellent speaker volume and adjustable tempo and pitch. Add our case set for a handsome finished look.
Complete kit, MM-5 ..... $24.95
Case + knob set, CMM-5 . $12.95

PACKET RADIO

Commodore C64/128 packet radio interface. Uses famous German Digicom software. Features EXAR IC chip set for reliable operation—runs HF or VHF tones. Includes FREE disk software. PC board, all necessary parts and full documentation.
Complete kit, PC-1 .... $49.95

LO NOISE PREAMPS

Make that reciever come ALIVE! Small size for easy installation with Hi-Q tuned input for peak performance. Excellent gain and noise figure—guaranteed to improve reception! Specify band: 2M—PR-10, 220 MHz—PR-20, 440 MHz—PR-40.
Each kit $17.95

NE DECODER

ompiete tone decoder a single PC board. Fea-es: 400–5000 Hz ad-able range via 20-turn voltage regulation, 567 Useful for touch-tone st detection, FSK, etc. also be used as a sta-tone encoder. Runs on 12 volts.
mplete kit, TD-1 . $5.95

VOICE ACTIVATED SWITCH

Voice activated switch kit provides switched output with current capability up to 100 mA. Can drive relays, lights, LED, or even a tape recorder motor. Runs on 9 VDC.
VS-1 kit. $6.95

TELEPHONE TRANSMITTER

Mini-sized with professional performance. Self-powered from phone line, transmits in FM broadcast band up to ¼ mile. Installs easily anywhere on phone line or inside phone!
PB-1 kit $14.95

NEW

SPEAKER PHONE

Talk on the phone hands-free, great to put in shop or shack, press the button to answer—no actual phone needed. Works same as commercial units. Talk from anywhere in room, phone line powered—no battery needed. Super for family and conference calls or buy two for hands-free intercom! Add our case set for a pro look.
SP-1 ..... $29.95 Case-CSP $12.95

CKLE STIK

shocking kit! Blink-LED attracts vic-s to pick up inno-nt-looking can—u watch the fun! al for office desks, ties, nosey know-lls!
-4 kit $9.95

LIGHT BEAM COMMUNICATORS

Transmits audio over infrared beam up to 30'—use simple lenses to go up to ¼ mile! Hum free, uses 30 kHz carrier. Great for wireless earphones or undetectable "bug." Transmitter + receiver set, LB56 .. $19.95

FM RADIO

Full-fledged superhet, microvolt sensitivity, IC detector and 10.7 MHz IF. Tunes Std. FM broadcast band as well as large portions on each end. Ideal for "bug" receiver, hobby experiments or even as FM radio!
FR-1 kit $14.95

SUPER SLEUTH

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2W rms output. Runs on 6 to 15 volts, uses 8–45 ohm speaker.
BN-9 kit $5.95

BROADBAND PREAMP

Very popular sensitive all-purpose preamp, ideal for scanner, TVs, VHF/UHF rigs, counters. Lo noise, 20 dB gain, 100 kHz–1 GHz, 9V–12 VDC operation.
SA-7 kit $14.95

NEW

FANTASTIC 2M FM TRANSCEIVER

SYNTHESIZED—NO CRYSTALS TO BUY!

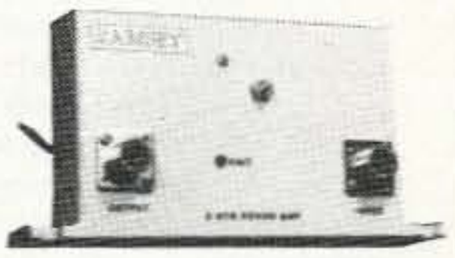
$149.95

Ramsey breaks the price barrier on 2 meter rigs! Here's the ideal rig for field days, hamfests, vacations, second cars and packet (it even has dedicated packet connections). Six expandable diode-programmed channels, 5W RF output, sensitive dual conversion receiver and EASY assembly. Why pay more for a secondhand old rig when you can make your own for less. Have some fun with your own truly AMERICAN-MADE FM rig! This kit comes complete except for the case, mike and speaker—ICOM or equal speaker-mikes plug right in. Add our own beautiful case set for a professional factory look.

FTR-146 kit	$149.95
FTR-146-C metal case & knob set	$24.95

2 MTR & 220 BOOSTER AMP

Here's a great booster for any 2 meter or 220 MHz hand-held unit. These power boosters deliver over 30 watts of output, allowing you to hit the repeater's full quieting while the low noise preamp remarkably improves reception. Ramsey Electronics has sold thousands of 2 meter amp kits, but now we offer completely wired and tested 2 meter, as well as 220 MHz, units. Both have all the features of the high-priced boosters at a fraction of the cost.
PA-10 2 MTR POWER BOOSTER (10 X power gain)
Fully wired & tested $79.95
PA-20 220 MHz POWER BOOSTER (8 X power gain)
Fully wired & tested $79.95



QRP TRANSMITTERS HAM RECEIVERS

20, 30, 40, 80M CW TRANSMITTERS

Join the fun on QRP! Thousands of these mini-rigs have been sold and tons of DX contacts have been made. Imagine working Eastern Europe with a $30 transmitter—that's ham radio at its best! These CW rigs are ideal mates to the receivers at right. They have two-position variable crystal control (one popular QRP XTAL included), one watt output and built-in antenna switch. Runs on 12VDC. Add our matching case and knob set for a handsome finished look.
Your choice of bands $29.95
(Specify band: QRP-20, 30, 40 or 80)
Matching case & knob set, CQRP $12.95

20, 30, 40, 80M All Mode RECEIVERS

Build your own mini ham station. Sensitive all-mode AM, CW, SSB receivers use direct conversion design with NE602 IC as featured in *QST* and ARRL handbooks. Very sensitive varactor tuned over entire band. Plenty of speaker volume. Runs on 9V battery. Very EASY to build, lots of fun and educational—ideal for beginner or old pro. New 30-page manual. Add the case set for well-fitted professional look.
Your choice of bands $27.95
(Specify band: HR-20, HR-30, HR-40, HR-80)
Matching case & knob set, CHR $12.95

E-Z KEY CMOS KEYER

Send perfect CW within an hour of receiving this kit! Easy-to-build kit has sidetone oscillator, speed control and keys most any transmitter. Runs for months on a 9V battery. 28-page manual gives ideas on making your own key for extra savings. Add our matching case set for complete station look.
CW-7 kit $24.95
Matching case knob set, CCW $12.95

ACTIVE ANTENNA

Cramped for space? Get longwire performance with this desktop antenna. Properly designed unit has dual HF and VHF circuitry and built-in whip antenna, as well as external jack. RF gain control and 9V operation makes unit ideal for SWLs, traveling hams or scanner buffs who need hotter reception. The matching case and knob set gives the unit a hundred dollar look!
AA-7 Kit $24.95
Matching case & knob set, CAA $12.95

SPEECH SCRAMBLER

Communicate in total privacy over phone or radio. Kit features full duplex operation using frequency inversion. Both mike and speaker or line in/out connections. Easy hookup to any radio, and telephone use requires no direct connection! Easy to build 2 IC circuit. Can also be used to descramble many 2-way radio signals. Finish your kit off with the handsome case & knob set.
SS-7 kit $29.95
Matching case & knob set, CSS $12.95

SHORTWAVE RECEIVER

Fantastic receiver that captures the world with just a 12" antenna! Can receive any 2 MHz portion from 4–11 MHz. True superhet has smooth varactor tuning, AGC, RF gain control, plenty of speaker volume and runs on a 9V battery. Fascinating Scout, school or club project provides hours of fun for even the most serious DXer. For the car, consider our shortwave converter. Two switchable bands (in 3–22 MHz range), each 1 MHz wide—tunable on your car radio dial. Add some interest to your drive home!
Shortwave receiver kit, SRI $27.95
Shortwave converter kit, SCI $24.95
Matching case set for SRI, CSR $12.95
Matching case set for SCI,CSC $12.95

2, 6, 10 MTR, 220 FM RECEIVERS

Keep an ear on the local repeater gang, monitor the cops, check out the weather or just plain listen around. These sensitive superhet receivers are just the ticket. They tune any 5 MHz portion of the band and have smooth varactor tuning, dual conversion with ceramic IF filters, AFC, adjustable squelch and plenty of speaker volume. Runs on 9V battery and performance that rivals the big rigs! For a complete finished pro look, add our matching case and knob set with screened graphics.
FM communications receiver kit $29.95
Specify band: FR 146 (2m), FR6 (6m), FR10 (10m), FR-220 (220 MHz)
Matching case & knob set, CFR $12.95

FM STEREO TRANSMITTER

Run your own stereo FM station! Transmit a stable signal in the standard FM broadcast band throughout the house, dorm or neighborhood. Connects easily to line outputs on CD player, tape decks, etc. Runs on 9V battery, has internal whip antenna and external antenna jack. Add our case set for a "station" look!
FM-10 kit $29.95
Matching case set, CFM $12.95

AIRCRAFT RCVR

Hear exciting aircraft communications—pick up planes up to 100 miles away! Receives 110–136 MHz AM air band, smooth varactor tuning superhet with AGC, ceramic filter, adjustable squelch, excellent sensitivity and lots of speaker volume. Runs on 9V battery. Great for air shows or just hanging around the airport! New 30-page manual details pilot talk, too. Add case set for "pro" look.
AR-1 kit $24.95
Matching case set, CAR $12.95

TERMS: Satisfaction guaranteed, examine for 10 days. If not pleased, return in original form for refund. •Add 7% (up to a maximum of $10) for shipping, handling and insurance. •For foreign orders add 15% for surface mail. •COD (USA only), add $4.50. •Orders under $20, add $3.00. •NY residents, add 7% sales tax. •90-day parts warranty on kits. •1-year parts & labor warranty on wired units.

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Number 21 on your Feedback card

QRP

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Mike's Rules of Twenty?

With the cold days of winter upon us, many hams turn to the bench for some winter projects. Getting all the parts for your latest project can sometimes be more of a hassle than getting the project running. Some time ago I described Mike's "rules of ten." Since the mail has been running heavy on obtaining small parts, it's time to update the rules.

In a nutshell, Mike's "rules of ten" are very simple. You order in lots of 10 to meet the minimum order amount (ten bucks) and wait 10 days for the parts to arrive.

Since this first came out in the October '86 "QRP" column, things have changed. First, it is almost impossible to find a part supplier with a minimum order of ten bucks. Nowadays, the minimum is closer to twenty bucks.

Jameco Electronics

Some of the suppliers since 1986 have gone almost entirely to computers and computer accessories, dropping most of their line of electronic parts. This seems to be the current trend at Jameco Electronics. With a minimum order of $30, which most of us can't afford to generate for a few parts, Jameco is no longer a good small parts supplier.

Photo. A hamfest bargain: a penny a microamp meter!

Circuit Specialists

A real old-time supplier of parts, Circuit Specialist, is stocking more and more computers and computer parts, but they're also still hanging onto the pieces and parts home-brewers need. They have a minimum of $20 for plastic money, or $10 for checks or money orders. They offer fast service and a large array of parts, from transistors and FETs to resistors and pots. They're one of my favorite suppliers—best price for resistors anywhere around! Phone: (800) 528-1417 or (602) 966-0764.

Mouser Electronics

Then there's Mouser Electronics. I was a bit leary of ordering from this company; somehow, I had this idea in my head that you had to have a letterhead and a Dunn and Bradstreet rating to place an order. Whoa! Was I wrong. Mouser could become the standard in part ordering, and perhaps mail-order in general. I'm serious!

Mouser has a minimum order of $20. Just about every credit card you can think of is honored. A toll free number is available for orders as well as for customer service.

With four regional distribution centers, Mouser can give you next day service just about anywhere. All orders are shipped the same day. When I order by phone, one of the very helpful phone operators takes my order, then checks for availability of the parts I just ordered. No surprises when the order arrives. The operator lets you know if any of the parts you have ordered are out of stock, and when they might come in. I have had parts orders shipped from three different distribution centers, all to arrive on my door step the very next day (using UPS next day shipping).

Mouser stocks just about everything you need. Is there a down side to all this? Well, some of the parts are a bit higher in cost, compared to what some of the other suppliers charge. But the difference is not overwhelming, considering all the service you get. Mouser gets my highest rating for QRP parts. Phone: (800) 346-6873.

KA7QJY Components

Here's a vendor that was not on the list in 1986: KA7QJY Components, P.O. Box 7970, Jackson WY 83001. Danny supplies a fine line of parts for the home-builder. There is no formal catalog, but rather a large sheet of components available and their prices. This list changes all the time, and Danny runs a lot of specials on transistors and other parts the QRPer uses. There is no minimum order, and you can't use your plastic. There is a shipping charge of $2.50 for each order. All the parts supplied by Danny are brand new, but they may be surplus. By buying surplus, sometimes you get a better part. If you want good quality parts, from transistors to cores, KA7QJY Components is a home-brewer's dream come true.

One thing you should know about some of the parts supplied by KA7QJY is that they might be "house numbered" parts. OK, what in the world is a house numbered part? It's simple. It's a number the manufacturer stamps on a part for a particular customer. If you have ever assembled a HeathKit project, you've worked with house numbered parts. They were called Heath part numbers. A 2N2222 may be numbered as 417P234. Same part, same

specifications, just a different number stamped on it.

One of the benefits of house numbered parts can be described in one word: price! In many cases, the house numbered part will be of higher quality. Some house numbered parts have to meet military specs.

All Electronics

All Electronics supplies house numbered parts, *and* a variety of surplus parts, at very good prices. They accept plastic money with a minimum order of $10. They're a good supplier for silver mica caps and high wattage resistors. Phone: (800) 826-5432.

Oak Hills Research

The last vendor is Oak Hills Research, 20879 Madison street, Big Rapids MI 49307. They offer complete kits for QRPers as well as parts. There is no minimum order if you pay by check or money order. There's a $15 minimum order if you want to use your plastic. It's a great source if you need only one or two transistors for your project and you don't want to brother with large minimum orders.

Of course, there are many more suppliers of parts, kits and circuit boards out there. This is only a sample of those I've had good results with.

Other Parts Sources

Don't forget to check out the local Radio Shacks. They offer parts when you really have to have them, like late at night on a Saturday. Sure, they're expensive, but they do stock a lot of parts that might come in handy in a pinch.

And then, of course, there are hamfests. These are great for picking up boxes, variable capacitors, transformers, and the like. I kind of stay away from transistors and other active components. Sometimes you don't know where the parts came from, or if they're any good.

And you won't be able to find the guy next time if they aren't. The meter in the photograph is a hamfest special. About the size of a quarter, this 0–100 microamp meter sold for a buck. That's a penny a microamp! I bought all the meters the guy had. Without a doubt, you'll be seeing them in upcoming projects.

For circuits boards, don't forget about Far Circuits, 18N640 Field Court, Dundee IL 60118. Send a large SASE for the latest list of PC boards.

Mike's Rules of Ten Still Good

Order in lots of ten, order the minimum, and wait ten days. That's Mike's "rules of ten"!

Next month I hope to have a project underway, so dig out the soldering iron and get it ready. If you did not get your copy of the *HW-8 Handbook*, you're out of luck. All copies have been sold. A reprint? Not likely, but who knows? 73

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Number 23 on your Feedback card

1991 Annual Index

Subject/Article	Description	Author	Issue	Page
Amplifiers, Audio, Preamps				
10m sideband amp	for QRP rig	NZ5G	NOV	52
gain	and capacitance	KB1UM	DEC	82
gain	general info	KB1UM	NOV	72
gain step switch	LM386	KB4ZGC	SEP	74
Voice ID on a Chip	construction	WB8ELK	NOV	11
Antennas				
Antennas by the Yard	HF	WA6TLK	JUL	22
antenna tuner	for QRP	WB8VGE	SEP	82
Apartment Antennas	several designs	W1GV	MAY	42
Artificial RF Ground	w/series circuit	KB4ZGC	APR	10
Collinear for Two Meters	construction	G3YCC	APR	24
Dual-Band Vertical	160/1750m	WD4PLI	SEP	38
ESV Mod Quad	50–1296 MHz	WBØESV	APR	14
Half-Wave Gain	450 MHz HTs	AD5X	NOV	26
Heli-Hat Antenna	10–17m	KB4ZGC	NOV	32
Indoor 10m Beam	2-ele coaxial	N9CAP	SEP	24
Lightning Protection	grounding	NU1A	JUL	32
L-O-N-G Wire	for DX	W1GV	SEP	46
Low Cost Discone	144–1296 MHz	AD5X	AUG	24
Low-Pass Ant Tuner	reduce harmonics	KB4ZGC	OCT	46
Mag-Mount	construction	AD5X	JAN	55
Megaloop	long, long-wire	W1GV	JUL	29
Mobile HF	CB mod	AA6NG	SEP	26
Pocket Portable	seven bands	KB4ZGC	APR	46
Quag-V	VHF/UHF	WB3AYW	DEC	36
Simple Gain Ant	for UHF	AD5X	OCT	25
SPSM Mobile Mount	no drilling	W6OAL	JUN	34
Square Pancake Antenna	multiband	W2SMR	SEP	18
Ten for 10	$10 beam	KM4UL	APR	52
Variometer Construction	general	WD4PLI	SEP	42
ATV, FSTV, SSTV, Video, Balloons				
10-minute timer	w/relay	WB8ELK	FEB	78
ATV network	activities	WB8ELK	NOV	58
BLT-2	Houston balloon	WB8ELK	OCT	54
demo, portable	HAMCAM	WB8ELK	JUN	85
demo, school	BEMARC	WB2MGP	FEB	46
Earthwinds flight	with ATV	WB8ELK	MAR	76
Franklin HS	weather balloon	WB8ELK	AUG	82
Future Modulation	ATV	W9NTP	FEB	32
Houston balloon	DARA	WB8ELK	SEP	58
Jet mobile	airshow	WB8ELK	DEC	58
"Lookie-Talkie"	RS Pocketvision	WB8ELK	FEB	76
Martin Emmerson EPROM	SSTV	WA3USG	JUL	46
Micro ATV Transmitter	70cm	KC6CCC	JUL	9*
Rockoon	w/ATV	WB8ELK	MAY	52
STS-37	70cm ATV	WB8ELK	JUL	82
W1BHD	ATV pioneer	WB8ELK	JAN	76
WeatherBrief	forecasting	WB8ELK	APR	89
Computers and Softwaree				
Computerized Tuning	for Ramsey kits	N8KDD	DEC	42
guide wavelength	calc software	WB6IGP	FEB	59
High Speed Data Acq	interface	N8KDD	JUL	28
Microprocessor Rptr Ctrlr	Part I	WB3ESS	OCT	28
Microprocessor Rptr Ctrlr	Part II	WB3ESS	NOV	44
modems	9600, TAPR	WA5ZIB	DEC	62
Parallel Port I/O Board	construction	VE6BGL	JAN	29
Software for Hamshack	Part I	WA4BLC	MAY	22
Software for Hamshack	Part II	WA4BLC	JUN	44
Software for Hamshack	Part III	WA4BLC	JUL	42
Software for Hamshack	Part IV	WA4BLC	AUG	32
TRTY.EXE program	RTTY	WA3AJR	APR	69
Universal CAT Interface	computer ctrl'd rig	K5YEF	AUG	38
Diagnostic, Test Equipment				
Crystal calibrator	using 7490 IC	KB4ZGC	MAR	74
expanded voltmeter	construction	WB8VGE	JUN	70
expanded voltmeter	schematic	WB8VGE	DEC	69
FSM plus	circuits	KB4ZGC	MAY	84
Handy Inductance Bridge	for small coils	KB4ZGC	MAY	11
High Precision Freq Standard	construction	Johnson	JAN	9*
Marker Generator	construction	KB4ZGC	JAN	27
Portable Freq Counters	uses	WB6NOA	NOV	15
Signal Generator	add digital output	WB9YBM	FEB	27
Tube Tester	construction	WA1IAO	MAY	30
UHF FSM	400–500 MHz	WBØESV	FEB	24
UHF Source Dipper	400–500 MHz	WBØESV	FEB	20
Digital Modes: Packet, CW, RTTY, AMTOR, etc.				
AMTOR	getting started	WB8VGE	JAN	80
Brass Pounder's Keyer	construction	AA6GG	JUN	22
CoCo Packet	& Mighty Mite	WA3AJR	FEB	67
Copperhead Keyer Paddle	construction	KI5AZ	MAY	9
HF RTTY	general	WA3AJR	SEP	61
Microlog	for RTTY	WA3AJR	DEC	70
Mini-Keyer	new version	WB9YBM	MAY	14*
Packet or RTTY?	AMTOR/RTTY bands	WA3AJR	AUG	69
Poor Man's Packet	software TNC	WB2EMS, N8KEI	AUG	8*
Portable RTTY	and software	WA3AJR	JUN	59
Pseudo CW Filter	construction	WR5B	JUN	18*
RTTY	software	WA3AJR	MAY	64
RTTY freqs	determination	WA3AJR	OCT	74
RTTY gifts	resources	WA3AJR	NOV	64
RTTY Index	column, '77 to date	WA3AJR	JAN	62
General Interest				
220 debate	band use	WA6ITF	SEP	68
4U1UN	ARS	WB2MGP	MAY	56
Berens River School	VE4AAL	WB2MGP	NOV	84
Dave Novak NØDN	Sacred Heart ARC	WB2MGP	OCT	48
Dayton Youth Forum	speakers	WB2MGP	AUG	54
Desert Voices Project	MARS	KA1UKM	MAR	18
DXDA '91	countries	staff	SEP	32
DXDA '91	winners list	staff	SEP	30
Hope for Monolingual Hams	resources	WA1LBP	AUG	50
Keys to Motivation	teaching	WB2MGP	DEC	72
Not Just Another Island	Walrus Islands	NL7KH	DEC	50
OMIK	address	staff	SEP	79
Peyton Montcure	no code	WA6ITF	JUN	68
Rose Parade Mobile	HF remote	WA6TWF	JAN	46
Rptr Rights	TASMA	WA6ITF	JUN	66
Tropo Time is Now!	KH6HME beacon	WB6NOA	JUL	14
Tune in on Philately	ham stamps	Schuessler	JUN	14
W3BE	Radio Amateur of the Year	WA6ITF	JUN	68
WARC Bandwagon	30/12/17m	N4LBJ	JUN	50
West Indies	DXpedition	VP2E/W1HEO	FEB	34
Microwave				
10 GHz Dish	plus feed system	WTØW	FEB	57
beacons	complete systems	WB6IGP	MAR	73
Directory	goodies at 902 MHz & above	KT2B	FEB	52
IMPATT devices	Gunn diodes	WB6IGP	JAN	78
mixers	3–6 & 10 GHz	WB6IGP	FEB	58
PLL brick filters	modifications	WB6IGP	NOV	66
PLL bricks	for converter	WB6IGP	DEC	74
PMTs and gain	as power supply	WB6IGP	AUG	62
Pour an Antenna	casting lenses	WA4WDL	FEB	48
Radar Detector Conversion	to 10 GHz rcvr	WA6EJO	FEB	10
RF filters	beer can cavity	WB6IGP	SEP	72
YIG oscillators	construction	WB6IGP	APR	72
YIG sweeper	drive circuits	WB6IGP	MAY	78
New Products				
A&A Engineering	BayComm	staff	NOV	62
A&A Engineering	QRP xcvrs	staff	JUN	61
AEA	PC-Pakratt II	staff	FEB	64
Alexander Batteries	H26204/5/6/7	staff	AUG	70
American Design Components	catalog	staff	FEB	64
American Design Components	catalog	staff	OCT	64
Ameritron	QSK-5	staff	OCT	66
Ampire Inc. preamps	146/146OS/440	staff	JUN	61
ASHTON ITC	SCORPIO	staff	FEB	64
A/V Technology	ant software	staff	SEP	65
A.W. Sperry Instruments	Model DM-8500	staff	DEC	78
Azimuth Communications	WeatherStar ALT6	staff	MAR	66
Aztec RF	Model DXB-1	staff	OCT	64
BelMERIT Corp.	catalog	staff	SEP	65
CCTV Corp.	CCD-300 camera	staff	DEC	78

Subject/Article	Description	Author	Issue	Page
Certified Products Corp.	ELF alert	staff	JUN	61
Chipswitch	to extend range	staff	MAY	62
Communications Corp.	Series S-7R	staff	OCT	66
Communications Specialist	components	staff	APR	63
Commucications Specialist	SS-12, -16	staff	MAY	62
Connect Systems	Model CS-800	staff	NOV	62
Coyne Co.	MacHam Tech	staff	DEC	78
CW Enthusiasts	PC Super Keyer 2.1	staff	NOV	62
Delta Research	DELTACOMM 1.04	staff	MAR	66
Delta Research	DELTATONE 2.0	staff	MAY	62
Drake	R8 rcvr	staff	AUG	70
Edward Oros	Uniden kit	staff	MAY	62
Electron Processing	keyer	staff	MAR	66
Electrosoft	CW software	staff	JAN	61
Electrosoft	new CW software	staff	SEP	65
Elenco Electronics	CM-1500B/1550B	staff	DEC	77
EPO Software	DX logging	staff	JUL	60
FB Enterprises	rptr map cards	staff	DEC	77
Fieldpiece Instruments	HB70 meters	staff	OCT	66
Fieldpiece Instruments	multimeters	staff	JUN	61
GAI Systems	HamStuff	staff	SEP	65
Giehl Electronics	software/TS-940, Paragon	staff	AUG	71
Gracilis, Inc.	PackeTwin interface	staff	AUG	70
Ham Jewelry Company	World Time Clock	staff	JUN	61
Hamtronics, Inc.	REP-200 Rptr	staff	JAN	61
Hart Publishing	catalog	staff	OCT	64
Hi-Res Communications	KWM2 video	staff	AUG	71
ICOM	IC-2410A/H xcvrs	staff	AUG	70
ICOM	IC-2410A/H xcvrs	staff	SEP	62
ICOM	IC-2SRA/4SRA	staff	NOV	62
IDC Communications	WBA1500 preamp	staff	MAR	66
Interflex	Pkt-GOLD 1.2	staff	JAN	61
ISD	ISD1016	staff	MAY	62
J•Com	audio filter	staff	FEB	64
J•Com	software	staff	SEP	62
JDR Microdevices	catalog	staff	APR	63
Jensen Tools, Inc.	catalog	staff	JAN	61
Kenwood	TS-450S & 690S	staff	SEP	62
MARCOMP	Mr. Morse	staff	DEC	78
Master Publishing	new Tech guide	staff	SEP	65
MFJ	912 balun 110 clock	staff	AUG	70
Midian Electronics Inc.	CW ID-1	staff	OCT	66
Milestone Technologies	CODEMASTER 4.0	staff	DEC	77
Mouser Electronics	Ungar 1200	staff	SEP	65
Muscle Products	MO-10	staff	JUL	60
Myers Engineering International Inc.	3–4-ele yagis	staff	OCT	66
NGC/COMET Antennas	Model CA-2x4MAX	staff	JUN	61
NGC/COMET Antennas	Model CX-908	staff	APR	63
OE2DYL	DX nets list	staff	JUL	60
Optoelectronics	brochure	staff	AUG	71
Optoelectronics	freq counter	staff	APR	63
Optoelectronics	Model 2300	staff	DEC	77
Owens/Browning	CW simulator	staff	DEC	78
Palomar Engineers	keyer	staff	APR	63
Palomar Engineers	Model SB-4 balun	staff	FEB	64
Pasternak Enterprises	catalog	staff	FEB	64
Performance Electronics	quads	staff	OCT	64
Polyphaser	ant lightning protection	staff	SEP	62
Polyphaser	lightning suppressors	staff	MAY	62
Polyphaser	video tutorial	staff	DEC	78
QRZ Industries VB-8A	voice recorder	staff	JUL	60
Radio Shack	HTX-202	staff	DEC	77
Radio Shack	Micronta pwr meter	staff	AUG	70
RAI Enterprises	Analog Plus II	staff	AUG	70
Rutland Arrays	Model RA7-50 ant	staff	MAR	66
Solarcon Corp.	Antron name	staff	SEP	62
Spectrum International	1691 MHz preamp	staff	MAR	66
Spi-Ro Manufacturing	toroids, beads	staff	SEP	62
Startek International Inc.	AP-90	staff	JAN	61
Startek International Inc.	freq counter	staff	SEP	62
Static Busters, Inc.	AS-1	staff	JAN	61
Telex Communications	boom-mike headset	staff	JUL	60
The Forbes Group	2m Ventenna	staff	SEP	65
The Grapevine Group	catalog	staff	MAY	62
The Radio Works	ant catalog	staff	DEC	78
Tiare Publications	catalog	staff	MAR	66
Time & Again	Time Zone Map	staff	OCT	64
Townsend Electronics	Rig Saver	staff	JUN	61
Tripp Lite	BC-450 LAN	staff	MAY	62
Tripp Lite	power supplies	staff	MAR	66
Tripp Lite	PR-Series	staff	NOV	62
Valor Enterprises	rubber ducks	staff	APR	63
Vector Control Systems	Circle Map	staff	JUL	60
Vector Control Systems	elec beam indicator	staff	NOV	62
Whats-Up	1.00 space software	staff	JUL	60
W&W Associates	batteries for Alinco	staff	OCT	66
Winter Design	clock	staff	NOV	62
ZCo Corp.	Mac software	staff	JAN	61
Power Supplies				
3-Terminal Reg	construction	N9RF	JAN	40
"Cheap and Simple"	improvements	WA9VLK/G0NBZ	DEC	66
distribution box	for reg voltage	KB4ZGC	JAN	58*
laser pwr supply	& tube testing	WB6IGP	JUN	62
pulse charger	portable	WB8VGE	AUG	52*
QRP	diode	KC3YB	SEP	75
voltage doubler				
Radio Direction Finding				
dealing with police	tips	K0OV	APR	74
ELTs, EPIRBs	PELTS	K0OV	MAR	59
FRG-91	in Oregon	K0OV	SEP	91
LoJack/SVRN	CLETS	K0OV	MAY	66
precautions	before the hunt	K0OV	JAN	66
RFI hunting	tips	K0OV	AUG	80
Showdown in Portland	FARS	K0OV	NOV	38
Soviet Union	FARS	K0OV	JUN	53
TBOX	construction	K0OV	NOV	60
TBOX	hidden foxbox	K0OV	OCT	52
Teletrac	33cm	K0OV	JUL	56
worldwide	styles	K0OV	DEC	60
Receivers				
Activated Scanner	PRO-57 & AK-4C	AA7Y	MAR	30
laser receive system	construction	WB6IGP	JUL	62
Simple SupeRX	80, 40, 30m	WA6IVC	APR	26
Sudden Receiver	160–20m	G3RJV	OCT	8
Reviews				
A&A Engineering	BayCom Packet	WA3USG	DEC	20
Ameritron	AL-811 linear amp	WA4BLC	APR	38
AntennasWest	Happy HalfSquare	W1XU	APR	22
Brainstorm Engineering	SR3 repeater	WA3USG	MAY	46
Commander II	2m amplifier	WA8SAJ	FEB	54
Communication Concepts Inc.	ATV-3 down cvtr		JUL	50
Drake	R8 rcvr	WA4BLC	OCT	50
ELNEC	antenna program	WA4BLC	JAN	52
Get-Tech	voice ID/rptr ctlr	WB8ELK	JUN	12
ICOM America	IC-2SRA HT	WB6NOA	DEC	46
ICOM America	IC-970H	KA7LDN	MAR	36
InterFlex Systems	Pkt-Gold Multimode	WA1R	AUG	20
J•Com MagicNotch	audio filter	N1GPH	MAY	40
JPS Communications, Inc.	NIR-10	WB2QLL	MAY	34
Kantronics Weathernode	EPROM	WA3USG	AUG	46
Kenwood TH-27A	mini HT	N1GPH	FEB	28
Kenwood TH-77A	dual band HT	KB1UM	OCT	42
Kenwood TM-941A	triband FM	N0IVN	JAN	36
Kenwood TS-850S	HF xcvr	N2GE	NOV	18
Martin Emmerson G3OQD	EPROM 4.0; SSTV	WA3USG	JUL	46
MFJ SWR Analyzers	MFJ-207 HF, 208 VHF	WA4BLC	JAN	19
Outbacker Antenna Sales	HF mobile	N1GPH	SEP	12
P.C. Electronics	VOR-2 relay	WA3USG	JUL	26
Practical Antenna Handbook	Joseph J. Carr	W6OAL	APR	21
Quantum Instruments, Inc.	battery	N1GPH	SEP	22
Radio Works Inc.	Carolina Beam	WA4BLC	SEP	34
Ramsey Electronics	2m xcvr kit	K1BQT	DEC	18
Sensible Solutions	WB2OPA LogMaster	WB8ELK	JAN	34
SHF Systems xvertrs	1240, 2304 MHz	KT2B	FEB	40
Skymoon	EME software	WA3USG	MAR	40
Solarcon	A-99 Antenna	WA4BLC	NOV	36
Startek International Inc.	Model 3500	WB9RRT	NOV	30
SV Products WARC yagi	Model 1824/2L	N4LBJ	APR	42
Swisslog 3.66	program	WA3USG	JUN	46
TAPR	METCON-1 kit	WB8ELK	AUG	34
The Radio Works	Carolina Windom 160	WA4BLC	APR	34
Tripp Lite	PR-25 supply	N1GPH	JUN	38
Yaesu USA	FT-990 xcvr	WA4BLC	DEC	32
ZD Engineering	hardline x-formers	WB9RRT	DEC	29
Satellite Operation, EME, Space				
AMSAT	at Dayton'91	WA5ZIB	AUG	56
AMSAT	general info	WA5ZIB	JUN	54
Elementary Mode S	on 2.4 GHz	KA9LNV	MAR	21
Hams in Space	SAREX II	Chien	MAR	54
Mir Packet	how-to	WA5ZIB	APR	70
OSCAR-22	details	WA5ZIB	OCT	62
Packet with Microsats	complete system	KI6QE	MAR	9

Subject/Article	Description	Author	Issue	Page
RS-12/13/14	tables	WA5ZIB	MAY	58
Shuttle Experiment	INSPIRE	KG6EK	DEC	22
Space Symposium	1990 report	WA5ZIB	JAN	84
STS-35	report	WA5ZIB	MAR	64
STS-37	report	WA5ZIB	JUL	54
STS-37	report	WB2MGP	JUL	76
systems	earth stations	WA5ZIB	NOV	70
The Flight of STS-37	all-ham crew	KC4YER	JUL	34*
Two Meter EME Primer	guide	W5UN	MAR	46
UoSATs 1–4, F, ARSENE	tracking programs	WA5ZIB	FEB	80
WA4SIR	school contacts	WB2MGP	JUN	56
Weather Sat Reception	using scanner	N6NHP	MAR	12
Webersat	WEBERWARE	WA5ZIB	SEP	54
Theory, Tips, Tutorial, How-To				
components	selection	KB1UM	SEP	56
how to break your radio	common ways	KB1UM	MAR	78
microphones	types, modes	KB1UM	FEB	66
parts	list of suppliers	KB1UM	NOV	73
parts, chips	FETs, semis	KB1UM	OCT	83
parts, kits	scrounging	WB6IGP	OCT	60
Parts Substitution	and tips	KB1MW/7	JUN	40
practical DXing	techniques	W5KNE	JUN	80
practical DXing	techniques	W5KNE	AUG	58
Scrounger's Guide	electronic parts	W5FG	JAN	22
selec/intermod	xcvr types	KB1UM	JUN	66
switches	types, care	KB1UM	AUG	79
Transceivers				
Covert Hamming	using HT	K6BRP	MAY	20
HW-8	modifications	WB8VGE	JUL	78
HW-9	thump suppressor	WB8VGE	OCT	78
Ten-Tec Argosy	mod with 4066 IC	WB8VGE	NOV	57
T/R controller	4 circuits	WB8VGE	FEB	62
T/R controller	continued	WB8VGE	MAR	68
Transmitters				
10m Sideband	for QRP	NZ5G	OCT	14
30 & 40m QRP	universal	WB8VGE	MAY	68
module	for monitoring	K1FHR	SEP	74
QRP transmitters	ether duster/ wave bender	KI5AZ	MAY	26
Simple TX TX	for the SupeRX	WA6IVC	NOV	10
Three Bands with One Rock	QRP	WW9X	JUN	10
universal xmtr	QRP	WB8VGE	APR	76
xmtr chatter	circuit	WB9YBM	FEB	27
***Updates**				
10 GHz Fun	ARP '90 issue	WB6IGP	FEB	59
Above & Beyond	AUG '90 issue	WB6IGP	MAY	63
C-64 & 1541 Drive Conversion	JUL '90 issue	K6YDW	MAY	63
Circuits	JAN '91 issue	KB4ZGC	MAR	83
distribution box	JAN '91 issue	KB4ZGC	MAR	83
Dual Voltage Ben Supply	OCT '90 issue	W6WTU	MAY	63
High Precision Freq Standard	JAN '91 issue	Johnson	MAR	83
High Precision Freq Standard	JAN '91 issue	Johnson	MAY	63
Micro ATV Transmitter	JUL '91 issue	KC6CCC	AUG	65
Mini-Keyer	MAY '91 issue	WB9YBM	DEC	59
Poor Man's Packet	AUG '91 issue	WB2EMS, N8KEI	NOV	85
Pseudo CW Filter	JUN '91 issue	WR5B	NOV	85
pulse charger	AUG '91 issue	WB8VGE	SEP	79
The Flight of STS-37	JUL '91 issue	KC4YER	SEP	79
VK3 QSL Bureau	APR '91 issue	staff	SEP	79

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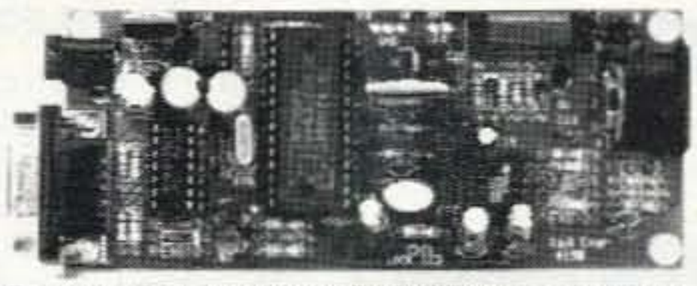

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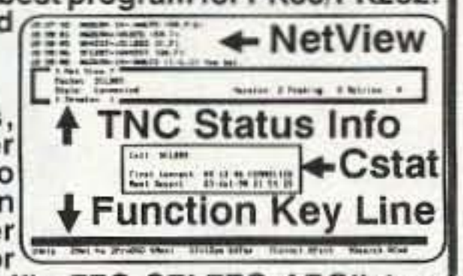

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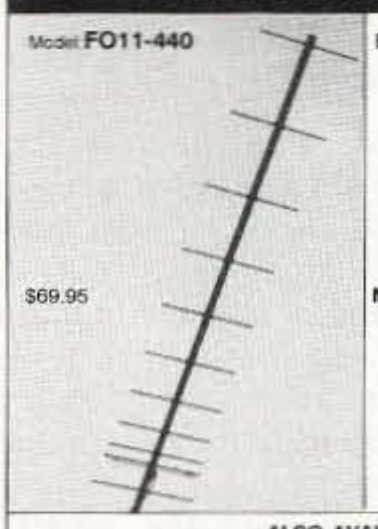

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Brainstorm Engineering has introduced the Multi-Mode SR4 Simplex Repeater, a fully self-contained, microprocessor-based, remote-programmable controller. The SR4 is capable of operating one or two radios in simplex repeater, split simplex repeater, duplex repeater controller, voice mail and voice IDer modes, separately or simultaneously. No duplexer is necessary if you use one radio and one frequency. The SR4 will store and forward any audio messages being received by the radio to which it is connected, allowing two or more radio operators to communicate when they aren't in range of each other but are in range of the simplex repeater site.

Prices start at $399. For more information, contact *Brainstorm Engineering, 2948½ Honolulu Ave., La Crescenta CA 91214; (818) 249–4383, FAX: (818) 248–0840.* Or circle Reader Service No. 201.

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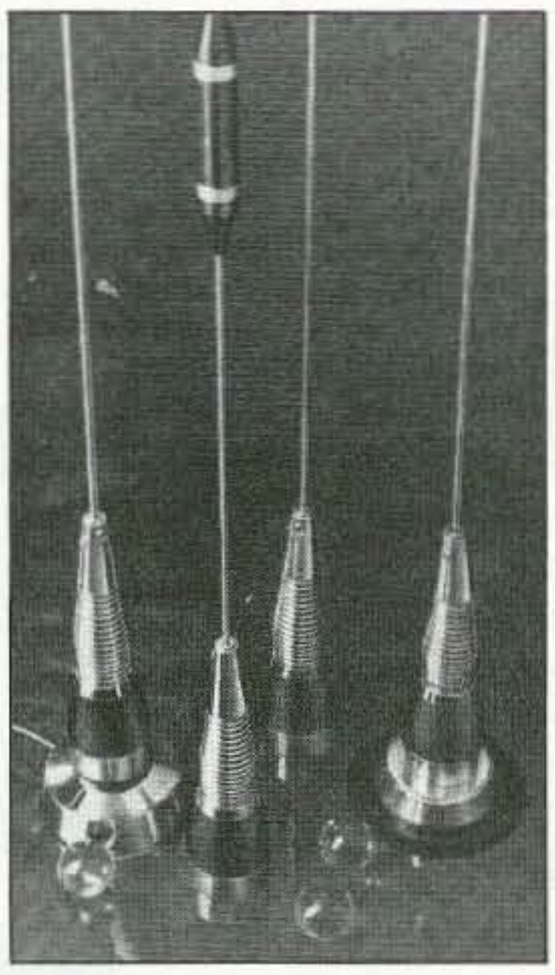

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For prices and more information, contact *The Antenna Specialists Co., 30500 Bruce Industrial Parkway, Cleveland OH 44139-3996; (216) 349–8400, FAX: (216) 349–8407.* Or circle Reader Service No. 202.

SENSIBLE SOLUTIONS

Sensible Solutions has announced the release of Version 4 of the WB2OPA LogMaster HF logging system for PC compatibles. This latest version allows users to connect to and monitor their local DX PacketCluster bulletin board system while simultaneously performing logging functions. Kenwood and ICOM computer-ready radios (Yaesu and Ten-Tec are being phased in—call for availability) can have their frequency set to that of the DX "spot" announced over the cluster, at the touch of a button. The program also allows the user to send a DX "spot" announcement, automatically formatted or from their log book. The LogMaster provides an automatic "needs" indicator that checks the log book to see if the country, state, prefix, CQ zone or ITU zone are needed as information is input. The program prints QSL cards and labels, will import K1EA CT files, provides unparalleled logging statistics, has a built-in English-to-metric and metric-to-English conversion calculator and an auto beam heading indicator.

The program requires 512K of memory, a hard drive or dual floppy drives. The program costs $69.95, including S & H; a demo diskette is available for $5 (refundable with purchase). Contact *Sensible Solutions, P.O. Box 474, Middletown NJ 07748; (800) 538–0001, (908) 495–5066.* Or circle Reader Service No. 203.

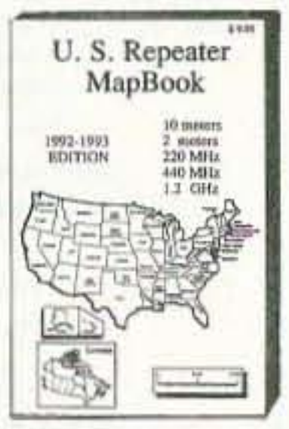
MARINE ELECTRONICS

Marine Electronics has announced a new software release for computer control of the Kenwood 440 and 940 units. SUPERLINK is a graphics-based program with special emphasis on ease of use. All input is via the keyboard, and all functions are controlled by a single keystroke. Frequency information is displayed digitally, but a unique analog dial makes visualization of position in the spectrum much easier. A complete memory subsystem allows unlimited memory capability with each memory having a field for comments. Multiple types of scanning are available, and scan delay is user adjustable.

SUPERLINK is priced at $19.95, plus $2.50 S & H. Contact *Marine Electronics, 1309 Crawford Dr., Friendswood TX 77546.*. Or circle Reader Service No. 204.

ARTSCI PUBLISHING

ARTSCI Publishing has released the 1992/1993 version of the *U.S. Repeater Mapbook* (8½" x 5½"), updated and cross-checked with the *ARRL Repeater Guide*. This version has two new additions: Canadian repeaters and U.S. 10 meter repeaters. This useful companion for traveling hams contains full-page state maps showing major cities and highways, plus the locations of the most popular wide-coverage repeaters.



The *U.S. Repeater Mapbook* is available for $9.95 at amateur radio stores nationwide. For more information, contact *ARTSCI Publishing, P.O. Box 1848, Burbank CA 91506; (818) 843–4080, FAX: (818) 846–2298.* Or circle Reader Service No. 206.

ELECTRONIC EQUIPMENT BANK

The Electronic Equipment Bank is offering a new, expanded 1992 catalog. With a new professional format, this catalog covers shortwave, amateur and scanner radios, and also includes pages of accessories, hundreds of books, and a new specialty hi-tech section. The catalog is free (bulk rate mail) in the U.S., $2 in Canada, and $3 elsewhere. Contact *EEB, 323 Mill Street, N.E., Vienna VA 22180; (800) 368–3270, (703) 938–3350, FAX: (703) 938–6911.* Or circle Reader Service No. 205.

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Caller Identification units from Eavesdropping Detection Equipment retail for $69 to $119.95, depending on the features offered. Your local telephone company must provide Caller ID service in order for the unit to operate. EDE also markets a complete line of surveillance and countersurveillance equipment. For more information, contact *EDE, P.O. Box 337, Buffalo NY 14226; (716) 691–3476.* Or circle Reader Service No. 207.

PERSONAL DATABASE APPLICATIONS

Personal Database Applications has released version 2.1 of LOGic, featuring over 50 enhancements to version 2.0 of LOGic and LOGic Jr. Version 2.1 features a rapid online awards progress facility which shows in chart form status per band and mode, as well as mixed single, single-mixed, and mixed-mixed. You can easily see if an item is confirmed, waiting for a QSL, worked but no QSL requested, or unworked. An online summary shows how many are confirmed, QSL waiting, worked and unworked. The chart is updated automatically. These features will work for common awards and for any award in which you try to work all of a defined set of entities.

For the price and more information, contact *Personal Database Applications, 2616 Meadow Ridge Dr., Duluth GA 30136-6037; (404) 242–0887, FAX: (404) 449–6687.* Or circle Reader Service No. 208.

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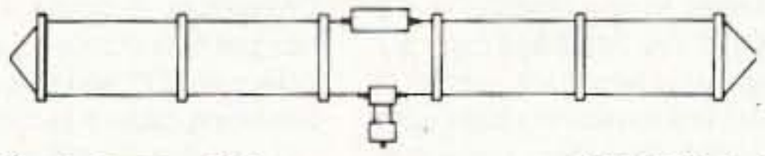

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Bill Pasternak WA6ITF
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Potty Training

Last October, the Southern California public learned what hams have known for a long time: Not every licensed amateur abides by the rules, and the FCC really has no interest in changing some of what goes on over the ham radio airwaves. So says an article titled "Radio Renegades" that appeared in the October 2, 1991, issue of the *Los Angeles Times*.

"Radio Renegades" was written by *Times* staff writer Bob Pool. It details the activities of some of the hams on the Los Angeles 147.435 MHz repeater. Some of its regular users have nicknamed it the "Notorious .435 Repeater." It is a system known nationally as a haven for advocates of freedom of speech and freedom of expression. Not so widely known is that sometimes this freedom of expression takes the form of personal verbal abuse, name calling, threats against life and property, and lots of potty-mouth language. It has also become a haven for numerous unlicensed operators who routinely interact with some of the licensed hams, though they are by no means welcomed.

Unfortunately, "Radio Renegades" shows only the seedy side of life on .435. I know that it may be hard for some of the locals in Southern California to believe, but .435 used to be the center of attention for many of the pioneering efforts in the areas of community service, technological development and public discussion. For example, some two decades and several licensees ago, the users of .435 (as WR6ABE), along with user groups of two other area systems, began visiting hospitals to bring a bit of sunshine to young patients who would not be home for the Christmas holidays. Using their radio gear, they would let these bedridden children chat for a few moments with old St. Nick. This concept was exported nationally and became known as "Operation Santa Claus." (Maybe your club or repeater group runs an annual "Operation Santa Claus" event. I'll bet you never knew that it all started on the "Renegade Radio" repeater in Los Angeles, with the designation of .435.)

The problem of potty-mouthed operation is not limited to one repeater in the City of Angels. If you travel and carry a 2 meter HT, then you know that a number of other big cities are developing ham radio "trash bins" of their own. These repeaters serve only as a kind of dumping ground for all of the community's less-than-desirable operators so that everyone always knows where they are corralled. Kind of the "NIMBY Syndrome" of amateur radio (NIMBY: Not In My Back Yard).

"Well, it's just those no-code Techs and their 2 meter rigs that are the problem!" Guess again. The problem existed long before there was no-code, and it is far from isolated to VHF. All you need do is tune across either 40 or 80 meters almost any night and, depending on where you live and on band conditions, you may get to hear some language that would make the proverbial "sailor" blush. And, lest we forget, some long-term name calling has been a part of the upper end of 20 meters for almost a decade. No, it's not something isolated to my back yard; it appears to be a national problem that is sitting in your back yard as well.

And why hasn't the government removed the offending operators from the air? At least one high ranking FCC official says: "Illegal transmissions are hard to track down, and the community standards test makes obscenity even harder to prove." According to Dan Emrick, Chief of Investigations and Inspections for the FCC, "It may be perfectly all right in New York City to make dirty references to your lineage, but if you did it in the Bible Belt you'd be run out of town on a rail. What goes in Southern California might not be acceptable in North Carolina."

The term for what Emrick is talking about is "Selective Enforcement." In other words, if this were broadcast radio and TV, then the community standards of where you live would be dictated by the type of language acceptable to the majority of those living there. In simpler terms, if the majority felt that the use of certain off-color words was proper in the workplace, in public and in the home, then it would also be proper for broadcasts. I can only guess at the way that the Commission is applying this analogy to amateur radio, but what the FCC seems to be saying is that a "repeater" in and of itself is a community of radio amateurs. Therefore, if that community is willing to accept potty-mouth operations, then why should the FCC intervene?

Obviously, this leaves open some rather interesting questions. If my analysis is correct, then the government may be able to get away with using the "community standards" excuse to permit localized filth on the ham bands, but what about the foul conversations you hear on the high frequency bands?

The ARRL Says It's the FCC

It seems that the ARRL has found out why the Commission is blankly staring at this problem that we all know exists.

The ARRL says that it is very much concerned about the FCC's refusal to prosecute potty-mouth hams and take them off the air. During the October 12, 1991, ARRL Forum at the Southwestern Division Convention in Scottsdale, Arizona, the League's first vice president, George Wilson W4OYI, was asked about the problem being caused by those operating the Los Angeles 147.435 repeater as outlined in the *L.A. Times* feature. Wilson, a lawyer himself, said that the problem of non-intervention was centered in the office of the FCC's General Counsel. He stated that "...content related stuff, we have a problem with. We have got a problem with the Commission on a national level in the General Council's office being concerned about First Amendment rights. They (the FCC) have had plenty of good opportunities to enforce it a lot stronger then what they have done."

Wilson went on to say that the League is extremely concerned about the problems caused by the abuses of the few, and is doing all it can to bring about change: "...I can't make you a promise, but I can tell you that it is a matter of deepest concern to me personally and to the League in general. Conversations are going on at all levels almost on a daily basis to try to break the log jam. But right now, we haven't been able to get the enforcement at the national level because the (FCC) General Counsel is concerned about the First Amendment." Wilson made it clear that the stumbling block was only the enforcement of problems of potty-mouth operations; the commission is still involved in stopping all other regulatory violations.

Conservative Court Could Bring Change

Many experts think that the FCC hasn't acted on this issue because it is probably fearful that any penalties it imposes would wind up being challenged in the Supreme Court. In the past, the court has usually sided with those demanding their right to use any foul language they please on the radio airwaves. The election of Associate Justice Clarence Thomas might bring a change.

The Thomas appointment now weighs the court very heavily to the conservative right. It would not be at all surprising to see a lot of the liberal interpretations of the past 40 years be altered or reversed. This could include the issue of a person's right to be a potty-mouth ham radio operator, if such a case is ever brought for review before the high court.

The FCC's position notwithstanding, many feel that "Radio Renegades" was a slap in the face to all amateur radio operators, especially after the story was picked up nationally by the wire services. You know, "If you can't do anything to solve the problem, then kill the messenger!"

Others take a different view, saying that it is the government, not amateur radio, that comes out on the short end of the "Radio Renegades" story. They say that "Radio Renegades" is the kind of negative publicity the government hates, that it is bound to cause at least a minor shake-up over at the FCC, and that the foul-mouths bothering our repeaters and our HF contacts will be taken off the air. I ask, "Will they?"

Packet Relief on Hold

Packet BBS sysops and owners of open repeaters who have been waiting for the FCC to act to relieve them of some of the responsibility for automatically retransmitted messages will have to keep on waiting, according to Tom Blackwell N5GAR of Dallas, Texas. Blackwell is one of the authors of RM 7649, a rule-making request that asks the FCC to place primary responsibility for the content of relayed traffic on the originating station, holding the relay stations responsible only on a secondary basis.

Keep in mind that I am writing this in early November 1991, so things may have changed a bit by the time you read it, but last summer Blackwell was told by one of of his legislators that the FCC would be acting on RM 7649 before the end of September. September blew into October, and nothing happened. Then Tom called us to say that he had received a letter from the Commission. In it, Robert McNamara said that RM 7649 would be combined with several other requests for regulatory relief that the commission has received from members of the amateur radio community.

The McNamara letter did not say what the FCC was contemplating, but action to combine regulatory requests usually means one of two things: Either the FCC is preparing to issue a Notice of Proposed Rule Making, or it intends to dismiss all of the requests in one fell swoop as having no merit or purpose. As we all learned as a result of Private Radio Bureau Chief Ralph Haller's talk at the ARRL National Convention, the concept of relieving packet sysops and repeater owners of responsibility for the content of communications is to be a part of any rewrite of Rule 97.113.

With the controversy surrounding that proposal, packet operators, sysops and repeater licensees remain in limbo, not really knowing what's legal to retransmit and what is not. According to an earlier conversation that I had with Blackwell, the hardest decision on what to keep from relaying falls to the voice repeater operator and his control stations. The current rules' interpretation makes censorship almost mandatory, and in real time. This, he said, was the primary reason for his filing RM 7649.

SBE

If you are involved in broadcasting, you might want to take note of the following item: The Certification Committee of the Society of Broadcast Engineers has approved the recognition of amateur radio activities for certification credits. Persons holding a valid amateur radio Extra Class license, who meet the service requirement for employment in the broadcast or broadcast related industries, will be awarded Broadcast Technologist Certification upon application. This recognizes that passing an Extra Class license exam demonstrates technical proficiency on a par with the old FCC Second and First Class license examination. Certification information and application forms may be obtained from the SBE national office in Indianapolis at (317) 253–1640. *[From a September 13, 1991, SBE news release.]*

Phones Out? Call the FCC

To end on a much lighter note, we offer this: The next time your phone goes out along with the rest of the phones in your neighborhood, federal regulators want to know about it immediately. The FCC has proposed new regulations that would require telephone companies to notify the government within 90 minutes of a telephone outage that involves 50,000 or more service subscribers and lasts 30 minutes or more.

The commission's proposal came after a summer that saw telephone companies fall short of being able to handle glitches brought about by the introduction of new technology, leading to numerous telephone outages across the United States. Last June, computer software problems knocked out over six million Bell Atlantic phone lines, while in July a million Bell of Pennsylvania customers lost service due to similar problems. The FCC says that it currently has no systematic way to become informed quickly of significant service disruptions, and no way of determining whether specific types of hardware or software are at fault.

To quote one of my favorite television personalities: "and so it goes..." 73

Food for thought.

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77.0 XB	100.0 1Z	131.8 3B	173.8 6A
79.7 SP	103.5 1A	136.5 4Z	179.9 6B
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30 MHz IF System Update for 10 GHz Transceivers

This month I'll cover the 30 MHz IF strip presented in my article, "10 GHz Fun," in the April 1990 issue of *73 Magazine*. This system is used in conjunction with a microwave oscillator and detector to form a complete 10 GHz wideband FM transceiver. Microwave burglar alarm units like the Solfan alarm are used for the microwave portion of the package. While this system is not very complex, it has developed a few wrinkles, which we will explore after reviewing the system.

The System

The PC board is based on a single chip FM receiver. This chip, a TDA-7000, has all the internal functions to provide for FM reception from the antenna, to low level audio output. The PC board includes an audio amplifier (LM386) which normally drives a headset. In addition to these two chips, the receiver portion includes a CA-3130 S-meter detector indicator circuit.

The transmit portion of the board is a single CA-3130 mike amplifier which drives the Gunn diode power supply adjust terminal (part of the LM-317 regulator) for wideband FM modulation. The remaining components are power supply regulators.

Bug Number 1

Like all projects, this system developed a few bugs. These problems, while not debilitating, did cause some head scratching. The problems consisted of: a PC board error on the mike input circuit (CA-3130); low sensitivity of the TDA-7000; and audio oscillation at high audio gain.

First, the PC board error. Pins 2 and 3 of the CA-3130 mike amplifier (U4) need to be reversed. I cut the PC board traces between pin 2 and the pad on the board next to pin 2. I also cut the trace going to pin 3, next to pin 3. Then I tied a short piece of jumper wire and connected this trace to pin 2. Pin 3 is then connected with a short section of insulated wire to the junction of C-37, R-26 and R9. Remove transformer T1 and attach an electret mike from the same junction to ground. Observe polarity on the mike, positive to the junction/pin 3 jumper. Also, use shielded cable such as RG-174 miniature coax cable or other small-diameter shielded cable. Sorry for the PC board error.

Bug Number 2

The next problem, low sensitivity, can be traced directly to the TDA-7000 circuitry. Though I never had this problem with my own transceiver, it has been reported in several units. Unable to duplicate the problem, I had one of the units returned to me to debug, and finally found the solution. The unit, with a sensitivity of about 200 microvolts for full quieting, was very much in trouble.

Photo B. Monument Peak, WB6IGP's dish looking south. The "golf ball" in the distance on Mt. Laguna is an Air Force radar installation.

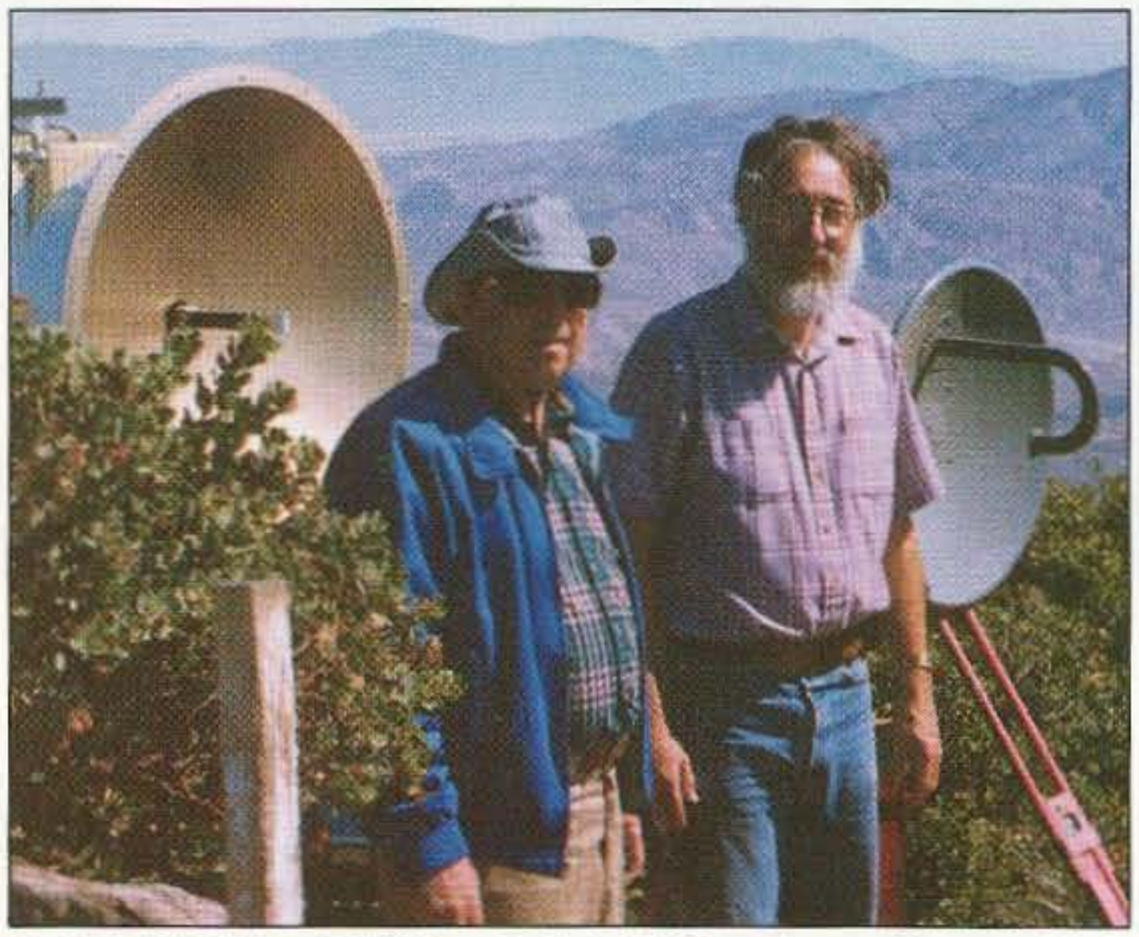

Photo C. WA6VLF and W6OYJ next to their 10 GHz systems on Monument Peak, looking north. The desert floor is some 5,000 feet lower in the distance.

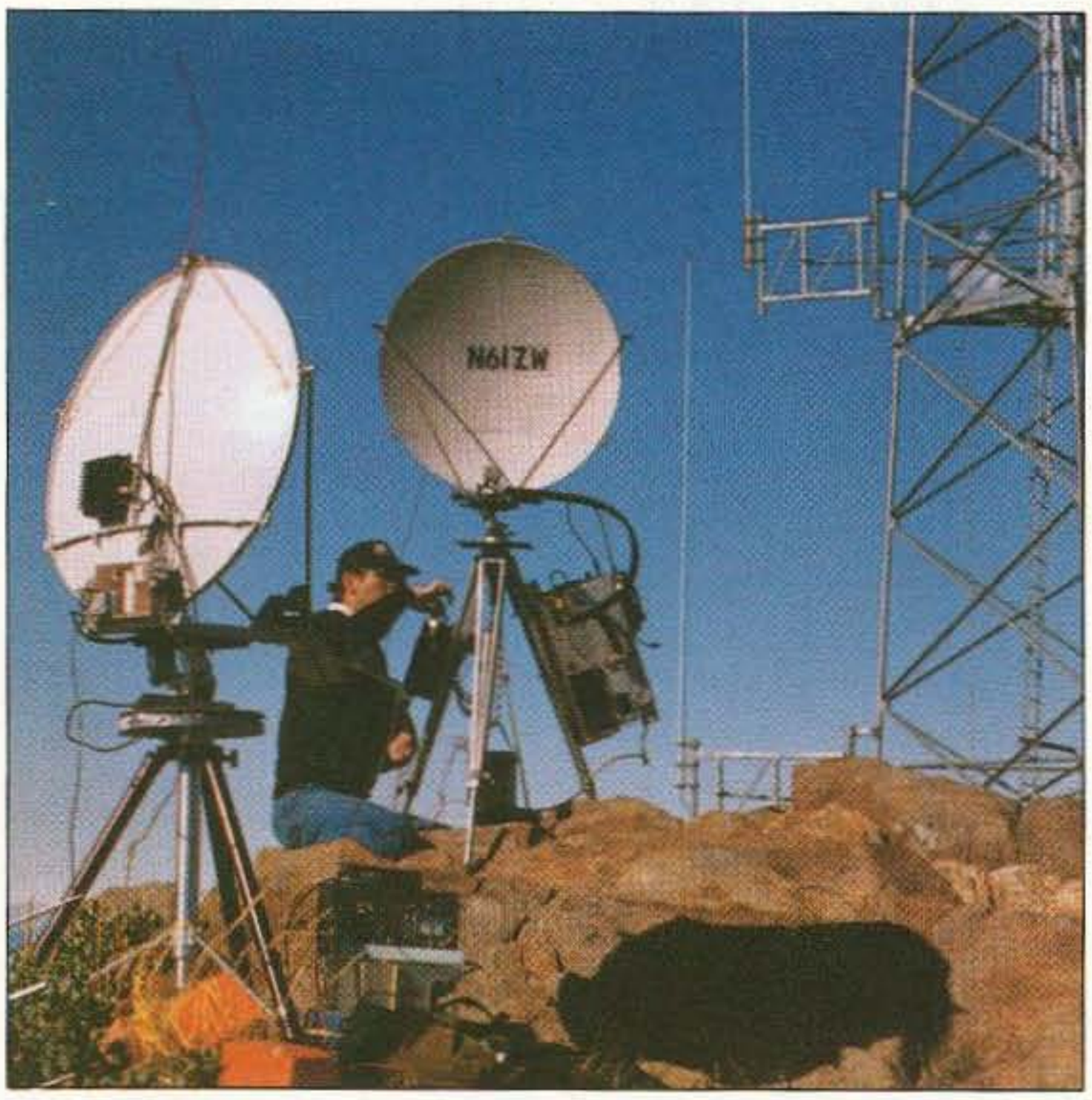

Photo A. N6IZW and WB6IGP dishes on top of the rock, part of a group effort of the San Diego Microwave Group last September. The longest QSO for the entire group that day was 415 km, from Monument Peak to KY7B's group south of Prescott, Arizona.

I thought that it was operating on some lower harmonic of 30 MHz, but initial sweep of other responses proved that theory wrong. I checked capacitor values external to the TDA-7000 chip, setting the chip up in one of several bandwidths and operating schemes, and all seemed OK. Placing the chip in my old PC board proved that the chip was OK, with full quieting at about four and a half microvolts. Perplexed, I tried replacing several capacitors—to no avail. Sensitivity was still at 200 microvolts. After quite some time I hit on the answer: The problem was with the oscillator coil!

It was wound as I specified—12 to 13 turns of #24 or so gauge wire. In this unit I had to replace the original coil and rewind it with #20 enamel wire (12 turns). This gauge of wire barely fit on the miniature coil, filling it up to the top of the form. When the power was reapplied, voila—5 microvolts sensitivity.

This seemed like black magic, as the original coil checked out resonant at 30 MHz with my grid dip meter. What was going on? I replaced the coil with the original coil, and low sensitivity resulted, confirming the coil to be the culprit. I have not determined just what is going on, but I suspect that coil "Q" was at error, and did not match the chip circuitry for some reason. Wind your coil with a larger gauge wire, and it should solve the problem.

I have picked up a Hewlett Packard RX-250B ("Q-Meter") capable of measuring impedance at a particular RF frequency. Though I don't have time right now to test my theory, I believe the coil impedance to be at fault. By the way, this HP-RX meter can measure impedance from a few MHz to just over 250 MHz, making a direct readout in resistance (impedance). When I get the test jig finished, I will report the results.

The ability to pick up such an instrument from surplus is attributed to my

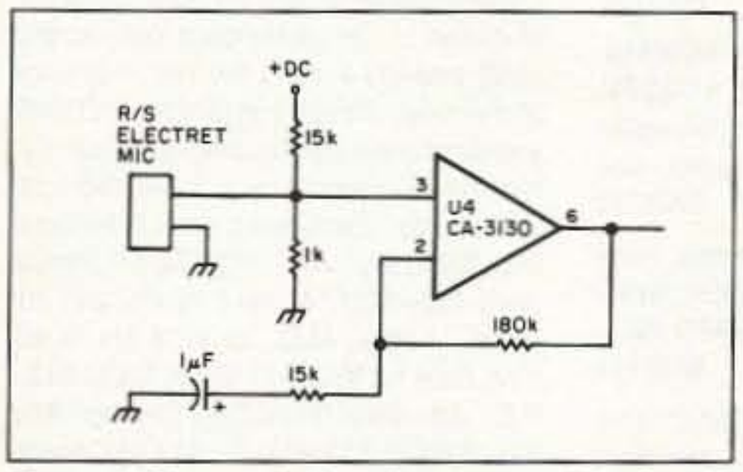

Figure 1. Changes in the mike diagram. Pins 2 and 3 were reversed on the U4-CA3130 op amp.

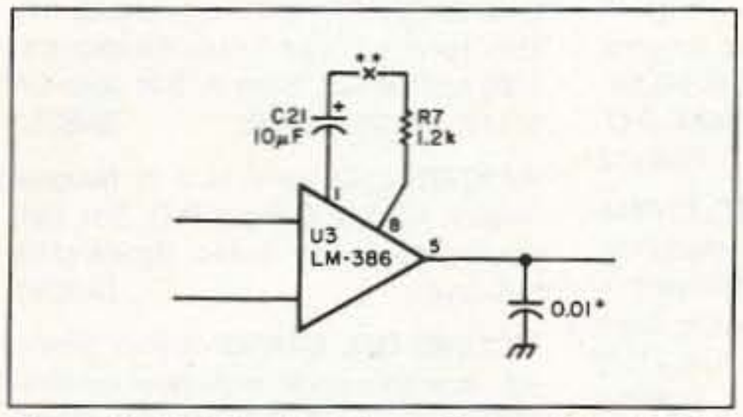

Figure 2. Modifications to audio amplifier LM386: Add a 0.01 μF bypass capacitor, pin 5 to ground.

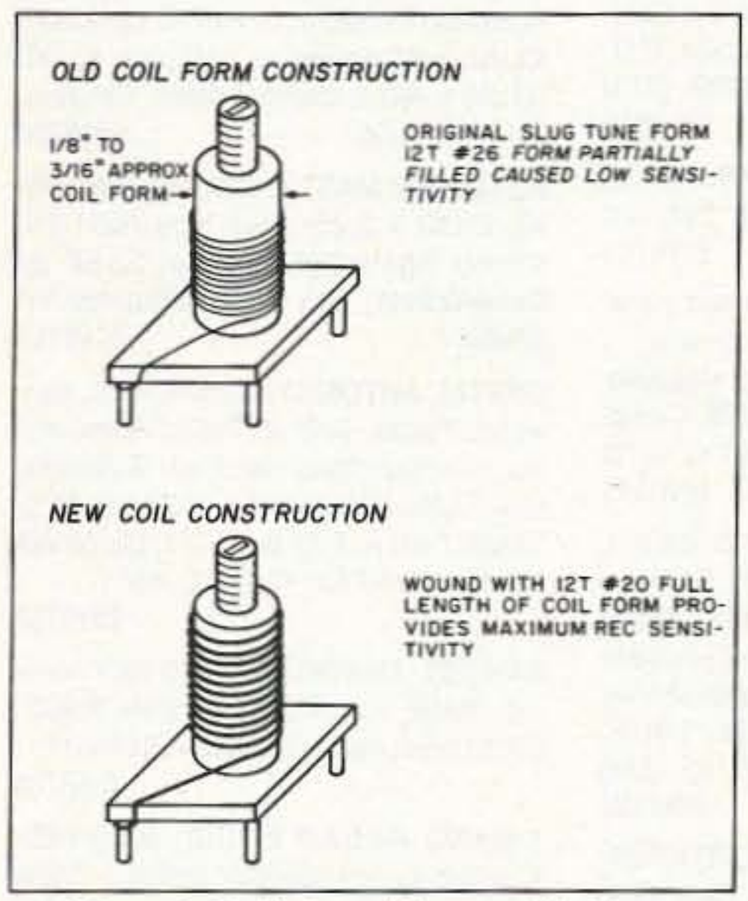

Figure 3. Oscillator coil form modifications.

location here in Southern California, where large surplus materials are disposed of by manufacturing and military contractors. Sometimes you get lucky, too, at a commercial auction and beat a dealer to a choice piece of equipment such as this HP impedance meter.

Bug Number 3

Now for the third and last problem: feedback in the audio circuitry at gain settings near mid-volume range. This is particularly troublesome with systems that use small speakers as part of the cabinet wiring. The rigs that I use are all equipped with a small headset (4 to 8 ohms) similar to Radio Shack's $5 version for small portables. Nothing fancy in a headset is needed here.

The feedback in most units was traced back to the output of the LM386 audio amplifier chip. The original design called for a ferrite bead shunted by a small value resistor to aid in suppression. However, an additional 0.01 μF bypass capacitor with pin 5 to ground will further aid in controlling feedback. I did not use sockets on my PC board, as all chips are soldered directly to the traces. This made for a very short path for the added 0.01 μF capacitor by soldering the capacitor on top of the board from the chip to the ground foil with almost no lead length at all.

Additionally, you should construct the ferrite bead with three turns of wire, and use short leads to connect it to the circuit. Long component leads do a disservice to this type of circuitry, and lead to instability and other problems. For further gain reduction, open up the capacitor and resistor on the LM386 pins 1 or 8. This places the chip in low gain mode.

Trouble-Shooting

To trouble shoot a PC board constructed from scratch, never attempt to look at it as a complete unit. Break it into small sections and test each portion of the circuit as an individual item, not as a complete circuit. If you do try to test the circuit as a whole, it can work, but go back to basics if trouble develops. Always verify voltage supplies first for proper operation.

Check voltage on the power pins and verify ground connections on the chips, such as the grounding on pin 16 of the TDA-7000. Check the audio amplifier, and touch the input with your finger. Can you hear a 60 Hz hum or other noise increase? If so, it's probably OK. Proceed to the TDA-7000, touch the antenna input with your finger, and if you can hear commercial FM broadcast stations, it is functioning. What this chip is responding to is the third harmonic of 30 MHz (assuming the coil is properly resonant or close to frequency).

You have to remember you are dealing with a single chip receiver, and there is no tuned circuit to prevent harmonics from coming through the front end of the system. This problem can be partially eliminated when the preamplifier is connected between the mixer diode of the microwave detector and the receiver input. The preamp is adjusted by the nature of its tuned circuits to provide a passband at 30 MHz, which helps to eliminate this harmonic problem.

In very stubborn cases of commercial FM broadcast interference, you might want to place a 30 MHz low pass filter in the circuit to totally eliminate the problem. Of course, the receiver housing cannot be plastic, since good RF shielding is the key to prevent RF interference from entering the circuits.

Construction tips include some information on the CA-3130 op amp. This op amp cannot be replaced by a conventional 741 op amp as it is a special type of device classified as a "zero offset voltage device." This is a special application for an op amp, in that the device does not require a split or two-voltage power supply to swing output voltages. It is designed by its special circuitry to swing its output voltage from ground potential and positive Vcc. No other chip that I am aware of will allow operation to ground potentials. That's where it gets the term "zero voltage offset." It can operate to ground potentials.

Most all other chips require a voltage offset from the negative rail for proper chip operation. The 741 op amp is typical of this type of offset voltage that is required. This makes circuitry a little more complex to run from a single power supply such as +12 volts and ground. Most circuits use a floating ground, allowing both a positive and negative potential for circuit operation. In comparison, the 3130 requires only a single power supply and ground, since the circuitry inside the chip makes this zero offset and single power supply operation a real boon to simple circuits.

The LM386 was selected for the same reason, a single power supply voltage for its operation. This keeps the parts count at minimum for the audio amplifier. Keep it simple and it's easier to build.

Microwave Brick Update

Confusion on ordering crystals for the 10 GHz brick oscillators for the Frequency West phase-locked oscillators prompt a short note. The oscillators operate on the crystal's 102nd harmonic. For example, assume a 10,368 MHz operating frequency and a 145 MHz IF. That makes the frequency minus IF to be 10,223 MHz for the brick oscillator. Divide that by 102 for the crystal frequency, which equals 100.2254902 MHz.

The multiplication scheme we use in the brick is 17 times the crystal to lock the cavity oscillator. This oscillator is then multiplied six times in a varactor multiplier for an output frequency of 10,223 MHz. Crystals can be ordered from International Crystal Co. and cost about $20 each. The part number is #585132. Specify your brick output frequency, crystal frequency for verification, and the type of brick you have, such as Frequency West type 54XOL.

10 GHz Contest Notes

Our furthest contact during the ARRL 10 GHz contest was 255 miles distant. Ed N6OYJ, Jerry WA6VLF, John WB6BKR, Kerry N6IZW and myself WB6IGP at DM12SV Monument Peak, near San Diego, worked KY7B at DM34TK, south of Prescott, Arizona. We were all very excited about five stations working five DX QSOs between the two states.

The Arizona end was operated by KY7B, WA7YLI, and WA7CJO. Twenty watts and a 30-inch dish was used at the Arizona end. Power on our end ranged from 4 to 8 watts for Kerry and myself with TWT amplifiers and similar dish antennas. N6OYJ, WA6VLF, and WB6BKR all used 0.1 watt! The contact on 10 GHz SSB sounded like a wailing banshee due to the cloud Doppler from thunderstorm activity.

Mail Box

Ward WB7VVD reports laser QSOs over an 18-mile path. He has just picked up a 110 mW Argon laser and is interested in some long-haul laser communications, somewhere in the 200-mile range. Ward is also constructing a 10 GHz SSB system in concert with several other stations in the Phoenix area. The biggest thing stopping construction is 10 GHz mixers. Ward reports that microwave components are not easy to come by in Phoenix.

Dave Pascoe KM3T is also constructing a 10 GHz SSB station. He is looking forward to getting his station running for the upcoming contests as he plans to do some mountain topping very soon. Note: The 10 GHz frequency normally used is 10.368 GHz, or 100 kHz higher in frequency to eliminate multiple station operation. Yes, even on contest weekends QRM on 10 GHz is noticeable.

John DeLong of Vancouver, B.C. picked up several Gunn diodes, and was wondering if I have access to other obscure materials such as Teflon™ PC board material. Yes, John, I have Teflon PC board material, and I use it to construct several different items. One is a dual-stage MGF-1402 amplifier for 10 GHz. I make bare board stock available from material on hand. While I am not a one-stop store, and do not intend to become one, I do stock many different microwave devices and materials such as boards and miniature capacitors. I try to gather microwave materials like a squirrel gathering nuts for the winter. With a great surplus area to wander through, lots of things turn up.

If there is something in particular you are looking for, drop me a line (please include an SASE) or give me a call on the weekends. If I don't have it I might be able to put you in contact with someone who does.

Dave N4JGQ of Falls Church, Virginia, is helping a new ham who is quite interested in 10 GHz WBFM. Dave is constructing two of the IF systems for use with Gunn systems. Douglas NØNAS of St. Paul, Minnesota, is also constructing two IF systems, and he has enough parts to complete the 10 GHz WBFM equipment. He is keeping his eye out at the next swap meet for 70 MHz TV converters. I presume they are for video operation. They should make a great video IF system.

Well that's it for this month. As always, I will be glad to answer your questions on microwave or other VHF/UHF related topics. Please include an SASE for a prompt reply. 73

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X-BAND RADAR EQUIP. WANTED: Working or not, civilian, military WWII, 1970 especially need delay lines for AN/UPM11A. APS10,15 UPN4 AN/PPS4,4A, complete or parts, manuals older Varian X-band catalogues. SHF, Box 10215, Pittsburgh PA 15224. BNB760

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The RC of JHS 22 NYC, INC., P.O. Box 1052, New York NY 10002. Round the clock HOTLINES: Voice (516) 674–4072, FAX (516) 674–9600. BNB762

HELP! N5AAN will be released from prison in April. I need a job, a place to stay, and relocation assistance. I have 3 FCC licenses and 8 years intense oilfield experience. I am factory trained on Mastr-II and Ferinon microwave/mux. For resume, write: Jim Cranford, 107159 S1-1, 27268 Hwy. 21, Angie LA 70426. BNB763

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PRINTED CIRCUIT BOARDS for projects in *73, Ham Radio, QST, ARRL Handbook.* List SASE. FAR Circuits, 18N640 Field Ct., Dundee IL 60118. BNB966

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COMPONENTS QRO–QRP LSASE KA7QJY, Box 7970, Jackson WY 83001. BNB995

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FOR SALE: Knight TR-108 2m AM transceiver V-107 remote VFO; receiver OK, transmitter may need slight help, $45 or best, Klaus Spies, P.O. Box 48185, Niles IL 60648-0185. BNB998

Never Say Die

Continued from page 4

your local schools to talk hamming, you're not doing your bit to revive our moribund hobby, which has turned into a pasture for retired old white American men. It's a nice place for old men to talk to each other without even having to listen. The crackpots can rail against perceived villains. The seriously demented can muster around KV4FZ on 20m. Those interested in hearing endless self-promotional harangues can tune in K1MAN's broadcasts.

A Baited Trap?

The recent FCC's offer to relax our rules so we can order pizza over our repeaters looks so reasonable that I suspect most hams will grab the bait and try to run.

Alas, the bait, as always, has a hook in it. But what about the wording of the offer? There's this bit in there about this helping to use our "excess capacity." Whoa there, Nelly! Yes, we have an incredible amount of excess capacity, but we know how bureaucratic systems work, so if we ever actually admit in public that we have excess capacity, we'll find it up on the chopping block like the two MHz we just lost from our 220 MHz band.

Bureaucracies are essentially socialist systems. There is no profit motive involved. The bureaucracy takes money away from people by force and spends it as it sees fit. When our beloved federal government starts running out of money to spend, they turn to the states for more. When the states start running dry, they increase taxes.

You're well aware of the bureaucratic funding system. Each department gets a yearly budget. This usually is a certain percentage higher than last year's budget. Comes the end of the fiscal year and the department better damned well have spent the full budget, or else they'll get their budget cut for next year. No department ever comes in under budget. No department ever needs less for the next year's budget.

It's the same with our frequencies. We have to spend our budget or we'll lose it. This means that even if we can't possibly use more than 10% of our allocated frequencies, we have to somehow give the impression that we're in terrible shape for the lack of more desperately needed frequencies.

Excess capacity? Once we admit to a bureaucrat that we have anything like that we're fair game. And those of you who still have hinged minds are aware of the pressures the spectrum allocators are under to make room for new communications technologies.

Mobile telephones, complete with fax machines, aren't a surprise to us. And we know full well that we're facing some sort of pocket telephone system. We know we'll be having pocket computers, complete with instant radio communications anywhere in the world.

The electronic giants are looking for under-used capacity. Their pressure has already started to break loose some bands reserved for military use.

QSL of the Month To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449. Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

So here we sit, with multi-megahertz of almost totally unused channels.

Sure, we have pile-ups on 20m when someone in a rare country has the stupidity to come on the air. We drive him off in short order with demands for tens of thousands of QSLs, all in the name of international goodwill. That's a laugh. I've sat and talked with hams in over a hundred countries and in case you don't know it, American hams are an international joke. We're considered to be the worst operators in the world.

American DXers have worked arrogantly and inconsiderately hard to achieve this world recognition. Maybe we need something more than an obscure *QST* Honor Roll listing as a reward.

While we have several thousand virtually unused repeaters and wide-open UHF bands, we're sitting ducks. More hams would help. And not admitting to excess capacity will certainly help.

The FCC Auctions

More and more readers are sending me clippings about the FCC's plans to auction off unused or sparsely used segments of the spectrum . . . wondering if "sparsely" means us. It certainly could. I think our use of our most valuable bands could easily come under that definition.

By most valuable I mean the 99% of our spectrum we're not using at all, not the 1% we're just barely using . . . or misusing.

Am I referring to 20m? No, I think any rational jury in the world would uphold our use of this band. What possible fault could they have found with our DX pile-ups, list operations, the wiping out of half the band by DXpeditions with no intelligent operators, the melee on 14.313 or K1MAN's endless self-promotions on 14.275? No, I think that band is safe.

And two meters is certainly being fully used. One only has to look at any repeater directory to see how full that band is . . . packed solid with almost totally unused repeaters self-identifying now and then.

One percent of our 1296 MHz band was busy the other night during the moonbounce contest. It gets busy once or twice a year for a few hours. That ought to hold the band, right? Bill Brown WB8ELK and I were going to listen to the fun via our Hancock Very Long Base Array dish just down the road, but the tilting motor had burned out.

I'm encouraged to get newspaper and trade magazine clippings because it shows there are at least a few hams who are beginning to become concerned about keeping our bands. And I thought no one cared!

The old "use 'em or lose 'em" warning holds to some degree. But that isn't everything. It also counts *how* we use 'em. There's a 2m repeater in L.A. that's so incredibly bad it made the front page of the local papers. That isn't likely to count heavily toward extending our lease. Nor are our increasing complaints, aggravating both the FCC and Congress, concerning problems we should be resolving by ourselves.

So what can we do about it? I've suggested in the past that you get the ARRL to dedicate a department to working with the members to clean up our bands. Just as businesses are having to attend to quality problems with their products and services, if we continue to be unconcerned about the perception that we are wasting valuable spectrum, we're eventually going to lose it.

It's difficult to get any hints yet as to whether we might just lose everything all at once, or whether we may see our bands frittered away through misuse and disuse. I hate to see us gambling with a hobby which has such a potential value to both our country and the world.

Since the ARRL is our *only* national ham organization, the responsibility for the health and welfare of the hobby would seem to fall on their shoulders. So yes, I'm critical of their refusal to accept this responsibility.

We need two major changes in the ARRL. One would be for the directors to establish a quality control department to help clean up our bands, and the other would be to set up a department dedicated to achieving ham growth. Lacking these basics I'll continue to carp.

Meanwhile, my sources deep within the FCC are leaking disturbing news. Our stock is not high in Washington. The suitors for our bands are well-heeled and spending where it counts. We're countering this spending offensive with bitching and complaints. Apparently the not exactly new concept that in Washington money talks loud and clear has yet to perk through to most ham minds.

Our License Exams Stink

Do you know why old-timers go into a total panic when anyone mentions retesting? Do you know why, when the ARRL proposed what they amusingly called "Incentive Licensing" in 1963, that it totally stopped our growth and tens of thousands of hams sold their stations for anything they could get for them? The panic put over 750 ham stores out of business in one year and killed off virtually every major ham manufacturer within two years.

It's the same basic problem which has poisoned our entire educational system and is helping to make America less and less competitive in the world.

There are two basic ways of learning: rote and cognitive. With one you memorize data so you can parrot it back later to pass a test. With the other you understand the concept so you don't have to memorize anything.

Our ham exams are designed to test memorized information, not concepts. So, in order to pass them, we sit down with a Q&A manual and memorize. This works fine if you take the test while the memories are fresh. But memorized information evaporates quickly . . . and it's gone.

Just think of how many years you wasted in school memorizing crapola just so you could pass all those stupid tests. You know you could never pass the same test a month later without re-memorizing the stuff all over.

I've got a good memory for things I enjoy. I can still recite poetry I learned 60 years ago and remember the words of the songs I've learned over the years . . . even those in foreign languages I don't understand.

But when it comes to things which aren't fun, my memory, like yours, is painfully short. For instance, I had a terrible time in high school. I needed three years of a foreign language to get into college so I started French in my freshman year. My mind rebelled. Every time I'd sit down to do my vocabulary memorization homework I'd fall asleep. My folks tried a tutor, but I still fell asleep. It took me four years and a summer school session just to pass three lousy years of French . . . and I still couldn't speak it.

They forced us to memorize the grammar rules and vocabulary, not how to actually use it. And that's what so much of high school was like . . . awful. History memorization. Geography, math, English literature . . . all almost 100% memorization . . . and pffft.

College, alas, wasn't any better.

Their English literature course required us to memorize the authors, the dates, titles and short synopses of about 300 Victorian novels. Calculus was worse, with hundreds of formulas to memorize. The "teacher" got mad when I asked him where we might find a use for all this in real life. He didn't know.

I found out how bad it was when, after spending four years in the Navy during WWII, and managing by several flukes not to get killed, I went back to finish my last two years of college. I'd passed two years of calculus and had one last course to go. But when I got back I found I had zero recollection of the first two years. I had to spend a whole lousy summer re-doing all of it again and none of it seemed even vaguely familiar.

Most of my college courses called for memorizing data just long enough to pass a test. I knew I hated this and was frustrated at the waste of my time, but I was too dumb to get the hell out of there and stop. I'd been brainwashed on the importance of a college degree. You know, no one hiring me has ever even asked about it.

I should have figured it out when I went through the Navy electronics course. That was incredibly good. No memorization involved. I know it's unbelievable that the military could ever do anything right, but they sure did . . . at least once.

We'd sit in a chalk-and-talk lecture to learn how something worked. Then we'd go into a lab to use what we'd just learned. For instance, they explained to us how a superheterodyne receiver works, circuit by circuit. Then we'd have to fix a bunch of fiendishly disabled receivers. We had to understand how they worked to figure out what they'd done to them.

That school was so good they were teaching kids who didn't know a volt from an ohm how to fix anything electronic in just nine months. I learned a hundred times as much in nine months there as I did in four years of college.

Right now I'm working in my sneaky way to try and change the American educational system . . . to get it to dump memorization and go for cognitive teaching.

Meanwhile, how can we go about changing our ridiculous ham exam system to something better? I have in mind a cognitive system with no written exam at all.

If we could do that and assure that newcomers had some understanding of radio, I'd be able to go back to publishing technical articles in *73*. But with about 50% of the readers still not sure about transistors and yearning for more tube equipment, the call for digital voice communications and digital signal processing articles is faint. Yet that's either where we're going to head, or we're going to be blown away.

Oh, I don't mind a couple of old fa . . . -timers . . . using AM on 75m. Maybe on one frequency. But I do take exception to their trying to lure others into their folly. Other than as a museum exhibit, AM should be dead. Old-timers can testify about how long it took after CW was invented before spark was finally eliminated. The FCC had to outlaw it to get 'em to stop. "Spark Forever" was the cry. So what's changed?

SSB is the spark of the 1990s. We're pathetically behind in technology, but we're making up for it by making sure that newcomers haven't a clue as to how radios actually work.

Well, I may not be able to convince anyone of the need to change our really dumb ham exams . . . you know, the ones which didn't keep out KV4FZ and K1MAN . . . but I will be trying to get New Hampshire to take a leading role in promoting conceptual teaching instead of memorization. Thank heavens we're a small state, so it's not difficult to be heard.

The New Ham Exam

Okay, if memorization for our tests has screwed up the hobby, what could we do instead? How can we go about teaching concepts? Well, I went this route in the Novice license study guide I put out around 25 years ago. Then came Bash saying hey, take the easy way, I'll help you memorize the answers to the tests so you can pass it with one weekend of work. He even helped thousands get Extra Class licenses without having to bother learning the code.

I like the idea of all newcomers being taught the concepts of radio by local ham clubs. They'd also teach 'em how to get on the air and make contacts. It would be a combination of teaching and apprenticeship. Then the club, once they're sure the newcomer knows enough, would issue a license. The club would continue to be responsible for the hams they accredited.

Thus, someone like K1MAN would have to answer to his peers when he started causing trouble . . . and the club would be able to suspend his ticket if he refused to behave. Yes, he'd probably sue. I'd ask for a rule which would suspend the license of any ham bringing a ham-related suit . . . until the legal action has been completely terminated. That would stop a lot of expensive nonsense.

Contributing Engineers

A letter from Don Lively W6SJQ had a great idea to help our educational system start teaching technology and math. Presuming that this isn't the first of my editorials you've ever read, and that you are not part of the 50% of the American public which reads no books or magazines at all, and that you've also isolated yourself from radio and TV, it will not come as a major surprise to you that our country is a tad behind on generating new engineers.

I claim that amateur radio is mainly to blame for this disaster. If amateur radio had kept growing at the rate it did from 1945–1963, at 11% per year, we'd today have 3.5 million licensed amateurs . . . about double those in Japan, which has half our population.

Further, we'd be generating about 385,000 new licensees this year. In the pre-1963 period 80% of these new hams were youngsters (300,000) and 80% of those (240,000) would be going on into high-tech careers as engineers, technicians, and scientists. And we would have already contributed 2.25 million high-tech careerists in that period.

My plan for getting kids started learning the fundamentals of electronics, communications and computers via peer-teaching grades 5–12 in our schools, and forming radio, computer and experimenters clubs should do it. I suggested that local ham clubs would be glad to lend a hand in answering questions for the classes. Ditto local computer clubs . . . and there are some big ones around.

The Boston Computer Society is humongous, complete with a very active ham special interest group. I know they'd jump to help any school within driving distance.

Don suggested a mother lode of available high-tech volunteers . . . the Ma Bell retirees. With Ma slimming down, like other big businesses, she's turning out thousands of early retirees. This is a great resource for teaching help.

Some states are so tightly controlled by the teachers' unions that it's illegal to let a qualified technical person come in and teach. That's ridiculous, so I hope you'll put on the pressure with your state legislature for a change. The teacher and state employee unions are particularly powerful on state levels, so it's going to take some strong parent group action to break their power hold.

New Hampshire permits alternative teachers, so it can be done here . . . even though we have a corker of a teachers' union.

Between volunteer hams and retirees, we should be able to help youngsters cope with technology . . . at least the basics. I don't think hams will be too helpful in explaining in simple language how telephone switches, facsimile, computers, and other modern conveniences work. But, unless they've Bashed their way into a license, they should be able to help teach electronic basics.

A New Hampshire Opportunity

The recession has hit New Hampshire particularly hard. I've watched For Sale signs going up everywhere and home prices drop like a rock. It's just about decimated the banks. In fact, the situation got so bad that the legislature decided it was getting time to try and do something about it.

They consulted themselves first. But they didn't know what to do, so they voted to put together an Economic Development Commission, with members from both industry and government, and have them appointed by the legislature and the governor. I know this is going to aggravate the hell out of my detractors, but I was one of the five appointed by the governor.

The goal of the Commission is to provide the legislature with a plan to tackle the short, medium, and long term problems facing our state. This is just the opportunity I'd been waiting for, so I could hardly wait to get started.

The Commission has some real strength. In addition to a couple senators and some legislators, we have the president of the University of New Hampshire, and a number of successful businessmen.

So why am I bothering you with all this, other than blowing my horn again? Because it's a fantastic opportunity for amateur radio to not just achieve record growth, but to nail down our hold on our bands just at a time when we're in serious danger of losing them.

Oh pshaw, you say . . . or something less printable. How can amateur radio help pull New Hampshire out of a recession? If you said that, then you either have a terrible memory or you haven't been reading my editorials for the last 40 years. Even worse, you may not even see how this opportunity up here in New Hampshire might easily be translated to your own state to help it cope with the world of 2002 . . . which is only 10 years away!

That reminds me, I'm getting really pissed at King Hussein for frittering away his time with all this hostility baloney when he should be gearing his people to be successfully competitive in the future. I haven't seen one hint that he's been planning for 10 and 20 years from now . . . and that's the mark of a good manager.

Is your state busy coping with immediate problems and losing sight of the future? That's what happened in New Hampshire and I don't think we're unique.

The Immediate Problem

New Hampshire has suffered more than most other states in this recession because such a high percentage of its jobs were in generation-old high-tech industries which were bound to collapse . . . and now are in the process of doing that.

Massachusetts-based minicomputer companies such as DEC, Data General, and Wang expanded into New Hampshire and became major employers. As I've pointed out in past editorials, the minicomputer industry is, like the mainframe computer industry, doomed by the microcomputer. This technological revolution will also eventually bring down IBM. It's the disintegration of these giant firms which has made New Hampshire suffer more than most other states.

The minicomputer firms arrogantly ignored microcomputers and are now paying the price. They are no longer competitive against computer systems which cost one-tenth as much for the same performance.

I have some fast fixes for the hole the collapse of these minicomputer firms has made in the New Hampshire economy, but in the longer range I'm recommending a fix which should be adopted by every state in the union, as well as other countries. It's a shame that bad planning on a state level has brought this about. I warned Governor Sununu that this was an inevitable result of our dependence on these huge firms.

In the short term I have a proposal which I believe will turn our economy around within two years. As an entrepreneur I tend to think in terms of self-financing changes, so my recommendations will call for a small venture capital investment up front...either from the state or from private sources, backed by the state. But it should be able to repay the investment within three years and make a nice profit from then on.

If you're interested in my reports to the Commission in detail, I'll put them on our BBS as I write them. I've only written about 50 printed pages so far, but I've a lot of material yet to be covered.

Now let's get to where amateur radio is going to save the bacon for New Hampshire...and maybe America, and then the world. And I'll get to how you can participate, helping to make this happen.

If you're living in a relatively small state such as New Hampshire, you'll be able to have more of an influence than if you're in a big state. That's one nice aspect of living in New Hampshire: It's small and it has a citizen legislature (the largest in the country), so it's not at all difficult to know the top people. I've been good friends with several governors and senators. Heck, my grandfather was a state senator.

The Problem

In the long run New Hampshire (and any other state) is going to be successful if it can attract high-tech businesses...preferably smaller entrepreneurial high-tech businesses.

The day when low or unskilled workers can survive is passing. The day when a state's economy can depend on low-tech manufacturing...or even manufacturing of any kind, for that matter, is passing. Transportation and communications costs have dropped, making it so workers in other countries are almost in direct competition with ours.

It's so easy to make things over the border in Mexico, at a fraction of our low-skilled wages, that production will be forced in that direction...and to the Philippines where 15¢ an hour is a good wage. Or to China where slave labor costs far less than that.

This means that the work force of 2002 is going to have to work smarter rather than harder. And that, in turn, means that we're going to have to make some major changes in our educational system. We're shortchanging our kids with an antiquated system. We're not teaching them math and science, even though we know full well that if we don't we're going to be sentencing them to failure.

Our educational system is heavily entrenched and has been able to resist every effort so far to make substantial changes. In a recent address to the largest chamber of commerce in New Hampshire, Governor Gregg explained that the teachers' union is one of the most powerful lobbying forces in our state.

Okay, we want a high-tech oriented and educated work force by 2002 so we'll be able to attract high-tech firms to the state. That means we've got to make some major changes in our whole educational system within the next year! We haven't got time to horse around.

But, whine the educators, we don't have the math and science teachers we'll need and it'll take at least 10 years to develop and accredit them to teach. That's only if we agree to go along with the present system. I'm proposing what's called a paradigm shift...going about this a whole new way.

I'm proposing that we start next fall with an eight-year course in the fundamentals of electronics, communications and computers, all taught via a weekly publication much like *Radio Fun*, which guess who would publish. The kids would get together every day in groups and discuss the material with each other. This is called peer-teaching and it's worked fabulously in a few trials.

To help these peer groups we'd make available consultants for them to invite in from the business and retirement community.

This weekly publication would, in addition to having the week's study material, also have columns encouraging kids to form school radio, computer, and electronic experimenter clubs. The key to getting them to learn would be to make it fun. The clubs would make it even more fun.

Since we have hams in every part of the state, we'd be able to enlist many of them as volunteer consultants for these classes. Plus, we'd be able to draw upon computer groups and high-tech retirees.

By making learning fun for a change, we can not only generate thousands of high-tech career workers for 2002 but, I believe, also get amateur radio into high gear for the first time in almost 30 years. With a bunch of kids coming along, anxious to experiment with our almost unused microwave bands, and eager to start using digital voice on our lower bands, we're a lot less liable to lose our frequencies.

Will I be able to sell the idea to the Commission and then to the legislature over the resistance of the NEA? We'll see. Surely at least one ham must be in a position to try and get a similar movement going in another state.

If we can fix our short-term problems quickly and then lay the groundwork for a future high-tech work force, we're going to have to fight off newcomers to the state. We have the lowest taxes in the country right now. And, despite our problems, we've been rated the "most liveable state." There certainly isn't a more beautiful state, nor one with more opportunities. And we attract vacationers in spring, summer, fall, and winter. Indeed, tourism is our largest industry.

Just as amateur radio has fallen behind in technology, New Hampshire bet the farm on minicomputers and is paying the price. The microcomputer publishing center I built in Peterborough provided an incredible opportunity, but instead of building on this strength, the town made it almost impossible for new entrepreneurial businesses to get started. Now Peterborough is paying a particularly heavy price. 73

Random Output

Continued from page 84

forget about it for the rest of the day? Do you provide snacks for breakfast and sandwiches for lunch? If not, have you recruited volunteers to visit the booths and take lunch orders? Many hamfests get the local Girl Scout troop to provide this lunch delivery service. The sight of those young ladies bringing you a cold drink after you've been standing and talking for five hours without even a bathroom break warms the heart of even the most disgruntled exhibitor.

Be A Good Business

Let's face it: Hamfests are big business. The same rules that apply to running a good business apply to running a good hamfest. Treat your customers like the important people they are, and they will return. Treat them like you are doing them a favor, and you will eventually go out of business. A hamfest's prime customers are the exhibitors—not the attendees.

A company spends thousands of dollars to attend your show. Retailers hope to make that back in sales at the show. A manufacturer or a company like *73* attends a show for the PR and customer relations value. Even if the hamfest is badly run, the retailer will return if he makes money. Not so with your other exhibitors. If the hamfest organizers are rude, inconsiderate, inconvenient and have bad attitudes, most of the exhibitors will eventually stop attending that show. There are hundreds of hamfests every year and we can only attend so many. If your show isn't the best—from the exhibitor's view—then we will simply attend a different show.

The Best

So...you may be wondering where the good and bad hamfests are. Since I'm in a particularly magnanimous mood this month, I will refrain from naming this year's worst hamfest. (It's too bad. It was my first time in that particular city, and I really liked the area, but the hamfest was so badly organized—and the organizers were so untruthful, uncaring and unbusinesslike—*73* will never again be seen at that particular gathering.)

As for the best, the hands-down winner is the Houston Com-Vention. The folks running that show, especially Richard Shankle, are pros at putting on a hamfest. They treat the exhibitors like gold, and the people in Houston are chock full of that famous Texas hospitality. Houston is nowhere near the biggest hamfest of the year, but Richard and the entire crew made us feel so welcome, and were willing to do anything to make our jobs as exhibitors easier, that I can guarantee you that *73* will return next year. Every once in a while, during setup and each day of the show, someone would come by our booth to see if we needed anything. I think I was asked at least a dozen times, "What can we do to make this hamfest better?" Congratulations to everyone involved with the Houston Com-Vention. You all did a great job.

Come to think of it, the Dallas Ham-Com was a close second. Maybe it has something to do with Texas. 73

Number 28 on your Feedback card

RANDOM OUTPUT

David Cassidy N1GPH

How To Have A Hamfest

As I write this, the hamfest "season" has wound down. As you read this, the new season is just about to begin. While there are companies that go to many more hamfests than *73* does, we have visited about 15 or 16 conventions over the past year or so.

One of the after-hours activities of the exhibitors is talking about how good or bad the various hamfests are. Putting on a good hamfest isn't difficult, but you'd be amazed at how bad some of these shows are. After numerous conversations with representatives from large and small companies, I would like to offer a few suggestions—through the eyes of the exhibitors—to those who are responsible for putting on hamfests.

Attitude

The fundamental problem at the root of all bad hamfests is attitude. With very few exceptions, most hamfest organizers have a basic attitude problem. They treat the exhibitors as an afterthought—as if we exhibitors should feel beholden to the event organizers for allowing us to show up and set up a booth. Though this attitude is never put blatantly into words, it is evident in the way many hamfest committees treat the exhibitors. They have forgotten that without the exhibitors there IS no hamfest. The money exhibitors pay for booth space is what makes the hamfest possible. The audience attracted by a good number of exhibitors is the lifeblood of an annual hamfest.

You would think that this would be simple common sense: Treat your exhibitors well, and your hamfest will prosper. You'd be surprised at how many hamfest organizers forget this basic fact.

Don't Lie

Treating the exhibitor right begins with telling the truth. Don't inflate your previous or expected attendance figures in the mistaken assumption that we won't notice. If you tell me that you expect 5,000, and only 2,000 show up, it will be very difficult for me to believe you next year, when you want my business again. Be honest. Even better, be conservative. If you expect 2,500, tell me you plan on 2,000. That way, when your actual attendance exceeds your projections, exhibitors will be pleasantly surprised instead of hopelessly disappointed.

Whether or not *73* attends a hamfest is a basic business decision. While that decision is based on many factors unrelated to the particular hamfest (schedule, budget, personnel), a large part of that decision is based on information provided by the hamfest organizers. If you give me the most accurate and honest information you can, I can make an informed business decision. If you lie to me, you will probably never see the *73* booth at your hamfest again.

Be Convenient

The job of a smart hamfest organizer is to make it as easy as possible for the exhibitors to attend. The less hassle I have to go through to attend your show, the more likely I will be to leave with a positive opinion of your efforts.

Convenience begins with things like where the show is held. Is it convenient to the airport, or will I have to drive for an hour to get there? Is the convention hall in or near the hotel, or will I have to drive there? If the convention is not in or next to the hotel, is there convenient "exhibitors only" parking at the convention sight? If I have to fight through a traffic jam to get to the parking lot, then fight for a parking space half a mile from the convention center, you have not been thinking about the convenience of your exhibitors.

Most hamfests run all day on Saturday and until mid-afternoon on Sunday. In order to be out of the office for as little time as possible, the vast majority of exhibitors will travel on Friday. If Friday night set-up time ends at 5:00 or 6:00, I either have to fight it out with the guy at the door to let me in to set up, or I have to get up very early in the morning to set up before the doors open on Saturday. You should arrange it so that Friday night setup runs until at least 8:00 or 9:00. There should be hamfest staff there to help with any problems, distribute exhibitor passes, etc. If you make me conform to your "rules" instead of bending over backwards to make it easy for me to attend your show, you have the wrong attitude and you're not making it convenient.

Is it really necessary to open the doors to the public at 7:00 a.m. on Saturday? Most hamfests run 9 to 5 on Saturday and 9 or 10 'til early afternoon (1 to 3) on Sundays. Remember . . . the exhibitors have spent all day Friday in airports, have arrived in a place they're unfamiliar with, have spent a few hours setting up their booths and have probably had a bad meal and little sleep. They will get up Saturday and spend a minimum of eight hours on their feet. Nine o'clock is plenty early enough to open the doors to the public. Any earlier and you are not being kind to your exhibitors.

Be Thoughtful

Few hamfest organizers take the time to think about how expensive and exhausting it is for a company to attend their show. Have you provided a convenient and comfortable exhibitors' lounge? Have you supplied plenty of coffee and soft drinks? Have you assigned someone to check the exhibitor's lounge every 30 minutes or so, or are you just going to put a cooler and coffee pot in there at 8:00 a.m. and

Continued on page 83

Number 29 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

This January will resemble every other January during the upper portion of the sunspot cycle. Early darkness combined with the winter solstice in the Northern Hemisphere will cause the higher DX bands (20 through 10) to close around sunset, with the highest bands going out first. On Good ("G" on the calendar) days, 20 and 17 meters will stay open later. But remember, we are on the down side of the cycle now, and conditions in general will be deteriorating rather than improving with each year.

The best days to look for Good ("G") conditions will be the 1st through the 5th; the 13th and 14th; and the 20th and 22nd.

The Poor ("P") days will be the 17th, 18th, 25th, 29th, and 30th—give or take a day or so.

The remainder of the days will exhibit Fair ("F") DX conditions, meaning that you will have to work harder and listen deeper into the noise to work the weak ones.

There is one very good feature of January propagation: Quiet band conditions where atmospheric QRN will be at a minimum, and the "weak" ones will be audible.

You can expect excellent DX on 160 through 30 meters during the hours of darkness on the days designated as Good ("G") and Fair ("F"). As always, be particularly alert during the twilight hours, around sunset and sunrise, when grayline signals will propagate along the terminator—the line between darkness and daylight around the earth.

You can also watch for an annular eclipse of the sun, in which the sun will appear as a dark center with a bright halo of light surrounding it. This will occur on January 4/5, 1992. The best locations for observing the eclipse will be east of Indonesia and south of New Guinea: Australia, New Zealand, part of Antarctica, Polynesia, and the west coast of North America. These locations don't really affect most of us up here in the northern latitudes, but our foreign readers in Southeast Asia and the Southwest Pacific will be favored.

As we move toward February and March, the bands will improve again for DX, so don't give up. Just make the best use you can of the charts. Check WWV frequently for updates at 18 minutes after any hour, and be alert for sudden changes in the A and K indices, and the solar flux. Magnetic storms could occur on or near the days marked Poor ("P"). 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	—	—	—	—	15/17 (1)
ARGENTINA	15/17	15/17	20	20	—	—	—	—	—	19/12	10/12	10/12
AUSTRALIA	15/17	15/17	—	20	20	—	20/40 (1)	20	—	—	—	—
CANAL ZONE	20	20	20	20	20	20	20	15/17	15/17	15/17	10/12	15/17
ENGLAND	20	20	20/40	—	—	—	—	15/17	15/17	—	15/17	20
HAWAII	15/17	15/17	20	20	20	20	20	—	—	—	—	10/12
INDIA	20 (1)	20 (1)	—	20 (1)	20 (1)	—	—	—	—	—	—	15/17 (1)
JAPAN	—	—	—	—	—	20	20	—	—	—	—	15/17 (1)
MEXICO	20	20	20	20	20	20	20	15/17	15/17	15/17	10/12	15/17
PHILIPPINES	—	—	20	—	—	20 (1)	20 (1)	15/17 (1)	15/17 (1)	—	—	—
PUERTO RICO	20	20	20	20	20	20	20	15/17	15/17	15/17	10/12	15/17
SOUTH AFRICA	—	40 (1)	20	20	20	—	—	15/17	15/17	20	—	—
U.S.S.R.	20	20/40	20/40	—	—	—	—	—	—	15/17	15/17	20
WEST COAST	15/17	15/17	40/80	40/80	40	40	40	—	20	15/17	15/17	15/17

CENTRAL UNITED STATES TO:

ALASKA	15/17 (1)	—	—	—	—	20	20	20	—	—	—	15/17 (1)
ARGENTINA	15/17	15/17	20	—	—	20 (1)	—	—	—	—	15/12	15/12
AUSTRALIA	15/17	15/17	—	20	20	—	20	—	—	—	15/17 (1)	15/17 (1)
CANAL ZONE	15/17	20	20	20	—	20	20	15/17	15/17	10/12 (1)	15/12	10/12
ENGLAND	20	20	—	—	—	20 (1)	—	—	—	—	15/17 (1)	15/17 (1)
HAWAII	—	—	20	20	20/40	—	20	—	15/17	15/17	15/17	10/12 (1)
INDIA	15/17 (1)	20 (1)	—	—	—	20 (1)	20 (1)	—	—	—	—	15/17 (1)
JAPAN	15/17 (1)	—	—	—	—	20	20	20	—	—	—	15/17 (1)
MEXICO	15/17	20	20	20	—	20	20	15/17	15/17	10/12 (1)	15/12	10/12
PHILIPPINES	15/17 (1)	—	20 (1)	—	—	—	20 (1)	20 (1)	—	—	—	—
PUERTO RICO	15/17	20	20	20	—	20	20	20	15/17	15/17 (1)	15/12	10/12
SOUTH AFRICA	—	—	20/40 (1)	20 (1)	—	—	—	15/17 (1)	15/17 (1)	20 (1)	—	—
U.S.S.R.	20	20	20	20	—	20 (1)	—	—	15/17 (1)	15/17 (1)	15/17 (1)	20

WESTERN UNITED STATES TO:

ALASKA	15/17	20	20	20	20	20	—	20	15/17 (1)	15/17 (1)	15/17 (1)	15/17
ARGENTINA	10/12	15/17	15/17	20	20	—	—	—	—	—	10/12	10/12
AUSTRALIA	10/12 (1)	15/17	15/17	20	20	20/40	20/40	20	—	—	—	10/12 (1)
CANAL ZONE	15/17	15/17	20	20	20	—	—	—	—	10/12 (1)	15/17	15/17
ENGLAND	20	20	20	20	—	20 (1)	—	15/17 (1)	15/17 (1)	—	—	20
HAWAII	10/12 (1)	15/17	20	20	40	40	20	20	—	15/17	10/12 (1)	10/12 (1)
INDIA	—	15/17 (1)	15/17 (1)	—	—	—	20 (1)	20 (1)	15/17 (1)	15/17 (1)	—	—
JAPAN	15/17	20	20	20	20	20	—	20	15/17 (1)	15/17 (1)	15/17 (1)	15/17
MEXICO	15/17	15/17	20	20	20	—	—	—	—	10/12 (1)	15/17	15/17
PHILIPPINES	—	15/17 (1)	15/17 (1)	—	—	20	20	20	15/17 (1)	—	—	—
PUERTO RICO	15/17	15/17	20	20	20	—	—	—	—	10/12 (1)	15/17	15/17
SOUTH AFRICA	—	—	—	20 (1)	—	—	—	20 (1)	15/17 (1)	15/17 (1)	—	—
U.S.S.R.	20	20 (1)	20 (1)	20 (1)	—	—	—	—	—	—	—	20
EAST COAST	15/17	15/17	40/80	40/80	40	40	40	—	20	15/17	15/17	15/17

Notes: (1) Possible but rare dual bands (10 or 12, 15 or 17, 20 or 40). Try where shown. The highest possible bands shown. Also try next lower band at times shown.

JANUARY 1992

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

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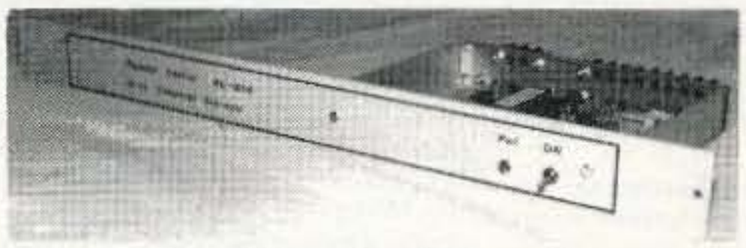

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73T05 **"Genesis"** **$5.95**

5 wpm—This is the beginning tape, taking you through the 26 letters, 10 numbers, and necessary punctuation, complete with practice every step of the way. The ease of learning gives confidence even to the faint of heart.

73T13 **"Back Breaker"** **$5.95**

13+ wpm—Code groups again, at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per. You'll need this extra margin to overcome the sheer panic universal in most test situations. You've come this far, so don't get code shy now!

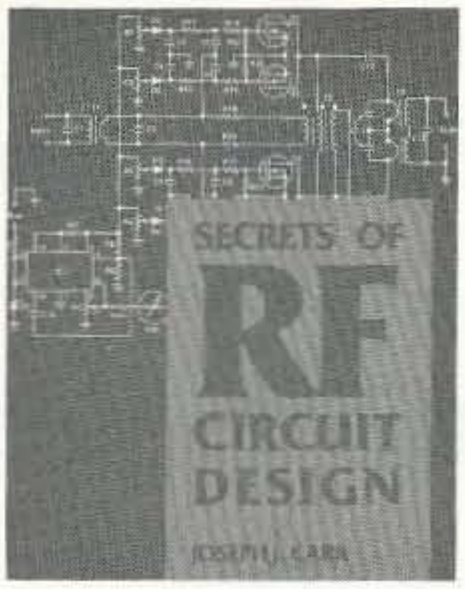
73T06 **"The Stickler"** **$5.95**

6+ wpm—This is the practice tape for those who survived the 5 wpm tape, and it's also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are sent at 13 wpm and spaced at 5 wpm. Code groups are entirely random characters sent in groups of five—definitely not memorizable!

73T20 **"Courageous"** **$5.95**

20+ wpm—Congratulations! Okay, the challenge of code is what's gotten you this far, so don't quit now. Go for the extra class license. We send the code faster than 20 per. It's like wearing lead weights on your feet when you run: You'll wonder why the examiner is sending so slowly!

NEW STUFF



20N020 **Secrets of RF Circuit Design** *by Joseph J. Carr* Written in clear non-technical language, covers everything from antennas to transistors. You will learn the basics of receiver operation, the proper use and repair of components in RF circuits, the principles of radio signal propagation from low frequencies to microwave, and much more! **$19.50**

20N019 **U.S. Repeater Mapbook** *by William Smith, N6MQS* The Guide for traveling radio amateurs gives you repeater frequencies, and locations on easy to read state map. Includes all 50 states, and 28-1200 MHZ. **$9.95.**

BOOKS FOR BEGINNERS

20N018 **Technician Class License Manual: New No-Code** *by Gordon West* This book will cover everything you need to become a Technician Class Ham. Every exact question and answer on the examinations is found in this one book covering element 2 and element 3A question pools. Gordon West tells you the right answer and then explains in detail why the answer is correct. Fully illustrated text, frequency chart showing privileges. list of examiners and an FCC Form 610 application. **$9.95**

01B65 **The Beginner's Handbook of Amateur Radio—2nd Editon** *by Clay Laster* Combines theory and practice in an easy-to-understand format, and provides information for choosing and installing radio receivers and transmitters, antennas, transmission lines, and test equipment. 400 pages, 291 illustrations. **$18.50**

20N092 **The Wonderful World of Ham Radio** *by Richard Skolnik, KB4LCS* This book addresses the plea that something simple, clear, and fun be written to introduce young people to amateur radio. Pick-up one for the new ham in your life. **$7.95**

20N100 **Electronics Build and Learn (2nd edition)** *by RA Penfold* combines theory and practice so that you can 'learn by doing.' Full construction details of a circuit demonstrator unit that is used in subsequent chapters to introduce common electronic components. Describes how these components are built up into useful circuits, oscillators, multivibrators, bistables, and logic circuits. 128 pp., 18 photos, 72 line drawings. **$12.50**

20N099 **Digital Electronics Projects for Beginners** *by Owen Bishop* contains 12 digital electronics projects suitable for the beginner to build with the minimum of equipment. 128 pp., 56 line drawings. **$12.50**

AR2073 **Novice Antenna Notebook** A beginners guide to easy and effective antennas and tuners you can build. **$8.00** An ARRL Publication.

AR2871 **W1FB's Help for New Hams** *by Doug DeMaw W1FB* Complete for the newcomer. Put together a station and get on the air. **$10.00** An ARRL Publication.

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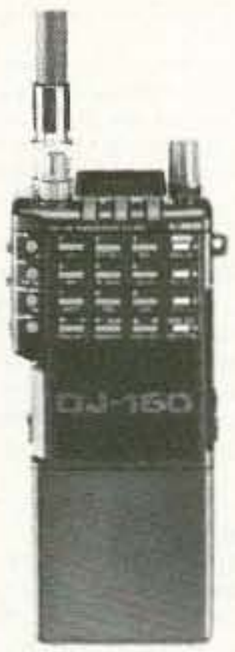

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NEW!

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The new compact FT-415/815 handheld radio deliver more than a dozen new features, including backlit keypad and display, louder audio output and large, easy-access buttons. Both the FT-415 and FT-815 offer 41 memories, built-in DTMF calling and paging, and four power levels via the FNB-27 battery. As if that's not enough, you can customize your FT-415/815 handheld with an array of optional accessories.

The competition is still working on a radio that's as powerful and easy to use as the FT-415/815 handheld. But why wait? Visit your Yaesu dealer today and leap ahead of the competition.

Shown Actual Size

Specifications subject to change without notice
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One Year Limited Warranty on all Amateur Products

FT-415/815

2M/UHF Handheld Transceivers

FT-415: 130-174 MHz Rx 140-150 MHz Tx

FT-815: 430-450 MHz Rx/Tx

41 Memories (All memories store separate transmit and receive frequencies for "odd splits")

2 VFOS

① DTMF Calling and paging built-in

Built-in VOX

② Back-lit Keypad and Display (with time delay)

③ DC Direct Operation (Automatically Charges Battery with 12 Volts, FNB-25 only)

④ Four Power Levels (With FNB-27 Battery)

Direct Keyboard Entry for All Functions

Programmable and Automatic Battery Saver (ABS)

⑤ CTCSS Encode/Decode Built-In

5 Watts Output With FNB-27 or DC Direct

⑥ Rugged Case Construction

Automatic Power-Off (APO) Turns Radio Off Automatically After 30 Minutes

DTMF 10 Memory Autodialer, Built-In

Selectable Frequency Steps (5,10, 12.5,15,20 or 25 KHz)

Four Ways to Scan (Band Scan, Memory Scan, Memory Skip, Programmable Scan)

Optional Accessories:

NC-42 1-Hour SMART Desk Charger

E-DC-5 DC Adaptor With Noise Filter

MMB-49 Mobile Mounting Bracket

YH-2 Headset for VOX Operation

FBA-12 AA 6-Cell Holder

Some accessories and options are standard in certain areas. Check with your Yaesu Dealer for details.

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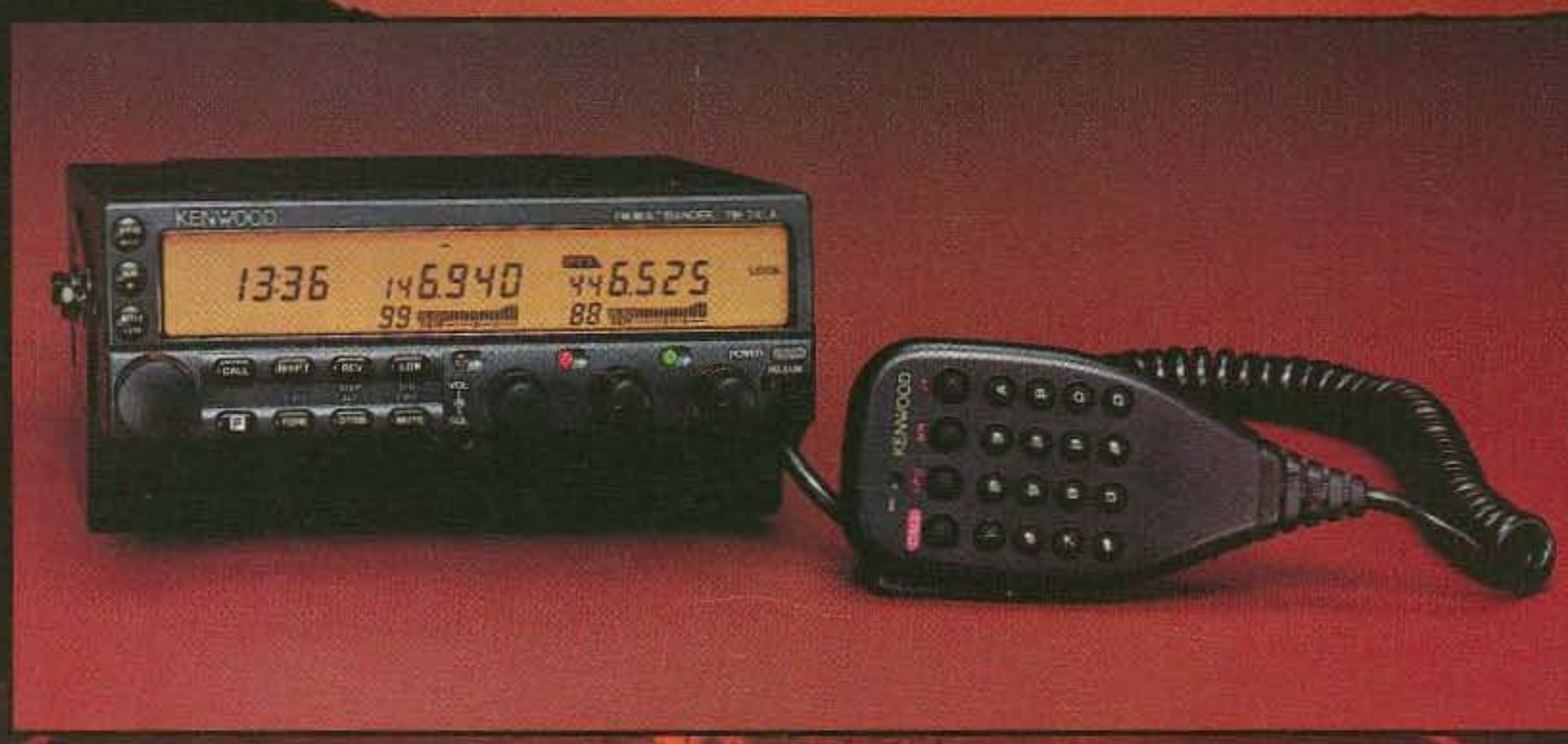

Freedom of Choice

TM-741A Modular FM Transceiver

The choice is yours. Kenwood's new FM Multibander allows you to start as a deluxe dual band radio – or add a third band. As a dual band, you'll have access to 144 and 450 MHz operation.

If you decide to add a third band – choose again. Select from the 28, 50, 220, or 1200 MHz bands. Then simply plug this option into the available slot.

Your ultra-compact TM-741A offers a full 50 watts on 10, 6, and 2 meters; 35 watts on 450 MHz; 25 watts on 220 MHz, and 10 watts on 1200 MHz!

On 2 meters, you'll find wide band receiver coverage with RX on 118 - 174 MHz, and TX on the Amateur bands. The 2 meter section is modifiable for MARS and CAP (permits required).

303 memory channels are available, with 101 in any one band. Cross band repeat between bands, or, choose dual band input with cross repeat to the third band. The offset function is active on the output, allowing you to repeat to repeaters.

Other features

Individual volume and squelch controls for each band. Remote mounting of front panel with optional cable kit. Optional selective calling or group calling. Optional DTMF memory stores 15 characters for repeater controlling. Versatile scanning. Auto offset on 2m. Fixed detect output for packet radio.

Multi-function DTMF microphone. Separate antenna and speaker outputs. Auto power off and time-out. 4 step dimmer. 3 step power. Clock, timer and calendar. DC cable, and mobile bracket.

UT-28S: 28MHz, 50 W, RX: 24-36 MHz, TX 28-29.7 MHz. **UT-50S**: 50MHz, 50 W, RX: 46-57 MHz, TX: 50-54 MHz. **UT-220S**: 220 MHz, 25 W, RX: 215-230 MHz, TX: 220-225 MHz. **UT-1200**: 1200 MHz, 10 W, 1240-130 MHz. **DTU-2**: digital paging unit. **PG-4K, PG-4L**: remote cable kit. **MB-11**: extra mounting bracket. **PG-2N**: extra DC cable. **PG-3B**: DC line noise filter. **TSU-7**: CTCSS encode/decode unit.

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