73

T.M.

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Amateur Radio's Technical Journal

A Wayne Green Publication

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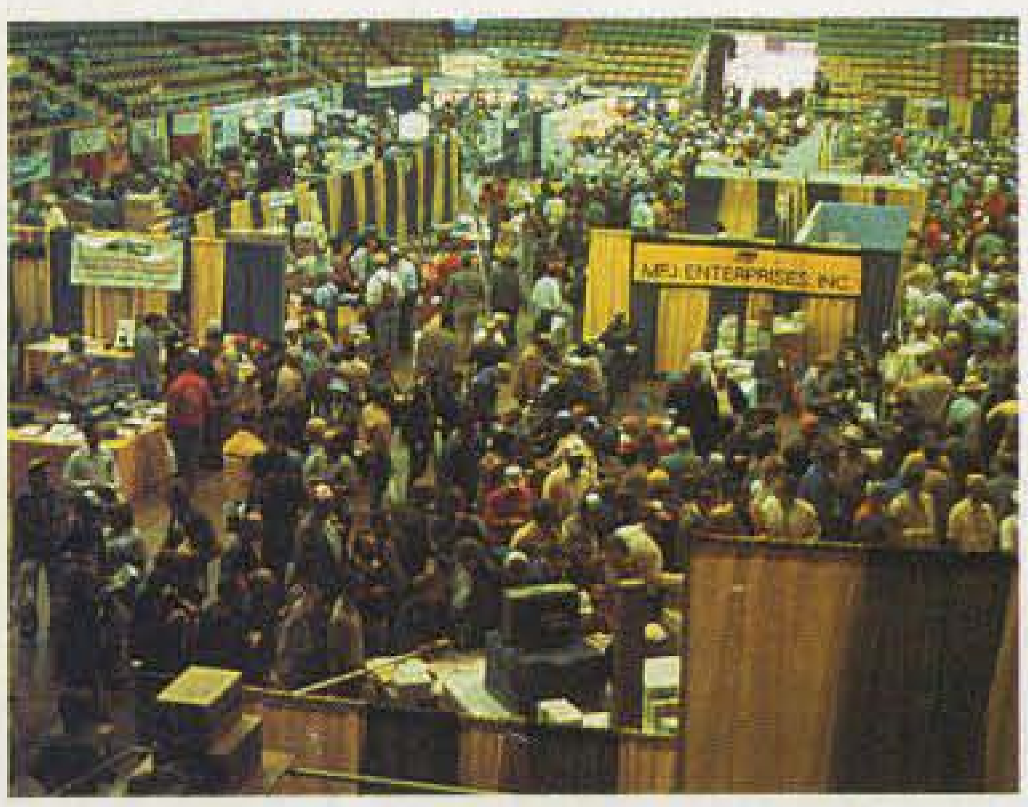

Dayton Doings—10

Sun Fun—100

ICOM IC-751

The New Standard of Comparison

ICOM is proud to announce the most advanced amateur transceiver in communications history. Based on ICOM's proven high technology and wide dynamic range HF receiver designs, the IC-751 is a competition grade ham receiver, a 100KHz to 30MHz continuous tuning general coverage receiver, and a full featured all mode solid-state ham band transmitter, that covers all the new WARC bands. And with the optional internal AC power supply, it becomes one compact, portable/field day package.

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AM: FL-33

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INFO

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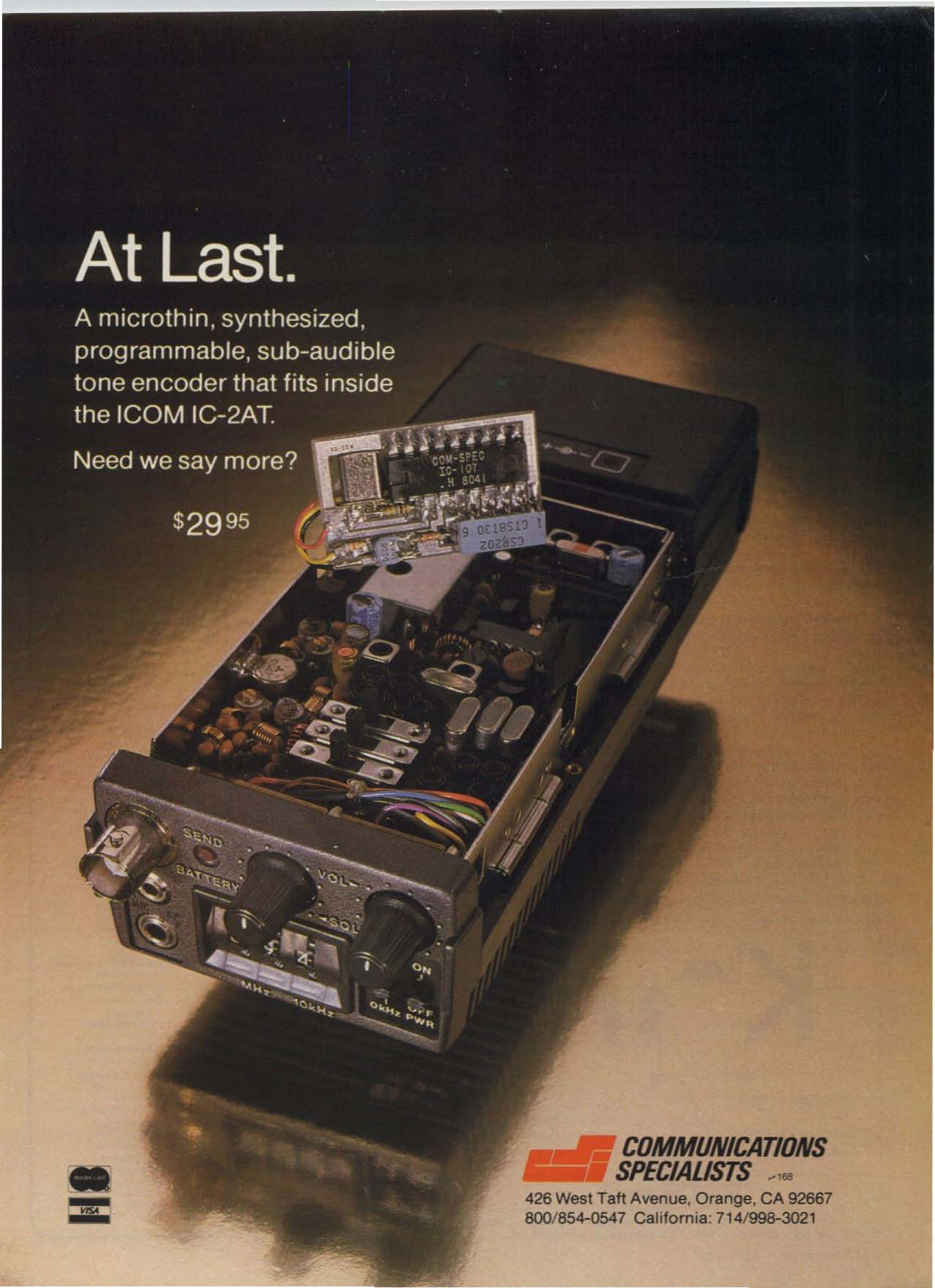
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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

THE SONY SURPRISE

A couple of years ago, Sony brought out their 2001 all-band digitally-controlled receiver. It wasn't terribly sensitive, but it would tune in CW and sideband and the price was, particularly for Sony, most reasonable. This was followed by their 7600 shortwave receiver—truly a marvel of compactness, small and light enough for the jacket pocket. It also had amazing bandspread for the most popular shortwave broadcasting bands—and a surprisingly low price.

This was followed a year later by the 7600A model, with a couple more bands. I liked this one particularly because it covered 40m and the CHU time signals, a nicety skipped in the first model. I took this radio with me on all of my foreign trips so I could check the VOA newscasts and make tapes of local AM/FM and SW stations in unusual spots around Asia and the Middle East.

Then last year Sony did it. They put the digital tuning system from the 2001 into the 7600, calling it the 7600D, (digital, I presume). Wowie! Again, as with the 2001, the sensitivity is about on a par with Don Rickles, but it tunes from 150 kHz to 30 MHz, plus the FM band! It has a bfo and a vernier on the tuning so you can tune in sideband just fine. It also has ten buttons you can program for instant frequency selection. I find that handy for WWV/CHU time and my favorite FM stations. Yes, it has an automatic scanner, too.

It's possible that some of the ham dealers carry this radio. You might want to check around. If you travel much, this can be a real prize. I love checking the 20m and 15m bands from different places around the world as I travel.

I've been looking for a ham to join my staff who might, in addition to testing new ham gear in the W2NSD/1 ham shack for reviews in *73*, arrange with Sony and other such manufacturers to make non-ham products such as this available via our magazines. Every now and then I find a toy like this which I think might interest readers but which could be hard to find for most people.

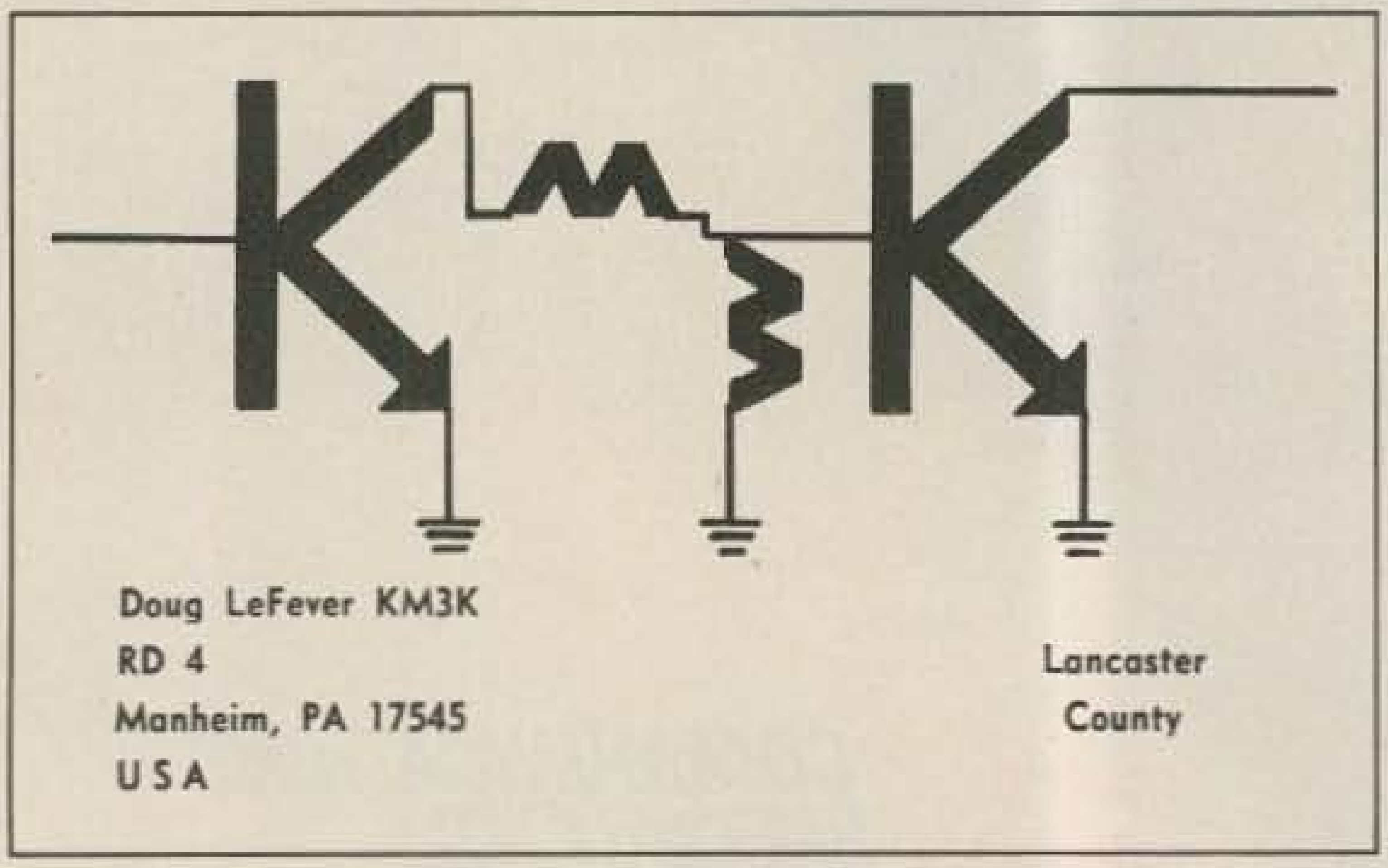
I'm one of those people who rush out and buy almost anything new. I almost always have a few surprising toys in my shoulder bag when I travel. It might be a radio, a miniature TV, a new kind of digital watch, or a new briefcase computer. Some people are just now discovering the Walkman...I had one of those within hours of its reaching this country eight years ago.

A lot of these gadgets you see in the mail-order catalogs are dogs, despite the glowing copy and gorgeous pictures. I pore over each new Sharper Image, Markline, JS&A, and so on catalog that arrives. Yep, I've tried the hanging by the feet gadget.

For instance, take the new tiny TV sets. Great technical marvels, no question about it, but who needs a Walkman TV? On most of the TV shows these days, you can turn off the picture and lose little, so if you're an addict, why not just get a miniature radio with the TV sound channels? I doubt that we are going to see many people walking around the streets with portable TVs on their hands.

Clive Sinclair has invested an enormous amount of time and money developing a very small portable TV. But for whom? I suspect that it was more the challenge of making it than any serious market expectations which drove Clive. I'll be watching the success of the Sony Watchman and the new Casio

Continued on page 146



QSL OF THE MONTH

To enter your QSL, put it in an envelope along with your choice of a book from *73*'s Radio Bookshop and mail it to *73*, Pine Street, Peterborough NH 03458, Attn: QSL of the Month. Entries not in envelopes or without a book choice will not be accepted.

John Wood WA4BPI
1101 Little Elton Lane
West Memphis AR 72301

Doing It at Dayton

This unofficial Hamvention handbook helps attendees and dreamers alike.

Change may be a hallmark of a democratic society, but it is also the byword of the 1984 Dayton Hamvention, whose leaders have made major modifications to the annual April event.

The location is the same, Dayton's Hara Arena, and the dates for the 1984 event are in their traditional location: the last full weekend of April (27, 28, and 29, for 1984), but there have been considerable changes made in other areas, primarily the flea market. According to the cochairman of the Hamvention, Harold "Hal" Judd WA8KNM, the changes should be "99 percent to everyone's benefit."

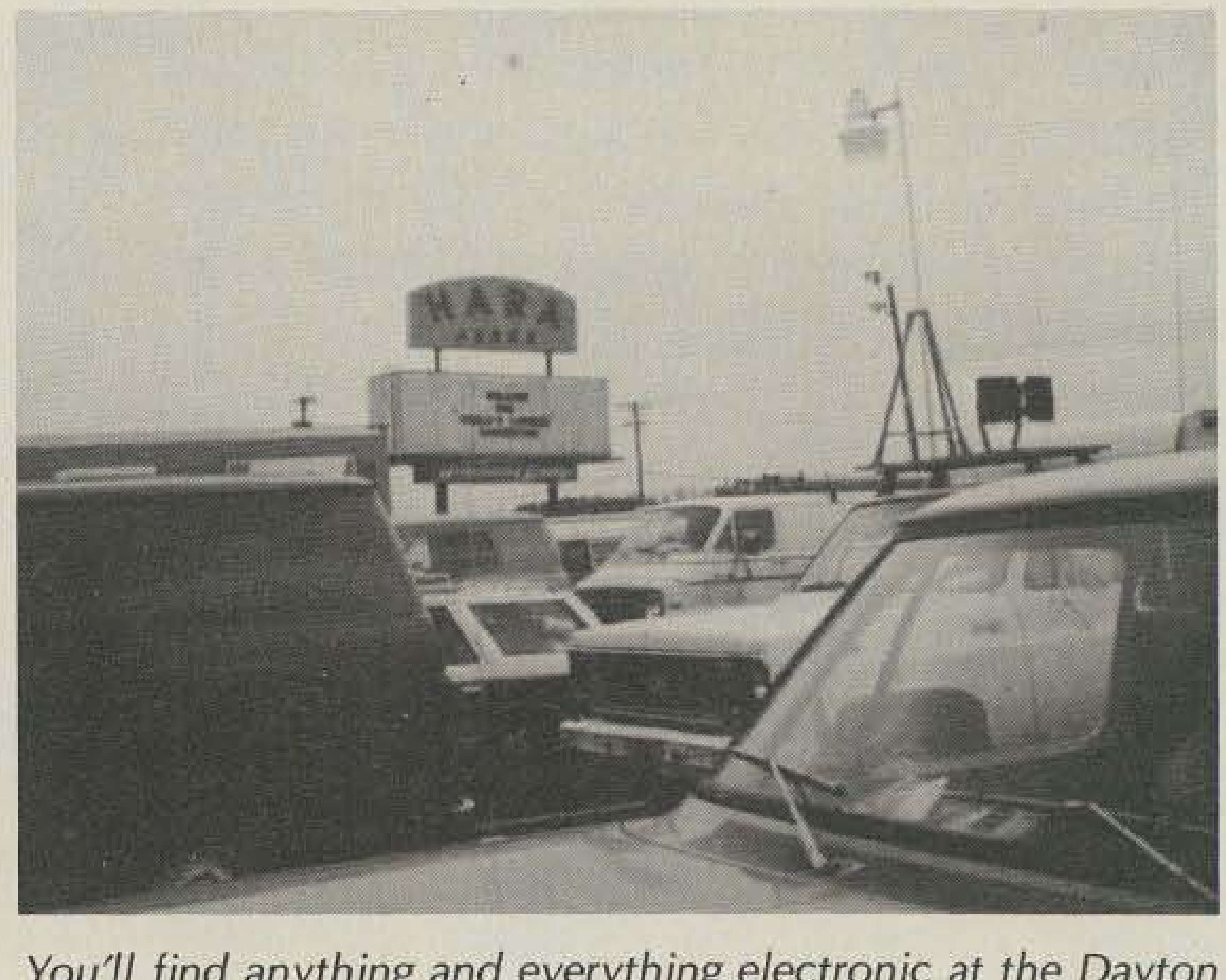
Topping the list of changes for 1984 are the setup times for the flea-market vendors who have waited long hours in line in the past to get a space. This year, those holding flea-market permits, which can be secured *only* by ordering in advance, will be allowed to set up as early as Wednesday or Thursday in an assigned, numbered space. The spaces will be assigned on a first-come, first-served basis, meaning those who request a flea-market space and include the appropriate money with the request ($15.00 per space, four-space maximum) will be assigned a space first. Hamvention Flea-Market Chairman, John Grody WB8TEK, hopes this will eliminate the imposing practice of vendors waiting in line, sometimes as long as three and four days, to get what some consider prime flea-market real estate on the Hara Arena parking lot.

The official times for setting up in the flea market (for those with advanced sale permits *only*) will be Wednesday, April 25, noon until 5:30 pm local time, and Thursday, 8:00 am through the time the flea market opens to the public at noon on Friday. No sales will be permitted in the flea market prior to noon Friday when the gates will be opened officially to an anticipated crowd of over 20,000. Flea-market vendors also are reminded that a general-admission ticket is required for admission to the flea market in addition to your flea-market permit, so be sure to order it when you request your flea-market permit.

Since flea-market spaces are available only by advanced sales, the wisdom of ordering early is obvious. Ordering your general-admission ticket early would also be wise since the price has been increased to $7.50 in advance and $10.00 at the door. No doubt about it this year—the early bird gets the worm, the best flea-market space, and gets to save $2.50 on his ticket.

For those who were there last year, you'll notice that the opening time for the flea market has been shifted

Hams show up in droves when April comes to Dayton. Here's just part of the typical crowd that overflows the Hara Arena each year.



You'll find anything and everything electronic at the Dayton Hamvention, even a ham who has brought his own street light.

The Silver Arena section of the Hara Arena is just one of three large areas devoted to dealers and manufacturers' representatives.

In between flea-market expeditions, vistors to the Hamvention might make a side trip to Wright-Patterson Field, home of the US Air Force Museum.

from Saturday morning (as in 1983) to noon on Friday (as it was in 1982). This means that sellers will have two and one-half days to display their wares, and it also improves their odds of getting dry weather, a must element for outdoor display of radios and other moisture-sensitive electronic equipment.

To order flea-market spaces, send $15.00 per space (maximum of four per customer) to the Dayton Hamvention, PO Box 2205, Dayton OH 45401. Grody said that no flea-market spaces will be assigned until after January, but that requests which have come in will be given spaces in order of their arrival.

For anyone needing more information, Grody and his committee have made yet another change by setting up a flea-market information hotline at (513)-223-0923; this will be answered between the hours of 8:00 am and 10:00 pm EST beginning well in advance of the Hamvention.

More Changes

The changes in Hamvention '84 don't stop with the flea market. The Hara Arena has been expanded since Hamvention '83 and now has an additional 10,000 square feet located near the Silver Arena. The new space will be used in 1984 for the many Hamvention forums, while the space previously occupied by the forums has been made available to indoor sellers. Cochairman Judd believes that between 200 and 225 exhibitors will be displaying their wares inside the arena this year, and that includes the dealers and the manufacturers' representatives from such well-known companies as Trio-Kenwood, Icom, Yaesu, Hy-Gain, Drake, and Cushcraft.

With the expanded number of indoor exhibitors and the expected 1,500 flea-market vendors, there's going to be a lot for the Hamvention attendee to peruse in a short, two-and-one-half-day tour. But never fear, there is a way to do it, and the key is planning. Plan to get an early start each day, and plan each day as carefully as possible.

As soon as you enter the indoor part of the Hamvention the first time, you will be given a plastic bag which will contain the Hamvention program. This is your key to the entire event and it is worthy of a few minutes of study. Flip through the program, find the pages allocated to overall and interior maps of the exhibit area, and orient yourself. Next, check the times of the forums and note the ones you might be interested in attending. Try to work your tour around these times because the forums come only once while the flea market and indoor exhibitors will be there for the duration. This is one way to guarantee that you won't miss anything and be forced to go home with some heavy regrets.

You might also try to plan to have some energy left after a full day of hamfesting on Saturday to attend that evening's banquet. This year's banquet speaker will be Harry Dannals W2HD, past president of the Amateur Radio Relay League.

Cochairman Judd added that there have been some changes made to the banquet, not in the ticket prices—which remain $14.00 in advance and $16.00 at the door—but in the menu. Judd said that the main course this year will be filet mignon. If you've ever intended to attend the banquet, this might just be the year to do it.

CHECKLIST FOR YOUR DAYTON TRIP

- Secure room reservations early, for the nights of April 27 and 28, and if you intend to arrive early on Thursday, for April 26.
- Purchase Hamvention tickets in advance and, if applicable, flea-market-space permits.
- Have the members of your group committed to attend the Hamvention and determine your transportation requirements.
- Save enough money to cover the cost of the trip and to cover the cost of any planned purchases. Turn most of your cash into traveler's checks as these are readily accepted at the Hamvention and at the flea market. Personal checks are NOT a readily-accepted method of payment. If a dealer has a choice of a cash sale or taking a risk by accepting a personal check, he'll probably take the cash.
- Pack clothing necessary for your three- or four-day trip. Don't forget, the weather is very changeable.
- Arrange for time off from work if you're part of the laboring class.
- Make and carry a list of things you intend to purchase at the Hamvention. The abundance of equipment found at the Dayton flea market is mind-boggling and could make you forget what you came there to buy.

Necessities

Hamvention veterans are well aware of what to bring to the event and how to dress, but for the sake of the newcomer, let me review some of the time-tested practices. If you plan to drive to Dayton in a private car from 500 miles away, as our group does, set aside at least $100 for gasoline, weekend accommodations, and food. Motel reservations should be made as early as possible and the Hamvention Housing Bureau can be a big help. You would be wise to take advantage of the service this Bureau offers. In the past, food has been plentiful and tasty at the Hamvention and, I might add, reasonably priced. The same is true for most of the restaurants in and around Dayton, so if you have the money set aside for eating, you will not starve. Just make sure you budget properly.

Let me suggest that you dress for the Dayton weather—and that means bring one of everything. I've seen years where the weather has been exceptionally beautiful—70 degrees plus during the days and no cooler than 40 degrees at night—while I've also seen the worst—constant rain and near-freezing temperatures during the days and nights. So dress according to the old outdoorsman's adage, in layers so that you can take off or put on as the weather changes. And make the final layer a waterproof garment while keeping the heavy coat within reach should the temps fall to an extreme. It can happen. The weather can be great or lousy and it can be a determining factor in how good a time you have at the Hamvention, so go prepared. The weather was great in 1982 with the only problem being chapped lips, while last year's weather was fit only for the ducks and the well-prepared.

To keep up with the members of your group, I would suggest that you rely on the ever-popular two-meter handie-talkie, but try to have everyone bring a synthesized rig so that you can be flexible in finding a standby frequency. A crowd of over 20,000 hams can generate a lot of rf.

GENERAL INFORMATION

Send ticket orders to:
Dayton Hamvention
PO Box 2205
Dayton OH 45401

Flea-Market Hotline
(513)-223-0923
(Try to limit calls to between 8 am and 10 pm EST.)

Inside Exhibits Information
(513)-236-6160

Prices: Registration general admission ticket is $7.50 in advance and $10.00 at the door. Tickets on sale in advance by mail or at the arena during the regular Hamvention hours; *not available over night as in the past.*

Hamvention General Chairman
Jack Mitchell AA8Q
Asst. General Chairman
Harold "Hal" Judd WA8KNM
Flea-Market Chairman
John Grody WB8TEK
Advance Registration
Marge Mitchell WD8DSN

April 28 Banquet Speaker: Harry Dannals, Past President, the Amateur Radio Relay League. Banquet tickets—$14.00 in advance, $16.00 at the door.

Flea-Market Setup Times
Wednesday, April 25: Noon to 5:30 pm. Thursday, April 26: From 8 am, all night, through to Friday at noon when the flea market opens to general public. *All flea-market permits will be sold in advance this year. None sold during the Hamvention. Flea-market vendors must have registration tickets and flea-market permits to be admitted to the flea market during setup times.*

Flea-Market Selling Times
Friday: noon to 6 pm.
Saturday: 6 am to 5 pm.
Sunday: 6 am to prize drawing.

Finances

Don't say it; I know what you're thinking. Here I've told you about all of the great changes for the granddaddy of all hamfests, but I haven't said how you can afford to go.

First things first. Talk to your buddies on the local repeater about a possible trip and find out who would like to go, and then get a concrete commitment from them so that you can plan properly. Then have each person arrange to have the days off from work that they'll need to make the trip. Setting aside Thursday for travel and Friday morning for setting up in the flea market may work, but if you're traveling far and plan to be in Dayton for the prize drawing Sunday afternoon, you might also consider taking the following Monday off from work to convalesce. You'll enjoy the trip more if you know that you don't have to go right back to work as soon as you get home.

Enough planning. Let's get down to paying for the trip. Overtime and part-time jobs are possible sources of extra revenue, but since it's a ham-radio activity, it seems appropriate to me that ham radio should help meet the expenses. That's where all of this talk about the flea market comes in. At a cost of $15.00 a space, three people can split the expense (investment?) and sell a lot of their unused equipment. Agreed, it's a common ploy at a hamfest, but I'm talking about Dayton, and that means you'll have probably 20,000 to 25,000 radio enthusiasts checking out your high-quality castoffs. As my Daddy used to say, "With that many fish, you're bound to get a bite." And with the three or four of you taking shifts at watching over the gear, you'll get a chance to check out everybody else's offerings and still not miss a sale.

Buying Gear

I always tell myself that if I sell one particular piece of equipment, then I'll use the money made on the deal to buy that new rig I've had my eye on. Besides being a great place to sell used equipment, Dayton is also the perfect place to buy that new rig since the dealers are always in a mood to sell at a good price. Call it their annual low-price fling or whatever you want, but I have always found what I was looking for at Dayton and found it at the best price. Ask anyone who's been there and I bet they'll tell you the same thing. You'll get to see what you want to see, put your hands on it, push the buttons and turn the knobs, and then buy for the best price imaginable.

I know the dealers will probably skin me alive for saying this, but let me pass along a word of advice—spot the piece of gear you want at three or four dealers, list the prices, and then go back to each one and ask them to give you their rock-bottom, last-day-of-the-hamfest price. If you think one of them is offering you the best deal you'll see, make your purchase from that dealer. If you think you can get it cheaper, wait until the second or maybe the last day of the hamfest and go back to the dealers again to get their prices. Be aware that if you decide to wait, all of the dealers could sell out of that rig you've been wanting so badly. With the prices being so right and so many people looking for a deal, the bargains do not last long. Once again, be prepared.

And keep one other fact in mind when you tackle the dealers—the more the dealers sell, the less they have to pack up and take home. That's why most of the best deals on the remaining equipment are made on the last day of the Hamvention, on Sunday afternoon when most folks are hanging around for the prize drawing or in the process of packing up to head home.

If you have trouble working the deal you want, get the dealer to toss in an accessory for little or nothing more. After all, it would make still less that he has to pack up and take back with him and it makes the deal even sweeter for you.

What Will I See?

When you arrive at the Hara Arena, don't worry if you think your eyes are starting to bug out. You'll probably be seeing a few things you've never seen before. Just in the past few years I've seen the first synthesized handie-talkie and the first digital-readout low-band rig make their initial appearances at the Dayton Hamvention. And there's a reason for it. Manufacturers like to take the wraps off their new items at the Hamvention because they know that it's their best chance to show it to a large share of the amateur-radio community at one time. The more people that see an item, the better the chances of selling it. Remember the 20,000 plus folks I said could be walking past your flea-market space? Most of the same people will get indoors also. The manufacturers also know that most of the hams who attend the Hamvention have a buying urge, and they'd like you to satisfy that urge by buying their product.

What else can you expect to see at Dayton? I would expect to see more computers interfaced with ham-radio equipment at the '84 Hamvention, and I would expect to see more dealers selling software for amateur applications. Last year, the RTTY-CW interfaces were on display and drew considerable crowds, so this year look for the dealers to take the next logical step and explore the computer field a few steps further. We've got satellite-tracking programs that run on VIC-20s and other basic machines, so don't be surprised if software abounds to turn all of your ham-radio drudgery into funtime with your computer. After all, it will be the coming thing for many a year to come.

Here We Go!

Okay, if you've followed me so far, you should have a pretty good idea as to how to prepare for the 1984 version of the Dayton Hamvention, the hamfest that is quickly earning the tag, "center of the ham-radio universe." So get your days off arranged, pack your clothes and the equipment you plan to sell, list the items you want to purchase, get your group together, and let's head to Dayton for April 27, 28, and 29.

The bunch of terrific guys I go with started talking about the 1984 trip on their way home from the 1983 event, so I think we'll be prepared to have another great time in Dayton, Ohio. Grab your HT and come join us. It's gonna be great! ■

Me and My Stupid Old PMOS Converter

At last, there's an easy way to get −12 V from a +5-V supply. Who said "trial and error"?

C. R. Bryan III WB1HKU/6
7311 Variel Avenue 4
Canoga Park CA 91303

Stupid old PMOS. It's slow, it runs hot, it gives protective input diodes a workout because its output low can go below ground, and it needs weird supply voltages. Most of the newer NMOS devices have been designed to make do with one 5-volt supply, either by some design rethinking or by inclusion of a substrate charge pump on the chip itself, but stupid old PMOS has to have strange supply levels provided in order to operate.

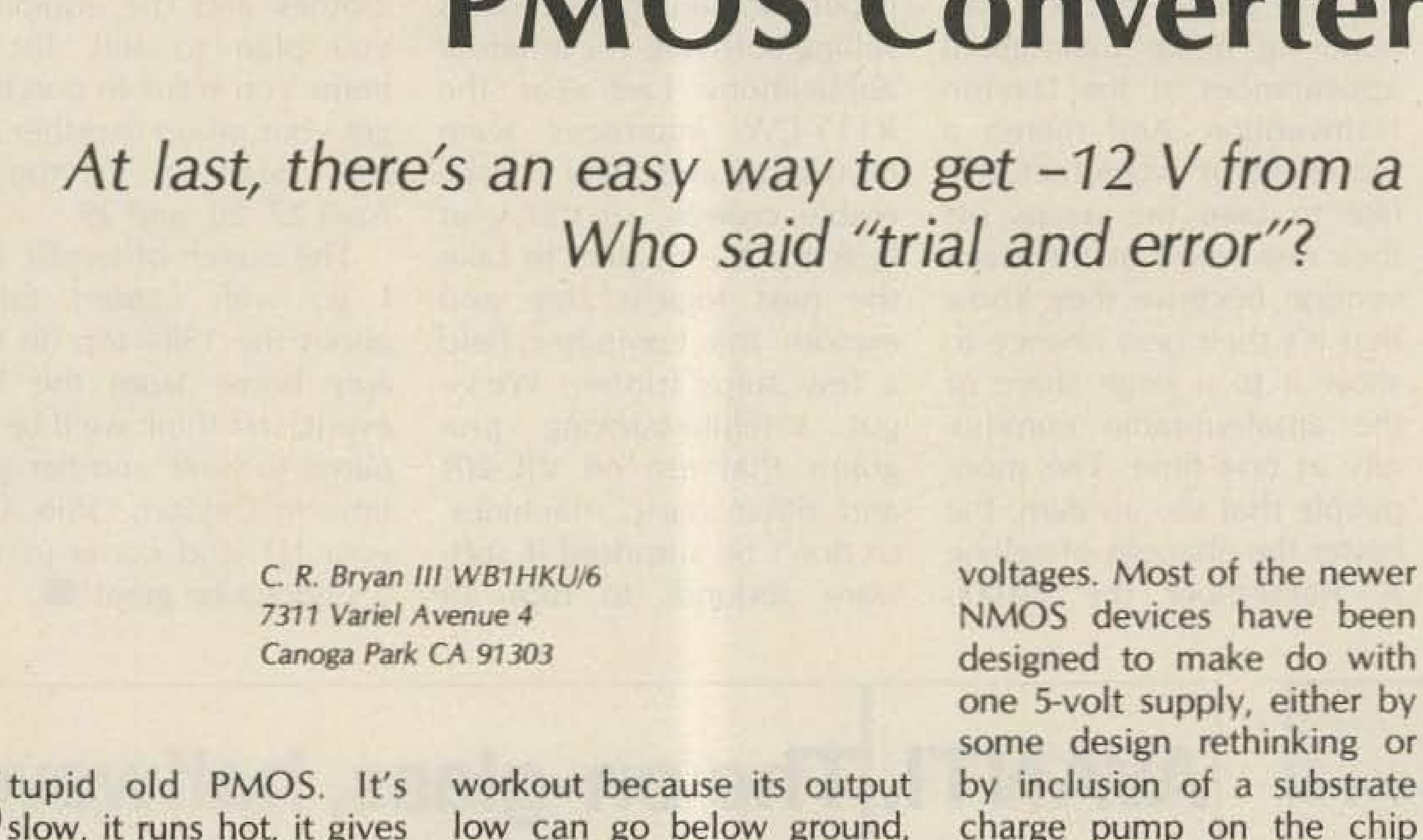


Fig. 1. Initial version. With 9 to 19 volts input, and the right toroid, this circuit might provide 50 V output. L1 is 10 bifilar turns #28, L3 is 25 to 50 bifilar turns #28 (I used 25 turns), and L2 is 8 to 10 turns #26. The toroid is a .375-inch ferrite from a Radio Shack "Ferrites" package. Capacitor C1 resonates with L2 to determine oscillating frequency; 200 pF is probably a good minimum value to keep interwinding capacitance from getting into the act. The transistors came from my junk box; the numbers listed are their rough functional equivalents. With different devices, the regulator circuit could waste a lot less current.

It was that last gripe that had me stymied for a while. I have an old keyboard from some junked phototypesetter somewhere, bought for all of ten bucks. It's TTL throughout, with maybe ½ A drain on the 5-V, 3-A supply in my home-brew Cosmac Elf. (One miserable PMOS shift register does have to have a −12 supply if I want anything but smoke from it.) At that, the keyboard outputs some weird code that makes sense only to the machine for which it was designed. A local outlet sells a keyboard encoder, the AY-5-2376. If I kludge-wired that onto the keyboard in place of the original logic, I'd have good old parallel ASCII coming out of a single 40-pin chip, made of. . .PMOS. Yep—it needs a −12 supply, drawing maybe 4 mA. I should build an *additional* line-powered power supply for *that?*

I've seen a few upconverter circuits around; most use

555s and voltage-doubler chains. Motorola even has one with a 7406. Somehow, all these capacitor-pulse designs struck me as being wasteful, inadequate, or both.

I'm a bit of a QRPp nut, and I have the toroids to prove it—some from Radiokit and Amidon, some from those blister cards Radio Shack started selling a year or so ago. I got out my dipper and my boxes of small-signal transistors, turned on the 'scope and the Weller, and waded in.

The first circuit I built does fine with at least 9 volts for a supply. The rectified secondary voltage soared up to 90 volts at one point in my experimenting—no load. That's why I put in the 10k load resistor, to keep the voltage within the survival zone of the diodes, to say nothing of any regulator I might care to put in.

As for the regulator circuitry, I must admit that I was playing. I had already decided to put a 79L12 in the finished unit, but I didn't have one on hand as yet, so I kludged this one up in order to see how much fun I could have putting together a regulator. If you look closely, you will see not only that I've abused the reference diode (which prefers to conduct only about 7.5 mA), but also that the converter is cranking out upwards of 25 mA, still with enough input headroom to the pass transistor for it to regulate. The medium-current pair of transistors in the oscillator got warm, but not hot, and nobody seemed to be hurting.

Then I dropped the supply rail to 5 volts, and the output got very mushy. . . maybe 8 volts across the output load resistor.

The problem is in the Darlingtons. I put in the second pair of transistors, Darlington-style, because the medium-current transistors weren't being driven fully under load, thus, there was not

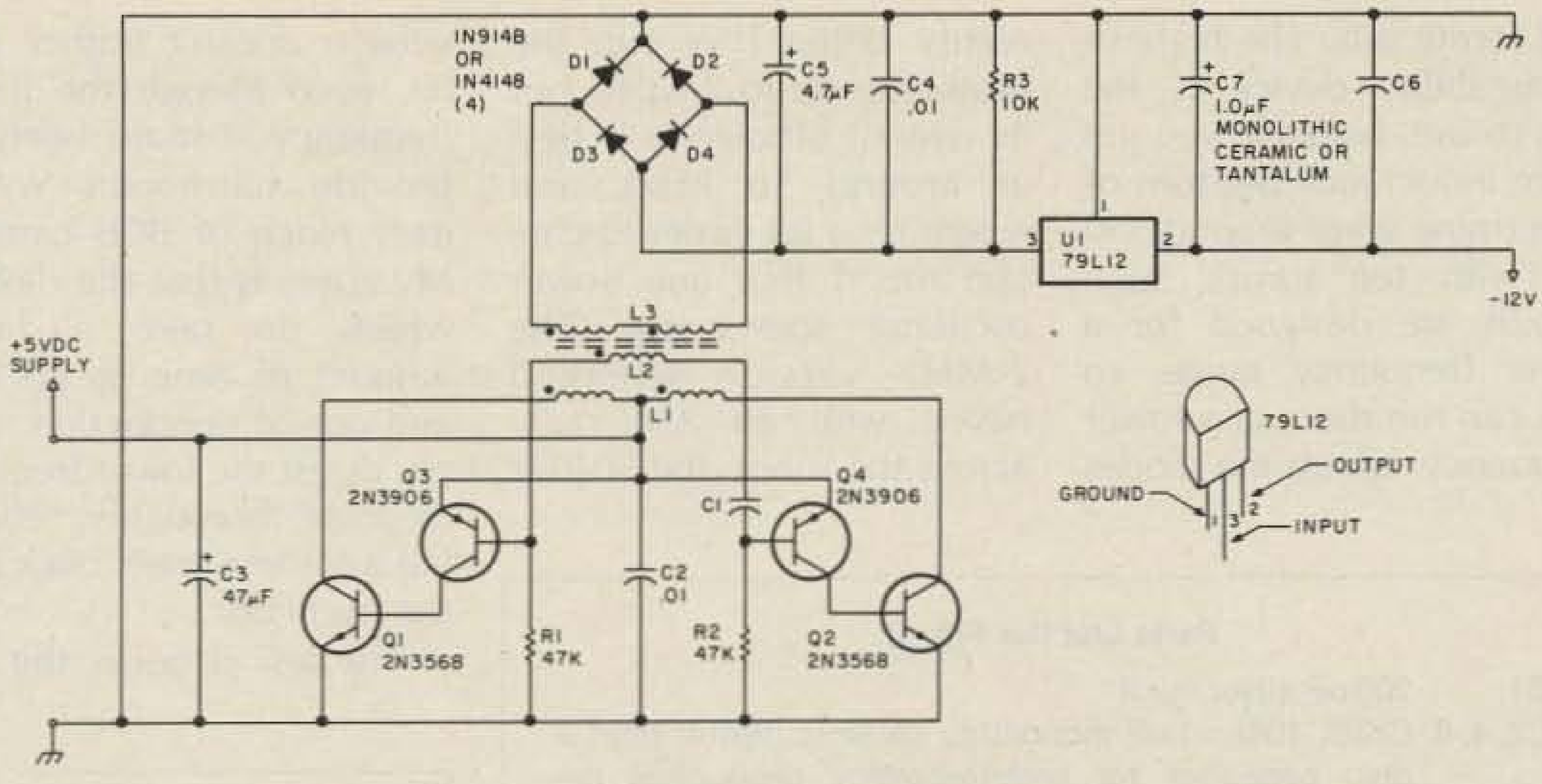


Fig. 2. 5-volt-input version. Note that L2's phase is reversed. Equivalent transistor types again. The 79L12 only burns about 4 mA.

enough gain at the frequency in use. The added pair corrected that but brought in a new problem: The saturation voltage ($V_{CE\text{-}sat}$) for a Darlington pair, measured from the ganged collectors to the lower emitter, is one $V_{CE\text{-}sat}$ plus one V_{BE} for a typical circuit, because the driver-half emitter is held high by the final-half base-emitter diode (one V_{BE}), and their collectors are tied together. The collector of the driver-half can't do more than saturate—it can't go lower than its emitter. More current into either the driver's base or the two collectors only drives both voltages higher, making the problem worse. I was losing virtually 2 V_{BE} on each side of the main winding, even with the protective series diodes shorted out. That's fine for circuits with, say, 9 volts or more rail-to-rail, but down at a 5-volt supply level, the missing voltage swing was proportionately too large to be ignored.

At this point I remembered the composite PNP in the final stage of National's LM380, and the final version started emerging on paper.

I have even more voltage gain here, because the driver stage is running common-emitter rather than the common-collector driver in the Darlington version. More important, the final stage is free to pull its end of the transformer's main winding as low as possible, roughly 0.2 volts with these particular parts. That means that the total possible swing for the transformer, ignoring coil losses, is 9.6 volts—much better. Of course, I've ignored here the effect of available voltage swing on circuit impedance, which affects the available juice (wattage) from what is, in effect, a self-excited balanced transmitter. I chose a more rudimentary approach, one within my immediate comprehension. In other words, I'm lazy, so I just called it an astable multivibrator and I played around with it until it worked.

It works. The keyboard converter starts up every time and feeds a dead quiet −12 volts to the shift register. It'll do the same for the 2376 instead, when I get around to the surgery involved. Then there's that Motorola character generator for translating ASCII into a video bit stream; that needs two weird voltages—and it's NMOS! That just means there'll be two secondaries on the toroid. I've even got a couple of PMOS character generators that need ±14 volts.

There are several points of design and technique to be mentioned here. First, most bipolar transistors behave very nicely like zener diodes when their bases are driven 5 to 10 volts more negative than their emitters (positive for PNPs). Unfortunately, the localized heat in the base region of the transistor chip causes permanent changes in the doping arrangement, so the beta goes down. This is why most multivibrator designs have diodes with high PIVs in them, to keep the sharp negative spike through the capacitor from doing damage. If you are running such a circuit with a supply higher than 5 volts, you must have them too. Otherwise, if the 'scope shows that the collector voltage has a needle-thin negative spike going lower than ground on the falling edge of its waveform, your transistors are being degraded even as you watch.

The second point is one of balance. Some of Doug DeMaw's QRP amplifier designs are *crawling* with toroids, just to swamp out tolerances and force a 50% duty cycle in the output signal. I got by with just one toroid by using the twisted-pair wiring shown, but a little artistic symmetry in windings placement is required too. Caveat constructor.

The third point is the toroid itself. I used some from those Radio Shack packages, and they work very well. The ones you will pull out of there might not—it's a matter of size and ferrite mix. The highest-permeability device is the one to use, because you get more inductance per turn of wire (mine were around 350 uH with ten turns). Such toroids are designed for a lower frequency range, so you can run them at a lower frequency, where the diodes rectify better (I've run the prototype up to 2 MHz, but its overall efficiency is best at around 50 kHz), and where it's a lot easier to contain the rf that any power oscillator spews out. The 2-MHz version wreaked havoc with an AM radio across the room; the 50-kHz version doesn't bother it a bit, even though the lower frequency is more likely to provide harmonics within easy reach of BCB carriers. My guess is that the diodes, which do take a finite amount of time to go into and out of conduction, simply digest the lower frequency more thoroughly, reflecting a lot less trash back into the oscillator.

The less rf noise, the less shielding is required, and the less hassle you have arranging for air flow to carry heat out of that shielding.

My converter simply sits parked in one corner of that keyboard, unshielded, kludge-wired into holes drilled in an etched-clean section, making less noise than the keyboard scanning clock.

Obviously, anywhere one or two greedy little circuits demand a strange supply

Parts List (for Fig. 1)

C1	200-pF silver mica
C2, 4, 6	CK05, 104k, .1-uF monolithic ceramic (Better than a disc capacitor for high-frequency decoupling because the internal sandwich construction results in a low-inductance package. Substituting for one usually involves a .01-uF disc ceramic paralleled with a .001 disc or a 100-pF silver mica. Here, a .01-uF disc will do.)
C3	47-uF, 16-V aluminum electrolytic
C5	4.7-uF, 50-V aluminum electrolytic (Up to around 25 uF is useful at this current level; more than that can cause start-up problems for the oscillator, due to loading.)
D1-6	1N4148 or 1N914B switching diodes
D7	1N825A temperature-compensated reference diode (It consists of a reverse junction in the same package with a forward junction; at 7.5 mA of current through the diode, the complementary temperature coefficients of the two junctions cancel each other out. With the voltages shown, the current through the diode in Fig. 1 is nearly double the correct value, which doesn't hurt it but wastes both the current and its compensation. Newark Electronics' Catalog 105 lists it for $1.90.)
L1, 2, 3	See text
Q1, 2	NPN medium-current switching transistors (The faster the better. I used 2N3568 equivalents; 2N2219A is easier to find.)
Q3, 4	NPN switching transistors (The faster the better. 2N3904 is widely available.)
Q5	NPN medium-current transistor (Speed isn't critical, but gain and wattage are. I used a 2N699, which is barely adequate. It should be at least a heat-sunk 2N2219A, maybe a TIP48. Better to be overcautious on wattage than to worry about its surviving a short or a still-air heat buildup.)
Q6, 7, 8	NPN small-signal transistors (I used 2N3904 equivalents. With higher beta, resistor values in the regulator may be raised, conserving current. Beyond the voltages shown, start paying attention to the collector-voltage ratings of these devices.)
R1, 2, 3	10k, ¼-W (With the regulator in place, R3 isn't really necessary, but it's a cheap security blanket.)
R4, 5	1k, ¼-W (As mentioned, R5 should be a 1.8k.)
R6	680-Ohm, ¼-W
R7	4.7k
R8	5.1k (The regulator (Q5-7) regulates by keeping the R7-R8 voltage divider's tap at the same voltage as the reference (6.3 V in Fig. 1). Their ratio sets the output voltage.)
R9	10-Ohm (This resistor sets the current-limiting level. When the voltage across it reaches the .6-V turn-on threshold of Q8, Q8 will begin stealing base current from Q5, turning it off. With this value for R9, that's at 60 mA output.)

Parts List (for Fig. 2)

C1	Select in test (200-pF starting value, may end up at .01 uF or higher. In order of preference: NPO ceramic, polystyrene, silver mica, mylar™, disc ceramic. The higher the frequency, the more the capacitor's quality matters. 220-pF silver mica: Jameco DM15-221J, 49¢.)
C2, 4, 6	.1-uF monolithic ceramic or .01-uF disc ceramic (.01 uF: Jameco DC.01/50, 8¢.)
C3	47-uF, 10-V electrolytic (47-uF, 16-V: Jameco A47/16, 24¢.)
C5	4.7-uF or more electrolytic (Working voltage should be at least 1½ times unregulated output voltage. 4.7-uF, 50-V: Jameco A4.7/50, 19¢.)
C7	1.0-uF tantalum or 10-uF aluminum electrolytic. (Working voltage should be significantly higher than regulated output voltage. 1.0-uF, 35-V tantalum: Jameco TMI/35, 29¢.)
D1-4	1N4148, 1N914B, or other silicon signal diodes (Should be rated for minimums of 50 PIV, 50 mA continuous forward current, maximum switching time 10 ns or so. 1N4001-type rectifiers can't switch fast enough. 1N4148: Jameco, 15/$1.00. Fairchild rates these devices at 100 PIV, 200 mA, 4.0 ns.)
L1, 2, 3	Windings are determined by application and circuit values. See text and schematic for prototype values. Bifilar windings are prepared by twisting twin lengths of pretensilized wire with electric drill to 10-20-turns-per-inch pitch. Toroid is from Radio Shack package of ferrites. A good equivalent is Micrometals FT50-43: Radiokit, 60¢.
Q1, 2	NPN medium-current switching transistors—2N2219A, MPSU06, 2N3568 (Dissipation limit should be at least ½ W. 2N2219A: Jameco, 2/$1.)
Q3, 4	PNP switching transistors—2N2907, 2N3906 (The faster the better. 2N3906: Jameco, 4/$1; Priority-One #052N3906, 5/$1.)
R1, 2	47k, ¼-W (Priority-One #05RCQ473L, 50/$1; Radio Shack #271-1342, 5/39¢.)
R3	10k, ¼-W (Priority-One #05RCQ103L, 50/$1; Radio Shack #271-1335, 5/39¢.)
U1	Motorola 79L12 in prototype (Device choice depends on application. PC layout will accept 78XX, 79XX, LM340, and LM320 devices with inline pins (L, P, M, T types). Check pinout before installing. Positive regulator may be used to regulate negative voltage by making regulator output common. 79L12: Priority-One #05MC79L12CP, $1.00.)

Converter will be most efficient in a frequency band whose low end is determined by transformer reactance and whose high end is determined by transistor and diode speeds and capacitor quality.

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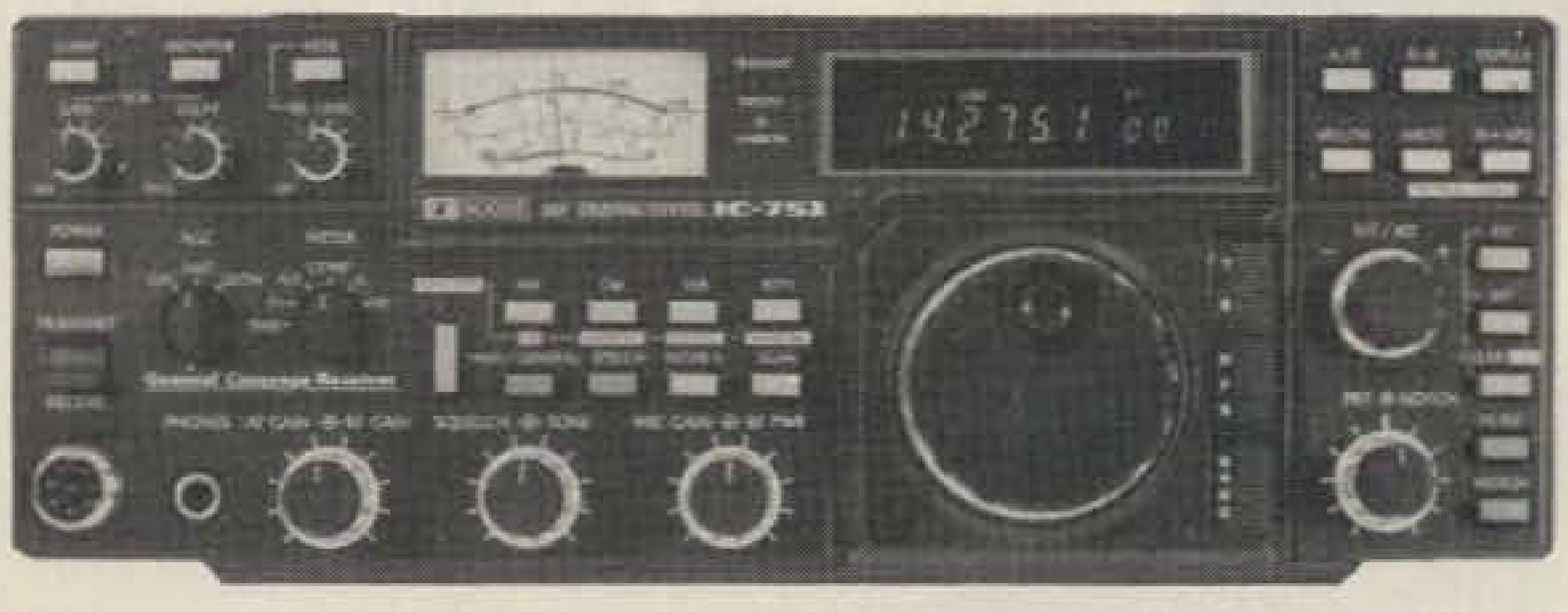

IC-751 General Coverage Receiver
9 Band Ham Transceiver

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- 12 Volt Operation
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- M to VFO, VFO to M
- Large Knobs/Spacing
- Fluorescent Display
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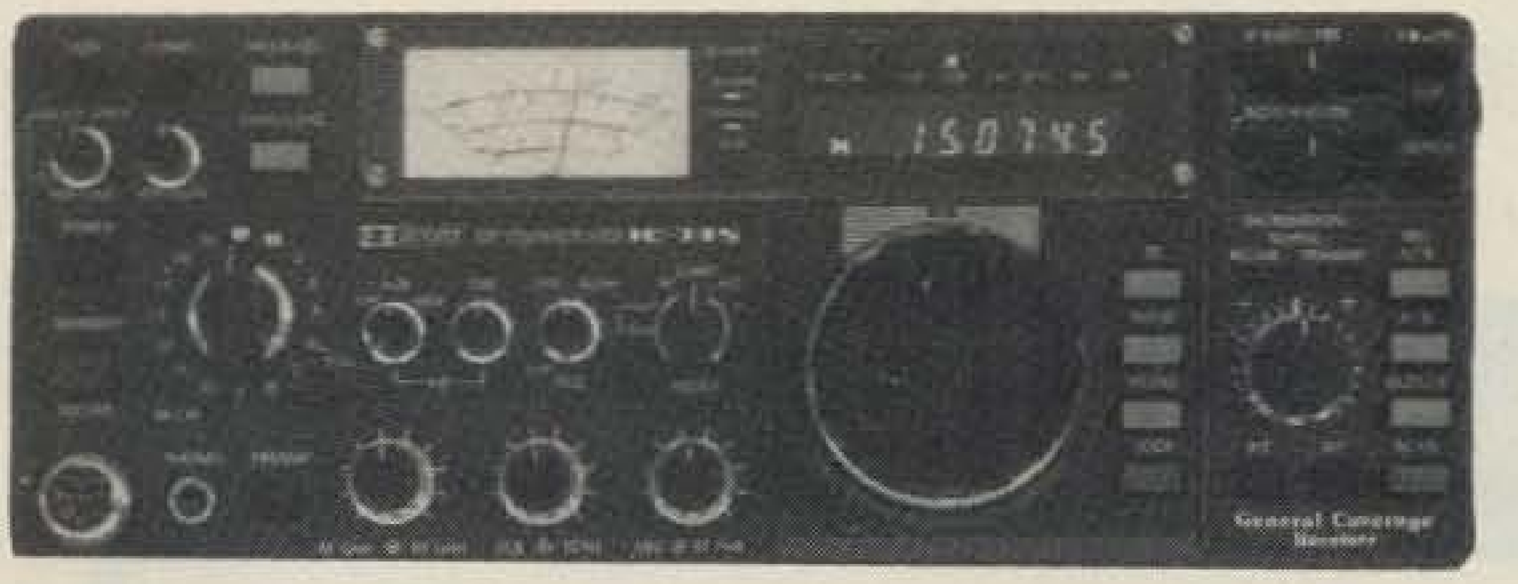
- 105dB Dynamic Range
- Mode Memory
- Squelch
- Passband Tuning
- Internal Power Supply Option
- Program Scan
- Memory Scan
- Mode Scan
- Dual VFO
- Multiple Filter Options
- 100% Duty Cycle
- Built-in Preamp (Top Panel Switch)



IC-745 General Coverage Receiver
9 Band Ham Transceiver

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- IF Shift
- Passband Tuning
- Program Scan
- Memory Scan
- 100dB Dynamic Range
- Internal Power Supply Option
- Dual VFO
- Multiple Filter Options
- Mode Memory
- Squelch
- CW Keyer Option
- 100% Duty Cycle
- Built-in Preamp

IC-730 8 Band Ham Transceiver
Compact, Mobile

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- Dual VFO
- IF Shift
- Passband Tuning Option
- CW Filter Option
- 100dB Dynamic Range
- 12 VDC Operation
- Large RIT Knob
- Mobile Size: Only 3.7"(H)x9.5"(W)x10.8"(D)
- Built-in Preamp

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This circuit can go in any number of directions. A better design could probably run an 8080A chip set with just 5 volts input. If you have both phases of a convenient frequency clock available, you can slave the converter to the clock and save yourself a few parts, guaranteeing the converter start-up in the process. A couple of VN10KMs (VMOS) would probably suffice, provided only that the clock signals swing fully rail-to-rail. (TTL typically needs a pull-up resistor to hoist its output above 3.5 volts.) Somebody else will probably put me to shame with the efficiency of their version, but that's okay; I just wanted to get that keyboard running on just a +5-volt supply. Stupid old PMOS. ■

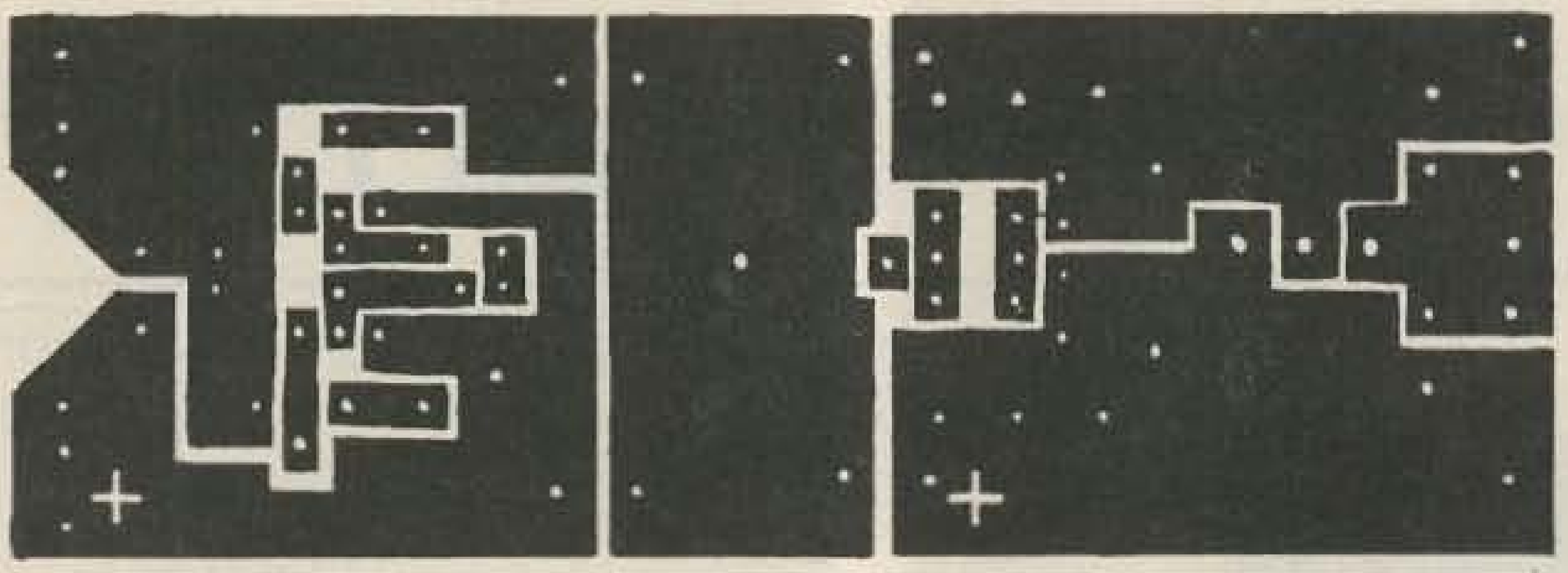

Fig. 3. PC board for the 5-V version.

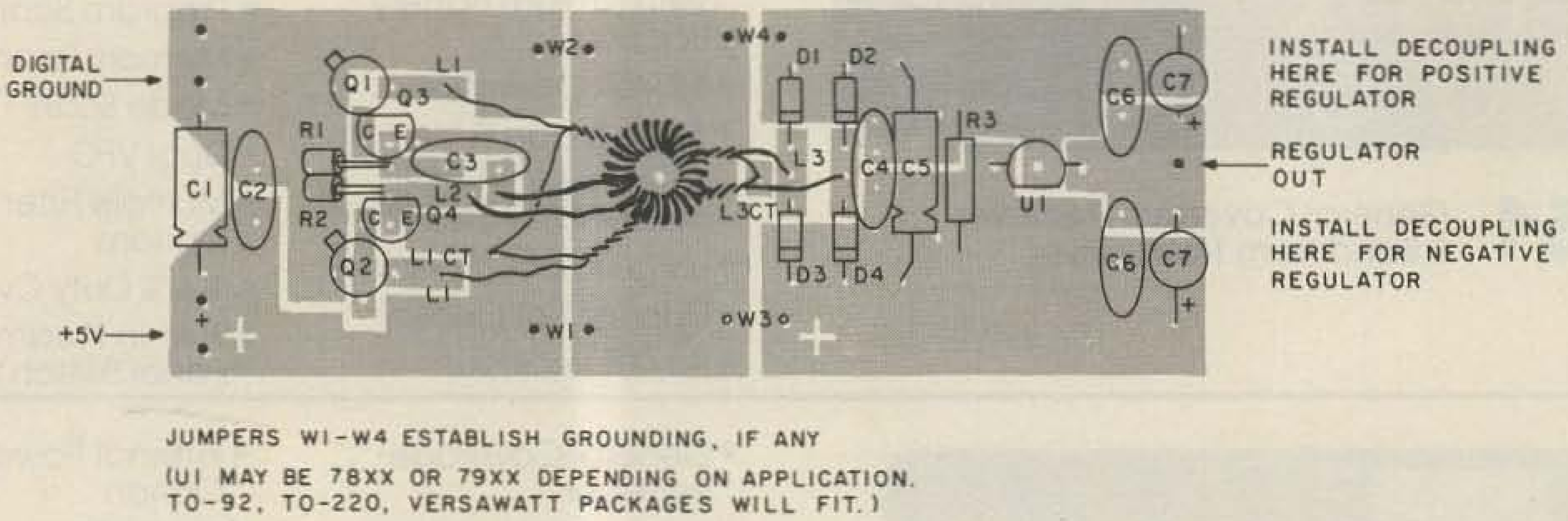

Fig. 4. Component layout.

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Watch That Signal!

Haul out your old oscilloscope and turn it into a signal monitor. The conversion is easy and the price is right.

An external view of the adaptor shown in Fig. 8, with shielded connections to the rear of the scope and onward to the vertical deflection plates.

Oscilloscope adaptors for rf have been around a long time. They became popular with the advent of SSB and inexpensive scopes after the end of World War II. Today, many of the leading ham equipment manufacturers, including Heath, Yaesu, and Kenwood, provide matching scope units for monitoring transmitted—and in some cases, received—signals. The equipment is excellent, but so is the price tag. There are cheaper ways to have an effective monitor, especially if you are interested only in seeing your transmitted signal. All you need is a cheap working scope and a simple adaptor. Fig. 1 shows in simplified form what we need.

As simple as this scheme is, relatively few hams monitor their transmitted signals or use monitors for making adjustments. The part of the equation that stops most hams is probably the scope itself and not the adaptor. There are several good working designs, and we shall look at a few before closing. However, the idea of owning and then modifying an oscilloscope still creates anxiety in many hams. So let's begin by looking at what makes a good scope for rf work.

Choosing a Scope for Rf

Current scope specifications make the units of even fifteen years ago look barbaric by contrast. The modern scope has triggered sweep calibrated in fractions of a second per division on the scope face. We can no longer create some

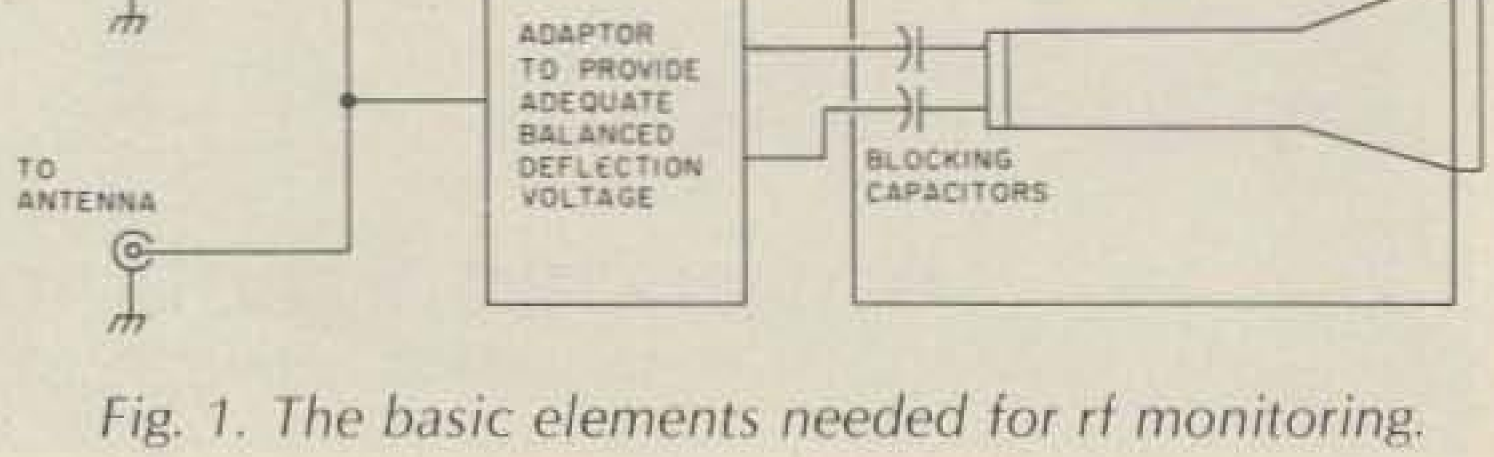

Fig. 1. The basic elements needed for rf monitoring.

of the funny pictures of yore because the recurrent sweep, calibrated in frequency, is gone. Virtually all scopes are solid state. Dual-trace capability is the rule rather than the exception. The frequency limits of the vertical amplifier have gone out of sight. Except for very expensive lab scopes, a 5-MHz limit was rare twenty years ago; today, the limit is fast approaching 100 MHz, with 20- and 30-MHz units common. One other thing has kept pace with the rising specifications: the price.

Modern scopes are excellent. If you own one, then rf monitoring is a simple matter of taking an exceedingly small sample of your transmitted signal and feeding it directly into the vertical amplifier of your scope. You need no adaptor. Unfortunately, few of us have the money for a 30-MHz scope that will get only an occasional workout in the shack. Indeed, if we have access to such a piece of equipment, it will most likely go on the test bench where it will be used more regularly.

If we do buy an older scope, our tendency is to choose one of recent vintage. This would be a solid-state scope with at least one MHz, and perhaps five, as the vertical amplifier limit. It would have recurrent sweep and single trace.

I should have stopped the moment I mentioned solid state! Although there are good solid-state scopes capable of handling the 50-odd volts of rf that we shall put into the case with at least an inch or two of lead, few of the cheap units have sufficient shielding between the amplifier boards and the neck of the scope tube where our leads are needed. The odds of popping one or more transistors is very great. We can add shielding, but our chances of successfully eliminating all rf danger are slim to nonexistent. Modern solid-state monitors begin with this problem as a design consideration, and it may be easier to build a scope from scratch than to rebuild a solid-state unit that was never intended for rf service.

Tube-type scopes of the next preceding generation do not suffer the problems of solid-state scopes. A few volts of rf in the case will not injure the tubes or other components. A hamfest will turn up many of these scopes for sale. The main item of concern is the quality of the cathode-ray tube and the power transformer. Both are difficult to replace and costly at best. If the scope puts out a bright, well-defined trace with the intensity control at the halfway point, then other faults can be repaired with the investment of troubleshooting time rather than money.

For an rf monitor at the operating desk, I prefer a smaller scope to the round-faced five-inch models. Toward the end of the tube era, a number of compact three-inch units appeared, including the Eico 435 and 430. The 8½" by 6" by 11" audio frequency 430 cost $69.95 in kit form in 1965, and it may be worth half to two-thirds of that price at a hamfest if it is in excellent condition. If you prefer a larger scope face, there are numerous Dumont and Heath models (among others) that can be picked up for a song and a few greenbacks.

Getting a scope is half the battle. Modifying it for direct rf input is simple. Locate the vertical deflector plate terminals on the scope tube socket. As close as possible to these terminals, install a pair of connectors on the rear panel of the scope. Phono connectors work well if you use thin coax for the leads from the adaptor (one lead for each terminal, since the signal will be balanced). Pin jacks or similar connectors will work if you use twinlead or other balanced lines from the adaptor; however, shielded leads are best, especially with higher power.

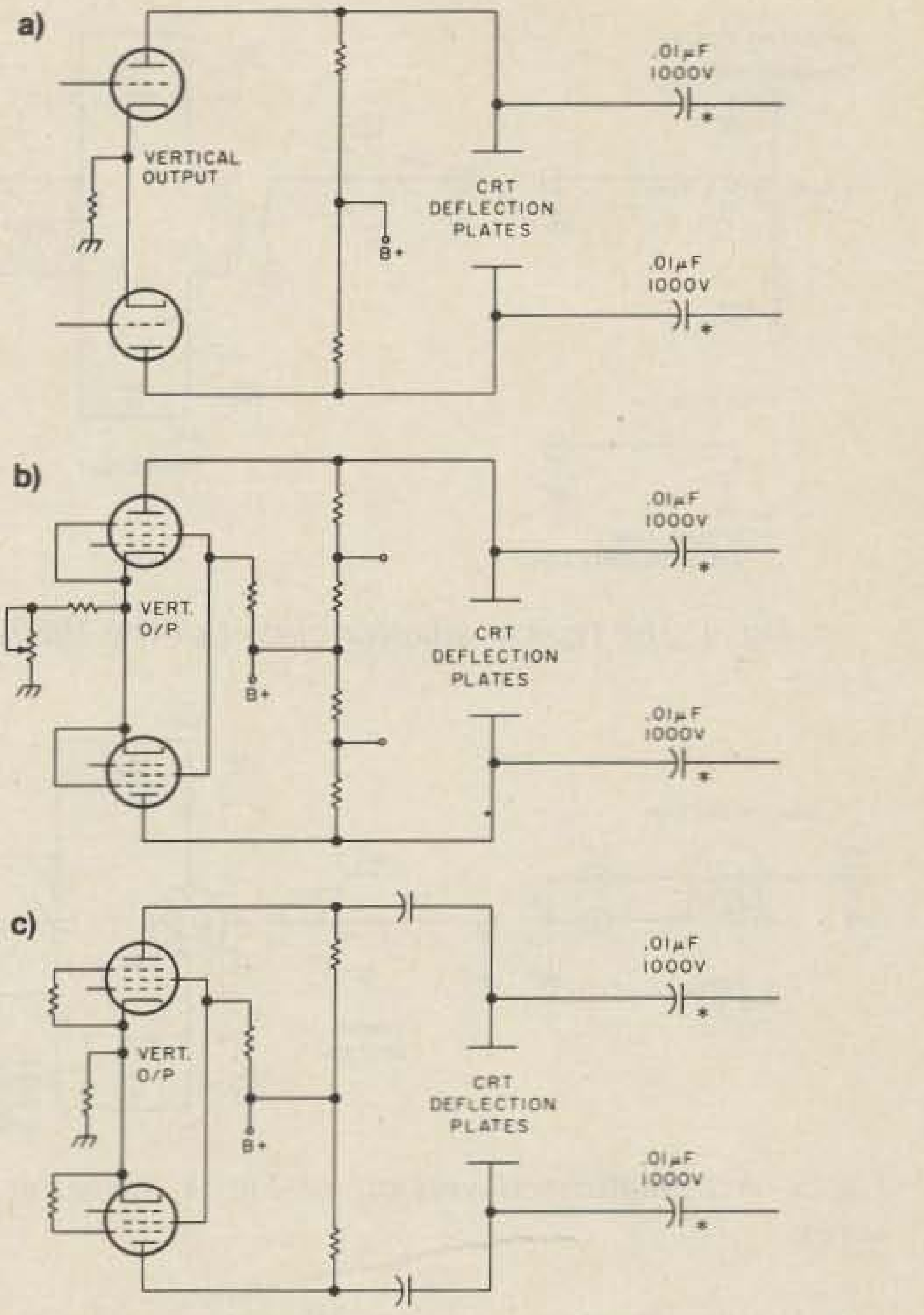

Fig. 2. Rf connections to typical vertical amplifier circuits. (a) Triode dc-coupled output stage. (b) Pentode dc-coupled output stage. (c) Pentode ac-coupled output stage.

Between the socket terminals and the jacks, install .01-μF disc ceramic capacitors of at least 1000-volt rating. Keep the leads as short as possible, and try to keep the capacitors at right angles to anything to which you might couple signal. Many scopes used to have accessory jacks on the rear panel for any number of improbable uses (for example, dc voltages to power units under test if they by chance happened to require exactly the voltages provided at a very limited current). If these are close enough to the scope tube socket, then mechanical work will be further minimized.

Fig. 2 shows the connections schematically, along with some typical vertical amplifier connections to the same socket pins. In most cases, you will need no other work on the scope. It will operate normally when rf is not present. When using the scope to monitor your transmitter, keep the vertical gain at minimum, and if you have input attenuator positions, set them at maximum. For monitoring, we simply bypass the vertical amplifier and generate the voltage needed to deflect the trace vertically by other means.

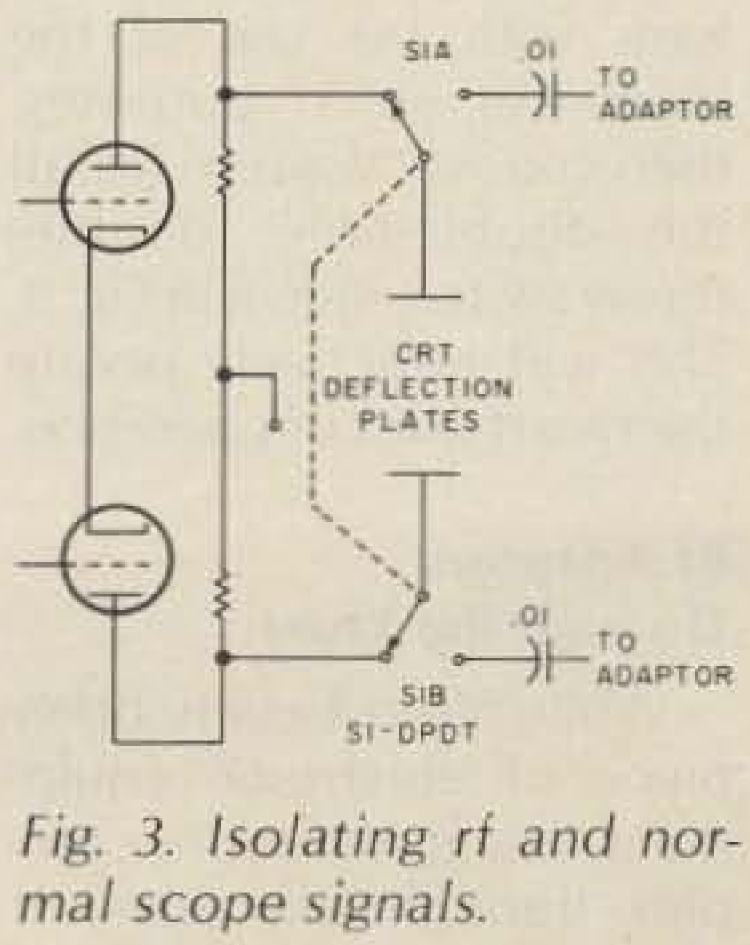

Fig. 3. Isolating rf and normal scope signals.

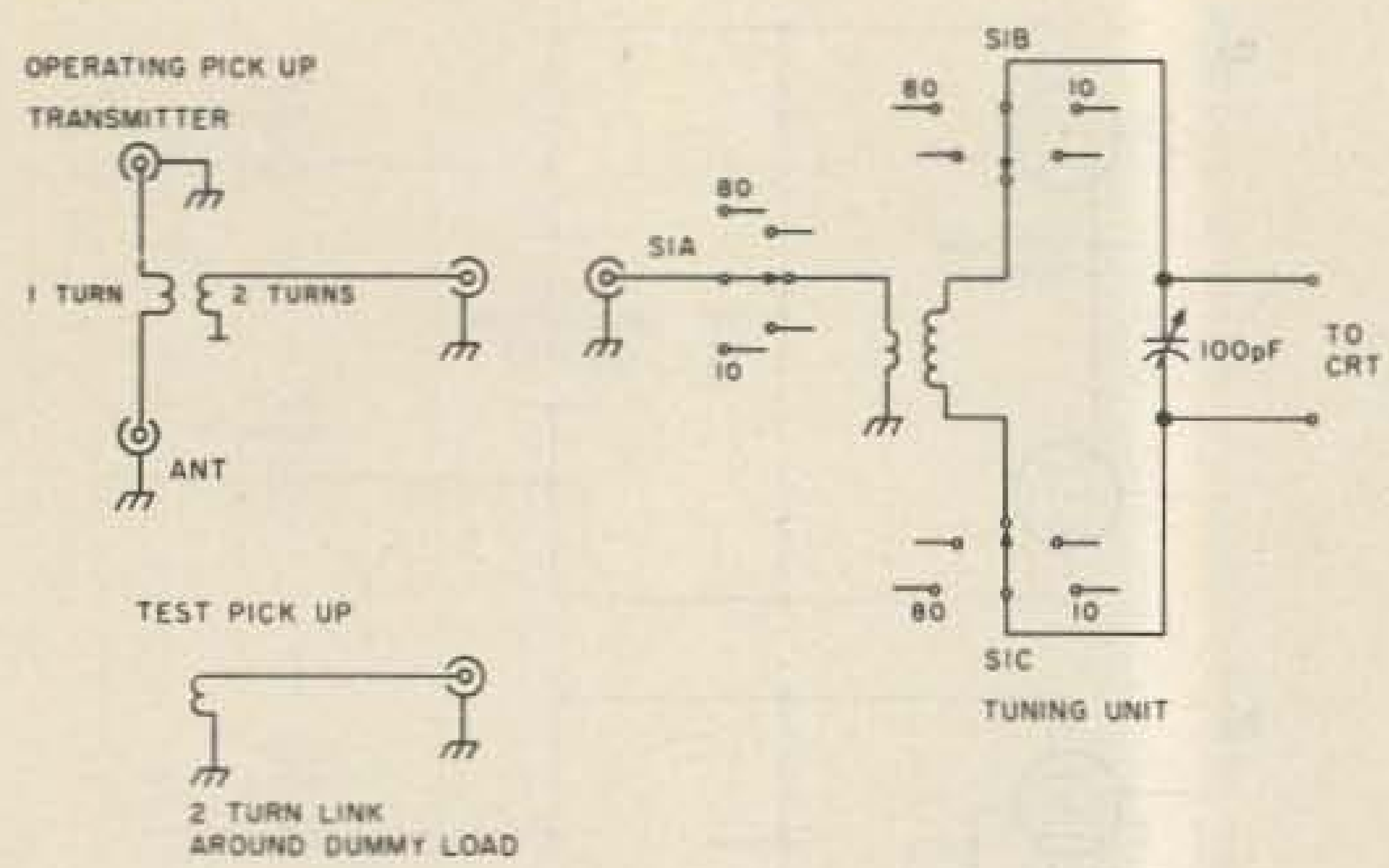

Fig. 4. The typical adaptor circuit of the 1960s.

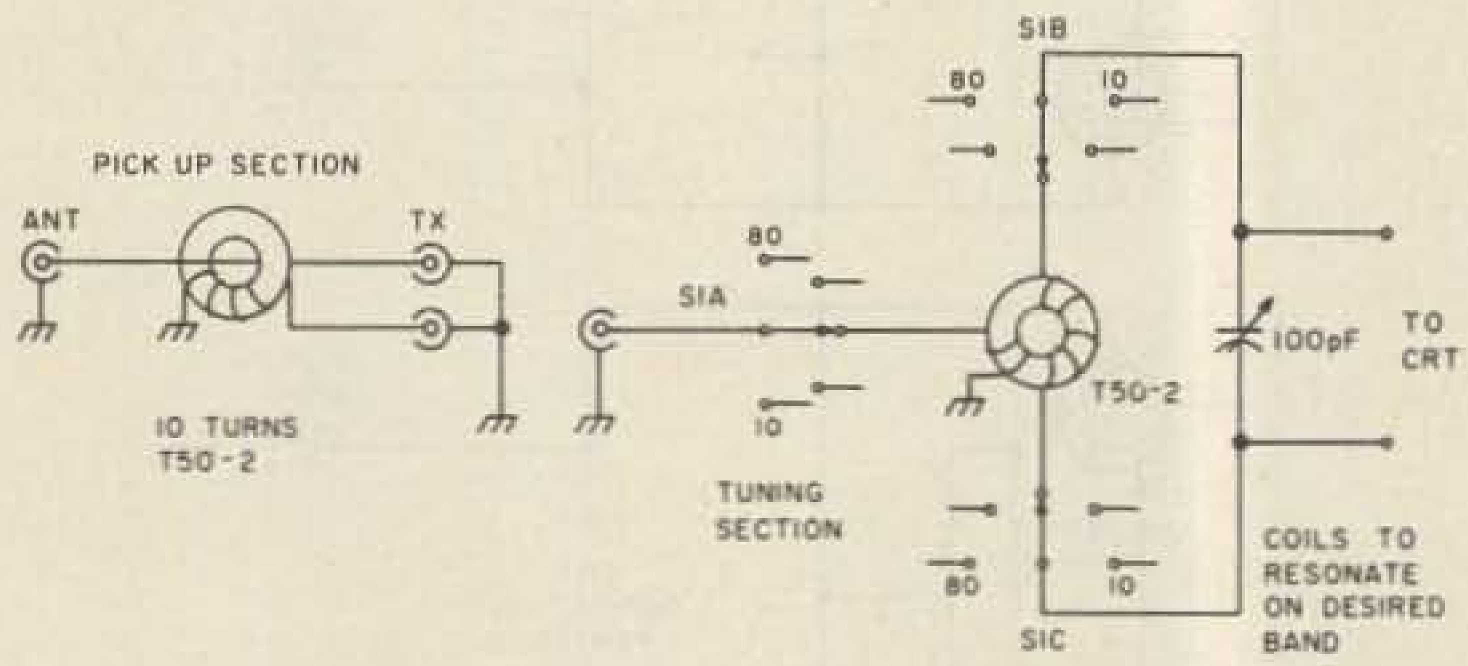

Fig. 5. A miniaturized version of Fig. 4, utilizing toroid cores.

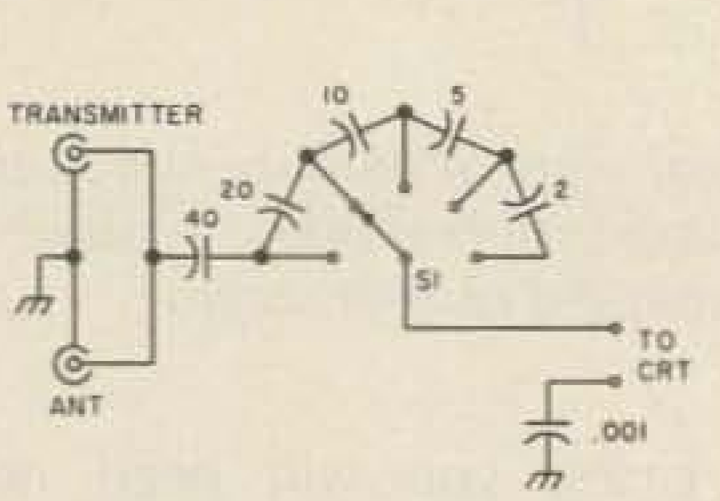

Fig. 6. A simple rf scope adaptor in wide use today.

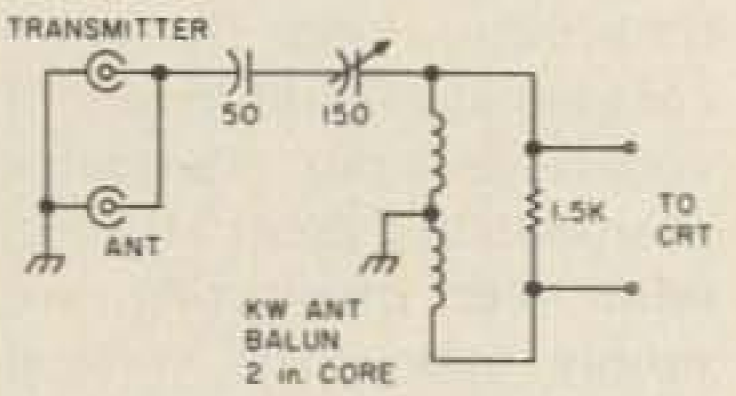

Fig. 7. The VE7CGK adaptor.

If you encounter problems with the use of the scope for non-rf purposes, then you will want to install the double-pole, double-throw switch shown in Fig. 3. This will effectively isolate the two modes of operation.

Rf Adaptors Through the Years

While almost every other piece of electronic equipment has grown more complex through the years, rf adaptors for oscilloscopes have grown simpler. I have built most of the designs, discarding them as a more compact arrangement became available. My present unit fits in a 2"×2"×4" aluminum box mounted on the back of my scope, with only one switch to manipulate. The photo shows how compact the adaptor can be. We may never reach the ultimate miniaturization in anything, but if another adaptor design comes along, I will hesitate before replacing the present unit.

Most early designs used tuned circuits, one for each band. Fig. 4 shows the general design which was fairly standard for about a decade. There were two separate boxes: a pick-up unit and a tuning unit. The pick-up box contained a one-turn coil running between the input and output coax connectors, with a two-turn link running to the tuning unit. The idea was to minimize the impedance bump in the transmitter transmission line.

The tuning unit went through stages of evolution. Initial designs were open breadboards. You were expected to tack-solder a coil each time you changed bands. Plug-in coils followed, but they required you to open the shielded box which was added to the design. In 1970, W1KLK mounted all the coils on a rotary switch (*QST*, October, 1970, p. 36). He also used the smallest diameter coils I had seen to that time, ranging from ½ inch for 10 meters to 1¼ inches for 80.

The principle of the design was to generate the necessary deflection voltage through the high Q of the tuned circuit. The tuning capacitor, insulated from the front panel and the operator's hand, provided peaking when tuned to resonance. If the voltage provided too much deflection (somewhat a rarity with older, less sensitive cathode-ray tubes), detuning the circuit attenuated it effectively. Despite its size, the unit worked very well.

The same design can be significantly miniaturized through the use of toroid cores for the inductors throughout, as shown in Fig. 5. The schematic diagram is essentially the same, although some changes have been made in the drawing to indicate the mechanical changes. A short straight line with Teflon™ insulation runs between the coax connectors and through a half-inch core. I have used from 6 to 20 turns of #28 wire in the secondary without disturbing the line impedance seriously. The tuned circuit coils in the aggregate take less room than the switch on which they are mounted. Although a three-section switch is shown, I have also used a two-section switch, with one side of each coil (and the capacitor) to a common. This did not seriously upset the balance of the output. The entire unit can be mounted in a single box with a partition between the pick-up and tuning sections.

Recent Adaptor Designs

More recently, designers have realized that tapping a 50- or 75-Ohm coax line would cause no significant problems if the tap impedance was fairly high. This has resulted in the use of almost direct connections between the rf line and the scope tube. Fig. 6 shows a generalized idea of the scheme. The switch controls a selection of capacitors arranged to successively double the reactance and lower the signal level seen by the scope plates. Since the scope deflection plates require a balanced input, the ground side is elevated off ground. The system is perfectly adequate for most monitoring purposes, although a better balance is easily achieved.

In 1979, VE7CGK presented an interesting scheme (*73*, June, 1979, p. 110); it is shown in Fig. 7. His balun used an ordinary 2-inch-diameter antenna core. The swamping resistor across the core is non-critical in value, and anything with up to a three-to-one ratio to the value given seems to work. It evens the frequency response by lowering the Q of the coil. However different his coupling scheme appears to be from that in Fig. 6, it is electrically identical. He has used a variable capacitor (with a series fixed capacitor) to replace the switch. Like all the units shown, his works well, with one exception. It is difficult to find a variable capacitor with a 150-pF top value that will go below 10 pF minimum. The 5-pF value in Fig. 6 is needed when viewing kW signals on a sensitive scope tube.

The final design that fits into the small box shown in the photo combines the best of these two designs with some miniaturization thrown in. Fig. 8 shows the circuit. The capacitor section is standard. The balun is

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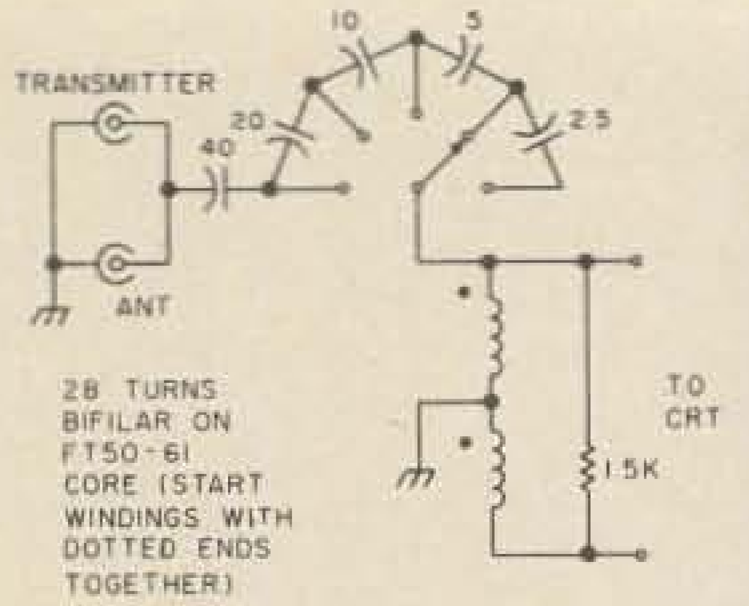
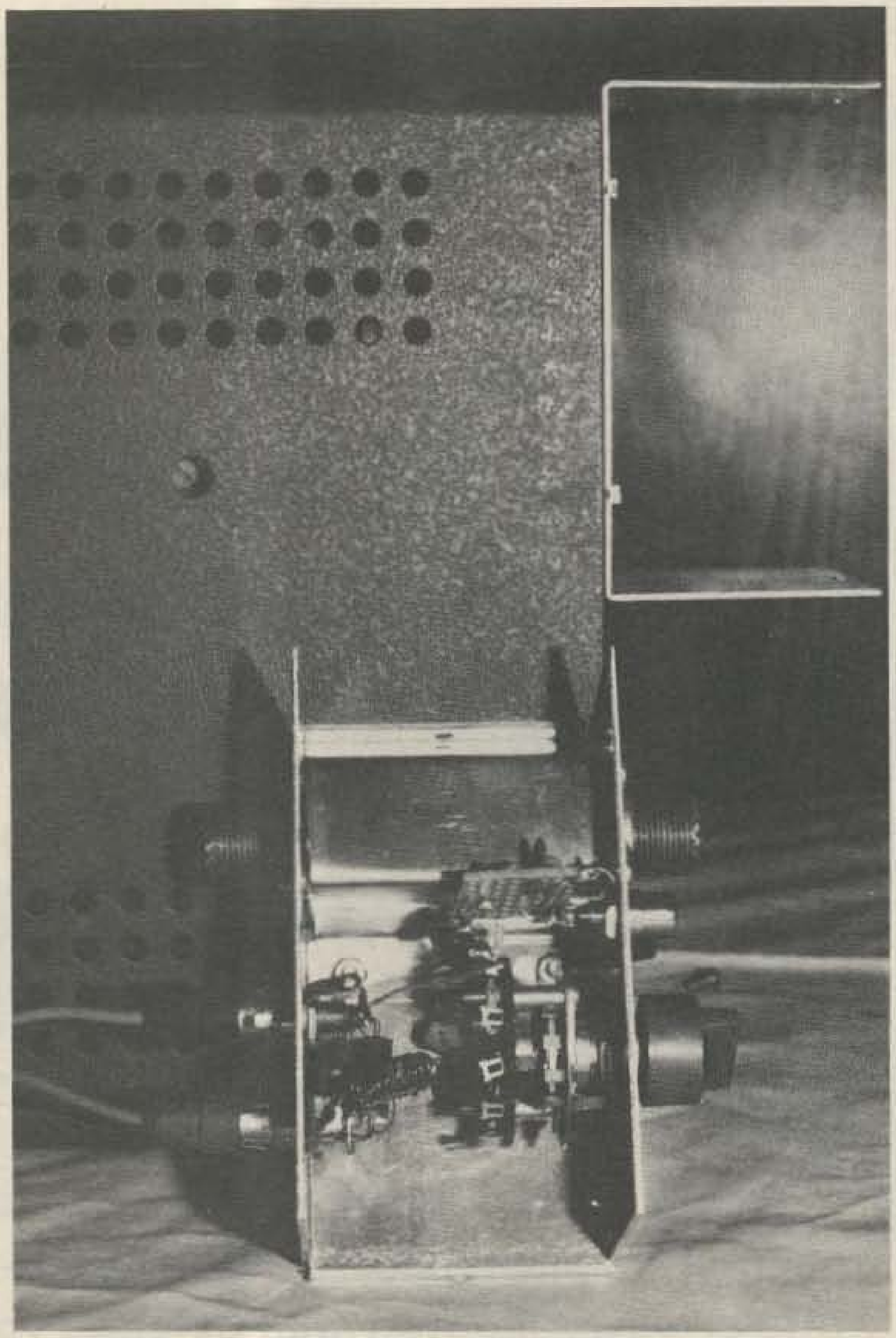


Fig. 8. The hybrid miniature scope adaptor.

wound on an FT 50-61 core and is designed for about 1200-Ohms impedance at 3.5 MHz, or about 54 microhenries per section. Twenty-eight turns bifilar, connected as shown, meet the requirement.

Construction is simplicity itself. As Fig. 9 shows, the switch is mounted on one side of the U-shaped channel of the box, the output jacks on the other. A thin aluminum cover with a hole for the capacitor lead covers the wire between coax connectors. The remaining part of the box mounts on the rear of the scope, so the unit is almost a plug-in device. Leads from the adaptor to the scope are kept short, partly by careful thought beforehand on parts arrangement. Construction can vary according to what is convenient in terms of your scope. The only rules to follow are the usual ones about short leads for rf.

The response of this adaptor is smooth across the ham bands from 80 to 10 meters, with no significant difference in the deflection of equal power signals among bands. Nor are there any peculiar peaks or other odd quirks. In short, the adaptor does its passive task tamely but effectively. Position 2 on the switch is used for the normal 100-Watt output from the rig and yields over an inch of deflection. Position 1 permits viewing of much lower power signals. The output from my SB-200 produces about an inch and a half of deflection in position 4, thus confirming that



Interior view of the adaptor shown in Fig. 8. The metal shield near the top covers the through line from transmitter to antenna, while the switch holds the capacitor-divider. The broadband transformer balun is mounted between the output jacks at the lower right. The small perfboard holds an envelope detector for synchronizing the scope's sweep.

the capacitor choice is adequate for the most common range of ham signals. The scope which the adaptor feeds, incidentally, is an Eico 430.

Using the Adaptor

Synchronizing the monitored signal to the scope sweep is desirable but not essential to the observation process. It is useful and pos-

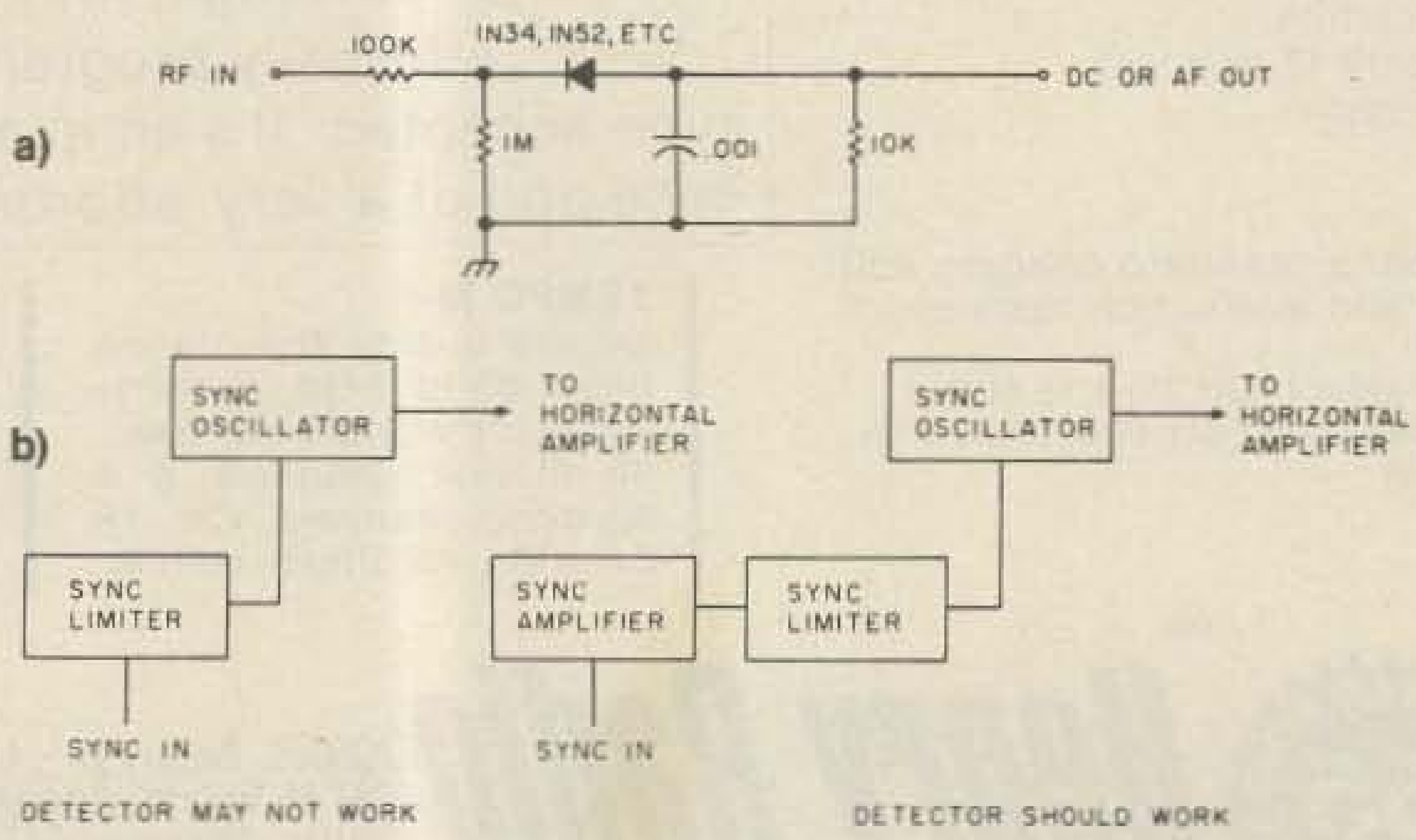


Fig. 10. A simple envelope detector for linearity checks and sync. (a) Envelope detector. (b) Scope sync systems.

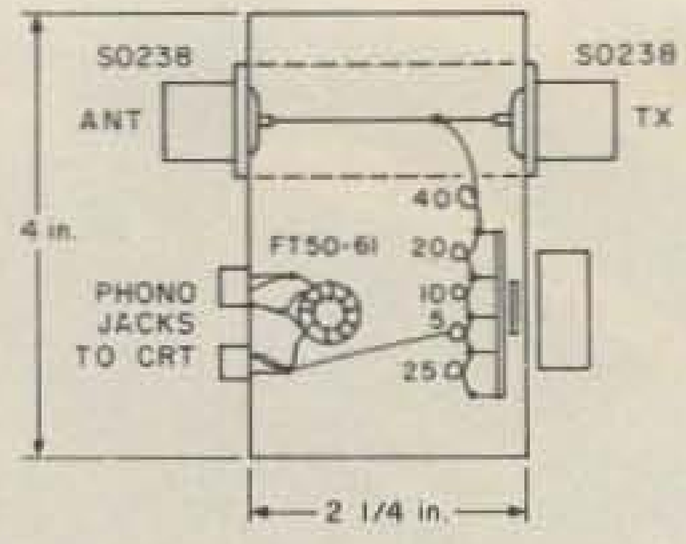


Fig. 9. Physical layout of the hybrid scope adaptor.

sible with CW dots or dashes sent at a constant rate (easily done with an electronic keyer) and with two-tone tests on SSB. For the usual Christmas-tree pattern seen in casual monitoring of SSB or for AM trapezoidal patterns, sync is useless. Nonetheless, the technique for deriving a sync voltage is simple in principle and deserves mention.

Fig. 10(a) shows a simple AM detector typical of those found in rf probes. With the isolating resistor, its output is very low, too low to drive the external sync connections on many scopes. The problem becomes clear in Fig. 10(b), block diagrams of two types of sync inputs. In one case, external sync is amplified before going to the sync limiter. In the other, sync voltage goes directly to the limiter. A small external sync voltage cannot drive the second circuit without further amplification. For two-tone testing SSB signals, an audio amplifier works well, but for CW, a dc amplifier is better. If your scope has a stable sweep oscillator, this additional circuitry adds little to the effectiveness of monitoring, but it does create a need for feeding power to the adaptor which is otherwise a passive device. For standard linearity patterns, of course, a pair of detectors is needed, but since the regular horizontal and vertical inputs of the scope are used for the test, no power source is needed.

Using the monitor is an easy process. Connected as shown early in the article, the adapted scope will dis-

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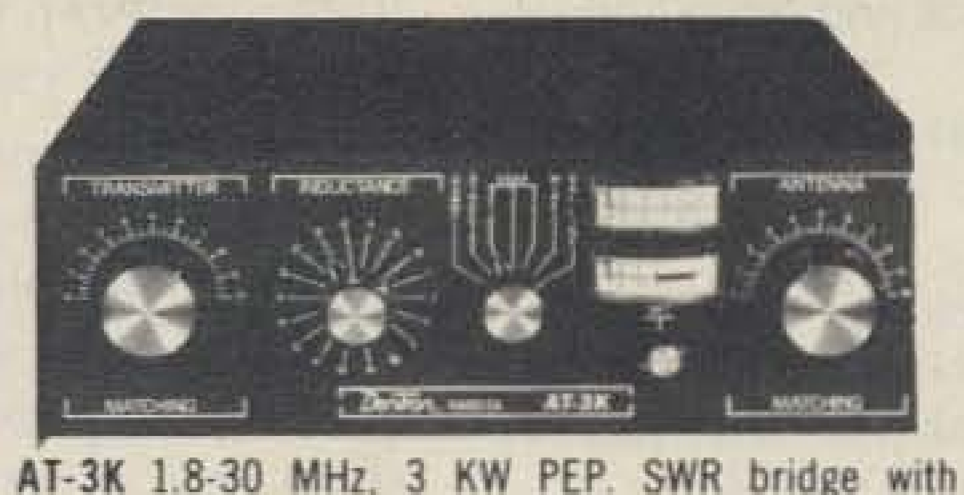

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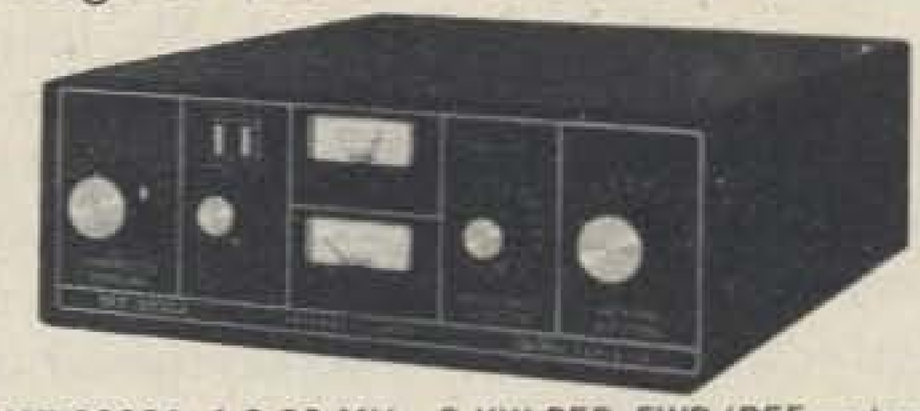

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2	SO-238 coax sockets	Radio Shack and other sources
2	phono sockets	Radio Shack and other sources
1	1.5k-Ohm, ½-Watt resistor	Radio Shack and other sources
1	40-pF silver mica capacitor	Available from mail-order sources such as Semiconductor Surplus
1	20-pF silver mica capacitor	
1	10-pF silver mica capacitor	
1	5-pF silver mica capacitor	
1	2.5-pF (or two 5-pF in series) silver mica capacitor	Note: disc ceramic capacitors with 350-volt or higher ratings will substitute for the silver micas
1	2¼"×2¼"×4" aluminum utility box	Radio Shack and other sources

Total cost: $10, if all parts new; under $5 with surplus and/or used parts.

play CW waveforms, plus two-tone and Christmas-tree SSB patterns. No better observation of CW make-and-break patterns has been invented, and the results of adjustments to component values become immediately apparent. With respect to observation of SSB, the simple adaptor technique might be considered somewhat archaic. A spectrum analyzer will in fact provide more sensitive indications of incorrect linear-amplifier adjustment. However, a spectrum analyzer is an expensive piece of equipment.

The two-tone test provides good indications of improper amplifier adjustment if the operator takes the time to become personally familiar with and sensitive to the meaning of the curves. Handbooks of a few years back provide ample drawings of various conditions of operation and their meaning.

Some recent materials on the subject have bent over backward to discredit our ability to read two-tone envelope patterns effectively. This is true only if we do not thoroughly learn the peculiarities of our equipment. The idiosyncrasies of each amplifier and each scope require that we make extensive on-the-air and dummy-load tests to discover at what point slight flattening of the pattern top, or slight curvature to the pattern sides, means distortion of our voices or adjustments of the drive or loading which are out of spec. We may not be able to match laboratory results, but we can keep our rigs well within FCC regulatory requirements and well within what courtesy to other operators dictates.

Despite the fact that rf adaptors for old audio scopes have been supplanted by more sensitive methods of monitoring, it will be a long time before we can all afford up-to-date test equipment. In the interim, a small investment (maybe $30 to $50 for a used scope and $5 for the monitor) can go a long way toward helping us put out cleaner signals. The tiny monitor box shown here (which might even fit inside some of the large old scope cases) makes the process of monitoring one step easier. I only wonder how small the next monitor design will be. ■

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Digital Design: How to Interface ICs

Connect ICs to the outside world with these hints from the author of "Digital Basics."

The reader response to my three-part series titled "Digital Basics" (*73*, September through November, 1982) was overwhelming even to an old tech-writing hack like myself. In addition to receiving more than a dozen positive letters (and no negative ones), I received a consulting offer; writing for *73* surely pays!

One theme which popped up in about one-third of the letters was digital interfacing. Readers wanted to know how to interface various digital IC logic families with each other and with the "outside world." In this extension of the original series, we will discuss interfacing techniques and how they can be applied in practical situations.

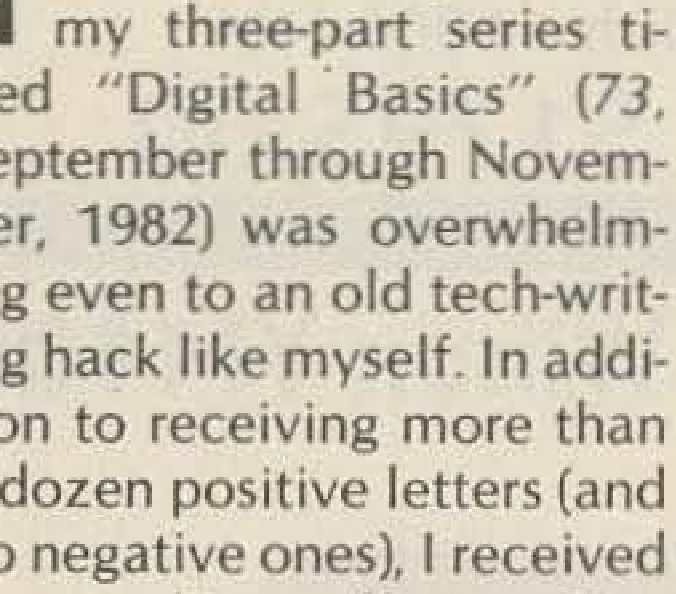

Fig. 1(a). TTL totem-pole output.

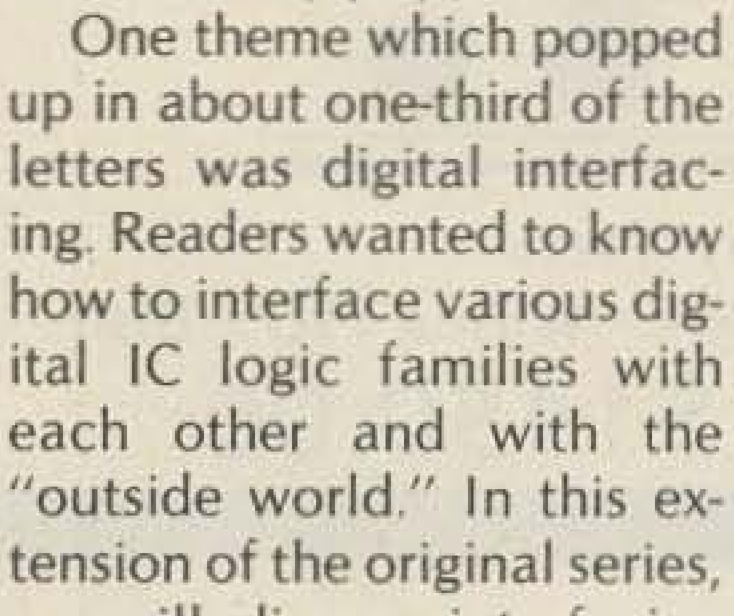

Fig. 1(b). TTL open-collector output.

Logic Family Outputs and Inputs

Most readers will be using either the transistor-transistor-logic (TTL) or complementary-metal-oxide-semiconductor (CMOS) and related MOS families. These will be the devices discussed in this article.

Before we can become too deeply involved in any discussion on interfacing, we must become familiar with just *what* is being interfaced. For digital electronics, this means a review of the input and output circuits of the devices, since these are what will be connected together.

The TTL logic family operates from a single-polarity dc power supply of +5 volts dc and ground. This supply must be regulated to keep the voltage within a narrow range—4.75 to 5.2 volts. Some texts permit slightly broader limits, but practical experience indicates that voltages lower than +4.75 volts cause erratic operation, especially of complex function devices, while potentials over about +5.2 volts lead to premature failure of large numbers of chips. I personally prefer to keep the potential within the even narrower range of +4.9 to +5.05 volts dc.

The TTL output stage is a *current sink* to ground, while the TTL input is a *current source*. Figs. 1(a) and 1(b) show two popular forms of TTL output, while Fig. 1(c) shows a typical TTL input circuit. The high and low logic levels in TTL are specified in terms of the voltages that satisfy the input requirements.

The high level will be anything between +2.4 volts and +5.0 volts. In most TTL devices, the output will produce a potential greater than +2.4 volts for high, but considerably lower than +5 volts; potentials in the 3.0-to-4.0-volt range are most frequently found. The low condition is defined as any potential between 0.0 volts and 0.8 volts, i.e., 800 millivolts. The region between 0.8 volts and +2.4 volts is undefined and is therefore to be avoided. One problem seen in some interfacing situations is the creation of a circuit that will not bring the outputs to within the defined high and low limits, thereby creating an unpredictable situation.

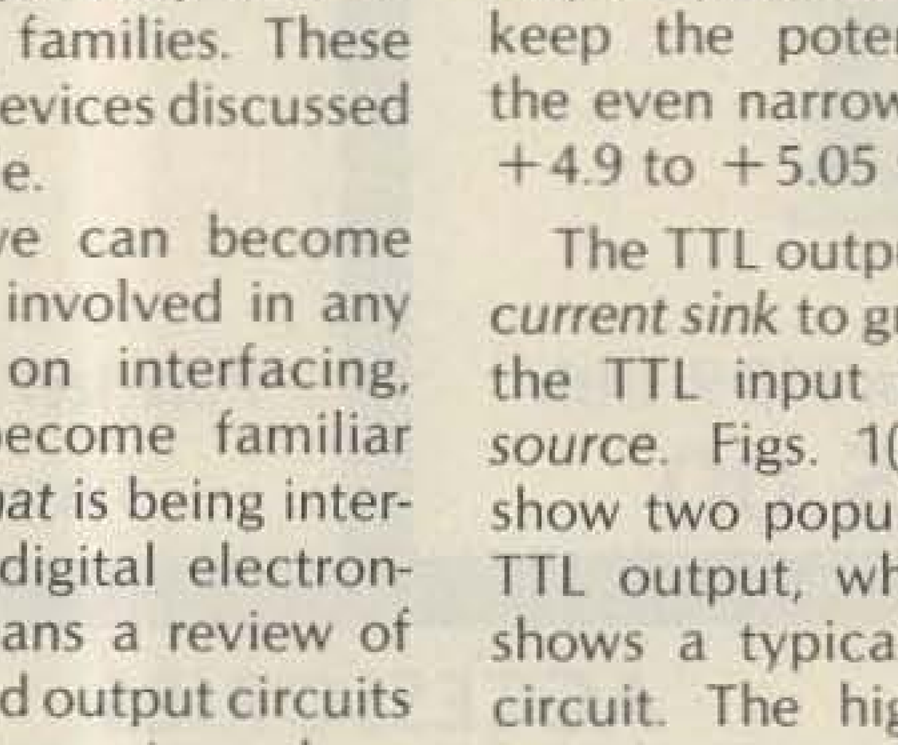

Fig. 1(c). TTL inputs.

One advantage of using IC logic elements is that we are free to avoid the problems of impedance matching (and other related headaches) when connecting the devices together in cascade. We can use the concepts of *fan-in* and *fan-out*. The term fan-in defines the load presented by any device in terms of standard TTL input loads. Since the TTL input is little more than a 1.6-milliampere current source, we define a fan-in of 1 as a current source of 1.6 mA, at standard TTL logic voltage levels. The fan-out is the drive capacity of a logic device defined in terms of the number of standard 1.6-mA TTL loads that the output will drive. In most devices, the fan-out is ten, so the device will successfully drive up to ten standard TTL loads. (In other words, it has a 16-mA output current sink capacity.) Some special devices called *buffers* or *line drivers* typically will have fan-outs of thirty, but up to one hundred are known.

Most TTL devices have an output circuit such as the one shown in Fig. 1(a). The output circuit is a totem-pole power amplifier consisting of two NPN transistors. A blocking diode prevents current flow from the output terminal through Q1 to the +5-volt power-supply line. When the output is low, transistor Q1 is turned off and Q2 is turned on. This places the output line at or near zero volts. The actual potential will be the Vce(sat) rating of Q2, which may be as much as 0.8 volts. In the opposite condition, when the output is high, the opposite occurs: Transistor Q1 is turned on and R2 is turned off. This places a potential on the output line that is the +5-volt power-supply voltage less the Vce(sat) rating of Q1 and the junction drop of the series diode (normally 0.6 to 0.7 volts).

An alternate form of TTL output is the *open-collector* circuit of Fig. 1(b). The open-collector device is used to drive external devices and is a prime tool in interfacing with other logic families as well as with the "outside world." Transistor Q1 will be connected to the V+ (which is not always +5 volts, even though the package power-supply voltage must be +5 volts dc) through a pull-up resistor or another form of load. Normally, if a simple pull-up resistor is used for the load, we will need 2000 to 3000 Ohms for +5-volt power supplies, and proportionally higher for higher potentials. TTL devices with open-collector outputs include the following hex inverters: 7405 (+5-volt supply only), 7406 (to +30 volts at up to 30 mA), 7416 (to + 15 volts at up to 40 mA), and the following hex non-inverting buffers: 7407 (30 volts, 30 mA) and 7417 (15 volts, 40 mA). These devices are of prime concern for our interfacing chores. Note that certain other TTL devices also have open-collector outputs.

An example of a TTL input circuit is shown in Fig. 1(c). The device shown here is a two-input circuit as is found in each section of a device such as the 7400 two-input NAND gate. Each input will source up to 1.6 mA of current.

A CMOS inverter circuit is shown in Fig. 1(d). The typical CMOS device will have a pair of complementary MOSFET transistors connected in series with the output taken at the junction between the two. Transistor Q1 is a p-channel MOSFET, while Q2 is an n-channel MOSFET. These devices have opposite properties such that Q1 will be turned off (high-resistance channel) by a high applied to the input, while Q2 is turned on by a high on the input. Thus, for each different binary logic level, we will always have a series circuit consisting of a high resistance and a low (approximately 200 Ohms) resistance. For output-low conditions, there will be a high resistance to V+ (Q1 off) and a low resistance to V−(Q2 on). For the output-high condition, exactly the opposite occurs: there is a low resistance to V+ (Q1 on) and high resistance to V− (Q2 off).

Thus, we will see the CMOS output sink current on low and source current on high. Although this fact is not needed when interfacing CMOS-to-CMOS, it is useful for other interfacing chores.

The CMOS input is essentially an open circuit. CMOS devices operate using electrostatic fields derived in the channel from potentials applied to the gate terminal. This terminal is insulated by a thin metal-oxide layer and thus represents an immensely large resistance. Various authorities quote not less than 1 megohm, with some going to 10^{12} Ohms. Thus, many CMOS devices can be driven from the same output with regard for current-driven capability. There may, however, be capacitance limitations, especially where a rapid rise time must be maintained.

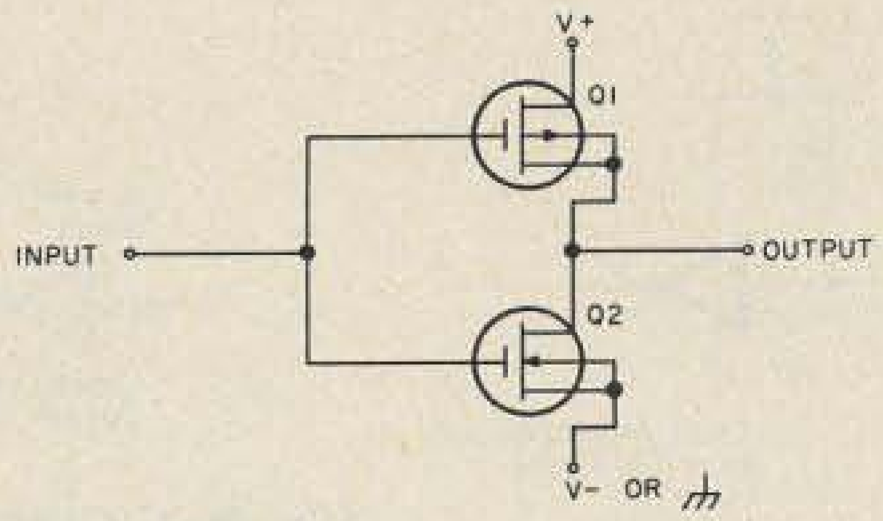

Fig. 1(d). CMOS inverter, showing inputs and outputs.

Interfacing Between Logic Families

Fig. 2 illustrates some of the circuit situations required to interface between CMOS and TTL devices. Ordinarily, a single low-power (74L) or low-power Schottky (74LS) TTL device can be directly driven from a CMOS output, *provided* that the CMOS device is operated from a +5-volt power supply and ground. Normally, CMOS devices can operate with ±V of ±4.5 to ±15 volts dc; furthermore, these supplies need not be equal. We could, for example, operate from V+ =5 volts, and V− =0 volts (grounded). It is only this latter situation that will accommodate Fig. 2(a). Here the CMOS device will directly drive the 74L or 74LS TTL device. These TTL devices operate from lower current levels than does regular TTL.

Two specific CMOS devices will directly drive a single regular TTL input: the 4001 quad two-input NOR gate and the 4002 dual four-input NOR gate. See Fig. 2(b). Note that the B series CMOS (4001B) would probably drive more than one input.

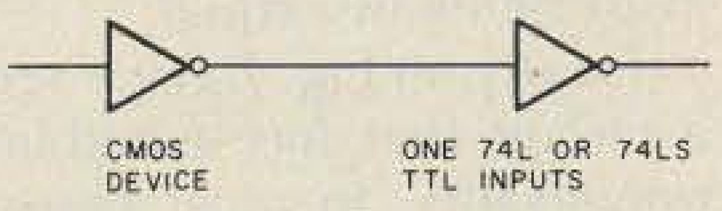

Fig. 2 (a). CMOS-to-74L or -74LS devices.

Fig. 2(b). 4001/4002 CMOS will drive one regular TTL load.

Fig. 2(c) shows the use of the 4049 or 4050 devices. These devices are hex inverter and hex non-inverting buffers, respectively. They are specially designed to directly drive up to two regular TTL inputs (output current of 3.2 mA) *provided* that the 4049/4050 package is operated from +5 volts and ground, rather than some other V+/V− combination.

In Fig. 2(d) we see that a TTL output will drive a CMOS input (actually, several can be accommodated) provided that there is a current source. Recall that the TTL output wants to see a 1.6-mA to 16-mA current source for its load, while the CMOS input is an extremely high impedance. In order to keep the TTL device operating properly, we must pro-

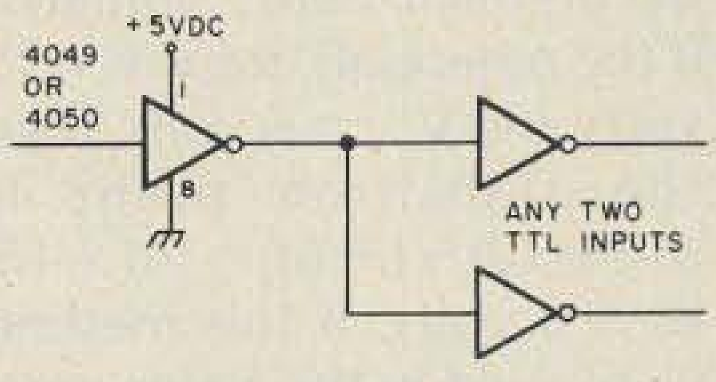

Fig. 2(c). 4049 and 4050 CMOS devices will drive up to two regular TTL loads.

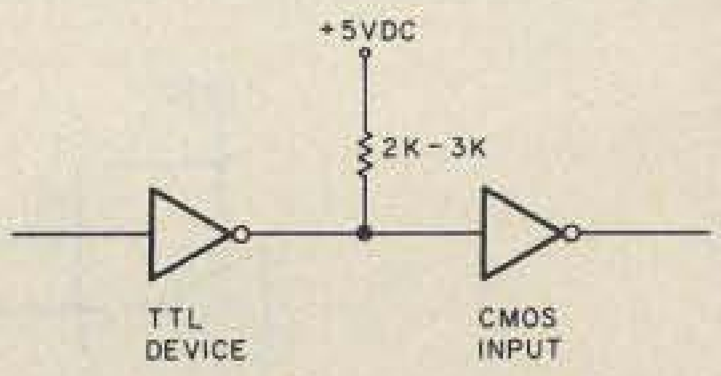

Fig. 2(d). TTL-to-CMOS (operated from +5 volt supply).

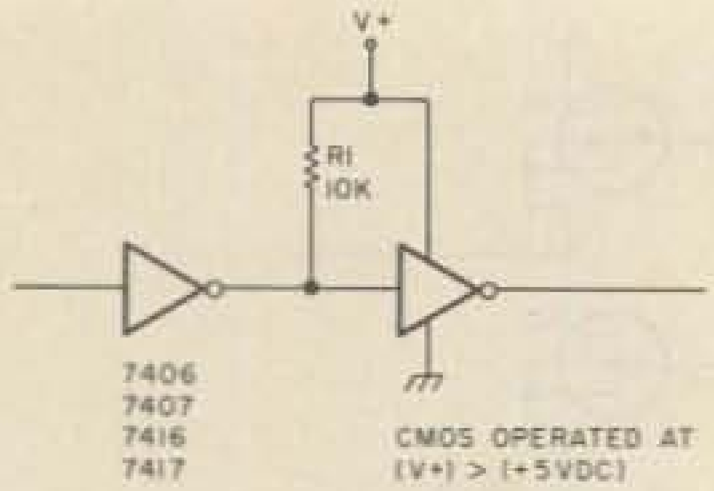

Fig. 2(e). TTL-to-CMOS (operated from V+ greater than +5 volts, and V− =0 volts).

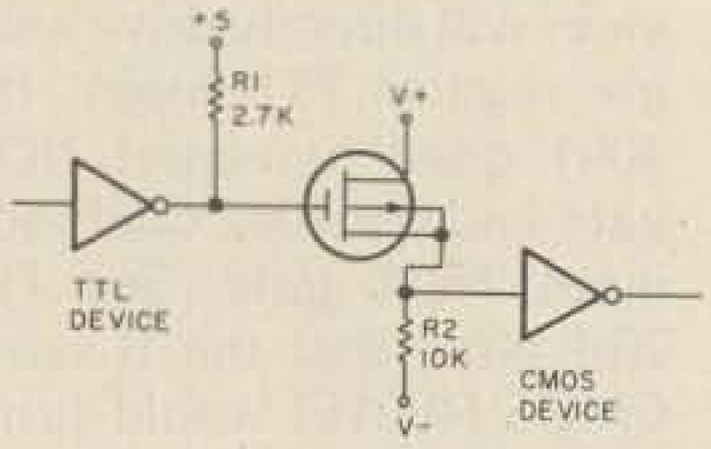

Fig. 2(f). TTL-to-CMOS (operated from ±V supplies).

vide a 2 to 3k-Ohm pull-up resistor between the TTL output and +5 volts dc. We must limit this method to those cases where the TTL voltage levels are compatible with the CMOS. If the CMOS device is operated from +5 volts and ground, then there is no problem.

Recall from the previous series on digital basics that the CMOS device output will go through a high/low or low/high transition when the input voltage is midway between the V+ and V− voltages. If, for example, the supplies are +5 volts and ground, then the transition occurs close to +2.5 volts. But, if the supplies are ±12 volts (or any other legal potential), then the transition occurs near zero. Similarly, if the potentials are V+ =12 volts and V− =6 volts, then the transition point is ½[(+12)−(−6)]=½(+18) or +9 volts. If this method were used in the latter case, the input of the CMOS device would jump back and forth between two "legal" low potentials, so the output

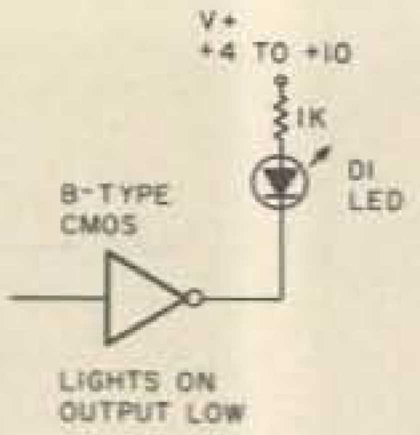

Fig. 3(a). CMOS light-on-output-low LED interfacing.

would never toggle. In Fig. 2(e) we show you how to deal with that problem.

For those cases where the CMOS device operates from power-supply potentials other than +5 volts and ground, we will need a circuit such as the one in Fig. 2(e). Here we will use one of the "high-voltage" hex inverter IC devices discussed at the beginning of this article: 7406, 7407, 7416, and 7417 are candidates; 7405 can operate only from +5 volts, so it is ruled out. Note that the package power-supply voltage for these TTL devices *must* remain at +5 volts only, but the voltage applied to the open-collector output transistor via the pull-up resistor can be up to the CMOS V+ limit of +15 volts dc. A 10k-Ohm pull-up resistor will suffice.

Fig. 2(f) shows how to interface the TTL device with CMOS devices that are operated from bipolar power supplies instead of V− = 0. In this circuit, we use a MOSFET transistor (or one section of the CMOS 4007 device) in between the two logic devices. Resistor R1 provides a current source for the TTL output, while R2 limits the MOSFET current to a safe value and develops the potential applied to the CMOS input. V+ and V− must be nearly equal.

Finally, in Fig. 2(g) we see a circuit that has a certain universality. In most cases,

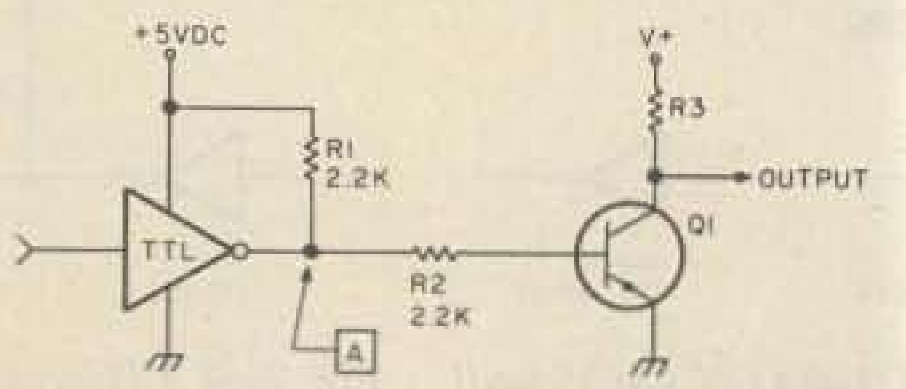

Fig. 2(g). Universal TTL to other logic devices.

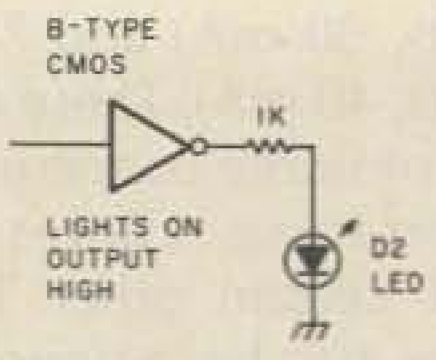

Fig. 3(b). CMOS light-on-output-high interfacing.

the function of this circuit will be to interface TTL to certain other higher-voltage logic families (such as CMOS operated from supplies over +5 volts, HNIL, HTL, etc.) In the majority of such instances, you will use a 7406, 7407, 7416, or 7417 device in place of transistor Q1, but this circuit may prove useful in some situations.

For example, in an existing device, there may be too little room to add an IC, but plenty of room to kludge on a 2N2222 or similar transistor. This situation turned up one time when I worked for a medical school electronics laboratory. It seems that one of the researchers had an elderly frequency/period counter that used zero and +12 volts as the logic levels, yet she wanted to interface this counter to a modern instrument that provided TTL output levels. The solution was to kludge R1–R3 and Q1 onto the PC board inside of the older instrument, and create a new input.

Register R1 is used, regardless of whether open-collector logic is used, and serves to provide a current for the TTL output to sink. When the TTL output is low, point A in Fig. 2(g) will be at zero potential, so the base of Q1 is turned off. Under this condition, the output is high (inverted). Similarly, when the output of the TTL device is high, the potential at point A is 3 to 4 volts, so it can bias the base of Q1 on. Under this condition, the transistor is saturated and will produce a low output. This method is useful so long as an inverted output is sufficient. Otherwise, cascade two similar stages. I

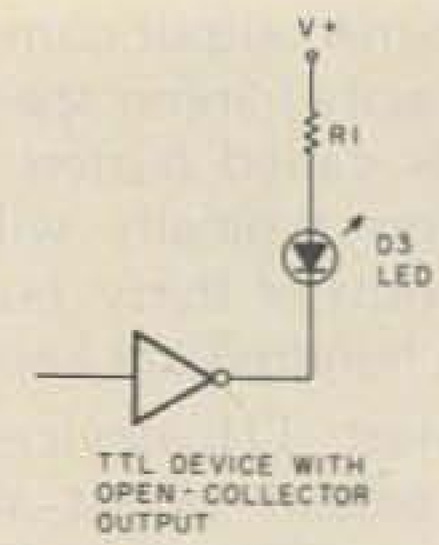

Fig. 3(c). TTL open-collector LED interfacing (circuit will also drive very-low-current lamps).

suspect, however, that any situation where cascading two Q1 stages is feasible will also permit the kludge of a 14-pin DIP, thereby making the use of the hex inverter the preferred method.

Interfacing Lamps and LEDs

Incandescent lamps and light-emitting diodes (LEDs) are often used in digital instruments to indicate logic status or to signal some event like the completion of a process, etc. The B series CMOS devices can often be interfaced directly with light-emitting diodes, provided that no more than about 15 mA of current will light the LED to an acceptable brightness (the usual case). The A series devices are not able to do this neat trick because they have as little as one-third the current sinking/sourcing capability of the B series devices.

Figs. 3(a) and (b) show the use of direct interfacing between a B series CMOS device and the low-current LED. The circuit in Fig. 3(a) uses the LED as a pull-up between the CMOS output and the positive power supply and will cause the LED to light on any output-low condition. The CMOS output in this case operates as a current source to ground. In Fig. 3(b), the LED is connected between the CMOS output and ground and will light only on output-high conditions. In this case, the CMOS output is used as a current source.

Fig. 3(c) shows the use of an open-collector TTL device to drive the LED. If V+

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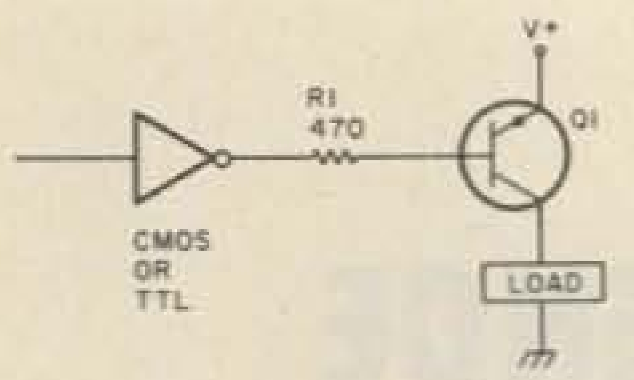

Fig. 3(d). Incandescent lamp interfacing with PNP transistor.

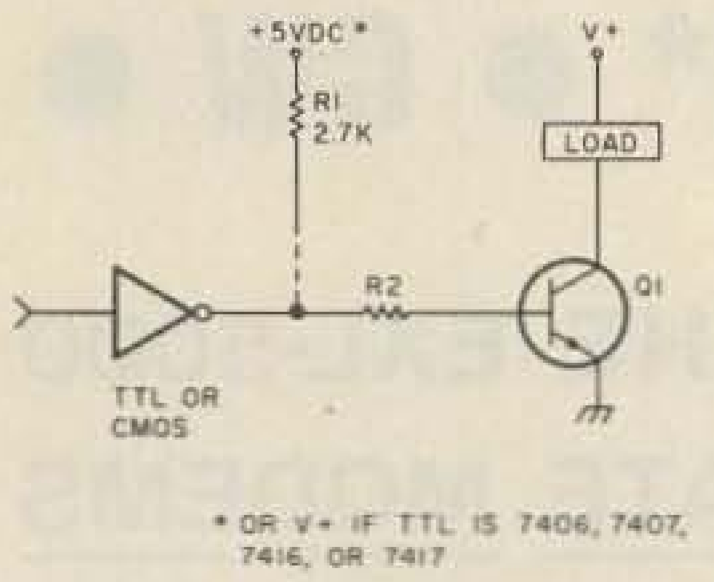

Fig. 3(e). Incandescent lamp interfacing with NPN transistor.

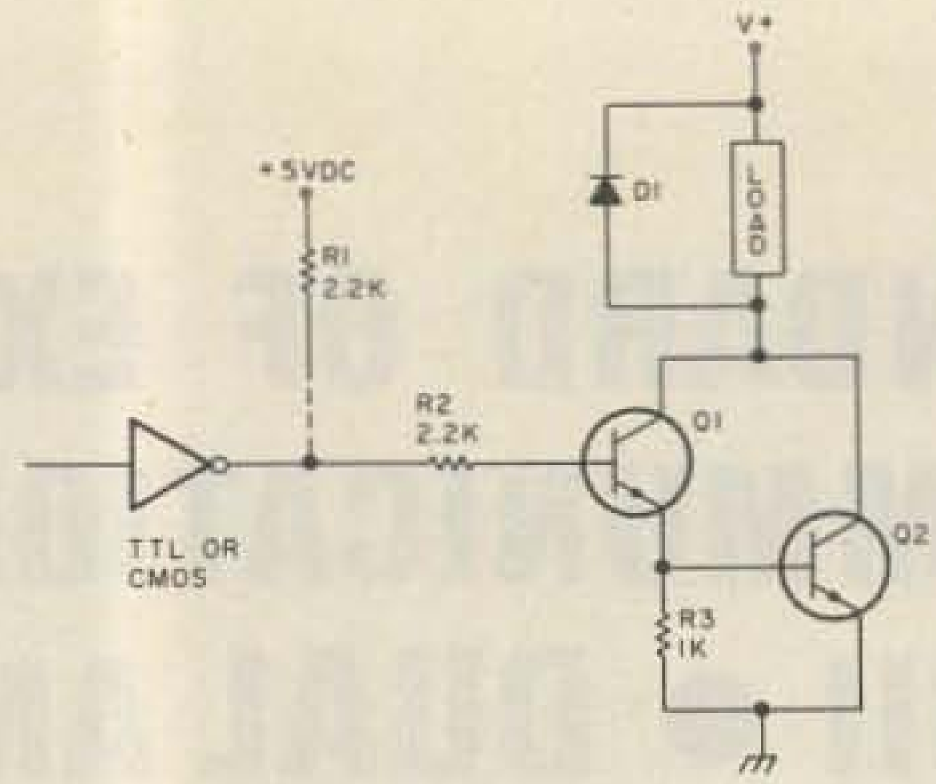

Fig. 4. Driving large loads using Darlington-pair transistors.

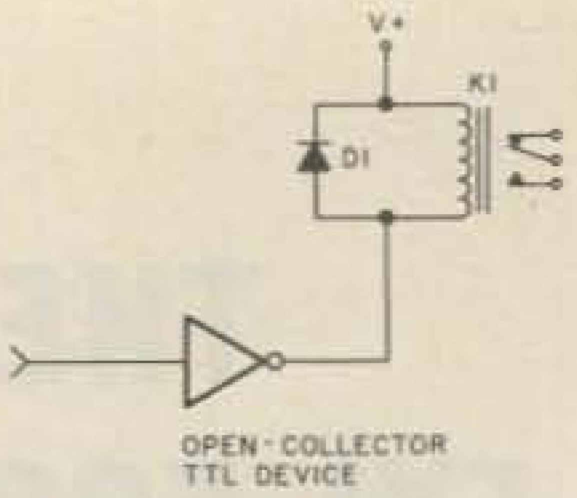

Fig. 5(a). Interfacing open-collector TTL to low-current relays.

is +5 volts, then the 7405 device may be used. The 7406, 7407, 7416, and 7417 devices may also be used at +5 volts or any potential up to the rated potential for the specific device (+15 or +30, depending upon type). Resistor R1 is used to limit the current through the LED and the TTL output to a safe value, usually 15 mA. The value of R1 is given by Ohm's law: $R1 = (V+)/I_{LED}$ or V+/0.015 if the 15-mA figure is acceptable. In this circuit, the TTL device operates as a current sink for the LED and will light on output-low.

Incandescent lamps typically draw a lot more current than LEDs. Some small current lamps ("grain-of-wheat" lamps) will operate directly from the 7417 TTL device, but most require too much current for safe operation directly from TTL. We can, however, use the TTL (or CMOS) device to drive a transistor switch that will, in turn, operate the lamp or other load. This situation is depicted in Figs. 3(d) and 3(e). In Fig. 3(d) we see the use of a PNP transistor to turn on the load. When the base of Q1 is made low, then the base-emitter potential is proper to turn on transistor Q1; current will flow in the c-e path to the load. If, however, the logic output is high, then the base-emitter voltage is nearly zero, so the transistor is cut off.

Fig. 3(e) shows the use of an NPN transistor for Q1. While the lamp in Fig. 3(d) will turn on for output-low, the circuit shown in Fig. 3(e) turns on for output-high. Again, either TTL or CMOS devices can be used, within certain limitations. One limitation applied to TTL devices is that a pull-up resistor (R1) be provided so that the TTL output sees a current source. For CMOS devices, we must use a transistor that has a high enough beta gain that it will saturate with the current available from the CMOS output. Resistor R2 is used to limit the current applied to the base of Q1. When the IC output is high, then a current flows in R2 that will turn on the transistor. Under that condition Q1 is saturated, so its collector will be at or near ground potential. This condition makes the load see a current flow, so if it is a lamp then it will light up.

Large loads, i.e., those of high current but limited voltage, can be accommodated with the circuit of Fig. 4. Here we extend Fig. 3(e) to account for the higher currents of the load. There are two transistors used in this circuit. In most cases, we will use a "driver" transistor such as the 2N3053 for Q1 and a "power" transistor such as the 2N3055 for Q2. Note that some semiconductor manufacturers offer TO-3 packages containing both Q1 and Q2 and term the combination "Darlington" transistors after the fact that the circuit in which these transistors are connected is called a "Darlington amplifier" or "Darlington pair."

The advantage of this circuit is the amplification of beta (H_{fe}) that occurs. The total beta is the product of the individual beta ratings, or: $H_{fe(total)} = H_{fe(Q1)} \times H_{fe(Q2)}$. If you recall your basic transistor theory, the beta is defined as the collector current divided by the base current, or I_c/I_b. For example, if the beta of Q1 is 80 and the beta of Q2 is 50, then the total beta is (80)(50) or 4,000. The implication of this is that the drive current need only be 1/4000 of the load current! Let's assume that there will be approximately 1.2 mA available to drive the Darlington pair when the TTL output is high. With a beta of 4000, the load current will be more than 4 Amperes! Of course, a transistor must be selected for Q2 that will "hack" the current of the load.

The diode shown in parallel with the load is advisable for all creative (capacitive or inductive) loads, and for most very high current loads. It is especially necessary in inductive-load circuits, for example, when the load is a relay or solenoid coil. The problem is the inductive spike produced by an inductor energized with dc when the circuit is interrupted. Under this circumstance, the energy stored in the magnetic field around the inductor will collapse and the counter-electromotive force generated will be opposite the polarity of V+ and will have a very high value (kilovolts are possible). If you have studied calculus, then you will see that V = L(dI/dt) can reach a very high number in the situation where the current flow is abruptly terminated (dI/dt is negative and has a rapid fall time).

The diode is reverse-biased most of the time but will conduct when the CEMF potential is applied. Since the potential can easily reach hundreds of volts in practical situations, the diode must have a piv rating of 1000 volts or more. I recommend 1N4007 for all but very heavy inductive loads; for heavier cases, use series-connected 1N4007 devices with each diode shunted by a 470k-Ohm-to-1-megohm, ½-Watt, carbon resistor.

Fig. 5 shows two situations where electromechanical relays—those workhorses of electricity/electronics left over from the 19th century but still viable—are interfaced with digital IC devices.

In Fig. 5(a) we see the use of an open-collector TTL device for directly interfacing with a low-current relay. Some manufacturers offer low-current (40-mA and under) relays, both in regular relay packages and in packages resembling IC packages (both metal-can and DIP packages are available). Keep in mind the voltage and current limitations of the 7406, 7407, 7416, and 7417 devices listed at the beginning of this article.

For heavier relays, we will

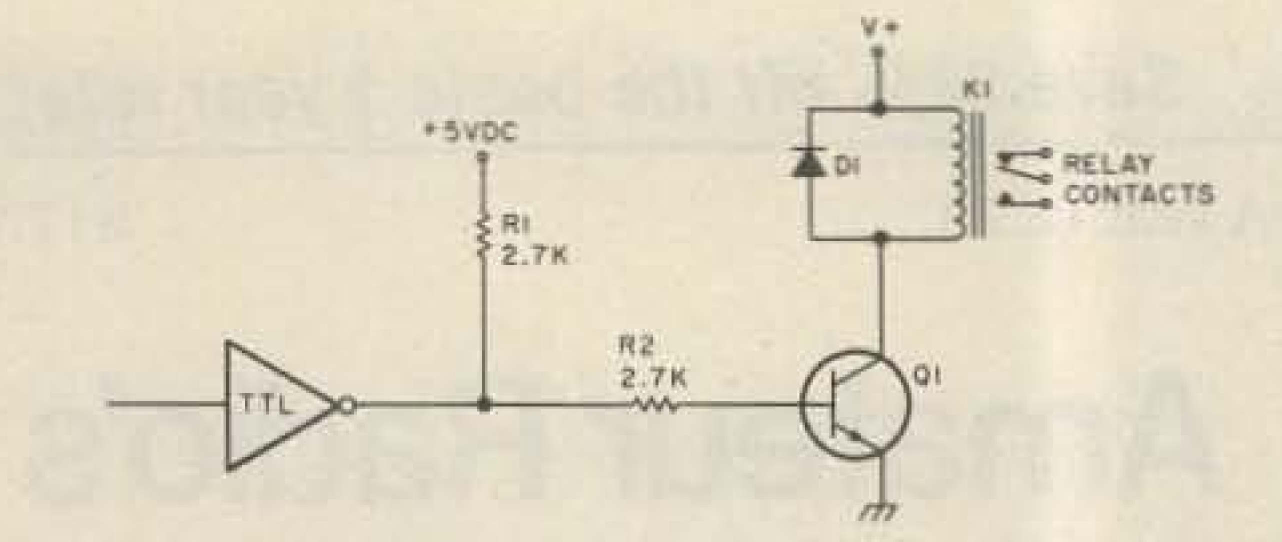

Fig. 5(b). Interfacing TTL or CMOS to higher-current relays.

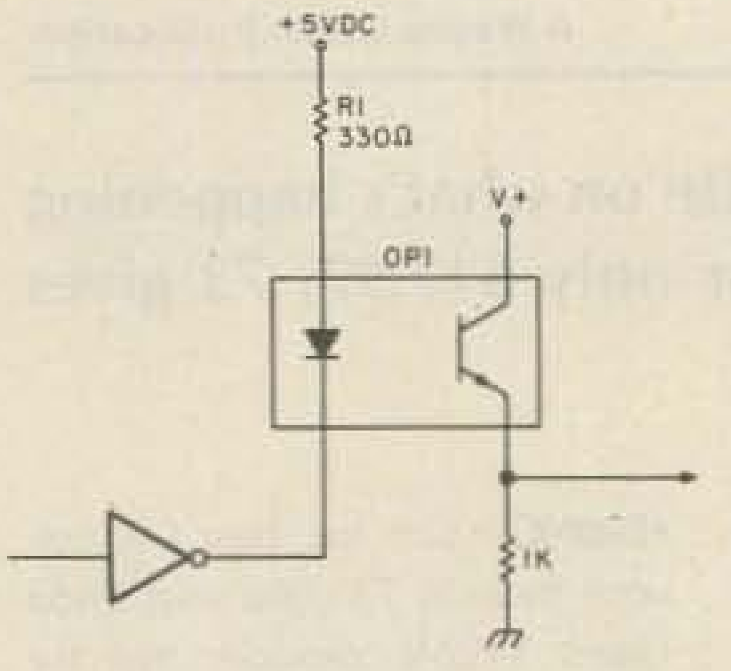

Fig. 6. Driving an isolated load.

use a switching transistor, as in Fig. 5(b). This is merely an extension of the earlier circuits. The diode transient suppressors are mandatory, however. If these are not used, especially in Fig. 5(a), the high voltage transient will blow the semiconductor.

Relays are used for many applications. Of course, if the current is too high to be conveniently handled by the semiconductor, then a relay is in order. But, today, we have numerous high-current power transistors and Darlington devices, so this application is fading. The isolation provided by the relay, however, makes it attractive whenever the logic device must be interfaced with a high-voltage circuit, or the ac power lines (115 volts ac).

Finally, we see one further method for providing isolation between a digital circuit and some outside-world load. There are devices called *optoisolators* (Fig. 6) available in which an LED and either a phototransistor or a photodiode are placed such that the LED will illuminate the transistor/diode (whichever). The pair is housed inside of an opaque DIP package that has the same 0.1″ × 0.3″ pinouts as the digital IC devices in the circuit. When the LED is turned on, i.e., when the logic device output is low, then the phototransistor base is illuminated, so the transistor is turned on. Under this condition, the output will be a potential close to V+. When the LED is extinguished, i.e., when the logic output is high, then the phototransistor base is turned off and there will be no voltage across the load resistor. In most cases, the dangerous isolated circuit will be on the transistor side of the optoisolator. In some cases, however, the dangerous side of the circuit will *send* the signal and thus will be on the LED side.

Conclusion

The advantages of digital logic are even greater when we can interface either between logic families or to the outside world. The techniques in this article allow us, among other things, to interface elderly digital equipment obtained on the surplus market to modern equipment, or to interface essentially non-digital circuits (control) that are still binary in nature to some digital instrument. For example, a trivial case would be the push-to-talk circuit on a transmitter. As another example, the transmitter control circuit on a linear power amplifier could be placed under control of a computer in which the digital interfacing is between a 3.2 mA (fan-out = 2) output port terminal and the radio equipment. Lots of luck. ■

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Emulate an EPROM Elephant

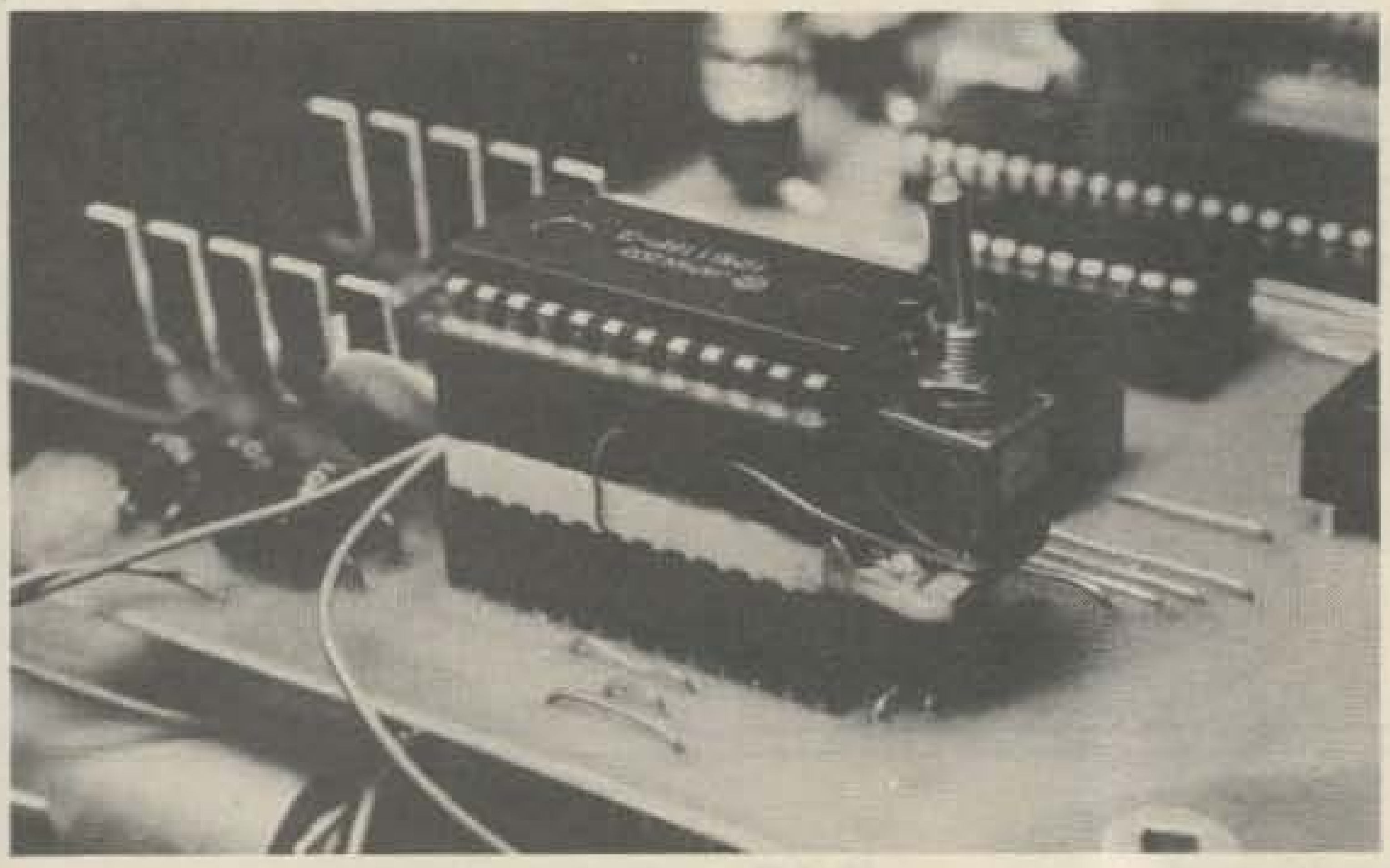
The portable RAM-faker never forgets. Well, hardly ever. . .

Members of the 2716 family of erasable, programmable, read-only memories (EPROMs) are extolled as the hobbyist's friends because of their ease of programming, either with a simple manual programmer or by microcomputer control. However, in the literature also appears a recurring theme of inconvenience. For example, you could spend four or five hours toggling in data with a manual programmer only to make a mistake in bit 16,383. What is the fix? Erase all 16,384 bits of the EPROM and begin again. Totally unacceptable! Even repeating 20 minutes of data input with a hexadecimal keyboard is too much!

Or maybe instead you eventually want a program in an EPROM but you want to try the program first before it is burned for posterity. The "EPROM Emulator," a RAM that pretends it is an EPROM, can help you.

The HM 6116 static RAM is almost pinout-compatible with the 2716 EPROM. Where the HM 6116 puts the WE on pin 21, the 2716 has Vcc pulling pin 21 high. All other pins are identical. This first suggests that empty EPROM sockets could be filled with 2K bytes of RAM to extend a small computer's memory. From here the CMOS construction makes the idea of battery backup of RAM data practical. Then the next logical step is to build a small package containing RAM with battery backup which can be programmed at full computer speed, data modified at will, but which can be removed from its socket without losing its data, placed in another socket in the same or any other computer wired for 2716 EPROMs, and used as an EPROM. Once the program is debugged and running satisfactorily in the Emulator, it can easily be copied into a 2716 for a permanent record.

A few simple modifications are made to the basic RAM circuit to make it emulate the EPROM. The Vcc must be applied through steering diodes so that the memory will see only one supply source at a time. Output enable (pin 20) is made continually low by at-



The EPROM Emulator mounted on the Kilobaud Klassroom SBC-2 computer. Here, you see three extra DIP sockets under the HM 6116 instead of the described two because I have mounted the RAM on a carrier so that repeated insertions will not hurt the RAM pins. I then can use the memory without the Emulator circuit most of the time.

Parts List

- 1 Switch, DPDT, Radio Shack 275-626 ($2.69)
- 2 Diodes, 1N914, Radio Shack 276-1620 (50 for $2.99)
- 1 Resistor, 100k Ohms, ¼ Watt (5 for $.49)
- 2 24-pin DIP sockets, Radio Shack 276-1989 ($1.69 each)
- 1 HM 6116 CMOS static RAM ($16.50 Quest; $14.95 James)
- 2 Batteries, 1½ volt

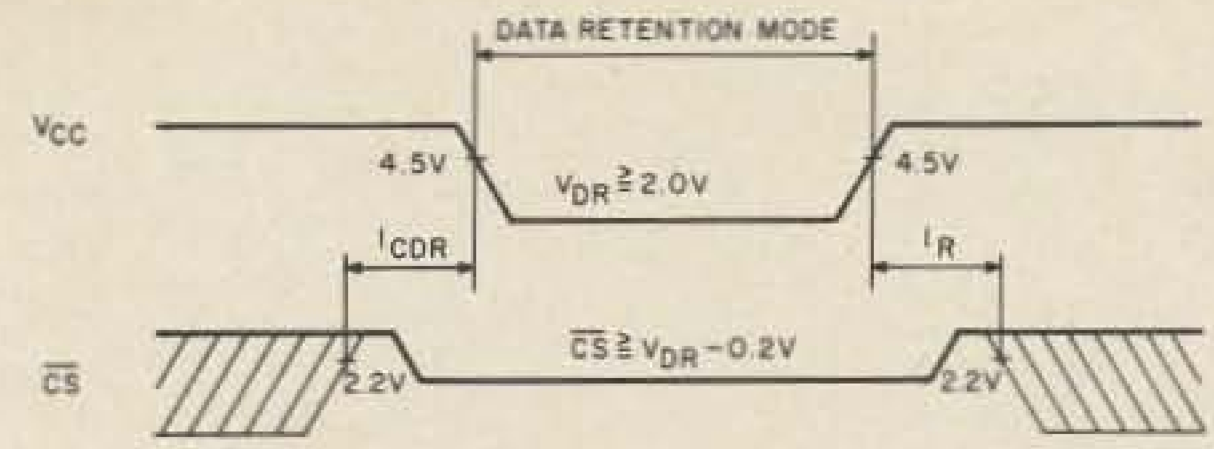


Fig. 1. Low Vcc data-retention waveform.

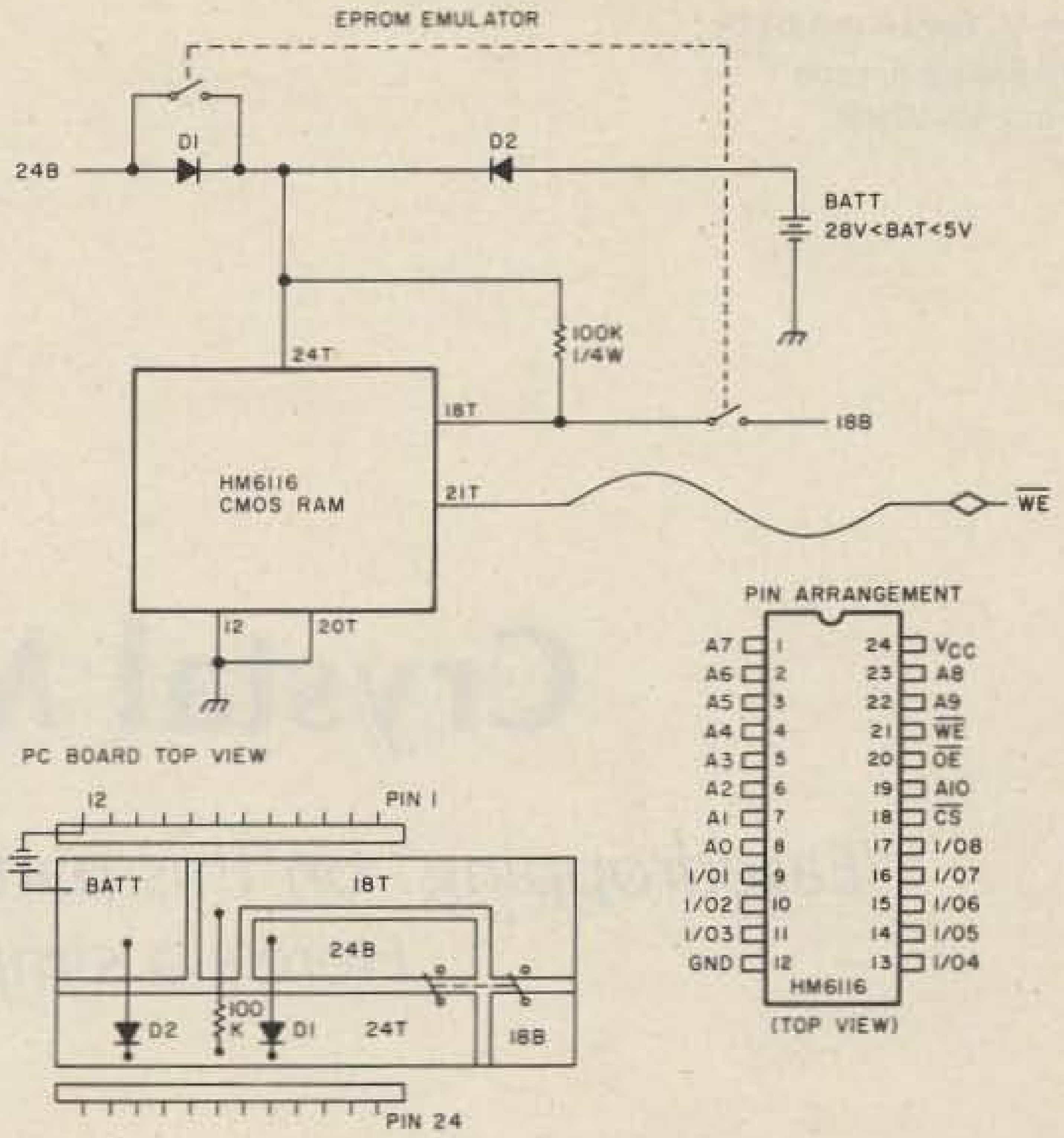


Fig. 2. The Emulator schematic. PC board is not to scale. Letters after pin numbers are B for bottom socket, T for top socket.

taching it directly to pin 12 and disconnecting it from computer pin 20. The low Vcc data-retention mode needs the chip select held at Vcc to retain the data. This is achieved with a pull-up resistor connected to memory pin 24 and a switch to disconnect the $\overline{CS}$ from external circuitry when in the data-retention mode. To enable the computer to write to memory, pin 21 is disconnected from the computer and brought out to a clip lead so that pin 21 can be connected to the computer $\overline{WE}$ line instead of being forced to Vcc in the 2716 socket. When used as a 2716, the $\overline{WE}$ line is attached to Vcc so that accidental and catastrophic writes do not occur.

These connections can be made using a small PC board to hold the components and using wire-wrap wire to make connections. I use masking tape as a PC board etch resist and cut away the tape where copper is to be removed. This is quite satisfactory for simple circuits such as this. The board then is epoxied between the pins of the bottom DIP socket and makes a secure foundation for the rest of the circuit. The components are attached to the copper side of the board facing up. Some miniaturization enthusiast could even find a way to store watch batteries in the case to make a one-box unit, although I am using an external battery pack.

To use the Emulator, I insert it into a 2716 EPROM socket with the switch set to battery supply. (It must never be inserted into the computer with the computer supply off if the switch is in the computer-supply position. The result would be a quickly-discharged battery.) The computer is then turned on and the Emulator switched to computer power. It can then be used either as RAM or ROM depending on the $\overline{WE}$ connection.

Construction

The EPROM Emulator is built on two 24-pin DIP sockets and a small PC board. This serves as the support for the HM 6116 RAM package.

1) Pin 20 of the bottom socket is removed.
2) Pin 20 ($\overline{OE}$) of the top socket is connected with a piece of wire to pin 12, the common pin.
3) Pin 18 ($\overline{CS}$) of the top socket is bent in so that no contact is made with the bottom socket. It is connected through a resistor to pin 24 of the top socket and through half of the DPST switch to pin 18 of the bottom socket.
4) Pin 21 of the bottom socket is removed.
5) Pin 21 of the top socket is connected to the computer $\overline{WE}$ line with a flexible wire and clip.
6) Pin 24 of the top socket is bent in and made to contact the PC board land to which the diode cathodes are connected.
7) Pin 24 of the bottom socket is connected to the anode of diode D1 to provide computer Vcc.
8) The second half of the DPST switch is connected across diode D1.

With the switches closed, the computer Vcc powers the memory and allows the computer to select the RAM for either a write or read. With the switch open, the battery backup can power the memory and forces $\overline{CS}$ to be at Vcc backup, putting the chip into its low Vcc data-retention mode. ■

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Norfolk VA 23508

Crystal Microwave

"Easedropping" on this part of the spectrum is up to you. Here's a simple way to start.

Interest in the microwave spectrum has increased rapidly since the introduction of the "Gunnplexer" by Microwave Associates. Many amateurs, though, have expressed interest in finding a more economical way to get started. What I hope to accomplish with this article is to show how to get involved in microwaves with a minimum investment of time and money.

The microwave spectrum is populated with myriads of signals, ranging from telephone relays to television-studio links to radar to satellite signals. How can we detect and monitor these signals? The simplest way is with a crystal receiver. Don't scoff. I know of several production microwave systems that use crystal detectors or crystal video receivers as they are called. The common police radar detector is a special type of crystal video receiver.

Front view of S-band unit showing diode placement.

A crystal receiver can be broken down into four basic parts: an antenna, a tuned circuit, the detector, and an amplifier (see Fig. 1). The most common tuned circuit is not really a tuned circuit but a high-pass filter, a waveguide. In this mode, the antenna and tuned circuit can be combined. If the detector is mounted in the waveguide, then the only external component is the amplifier.

Rectangular waveguide will pass all frequencies above a cutoff frequency (f_c). The cutoff frequency is determined by the internal width dimension of the waveguide. The cutoff frequency occurs when the internal width is exactly one-half wavelength. A simple formula for calculating this is $f_c = 15/b$, where b = internal width in centimeters and f_c = cutoff frequency in GHz. For example, the most common waveguide for the 3-cm amateur band (10 GHz) has an internal width of 0.9 inches or 2.29 cm. Hence, $f_c = 6.55$ GHz.

If the frequency is raised such that the width is now one wavelength, the guide can support another mode. This occurs at $f = 2f_c$. So, the maximum stable frequency range is from f_c to $2f_c$. Well, if you consider skin losses and other factors, the practical frequency range is

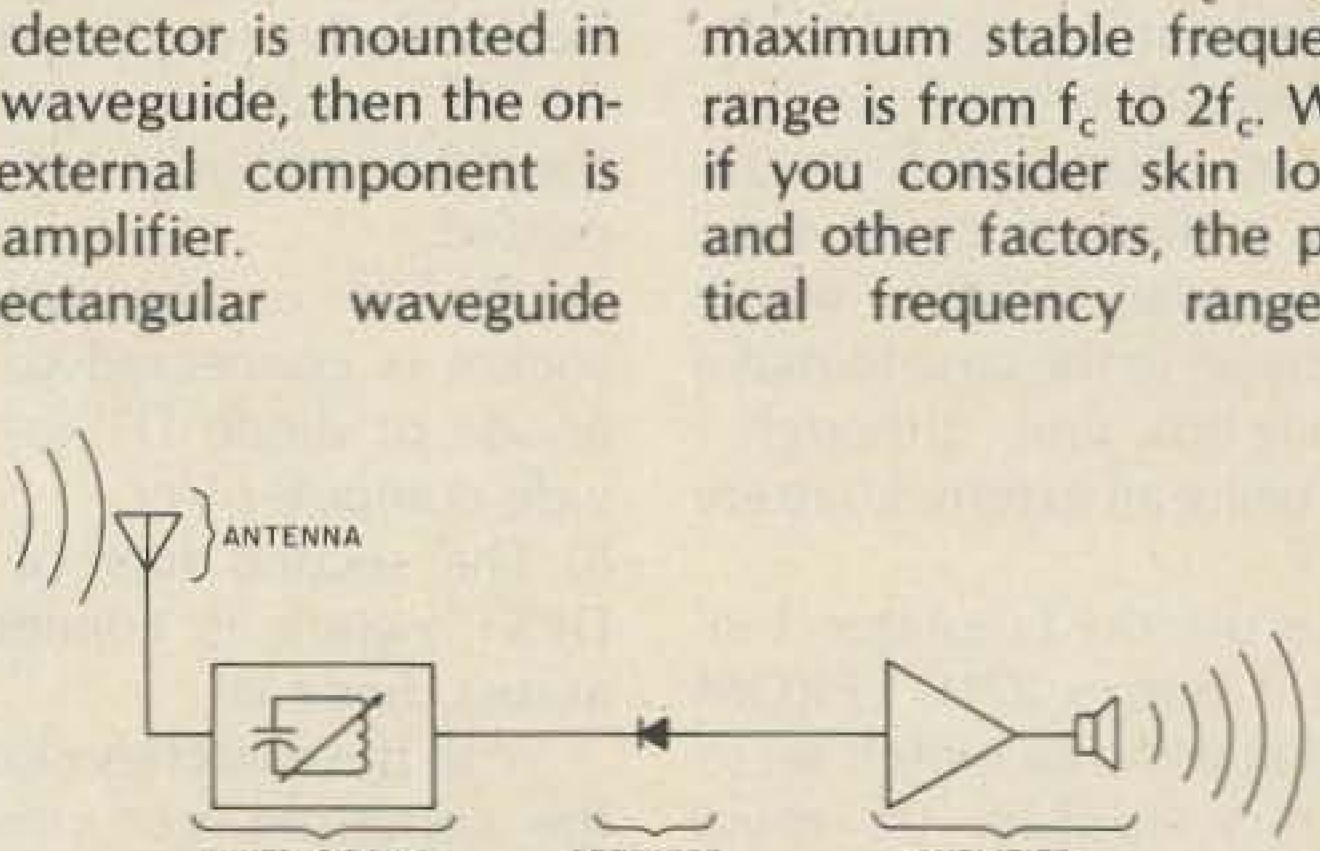


Fig. 1. Basic elements of a crystal video receiver.

from 1.25 f_c to 1.9 f_c. For the previous example, the practical or useful frequency range is 8.19 GHz to 12.44 GHz. This is in good agreement with the published range of 8.2 GHz to 12.4 GHz. Fig. 2 is a graph of the upper and lower practical frequency range of rectangular waveguides having internal widths from 2 cm to 18 cm.

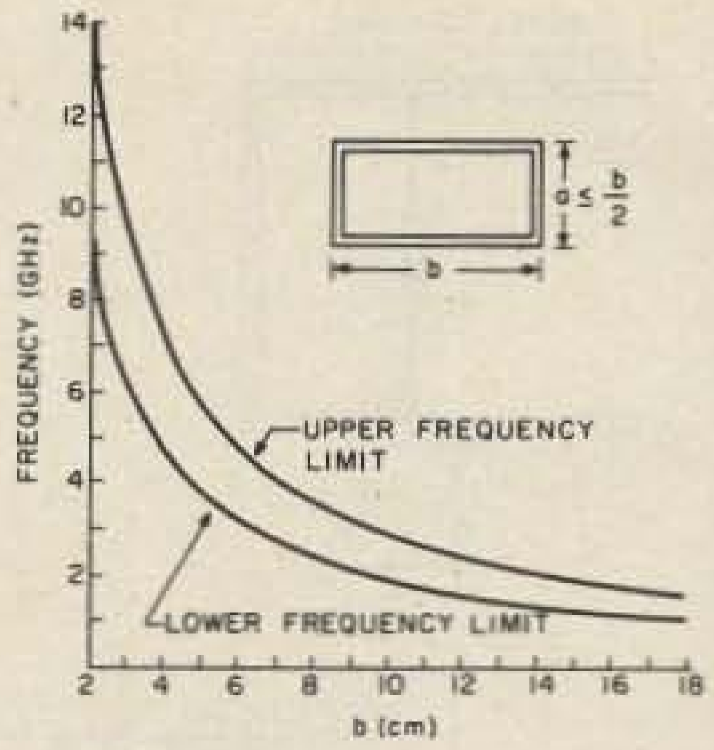


Fig. 2. Upper and lower frequencies shown for rectangular waveguides.

The graph is not meant just to enable you to determine the frequency range of a piece of surplus waveguide. It will also enable you to decide how wide to make a piece to use. Yes, you can make your own waveguide and do it without a machine shop. Waveguide can be made from flashing copper, brass shim stock, or, my favorite, printed circuit board. To illustrate, I made a crystal video receiver to monitor several radars located near my home.

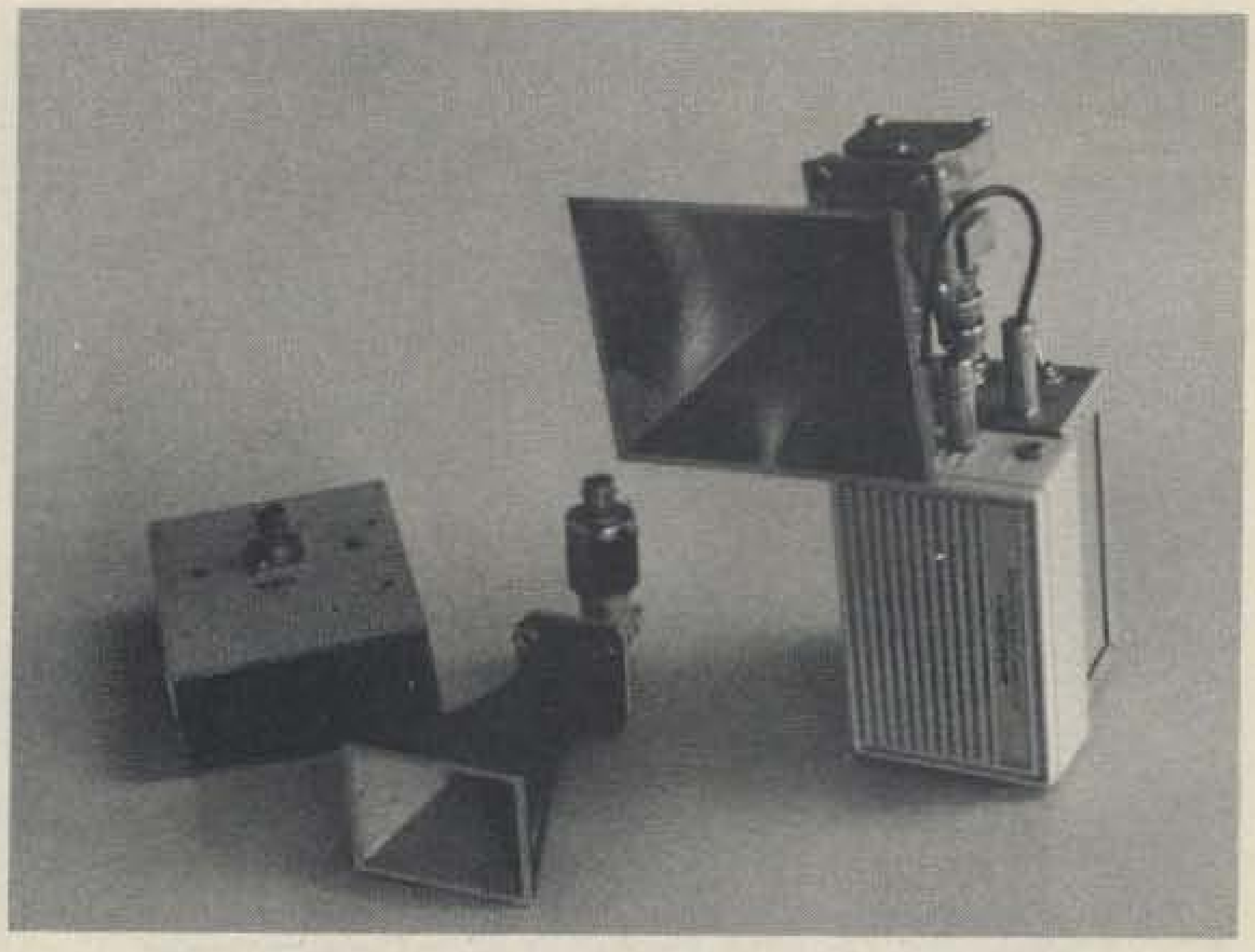
There are three S-band search radars within 20 miles of my home. The term S-band refers roughly to any frequency between 1.5 GHz and 5 GHz. Table 1 is a listing of these informal designations. Table 2 is a listing of some microwave frequency ranges of interest. The local search radars are grouped from 2.7 GHz to 2.9 GHz.

Hence, from Fig. 2, the waveguide should have an internal width between 6.9 cm and 9.5 cm. I chose 8 cm as a compromise. The internal height should be one half or less than the internal width. The guide height determines the impedance and power-handling capability of the guide. The useful frequency range of the 8-cm guide is approximately 2.4 GHz to 3.6 GHz. This range just happens to include the amateur 2400-MHz and 3300-MHz bands. Higher frequencies can travel or propagate down the guide, but the mode structure would be uncertain. I mention this because the guide will pass X-band signals and you should not be surprised to hear them.

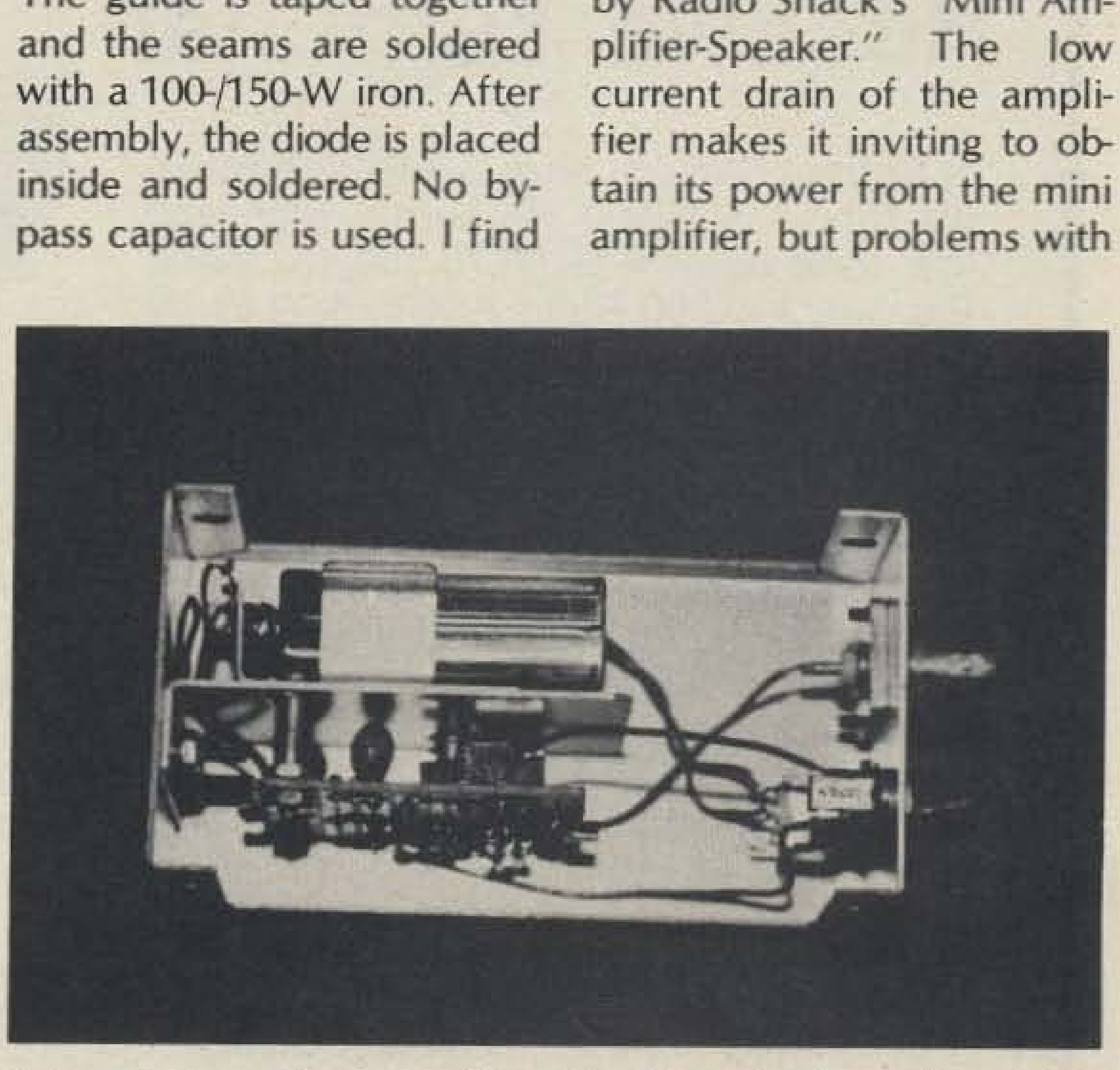
For a crystal receiver, I prefer to make the guide 1 to 2 widths long. For the example, the guide is 9.5 cm or 1.125 widths long. This length was chosen on the basis of available pieces of circuit board. Since the receiver will not be used for a specific frequency but rather for a band, I mounted the BNC connector and detector one-half guidewidth from the shorted end.

Construction is simple. The circuit board material is easily sawed or sheared to size. The BNC mounting holes and the opposing diode hole are drilled next. The guide is taped together and the seams are soldered with a 100-/150-W iron. After assembly, the diode is placed inside and soldered. No bypass capacitor is used. I find that normal construction techniques are adequate to block the microwave energy and pass only the modulation. Surplus mixers have a very efficient bypass scheme and function well as crystal receivers. I use an X-band mixer to monitor small marine radars in the harbor.

The weak detected signal is boosted by the amplifier shown in Fig. 3. An LM301 is used instead of the more common 741 because of the lower noise output of the LM301. The output of the amplifier is further boosted by Radio Shack's "Mini Amplifier-Speaker." The low current drain of the amplifier makes it inviting to obtain its power from the mini amplifier, but problems with



Detector/amplifier with X-band head and nearby S- and K-band heads.



Internal view of preamplifier showing circuit card and battery.

Band Designation	Freq. Range (GHz)
P	.2– .4
L	.4– 1.5
S	1.5– 5.0
C	4.0– 6.5
X	5.0–12.0
K	12.0–36.0
Q	36.0–45.0
V	45.0–60.0

Table 1. Microwave band designations.

Source/Emitter	Freq. Range (GHz)
ILS Glideslope	.3286–.3354
TACAN-DME	.96–1.215
Radar Beacons (IFF)	1.03, 1.09
Air Route Radar	1.3–1.35
Airport Radar	2.7–2.9
Aircraft Doppler Radar	8.8
Precision Approach Radar	9.0–9.2
Marine Radar	9.3–9.5

Table 2. Selected emitter frequencies.

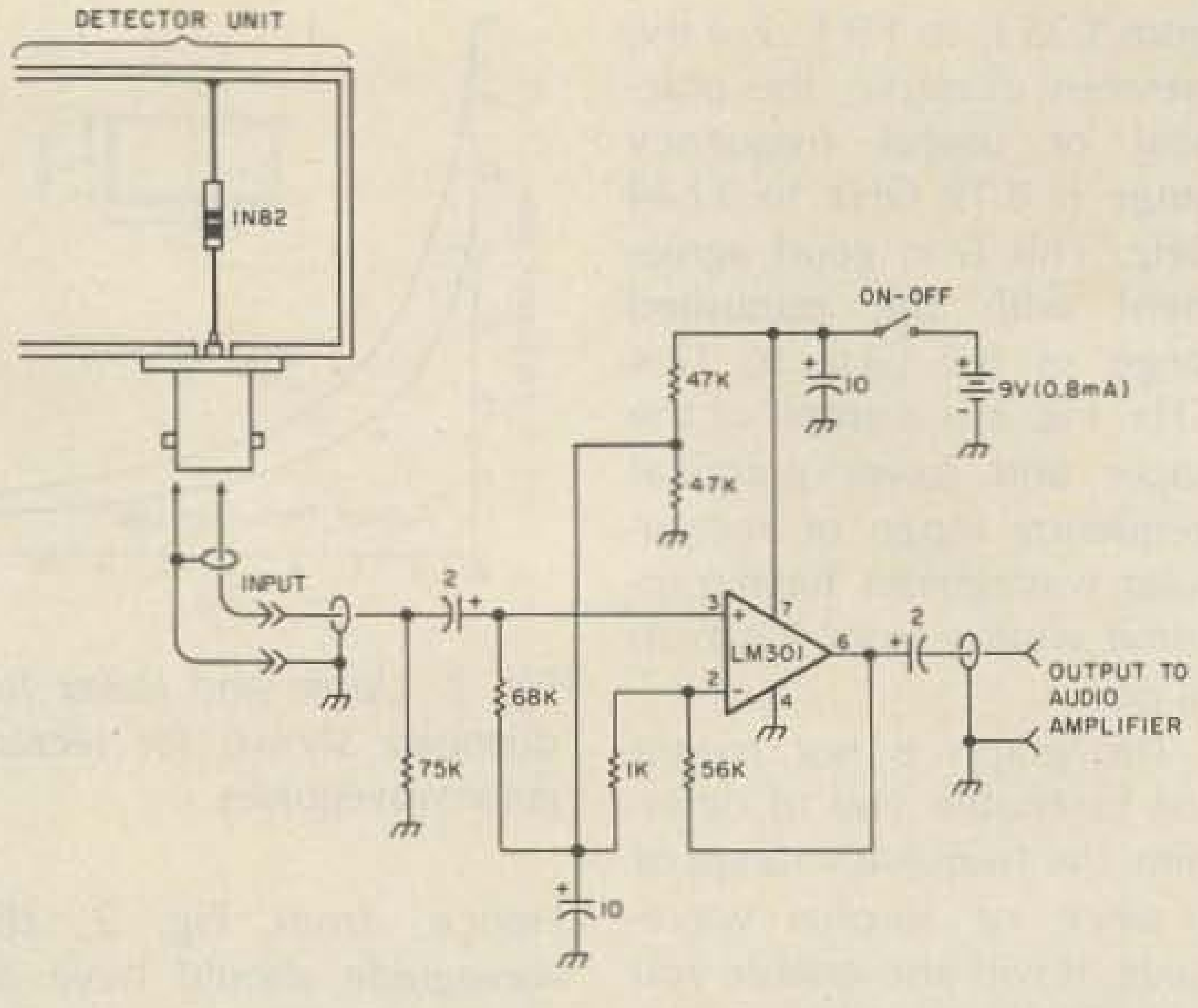


Fig. 3. Schematic of a 50× audio preamplifier.

motorboating forced me to use an independent battery. The compact assembly is quite portable and accompanies me on short outings.

Waveguides are not the only usable form of crystal receivers. For narrowband signals, a separate antenna, tuned circuit or cavity, and detector might be better. Preamplifiers, if available, greatly enhance the overall sensitivity.

Try something simple and build one of these. This might be the easiest microwave construction article yet. Let me know what you build and how it worked, and please remember to enclose an SASE! ■

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The programs you hear from West Germany emanate from this brand-new Broadcasting Center of Deutsche Welle in Cologne.

Want to visit a ski resort in Switzerland? Listen to a concert in Vienna or the Scots Guard's Band on parade in London? Or go behind the Iron Curtain to hear the latest word from the Kremlin?

You can experience all of these and much more by tuning to the European shortwave broadcasters. With more than thirty stations daily sending out broadcasts in English, you have a wide variety of programs to choose from. And most are heard easily on even the most modest receivers here in North America.

The majority of these stations are state-owned and/or operated and all but one are noncommercial. Some—particularly those located in Eastern Europe—can fill your ears with propaganda, but even some of these broadcasters can offer good programs to listen to. Others, like the BBC from London, Radio Netherlands, and the Swiss Broadcasting Corporation, produce a multitude of excellent programs every week with practically no political undertones.

With so many stations and programs to choose from, you should easily be able to discover some of particular interest to you.

Are you interested in programs giving the latest DX news? There are some good ones coming out of Europe every week. The best is probably from Radio Netherlands, where every Thursday night they broadcast the popular *Media Network*. The producer, Jonathan Marks, talks with a network of correspondents in various parts of the world, examining developments in the electronic media on both the technical and the programming side. In addition to reporting changes in broadcasting frequencies by stations all over the world, *Media Network* does an excellent job of keeping listeners informed about new receivers, antennas, and other equipment for the shortwave enthusiast. Hear this on 9.590 or 6.165 MHz at 0230 GMT and 9.715 and 6.165 MHz at 0530 GMT Fridays.

Another excellent DX program comes from Switzerland—*The Shortwave Merry-Go-Round*. This features the "two Bobs," Bob Thomann and Bob Zannotti. This team answers letters with technical questions, reports on new developments in antennas and receivers, and carries on lively discussions about the state of the art. This program is on twice each month—on the 2nd and 4th Saturdays. Hear it at 1315 GMT on 21.570 or 25.780 MHz.

Radio Sweden International brings you another fine DX program, *Sweden Calling DXers*. This is on every Tuesday and Wednesday and gives you a whole list of new or changing frequencies for stations all over the world. It is one of the best for keeping your "where to tune to" list up to date. Hear it Tuesdays at 1415 GMT on 21.615 MHz or at 2315 GMT on 9.695 and 11.705 MHz, and on Wednesdays at 0245 GMT on 9.695 and 11.705 MHz.

Radio Sofia from Bulgaria is the one broadcaster from behind the Iron Curtain that is worthwhile listening to for its DX program. It is particularly good for radio amateurs, giving club news from around the world and holding contests. You can hear it on Mondays at 0045 GMT on 9.700 MHz.

There are some nine or ten other DX programs coming out of Europe, but at this writing, the ones mentioned above are by far the best. Belgium has a nice little program on Mondays at 0045 GMT on 11.695 or 9.870, and Austria has an excellent program on Sunday mornings at 1230 GMT on 21.615 MHz.

The Spanish Foreign Radio from Madrid broadcasts a number of frequency changes and other DX matters on Mondays at 0050 on 11.880. Reception is usually excellent here in North America. And Radio Prague from Czechoslovakia has a DX show that features news and information for radio amateurs. It is very elementary, however, and most listeners won't gain much knowledge from its usual fare. The program is on Fridays at 0135 GMT, on 5.930 or 9.630 MHz.

World and local news are popular with experienced European shortwave broadcast listeners. Almost every station broadcasts news, usually at the start of their programs. Some attempt to cover the world while others tend to stay strictly with news of their own countries or sections of Europe.

The leader in news programs, by a wide margin, is the British Broadcasting Corporation (BBC). They broadcast more than 250 news programs a day from their London headquarters. News is fed to their editors from BBC correspondents located all over the world, and from their world-famous Monitoring Service which provides round-the-clock reports on what foreign broadcasters are saying over the air. This service is so popular that the BBC sells it to subscribers—other foreign broadcasters, governments, news agencies, etc.

You can hear world news in English from the BBC 16 times a day. It is broadcast on the hour except for the GMT hours of 0100, 1000, 1200, 1400, 1500, 1900, 2100, and 2200. If you are interested in local Great Britain news, listen daily at 0009, 0309, 1109, and 1809 GMT, and, on weekends, also at 0709 GMT.

The BBC has many other news-related and special-news programs such as British Press Review, Financial News, etc. A BBC buff could spend 24 hours a day listening to their programs, many of them about current affairs.

The other European stations that broadcast world news are West Germany, Radio Netherlands, Swiss Radio, Spanish Foreign Radio, Radio Portugal, Belgium, Austria, and a whole slew of Iron Curtain broadcasters. Few people would bother to tune to these stations for

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These modern broadcasting facilities of Radio Netherlands at Hilversum, Holland, bring you some of the best English-language programs from Europe.

their world news alone as, for the most part, they are not in the same league as the BBC. There are, however, occasions when it does pay to tune to one of these countries. Those would be when particular news events take place in that country or area: earthquakes, revolutions, invasions, big fires, etc. This is when shortwave listening really comes into its own. You can get the story firsthand and often before the international wire services get it to your local AM radio or TV newscasters.

Some European shortwave stations skip world news entirely and stick to reporting localized news. The Scandinavian broadcasters are good examples. Rather than try to compete with the BBC for world news reporting, Radio Sweden broadcasts news only about that country. The Norwegians and Finns do likewise. (The Danes do not broadcast any English language programs, so I have no idea how they report the news.)

You can, of course, get local news from the stations that also broadcast world news, but often, as is the case with the BBC, it comes in separate and distinct programs such as the daily "News About Britain" and the weekly "Letter from London" programs.

Listeners to Europe generally either concentrate on a few select stations or on certain types of programs that appear on a number of different stations. It all depends on the listener's background or interests. If family ties are to a certain country or if travel or being stationed there during time in the service generates interest, these may be reasons for listening. Other listeners stumble onto certain stations as they tune around the frequencies and find that certain programs grow on them.

Most of the European stations try to broadcast to the US in so-called "prime time." This is the period between 0000 GMT and 0430 GMT. This is to catch the maximum number of listeners in their evening hours. Many stations will have two broadcasts of the same program, one at the earlier hour to catch East Coast listeners and the other at the later time to pick up the West Coast.

There are exceptions, like Radio Finland, which directs its broadcasts to North America only in the mornings. And some of the "powerhouses" like Radio Moscow and the BBC can be heard at almost any time.

A recent survey among shortwave listeners indicated their favorite broadcasters. The question simply asked, "What is your favorite shortwave broadcast station?" The results, in order of popularity, were as follows for European stations:

1) BBC
2) Radio Netherlands
3) Swiss Radio
4) Deutsche Welle (W. Germany)
5) Spanish Radio
6) Austrian Radio
7) Radio Moscow
8) Radio Finland
9) Vatican Radio
10) Radio Sweden
11) Radio France International

Your choice may be different. If you haven't listened to European broadcasters lately, here in alphabetical order are brief outlines of what you can expect to hear from each. See table for best frequencies and times of broadcasts.

● *ALBANIA (Radio Tirana)* —Unless you have some special interest in this country, this station is not likely to become one of your favorites. Mostly political discussions.

● *AUSTRIA (Austrian Radio)* —One of the better stations to listen to. You can hear it every night with news followed by a feature program. Additionally, Mondays are for answers to listeners' letters, Tuesdays are for sports, Fridays have music, and Sundays feature tourist attractions. This station is presently upgrading its transmitting equipment and should be easier to receive in the months ahead.

● *BELGIUM (BRT)*—Has the usual news programs first and then various features, many dealing with the European Common Market which is headquartered in Brussels. You can hear their DX program on Mondays at 0100 GMT.

● *BULGARIA (Radio Sofia)* —Their best program is their DX news on Mondays at 0045 GMT. The rest is pretty much "party line" discussions of politics.

● *CZECHOSLOVAKIA (Radio Prague)*—Many listeners feel that this is the best of the Iron Curtain broadcasters. While it has its share of political discussions, it also has a number of interesting shows that are free from that taint.

● *FINLAND (Radio Finland)* —This is one you catch in the morning hours, and reception is usually good. They start with news about Scandinavia called *The Northern Report* and then switch over to various feature programs, including pop music.

● *FRANCE (Radio France International)*—You can hear this one only in the early afternoon hours, and then you are listening to their broadcast to Africa—the only program they offer in the English language. Much of their programming is devoted to listeners' interests in Africa, such as Third World countries. Rumors persist that RFI will increase English programming, but so far this is all they offer.

● *E. GERMANY (Radio Berlin International)*—A typical "Iron Curtain" country broadcaster. Lots of news, all with political implications.

● *W. GERMANY (Deutsche Welle)*—Excellent news broadcasts and interesting current-events discussions. If you like music, listen on Saturday evenings. Want to learn German? They have a language course on Sundays.

● *GREAT BRITAIN (BBC)*—Besides news and current events, this station offers a whole slew of other programs including both jazz and concert music, short stories, and dramas. One of their most popular programs originates here in the US where Alistair Cooke tapes his *Letter from America.* There is something for everyone during the 24 hours of broadcasting by this station.

● *GREECE (Voice of Greece)*—Probably will be of interest only to those with special ties to the country or area. Can be interesting when one of the frequent quarrels with Turkey comes up or Cyprus erupts.

● *HUNGARY (Radio Budapest)*—Sometimes, but not often, you can hear an interesting program. I would rank it about in the middle as far as Iron Curtain SW broadcasters go.

● *ITALY (RAI)*—If you are a lover of music, this is the station for you. They have opera, Italian folk music, and "pops." Also, programs on other aspects of Italian culture and life. One of the better European stations.

● *LUXEMBOURG (RTL)*—This is a rare one, a commercial station that you can hear from Europe. It beams its programs to London, and you can hear commercials like those on a US AM or FM station. The programs are all "mod" music.

● *MALTA (Xandir Malta)*—This little station is heard only once a week, on Saturdays, and at an impossible hour for most of us here in North America (0700–0800 GMT). Not much to recommend, but if you can't sleep some Friday night, give it a try.

● *MONACO (TWR Monte Carlo)*—Another one with very late hours for North American listeners. This is a religious station and the programs are all in that mode.

● *NETHERLANDS (Radio Netherlands)*—Many fine programs to hear on this popular European station. On Sundays, host Tom Meyer has the *Happy Station* show. Mondays feature life in Holland. Tuesdays is *Shortwave Feedback* which answers listeners' letters. On Wednesdays listen to *Dutch Spot* on a magazine-format program about events in Holland. Thursday is devoted to that very popular DX program, *Media Net-*

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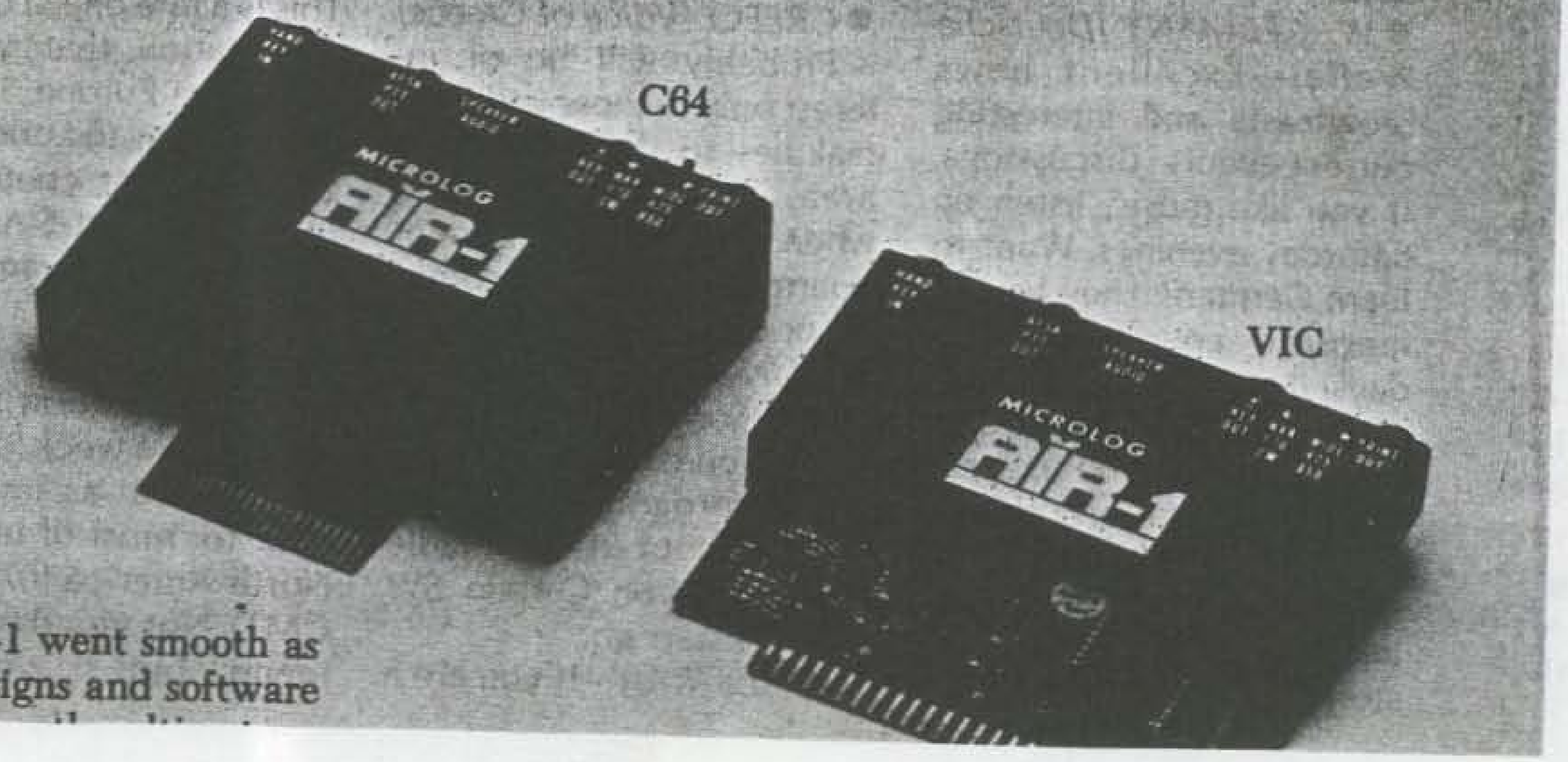

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work. Friday features *Opinion* and discusses some of the views of the Dutch press. Saturday is a light program with talk and music; it is pleasant listening all the way.

● *NORWAY (Radio Norway)*—This is one you have to catch on Sundays since that is the only time they broadcast. Some good programs for people interested in traveling there some day and also interested in good music.

● *POLAND (Radio Polonia)*—Not the best of reception for most of its programs. But then the programs aren't anything to write home about, anyway.

● *PORTUGAL (Radio Portugal)*—Their first program isn't on until 0300 which makes it pretty late for East Coast listeners. While their programs are not particularly earth-shattering, it is a pleasant station to listen to and most programs are nonpolitical.

● *ROMANIA (Radio Bucharest)*—Has some interesting programs. *DX Mailbag* is on Wednesdays, and other DX programs are on Mondays and Fridays. Tuesdays they have a very interesting *Tourist News* program that makes you want to visit the country. Interested in stamp collecting? Tune in on Sundays for a special program on this hobby.

● *SPAIN (Spanish Foreign Radio)*—Another one of the top European broadcasters providing good listening on most nights. Reception is consistently good, too. Their DX program is on Mondays at 0050 GMT.

● *SWEDEN (Radio Sweden)*—Another good one from Europe. Aside from their DX program, already mentioned, they have a very fine program on the weekend called *Saturday from Stockholm*.

● *SWITZERLAND (SRI)*—One of the most popular of all from Europe. While their weekday programs, primarily news and background, are good, their weekend programs are superior. On the second and fourth Saturdays, listen to their popular DX programs—among the best on the air. On Sundays they have a new program called *Balance Sheet*. This is about Swiss business. Don't think, however, that it is dry statistical reporting. Instead, it is a very lively description of Swiss industry. Recently, for example, they had a very interesting program on the Swiss chocolate industry. Another one brought us up to date on clocks and watches.

● *USSR (Radio Moscow and Radio Kiev)*—Many people listen to Radio Moscow just to hear their viewpoint on world affairs, US diplomatic steps, etc. One of their most popular programs is called *Listeners' Forum* and you can hear this on Sundays at 0010. Right after this comes *Russian by Radio*, if you have any interest in learning to speak their language. Another good program is *Round about the USSR*, heard on Tuesdays and Saturdays at 0210 and 0510.

Radio Kiev is preferred by many people over Radio Moscow. Weekdays provide the usual news followed by feature programs—most political. They have a DX program on Wednesdays which is pretty good, but perhaps their best program is on Sundays when you can hear *Music from the Ukraine*.

● *VATICAN (Vatican Radio)*—You can hear it every evening, even though it is on for only 16 minutes. Programs express Vatican opinions on current events and other matters.

● *YUGOSLAVIA (Radio Yugoslavia)*—Strictly news, and all handpicked for political implications.

So there you have it. There is a wonderful choice of programs from Europe in English just waiting for you to tune in. Most are easily heard and offer you entertainment, education and/or enlightenment. With your shortwave receiver, you can travel to Europe every day. ■

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***FL-52A** 500 Hz CW filter (2nd IF)	96.50	89^{95}
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***FL-44A** SSB filter (2nd IF)	159.00	144^{95}
SM-5 8-pin electret desk microphone	39.00	
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FL-44A SSB filter (2nd IF)..........	159.00	144^{95}
FL-45 500 Hz CW filter............	59.50	
EX-195 Marker unit................	39.00	
EX-202 LDA interface; 730/2KL/AH-1	27.50	
EX-203 150 Hz CW audio filter......	39.00	
EX-205 Transverter switching unit	29.00	
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MB-5 Mobile mount................	19.50	
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PS-35 Internal power supply.......	160.00	144^{95}
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HM-12 Hand microphone	39.50	
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**See IC-740 list above for other options (*)*

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FL-52A 500 Hz CW filter	96.50	89^{95}
FL-53A 250 Hz CW filter	96.50	89^{95}
FL-33 AM filter....................	31.50	
FL-70 2.8 Khz wide SSB filter......	46.50	
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SM-6 Desk microphone	39.00	
RC-10 External frequency controller	35.00	
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EX-144 Adaptor for CF-1/PS-15....	6.50	
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SP-3 External base station speaker ...	49.50	
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BC-10A Memory back-up............	8.50	
EX-2 Relay box with marker	34.00	
AT-100 100w 8-band automatic ant tuner	349.00	314^{95}
AT-500 500w 9-band automatic ant tuner	449.00	399^{95}
MT-100 Manual antenna tuner........	249.00	224^{95}
AH-1 5-band mobile antenna w/tuner	289.00	259^{95}
PS-30 Systems p/s w/cord, 6-pin plug	259.95	233^{95}
OPC Optional cord, specify 2 or 4-pin	5.50	
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HF linear amplifier	Regular	SALE
IC-2KL w/ps 160-15m solid state amp	1795.00	1299

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IC-251A* 2m FM/SSB/CW transceiver	$749.00	549^{95}

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IC-551D 80 Watt 6m transceiver......	$699.00	599^{95}
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EX-106 FM option..................	125.00	112^{95}
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SM-2 Electret desk microphone	39.00	
IC-271H 100w 2m FM/SSB/CW xcvr	TBA	
PS-35 Internal power supply.......	160.00	144^{95}
IC-271A 25w 2m FM/SSB/CW xcvr...	699.00	629^{95}
AG-20 2m preamplifier............	56.95	
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EX-310 Voice synthesizer	39.95	
PS-25 Internal power supply.......	99.00	89^{95}
EX-310 Voice synthesizer	39.00	
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VHF/UHF/1.2 GHz FM	Regular	SALE
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EX-199 Remote frequency selector	35.00	
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EX-388 Voice synthesizer...........	TBA	
IC-45A 10w 440 FM xcvr, TTP mic	399.00	359^{95}
AG-1 15 db 440 Mhz preamplifier	89.00	79^{95}
EX-270 CTCSS encoder...............	39.00	
BU-1 Memory back-up..............	38.50	
RP-3010 10w 440 Mhz FM repeater	999.00	899^{95}
IC-120 1w 1.2 GHz FM transceiver....	499.00	449^{95}
RP-1210 10w 1.2 GHz FM repeater....	1199.00	
Cabinet for RP-1210 or RP-3010.....	249.00	

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BP-15 AC charger..................	12.50	
EX-248 FM unit.....................	49.50	
LC-10 Leather case.................	34.95	
SP-4 Remote speaker................	24.95	

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IC-02A for 2 meters	$ 319.00	289^{95}
IC-02AT w/DTMF.....	349.00	314^{95}
IC-04A for 440 MHz	TBA	
IC-04AT w/DTMF.....	TBA	

Standard models	Regular	SALE
IC-2A for 2 meters	$ 239.50	214^{95}
IC-2AT with TTP	269.50	219^{95}
IC-3A for 220 MHz...	269.95	234^{95}
IC-3AT with TTP	299.95	239^{95}
IC-4A for 440 MHz...	269.95	234^{95}
IC-4AT with TTP	299.95	239^{95}

Accessories for Deluxe models	Regular
BP-7 800mah/13.2V Nicad Pak - use BP-35	67.50
BP-8 800mah/8.4V Nicad Pak - use BP-35...	62.50
BC-35 Drop in desk charger - all batteries....	69.00
BC-16U Wall charger - BP7/BP8..............	10.00

Accessories for both models	Regular
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BC-30 Drop in Charger - BP2/BP3/BP4/BP5	69.00
BP-2 425mah/7.2V Nicad Pak - use BC30....	39.50
BP-3 Extra Std. 250 mah/8.4V Nicad Pak....	29.50
BP-4 Alkaline battery case..................	12.50
BP-5 425mah/10.8V Nicad Pak - use BC30	49.50
CP-1 Cigarette lighter plug/cord - BP3........	9.50
DC-1 DC operation pak for standard models	17.50
LC-2AT Leather case for standard models.....	34.95
HM-9 Speaker microphone....................	34.50
HS10/HS10SB Boom mic headset/switchbox	39.00
HP-10SA Vox unit for HS-10.................	TBA
ML-1 2m 2.3w in/10w out amplifier..... **SALE**	**79.95**
ML-25 2m 2.3w in 20w out amplifier.... **SALE**	**179.95**
3A-TTN Optional TT Pad - 2A/3A/4A..........	39.50
SS-32M Commspec 32-tone encoder..........	29.95
Marine model	
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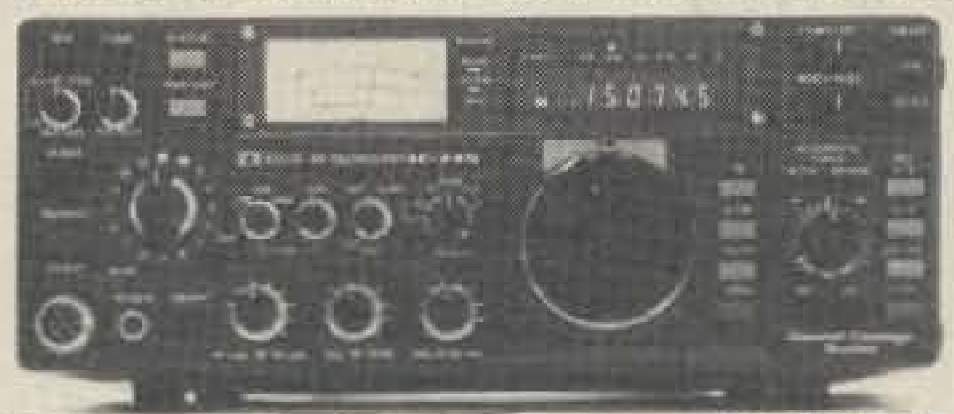

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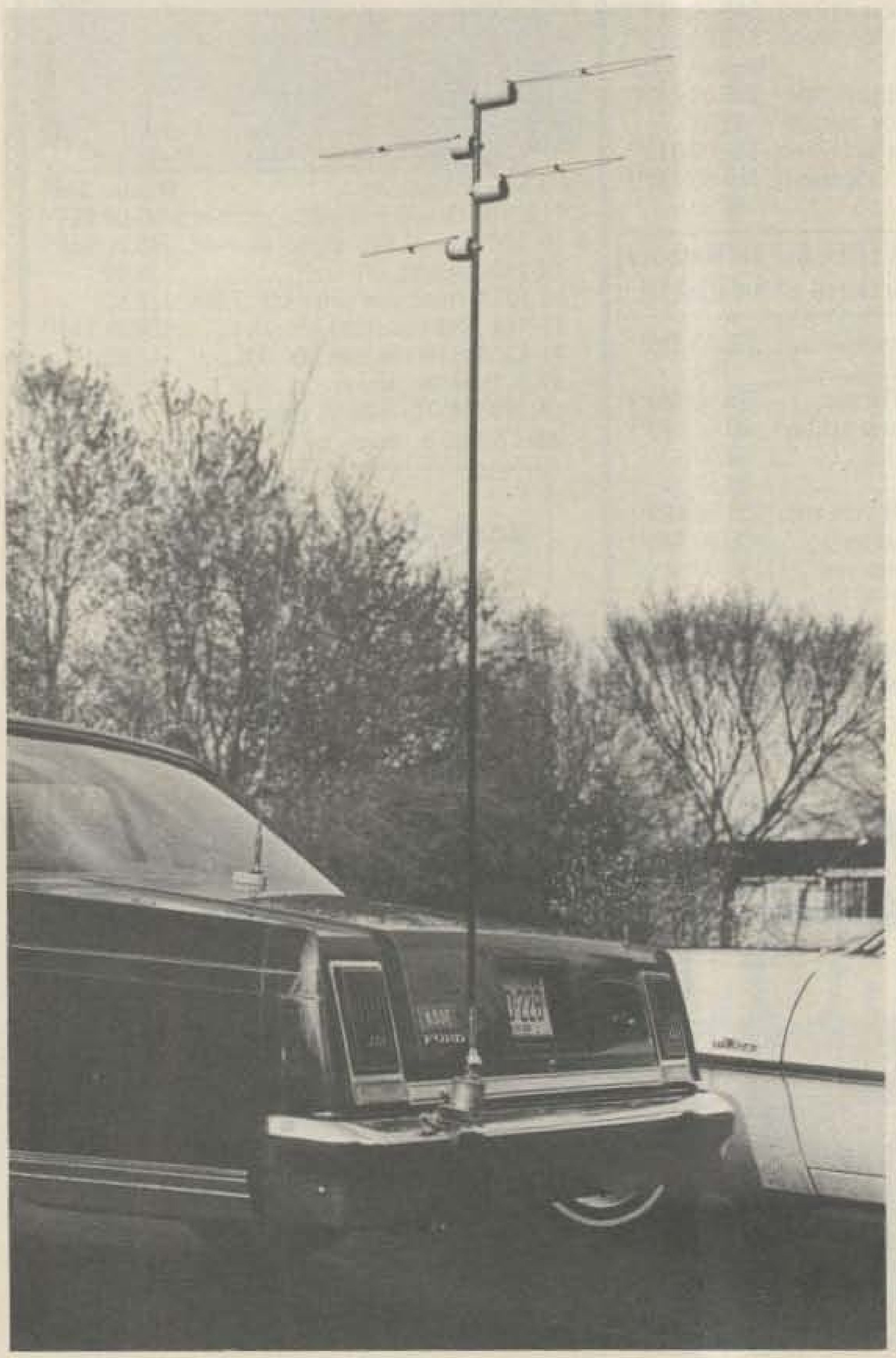

A Look at the Basics

The six-foot mast is constructed from ½" copper water pipe. The overall length is not critical, but signal reception will suffer at anything much less than a five-foot mast length. If you own a Hustler or similar mast, you already have the first part of your new multiband mobile antenna.

Multibanding is obtained by the use of multiple LC circuits—one for each band desired. A typical mobile antenna has resonators (LC circuits) with an adjustable whip. The adjustable whip is actually the C of the resonant LC circuit. You might think of such a mobile antenna as shown in Fig. 1.

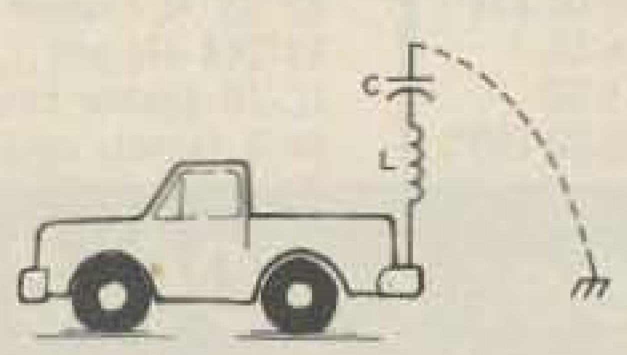

Fig. 1. Top-loaded mobile antenna.

Adjusting the whip changes the C and raises or lowers the resonant frequency. A tip: In general, a greater amount of capacitance will result in a greater bandwidth. These mobile antennas are "top-loaded," i.e., the LC circuit is at the top of the antenna and, for all practical purposes, the only part of the antenna that radiates is that portion *below* the resonator. That is the reason you should make the mast as long as is practical. Since the whip is basically C, why stick it up in the air where it will just give your antenna increased ability to reach all those nearby objects—trees, carports, etc.? You can actually place a typical resonator at a 90° angle to the mast and probably notice no difference in performance, although tuning may change slightly. This could present an eye hazard or you might even spear a bird. Let's look at this change as shown in Fig. 2.

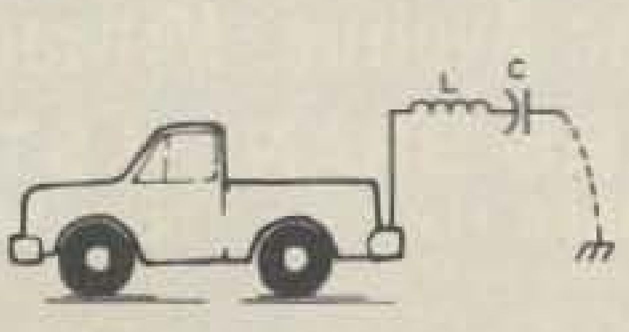

Fig. 2. Resonator positioned at 90° (vertical polarization retained).

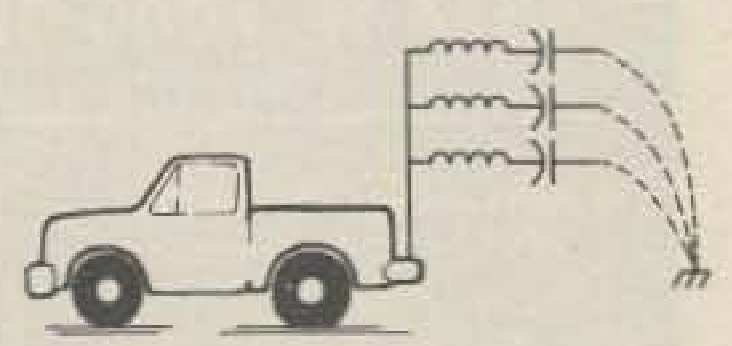
Fig. 3. Multiband antenna setup.

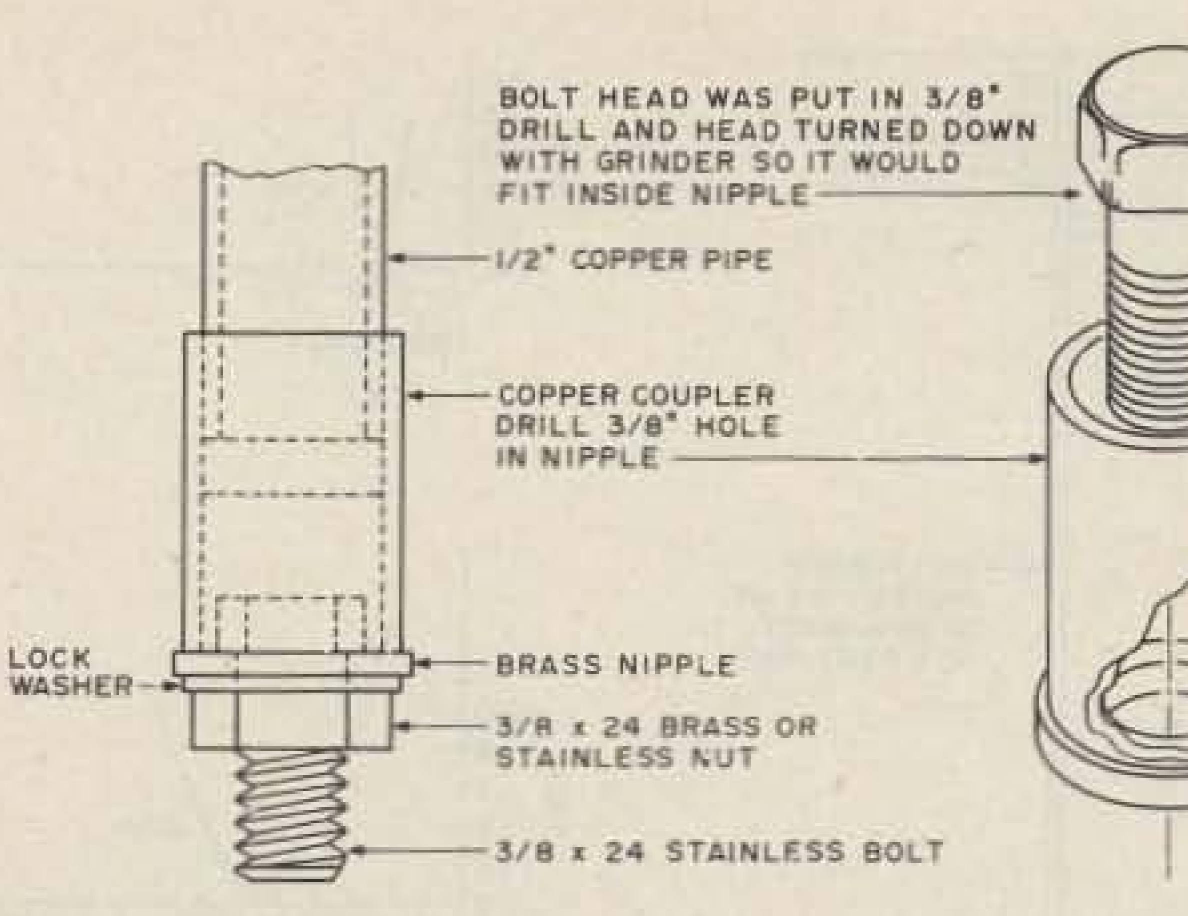

Fig. 4. Mast-to-mobile attachment.

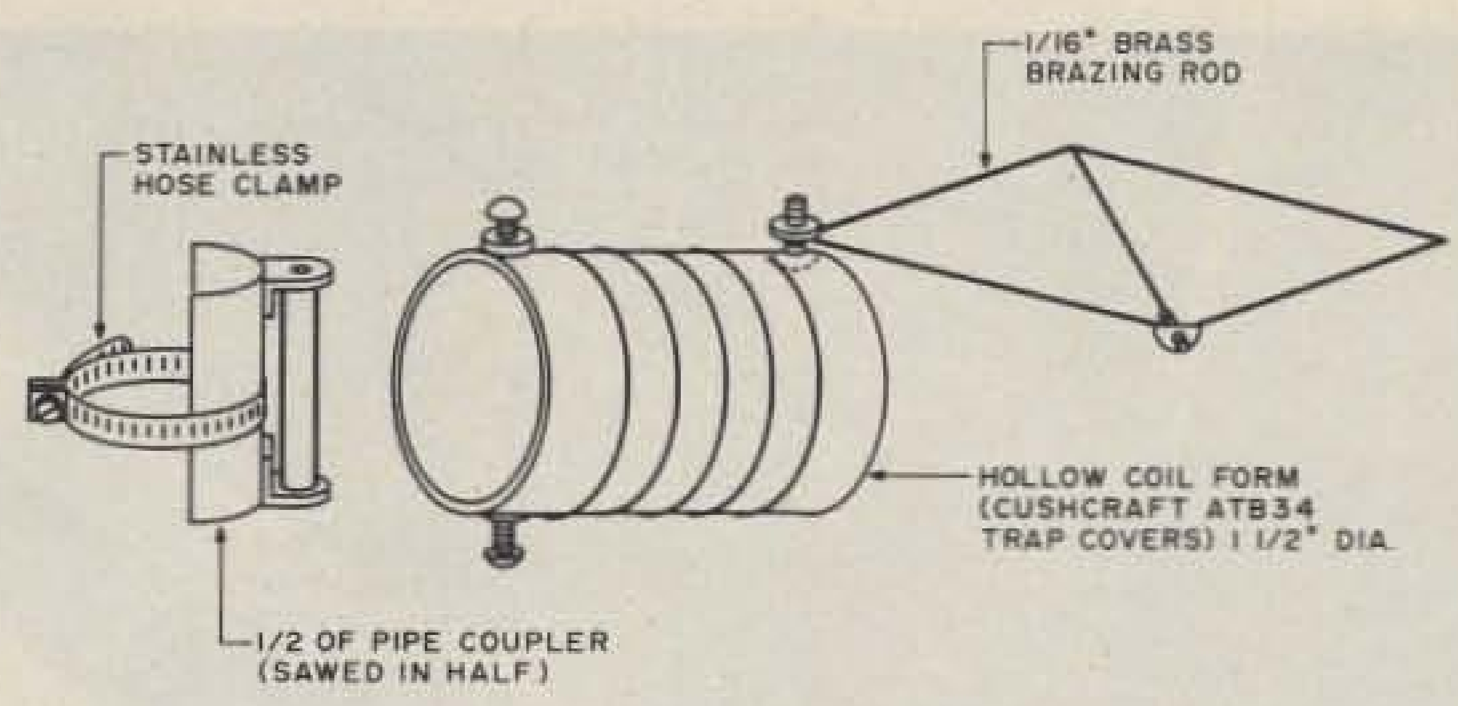

Fig. 5. Details of mounting bracket.

Capacitance does not have to come in the form of a whip. Two wires in the shape of a V form a capacitor proportional to the area within the V. The V is easy to adjust (change C). In fact, I used exactly this method in my initial experiments. It doesn't work too well for actual mobile use because the V is not rigid during vehicle motion and the vibration of the V causes fairly wide and constant changes in resonance.

Now that I had decided to place the LC in a horizontal position, I also decided to multiband the antenna by using more than one LC circuit. The configuration now becomes that shown in Fig. 3.

I am currently using four LC circuits on my mobile antenna, but you can use one, two, three, four, or more. I haven't tried five yet, but that's one of the next steps. The LC for the lowest frequency should be at the top of the mast with the next higher frequency below that and so on.

Mechanical Construction

The idea for the mast came from an article in *73 Magazine* (February, 1979, p. 42). I used non-ferrous materials to avoid any rust problems. The mast itself is a six-foot length of ½" copper water pipe. The details of the fitting which attaches the mast to your mobile mount are shown in Fig. 4. I used a brass end cap through which I drilled a 3/8" hole for the 3/8" × 24 stainless steel bolt. The brass end cap is considerably stronger than the copper end cap used in the *73 Magazine* article. However, it does require that the head of the bolt be reduced to allow it to fit in the inner diameter of the brass end cap. I simply chucked the 3/8" × 24 bolt in my 3/8" electric drill and used my shop grinder on the bolt head while letting the drill rotate the bolt for a nice even "machining." The end cap is assembled with a bronze or stainless steel lock washer and a brass or stainless steel nut. If you have any difficulty in finding a stainless steel bolt, you might try a local boat or marine dealer.

The end cap is assembled to the mast with an ordinary copper sleeve and soldered with a propane torch. Do a good job here because there is a lot of force at the base of the mast. I use a rigid mount and do not tie or guy my antenna. Now we close the end of the mast to keep out water. I soldered a flat piece of copper to the end of the mast.

LC Construction

I used some spare trap covers from my Cushcraft HF antenna for the supporting structure for the inductor and capacitor. These trap covers are thin and do not offer much wind resistance as the wind flows through them. They are probably a phenolic material, which is very suitable for an inductor form.

The part which kept me from building the antenna for over a year (I love to procrastinate) was deciding how to fasten the LC circuits to the mast. Fig. 5 and Photo A show the construction details of the mounting bracket. I cut a copper sleeve in half longitudinally and brazed copper tabs to the half coupling. Copper for the tabs was obtained by splitting a short length of copper pipe, opening it up, and flattening it with a hammer. (I had four feet of copper pipe left after cutting six feet off for the mast, so the material was handy.) The tabs were bent 90° and a piece of ¼" copper tubing was brazed between the 90° tabs so that the inductor form would not be crushed when attaching it to the bracket. Brass nuts, 6" × 32, were soldered to the top and bottom of the bracket. You might want to use one long screw to attach the whole assembly and not be bothered with the brass nuts.

A word about brazing the copper parts: The high heat anneals the copper. It becomes soft and I have had one bracket fail due to the vibration. It lasted over eight months and over 20,000 miles. The 15-meter LC was made with #12 copper wire and was quite heavy. You might solder or silver solder your bracket or find an even better method of attaching the LC assembly to the mast.

I have made inductors using #12, #18, and #20 wire. The #12 wire is quite heavy for a 20-meter LC circuit and probably impractical for a 40-meter LC circuit. The #20 wire gets warm when using a steady carrier but has caused no problem with SSB. If you run a kilowatt mobile, the #12 wire should do just fine.

The capacitance was added by using 1/16" brass welding rods. I chose the modified rhombic because it did

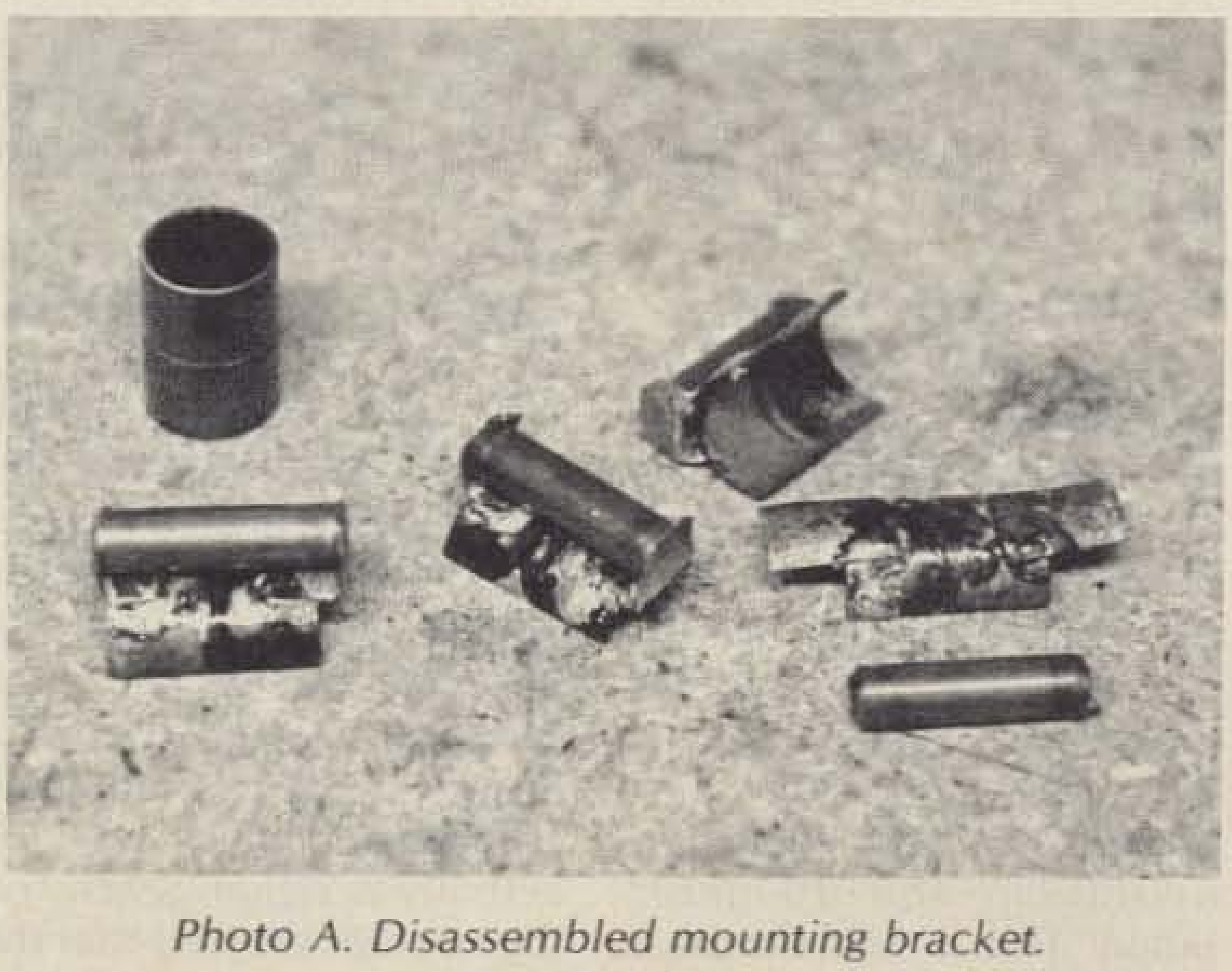

Photo A. Disassembled mounting bracket.

Photo B. Grid-dip meter position.

not have a sharp end as would a V and should avoid some static problems. I had hoped to adjust the C by bending the rhombic (increasing or decreasing its area). I found that vibration and vehicle motion caused erratic changes in resonance, so I added the adjustment spanner to the center of the rhombic. This allows easy adjustment of the resonant frequency.

Determining LC Values

If you like to experiment by trial and error, you'll love this. I spent many hours removing one turn at time, varying capacitance, and trying to find where the LC was resonant. I would be looking for a 15-meter or 20-meter resonance and would all of a sudden find myself in the 10-meter range. This is not the best way to start, although you will probably have to use this cut and try method for the 10-meter LC.

I found that I could use my Heathkit® grip-dip oscillator (gdo) to find the resonant frequency of the LC. The secret is to put a pickup coil at the base of the antenna and insert the gdo coil inside the coil (see Photo B). The Heathkit gdo is a handy piece of equipment but hardly a laboratory-grade instrument. I first found a resonant frequency of 14.2 MHz, so I connected the antenna to the transmitter and checked swr. It was not resonant anywhere in the 20-meter band! Suspecting something funny, I used the same pickup coil and connected it to my frequency counter and, since a gdo is actually a signal generator, the counter showed that the indicated 14.2 MHz was actually 13.8 MHz. It was convenient that the error was on the low side because I had to remove only one turn to raise the frequency of the LC circuit (or decrease capacitance, which would not be as desirable as it would reduce bandwidth). You don't need a frequency counter to check your gdo. Just use a short antenna on your HF rig and sweep the frequency with the gdo until you hear its signal on your HF receiver. This is an easy method to calibrate or compensate your gdo.

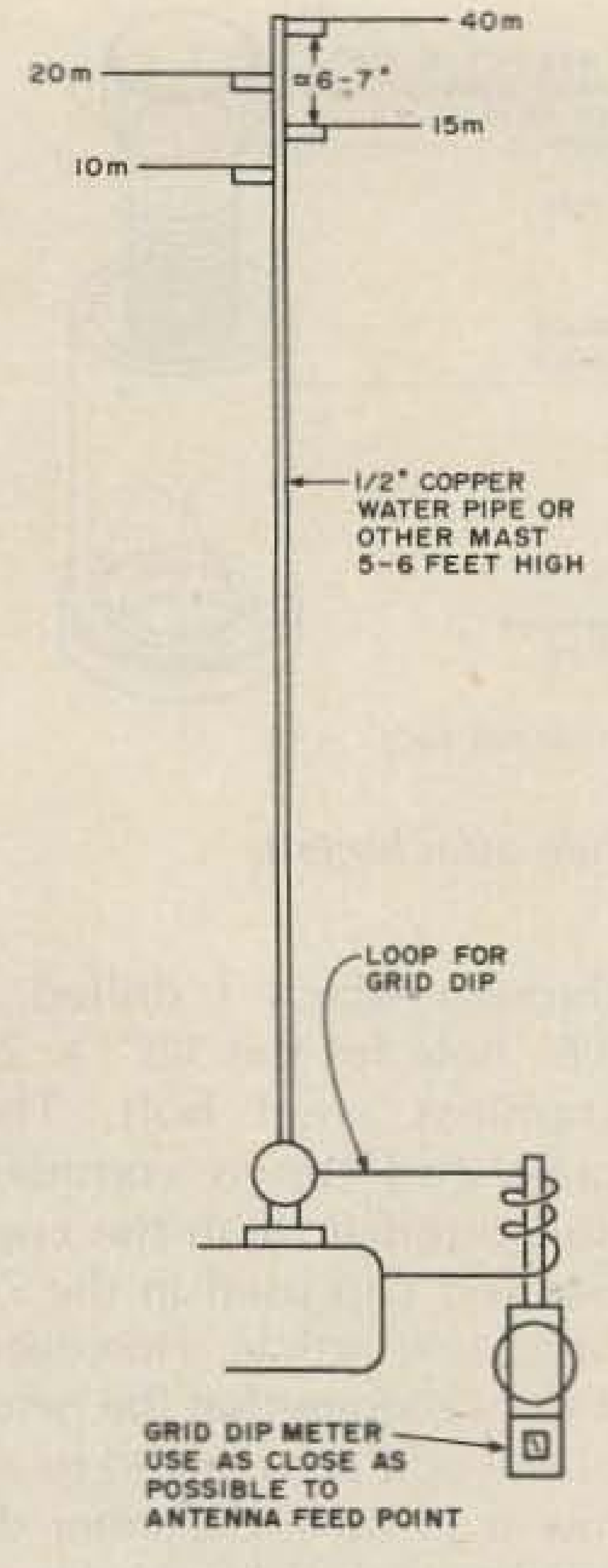

Fig. 6. Grid-dip meter positioning.

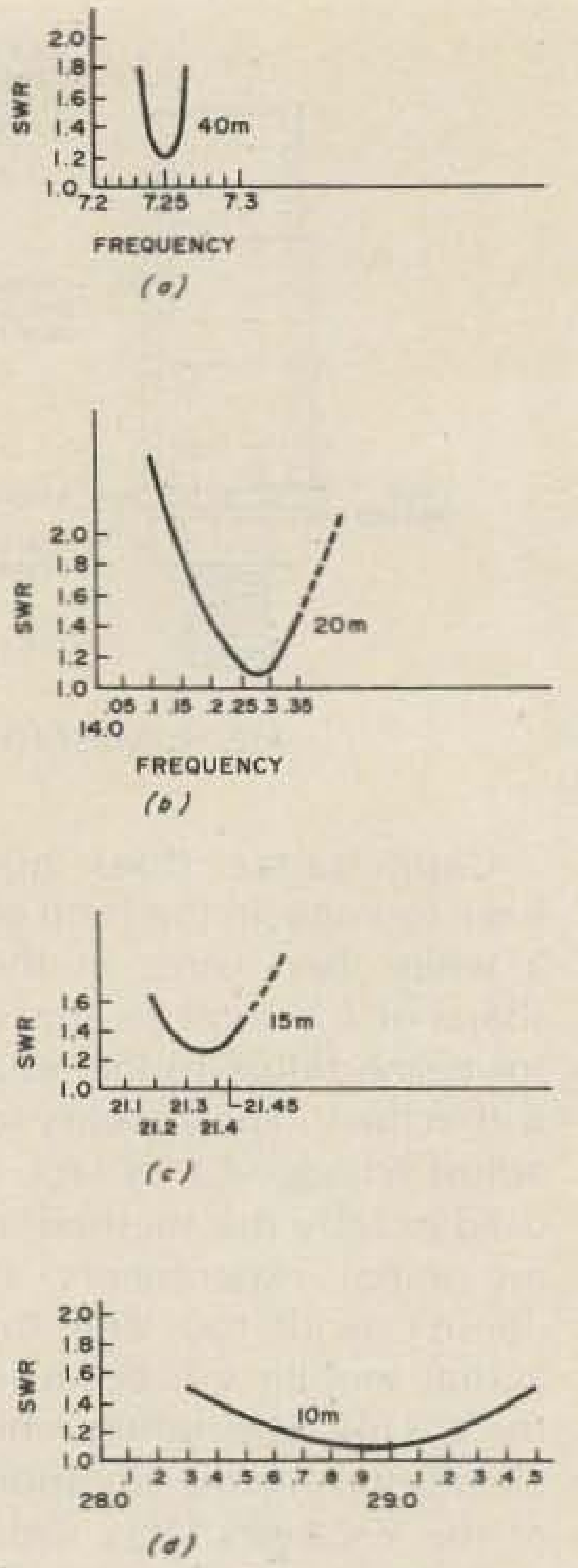

Fig. 8. Typical swr and bandwidth. (a) 40m swr (approx. 25 kHz @ 1.5 or less swr). (b) 20m swr (approx. 150 kHz @ 1.5 or less swr). (c) 15m swr (approx. 300 kHz @ 1.5 or less swr). (d) 10m swr (approx. 1.3 MHz @ 1.5 or less swr).

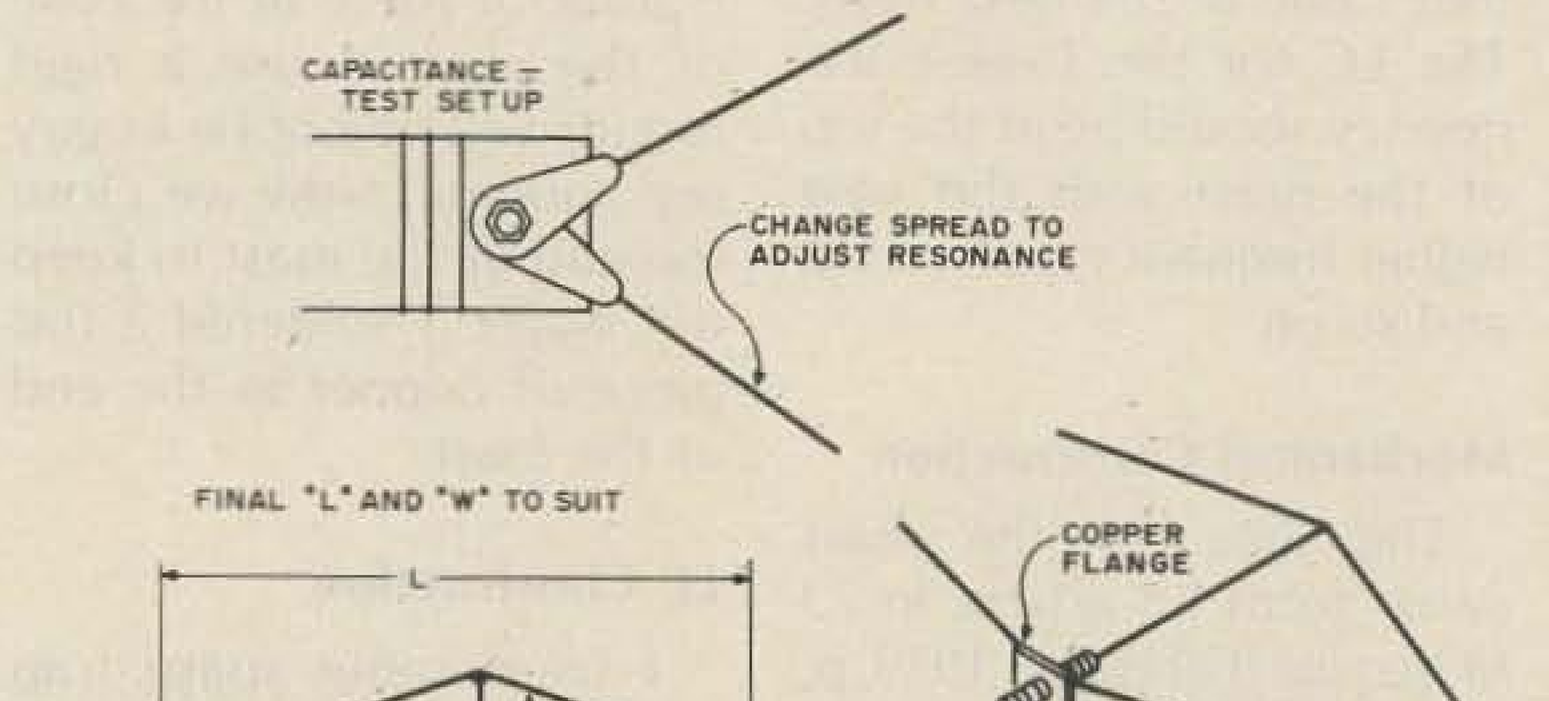

Fig. 7. Resonance adjustment assembly. Inductance—any diameter, any wire size (to suit power level), number of turns to suit frequency.

1-19/32"-Diameter Inductor Forms

	Band	# Turns	L × W
#12 Wire	20m	32	10" 2-1/8"
	15m	16	11-1/4" 1-3/8"
	10m	11	9-1/4" 1-1/8"
#20 Wire	40m	55	14-1/4" 1-1/2"
	20m	22-1/2	13-1/4" 1-1/2"

Additional data using #20 wire
92 turns = 5.5 MHz
83 turns = 5.9 MHz
67 turns = 6.6 MHz
62 turns = 6.8 MHz
59 turns = 7.1 MHz
55 turns = 7.25 MHz
38.5 turns = 11 MHz

Note: L and W are the length and width of the rhombic (C).

Table 1. Inductor winding data.

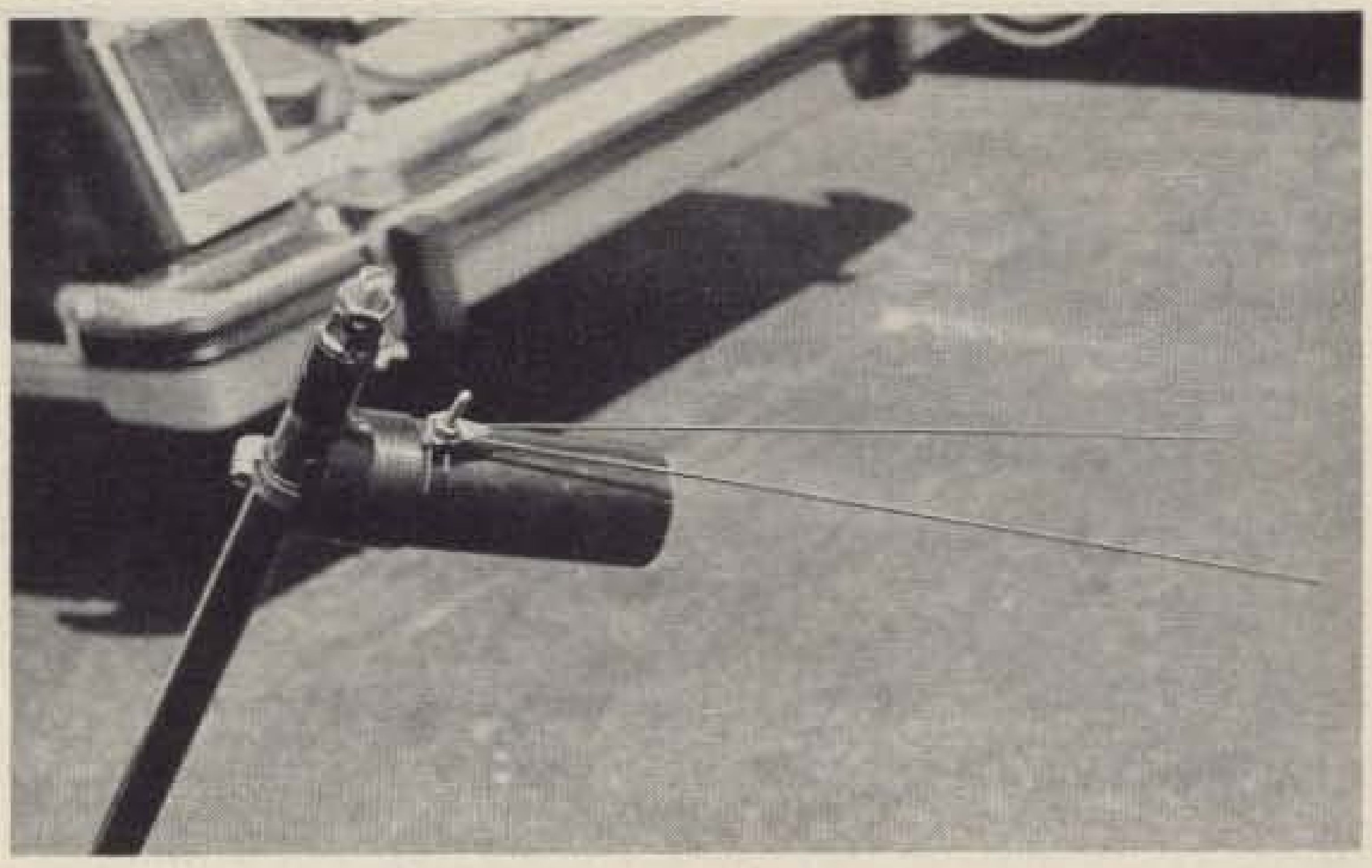

Photo C. Resonator test assembly.

As previously mentioned, I used a V configuration (Photo C) for the initial capacitance as it could be easily changed to adjust the resonant frequency. Work on one LC circuit at a time. Table 1 gives some dimensions which are intended to be a guide and give you a place from which to start. Differences in form diameter, wire size, and materials will require that you find your own right combination.

Weatherproof

Your LC assembly must be weatherproof. I learned from experience what a little rain will do to the resonant frequency. I guess I just figured out why commercial antennas use trap covers! My first attempt at weatherproofing was by dipping the LC assembly in polyurethane varnish. This lowers the resonant frequency about 500 kHz and is heavy. I have used epoxy resin, the type used to make fiberglass repairs, with good results. There is no appreciable frequency change; it is tough, medium in weight, easy to apply (pipe cleaners make excellent disposable paint brushes), and cures in about 30 minutes.

My preferred method is to put some silicone seal at the end of the LC assembly and enclose the inductor in heat-shrink tubing (obtained surplus or at a hamfest, in case you don't know how much a piece of new 2"-diameter heat-shrink tubing costs!).

Assembly and Adjustment

When you have completed the desired number of LC assemblies, they are attached using stainless steel worm-type hose clamps. The LC assemblies should be positioned fore and aft very carefully to minimize wind resistance. They should be carefully aligned or you may have one big rudder and a very "mobile" antenna. I have used care in alignment and have watched the antenna at highway speeds—it does not whip around. Proper positioning may actually create a stabilizing effect.

Fig. 6 shows the positioning I am presently using. There is some interaction between the LC assemblies, and "four in a row" caused some swr problems, particularly on 15 meters.

Adjust each LC circuit to the frequency you desire. Start with the highest frequency first (10 meters) and adjust each until you have adjusted the LC circuit of your lowest band.

More Thoughts

You don't have to make a multiband antenna. You may make an LC assembly for only one band. It might be used on a four-foot mast when height is a consideration such as on a motor home or tractor-trailer. You might combine two or more LC circuits on a single inductor form. You might use a circle instead of a rhombic for capacitance. You might leave the circle or rhombic open at the end and adjust the spread with a movable insulator. You might use a ferrite core to reduce the size of the inductor. You might use the LC assemblies for a temporary or space-restricted base antenna (with proper radials or counterpoise). You might build a small beam or rotating shortened dipole. You might . . .

Thanks to Bo Owen K4QKH, senior staff engineer at Teledyne Avionics in Charlottesville, Virginia, for the fundamentals and basic ideas.

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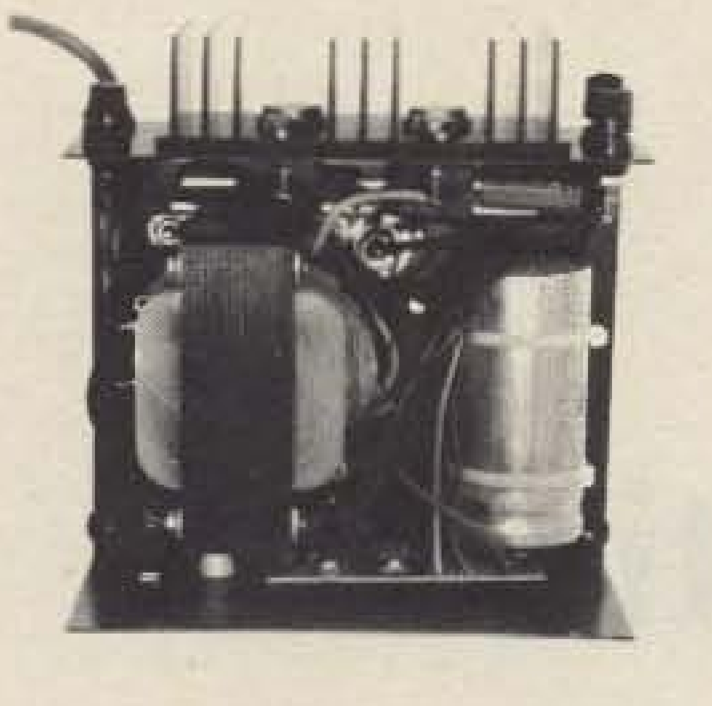

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- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE: Less than 5mv peak to peak (full load & low line)

MODEL RS-50A

MODEL RS-50M

MODEL VS-50M

RM-A Series

MODEL RM-35A

19" X 5¼ RACK MOUNT POWER SUPPLIES

Model	Continuous Duty (AMPS)	ICS* (AMPS)	Size (IN) HXWXD	Shipping Wt. (lbs.)
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50

RS-A SERIES

MODEL RS-7A

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

RS-M SERIES

MODEL RS-35M

- Switchable volt and Amp meter

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-12M	9	12	4½ x 8 x 9	13
RS-20M	16	20	5 x 9 x 10½	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13¾ x 11	46

VS-M SERIES

MODEL VS-20M

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

MODEL	Continuous Duty (Amps) @13.8VDC @10VDC @5VDC	ICS* (Amps) @13.8V	Size (IN) H x W x D	Shipping Wt (lbs)
VS-20M	16 9 4	20	5 x 9 x 10½	20
VS-35M	25 15 7	35	5 x 11 x 11	29
VS-50M	37 22 10	50	6 x 13¾ x 11	46

RS-S SERIES

MODEL RS-12S

- Built in speaker

MODEL	Continous Duty (Amps)	ICS* Amps	Size (IN) H x W x D	Shipping Wt (lbs)
RS-7S	5	7	4 x 7½ x 10¾	10
RS-10S	7.5	10	4 x 7½ x 10¾	12
RS-10L(For LTR)	7.5	10	4 × 9 × 13	13
RS-12S	9	12	4½ x 8 x 9	13
RS-20S	16	20	5 x 9 x 10½	18

The Conlog Solution

What's the key to winning contests? Put an Atari and this program at the helm of your station and find out.

Charles D. Moore N5ATD
PSC #2 Box 3000
Elmendorf AK 99504

This program enables a radio operator to keep a more accurate contest log. It fits quite handily into a 16K Atari 400/800, yet will save and compare up to 750 callsigns. The information can be saved or recalled to/from disk or cassette and output to the screen or a printer. A callsign can be compared with up to 750 others in slightly less than one second.

I never really intended to write this program. But the rest of you hackers out there will recognize the symptoms. At the request of a friend, I tried to translate a short program written in Microsoft Basic to Atari Basic. But, after adding a little bit here and a "Hey, this would be nice" there, it grew into the present monster. Well, maybe not a monster, but certainly more than I intended.

As usual, the hardest part of translating to Atari Basic is the string handling. In Atari Basic, strings cannot be directly dimensioned into arrays. Instead, DIM A$ (1000) sets aside 1000 spaces for one long string. While in some ways not being able to dimension a string array is more difficult, having a single long string is in other ways very fast and controllable. I made a single string 9000 characters long and sort of partitioned it off into segments of 12 characters each (12 * 750 = 9000). By taking, for example, the seventh callsign and multiplying it by 12, the 84th through 95th characters in A$ can be accessed by A$(84,95). In other words, for N=7, A$(N*12,N*12+11). The subroutine to search CALL$, the string that holds all the callsigns, is a machine-language subroutine loaded into page six by line 445. The subroutine searches the length of CALL$ for a match to the current entry using X= USR(XX). This is accomplished in lines 160 through 170. The variable GOOD is used to count the number of good contacts. I used GRAPHICS MODE 2 because the letters were bigger and I could throw in a little color without using up room needed for string space by taking advantage of the additional colors available in MODE 2 with inverse letters, lowercase letters, and inverse lowercase letters. The sound is simple, but I found that anything more elaborate tended to slow down the program a great deal. If a callsign is good (it has not been encountered before), a high tone is sounded. A bad callsign will result in a low tone. This way the operator cannot tell if an entry is good without looking at the screen.

Operating Conlog

First of all, type in the program. It helps, believe me. Hopefully, upon RUN, the screen will display the number of stations worked, zero at this point. In the text window, two lines of information are displayed in inverse video. The first merely reminds you that no more than 12 characters may be made on each entry; the program will ignore any extra. The second line gives the functions. To access these instead of a callsign, type: SCREEN for output to the screen, PRINTER for an output to the printer, or MENU for saving or loading information. The output to the screen is pretty quick but may be stopped and restarted by CNTL 1 at any time. The output to the printer is one callsign per line because I was running out of program space. Now you are ready to enter a callsign. Upon typing one in and RETURN, the program will print the callsign in the box and then search the string CALL$ for a duplication. A message, GOOD or WORKED, will be printed below the callsign in the box.

If at any time you desire to save or load information, use MENU and follow the questions you will be asked. First, you will be asked if you are using disk or cassette. Just press the first letter, D or C. If you are using disk, you will be asked for a file name. Follow the general guidelines for a file name given in the Atari Basic reference manual. Next, a message SAVE LOAD QUIT will be printed. When you press S or L, you will be asked to ready the device you are using. Q will return to the callsign entry portion. Now, if you operate on a band and want to change

```
10 REM CONTEST LOG-Charles Moore  N5ATD
15 GRAPHICS 2
20 GOSUB 445:GOOD=0
25 DIM CALL$(9010),C$(12),TEST$(12),HOLD$(12),FILE$(14),D$(14)
30 FOR Z=1 TO 40:CALL$(Z,Z)=" ":NEXT Z
35 TRAP 65:CLOSE #1
40 POSITION 0,2:? #6;"input callsign:";
45 POSITION 1,5:? #6;"******************";
50 POSITION 1,6:? #6;"*                *";
55 POSITION 1,7:? #6;"*                *";
60 POSITION 1,8:? #6;"******************";
65 POSITION 0,0:? #6;"WORKED=";GOOD
70 ? " ";
75 IF GOOD=0 THEN CALL$="":C$=""
80 IF GOOD=750 THEN 255
85 ? "maximum entry: 12 char":? "SCREEN  PRINTER  MENU"
90 INPUT C$:IF LEN(C$)=0 THEN 70
95 HOLD$="            "
100 HOLD$(1,LEN(C$))=C$(1,LEN(C$))
105 POSITION 3,6:? #6;"              ";
110 POSITION 3,7:? #6;"            ";
115 ? " ";
120 POSITION 3,6
125 ? #6;C$;
130 IF C$="SCREEN" THEN 335
135 IF C$="MENU" THEN 255
140 IF C$="PRINTER" THEN 415
145 IF GOOD=0 THEN GOSUB 250:GOTO 65
150 GOSUB 155:GOTO 65
155 C$(LEN(C$)+1)=" "
160 LY=LEN(CALL$):LX=LEN(C$):POKE 207,LX-1
165 B=LY-LX-1+3
170 A=USR(1664,ADR(CALL$(1)),ADR(C$),B)
175 IF A=0 THEN 190
180 POSITION 3,7:? #6;"WorKeD";:S=230:GOTO 240
185 IF HOLD$(1,12)=CALL$(LEN(CALL$)-11,LEN(CALL$)) THEN 500
190 POSITION 3,7:? #6;"GooD!!";
195 S=50
200 ? " ";"ADD TO LIST (Y/N)";:OPEN #1,4,0,"K:":SOUND 0,122,14,1
205 GET #1,T:CLOSE #1:? " ":SOUND 0,0,0,0:IF CHR$(T)="Y" THEN 220
210 IF CHR$(T)="N" THEN 85
215 GOTO 200
220 GOOD=GOOD+1
225 CS=12*GOOD+1
230 CALL$(CS,CS+11)="            "
235 CALL$(CS,CS+11)=HOLD$(1,12)
240 FOR Z=1 TO 50:SOUND 0,S,10,10:NEXT Z:SOUND 0,0,0,0
245 RETURN
250 CALL$(1,12)=HOLD$(1,12):GOTO 505
255 GRAPHICS 0:CLOSE #1:TRAP 255
260 GOTO 280
265 ? "INPUT FILE NAME  ex: 'BAND10'":?
270 INPUT FILE$:IF LEN(FILE$)=0 THEN 265
275 RETURN
280 D$="              "
285 OPEN #1,4,0,"K:"
290 ? " DISK  OR  CASS":GET #1,Z
295 IF Z=68 THEN GOSUB 265:D$(1,2)="D:":GOTO 510
300 IF Z=67 THEN D$(1,2)="C:":GOTO 310
305 GOTO 255
310 ? " ":? " SAVE LOAD QUIT":GET #1,Z
315 IF Z=81 THEN GRAPHICS 2:GOTO 35
320 IF Z=83 THEN CLOSE #1:GOSUB 435:OPEN #1,8,0,D$:GOTO 375
325 IF Z=76 THEN CLOSE #1:GOSUB 435:OPEN #1,4,0,D$:GOTO 400
330 GOTO 255
335 IF GOOD=0 THEN GRAPHICS 2:GOTO 35
340 C=-1:R=0
345 GRAPHICS 0:FOR Z=0 TO GOOD-1:CS=12*Z+1
350 C=C+1:IF C=2 THEN R=R+1:C=0:IF R=23 THEN R=0
355 TEST$=CALL$(CS,CS+11):POSITION C*20+4,R
360 ? TEST$:NEXT Z
365 ? CALL$(LEN(CALL$)-11,LEN(CALL$))
370 FOR Z=1 TO 1000:NEXT Z:GRAPHICS 2:GOTO 35
375 IF GOOD=0 THEN ? "NOTHING TO SAVE":FOR Z=1 TO 1000:NEXT Z:GOTO 35
380 PRINT #1,GOOD
385 FOR Z=0 TO GOOD-1:CS=12*Z+1
390 TEST$=CALL$(CS,CS+11):? #1;TEST$:NEXT Z
395 TEST$=CALL$(LEN(CALL$)-11,LEN(CALL$)):? #1;TEST$:CLOSE #1:RUN
400 GOOD=0:INPUT #1,GOOD:FOR Z=0 TO GOOD:CS=12*Z+1
405 INPUT #1,TEST$:CALL$(CS,CS+11)=TEST$(1,12)
410 NEXT Z:GRAPHICS 2:GOTO 35
415 OPEN #1,8,0,"P:":FOR Z=0 TO GOOD-1:CS=12*Z+1
420 TEST$=CALL$(CS,CS+11):? #1;TEST$:NEXT Z
425 ? #1;CALL$(LEN(CALL$)-11,LEN(CALL$))
430 CLOSE #1:GRAPHICS 2:GOTO 35
435 ? " ":? "PREPARE DISK/CASSETTE":? :? "PRESS RETURN"
440 INPUT TEST$:RETURN
445 FOR I=1664 TO 1755:READ A:POKE I,A:NEXT I:RETURN
450 DATA 104,104,133,204,104,133,203,104,133
455 DATA 206,104,133,205,104,141,222,6,104
460 DATA 141,221,6,169,1,133,212,169,0,133
465 DATA 213,160,255,200,177,203,209,205
470 DATA 240,40,24,165,203,105,1,133,203
475 DATA 165,204,105,0,133,204,24,165,212
480 DATA 105,1,133,212,165,213,105,0,133
485 DATA 213,205,222,6,208,216,165,212,205
490 DATA 221,6,208,209,240,7,152,197,207,208
495 DATA 204,240,6,169,0,133,212,133,213,96
500 POSITION 5,7:? #6;"WoRkEd";:S=230:GOTO 240
505 S=150:GOOD=GOOD+1:POSITION 5,7:? #6;"GooD";:GOTO 240
510 D$(3,LEN(FILE$)+3)=FILE$(1,LEN(FILE$)):GOTO 310
```

Program listing.

bands for a while because conditions change, you can dump the information to disk or cassette and easily start again later by calling up prior callsigns by file name. This can lead to a few less headaches and improved eyesight.

Notes

Unfortunately, there was very little room left for remarks, so they are rather sparse in the listing. If you are using disk, you of course have more than 16K, so it would be easy to expand the number of entries. When you save the information, be sure you have plenty of room, as 750 entries takes about 75 sectors on a disk and a correspondingly great amount of cassette space.

This program is designed as a help for contest logging, but it could be used to check for duplicate entries for just about anything. With minor effort, the string partitions could be shortened or lengthened. Likewise, the graphics could easily be changed to fit a specific application. The substring search would only need to be changed so that the new length of the substring is used for comparison.

I hope this program will make all the users of other than Atari Basic jealous. It runs quickly and looks nice. With the small blend of machine language, the program makes a nice addition to the ham's computer library. If you really mess up and break the program, you can restart it by GR.2:GOTO 35 and nothing will be lost or affected. If you have any comments, questions, or (hopefully) improvements, please let me know. I'll answer/comment on anything with an SASE. Also, if you would like a copy of this program, just send a blank disk or cassette with a stamped, self-addressed mailer and $3.00 to PSC #2 Box 3000, Elmendorf AK 99504.

Credit Department

I learned the technique used for the substring search from a very good article by E. C. Smith in the August, 1982, issue of *Compute* magazine. My Basic version of the same type of search took about 13 seconds to compare 750 entries. ■

✓See List of Advertisers on page 130

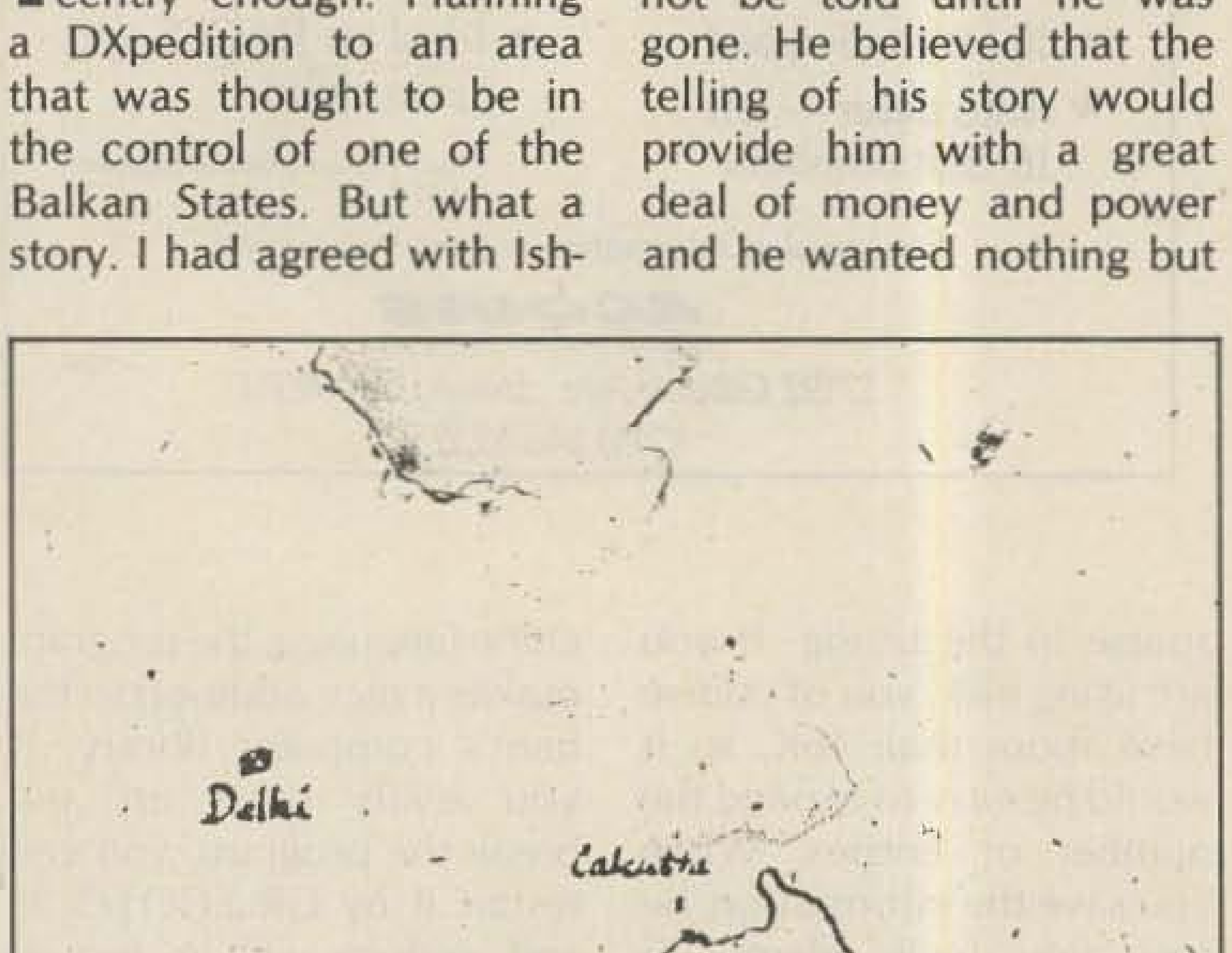
Spenser Whipple, Jr.
c/o 73

Ishmod's Journal

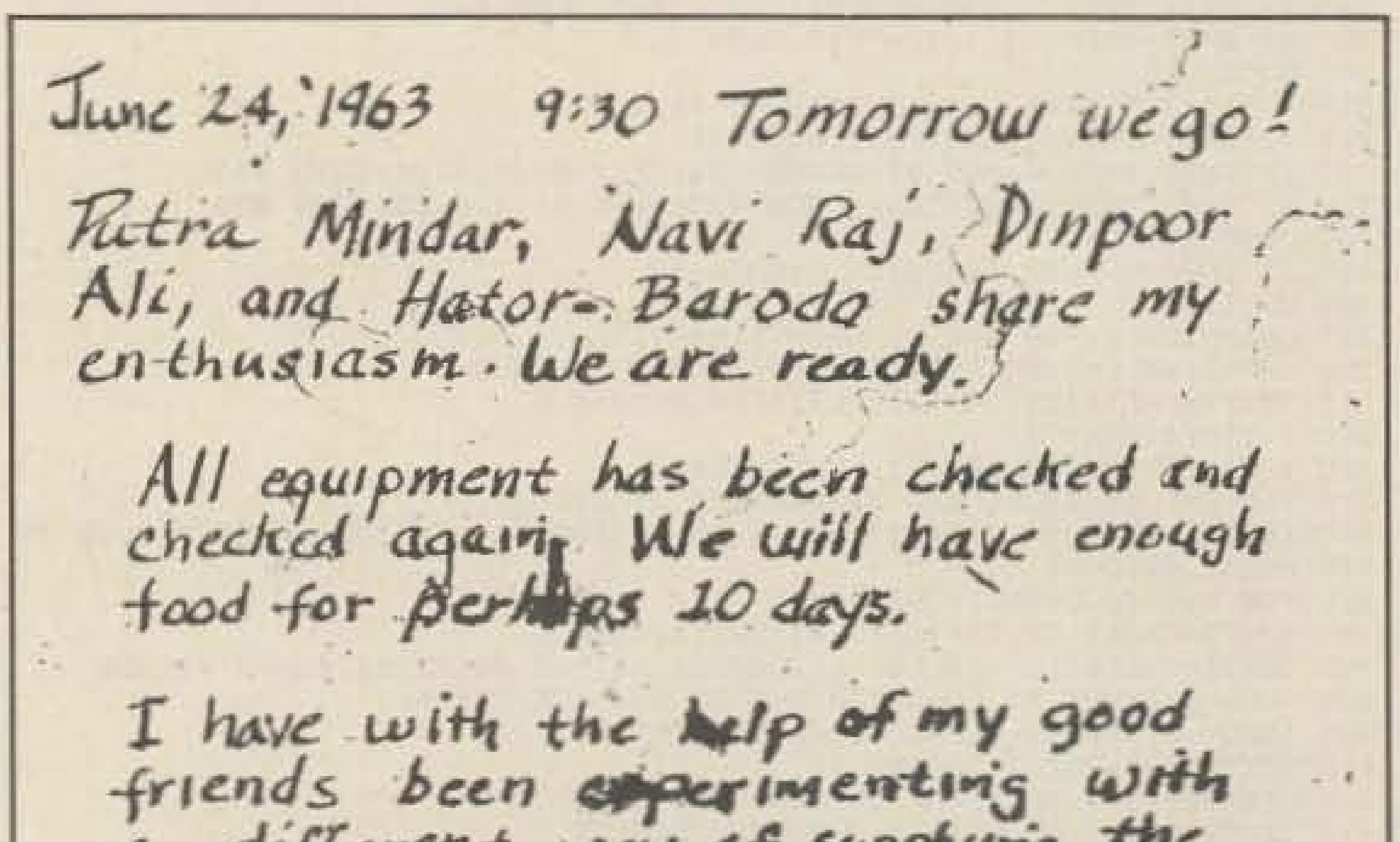
What happened in 1963 finally surfaced in 1983. Was he a fool?

It all started out innocently enough. Planning a DXpedition to an area that was thought to be in the control of one of the Balkan States. But what a story. I had agreed with Ishmod that the story would not be told until he was gone. He believed that the telling of his story would provide him with a great deal of money and power and he wanted nothing but to be left alone.

It began in early July in 1967. My wife and I had spent a relaxing holiday on Capri. On our way back to Athens she wanted to do some more shopping, so we looked for a locker at the train station to temporarily store some of our packages. When I opened it, a crumpled paper bag was in it. Curious as to its contents, I looked inside. A strangely familiar sequence of letters and numbers caught my eye on the front of an old leather-bound notebook—



Map page from the Ishmod Journal. The map is hand-drawn and centers around the Bay of Bengal and the tiny speck of land that was to be the DXpedition's destination. Water damage has obliterated the coordinates of the island and other critical parts of the puzzle.


June 24, 1963 9:30 Tomorrow we go!

Petra Mindar, Navi Raj, Dinpoor Ali, and Hator-Baroda share my enthusiasm. We are ready.

All equipment has been checked and checked again. We will have enough food for perhaps 10 days.

I have with the help of my good friends been experimenting with a different way of supplying the antenna with excitation current. Preliminary results show that this means should perform well over water.

We plan to run our equipment from a petrol-driven motor-generator graciously loaned to us by the university. We will have two camps.

The antennas will be directed to the north and west using special

Another loose page from the journal. These entries were made the night before Ishmod and his friends were ferried to the island.

what turned out to be what I would later call the Ishmod Journal

Unaware of its historic importance, I tucked the ragged notebook under my arm, figuring I would take a quick look at it while my wife made still another of her forays into the local shops. So, when I did look at the cover again, it dawned on me why the faded legend on the cover seemed familiar. It read S7Z2B. That could well be an amateur-radio callsign, although I had no idea to which country it might have belonged. Settling under an olive tree, I began to read. When my wife came back about 40 minutes later, she thought I was crazy from too much sun. I was babbling about someone named Ishmod and that the world had to know about him. So this is Ishmod's story, at least as well as I could put it together. I say that because there still are some areas that can't be accurately put together.

Though the handwriting was poor and some of the pages were damaged from moisture, I think I figured out most of it. I do wonder, though, because most of it, if I interpreted it correctly, is almost too much to believe. Hams around the world have had some wonderful and disastrous DXpeditions, but this one takes the cake. And through an incredibly intricate string of events, the story has remained hidden all these years. A novel could be based on the travels of the journal itself.

It seemed that Ishmod Kaduk S7Z2B, an amateur-radio operator from the Indian state of Sikkim, had gathered a group of fellow hams from two neighboring villages to share in his dream of putting a new prefix on the air. Ishmod had intended to use a barren rocky footprint of land about 70 miles off the coast of India in the Bay of Bengal. The exact location is hard to determine as this information was on one of the pages damaged by water, but it appeared to be southeast of Chilka Lake, which is about 200 air miles from Calcutta, down the eastern coast of India.

Apparently, Ishmod was an experienced sailor, having grown up in Chatrapur, a small village near Chilka Lake and the sea. He had spent his boyhood there until he went off to the university at Delhi. This much was clear.

One summer after his next to last exams in what was to lead him to the equivalent of an electrical engineering degree, he had packed his small sturdy sailboat with enough provisions for a week and was planning a relaxing cruise in the familiar bay. Three days out, he saw something ahead in the water. There was no land indicated on any of his charts, but there it was. Using a sextant, he noted his position and resumed his vacation from his studies.

When he returned to school in Delhi, he spent some time in the great libraries and government record buildings looking for some reference to the small island he had found the previous summer. Having grown up in that area and sailed there all his life, he could not recall any mention of the land from the sailors he used to talk with down on the dock near his village.

Eventually, he did find an old document at the Indian Registry of Vessels that warned ship captains of the menace of a reported shoal at about the location he had seen the rocky island. The document also noted that "landing rights thereon" had been claimed over a hundred years ago by a Serbo-Croation prince through some special diplomatic agreement. Although claimed by the prince, the landfall had not become the legal territory of any country. Ishmod could not believe what he read. The following summer he planned to have his DXpedition. And this was the beginning of the adventure chronicled in the Ishmod Journal.

Late in the evening on June 24, 1963, Ishmod and four other hams sat around a small table on the dock at Chatrapur, double-checking their equipment lists. They had pooled their money and chartered the only boat large enough to ferry their equipment and provisions to the rocky island that was to be home for the next six days. Little did they know then that they were about to make history. They were to be the first to observe a phenomenon that defied the laws of physics and electromagnetism. The rocks of the island exhibited the incredible capacity to alter the infundib-

Continued on page 224

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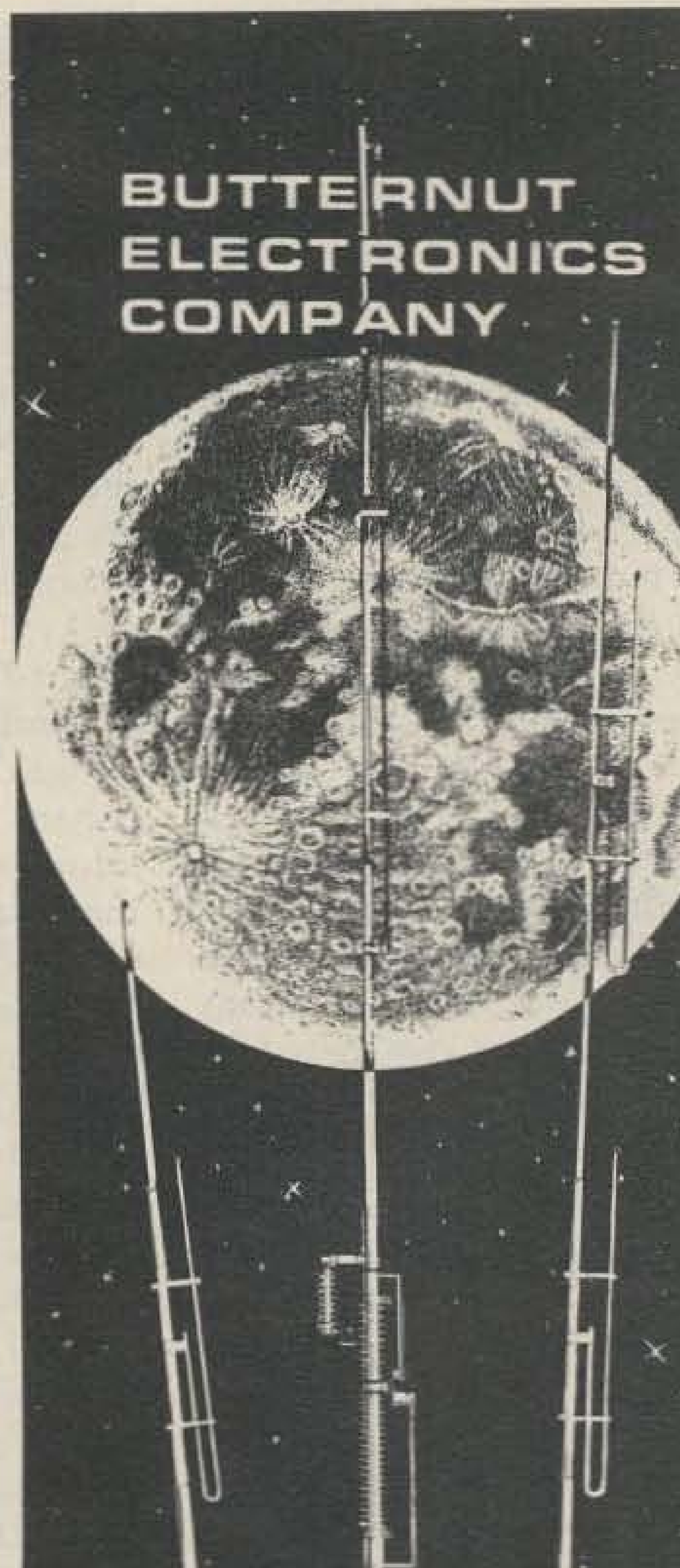

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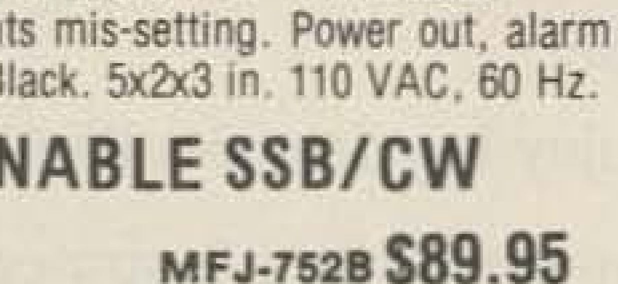

Switch to 24 hour GMT or 12 hour format! Battery backup maintains time during power outage. ID timer alerts every 9 minutes after reset. Switchable seconds readout. Elapsed timer. Just start clock from zero and note time of event up to 24 hours. Bright blue .6" digits. Alarm with snooze function. Synchronizable with WWV. Lock function prevents mis-setting. Power out, alarm on indicators. Black. 5x2x3 in. 110 VAC, 60 Hz.

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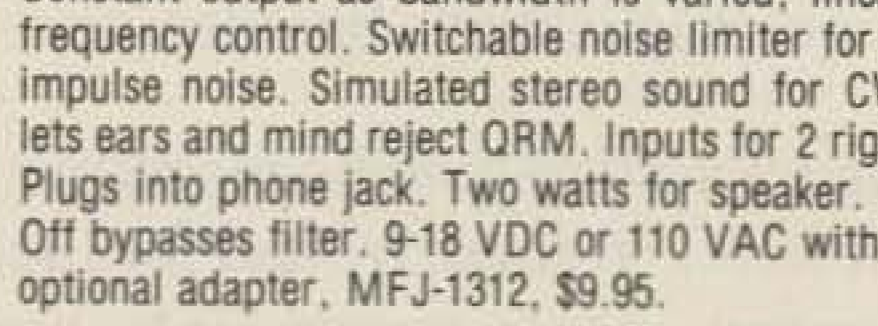

Dual filters give unmatched performance! The primary filter lets you peak, notch, low pass or high pass with extra steep skirts. Auxiliary filter gives 70 db notch, 40 Hz peak. Both filters tune from 300 to 3000 Hz with variable bandwidth from 40 Hz to nearly flat. Constant output as bandwidth is varied; linear frequency control. Switchable noise limiter for impulse noise. Simulated stereo sound for CW lets ears and mind reject QRM. Inputs for 2 rigs. Plugs into phone jack. Two watts for speaker. Off bypasses filter. 9-18 VDC or 110 VAC with optional adapter, MFJ-1312, $9.95.

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True dual channel mark and space active filters and automatic threshold correction gives good copy when one tone is obliterated by QRM or selective fading.

Easy, positive tuning with twin LED indicators. **Narrow 800 Hz** active CW filter. Automatic PTT. **Exar 2206** sine generator for AFSK output.

Shielded XCVR AFSK/PTT interface cable provided. Plus or minus CW keyed output. FSK out.

Powered by computer (few mA.), no power adapter to buy or extra wire to dangle or pick up/radiate RFI.

Glass epoxy PCB. Aluminum enclosure. 4½x4½x1".

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SUPER RTTY FILTER

MFJ-725
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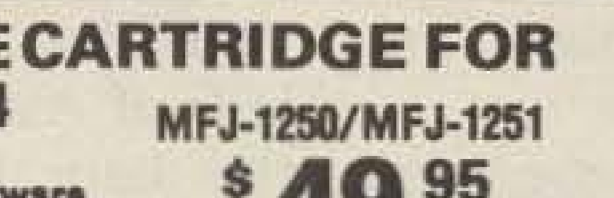
NEW



Super RTTY filter greatly improves copy under crowded, fading and weak signal conditions. Improves **any** RTTY receiving system. 8 pole bandpass active filter for 170 Hz shift (2125/2295 Hz mark/space). 200 or 400 Hz bandwidths. Automatic noise limiter. Audio in, speaker out jacks. On/off/bypass switch. "ON" LED. 12 VDC or 110 VAC with optional AC adapter, MFJ-1312, $9.95. 3x4x1 inch aluminum cabinet.

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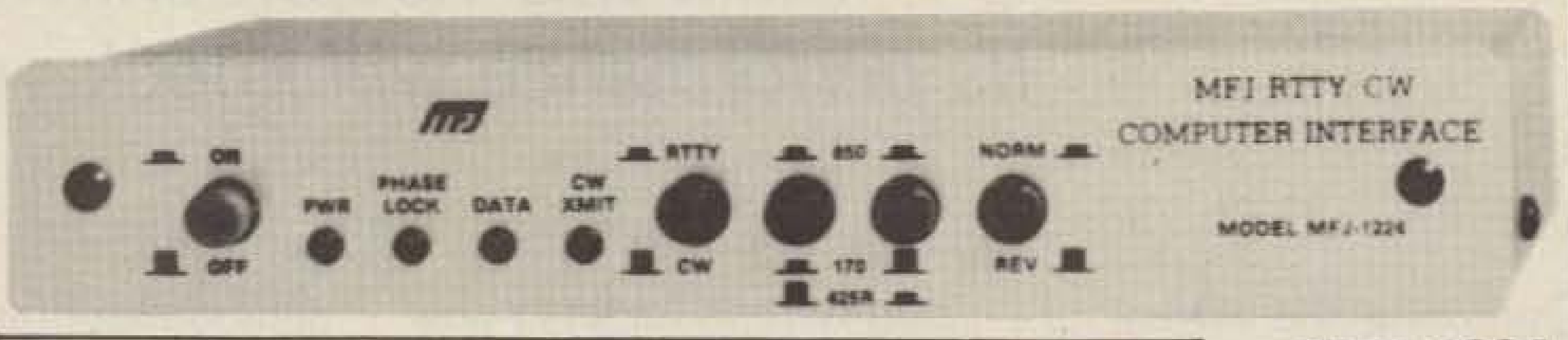

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Easy, positive tuning with twin LED indicators. **Copy any shift** (170,425,850 Hz and all other shifts) and any speed (5-100 WPM RTTY/CW and up to 300 baud ASCII).

Copies on both mark and space, not mark only or space only, to improve copy under adverse conditions.

Sharp 8 pole 170 Hz shift/CW active filter gives good copy under crowded, fading and weak signal conditions. Automatic noise limiter suppress static crashes for better copy.

Normal/Reverse switch eliminates retuning. +250 VDC loop output drives RTTY machine. Speaker jack.

Automatic tracking copies drifting signal.

Exar 2206 sine generator gives phase continuous AFSK tones. Standard 2125 Hz mark and 2295/2975 Hz space. Microphone line: AFSK out, AFSK ground, PTT out and PTT ground.

FSK keying output. Plus and minus CW keying. CW transmit LED. External CW key jack.

Kantronics compatible socket.

Exclusive general purpose socket allows interfacing to nearly any personal computer with most appropriate software. Available TTL lines: RTTY demod out, CW demod out, CW-ID input, +5 VDC, ground. All signal lines are buffered and can be inverted using an internal DIP switch.

Use Galfo software with Apple, RAK with VIC-20, Clay Abrams with TRS-80C, N4EU with TRS-80 III, IV. Some computers with some software may require some external components.

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MFJ-1223, $29.95, RS-232 adapter for MFJ-1224.

CW INTERFACE CARTRIDGE FOR VIC-20/C-64

NEW

$39.95

MFJ-1226

High performance CW interface cartridge. Gives excellent performance under weak, crowded, noisy conditions. Works for both VIC-20 and Commodore 64. Plugs into user's port.

4 pole 100 Hz bandwidth active filter. 800 Hz center frequency. 3 pole active lowpass post detection filter. Exclusive automatic tracking comparator.

Plus and minus CW keying. Audio in, speaker out jacks. Powered by computer.

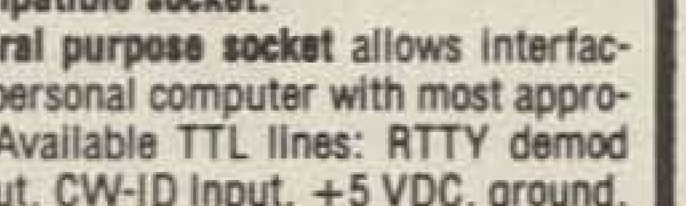
Includes Basic listing of CW transmit/receive program. Available on cassette tape, MFJ-1252 (VIC-20) or MFJ-1253 (C-64), $4.95 and on software cartridge, MFJ-1254 (VIC-20) or MFJ-1255 (C-64), $19.95.

You can also use MFJ-1250 (VIC-0) or MFJ-1251 (C-64), $49.95 each, RTTY/ASCII/CW software cartridge. Or use Kantronics, AEA and others.

Also copy RTTY with single tone detection.

UNIVERSAL SWL RECEIVE ONLY COMPUTER INTERFACE FOR RTTY/ASCII/AMTOR/CW

MFJ-1225
$69.95



MFJ-1225 plus MFJ-1250 or MFJ-1251 $99.95.

Use your personal computer and communications receiver to receive commercial, military and amateur RTTY/ASCII/AMTOR/CW traffic.

Plugs between receiver and VIC-20, Apple, TRS-80C, Atari, TI-99, Commodore 64 and most other personal computers. Requires appropriate software.

Use MFJ(see this ad), Kantronics, AEA and most other RTTY/ASCII/AMTOR/CW software.

Copies all shifts and all speeds. Twin LED indicators makes tuning easy, positive. Normal/Reverse switch eliminates tuning for inverted RTTY. Speaker out jack. Includes cable to interface MFJ-1224 to VIC-20 or Commodore 64. 4½x1¼x4¼ inches. 12-15 VDC or 110 VAC with optional adapter, MFJ-1312, $9.95.

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The Terminal Terminal Unit

*Build this variable-shift TU.
Its performance will knock you dead.*

Following the advent of the affordable home computer, increased interest in RTTY operation was generated in the amateur community. The benefits of being able to do away with the noisy printer and use video displays for received and transmitted data moved this mode of operation into the electronic age. Since computers are not normally designed to perform RTTY operations unaided, specialized hardware interfaces between receiver/demodulator and transmitter, as well as software to control them, were required. Aside from those specialized or dedicated systems for RTTY now available from manufacturers such as Hal, Robot, and DGM, hardware/software is commercially available for the popular Radio Shack TRS-80,* Apple,** and the Pet*** computer systems to provide this added capability to the ham station.

For RTTY/Baudot operation, the requirements of the demodulator/terminal unit (TU) for computer operation have changed very little from the days of the Model 15 printer and current loop driver/relay. The input signal is still provided by the receiver audio, filtered and conditioned by the TU, and output as either an "on" or "off" level, depending upon the mark or space frequencies. However, while the output for the Teletype® printer was required to be a 20- or 60-milliamp current driver for the mechanical system, the computer requires only a plus-five-volt (1) or zero-volt (0) level.

Over the years, many "improved" TU designs were produced to overcome the effects of signal fading, interference, noise, etc. The variation of mark and space shift, that is, the separation between these frequencies, required different filters to be incorporated in the TU to be able to copy the desired signals. Similarly, in order to copy different speeds, switchable-speed filters were required. Amateurs have almost universally standardized on the 170-Hz shift for better noise immunity and on 60 words per minute, since most surplus printers are equipped for this speed. With the approval by the FCC of ASCII operation on the ham bands, new requirements were necessary to enable amateur use of this new mode. Many surplus ASCII machines are available, but not too many amateurs desire to purchase and maintain two machines to be able to operate both Baudot and ASCII. Additionally, ASCII operation is authorized on the HF bands to 28 MHz at speeds of 110 and 300 baud. These speeds are approximately 1.7 and 4.6 times faster than 60 words per minute, respectively, thus affecting TU filter parameters for reliable copy.

In originating design requirements for a TU oriented to computer operation, a number of trade-offs must be considered. First,

*TRS-80 is a registered trademark of Tandy Corp.

**Apple is a registered trademark of Apple, Inc.

***Pet is a registered trademark of Commodore Business Machines.

Photo A. Terminal unit front-panel layout.

we must decide whether we will be satisfied with copying only amateur 170-Hz-shift signals as opposed to the older 850-Hz-shift and commercial RTTY stations, such as news service at 425-Hz shift. The trade-off incorporated into the described design provides an input bandpass filter to allow reliable copy of the 170-Hz shift and the capability to switch this filter out of the circuit to pass wider shifts. Differing shifts mean different mark and/or space frequencies which lead to the requirement for multiple filters. This problem is solved by using active filters and designing the space filter with a center frequency which can be varied by front-panel control over the shift range desired. For additional selectivity on wide-shift signals, an available receiver filter may be used to perform the function of the switched-out bandpass unit.

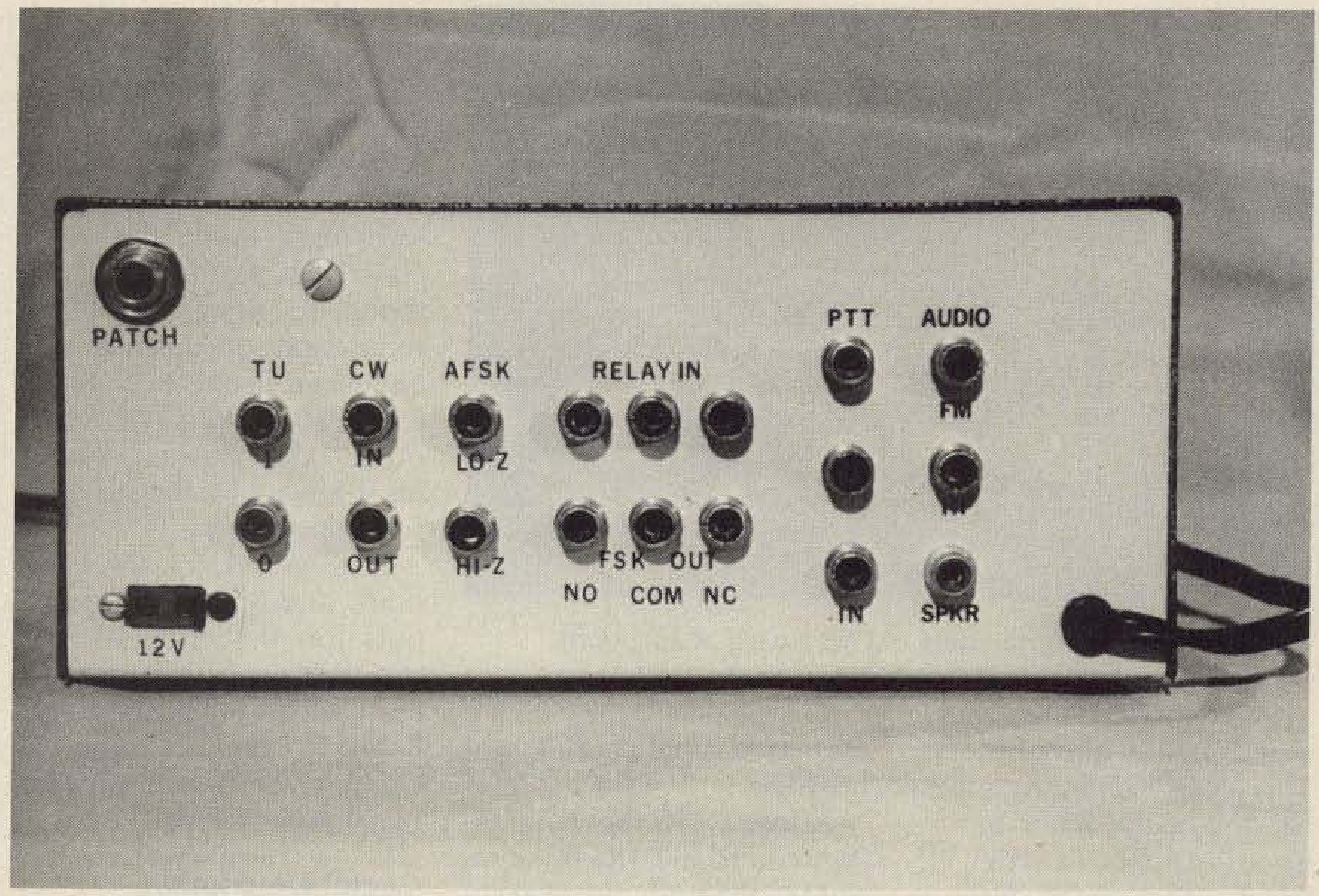


Photo B. Terminal unit rear-panel jack arrangement.

Second, we must determine the amount of sophistication or "bells and whistles" we desire to add. The incorporation of a limiter circuit is a basic requirement for accommodating signal fading. However, the capability of switching out the limiter or changing its parameters for AM-type signals or interference thresholding should also be available and is included in the design. Since this TU is also used to copy CW signals with a TRS-80, a threshold control is provided to allow the level of the desired signal above interference to be set with or without the limiter in the circuit.

Active filters are sensitive to increases in signal level over the design amplitude and distortion in the desired response will occur if this parameter is not considered. Therefore, a single transistor stage has been included which adjusts the signal level when the limiter is switched out of the circuit and precludes overdriving the mark and space filter through the use of clipping diodes in the base circuit. Fig. 1 shows the circuit performance for varying input-signal levels with the limiter switched in and out.

Filter response/width is a function of signal intelligence bandwidth versus noise and interference. Theoretically, a filter of bandwidth "n" should be able to pass "2n" bits of intelligence. However, this figure does not take into account noise, fading, and interference. Naturally, we would like to have the narrowest filter response which will cut off all interference on either side of the desired signal, but one wide enough to preclude having to retune for drifting transmitter oscillators.

The input bandpass filter used in this design can be tuned by the circuit-board trimmers for a bandwidth of 160 Hz with the values shown. This is wide enough to pass 170-Hz-shift mark and space signals without any problems at both 60-word-per-minute Baudot and 110-baud ASCII. However, at 300 baud, with the input filter tuned for maximum amplitude at 2210-Hz center frequency (f_o), the filter response drops off rather sharply, decreasing the mark/space intelligence bandwidth (as shown in Fig. 1).

In order to provide a good recovery capability for 300-baud signals, the input filter is slightly detuned, as described later, to widen the 3-dB width. The LM3900 op amp used for the active filters is a Norton amplifier. It differs from the common 741 op-amp series in that it is a current-differencing device. The main consequence of this difference is that it makes the amplifier a low-impedance device as opposed to the high-impedance 741. Further information on the LM3900 is available from National Semiconductor Corporation in their AN72-15 *Application Note.*

With the values shown and careful alignment, the 2295-Hz mark filter achieves

Sensitivity	0.1 volts p-p
Input filter width, 3 dB	170 Hz (adjustable)
Space filter width, 3 dB	85 Hz (adjustable on panel from 1700-2700 Hz f_o)
Mark filter width, 3 dB	85 Hz, 2295 Hz f_o
Shift reception	100–600 Hz with both mark and space filters in use; adjustable from panel
Adjacent-channel filter rejection	20 dB
Dynamic range (limiter out)	>30 dB
Minimum threshold separation	0.2 volts
Output	5 volts (1) or 0 volts (0) on space or mark
Supply voltage	+ 12.5 volts
Current drain, space on	100 mA; add 100 mA for relays

Table 1. Terminal unit specifications.

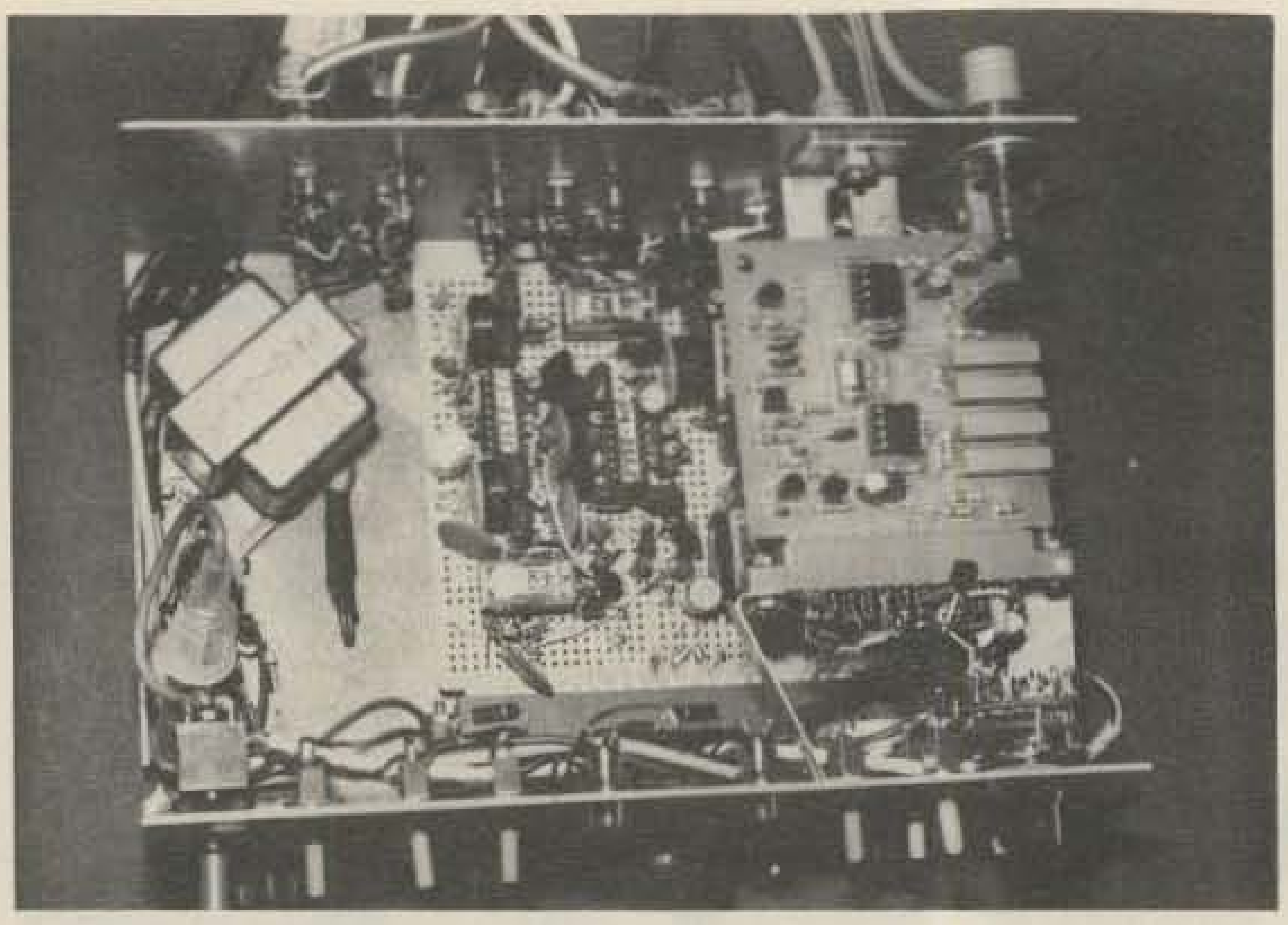


Photo C. Internal view, AFSK board at top right.

a 3-dB bandwidth of 85 Hz. This value is about optimum for any of the RTTY modes encountered in the HF bands. The space filter is that part of the design which provides the capability for copying different frequency shifts and varying bandwidth signals. Front-panel controls allow the operator to tune the filter for a 3-dB width of 85 Hz at the nominal 170-Hz shift frequency of 2125 Hz or tune the center frequency over a wide range of values to accommodate other frequency shifts.

With the component values shown, the old shift of 850 Hz cannot be tuned. This was considered an unnecessary requirement that would have lowered the Q and response of the filter. Obviously, the wider shifts can be implemented, if desired, by switching in different component values.

Although the specifications in Table 1 indicate that 100 Hz is the lowest frequency shift copyable, the TU will copy smaller shifts, depending only on adjacent channel interference and fading. As shown in Fig. 1, the skirts of the mark and space filters are not steep enough to provide more than 20-dB rejection at frequency shifts of less than 100 Hz, but if the only signal in the passband is the desired one and feedthrough in the adjacent filter is not excessive, smaller shifts are possible.

At my QTH, the TU is interfaced to my TRS-80 computer through a Macrotronics M80 unit. Only the space frequency is required for copy. However, this is not an advantage which allows only one channel of the RTTY signal to be processed from receiver to computer. Rather, if such a scheme is attempted on other than a clear FM channel, noise and interference will cause erratic copy and an amount of "garbage" which is directly proportional to the speed of the desired signal versus that of the noise/interference. This anomaly occurs due to the fact that, in a single-channel system which reacts only to the space signal level, when the desired signal is not there (normal mark condition), a time span is open to receive any type of interference which might simulate a space signal.

This problem can be minimized by clocking the desired signal only, but cannot be completely eliminated due to the variation which must be allowed for pulse timing. Therefore, the simplest method of precluding the occurrence is to process the mark signal in the normal manner in the TU and use its detected level to keep the output from switching in the absence of a space signal.

Of course, this method is not valid for copying CW using the space frequency filter. In this mode, we rely on the threshold control to set the switching circuit input to react to the desired signal level only, while the mark channel is switched off. Although the design allows the separation of desired and undesired signal levels to be within 0.2 volts of each other, the desired signal must always be the stronger for reliable copy.

The facility for reversing mark and space filter outputs for AFSK operation is included in the design; a Flesher FS-1 AFSK oscillator board is installed in the TU cabinet for transmitting in this mode on FM.

Circuit Description

Audio input for the TU is obtained from the receiver speaker jack, as shown in Fig. 3. A jack on the rear panel allows the connection of a speaker which can be turned off via a front-panel switch. Transformer T1 converts the 4/8-Ohm audio input to a 500/600-Ohm impedance signal which is controlled in amplitude by a front-panel-mounted 5k pot and switched either to a phone-patch jack or the RTTY/TU position for the demodulator. The 8.2k-Ohm resistor precludes loading down the U1 filter input, while the back-to-back diodes ensure that the input signal will be clipped at a level which precludes overdriving U1.

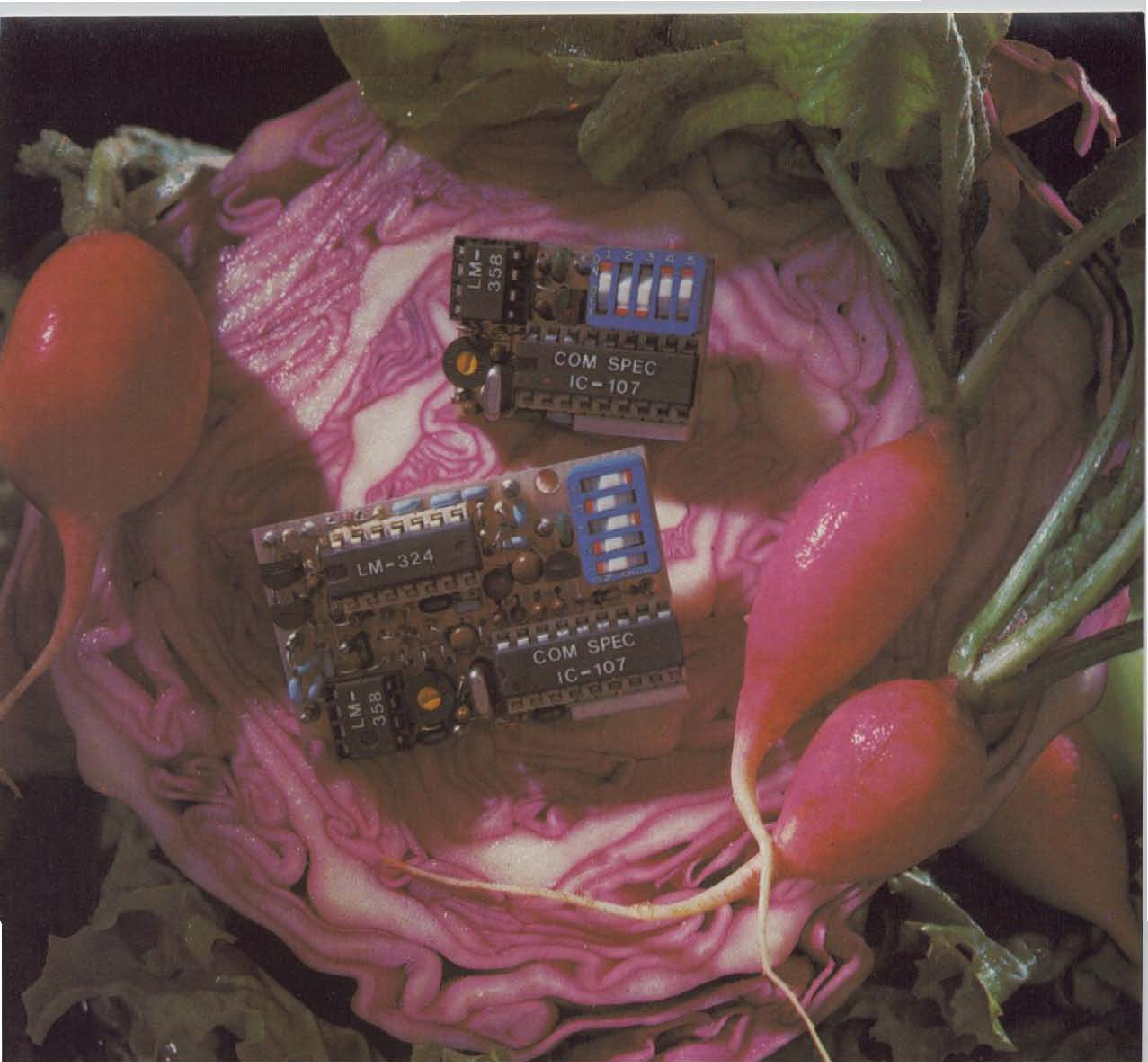
Relay K1 allows filter U1 to be switched out of the circuit to enable copying wide-shift signals outside of U1's passband. Bandpass filter U1 consists of a 2-pole configuration tuned to a center frequency (f_o) of 2210 Hz. Trimmers R1 and R2 allow the tuning of the filter poles, while the overall Q and gain of the circuit are controlled by the 27k-Ohm feedback resistors. The response with this filter, as shown in Fig. 1, sets the overall bandpass capabilities of the TU. Test point TP1 provides a convenient monitoring point for the output of the bandpass filter.

Limiter U2 captures the strongest signal provided at its input and maintains the output level of that signal despite a decrease in signal strength caused by fading or adjacent signal "pulling." The operation of the limiter circuit for varying signal levels is depicted in Fig. 2. Trimmer R3 sets the offset voltage on pins 2 and 3 to plus six volts, while the 390k-Ohm feedback resistor controls the gain and symmetry of the limiter. The output of U2 is a symmetrical square wave monitored via TP2.

Relay K2 allows the limiter to be switched out of the circuit for better reception of AM/CW-type signals. Transistor stage Q1 maintains the signal level to the mark/space filters when U2 is switched out and clipping diodes in the base circuit ensure that the signal level does not reach a point at which the filters will be overdriven. When relay K2 is activated, relay K3 also switches input resistors to the mark/space filters to maintain appropriate signal level.

The mark and space filters, U3 and U4, operate similarly to bandpass filter U1. The mark frequency of 2295 Hz is set by trimmers R4 and R5, while the space filter frequency of 2125 Hz (or other shift frequency) is set by two pots located on the front panel. The output of these filters is a sine wave which can be monitored at TP3 and TP4.

Relay K4 allows the mark and space filter outputs into the detectors to be switched for AFSK or reverse-shift operation. The detectors convert the sine waves from the filters to a doubled dc level and filter the remaining ac to ground. Test points 5 and 6 provide a means of monitoring the detector output voltage and ensuring that



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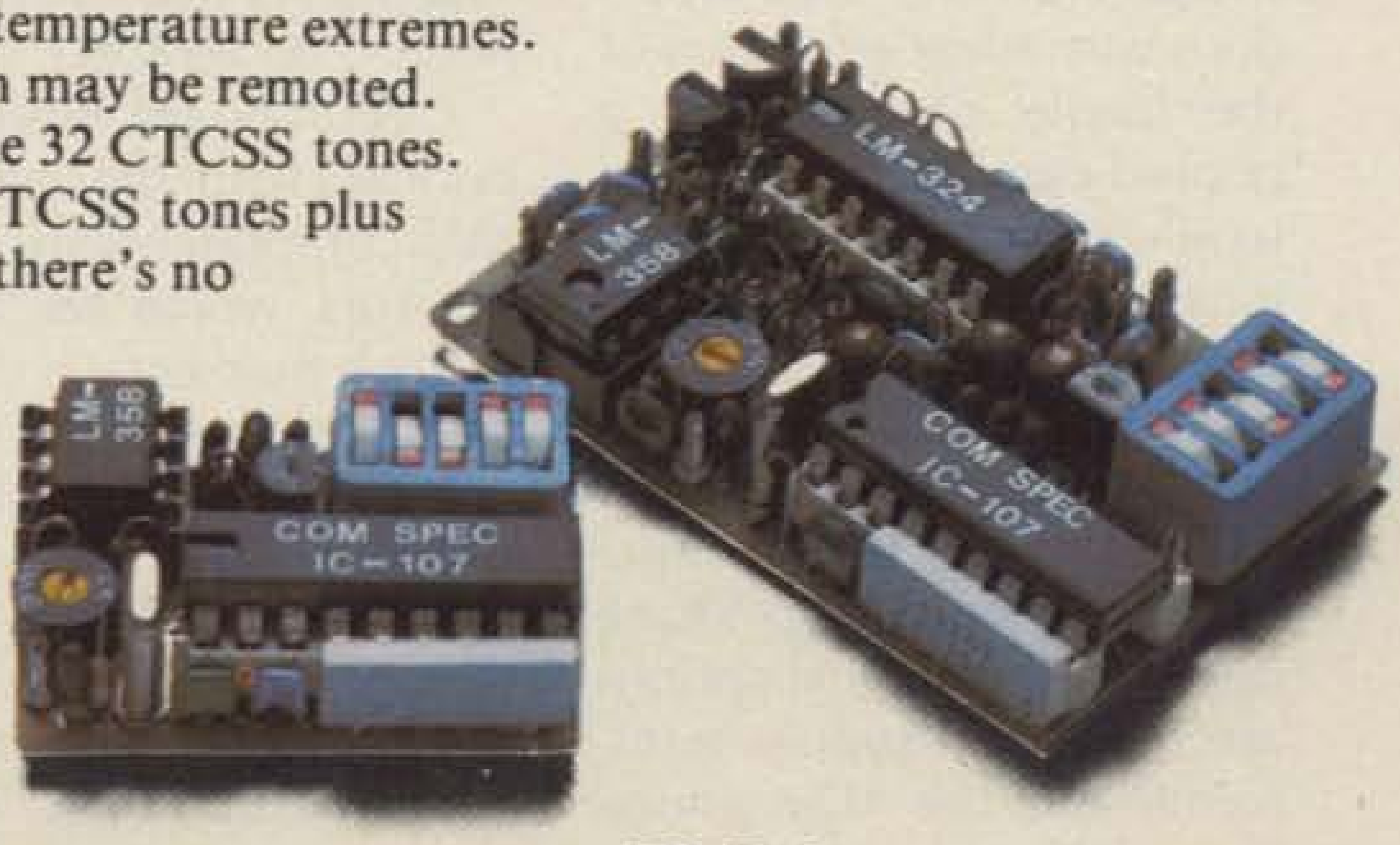

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both mark and space signals are equal in level. The diodes in the base circuit of Q2 and Q4 prevent any interaction between the detectors and transistors, while S7 deactivates the mark output for CW or space-only operation.

Pot R9 is mounted on the front panel and sets the threshold level to Q4, which in turn determines at what point output transistor Q8 will switch to "on." This capability precludes triggering on interference or signals of the same frequency as that of the desired signal but lower in level. When S7 is in the open position, Q2 cannot receive the necessary bias to drive mark indicator Q3 into conduction or turn Q4 off, preventing an output. Thus, any interference in the mark channel during CW or space-only operation will not affect copy.

When driven "on" by the detected space signal, Q4 draws current and applies approximately 4.5 volts on the emitter. This voltage and available current then turn on Q6 (to give an LED indication of space) and Q7, which drives Q8 to the on state, switching the high input from the Macrotronics M80 interface key terminal to ground.

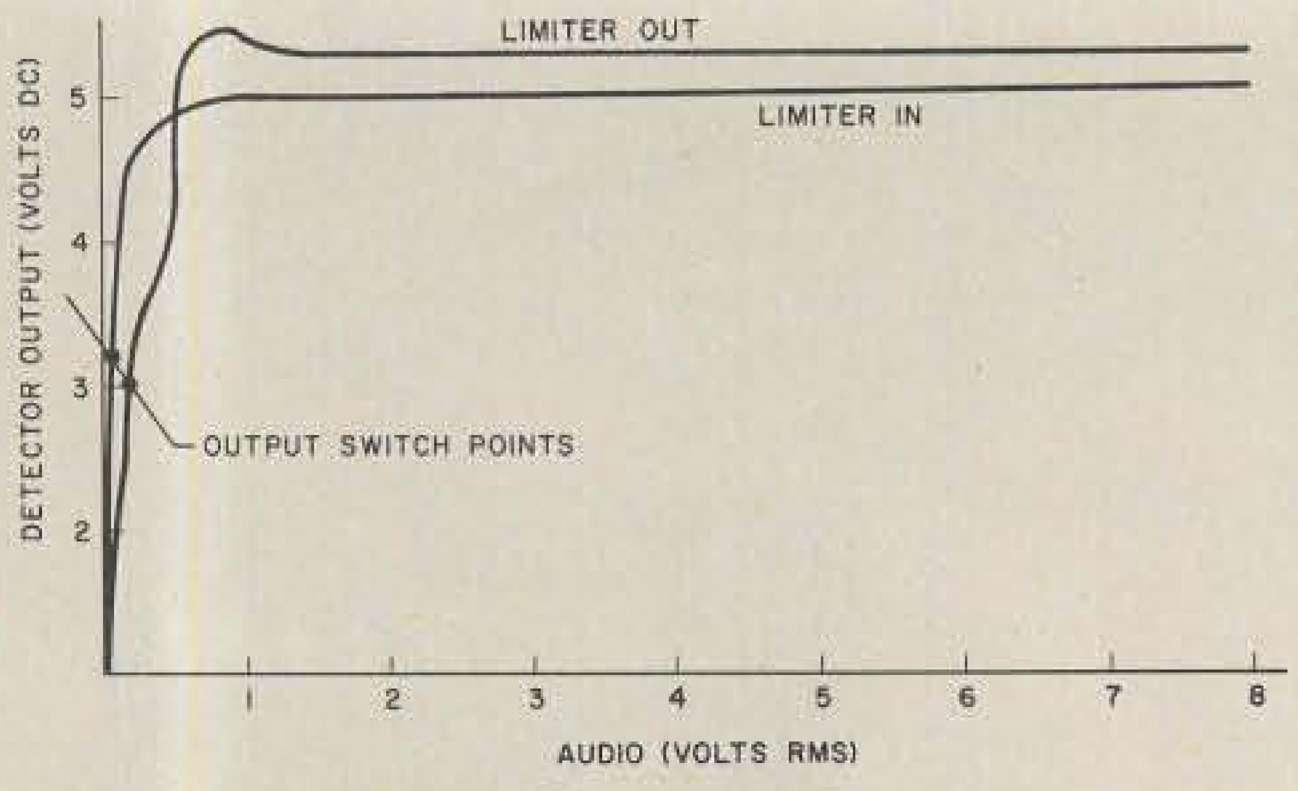

Fig. 1. Circuit performance curves.

Construction

The TU circuitry was fabricated using a Radio Shack prototype board (which has solder pads for each hole) and point-to-point wiring. This is a time-consuming process requiring careful attention to detail to prevent shorts. However, this procedure was adapted in lieu of the hassle of designing a printed-circuit pattern and to allow ease in circuit modification between breadboard and final-design stages.

Almost all parts are available through local Radio Shack stores; the part numbers listed are Radio Shack numbers. Major exceptions are the power-supply transformer and the AFSK generator board. The power-supply design is not shown since any supply of 500 milliamps or better will work. A regulated voltage is necessary to ensure constant filter parameters; this requirement is easily accomplished via a 12-volt, 1-Watt zener diode.

Although Radio Shack stocks 12-volt transformers, these units are not enclosed in a metal shield. The metal case is necessary to prevent coupling of the ac field into the audio lines and circuit of the TU. Appropriate transformers are available from a number of supply houses such as Circuit Specialists or from local consumer electronics repair shops which handle Japanese equipment from Panasonic, Pioneer, etc.

Vernier dials or 10-turn pots were considered for the space-filter tuning controls but not incorporated due to the increase in cost over the last year. However, good-quality pots are necessary to preclude dead spots or dropouts when tuning. The FS-1 AFSK oscillator board is available from Flesher Corporation, PO Box 976, Topeka KS 66601, with connector, for $37.50.

Circuit-board wiring is not critical, with the exception that components such as capacitors, which are located in each mark/space channel, should not be placed in close proximity to each other (to prevent adjacent-channel signal pickup). Those capacitors which function as frequency-determining components in the filter circuits should be of mylar™ or polyester construction while others may be of the disk type.

Resistors are quarter-Watt, five percent, for minimum board-space requirements. Sockets are used for all integrated circuits, but transistors are soldered directly to the board. Intracabinet wiring for audio lines should be shielded and the power-supply ac wiring kept away from other cables. The DIP relays should have a dab of contact cement applied to each side where the relay touches the socket to ensure that vibration does not cause them to rise out of the sockets.

The Radio Shack Model 270-253 cabinet provides just enough front-to-back space to mount the prototype board and connector on the bottom of the chassis. There is space on either side of the board for the power supply and input-audio transformer. The AFSK board is mounted above the TU board with connector brackets made from thin aluminum stock and anchored by two of the front-panel switches and an L-bracket support from the rear panel. Intracabinet wiring is shown in Fig. 4.

Power-supply wiring should be done first in the enclosure, followed by the TU-board connector wiring. Installation of the switches, pots, and jacks is then completed, followed by installation and wiring of the AFSK board/connector. The space-filter tuning pots are mounted in the front panel so that the left and right controls both have maximum frequency setting at a marking between the two. Wiring to the pots must be reversed on each to allow the left to operate in a clockwise direction for maximum frequency while the right pot is moved in a counterclockwise direction for the same frequency. Decals or transfers should be applied to the front panel to indicate scale marks around the control knobs.

Alignment

After the normal checks for solder bridges and power-bus shorts, alignment can begin. None of the switches needs to be connected for calibration, but a shorting wire should be connected across the S7 diode if it is mounted on the board. Use temporary connections to the LEDs, which will be panel-mounted later. As a signal source, an audio signal generator is required. If that piece of test equipment is not part of your inventory, you might consider building a breadboard variable audio generator using a function-generator integrated circuit or a 555 timer chip.

Another option is to use the calibrator on your transceiver and adjust the beat note to provide the necessary audio output. In any case, a frequency counter is required to ensure that what you see is what you get. The filters are extremely narrow and any alignment which is off the desired frequency will produce lower gain, distortion, and undesirable operational characteristics.

An oscilloscope is helpful in tracing the signal and confirming relative waveshapes and amplitude. However, the Q of the filters, which makes precise tuning/alignment essential, precludes the use of the scope for monitoring maximum filter response while calibrating. A VOM/VTVM with a dB scale is much simpler to use

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for this function. After coupling via a 0.1-uF capacitor from the applicable test point, the meter will show the change in signal level as the filter is aligned to the input frequency. Any oscillation or false response will exhibit a higher-than-normal swing of the VOM needle and should be monitored by the oscilloscope.

As a first step in the alignment procedure, adjust R3 for plus six volts at pins 2 and 3 of limiter U2. Next, attach an input signal source of 2210 Hz to the input and couple (via a 0.1-uF capacitor) the output of filter U1 from TP1 to the VOM/VTVM which has been set to the 10-volt scale. Adjust R1 and R2 until the meter indicates maximum output at this frequency. The 3-dB bandwidth will now be approximately 160 Hz.

If you do not desire to copy anything other than 170-Hz shift in Baudot or 110-baud ASCII, the response of the filter is fine. However, if you desire to use the filter for 300-baud ASCII, you may wish to retune the bandwidth to increase the width and noise characteristics. This may be accomplished by alternately changing the frequency of the input signal from 2125 Hz to 2295 Hz and adjusting R1 and R2 for a meter reading 3 dB below the maximum value obtained at 2210 Hz. Repeat this procedure until the meter reading at both the mark and space frequency is equal.

As you change the input frequency from the lower to the higher frequency, you will notice that maximum gain is still at 2210 Hz, showing that the response has not been degraded but only widened at the 3-dB point via stagger tuning. Note that this adjustment will not affect the capability of the bandpass filter to accept only 170-Hz-or-less shifted signals.

If a scope is available, check the output of the limiter, which should appear as a square wave of equal pulse widths. A check of the filter outputs should show a sine wave without distortion. Once the input signal has been set to the limiter capture level, which is matched to the limiting effect of the diodes across the input and the gain of U1, there should be no noticeable change in output amplitude for further increases in signal level.

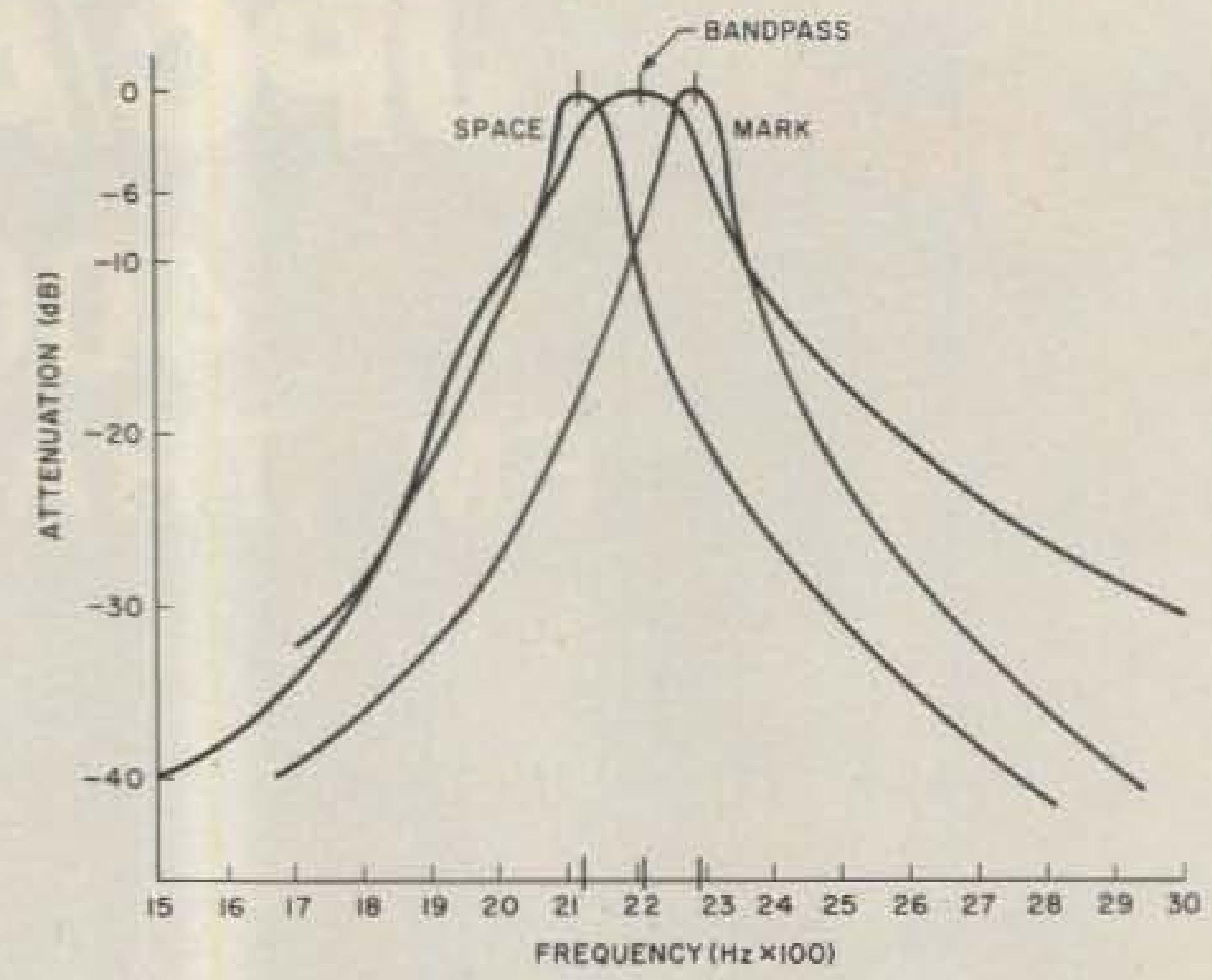

Fig. 2. Active filter response.

Bandpass filter U3 is aligned at 2295 Hz in a manner similar to that accomplished at U1. Use TP3, a 0.1-uF capacitor, and adjust R4 and R5 for maximum meter indication. No further tuning for widening the response of this filter is required.

Bandpass filter U4 is aligned during operation from the front panel by pots R6 and R7. After wiring the pots and connecting the leads to the circuit-board connector, ensure that a frequency range of 1800–2150 Hz can be covered and that when both pots are set to the same frequency, the output level is approximately the same as that provided by U3 at its center frequency.

During the alignment procedure, the appropriate indicator LEDs should have lighted as the filters were tuned. If all is well to this point, continue the alignment. Otherwise, go back and determine where the problem exists.

Set the input frequency for 2295 Hz and attach the meter leads across TP5 with the meter set to read 5.5 volts dc. Record the indicated value. Now, move the meter leads to TP6 and ground and change the input frequency to 2125 Hz. Adjust the front-panel filter controls for maximum meter indication and note the value. If the two readings are not the same, adjust R8 and repeat the procedure. Note that equal output of the detectors is mainly dependent upon the alignment of U1 to pass equally both frequencies and the alignment and gain of U3 and U4.

Since the mark and space voltages drive different parts of the circuit after detection, you should check to ensure that both LEDs light with the same level of input signal. Set the signal generator for 2125 Hz, tune the space filter for maximum output/LED brightness with the FSK/CW/AFSK/Reverse switch in the FSK position, and lower the generator level until the LED is just lighted. If the FSK switch is not yet wired into the circuit, the relay will still be in this position, unactivated. Now put the switch in the Reverse position, or apply 12 volts to the relay lead for K4, and note the brightness of the mark LED. If the mark and space LEDs do not light at the same level, adjust R8 until they do.

Depending on whether you have used the mark or space signal to provide a high or low output, the appropriate LED should illuminate when that signal is applied to the input. The output should measure either 4.5 volts at the "1" jack or almost zero at the "0" jack.

Check the front-panel switches to ensure that they all work, activating the relays or switching the appropriate parts of the circuit in or out. A continuity check with the VOM of the output/input jacks on the rear panel will prevent surprises after the cover is attached.

Operation

After a complete bench check and filter alignment, you are ready to place the TU on line and connect all the interfacing cables. Online tests should start with reception of various RTTY signals to allow you to become familiar with the operation of the TU. Some apprehension was originally felt during the design phase about the ability to tune a signal into the mark channel before tuning the space filter. Operation of the completed unit has shown that this is not really a concern and that the procedure is quickly learned. I had also previously installed a 1-mA meter on the original space output LED of the Macrotronics M80 interface, which helps in the fine-tuning of the space filter and displays the actual level of the switching signal from the TU.[3]

For normal RTTY operation, with all filters and the limiter in operation, the audio-level control on the receiver need only be set in the low range, 2 or below, for a front-panel scale of 1 to 10. The level control on the TU will then provide satisfactory copy for an S9 signal when set about one-third of the way into its range. It is important to ensure that the

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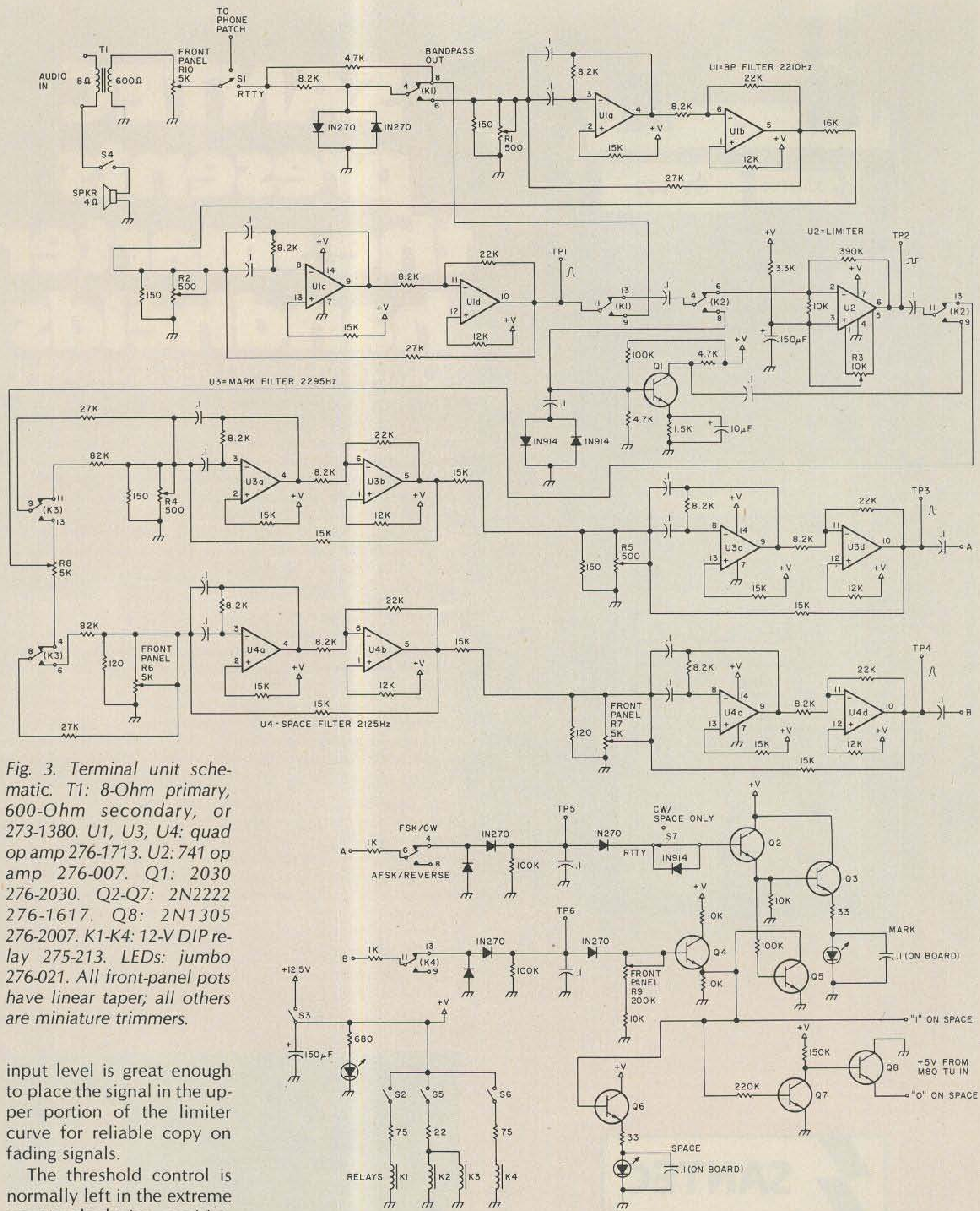

Fig. 3. Terminal unit schematic. T1: 8-Ohm primary, 600-Ohm secondary, or 273-1380. U1, U3, U4: quad op amp 276-1713. U2: 741 op amp 276-007. Q1: 2030 276-2030. Q2-Q7: 2N2222 276-1617. Q8: 2N1305 276-2007. K1-K4: 12-V DIP relay 275-213. LEDs: jumbo 276-021. All front-panel pots have linear taper; all others are miniature trimmers.

input level is great enough to place the signal in the upper portion of the limiter curve for reliable copy on fading signals.

The threshold control is normally left in the extreme counterclockwise position unless it is being used to prevent triggering of an interfering lower-level signal. Once the space filter controls are set to the approximate shift value by the front-panel markings, the signal can be tuned to give an indication on the mark LED. If correctly tuned, the meter on the M80 will show no deflection if there is no space signal. Depending on how close the original settings on the space filter controls were, the space LED may flicker or light with a corresponding M80 meter deflection. The tuning of the first and then second space-filter pole controls will display an equal mark/space LED intensity and maximum space signal on the meter.

Printer or CRT copy should also be evident. Switching to AFSK/Reverse should reverse the mark/

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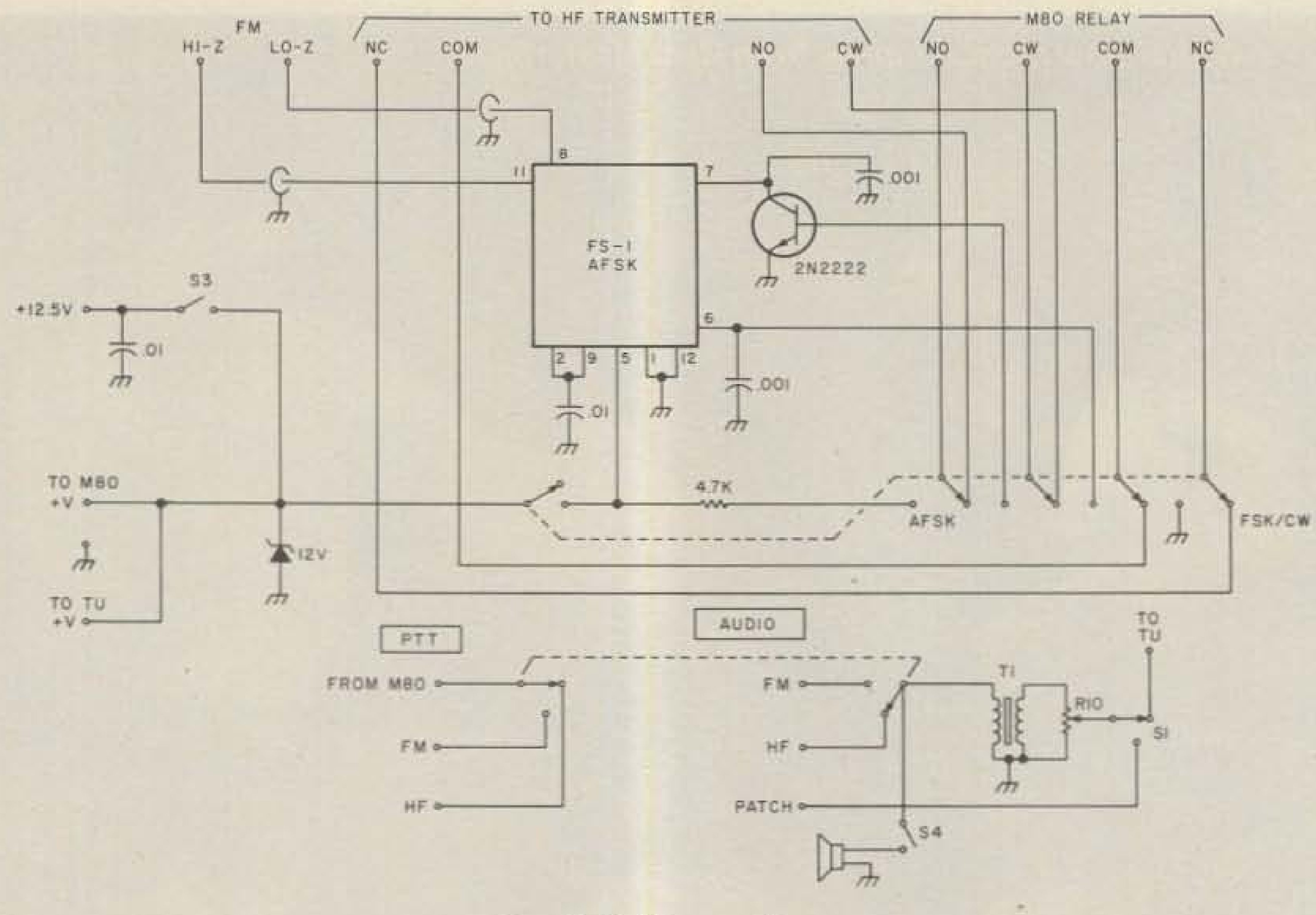

Fig. 4. Cabinet wiring.

space LED indication and meter response and print garbage. The only difference in receiving AFSK, as opposed to FSK, with the function switch in the AFSK/Reverse position is that you are now receiving the 2125-Hz signal on the mark LED. This is due to the fact that AFSK mark and space frequencies are reversed for VHF operation. Therefore, the tuning of the filter controls must be monitored on the mark LED and the first tuning (if not channelized FM) done on the space LED and M80 meter. It is easiest to tune in the normal manner and then switch to AFSK.

For CW or AM signals on HF (such as AFSK), you may find that switching the limiter out of the circuit will provide better reception when noise or interference is present. When this is done, the input level should be adjusted to maintain a reliable switching point and compensate for the hold-in range of the switched-out limiter. The same level adjustment should be made when switching out the bandpass filter to copy shifts wider than 170 Hz.

Referring to Fig. 4, the FSK/CW-AFSK transmit function switch makes all connections for the selected mode. The relay on the M80 interface board is activated by the computer in transmit, but all relay contacts are brought to the TU for the appropriate mode connections. In AFSK, the relay contacts are connected directly to the transmitter vfo.[3] In AFSK, the relay contacts are connected to provide a mark/space keying input to the Flesher AFSK board.

The CW output of the M80 interface is connected to the ID input of the Flesher board through a switching transistor which precludes transmitting the CW ID tone at the same time as the mark tone. When the transmit function switch is in the AFSK position, the mark tone is on and a 2125-Hz signal is sent to the transmitter. The AFSK board has the capability of supplying either 850- or 170-Hz shift. Since only 170-Hz shift is used at my QTH, the 170-Hz position is hard-wired on the AFSK board connector.

Parts List

Part No.	*Description*	*Source*	*Price*
276-153	Plug-in circuit board	Radio Shack	$ 3.69
276-1551	44-pin card-edge connector	Radio Shack	2.99
273-1380	Audio output transformer	Radio Shack	1.29
E7-128	115/12-volt transformer	Circuit Specialists PO Box 3047 Scottsdale AZ 85267	3.19
276-1713	LM3900 quad op amp	Radio Shack	1.39
276-007	741 op amp	Radio Shack	.79
276-2007	2N1305 transistor	Radio Shack	.89
276-2030	2N305 transistor	Radio Shack	.89
276-1617	2N222 transistor	Radio Shack	15/1.98
273-213	12-V subminiature DIP relay	Radio Shack	4.49
276-021	Jumbo LEDs	Radio Shack	2/.89
276-080	LED holder	Radio Shack	2/1.19
276-563	12-V, 1-W zener	Radio Shack	2/.89
270-253	Enclosure	Radio Shack	4.79
276-1995	8-pin DIP socket	Radio Shack	2/.59
276-1999	14-pin DIP socket	Radio Shack	2/.89
275-624	SPST toggle switch	Radio Shack	1.59
275-625	SPDT toggle switch	Radio Shack	1.69
E2-169	2-position, 6-pole rotary switch	Circuit Specialists	1.80
276-1123	1N270/1N34 diodes	Radio Shack	10/.99
276-1122	1N914 diodes	Radio Shack	10/.99
272-1029	220-uF (150-uF) electrolytic	Radio Shack	.89
276-1101	Rectifier diodes	Radio Shack	2/.49
271-210	500k pot (place 270k fixed resistor across for 200k)	Radio Shack	1.09
271-226	500-Ohm trimmer	Radio Shack	.59
271-1714	5k pot	Radio Shack	1.09
FS-1	AFSK board/kit	Flesher Corp.	37.50
M 1143	AFSK board connector	Flesher Corp.	
	Miscellaneous fixed resistors	Radio Shack	4.80
	Miscellaneous capacitors	Radio Shack	6.00
274-392	Knobs	Radio Shack	3/1.99
274-346	Phono jacks	Radio Shack	4/1.79

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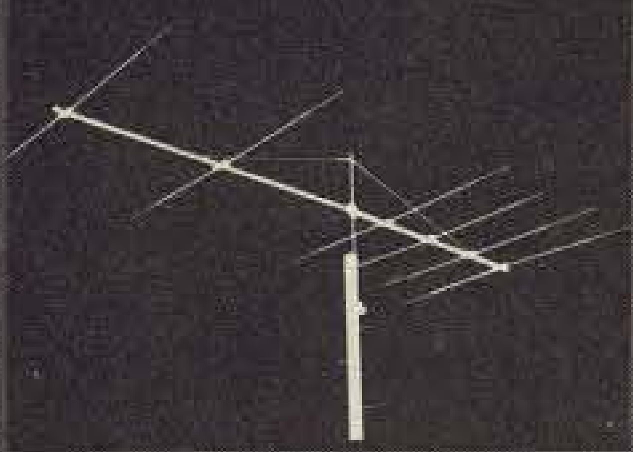

Specifications: (20M-6)
BANDWIDTH: ... 13.9-14.4 MHz
VSWR: 1.5:1
F/B .... 35 dB
FEED IMP.: .... 50 ohms
ELEMENT LENGTH: .... 37 ft.
BOOM LENGTH: .... 57 ft.
WINDLOAD: .... 12.8 sq. ft.
GAIN: .... 11 dBd

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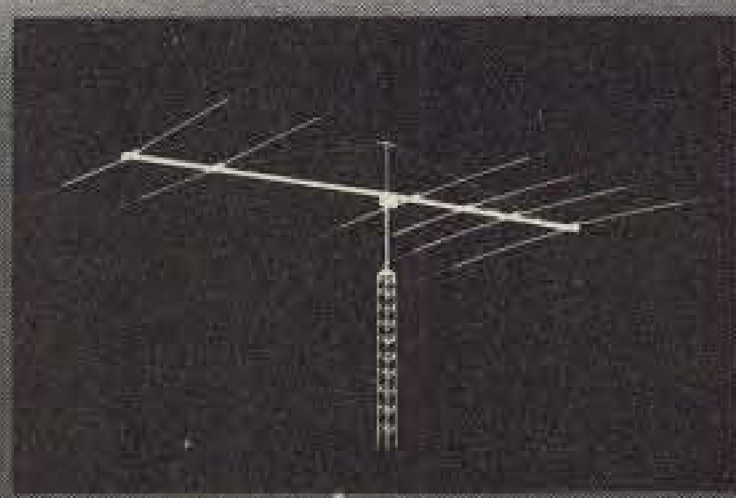
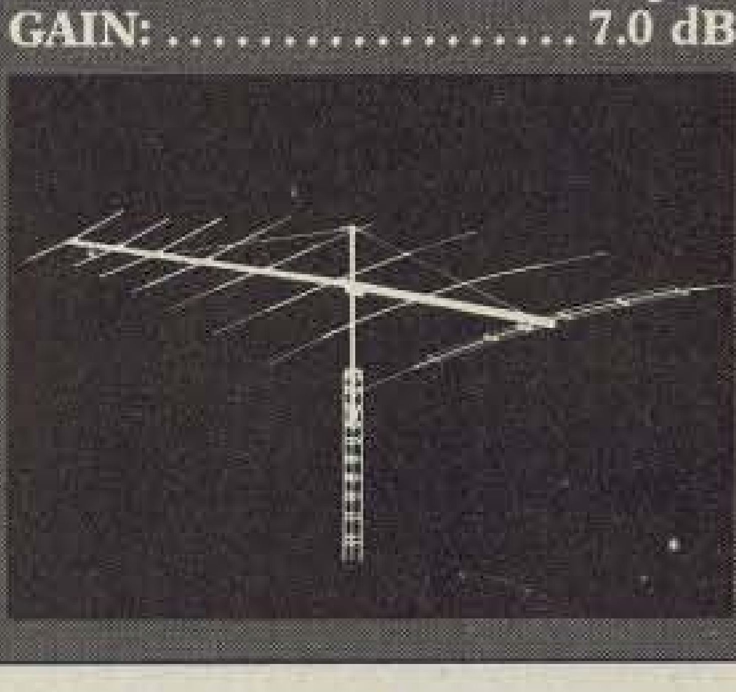
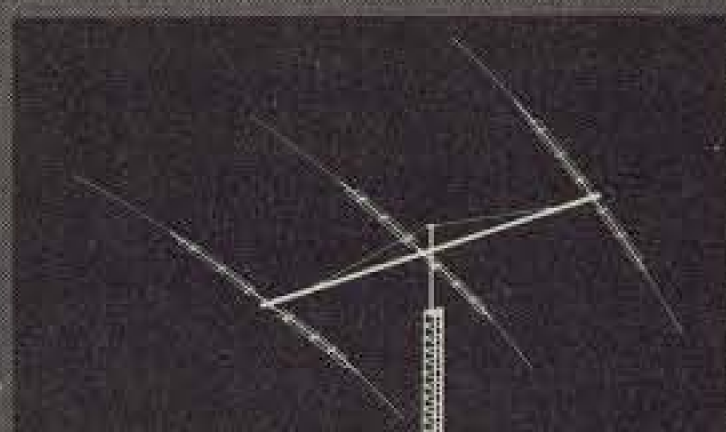


Specifications: (30M-3)
BANDWIDTH: ... 10.1-10.150 MHz
VSWR: 1.5:1
F/B .... 20 dB
FEED IMP.: ... 50 ohms unbal.
ELEMENT LENGTH: .... 35'6"
BOOM LENGTH: .... 24'3"
WINDLOAD: .... 7 sq. ft.
GAIN: .... 7.0 dB



Specifications: (15M-6)
BANDWIDTH: ... 21.0-21.5 MHz
VSWR: 1.5:1
F/B: .... 30 dB
FEED IMP.: .... 50 ohms
ELEMENT LENGTH: .... 25 ft.
BOOM LENGTH: .... 36 ft.
WINDLOAD: .... 8.5 sq. ft.
GAIN: .... 10.5 dBd



Specifications: (7.2/10-30-7LPA)
BANDWIDTH: ..7.2/10-30 MHz
VSWR: .... 2:1 typical
F/B: 10/15
FEED IMP.: .... 50 ohm unbal.
ELEMENT LENGTH: .... 46 ft.
BOOM LENGTH .... 42 ft.
WINDLOAD: .... 12 sq. ft.
GAIN .... 3/7 dBd typical

Most rigs will take the low-Z output of the AFSK board, but both the levels are brought out to the rear panel for use as required.

The FM/HF switch selects both the audio and push-to-talk relay line from the desired transmitter. When using the M80 interface unit with the M800 software, a PTT module is provided which automatically activates the transmitter. The M80 PTT output is the control line which is switched in the TU.

For CW operation, the CW/Space Only switch is used to inactivate the mark circuitry in the TU. Only the space LED is used for tuning with the filter controls, to provide maximum M80 meter deflection. The threshold control can be used to set the switching level to prevent lower-level adjacent-signal interference. In CW transmit, the transmit function switch connects the CW output of the M80 through the TU switch to the transmitter key input. This same connection is made for FSK.

Operation has been both gratifying and educational. It is interesting to watch the independent fading of mark versus space signals, as shown by LED brightness and M80 meter deflection. The only other evidence of poor copy occurs when the signal of interest fades while a background signal, which was not heard before, increases in strength and captures the limiter. Good copy has been obtained on low-level signals which are not strong enough to provide an LED indication. ■

References

1. *Specialized Communications Techniques*, ARRL.
2. "Active Bandpass Filter for RTTY," Nat Stinnette W4AYV, *Ham Radio*, April, 1979.
3. "Welcome to the '80s," F. Dale Williams K3PUR, *73*, July, 1980.

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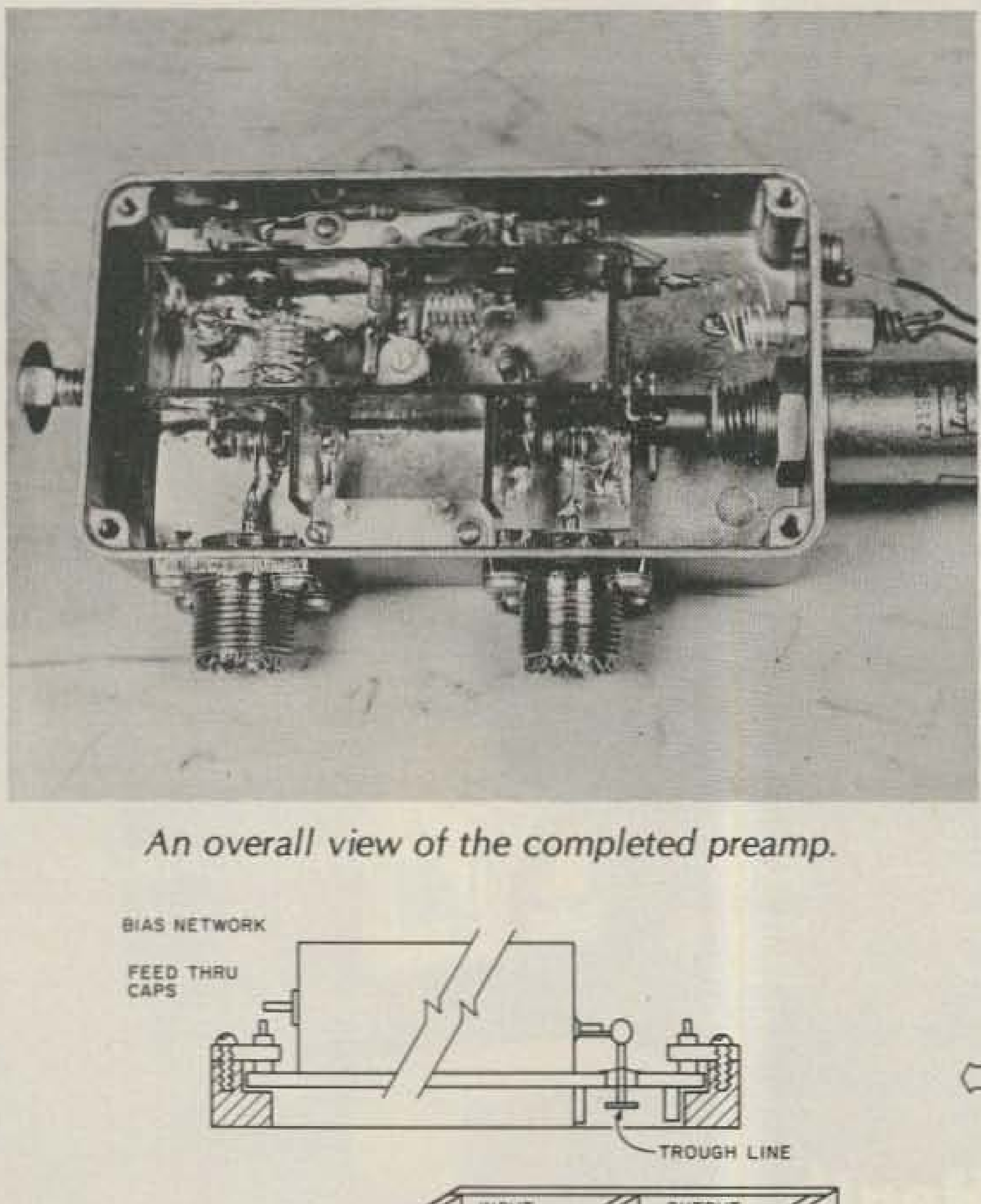

An overall view of the completed preamp.

After many years of 2-meter FM operation, I found myself increasingly interested in SSB operation on the lower portion of the band. After spending an evening in the shack with Don WB8ZTV and hearing for myself the potential of SSB and CW operation, I was soon the proud owner of a brand new all-mode rig.

The old 11-element vertically-polarized beam soon went to its storage place (holding up tomato plants) and a homemade 6-element horizontal took its place on the tower. Local FM operation was unaffected by this change, and contacts out to 75–125 miles were possible with the 10-Watt output of the all-mode rig.

A 4CX250 amplifier that provided around 300 Watts output in linear or Class C had been around for a while and this enabled occasional contacts in the range of 150–200 miles. Before anyone scoffs at the limits, let me remind them that this area of West Virginia is quite hilly and that I live well below the tops of the surrounding aforementioned geographic features; hence, I felt reasonably pleased with the performance of my equipment.

My only problem was listening to Don run his weekly SWOT net and realizing that I didn't hear half of the stations that he was routinely conversing with week after week. Now, don't get me wrong, I fully realized that he had a superior location, stacked 88-element super whizbangs, and an antenna-mounted GaAsFET preamp, so I decided that my first project would be to try putting together a respectable preamp to mount at the antenna.

After researching several articles on preamp construction, it became apparent that one of the major problems and least discussed chores associated with remote devices such as this was switching the preamp in and out of the transmission line during use.

Fig. 1. The approximate method of fabricating the double-sided printed circuit board base and shielding of the preamp. The shields are covered with copper foil "lids" that are soldered to the edges of the shield enclosures. The drawing also shows the mechanical details of the switching contacts.

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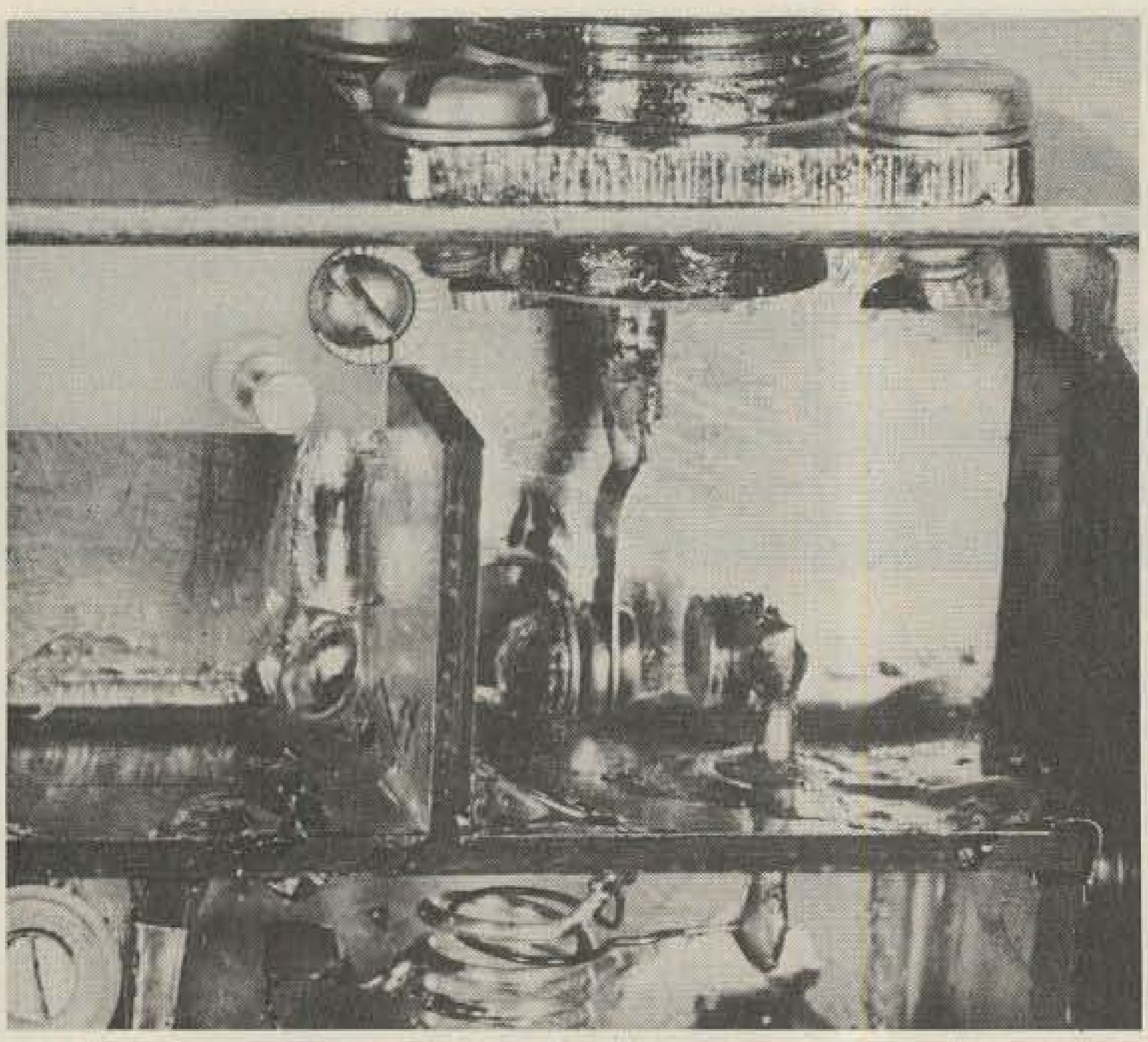
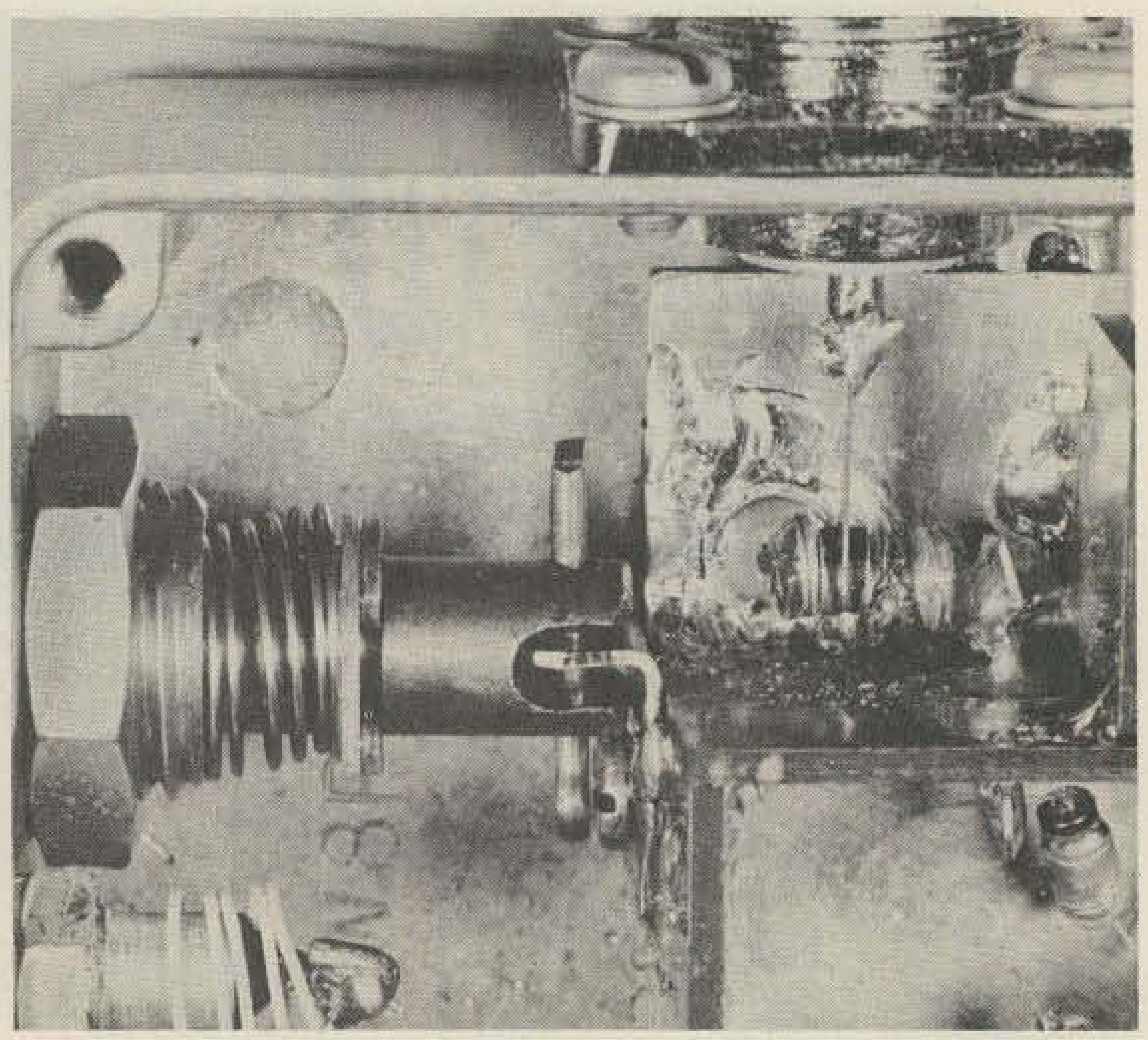


A detailed view of the input contacts of the preamp. The glass feedthroughs are visible, and the method of attaching the relay contacts to the feedthroughs can be seen.



Some details of the output end of the preamp. The relay contacts and the mounting of the solenoid are seen. The copper foil covers of the preamp shields are not in place.

Being a peculiar type of person that hates to cut and strip coax for BNC connectors, I felt that there had to be another means of switching a device like a preamp without the need for multitudes of ¼-wave cables and 2 BNC-type relays. What could be simpler than making the whole PC board (containing the preamp circuits) switch back and forth with a solenoid?

After several attempts, the mechanical layout shown in Fig. 1 was produced. The rf circuit does not represent the state-of-the-art in VHF rf amplifiers, but it does serve to illustrate the concept. With the addition of a few more contact strips, it would be possible to either ground the input and output of the preamp during transmission or switch them to ground through 50-Ohm resistors. The latter method seems to be the manner of choice when using GaAsFETs.

The preamp is switched out of the transmission line until the solenoid is energized. Power for the preamp is now supplied separately through an extra pair of wires in the antenna rotor cable. A 24-volt-dc supply is used, and an LM317 adjustable voltage regulator is now inside the preamp box. Remember to include the bypass capacitors on the regulator input and output. The solenoid is also shunted with a 1N4004 diode to protect against the voltage spike produced when the magnetic field collapses on turn-off.

Isolation of the preamp circuit during transmission is at least as good as some of the VHF BNC relays and could be increased by physically increasing the spacing between contacts. The design routes the rf path during transmission to the underside of the double-sided PC board where it forms an air-insulated troughline between the PC board and the diecast box. Granted, there would be other ways to improve the impedance bump that this arrangement produces, but it is no worse than the average swr indicator.

I plan to eventually dedicate an MGF-1400 GaAsFET to the MRF-901's role, but it did provide a wealth of experience in rf amplifier design at a low cost. The original circuit (Fig. 2) proved to be extremely unstable, even with several changes of transistors, and the circuit of Fig. 3 eventually evolved. It was much easier to tame while still providing usable gain. The instability is a function of the device and only means that the MRF-901 is really a poor choice for a 2-meter rf preamp. Anyone who would like to check out that statement is referred to an article by B. H. Krauss WA2GFP, in the December, 1981, issue of *QEX*.

Construction

The circuit is mounted inside a diecast metal box approximately 4.5" × 2.5" × 1" (Hammond 1590B). Input and output connectors shown are SO-239, but BNC- or N-types are easily substituted. A fine saw is used to cut a slit in the center pin of the connector in order to mount the fixed contactor (salvaged from a 5-Amp DPDT relay). The saw blades are available from X-acto® and can be found in any hobby or hardware store.

The feedthrough connectors are an item I picked up in a flea market and are

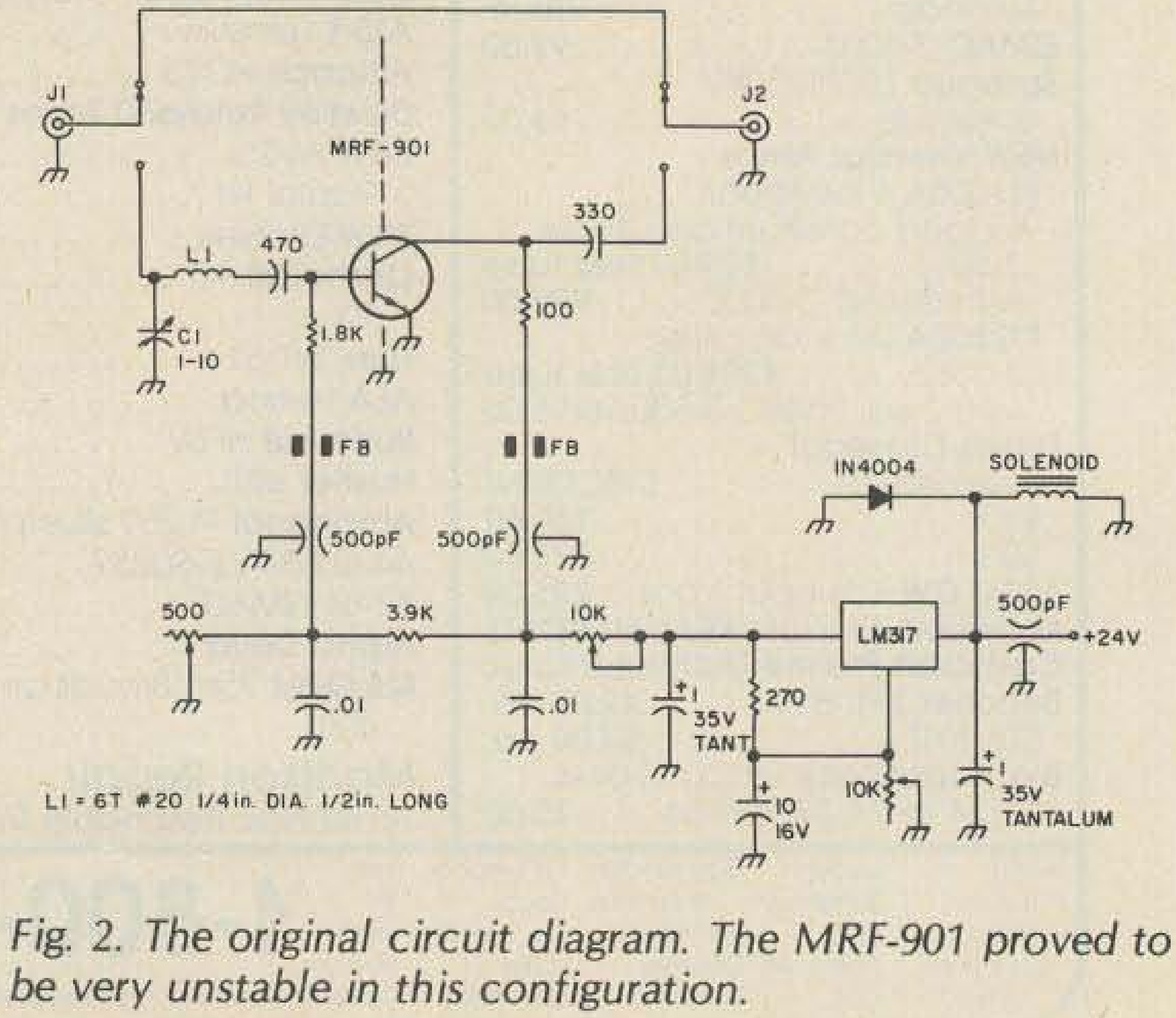


Fig. 2. The original circuit diagram. The MRF-901 proved to be very unstable in this configuration.

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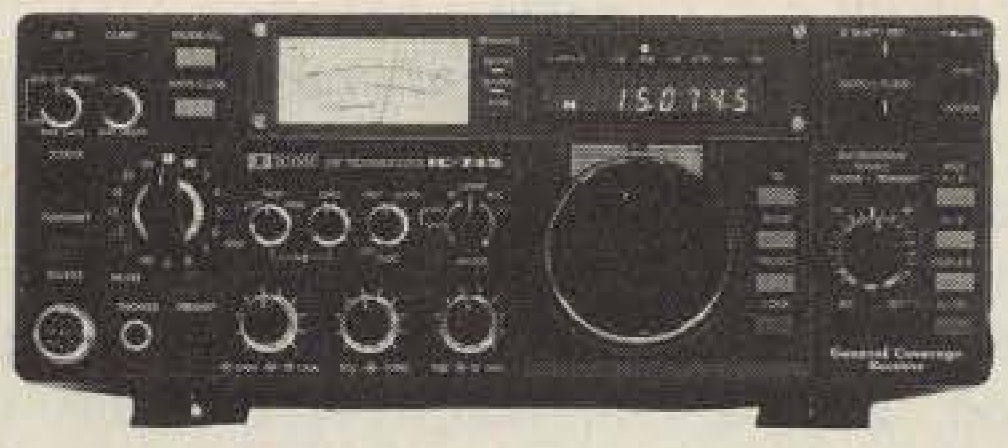

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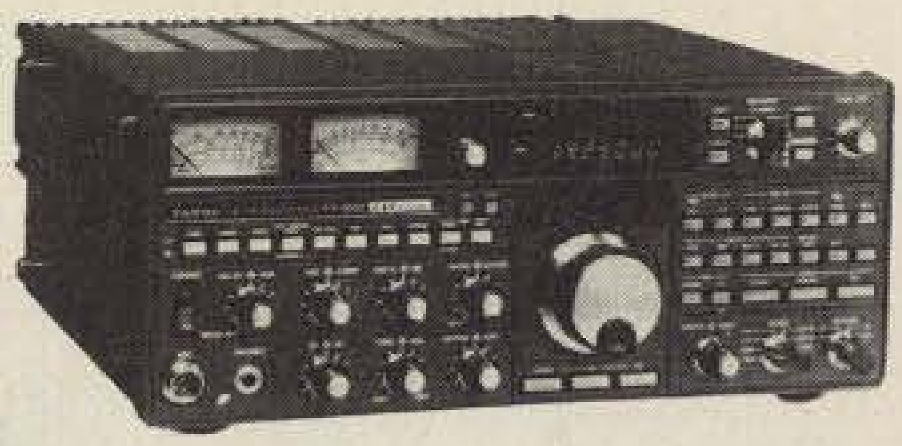

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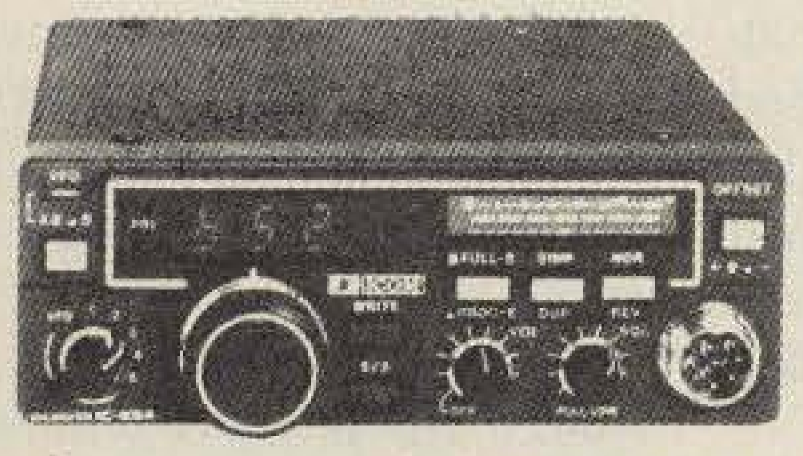

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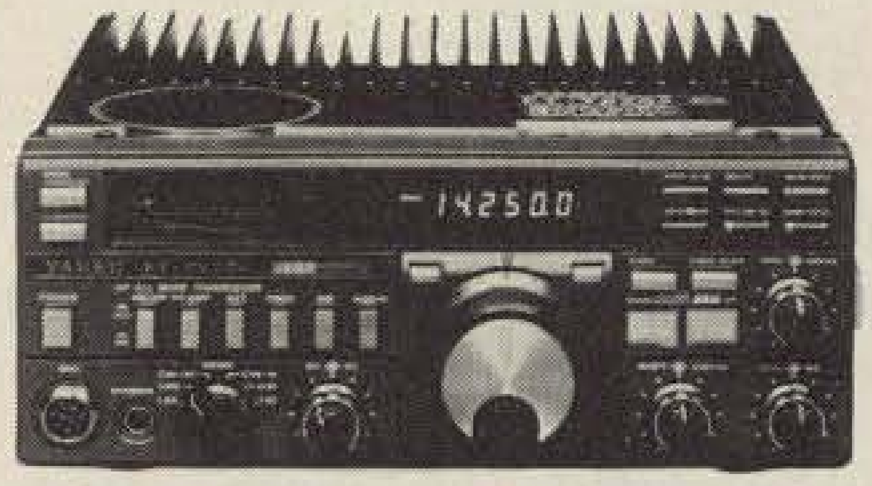

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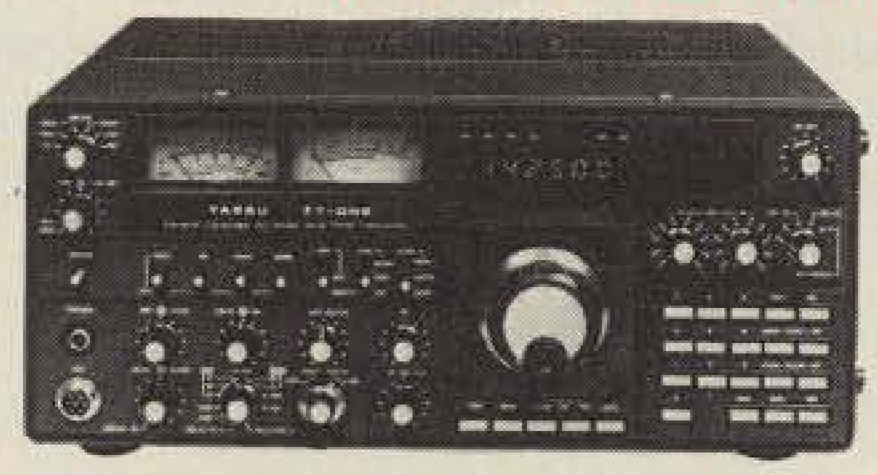

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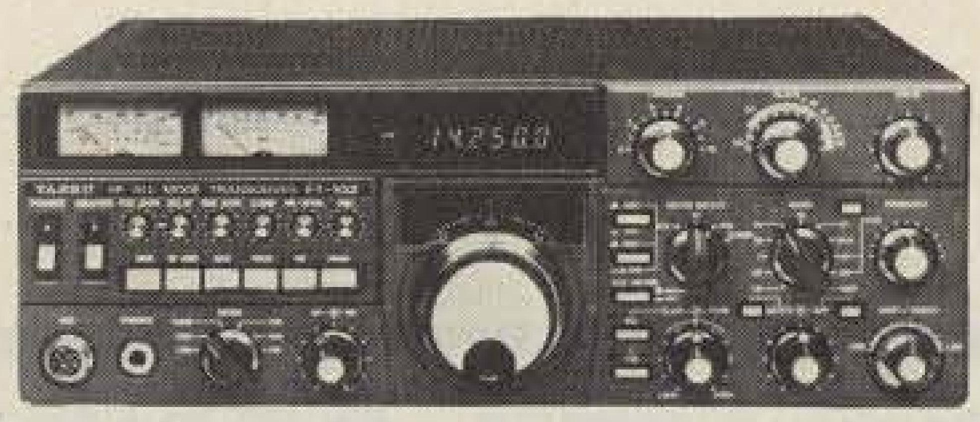

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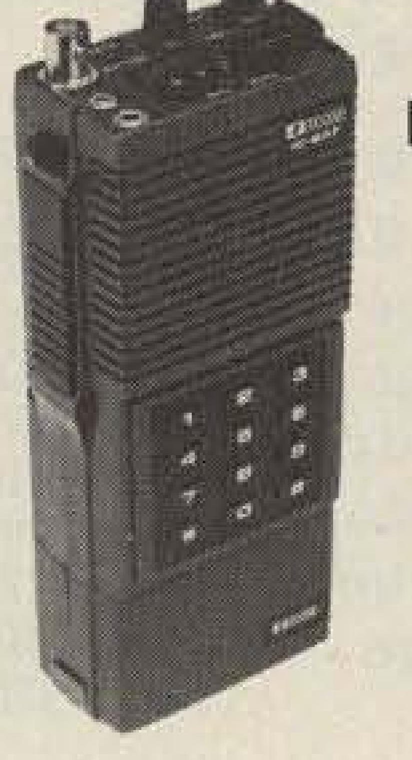

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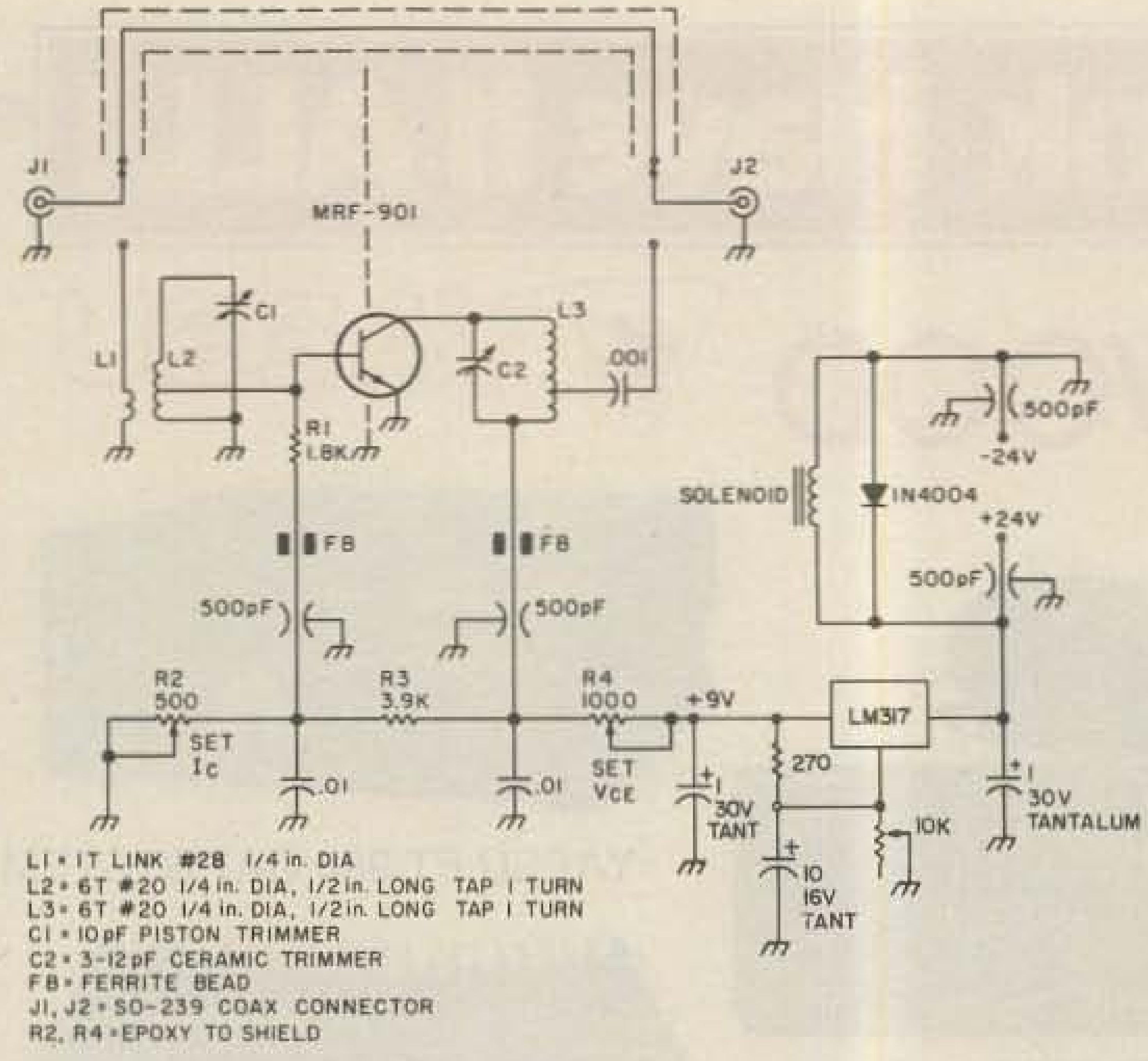

Fig. 3. The final circuit that was used in this version. It is reasonably stable once the initial tune-up is completed. It is much more narrow-banded than the original.

glass insulated. They represent the only parts that might have to be specially fabricated and might be substituted by using brass rod epoxied in the center of brass grommets. These are available anyplace that sells sewing supplies. The silver contacts for the relay end should be soldered to the rod before trying to fill in the epoxy resin. I made loads of these for feedthrough use years ago, and they can be made by sticking the rod into a wax block (paraffin canner's wax), centering the grommet, and filling in the center of the grommet with epoxy on a small screwdriver blade.

The PC board is mounted on a pair of brass rails that act as guides during the mechanical shifting. A springy piece of finger stock maintains a good ground contact on the underside of the PC board during operation. Teflon® blocks are attached to the side rails and are used to hold the PC board. Any method that will permit good electrical contact with freedom of motion should suffice.

The solenoid used is a Ledex #12180133-REV A. It just surfaced in the junk box; however, it is possible to modify any screw-mounted solenoid to perform the task of pushing the PC board into its preamp position. There is sufficient spring tension to return the PC board to the neutral, or transmit, position when power is removed from the solenoid. Radio Shack is currently selling a 12-volt solenoid that should be usable.

A final construction tip is to drill and tap a hole on the end of the diecast box that will allow you to run a ¼-20 screw into the shielding to manually switch the preamp to receive position during tune-up.

I would not recommend trying to use the Hammond box out in the weather. It is not waterproof, and the solenoid, having a steel armature, will probably rust and freeze up if used where it can get wet. The whole assembly should be packaged inside a weatherproof enclosure of metal or plastic if it is mounted at the antenna. ■


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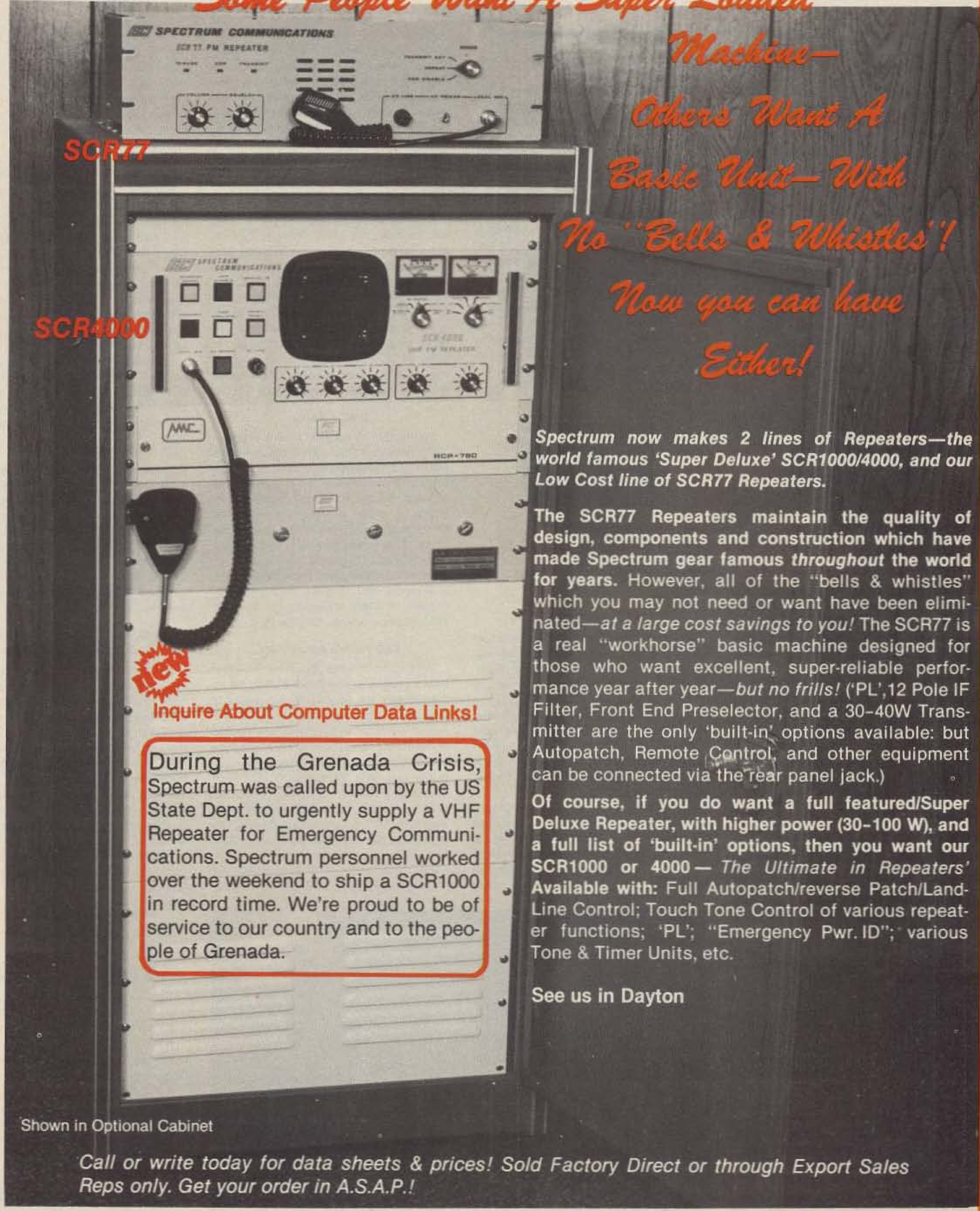

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73 INTERNATIONAL

Each month, 73 brings you ham radio news from around the world. In this collection of reports from our foreign correspondents, we present the latest news in DX, contests, and events, as well as keep you abreast of the technical achievements of hams in other countries.

If you would like to contribute to your country's column, write to your country's correspondent or to 73: Amateur Radio's Technical Journal, *Pine Street, Peterborough NH 03458, USA, Attn: Jack Burnett.*

AUSTRALIA

Jim Joyce VK3YJ
44 Wren Street
Altona 3018, Victoria
Australia

It has been claimed that no two nation's people are more alike in all ways than Australians and New Zealanders. Considering our common heritage, it is not surprising that there were moves in the late 1900s to make New Zealand another state of Australia, but the plans were eventually dropped.

With New Zealand being closer to the eastern states of Australia than our own West Australian city of Perth and with, up until lately, no travel restrictions between our two countries (e.g., passports, health certificates, etc.), it is no wonder we have a unique relationship with our Kiwi (as we call them) neighbors.

With this in mind, the annual VK-ZL-Oceania contest has a special significance to both of us in further cementing our close relationship via amateur radio. Sponsored jointly by the WIA and NZART on alternative years, this contest aims at attracting overseas participation looking for contacts in those areas.

This year there should be a good chance of picking up a rare one with Warrick ZL8AFH from Kermadec, if he gets the time with his work load—and also if he gets his amateur gear fixed. At the present time, he is waiting for an air drop of either another rig or parts to repair his own gear. Warrick also has been heard using commercial marine gear, operating on both 40 and 80 meters, the frequencies being 3874-3855 and 7774.

David VK0CK is operating from Macquarie Island; with an added bonus of a six-meter beacon in operation from this location, VK0GL should be active from Mawson with an interest in both HF and VHF.

I cannot guarantee that these stations will be on frequency during this contest, but with most of the South Pacific islands having at least one or two Australian or New Zealand amateurs as residents, the chance of picking up a new one is quite good.

This contest is held on the first and third weekends in October each year, with phone on the first weekend and CW on the third. The contest lasts for the full 48 hours each weekend.

We in VK have lately been given extensions to our frequencies of operation, two of which should be of interest to DX operators, considering the downturn in the sunspot cycle. We now can operate on 40 meters from 7000 to 7300, and we have a DX window of 3795 to 3800 on 80 meters.

When listening, please don't forget that our Novice operators can operate only on 10 meters up to 28600, on 15 meters up to 21200, and 80 meters up to 3625. With only 30 Watts PEP output allowed, you will have to listen real hard to hear them, with the band conditions of late.

Any queries regarding VK contests in the 1981-1984 period should be directed to our Federal Awards Manager, Reg Dwyer VK1BR, PO Box 236, Jamison, Australian Capital Territory 2614, Australia.

Good luck in the contest!

BRAZIL

Gerson Rissin PY1APS
PO Box 12178, Copacabana
20000 Rio de Janeiro, RJ
Brazil

RFI SYMPOSIUM

Sponsored by the Brazilian Amateur Radio League (LABRE) and the National Telecommunications Department (DENTEL), the symposium was held in the city of Porto Alegre, the first such trying to solve RFI problems between the radio operators and the sound listeners. The most important factories of sound equipment in Brazil were represented, among them, Philco/Hitachi, Sharp, Telefunken, Sanyo, and Evadin.

According to Brazilian laws, the participants agreed that RFI should always be considered as due to the sound equipment, and all complaints must be met by the factories. This decision made the radio operators happy, and it was a big step toward solving also the TVI problem, when sometimes it is due to the TV manufacturers.

WORLD COMMUNICATIONS YEAR STAMP

To commemorate World Communications Year, the Brazilian Post issued a special stamp. A must for collectors, the stamp shows the domestic Brazilian satellite and is printed in offset, in blue and orange over phosphorescent gummed paper. If you are interested in the special stamp, you may request it from: Divisao Central Filatelica, Edificio-Sede, ECT, SBN, Conjunto 3, Bloco A, 20º andar, 70002 Brasilia, DF, Brazil.

144-MHz EXPEDITIONS

During the last weekend of June, 1984, will be held the Third 144-MHz Expeditions, an event which brings together Brazilian operators interested in propagation experiences on the two-meter band. The expeditioners reach the top of the higher hills with their equipment—generators, antenna arrays, etc., doing their best to make long-distance QSOs. Last year, in spite of poor weather conditions, more than 1,500 long-distance QSOs were made by about fifty expeditioners.

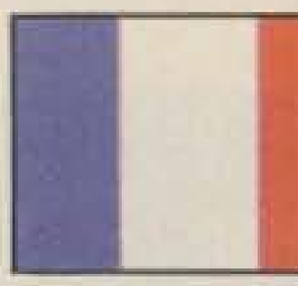
DMS AWARD

Sponsored by LABRE in the state of Mato Grosso do Sul, the DMS Award is available to all licensed amateurs for confirmed contacts with PT9 stations as follows: South American countries: 10 contacts; other countries: 5 contacts. QSOs must have been made after February 2, 1978, on any amateur band and any mode. No QSLs; send GCR list of PT9 stations worked (call, date, time, band, mode, and report) and 15 IRCs for mailing expenses to DMS Manager, PO Box 08, 79100 Campo Grande, MS, Brazil.

SAO PAULO A/Z AWARD

Sponsored by the Brazilian Amateur Radio League of the State of Sao Paulo (LABRE-SP), the Sao Paulo A/Z Award is available to all licensed amateurs for confirmed contacts with 26 stations located in the state of Sao Paulo (PY2) which have all 26 different letters, considering only the last letter of each call. Example: PY2XXA, PY2XXB...PY2AAY, PY2ABZ. Contacts must have been made after August 1, 1977, on any amateur band. Only two-way CW mode. No QSLs; send GCR list of stations worked (call, date, time, band, mode, and report) and 15 IRCs for mailing expenses to LABRE-SAO PAULO, Diretoria de Concursos e Diplomas, PO Box 22, 01000 Sao Paulo, SP, Brazil.

Gerson PY1APS and his wife, Mirian PY1XBT, and their twin daughters, Natasha and Tatiana.



FRANCE

Claude Guee F1DGY
11 Rue Emile Labiche
28100 Dreux
France

FRENCH LISTENERS (FE)

For two years new French SWLs have not been receiving official licenses. As a matter of fact, before the CB legalization and during the big growth of CB, many CBers asked for this FE call (free of charge), this way getting the official OK for their antennas. Next year, it is likely they will be issued again, nevertheless with, probably, two alterations: an annual charge (why not!), and no official OK for an antenna. So, till then, don't be afraid to receive some French SWL QSLs with calls like REF, URC, or eventually, FEM, instead of the official FE. In fact there are provisional "calls" issued by different ham associations (association code numbers).

70-CM BAND

In 1984, a new band plan will be used for a maritime radio-navigation system called Syledis. French hams living near coasts and harbors are rather worried; they have to share the 430-434-MHz part exactly in the new UHF repeater's band. Some years ago, this part was unused. Fortunately, Syledis is known as a very excellent system, and QRM could be weak. We'll wait and see...

COLUMBIA, STS-9, W5LFL, AND EUROPEAN SPACELAB

For this event, the French broadcast station Europe 1, thanks to its scientific reporter Albert Ducrocq, had the bright idea to light up the Greenwich meridian (and also partly the Paris meridian) when the shuttle crossed this line, for the beginning of this mission. This was done with hundreds of headlights along about a 180-mile line! The center (La Fleche airport) was marked by a fiery cross. Thanks to clear skies, the shuttle's passengers should have seen this winking!

W5LFL was heard by many hams here, and many hoped to receive the first space QSL!

EXPEDITION RUMORS IN 1984

FO Clipperton with W and FO8 hams, and YV0.

SOME FRENCH OVERSEAS AWARDS

The usual conditions apply to these awards. Sent certified log extracts only. QSLs are not required.

1) *FO: Tahiti*—6 contacts with FO8 stations; fee: 12 IRCs; manager: Radio Club Oceanien, BP 374 Papeete.

2) *FK: Nouvelle Caledonie*—6 contacts with FK8 stations; fee: 12 IRCs; manager: Guy Francois FK8DH, Villa 55 Tontouta.

3) *FP: Saint Pierre Et Miquelon*—Two classes: phone, 3 contacts with FP stations, and CW, 2 contacts with FP stations; fee: 3 IRCs; contact after January 1, 1981, manager: Henry Lafitte FP8HL, BP 1107, 97500 St. Pierre et Miquelon.

4) *FY: Guyanne*—6 contacts with FY stations; fee is 3 IRCs; manager: Christian Loit FY7AN, Cite Rebard, BP 746, 97305 Cayenne. (Note: In French Guiana there is a 50,035-MHz beacon call: FY7THF (100 Watts, GP antenna); Send reports to FY7AZ, BP 1001 Cayenne.)

5) *Diplome des Ameriques Francaises*—Certified contacts (after January 1, 1966) with 2 FP8s, 2 FG7s, 2 FY7s, and 1 FM7 or FS7; for Asian or Oceanian stations, only one contact is required; fee: 10 IRCs; manager: Alex Desmeules VE2AFC, 2525 La Fleche Sainte Foy, Quebec G1V 1J9, Canada.

GREAT BRITAIN

Jeff Maynard G4EJA
10 Churchfields
Widnes WA8 9RP
Cheshire
England

THE UK SCENE

By the time you read this, the flight of W5LFL in *Columbia* will be some months old and will have entered the realm of ham folklore. However, as I write this piece, the shuttle has barely landed and I guess the computers are still warm.

You might be wondering why I have chosen even to mention the project knowing it will be so long before this is in print. I am doing so because I feel that there is a lesson to be learned and a message to be repeated loudly to all hams. The message is, of course, do not let us have another ham in space.

Please don't give up reading in disgust at this point, thinking I am a head-in-the-sand merchant against progress and innovation. Far from it; I do like to see new activities, new ventures, and new technology. I also think the entire shuttle program is a marvelous tribute to American technological know-how, and W5LFL is my new hero.

Why then, the antipathy towards any further such missions? Well, this is largely because, I am sorry to say, W5LFL's trip brought out a side of amateur radio I would not wish to see again. I will explain this, but first some background.

There has been keen interest in the United Kingdom in the ham-in-space program since it was first mooted about some time ago. When NASA gave tentative approval there was considerable activity. The RSGB magazine, *Radio Communication*, outlined the proposals as did the AMSAT-UK newsletter, *Oscar News*.

With the shuttle flight quite close, *Radio Communication* featured a long article describing the proposed operating method and suggesting likely times of spacecraft visibility in the UK. *Oscar News* featured more detailed information on the orbital parameters expected. As the time of launch drew closer, the Sunday morning news bulletins from RSGB (on 2 meters and 80 meters) gave very comprehensive coverage of the final plans for operating and the expected launch program. AMSAT-UK nets on 80m and on OSCAR 10 talked of little else but the shuttle program, and much time was spent swapping orbital prediction programs and planning strategy.

The RSGB set up a telephone-answering machine giving up-to-the-minute information. (So popular was this, that I ended up calling Westlink in California after trying unsuccessfully for two days to get through to RSGB.) The Sunday morning newscasts became daily, with bulletins each evening at 1700 local time on 80m for the duration of the mission. AMSAT-UK of course was having a field day with nets and special news sheets (even *Radio Communication* for December carried a loose insert with the latest orbital predictions).

So you would expect everyone to know what to expect and to know what to do. I was active for five of the projected overpasses of the UK. I did not hear W5LFL, but I did hear enough to suspect that he would not wish to have had any QSOs with UK stations. First, there were the lids who can't read, didn't read, or just did not believe what they were given by the RSGB. Calling on the downlink was the favorite of course—even by some G3s whose callsigns indicate that they have held a license for at least 15 years (and are presumably, therefore, of mature years).

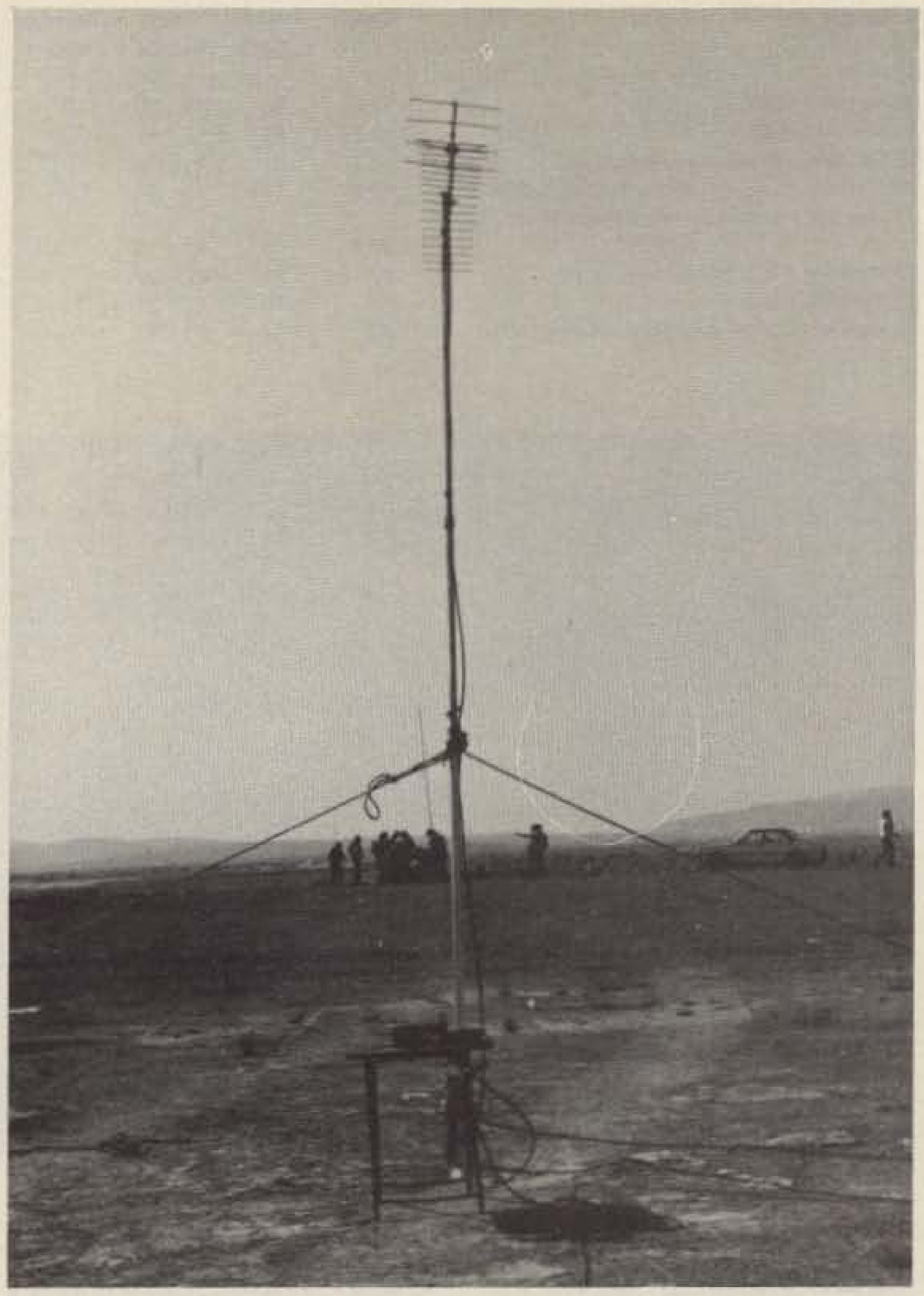
Lids also invented their own brand of brief, short, snappy calls to minimize uplink occupancy: *CQ CQ CQ W5LFL*—and *CQ CQ CQ* Columbia, and *CQ CQ CQ* Columbia, *this is G6??? calling from Puddlehampton in*... all of which was enough to occupy the entire pass, never mind the one-minute listening period. Mind you, stations were heard calling *Columbia* up to one hour before the computed (and much publicized) AOS times.

One could, perhaps, forgive the abovementioned operators for just enthusiasm. But what of the following—

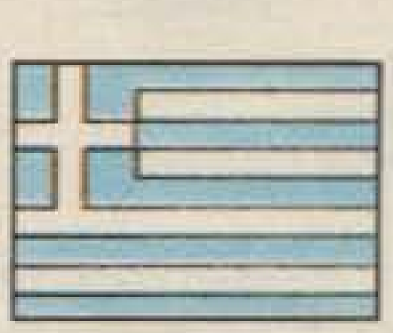
- running RTTY (RYs) on one of the uplink frequencies
- publicly stating that 145.550 (the downlink) is for everybody's use, and calling CQ
- responding with foul language to a polite request to move from the downlink frequency
- telling listeners that the mission is "silly" and threatening to jam if heard
- boasting of running enough power to drown every other UK station

I might have heard more, but I gave up listening. I did not think hams anywhere could behave so badly, but to hear it in England was very sad.

I salute the shuttle program and Dr. Garriott, but please don't give him a rig again.



One of the test antennas.



GREECE

Manos Darkadakis SV1IW
PO Box 23051
Athens 11210
Greece

With AMSAT's new bird, OSCAR 10, the need for a good UHF antenna is a must for somebody who wants to work with it. So, many amateurs in Greece, after the successful departure of the satellite, were thinking of what antenna they should put on. Since Greece doesn't offer many choices for buying goods like that, many of us make our own antennas, but there are not suitable instruments to test them.

So, one day while on a round table on a local channel on two meters, SV1DH promised to bring a very accurate power meter in order to test the homemade an-

Left to right: SV1OE, SV1RJ, SV1DC, SV1IW, SV1DH, and SV1HM.

Left to right (standing): SV1DS, SV1DH, SV1DC, SV1AB, SV1RJ, and SV1RC; squatting: SV1BL, SV1OE, SV1RL, and SV1IW.

tennas along with some commercial ones, too.

The antenna party was organized very fast, and about ten days later on a beautiful Sunday morning, more than 25 SV hams were gathered in Spata, a place some 10 miles east of Athens. This place is a very large area free from obstacles of any kind, as the new International Airport of Athens will be there.

In the transmitting position, an FT-790R UHF transceiver was put with a 23-element Fracaro antenna on a 20-foot mast. On the other end, 200 feet apart, the HP-432A power meter was ready with all the antennas under test.

The measurements for the antennas are in Fig. 1. Note that all of them were put on a similar 20-foot mast just like the transmitting antenna. As you can see, for some of the home-brewers things are not so easy, while on the other hand a few have made very good copies of some popular antennas such as the Jaybeam Parabeam.

Finally, besides all of these measurements, it was a very pleasant Sunday morning; the weather helped a lot for about 25 people to meet and have fun playing amateur radio!

Antennas	Gain	Front to back	Front to side L	Front to side R	Manufacturer's gain
19-element F9FT	12.7	22	18	15	16
21-element F9FT	14	20	17	12	18
88-element Jaybeam's Multibeam	15.2	21	11	13	18.5
15-element Quagi (homemade from SV1RL)	10.5	4	11	14	15
17-element Parabeam (homemade from SV1RC)	12.5	15	11	13	14.9
19-element F9FT (homemade from SV1LY)	8.6	23	22	22	16
23-element Fracaro	9.8	26	22	22	—
13-element K2RIW (homemade from SV1LY)	8.6	17	13	13	—

Fig. 1.

ISRAEL

Ron Gang 4Z4MK
Kibbutz Urim
Negev Mobile Post Office
85530 Israel

THE MASADA EXPEDITION

"Masada? You'll never be able to get a signal out from there down by the Dead Sea!"

That was the kind of reaction received by Dani 4Z4GU and Adam 4X6IY when they let it be known that they were organizing an amateur-radio expedition to this ancient fortress.

The event—the 1983 Scouts' International Jamboree On The Air; the place—Masada, a fortress dating back to the time of Christ situated on a rock plateau overlooking the Dead Sea, the lowest spot on the face of the Earth. Dani and Adam, leading six members of the Tel Aviv Sea Scouts' radio club, ventured out to this foreboding spot, set up 4Z4HS/Masada, and dispelled for once and for all the myth that this area is an rf trap!

A few words about the history of Masada: Situated in the parched Judaean desert, hovering 1,425 feet over the Dead Sea, stand the remains of this stronghold built by King Herod around the year zero. Containing vast food stores and a cleverly-engineered system of drainage canals and cisterns to catch every valuable raindrop, King Herod designed this place to be both his winter palace and a place of refuge from his many enemies, both real and imagined. Perched on top of sheer rock cliff, it was easily defensible.

A few generations later, with the Jewish rebellion against the Roman Empire, Masada was the site of the last stand of the Zealots. Jerusalem fell to the legions of Emperor Titus in 70 AD, and Masada's defenders held out under siege for three more years. Painstakingly building a massive embankment up to the top of the plateau, the Romans were able to bring their catapults and battering rams to the walls of Masada. When they reached the top and entered, they found that the defenders had taken their own lives rather than fall into captivity. This closed the last chapter of Israel's independence in ancient times.

Today, Masada has become a kind of national shrine. Excavated by archeologists, many of its ruins have been reconstructed to give an idea of what it was once like. A few years ago, a cable car was installed to ease the visitor's ascent up the rock face.

Armed with a TS-830, gasoline generator, storage battery, a twenty-foot mast and assorted dipoles, the group from the Sea Scouts made their way from Tel Aviv to the Dead Sea in the Great Rift Valley. Unloading the gear from the cable car, the

The Tel Aviv Sea Scouts on the 1983 Scouts' International Jamboree On The Air, at Masada, overlooking the Dead Sea. (Photos by Dan Shalem 4Z4GU.)

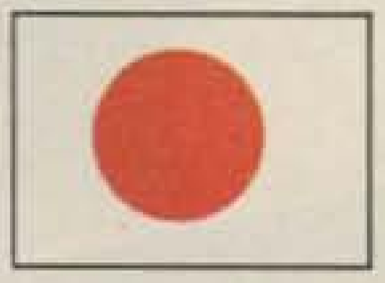
✓See List of Advertisers on page 130

setting up of the station went without a hitch and it looked like clear sailing ahead.

Suddenly a sandstorm blew up from the Judaean desert. The scouts were forced to retreat into a reconstructed building, and when they got back on the air they found that they were in what had once been King Herod's bedroom!

The twenty-meter band was in good shape and good, clear signals were pouring in from Europe and Africa, with weaker ones being heard from Oceania and the Americas. In the finest tradition of the Jamboree On The Air, Dani and Adam's scouts were making contact with their counterparts around the world, exchanging their names and ages. Many pages of the log were filled, and the group felt the venture to be a huge success.

Masada will be on the air again! Dani has invited me to a similar expedition he is planning with the Sea Scouts. So, in October, 1984, keep your ears open for 4X4HS/Masada!



JAPAN

Roy Waite W9PQN
Tomigaya Grand-301, 2-19-5 Tomigaya
Shibuya-Ku
Tokyo 151
Japan

QUESTIONS MOST OFTEN ASKED ABOUT JAPAN

Throughout the years as a resident here in Japan, I have been asked many questions about ham radio in this country, such as regulations, statistical information, etc., as well as many non-ham-related items. Here are some of the most-often-asked questions along with the answers, which I thought might be interesting. This also might possibly be saving of my time so that I don't have to answer the same questions more than once!

Q: How many Japanese hams are there?

A: There are 1,080,000 operators and 576,000 stations at the present time.

Q: Why this difference between operators and stations?

A: In Japan, the operator's license (good for life) and the station license (5 years) are separate.

Q: It looks like a lot of operators don't have a station. Right?

A: Right. Many are high-school and university students who confine their operating to the school club station and have never applied for their own station licenses. Also, in Japan some families have a "family club callsign," which all family members with an operator's permit may use. Another factor is that since the operator's license is lifetime, the big number doesn't reflect those who have lost interest in ham radio.

Q: Since there are so many hams in Japan, I am surprised that the DX Callbook *lists so few. Why is that?*

A: Simply because no one has taken the time to translate the Japanese callbook into English. The Japanese calls and addresses listed in the American *DX Callbook* have apparently either been sent in by the Japanese ham himself or sent in by an American ham friend. Incidentally, the Japanese ham callbook is enormous—as you would expect. It contains 1,500 pages, weighs over 4 pounds, and costs approximately $27.00. And, as stated above, it is entirely in Japanese.

Q: I am a US citizen planning to be in Japan for a month. Can I operate?

A: As of the date of this writing there is no reciprocal agreement yet, but you could possibly operate a club station. The problem is that it takes from two weeks to a month to obtain permission to operate, assuming that you find a club willing to lend you its callsign. The Tokyo International Amateur Radio Association (TIARA) might be able to help you. Just call 585-2236 after you arrive in Japan.

Q: Is repeater operation permitted in Japan?

A: Yes, on 435 and 144 MHz, since 1982.

Q: How about phone patches?

A: Not allowed.

Q: How about fax, RTTY, and slow-scan TV?

A: Yes, they are allowed.

Q: What are the power limitations?

A: The two Novice classes are limited to 10 Watts output; Second class is 100 Watts; and First class generally is 500 Watts although First class is actually open-ended, applications being considered on a case-by-case basis. For instance, I know of one Japanese ham who runs 13 kW legally. In Japanese law, no distinction is made between amateur and commercial regulations. The power limits given above apply to the HF bands. On VHF and higher, the limitation is 50 Watts output.

Q: I understand that the Japanese have another code in addition to the Morse code.

A: Yes, it is called "wabun" and is one of the requirements to obtain a First-class license. When a Japanese operator listens to wabun he writes down Japanese letters on the paper, not English. When you first listen to wabun it sounds like ordinary Morse until you come to some "new" characters—like four dashes, for instance.

Q: Has any American ever passed the Japanese amateur-radio test?

A: As far as is known, no non-Japanese has ever sat for the First-class exam, which would include a wabun exam. But on the other hand, several Americans and others have passed the "denwakyu" or Novice no-code exam. We believe that the first non-Japanese ham to pass the Japanese Novice test was Norman Smith G3HFO in 1970 while he was working for the British embassy here in Tokyo. Since that time several Americans have taken and passed the test, and more recently a New Zealander, Keith Wilkinson ZL2BJR, passed the Second-class test. Definitely a first!

Q: So I assume that those who pass the test can get a callsign and go on the air.

A: No, they cannot! At this writing, only Japanese citizens can receive a station license and callsign. Passing the test gives one only an operator's license, which you could obtain by showing your ham license from your own country if you happen to be American, German, Irish, or Finnish. (So why bother with the Japanese test?) You still need to find a club station to operate. But that may all be behind us by the time you read this, as we soon may have a full reciprocal agreement with Japan.

Q: It is pretty well known that the Japanese are generally law-abiding citizens, so based on that information I would assume that there are not many violations with regard to amateur-radio operators in Japan. Is that right?

A: There are some problems. I am told that many First-class operators apply for low power to escape a station inspection, then operate with 2 kW or more. Also, there is a lot of repeater jamming. Deliberate jamming, apparently. Also, we often observe out-of-band operation on the 40-meter band, which seems to be deliberate as the operators use fake or comical callsigns. The percentage of bad apples is probably very low, but the repeater jamming has really gotten out of hand. We are told that English-speaking hams are special targets for these jammers. This seems to be true. We also have heard singing, dirty talk, and sex tapes on 2 meters from time to time. (Some people cheer them on.) Then, too, there was a problem when Owen Garriott orbitted this part of the world, bringing the jammers out in force. Japanese country-style "enka" music was heard on one of the downlink frequencies, ruining it for everyone. It was a lot of fun. Generally, Japanese hams have a good reputation on the DX bands and are known for their good manners and good operating techniques.

Q: Who is the president of the JARL?

A: Shozo Hara JA1AN is the president of the JARL. He is 57 years old and has been JARL president for 14 years.

Q: Can I save money by buying a rig in Japan and bringing it home?

A: Yes, if you hand-carry it with you. But be sure the rig you buy has an English manual, that the warranty is good in your country back home, that it has taps for 110/120 volts, and in the case of a 2-meter rig, that it covers the entire band and not just 144 and 145 (Japan frequencies). Incidentally, since the companies went to a lot of trouble to set up dealerships in the US and other countries, they prefer that you buy in your own country through those dealers.

Q: I'd like to stay in a Japanese Inn, called "ryokan," in Tokyo. Can you recommend one to me?

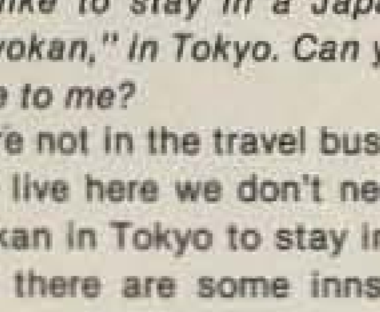
A: We're not in the travel business, and since we live here we don't need to look for a ryokan in Tokyo to stay in, but I understand there are some inns in Tokyo that cater to foreigners. The information desk at the New Tokyo International Airport can provide you with information. Incidentally, the Japanese hot baths are very good for arthritis sufferers like myself. Outside of Tokyo at the various resorts you can find many beautiful inns that you might enjoy. Generally, supper and breakfast are included in the price, which ranges from $40 to $300 a night, per person!

Q: Is English understood widely in Japan?

A: No, not really. You will have no problems at international hotels and restaurants, but outside of that you're on your own.

Q: What one piece of advice would you give to a person coming to Japan as a tourist?

A: Bring large buckets of money! Prices are high here.



LIBERIA

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EL2AL/WB8HFY
Brothers of the Holy Cross
St. Patrick High School
PO Box 1005
Monrovia
Republic of Liberia

How would you like to know all the amateurs in the United States?

Well, in Liberia the amateurs all know each other. When a new call is heard on the air, all the hams want to know who he is, where he lives, where he came from, and what he is doing in Liberia. It is not unlike many small communities in the States. There is one exception, though. Here the new amateur is always welcome and any doubts will be erased on his first contact.

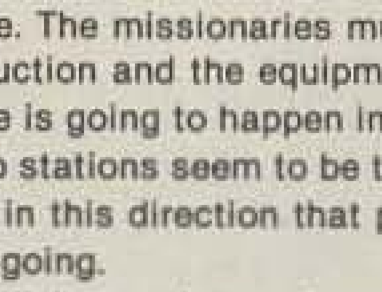
The country, from its northwestern tip to its southeasterly point, runs about three hundred miles, and it is about the same diagonally from southwest to northeast. But in area, the country, roughly rectangular, is quite a bit smaller. Liberia is divided into nine counties. The most densely populated is Montserrado (EL2) in which is found Monrovia, the capital city and the greater part of the Firestone Rubber Plantation. More than half of the hams in Liberia operate from Montserrado County, so many of the amateur operators around the world get the idea that Liberia is EL2-land. Most of the radio amateurs in Liberia are expatriates, and in the Monrovia area most of them are either American or German. The Americans are associated with the embassy, with the Voice of America, or with the administrative offices of various American government activities. Also, a number of Americans are engaged in hospital and dispensary work and in education. The Germans, for the most part, are engineers.

Nimba County (EL8) has seven amateurs and all of them are missionaries. Bong County (EL7) has four amateurs. They are engineers operating an iron-ore mine. Grand Cape (EL9) has four amateurs who are missionaries. Grand Bassa (EL1) had two. One of them has left, so in that county the count is down to one. Sinoe (EL3) has none. Maryland County (EL4) has one. Lofa County (EL5) has four. Grand Gedah (EL6) has one, and all of these are missionaries.

Some of the missionaries up and down Liberia use commercial-type fixed-frequency radios for their business communications and use the amateur radio to keep in touch with their friends both in Liberia and in their homelands. Communication in this country is difficult or nonexistent except for the radio. In the outlying areas there is either no electrical power at all or it is supplied for a few hours a day. Radios in those areas are operated on battery power.

The problem of building amateur radio among the natives becomes more understandable. The missionaries must supply the instruction and the equipment, otherwise little is going to happen in this area. Area club stations seem to be the answer and it is in this direction that present efforts are going.

It would be an interesting project to contact all the amateurs in Liberia. There are less than a hundred. Perhaps one of these years, the LRAA (Liberia Radio Amateur Association) will issue an award for such an accomplishment. Wouldn't it be nice to have a beautiful certificate on the wall of your shack stating that you have contacted every ham in Liberia?



MEXICO

Mark K. Toutjian XE1KMT
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I was recently informed by William Alzaga Ch. XE2WAL, here in Mexico City, that a new link from 10m FM to 2m FM is being installed and used through the Satellite Radio Club repeater (147.030/147.630) so that local hams can operate

Continued on page 152

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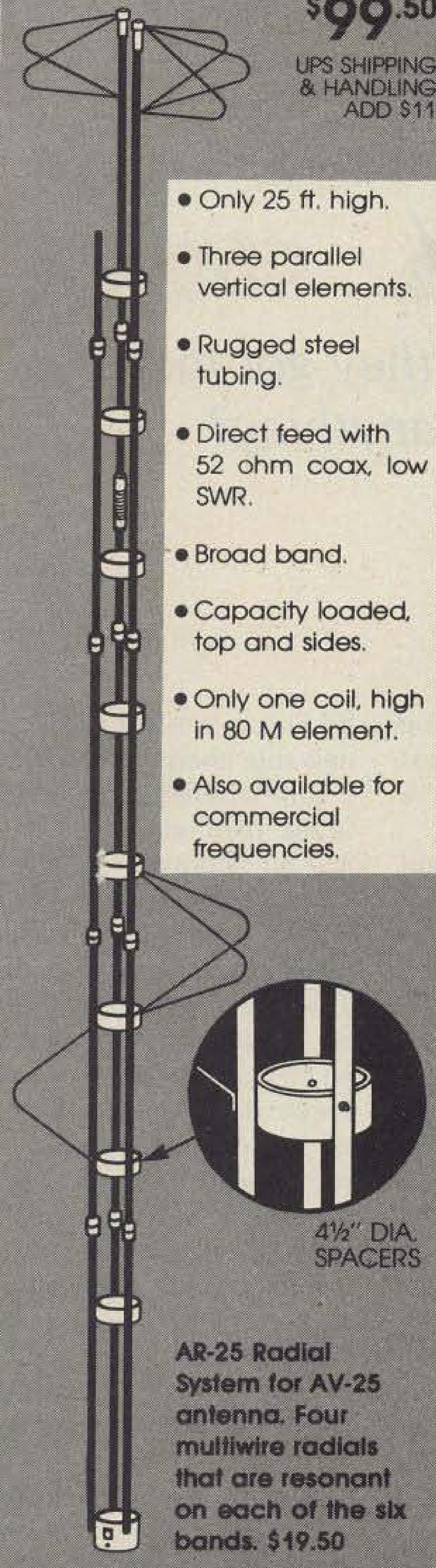

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David A. Smith W8YZ
530 Hollywood Drive
Monroe MI 48161

How to Have a Sunny Field Day

When Michigan hams turned to solar power, they got more than they asked for. Does success mean anything?

Our club, The Monroe County Radio Communications Association, has always earned the natural-power bonus points at Field Day by hand-cranking a generator and using the power produced to operate a 5-Watt CW QRP rig. Believe me, it takes real concentration on the handles when the operator keys down to adjust the antenna tuner.

Well, to a radio ham who is always looking for a better way to improve a station, it seemed that there had to be a better way to earn the bonus points. I had seen a demonstration of photovoltaic power at a local hamfest and it sure seemed like a better way to go.

Battery box, charge controller, and solar panel with (from left to right) Paul DeNapoli WD8AHO, Lee Loose KD8DA, Dave Smith W8YZ, and Ron Loveland KA8RNE.

We contacted Mr. Paul DeNapoli WD8AHO, the Communications Director for The Encon Corporation (27600 Schoolcraft Road, Livonia MI 48150, (313)-523-1850). Paul was glad for the opportunity to demonstrate his company's products. To our surprise, he told us to plan on running at least one solid-state rig of the 200-Watt class for the entire period on equipment that he would loan us for demonstration purposes. We expected only to run a handheld on 2 meters for five contacts.

We took Paul at his word. One of our members supplied an Icom IC-740 for the project. This station was to be operated on both 80-meter phone and CW with capability for other bands as well. We planned to use it around the clock.

The equipment provided by Encon was four Exide renewable-energy, deep-cycle, 6-volt batteries connected in series parallel, 12 V dc @ 370-Ah storage, an Encon charge controller, and three Encon solar panels each measuring 17 by 42 inches. The latter were mounted on an aluminum framework and pointed south under Paul's direction. We expected to need to rotate the framework to follow the sun, but Paul explained that this was not needed.

We started Field-Day operation using the mad-scramble technique which permits 27 hours of operation. The solar installation proved to be easier to set up than a gas generator. Paul brought the whole installation to our site in the back of a compact automobile. All that was needed was to make several connections to the rig and batteries with #10 copper wire and aim the panels south.

We were quickly able to make the needed 5 contacts for the natural-power bonus points. Everything was working fine and we continued to operate the station full bore on both phone and CW.

The charge controller supplied by Encon had a battery voltmeter as well as a separate charge and discharge ammeter. The voltage remained at a steady 13.4 volts while the charge indicator indicated between 1 and 6 Amperes to charge. This was due to the periodic cloud coverage. Under full sun, we had 6.6 Amps. The output ammeter fluctuated wildly between 1 and 20 Amperes while we were operating!

The station was on the air all night and of course there was no charge current to the batteries. The voltage dropped to 12.6 volts. This was quickly recovered, however, with the batteries topping off at full charge by 10 am. The charging current from the panel array was 6.6 Amperes.

It became clear at this point that the three panels and batteries were large enough to run at least one more rig. We had failed to consider how low the full-current duty cycle is with solid-state amateur gear, even during a contest.

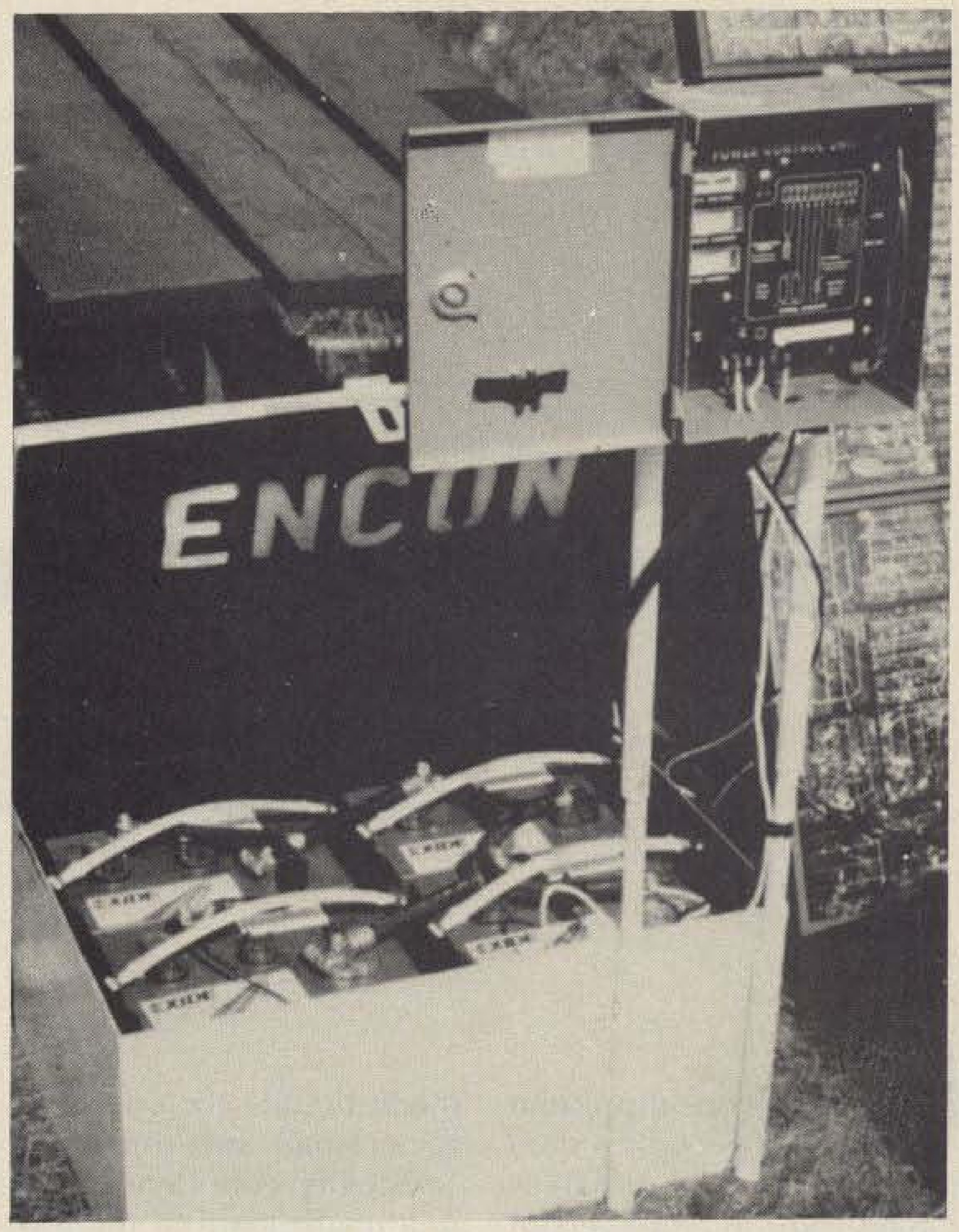
Considering the advantages of solar power for Field Day, one must think beyond multipliers and bonus points. For example, there were a couple of times when the solar station was the only station operating, once because of a breakdown of a generator when a spark plug fouled and another time when there was a fuel-line blockage. It was clear that the solar installation is far superior for emergency applications. Also, there was no ignition noise to contend with when the generator failed. The "ears" on the solar station got even better.

This demonstration of amateur radio was well covered by the press with all area papers giving it attention. The county's general-coverage paper, *The Monroe Evening News*, did a half-page photo story on our Field Day with particular emphasis on the solar-power aspect. This publicity got a lot of attention for our hobby and provided many opportunities for the club members to explain to their friends the hobby with its unique emergency capabilities.

One response is most interesting. The local power company contacted the club and offered to "do whatever is needed," including setting poles and transformers free of charge and providing free power, for any future field activities of the club. They wish to emphasize the dependability of commercial power.

In Michigan, users pay a penalty for "excess use" of electricity. Consumption beyond 810 kwh is charged at a rate of 14¢ a kwh. This means that any optional use of electricity such as amateur radio must be considered to cost the penalty rate. Nearly every ham I know has a part of his electrical consumption in the "excess" category; any home application of photovoltaics must take into account ham operating at the penalty rate.

Also, hams who are especially interested in emergency preparedness would do well to consider the potential of photovoltaic power for their home stations. After all, a widespread outage of commercial power would have no effect on an operational photovoltaic system, while the demands upon a ham who was needed to send health and welfare traffic might well include cleaning spark plugs and gas lines of infrequently used equipment before the traffic could be sent. Clearly, there is an advantage in using something that works every day of the year.■



View of charge controller and battery box.

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L. B. Cebik W4RNL
5105 Holston Hills Road
Knoxville TN 37914

Painless Op-Amp Filter Design

Custom applications can be easy. Just follow this step-by-step guide to a perfect triple op-amp filter.

The triple op-amp audio filter has become a standard, not only in amateur circles but in commercial design as well. Easy to design and nearly foolproof in construction, the various configurations of this filter have found their way into a large percentage of existing ham shacks, either hidden within a transceiver or sitting on the speaker as an audio adjunct. Numerous small companies offer post-receiver audio units using from one to eight filter units.

Even though popular, op-amp filters seem to confuse most ham builders. Despite the low cost of parts, few hams build their own. A simple but effective single filter with a bandpass of between 100 and 200 Hertz would cost about $10.00 for parts, excluding the case and power supply, which together might double the cost. This is a small investment in selectivity, considering what one might learn in the process. Still, there are few takers.

Part of the problem stems from the volume of material that has been written about triple op-amp filters. There are at least three semi-distinct configurations of these filters, but only two different models. However, because designers recast schematic diagrams in different ways, the average ham comes to believe there may be dozens of models. Going even further, different designers choose different circuit values without explaining their choices; the variations seem to grow without limit and without any clear sense. The available books on filter design mire the ham builder in theoretical design math while simultaneously claiming simplicity. There is *some* necessary math to designing a personally-satisfying triple op-amp filter, but it is straightforward hand-calculator stuff.

For the CW buff, most of the existing designs have limitations. Many are fixed-frequency units allowing no tuning to please the ear. The units that permit tuning tend to cover 300 to over 3000 Hz, a fine range for the SSB fan who can use high- and low-pass capabilities built into the filter, but extraneous for CW. A filter that covers a span ranging from 300 to 400 Hz at the bottom to perhaps 1200 Hz at the top would reach two goals. First, the filter would cover the main receiver passband for CW, which runs (depending upon preference) from 400 to 800 Hz wide. Second, the filter would spread its narrower tuning range across the filter frequency dial, permitting the operator to find more easily the desired signal. Unfortunately, most home-brew designers have merely guessed their way into a tuning range.

There is a very direct and easy-to-follow procedure for designing triple op-amp filters in the ham shack. Not only will the procedure ensure a filter that works, but also it will allow the builder to refine the filter's tuning range to his desires. The following notes present a procedure used to design several dozens of different filters for experimental, evaluative, and operational use, and those who have tried the procedure claim they

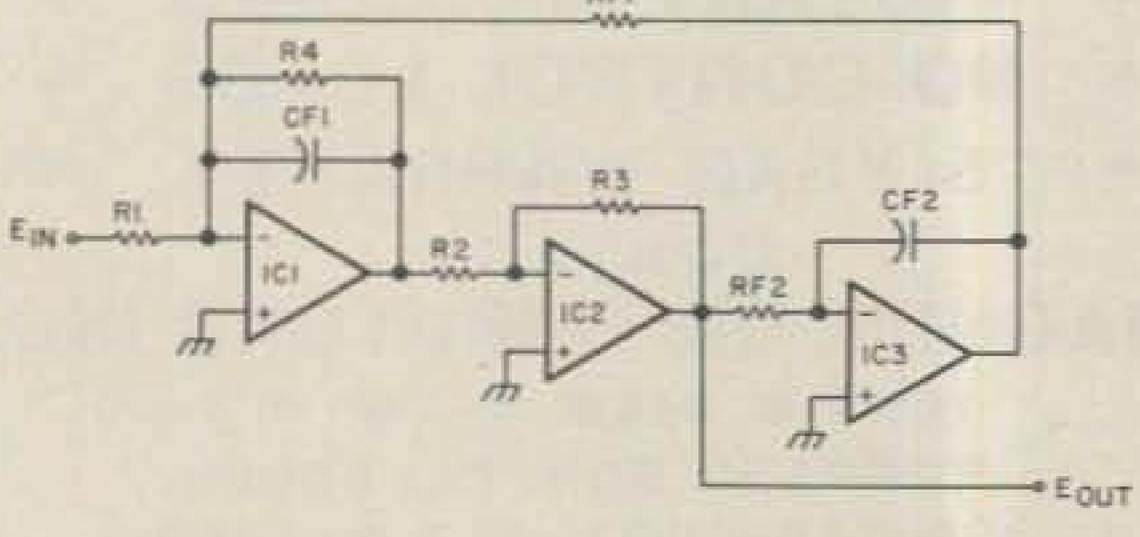

Fig. 1. The basic bi-quad filter.

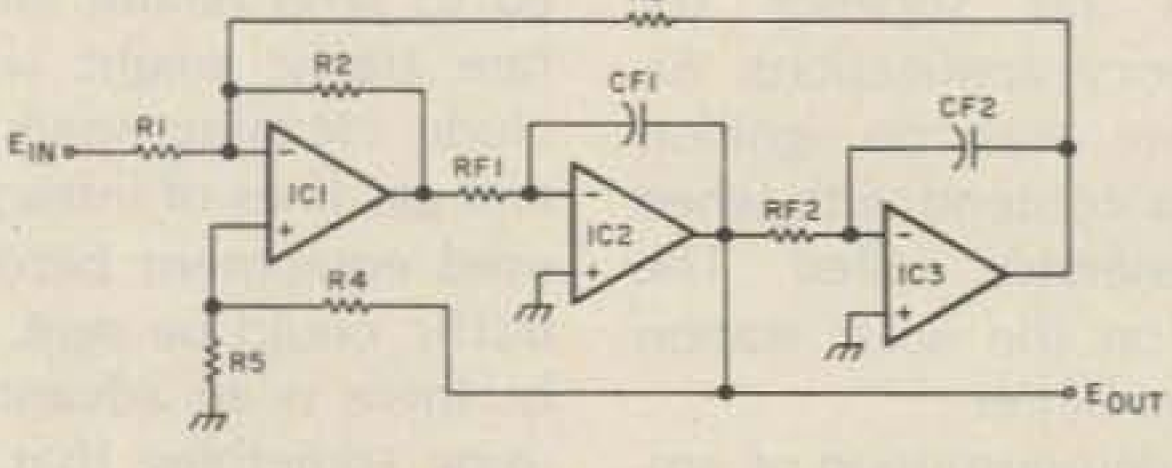

Fig. 2. A basic state-variable filter (−SVF).

have finally made a filter that works and that they like. The procedure even includes steps that show how to let a hand calculator do most of the work.

Some Op-Amp Basics

There are many triple op-amp filter designs but only two fairly distinct types. Unfortunately, the history of op-amp filter terminology has obscured the subject. Originally, the mathematical methods of designing filters gave rise to the name "bi-quad" as a label for all designs. Newer derivations yielded the name "state-variable filter." For some, these names refer only to the design methods; for others, they refer to circuit configurations. At the risk of arousing the wrath of some professional designers, let's follow the latter course.

The bi-quad (or B-Q) appears in Fig. 1. Note that the input op amp is an integrator, as is the third op amp. (Theory aside, an integrator circuit is little more than an op amp whose feedback is provided by a capacitor rather than a resistor.) The middle op amp is an inverter, and we take our bandpass output from this stage. Feedback from the first and third stages is fed back to the first stage input. By controlling the amount of feedback from one of these stages, the first, we control both the gain and the Q or selectivity of the filter. The components marked RF1, CF1, RF2, and CF2 control the frequency of the filter.

Fig. 2 shows the other triple op-amp filter design. The state-variable filter (or −SVF, with the minus sign to be explained very soon) also consists of two integrators, but this time in positions two and three, with a summing amplifier as the input stage. Feedback from the integrators combines with the input signal at the inverting or negative input of the first op amp. We control the gain and Q of the filter by the ratio of resistors R4 and R5, and we set the frequency by the components marked to correspond to those in the B-Q filter. Bandpass output comes from the middle stage, this time an integrator. Unlike the B-Q filter, the −SVF design provides high-pass and low-pass outputs, but at different signal levels than the bandpass output.

The −SVF filter has a near twin which we can call the +SVF. Fig. 3 shows the configuration. The major difference between the SVFs is that this version feeds the input signal to the non-inverting or positive input of the summing op amp. (The reason for the labels +SVF and −SVF should now be clear.) Gain and Q feedback also return to this pin, now being controlled by the ratio of R4 to R1. Although this filter belongs in the SVF family, some of its components require slightly different values from its brother, and the gain vs. Q characteristics will differ. Otherwise, it works perfectly well.

The B-Q and SVF filters have different properties that, for various needs around the shack, give one advantages over the other. First, both SVF filters will have a constant Q and gain throughout their tuning ranges. This means that the bandwidth, when measured in Hertz, will increase as the filter frequency increases. In contrast, the B-Q filter has a constant bandwidth in Hertz, but consequently increases in Q and gain with frequency. For fixed-frequency filters, this phenomenon is meaningless, but for tunable filters, it is important. The constant output of the SVF designs makes follow-up amplification simple. However, every SVF section (i.e., three op-amp filter) requires a dual potentiometer to change RF1 and RF2 together.

The B-Q filter is tunable in the same way but may also be tuned by changing just RF1. Since, like virtually all other filter sections, these filters will ring if the Q is very high, we can cascade two lower Q B-Q sections for a sharper bandpass using only one dual pot. Dual pots are hard enough to find; four-section pots in audio (log) taper are nearly impossible to come by, being either inaccessible or very expensive (which amounts to the same thing for most of us). A newer variety of op amp, the operational transconductance amplifier (OTA), promises to relieve us of these problems, but few practical ham designs using the device have yet to appear.

Notice that there is no clear winner in the contest between the B-Q and the SVF filters. Rather, we must design around their limitations. For example, we can overcome the gain change of the B-Q filter by making the Q resistor, R4, variable, or by following the filter with a limiting amplifier such as the one in Fig. 4. This is the W4MLE variable-compression version of the N6WA Audio Elixir. (See *73* for September, 1979, p. 116, and November, 1982, p. 32.) Until OTAs become more common, there is no way to solve the multiple-pot problem of cascaded SVFs; however, for most work on CW, a single-section, moderate-Q filter requiring just one dual pot will do wonders. A Q of 20 theoretically yields a half-power bandwidth of just 30 Hz at 600-Hz center frequency. Even allowing for low-precision components, we do not need excessively high Q filters to enhance CW. In practice, design Qs in the range of 15 to 20 will yield −6 dB (half-voltage) bandwidths in the 100-to-120-Hz range for a 600-Hz center frequency.

Designing Your Filter

In Fig. 1 through Fig. 3, components having comparable duties have the same designation. For all designs, the frequency-determining components are the same although differently placed. R2 and R3 provide feedback and can be treated as alike in all three cases. In the −SVF design, R1 equals the feedback resistors, while in the +SVF version, it will be half their value. In the B-Q, the input resistor can equal the feedback resistors

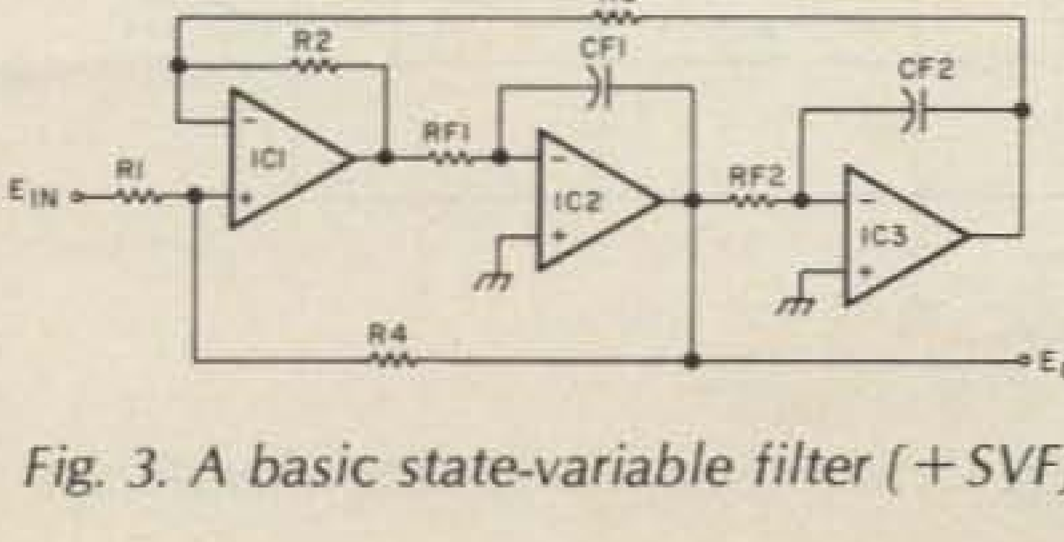

Fig. 3. A basic state-variable filter (+SVF).

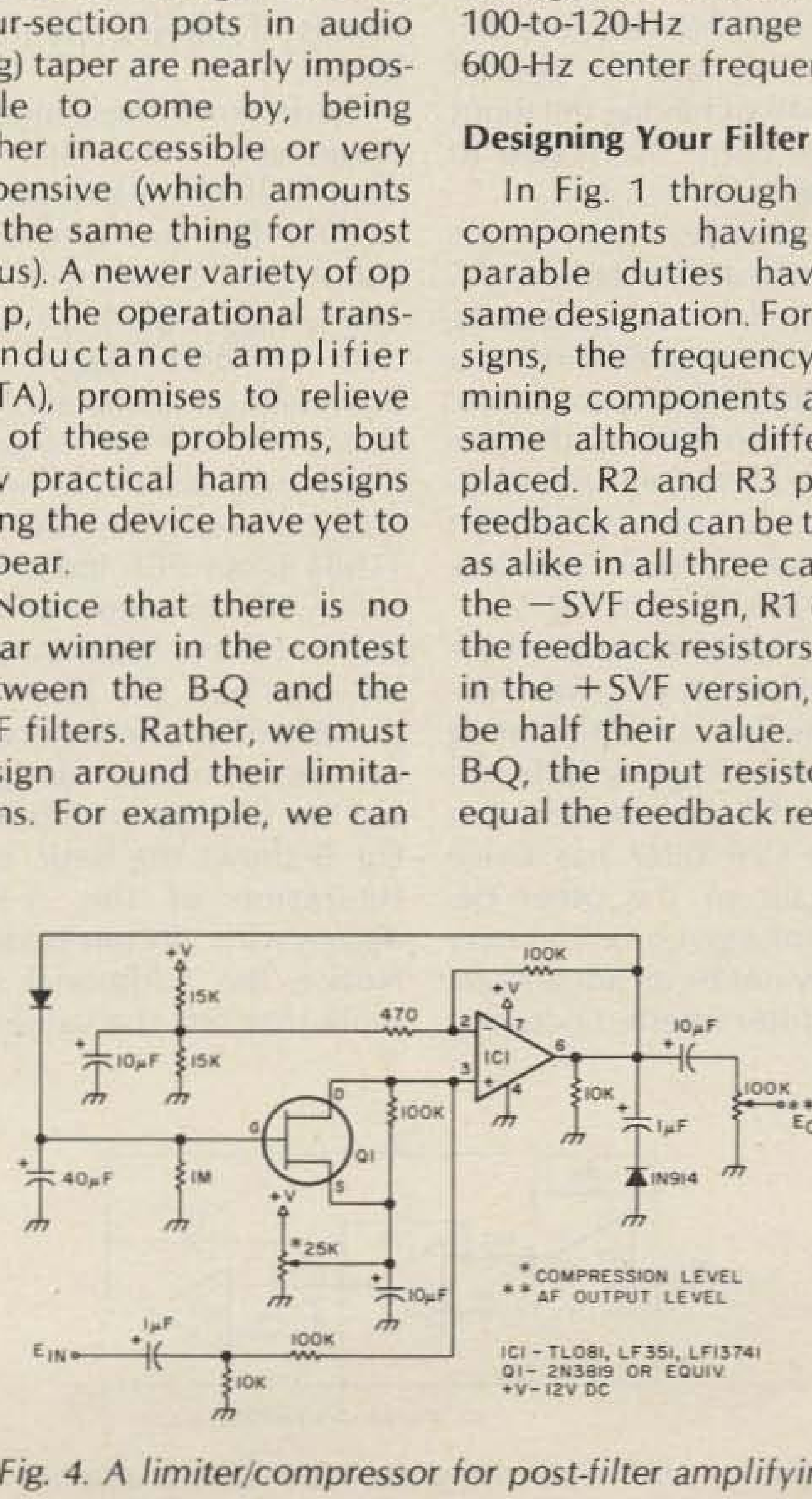

Fig. 4. A limiter/compressor for post-filter amplifying.

Filter Type	State-Variable Inverting Input	State-Variable Non-Inverting Input	Bi-Quad
Schematic	**Fig. 2**	**Fig. 3**	**Fig. 1**
Frequency	$F_c = 1/2 \text{pi} R_f C_f$	$F_c = 1/2\text{pi} R_f C_f$	$F_c = 1/2\text{pi} R_f C_f$
Frequency-determining resistors	RF1 = RF2	RF1 = RF2	RF1 = RF2
Frequency-determining capacitors	CF1 = CF2	CF1 = CF2	CF1 = CF2
Bias resistors	R1 = R2 = R3	R2 = R3 = 2R1	R1 = R2 = R3
Q-determining resistors	R4 = R5(3Q − 1)	R4 = R1 (2Q − 1)	R4 = R1Q
Q	Q = (R4 + R5)/3R5	Q = (R4 + R1)/2R1	Q = R4/R1
Gain ($A_o = E_{out}/E_{in}$)	$A_o = Q$	$A_o = 2Q$	$A_o = Q$
Non-inverting input bias resistors	N/A	Fig. 6, Norton amplifier configuration only $R6 = R5 = 2R_f$	N/A

Fig. 5. A comparison of filter design relationships.

or vary somewhat from their value according to the needs of the Q relationship. Only in the −SVF design does Q leave the input resistor unaffected, being determined by the relationship between R4 and R5. In the other designs, the input resistor will be a compromise (if needed) between the dictates of Q and the desired situation of having the input resistor correctly related to the feedback resistors.

This discussion may make designing a filter appear difficult. In fact, design is quite easy if done according to a straightforward procedure. Taken step by step, the procedure almost ensures satisfying success. Let's start with some basic relationships, as shown in Fig. 5.

This table reveals where the differences between designs will occur. Calculating R4 will be slightly different for each case. Notice that the +SVF filter has twice the gain of the other designs for a given Q. This may or may not be an advantage. For a filter inserted between the detector and audio amplifier of a receiver, the doubled gain with a low-level input can be useful. For post-receiver use with normal speaker input to the filter, the lower gain of the −SVF and B-Q designs may be more than we need. In all cases, we should have a means of varying the input level.

Aside from these points, design of the three-filter versions will be nearly identical. The first step is to think about the ICs we will use. The LM324 is perhaps standard for both single- and dual-voltage supply applications. Its current requirements are relatively small and it is easy to handle. The TL084 is an FET input version with an identical pinout; its current requirements are even less. The 3900 Norton amplifier also is popular in single-voltage designs, but its biasing is different. Fig. 6 shows the basic configuration of the +SVF design with Norton biasing. Notice the additional formula that sets the values of the bias resistors to the non-inverting positive op-amp inputs. Otherwise, our work will be the same as for regular op amps.

Much of the available literature on filters is still written in terms of the relatively high current 741 op amp. Hence, about the highest value shown for feedback resistors is 10k. In fact, 10k should be about the minimum value for R1, R2, and R3. Something approaching 100k is more appropriate, although we will not freeze that value at this point. Instead, we will start by selecting an op amp and the desired frequency range.

This differs from textbook procedures, but for good reasons. First, the ham builder ordinarily has access to components with 5% or 10% tolerances rather than the 1% and .1% tolerances commercial designers prefer. Consequently, absolute peak performance from ham models of op-amp filters is not possible. Very good performance is possible and practical. Since we will aim at good though imperfect performance, we can take a few liberties with absolute precision at some points to gain better precision at points more important to hams.

Second, one of the most evident shortcomings of home-brew filter designs is the fact that tuning controls for frequency and Q rarely cover the most desirable ranges. The techniques for designing filters are easy, but almost never described.

Third, the current crop of op amps available for filter work is very forgiving when we compare the precise operating level to overall filter performance. Hence, we can set our own priorities when establishing a design procedure. In fact, feel free to modify the following procedure to suit personal needs and desires.

While the procedure involves twelve individual steps, they cover only three areas of concern: setting the frequency or tuning range of the filter, ensuring correct feedback, and setting the selectivity and gain of the filter. With a few reservations noted in the procedure steps, these are almost independent design operations. To make the procedure more thoroughly clear, let's step through it, working an example as we go along.

Twelve-Step Filter Design

Step 1. Select an op amp.

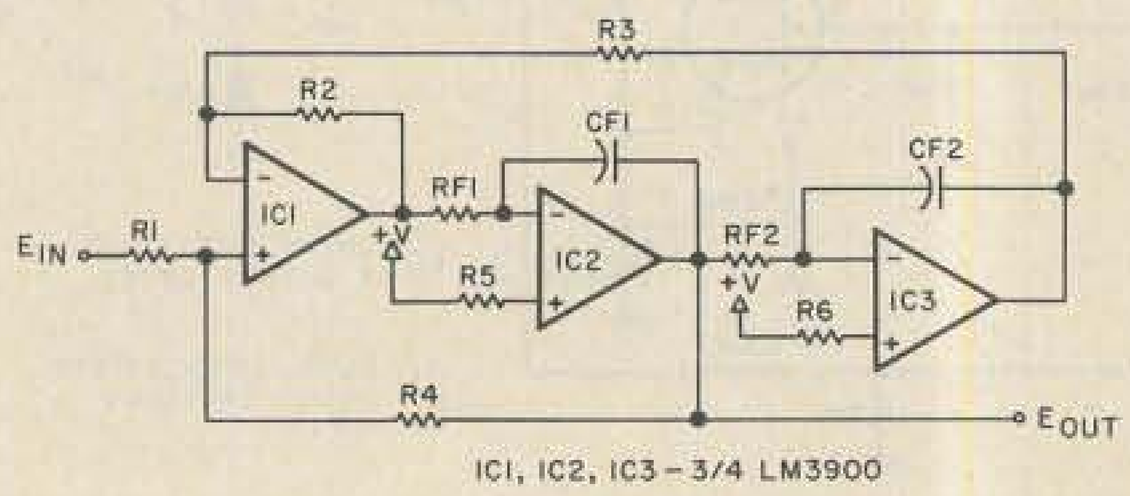

Fig. 6. A +SVF filter using the 3900 Norton amplifier.

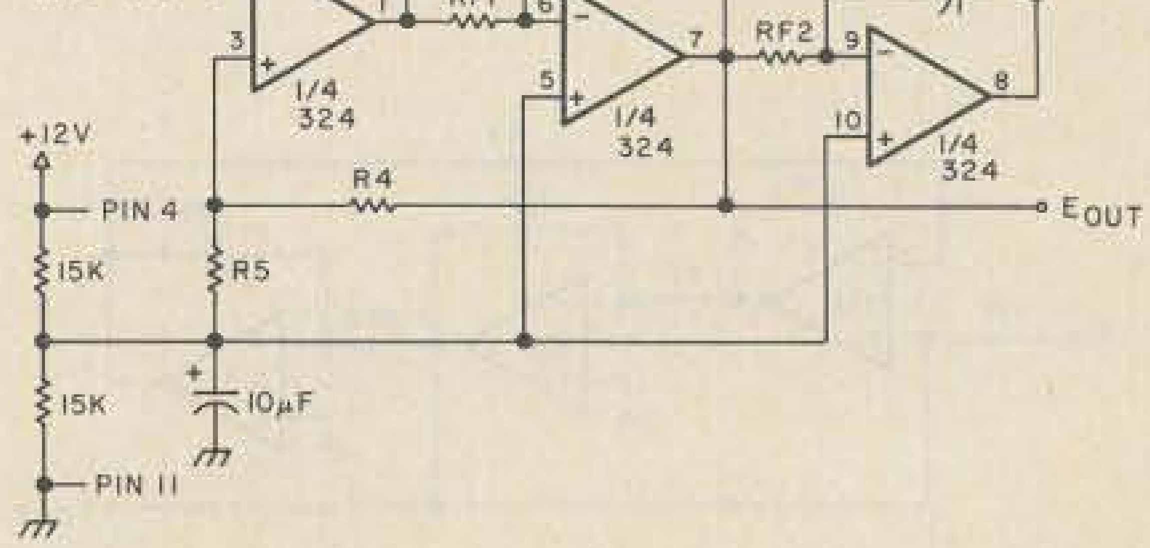

Fig. 7. Setting up the 324 for filter design.

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In this case, let's use the reliable LM324.

Step 2. Select a circuit. We can start with the −SVF of Fig. 2 and later see what happens when we convert the design to the other circuits.

Step 3. Choose a power supply. In this example, we have chosen a single 12-volt source. This forces us to provide a voltage divider to feed the positive input lines that we would directly ground if we used a dual supply. Fig. 7 shows the basic configuration of our circuit, with the 324 pins and power connections drawn in.

Step 4. Choose a frequency range. For CW, let's try 300 to 1200 Hz.

Step 5. Find the center frequency, F_c. This is our first calculation. Let k be the ratio of the highest (F_{hi}) and lowest (F_{lo}) frequencies of our chosen range. Then: $k = F_{hi}/F_{lo} = 1200/300 = 4$.

The square root of k is 2 (and let's call this ks). If we have not made a mistake, then $F_c = F_{hi}/ks = F_{lo}ks = 1200/2 = 300 \times 2 = 600$ Hz.

This is the design center of our filter. Since the filter is tunable, let's next turn to the task of being sure it tunes exactly the range we want it to tune.

Step 6. Choose a dual pot to tune the filter. This is a practical decision. Since we have already said that we would like to keep the feedback resistors well above 10k and hopefully near 100k, a dual 500k pot would be nice. Dual 100k audio-taper pots may be more accessible, so let's see what happens if we use this value.

Step 7. Calculate R_{hi} and R_{lo}. In order to limit the tuning range to specific values (e.g., 300 to 1200 Hz), we will need a fixed resistor and a pot in series to make up each of the frequency-controlling resistors. R_{hi} will be the needed resistance when the frequency is the lowest, and R_{lo} will be the resistance at the highest frequency.

We know something about these values, even though we have not yet selected a capacitor. First, we know that their difference will be 100k, the value of the pot. Hence, $R_{hi} - R_{lo} = 100k$. We also know that $R_{hi} = 4R_{lo}$, since the ratio of low to high frequency is 4:1. (Note: If we hold the capacitance constant, as we will do with a fixed-value unit, the frequency and resistance will vary inversely with each other, i.e., $F_{hi}/F_{lo} = R_{hi}/R_{lo}$.)

Knowing the two relationships between the highest and lowest resistances lets us substitute and solve for R_{lo}. Since the ratio of the resistances is 4:1, then $R_{hi} = 4R_{lo}$. In the difference formula, we now can say that $4R_{lo} - R_{lo} = 100k$, or $3R_{lo} = 100k$. Dividing 100k by 3, we get $R_{lo} = 33.3k$. Since the highest resistance is 100k higher, $R_{hi} = 133.3k$. As a check, we can use the other original formula and let $R_{hi} = 4R_{lo} = 4 \times 33.3k = 133.2k$.

I have carried out the calculation to more precision than we can possibly get with real components to show how good the method is. In fact, since real pots are often shy of 100k by as much as 10%, it is wise to have a pot in hand before working out a design. The decimal places might get long, but rounding to the nearest whole number for resistors and keeping k and ks to no more than two decimal places will give perfectly good design accuracy.

We now know the fixed series resistor for RF1 and RF2 will be 33k, with the 100k pot making up the rest of the resistance. If we discover that our dual pot does not track and can determine by how much it is off, we might make one of the two fixed resistors a 50k trimmer pot. (Adjustment of trimmers in the frequency-determining circuits of a filter is best done with the circuit wired but the op amp out of its socket, using a precise ohmmeter. Accurate adjustment with the circuit in operation requires a scope with frequency-scanning capability. Output-level readings taken on an ac/audio voltmeter can be misleading.)

Step 8. Calculate capacitors CF1 and CF2. At all frequencies, the resistance will equal the capacitive reactance. Hence, the standard formula for calculating capacitance from frequency and reactance becomes $CF1 = CF2 = 1/2piFR_f$. In this case, start with either end of the tuning range. For the example, use 300 Hz, where the resistance is 133k. If your calculator has a 1/X key, you can just multiply all the denominator numbers together and then hit the inverse key. The answer is likely to appear in exponential notation. For example, $C_f = 1/(2 \times 3.14 \times 300 \times 133{,}000) = 3.99 \times 10^{-9}$.

We need to convert this to either microfarads (10^{-6}) or picofarads (10^{-12}) to see what capacitors we should purchase. 3990-pF or .04-uF capacitors will do the job. We can parallel some 5% polystyrene capacitors to hit 4000 pF fairly closely. Given the fact that we can rarely buy the exact value that the formula says we need, we should design the frequency range of the filter with an extra 5% on either end to allow for the slight range shift our approximations will produce.

We can check our work by calculating the two frequency-determining capacitors from the other end of the range. This time, $C_f = 1/(2 \times 3.14 \times 1200 \times 33{,}000) = 4.02 \times 10^{-9}$, or about 4000 pF again. Because we used pi to only two decimal places and dropped the last 300 Ohms off the resistance values, the answers diverge by about 1%, well within the 5% component tolerance. Note that had we used the 500k pot we considered at the beginning of the example, our capacitors would be about one-fifth the present value. Some builders have difficulty obtaining 5% capacitors in the higher values and may want to use the larger pot in order to combine it with capacitors in the 800-pF range.

Step 9. Calculate the resistance at the center frequency, F_c. Since the resistance at center frequency will equal the reactive capacitance, $R_{fc} = 1/2piF_cC_f = 1/(2 \times 3.14 \times 600 \times 4 \times 10^{-9}) = 66{,}348$ Ohms. This is the resistance value of the frequency-determining resistors at the design center of the filter. We will use this figure in a very broad way to determine the remaining resistors in the filter. Most filter-design manuals scale a filter from an initial assumption of equal value resistors throughout as much of the design as possible. On this assumption, R1 through R3 should equal the center-frequency resistance, and R5 should approximate it, if possible. Similar assumptions apply to the other filter designs, with adjustments for values that must differ.

In practice, using components readily accessible to amateurs, the assumption is not very important as long as filter resistor values fall within the range that permits the op amps to perform well. Values from 10k to 100k have been used with no specifically noticeable change of performance. As a rule of thumb, try to let the feedback resistors fall within a 2 to 1 or 3 to 1 ratio of the center-frequency resistance.

Step 10. Determine the feedback and input resistors, R1 through R3. On the basis of the previous calculation and discussion, 68k resistors appear to be the closest value to the calculated center-frequency resistance. In practice, 100k resistors do not change the filter performance. What is important is to use the same value for all three. Since 100k is a nice round value found in most ham junk boxes, let's use it. No-

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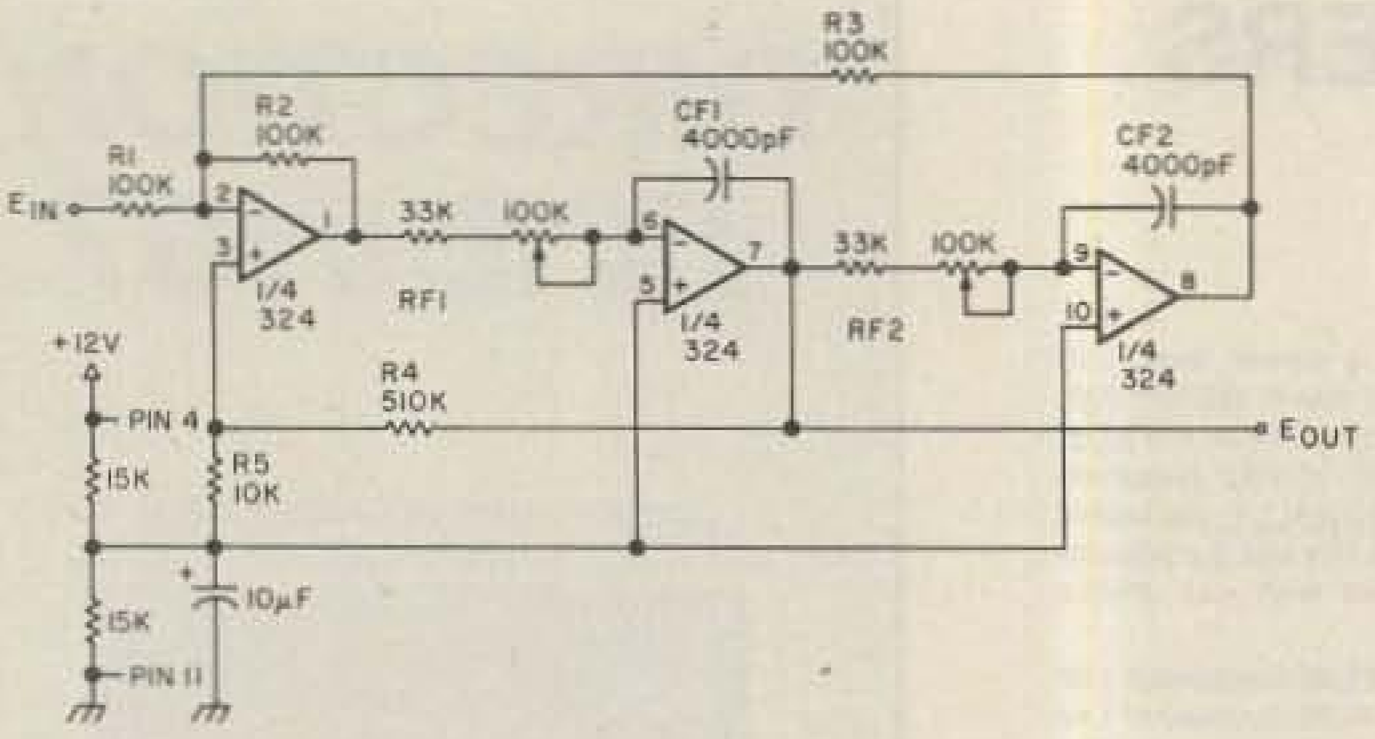

Fig. 8. A fixed-Q −SVF filter.

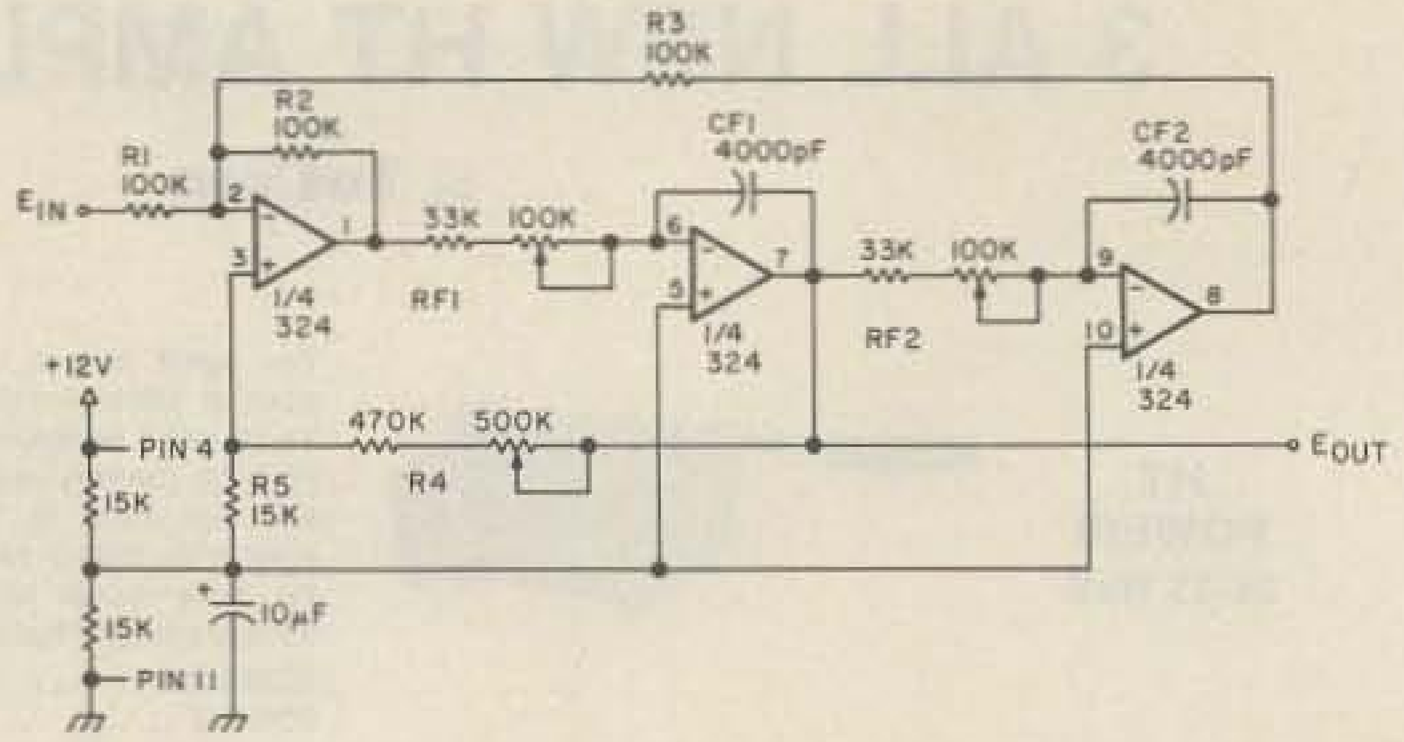

Fig. 9. A variable-Q −SVF filter.

tice that, like many ham building decisions, the grounds for our choice have little relationship to theory. If our value does not work for some reason, we have another value to try.

Step 11. Select a value for Q and choose the Q-determining resistors, R4 and R5. Since both resistors affecting Q and gain are independent of the input resistor, we have more latitude in choosing values than with the other two designs. For CW filters, there is rarely a need for a Q greater than 25, and the range of 10 to 20 will generally produce sufficient selectivity without ringing. For greater selectivity, we should use identical successive filters which will give us a steeper bandwidth curve and greater ultimate rejection on unwanted signals. As a rule of thumb, using 5% and 10% components, I anticipate that the half-voltage (−6 dB) bandwidth will approximate $3F_c/Q$, about 50% wider than theory indicates. For the SVF filters, bandwidth in Hz will vary directly with frequency. Thus, if I choose a 100-Hz bandwidth for the 600-Hz center frequency, it will vary from 50 Hz at the 300-Hz end of the range to 200 Hz at the 1200-Hz upper end of the tuning range. If this bandwidth is acceptable, then $Q = 3F_c/BW_{fc} = (3 \times 600)/100 = 18$. Let's see what happens if we use this figure.

From the formulas governing the −SVF filter, $R4 = R5(3Q-1)$. For our case, $3Q-1 = (3\times18)-1 = 53$, and $R4 = 53R5$. If we let $R4 = 100k$, then $R5 = 5.3$ megohms; use either 4.7-megohm or 5.1-megohm standard resistor values. In fact, we can change the values proportionately by factors of ten without disrupting filter performance. Values of 10k and 510k work well and may be easier to find. A rule of thumb is to let R4 be the highest easy-to-find value that permits R5 (or R1 in the other two designs) to approach its proper theoretic relationship to the other resistors. However, other considerations may enter into the final selection. Fig. 8 shows our completed fixed-Q design.

One major consideration is whether we wish to be able to vary the Q of the filter and thereby to broaden or narrow the bandwidth over some useful range. For example, we might wish to have a Q ranging from 10 to 20 for this design. At $Q=10$, the resistor ratio $(3Q-1)$ will be 29, and at $Q=20$, the ratio will be 59. Suppose that we have a 500k pot we wish to use to vary the Q. Since we will not vary the Q to nothing, we will need a series resistor with the pot to make up R4. We know that the value of R4 at $Q=20$ will be the series resistor R_s +500k, the highest value of the pot. At $Q=10$, R4 will be just R_s, the value of the fixed

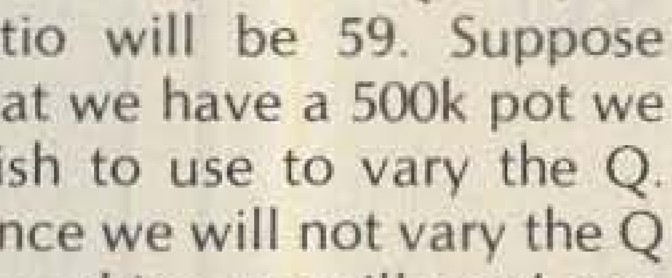

Fig. 10. Filter input- and output-level controls.

series resistor. At the higher Q, $R5 = (R_s + 500{,}000)/59$, while at the lower Q, $R5 = R_s/29$. We can solve for the series resistor by letting $R_s/29 = (R_s + 500{,}000)/59$. Cross multiplying, we get $30R_s = 29 \times 500{,}000$, or $R_s = 1{,}450{,}000/30 = 483{,}333$ Ohms. This is the series resistor to go with the 500k pot for R4. $R5 = R_s/29 = 483{,}333/29 = 16{,}667$ Ohms. (As a check, $R5 = (483{,}333 + 500{,}000)/59 = 16{,}667$.) We can choose a 15k or 18k resistor for R5 and a 470k or 510k resistor for R_s, respectively. Exactness will not matter too much here since we will tune the control for best reception rather than for some specific value of Q. Fig. 9 displays our completed variable-Q design.

Step 12. Consider the gain. This step does not require special calculations, but it does bring the matter of gain to your attention. For the −SVF design, gain will equal Q. If you design a fixed-Q filter, you can accommodate the filter gain with preceding and succeeding level controls, as shown in Fig. 10. Set the input-level control so that the strongest signal will not drive the filter

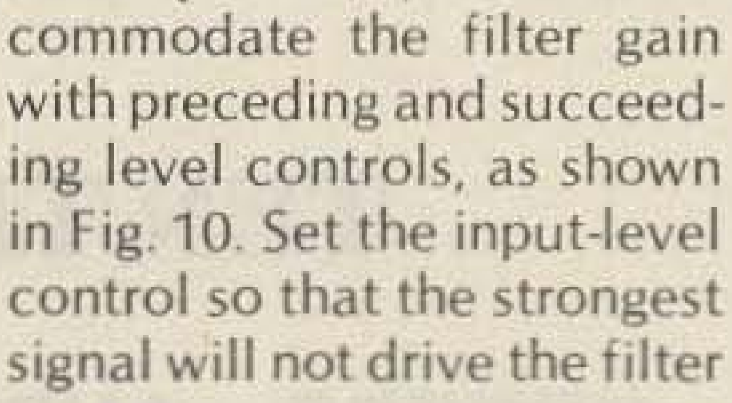

Fig. 11. A simple post-filter amplifier for speaker or phones.

to clipping. A scope will show this as a sharply flattened sine wave. Since the voltage gain will be considerable, the filter may drive the succeeding stage too hard, causing distortion in the amplifier feeding the speaker or phones. We can kill the unwanted voltage with another trimmer set to hold the amplifier relatively distortionless at full volume.

If the filter has a variable-Q control, then its gain will also vary. To avoid the need for constant volume-control adjustments, the compression amplifier shown in Fig. 4 should follow the filter and precede the output amplifier. With the values shown for the compression circuit, a normal CW signal will leave the speaker quiet between dots and dashes. The circuit needs no input-setting pot, and the output-level control serves the same function as the filter-output control in Fig. 10.

These 12 steps complete the design phase of the work. The next step is to breadboard a model, verify its operation, and finally construct a permanent version complete with case and power source. Robbing power from the receiver and installing the filter in either the receiver cabinet (especially if inserted between the detector and audio stages) or the speaker cabinet (along with an audio amplifier such as the LM386 circuit shown in Fig. 11) is one popular way to handle final construction. However, to avoid cabinet and circuit modifications, you may

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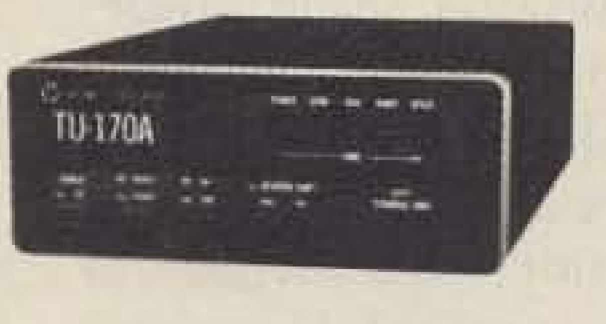

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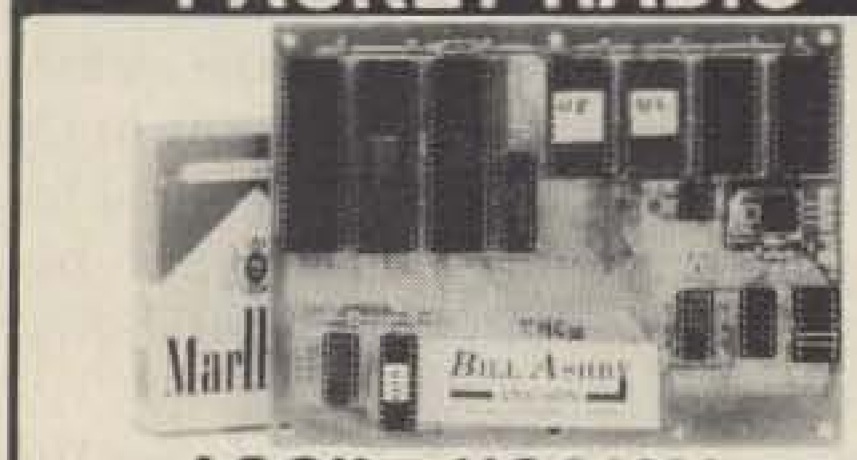

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wish to make the filter a self-contained unit.

Additional Procedures— +SVF and B-Q Designs

The first eight steps of the procedures just outlined are identical for all three filter designs. Nothing changes until Step 10, selection of the input resistor, where we have only a minor modification for the +SVF filter. R1 should be half the value of either R2 or R3 if we wish to have the relationship of Q and gain follow the formulas given with Fig. 5. Other ratios are possible, although the input resistor should not be greater than the feedback resistors. The gain will change but remain constant across the tuning range.

Let's look more closely at the final steps of the procedure, customizing them for each particular design. First, the bi-quad filter:

Step 11: B-Q. Select a value for Q, and choose the Q-determining resistors. In the B-Q design, the input resistor, R1, interacts with R4 to determine Q and gain. Having selected an input resistor, R4 = QR1. Selecting Q follows the same guidelines given for the −SVF design, with the proviso that Q will vary across the tuning range, since bandwidth in Hertz is constant. Using our −6-dB (half-voltage point) rule of thumb, we can design with the formula $Q = 3F_c/BW$, where BW is the desired bandwidth in Hertz. If we wish about 100 Hz, then $Q = (3 \times 600)/100 = 18$. $RV = 18R1 = 18 \times 100k = 1.8$ megohms, a usable value. However, with very little change in performance, we can reduce both R1 and R4 as long as we keep them in the proper ratio. Fig. 12 shows the full results of our design work.

We can vary the Q and consequently the bandpass of B-Q filters. We need only make R4 variable. Suppose we wish to vary the Q between about 10 and 20. If R1 is 100k, then R4 needs to be 1 megohm for a Q of 10 and 2 megohms for a Q of 20. We can use a one-meg fixed resistor in series with a one-meg pot for R4, and the problem is solved. Fig. 13 shows the changes necessary for variable Q.

Step 12: B-Q. Consider the gain. Variable Q plus the natural gain variability of the B-Q filter makes a compression amplifier almost mandatory. However, the 100-to-1 compression capability of the audio elixir circuit will more than cover the situation. The natural gain variability of a fixed B-Q filter with the 300-to-1200-Hz tuning range is about 4 to 1, while Q variability expands the total range to 40 to 1, well within the amplifier's capabilities and with room to spare for audio signal strength variations.

The B-Q filter has one special property not shared by either SVF design. You can tune the B-Q using only RF1, leaving RF2 fixed for F_c. The variable resistor, however, will change frequency only with the square root of the resistance change, meaning that the pot will have to have a much wider range to cover the chosen frequency range. Since the frequency limits in the example are $2F_c$ and $F_c/2$, the resistance range must be $R_{fc}/4$ and $4R_{fc}$. In this design, $R_{fc} = 66{,}348$ Ohms. The lowest resistance (for the highest frequency) will be $66{,}348/4 = 16{,}587$, while the highest resistance (for the lowest frequency) will be $66{,}348 \times 4 = 265{,}392$. The difference is 248,805. A 250k pot in series with a 15k fixed resistor will form a satisfactory RF1. An audio taper or reverse log pot is mandatory in this application, since even with a log pot the frequency will compress at one end of the scale.

In this example, we were fortunate to wind up with a required value close to an existing potentiometer value. For designing a single pot B-Q filter from scratch, we can begin at Step 6, choosing a pot to tune the filter. Let's select a 500k pot and see what happens.

Step 7: B-Q, single pot. Calculate R_{hi} and R_{lo}. Since frequency will vary as the square root of resistance changes, the total resistance change will be k^2, where k is the frequency ratio. Since $k = 4$ (1200/300 Hz), $k^2 = 16$. $R_{hi} = 16R_{lo}$. We also know that $R_{hi} = R_{lo} + 500k$. Now we can solve for R_{lo}: $16R_{lo} = R_{lo} + 500{,}000$, or $R_{lo} = 500{,}000/15 = 33{,}333$ Ohms. This is the value of the fixed-series resistor. $R_{hi} = 33{,}333 + 500{,}000 = 533{,}333$ Ohms. As a check, $533{,}333/16 = 33{,}333$ Ohms.

The resistance at center frequency (and fixed frequency-determining resistor RF2) will be $R_{hi}/4 = 4R_{lo} = 533{,}333/4 = 33{,}333 \times 4 = 133{,}333$ Ohms. We can use 100k and 33k resistors in series or use the nearest standard value.

Step 8: B-Q, single pot. Calculate capacitors CF1 and CF2. This calculation uses the same procedure as in the −SVF filter. Since resistance and capacitive reactance are the same at the center frequency (and we must use F_c for this calculation), $C_f = 1/2piF_cRF2 = 1/(2 \times 3.14 \times 600 \times 133{,}333) = 1.99 \times 10^{-9}$. This is about 2000 pF, an obtainable value in polystyrene capacitors.

Determine the remaining values for the filter in the ordinary way. 100k feedback and input resistors appear to be in order, since they vary only a little from the value of RF2. Considerations of Q and gain will be identical to those for the dual-pot biquad design. Fig. 14 shows our new filter.

The SVF filters always require dual pots. Therefore, the only difference between the +SVF filter and the −SVF design concerns Q and gain.

Step 11: +SVF. Select a value for Q, and choose the Q-determining resistors. Q selection for the +SVF is

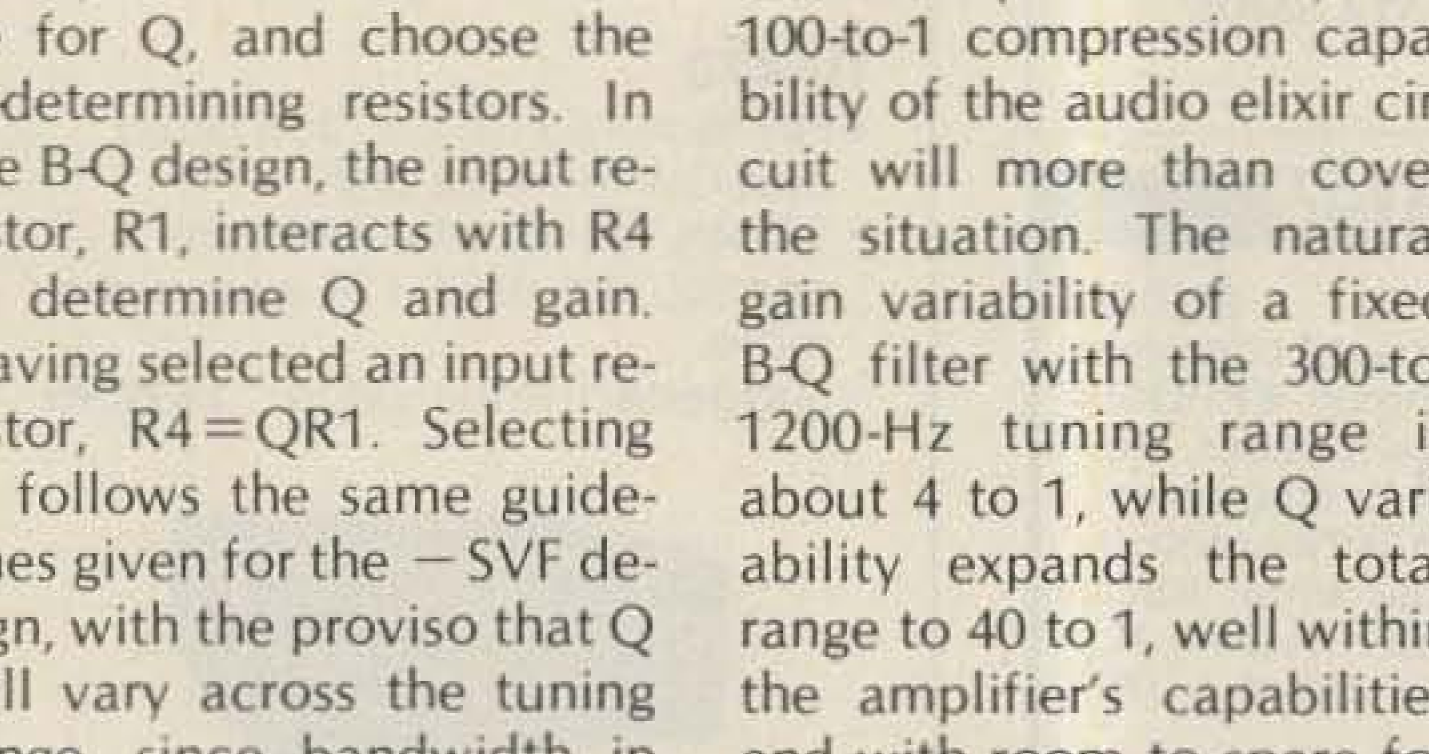

Fig. 12. A fixed-Q B-Q filter.

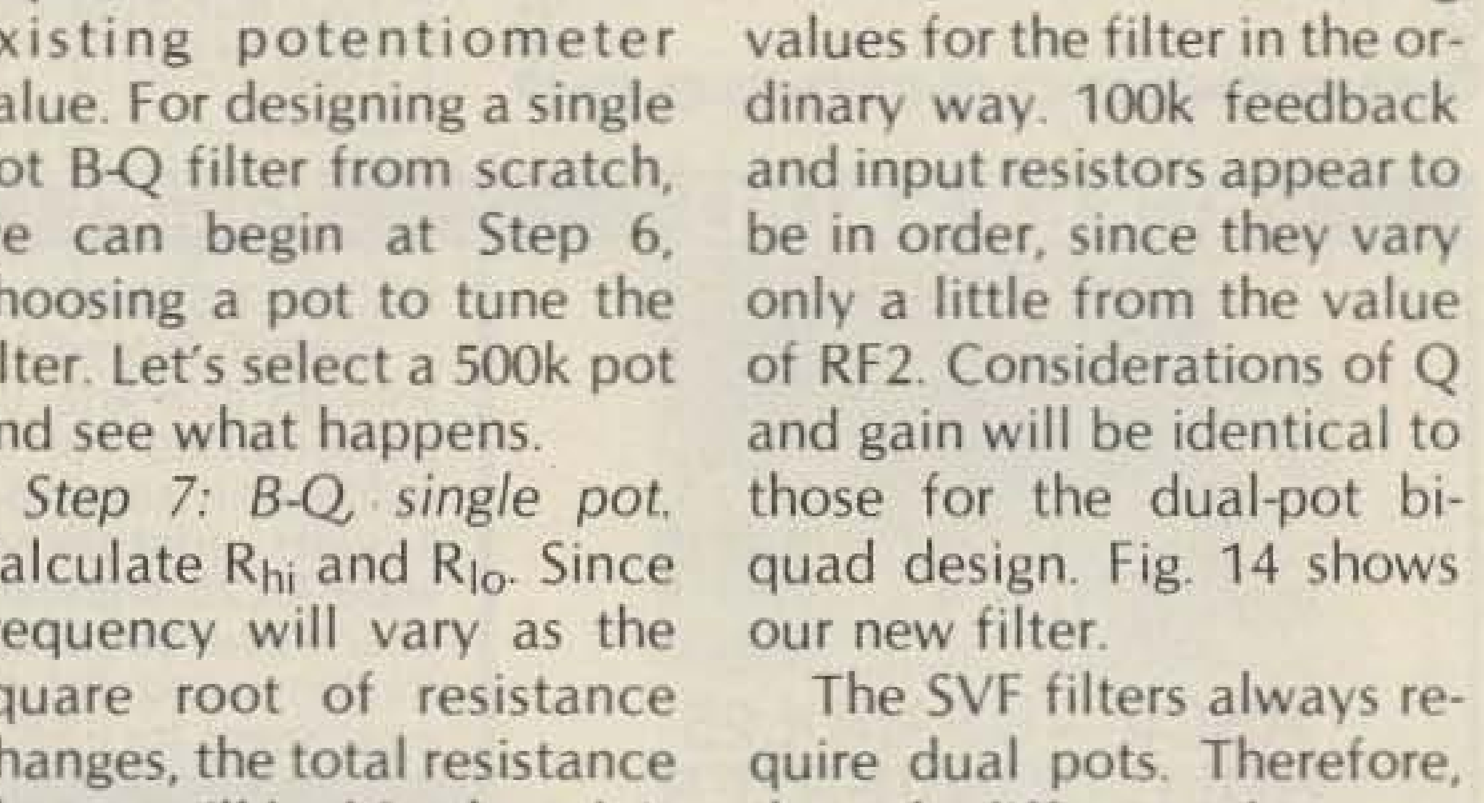

Fig. 13. A variable-Q B-Q filter.

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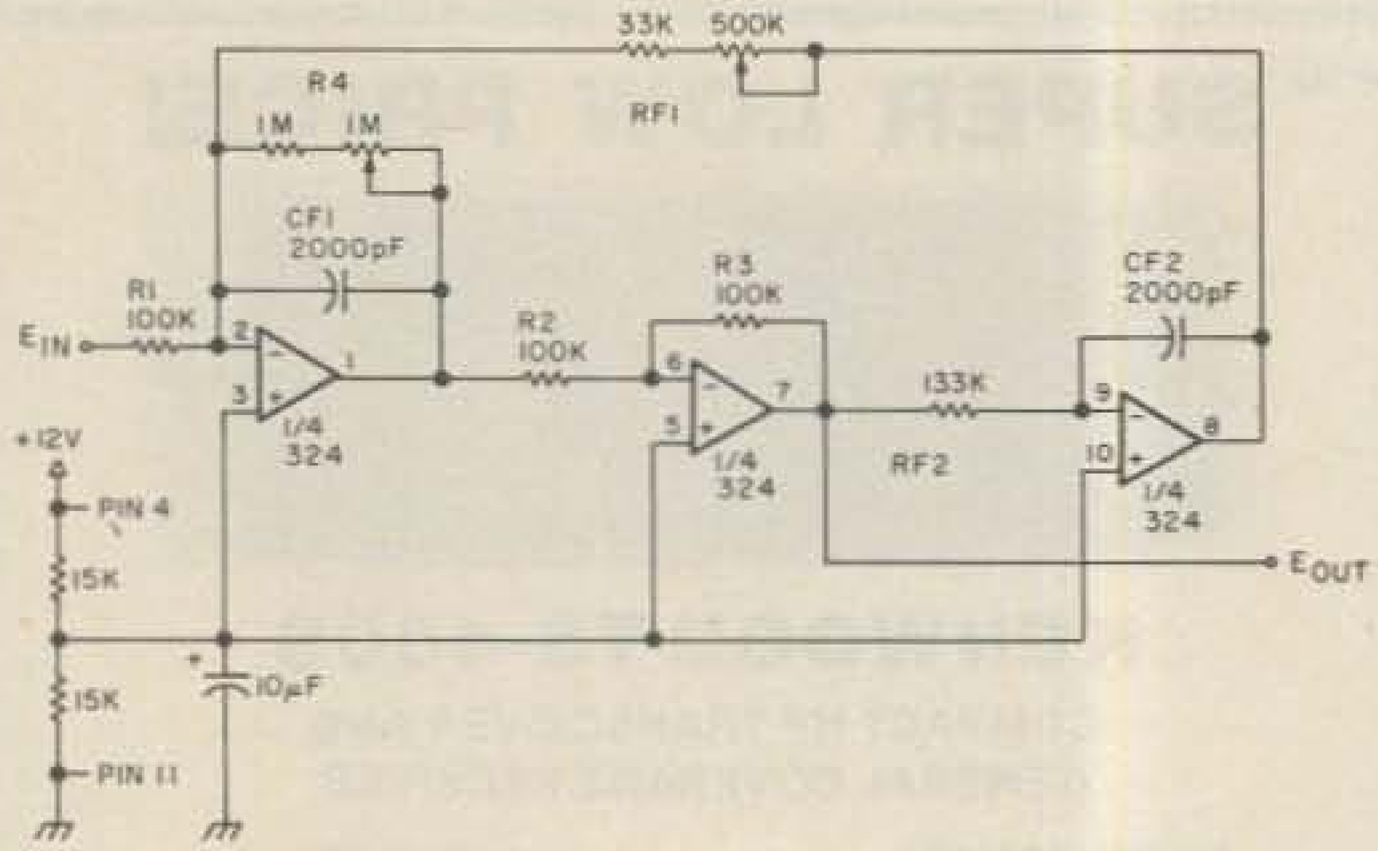

Fig. 14. A single-pot tunable variable-Q B-Q filter.

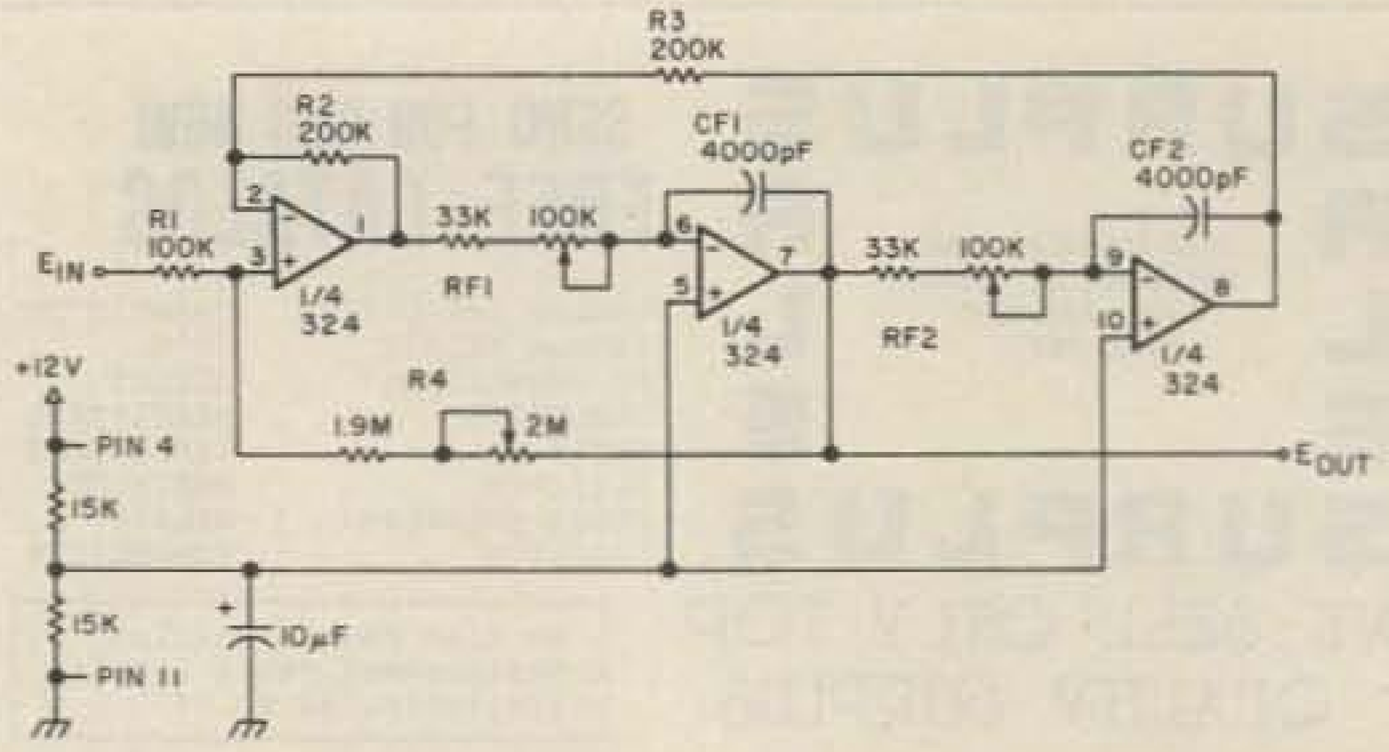

Fig. 15. A variable-Q +SVF filter.

identical to that for the −SVF design. We must make mental note that gain will double Q if we follow recommended resistor relationships. Let Q=18. R4=R1 (2Q−1). If we use 100k resistors for feedback, the R1 is 50k. Many designs use 200k values for R2 and R3, in which case, R1=100k. Let's use this latter value for our design. For a Q of 18, 2Q−1 =35, and therefore R4=100k×35=3.5 megohms. 3.3 megohms would work well. For a variable Q of, say, 10 to 20, the maximum resistance value of R4 would be 39R1 and the minimum value would be 19R1. R4 will range from a series resistor value of R_s to R_s+pot, where pot is the potentiometer value we select. Let's try a 2-megohm pot. Then $R1=R_s/19$ at low Q and $(R_s+2{,}000{,}000)/39$ at high Q. Solving for R_s, we get $R_s = 38{,}000{,}000/20 = 1.9$ megohms. R4 thus becomes a 1.9-megohm fixed resistor in series with a 2-megohm pot. $R1 = R4/(2Q-1) = 3.9$ megohms/39 = 1.9 megohms/19 = 100k, a desirable value.

Step 12: +SVF. Consider the gain. The gain of this +SVF filter, shown in Fig. 15, ranges from 20 to 40, depending upon the variable Q. Again, following this design with a compression amplifier is a must for easy use.

Construction and Results

All of the designs shown in the examples have been breadboarded to confirm that they will work. In fact, they all work even when some non-frequency-determining components vary by 20% from the design values. Fig. 16 charts the test results. (Always test a design on a breadboard before wiring a final version. If nothing else, the breadboard test will turn up bad components. More important, adjusting the design to more precisely meet your needs is much simpler on a breadboard.)

Construction of the final model can take any form. Perfboard and printed circuit board peform equally well. Layout is not critical with the LM324. The TL084 requires some care to prevent inadvertent coupling, a more serious concern with the very high impedance inputs to each section. One easy way to overcome the problem is to avoid compressing the components into too small a space. Spreading the fixed components at the IC corners in a radial pattern tends to prevent unwanted coupling and makes component replacement simpler. Beyond this, construction is left to individual ingenuity.

Part of the construction ease stems from the low Q of these filters. Most practical filter articles still manage to repeat the virtually useless fact that these designs are good to a Q of 500. At normal CW audio, the bandwidth would be just over 1 Hz, and the filter would ring for a week with just one receiver electron pop, if it was not already oscillating. With normal components, practical Qs of 5 to 25 ensure good stability and

Figure	Filter	Tuning Range	Bandwidth	Q	Output Voltage Ratio	Notes
8	−SVF, fixed Q	330–1250 Hz	25–100 Hz	26	1.08:1 F_{hi}:F_{lo}	3900 pF, 5% C*; reduce R4 from 510k to 330k**
9	−SVF, variable Q	330–1250 Hz	40–75 Hz at (at F_c)	16 to 30	2.5:1 Q_{hi}:Q_{lo}	Reduce fixed-series Q resistor from 470k to 330k
12	B-Q, fixed Q	330–1250 Hz	30 Hz	35 at F_C	1.4:1 F_{hi}:F_{lo}	Reduce R4 from 1.8 megohms to <820k
13	B-Q, variable Q	330–1250 Hz	30 Hz at Q_{hi} 50 Hz at Q_{lo} (at F_c)	35 21	2:1 Q_{hi}:Q_{lo} 2.8:1 total change due to both F and Q	Reduce fixed series Q resistor from 1 megohm to 470k
14	B-Q, single pot, variable Q	350–1330 Hz	55 Hz at Q_{hi} 140 Hz at Q_{lo} (at F_c)	18 7.3	2.6:1 total change due to both F and Q	2000 pF, 10% C_f; increase fixed tuning resistor from 33k to >47k to adjust tuning range
15	+SVF, variable Q	340–1260 Hz	40 Hz at Q_{hi} 75 Hz at Q_{lo} (in passband)	32 17	1.6:1 total change due to both F and Q at R4	Reduce fixed series Q resistor from 1.9 megohms to <1 megohm

Notes: *All filters except the single-pot B-Q used 3900-pF, 5% polystyrene capacitors. The single-pot B-Q model used 2000-pF, 10% polystyrene capacitors. **In any of the filters, raise or lower Q by raising or lowering R4, the Q-determining resistor.

Fig. 16. Test results and comments on the six sample filters.

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easy adjustment for ham audio filters. Using 5% and 10% tolerance components (or bridge-matched 20% components), Q will be slightly less than theory predicts but more than adequate. Moreover, a close examination of the peak of the response curve will reveal irregularities compared to the theoretic ideal, but these will always be too small to make a difference to CW or to phone reception. In short, for all practical purposes, home brew can be as good as commercial when it comes to simple audio filters to enhance reception. To the degree that we can customize the design to our specific needs, they might even be better than commercial for some hams.

The purpose of outlining these procedures is to reduce the design of custom ham CW bandpass filters to a series of steps that ensures not only a filter that works, but, as well, a filter that tunes frequency and Q over just the operator's desired range. The procedures are applicable to today's run of multiple ICs such as the LM324, the TL084, and the 3900 Norton. As new generations of op amps emerge, with different biasing, input, and current requirements, the rules of thumb will likely change. However, the basic principles of determining RC tuning ranges will not. Only our selection of pots and fixed resistors will vary for new impedance-matching conditions. Hence, with adaptation for new devices, CW operators and other hams who need bandpass filters using the usual lot of reasonably priced 5% and 10% components should be able to satisfy their needs on their own work benches. A hand calculator, a sharp pencil, and a breadboard are the basic tools for good filtering. Triple op-amp designs just make the task a bit more challenging. ■

HAM HELP

We are happy to provide Ham Help listings free, on a space-available basis. We are not happy when we have to take time from other duties to decipher cryptic notes scrawled illegibly on dog-eared postcards and odd-sized scraps of paper. Please type or print your request (neatly!), double spaced, on an 8½"×11" sheet of paper and use upper- and lowercase letters where appropriate. Also, please make a "1" look like a "1," not an "l," which could be an "el" or an "eye," and so on. Hard as it may be to believe, we are not familiar with every piece of equipment manufactured on Earth for the last 50 years! Thanks for your cooperation.

Wanted: bfo transceiver for a Hammarlund SP-600-JX-1 s/n 4528 (R274C/FRR 650), part number 31160-1. Also have a box of coils for National RAO-6 which I will donate to the first taker.

Peter Doherty W1UO
PO Box 291
Port Townsend WA 98368

About 25 years ago, Emerson (I believe) came out with a portable radio powered by batteries and/or a built-in solar cell. They only made a few. (I wonder why?) It worked well with both sun and artificial light. I would like the name and address of the manufacturer since I want one of these old radios.

O. R. Estrada
1866-48th Ave.
San Francisco CA 94122

I need help on the Galaxy (Hy-Gain) R-530 solid-state general-coverage receiver. The phase-lock oscillator is not working. I need any information on parts sources, alignment/troubleshooting data, or individuals who can repair. If anyone wants to start an R-530 club or newsletter or knows of same, contact me.

Jim Turner K5YZS
103 Karla Drive
Whitehouse TX 75791

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NEW PRODUCTS

DANISH SWITCHES ARE MADE USER-FRIENDLY

MEC, a Danish company situated in Ballerup, a suburb of Copenhagen, Denmark, has been a switch manufacturer since 1938, until recently concentrating on rotary wafer switches. It now announces the multipurpose UNIMEC modular switch range.

Fig. 1 shows the basic alternate-action version of the PCB-mounting switch (the other option being a momentary-action version). The innovation is that each of the two switches contains all the contacts necessary to provide five alternative contact functions: two c/o contacts, two make contacts, two break contacts, two make and two break contacts, and reversed polarity.

From the point of view of ordering and stocking, this gives the great advantage that only two types of switch need to be held in store. The required function is determined by simply selecting the appropriate switch terminal with the PCB tracking.

The UNIMEC is a low-profile switch (10 mm high) designed for 2.54-mm-grid PCB mounting. The housing and key are of glass-reinforced polycarbonate (Makrolon), the keycap system is ABS (Novodur), and the contacts, both fixed and moving, are 0.006-mm silver-plated brass, with gold plating available on request. Stainless steel is used for the moment spring, latch pin, and keyspring. The switch has a minimum lifetime of 1 million cycles. It can be positioned on the board straight or with a 180° twist. Contact resistance after 1 million cycles is typically 20 milliohms and contact bounce is less than 1 ms.

Figs. 2 and 3 show the assembly of the finished switch with knob and bezel. The design is intended to have tactile appeal, and the keys, knobs, and bezels are all available in a choice of ten colors. In addition to the color-coding possibilities, the UNIMEC can also be illuminated with up to four LEDs on any one switch. The LEDs are available in rectangular or pinhead format.

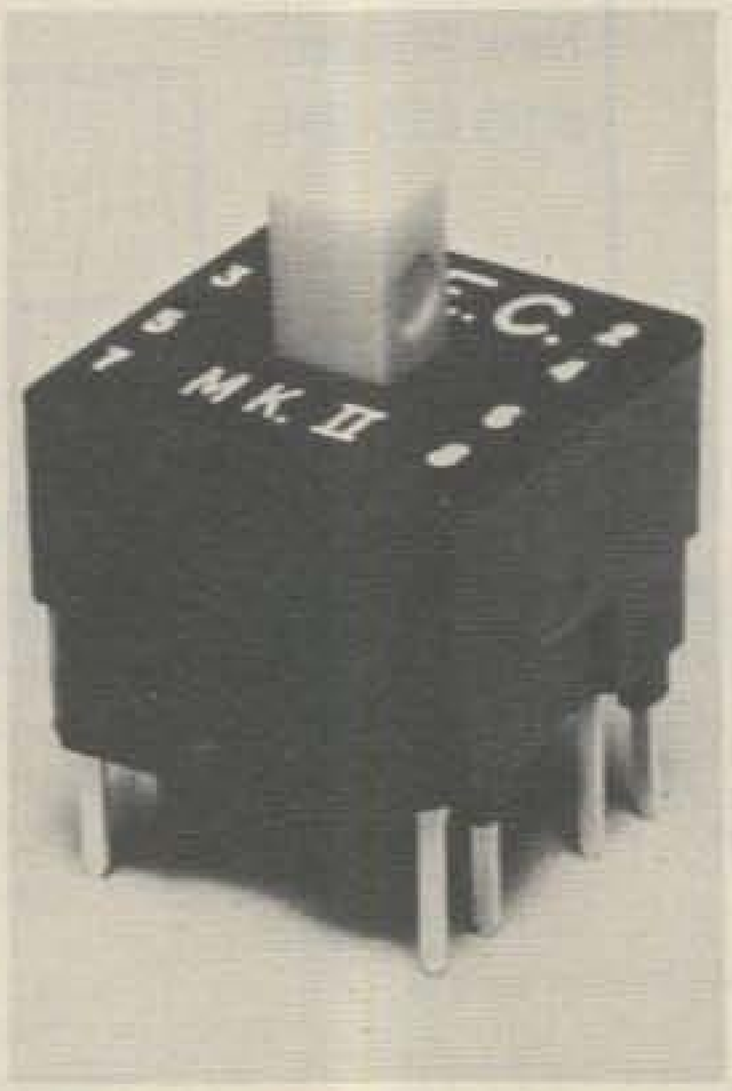


Fig. 1. UNIMEC modular switch.

In order to make up individual switches into a keyboard, MEC produces the Vario-Support, a Makrolon matrix system available in any cell combination up to 10 × 10 (Fig. 4). The support it provides to the switch ensures accurate alignment and enables the switch to be mounted on a front panel. Pressure on the PCB is minimized, and PCB mounting is, in fact, no longer necessary.

The whole emphasis is on making things easy—the designing, ordering, and assembling—while the materials satisfy the engineer and the emphasis on a tactile design makes the finished product easy and pleasant to use.

To get the name of distributors in countries other than the US, contact MEC, PO Box 26, DK-2750 Ballerup, Denmark. The US distributor is *Electronic Components Group, 26 North Fifth Street, Minneapolis MN 55403; (612)-375-1606.* Reader Service number 480.

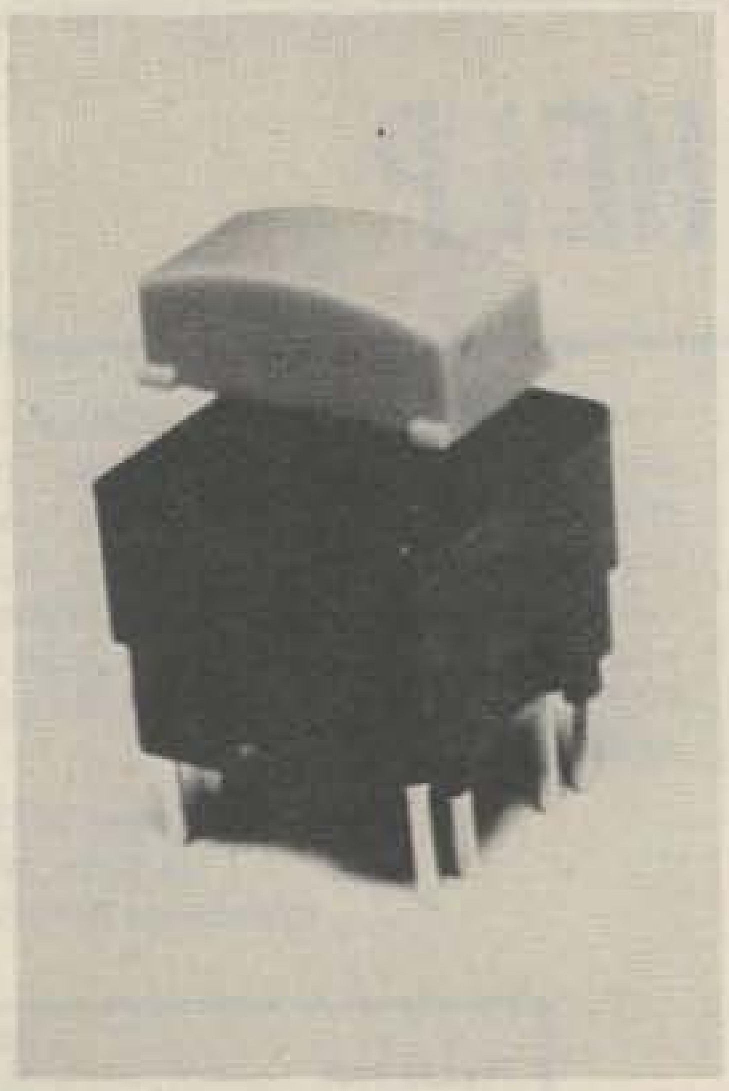


Fig. 2. UNIMEC switch with button.

Fig. 3. UNIMEC switch with knob and bezel.

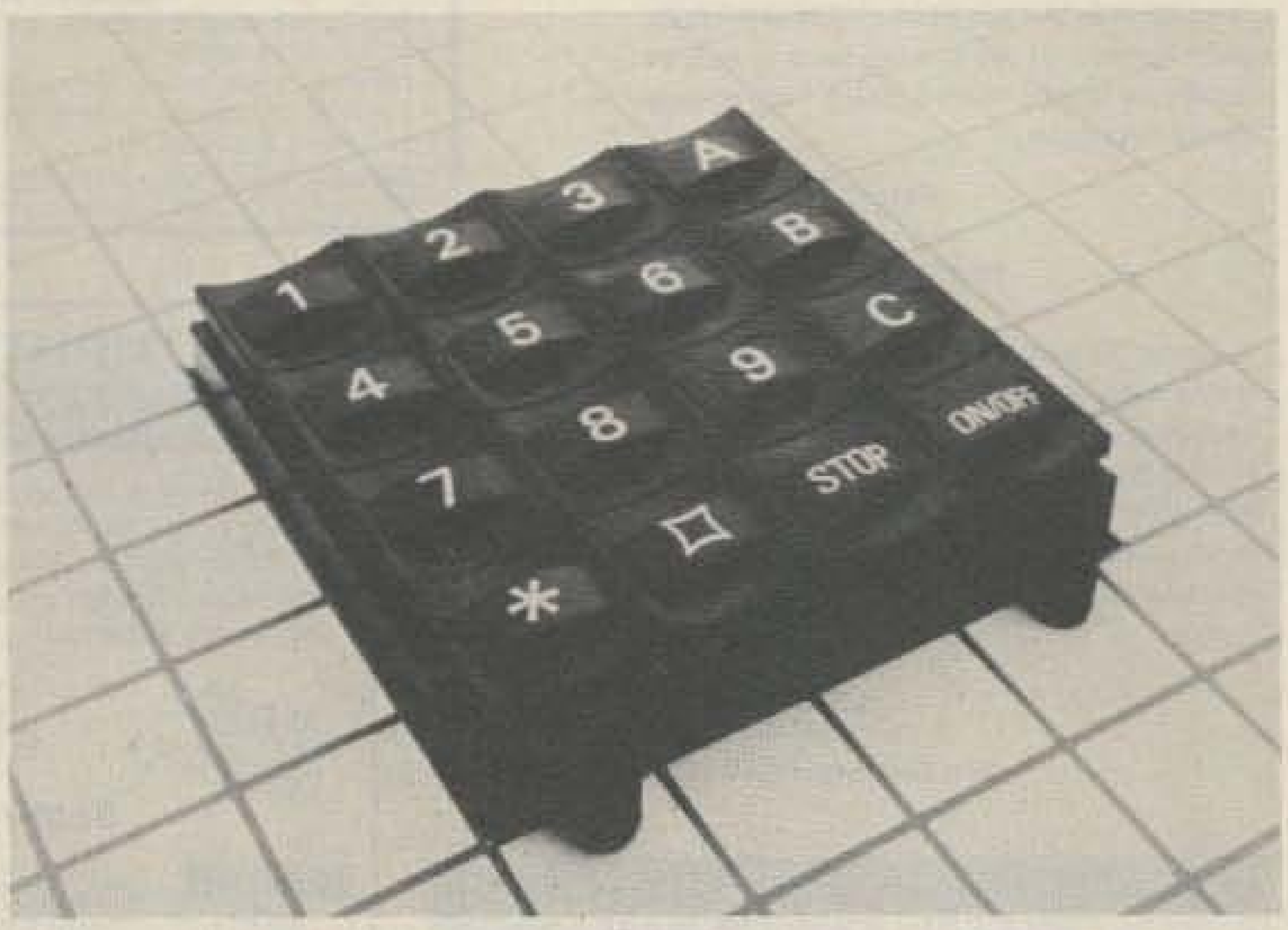


Fig. 4. The Vario matrix system for design-to-purpose panels.

NEW HAMTRONICS CATALOG

Hamtronics, Inc., has announced publication of their new 1984 mail-order catalog for the VHF/UHF/OSCAR enthusiast and two-way radio shops. The 36-page two-color catalog features many new products, including an expanded line of FM repeaters and accessories such as power amplifiers, DTMF tone decoder/controllers, and autopatches. Also included are the lines of FM and AM receivers, FM transmitters, VHF and UHF transmitting and receiving converters, space-shuttle receivers, 800-MHz scanner converters, preamps, and other products Hamtronics has long been noted for.

For your free copy of this attractive new catalog, write to *Hamtronics, Inc., 65F Moul Rd., Hilton NY 14468, or call (716)-392-9430.* (For overseas mailing, please send $2.00 or 4 IRCs.) Reader Service number 479.

REGENCY'S 10-CHANNEL PROGRAMMABLE SCANNER

Regency Electronics, Inc., now offers a 10-channel programmable scanner with an arsenal of advanced features—including a little extra help during programming. Regency (the only American-made scanner brand) has announced the production of its Z10, covering six complete VHF and UHF frequency bands for access to thousands of police, fire, public service, business, commercial, and amateur-radio frequencies and channels. Selected frequencies from any band are easy to program into the scanner's memory; the Z10 can scan the frequencies in its memory or search the bands for whomever happens to be there.

The Z10 can scan its 10 channels in 2/3 of a second. Searching its three VHF bands, it can cover 1 MHz (200 frequencies in 5-kHz increments) in about 17 seconds; on its three UHF bands, it can search 1 MHz (80 channels in 12.5-kHz increments) in about 6 seconds. An automatic priority control checks any selected channel every two seconds and switches instantly if it's active.

Programming the Regency Z10 is made easier by a series of plain-language messages that appear on its display. These prompts identify the action that's in process or required next. Individual channels are programmed by using the numeric keypad to enter a desired frequency or by identifying a desired frequency when searching. A special circuit saves these entries in memory for up to a week (should power fail or if the unit is transported or temporarily stored); it does so without batteries (the usual method of memory protection) to avoid problems associated with battery failure from neglect.

The Z10 can pick up most transmissions in the low VHF (30–50 MHz), VHF two-meter amateur (144–148 MHz), standard UHF (450–470 MHz), and extended UHF (470–512 MHz) bands. Its telescoping antenna is

HAM HELP

I am looking for a schematic diagram and/or manual for the Electronics International Corporation model 150 VHF receiver.

John Vining
1514 A, 2nd Street, West
Cornwall, Ontario
K6J 1J3 Canada

I need a copy of the Kenwood phone patch PC-1A manual. Will pay for the reproduction gladly.

Albert S. Wilde W8JZZ
5580 E. Galbraith Road
Cincinnati OH 45236

Wanted: schematics for (1) RCA WO-33A scope, (2) Radio Shack catalog no. 40-217 stereo amp, (3) Olson RA-193 stereo receiver, and (4) Realistic 13-1180 stereo receiver. Advise cost.

J. L. Orysen
2025 Sunkist Ave.
Waukesha WI 53186

I need installation instructions for the Icom AH-1 automatic mobile antenna tuner.

Tom Phipps KA4CSG
PO Box 5404
Ft. Hood TX 76544

A friend of mine in Africa asked me if I could get for him a circuit diagram (schematic diagram) for a Hallicrafters HT-32 A and a National HRO model STA 1.

I will gladly pay postage and copying costs if anyone can supply these.

Rob Harrington
PO Box 3434
Littleton CO 80161

I need service literature and an operating manual for a Friden 2305A TTY Flexwriter. Name your price. Also, does anyone know the location of the manufacturer?

Bob Somers W2QYH
411 Hamilton Rd.
Glassboro NJ 08028

electronically optimized for each band, and an antenna jack is provided for an optional external antenna.

A channel lockout excludes selected channels from being scanned, a useful feature when interest is in monitoring some limited number of channels or when a selected channel becomes only occasionally of interest. Scanners in newsrooms, for example, often exclude fire-department tactical channels except during major fires.

A scan-delay feature helps keep on top both sides of a conversation on channels where calls are usually met by replies. With scan delay selected, the Z10 waits for about two seconds at the end of a transmission (in case there's a reply) before it resumes scanning; without scan delay, scanning resumes in about six-tenths of a second.

When searching, the Z10 delays four seconds after a transmission before resuming its search. This not only allows time to listen for a reply, but also provides enough time to select the frequency for programming into one of the ten scanner channel memories—or simply to note the frequency on paper.

The human factors in the design of the Regency Z10 are quite apparent. Its easily-readable (vacuum fluorescent) display has big digits and a choice of two brightness levels. Sliding volume and squelch controls are easy to position accurately and easy to read with a glance. Its audio amplifier delivers a full 1 Watt at less than 10% distortion, and a jack for an external speaker is provided. The keyboard and display are angled for easy legibility.

Dual power supplies are built in to permit plug-in ac operation at home or dc operation in a car or other vehicle (where not prohibited by law).

The Regency Z10 is UL-listed and FCC-certified (Part 15, Subpart C). It measures

The Regency Z10 scanner.

10-3/4 inches wide by 2-7/8 inches high by 8-3/8 inches deep.

For additional information, contact *Regency Electronics, Inc., 7707 Records St., Indianapolis IN 46226-9986; (317)-545-4281.* Reader Service number 484.

SEA'S AUTOMATIC ANTENNA COUPLER

Stephens Engineering Associates (SEA) has just introduced the SEA 1612 fully automatic antenna coupler. A state-of-the-art microprocessor-based coupler, the SEA 1612 features a "learning mode" that allows it to remember, store, and immediately access data for instant recall and matching the next time the same frequency is used. On-the-spot tuning is fast, accurate, and automatic.

The 1612 activates on the first syllable of a voice transmission and functions automatically to effect optimum transceiver-to-antenna power transfer over a full 1.6-to-25-MHz frequency range. The matching procedure is fully automatic and requires no action by the operator other than the normal press-to-talk function. The SEA 1612 does not require setup by a technician and has virtually no channeling limitations, providing an infinite number of channels within its specified frequency range.

The 1612 will operate with any HF/SSB transceiver that has standard 50-Ohm output. Connections between a transceiver and the coupler consist only of 50-Ohm coax and a 13.6-volt-dc cable. An "Antenna Tuned" flag line is also available to signal the operator that the antenna system has tuned. A single 23- to 75-foot antenna is all that is required.

The coupler is self-contained within a sturdy housing of molded fiberglass with a gasket-sealed weatherproof cover. For complete details and technical specifications, please contact *Stephens Engineering Associates, Inc., 7030 220th SW, Mountlake Terrace WA 98043: (206)-771-2182.* Reader Service number 478.

SOLDERING SYSTEM HAS OVER 270 OPTIONS

With Wahl Clipper Corporation's new assortment of 15 miniature soldering irons and 23 tips, a user can choose from over 270 different soldering combinations to match precise soldering needs.

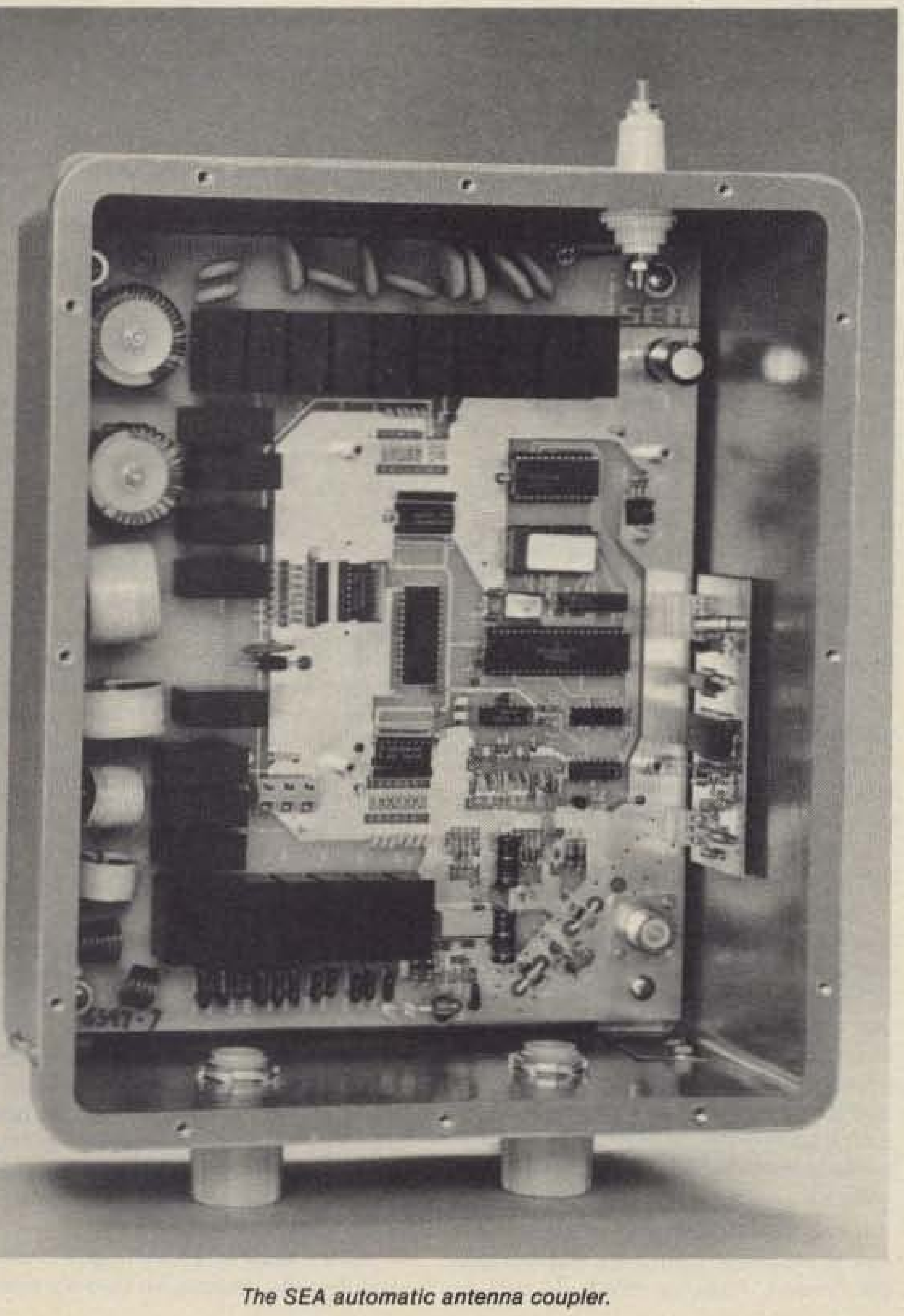
The 15 Oryx® miniature irons, each weighing ½ an ounce or less, are available for temperatures ranging from 575° to 850° F, from 5 to 25 Watts, and from 4.5 to 24 volts. Their compact size and precise temperature control make them useful for soldering heat-sensitive components.

The irons can be combined with any of 23 tips ranging in size from 1/25" to 3/32" in several choices of configuration. Tip construction is nickel-plated or iron-plated copper for most applications, with solid nickel, gold-end, and bare copper alloy (NASA) tips available for special requirements. Tip changes are easy and no tools are required. Cooled tips simply slide off and on.

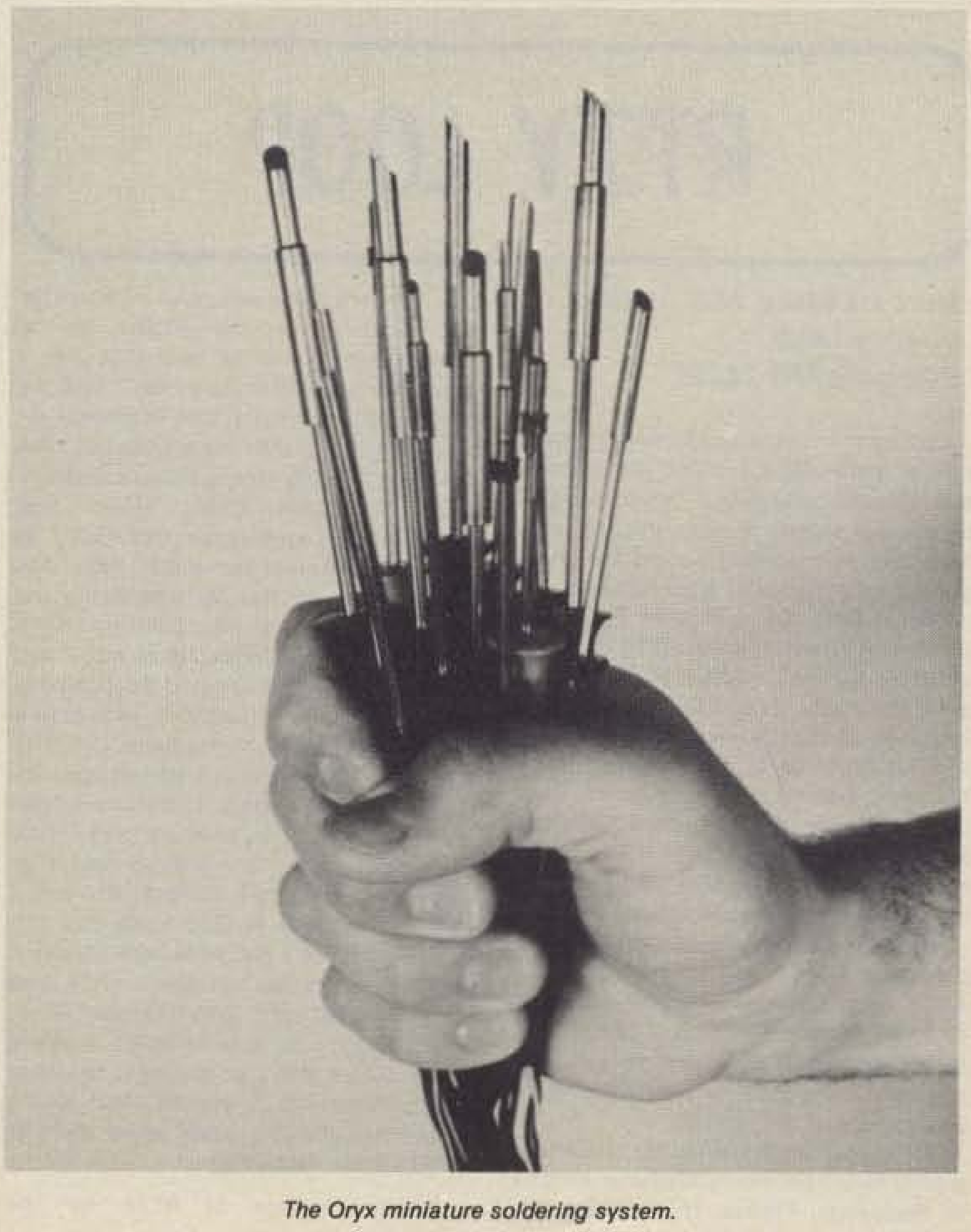
For further information, contact *Wahl Clipper Corporation, Sterling IL 61081; (815)-625-6525.* Reader Service number 483.

FLESHER CORPORATION'S NEW TU-1200

The new TU-1200 UHF/VHF RTTY terminal unit from Flesher Corporation is in answer to rapidly-growing high-speed com-



The SEA automatic antenna coupler.



The Oryx miniature soldering system.

Flesher Corporation's TU-1200.

munication needs. The TU-1200 receives all Baudot and ASCII rates to 1200 baud and uses Bell 202 standard tones (1200 Hz and 2200 Hz). The TU-1200 has many applications for modern communications, including RTTY repeater systems. The TU-1200 provides TLL- and RS-232C-compatible I/O and includes transmitter PTT output for complete remote control. It also provides AFSK output and RDA (received data available).

Front-panel controls include only three push-button switches to operate: POWER, SEND, and NORMAL/REVERSE SHIFT. Three LED indicators show their status. The TU-1200 is constructed with a all-metal case for protection. It's 5-1/8" W × 1-3/4" H × 6" L, and rear-panel DB-25 I/O connectors make installing and using the TU-1200 simple.

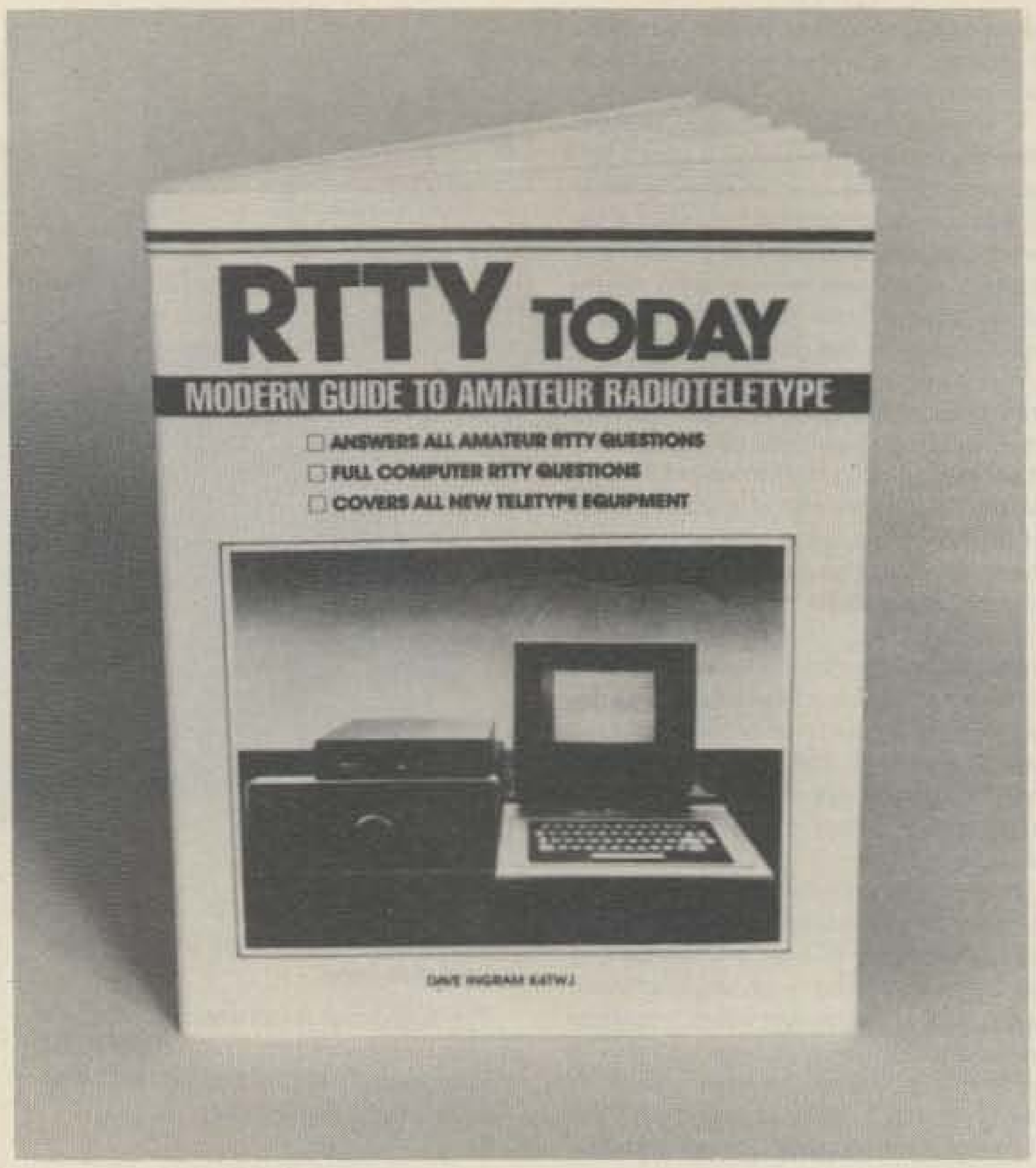
Available either wired or in kit form, the TU-1200 comes complete with a mating DB-25 I/O plug, power supply, and an operator/assembly manual. The TU-1200 will be available for delivery by April 30, 1984.

For more information and for a catalog, write the *Flesher Corporation, PO Box 976, Topeka KS 66601 or call 1-800-HAM-RTTY.* Reader Service number 482.

RTTY TODAY

RTTY Today is a completely new guide to amateur RTTY which covers all phases of radioteletype. This new book answers many questions asked about amateur RTTY and other areas such as the home computer for RTTY use.

Authored by Dave Ingram K4TWJ, a noted authority on all phases of RTTY, it's written in a clear, concise manner; all material is new and up-to-date and covers the most recently developed RTTY equipment and systems. *RTTY Today* is fully illustrated with photos, diagrams, RTTY-station setups, and equipment.



K4TWJ's new guide.

In a large 8½" × 11" softbound edition with an easy-to-read type style and format, the book's eleven chapters cover: The Exciting World of Amateur RTTY, Operating Parameters and Concepts of RTTY, Straight Talk on Home Computers and RTTY, RTTY Systems for Home Computers, RTTY Converts You Can Build, Dedicated RTTY Terminals and Systems, New Mini-RTTY Systems, Fascinating RTTY Outside the Amateur Bands (Press, Military, Weather, Etc.), Frequency list of Commercial Press Services, Secrecy and Other Codes Used in Radioteletype Work, and Tables of Abbreviations Used in RTTY.

For further infomation, or to order, write or call *Universal Electronics, Inc., 4555 Groves Road, Suite 3, Columbus OH 43227; (614)-866-4605.* Reader Service number 481.

RTTY LOOP

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

Last month I wrote a bit about a new toy here at WA3AJR, a TRS-80C Color Computer. Based on the most powerful eight-bit microprocessor around, the Motorola 6809, this is a fascinating computer which gives huge potential at a bargain price.

Well, I have had a chance to take a quick look at one piece of RTTY software available for the CoCo—a RTTY/CW program from Clay Abrams Software. Clay is known to us 68xx mavens from way back and has been one of a kernel of boosters for 68xx systems for many years. This looks like one fine piece of software, folks. I will have a full review next month, but for those of you who just can't wait, let me dangle a few choice tidbits. This program will receive and transmit RTTY at all common speeds, either in Murray or ASCII, and receive and transmit Morse at up to 99 words per minute. It has buffers for transmit, tape save, and more. Not all is golden, Clay, but I am impressed! More about this gem next month.

Not to stay stuck in one CPU vein, I have a card here from Henry Kirchmer KF4UW in Rockledge, Florida. Henry asks, "Do you know if anyone makes an interface for RTTY and CW and the software for the Timex/Sinclair 1000 or new 1500 that I could use with my (transceiver)?" Well, by a stroke of serendipity, also in the mail arrived an issue of *QZX*, billing itself as "The Journal Covering Amateur Radio and Sinclair Computers—ZX-80, Micro Ace, ZX-81, and Timex/Sinclair 1000/1500." In the issue I received (November, 1983), articles include several for interfacing the Timex/Sinclair-type machines on RTTY and CW, with explanations of ASCII and Murray (although they call it Baudot) code for the computerist ham. They even have a short bibliography in the back with articles in various amateur-radio magazines related to RTTY. I am a bit disturbed, however, that while they have a listing for *73: Amateur Radio's Technical Journal*, they do not mention this column. Oh well, I quess somebody at *QZX* reads this column—after all, I did get a copy. Anyway, interested prospective readers might drop them a line at *QZX*, 2025 O'Donnell Drive, Las Cruces, New Mexico 88001. A year's subscription is $12, according to the information received. It wouldn't hurt if you mentioned that you read about them in "RTTY Loop," would it?

Another source of RTTY for the Timex/Sinclair is Ken Carpenter KC4UG who makes a series of programs under the business name of Kentronics. That is not to be confused with Kantronics, mind you! Well, Ken offers a series of programs, including RTTY transceive programs, Morse programs, and some amateur-radio utilities, all designed for the Timex/Sinclair 1000 or Sinclair ZX-81. His RTTY program, for example, is touted as featuring receive and transmit buffers, split-screen display, multiple baud rates for either Murray or ASCII modes, hardcopy option, and more. Requirements include a computer with 16K or more of RAM, a RTTY I/O port, and a terminal unit capable of interfacing with TTL-level (not RS-232) signals.

That I/O port is designed around an 8250 ACIA which takes care of providing a baud clock along with converting serial to parallel and back again. Apparently, there are also transistors provided for some degree of isolation from outside voltages. No mention is made of optoisolators or the like.

Typical prices for these items are $25 for a tape of the RTTY program, guaranteed to load or it will be replaced upon return, and $70 for an assembled and tested interface unit, plus postage and handling. I have no information on how well or easily this RTTY interface operates; maybe some of you who have played with it will let me know. However, it does seem as though more is becoming available for this truly low-cost computer.

If you would like more details, write to Ken at his office, Kentronics, Inc., PO Box 586, Vernon, Alabama 35592. Be sure to watch the spelling of their name, and drop ours, OK?

While I cannot speak from the experience of having used the following program myself, a letter from Jerry Weikrauch KØHZI in North Riverside, Illinois, speaks very highly of a RTTY program for the VIC-20 and Commodore-64 computers. Available from RAK Electronics, these packages feature software to turn either computer into a basic RTTY terminal and sell for under twenty dollars each. Sounds like quite a bargain! You have to provide a terminal unit or some other way to turn the receiver audio into on/off pulses and an AFSK oscillator to generate the necessary tones. If you're interested, drop RAK a line at PO Box 1585, Orange Park, Florida 32067-1585. I don't need to prompt you as to where to tell them you read about them, but let me know what you think if you try the software.

Going from systems that seem to have a lot written for them to the other extreme, I have a letter here from Philip Shulins WD4OSS in Daytona Beach, Florida. Phil notes that he is "drooling with anticipation" looking for a RTTY program for his Kaypro-2 computer. Well, Phil, as I have indicated here before, there have been relatively few programs, or even program announcements, that have crossed my desk for the IBM-type computers. If you can run a standard CP/M-type program, you may be able to find one on a local RBBS, but otherwise, I am afraid I draw a blank. I will keep my eyes out, though, and pass along any information I receive here to you and the rest of the gang.

I have a letter here from Hughie Chavis (I can't find the envelope, so I am not exactly sure where he is). Anyway, Hughie is trying to run a Teletype® KSR-35 from his TI-99/4A computer by running data out of an RS-232 module. He writes, "The KSR-35 is set for 100-wpm serial data transfer. The lowest baud rate for the TI RS-232 module is 110 baud. The TI RS-232 module has a PIA port in addition to the serial I/O port. My question is, how do I connect the KSR-35 to the RS-232 module so the printer capability can be utilized?"

Well, there is a very basic problem with connecting these two units together; they are not speaking the same language. Forget dialects, I'm talking major languages—ASCII and Murray are about as different as English and Hebrew. It would not be too hard to connect the parallel port of the TI interface module to a simple UART chip (such as the common 1013 variety), provide a clock circuit, and put the data out at the correct rate, but the problem remains that the data coming out of the computer is in the wrong code.

Let me explain. To begin with, realize that the "baud" designation merely refers to how many data bits per second are being transmitted. There is no relation between the "baud rate" and the type of encoding used to send the data. With plain old Murray code—the one we are all familiar with on RTTY, and the one which your KSR-35 speaks—one common speed is the so-called 60 words per minute. Now, not to go into all the math right now, each character consists of five data bits, one start bit, and a stop bit which is a tad longer than the others. This works out to 7.41 units per character, with each unit being one bit of 21 ms length. Each character thus takes 7.41 times 0.021 seconds, or 0.163 seconds. In one minute, there would be 368 characters; in one second, 6.134 characters. Now, 6.134 characters per second times 7.41 bits per character (remember how the units canceled out in algebra?) yields 45.45 bits per second. This is 45.45 baud.

Without working through all this math again, trust me that the commonly called "100-wpm" speed is about 75 baud. That's one problem, and we're still talking five-level Murray code.

The TI computer, as most others, uses seven-bit ASCII to communicate with the outside world. Now each character consists of a start bit, seven data bits, a parity bit, and either one or two stop bits, depending often on the hardware involved. These bits do not in any way, shape, or form correspond to the RTTY Murray code. What you will have to do is convert the ASCII coming out of the computer to Murray, shift speeds, then put it in a form that the KSR-35 can accept.

I'll let you think on that one for a bit, and next month I'll show you a few ways to accomplish this task. While software techniques have been the most popular with users of some computers, the limited access to the TI-99/4A's innards might well hamper that approach, and I feel that you might be inclined to stick with a totally outboard approach. Let me get out the drafting board and see what develops.

Now, a note to all of you who have tried to call me on the phone over the last few months. Please don't. It's not that I dislike your calls, but I am a physician and my home number is not listed. It will stay that way for professional reasons. My office number, or answering service, has fielded a number of RTTY calls in past months, and they don't always know what to do with them. So, if you have a question or would like to offer some words to the column, jot them down on a card or letter and mail them to me at the above address. If you would like a reply, enclose a self-addressed, stamped envelope, and I shall try to answer you as soon as possible. I try to scribble something down, usually at the bottom of your letter, and return it to you within a few days, unless I need to hold it for information, publication, or the like. I love hearing from you all, pro and con, and it is often your input, suggestions, and questions which make many readers write that the first thing they look for when they get their copy of *73* is "RTTY Loop."

CONTESTS

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

HOLIDAY-IN-DIXIE QSO PARTY
1800 GMT to 2300 GMT April 7

The seventh annual Holiday-in-Dixie QSO Party will be sponsored again this year by Shreveport, Louisiana, ham-radio operators. Operators will be working on 40 meters, 20 meters, and 15 meters. If 10 meters is open, we will try it from 1800Z to 1900Z.

Holiday-in-Dixie is an annual ten-day celebration of the Louisiana Purchase.

EXCHANGE:

RS(T) and QTH.

FREQUENCIES:

CW—60 kHz up from low edge of 40-, 20-, and 15-meter bands.

SSB—7240, 14280, 21370, and 28570. Novice—7125 and 21125.

AWARDS:

Send an SASE with QSL card to Holiday-in-Dixie QSO Party, PO Box 4842, Shreveport LA 71104. 8½" × 11" certificates will be mailed upon receipt of the SASE and QSL card.

QRP ARCI APRIL QSO PARTY
Starts: 1200 GMT April 21
Ends: 2400 GMT April 22

Stations may be worked once per band for QSO multiplier credits. Participants may operate a maximum of 24 hours during the contest period.

EXCHANGE:

Members—RS(T), state-province-country, and QRP ARCI membership number. Nonmembers—RS(T), state-province-country, and power output.

SCORING:

Each member QSO counts 5 points regardless of location. Nonmember QSOs are 2 points with US and Canadian stations, others 4 points each. Multipliers are as follows: 4-5 Watts output—×2, 3-4 Watts output—×4, 2-3 Watts output—×6, 1-2 Watts output—×8, and less than 1 Watt output—×10. Entries from stations running more than 5 Watts output will count as check logs only. Stations are eligible for the following bonus multipliers: if 100% natural power (solar, wind, etc.) with no storage—×2, if 100% battery power—×1.5.

Final score is total QSO points times total number of states-provinces-countries per band times the power multiplier times the bonus multiplier (if any).

FREQUENCIES:

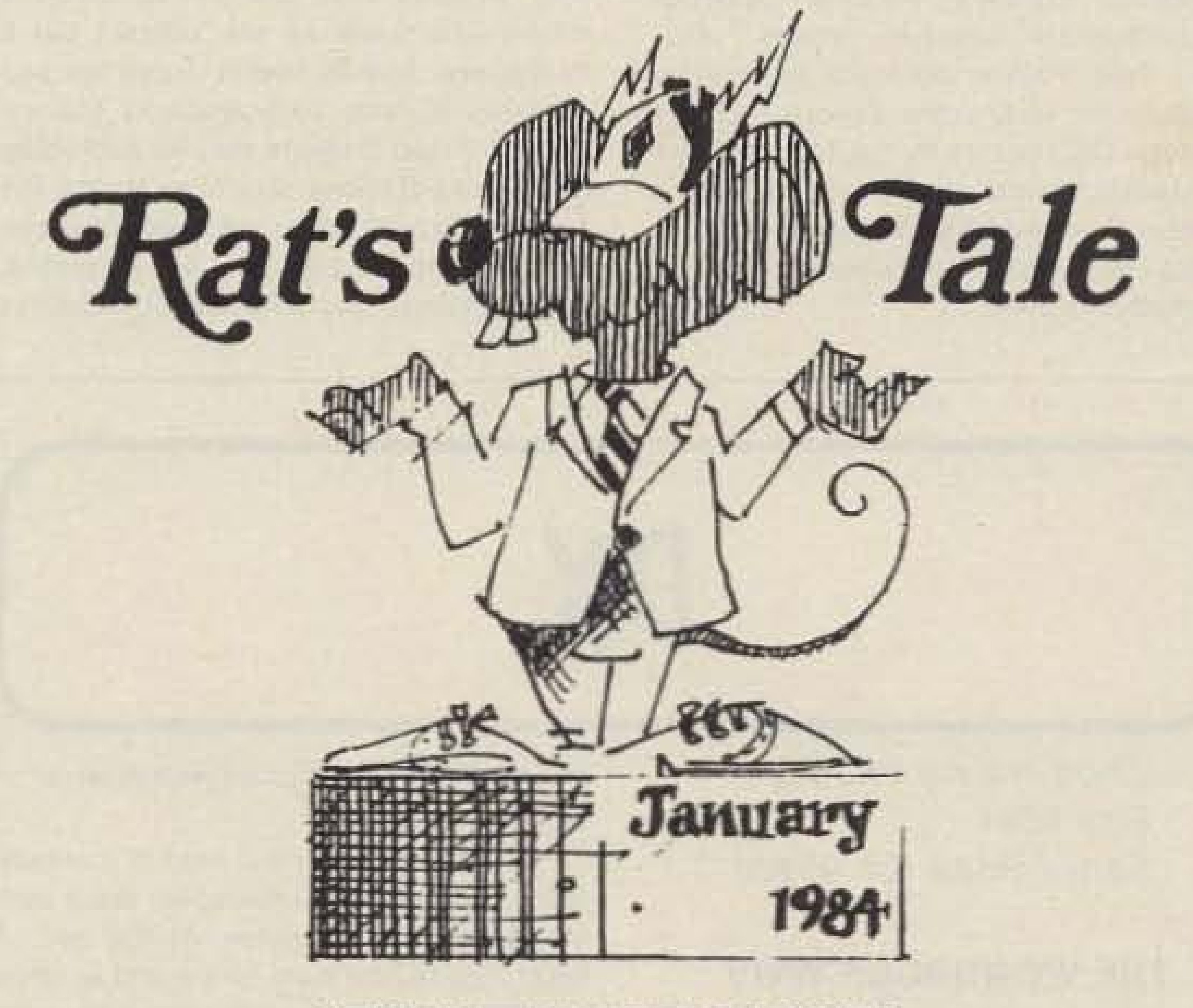
1810, 3560, 7040, 14060, 28060, 50360. Novice/Tech—3710, 7110, 21110, 28110. No 30-meter contacts will be counted!

AWARDS:

Certificates to the highest-scoring station in each state, province, or country with 2 or more entries. Entries automatically considered for annual Triple Crowns of QRP Award. A special MILLIWATT certificate is being sponsored by WØRSP for

CALENDAR

Apr 7	Holiday-in-Dixie QSO Party
Apr 21-22	QRP Amateur Radio Club April QSO Party
Apr 28-29	Massachusetts QSO Party
Apr 28-29	County Hunters SSB Contest
Apr 28-29	Helvetia Contest
May 5-6	Late Spring QRP SSB Activity Weekend
May 5-6	Florida QSO Party
May 19-21	Michigan QSO Party
Jun 9-10	ARRL VHF QSO Party
Jun 23-24	ARRL Field Day
Jul 13-15	*A5* International SSTV-DX Contest
Aug 4-5	ARRL UHF Contest
Aug 11-12	New Jersey QSO Party
Aug 24-27	*A5* North American UHF FSTV-DX Contest
Sep 8-9	ARRL VHF QSO Party
Sep 15-17	Washington State QSO Party
Sep 22-23	Late Summer QRP CW Activity Weekend
Oct 6-7	ARRL QSO Party—CW
Oct 13-14	ARRL QSO Party—Phone
Nov 3-4	ARRL Sweepstakes—CW
Nov 17-18	ARRL Sweepstakes—Phone
Dec 1-2	ARRL 160-Meter Contest
Dec 8-9	ARRL 10-Meter Contest
Dec 26-Jan 1	QRP Winter Sports—CW



NEWSLETTER OF THE MONTH

Dateline Nashville: Source of muffled guffaws emanating from city sewers confirmed. RATS! Don't panic, Music City, it's only members of the Radio Amateur Transmitting Society of Nashville enjoying the latest issue of *Rat's Tale*.

This publication is a pleasure to read. Surrounding the obligatory meeting announcements are the exploits of Chairman Mac, Boy George, and the ubiquitous Dr. Jack Byrd. Animals tiptoe across the pages. Seedy rodents in three-piece suits adorn the masthead.

Despite the lighthearted mood of *Rat's Tale*, editor Wayne Renardson NZ4W has skillfully tempered the hilarity with genuine news stories, thought-provoking commentary, and scathing letters from the membership. Close attention to mechanical detail rounds out a package any RAT would be proud of.

To enter your club's newsletter in *73*'s Newsletter of the Month Contest, send it to *73*, Pine Street, Peterborough NH 03458, Attn: Newsletter of the Month.

the highest-scoring station in the less-than-1-Watt category, provided there are two or more entries in that power category.

LOGS AND ENTRIES:

Separate log sheets are suggested for each band for ease of scoring. Send full log data, including full name, address, and bands used. Also send a work sheet showing details and time(s) off air. Make sure your callsign is written on the top margin of every page submitted! No log copies will be returned. All entries desiring results and scores please enclose a business-size envelope with return postage for one ounce or an IRC. It is a condition of entry that the decision of the QRP ARCI Contest Chairman is final in case of dispute. Logs must be received by May 21 to qualify. Send all logs and data to: QRP ARCI Contest Chairman, Eugene C. Smith, Jr. KA5NLY, #16 Fairmont Drive, Little Rock AR 72204.

MASSACHUSETTS QSO PARTY
Starts: 1600 GMT April 28
Ends: 2400 GMT April 29

Sponsored by the Pilgrim Amateur Wireless Association. A station may be worked once per band. Phone and CW are considered separate bands. No cross-band or repeater contacts are permitted. Mobiles and portables may be contacted each time a county change takes place.

EXCHANGE:

RS(T) and state, VE province, or Massachusetts county. Massachusetts stations also will indicate if member of PAWA.

SCORING:

All stations count 2 points for each completed SSB exchange and 4 points for each completed CW exchange. Massachusetts stations then take the total QSO points and multiply by the total number of Massachusetts counties, states, provinces, and PAWA members worked to compute the final score. Others, multiply the total QSO points by the total number of Massachusetts counties and PAWA members worked. Multiplier credit for PAWA club members worked may be counted only once.

FREQUENCIES:

Phone—1820, 3960, 7260, 14290, 21390, 28590, and 50110.

CW—1810, 3560, 7060, 7120, 14060, 21060, 21120, 28060, and 28120. Use of FM simplex is encouraged. Please use CW on CW bands only!

AWARDS:

Certificates will be awarded to 1st-, 2nd-, and 3rd-place winners in each Massachusetts county, state, and VE province, plus the high-scoring Novice in each state. A plaque will be given to the Massachusetts station submitting the highest number of QSOs bettering the record of 1483 QSOs now held by K1GSK in the 1979 Massachusetts QSO Party.

ENTRIES:

Logs must show date, time, band, mode, callsign, state and province worked, and exchange RS(T). Submit a separate summary sheet along with the logs. Summary sheet should include: name, call, mailing address, Massachusetts county, total QSO points, multipliers claimed, and total score. All entries with more than 100 QSOs please send a dupe sheet. Deadline for mailing is May 31. For awards and results include $0.40 postage (no envelope). Address entries to: Ed Peters K1KJT, 29 Greenbrier Drive, New Bedford MA 02745.

COUNTY HUNTERS SSB CONTEST
0001 to 0800 GMT April 28
1200 GMT April 28 to 0800 GMT April 29
1200 to 2400 GMT April 29

Please note the two 4-hour rest periods. Mobiles may be worked each time they change counties or bands. Mobiles that are worked again from the same county on a different band count for point credit only. Mobiles that are contacted on a county line count as one contact but 2 multipliers. Mobile teams count as two contacts if both participate in the exchange. Fixed stations may be worked by other fixed stations only once during the contest. Repeat QSOs between fixed stations on other bands are not permitted. Fixed stations may be worked by mobiles each time they change counties or bands. Repeat contacts between mobiles are permitted provided they are on a different band or county. Mixed-mode contacts are permitted provided that one station is on SSB. Contacts made on net frequencies will not be allowed for scoring in this year's contest.

EXCHANGE:

Signal report, county, and state or country.

FREQUENCIES:

Suggested frequencies are as follows: 3920-3940, 7220-7240, 14275-14295, 21375-21395, 28625-28650. There will be a "mobile window" of 10 kHz on the following frequencies: 3925-3935, 7225-7235, 14280-14290. Mobiles will be in this 10-kHz segment and fixed stations are asked to refrain from calling "CQ contest" in the mobile window. After working mobiles in the window, fixed stations are requested to QSY outside the window to work fixed stations in the contest. This will allow the mobiles running lower power a chance to be heard and worked in the contest.

SCORING:

Contact with a fixed US or Canadian station—1 point. Contact with a DX station (KL7 and KH6 count as DX)—5 points. Contact with a mobile station—15 points. Contact with a mobile team station—30 points. The multiplier is the total number of US counties plus Canadian stations worked. The final score is this multiplier times the total QSO points.

AWARDS:

MARAC plaques to the highest-scoring fixed US or Canadian station, DX station, mobile team, and top 2 mobile stations. Certificates to the top 10 fixed, mobile team, and mobile stations in the US and Canada, and to the highest-scoring station in each DX country.

ENTRIES:

Logs must show date and time, station worked, reports exchanged, county, state, band, claimed QSO points (1, 5, 15, or 30), and each new multiplier must be numbered. Logs and summary sheets are free for a #10 SASE or SAE and appropriate IRCs. Write to: John Ferguson WØQWS, 3820 Stonewall Ct., Independence MO 64055. All entries must be received by June 15 to be eligible for awards. DX entries should use air mail. Winners will be announced at the 1984 Independent County Hunters Convention during July, and in the ***MARAC Newsletter.***

HELVETIA CONTEST
Starts: 1300 GMT April 28
Ends: 1300 GMT April 29

Use all bands, 1.8 to 28 MHz, on CW or phone. Each station can be worked once per band regardless of mode.

EXCHANGE:

RS(T) plus three-figure serial number starting at 001. Swiss stations will also give their 2-letter canton.

SCORING:

Each contact with an HB station counts 3 points. The multiplier is the sum of Swiss cantons worked on each band, 26 maximum per band. Final score is the sum of QSO points multiplied by the sum of cantons worked on each band.

ENTRIES AND AWARDS:

Certificates will be given to the highest scorer in each country. USA and Canadian call area are considered as separate countries. Entries with more than 1 log sheet must have QSOs separated per band. A multiplier checklist is appreciated. Use a summary sheet as usual and indicate call, name, address, single or multi-operator, number of QSOs, points and multipliers per band, plus total final score. Also include station description, power output, and declaration that rules of the contest and license regulations have been observed. Logs must be postmarked not later than 30 days after the contest and sent to: Gody Stalder HB9ZY, Tellenholf, CH-6045 Meggen, Switzerland. Canton abbreviations are: ZH, BE, LU, UR, SZ, OW, NW, GL, ZG, FR, SO, BS, BL, SH, AR, AI, SG, GR, AG, TG, TI, VD, VS, NE, GE, JU.

H26 AWARD:

This award is for contacts made after January 1, 1979. Send a list and QSL for each of the 26 cantons worked to: Kurt Bindschedler HB9MX, Strahleggweg 28, CH-8400 Winterthur, Switzerland.

DX

Chod Harris VP2ML
Box 4881
Santa Rosa CA 95402

THE WONDROUS WWV

What one station do hams listen to more than any other? WWV probably has the lock on that statistic. WWV has been providing time and frequency information to amateurs and others for more than 60 years. Let's have a close look at the station and how WWV can improve your DXing.

First, you have to hear the station. Almost every modern amateur rig has a separate position on the bandswitch to receive WWV, usually on 10 MHz. Simply connect an antenna, switch to the WWV position, and tune to the appropriate frequency. Note that WWV transmits in AM, so use the AM position on your receiver or turn off the bfo.

The first thing you will hear is a steady 500- or 600-Hz tone, interrupted every second by a "tick" or pulse. At the end of each minute, the tone stops and a voice gives the time in Coordinated Universal Time (UTC). The next minute begins with a longer tone of 1000 Hz. The *start* of this longer tone is the exact *start* of the minute just identified by the voice announcement. In other words, you hear "At the tone 17 hours, 19 minutes Coordinated Universal Time. . . . Beep." The time is exactly 1719 UTC at the start of the beep.

Probably the first thing a DXer will do when listening to WWV is to reset his or her watch and radio-shack clock. Every DXer should have at least one reasonably accurate clock set to UTC. Since you can purchase a digital watch or small, stick-on clock for less than five dollars, there is really no excuse not to have a timepiece dedicated to UTC. And do you know how you can tell a true DXer? His wristwatch is set to UTC!

How often should you reset your clock or watch? That depends on how well it keeps time. My ancient Tymeter clock (the one with the numbers on plastic cylinders which provided a "digital" readout years before liquid-crystal displays) keeps such good time that I only reset it every month or so. You can note the time you reset the clock in your log so that you can look back to see how much time your timepiece has gained or lost. If your clock is off by more than one minute a day, reset it every day.

An error of only a few minutes in your log can make the difference between confirming the contact and not. A DX station might be making as many as 6 contacts a minute. If your time on your QSL card is off by only 3 minutes, your callsign might be 20-30 calls away from your claimed time. The DX station or QSL manager may have to search an entire log sheet for your call. By having your time accurate to the minute, you can reduce the chances that the DX station will not find your call.

You can also check the time on your shack clock *after* an important contact. Simply tune immediately to WWV and note the time difference between WWV time and your clock. Then change the time in your log to match the correct time. You can trust WWV to broadcast the correct time.

The Atomic Clock

Let's have a look behind the signal and see why you can trust the accuracy of WWV. The time broadcast on WWV derives from *the* clock a few miles south, in Boulder, Colorado. There, nestled against the Rockies, only a few miles from the Continental Divide, sits NBS-6 (see Photo A). NBS-6 is the latest in a line of cesium-beam clocks produced by the National Bureau of Standards. These cesium-beam clocks use an automatic feedback system to produce a microwave signal of exactly 9,192,631,770 Hz. This frequency is a resonant frequency of the cesium atom, upon which the atomic clock is based.

During the 30 years that the National Bureau of Standards has been working on atomic clocks in Boulder, they have produced the most accurate and stable timepiece in the world. In fact, scientists recently redefined the international unit of length, the meter, on the basis of the ac-

Photo A. NBS-6, the cesium-beam atomic clock at the National Bureau of Standards in Boulder, Colorado. This clock is the most accurate timepiece in the world!

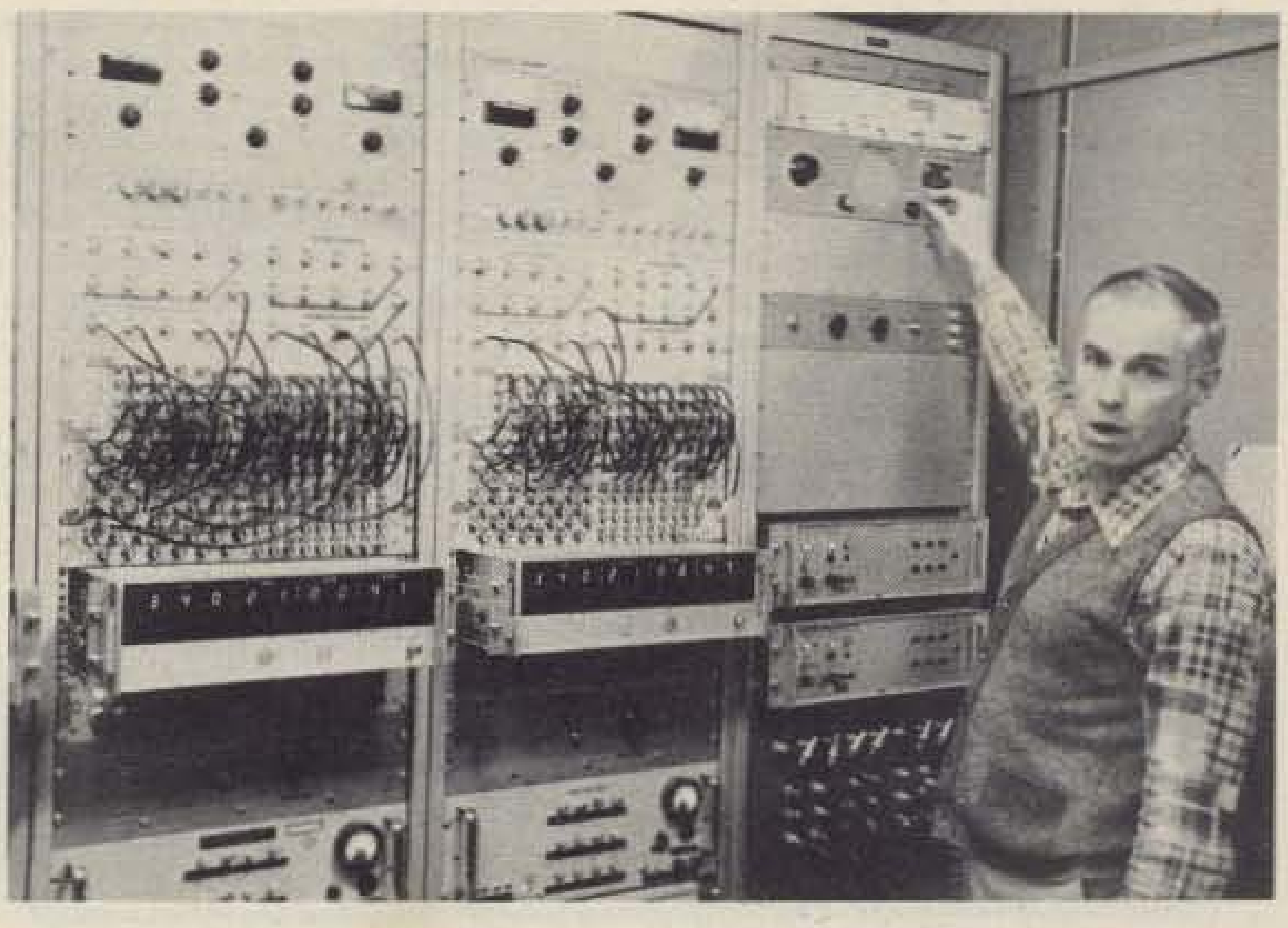


Photo C. Engineer Howard Machlan with two of the three identical cesium-beam clocks which keep the time at the WWV transmitter site in Fort Collins.

curacy of the cesium-beam clock. NBS-6 is accurate to better than one part in 10 trillion. That's about one second in 3 million years!

NBS-6 is so accurate that the time it determines is more accurate than the Earth's rotation. Since all our clocks are based on the cesium-beam atomic clock in Boulder, it would be possible for this time to be "out of synch" with the real world. Midnight would move slowly toward evening. A far more practical problem would be that sailors navigating by the stars would find themselves in the wrong place! Scientists got around this problem by agreeing to add "leap seconds" to UTC as often as needed to keep atomic time in step with sunrises and sunsets. About once a year they add an extra second to the day at midnight, to keep everyone on the same time scale.

But all this is down in Boulder, about 30 miles from the site of WWV, outside Fort Collins, Colorado. What's the connection between the atomic clock in Boulder and the WWV transmitters? Surprisingly, there is *no* direct connection. The time transmitted by WWV is generated right there at the WWV site, by smaller cesium-beam clocks. WWV uses three of these Hewlett-Packard commercial-model cesium clocks (at about $25,000 each).

Why three clocks? The argument is as follows: If you have only one clock, it might break down, putting you off the air, or it might be wrong. There would be no way to check its accuracy. On the other hand, if you had two clocks, and they showed different times, you wouldn't be able to tell which one was correct. Only with three clocks can you tell if one is incorrect. If one of the three clocks malfunctions, an operator must repair it as quickly as possible, to avoid the two-clock problem.

Of course, these atomic clocks keep pretty good time all by themselves. I watched a strip-chart recorder measure the time variation in the WWVB clocks, and with a full scale of only one microsecond, the pen didn't even wiggle down the center of the chart! Even so, the time they generate is regularly compared to that produced by the master atomic clock down in Boulder.

At one time they physically moved a portable atomic clock from one town to the next to make this comparison, but the WWV Chief Engineer, John Milton ex-WØDAV, came up with a better way using Denver TV stations. He compares the time a certain reference point on the TV signal arrives at Boulder and at the WWV site further north. He knows how much further Fort Collins is from Denver than Boulder and can determine the extra time the reference point should take to reach his receiver. A custom computer program handles the actual comparison and recalibrates the WWV atomic clocks daily.

Even without this daily check, John Milton feels confident enough of his equipment that he could maintain the high accuracy of the WWV information. "We know the drift rates of each clock so well that we can keep going for months without any reference standard," John says. This drift isn't much: about one-tenth of a microsecond in four hours!

Getting the Word Out

Of course, all the accuracy in the world would be worthless if you had to go to Fort Collins to check your watch. Thanks to WWV, however, you don't have to travel to Colorado for this information.

All the WWV signals, tones, and even the basic carrier frequencies are derived from the same cesium-beam clocks which keep track of the time. The extremely stable signal from the clock is divided and mixed to produce each different signal, tick, tone, and beep. Only the voice announcements don't come out of the clock. This means that just about everything you hear on WWV (carrier frequency, tone frequencies, etc.) has the same high degree of accuracy. That mass of cables above the digital readout (see Photo C) is a patch panel for all the frequency dividers and other circuits which produce the pattern of tones and ticks on the WWV signal.

The only parts of the WWV signal which are *not* produced by the cesium clocks are the voice announcements of time and other factors. These voices are recorded on high-quality drums and added to the WWV signal at the appropriate time. No, there isn't anyone sitting there reading the time all 24 hours.

All the WWV signals, on 2.5, 5, 10, 15, and 20 MHz, are amplitude modulated (AM). After the basic signal is generated by the clock, complete with tones, etc., it leaves the heavily-shielded clock room and goes to the series of 8 amplifiers arranged in the circle around the building. These transmitters are linear amplifiers which take the low-level signal from the clock room and amplify it to about 10,000 Watts output! (The 2.5- and 20-MHz amps run a mere 2,500 Watts.) For good reliability, these amplifiers are 40,000-Watt units, run at low power.

Reliability is a key factor at WWV. The total "down time" is less than 0.002%! Engineer John Milton has developed a complete package of procedures and equipment to ensure this fantastic reliability. First, each of the three cesium clocks has a backup battery system, should commercial power fail. A huge diesel generator sits in the back of the WWV building, ready to kick in at a moment's notice and power all the transmitters. And each transmitter has an automatic reset feature. If the transmitter fails for whatever reason, the built-in system will restart the transmitter. If it fails again, one of the standby transmitters takes over.

There is a "dedicated" standby transmitter for the 5-, 10-, and 15-MHz signals, all wired and tuned, set for automatic replacement. WWV monitors the actual transmitted rf, listening for any change in signal strength.

The signals leave the WWV building through gas-filled coaxial lines to one-half-wavelength, vertical antennas. These are simply dipoles stood on end. This gives a good omnidirectional pattern. There are even spare antennas: Two all-band verticals stand ready to take over if one of the primary antennas is damaged.

WWV has achieved this excellent on-line record in spite of major cutbacks in funding. The station had as many as 20 people at one time, monitoring the equipment around the clock. Now, thanks to automated backups, the staff consists of exactly three engineers and a single secretary, all working standard hours. The rest of the time the entire station is deserted, except for dozens of fuzzy brown rabbits

Photo B. John Milton, chief engineer at WWV, keeps the time-and-frequency-standard station on the air, on time, and under budget.

and an occasional deer. The entire annual budget for the station, including the low-frequency WWVB, is about $200,000, and that includes an electricity bill of about $6,000 per month!

One casualty of the budget crunch has been the 25-MHz signal, which was discontinued in 1977. It wasn't taken off the air because it cost too much to operate; the transmitter was needed as a dedicated standby for the other frequencies. Still, WWV is *one* government organization which provides an excellent service for a remarkably small amount of money.

(Next month we'll look at some of the *other* (non-time) reasons to listen to WWV. Meanwhile, tune in to 10.00000000 MHz at 18 minutes after the hour.) Don't worry; we'll show how this WWV information is vital to successful DXing in future columns.

DEVIL'S MOUNTAIN

Churum-Vena Expedition. In one of the more unique DXpeditions of 1984, a group of Venezuelan amateurs will operate from Devil's Mountain, deep in the heart of Venezuela. Churum Vena is better known as Angel Falls. At 3213 feet, it is the highest waterfall in the world. The waterfall (named after its discoverer, James Angel) plunges down the side of seldom-climbed Devil's Mountain. The normal viewing point for the falls is at the bottom of the canyon below, but at the end of March and early April, 4M5ARV/6 will be on all bands from the top. Frequencies are: CW—3710, 7010, 14010, 21110, and 28110 (Novices take note!); SSB—3795, 7095, 14195, 21295, and 28595. QSL via PO Box 3636, Caracas 1010-A, Venezuela.

And who is that you hear on 15-meter SSB? VP2ML? Montserrat might not be the rarest of DX, but I look forward to working you the last week in March and the first week in April. QSL via K1RH. 73, and see you on the bands!

SOCIAL EVENTS

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received by 73 Magazine by the first of the month, two months prior to the month in which the event takes place. Mail to Editorial Offices, 73 Magazine, Pine St., Peterborough NH 03458.

FRAMINGHAM MA
APR 1

The Framingham ARA, Inc., will hold its annual spring flea market on Sunday, April 1, 1984, beginning at 10:00 am at the Framingham Civic League Building, 214 Concord Street (Rte. 126), downtown Framingham. Admission is $2.00 and tables are $10.00 (pre-registration required). Sellers may begin setups at 8:30 am. There will be radio equipment, computer gear, and food in-house. Talk-in on 147.75/.15 and .52. For more information, contact Jon Weiner K1VVC, 52 Overlook Drive, Framingham MA 01701, or phone (617)-877-7166.

TRENTON NJ
APR 1

The Delaware Valley Radio Association will hold its 12th annual flea market and computer show on Sunday, April 1, 1984, from 8:00 am to 4:00 pm, at the New Jersey National Guard 112th Field Artillery Armory, Eggerts Crossing Road, Lawrence Township, Trenton NJ. There will be an indoor and outdoor flea-market area, commercial dealers, and refreshments. Sellers are asked to bring their own tables. Talk-in on 146.52 and 146.07/.67. For advance tickets and space reservations, please send an SASE to Walter L. Sharpe KB2ZY, 140 Susan Drive, Trenton NJ 08638.

CHICAGO IL
APR 4

The Chicago Amateur Radio Club will hold an open house on Wednesday, April 4, 1984, from 7:00 pm to 10:00 pm, at Edgebrook Golf Course Field House, 6100 N. Central Avenue, Chicago IL. Everyone is welcome—especially those interested in learning about amateur radio and how to obtain a license. There will be a film shown and live demonstrations of all aspects of amateur-radio communications and equipment. For additional information, call (312)-545-3622.

ROCHESTER NH
APR 7

The Great Bay Radio Association will hold its 4th annual hamfest/flea market, Springfest '84, on Saturday, April 7, 1984, from 9:00 am to 3:00 pm, at the Rochester VFW Post 1772 Hall, Pickering Road, Rochester (Gonic) NH. Admission is $1.00. Food, refreshments, and plenty of free parking will be available. Talk-in on 147.57. For advance table reservations and further information, write Great Bay Radio Association, PO Box 911, Dover NH 03820.

SAN ANTONIO TX
APR 7

The San Antonio Area Radio Club will hold its first annual Swapfest and Bar-B-Q on April 7, 1984, from 7:00 am to 5:00 pm, at Comanche Park. Talk-in on 147.36 MHz. For more details, write Melvin Anderson, 8932 Saddle Trail, San Antonio TX 78255.

ROCHESTER MN
APR 7

The Rochester Amateur Radio Club and the Rochester Repeater Society will sponsor the 7th annual Rochester Area Hamfest on Saturday, April 7, 1984, beginning at 8:30 am, at John Adams Junior High School, 2535 NW 31 Street, Rochester MN. There will be a large indoor flea market for radio and electronic items, refreshments, and plenty of free parking. Talk-in on 146.22/.82 MHz. For further information, contact RARC, c/o W. C. McGurk WB0YEE, 2253 Nordic Court NW, Rochester MN 55901.

FLEMINGTON NJ
APR 7

The Cherryville Repeater Association will sponsor the annual Flemington NJ Hamfest on Saturday, April 7, 1984, from 8:00 am to 3:00 pm, at the Hunterdon County High School Field House on Route 31. General admission is $3.00. For early birds, breakfast will be available on site from 6:30 am. Talk-in on 147.375, 147.015, 146.52, 224.12, and 444.85. For additional information or table reservations, write Bill Inkrote K2NJ, RD 10, Box 294, Quakertown-Croton Road, Flemington NJ 08822, or call (201)-788-4080.

GREENCASTLE IN
APR 7

The Putnam County Amateur Radio Club will hold its second Amateur Radio and Electronics Auction on April 7, 1984, at the Putnam County Fairgrounds, US 231, north of Greencastle IN. Admission is $1.00, sales commission is 5%, and there will be a $1.00 service charge on buybacks. Doors will open at 8:00 am and the auction will start at 10:00 am. Bring your equipment to be sold on consignment. All activities will be inside and food will be available. Talk-in on 147.93/.33. For more information or a flyer, contact John Underwood K9IIB, RFD 1, Box 10, Fillmore IN 46128.

KANSAS CITY MO
APR 7-8

The PHD Amateur Radio Association, Inc., will sponsor the 1984 Missouri State ARRL Convention on Saturday and Sunday, April 7-8, 1984, from 10:00 am to 5:30 pm (both days), at the Trade Mart Building, at the downtown Kansas City MO airport. For both days, registration is $4.00 and swap tables are $10.00, which includes one registration with each table. Commercial exhibitors may set up from 7:00 pm to 9:00 pm on Friday or 7:00 am to 10:00 am on Saturday; swappers may set up at 9:00 on Saturday. The Saturday-night banquet at the world-famous Gold Buffet is $10.50. Those desiring banquet tickets and swap tables are urged to order in advance. Other features will be a complete program of forums, commercial booths, a large flea market, a home-brew contest, Missouri-Kansas Amateur-of-the-Year and CW Contest awards, and on Sunday, a Missouri-Kansas Repeater Council meeting, as well as QCWA and YL luncheons. Unlimited free parking, including RV space (no hookups), will be available. Talk-in on 146.34/.94. For more information and registrations, write PHD Amateur Radio Association, Inc., Liberty MO 64068-0011, or call (816)-781-7313 or 452-9321. All pre-registrations will be held at the door.

AMBOY IL
APR 8

The 19th annual Rock River ARC Hamfest will be held on Sunday, April 8, 1984, beginning at 8:00 am, at the Lee County 4-H Center, one mile east of the junction of 52 and 30. Ticket donations are $2.00 each in advance and $3.00 at the gate; 8-foot tables are $5.00 each. Camping space will be available for a nominal charge and breakfast and lunch will be served. There will be an auction of amateur-related gear. Talk-in on .37/.97 repeater. For more information or advance tickets (available until April 1, 1984) and tables, write to Shirley Webb KA9HGZ, 618 Orchard Street, Dixon IL 61021, or phone (815)-284-3811.

MADISON WI
APR 8

The Madison Area Repeater Association, Inc. (MARA), will hold its 12th annual Madison Swapfest on Sunday, April 8, 1984, at the Dane County Exposition Center Forum Building in Madison WI. Admission is $2.50 per person in advance and $3.00 at the door. Children twelve and under will be admitted free. Flea-market tables are $4.00 each in advance and $5.00 at the door. Doors will open at 5:00 am for commercial exhibitors, 8:00 am for flea-market sellers, and 9:00 am for the general public. Features will include commercial exhibitors, a flea market, an all-you-can-eat pancake breakfast, and a barbecue lunch. Plenty of parking space and nearby hotel accommodations are available. Talk-in on 146.16/.76 (WB9AER/R). For reservations (early ones are advised) or more information, write to MARA, PO Box 3403, Madison WI 53704.

MUSKEGON MI
APR 14

The Muskegon Area Amateur Radio Council will hold the ARRL Michigan State Convention and Muskegon Hamfest on April 14, 1984, at the L. C. Walker Arena, 4th at Western, Muskegon MI. Features will include Friday-evening hospitality rooms, programs covering areas of amateur radio interest, ladies' activities, and a Saturday-evening convention dinner program. Setups for manufacturers and dealers will begin at 2:00 pm on April 13th. For more information, write Muskegon Area Amateur Radio Council, PO Box 691, Muskegon MI 49443.

WELLESLEY MA
APR 14

The Wellesley Amateur Radio Society will conduct its annual auction on Saturday, April 14, 1984, at the First Congregational Church of Wellesley Hills, 207 Washington Street, at the intersection of Routes 9 and 16, Wellesley MA. Doors will open at 10:00 am and the auction will begin at 11:00 am. Talk-in on .63/.03, .04/.64, and .52. For more information, contact Kevin P. Kelly WA1YHV, 7 Lawnwood Place, Charlestown MA 02129.

PIKES PEAK CO
APR 14-15

The Pikes Peak Radio Amateur Association will present the 1st annual Electronic Exhibition and Trade Show on Saturday and Sunday, April 14-15, 1984, from 10:00 am to 6:00 pm, at a site soon to be confirmed. A fee will be charged at the door. Well-known equipment manufacturers will present seminars on Saturday, starting at 1:00 pm, and admission will be free. Live TV and radio broadcasts will be on during the show. Talk-in on 146.52 simplex or 146.97/.37.

JACKSON MS
APR 14-15

The Jackson Amateur Radio Club will host the Capital City Hamfest and 1984 ARRL Mississippi State Convention on Saturday and Sunday, April 14-15, 1984, at the Communications Workers of America Building, I-220 at Country Club Drive. Hours on Saturday are 9:00 am to 5:00 pm and on Sunday, 8:00 am to 1:30 pm. Admission is free and flea-market tables are $5.00 each. Attractions include commercial dealer exhibits, a large indoor flea market, concessions, forums, and free parking (including self-contained RVs). For special hamfest rates, contact the Holiday Inn Southwest directly. Talk-in on 146.16/.76. For further information, contact Carol Kemp NA5Y, 3581 Beaumont Drive, Pearl MS 39208, or phone (601)-939-7612.

RALEIGH NC
APR 15

The Raleigh Amateur Radio Society will hold its 12th annual hamfest and flea market (all under cover) on Sunday, April 15, 1984, beginning at 8:00 am, at the Crabtree Valley Shopping Mall, located at the intersection of US 70 west and US 1 and 64. Admission is $4.00 at the gate, with no extra charge for tailgaters. Tables will be available for rent. Features will include a CW contest, a home-brew contest, and special-interest meetings. Talk-in will be on 146.04/146.64 (W4DW) and 146.28/146.88 (K4ITL). For more information, contact Pete Thacher N4HQZ at (919)-876-4073 or Jim Bradley WA4AOO at (919)-851-2437 from 6:00 pm to 8:00 pm weekdays or on weekends, or write RARS, PO 19127, Raleigh NC 27619.

DAYTON OH
APR 27

The 15th annual B*A*S*H will be held on Friday night, April 27, 1984, at the Dayton Hamvention at the Convention Center, Main and Fifth Streets, Dayton OH. Admission is free and parking is available in the adjacent city garage. There will be sandwiches, snacks, and a COD bar, as well as live entertainment. For further information, contact the Miami Valley FM Association, PO Box 263, Dayton OH 45401.

DAYTON OH
APR 27

The Dayton-Cincinnati Chapter of the Quarter Century Wireless Association will hold its annual banquet during the Dayton Hamvention on Friday, April 27, 1984, at Neil's Heritage House Restaurant, 2189 S. Dixie Drive, Dayton OH. Tickets are $12.50. The cash bar will open at 6:30 pm and dinner will begin at 7:30 pm. The dinner speaker is Dr. Jerrold Petrofsky, developer of computerized equipment that enables paraplegics to walk. The presentation will be illustrated. For more details, write Doug Horner W8PH, 186 Golfwood Drive, Dayton OH 45449, or call (513)-859-3210.

DAYTON OH
APR 27-29

The 1984 Dayton Hamvention's International VHF/UHF Conference will be held concurrently with the Hamvention from Friday through Sunday, April 27-29, 1984, at the Hara Arena and Exhibition Center, Dayton OH. There will be technical forums by acknowledged experts; noise-figure, dynamic-range, and antenna-range measurement contests; and a hospitality suite with refreshments. Technical papers and presentations on VHF/UHF topics of interest are being solicited for consideration. Potential speakers should submit their requests immediately. For further information, contact Jim Stitt WA8ONQ, VHF/UHF Conference Moderator, 4126 Crest Manor, Hamilton OH 45011.

DAYTON OH
APR 27-29

The Dayton Amateur Radio Association, Inc., will sponsor the Dayton Hamvention on April 27-29, 1984, at the Hara Arena and Exhibition Center, Dayton OH. Admission, valid for all three days, is $7.50 in advance and $10.00 at the door. The Saturday evening Grand Banquet and Entertainment is $14.00 in advance and $16.00 at the door. Harry Dannals W2HD, past president of the ARRL, will be the featured speaker. Because seating is limited, early reservations are requested. There will be a giant flea market starting at noon on Friday and continuing all day Saturday and Sunday. Flea-market space is $15.00 for all three days and will be sold in advance only. Entrance for setups will be available starting Wednesday and the special flea-market telephone is (513)-223-0923. Other features will include forums, awards, and exhibits. For special motel rates and reservations, write Hamvention Housing, Box 1288, Dayton OH 45402; no telephone reservations will be accepted. Address all other inquiries to Box 44, Dayton OH 45401, or phone (513)-433-7720. Please send advance registration checks to Dayton Hamvention, Box 2205, Dayton OH 45401.

HARTWELL GA
APR 28-29

The Anderson, Hartwell, and Toccoa Ham Clubs will sponsor the sixth annual Lake Hartwell Hamfest on April 28-29, 1984, at the Lake Hartwell Group Camp located on Highway 29, about 2 miles south of Hartwell Dam. Admission, camping, and flea-market space are all free. Activities will begin at 9:00 am on Saturday and include a horseshoe tournament and a left-footed CW contest. The camping area will be open Friday and Saturday nights. Talk-in on 146.895/.295 and 146.19/.79. For further information, contact Carl Davis KY4T, 203 College Avenue, Hartwell GA 30643.

EAST HARTFORD CT
APR 29

The seventh annual Pioneer Valley Radio Association (PVRA) Flea Market will be held on Sunday, April 29, 1984, from 10:00 am to 4:00 pm, at Penney High School, Forbes Street, East Hartford CT. Talk-in on .19/.79. For reservations and more information, write Jon Patz KA1FYL, 34 Whiting Lane, West Hartford CT 06119, or call (203)-232-8772 (evenings).

BRAINTREE MA
APR 29

The South Shore Amateur Radio Club of Braintree MA will celebrate its 53rd year in amateur radio by holding an indoor flea market on Sunday, April 29, 1984, rain or shine, from 11:00 am to 4:00 pm, at the Viking Club, 410 Quincy Avenue, Braintree MA. The entrance fee is $1.00 and 8-foot tables are $10.00 (which includes 1 free admission per table). Vendors will be admitted at 9:30 am and plenty of parking will be available. For advance table reservations, send a check payable to the South Shore Amateur Radio Club to Ed Doherty W1MPT, 236 Wildwood Avenue, Braintree MA 02184. A confirmation of check receipt will be sent and there will be no cancellation refunds after April 25. For more information, call Ed at (617)-843-4431, evenings.

CHICAGO IL
MAY 2

The Chicago Amateur Radio Club's Evening Mini-Hamfest will be held on Wednesday, May 2, 1984, from 6:00 pm to 10:00 pm, at the Edgebrook Golf Course Field House, 6100 N. Central (between Elston and Devon), Chicago IL. Admission is $1.00 and card-table spaces are $3.00. Refreshments will be available. Talk-in on 146.52 MHz. For tickets, space reservations, or more information, send an SASE to CARC, 5631 W. Irving Park Road, Chicago IL 60634, or phone (312)-545-3622.

ST. DAVID AZ
MAY 4-6

The Cochise Amateur Radio Association, Inc., will hold a hamfest (upgraded from a swapmeet) on May 4-6, 1984, in St. David AZ. There will be a flea market and all tailgaters are welcome. Tours planned to Tombstone, the Bisbee Lavender Pit, and other places of interest. Talk-in on .16/.76 and .52 simplex. For more details, contact CARA, Attention: Bob Clay KB7HB, PO Box 1855, Sierra Vista AZ 85636.

CEDARBURG WI
MAY 5

The Ozaukee Radio Club will sponsor its 6th annual swapfest on Saturday, May 5, 1984, from 8:00 am to 1:00 pm, at the Circle B Recreation Center, Highway 60, Cedarburg WI (located 20 miles north of Milwaukee). Admission is $2.00 in advance and $3.00 at the door. Six-foot tables are $2.00 and eight-foot tables are $3.00. Food and refreshments will be available. Sellers will be admitted at 7:00 am for table setups. For tickets, tables, maps, or more information, send a business-size SASE to 1984 Ozaukee Radio Club Swapfest, PO Box 13, Port Washington WI 53074.

COLUMBIA MO
MAY 5-6

The Central Missouri Radio Association will hold Columbia Hamfest '84 on May 5-6, 1984, at the Hilton Inn, I-70 and Stadium Boulevard, Columbia MO. Features will include forums, a hospitality room, a Saturday-night banquet, a hard-surfaced flea market, display tables, and shuttle-bus service to parking areas and shopping centers. Talk-in on .16/.76 or 220.42/.02. For banquet tickets, reservations for hotels, flea-market spaces, or dealer tables, and more information, contact Ben Smith KØPCK, Route 1, Prairie Home MO 65068, or phone (816)-427-5319.

GREENVILLE SC
MAY 5-6

The Blue Ridge Amateur Radio Society will sponsor the Greenville SC Hamfest on Saturday and Sunday, May 5-6, 1984, at the American Legion Fairgrounds, White Horse Road, ½ mile north of I-85, Greenville SC. Admission is $3.00 in advance and $4.00 at the door. Talk-in on 146.01/.61. For advance tickets, write Mrs. Sue Chism N4ENX, Rte. 6, 203 Lanewood Drive, Greenville SC 29607. For further information, write Phil Mullins WD4KTG, Hamfest Chairman, PO Box 99, Simpsonville SC 29681.

LONG ISLAND
MAY 6

The Suffolk County Radio Club Indoor and Outdoor Flea Market will be held on Sunday, May 6, 1984, from 8:00 am to 3:00 pm, at Republic Lodge No. 1987, 585 Broadhollow Road (Route 110), Melville NY. General admission is $2.00; children under 12 and wives will be admitted free. Indoor seller's tables are $7.00 and outdoor space is $5.00 (includes one admission). There will be refreshments on the premises and plenty of free parking. Talk-in on 144.61/145.21 and 146.52. For additional information, contact Richard Tygar AC2P at (516)-643-5956 (evenings).

SULLIVAN IL
MAY 6

The Moultrie Amateur Radio Klub will hold its annual Sullivan IL MARK Hamfest on May 6, 1984, at the 4-H Fairgrounds, 3 miles east and 1 mile north of Sullivan on the Cadwell Road. Features include covered facilities, lunch, and a free swapper's row. Talk-in on 146.655/.055 and 146.520. For more information, contact William Guennewig WA9WOB at (217)-268-3139 (evenings).

SANDWICH IL
MAY 6

The Kishwaukee Radio Club of DeKalb IL will hold its annual hamfest on Sunday, May 6, 1984, at the Sandwich Fairgrounds, Sandwich. Tickets are $2.50 in advance and $3.00 at the door; tables are $5.00 each. Overnight camping without hookups will be available. For more information, contact Howard Newquist WA9TXW, PO Box 349, Sycamore IL 60178.

CENTRALIA IL
MAY 6

The Centralia Wireless Association, Inc., will hold its annual hamfest on Sunday, May 6, 1984, at the Kaskaskia College Gymnasium, 3 miles northwest of Centralia IL. Admission to the hamfest is free and there will be no charge for the flea-market and exhibit space (a limited number of tables will be issued on a first-come, first-serve basis). Doors will open at 7:00 am for flea-market and exhibit setups. Food and refreshments will be available, as well as plenty of free parking. Talk-in on 147.27/.87 and 146.52. For further information, contact Bud King WB9QEG at (618)-532-6606 or Lou Hodges W9IL at (618)-533-4724, or write to CWA, Inc., PO Box 1166, Centralia IL 62801.

PARAMUS NJ
MAY 6

The Bergen ARA will hold a Ham Swap 'n' Sell on May 6, 1984, from 8:00 am to 4:00 pm, at Bergen Community College, 400 Paramus Road, Paramus NJ. There will be tailgating only and admission for sellers is $4.00 (bring your own table). Buyers will be admitted free. Talk-in on .79/.19 and .52. For more information, contact Jim Greer KK2U, 444 Berkshire Road, Ridgewood NJ 07450, or phone (201)-445-2855.

DURHAM NC
MAY 12

The Durham FM Association will hold the Durham Hamfest on May 12, 1984, at the South Square Mall, Durham NC. Talk-in on 147.225. For more information, write Milan R. Burger, President, DFMA, 5711 Spruce Drive, Durham NC 27712.

FUN!

John Edwards KI2U
PO Box 73
Middle Village NY 11379

HOW HAMS VIEW THEMSELVES

You can say one thing about hams: They're not at all shy. Bring up an issue affecting our hobby, and hams, like no other special-interest group, are certain to express their views about it. Remember the Jack Anderson incident back in the 1970s? And what about no-code? I think it was no mere coincidence that the FCC commissioners switched from a unanimous endorsement of no-code to a position of unanimous disapproval within the span of only a few months. Tens of thousands of letters from concerned amateurs certainly played a role, as did the influence of some friends in high places.

Yes, hams love to express their views. And that's why we take time out each year to let the FUN! readership comment on the day's important ham issues. One never knows exactly what form the responses will take, but there's always lots of input.

This year, as in previous FUN! polls, we're keeping some old questions in order to keep track of developing trends in our hobby and adding some new ones to keep up with the times. Whatever your views, send your responses to PO Box 73, Middle Village NY 11379. Or, if you've given up on the U.S. Mule, you can transmit your answers electronically via CompuServe's Email or HamNet. My ID is 70007,412. My Source ID, if you prefer that system, is TCU335.

ELEMENT 1—BACKGROUND

1) Sex:
A) Male
B) Female

2) Age:
A) 15 or below
B) 16-21
C) 22-39
D) 40-59
E) 60 or above

3) License class:
A) Novice
B) Technician
C) General
D) Advanced
E) Extra

4) Number of years licensed:
A) 1 year or less
B) 1-5 years
C) 6-10 years
D) 11-20 years
E) 21 years and up

5) Do you have a new (post-March '78) call?
A) Yes
B) No

6) How many hours a week do you devote to amateur radio?
A) 0-1 hour
B) 2-5 hours
C) 6-10 hours
D) 11-20 hours
E) 21 hours or more

7) Which HF band do you use most?
A) 80-75 meters
B) 40 meters
C) 20 meters
D) 15 and/or 10 meters
E) Don't operate HF

8) Which VHF-UHF band do you use most?
A) 6 meters
B) 2 meters
C) 220 MHz
D) 420 MHz and/or up
E) Don't operate VHF-UHF

9) Which mode do you use most?
A) SSB
B) CW
C) FM
D) RTTY
E) Other

10) How much money have you spent on amateur radio within the past year? (Include QSL expenses, magazine subscriptions, club dues, and other incidental expenses.)
A) 0-$250
B) $251-$500
C) $501-$1,000
D) $1,001-$2,500
E) $2,501 and up

ELEMENT 2—SOCIAL CHARACTERISTICS

11) Has amateur radio influenced your career choice?
A) Greatly
B) Somewhat
C) Not at all

12) Should the ARRL get rid of the DXCC Honor Roll?
A) Yes
B) No

13) Politically, how would you define yourself?
A) Conservative
B) Middle-of-the-road
C) Liberal

14) Should the ARRL get rid of the DX Century Club?
A) Yes
B) No

15) How old were you when you first became a ham?
A) 15 or below
B) 16-21
C) 22-39
D) 40-59
E) 60 or above

16) Should the FCC increase the speeds on amateur CW examinations?
A) Yes
B) No

17) Do you own a home computer?
A) Yes
B) No

18) Do you think hams, compared to computer hobbyists, are:
A) More technically inclined in their hobby
B) Less technically inclined in their hobby
C) Both are about equally skilled in their hobby

19) Do you think that home computing is siphoning people (including youngsters) away from amateur radio?
A) Yes
B) No

20) Will the volunteer exam system increase cheating?
A) Yes
B) No

21) Should volunteer examiners be allowed to collect a fee to help defray expenses?
A) Yes
B) No

22) Has ham radio helped to make you a better person?
A) Yes
B) No

RESPONSE FORM

Instructions: Read each question and mark your response by circling the appropriate letter next to the number of the question.

Element 1:	7) A B C D E	12) A B	19) A B	*Element 3:*	31) A B	38) A B	45) A B C D E
1) A B	8) A B C D E	13) A B C	20) A B	25) A B	32) A B	39) A B C D E	46) A B C D E
2) A B C D E	9) A B C D E	14) A B	21) A B	26) A B	33) A B C D E	40) A B	47) A B C D E
3) A B C D E	10) A B C D E	15) A B C D E	22) A B	27) A B	34) A B C D E	41) A B	48) A B C D E
4) A B C D E		16) A B	23) A B	28) A B	35) A B	42) A B	49) A B
5) A B	*Element 2:*	17) A B	24) A B	29) A B	36) A B	43) A B	50) A B
6) A B C D E	11) A B C	18) A B C		30) A B	37) A B		

Comments: ______________________________

23) Should ham licenses have a minimum age requirement?
A) Yes
B) No

24) Should hams be subject to periodic retesting?
A) Yes
B) No

ELEMENT 3—OPERATING HABITS

25) If the users were restricted to data communication only (no phone or CW operation), would you be in favor of a no-code 220-MHz Digital-class license?
A) Yes
B) No

26) Would you be in favor of a no-code 220-MHz Digital-class ticket if it permitted phone operation in addition to data transmission?
A) Yes
B) No

27) Have you ever used a personal computer in connection with your amateur-radio activities?
A) Yes
B) No

28) Is it time to completely deregulate amateur radio by having the FCC turn over all responsibity for ham operation to the amateur community?
A) Yes
B) No

29) What do you think of people who view pay-television services with MDS converters and satellite dishes that are not approved by broadcasters?
A) They're skunks
B) They're within their rights

30) Should we get rid of, or reduce in size, the CW subbands?
A) Yes
B) No

31) Do you think DX nets have a place in ham radio?
A) Yes
B) No

32) Do you think nets in general have a place in ham radio?
A) Yes
B) No

33) The next time a ham operates from space, which band should he/she use?
A) 2 meters
B) 220 MHz
C) 450 MHz
D) An even higher band
E) Shouldn't bother to operate

34) If, while tuning across a band, you heard a net called "Jammers International" in progress, would you:
A) Jam it
B) Ignore it
C) Complain to the FCC or some other organization
D) Listen
E) Join it

35) If required, could you solidly copy CW at the speed at which you were licensed?
A) Yes
B) No

36) If required, could you pass the FCC theory test for your license class?
A) Yes
B) No

37) Have you ever purposely operated in an amateur subband you weren't licensed to use?
A) Yes
B) No

38) Do you think the ARRL affects amateur radio in a positive manner?
A) Yes
B) No

39) Do you ever speak to foreign, non-English-speaking, hams in their own language?
A) Always
B) Sometimes
C) I attempt it
D) Rarely
E) Never

40) Do you feel yourself competent to replace the finals in a tube-type rig?
A) Yes
B) No

41) Do you feel yourself competent to replace the finals in a transistor-type rig?
A) Yes
B) No

42) Do you solder together your own coax connectors?
A) Yes
B) No

43) Is your antenna system mounted on your house or a tower?
A) House
B) Tower

44) Have you ever designed your own antenna?
A) Yes
B) No

45) What do you think of contesting?
A) Great
B) Good
C) Okay
D) Don't like it
E) Despise it

46) What do you think of DXing?
A) Great
B) Good
C) Okay
D) Don't like it
E) Despise it

47) What do you think of repeaters?
A) Great
B) Good
C) Okay
D) Don't like them
E) Despise them

48) What do you think of traffic handling?
A) Great
B) Good
C) Okay
D) Don't like it
E) Despise it

49) If you heard an emergency net in progress, would you immediately join in and offer your services?
A) Yes
B) No

50) Should all hams be required to join some type of national amateur-radio organization?
A) Yes
B) No

FCC

47 CFR Part 97

[PR Docket No. 83-27; RM-4229]

Allow the Use of Volunteers to Prepare and Administer Operator Examinations in the Amateur Radio Service and Correction

AGENCY: Federal Communications Commission.

ACTION: Final Rules and Correction.

SUMMARY: This document corrects FCC rules regarding the use of voluntary and uncompensated volunteers to prepare and administer amateur operator examinations in order to eliminate unintended inconsistencies in the rules adopted in the *Report and Order* in this proceeding.

EFFECTIVE DATE: January 11, 1984.

FOR FURTHER INFORMATION CONTACT: John J. Borkowski, Federal Communications Commission, Washington, D.C. 20554, (202) 632–4964.

Errata

In the matter of amendment of Parts 0, 1 and 97 of the Commission's rules to allow the use of volunteers to prepare and administer operator examinations in the Amateur Radio Service (PR Docket No. 83-27 RM-4229).

Released: December 30, 1983.

1. On September 22, 1983, the Commission adopted a *Report and Order*, 48 FR 45653 (October 6, 1983), in the above captioned proceeding. In the *Report and Order*, the Commission amended Parts 0, 1 and 97 of its Rules to allow the use of volunteers to prepare and administer operator examinations in the Amateur Radio Service.

2. In the rules set forth in the Appendix to the *Report and Order*, volunteers are given ten days from the time they administer an examination to forward candidates' applications to the VEC (§ 97.28(h)). However, VEC's are given only ten days from the date of the examination to forward candidates' applications to the FCC (§ 97.519(c)). This could result in a VEC having no time to perform the functions listed in § 97.519, and was not intended. The Commission intended to give the VEC adequate time to perform these functions.

3. At paragraph 28 of the *Report and Order*, The Commission stated: ". . . we have incorporated all of the present telegraph requirements and guidelines from our present rules." With respect to telegraphy examination grading, no changes were intended. However, § 97.29 (c) in the Appendix imposed an additional burden not included in the present rules of grading on the basis of "one continuous minute." Inclusion of this new burden was not intended.

4. Sections 97.503 and 97.515 of the Rules in the Appendix cross-reference § 97.30. There is no § 97.30. The cross-references should be deleted.

5. Section 97.28(i)(2) provides for FCC retesting of any person who obtained an operator license through the volunteer examination process. It does not indicate what the FCC will do if such a person does not pass the examination. This was an inadvertent omission. Therefore, we are adding a new paragraph (j) to § 97.28 to clarify that an examinee who fails to appear for readministration of an examination or who fails to pass the retested examination element(s) will have his/

her operator's license cancelled and will be issued a new operator license for the operator license class previously held by the examinee. We are also clarifying that FCC retesting applies only for examinations above the Novice Class.

6. Additionally, the definition of the term "Amateur Code Credit Certificate" in § 97.3 was inadvertently retained.

7. Finally, the wording of § 97.513 regarding where VEC's may coordinate examinations is unintentionally ambiguous. While this wording was designed to permit VEC's to coordinate examinations outside of the regions listed in § 97.507(b) (such as United States military bases in foreign countries), it was not intended to permit one regional VEC to coordinate examinations in another region.

8. Accordingly, the following corrections are made to the Appendix of the *Report and Order* in this proceeding:

§ 97.3 [Corrected]

1. Paragraph (aa) of § 97.3 is removed and reserved.

2. Section 97.28 is amended by revising paragraph (i) and adding a new paragraph (j) as follows:

§ 97.28 Examination administration.

* * * * *

(i) The FCC reserves the right, without qualification, to:

(1) Administer examinations itself; *or*

(2) Readminister examinations itself or under the supervision of an examiner designated by the FCC to any person who obtained an operator license above the Novice Class through the volunteer examination process.

(j) If a licensee fails to appear for readministration of an examination pursuant to paragraph (i)(2) of this section, or does not successfully complete the examination element(s) which are readministered, the licensee's operator license is subject to cancellation; in an instance of such cancellation, the licensee will be issued an operator license consistent with completed examination elements which have not been invalidated by not appearing for or failing readministration of an examination.

3. The words "for one continuous minute" are removed from the first sentence of paragraph (c) of § 97.29.

4. The cross-references to § 97.30 are removed from § 97.503(b) and from § 97.515.

5. The first two sentences of § 97.513 are revised to read:

§ 97.513 Scheduling of examinations.

A VEC will coordinate the dates and times for scheduling examinations (see § 97.26) throughout the region(s) it serves. Any VEC may also coordinate the scheduling of testing opportunities outside of the regions listed in § 97.507(b).

* * * * *

6. Paragraph (c) of § 97.519 is revised to read:

§ 97.519 Examination procedures.

* * * * *

(c) Forward the application within ten days of its receipt from the examiners to: Federal Communications Commission, Licensing Division, Private Radio Bureau, Gettysburg, Pennsylvania 17325.

* * * * *

(Secs. 4(i) and 303 of the Communications Act of 1934, as amended, 47 U.S.C. 154(i) and 303)

Federal Communications Commission.

William J. Tricarico,

Secretary.

47 CFR Part 97

[PR Docket No. 83-524; FCC 84-16]

Making Additional Frequencies Available to the Radio Amateur Civil Emergency Service During Declared National Emergencies

AGENCY: Federal Communications Commission.

ACTION: Final rules.

SUMMARY: This document amends the Amateur Radio Service Rules to make additional frequencies available to the Radio Amateur Civil Emergency Service (RACES) during declared national emergencies. Additional RACES frequencies are needed since, even in peacetime, the number of RACES frequencies are inadequate. The effect of this action is to assure that sufficient RACES frequencies would be available if the President invokes the war emergency powers.

EFFECTIVE DATE: March 26, 1984.

ADDRESS: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT: Maurice J. DePont, Private Radio Bureau, Washington, D.C. 20554.

List of Subjects in 47 CFR Part 97

Civil defense, Defense communications, Radio.

Report and Order

In the matter of amendment of the Amateur Radio Service Rules, Part 97, to make additional frequencies available to the Radio Amateur Civil Emergency Service during declared national emergencies (PR Docket No. 83-524).

Adopted: January 16, 1984.

Released: January 19, 1984.

By the Commission.

1. On May 26, 1983, the Commission adopted a Notice of Proposed Rule Making (48 FR 26647; June 9, 1983) proposing to make additional frequencies available to the Radio Amateur Civil Emergency Service (RACES) in the event of an emergency which causes the President to invoke certain war emergency powers, pursuant to Section 606 of the Communications Act of 1934, as amended. Also proposed were operational limitations on the additional frequencies so as to provide protection to the Government Radiolocation Service, to the Aeronautical Radionavigation Service and to Canadian radio stations. The restrictions that limited RACES operations to thirty days and to specific geographical areas were also proposed to be deleted. Nineteen comments were filed in this proceeding.

2. This proceeding originated in response to a request from the Department of Defense (DOD), through the National Telecommunications and Information Administration (NTIA) and the Interdepartmental Radio Advisory Committee (IRAC), for additional frequencies for RACES stations during a declared national emergency. DOD had reviewed the role of RACES in support of civil defense activities during a national emergency declared by the President and had concluded that additional RACES frequencies are needed under war emergency conditions. DOD said that since the presently available RACES frequencies have proven inadequate in peacetime, they would be completely unsatisfactory in wartime. In addition, DOD noted that although the number of amateur radio repeater stations have increased, they operate on frequencies which are not now available to RACES. Hence, DOD wanted the frequencies that repeaters operate on made available to RACES stations. For the same reason, DOD asked that frequencies used by high frequency (HF) nets also be made available to RACES stations. The deletion of the restriction on the use of certain RACES frequencies to the initial 30 days of the emergency and the areas where they could be used was proposed since those restrictions are no longer needed.

3. The comments generally supported the proposal to make additional frequencies available to RACES stations.[1] Robert N. Dyruff wanted all of the Amateur Radio Service frequencies made available to RACES. He also suggested that the RACES rules should be deleted in their entirety and replaced by a joint working arrangement between the Federal Emergency Management Agency, State Offices of Emergency Services and local organizations of amateur radio operators. The suggestions of Mr. Dyruff are so broad as to exceed the scope of this proceeding. In our Notice of Proposed Rule Making, we proposed to make the frequencies 146-148 MHz available for RACES operations. Several of the commenters, however, suggested that the repeater subband 144.50-145.50 MHz be included for RACES operation. In this connection, the American Radio Relay League, Inc. (ARRL) stated that this would make it unnecessary for anyone to alter existing equipment, especially repeaters, to operate on RACES frequencies during a declared emergency, since Amateur Radio Emergency Service (ARES) members could switch from ARES to RACES immediately without a shift in equipment.

4. We referred the matter of inclusing the subband 144.50-145.50 MHz to DOD (through IRAC). It interposed no objection. Therefore, since inclusion of these frequencies will bring more repeaters into RACES operation and will expand the potential for use of RACES stations in the future, we will include the 144.50-145.50 MHz subband in these final rules. Some commenters suggested that additional frequencies in the 6, 10, 40, and 75-meter bands be added for RACES operations. Those frequencies were not included in DOD's original request. Therefore, we have not included them in these final rules.

5. In our proposal, we stated that additonal amateur radio frequencies in the 10 MHz and 18 MHz frequency bands might also be considered if the United States ratified the final acts of the World Administrative Radio Conference (WARC), 1979. Although such ratification took place on September 6, 1983, it would not be appropriate to include those frequencies in this Report and Order since the Amateur Rules have not yet been amended to make those bands available for use in the Amateur Radio Service on a regular basis.

6. We will adopt the rules as proposed, with the inclusion of the additional 2-meter band frequencies. The thirty day limitation on the use of the frequencies is deleted since the use of amateur frequencies for RACES would undoubtedly be authorized beyond the thirty day period if an emergency continued beyond that time. Also, we have deleted the geographic limitations since to retain them could hinder emergency communications between the continental United States and the States of Hawaii or Alaska, or between the continental United States and U.S. possessions. These latter amendments are in keeping with our continuing efforts to eliminate unnecessary rules and restrictions. Finally, necessary corrections have been made to the table in § 97.185(b).

7. It is ordered, that Part 97 is amended as set forth in the Appendix hereto. This action is taken pursuant to the authority contained in Sections 4(i) and 303(r) of the Communications Act of 1934, as amended. It is further ordered, that these rule amendments shall become effective March 26, 1984.

8. It is further ordered, that the Secretary shall cause a copy of this Report and Order to be published in the Federal Register.

9. It is further ordered, that this proceeding is terminated.

10. Information in this matter may be obtained by contacting Maurice J. Depont, (202) 632-4964, Private Radio Bureau, Federal Communications Commission, Washington, D.C. 20554.

Federal Communications Commission.

William J. Tricarico,

Secretary.

[1] The late-filed comments of John A. Carroll are accepted and have been considered insofar as they relate to this proceeding.

Appendix

PART 97—[AMENDED]

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended, as follows:

1. Section 97.185 is revised to read as follows:

§ 97.185 Frequencies available.

(a) All of the authorized frequencies and emissions allocated to the Amateur Radio Service are also available to the Radio Amateur Civil Emergency Service on a shared basis.

(b) In the event of an emergency which necessitates the invoking of the President's War Emergency Powers under the provisions of § 606 of the Communications Act of 1934, as amended, unless otherwise modified or directed, RACES stations and amateur radio stations participating in RACES will be limited in operation to the following:

FREQUENCY OR FREQUENCY BANDS—Continued

	Limitations
kHz:	
1800-1825	
1975-2000	1
3500-3550	
3930-3980	
3984-4000	
3997	2
7079-7125	
7245-7255	
14047-14053	
14220-14230	
14331-14350	
21047-21053	
21228-21267	
MHz:	
28.55-28.75	
29.237-29.273	
29.45-29.65	
50.35-50.75	
53.30	2
53.35-53.75	
144.50-145.71	
146-148	
220-225	4
420-450	3, 5, 6
1240-1300	3
2390-2450	3

(c) *Limitations.* (1) Use of frequencies in the band 1975-2000 kHz is subject to the priority of the LORAN system of radionavigation in this band and to the geographical, frequency, emission, and power limitations contained in § 97.61 (Subpart C of this part pertaining to Technical Standards).

(2) For use in emergency areas when required to make initial contact with a military unit; also, for communications with military stations on matters requiring coordination.

(3) Those stations operating in the bands 420-450, 1240-1300 and 2390-2450

MHz shall not cause harmful interference to, and must tolerate any interference from, the Government Radiolocation Service; and also the Aeronautical Radionavigation Service in the case of the 1240–1300 MHz band.

(4) Those stations operating in the band 220–225 MHz shall not cause harmful interference to, and must tolerate any interference from, the Government Radiolocation Service until January 1, 1990. Additionally, the Fixed and Mobile Services shall have equal right of operation.

(5) In the band 420–430 MHz, no station shall operate North of Line A. Line A begins at Aberdeen, Washington, running by great circle arc to the intersection of 48° N., 120° W., thence along parallel 48° N., to the intersection of 95° W., thence by great circle arc through the southernmost point of Duluth, Minn., thence by great circle arc to 45° N., 85° W., thence southward along meridian 85° W., to its intersection with parallel 41°N., thence along parallel 41° N., to its intersection with meridian 82° W., thence by great circle arc through the southernmost point of Bangor, Maine, thence by great circle arc through the southernmost point of Searsport, Maine, at which point it terminates.

(6) In the band 420–450 MHz and within the following areas, the peak envelope power output of a transmitter used in the Amateur Radio Service shall not exceed 50 watts, unless expressly authorized by the Commission after mutual agreement, on a case-by-case basis, between the Federal Communications Commission Engineer-in-Charge at the applicable District Office and the Military Area Frequency Coordinator at the applicable military base:

(i) Those portions of Texas and New Mexico bounded on the south by latitude 31° 45' North, on the east by longitude 104° 00' West, on the north by latitude 34° 30' North, and on the west by longitude 107° 30' West;

(ii) The entire State of Florida including the Key West area and the areas enclosed within a 200-mile radius of Patrick Air Force Base, Florida (latitude 28° 21' North, longitude 80° 43' West), and within a 200-mile radius of Eglin Air Force Base, Florida (latitude 30° 30' North, longitude 86° 30' West);

(iii) The entire State of Arizona;

(iv) Those portions of California and Nevada south of latitude 37° 10' North, and the areas enclosed within a 200-mile radius of the Pacific Missile Test Center, Point Mugu, California (latitude 34° 09' North, longitude 119° 11' West).

(v) In the State of Massachusetts within a 160-kilometer (100 mile) radius around locations at Otis Air Force Base, Massachusetts (latitude 41° 45' North, longitude 70° 32' West).

(vi) In the State of California within a 240-kilometer (150 mile) radius around locations at Beale Air Force Base, California (latitude 39° 08' North, longitude 121° 26' West).

(vii) In the State of Alaska within a 160-kilometer (100 mile) radius of Clear, Alaska (latitude 64° 17' North, longitude 149° 10' West). (The Military Area Frequency Coordinator for this area is located at Elmendorf Air Force Base, Alaska.)

(viii) In the State of North Dakota within a 160-kilometer (100 mile) radius of Concrete, North Dakota (latitude 48° 43' North, longitude 97° 54' West). (The Military Area Frequency Coordinator for this area can be contacted at: HQ SAC/SXOE, Offutt Air Force Base, Nebraska 68113.)

LETTERS

PET PEEVE, CROSS LINK

W1UKZ's article ("Breakthrough in Boston: The Birth of Crosslinking," *73*, January, 1984) provides me with an opportunity to air a pet peeve about wiring diagrams shown as schematics.

A drawing such as shown in Fig. 2 of David's article may be good to use while wiring the unit, but a "flow-of-information" type of drawing would better help the reader understand what the writer is saying.

This is an excellent article, doing just what *73* does best—breaking new ground. Keep up the good work.

W. S. (Bill) Kemper W4KOF
Miami FL

Your comments make sense, Bill, but to avoid drawing two diagrams I think that a circuit description a la good old BSP (Bell System Practices) would make better sense. That way we need show only the wiring diagram (most necessary). I have written such a circuit description for the crosslink logic box. (See below.)

I notice that in redrawing the circuit you found the error in the original drawing with the article. Pin 9 of RY1 does NOT connect to the microphone circuit as shown but, instead, should connect to the top of the coil of RY1, contact 13.

Thank you very much for your insight, Bill.—David P. Allen W1UKZ.

CIRCUIT DESCRIPTION

When connected as shown in Fig. 2 and turned on with both rigs powered, the circuit defaults to receive mode in both transceivers. Signals normally would be heard via external speakers (not shown) paralleling the external speaker circuits for each rig. None of the LEDs will be illuminated.

When microphone PTT switch is closed, ground pin 1 of RY3 is grounded through D6, operating RY3. RY3 contacts 4 and 8 close, illuminating LED2 to indicate microphone "on" condition. PTT ground is passed through normally-closed contacts 3 and 11 of RY1 and RY2, keying both transceivers. Normally-closed contacts 2 and 10 of RY1 and RY2 feed microphone audio into both transceivers. When the microphone is released, default receive mode is restored and RY3 releases.

From default condition, if SX1 is pressed to close contacts 1 and 2, and 4 and 5 (HF listen, VHF xmit), then the following takes place: Vcc is fed through normally-closed contacts 4 and 6 of RY3 through contacts 1 and 2 of SX1, through normally-closed contacts 1 and 9 of RY2, to the coil of RY2. Since Q2 is forward-biased by Vcc through R4, Q2 acts as a closed switch between emitter and collector, providing a ground for RY2 coil. RY2 operates and LED1 is illuminated. Contacts 5 and 9 close on RY2, providing latching voltage for RY2, and RY2 remains operated when SX1 returns to neutral. Closed contacts 7 and 11 of RY2 provide keying ground for the VHF rig and closed contacts 6 and 10 of RY2 feed HF speaker audio into the microphone input of the VHF rig. C2 provides holding voltage for RY2 while contact 9 is travelling from contact 1 to contact 5.

If, at this point, microphone PTT switch is closed, RY3 operates opening contacts 4 and 6 of RY3, thus releasing RY2. Simultaneous local keying of both rigs will follow as described above.

If instead of local microphone PTT keying, SX1 is thrown downward, then the following sequence will happen: Closed contacts 5 and 6 of SX1 remove the forward bias from Q2. This opens the circuit between emitter and collector of Q2, opening the ground circuit of RY2, and RY2 drops open. By process described above for operation of RY2, RY1 now operates and audio is transferred from the VHF speaker output to the HF microphone input. If SX1 were pressed upwards, then contacts 4 and 5 of SX1 would cause Q1 to open the ground circuit of RY1, dropping RY1 as RY2 operates. Thus signals may be transferred from rig to rig by the local operator by successive reverse operations of SX1. LED1 and LED3 will show the current status.

EXTRA PANE RELIEVER

I've read KC8DU's article, "Instant Pane Relief" (*73*, January, 1984), and I believe a few follow-up comments are needed to round out the article.

KC8DU stated that one of his goals was to produce a weathertight and insect-tight assembly. Having worked most of my adult life in the building-material industry, I believe I have spotted an oversight in his reasoning.

Gary described an efficient system for making a weathertight seal as far as it goes. However, the article failed to mention that raising the sash *breaks* the weatherseal between the top and bottom sashes of the window.

To fix this problem, something has to be slid in between the overlapping top and bottom sashes to seal the gap created by separating the sashes. Fiberglass insulation or sponge rubber come to mind to do this. If a storm window is mounted on the prime window, don't forget to seal between those sashes, too. A piece of weatherproof tape placed across the gap should resolve the storm-sash problem.

James C. Burtoft KC3HW
Washington PA

WEST INDIES THANKS

On behalf of the Trinidad and Tobago Amateur Radio Society, I would like to extend our sincere thanks to you and *73* magazine for the books, magazines, and tapes you so generously donated for use in our WCY exhibit. All of the materials arrived in good condition and in time for the exhibition. They were all used in our publications exhibit and helped to illustrate to our visitors what a well-organized and well-supported hobby amateur radio is.

Our exhibit was visited by several thousand persons, many of whom had never even heard of this hobby before. The demonstration radio stations made about 1000 contacts during the weeklong exhibition on the various bands, on SSB, CW, and RTTY. The exercise turned out to be a very successful public relations one and we have added about 40 new associate members as a direct result of it. Many of them have joined the training courses presently being conducted in preparation for this year's amateur-radio exam. The materials you provided have been passed on to those responsible for the training course, and the Morse-code tapes should prove invaluable to our tutors.

Once again, thank you for your support, and I wish you prosperity in 1984.

John L. Webster 9Y4JW
Trinidad, West Indies

And welcome, 9Y4JW, to 73. (See the Trinidad and Tobago column in "73 International.")—Editor.

DX WORLD ON THE C-64

Received the February, 1984, issue and adapted the WB7RLX computer program for the VIC-20 to the Commodore 64 ("Put the DX World on a Screen"). While making the necessary changes, I found a few errors that others might correct when typing:

Line 1059—DATA omitted
Line 1088—OCEN should be OCEAN
Line 1037—SAUDIA ARABIA should be SAUDI ARABIA (line 1125 has the correct spelling, but the two lines would not cross reference).

My compliments to Gene for a very FB program. Mine works beautifully on my C-64. I've changed the screen colors for better contrast and formatted the screen printouts to fit the C-64. Memory required is 12.6K, which is no problem for the Commodore.

If anyone is interested in the C-64 program listing, send me $2.00 plus an SASE; a personalized tape is available for $8.00 if you include your QTH's latitude and longitude.

I love it! Congratulations to WB7RLX and to *73*!

Bubba Johnson N4CII
5043 Victoria Avenue
Charleston SC 29406

LIMELIGHT PROBLEMS

I had to chuckle as I read your last editorial regarding the impression by others that your ego is suffering from overindulgence!

We share the problems and benefits of being in the limelight and suffering scrutiny by the public. Too often our images, projected to that public, are far different from real life.

I am often amused by the reaction that I receive when meeting new amateurs here in Indianapolis. There is a sudden "recognition" that flashes across their faces when they realize that the fellow standing in front of them, dressed in cut-offs, a T-shirt that touts the joy of computerized RTTY, and a much abused hat, is really the "star" they see each night on television!

Just making an appearance without a three-piece suit is enough to prove that I am, after all, an OK guy.

I can't count the times that newcomers to my circle of friends have made the comment that I am certainly a lot different in real life than I am on television. What they expect of me I have never been able to nail down, other than the fact that they expect the "image" and not the real person!

To those who offer you the adjective of egotistical, you may use this quote—no charge!

There are those who do,
and those who don't.
Winners achieve their dreams,
The others just . . . won't.

There is certainly a difference: professional desire and inner-drive versus egotism. I believe that your comments over the months have been composed more as an intended inspirational message for your readers, not mere backslapping. So keep up the good work. If you can get just one or two of those beer-guzzling, television addicts to reconsider their lifestyle, you will have achieved a worthy goal.

For me, each new day has to be filled with some tangible achievement.

I have the unique opportunity of having most of the day for my personal pursuits and then working at the television station in the evenings.

I decided at the first of the year that I was going to do more writing, a pleasurable pursuit that I have neglected for about five years. My free time needed to become money-making time.

It took me a couple of weeks to get organized, and Monday I sat down to research some ideas.

I mailed a letter to your editorial staff at 73 this morning, with four story ideas... and found two more this afternoon that look promising.

I had been working on a computer database that provides a listing of beam headings for almost 600 DX, US, and Canadian cities. After six months of hesitation, the program is complete, and another letter will leave here this afternoon addressed to the "Barter 'N' Buy" column. After all, why enjoy the results of the labor without sharing it with others, at a modest price?

In addition, I outlined query letters for the local city magazines for four stories and completed a much-needed giveaway booklet about Indiana weather for the TV station advertising sales team.

By this time, you are probably asking, what's the point?

Tell people to quit dreaming and start doing!

Tell those who doubt your advice to quit questioning and take action. The hardest part of achieving a dream is the fear of failure. Failure can at times be a success in itself; after all, Columbus sailed west to find The East. He failed in his quest, but his failure proved to be more profitable than his original dream!

Cheers, and thanks for listening!

Bob Foster WB7QWG/9
WTTV-TV
Indianapolis IN

HW-8 ON 30 AT 2.1 W

I just completed modifying my Heathkit HW-8 for 30 meters as described by Kerry Holliday WA6BJH in your December, 1983, issue ("A Perfect Match for the HW-8"). I really appreciate the great job Kerry did researching and documenting the modification.

Kerry reported that the 30-meter output of the modified HW-8 was about 1.2 Watts. That seemed low since my HW-8 puts out a full 2 Watts on 40 and 20. The problem turned out to be that the mixer output circuit, L15/C68, does not reach resonance when retuned for 10 MHz. As Kerry describes in step 6, a peak output is noted when the slug is turned almost to the bottom. However, the rf voltage at the test point, the emitter of Q5, was only about 0.6 V while the other bands produced between 1.1 V and 1.5 V. Adding 68 pF in parallel with the existing C68 brought the adjustment range of the slug within reach of 10 MHz, and a peak of about 1.2 V was noted. The rf output rose to 2.1 Watts, virtually the same as on 40 meters.

Incidentally, there is yet another tuned circuit at the output of the driver, Q8. It is a very broad-tuned circuit, however, and no adjustment was provided in the original circuit. Adding more capacitance to bring the resonant peak to 10 MHz only increased the power output by another 0.03 dB; clearly this is not worth the effort!

Again, thanks to Kerry for making the move to 30 so easy!

Ron D'Eau Claire AC6Y
Santa Cruz CA

S-UNITS ON A PINHEAD?

Regarding VE1BZJ's "Thank You for Listening" (*73*, January, 1984), he says, "It certainly adds a few S units when trying to make a QSO through the QRM."

One S unit = 4 to 6 dBs; 2 S units = a couple. A few S units would seem to be at least *12 to 18 dBs*. Most S-meters react to peak power, not average power. Can you have BZJ explain how his "expander" increases peak power by a factor of 40 or so?

LXXIII,

A. J. Massa W5VSR
New Orleans LA

I have not actually been able to count the S units at the distant station and could only go by the reports received from the other stations which confirm that my signal is not copyable without the compressor/expander unit turned on.

The statement concerning "a few S units" was figuratively written to convey the point that the signal does get enhanced. Since this is a technical journal and article, I will not waste your time and mine in explaining semantics. It would be more enlightening if the reader experimented with the unit rather than nit-picking the literary style or choice of words of the article.

I am hoping that someone else will build the unit and then perhaps I could judge for myself, and from my end, the exact number of S units that make the difference.—Dennis P. Sladen VE1BZJ.

DR. DIGITAL

Robert Swirsky AF2M
PO Box 122
Cedarhurst NY 11516

THE END OF AMATEUR RADIO

Nothing has prompted more argument among hams than the issue of no-code licenses. Many feel that the code requirement is what keeps the amateur band civilized. It has been argued that the code is the only thing that keeps large numbers of "undesirables" off the amateur bands; without it, we would have chaos.

For some reason, many hams want to make it extremely difficult to obtain a license, and a Morse-code requirement fulfills this need nicely. Apparently, those that take this position don't seem to realize that a large ham population is in the best interest of amateur radio. With a large and active body of hams there could be more amateur-radio-related business. Also, other services would be less likely to want a piece of our already-diminished portion of the radio spectrum.

In New York, the FCC now gives ham exams quarterly. This is bound to discourage many people from getting their tickets—something sure to please those who want to restrict the ham population. The way I see it, this could easily cause the amateur-radio service to disappear. As David Byrne said: "Watch out—you might get what you're after."

PACKET RADIO UPDATE

The newest amateur-radio frontier is packet radio. Interest in this mode is steadily growing, although slowly.

A few months ago, I mentioned *SLAPR Protocol*, the St. Louis Area Packet Radio Club's newsletter. The newsletter is no longer being published, and the group is being reorganized. If you are in the St. Louis area and want to get involved in packet radio, their new address is:

- St. Louis Area Packet Radio (SLAPR), c/o Spence Branham KAØIXI, 9926 Lewis and Clark, St. Louis MO 63136.

St. Louis is certainly not the only area where packet radio is thriving. If you live near Tucson, Vancouver, or Menlo Park CA, you will find the following groups useful:

- Tucson Amateur Packet Radio (TAPR), PO Box 22888, Tucson AZ 85734.
- Vancouver Amateur Digital Communications (VADCG), c/o Don Oliver VE7AOG, 818 Rondeau St., Coquitlam BC V3J 5Z3, Canada.
- Pacific Packet Radio Society (PPRS), c/o Hank Magnuski KA6M, 311 Stanford Ave., Menlo Park CA 94025.

NARROWBAND VOICE MODULATION, REVISITED

A few years back, there was much talk about a "new" mode. The American Radio Relay League thought this mode (which in my opinion was just a fancy speech processor) was so important that they devoted a chapter to it in their annual *Handbook*. It never did catch on—I suppose NBVM went the way of quadraphonic sound and other similar technological "breakthroughs."

Now that computers have entered the ham-radio scene, there is a low-cost way to have extremely narrowband voice signals transmitted over the air. What's more, this technique only takes up 170 Hz (!) of bandwidth and is legal in the CW portions of the band.

The way to accomplish this is to use a phoneme speech synthesizer. One such device is the Votrax (500 Stephenson Highway, Troy, Michigan 48084) SC-01 speech-synthesizer IC, which is the basis of a number of speech-synthesizer products (e.g., Votrax Type 'n' Talk). Of course, there is a limitation—one must provide phonetic data for the synthesizer, which can be encoded manually or by computer. There are a number of firms offering text-to-speech programs for microcomputers. These programs take ASCII-encoded English, and by following a set of rules, convert it into the phonetic equivalent.

According to the data sheet for the Votrax SC-01 speech-synthesizer IC, only 70 bits per second of data are required for continuous speech production. If you can prepare what you want to say in advance, this provides a way to have "speech" over extremely narrow bandwidths. It would also provide a way for a visually impaired person to communicate with RTTY.

As I mentioned before, a synthesizer based around SC-01 is programmed using phonemes—the basic speech sounds of English. There are 64 phonemes—this means that only 6 bits need to be transmitted for each sound (since any digital code is now legal, within band limitations, there is nothing wrong with using 6-bit "words"). Votrax has symbols associated with each phoneme to make transcription easier. For example, "catalog" would be K AE2 EH3 DT UH3 L AW2 AW2 G, and "empty" would be EH2 EH3 M P T Y. The phoneme symbols that end in a number (EH2, EH3, etc.) are for vowel durations. Phonemes that end in a higher number are for short-duration vowel sounds.

With a bit of practice, one can encode text into phonemes very quickly. A text-to-speech program, such as the one available from MicroMint (917 Midway, Woodmere NY 11598) for the Apple II computer, permits the user to simply type the text in English and let the computer worry about the conversion.

Receiving phoneme-encoded data over the air is a simple process. Just feed the received data, through a buffer, into the speech synthesizer. All the buffering and controlling can be handled easily with a short machine-language program.

Since this "mode" is not a true speech mode, in that one must type one's transmission rather than speak it, it is not suited for conversational communications. An appropriate application would be for radio bulletins and similar one-way communications, where the transmitting station has prepared the message far in advance.

A novel use of this technique might be to have a "subcarrier" voice channel on an FM repeater. By FSKing the repeater's output, a few stations can receive the data using the discriminator output on their FM receivers. Any station using the repeater for conventional voice communications would not be able to notice the small frequency shift on the repeater. Such a subcarrier channel could be used to transmit repeater-status information, club bulletins, weather reports, etc.

Other Speech-Synthesis Techniques

There are a number of speech-synthesis techniques available. Phoneme synthesis, the technique just described, requires a very low data rate (70 bps). Speech quality, however, is not that good. It is understandable but requires a bit of getting used to. (An analogy is the "monkey chatter" of SSB. It sounds strange to people who have never heard SSB before.)

If one wants better speech quality, there are two choices: linear predictive coding and speech digitization. Linear predictive coding (LPC) is what Texas Instruments uses in its "Speak and Spell" talking toys. The technique involves analyzing human speech with computer and breaking it down into sound components. To reproduce these sound data, they are fed into a circuit which, by simulating a human vocal tract, reconstitutes the data into fairly natural sounding speech. Unfortunately, to encode LPC data, time-consuming algorithms are needed. Because of this, the calculations are usually done on mainframe computers or large minicomputers. The encoded data take up more room than phoneme-encoded speech, per second.

Speech digitization is much like using the computer's memory as a tape recorder. Speech is analyzed with an analog-to-digital converter—samples are taken at a rate of 12,000 per second. The data from the A/D converter are stored in memory. To recreate the sound, the data are played back into a digital-to-analog converter, which is connected to an amplifier. Digitization uses a lot of memory—64 kilobytes can only hold a few *seconds* of speech. The quality, however, is extremely natural sounding.

As you can see, there is no "best" way. Each method has distinct advantages and disadvantages. After working with phoneme synthesizers for a number of years, I tend to favor them. The speech sounds much like one would expect a computer to talk—with a heavy monotone "robot" accent—but considering the memory efficiency that a phoneme synthesizer offers, it is one of the best methods around. It's also the only method that can provide an unlimited vocabulary without extensive preparation.

Phoneme-synthesized speech can be a useful and practical part of a digital communications system. In addition to using it as a narrowband speech technique, it is useful in providing voice output on a RTTY mailbox—stations without RTTY (or mobile stations) can hear what messages are in memory. I will update speech-synthesis technology as more hardware becomes available.

REVIEW

NOVICE GUIDE FROM BASH

Bash has done it again! The all-new *Novice Class Amateur Radio Operator Guide* is now available, and it's a beauty.

No, don't expect the old *Final Exam* book, and don't expect to get the exact answers to every question on the Novice examination, because the *Guide* is not that kind of a book. This time, due perhaps to the new FCC requirements (which are covered by the *Guide*), the format is tutorial, but not pedantic or dull. It is light, easy to read, and *fun*! Virtually everything the prospective Novice will need to know to pass the theory portion of the exam is included.

Let's take a look at some specific features covered by the guide, as well as the mechanical specifications. The book itself has a soft cover with a glossy finish in light blue and black, measures 6" × 9" × ¼", and weighs only a few ounces... exactly the neat, easy-to-carry size that you will find convenient to take with you but not so small that it will be hidden under the piles of things on your desk, table, or bench. Of course, you can't judge a book by its cover, size, or weight... you have to look inside.

Divided into 26 convenient chapters or sections with such titles as "In the Beginning," "The Rules Jewels," "Zip Zap: About Lightning," "Shorties," "So What Do I Say Now?", and the like, the *Guide* tells you neither too much nor too little, but gives you exactly what you need to know to pass the exam.

As many of you know, the FCC has now followed a long-time practice of the FAA with respect to exam questions—that is, the questions that will be asked on examinations are published. That's right, THE questions! So, what's the trick, you ask? Well, the trick is that they choose only one question out of a possible ten or twenty in each of twenty categories covering the subject matter you are supposed to know. Therefore, it doesn't do any good to memorize specific answers to particular questions... you have to know the basic material. Knowing that, you will be able to answer any questions asked, and that's the way it should be. If you read the *Guide* and understand what it teaches and are able to answer the practice questions, then you will be able to take the Novice examination with full confidence that you will pass. You'll be able to answer any question in any category.

The *Guide* provides a catch-all chapter covering many miscellaneous questions that don't fall conveniently into any of the twenty categories. Dick Bash doesn't want you to be caught by any surprise questions.

A very helpful chapter is "So What Do I Say Now?" It covers the Novice version of mike fright—a condition that often occurs when you are making your first half-dozen or so contacts. Let's say you call CQ and suddenly, magically, receive an answer. Maybe it's a more experienced Novice on the other end, and he seems to be sending so fast that even your call (much less his call) is barely recognizable. Before you know it, he has signed over to you... and there's a great dead spot on the band, waiting for your answer. You shake, you sweat, your fingers cramp, and you are scarcely able to send your call. You think, "Oh my gosh, he's waiting for me to say something, and I don't know what to say!" Enter Bash, stage left, to help you out of the dilemma. He gives you sample exchanges, things that are said by both sides in a typical CW exchange. You could almost copy the information verbatim, or you can vary it to suit your own special case by merely changing a word or two here and there. It does get you over those first few critical moments when everything goes blank.

There's much, much more, of course, to the *Guide*, but we don't want to spoil it for you by telling you everything that Dick Bash has up his sleeve. Join in the fun. Give the *Guide* to a son or daughter, a friend, or anyone who might be thinking of taking a Novice exam. Here's a thought: Maybe you will be giving the Novice exam yourself to some potential hams in the club or neighborhood, and you're saddled with teaching the course. If you need a syllabus and text to work from, you could use the Bash book for this purpose, too. In fact, I'll bet that you will find things there that even you have forgotten. Heck, it'll cost you only a well-spent $9.95 (cover price) from *Bash Educational Services, PO Box 2115, San Leandro CA 94577.* Reader Service number 476.

Jim Gray W1XU
***73* Staff**

THE COMPLETE DXER

Few enjoyments surpass the comfortable pleasure of settling in for an evening's reading of a good book in a snug and cozy environment. For best results, the book should be interesting—which could mean entertainingly written or instructive, preferably both. It should be fact-filled, yet exciting enough to move the reader quickly through the action, never permitting boredom. Most of all, a good book should fascinate the reader and, when possible, place him or her right in the middle of the action. The reader then becomes immersed and is no longer aware of being a reader; instead, he becomes a participant... involved in the story. Time loses meaning, and the story is all. You will find Bob Locher W9KNI's *The Complete DXer* such a book.

Written by an experienced DX chaser, yet clear and simple enough for the beginner, the book tantalizes and teaches at the same time. It recognizes that we all start as beginners, but, more than that, it helps us learn to do things the right way, to avoid the traps and pitfalls waiting to turn a neophyte into a lid, until the goal is in sight—the DX Honor Roll. If you're not on your way to Honor Roll after reading and practicing Bob's brand of DXing magic, then the fault will be yours, not his.

The Complete DXer can be a reference and a guide... a welcome companion to be savored at leisure. Most assuredly, it represents a solid-gold treasure trove of information amassed by a skilled operator during a lifetime of DX chasing. After reading the brief foreward and acknowledgements, you are plunged into Chapter 1, "A Night on the Bands," a foray into the DX jungle of twenty meters on an evening when the band is open. You're there when Bob stalks—and bags—a rare A71 station on Qatar, beating out the rest of the world for this big-game trophy. Then, almost before you can recover your breath, you happen upon the trail of a T55 but don't manage to track him to his lair before he disappears. Bob has managed to decipher his wily habits, however, and you know that next time, Somalia will be yours. This chapter creates the desire to know more, to become a patient and skillful hunter, so you can go out on your own and capture your own DX prizes. You learn that listening and patience and skill mean more than raw power, setting the stage for Chapter 2, "Basic Listening."

The first section of the book deals with basic and intermediate skills and equipment. What to use, where to find it, how to use it... a primer of great and lasting value. The second section of the book builds upon the first, adding refinements of technique, special tricks of the trade, and how to be a sportsman in the truest sense of the word. It teaches you about "Winning, Losing, and Playing the Game." Finally, Bob teaches you his "Last Secret" before turning you loose on the unsuspecting world. In "Conclusion," you are left with a philosophy and a new beginning.

Just the other day when I was talking with Bob about his book, he asked me how I liked it. I gave this answer: "I wish I had written it"—the ultimate accolade... and the truth. *The Complete DXer* is bound to be a smash hit, so you had better get out the checkbook right away and put in your order before they're gone. The price is $10.95 plus $2.00 postage and handling. VISA and Mastercard are accepted. It's available from *Idiom Press, Box 583, Deerfield IL 60015.* Reader service number 477.

Jim Gray W1XU
***73* Staff**

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FREE FREE GIFT. Interested in amateur radio, computers, video? Large SASE pse and mention *73* magazine. Free gift to all. Narwid Electronics, 61 Bellot Road, Ringwood NJ 07456. BNB098

FIND OUT what else you can hear on your general-coverage transceiver or receiver. Complete information on major North American radio-listening clubs. Send 25¢ and SASE. Association of North American Radio Clubs, 1500 Bunbury Drive, Whittier CA 90601. BNB099

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SULTRONICS offers TET antenna systems with factory backup and parts. Call or write for our complete catalog with full descriptions and specs on the full line of TET antennas—the best! For fast and friendly service as usual, contact Dan WD8IDZ or Nina N8ANU at Sultronics Amateur Radio, 15 Sexton Drive, Xenia OH 45385; (513)-376-2700. BNB102

SULTRONICS has Hy-Gain at the lowest prices anywhere!! TH7DX—$369.96; TH5MK2S—$303.95; new Explorer-14—only $264.95!! Limited to stock on hand, so call or write now!! Sultronics Amateur Radio, 15 Sexton Drive, Xenia OH 45385; (513)-376-2700. BNB103

WANTED: older tube-type amateur or general-coverage receiver in good condition. Send description and asking price. Steven D. Jones N2AMY, Box 6585, Ithaca NY 14851. BNB104

AWARDS

DAVY CROCKETT

On April 28, 1984, the Bryan Amateur Radio Club will run a special-event station in the Crockett National Forest to commemorate the contributions of Davy Crockett to the fight for Texas independence. The club will operate W5RAS from 1800 UTC Saturday to 0600 UTC Sunday on 80–2 meters on the phone bands. Certificate for $1 and an SASE to QSL manager KA5OIT, 2203 Franklin, Bryan TX 77801.

TATER DAY

The Marshall County ARA will be operating a special-event station from 1800Z April 1 to 2400Z April 2 to commemorate the 141st Tater Day Celebration. Operation will be on CW, 7120. Operation 20 kHz up from lower 40–15-meter General phone-band edges and 146.55 simplex. Certificate will be given. Send QSL and large SASE to WG4U, Route 2, Benton KY 42025.

X-WARN

X-WARN (Xenia Weather Amateur Radio Net) announces the planned operation of special-event radio station WB8QZZ on March 31 and April 1, 1984. Our operation commemorates the rebuilding of the Xenia community on the 10th anniversary of the killer tornado of April 3, 1974. This triple twister damaged half of the homes and businesses in a city of 25,000 and killed 33 persons. Amateur radio contributed immensely with emergency communications in the hours and days after the storm. X-WARN was organized subsequent to the tornado as a means of providing prompt local weather observations during National Weather Service alerts.

The special event will operate two HF transceivers from 1500 to 0300 UTC on Saturday and 1500 to 2300 UTC on Sunday. Frequencies will be SSB: 7.275, 14.275, and 21.375 (± 10 kHz). We will also have a third rig on 2-meter FM: 146.52 simplex or the X-WARN repeater 147.165/765. Please send QSL and SASE to N8CYS (per *Callbook*) for special commemorative QSL.

ARBOR DAY

A special-events station will be operating from the Nebraska State Arbor Lodge, former home of J. Sterling Morton (founder of Arbor Day), in Nebraska City, Nebraska, during the annual Arbor Day celebration. This station, in addition to other club-member stations, will be operating in the General portion of the phone and CW bands on 80 through 10 meters from 2400 UTC April 27 to 0600 UTC April 29. In addition, other club-member stations will be operating from their own QTHs from 2400 hours UTC April 23 to 0600 hours UTC April 29. All amateurs contacting this station, KØTIK, or any other club-member stations during these times will be eligible to receive an Arbor Day commemorative certificate from the Nebraska City Amateur Radio Club. Please send one dollar and a business-size self-addressed envelope to John K. Nihart KAØOKI, 7731 Holdredge, Lincoln NE 68505.

HAM HELP

I have recently purchased a Radio Shack TRS-80 model 100 and would like to know if there is any ham software available for it commercially. I am particularly interested in any CW send/receive and RTTY software and would appreciate having the names of any companies that might have such systems.

Information about software for other computers that run Basic would even be helpful, as I think that I could adapt it for the model 100.

David C. Eanes N4AZI
4866 Drusilla Lane
Baton Rouge LA 70809

I want someone to have a sked with me to increase my CW speed. Must use keyboard and start at 25 wpm. For more info, call (304)-983-2157.

Roger Vankirk KX8Y
Rt. 2, Box 388X
Morgantown WV 26505

I would like to hear from anyone who has modifications to put the Ten-Tec Omni on 10-meter FM.

Stephen J. O'Malley N2CLE
140-26 Poplar Ave.
Flushing NY 11355

I need a service manual or schematic or copy of same for a Yaesu FM FT-202R handie-talkie. Also need crystals for 2 meters or charger.

Cyril T. Wolff WA7LOV
S. 5507 Marshall Road
Spokane WA 99204

HAM HELP

I want a program for a Commodore 64 where I can put in my latitude and longitude and the other station's latitude/longitude and get the other station's distance in miles.

I have tried converting programs for this written for the Radio Shack models 1 and 3, Heath, and Hewlett-Packard 9845 and cannot get any to run. Also, one written for the VIC-20 didn't work either.

Gary Payne KE6CZ
1347 E. Dakota
Fresno CA 93704

I need the schematic and operating manual for the Knight TR-106 6-meter transceiver with the model V-107 remote vfo. Any help will be appreciated.

P. J. Mikula KA8RZL
70 Clay St.
Manistee MI 49660

I have a Hallicrafters SR-150 transceiver and need a replacement rf switching relay, Hallicrafters part number 021-000651. It's a 3-pole, double-throw miniature manufactured by Jayco. A used but operable relay would be fine. Would also be interested in an SR-150 that someone is willing to "part out."

Larry Kaja WA9RWO
4001 N. Holster
Tucson AZ 85749

I would appreciate hearing from anybody who operates 10 through 20 meters from a travel trailer. I need to know the type of antenna being used and how it is mounted.

James L. Laherty KA6CMD
1805 Bahia
San Mateo CA 94403

I need a schematic and operation manual for DuMont 274 scope. I will gladly pay copying costs and postage.

Robert A. Johnson N7CFX
833 E. Gwinn Pl.
Seattle WA 98102

I would like to hear from anyone who has converted any Motorola UHF Motracs U64LHT or U54LHT units to the 440 amateur band. Areas of most concern are the oscillator and the front-end cavities.

Marion L. Kasekamp KK3L
PO Box 222
Ellerslie MD 21529

I am looking for a service manual for a Pace BI-3100 UHF FM 6-channel business-band rig and a Lafayette Micro P100 UHF tunable receiver. I will pay for copying and mailing charges.

S. May
PO Box 295
Simcoe, Ontario N3Y 4L1
Canada

SATELLITES

Amateur Satellite Reference Orbits

Date		OSCAR 8 UTC	OSCAR 8 EQX	RS-5 UTC	RS-5 EQX	RS-6 UTC	RS-6 EQX	RS-7 UTC	RS-7 EQX	RS-8 UTC	RS-8 EQX	Date
Apr	1	0137	119	0151	34	0144	39	0114	27	0104	19	1
	2	0142	120	0146	34	0128	36	0104	26	0101	20	2
	3	0003	95	0141	35	0113	34	0054	25	0059	21	3
	4	0007	97	0135	35	0057	32	0045	24	0056	21	4
	5	0011	98	0130	35	0042	29	0035	23	0053	22	5
	6	0016	99	0125	35	0027	27	0025	22	0050	23	6
	7	0020	100	0119	35	0011	25	0016	21	0047	24	7
	8	0024	101	0114	36	0155	52	0006	20	0044	25	8
	9	0029	102	0108	36	0139	50	0156	50	0042	25	9
	10	0033	103	0103	36	0124	48	0146	49	0039	26	10
	11	0037	104	0058	36	0108	45	0136	48	0036	27	11
	12	0042	105	0052	36	0053	43	0127	47	0033	28	12
	13	0046	107	0047	37	0038	41	0117	46	0030	29	13
	14	0050	108	0042	37	0022	38	0107	45	0027	29	14
	15	0055	109	0036	37	0007	36	0058	44	0025	30	15
	16	0059	110	0031	37	0150	63	0048	43	0022	31	16
	17	0103	111	0026	37	0135	61	0038	42	0019	32	17
	18	0108	112	0020	37	0119	59	0029	41	0016	33	18
	19	0112	113	0015	38	0104	56	0019	41	0013	34	19
	20	0116	114	0010	38	0048	54	0009	40	0010	34	20
	21	0121	116	0004	38	0033	52	0000	39	0008	35	21
	22	0125	117	0159	68	0018	49	0149	68	0005	36	22
	23	0129	118	0153	68	0002	47	0140	67	0002	37	23
	24	0134	119	0148	69	0145	75	0130	66	0159	68	24
	25	0138	120	0143	69	0130	72	0120	65	0156	69	25
	26	0142	121	0137	69	0115	70	0111	64	0153	69	26
	27	0004	96	0132	69	0059	68	0101	63	0150	70	27
	28	0008	98	0127	69	0044	65	0051	63	0148	71	28
	29	0012	99	0121	70	0028	63	0042	62	0145	72	29
	30	0017	100	0116	70	0013	61	0032	61	0142	73	30
May	1	0021	101	0111	70	0156	88	0022	60	0139	73	1
	2	0025	102	0105	70	0141	86	0013	59	0136	74	2
	3	0030	103	0100	70	0125	83	0003	58	0133	75	3
	4	0034	104	0054	71	0110	81	0153	87	0131	76	4
	5	0038	105	0049	71	0055	79	0143	86	0128	77	5
	6	0043	106	0044	71	0039	76	0133	85	0125	78	6
	7	0047	108	0038	71	0024	74	0124	84	0122	78	7
	8	0051	109	0033	71	0008	72	0114	84	0119	79	8
	9	0056	110	0028	71	0152	99	0104	83	0116	80	9
	10	0100	111	0022	72	0136	97	0055	82	0114	81	10
	11	0104	112	0017	72	0121	95	0045	81	0111	82	11
	12	0109	113	0012	72	0106	92	0035	80	0108	82	12
	13	0113	114	0006	72	0050	90	0026	79	0105	83	13
	14	0117	115	0001	72	0035	88	0016	78	0102	84	14
	15	0122	117	0155	103	0019	85	0006	77	0059	85	15

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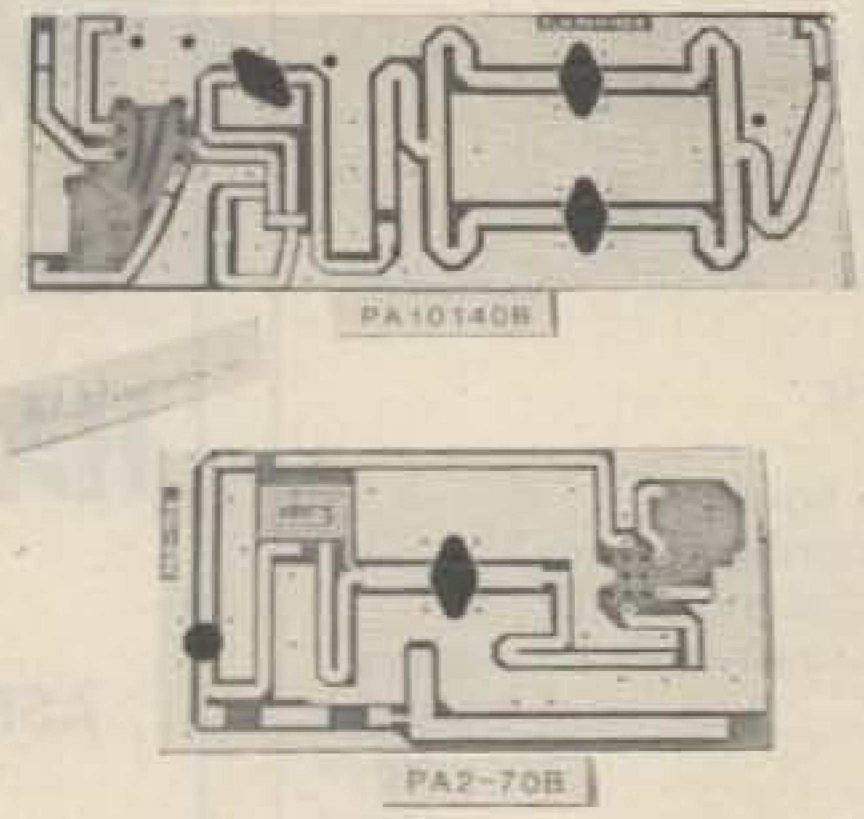

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THOMSON CSF							
SD345	$ 5.00	SD1119	$ 5.00	SD1278-5	$18.00	SD1453-1	$48.00
SD445	5.00	SD1124	50.00	SD1281-2	8.00	SD1454-1	48.00
SD1004	15.00	SD1127	3.50	SD1283	10.00	SD1477	48.00
SD1009	15.00	SD1133	14.00	SD1289-1	15.00	SD1478	21.00
SD1009-2	15.00	SD1133-1	14.00	SD1290-4	15.00	SD1480	60.00
SD1012	9.90	SD1134-1	3.00	SD1290-7	15.00	SD1484	1.50
SD1012-3	9.90	SD1135	8.00	SD1300	3.00	SD1484-5	1.50
SD1012-5	9.90	SD1136	15.00	SD1301-7	3.00	SD1484-6	1.50
SD1013-3	13.50	SD1136-2	15.00	SD1305	3.00	SD1484-7	1.50
SD1013-7	13.50	SD1143-1	12.00	SD1307	3.00	SD1488	39.00
SD1014	11.00	SD1143-3	17.00	SD1308	3.00	SD1488-1	28.00
SD1014-6	11.00	SD1144-1	3.00	SD1311	1.00	SD1488-7	27.00
SD1016	15.00	SD1146	15.00	SD1317	10.00	SD1488-8	28.00
SD1016-5	15.00	SD1147	15.00	SD1335	3.00	SD1499-1	39.00
SD1018-4	15.00	SD1188	10.00	SD1345-6	5.00	SD1520-2	18.00
SD1018-6	15.00	SD1189	24.00	SD1365-1	2.50	SD1522-4	33.00
SD1018-7	15.00	SD1200	1.50	SD1365-5	2.50	SD1528-1	24.00
SD1018-15	15.00	SD1201-2	10.00	SD1375	7.50	SD1528-3	34.00
SD1020-5	10.00	SD1202	10.00	SD1375-6	7.50	SD1530-2	38.00
SD1028	15.00	SD1212-11	4.00	SD1379	15.00	SD1536-1	41.00
SD1030-2	12.00	SD1212-12	4.00	SD1380-1	1.00	SD1545	34.00
SD1043	12.00	SD1212-16	4.00	SD1380-3	1.00	SD1561	79.00
SD1043-1	10.00	SD1214-7	5.00	SD1380-7	1.00	SF4557 Mot.	25.00
SD1045	3.75	SD1214-11	5.00	SD1405	40.00	SK3048 RCA	5.00
SD1049-1	2.00	SD1216	12.00	SD1409	18.00	SK3177 RCA	15.00
SD1053	4.00	SD1219-4	15.00	SD1410	22.00	SMS7714 Mot.	2.50
SD1065	4.75	SD1219-5	15.00	SD1410-3	21.00	SRF750 Mot.	36.00
SD1068	15.00	SD1219-8	15.00	SD1413-1	18.00	SRF1018 Mot.	5.00
SD1074-2	18.00	SD1220	8.00	SD1416	50.00	SRF2147 Mot.	22.00
SD1074-4	28.00	SD1220-9	8.00	SD1422-2	24.00	SRF2356 Mot.	38.00
SD1074-5	28.00	SD1222-8	16.00	SD1428	33.00	SRF2378 Mot.	16.00
SD1076	20.00	SD1222-11	7.50	SD1429-2	15.00	SRF2584 Mot.	40.00
SD1077-4	4.00	SD1224-10	18.00	SD1429-3	15.00	SRF2821 Mot.	25.00
SD1077-6	4.00	SD1225	18.00	SD1429-5	15.00	SRF2857 Mot.	20.00
SD1078-6	24.00	SD1228-8	POR	SD1430	12.00	TA8894 RCA	15.00
SD1080-8	6.00	SD1229-7	13.00	SD1430-2	18.00	TIS189/MRF966	3.55
SD1080-9	3.00	SD1229-16	13.00	SD1434-5	30.00	TP312	2.50
SD1084	8.00	SD1232	4.00	SD1434-9	30.00	TP1014 TRW	5.00
SD1087	15.00	SD1240-8	15.00	SD1438	26.00	TP1028 TRW	15.00
SD1089-5	15.00	SD1244-1	14.00	SD1441	91.00	01-80703T04/ 458-949 Mot.Comm.	65.00
SD1095	15.00	SD1262	12.00	SD1442	15.00	TXVF2201 H.P.	450.00
SD1100	5.00	SD1263	15.00	SD1444	6.00	62803 RCA	100.00
SD1109	18.00	SD1263-1	15.00	SD1444-8	6.00	TA7205/2N5921	80.00
SD1115-2	8.00	SD1272	13.00	SD1450-1	28.00	TA7487/2N5920	75.00
SD1115-3	8.00	SD1272-2	15.00	SD1451	18.00	TA7995/2N6267	150.00
SD1115-7	2.50	SD1272-4	15.00	SD1451-2	18.00	SRF2092 Mot.	18.00
SD1116	5.00	SD1278	20.00	SD1452	20.00	MRF479	8.05
SD1118	22.00	SD1278-1	18.00	SD1452-2	20.00		

We Can Cross Reference Most RF Transistors, Diodes, Hybrid Modules And Any Other Type Of Semiconductor.

* DIODES (HOT CARRIER, MICROWAVE, PIN, SCHOTTKY, TUNNEL, VARACTOR, GUNN) *

1N21	$ 3.40	1N21B	$ 3.40	1N21BR	$ 3.40	1N21C	$ 3.40
1N21D	4.00	1N21DR	4.00	1N21ER	6.00	1N21RF	5.00
1N21WE	5.80	1N21WG	5.80	1N22	5.00	1N23A	10.00
1N23B	3.40	1N23C	3.40	1N23CR	3.40	1N23D	4.95
1N23DR	4.00	1N23WE	5.00	1N25	7.50	1N25AR	18.00
1N28WE	10.00	1N29	10.00	1N32	20.00	1N53A	55.50
1N76	26.00	1N76R	28.00	1N78	26.00	1N78A	20.00
1N78B	26.00	1N78D	28.00	1N78DR	28.00	1N78R	28.00
1N149	6.00	1N150MR	18.00	1N415	4.00	1N415C	4.00
1N415G	15.00	1N416D	5.00	1N416E	6.00	1N446	10.00
1N831	10.00	1N833	10.00	1N950	4.00	1N1084	2.00
1N2930	15.00	1N2932	15.00	1N3540	15.00	1N3712	11.00
1N3713	18.00	1N3714	11.00	1N3715	16.00	1N3716	10.00
1N3717	14.00	1N3718	10.00	1N3721	14.00	1N3733	10.00
1N3747	21.00	1N4386	20.00	1N4396	15.00	1N4785	11.00
1N4812B	9.00	1N5139A/B	4.25	1N5140A/B	4.25	1N5141A/B	4.25
1N5142A/B	4.25	1N5143A/B	4.25	1N5144A/B	4.25	1N5145A/B	4.25
1N5146A/B	4.25	1N5147A/B	4.25	1N5148A/B	4.25	1N5167	5.50
1N5453	3.75	1N5465	7.65	1N5711	1.00	1N5711 JAN	2.00
1N5713	5.00	1N5767	2.00	1N6263	1.00	1S2199	15.00
1S2200	15.00	1S2208/9	1.00	8B1087/48R869558	65.00	8D3020	65.00
A2X116M Aertech	50.00	BB105B	1.00	BB105G	1.00	BD4/4JFBD4 G.E.	15.00
BL161 Bomac	5.00	CMD514AB C.M.	POR	D4060 Alpha	POR	D4159 Alpha	POR
D4233B Alpha	POR	D4900 Alpha	POR	D4959 Alpha	POR	D4987M Alpha	POR
D5047C Alpha	POR	D5147D Alpa	POR	D5503 Alpha	POR	D5506 Alpha	POR
DGB6158-98 Alpha	POR	DMD6022 Alpha	POR	DMD6460A Alpha	POR	DP20054 Crown	POR
GC1691-89 GHZ	31.35	GC1602-89 GHZ	31.35	GC1607-40 GHZ	31.35	GC2531-88 GHZ	37.40
GC2542-46 GHZ	37.40	GC3208-40 GHZ	37.40	GC17044 GHZ	50.00	HP33644A-HO1	125.00
HP5082-0112	14.20	HP5082-0241	75.60	HP5082-0253	105.00	HP5082-0320	58.00
HP5082-0375	POR	HP5082-0386	POR	HP5082-0401	POR	HP5082-0438	POR
HP5082-1028	POR	HP5082-1332	POR	HP5082-2254	POR	HP5082-2302	10.70
HP5082-2303	5.20	HP5082-2696	POR	HP5082-2711	23.15	HP5082-2727	POR
HP5082-2800	1.00	HP5082-2805	4.45	HP5082-2835	1.00	HP5082-2884	POR
HP5082-3039	6.70	HP5082-3040	36.00	HP5082-3080	2.00	HP5082-3188	1.00
HP5082-3379	1.50	HP5082-6459	POR	HP5082-6462	POR	HP5082-6888	POR
HP5082-8016	POR	HP5082-8323	POR	K3A Kemtron	7.00	MA450A	POR
MA475	POR	MA40008	POR	MA41487	POR	MA41765	POR
MA41766	POR	MA43004	48.00	MA43589	POR	MA43622	POR
MA43636	POR	MA45104	27.00	MA47044	POR	MA47051	25.50
MA47100	3.05	MA47202	30.80	MA47771	POR	MA47838*	POR
MA47852	POR	MA49106	37.95	MA49558	POR	MA86731	125.00

* OUR STOCK CHANGES DAILY SO CALL IF IF THE PART YOU NEED IS NOT LISTED

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(For orders only)

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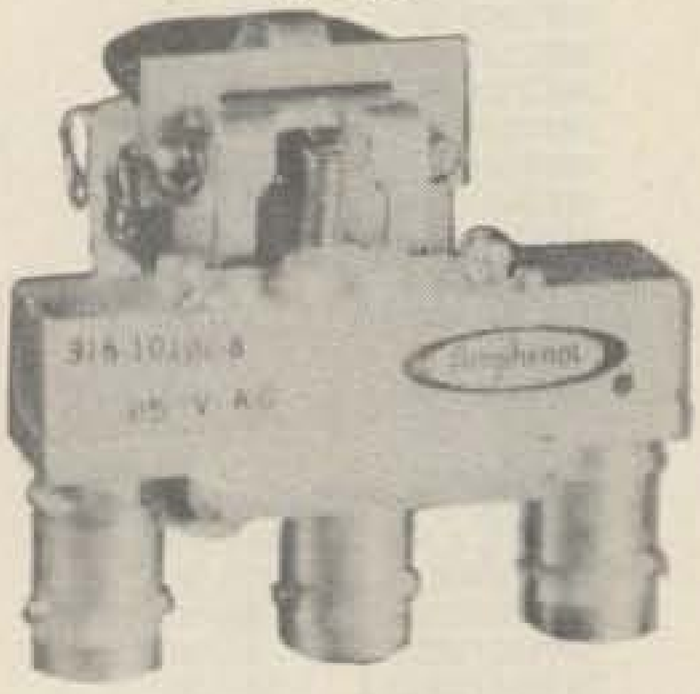
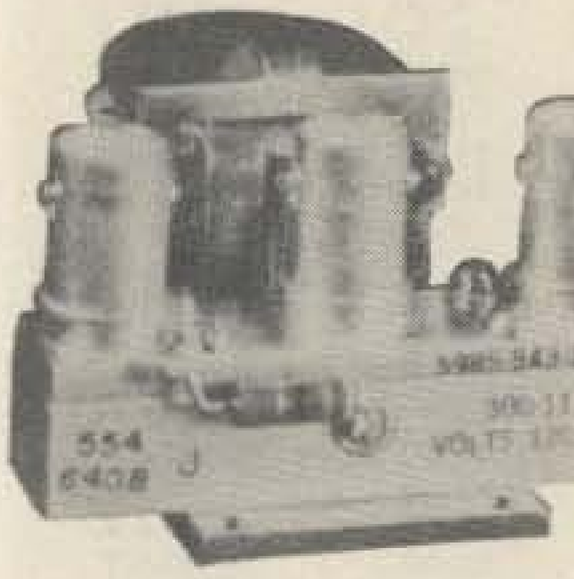
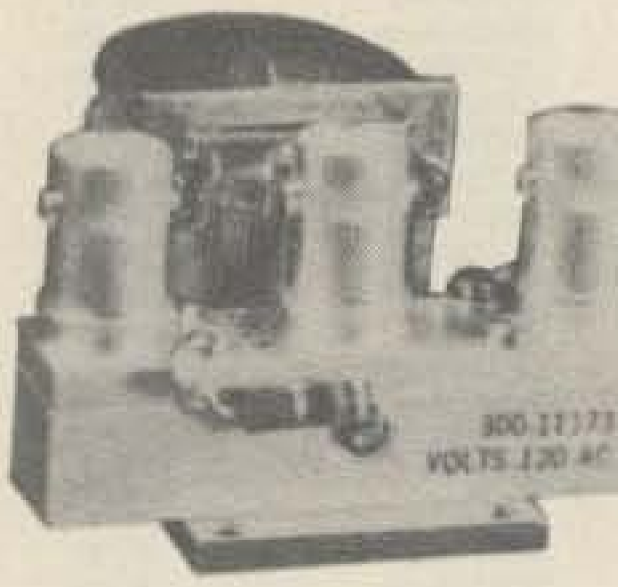
COAXIAL RELAY SWITCHES SPDT

Electronic Specialty Co./Raven Electronics FSN 5985-556-9683 $49.00
Part # 25N28 Part # SU-01
26Vdc Type N Connector, DC to 1 GHz.

Amphenol	FXR	FXR
Part # 316-10102-8	Part # 300-11182	Part # 300-11173
115Vac Type BNC DC to 3 GHz.	120Vac Type BNC DC to 4 GHz.	120Vac Type BNC Same
	FSN 5985-543-1225	FSN 5985-543-1850
$29.99	$39.99	$39.99







BNC To Banana Plug Coax Cable RG-58 36 inch or BNC to N Coax Cable RG-58 36 inch.

$7.99 or 2 For $13.99 or 10 For $50.00 $8.99 or 2 For $15.99 or 10 For $60.00

SOLID STATE RELAYS

P&B Model ECT1DB72 PRICE EACH $5.00	5vdc turn on	120vac contact at 7amps or 20amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.
Digisig, Inc. Model ECS-215 PRICE EACH $7.50	5vdc turn on	240vac contact 14amps or 40amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.
Grigsby/Barton Model GB7400 PRICE EACH $7.50	5vdc turn on	240vac contact at 15amps or 40amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.

NOTE: *** Items may be substituted with other brands or equivalent model numbers. ***

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RECALL PHONE MEMORY TELEPHONE WITH 24 NUMBER AUTO DIALER

The Recall Phone Telephone employs the latest state of art communications technology.It is a combination telephone and automatic dialer that uses premium-quality,solid-state circuitry to assure high-reliability performance in personal or business applications. $49.99

ARON ALPHA RAPID BONDING GLUE

Super Glue #CE-486 high strength rapid bonding adhesive.Alpha Cyanoacrylate.Set-Time 20 to 40 sec.,0.7fl.oz.(20gm.)
$2.00

TOUCH TONE PAD

This pad contains all the electronics to produce standard touch-tone tones. New with data.

$9.99 or 10/$89.99

MITSUMI UHF/VHF VARACTOR TUNER MODEL UVE1A

Perfect for those unscrambler projects. New with data.

$19.99 or 10/$149.99

INTEGRATED CIRCUIT.

		1 to 10	11up
MC1372P	Color TV Video Modulator Circuit.	$ 4.42	$2.95
MC1358P	IF Amp.,Limiter,FM Detector,Audio Driver,Electronic Attenuator.	5.00	4.00
MC1350P	IF Amplifier	1.50	1.25
MC1330A1P	Low Level Video Detector	1.50	1.15
MC1310P	FM Stereo Demodulator	4.29	3.30
MC1496P	Balanced Modulator/Demodulator	1.50	1.25
LM565N	Phase Locked Loop	2.50	2.00
LM380N14	2Watt Audio Power Amplifier	1.56	1.25
LM1889N	TV Video Modulator	5.00	4.00
NE564N	Phase Locked Loop	10.00	8.00
NE561N	Phase Locked Loop	10.00	8.00

FERRANTI ELECTRONICS AM RADIO RECEIVER MODEL ZN414 INTEGRATED CIRCUIT.

Features:

1.2 to 1.6 volt operating range.,Less than 0.5ma current consumption. 150KHz to 3MHz Frequency range.,Easy to assemble,no alignment necessary. Effective and variable AGC action., Will drive an earphone direct. Excellent audio quality.,Typical power gain of 72dB.,TO-18 package. With data. $2.99 or 10 For $24.99

NI CAD RECHARGEABLE BATTERIES

AA Battery Pack of 6 These are Factory New. $5.00

SUB C Pack of 10 2.5Amp/Hr. $10.00

Gates Rechargeable Battery Packs

12vdc at 2.5Amp/Hr. $11.99
12vdc at 5Amp/Hr. $15.99

MOTOROLA MRF559 RF TRANSISTOR

hfe 30min 90typ 200max.
ft 3000mhz
gain 8db min 9.5typ at 870mhz
13db typ at 512mhz
output power .5watts at 12.5vdc at 870mhz.

$2.05 or 10/$15.00

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"SOCKETS AND CHIMNEYS"

EIMAC TUBE SOCKETS AND CHIMNEYS

SK110	Socket	$POR
SK300A	Socket For 4CX5000A,R,J, 4CX10,000D, 4CX15,000A,J	$520.00
SK400	Socket For 4-125A,250A,400A,400C,4PR125A,400A,4-500A,5-500A	260.00
SK406	Chimney For 4-250A,400A,400C,4PR400A	74.00
SK416	Chimney For 3-400Z	36.00
SK500	Socket For 4-1000A/4PR1000A/B	390.00
SK600	Socket For 4CX250B,BC,FG,R,4CX350A,F,FJ	51.00
SK602	Socket For 4CX250B,BC,FG,R,4CX350A,F,FJ	73.00
SK606	Chimney For 4CX250B,BC,FG,R,4CX350A,F,FJ	11.00
SK607	Socket For 4CX600J,JA	60.00
SK610	Socket For 4CX600J,JA	60.00
SK620	Socket For 4CX600J,JA	66.00
SK626	Chimney For 4CX600J,JA	10.00
SK630	Socket For 4CX600J,JA	66.00
SK636B	Chimney For 4CX600J,JA	34.00
SK640	Socket For 4CX600J,JA	36.00
SK646	Chimney For 4CX600J,JA	71.00
SK700	Socket For 4CX300A,Y,4CX125C,F	225.00
SK711A	Socket For 4CX300A,Y,4CX125C,F	225.00
SK740	Socket For 4CX300A,Y,4CX125C,F	86.00
SK770	Socket For 4CX300A,Y,4CX125C,F	86.00
SK800A	Socket For 4CX1000A,4CX1500B	225.00
SK806	Chimney For 4CX1000A,4CX1500B	40.00
SK810	Socket For 4CX1000A,4CX1500B	225.00
SK900	Socket For 4X500A	300.00
SK906	Chimney For 4X500A	57.00
SK1420	Socket For 5CX3000A	650.00
SK1490	Socket For 4CV8000A	585.00

JOHNSON TUBE SOCKETS AND CHIMNEYS

124-111/SK606	Chimney For 4CX250B,BC,FG,R, 4CX350A,F,FJ	$ 10.00
122-0275-001	Socket For 3-500Z, 4-125A, 250A, 400A, 4-500A, 5-500A	(pair)15.00
124-0113-00	Capacitor Ring	15.00
124-116/SK630A	Socket For 4CX250B,BC,FG,R, /4CX350A,F,FJ	55.00
124-115-2/SK620A	Socket For 4CX250B,BC,FG,R, /4CX350A,F,FJ	55.00
	813 Tube Socket	20.00

TUBE CAPS (Plate)

HR1, 4	$11.00
HR2,3, 6 & 7	13.00
HR5, 8	14.00
HR9	17.00
HR10	20.00

CHIP CAPACITORS

.8pf	10pf	100pf*	430pf
1pf	12pf	110pf	470pf
1.1pf	15pf	120pf	510pf
1.4pf	18pf	130pf	560pf
1.5pf	20pf	150pf	620pf
1.8pf	22pf	160pf	680pf
2.2pf	24pf	180pf	820pf
2.7pf	27pf	200pf	1000pf/.001uf*
3.3pf	33pf	220pf*	1800pf/.0018uf
3.6pf	39pf	240pf	2700pf/.0027uf
3.9pf	47pf	270pf	10,000pf/.01uf
4.7pf	51pf	300pf	12,000pf/.012uf
5.6pf	56pf	330pf	15,000pf/.015uf
6.8pf	68pf	360pf	18,000pf/.018uf
8.2pf	82pf	390pf	

PRICES: 1 to 10 - .99¢ 11 to 50 - .90¢ 51 to 100 - .80¢ 101 to 1000 .60¢ 1001 & UP .35¢

* IS A SPECIAL PRICE: 10 for $7.50 100 for $65.00 1000 for $350.00

WATKINS JOHNSON WJ-V907: Voltage Controlled Microwave Oscillator $110.00

Frequency range 3.6 to 4.2GHz, Power ouput, Min. 10dBm typical, 8dBm Guaranteed. Spurious output suppression Harmonic (nf_0), min. 20dB typical, In-Band Non-Harmonic, min. 60dB typical, Residual FM, pk to pk, Max. 5KHz, pushing factor, Max. 8KHz/V, Pulling figure (1.5:1 VSWR), Max. 60MHz, Tuning voltage range +1 to +15volts, Tuning current, Max. -0.1mA, modulation sensitivity range, Max. 120 to 30MHz/V, Input capacitance, Max. 100pf, Oscillator Bias +15 +-0.05 volts @ 55mA, Max.

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TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
2C39/7289	$ 34.00	1182/4600A	$500.00	ML7815AL	$ 60.00
2E26	7.95	4600A	500.00	7843	107.00
2K28	200.00	4624	310.00	7854	130.00
3-500Z	102.00	4657	84.00	ML7855KAL	125.00
3-1000Z/8164	400.00	4662	100.00	7984	14.95
3B28/866A	9.50	4665	500.00	8072	84.00
3CX400U7/8961	255.00	4687	P.O.R.	8106	5.00
3CX1000A7/8283	526.00	5675	42.00	8117A	225.00
3CX3000F1/8239	567.00	5721	250.00	8121	110.00
3CW30000H7	1700.00	5768	125.00	8122	110.00
3X2500A3	473.00	5819	119.00	8134	470.00
3X3000F1	567.00	5836	232.50	8156	12.00
4-65A/8165	69.00	5837	232.50	8233	60.00
4-125A/4D21	79.00	5861	140.00	8236	35.00
4-250A/5D22	98.00	5867A	185.00	8295/PL172	500.00
4-400A/8438	98.00	5868/AX9902	270.00	8458	35.00
4-400B/7527	110.00	5876/A	42.00	8462	130.00
4-400C/6775	110.00	5881/6L6	8.00	8505A	95.00
4-1000A/8166	444.00	5893	60.00	8533W	136.00
4CX250B/7203	54.00	5894/A	54.00	8560/A	75.00
4CX250FG/8621	75.00	5894B/8737	54.00	8560AS	100.00
4CX250K/8245	125.00	5946	395.00	8608	38.00
4CX250R/7580W	90.00	6083/AZ9909	95.00	8624	100.00
4CX300A/8167	170.00	6146/6146A	8.50	8637	70.00
4CX350A/8321	110.00	6146B/8298	10.50	8643	83.00
4CX350F/8322	115.00	6146W/7212	17.95	8647	168.00
4CX350FJ/8904	140.00	6156	110.00	8683	95.00
4CX600J/8809	835.00	6159	13.85	8877	465.00
4CX1000A/8168	242.50*	6159B	23.50	8908	13.00
4CX1000A/8168	485.00	6161	325.00	8950	13.00
4CX1500B/8660	555.00	6280	42.50	8930	137.00
4CX5000A/8170	1100.00	6291	180.00	6L6 Metal	25.00
4CX10000D/8171	1255.00	6293	24.00	6L6GC	5.03
4CX15000A/8281	1500.00	6326	P.O.R.	6CA7/EL34	5.38
4CW800F	710.00	6360/A	5.75	6CL6	3.50
4D32	240.00	6399	540.00	6DJ8	2.50
4E27A/5-125B	240.00	6550A	10.00	6DQ5	6.58
4PR60A	200.00	6883B/8032A/8552	10.00	6GF5	5.85
4PR60B	345.00	6897	160.00	6GJ5A	6.20
4PR65A/8187	175.00	6907	79.00	6GK6	6.00
4PR1000A/8189	590.00	6922/6DJ8	5.00	6HB5	6.00
4X150A/7034	60.00	6939	22.00	6HF5	8.73
4X150D/7609	95.00	7094	250.00	6JG6A	6.28
4X250B	45.00	7117	38.50	6JM6	6.00
4X250F	45.00	7203	P.O.R.	6JN6	6.00
4X500A	412.00	7211	100.00	6JS6C	7.25
5CX1500A	660.00	7213	300.00*	6KN6	5.05
KT88	27.50	7214	300.00*	6KD6	8.25
416B	45.00	7271	135.00	6LF6	7.00
416C	62.50	7289/2C39	34.00	6LQ6 G.E.	7.00
572B/T160L	49.95	7325	P.O.R.	6LQ6/6MJ6 Sylvania	9.00
592/3-200A3	211.00	7360	13.50	6ME6	8.90
807	8.50	7377	85.00	12AT7	3.50
811A	15.00	7408	2.50	12AX7	3.00
812A	29.00	7609	95.00	12BY7	5.00
813	50.00	7735	36.00	12JB6A	6.50

NOTE * = USED TUBE NOTE P.O.R. = PRICE ON REQUEST

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MHz electronics

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HEWLETT PACKARD SIGNAL GENERATORS

606A	50KHz to 65MHz in 6 bands +-1%,Output level adjustable 0.1uV to 3V into 50 ohms.Built-in crystal calibrator.400 -1000Hz modulation.	$ 650.00
606B	Same as above but has frequency control feature to allow operation with HP 8708A Synchronizer.	$1100.00
608C	10MHz to 480MHz,0-1uV-1V into 50 ohms,AM,CW,or pulse modulation, calibrated attenuator.	$ 500.00
608D/ TS510	10MHz to 420MHz, 0.1uV-0.5V into 50 ohms,+-0.5% accuracy, built-in crystal calibrator, AM-CW or pulse output.	$ 375.00
608E	Improved version of popular 608C.Up to 1V output.Improved stability,low residual FM.	$1450.00
608F	10MHz to 455MHz in 5 bands +-1% frequency accuracy with built-in crystal calibrator.Can be used with HP 8708A Synchronizer. Output continuously adjustable from .1uV to .5V into 50 ohms.	$1100.00
612A	450-1230MHz ,o.1uV-0.5V into 50 ohms,calibrated output.	$ 750.00
614A	900-2100MHz with many features including calibrated output and all modulation characteristics.	$ 500.00
616A/ TS403	Direct reading and direct control from 1.8 to 4.2GHz. The H.P.616A features +-1.5dB calibrated output accuracy from -3127dBm to -dBm.The output is directly calibrated in micro-volts and dBm with continuous monitoring. Simple operation frequency diod accuracy is +-1% and stability exceeds 0.005%-/ C change in ambient temperature. Calibrated attenuator is within +-1.5dB over entire output band. 50 ohm impedance unit has internal pulse modulation with rep rate variable from 40 Hz to 4KHz,variable pulsewidth(1 to 10usec)and variable pulse delay(3 to 300usec).External modulating inputs increas versatility.	$ 375.00
616B	Same as above but later model.	$ 600.00
618B	3.8 to 7.6GHz range,with calibrated output and selection of pulse-FM or square wave modulation.	$ 600.00
618C	Same as above but later model.	$2200.00
620A	7 to 11GHz range,with calibrated output and selection of pulse-FM or square wave modulation.	$ 750.00
620B	Same as above but later model.	$2200.00
626A	10 to 15GHz,10mw output power with calibrated output and pulse-square wave or FM modulation.	$4200.00
8708A	Synchronizer used with 606B,608F.The synchronizer is a phase-lock frequency stabilizer which provides crystal-oscillator frequency stability to 430MHz in the 608F signal generator.Phase locking eliminates microphonics and drift resulting in excellent frequency stability.The 8708A includes a vernier which can tune the reference oscillator over a range of +-0.25% permitting frequency settability to 2 parts in 10 to the seventh.Provides a very stable signal that satisfies many critical applications. (With HP 606B or 608F) (Without)	$ 350.00 $ 450.00
EMC-10	ELECTROMETRICS EMC-10 RFI/EMI RECEIVER Low frequency analyzer covering 20Hz to 50KHz frequency range.Extendable to 500 KHz in wideband mode.	$2500.00
NF-105F	Empire Devices Field Intensity Meter. Has NF-105/TA,NF-105/TX,NF-105/T1,NF-105/T2,NF-105/T3. Covers 14KHz to 1000MHz.	$2100.00

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these headsets come with data to hook up to a ICOM radios and many other equipment.

Perfect for Airplanes , Helicopters , Mobile Radios , or Just the Telephone.

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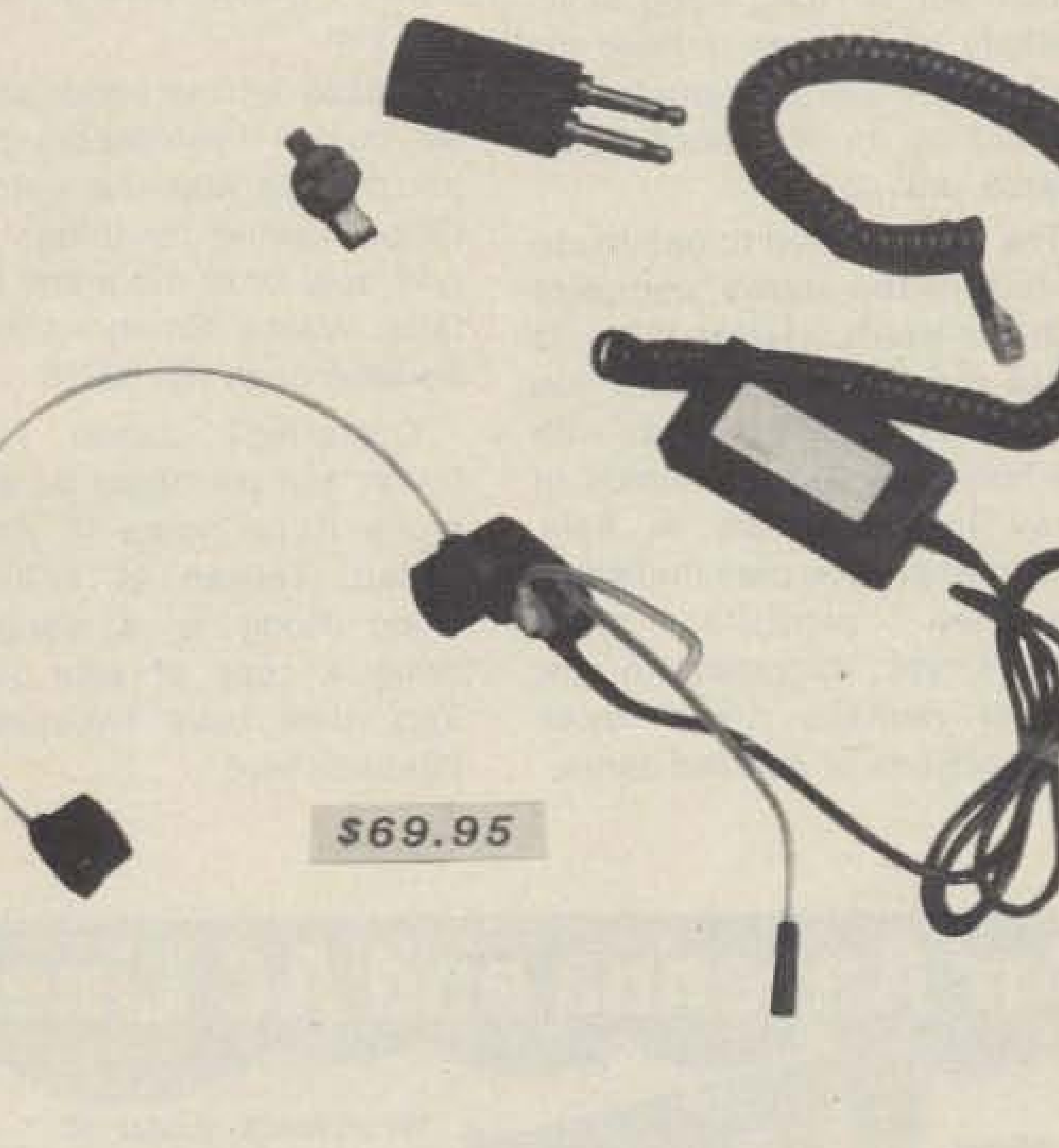

TERMS: DOMESTIC: Prepaid, C.O.D. or Credit Card
FOREIGN: Prepaid only, U.S. Funds, Money Order, or Cashier's Check Only.

C.O.D.: Acceptable by telephone or mail. Payment from customer will be by Cash, Money Order, or Cashier's Check. We are sorry but we cannot accept personal checks for C.O.D.'s. C.O.D.'s are shipped by air only and thru United Parcel Service.

CONFIRMING ORDERS: We would prefer that confirming orders not be sent after a telephone order has been placed. If company policy necessitates a confirming order, please mark "CONFIRMING" boldly on the order. If problems or duplicate shipments occur due to an order which is not properly marked, the customer will be held responsible for any charges incurred, plus a 15% restock charge on the returned parts.

CREDIT CARDS: We are now accepting MASTERCARD, VISA, AND AMERICAN EXPRESS

DATA SHEETS: When we have data sheets in stock on devices we will supply them with the order.

DEFECTIVE MATERIALS: All claims for defective materials must be made within 30 DAYS after receipt of the parcel. All claims must include the defective material (for testing purposes), a copy of our invoice, and a return authorization number which must be obtained prior to shipping the merchandise back to us. This can be obtained by calling (602) 242-8916 or sending us a postcard. Due to Manufacturer warranties we are unable to replace or issue credit on items which have been soldered to or have been altered in any way. All return items must be packed properly or it will void all warranties. We do not assume responsibility for shipping and handling charges incurred.

DELIVERY: Orders are usually shipped the same day they are placed or the next business day, unless we are out of stock on an item. The customer will be notified by post card if we are going to backorder the item. Our normal shipping method is UPS or U.S. Mail depending on size or the weight of the package. Test Equipment is shipped only by air and is freight collect, unless prior arrangements have been made and approved.

FOREIGN ORDERS: All foreign orders must be prepaid with a Cashier's Check, or Money Order made out in U.S. FUNDS ONLY. We are sorry but C.O.D. is not available to foreign countries and letters of credit are unacceptable as a form of payment. Further information is available on request.

HOURS: Monday thru Friday 8:30 a.m. to 5:00 p.m. Saturdays 8:30 a.m. to 4:00 p.m.

INSURANCE: Please include 25¢ for each additional $100.00 over $100.00, UPS ONLY. All insured packages are shipped thru UPS only. If you wish to have it shipped through the post office there is a $5.00 fee which is additional to the shipping, handling and insurance.

OPEN ACCOUNTS: We regret that we do not issue open accounts.

ORDER FORMS: New order forms are included with each order for your convenience. Additional order forms are available on request.

PARTS: We reserve the right to substitute or replace any item with a part of equal or comparable specification.

POSTAGE: Minimum shipping and handling in the U.S., Canada, and Mexico is $3.00 for ground shipments, all other countries is $5.50. Air rates are available at the time of your order. All foreign orders please include 25% of the ordered amount for shipping and handling. C.O.D.'s are shipped AIR ONLY.

PREPAID ORDERS: Orders must be accompanied by a check.

PRICES: Prices are subject to change without notice.

PURCHASE ORDERS: We accept purchase orders only when they are accompanied by a check.

RESTOCK CHARGES: If parts are returned to MHZ ELECTRONICS, INC. due to customer error, the customer will be held responsible for all fees incurred and will be charged a 15% RESTOCK CHARGE with the remainder in CREDIT ONLY. The following must accompany any return; A copy of our invoice, return authorization number which must be obtained prior to shipping the merchandise back. Returns must be done within 10 DAYS of receipt of parcel. Return authorization numbers can be obtained by calling (602) 242-8916 or notifying us by post card. Return authorizations will not be given out on our 800 number.

SALES TAX: ARIZONA residents must add 6% sales tax, unless a signed ARIZONA resale tax card is currently on file with us. All orders placed by persons outside of ARIZONA, but delivered to persons in ARIZONA are subject to the 6% sales tax.

SHORTAGE OR DAMAGE: All claims for shortages or damages must be made within 5 DAYS of receipt of parcel. Claims must include a copy of our invoice, along with a return authorization number which can be obtained by contacting us at (602) 242-8916 or sending a post card. Authorizations cannot be on our 800 number. All items must be properly packed. If items are not properly packed make sure to contact the carrier so that they can come out and inspect the package before it is returned to us. Customers which do not notify us within this time period will be held responsible for the entire order as we will consider the order complete.

OUR 800 NUMBER IS STRICTLY FOR ORDERS ONLY (800) 528-0180. INFORMATION CALLS ARE TAKEN ON (602) 242-8916 or (602) 242-3037.

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✓See List of Advertisers on page 130

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 6

TV-10 to see if I've guessed right about hand TV sets.

Speaking of Sinclair, the absence of Timex from The Winter Consumer Electronics Show was most obvious. Last year they made a big fuss about introducing the Sinclair Spectrum, only to change their minds when the Model 1000 was bombed out by the VIC-20.

Timex, which has been quite stand-offish to firms interested in supporting their computers with a magazine or software, is paying the piper for this bit of folly—to the tune of hundreds of millions of dollars. They fired the people who engineered the disaster, but it is probably far too late now to recoup. Texas Instruments pulled the same stunt, with even greater losses.

Despite the dead and badly wounded microcomputer manufacturers, the industry itself is still growing at about the same 250% per year rate. It's just that Timex, Texas Instruments, Atari, and so on are not getting big chunks of it. Radio Shack has been holding on. Apple is at the crossroads, gambling everything on their MacIntosh.

All of this has been a bonanza for hams who early on got interested in computers and who have jumped aboard the industry. The micro industry is rife with hams, as I see when I'm stopped by hundreds of old *73* subscribers at the Comdex and CES shows. Many claim that it was my editorials and articles in *73* that got 'em into computers—and rich.

The next big field, as I've written before, is going to be communications. Some ham is going to design a simple radio system to automatically send messages and parlay that into a $500 message communications system for private aircraft which will eliminate the need for voice communications between pilots and towers. This chap could easily get extremely wealthy. The nice thing about this is that everything needed for the system has already been invented. All it takes is an experimenter to put it together, test it, and find a venture capitalist to back him. Eureka! Millions. And, you know, a kid of 15 could do it.

Let's get some work done and get some articles in *73* to spur more experimenting. It's possible for hams to again get up front in developments and regain some of the prestige we once had. The FCC is off our backs now, so we can experiment.

COME FLY WITH ME

Are you looking for some small electronic or ham product from Asia which you might import and sell by mail order? Quite a few big businesses have been built in the last few years doing this—JS&A, the Sharper Image, Markline, and so forth. The best time to see the smaller Asian firms is in October during a series of consumer electronics shows.

These shows are set up so you can attend four of them in the four key Asian electronics manufacturing countries—Japan, Korea, Taiwan, and Hong Kong—one after the other, all in two weeks. This could be two weeks which might change your life—if you have some entrepreneurial spirit.

Commerce Tours has been arranging trips to Asia which bring people to these four shows for several years now. I've been going on them for five years and have been very impressed by the fine hotels, the number of special events and meals, and the planning of every detail by the firm. And the price—I don't see how they provide so much so reasonably.

I've encouraged hams to accompany me on these trips in the past and every one of them has had a great time—often meeting with Tim Chen BV2A in Taipei, shopping for electronic equipment in Hong Kong at incredibly low prices (I have my shopping list already made out), loading up on dirt-cheap Apple boards, and so on.

The tour is timed to get you to all four of the shows, complete with all transportation. This is about the only real way for you to meet and talk business with the hundreds upon hundreds of small manufacturers in Asia. This is where you may find some brand-new products which haven't yet migrated to the US—or perhaps some lower-cost versions of popular items.

The whole trip costs $2,000. That includes all transportation, first-class hotels, lavish breakfasts, a number of other meals, show admissions, several optional shopping tours, and so on. Bob Chang and his family, who organize electronics and computer tours, are at home in Asia and thus have everything under superb control.

We've always had a group of hams on these tours, which usually run from 150 to 250 in number. This year we're going to be joined by a group of Australian amateurs, so we should have even more fun. And wait until you see the price of Japanese ham rigs in Hong Kong!

The trip leaves California October 2 and returns October 16. You can leave from either San Francisco or Los Angeles. Further, if you want to take some extra time at the end of the tour, you can come back for a small additional fare any number of ways. I've made low-cost side trips to China, Macao, down to Borneo, stopping off at Sarawak, Brunei, Sabah, and Manila, or via Bangkok and Singapore, Hawaii, and so on. Why not add a couple unusual shopping stops and visit some rare DX hams? They'll love it and so will you.

Please let me know as soon as you can if you are planning to join me this year. But watch out, I'll be looking for things to import, too. Drop me a line for details: Wayne Green—Asia!, *73*, Peterborough NH 03458.

Operating? Japan is still tough, but we might be able to make it in Korea if you ask ahead. Taiwan is still tight. Hong Kong is a song—just bring a copy of your license. Yep, they have two-meter repeaters there.

Attention Moonbouncers

and Satellite Communications Enthusiasts

Introducing New Ultra High Performance Antennas from KLM Electronics, Inc.

KLM Electronics is fueling the Moonbounce and Oscar 10 revolution with Antenna Equipment that delivers truely Out-of-This-World performance.

For the Moonbouncer, our New 2M-16LBX is designed to be the highest gain 2 meter antenna available on the market today by more than a full db, making the 2M-16LBX an outstanding performer as a single antenna or in Moonbounce (EME) arrays.

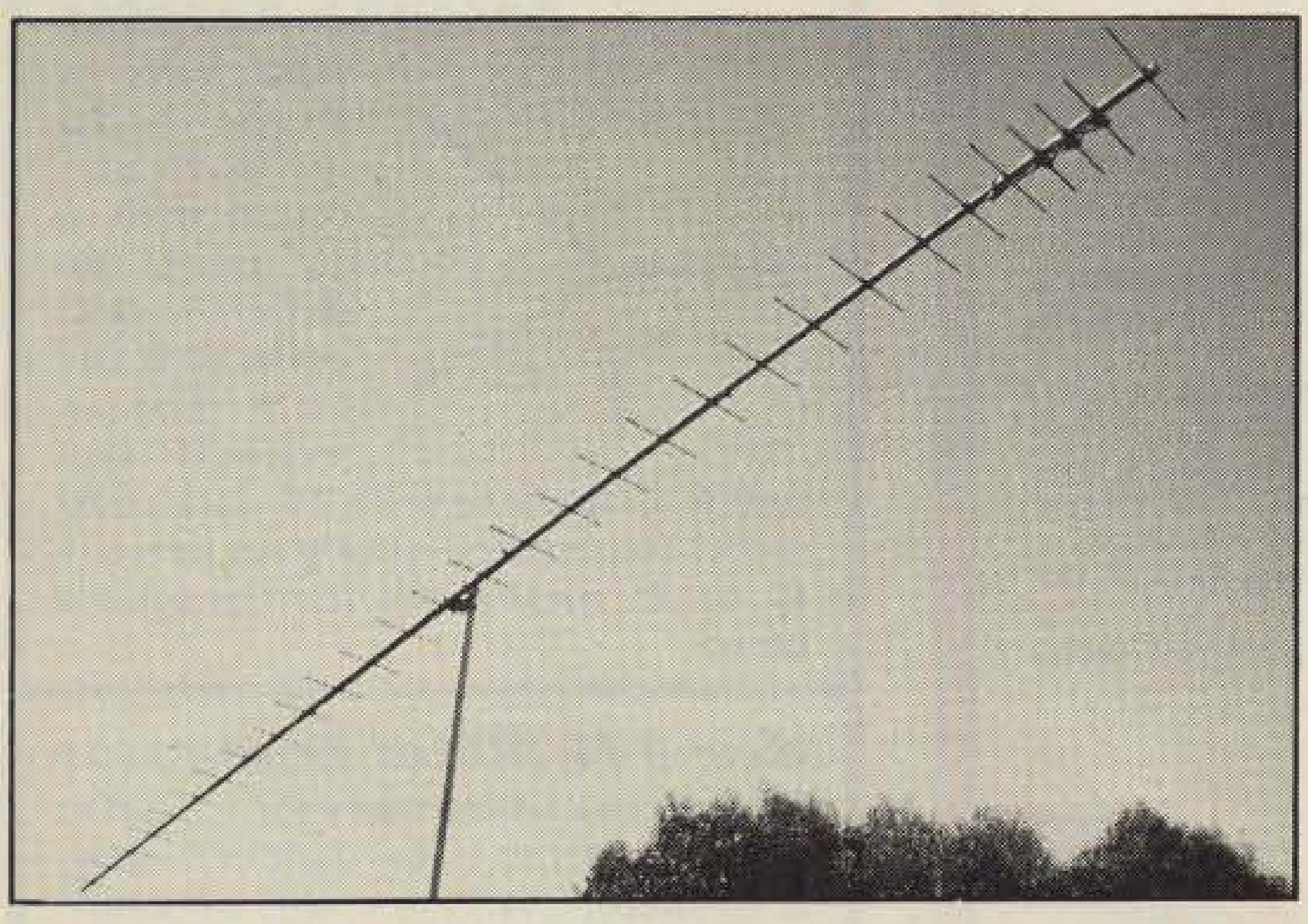
The New 432-30LBX follows the same pattern as the 2M-16LBX, and soon will become the industry's standard of comparison.

Featuring straight forward construction, and an innovative tapered boom that greatly reduces windload and adds strength and durability. Virtually unbreakable, insulated, 3/16″ rod parasitic elements are anchored through the boom to insure years of trouble-free performance.

For the satellite enthusiasts, the 2M-22C high gain 2 meter, circular polarized antenna, features the same rugged construction and total flexibility as our very popular 2M-14C with a 2db increase in gain.

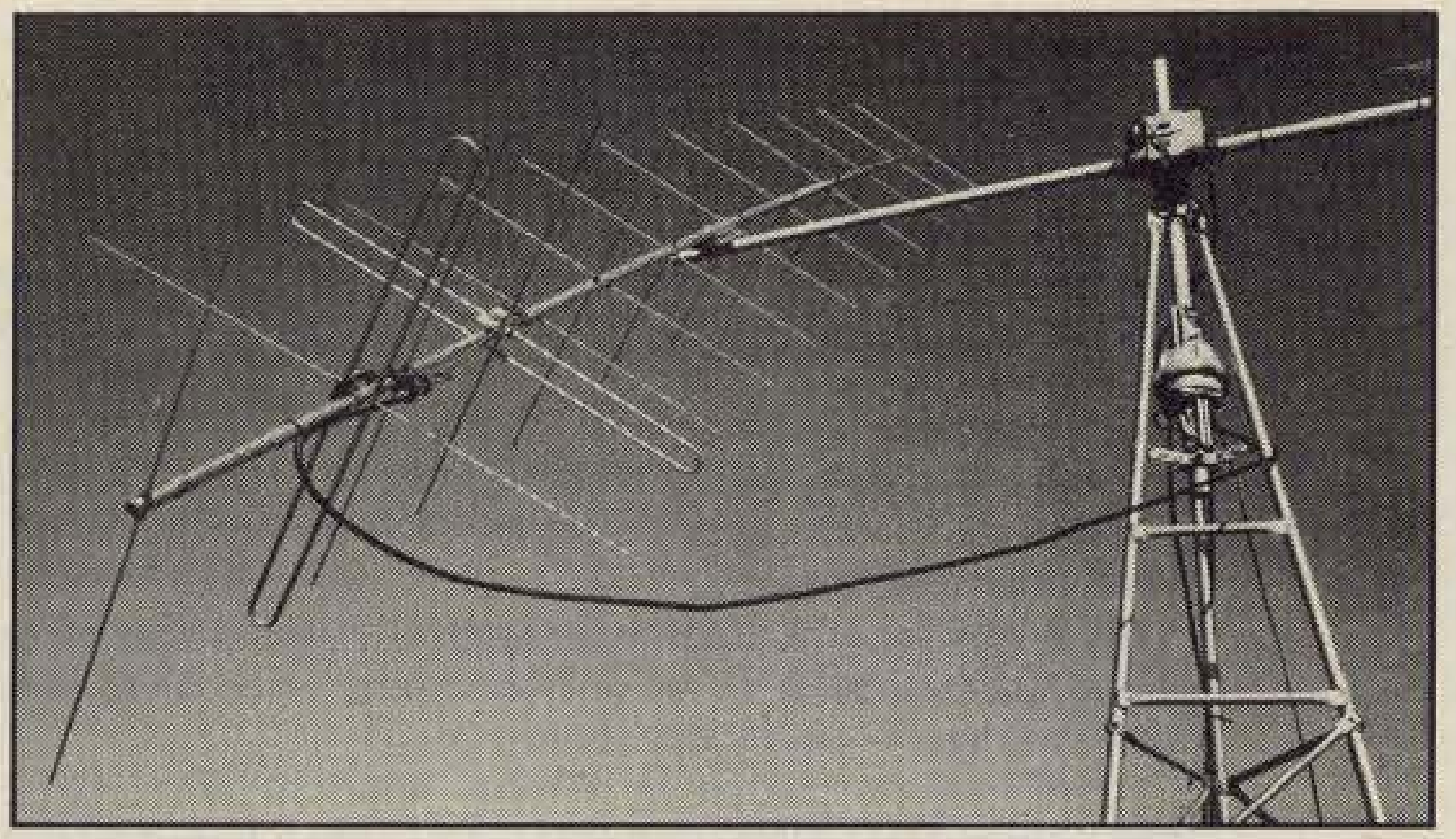
Four or more 2M-22Cs make an excellent array for Moonbounce (EME) by elminating Faraday fading.

Fiberglass/aluminum stacking frames are available as well as 2 and 4 port power dividers and phasing harnesses to optimize the performance of these type arrays. Watch for our new elevation drive system coming soon.



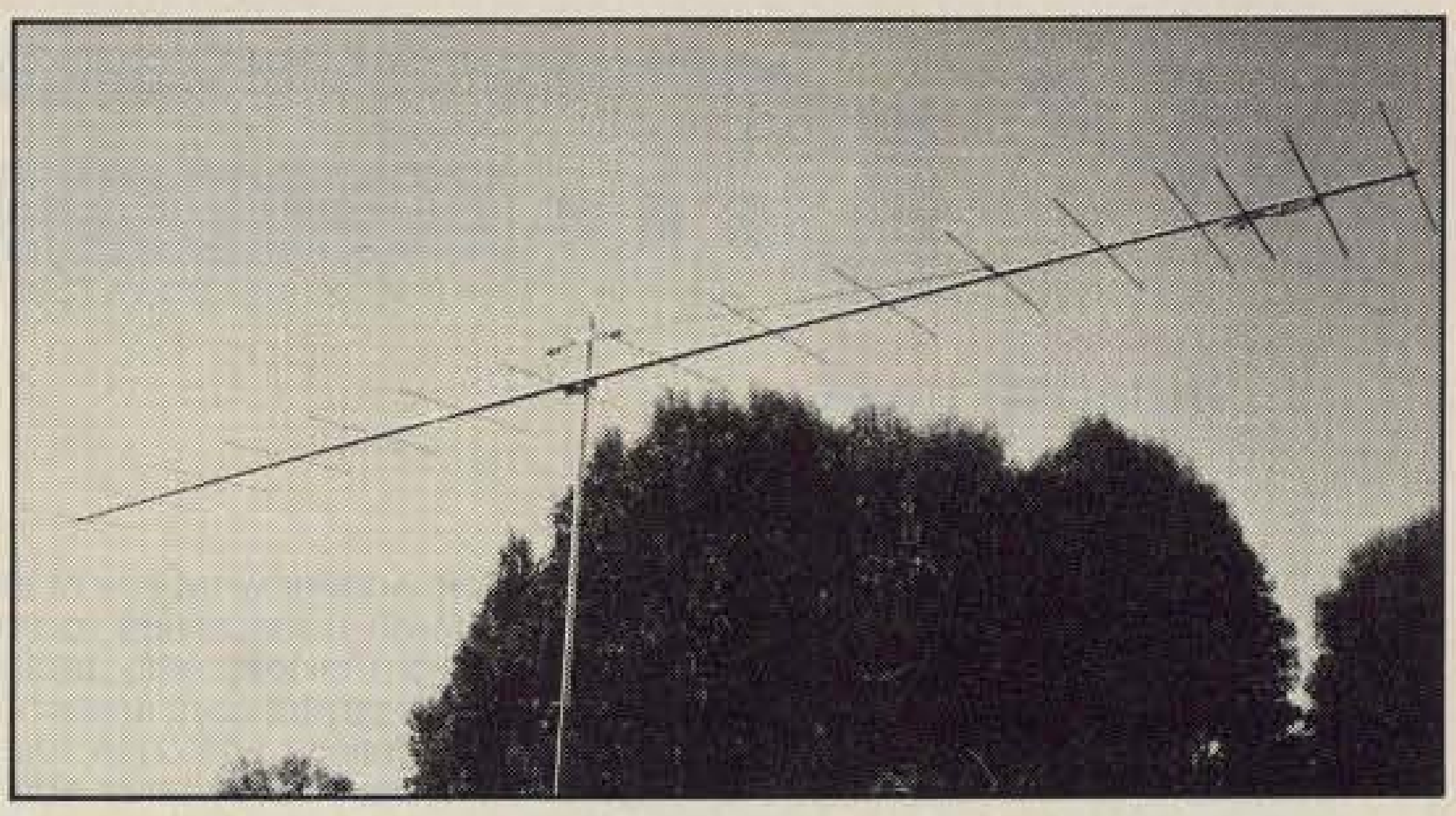
432-30LBX

BANDWIDTH	430–440 MHz
GAIN	17.3 dBd
BEAMWIDTH	20°
FEED IMP	50 ohms unbal.
BALUN	included
BOOM LENGTH	21 ft. 9 in.
F/B	20 dB
F/S	35 dB
VSWR	1.5:1
WINDLOAD	1.43 sq. ft. (typical)
TURNING RADIUS	12 ft. 5 in.
WT. (lbs.)	9 lbs.



2M-22C

BANDWIDTH	143–146 MHZ
GAIN	(144 MHz) 14.8 dBdc
BEAMWIDTH	(V) 28°, (H) 33°
FEED IMP	50 ohms unbal.
BALUN	4:1 RG303, Teflon
BOOM LENGTH	28 ft. 1 in. (tapered)
VSWR	1.4:1
WINDLOAD	(H) 1.75 sq. ft. (V) 2.44 sq. ft.
WT. (lbs.)	10 lbs.
TURNING RADIUS	15 ft. 6 in.



2M-16LBX

BANDWIDTH	144–148 MHz
GAIN	13 dBd
BEAMWIDTH	34°
FEED IMP	50 ohms unbal.
BALUN	(2) 4:1 coax
BOOM LENGTH	19 ft. 1 in. (tapered)
VSWR	1.5:1
WINDLOAD	1.85 sq. ft.
ELLIPTICITY	3 dB max.
CIRCULARITY SWITCHER	CS-3 included
WT. (lbs.)	11 lbs.

See all our new antennas and equipment at the Dayton Hamfest, Booth #25.

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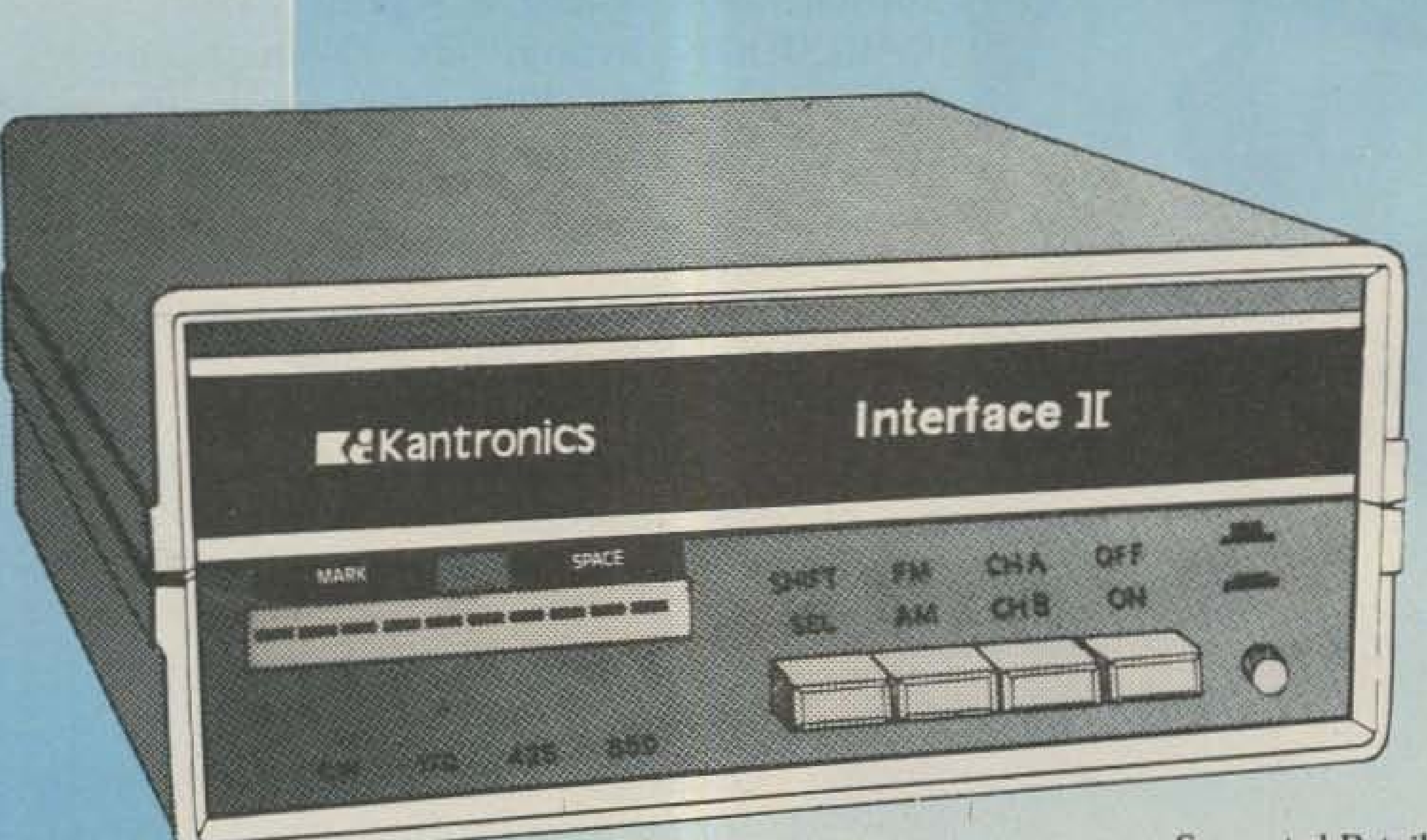
REMOTE BASE

Kantronics Interface II

The Interface For *Apple, Atari, TI-99/4A, TRS-80C, VIC-20, and Commodore 64* Computers



Suggested Retail Price 269.95

Interface II is the new Kantronics transceiver-to-computer interface. Interface II features a highly sensitive front end with mark and space filtering. Even the most discerning operator will be surprised with the Interface II's ability to dig out signals in poor band conditions. Our unique tuning system even displays signal fading.

X-Y scope outputs and dual interface outputs for VHF and HF connections make Interface II compatible with almost any shack. All three standard shifts are selectable, and Interface II is AMTOR compatible. Interface II is designed for use with Kantronics software.

Kantronics Software — The Industry Standard

Hamsoft

Our original program for reception and transmission of CW/RTTY/ASCII. Features include Split Screen Display, Message Ports, Type-ahead buffer, and printer compatibility. Apple Diskette $29.95, VIC-20 cartridge $49.95, Atari board $49.95, TRS-80C board $59.95, TI-99/4A cartridge $99.95.

Hamtext

All the features of Hamsoft with the following additional capabilities: text editing, received message storage, variable buffer sizes, diddle, word wraparound, time transmission, and text transmission from tape or disc. The program is available on cartridge for the VIC-20 or Commodore 64, and diskette for the Apple. Suggested Retail $99.95.

Hamsoft/Amtor

This program has Hamsoft features with the added ability of communicating in the newest coded amateur format-AMTOR. AMTOR offers error free low power communication. Hamsoft/Amtor is available for the Atari, TRS-80C, VIC-20, and Commodore 64 computers. Suggested Retail $79.95.

Amtorsoft

For the serious AMTOR operator using a VIC-20, Commodore 64, or Apple computer. This program is similar to Hamtext in capabilities, but can only be used for AMTOR. The Apple version includes both Hamtext and Amtorsoft on one diskette ($139.95), while the Vic-20 and Commodore 64 cartridge is just Amtorsoft ($89.95).

Kantronics UTU

The Universal Terminal Unit For Everyone Else

Suggested Retail Price 199.95

KANTRONICS SETS A NEW STANDARD WITH THE KANTRONICS UNIVERSAL TERMINAL UNIT.

UTU allows any computer with an RS232 port and a terminal program to interface with any transceiver. Additional software isn't necessary with UTU, as an internal microcomputer gives the unit data processing capabilities to send and receive in four coded amateur formats; Morse code, Radioteletype, ASCII, and AMTOR.

Sample terminal programs for IBM, TRS-80 Model III and IV, Kaypro, and other computers are included in the manual. Enhanced features can be user defined by altering the terminal program, giving you flexibility to program for your specific needs.

The Kantronics Universal Terminal Unit can send and receive CW at 6-99 WPM; RTTY 60, 67, 75, 100, and 132 WPM; ASCII 110, 150, 200, and 300 baud; and AMTOR. Dual tone detection and our unique bargraph tuning system make tuning fast and easy. Additional LEDs indicate Lock and Valid status during AMTOR operation. The RS232 port is TTL or RS232 level compatible.

If you've been waiting for a Kantronics system for your computer, the wait is over.

For more information contact an Authorized Kantronics Dealer,

or write: Kantronics
1202 E. 23rd Street
Lawrence, Kansas 66044

73 INTERNATIONAL

from page 96

DX from 7:00 am to 9:00 am at first, and then later perhaps for another hour. Later, it is expected that there will be a new repeater for the 10m-FM band (which I understand has already been purchased) so that daily DX contacts can be made continuously, especially with friends in the United States. Question: Would you be able to recommend a frequency that we could set our repeater on for 10m-FM use? If so, please contact me immediately with the information and I will have it relayed to the proper authorities. We need to have an idea of a frequency that would be preferred to our fellow hams in the USA as well.

REPEATERS IN MEXICO CITY

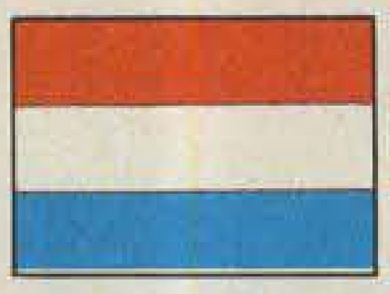
As you may know, Mexico City is said to be the largest city in the world (population-wise). Some have said that there are more than 16 million people (taking into account the metropolitan area as well as the surrounding areas that are practically part of the city itself). Well, if you come to visit us someday, you'll know what I mean! Better freeways and overpasses are constantly being constructed, adapted, and changed. To illustrate the point, I was driving along with my father-in-law one day (he's a native from Mexico City). Well, we got lost for about 2½ hours! So you can imagine what it's like, even when you think you know what you're doing! (Unfortunately we did not have our 2-meter equipment with us at the time. Last time I'll make that mistake!)

So, where you have a big city, you have a larger ham population as well, and even a few repeaters and radio clubs who own them. (See Fig. 1 for a list of clubs and their repeaters in Mexico City.) Of course, you have to be authorized by the Mexican Communications Department in order to use your equipment here in Mexico. Be sure your papers are in order before vacation time unless you just want to go "all ears." The local operators here are very friendly and sociable and enjoy having foreign visitors drop in. And it's nice also if they have personally been in contact (QSO) with you beforehand, which makes it all that more interesting.

With most radio clubs that I have known in different parts of the country, it's a custom to get a few of the members together for a cup of coffee and maybe a small meal (tacos anyone?) whenever foreign colleagues show up. It's a real social occasion and sometimes very interesting. At one celebration that the Satellite Radio Club sponsored, Marciano XE1GIY flew his jet overhead a couple of times as we made contact on two meters with him before his departure. I'm sure you'd enjoy good-old Mexican hospitality! And your friends would enjoy sharing it with you!

ID	Frequency	Radio Club
XE1RPV	146.31/.91	Aztec Radio Club
XE1ERA	146.34/.94	Aztec Radio Club
XE1RUL	147.72/.12	La Salle University Radio Club
XE1RSC	147.63/.03	Satellite Radio Club
XE1TLA	147.84/.24	Latin American Tower Radio Club
XE1VHF	146.28/.88	VHF Association
XE1YG	146.16/.76	VHF Association
XE1UHF	449.100/444.100	VHF Association

Fig. 1. Repeaters in Mexico City.



THE NETHERLANDS

H. J. G. Meerman, Jr. PD0DDV
Zandvoorterweg 33
2111 GR Aerdenhout
The Netherlands

THE VRZA

This month I would like to write something about the VRZA (the Vereniging van Radio Zendamateurs). As you may already know, there are three amateur-radio societies in Holland and one of them is the VRZA. Translated into English, these letters stand for Union of Ham Radio Amateurs.

The VRZA was founded in 1951, about 33 years ago. The number of members is enormous for a small country like ours. As far as I know, they have 4500 members, but by the time you read this the number will no doubt be much higher. Well, as you see, amateur radio is a fast-growing style of life in Holland.

The VRZA has also its own magazine which is sent out to members once a week. It is full of news and technical articles concerning ham radio. Many of the build-it-yourself projects that are published in this magazine (called *CQ-PA*) are from VRZA members. Often the VRZA has circuit boards available for these build-it-yourself projects, for cost price. Another service is the selling of hard-to-come-by parts, such as special coils, filters, transistors, etc.

PA0VRZ/A is the callsign of the VRZA club station. This station is on the air every Saturday morning on the 80- and 2-meter bands with news on phone, CW, and RTTY. Also a code course is given.

AWARDS

Although the VRZA has a large number of awards, there is one that deserves special attention, namely the WAP Award (Worked All Provinces). This award is available to hams who have worked all Dutch provinces or to SWLs who have received amateur stations from all provinces. For those who wish to know more about VRZA awards or about the VRZA itself, I'll give you the address: VRZA, Postbus 61420, 2506 Ak Den Haag, The Netherlands.

Don't forget some IRCs to cover the expense of answering and mailing your letter.

DUTCH QRP ACTIVITY

For the QRP enthusiast in Belgium, Holland, and Luxembourg, we have the Benelux QRP club (BQC). This club is especially for amateurs who like to work with low power. An output of 5 Watts for CW and 13.4 Watts for SSB is the maximum power that can be considered as QRP.

The Benelux QRP club gives advice to its members, organizes QRP contests, and has its own low-power network every Saturday morning at 0930 UTC. Members of the club use the international QRP frequencies: 3,560, 3,690, 7,030, 21,060, 21,285, 28,060, and 28,885 MHz. The BQC is also a member of the World QRP Federation. The address of the BQC is: PO Box 15, 2100 Heemstede, The Netherlands.

NEW ZEALAND

D. J. (Des) Chapman ZL2VR
459 Kennedy Road
Napier
New Zealand

As this column is being prepared during December, while our northern-hemisphere confreres are celebrating the Christmas festive season in true form with the traditional winter scenes and trappings, we here down under celebrate under somewhat different conditions. There is no snow, and a large part of the populace heads for beach and lakeside resorts to celebrate Christmas in temperatures of 20° C plus, depending upon the location.

But no matter where we are in the world, as far as seasons are concerned, Christmas will always consist of a Christmas tree trimmed with lights and artificial snow, Santa Claus in his heavy red uniform, complete with white beard and hat (always a very hot job), with his sleigh full of presents for all, and a huge dinner on Christmas day of roast turkey, chicken, pork, or lamb (depending upon choice) plus vegetables, followed by Christmas plum pudding and complemented with the usual beverages.

Although it is somewhat out of season for us here in ZL-land to have a huge hot midday meal when the weather would indicate a cold-cuts-and-salad-type meal, followed by cold sweets, most New Zealand families still stick to the traditional dinner and celebrations, following the traditions of our forebears who, in most cases, came from the northern hemisphere. Christmas in ZL is also the main holiday season, most of the commercial concerns closing from Christmas Eve until about January 10th for their annual holiday, with the exception of small staffs to handle urgent business. The retail section of the business community goes on as usual, although almost everything closes down completely on Christmas Day.

BITS 'N' PIECES

Recently NZART obtained permission for radio amateurs to play chess against other radio amateurs on the air. This is another step in the expanding international group: Chess Amateur Radio International (CARI), whose headquarters are at PO Box 682, Cologne NJ 08213, USA. This group is encouraging participation in on-air chess games between radio amateurs, and the group has interested members from W, VE, HH, I, OH, VK, ZL, DA, KH6, and KL7. Write to the address stated for further information.

The first CARI Oceania tournament was held in August, 1983, with stations from KH6, VK, and ZL participating. Now in its second year, CARI has 160 members, has regular weekly and daily schedules, and a special "contact wheel" for finding chess QSOs. A rating system has been established and regional tournament directors appointed in seven areas worldwide. The founder and first president of CARI is Vince Luciani K2VJ. It is interesting to note that amateurs in New Zealand were playing chess over the air prior to 1932, and an article in *Break-In*, the NZART official journal, in August, 1932, covered the activity. In the intervening years, the activity went into recess until it was revived by the formation of CARI.

Morse code is alive and well—so goes a report from ZL4FC in *Break-In* on the use of Morse code in commercial communications, particularly marine communications, here in ZL. There are still professional brass pounders here, employed by the New Zealand Post Office at three of the four Marine Coast Stations operated by the NZPO, and many of them are amateur-radio operators, too. Morse is the main mode of long-distance high-frequency communication and still proves reliable when all else fails.

Morse is the main mode of communications at Awarua Radio, situated at the southern end of the South Island and, to a lesser extent, at Auckland and Wellington Radio Stations. The New Zealand Post Office still trains operators at their school in Wellington, where the trainees have to attain proficiency in the code at 25 wpm both sending and receiving, over a 10-minute test period, with only two errors allowed. This high standard of proficiency in Morse has been unchanged since the days of the telegraph landline circuits, when the Post Office employed hundreds of Morse operators on circuits throughout the country.

Morse is on the decline in the commercial communications area, with the inroads made into Morse traffic by Telex (SITOR) and satellite traffic, but the biggest impact on marine traffic has been the decline in the number of ships now in world fleets. Two vessels now do the job of 10 ships since the concept of carrying cargo in containers was introduced, and this has had more impact on Morse traffic than anything else. But as the writer of the *Break-In* article says, "Morse is alive and well, and the skills of the brain and fingers of the Morse operator still play a part in modern technology."

The historic space-shuttle flight of Owen Garriott W5LFL during the latter part of November was followed with great interest in ZL, but as far as can be ascertained to the date of this writing, no ZL was able to record a QSO with W5LFL, and I don't think any ZL was successful in copying him, either. But I am awaiting confirmation of this from the VHF and satellite experts elsewhere in the country.

An extract from a lecture sponsored by the Auckland University Foundation, given by the distinguished space scientist and ZL, Sir William Pickering, congratulated New Zealand communications engineers on the development of a hand-held radiometer, produced as a joint venture by the government Department of Scientific and Industrial Research and an Auckland electronics firm, Delphi Industries. It proved that local New Zealand industry and engineers are capable of competing with the world's best. The newly developed radiometer is to be tested on a forthcoming space-shuttle flight.

In a recent issue of one of the popular US amateur magazines, I noted in the DX column that some concern was expressed by a prominent DXer about the Kermadec Islands and the possibility of them being the likely subject of a DXpedition in the

near future. I was somewhat dismayed to read this report when there is at present a resident amateur on Raoul Island at the weather station who was active for short periods during the latter part of 1983 and who intends to be more active during 1984. He is Warwick ZL3AFH/ZL8AFH (new callsign of the Kermadecs), and according to my information, after the settling-in period just before Christmas, he was to get antennas up and be as active as his duties permit on most bands during 1984. (*Editor's note: See the Australia column, this issue.*)

The Rose City NZART Conference will be held in Palmerston North from June 1 to 4, 1984. Details of the conference venue are as follows: The Rose City Conference will be held at the Awapuni Racecourse and will commence with a reception, registration, and a wine and cheese evening on Friday night. The formal business of the NZART will be conducted on Saturday, followed by the Grand Dinner and Dance in the evening. On Sunday, the AREC, OTC, WARO, and other meetings will take place, as well as other activities including the transmitter hunt (fox hunt) and a mobile rally. An informal social and prize-giving session will conclude Sunday's activities. Enquiries for accommodation, etc., to PO Box 1718, Palmerston North, as soon as possible.

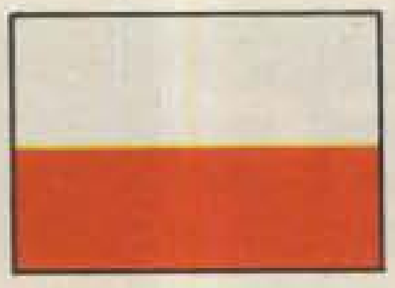
NEZCHEQ 83, the second biannual North American/New Zealand County Hunters Eyeball QSO Party mentioned in a previous column was a great success. It was held over the US Labor Day weekend at Shelton, 50 miles west of Seattle, Washington, and finished with a banquet at the Alderbrook Resort Hotel on Sunday night. In all, 17 ZL hams and YLs were amongst the 40 US and ZLs at the QSO Party. In the US group were some from as far away as Oklahoma and Alaska. The weekend activities were mainly social with a little "hamming" at the official County Hunters station and plenty of eyeballing with those so often heard and worked on 10 and 15 meters. The festivities were continuous fun from dawn until almost dawn.

It is reported that one station which worked the Convention station said he believed that the whole gathering was in the state of intoxication, but he was informed that no, the station was in the State of Washington. At the banquet, after the obligatory short speeches, the fun climaxed with awards presentations. Special awards were made to Jay W7KBC, the first-ever North American County Hunters W7KBC Award, in honor of Jay being the first North American amateur to work all 112 New Zealand counties for the NZART Counties Award.

A special gift was made by the attending ZLs to the host, Tom KB7MT, and all other members present exchanged souvenirs and gifts. The next convention (NEZCHEQ 85) will be in Houston, Texas, and most of the ZLs and North Americans present at the 1983 convention plan to be present again.

Another member of the Old Timers Club has joined that elite band of 60-year Jubilee Certificate holders. He is Frank Bell ZL4AA, the first licensed amateur in ZL, who received his license in January, 1923. Frank is a life member of the OTC and is its Immediate Past Patron. 50-year certificates have also been issued to J. (Rollo) Schofield ZL1JK, Arthur Allen ZL1JQ, and Arthur Lyes ZL3JD.

Silent Keys recorded recently were John Palmer ZL1KV, Norman Walding ZL2GZ, Sam Hopkins ZL2AGX, Stan French ZL2JB, and Eric Pool ZL2MZ.



POLAND

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SCOUT RADIO AMATEURS

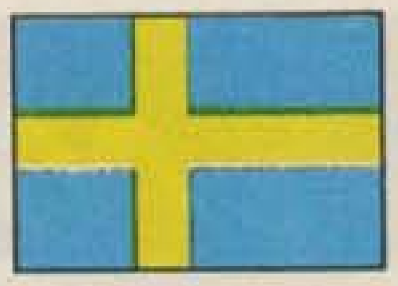
Scout radio club activity was suspended after martial law was declared in Poland, but even before a reinstatement of individual ham activity, 30 Scout radio clubs got licenses. Two contests, "Scout's Wave" and "Silesia-Polish Scouts' Association," were organized this year. Among individual stations, the other contest was won by SP9EMI. The best club station was SP7KTE, and the best monitor was SP7-6801/K. Regularly on Mondays and Fridays at 1700 GMT on 3700 kHz, the so-called Scouts' Circles take place. An exchange of training radio telegrams on 3550 kHz CW on Mondays, Wednesdays, Thursdays, and Saturdays, and on 3700 kHz SSB on Tuesdays and Fridays begins, always at 1600 GMT.

Scout radio stations working on 3.5 MHz revived the activity of Polish hams this summer. Many young hams in Scout uniforms practiced their skills in camps competing for the certificate, "Scout's Camps." One of these camps was organized by the Communication Committee of the Polish Scouts Association (PSA) together with the Konin Troop of PSA in Mikorzyn, near Konin. 15 Scouts and 2 instructors from the Korin, Leszno, and Poznan troops were to take part in a school of Scout communication and amateur-radio location. Finally, 49 participants for the communications course and 10 candidates for referees of amateur-radio location gathered in this beautiful spot.

Participants at the Mikorzyn camp were taught all kinds of Scout walking, telephone, and radio communication. Shortwave instructions, treated at this camp as an introduction, will be continued at a winter camp in Kiekrz. Instructors were confronted with the problem of teaching communications courses to budding novices of the communication art, 13 to 18 years old. In spite of nearly 10 compulsory lessons daily, these Scouts elected to have supplementary sessions. Radio station SP3ZCU/3 was establishing contacts during the time of the camp. Films on principles of electrical engineering and electronics rounded out theoretical and practical courses.

A final session took place on August 6th. Candidates for referees of amateur-radio location prepared and carried out the final contest on 3.5 MHz and 144 MHz by themselves. Other participants at the school acted as competitors and proved their skills before the coming Radiolocation Contest of Poland. Skilled staff and the lovely neighborhood of Slesinskie Lake contributed to a nice atmosphere at the camp. Many Polish and foreign visitors (these last from Germany and Bulgaria) went and saw their friends.

Some months ago I mentioned the SPDX Contest 1983 that was doubtful then. Among individual stations taking part in this contest were SP7AW, leading with 609 points and 232 certificates, SP9DH (573 and 138), and SP9ADU (557 and 182). The best club station of the contest was SP7KTE (660 and 201), and among monitoring stations, SP9-3354-KA (132 and 40).



SWEDEN

Rune Wande SM0COP
Frejavagen 10
S-155 00 Nykvarn
Sweden

SSA ANNUAL MEETING

The Swedish amateur radio league, SSA, is holding its annual membership meeting this year in the city of Falun in the province of Dalarna (Dalecarlia). The meeting is taking place during the weekend of April 14-15. The hosting Falu Radioclub is celebrating its 60th anniversary.

The province of Dalarna has played an important role in Swedish history. The farmers were willing to fight for their freedom and, among other kings, Gustav Wasa managed to get them to uprise against the Danish intruders in 1521. To celebrate this, every year over 10,000 skiers compete in the world's oldest and largest cross-country ski race from Salen to Mora, a distance of close to 90 kilometers (65 miles). Besides the regular meeting on Sunday, there will be exhibitions, speakers, women's activities, and the Saturday night banquet. Dalarna is in the SM4 call area.

PACKET RADIO

The Softnet User Group at the University of Linkoping is inviting everybody interested in experimental packet radio for both ground and satellite systems to EXPRAN 84, this year's Softnet workshop.

The Experimental Packet Radio Network Symposium is taking place in the city of Linkoping (SM5 call area) on May 26 and 27, 1984. Planned subjects for seminars are packet radio, network control and routing, distributed processing, proposals for standards, and Softnet. The Swedish high-technology aeroplane and computer industry, SAAB, is located in Linkoping.

TELEPHONE INTERFERENCE

Televerket is the National Swedish Telecommunications Administration and has the monopoly for telephone communications distribution in Sweden as well as being the licensing authority for radio communications. Televerket is also a manufacturer of telecommunications equipment as well as the approving authority for equipment manufactured by others that is designed to be connected to their systems.

Only a couple of years ago the telephone system in Sweden allowed modern push-button telephones. These have, of course, turned out to become very popular and are replacing the old rotary-dial phones. Televerket manufactures a push-button phone called Diavox, about the only one, for the time being, approved for their own system, i.e., the only system in Sweden.

These new telephones made by Televerket and spreading very rapidly are of great concern to us active radio amateurs. The Diavox telephone is extremely susceptible to rf. Televerket is now very well aware of this fact and is trying to take care of problems when interference complaints are filed. Before then, however, the innocent ham operator has had another confrontation with his neighbors. Everyone that has had such an experience can tell that there are more pleasant meetings than these. I had one fellow from Televerket working on my Diavox telephone for 2½ hours without complete success. The interference was there either when operating on 14 MHz or 28 MHz. Considering the low sunspot cycle we are in now, I chose to have the interference on 28 MHz!

It is very unfortunate to have this unnecessary interference problem, especially now with the growing popularity of video recorders that may become our worst RFI problem to date. The video recorders seem to be more susceptible to rf than any of the other home electronic equipment we have fought so far.

WINTER CONDITIONS

In this arctic region, aurora borealis is very common during the winter season. This dark time of the year favors the low-band DXers propagationwise. It is even possible to work the 160-meter band 24 hours a day during several weeks around Christmas.

As a rule, you can say that "the closer to the equator you are, the better shortwave propagation you have." Being a DXer, living this far north as we Scandinavians do is sometimes tough. About the only time we have a more favorable situation than the south Europeans is when propagation to the Pacific is over the North Pole. This is common during early morning local time in the summer.

During the deep winter season, our most stable DX band, 20 meters, closes down completely in the evening around 1800 hours and opens up when it is time to leave for work in the morning. If you do not like the very noisy low bands, there is not much hamming to do these dark winter nights. It is hard for non-Europeans to imagine how crowded the low bands are here at night. The broadcast and other commercial intruders on the 40-meter band that you may be bothered with are much stronger here than anywhere else!

RECEIVER SHORTCOMINGS

In the late 60s and early 70s, many hams here lost interest in the 40-meter band. I think this was primarily because of the cross-modulation problems the new transistorized receivers were impaired by. One major importer of Japanese ham equipment once told me that he could not convince the manufacturer how severe this problem was here is Europe until they got to experience this on the spot. The receivers certainly have improved in this respect, but the intruders are still pounding their hundreds of kilowatts within the ham-exclusive 100 kHz of the 40-meter band.

80 METERS SHARED

The 80-meter band is shared with other services in Region 1. In the evening it is hard to find a spot where the S-meter drops below the S9 level. With good antennas, sharp filters, and a great deal of stamina, some avid DXers manage to break through the noise level and to work distant stations even on eighty.

AURORA AND TWENTY METERS

When there is aurora, which happens quite often, the 2-meter buffs are happy. However, it also favors very short skip QSOs on 20 meters. Normally, you cannot work within Scandinavia on twenty, but in aurora conditions LA, SM, OH, and UA1 are workable. Very seldom we can reach as far south as OZ Denmark. In aurora a totally dead band suddenly becomes alive.

STRANGE OPENINGS FROM LAPLAND

I grew up in Lapland, northern Sweden, just north of the Arctic Circle, which is the call area SM2. My QTH was located further north than Fairbanks in Alaska, which might be of some reference help to you. In the wintertime from up there I usually could work the west coast of the North American continent at night. VE8, VE7, KL7, W7, and all the way down to W6 was (and, of course, still is) workable. The signals crossing the North Pole are characterized by a very rapid flutter. In those openings you may not hear too many stations from here. The reason is simple. The population is small in those arctic areas of Sweden, Norway, Finland, and the Soviet Union.

Now summer is quickly approaching. The conditions are changing. With the midnight sun and daylight 24 hours a day, the change is not entirely to the better, but it surely is different!

TRINIDAD AND TOBAGO

John L. Webster 9Y4JW
c/o Department of Soil Science
University of the West Indies
St. Augustine
Trinidad
West Indies

John L. Webster 9Y4JW/8P6KX.

The Trinidad and Tobago Amateur Radio Society (TTARS), formed in 1951 and incorporated by an Act of Parliament 30 years later in 1981, has a membership of 140, from a total population of 1.2 million persons on the two islands. There are also about 100 associate members in the society. Only about fifty percent of the 140 hams are active, some on VHF, some on HF, and others on both.

The TTARS has been a member of the IARU for about 10 years and is an affiliate of the Radio Society of Great Britain (RSGB).

The British City and Guilds Radio Amateur's Examination (RAE) is the certification required by the Government of Trinidad and Tobago, along with Morse code proficiency at 13 wpm, for the issue of a 9Y license. The code test is administered by the Director of Telecommunications after the successful completion of the RAE exam. In 1982, the TTARS stepped up its training program in an effort to encourage more persons to become hams, and weekly classes are conducted to prepare its associate members for both.

Unfortunately, the exam is offered only once a year as it is an external examination. It is written in May and the results are not known until the end of August or about three months later! The successful candidate then applies for the code test.

The 1982/83 training classes were conducted at two centers, one in the north of the island, in the captial city of Port-of-Spain, and the other in the south, in San Fernando, the industrial center. There is now a third center for the 1983/84 classes, in the center of the island, at Chaguanas. At each center, classes are conducted twice weekly, one session for theory and the other for CW.

The TTARS normally charges a small fee, the main objective being to encourage those who started the course to complete it. Any funds raised in this way are available to assist in acquiring equipment and materials needed in running the course. However, as 1983 was World Communications Year, the TTARS decided on an "open-house" policy for the 1983/84 training classes and there is no charge for the course this time.

Good results have been achieved by the TTARS in the RAE examinations. In the 1982/83 examination, 90 percent of the candidates prepared by the TTARS were successful. In actual numbers this means that there are 22 potential new 9Y hams if they complete their code tests. One of the successful candidates, Mark Massiah, obtained a double distinction in the exam and provided a very good showing in his code test. Mark, who has been assigned the callsign 9Y4M, favors CW operating and should be providing a new country to many of you still needing 9Y on this mode.

The TTARS does not have a clubhouse but is allowed the use of Boy Scout Headquarters in Cascade, north Trinidad. Meetings are held on the first Monday of each month at 7:30 pm. The meetings alternate between north and south Trinidad, those in the south being held at Presentation College in San Fernando. The Annual General Meeting, at which new officers are elected, is always held in north Trinidad during the month of March.

In my next column I will present part I of a two-part review of the activities of the TTARS during 1983, World Communications Year.

✓See List of Advertisers on page 130

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✓62

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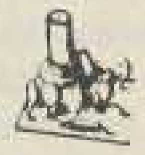
FM Wireless Mike Kit



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1.5 uF 25V	3/$1.00	1000 uF 16V Radial	$.50	.01 16V disk	20/$1.00
1.8 uF 25V	3/$1.00	500 uF 20V Axial	$.50	.1 16V	15/$1.00
.22 uF 25V	3/$1.00	150 uF 16V Axial	5/$1.00	.001 16V	20/$1.00
		10 uF 15V Radial	10/$1.00	100 pF	20/$1.00
				.047 16V	20/$1.00

DC-DC Converter

+5 vdc input prod. -9 vdc @ 30ma
+9 vdc produces -15 vdc @ 35ma **$1.25**

Ceramic IF Filters

SOLD OUT

Mini [illegible] 7 kHz B.W. [illegible] $1.50 ea.

25K 20 Turn Trim Pot **$1.00**
1K 20 Turn Trim Pot **$ .50**

Trimmer Caps

Sprague - 3-40 pf
Stable Polypropylene
.50 ea.

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge **$.75**

Mini RG-174 Coax
10 ft. for $1.00

Coax Connector

Chassis mount
BNC type **$1.00**

9 Volt Battery Clips

Nice quality clips **5 for $1.00**
¾" Rubber Grommets **10 for $1.00**

Parts Bag

Asst. of chokes, disc caps, tant. resistors, transistors, diodes, MICA caps etc.
sm. bag (100 pc) **$1.00** lg. bag (300 pc) **$2.50**

Connectors

6 pin type gold contacts for mA-1003 car clock module price **.75 ea.**

Leds - your choice, please specify
Mini Red, Jumbo Red, High Intensity Red, Illuminator Red **8/$1**
Mini Yellow, Jumbo Yellow, Jumbo Green **6/$1**

Varactors

Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range -
.50 each or 3/$1.00

Audio Prescaler

Make high resolution audio measurments, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit **$ 39.95**
PS-2 wired **$ 49.95**

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. specify - 10 or -100

Wired, tested, PS-1B **$59.95**
Kit, PS-1B **$44.95**

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit **$ 24.95**
TR-1, RF sensed T-R relay kit **6.95**

MRF-238 transistor as used in PA-1 8-10db gain 150 mhz **$11.95**

RF actuated relay senses RF (1W) and closes DPDT relay.
For RF sensed T-R relay
TR-1 Kit **$6.95**

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V @ 1 A and 24 VCT
Complete kit, PS-3LT **$6.95**

OP-AMP Special

SOLD OUT

BI-FET LF 13741 - Direct pin for pin 741 co[illegible], but 500,000 MEG input z, super low 50 pa input curr[illegible] power drain
50 for only $9.00 **10 for $2.00**

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size 1" x ¼" shrink to ⅛". Great for splices **50/$1.00**

Mini TO-92 Heat Sinks

Thermalloy Brand **5 for $1.00**
To-220 Heat Sinks **3 for $1.00**

Opto Isolators - 4N28 type **$.50 ea.**
Opto Reflectors - Photo diode + LED **$1.00 ea.**

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets **20 strips for $1.00**

CDS Photocells

Resistance varies with light, 250 ohms to over 3 meg **3 for $1.00**

John J. Meshna Jr., Inc. 122

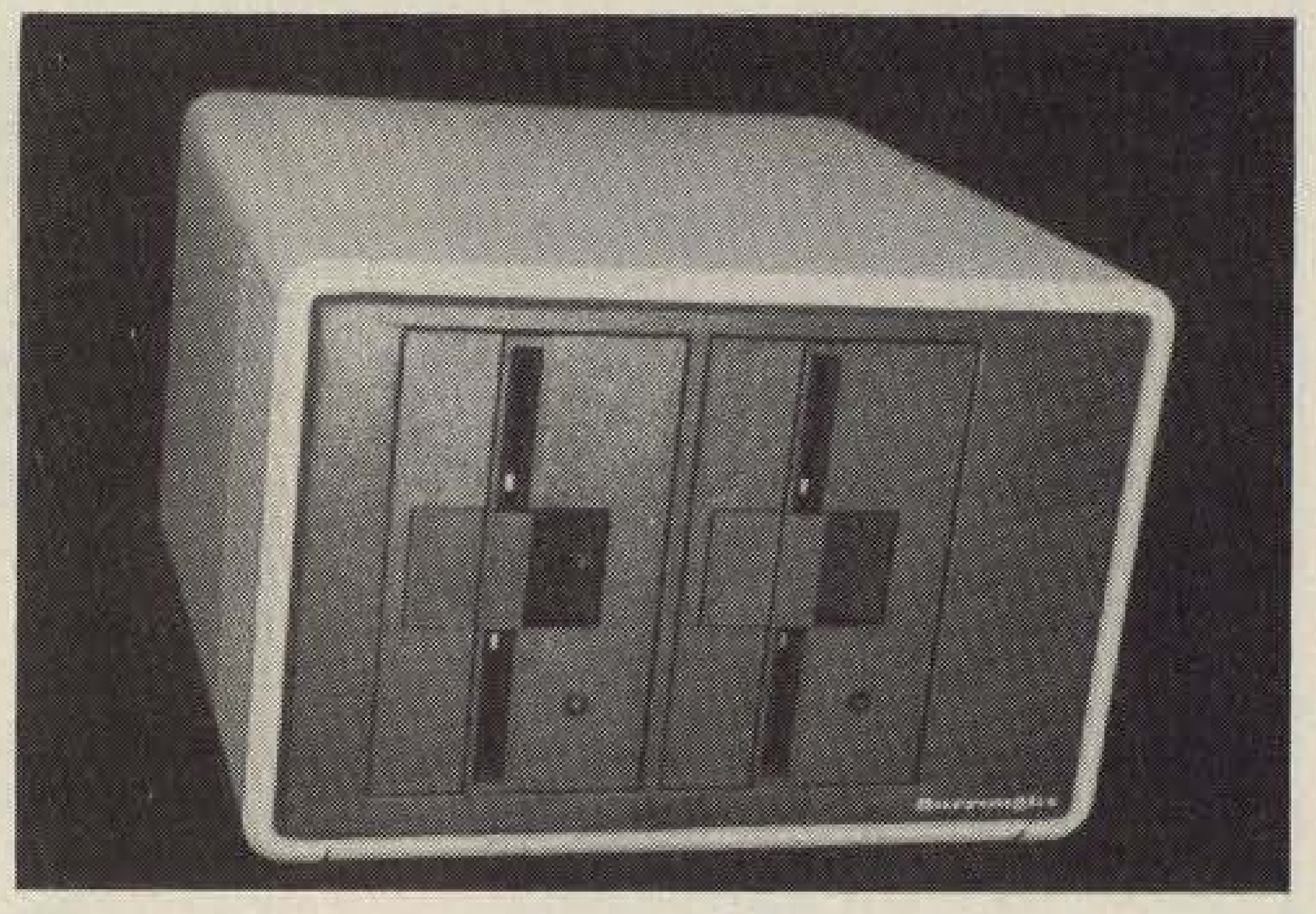
19 Allerton Street • Lynn, MA 01904 • Tel: (617) 595-2275

SELF STANDING COMPUTER TERMINALS

We acquired a small number of these beautifully made computer terminals which were made by a major U. S. manufacturer. We do not know all the details about them at press time, but we can tell you that someone lost over $2000 on each of them. They lose you win. The terminals feature 3 micro-processors for powerful capabilities, 106 key, Hall Effect ASCII keyboard, 10 user defineable keys, EAROMs, 16K RAM, 48K ROM, serial RS 232 asynchronous data communications, (synchronous optional), selectable baud rates of 75-38.4K BPS, high resolution, 12" green screen, composite video monitor, 80 X 25 line scrolling display, built-in reverse video option, self-contained, lightweight, tightly regulated switching power supply & more than can be fit in this space. The terminals were designed to be daisy chained around a central host computer and used as individual work stations. The host system could then selectively address any machine in the network for any message it may have. All units are visually inspected prior to shipment. An operators manual is provided w/ each unit. Shpg. wt. 55 lb. model no. MT 686 $289.00
With the addition of our TP 420 dual FDD system below, you can create your own office system.

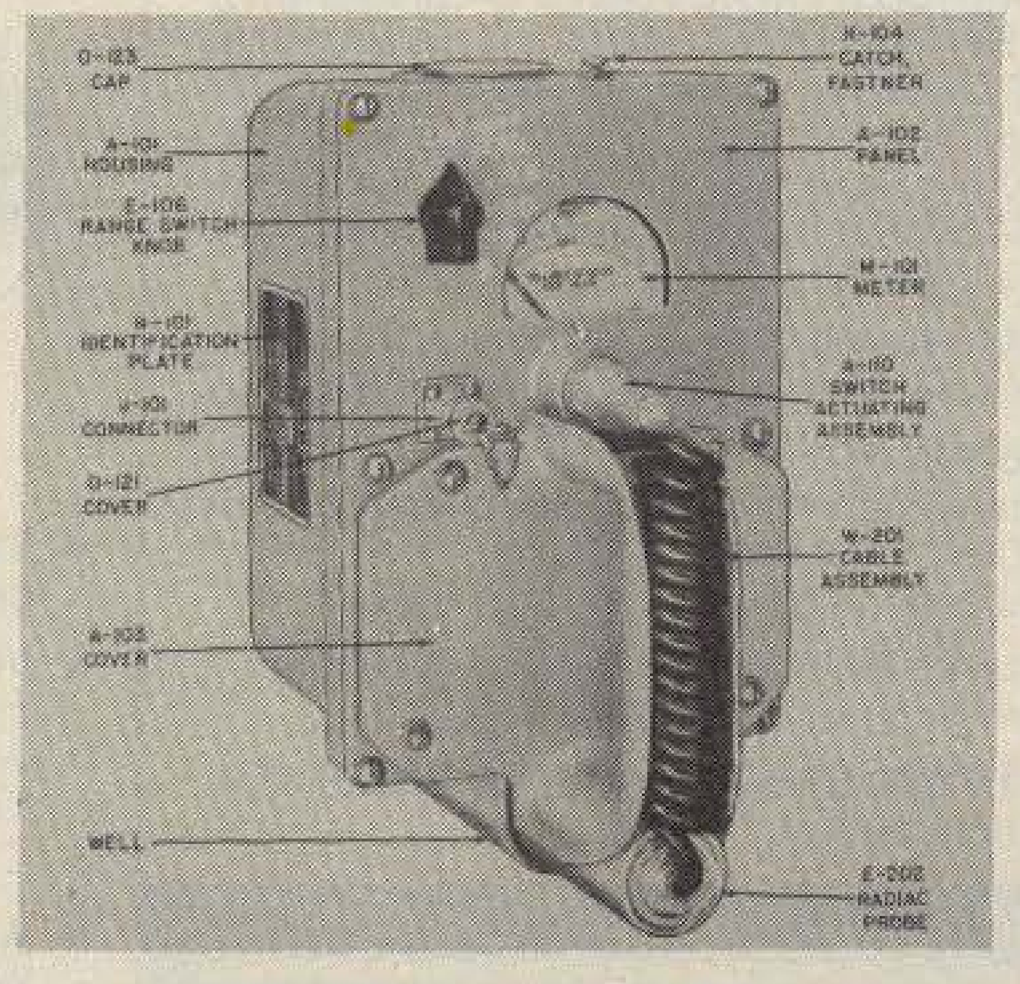
We offer the following as options: schematic pac. 3 lb.	$ 10.00
USRT for synchronous data comm. w/ installation data	$ 10.00
25' RS 232 cable, 1 male & 1 female DB 25 connector	$ 20.00

TP 420 DUAL MINI-FLOPPY DISC SYSTEM



The TP 420 is an extremely versatile mini floppy disc drive system. It consists of 2 Shugart SA 400 5¼" floppy disc drives, associated logic, controller card, power supply, cooling fan, and case. The TP 420 has a built in controller card which features: Z 80 A CPU, Z 80A DMA, Z 80A CTC, Intel 8271 controller chip, 6K RAM, ROM, plus other goodies. We have been told that the serial interface controller card within the TP 420 will support up to 4 8" drives from the unused port on it. The con troller card can be easily removed should you wish to use it on some other system. Also built in is a tightly regulated, switching power supply which runs on 115/230 v 50/60 hz.. The TP 420 is shipped w/ the interface cable for the MT 686, data, & schematics. Shpg. wt. 22 lb. Stock no. TP 420 $300.00

PDR-27 NAVY RADIATION METER



Just released by the US Navy. They appear to be in excellent condition and include the fitted aluminum transit case. Batteries not furnished but are available in most electronic supply houses. 4 ranges 0.5 to 500 mr/hr. Removeable hand probe, detection of Beta and Gamma radiation. With todays world conditions and perhaps proximity to a nuke power station, it might provide a little insurance to own one of these instruments. With no facilities to check or test, we offer AS IS, visually OK Schematic provided with each. We have some accessories and offer as an option although not required for operation.
Shipping wgt. 22 lb. PDR-27 Rad Meter $50.00

PDR-27 phones $7.00	Approx. 100 page Instr. Book $10.00
Hi Sensitivity GM tube $10.00	Low Sensitivity GM tube $5.00

The above listed tubes are already installed in the meter.
We are offering these as spares if desired.

PHONE ORDERS accepted on MC, VISA, or AMEX
No COD's. Shpg. extra on above.
Send for free 72 page catalogue jam packed w/ bargains.

See List of Advertisers on page 130

NEW LOW-NOISE PREAMPS

New low-noise microwave transistors make preamps in the 0.9 to 1.0 dB noise figure range possible without the fragility and power supply problems of gas-fet's. Units furnished wired and tuned to ham band. Can be easily retuned to nearby freq.

Models LNA( ), P30, and P432 shown

Model	Tunable Freq Range	Noise Figure	Gain	Price
LNA 28	20-40	0.9 dB	20 dB	$39
LNA 50	40-70	0.9 dB	20 dB	$39
LNA 144	120-180	1.0 dB	18 dB	$39
LNA 220	180-250	1.0 dB	17 dB	$39
LNA 432	380-470	1.0 dB	18 dB	$45
LNA 800	470-960	1.2dB	15 dB	$45

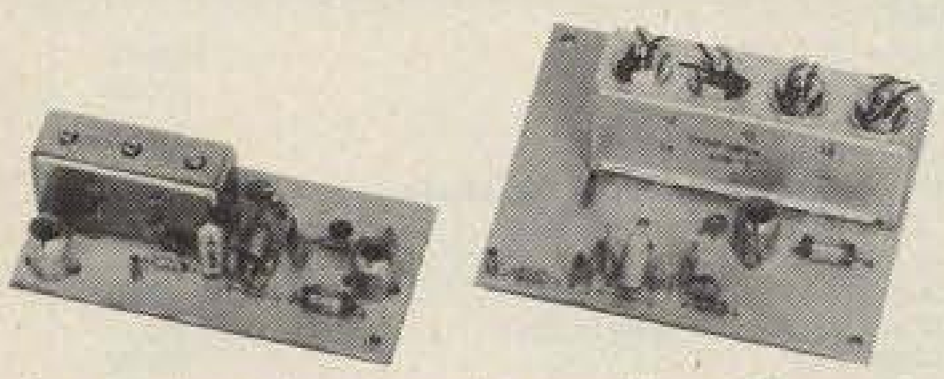
ECONOMY PREAMPS

Our traditional preamps, proven in years of service. Over 20,000 in use throughout the world. Tuneable over narrow range. Specify exact freq. band needed. Gain 16-20 dB. NF = 2 dB or less. VHF units available 27 to 300 MHz. UHF units available 300 to 650 MHz.

- P30K, VHF Kit less case $18
- P30W, VHF Wired/Tested $33
- P432K, UHF Kit less case $21
- P432W, UHF Wired/Tested $36

P432 also available in broadband version to cover 20-650 MHz without tuning. Same price as P432; add "B" to model #.

HELICAL RESONATOR PREAMPS



Our lab has developed a new line of low-noise receiver preamps with helical resonator filters built in. The combination of a low noise amplifier similar to the LNA series and the sharp selectivity of a 3 or 4 section helical resonator provides increased sensitivity while reducing intermod and cross-band interference in critical applications. See selectivity curves at right. Noise figure = 1 to 1.2 dB. Gain = 12 to 15 dB.

Model	Tuning Range	Price
HRA-144	143-150 MHz	$49
HRA-220	213-233 MHz	$49
HRA-432	420-450 MHz	$59
HRA-( )	150-174MHz	$69
HRA-( )	450-470 MHz	$79

RECEIVING CONVERTERS

Models to cover every practical rf & if range to listen to SSB, FM, ATV, etc. NF = 2 dB or less.

	Antenna Input Range	Receiver Output
VHF MODELS	28-32	144-148
Kit with Case $49	50-52	28-30
Less Case $39	50-54	144-148
Wired $69	144-146	28-30
	145-147	28-30
	144-144.4	27-27.4
	146-148	28-30
	144-148	50-54
	220-222	28-30
	220-224	144-148
	222-226	144-148
	220-224	50-54
	222-224	28-30
UHF MODELS	432-434	28-30
Kit with Case $59	435-437	28-30
Less Case $49	432-436	144-148
Wired $75	432-436	50-54
	439.25	61.25

SCANNER CONVERTERS Copy 72-76, 135-144, 240-270, 400-420, or 806-894 MHz bands on any scanner. Wired/tested Only $88.

SAVE A BUNDLE ON VHF FM TRANSCEIVERS!

FM-5 PC Board Kit - **ONLY $178** complete with controls, heatsink, etc. 10 Watts, 5 Channels, for 2M or 220 MHz.

Cabinet Kit, complete with speaker, knobs, connectors, hardware. Only $60.

REPEAT OF A SELLOUT!

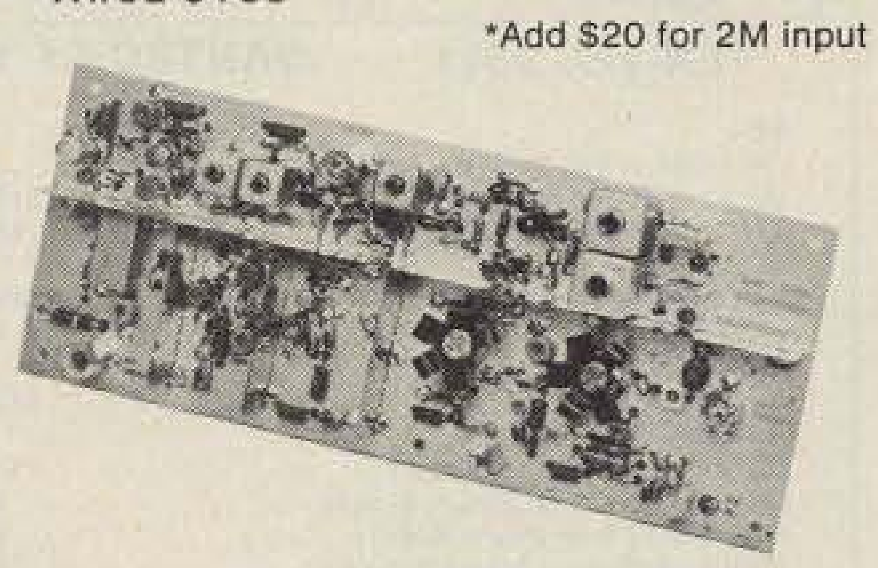
While supply lasts, get $60 cabinet kit free when you buy an FM-5 Transceiver kit. Where else can you get a complete transceiver for only $178

TRANSMIT CONVERTERS

For SSB, CW, ATV, FM, etc. Why pay big bucks for a multi mode rig for each band? Can be linked with receive converters for transceive. 2 Watts output vhf, 1 Watt uhf.

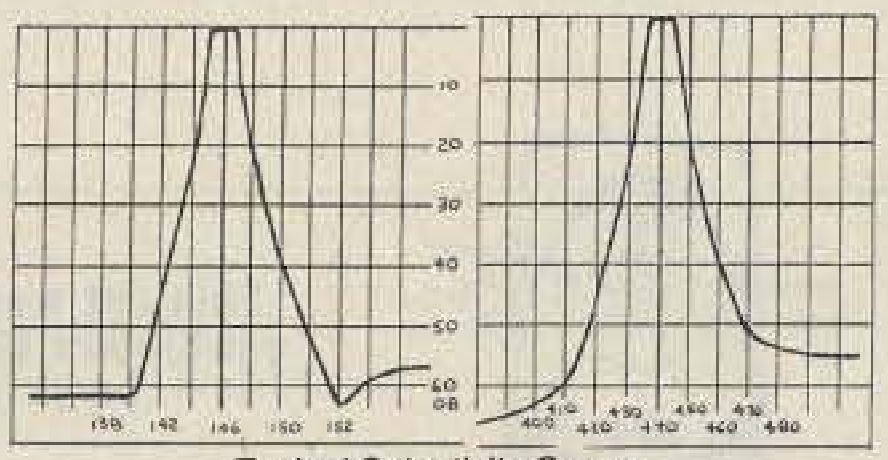
	Exciter Input Range	Antenna Output
For VHF,	28-30	144-146
Model XV2	28-29	145-146
Kit $79	28-30	50-52
Wired $149	27-27.4	144-144.4
(Specify band)	28-30	220-222*
	50-54	220-224
	144-146	50-52
	50-54	144-148
	144-146	28-30
For UHF,	28-30	432-434
Model XV4	28-30	435-437
Kit $99	50-54	432-436
Wired $169	61.25	439.25
	144-148	432-436*

*Add $20 for 2M input



VHF & UHF LINEAR AMPLIFIERS. Use with above. Power levels from 10 to 45 Watts. Several models, kits from $78.

LOOK AT THESE ATTRACTIVE CURVES!



Typical Selectivity Curves of Receivers and Helical Resonators.

IMPORTANT REASONS WHY YOU SHOULD BUY FROM THE VALUE LEADER:

1. *Largest selection of vhf and uhf kits in the world.*
2. *Exceptional quality and low prices due to large volume.*
3. *Fast delivery; most kits shipped same day.*
4. *Complete, professional instruction manuals.*
5. *Prompt factory service available and free phone consultation.*
6. *In business 21 years.*
7. *Sell more repeater modules than all other mfrs. and have for years. Can give quality features for much lower cost.*

- **Call or Write for FREE CATALOG**
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- **Order by phone or mail ● Add $3 S & H per order** ✓33
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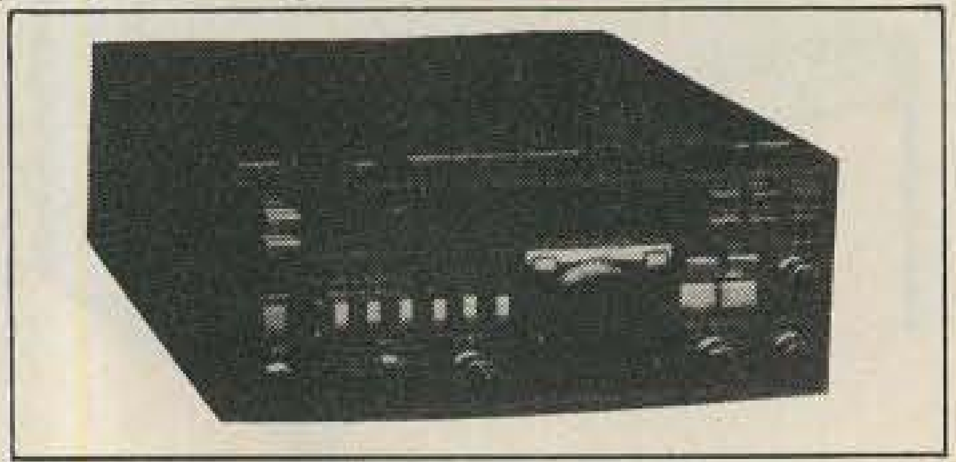
CP-1/C-64 or VIC-20 Software Package ... Call
MP-20 or MP-64 Interface Package ... $129.00
AMT-1 Amtor/RTTY/CW ... 449.00
ALLIANCE
HD73 (10.7 sq. ft.) Rotator ... $99.00
U110 Small Elevation Rotator ... 49.00
AMERITRON
AL-80 QSK Amp ... $599.00
ASTRON
RS7A 5-7 Amp Power Supply ... $49.00
RS10A 7.5-10 Amp Power Supply ... 59.00
RS12A 9-12 Amp Power Supply ... 69.00
RS20A 16-20 Amp Power Supply ... 89.00
RS20M 16-20 Amp w/meter ... 109.00
RS35A 25-35 Amp ... 135.00
RS35M 25-35 Amp w/meter ... 149.00
RS50A 37-50 Amp ... 199.00
RS50M 37-50 Amp w/meter ... 225.00
AZDEN
PCS4000 2M mobile rig ... $280.00
BENCHER
BY-1 Paddle/BY-2 Chrome ... $39.00/49.00



YAESU FT-757GX

BUTTERNUT
HF6V 80-10 Meter Vertical ... $119.00
CONNECT SYSTEMS
Private Patch II ... $425.00
CUSHCRAFT
A3 Tribander 3EL ... $215.00
A4 Tribander 4EL ... 279.00
214B/214FB Boomers 14EL 2M ... 75.00 each
32-19 Super Boomer 19EL 2M ... 89.00
DAIWA
CN-520 1.8-60 MHz SWR/Pwr Mtr ... $63.00
CN-620B 1.8-150 MHz SWR/Pwr Mtr ... 110.00
CN630 140-450 MHz SWR/Pwr Mtr ... 129.00
CN720B 1.8-150 MHz SWR/Pwr Mtr ... 150.00
ENCOMM (SANTEC)
ST-142, 222, 442, Also Stocking KDK FM-2033
The Handhelds Still Offering the Most Features
Call for Your Discount Price
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CRI 200 Computer Interface ... $270.00
CRI 100 Computer Interface ... 225.00
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Explorer 14 Tribander ... 279.00
CD45 8.5 sq. ft. Rotator ... 129.00
Ham IV 15 sq. ft. Rotator ... 199.00
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Free Shipping on all Crank-up Towers
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IC-02AT Now Available ... Call
27A New Ultra-Small 2M ... Call
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R71A New & Improved Receiver ... Call
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Amtor Software Now Available
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KR-500 Elevation Rotator ... $179.00
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MFJ
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313 VHF Conv for HT ... $36.00
Very Large Stock of MFJ Products. Call for Discount Pricing.
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The fantastic Corsair ... $1020.00
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HL82V 10/80W Preamp ... 139.00
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YAESU
FT-980 Computer Aided Xcvr System ... $1289.00
FT-757GX Super Buy ... 740.00
FT-208R 2M Handheld ... 265.00
FT-726R Triband Xcvr ... Call
FT-203R New H.T. ... Call

USED EQUIPMENT

This list was compiled 2/8/84. Our used equipment changes daily. Please write or call for our current listing.

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AZDEN
PCS-3000 2MTR ... $215.00
PCS-4000 2MTR ... 229.00
PCS-300 H.T. ... 209.00
DENTRON
Clipperton L Amp ... $459.00
W2 Wattmtr ... 49.00
DRAKE
TR7/PS7, fan ... $899.00
R7A Rcvr ... 1025.00
TR4, RV4, AC4 ... 349.00
TR4, AC4 ... 279.00
TR6, RV6, AC4 etc. 6 MTR ... 469.00
T4X, R4A, P.S., MS4 ... 339.00
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ST7T 440MHz H.T. ... 169.00
HAL
ST6000 Demodulator w/Scope ... $469.00
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SA2060 2Kw Tuner ... $189.00
SA2040 2Kw Tuner ... 139.00
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SB 104A, CW, P.S., Spkr ... 399.00
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SB 101, CW, P.S. ... 225.00
HW 101, CW, P.S. ... 289.00
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ICOM
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740/P.S. ... 769.00
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22S 2MTR ... 125.00
2AT 2MTR H.T. ... 175.00
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440 MHz Preamp ... 59.00
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Interface ... $79.00

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TS 830S, CW ... $689.00
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7625 2MTR ... 189.00
RM 76 Remote ... 50.00
BC5 DC Chgr ... 25.00
R300 Rcvr ... 149.00
820Vfo ... 125.00
7200 2MTR/P.S.5 ... 115.00
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YK 88C 500 Hz (830) ... 35.00
CW Filter (520) ... 25.00
PC-1 Phone Patch ... 29.00
MFJ
496 Super Keyboard/RTTY ... $199.00
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721 SSB/CW Filter ... 40.00
CWF-2 Filter ... 25.00
24 Hour Clock ... 20.00
1210 Interface ... 59.00
SWAN
Astro 150 Xcvr ... $399.00
WM2000 MTR ... 49.00
TEN-TEC
560 Corsair ... $799.00
263 Vfo ... 135.00
OMNI-C ... 625.00
OMNI D/B ... 449.00
544 Xcvr ... 375.00
525 Argosy ... 375.00
509 Argonaut ... 225.00
252MO P.S. ... 99.00
252M P.S. ... 99.00
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1A P.S. ... 19.00
YAESU
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FT225RD 2MTR All Mode ... 479.00

FT221 2MTR All Mode ... 269.00
YC221 Dig. Read ... 69.00
YD148 Desk Mic ... 29.00
FRG 7700/Memory ... 399.00
FRG 7000 Rcvr ... 299.00
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DX302 Rcvr ... 239.00
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Wilson 1405 H.T. ... 100.00
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25H/Mem. BK up ... 295.00
MFJ
313 H.T. Converter ... $32.00
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MK-1 Keyer ... 49.00
DRAKE
Theta 7000E Terminal ... $569.00
ICOM
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ICOM, WILSON, KENWOOD and MAXON Commercial Equipment Available

30 DAY WARRANTY ON USED EQUIPMENT

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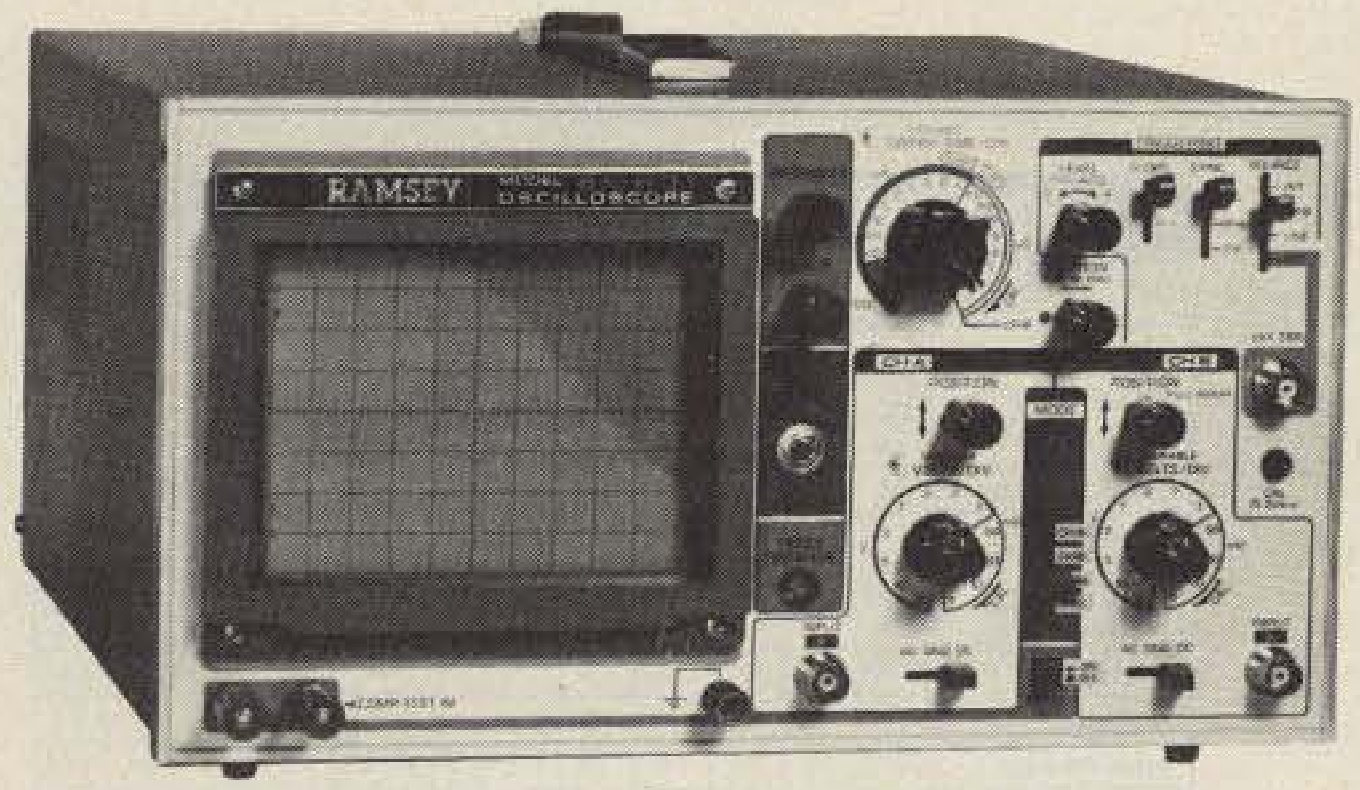
RAMSEY

THE FIRST NAME IN ELECTRONIC TEST GEAR



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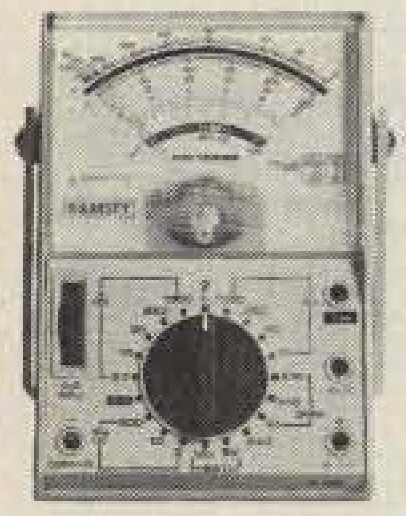
Unsurpassed quality at an unbeatable price, the Ramsey oscilloscope compares to others costing hundreds more. Features include a component testing circuit that will allow you to easily test resistors, capacitors, digital circuits and diodes • TV video sync filter • wide bandwidth & high sensitivity • internal graticule • high quality rectangular CRT • front panel trace rotator • Z axis • high sensitivity x-y mode • very low power consumption • regulated power supply • built-in calibrator • rock solid triggering • high quality hook-on probes

$399.95 high quality hook-on probes included



RAMSEY D-1100 VOM-MULTITESTER

Compact and reliable, designed to service a wide variety of equipment. Features include • mirror back scale • double-jeweled precision moving coil • double overload protection • an ideal low cost unit for the beginner or as a spare back-up unit.

$19.95

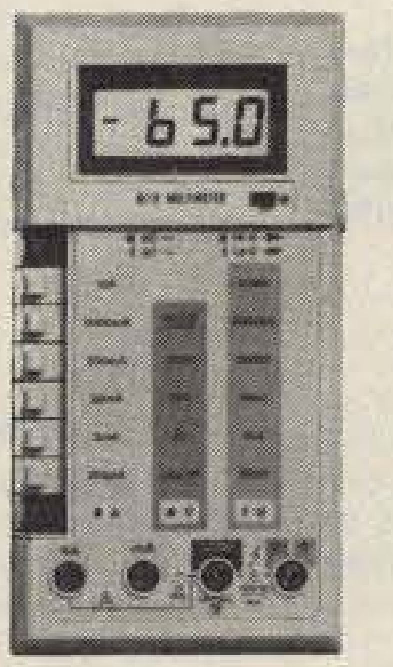
test leads and battery included

RAMSEY D-2100 DIGITAL MULTITESTER

A compact easy to use unit designed to operate like a pro. Featuring • 3½ digit LCD • low BAT. indicator • all range overload protection • overrange indication • auto-polarity • Transistor tester • dual-slope integration • vinyl carrying case

$54.95

h_{FE} test leads, battery & vinyl carrying case included

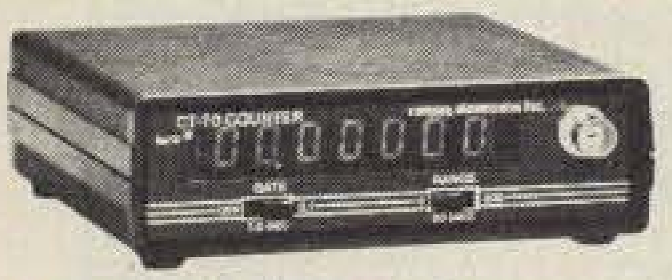


RAMSEY D-3100 DIGITAL MULTIMETER

Reliable, accurate digital measurements at an amazingly low cost • In-line color coded push buttons, speeds range selection • abs plastic tilt stand • recessed input jacks • overload protection on all ranges • 3½ digit LCD display with auto zero, auto polarity & low BAT. indicator

$59.95

test leads and battery included



CT-70 7 DIGIT 525 MHz COUNTER

Lab quality at a breakthrough price. Features • 3 frequency ranges each with pre amp • dual selectable gate times • gate activity indicator • 50mV @ 150 MHz typical sensitivity • wide frequency range • 1 ppm accuracy

$119.95

wired includes AC adapter

CT-70 kit $99.95
BP-4 nicad pack 8.95

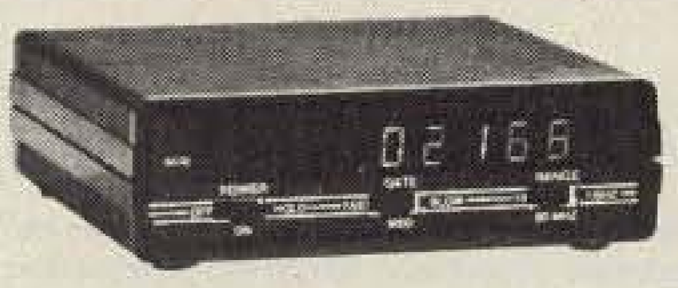
CT-90 9 DIGIT 600 MHz COUNTER

The most versatile for less than $300. Features 3 selectable gate times • 9 digits • gate indicator • display hold • 25mV @ 150 MHz typical sensitivity • 10 MHz timebase for WWV calibration • 1 ppm accuracy

$149.95

wired includes AC adapter

CT-90 kit $129.95
OV-1 0.1 PPM oven timebase ... 59.95
BP-4 nicad pack 8.95



CT-125 9 DIGIT 1.2 GHz COUNTER

A 9 digit counter that will outperform units costing hundreds more. • gate indicator • 24mV @ 150 MHz typical sensitivity • 9 digit display • 1 ppm accuracy • display hold • dual inputs with preamps

$169.95

wired includes AC adapter

BP-4 nicad pack 8.95

CT-50 8 DIGIT 600 MHz COUNTER

A versatile lab bench counter with optional receive frequency adapter, which turns the CT-50 into a digital readout for most any receiver • 25 mV @ 150 MHz typical sensitivity • 8 digit display • 1 ppm accuracy

$169.95

wired

CT-50 kit $139.95
RA-1 receiver adapter kit 14.95

DM-700 DIGITAL MULTIMETER

Professional quality at a hobbyist price. Features include 26 different ranges and 5 functions • 3½ digit, ½ inch LED display • automatic decimal placement • automatic polarity

$119.95

wired includes AC adapter

DM-700 kit $99.95
MP-1 probe set 4.95

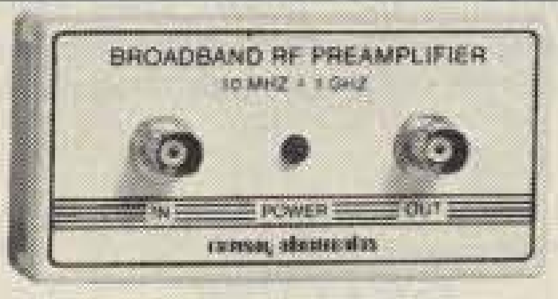
PS-2 AUDIO MULTIPLIER

The PS-2 is handy for high resolution audio resolution measurements, multiplies UP in frequency • great for PL tone measurements • multiplies by 10 or 100 • 0.01Hz resolution & built-in signal preamp/conditioner

$49.95

wired

PS-2 kit $39.95



PR-2 COUNTER PREAMP

The PR-2 is ideal for measuring weak signals from 10 to 1,000 MHz • flat 25 db gain • BNC connectors • great for sniffing RF • ideal receiver/TV preamp

$44.95

wired includes AC adapter

PR-2 kit $34.95

PS-1B 600 MHz PRESCALER

Extends the range of your present counter to 600 MHz • 2 stage preamp • divide by 10 circuitry • sensitivity: 25mV @ 150 MHz • BNC connectors • drives any counter

$59.95

wired includes AC adapter

PS-1B kit $49.95

ACCESSORIES FOR RAMSEY COUNTERS

Telescopic whip antenna—BNC plug .. $ 8.95
High impedance probe, light loading ... 16.95
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TELEX 466735 RAMSEY CI

TERMS: • satisfaction guaranteed • examine for 10 days; if not pleased, return in original form for refund • add 6% for shipping and insurance to a maximum of $10.00 • overseas add 15% for surface mail • COD add $2.50 (COD in USA only) • orders under $15.00 add $1.50 • NY residents add 7% sales tax • 90 day parts warranty on all kits • 1 year parts & labor warranty on all wired units.

RAMSEY

RAMSEY ELECTRONICS, INC.
2575 Baird Rd.
Penfield, N.Y. 14626

DEALER DIRECTORY

Culver City CA

Jun's Electronics, 3919 Sepulveda Blvd., Culver City CA 90230, 390-8003. Trades 463-1886 San Diego, 827-5732 (Reno NV).

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Complete lines ICOM, DenTron, Ten-Tec, Mirage, Cubic, Lunar, over 4000 electronic products for hobbyist, technician, experimenter. Also CB radio, landmobile. **Fontana Electronics, 8628 Sierra Ave., Fontana CA 92335, 822-7710.**

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New Castle DE

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ICOM, Bird, Cushcraft, Beckman, Fluke, Larsen, Hustler, Antenna Specialists, Astron, Avanti, Belden, W2AU/W2VS, AEA, Vibroplex, HamKey, Amphenol, Sony, B&W, Coax-Seal, Cover Craft, J.W. Miller/Daiwa, ARRL, Ameco, Shure. **LaRue Electronics, 1112 Grandview St., Scranton PA 18509, 343-2124.**

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IBM PC/Apple aftermarket products; hobbyists' electronics project kits: $50.00 complete modem kit, subscription/satellite TV decoder kits, EPROM programmer/duplicator, popular memory IC testers, data sheets, application notes, and more than 6000 parts in stock. Semiconductors, discretes, video products, tools... Please write for your free literature/catalog. **Independent Electronics, 6415-06 Airline Rd., Dallas TX 75205.**

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Avantek transistors, amplifiers, oscillators, and LNAs. Coaxial cable and connectors. Blonder Tongue dealer with Microwave laboratory. **Applied Specialties, Inc., 10101G Bacon Drive, Beltsville MD 20705. Wash. 595-5393, Balt. 792-2211. 7:30 am to 6:00 pm, Monday thru Friday.**

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Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the May '84 issue must be in our hands by March 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Nancy Ciampa.

PROPAGATION

J. H. Nelson
4 Plymouth Dr.
Whiting NJ 08759

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7A	14	14	14
ARGENTINA	21	14	14	14	7B	7B	14	21	21A	21A	21A	21
AUSTRALIA	21A	14	14	7B	7B	7B	7B	14B	14B	14	21	21A
CANAL ZONE	14A	14	7A	7	7	7	14A	21	21	21A	21A	21
ENGLAND	7	7	7	7	7	7	14	14A	14A	21	14	14
HAWAII	21	14	7B	7B	7B	7	7	7	14	14A	21	21A
INDIA	14	7B	7B	7B	7B	7B	14	14	14	14	14	14
JAPAN	14A	14	7B	7B	7B	7B	7	7	7	14	14	14A
MEXICO	21	14	7A	7	7	7	7	14	14A	21	21A	21
PHILIPPINES	14A	14	7B	7B	7B	7B	7B	14B	14	14	14	14A
PUERTO RICO	14A	14	7	7	7	7	14	14A	21	21A	21	21
SOUTH AFRICA	14	7B	7	7B	7B	14	21	21	21A	21A	21	14A
U. S. S. R.	7B	7	7	7	7	7B	14	14	14A	14	14	7B
WEST COAST	21	14A	7A	7	7	7	7	14	14A	21	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	14	14	14	14A
ARGENTINA	21	14	14	14	7B	7B	14	21	21A	21A	21A	21
AUSTRALIA	21A	14A	14	7B	7B	7B	7B	14B	14B	14	21	21A
CANAL ZONE	21	14	7A	7	7	7	14	14A	21	21A	21A	21A
ENGLAND	7B	7	7	7	7	7B	14B	14	14A	14A	14	14
HAWAII	21A	21	14	7	7	7	7	7	14	14A	21	21A
INDIA	14	14	7B	7B	7B	7B	7B	14B	14	14	14	14
JAPAN	14A	14	14B	7B	7B	7B	7	7	7	14	14	14A
MEXICO	14A	14	7	7	7	7	7	14	14	14	21	21
PHILIPPINES	14A	14	14B	7B	7B	7B	7B	7	14	14	14	14A
PUERTO RICO	21	14	14	7	7	7	7A	14A	21	21A	21	21
SOUTH AFRICA	14	7B	7	7B	7B	7B	14	21	21	21A	21	14A
U. S. S. R.	7B	7	7	7	7	7B	7B	14	14A	14	14	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7	14	14	14	14A
ARGENTINA	21	14A	14	14	7B	7B	7B	14A	21A	21A	21A	21
AUSTRALIA	21A	21A	21	14	14	14B	7B	14B	14B	14	21	21A
CANAL ZONE	21	14	7A	7	7	7	14	14A	21	21A	21A	21A
ENGLAND	7B	7B	7	7	7	7B	7B	7B	14	14A	14	14
HAWAII	21A	21	21	14	14	7A	7	7	14	21	21	21A
INDIA	14	14A	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	21	14A	14	14B	7B	7	7	7	7	14	14	14A
MEXICO	21	14	14	7	7	7	7	14	14	21	21	21A
PHILIPPINES	21	14A	14	14B	7B	7B	7B	7	14	14	14	14A
PUERTO RICO	21	14	14	7	7	7	7	14	14A	21	21A	21
SOUTH AFRICA	14	7B	7	7B	7B	7B	7B	14	14A	21	21	14A
U. S. S. R.	7B	7B	7	7	7	7B	7B	14B	14	14	14	7B
EAST COAST	21	14A	7A	7	7	7	7	14	14A	21	21A	21A

A = Next higher frequency may also be useful.
B = Difficult circuit this period.

First letter = night waves. Second = day waves.
G = Good, F = Fair, P = Poor. * = Chance of solar flares.
 # = Chance of aurora.

NOTE THAT NIGHT WAVE LETTER NOW COMES FIRST.

April

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

YAESU FT-726R TRIBANDER

NEW GALAXIES OF PERFORMANCE ON VHF AND UHF

FULL DUPLEX!!

ATELLITES!! SCATTER!!

M!! EME!!

The New Yaesu FT-726R Tribander is the world's first multiband, multimode Amateur transceiver capable of full duplex operation. Whether you're interested in OSCAR, moonbounce, or terrestrial repeaters, you owe yourself a look at this one-of-a-kind technological wonder!

Multiband Capability

Factory equipped for 2 meter operation, the FT-726R is a three-band unit capable of operation on 10 meters, 6 meters, and/or two segments of the 70 cm band (430-440 or 440-450 MHz), using optional modules. The appropriate repeater shift is automatically programmed for each module. Other bands pending.

Advanced Microprocessor Control

Powered by an 8-bit Central Processing Unit, the ten-channel memory of the FT-726R stores both frequency and mode, with pushbutton transfer capability to either of two VFO registers. The synthesized VFO tunes in 20 Hz steps on SSB/CW, with selectable steps on FM. Scanning of the band or memories is provided.

Full Duplex Option

The optional SU-726 module provides a second, parallel IF strip, thereby allowing full duplex crossband satellite work. Either the transmit or receive frequency may be varied during transmission, for quick zero-beat on another station or for tracking Doppler shift.

High Performance Features

Borrowing heavily from Yaesu's HF transceiver experience, the FT-726R comes equipped with a speech processor, variable receiver bandwidth, IF shift, all-mode squelch, receiver audio tone control, and an IF noise blanker. When the optional XF-455MC CW filter is installed, CW Wide/Narrow selection is provided. Convenient rear panel connections allow quick interface to your station audio, linear amplifier, and control lines.

Leading the way into the space age of Ham communications, Yaesu's FT-726R is the first VHF/UHF base station built around modern-day requirements. If you're tired of piecing together converters, transmitter strips, and relays, ask your Authorized Yaesu Dealer for a demonstration of the exciting new FT-726R, the rig that will expand your DX horizons!

Price And Specifications Subject To Change Without Notice Or Obligation

YAESU
The radio. 483

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"DX-traordinary."

Superior dynamic range, auto. antenna tuner, QSK, dual NB, 2 VFO's, general coverage receiver.

TS-930S

The TS-930S is a superlative, high performance, all-solid state, HF transceiver keyed to the exacting requirements of the DX and contest operator. It covers all Amateur bands from 160 through 10 meters, and incorporates a 150 kHz to 30 MHz general coverage receiver having an excellent dynamic range.

Among its other important features are, SSB slope tuning, CW VBT, IF notch filter, CW pitch control, dual digital VFO's, CW full break-in, automatic antenna tuner, and a higher voltage operated solid state final amplifier. It is available with or without the AT-930 automatic antenna tuner built-in.

TS-930S FEATURES:

- **160-10 Meters, with 150 kHz-30 MHz general coverage receiver.**
  Covers all Amateur frequencies from 160-10 meters, including new WARC bands, on SSB, CW, FSK, and AM. Features 150 kHz-30 MHz general coverage receiver. Separate Amateur band access keys allow speedy band selection. UP/DOWN bandswitch in 1-MHz steps. A new, innovative, quadruple "UP" conversion, digital PLL synthesized circuit provides superior frequency accuracy and stability, plus greatly enhanced selectivity.
- **Excellent receiver dynamic range.**
  Receiver two-tone dynamic range, 100 dB typical (20 meters, 50-kHz spacing, 500 Hz CW bandwidth, at sensitivity of 0.25 μv, S/N 10 dB), provides the ultimate in rejection of IM distortion.
- **All solid state, 28 volt operated final amplifier.**
  The final amplifier operates on 28 VDC for lowest IM distortion. Power input rated at 250 W on SSB, CW, and FSK, and at 80 W on AM. Final amplifier protection circuits with cooling fan, SWR/Power meter built-in.
- **CW full break-in.**
  CW full break-in circuit uses CMOS logic IC plus reed relay for smooth, quiet operation. Switchable to semi-break-in.
- **Automatic antenna tuner, built-in.**
  Covers Amateur bands 80-10 meters, including the new WARC bands. Tuning range automatically pre-selected with band selection to minimize tuning time. "AUTO-THRU" switch on front panel.
- **Dual digital VFO's.**
  10-Hz step dual digital VFO's include band information. Each VFO tunes continuously from band to band. A large, heavy, flywheel type knob is used for improved tuning ease. T.F. Set switch allows fast transmit frequency setting for split-frequency operations. A=B switch for equalizing one VFO frequency to the other. VFO "Lock" switch provided. RIT control for ±9.9 kHz.
- **Eight memory channels.**
  Stores both frequency and band information. VFO-MEMO switch allows use of each memory as an independent VFO, (the original memory frequency can be recalled at will), or as a fixed frequency. Internal Battery memory back-up, estimated 1 year life. (Batteries not Kenwood supplied).
- **Dual mode noise blanker ("pulse" or "woodpecker").**
  NB-1, with threshold control, for pulse-type noise. NB-2 for longer duration "woodpecker" type noise.
- **SSB IF slope tuning.**
  Allows independent adjustment of the low and/or high frequency slope of the IF passband, for best interference rejection. HIGH/LOW cut control rotation not affected by selecting USB or LSB modes.
- **CW VBT and pitch controls.**
  CW Variable Bandwidth Tuning control tunes out interfering signals. CW pitch controls shifts IF passband and simultaneously changes the pitch of the beat frequency. A "Narrow/Wide" filter selector switch is provided.
- **IF notch filter.**
  100 kHz IF notch circuit gives deep, sharp, notch, better than -40 dB.
- **Audio filter built-in.**
  Tuneable, peak-type audio filter for CW.
- **AC power supply built-in.**
  120, 220, or 240 VAC, switch selected (operates on AC only).
- **Fluorescent tube digital display.**
  Six digit readout to 100 Hz (10 Hz modifiable), plus digitalized sub-scale with 20-kHz steps. Separate two digit indication of RIT frequency shift. In CW mode, display indicates the actual carrier frequency of received as well as transmitted signals.
- **RF speech processor.**
  RF clipper type processor provides higher average "talk-power," improved intelligibility.
- **One year limited warranty on parts and labor.**

Other features:

- SSB monitor circuit, 3 step RF attenuator, VOX, and 100-kHz marker.

Optional accessories:

- AT-930 automatic antenna tuner.
- SP-930 external speaker with selectable audio filters.
- YG-455C-1 (500 Hz) or YG-455CN-1 (250 Hz) plug-in CW filters for 455-kHz IF.
- YK-88C-1 (500 Hz) CW plug-in filter for 8.83-MHz IF.
- YK-88A-1 (6 kHz) AM plug-in filter for 8.83-MHz IF.
- SO-1 commercial stability TCXO (temperature compensated crystal oscillator). Requires modifications.
- MC-60A deluxe desk microphone with UP/DOWN switch, pre-amplifier, 8-pin plug.
- TL-922A linear amplifier (not for CW QSK).
- SM-220 station monitor (not for pan-adapter.
- HS-6, HS-5, HS-4, headphones.

More information on the TS-930S is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

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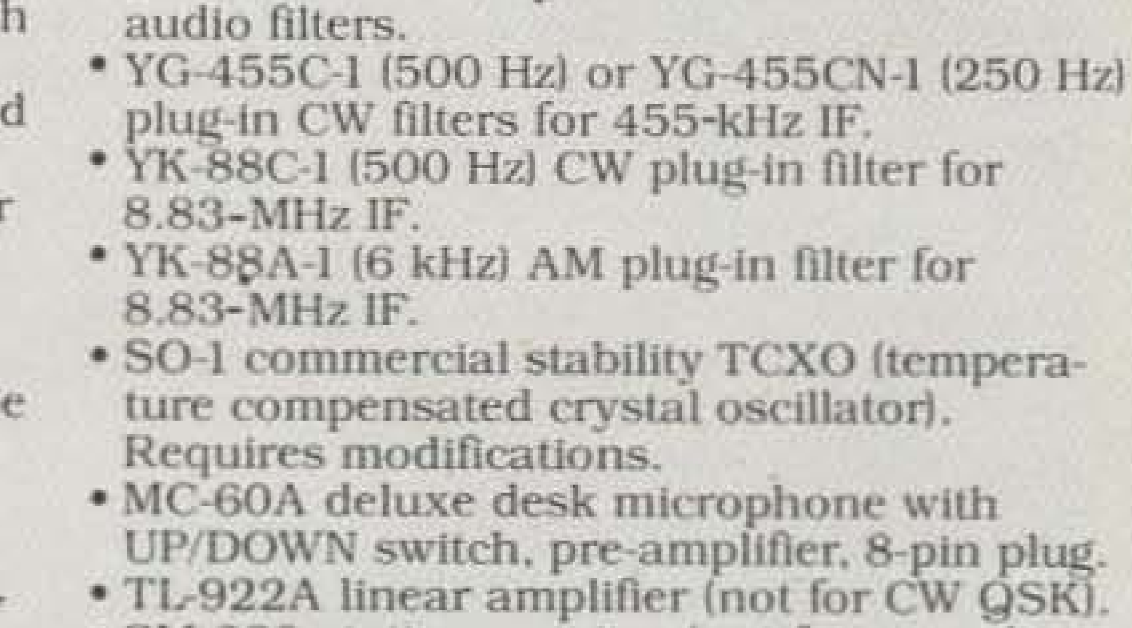

Specifications and prices are subject to change without notice or obligation.