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✓ Reader Service—see page 195

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

GETTING ORIENTED

A trip to Korea, Taiwan, Hong Kong, Guam, and Japan in October helped put things into sobering perspective as far as the US leadership in technology is concerned. Oh, the evidence was there without the trip—on my wrist in the form of a digital watch with built-in calculator from Japan, two or three more Casio calculators always at hand, a Sansui hi-fi system at home, Icom, Kenwood, Tempo, and Yaesu ham gear at every turn, Hitachi and Sanyo televisions, VTR systems made in Japan, etc. Even my new rechargeable pencil sharpener says Sanyo.

While traveling through the Orient visiting consumer electronic shows in Seoul, Osaka, Taipei, and Hong Kong, I got the full brunt of the competition the US faces from this area. It is no wonder that these countries have taken over 80-90% of the production of high technology electronics equipment being sold in our country . . . they're ahead of us in just about every field except computers and microwaves.

Can anything be done to reverse this worsening situation? I think it can, and I think that you, the readers of *73 Magazine*, can have a profound effect on the position of the US in electronics over the next few years. I don't think this is a situation which can be helped by setting up trade barriers. I do think it is high time the US did get vigorously to work to break down the one-way Japanese trade barriers . . . in essence, forcing them to fight us on more equal terms.

My visits to the electronic shows and Japanese electronic firms had me in contact with Asian amateurs at every turn. While this was no surprise, it did back up what I have been writing in my editorials for many years. Byron Kretzman W2JTP recently dropped me a letter reminding me of an editorial I published in the June, 1969, issue of *73*, pointing out that if our ham clubs did not get busy and get the amateur radio ranks growing again (growth had stopped for a six-year period at that time as a result of the FCC handling of the so-called "incentive licensing" proposals), the US dominance of the electronic industry worldwide could be lost within twenty years. I missed my guess; we lost it within ten years.

If amateur radio had been permitted to continue to grow at the rate it had established during the years after WWII until 1963, at which time it was proposed that we go back to the pre-war Class A and Class B licensing system and all growth stopped, we would today have well over 1,500,000 licensed amateurs and I sincerely believe that the US would be making 80% of the electronic equipment instead of Japan and their off-shore workshops in Hong Kong, etc.

Let's look at the situation carefully and think about it. Statistics (ARRL) show that about 50% of the new licensees are either 14 or 15 years old. We also know that about 80% of these newcomers to amateur radio get involved enough with electronics so they choose it for their career. This means that if our ham growth had not been brought to a halt in 1963 by the FCC failure to immediately dismiss the "incentive licensing" proposals, we might expect to have 166,000 new hams just in 1980. This would also result in about 133,000 of these new people entering the electronics industry within about five years.

Now, look here, don't come whining to me about how crowded the ham bands would be with 2,000,000 or more hams trying to use them. We have so damned many UHF and microwave bands that we aren't even using and so many techniques for getting more use out of the low bands that I don't think a big ham population would be anything but a big plus which would force more inventing and pioneering on us.

If you, the readers of *73 Magazine*, make it your business to see that your ham club gets busy and starts filling up those Novice classes with high school kids, we'll start having some good technicians and engineers flowing into our electronics industry within ten years. We want to get the kids at this time of their lives and infect them with one of the most virulent of viruses . . . amateur radio. If you get their attention at 14 and 15 years of age, you'll have most of them for life.

But we need a 20% growth rate or better, not a puny 11% that we had for the years prior to 1963 and the licensing debacle. We have to catch up so we can eventually get back our high technology industries. This means that your club must find some way to get into the nearby high schools and put on demonstrations of the wonders of amateur radio . . . repeaters, satellite communications, DXing, emergency service . . . the dozens of facets of our hobby which have made it one of the most important in the world.

With only about 30% of the licensed amateurs belonging to clubs, we need to have some vigorous club promotions. It's been some time since I have run articles in *73* on how to build up clubs, so perhaps it is time for you to write about this aspect of the hobby. There are some relatively simple rules for promoting club growth which I can pass on . . . such as making sure that your club meetings are fun to attend. That may sound too simple an idea, but unfortunately, I have been to far too many club meetings which were anything but fun. Long battles over buying paint to spruce up the clubhouse will not bring the membership back to the next meeting.

Let me provide some basic rules for getting clubs to grow. I

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mentioned that meetings should be fun . . . that means keeping the business part of the meeting mercifully short. The business aspect of a club should be handled almost 100% by an executive committee, with merely brief reports to the membership. There is a tendency on the part of some nitpickers to try to get long bitter battles going over obscure matters. Somehow the whole club then joins in and the meeting goes on endlessly with everyone deeply involved in the discussion. It seems like this amount of participation and interest must be a good thing. Not true. The fact is that many of these battlers will find something more enjoyable to do instead of the next meeting . . . like watching television.

Think of the club meeting as show biz. Look for some interesting people to bring in and talk to the group. If you have any ham manufacturers in the area, draw on them. Arrange shows of RTTY, SSTV, and other new or unusual developments. Microcomputers are also a big draw. Get some of your experts to talk about DXing, satellite communications . . . maybe a short QSL show-and-tell during each meeting for the DX gang to brag about their accomplishments. New equipment is always of interest. If someone has built a piece of gear, have show and tell about that.

Don't forget the refreshments. I'm not the only one who will drive miles for a coffee and doughnut break . . . or, better yet, cider and doughnuts.

Club projects are a plus . . . Novice and higher class license classes will interest many amateurs and help the club to grow. If you don't have at least 50% youngsters in your club, then you may find that it is in the hands of some old-timers who are keeping out the newcomers. Novices are disruptive, and old-timers try to avoid them . . . kids get bored easily and make noise. When the noise starts, that means that the meeting really is getting boring and that should be fixed rather than dump on the kids.

Club activities for contests can help provide fun . . . VHF contests, DX contests, Field Day . . . all can bring excitement to the club members and increase their enjoyment of amateur radio. Providing communications for civic events is a wonderful way to help the club and also promote amateur radio. The recent ham communications provided at Colorado Springs for the National Sports Festival was a great demonstration of what a club can do to provide a valuable service and promote amateur radio.

But the key to changing the increasing loss of high technology industries to Asia is, I feel, in the growth of amateur radio here. We have to get busy and work as we never have before to build up our club Novice classes . . . to get high school students involved with amateur radio and moving up the ladder of ham licenses. This means we have to be visible. We have to provide service and make sure that everyone knows about it. We have to acquaint every high school student with the wonders of amateur radio and then fan the flames of interest which result.

Even with a 25% growth in amateurs, it will be several years before we are able to catch up with where we would have been in amateurs today if our growth had not stopped in 1963. By 1986, we could be caught up with where we would have been in 1979. If we are able to manage a 25% growth from now on, we would catch up with our previous 11% growth by 1991.

Until we have more amateurs than they have in Japan . . . and they are way ahead of us today . . . I don't think we have a serious prayer of catching up with them technologically. Hams just have too much of an influence on industry and even government. Heck, when I met the Mayor of Osaka as a representative of the visiting IEEE tour group, one of the chief aides of the mayor was a ham (JE3DTA).

When you consider that we have double the population of Japan, their passing us in the number of hams is doubly distressing. Of course, one advantage they do have over us is their no-code license. This does not seem to have seriously hurt their quality of amateurs, while it certainly has contributed much to the quantity. Perhaps it is getting time for us to start putting pressure on the FCC to get this rule change into effect. We might find it easier to attract newcomers to amateur radio if we only had to worry about the technical and rule tests. You and I know how easy it really is to learn the code, but a large percentage of the newcomers are so panic-stricken by the thought that they are not able to react reasonably. For some reason, the code seems to present a terrible threat to many people . . . despite proof that kids of four are able to surmount the obstacle.

Now that the pay rates are fairly equal between Japan and the US, the big difference in technical consumer goods lies in development and production. This is a situation that I think we could surmount if we had the technical people we need.

Even if we give up on the presently lost fields, we could still hold on to the microwave and computer fields if we had enough engineers, technicians, and technically-educated businessmen. The key to this lies with *you*. If you get things moving with classes in your club, it could make a substantial difference over the next generation. Take delight in bringing the fun of amateur radio to the kids . . . they need it . . . you need it . . . and, for sure, our country needs it.

CB IMPORTS REALLY DOWN

The government figures on CB imports show that they are down from a year ago . . . substantially. During the first nine months of 1979, there were only 341,503 CB sets imported as compared with over two million during the same period in 1978.

While I don't particularly feel sorry for the Japanese firms and people inconvenienced by this radical change in the market, still, it is a bit unfair to them from the aspect that they apparently had very little to do with bringing this state of affairs about. Of course, perhaps we could fault them for trying to take over every one of our high technology industries . . . and doing it so successfully. But we can't honestly fault them for being smart enough to understand that their firms and country will do best if they export high-priced goods instead of shoes and shirts, nor can we really fault them for the help the American government has given them in their enterprise . . . making it almost unable to fail.

By taxing risk capital which succeeds and offering no help for risk capital which fails to make a profit, a stupidity which none of the successful countries has been foolish enough to enact, we have virtually thrown most of our major high technology industries out of our country. We could start bringing them back by abolishing the capital gains tax.

Getting back to the CB disaster, for those of you who have missed my comments on that some time ago: It was the greed of a couple American businesses which screwed up the entire CB industry. It was with perhaps some amusement I watched Hy-Gain go bankrupt since it was my understanding that the president, Andy Andros, was one of the people behind much of the EIA plan to "sell all the CBers another radio." This was the 50-channel plan. Andy was, I believe, also one of the main people behind the EIA push to take 220 MHz away from amateurs. If I'm wrong, I'd sure like to hear from anyone with better information.

Continued on page 148

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SWEEP WIDTH	144-148 or only the mHz segment you select on mHz switch	142-149.995	complete band or mHz you want	complete band or mHz you want	adjustable eg. 146-148 144-146 146-147	scans the mHz seg. selected by the mHz switch	same as Midland	145.35-147.99
SCAN CONTROLS	2 mini toggle switches mounted on rig — LOCK switch may be mounted on mic.		2 mini toggle switches mounted on rig.	2 mini toggle switches mounted on rig.	1 mini toggle switch mounted on mic or rig.	2 mini toggle switches mounted on rig.	same as Midland	1 mini toggle switch mounted on mic or rig.
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Looking West

Bill Pasternak WA6ITF
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Letters from all you videotape enthusiasts tell me you want more, so here goes. At the outset, let me state that I am no expert on the subject. I do service U-Matic, Beta, and VHS-type machines. In fact, I cut my teeth on the Sony VØ-1600 U-Matic series, but that's it, except for a stint working on the now deceased Cartravision units. I'm probably one of the few people who ever was actually schooled on them, but that's long ago, one of those things best left forgotten. Anyhow, my postal person's complaints about the volume of mail on this subject seem to indicate that there is a good deal of interest in the topic, so let's go a bit further than last time.

Between Bill Orenstein KH6IAF and myself, we possess three videocassette machines. They are a ¾" U-Matic format Panasonic, an RCA Selectavision VHS, and my Sony SL-7200 Beta machine. The RCA and Panasonic are at the Westlink facilities in Hollywood and the Beta is at my home. All perform the same function: They record and play back a television picture, either color or monochrome, and the audio that goes with the picture. Without getting super technical, the ¾" machine reproduces a better picture than either of the ½" machines, but this is to be expected. However, to people like you and me, cost is a very important factor, and most people cannot afford the $35/hour price of U-Matic tape cassettes. When Bill and I decided we were going to get home-type machines, we fought about which format was best. Bill opted for VHS and I chose Beta. Neither of us has been disappointed in his choice. I will venture to say that Bill and I represent two average consumers, even though our backgrounds are in the electronics/broadcast businesses.

Recently, we had an opportunity to utilize our equipment in a manner directly related to amateur radio. The Valley Good Guys Radio Club offered to procure for Westlink a suite at the Anaheim Sheraton Hotel during the 1979 ARRL Southwestern Division Convention. The room would be called the "Westlink Radio Network VHF/UHF/FM Hospitality Suite," and part of the agreement was that we supply some form of program for amateurs with those particular interests. We were puzzled as to how to do this without bringing in live speakers. The convention program itself had gobbled up most of the top-notch local personalities, including two members of the Westlink staff—anchorman Jim Davis KA8BWZ/6 for the Public Relations seminar and legal correspondent Joe Merdler N6AHU to host a forum titled "The Legal Considerations of Amateur Radio." More about Joe's talk later on.

We had a problem. The Westlink Radio Network is a free service by amateurs for amateurs, currently funded out-of-pocket by Bill and myself. There are no paid employees and no excess funds with which to cover the cost of bringing in out-of-town speakers. One Sunday, during a break in one of our editing sessions, the idea hit us simultaneously. There in the corner sat a possible solution to our problem: If we couldn't bring the speakers to the convention live, how about "live on tape"? An announcement was added to that and the next week's Westlink news soliciting 30- to 60-minute presentations on VHF/UHF/FM-related topics.

Within two weeks, tapes and films started pouring in. A fellow *73* writer, Bob Heil K9EID, supplied a tape of Wayne Green's talk to the Marissa (Illinois) Radio Club dealing with WARC preparations and a synched audio/slide presentation about the WD9GOE Marissa multi-band/multi-mode repeater. Wayne himself prepared a 20-minute talk dealing with microwaves, microwave communication, and how he obtained his world's microwave record. From Washington DC came a tape about AMRAD and the Metrovision ATV Repeater. The JPL Radio Club provided tapes about the *Voyager* commemorative operation—thanks to Dr. Norm Chalfin K6PGX. Hank Feinberg K2SSQ sent a print of a film he directed at Bell Labs titled *I-C A Shrinking World* (a must for any radio club program) and Dave Bell W6AQ permitted our use of his new film, *The World of Amateur Radio*.

Our decision was to edit all of this material onto three VHS format cartridges, thereby having to tote only the RCA machine to the convention with us, where we would use the hotel's TV as a playback monitor. We also prepared an 8-track audio cartridge with a number of Westlink newscasts thereon, to be played at low level whenever the room was open.

The 220-SMA of Southern California and TASMA provided literature about their activities, and the Southern California ATV Club supplied additional taped video material. Except for changing tapes every four hours, the room was literally automated, thus allowing Bill and myself to enjoy other convention festivities and do other things.

Results? The place was loaded from the moment it opened until it closed. The crowds glued themselves around the TV watching Wayne complain about the size of the rocks on Mt. Monadnock or Roy Neal explain the "World of Amateur Radio" time and again. The Valley Good Guys, who were also running a video-equipped hospitality suite, reported similar results. They were also using VHS format cassettes which told the story of their club and repeater, but they had done us one better by bringing along a Panasonic 6' projection TV.

I mentioned earlier that automating the hospitality suite left us free to do other things. This is not to say that we were not ever present. Quite the contrary. Usually Bill, myself, or some other Westlink staff member was there to oversee operations and answer questions pertaining to Westlink operation. However, when things came up that we wanted to do, we could do them without having to shut down operations.

For instance, there were three seminars we planned to record, all three on audio and one of them both audio and video. Of these, the one we deemed most important was that of Attorney Joseph Merdler N6AHU. As mentioned, his talk was titled "Legal Considerations in Amateur Radio," but with Joe being a staff member, we were well aware that his talk would be going well beyond simple (or complex) tower ordinance cases and the like. We knew that most of Joe's talk would deal with the handling of willful and malicious interference problems to amateur communications and that it would be a no-holds-barred presentation. The Valley Good Guys group stepped in here and provided a JVC EJ camera and portable Panasonic EJ recorder (VHS), along with Wayne Rankin WA6MPG and Paul Strauss WD6EBY as an EJ crew. If the new cassette had not been a damaged one, everything would have gone smoothly. As it was, about 45 minutes into Joe's talk, the cartridge went bad, but we did not realize that it had an oxide flaking problem until playback. We were most concerned with the first 30 minutes anyway; only part of the question and answer session was lost videowise. We have since transferred what we had to ¾" U-Matic and have sent the bad cartridge back to its manufacturer with a rather "explicit" note. An interesting aside to the foregoing: Joe's presentation became a prime attention-getter in our suite later on. People who arrived late and missed it found that they really had not missed it at all. It was played at least a half dozen times to a packed room.

You have just read a quick account of an actual test using recorded video as a prime attention-getter in an amateur radio hospitality suite at a major convention. Production costs involved just the raw tape and return postage on supplied material and one sleepless night crash-editing it all together. The results were very positive, and we intend to expand our prerecorded library to do an even better job next time. A few months ago, I suggested that someone give this idea a try. We took our own advice and are very gratified with the results.

THE RETURN OF NATIONTIE 80

Due to other important news, we dropped the national open intertie concept for a month. As it was, this turned out to be a good idea, in that it has given readers time to start voicing their opinions on the concept. Thus far, all mail received has been supportive, and this makes me think that there may be some merit to my madness. Of particular interest are two wide area open intertie systems now under construction, one in Texas and the other in Baja California, Mexico. I will begin by telling you about the Baja intertie and Ron Johnson WA5RON will explain a bit about TIRS, the Texas Intercity Relay System.

I learned about the Baja project only this past weekend when I ran into Alex Hodayan XE2IO at the ARRL convention mentioned earlier. I've known Alex for about five of the nine years I have lived in the southwest, and the highest compliment I can think of to pay him is to say that he has become to Baja what people such as Art Gentry and Burt Weiner have been to the US. He is a true pioneer in FM and FM repeater technology. He is currently involved in a truly humanitarian project.

The Baja peninsula is truly rugged territory, yet each year thousands of tourists, mainly Americans, visit it because of its overall natural beauty. Many come in "off-road vehicles" such as dune buggies or motorcycles. Most heed the warnings given them by both US and Mexican tourist bureaus as to how

Continued on page 157

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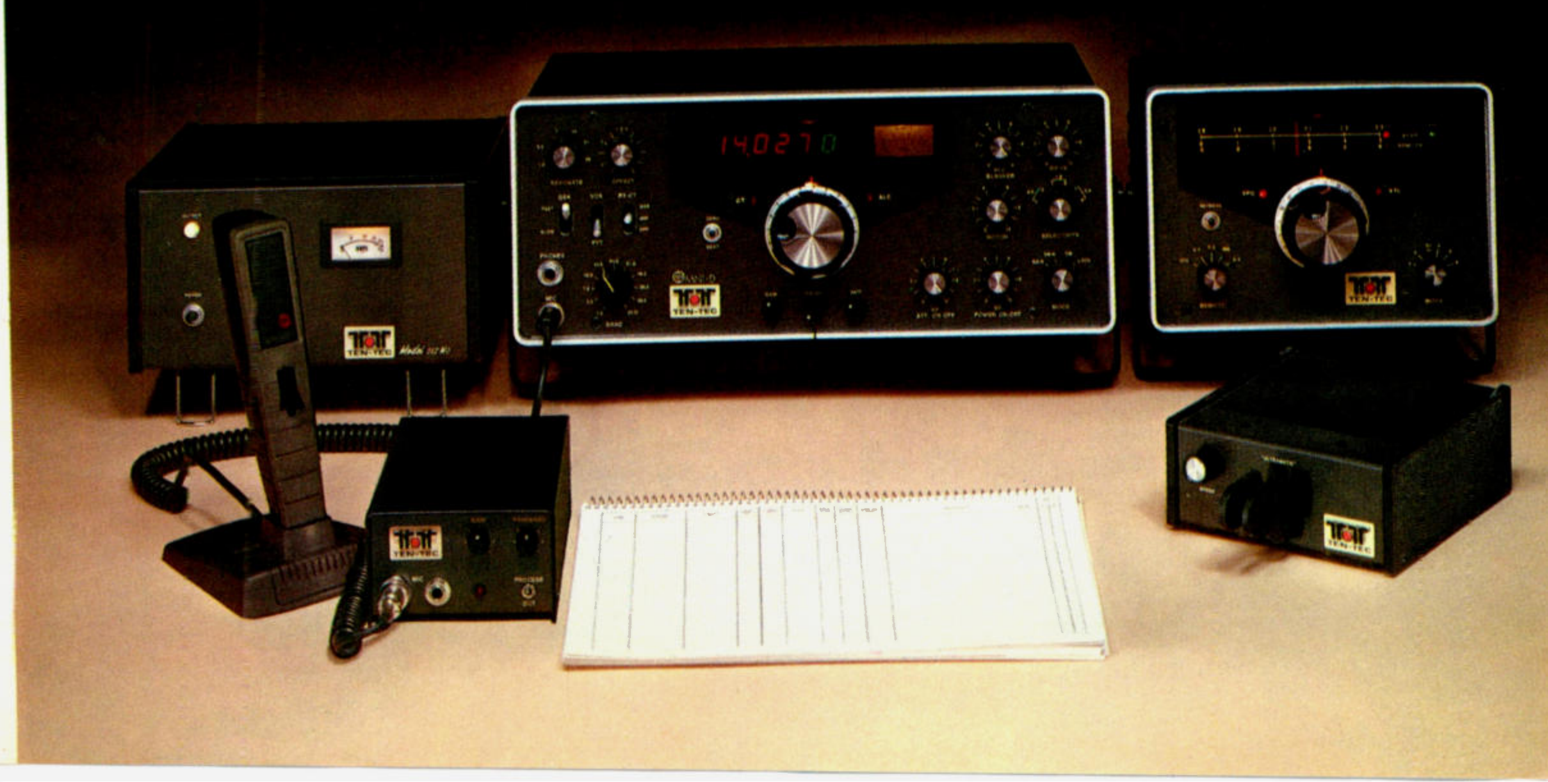
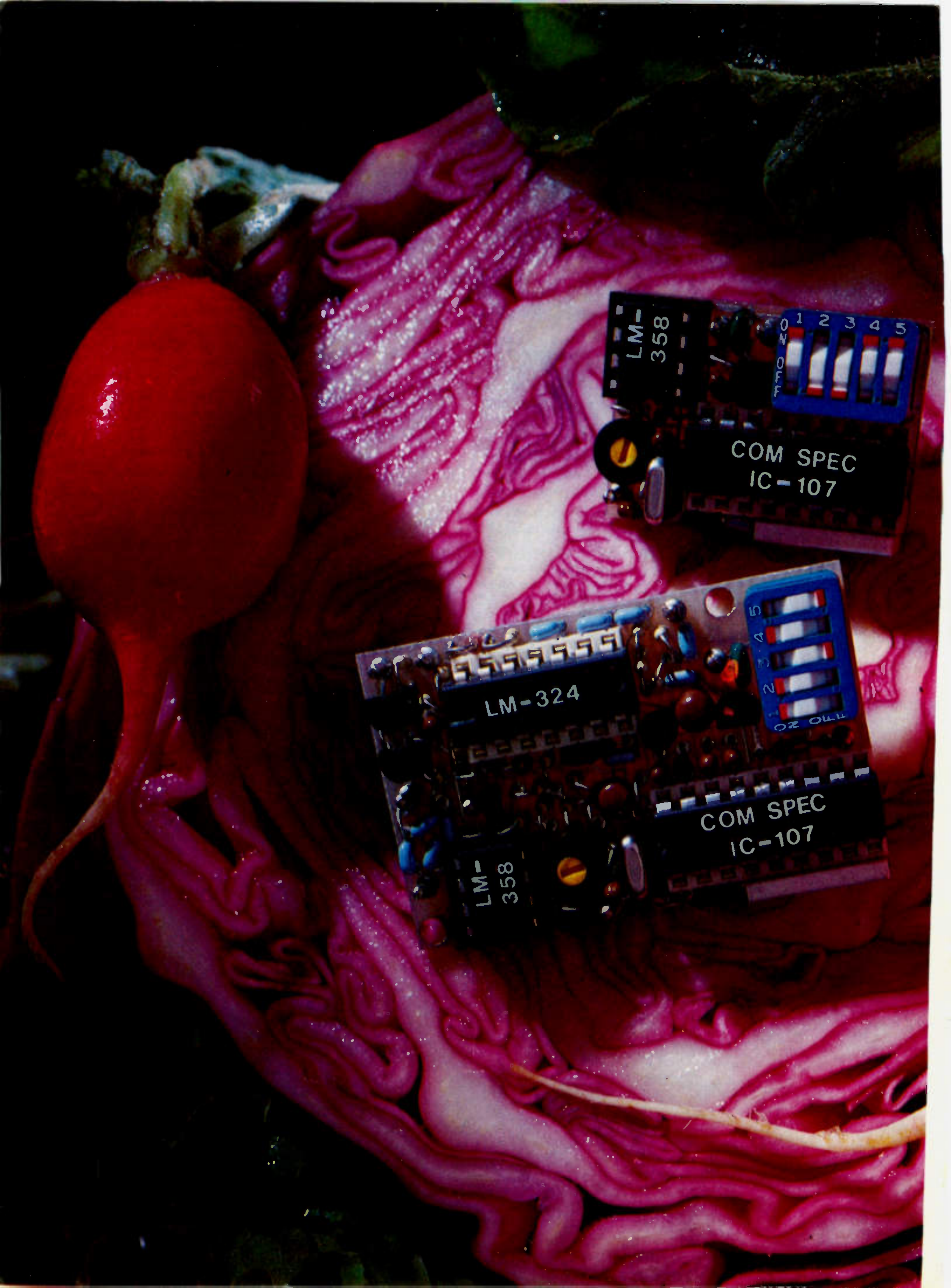
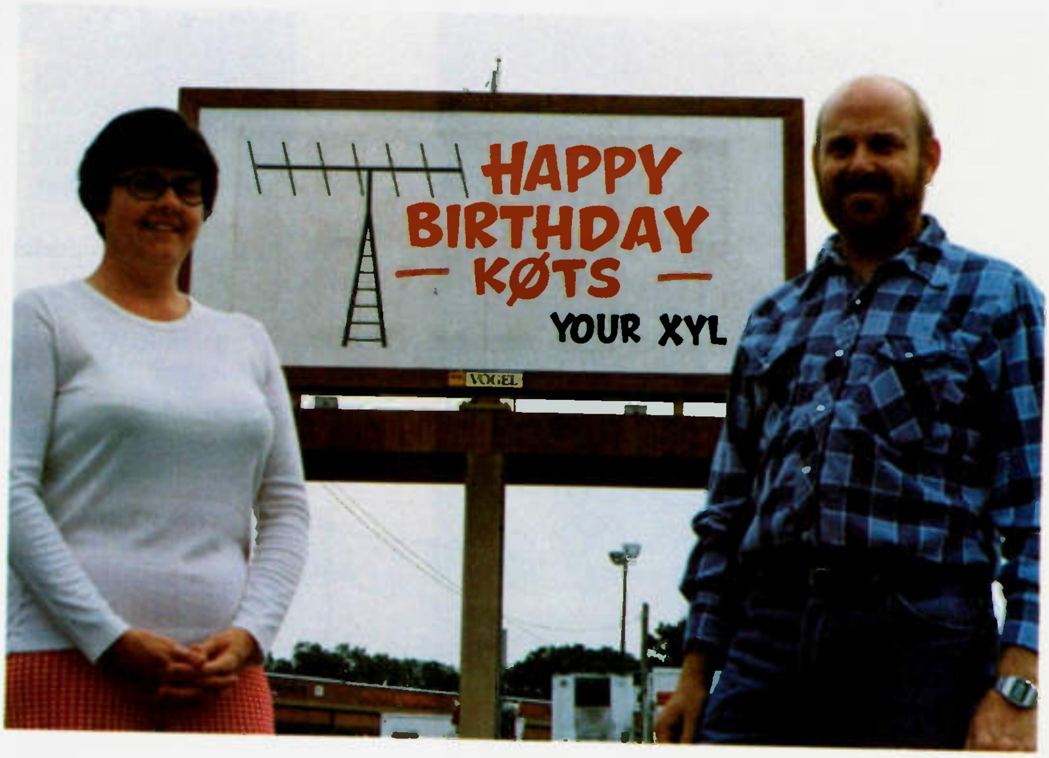


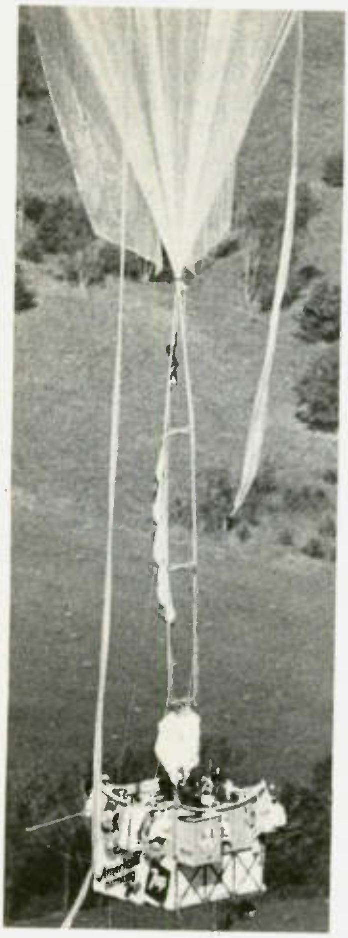

LM-358
COM SPEC
IC-107
LM-324
COM SPEC
IC-107
LM-358

Faces, Places

Say hello to the new Avanti Amateur Radio Club (Addison IL) and you'll receive their attractive QSL card. Members (left to right) are: Howard VanValzah WB9IPG, Joe Krusa WB9PIT, Dale Parfitt WA2YPY, Herb Blaese WB9PXD, Bob Steinhofer KA9FPB, Louis Martino W9DSG, Marty Linke WD9ABG, and Jack Pickering KA9FNR.



Alice Fishburn of Rochester MN presented her OM, Joe KØTS, with a 12-by-25-foot 35th birthday card in August.



John Shideler WAØNEV piloted the plane from which Dale Monaghen WØHSK photographed the DaVinci transamerican balloon on September 30, 1979. While they circled at 2500 feet about 30 miles northwest of Topeka, they used 2m to speak with the craft.

Bill Allsopp W5TJI and his XYL, Mary WB5DVA, headed up the CAREN radio club (Little Rock AR) team at the annual Arkansas State Fair in October. (Photo by Paul J. Kirsch WA8ASQ/5)

Ham Help

I need help in obtaining a repair/service manual with schematics for a Micro Match swr wattmeter, model NBR 263.11. The meter was manufactured by M. C. Jones Electronics Co., Bristol CT.

I will pay for the manual or copies of the manual and any shipping.

Nick Marsala AB5M
5339 East 97th Street South
Tulsa OK 74136

I need a manual for an Eico model 324 signal generator. I will pay for copies.

Bill Morehouse
PO Box 214
Waukesha WI 53187

I'm interested in contacting anyone who owns a TRS-80.

Sam Martinez N3SM/HK1CWB
PO Box 8814
Baltimore MD 21224

I have just purchased an older-type dc supply manufactured by Universal Electronics of Santa Monica, California. It is a Transistorized Power Supply, Model LQ35, 15 Amps, 0 to 35 volts.

If anyone has a schematic or service manual to sell or copy, please contact me. Any help will be greatly appreciated.

John Pisarski
114 Evans Rd.
Norristown PA 19403

(616) 982-3296

WA8ZVO

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AM-402

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

With the new year, it is time to consider the new readership this column has picked up in the three years it has been running. One of the most frequent questions received by this column is typified by a letter written by Robert Bunn WA0LKE, who writes, ". . . I am seriously considering getting into RTTY, (and) the confusing mass of hardware and software approaches are about to 'boggle my mind' . . ."

The approaches that Robert describes in his letter are rather typical of the options facing anyone interested in getting on RTTY. Typically, these options include:

1. Purchasing a mircrocomputer with requisite software to run RTTY.
2. Purchasing an ASCII-encoded Teletype™ machine and hard-wiring an ASCII-Baudot converter.
3. Purchasing or acquiring an old Baudot machine and using it directly.

In terms of cost, the Baudot machine may well be available at a minimal expense. What the beast lacks in "bells and whistles," i.e., noise factor, off-line use as a computer, or automatic functions, it may make up in the convenience of immediate use. Now don't forget, except for some of the computer software packages, you still will need a converter (demodulator) to decode the RTTY off the receiver audio and feed the printer. Depending on what you choose there, that could be $35 or so on up to your yearly net!

Now, I have not yet answered your question, and I know that I must, so here it goes. I cannot see buying a microcomputer if all you want it for is RTTY. There are several video-based RTTY terminals on the market, any of which should do a fine job of getting you on RTTY effortlessly and quickly. If you want to use the computer for other purposes (as I do mine, and as most everyone I know does), then your choice of a computer should be governed by considerations of the system as a computer, not a teleprinter. Adequate software is available for just about any system to turn it into a RTTY machine. Certainly, the articles mentioned in this column over the past few months show that 6800s, 8080s, KIMs, TRS-80s, and even SC/MPs are useful on RTTY. As you may know, commercial modules are even available for the PET and TRS-80, among others, to allow direct use on RTTY. However (you knew that was coming), if you want hard copy, the game changes. The cheapest, simplest path to hard copy is with a Baudot-encoded Teletype machine, such as a Model 15 or 28, hung onto a demodulator off the receiver. If you plan to use the computer for things needing hard copy, then you will probably want something a bit nicer than a Model 33 Teletype, but that is your choice.

I don't know if all this cleared things up or only served to "boggle" you a bit more, but I would urge you to ask around your area, at clubs and such, to see if you can take a look at any of the options we have discussed. That is probably the surest way to help make up your mind.

By the way, on this never-ending (it seems) topic of "silent RTTY," add another few articles to the queue. The July, 1979, issue of *73* featured two articles dealing with interfacing computers to RTTY. Albert S. Woodhall N1AW wrote "Microcomputer RTTY . . . a Software TU," which details interfacing to an 8080 system. A few pages later, Garry Caudell K4HBG shows how to hook a Teletype to an SWTPC 6800 system in his article, "Baudot Hard Copy For Your SWTPC." Also, the November, 1979, issue of *Popular Electronics* features a "Radioteletype Reader for Shortwave Receivers" as its lead article. This is a device which accepts Baudot RTTY at all commonly sent speeds, or ASCII at 110 baud, and displays eight characters on a moving LED display. Written by George Steber WB9LVI, the circuit has a self-contained demodulator that may be worth building on its own for computer interfacing.

For those of you who delight in covering the cracks in the shack wall with "ham wallpaper," the staff at *73* may have just the thing for you. The Specialty Communications Achievement Award is dedicated to amateurs worldwide who take pride in the field of specialty communications, and that includes RTTY!

To be eligible for this award, contacts must have been made on or after January 1, 1979. And

Continued on page 156

DX

The new month, new year, and new decade get off to a rousing start if all goes as planned: one major DXpedition in progress and one commencing the first week of January.

David Schoen N2KK should presently be operating from the Indian Ocean, on Juan de Nova, through about January 8; then he's on to Mauritius, an unnamed (at this time) island in the 3B group, the Malagasy Republic 5R8 on the 20th, and the pièce de resistance, the Somali Republic, around January 30. Dave is mainly interested in operation on the "low bands," but he plans to be wherever the demand is, 160-10 meters. N2KK is a professional photographer on assignment and should have an incredible slide show to present when he returns.

Since "becoming a country" in 1974, Kingman Reef has hosted two operations: the first in 1974 and another in June, 1977. At today's rates of amateur population growth, three years is enough time for a country to pass from not-needed status by most DXers into a slot on the "most-needed" lists again. In the case of Kingman, this may be rectified in the next couple of weeks, with Palmyra as a bonus.

January 4, 1980, is the starting date for operation from Kingman and Palmyra by WA2FIJ, W2TDQ, WA6YQW, K6LPL, and K2HFX. The operations will be simultaneous, with one group signing a KH5 callsign from Palmyra and another using a KH5K callsign from Kingman. Five days of operation are planned.

October, 1979, was a wild 31 days of DX by several well-known individuals and groups. Expeditions were mounted to FP8, 3D2, YJ8, FO8, FC, TF, HB0, KC6, 3C1, and CQ Zone 23. Here's a rundown of this extravaganza of a month.

DK6XR and DK7XN operated from the New Hebrides as YJ8XR the first week of October, then activated Tahiti for four more days. They were joined in the Pacific by Darrell Bevan N6DX, who finished a venture begun in September operating from the Fiji Islands. Darrell treated many DXers to contacts from the various islands on 6 meters.

In North America, K2RW and W2BHM vacationed on St. Pierre Island and put FP8AA and FP0VI on all bands. Meanwhile, during the first week of October, Lloyd and Iris Colvin, W6KG and W6QL, were plotting the next YASME Foundation jaunt through the Caribbean, with help deciding provided by attendees of the Houston Com-Con convention.

Boston hosted the annual New England DXCC meeting, featuring K1MM, KP4AM (of Desecheo fame), and former *West Coast DX Bulletin* editor WA6AUD. About 80 DXers showed up for this event.

In Europe, while HB9NL was accommodating 40- and 80-meter country chasers looking for Liechtenstein (HB0), DL1RK operated CW on all bands from Corsica (FC). Meanwhile, a large group of Ukranian operators were en route to Siberia, to Tana Tuva, which is in CQ Zone 23. They appeared on the bands mid-October for a one-month stay, and, by putting that zone on for the *CQ* Worldwide Phone Contest, made it possible for contestants to work all 40 zones during the contest. Zone 23 turned out to be a snap; the toughies were 34 and 37.

As if all this wasn't enough to make DXers happy, although busy, the two most important operations were yet to come. At mid-month, the long-awaited operation from the West Carolines group came to pass: JE1JKL and JA7FFN stayed four days on Yap Island and made 5278 contacts . . . 3738 were on CW on HF, with another 1540 on 6 meters! They must have had a 50-MHz pipeline home to Japan. JE1JKL has his QSL-handling chores cut out for him.

Finally, after weeks of rumors and counter-rumors, Equatorial Guinea came on the air to the delight of many. A Spanish DX contingent opened up with 3C1AA on October 13 and operated for several days. Their plans to proceed to Annobon Island ran into some snags, but persistence prevailed. After a fly-over the island, during which the pilot ruled out landing on the overgrown runway, the operators regrouped on the continent, hired a boat, and took the waterway to 3C0.

Annobon finally showed up on the bands on Saturday, October 27, during the *CQ* Phone Contest. The operators wisely stuck close to CW during the weekend. A full two weeks had passed between opening gun from 3C1 and starting mark for 3C0. Never say die! QSLs for 3C1AA to EA4MY, and for 3C0AB to EA4LH.

Politics often rears its head in the world of DX, especially on the continents of Africa and Asia. Last spring's expedition to Spratly Island (1S1DX) satisfied much of the demand for that country and may have been the last hamming to be done from there for some time. In its September 25 issue, *The DX Bulletin* out of Vernon, Connecticut, presented material demonstrating the tensions surrounding Spratly and the South China Sea area in general. Late last winter, the Philippines quietly annexed the major parts of the Spratly group, contrary to claims on the islands already made by Vietnam, China, and Taiwan. The main Spratly island is occupied by Vietnamese troops, while Taiwan uses three of the islands and the Philippines six.

Those who have attended a convention and seen the slide presentation by one of last year's 1S1DX operators can vouch for the uninviting nature of this "country." If you worked it, be glad. If not, you are in good company.

Franz Josef Land of the USSR is a much-needed DXCC country, and activity there has picked up. Look for UK1PAA, UK1PGO, and UA1PAL on 20 meters, both phone and CW.

Other than the Japanese, who regularly make business trips into China, the best bet for someone's foot getting in the BY door for amateur radio appears to be Thomas Wong VE7BC. He was in China in October for his twice-yearly business visit and stopped off to see JA6HOZ en route. JA6HOZ, you may recall, put BY on the air for an hour in August as part of a demonstration to city officials. VE7BC is scouting the territory and testing the waters, but the word from Chinese officials and from JA6HOZ is that it will "be a long time" before amateur radio comes to fruition in China.

Jim Bullington N4HX may be active from Chad (TT) by the time you read this. Jim works for the US government. Don Riebhoff of XV5AC, XU1DX, and CT4AT fame has his bags packed for Czechoslovakia. He visited Prague in October, showed some slides to the DX crowd at OK1ADM, and hopes for an OK8 callsign.

Bangladesh came back on the air in early autumn, after a short hiatus; S2BTF was found on 20 meters at various times

Continued on page 156

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8010 *8010.1	325.00 405.00	1 GHz	9	1-10 mV	5-20 mV	10-25 mV	1-10 mV	8: .01-20 SEC	.1 Hz	1 Hz	10 Hz 1 GHz	1 PPM 0.1 PPM	10 MHz	YES STD	YES OPTION $39.

* Has precision 0.1 PPM TCXO time base.

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#CC-70	Carry Case, Padded Black Vinyl	$ 8.95

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#8010.1	1 GHz Counter - 0.1 PPM TCXO	$405.00
#8010.1-13	1.3 GHz Counter - 0.1 PPM TCXO	$495.00

OPTIONS

#Ni-Cad-801	Ni-Cad Battery Pack & charging circuitry Installs inside unit	$ 39.00
#CC-80	Carry Case, Padded Black Vinyl	$ 9.95

ACCESSORIES

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Awards

Bill Gosney WB7BFK
2665 North 1250 East
Whidbey Island
Oak Harbor WA 98277

The holiday season has come again. Now that you found that new radio or antenna packed under the Christmas tree, it's about time you got it out and gave it the old smoke test. How about a contact or two with our Middle Eastern friends where some booming signals have been originating lately?

Just this week I received a letter from Bruce Blackburn JY9BB, who is the Communications Advisor for His Majesty King Hussein of Jordan. As maybe you know, King Hussein and the Royal Jordanian Family are avid amateur radio operators. Perhaps you have heard their calls on the air, JY1 and JY2.

Mr. Blackburn writes to share three very spectacular awards being sponsored personally by King Hussein and the Arab Radio Amateur League. Of course, upon receipt of this letter, the very first thing I did was go through my own card file to see if I qualified. Much to my disappointment, I still need one more contact, that being with either JY1 or JY2. Perhaps, just perhaps, if they read my column this month, they'll sympathize with my need and arrange a future sked.

As you can see by the requirements of the three Jordanian awards, none was meant to be accomplished in one sitting. Naturally, that creates an even greater incentive for those of us wishing to pursue their goals.

THE ARABIAN KNIGHTS AWARD

This award is issued by the Arab Radio Amateur League (ARAL) members and presented by His Majesty King Hussein (JY1) of Jordan.

To qualify for this recognition of achievement, amateurs must have proof of having contacted at least ten (10) Arab countries, and one contact must be with either JY1 or JY2. All contacts must be made on or after January 1, 1971, on any authorized mode of communications. There are no special endorsements.

JY1	King Hussein
JY2	Royal Jordanian Family
A4X	Oman
A6X	United Arab Emirates
A7X	Qatar
A9X	Bahrain
CN	Morocco
HZ, 7Z	Saudi Arabia
J2	Djibouti
JY	Jordan
OD5	Lebanon
ST	Sudan
SU	Egypt
YK	Syria
YI	Iraq
3V8	Tunisia
4W	Yemen
5A	Libya
5T5	Mauritania
6O	Somali
7O	South Yemen
7X	Algeria
9K2	Kuwait

To apply for the Arabian Knights Award, the applicant must prepare a list of claimed contacts in prefix order. Each entry must also include the date and time in GMT, the band and mode of operation, and the and station worked.

Do not send QSL cards, as photocopies will be accepted. As an alternative, you may have your list verified by two local amateurs, a local radio club secretary, or a notary public.

Enclose this list along with an award fee of ten IRCs and send to the attention of: JY1 Award Manager, PO Box 1055, Amman, Jordan.

THE ROYAL JORDANIAN AWARDS

To amateurs throughout the world who qualify, JY1, His Majesty King Hussein I of Jordan, will issue a very elegant award of achievement to recognize one of two levels of accomplishment.

First, the Silver Award is offered in recognition of having worked six different JY prefixes. There are no band or mode restrictions; however, all contacts must be on or after January 1, 1971, to count.

The second and probably the toughest award of all to obtain is the Coral Award, which is issued to amateurs who visit Jordan and make a QSO from Aqaba. Simple, huh? Anyone for a charter trip this winter?

As with all awards sponsored by our Jordanian friends, applicants must prepare a list of claimed contacts made citing the usual logbook information including RS(T).

Forward this list, stating which award it is you are applying for, along with an award fee of ten (10) IRCs to: JY1 Award Manager, PO Box 1055, Amman, Jordan.

While you have your beam in that direction, why not turn it a few more degrees and see if perhaps propagation doesn't allow a few contacts with our friends in Switzerland. Here would be your chance to qualify for the very attractive award being offered by the union of Swiss Short Wave Amateurs

Continued on page 145

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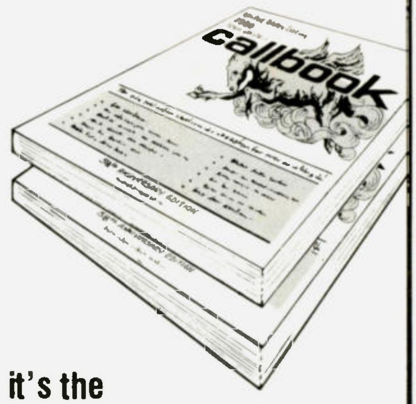

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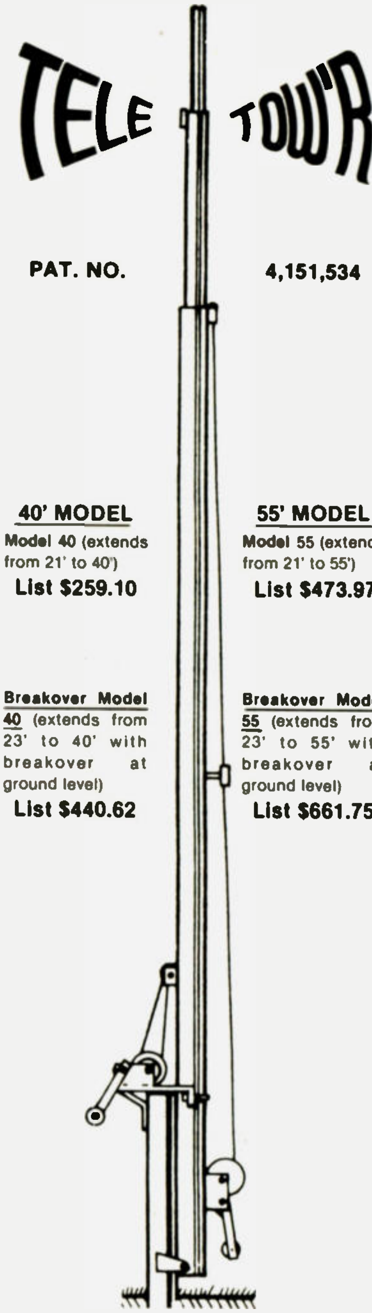

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Microcomputer Interfacing

Peter R. Rony
Jonathan A. Titus
Christopher A. Titus
David G. Larsen

Most eight-bit microprocessors such as the 8080A, Z-80, 6800, 6502, and F-8 can add and subtract only eight-bit numbers, which can represent only decimal quantities between 0 and 255. This is not enough resolution or dynamic range for many applications. Consequently, *multiple-precision* and *floating-point numbers* are used.

The term multiple precision refers to the use of two or more computer words to represent a numeric quantity. In the above-mentioned microprocessor chips, a computer word is called a *byte*, and is eight bits long. A double precision number, therefore, contains two bytes, or 16 bits, and can represent any unsigned integer number between 0 and 16,777,216. Despite this ability to represent very large numbers, multiple-precision numbers do have their limitations, especially when units such as picograms, liters/second, and kilograms all appear in a single equation.

Floating-point numbers are frequently used for scientific and engineering calculations because they can represent quantities that vary greatly in magnitude. The term floating-point number refers to a computer quantity that is usually composed of two parts, a *mantissa* and an *exponent*. For eight-bit microprocesses, a floating-point number is often represented by a 16-bit mantissa and an eight-bit exponent. Since the exponent and mantissa may be either positive or negative, one bit in each is used as a *sign bit*. This means that the three-byte floating-point number (15-bit mantissa plus sign bit, 7-bit exponent plus sign bit) can represent numbers between 32,767 x 2^{-127} and 32,767 x 2^{+127}, which correspond to the decimal number range, 1.93 x 10^{-127} to 5.58 x 10^{+42}. It is quite common for the mantissa to contain an implied binary decimal point, and thus to represent binary numbers between 0 and 1.000 or between 0.500 and 1.000.[1]

Unfortunately, a *floating-point package*, which is a collection of subroutines that perform the addition, subtraction, multiplication, and division of floating-point numbers, is a complex program. The Intel 8080 floating-point package,[1] which was written by O. C. Jelich and had its origin in an earlier 8008 floating-point package written by C. E. Ohme, requires 865 bytes of read-only memory (ROM) and 24 bytes of read/write memory. Few programmers write floating-point packages because they are available from computer manufacturers of their respective users' groups.

Integer, or *fixed-point*, mathematical programs are relatively easy to write. For 8080A-based microcomputers, the add (ADD) and add-with-carry (ADC) instructions are used to write integer addition subroutines and programs. These instructions are used not only to add eight-bit numbers, but also 16-bit, 24-bit, and larger numbers. The add-with-carry instructions are particularly useful in this regard, since they add the content of the *carry bit* to the sum of two eight-bit bytes. The carry bit is also either set or cleared as a result of this addition.

A typical triple-precision integer-addition subroutine for an 8080A microcomputer is shown in Fig 1. The subroutine adds two three-byte (24-bit) numbers that are stored in memory and returns the sum back to memory. When subroutine ADD3 is called, register pair D must contain the memory address where the least significant byte (LSBy) of one of the numbers is stored in memory. The more significant bytes of the three-byte number must be stored in consecutive memory locations at the next two higher memory addresses. At location ADD3, the C register is loaded with the number of bytes that are to be added, in this case, three. Register pair H is then loaded with the memory address where the other 24-bit number is stored. The first of the three memory locations used for this storage is assigned the symbolic address IACC (Integer ACCumulator). It should be noted that it is always possible to use a group of consecutive bytes in memory to create a multi-byte accumulator, which contains one of the operands and in which the final result of an arithmetic or logical operation is stored.

The next instruction that the 8080A executes, XRAA, clears the carry to a logic zero. This instruction must be included in the subroutine because you have no way of knowing what the state of the carry is when the subroutine is called. You do not want to add the carry from some previous operation into the 24-bit result.

At ADDAGN (ADD AGaiN), a single byte is moved to the A register from the memory location addressed by register pair D. The content of the memory location addressed by register pair H is then added to the content of the A register, and the result of this addition is copied into the memory location addressed by register pair H. Both register pairs, D and H, are then incremented by one with the aid of the INXC and INXH instructions, respectively. The *byte count*, which is contained in the C register, is then decremented by one.

When the content of the C register is decremented to zero, the 8080A returns from the subroutine. If the content of the C register is not zero, the 8080A jumps back to ADDAGN and adds the next two bytes in sequence. Note that the XRAA instruction is used to clear the carry to a logic zero only when the subroutine is first called.

Subroutine ADD3 can be easily modified to add a four, seven, or even a 200-byte number simply by changing the immediate data byte of the MVIC instruction. Of course, if four-byte numbers are to be added, you must provide a four-byte integer accumulator to store the *accumulated* result.

A triple-precision integer-subtraction subroutine for an 8080A microcomputer is shown in Fig. 2. The program is almost identical to the integer addition program given in Fig. 1; the instruction ADCM in Fig. 1 is replaced by SBBM in Fig. 2. Note that the content of the integer accumulator is subtracted from the content of memory addressed by register pair D, with the result of the subtraction stored in the integer accumulator.

In the next column, we shall discuss integer multiplication and division subroutines. A subsequent column will describe the application of these subroutines to the *smoothing* or *filtering* of data acquired from an analog-to-digital converter (ADC).

```
ADD3,   MVIC    /LOAD THE C REGISTER WITH THE
        003     /NUMBER OF 8-BIT BYTES TO BE ADDED.
        LXIH    /LOAD REGISTER PAIR H WITH THE
        IACC    /MEMORY ADDRESS WHERE ONE OF THE
        0       /ARGUMENTS IS STORED.
        XRAA    /CLEAR THE A REGISTER AND CARRY
ADDAGN, LDAXD   /GET ONE ARGUMENT INTO A
        ADCM    /ADD THE OTHER ARGUMENT TO IT
        MOVMA   /SAVE THE RESULT BACK IN MEMORY
        INXD    /INCREMENT ONE MEMORY ADDRESS AND
        INXH    /THEN INCREMENT THE OTHER.
        DCRC    /DECREMENT THE BYTE COUNT IN C
        JNZ     /IF THE COUNT IS NON-ZERO,
        ADDAGN  /PERFORM THE ADDITION AGAIN
        0
        RET     /OTHERWISE, RETURN FROM THE SUBROUTINE
```

Fig. 1.

```
SUB3,   MVIC    /LOAD THE C REGISTER WITH THE
        003     /NUMBER OF 8-BIT BYTES TO BE SUBTRACTED
        LXIH    /LOAD REGISTER PAIR H WITH THE
        IACC    /MEMORY ADDRESS WHERE ONE OF THE
        0       /ARGUMENTS IS STORED.
        XRAA    /CLEAR THE A REGISTER AND CARRY
SUBAGN, LDAXD   /GET ONE ARGUMENT INTO A
        SBBM    /SUBTRACT THE OTHER ARGUMENT FROM IT
        MOVMA   /SAVE THE RESULT BACK IN MEMORY
        INXD    /INCREMENT ONE MEMORY ADDRESS AND
        INXH    /THEN INCREMENT THE OTHER.
        DCRC    /DECREMENT THE BYTE COUNT IN C
        JNZ     /IF THE COUNT IS NON-ZERO,
        SUBAGN  /PERFORM THE SUBTRACTION AGAIN
        0
        RET     /OTHERWISE, RETURN FROM THE SUBROUTINE
```

Fig. 2.

Ham Help

I would like to get in touch with anyone who had had experience getting a computer (OSI C1P, 4K) set up and running on the ham bands sending and receiving RTTY and Morse code. Thank you.

Larry Herbert WB3HEX
2315A 14th Street
Ft. Eustis VA 23604

Leaky Lines

Dave Mann K2AGZ
3 Daniel Lane
Kinnelon NJ 07405

Phlukey phonetics are back with us again. For a brief while it appeared that the forces of Alfa, Bravo, Charlie, and Delta had prevailed; one heard the preferred phonetics and only occasionally ran into those of the humorous (or not so humorous) variety. But now they are all over the place. The bands are full of Hot Water Bottles, Soggy Tennis Sneakers, Aunt Maggie's Drawers, Jersey's Ugliest Quad, Mississippi Pea Picker, and Always Going Zigzag (you see, I'm in there, too).

I must confess that I like this sort of thing. Granted, such frivolities shouldn't be used on MARS or RACES, where a certain decorum and protocol must be observed, but what's wrong with injecting a bit of informality where it isn't out of place?

Some callsigns defy all efforts, however. As a wordsmith of somewhat lengthy experience, especially in the pop song field, I think that I'm pretty good at devising fairly clever phonetics. But when somebody hits me with those Qs, Zs, and Xs, I generally shrug my shoulders and give up. Good ones seem to come spontaneously. The very first time I ever worked Tony W2IOO, it didn't take five seconds for me to bestow upon him the sobriquet, Italy's Oiliest Olive. Whether he approved or not is an entirely different matter. I never promised him a rose garden! But it's a heckuva lot easier to remember than India Oscar Oscar, isn't it? And as for Ida Oboe Oboe, forget it!

On Christmas Day of 1964 or 1965, I've forgotten which, and I'm far too lazy to pull the appropriate logbook from the disreputable looking pile of rubble in the bottom of the shack closet to find out, I hooked up with a guy who signed We Broke 4 Plate Glass Windows. QSB was closing in fast, and we lost each other very quickly. I haven't heard him since, but I guarantee that I'll know him at once if ever I hook up with him again. How in the world could anyone ever forget We Broke 4 Plate Glass Windows? But I don't think I'd be able to remember Whiskey Bravo 4 Papa Golf Whiskey.

I'll admit that there are times when it can get confusing. I used to work a certain Horses, Ponies, & Zebras. I am now acquainted with Horses, Zebras, & Ponies. The latter happens to be a musician, and I've decided to suggest that he use Hungarian Zither Player. It doesn't matter that he's not of Magyar descent. You can't have everything.

Quarters, Dimes, & Nickels . . . Pints, Quarts, & Gallons . . . April, May, & June . . . Jacks, Queens, & Kings—all friends of mine, all instantly recognizable on the ham bands. So are Ugly Lover, Hot Little Hands, and Red Hot Electrons, not to mention one of the most well known of all, Never Say Die, who, I'm told, has something to do with this magazine.

We not only apply phonetics to our callsigns, but to many things. Who has not heard a thousand guys calling, "CQ, CQ, CQ Dog X-Ray," and what ham is not familiar with Heathkit's Hot Water series of equipment? Sometimes it's not very flattering; some AM enthusiasts still refer to sideband as Slop Bucket. And who among us has not sometimes said of another service, Criminal Band, Chicken Band, or Children's Band?

Once in a while you will hear someone use trick phonetics to clarify his name. I suppose that almost all the Floyds have used Funny Little Old Yellow Dog, and all the Bobs spell out Broken Old Bottles.

Please, I beg you, don't infer that just because I've done a little bragging here about my facility with phonetics, I'm ready, willing, and able to dig one up for you. Don't ask me to assume the burden . . . I've got enough troubles of my own. I once had the temerity (and stupidity) to offer to help someone select a name for a forthcoming blessed event, and I got into the middle of a horrendous family argument that is still going on. The mother's family is sore because they think the kid should have been named after a maternal grandfather, and the father's family is sore because he was named after a wealthy uncle who promptly changed his will in favor of the kid, thus cutting them out of their anticipated bequests . . . the kid got it all! In point of fact, he isn't even known by the name I helped to select. Everybody calls him Red, since his hair is the color of a ripe tomato.

But I resolved that I would never get inveigled into such a situation again, and I am just as adamantly determined to avoid helping with callsign phonetics. So please don't ask me for any help . . . as I say, I've got enough troubles of my own.

* * *

A serious note: Some weeks ago, while sitting in the living room, I became aware of a faintly acrid odor which seemed to be wafting in from the radio shack, about thirty feet down the hall. I went to investigate and found the room blanketed in a vast, impenetrable cloud of yellowish smoke.

The first thing I did was reach for the convenient circuit-breaker switch, just inside the doorway. Then I slammed the door shut, went into the bathroom, saturated a towel in cold water, and draped it over my mouth and nose. I took a very deep breath, opened the door, ran over to the windows and threw them open (it was a chilly night and they had been closed), and turned on the exhaust fan. I then reclosed the door and waited for about two hours before venturing back into the shack.

The surface of my operating desk was covered with an ugly, dark brown film of goop, vile-smelling and extremely viscous, like molten tar. Evidently, all the potting compound of a transformer had melted and run out through the apertures in the bottom of my prop pitch rotator control. But the worst of it had been due to the burn-up of some selenium diodes. The gas generated from these is noxious enough to be used in the California lethal death chamber!

I had been under the distinct impression that this device was adequately protected against short-circuit damage. It was designed with a power main fuse and with the appropriate interlocks and so forth. It ran on 110 V ac and its sole function was to provide 36 V dc to run the motor and to switch from clockwise to counterclockwise rotation . . . a very simple device indeed. But its power supply contained selenium diodes, and these are not to be taken lightly.

A tragedy was averted. But I am chilled by the realization that I frequently used to leave all my gear running on standby overnight, and if this malfunction had occurred while the family was asleep, we might all have been asphyxiated in our beds!

At nine o'clock on the very next morning, I drove over to my handy-dandy local hardware store and purchased a number of smoke detector alarms. One of them was promptly installed in the radio room, and others are placed in strategic locations all over the house. I do not intend to run the risk of a recurrence.

Every radio shack should be equipped with certain basic items. We have been aware of the necessity of a dependable fire extinguisher, a dummy load, certain test equipment, and so forth. But every ham should make sure that he adds to this list of fundamental necessities a good smoke detector alarm. Don't put it off . . . it may save your life and the lives of your loved ones.

* * *

If you have a strong stomach and can withstand disgusting things, go down to 14.195 when a rare DX operation is working split. I always thought that this frequency was off limits for us, but I was amazed to learn that it is a gathering place, not only for a flock of self-appointed monitors, but for one of the foulest-mouthed groups of morons and idiots I've ever had the displeasure of running into.

The usual procedure followed when DXpeditions operate split frequency is for the operator to announce his listening frequencies. He will invariably do this, and for people to insist upon calling him on his transmit frequency is bad enough, but for fifteen or twenty big mouths to feel that it is their prerogative not only to inform others that they are out of the US phone band, but to call them vile names in the bargain, is really too much. This generally occasions a retort by either the offending station or by the other filth peddler and the result is pretty chaotic.

The DX station is not bothered by the carrier throwers, the tuner-uppers, and the occasional excitable QSO seeker who forgets to flip his bandswitch . . . he is listening up the band for callers. All these guys do is make it impossible for the station being recognized by the DX operator.

Most of their voices are recognizable by their friends and associates. In all good conscience, they should be told to knock it off. And their friends need not take the trouble to be tactful or diplomatic about telling them. They are perfectly aware of the trouble they cause, and if they persist in these sorts of carryings-on, they ought to have their heads handed to them.

There's absolutely no excuse for it, and the sooner they are exposed and given what they deserve, the better. Imbeciles who do this sort of thing deserve no consideration, because they give none to others, and the very last thing their friends should provide them with is anonymity. This only enables them to continue the misbehavior.

I had occasion, even though I did not need it, to listen to the most recent operation on Mount Athos, and despite the fact that I am a guy who's been around and who's been exposed to some pretty filthy talk in my day, I was appalled at the foul talk that I heard. It's an intolerable

Continued on page 156

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Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

QSL EXCHANGE CONTEST
Starts: 0000 GMT January 5
Ends: 2359 GMT January 6

While there are many efficient, inexpensive ways by which QSL cards can be exchanged with DX stations, exchanging QSLs within the US is an expensive proposition. This contest was proposed to eliminate the high cost of QSLing and to provide an opportunity to work those rare states, counties, etc., knowing that you will actually receive a QSL card for each contact. In making a contact in this contest, you agree that you are actually filling out the other station's QSL card as the contact is being made. The objective is to receive as many QSLs as possible for contacts in the contest period.

The contest is open to all single-operator stations. Contacts may be made with the same station more than once, provided that they are made only once on each band on each mode. All modes are permitted.

EXCHANGE:

The contest exchange is an exchange of callsigns and signal reports, accompanied by the statement "I have completed your QSL card" (or "QSL DONE" on CW), or its equivalent. I suggest on phone that you actually read the time, date, band, etc., as you fill in the blanks on your QSL as a part of the exchange, but that is optional. On CW, a QRX can be used to free the hand to write the card, followed by the "QSL DONE," but again that is optional. The QSO should, in any event, be completed only when both stations have completed their QSL cards. Make sure the other station is actually in the QSL Exchange Contest and is filling out your card at the same time. Only one QSO per QSL card should be used to provide easier counting by the contest committee.

SCORING:

Scoring is the count of QSL cards which are received for you at the contest address by February 6th. Cards will be sorted and mailed to their new owners by March 6th. For each call district and for foreign countries with sufficient entrants, a trophy will be awarded the highest scorer. For each state, province, or country, the highest-scoring station will also receive a certificate.

ENTRIES

All QSL cards must be mailed as described below to: H. W. Barry Merrill W5GN, 10717 Cromwell Drive, Dallas TX 75229. The mailing must include an SASE which is at least as large as your outgoing envelope. You can use your own outgoing mailing to determine the amount of postage on the return envelope, being careful if your QSL cards are thin to add enough postage. You must sort your QSL cards in the same order that is used by the *Callbook*—by call district, then by suffix, and then by prefix. Use the station callsign, disregarding any portable callsigns for this sort. Finally, you must accompany your entry with $1.00 for every 100 QSL cards, preferably by check.

INTERNATIONAL ISLAND DX CONTEST
Starts: 0000 GMT January 12
Ends: 2400 GMT January 13

The object of this contest is to work as many stations worldwide with special emphasis on DXCC countries which are designated IDX Islands. A complete list of IDX Islands is available from the contest committee. Maximum operating time is 36 hours for single operators and 48 hours for multi-op stations. No crossmode contacts are allowed. Operating categories include phone only, CW only, or mixed mode. Entry classes include single operator/single transmitter, multi-operator/single transmitter, or multi-operator/multi-transmitter.

EXCHANGE:

All stations give RS(T) and consecutive contact number. DXCC countries which are designated IDX Islands must also give their island name.

SCORING:

Score 1 point for contacts within your own DXCC country, 2 points for contacts outside your own DXCC country. Score 1 bonus point for contacts with stations located in a DXCC country which is a designated IDX Island. Hawaii and Alaska are considered separate DXCC countries from the continental US. A station may be worked only once in the contest for point value, but may be worked on a new band for multiplier credits. The multiplier is the number of DXCC countries worked on each band. Final score is total QSO points times the total multiplier.

FREQUENCIES:

Lower 50 kHz of each phone and CW segment of the US amateur bands on 6 through 160 meters.

AWARDS:

Contestants must operate a minimum of 12 hours to be eligible for awards. Awards will be issued to those qualifying high-score entries for each operator class and mode in each US state, each DXCC country, and each IDX Island.

ENTRIES:

All entries must be postmarked no later than February 15th and must include a log-sheet(s) for each band and indicate stations worked, date and time in GMT, frequency, mode, and points per QSO. Each entry must include a multiplier list for each band, a dupe sheet for contacts of 100 or more, and a summary sheet which is available from the contest committee. All entries or inquiries concerning the IDX Contest must enclose a business-size SASE or 3 IRCs and be sent to: Gary Pierson WA7GVM, Box C, LaConner WA 98257.

HUNTING LIONS IN THE AIR CONTEST
Starts: 1200 GMT January 12
Ends: 1200 GMT January 13

The contest is sponsored by Lions Clubs International and is coordinated by Lions Club Rio de Janeiro ARPOADOR, Brazil. Participation in the contest is open to all duly licensed radio operators, Lion and non-Lion, except members of the Contest Committee of the Lions Club Rio de Janeiro. There are two operating modes: phone and CW. Participation in both modes is allowed, but points are counted separately. All participating stations must operate within their licensing regulations. Categories include single operator and radio clubs (multi-op). Points of radio clubs and radio societies will be

Continued on page 144

Calendar

Jan 1	ARRL Straight Key Night
Jan 5-6	QSL Exchange Contest
Jan 12-13	International Island DX Contest
	ARRL VHF Sweepstakes
	Hunting Lions In The Air Contest
Jan 19-20	North and South America RTTY Flash
Jan 26-27	French Contest—CW
Jan 27-28	Classic Radio Exchange
Feb 1-10	ARRL Novice Roundup
Feb 2-3	South Carolina QSO Party
Feb 9-10	QCWA QSO Party—CW
Feb 16-17	ARRL DX Competition—CW
Feb 23-24	French Contest—Phone
Mar 1-2	ARRL DX Competition—Phone
Mar 8-9	QCWA QSO Party—Phone
Mar 9-10	Europe and Africa RTTY Giant Flash
Mar 22-24	BARTG Spring RTTY Contest
Mar 29-30	YL International SSBers QSO Party—CW
Apr 19-20	YL International SSBers QSO Party—Phone

Results

RESULTS OF THE 1979 RHODE ISLAND QSO PARTY

COUNTY AWARD WINNERS

County	*Call*	*QSOs*	*Points*	*Mult.*	*Score*
Bris	KA1BBY	201	434	42	18,228
Kent	W1GOG	39	99	24	2,328
Newport	WA1OSL	82	180	33	5,940
Providence	WA1TAQ	268	536	51	27,336
Washington	K1QFD	52	120	24	2,880

SECTION AWARD WINNERS

State	*Call*	*QSOs*	*Points*	*Mult.*	*Score*
Conn.	WA1HYN	5	10	3	30
Maine	WA1WRI	9	40	4	160
Penn.	WA3ZGL	12	32	4	128
Georgia	AI4X	7	22	2	44
Ken.	KA4AZT	33	99	5	495
Tenn.	WB4WHE	4	8	2	16
Calif.	WA6JGB	10	28	3	84
Idaho	WB7URE	14	39	5	195
Oregon	KA7EOG/N	1	10	1	10
Wash.	WB7QEL	17	53	5	265
WV	WB8BMX	5	18	3	54
Ill.	W9QWM	14	28	5	140
Colo.	KA0CLS	4	16	2	32

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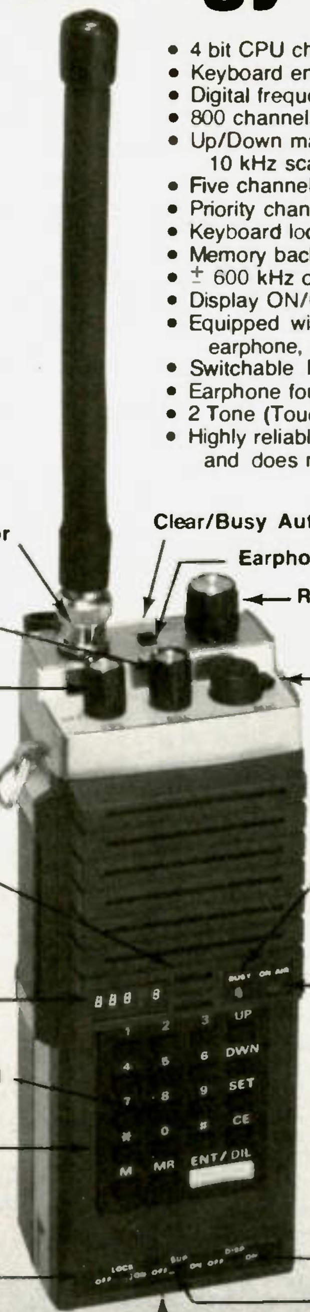

SPECIFICATIONS:

GENERAL

Frequency coverage: 144-148 MHz
Number of channels: 800
Emission type: F3
Batteries: NiCd battery pack
Voltage requirement: 10.8 VDC ± 10%, maximum
Current consumption:
Receive: 35 mA squelched (150 mA unsquelched with maximum audio)
Transmit: 800 mA (full power)
Case dimensions: 68×181×54 mm (HWD)
Weight (with batteries): 680 grams

RECEIVER

Circuit type: Double conversion superherterodyne
Intermediate frequencies.
1st IF = 10.7 MHz
2nd IF = 455 kHz
Sensitivity: 0.32 uV for 20 dB quieting
Selectivity: ± 7.5 kHz at 60 dB down
Audio Output: 200 mW at 10% THD

Price And Specifications Subject To Change Without Notice Or Obligation

TRANSMITTER

Power Output: 2.5 watts minimum /200mW
Deviation: ± 5 kHz
Spurious radiation: −60 dB or better
Microphone: Condenser type (2000 ohms)

OPTIONS

LC-C7 Leather Carrying Case
YM-24 Remote Speaker/Microphone
Tone Squelch Unit
NB-P9 Battery Pack
NC-2 Quick Charger

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YAESU ELECTRONICS Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

New Products

THE AZDEN PCS-2000

Amateur-Wholesale Electronics is proud to announce its superior new Azden PCS-2000 2-meter FM transceiver. The PCS-2000 covers 144-148 MHz in 5-kHz steps (800 channels). It features six memory channels and scanning of memory or the full band in "free," "busy," and "vacant" modes. All frequency control functions are performed by a microcomputer.

Upon inspection, the most striking feature is the absence of a large knob for frequency control. In place of a knob, there is a 12-button microcomputer control keyboard. The desired frequency is programmed into the radio digit by digit. Simplex, −600-kHz, or +600-kHz operation is selected by pushing a keyboard button. Using a front-panel rotary switch, three additional offsets become available: +400 kHz, +1 MHz, and +1.6 MHz.

It won't take an observer long to notice that the unit comes apart into two pieces: the control head and the main unit. With an optional connecting cable, the two units can be located as much as 15 feet apart. This allows great flexibility for mobile and portable operation.

The microphone contains a volume and squelch control, two frequency control buttons, and a button for instant recall of memory channel 1. By using these controls, the necessity of reaching down to the control panel while driving is greatly minimized.

The PCS-2000 has a huge ½-inch LED display that makes frequency determination easy. The S-/rf meter is digital, using LEDs instead of the usual, often-troublesome mechanical movement. There are two selectable power output levels: 5 Watts and 25 Watts. Low power is internally adjustable from 3 to 7 Watts. Frequency deviation is ±5 kHz maximum. Azden units significantly exceed FCC regulations limiting spurious emissions.

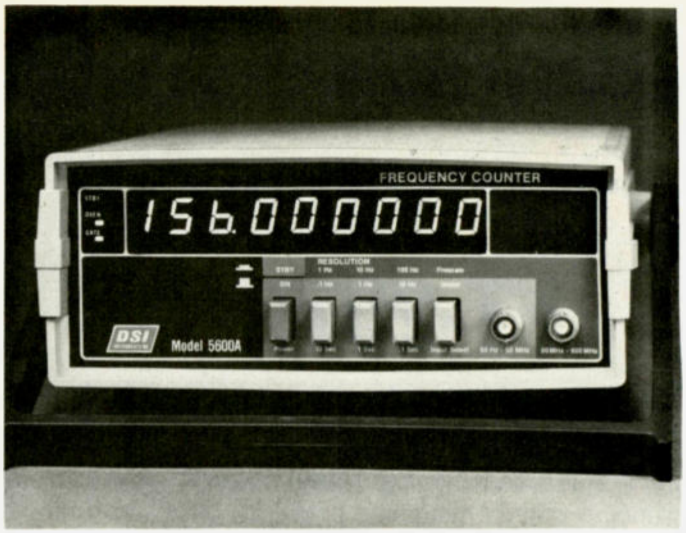
An external speaker jack is provided on both the control head and the main unit. Optional accessories include external speaker, remote cable, desk microphone, and touchtone™ microphone kit. Both the desk microphone and the touchtone kit provide the same remote-control functions. For additional details, contact *Amateur-Wholesale Electronics, 8817 SW 129 Terrace, Miami FL 33176.* Reader Service number A21.

50 HZ-550 MHZ 9-DIGIT FREQUENCY COUNTER

DSI Instruments, Inc., of San Diego, has announced its new Model 5600A frequency counter. Its large-character, bright-clarity, 0.5-inch-high 9-digit LED array—with automatic zero blanking—provides enhanced readability at a distance and at wide viewing angles, even under high ambient light conditions.

Two input channels are provided. One covers the 50 Hz-to-50 MHz range while the other is for the 50 MHz-to-550 MHz frequency spectrum. High-visibility indicator lights for "Standby," "Oven-Ready," and "Gate-Time" status are included as standards rather than extra-charge options. The user can quickly select a desired resolution from 0.1 Hz to 1.0 kHz with convenient push-button ease. Additional features include an rf preamplifier and a 550-MHz prescaler.

Housed in a compact, high-impact-resistant portable cabinet with a coordinated multi-position combination carrying handle-easel, the 5600A operates directly from an internal 8.2-to-14.5 V dc battery or a 115 V ac adaptor. It measures 3.25 inches high by 9.5 inches wide by 9.0 inches deep, including a self-contained battery holder compartment, facilitating convenient and quick adaptation to field or bench usage.



DSI's Model 5600A counter.

Cost-effectively priced options include a 10-hour rechargeable battery pack, as well as an audio multiplier that allows up to 0.001-Hz resolution, and a 25-dB preamplifier with a variable sensitivity control.

The 5600's low-cost to high-performance quotient and convenient portability make it ideally suited for measuring, troubleshooting, calibration, and servicing applications—on the bench or out in the field.

For additional information, contact *DSI Instruments, Inc., 9550 Chesapeake Drive, San Diego CA 92123; (800)-854-2049, (800)-542-6253 (California).* Reader Service number D25.

THE AEA MORSEMATIC™

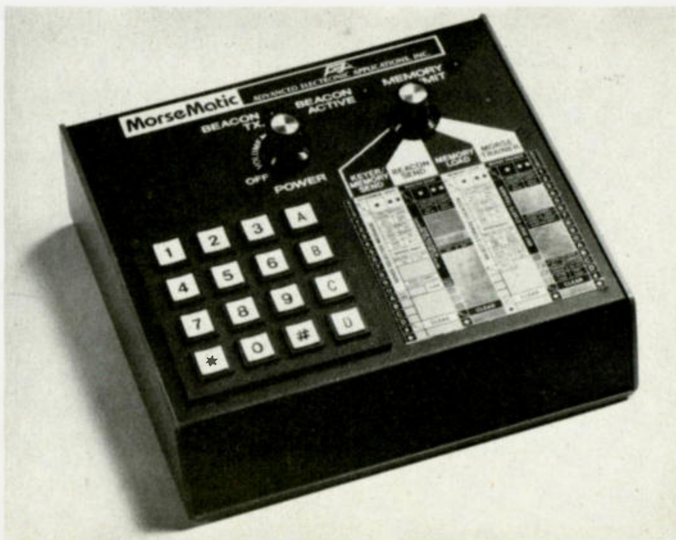
At last, a computerized electronic keyer is available that combines virtually all the features of all the other keyers in the marketplace. The AEA MorseMatic utilizes two custom state-of-the-art microcomputer chips to perform functions that were previously only a CW operator's fantasy.

For serious contest enthusiasts, the MorseMatic offers the most flexible automatic serial number generator on the market. For VHF DXers, it offers the exclusive automatic beacon mode for precise moonbounce, scatter, or tropospheric DX scheduling. To utilize the beacon mode, the MorseMatic can be instructed as to how long to transmit any selected message and how long to pause before the message is automatically transmitted again. The computers will automatically set the message code speed to fit the desired transmit window. The beacon mode can also be used for contest operating and for VHF beacon transmissions.

The MorseMatic keyer is the

Continued on page 147

The Azden PCS-2000.



The MorseMatic™.

✓ Reader Service—see page 195

LETTERS

DO SOMETHING

I have just subscribed to *73 Magazine*, but I only did so in order to obtain some fine technical and operating articles which I have had the pleasure to read in the past. The editorials are, however, another item.

Now, I realize that our government has its problems, but it is ours. We elect its representatives and it is our civil right to improve it. The ARRL is our national amateur organization and it is the right of its members to improve it. My observations have shown that when it comes to ARRL decision making, *73* is quick to criticize, but lacks either the ability or the capability to do something about it. Mr. Green, if you are intelligent enough to discover a problem, gather your band of followers and run for League president! Hams should not point fingers if they are incapable of trying to correct the problem. The ARRL is *our* organization and we should do our best to improve it rather than belittle it. For myself, I am proud to be an ARRL member.

My second point of friction concerns a segment of your September, 1979, editorial concerning "Spreading the Word." Mr. Green, this nation has had enough economists and Ralph Naders to keep our heads spinning for the next century. Tattling on grocery store chains is not our normal form of amateur activity. Besides, many factors go into the price of differing items, such as wholesale prices, middleman prices, operating and maintenance costs, taxes, wages, and, of course, a profit which is usually less than 10% of the store's actual income. If we are to develop a strong picture of amateur radio to the public, let us continue to do so as we have in the past: teaching classes, speaking to groups, giving school demonstrations, appearing at local fairs, monitoring track events, passing traffic, and, of course, working to *save lives* in the event of natural disasters, and allowing the media to know of it. *This* will continue to develop the public relations we need. Saving lives will always be more important than saving pennies!

Finally, I would like to comment on the "ARRL Line" which also appeared in the September issue. I have only been licensed three years, and I am currently an Advanced. I was not around when the ARRL pushed for this dividing line at 14.275 MHz, but I would have supported it, even as a General. What would be the use of upgrading if I would have had the chance to operate on the elite part of 20 meters? This line keeps SSTV for those who have adequate knowledge of it (i.e., Advanced and Extra). Using callsigns as the only means of incentive is all too foolish. You mentioned that this line was also the cause of losing the old manufacturers of amateur radio such as Hallicrafters, National, and Hammarlund. These companies died because of a lack of distributors, not the dividing line. Local radio dealers of the 1960s could not continue to cut their prices in order to beat the dealer down the street. Profits were lost, and the local dealer was among a vanishing breed. The manufacturers therefore lost their distributors, which caused their collapse. Another piece of evidence: The dividing line is still with us, yet names like Kenwood, Swan, Icom, Den-Tron, Yaesu, Drake, and Ten-Tec have prospered.

In closing, Mr. Green, please get your facts straight, do something rather than nothing, and keep up the great technical and operating articles. I assure you that I'll never say die.

Edward Middlebrook WD5BCI
West TX

NOT FOR SALE

The FCC column in the October, 1979, issue (p. 29) clarified a most irritating point for me. Apparently the struggle between freedom of reception and greedy commercialism was bent towards commercialism in Section 605 of the Communications Act of 1934. It is hard to believe that in this supposedly free country, artificial (fiat) restrictions would be legislated against citizens entirely for the purpose of creating a commercial market for a minority.

In order to correct the situation, I believe that a statement of the ideal for a reception law in a free country should be made and then possibly adopted as a new Constitutional amendment. I propose the following:

1. There shall be no law passed or action taken to abridge the citizen's right to receive transmissions of communications or entertainment material which are broadcast, by any means, through the citizen's private property or through public property.
2. No means of reception shall cause interference with any other reception.
3. Any broadcast material shall, during the real-time broadcast, become public domain to be disposed of at the discretion of the citizen receiving the broadcast. No copyright shall exist for material which has been broadcast.

In the foregoing, I would define broadcast to mean transmission by any means which are not shielded from radiating.

The proposal would affect zoning, mobile scanner, satellite, MDS, unscrambler, and Fuzzbuster™ restrictions, along with any other attempts to conceal from the public, deceive the public, or profit from fiat restriction of the public. It would allow all present forms of commerce to continue, except without the protection afforded by artificial law.

In my opinion, transmission must be regulated to maintain order, but reception must remain uncompromised.

I presently hold a commercial operator's license which would allow me to profit from the restrictions of the public's right to receive, but I am appalled to think that a citizen could be arrested and fined or jailed for receiving transmissions which are broadcast through his own private property. Compromise of the right to receive opens the door to all forms of censorship, greed, and tyranny. By any reasonable sense of ethics, Section 605 is out of line and MDS is out of business. The airwaves are not for sale!

Carl B. Rayman WA0RLY
Austin TX

WINDMILLS

The conversations, editorials, letters, strong words, and anger about CBers on 11 meters all seem a little fruitless to me. The false premise is that something significant can be done about it.

The FCC choices really are: Shall we waste $100,000 trying to enforce present regulations or shall we legalize the 11-meter facts of life?

Isn't it perfectly obvious that nothing of value is being gained through present levels of enforcement? And isn't it equally obvious that Congress isn't going to fund a vastly increased enforcement effort? Besides, 11 meters will be dead in a couple of years anyway. It seems, to me, more productive to worry about unlicensed operators on the bands that will be open.

I have no statistics to support my belief that 7, 14, and 21 are loaded with Novice operators who can't master code or who haven't the engineering background to upgrade. Nor do I have any statistics to support my guess that as 11 meters dies, thousands of CBers will convert their ham rigs back to the ham bands. It's either that or junk some very expensive equipment.

Of course, ham ranks have grown greatly as CBers upgraded. I would expect this to continue, but not to the exclusion of unlicensed operators.

Hams now operating on 11 meters—some think it's more fun than the typical signal report—will go back to legal operation, but the amateur bands will never be the same.

I would expect the next step to be, as ham frequencies become vastly overloaded, hams going outside the bands. Won't that be embarrassing?

Old hams will battle against the new boys. Amateur radio will never be the same—whether that's for the better (vastly increased use by citizens of their airwaves) or for the worse (pollution of those airwaves).

It's a matter of opinion, but one thing is for sure: It *will* be different! And tilting at windmills is just as fruitless today as it was in the days of Don Quixote.

Name withheld
by request

NITPICKING

This letter is about the comments in *73* Letters concerning the ARRL.

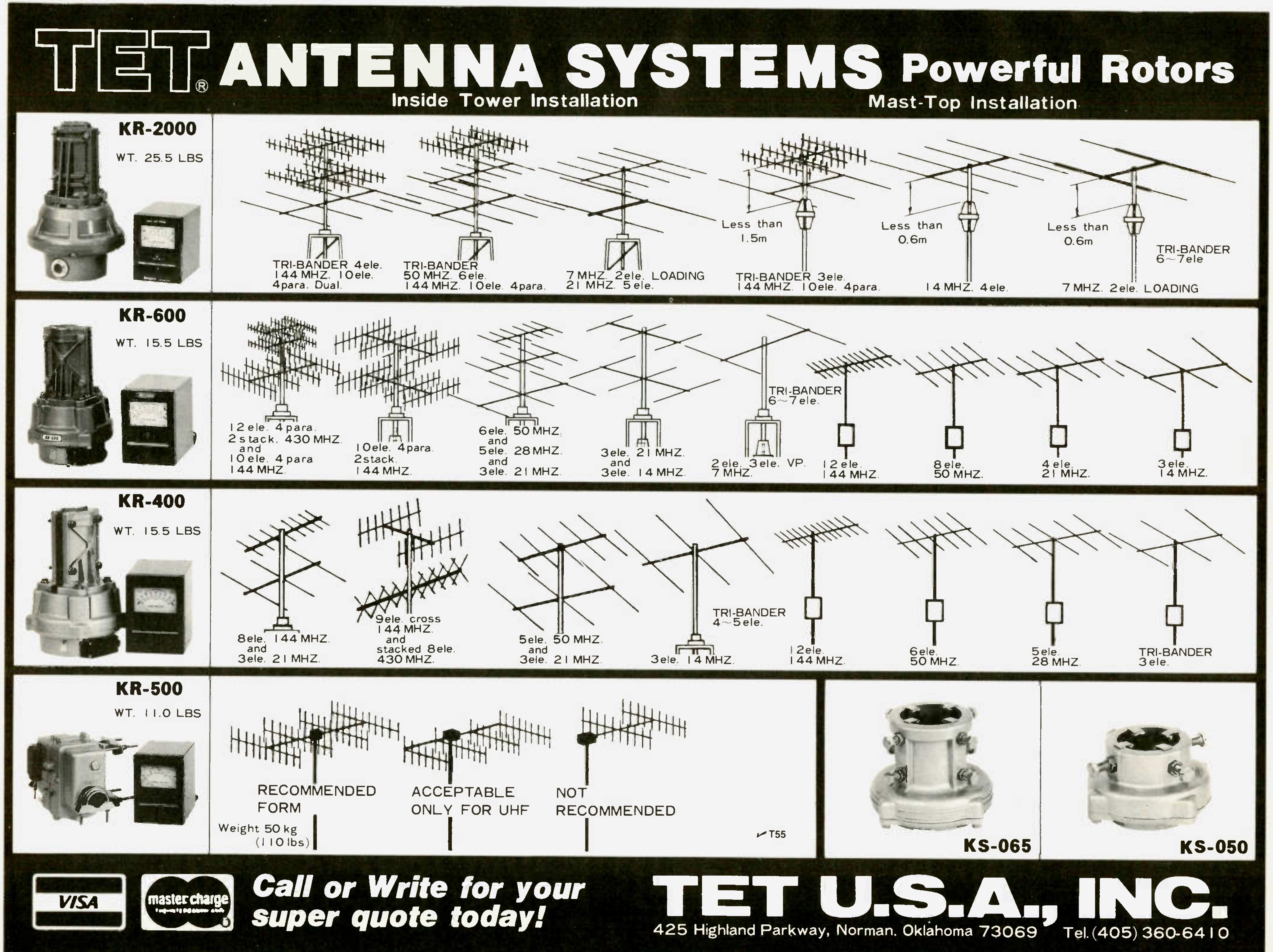
It is likely that the things they say are true, but I have yet to hear of any of these characters recommending an outstanding ham for election to the ARRL Board of Directors. Criticism without constructive countermeasures accomplishes nothing. Seems more like the writers are just jackals on an ego trip.

I'd sort of like to see a good "Bismarck" in ARRL headquarters. They tell me the only good time to live in Europe was when he ruled with an iron fist.

The mass of hams in the US are too diversified a group to be governed in such a manner that all hands will be content with everything. I have doubts that a good Bismarck will ever be found, so I guess hams will have to depend on the Board of Directors.

How many. more years are

Continued on page 154



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7 MHZ. 2ele. LOADING 21 MHZ. 5ele.
Less than 1.5m
TRI-BANDER 3ele. 144 MHZ. 10ele. 4para.
Less than 0.6m
14 MHZ. 4ele.
Less than 0.6m
TRI-BANDER 6~7ele
7 MHZ. 2ele. LOADING
KR-600
WT. 15.5 LBS
12ele. 4para. 2stack. 430 MHZ. and 10ele. 4para 144 MHZ.
10ele. 4para. 2stack. 144 MHZ.
6ele. 50 MHZ. and 5ele. 28 MHZ. and 3ele. 21 MHZ.
3ele. 21 MHZ. and 3ele. 14 MHZ.
TRI-BANDER 6~7ele.
2ele. 3ele. VP. 7 MHZ.
12ele. 144 MHZ.
8ele. 50 MHZ.
4ele. 21 MHZ.
3ele. 14 MHZ.
KR-400
WT. 15.5 LBS
8ele. 144 MHZ. and 3ele. 21 MHZ.
9ele. cross 144 MHZ. and stacked 8ele. 430 MHZ.
5ele. 50 MHZ. and 3ele. 21 MHZ.
TRI-BANDER 4~5ele.
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Tim Daniel N8RK
73 Magazine

NBVM: Dawn of an Era or Promotional Hype?

—the performance and politics of Narrow Band Voice Modulation

In December, 1977, a well-known radio organization announced the development of "Narrow Band Voice Modulation," a breakthrough that would "revolutionize" voice communications. In the months that followed, two feature articles in *QST* and a chapter in the *Radio Amateur's Handbook* were devoted to NBVM. A prototype was developed and tested, and now a commercially-produced version of the system is in the hands of approximately 300 amateurs. If you are curious about the future in store for one of amateur radio's most publicized developments, read on.

At first glance, NBVM proponents have presented a number of highly beneficial reasons for adopting the system. Among those listed are:

1) Savings in spectrum. This is accomplished by reducing the bandwidth of your SSB signal to one-half its original size.
2) Significant improvement in the signal-to-noise ratio as a result of reducing bandwidth.
3) Better adjacent-channel rejection. This means cutting down on QRM.

In an age where our frequency allocations are threatened and the number of hams is growing, it is hard to criticize any proposal that would reduce congestion in the "overcrowded voice segments of the high-frequency amateur bands"—as one editor put it.

As a bonus, NBVM is supposed to increase your capability per Watt and reduce the bother of QRM! However, it is important to remember that performance, not promotional tactics, will be the deciding factor for the acceptance by the amateur radio community of any new communication system.

This article discusses the theory behind NBVM, evaluates the only commercial unit available, and offers some insight into the politics surrounding amateur radio's newest mode. Readers who are not technically inclined may want to skip the "How It Works" section and go directly to the later material on the performance and politics of NBVM.

How It Works

Narrow Band Voice Modulation is based on two methods of audio processing. The amplitude-compandor portion of the system compresses the amplitude of the signal. Expansion of the audio takes place at the receiving end. The concept of amplitude companding has been around for many years but did not become economically feasible until the development of large scale integrated circuits. The signal's bandwidth is compressed by using a frequency compandor. NBVM pioneer Dr. Richard W. Harris claims that this is a newly developed technique of audio processing.

The concept behind the amplitude compandor is a familiar one to many SSB operators. More efficient use of the transmitter power is obtained when the audio signal is compressed before it reaches the modulation stage. Compression and clipper circuitry have been the mainstay for most amateur speech processors. The problem of a noisy waveform arises when compression goes beyond the first few decibels of improvement. Characteristically, most hams using processors keep the level of compression low enough to avoid this problem. The NBVM system allows a greater level of compression since the receive station has an expander that reduces the noise level during the quiet part of the voice passage.

Many of the NBVM benefits rely on a reduction in bandwidth. Normal single sideband techniques use the voice information between 350 and 2400 Hz. The lower and upper responses are determined by the characteristics of the microphone and the filters built into your transmitter. The resulting carrier contains about 2100 Hz of usable audio.

I doubt if most audiophiles would praise the fidelity of a typical SSB signal, but the quality is more than adequate for everyday amateur use. Since SSB is the most effective method of rf modulation for voice communication presently in use, any conservation of bandwidth must take place in the audio frequency range. Accordingly, NBVM is known as a "baseband communications system." This allows any required processing scheme to be interfaced to the microphone and speaker lines of your rig, a much more pleasant concept than the alteration needed for rf processing.

Analysis of speech has shown that there are several parts of the audio spectrum that carry the information needed for acceptable intelligibility. Three such formants lie below 2500 Hz. It is important to remember that these formants are separated with noncritical spectrum between them. By removing these gaps, the frequency compandor portion of an NBVM unit is able to reduce the required audio bandwidth. The vocal chord sounds between the 400-Hz system rolloff and 600 Hz are passed through unaltered. The second and third formants are composed of voice sounds between 1000 and 2500 Hz. By mixing this audio with a 3100-Hz sine wave and filtering the output, the 1000- and 2500-Hz segments are folded into the 600-to-2100-Hz spectrum.

A further savings in bandwidth can be achieved by inverting and translating only the 1500-to-500-Hz segment. This means the output will fall between 600 and 1600 Hz. Fig. 1 shows a block diagram for a 1600 Hz frequency compandor.

The frequency compandor theory may look fine on paper, but the ability to translate it into a working model is what counts. The most important element of the design is the need for extremely sharp filters. Dr. Harris chose to use active-type filters for his prototype. Filter theory has been thoroughly discussed in previous amateur articles, so I will mention only the most important characteristics.

With the exception of a 700-Hz high-pass device, the filters in the commercial model are of the low-pass variety. The *QST* "construction" article states that they are based on 0.1-dB Chebyshev prototypes. They must exhibit a very small delay yet remain selective. The crucial 1600- and 2100-Hz filters have 16 poles each, while the remaining three use either 6 or 8 poles.

The resulting circuitry involves approximately 20 operational amplifiers. In order to ensure low noise and uniform gain, high quality Tl074 bi-FET quad op amps are used. The resistors and capacitors used in the filters should have no more then one percent tolerance for best results. A great deal of attention must be paid to eliminating potential audio and rf feedback as well as troublesome ground loops.

Due to the complexity of the frequency compandor and the problems associated with discrete layouts, Dr. Harris and the VBC corporation developed six hybrid chips that contain most of the necessary circuitry. In addition to the filters, the VBC chips contain the 3100-Hz oscillator, balanced mixer, preamplifier, and buffers. Because the filters become saturated if the audio level gets too high, the voice signals are kept at around -10 dBm.

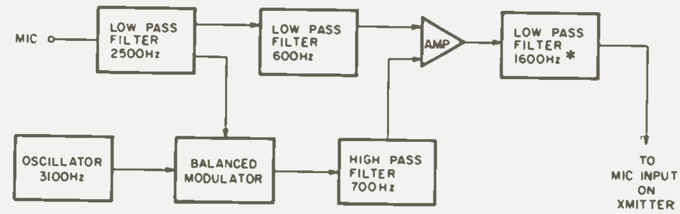

*Fig. 1(a). 1600-Hz frequency compandor used to transmit narrow band voice modulation. *2100-Hz low-pass filter is used in the wider frequency expander mode.*

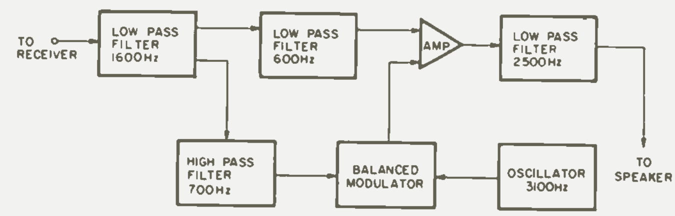

Fig. 1(b). 1600-Hz frequency compandor used to receive narrow band voice modulation.

Several standard ICs are incorporated in the VBC design. These include an LM380 that gives one Watt of audio output during receive and an NE571 for the amplitude compandor. The power supply uses two garden-variety regulator chips. All of the system's active components reside on a 4.5" x 5.5" circuit board. A 44-pin edge connector provides connection to the inputs and outputs as well as to the switches and gain controls.

Theoretical and Test Performance

The *QST* articles on NBVM stressed the idea of ham experimentation to evaluate and improve the NBVM system. Prior to the availability of the VBC-3000 unit, very few high-frequency tests were conducted. Most of the performance data resulted from a study by the FCC's Land Communications Office. Their tests were oriented towards channelized SSB applications in the VHF commercial radio bands. The Commission's findings give some numerical indications of the effectiveness of NBVM.

When a 1600-Hz method (1300-Hz bandwidth) is used, the bandwidth of a normal SSB signal is cut in half. The broader 2100-Hz method (1800-Hz bandwidth) gives only a 33% savings. The smaller bandwidth can be interpreted as an improvement in the signal-to-noise ratio. The log (base ten) of the bandwidth in kilohertz is multiplied by 10 to obtain a comparative value. An unaltered SSB signal is computed to be 10 x log 3.2 = 5.05 dB.

Calculating the bandwidth factor for the 2100-Hz system gives 3.22 dB, and when the 1600-Hz setup is used, the value is reduced to 2.04 dB. The NBVM numbers are subtracted from the SSB value to give the improvement resulting from frequency companding. With the 1600-Hz filter, a theoretical improvement of 3 dB is achieved. Dr. Harris's description of the FCC results states only that a net improvement in the SNR was found. No numerical figure was given.

FCC tests also showed a 12- to 15-dB increase when only the amplitude compandor is used. Unlike the frequency compandor mode, improvement occurred when the received signal was measured straight through, without expansion. The *Radio Amateur's Handbook* states that amplitude companding becomes effective when the signal is several decibels above the noise level. Apparently, the expander requires a signal that is strong enough to act as a reference.

The VBC Model 3000

There were a number of comments in the early NBVM write-ups which suggested that many amateurs could get involved in NBVM tests by building their own baseband unit. Unfortunately, the detailed technical information dealt only with a system based on the VBC hybrid chips. Since most hams lack the ability or initiative to design and build a project of this magnitude, the only practical way to get involved was by purchasing a commercial NBVM transceiver. Only one model is available, the VBC Model 3000 Baseband Transceiver.

The 3000 is manufactured by Dr. Harris's company, VBC, and is marketed to amateurs by Henry Radio. One of the first units available (serial number 12) was acquired by *73* early last spring. Since then several cosmetic changes have been made in the 3000's design, but our unit functions identically to the newer ones.

The 6.5"W x 2"H x 9.5"D size is slightly smaller than a typical two-meter rig, and the Model 3000 weighs approximately two pounds. The two-piece grey cabinet contains the circuit board described previously plus the necessary controls and jacks that interface it to the real world. The user must supply 12.5-20 volts dc. VBC offers an optional wall-plug transformer that will meet this need. A 40-page operator's manual gives a thorough functional description and hookup information. The manual provides a number of tips for the NBVM, but it appears to be written hastily and includes a number of spelling mistakes.

There are two receive inputs, three receive audio outputs, two microphone inputs, and two transmit audio output lines. It is very important that the 3000 be properly matched to the microphone, speaker, and transmit/receive apparatus in your station. I found out the hard way! Attention must be paid to impedance matching if you want decent results. The amateur compatible microphone input can be varied to match a 500-50k-Ohm microphone by clipping two jumpers inside the cabinet. The stereo phone jack was factory wired to be used with a 600-Ohm rig. By swapping the 600-Ohm line with the high impedance output at the circuit board connector, I was able to hook the VBC system to a Kenwood TS-820 microphone input. An Astatic D104 microphone was used during the *73* tests.

Care must be taken to avoid applying dc to the Model 3000's audio connections. For example, the Icom IC-701 transceiver microphone line has a nine-volt potential used to power a preamp in the microphone. If you were not aware of this, serious damage might result to the baseband transceiver's protective capacitors when the 701 was turned on.

On the Air

The operator's manual suggests that a Model 3000 owner familiarize himself with the NBVM functions by using a tape recorder, before going on the air. Frequency-companded speech sounds far different than normal SSB when it has not been expanded at the receiving end. I found the tape recorder practice to be well worth the time. Once I was familiar with the unit and was ready to go on the air, I had to find another station with NBVM capabilities. Since there were no widely publicized NBVM nets or frequencies, I resorted to using the telephone to set up the first few contacts. Needless to say, NBVM is not in wide use.

The initial QSOs were very unsatisfying since the transmitter was not getting enough drive from the NBVM transceiver. This problem was solved by checking for and finding an impedance mismatch. When the gain controls on the 3000 and the transmitter are properly adjusted, there should be plenty of drive. This can be checked on most rigs by using the alc meter. I found that these adjustments were somewhat critical, and it was easy to overdrive the system, causing distortion.

When receiving NBVM signals, it is important to experiment with different rf and af gain settings on the receiver as well as the volume control on the Model 3000. The best copy was achieved when the rf gain was substantially reduced, although there was then degradation of the agc action. If good performance is desired, it is necessary to readjust the three receive and two transmit audio controls constantly. This is not a "set it and forget it" system.

Early narrow band publicity stressed that the frequency-companded signals could be copied by a station not equipped with NBVM. Since the second and third formants of the voice are inverted, they will be on the opposite sideband compared to the conventional signal. If the NBVM is transmitted on lower sideband, these formants can be understood by tuning in the signal on upper sideband. A more complete explanation is given in the "Listening to NBVM" box.

It is important to note that this is a very compromised situation. The level of intelligibility is low, and the advantages of NBVM aren't being used. It would be extremely awkward to conduct a QSO between an NBVM and non-NBVM station due to the need to change sidebands and turn the frequency compandor on and off. The ability to listen to NBVM without having a compandor is of little practical consequence.

The *73* tests were carried out under a variety of actual operating conditions. Although we did not perform a laboratory-style evaluation, several NBVM claims were confirmed. The amplitude compandor provides at least 12 dB of improvement, as long as the signal-to-noise ratio is positive. The amplitude compressor offers a number of advantages for everyday use. Simple tests on bandwidth savings showed that the 1600-Hz mode (1300-Hz bandwidth) provided no noticeable improvement. This result was confirmed by several other NBVM users, and the general consensus is that the 1600-Hz mode is the only beneficial one in terms of spectrum savings.

The most obvious benefit occurs during QSOs with stations which are weak and where adjacent channel interference (QRM) is causing problems. Provided the other station has NBVM, it may be possible to conduct a QSO when it would not be possible using conventional sideband. For day-to-day strong signal amateur activity, the VBC Model 3000 does not offer much in the way of improvement.

Bells and Whistles

One of the selling points of the 3000 is its multipurpose nature. A number of uses besides NBVM are suggested. These include having the unit serve as an audio amplifier or perhaps as the filter-power amplifier for a simple receiver. At one time, VBC was investigating the possibility of providing hybrid chips for such a receiver. If you experiment with digitally-based voice communications, the frequency compandor might offer some interesting possibilities. Commercial owners are using the 3000 to combine voice and data information on the same telephone line.

A more practical ham use of the 3000 could be as an auxiliary filter. Front-panel switches allow the user to select this option for receive only. The high quality of the filters make them useful for non-NBVM use. However, they are not specifically meant for this, and provide a compromise in this respect. The alternate functions do enhance the Model 3000's value, but they should not be considered when evaluating NBVM.

Pound for pound, the VBC Baseband Transceiver is probably not one of the better electronic buys available. The Model 3000 costs $349.00. A circuit board configuration is available for $279.00. The early model tested at *73* has poor quality switches which do not enhance the unit's value. The later version uses better parts, and as a result, it looks and handles better. The amplitude compandor is centered around an NE571 IC which has a single unit price of about $5.00. The major reason for the $349.00 price tag lies in the frequency-compandor circuitry. The overall dollar value of the 3000 is a subjective matter. I don't think the price is right to encourage widespread amateur use.

Another subjective area is the evaluation of the NBVM sound. I am certainly not a high-fidelity freak, but the frequency-companded speech does not have nearly as pleasing a quality as traditional sideband modes. As a result, I found it more difficult to fully comprehend the other stations. Any NBVM test should consider the factors of operator fatigue and enjoyment. Like any new system, it takes time to adjust to NBVM.

A Commercial Gold Mine?

Technological breakthroughs are not an everyday occurrence in amateur radio. No matter what the result is for the art of communications, politics is sure to be involved. NBVM is no exception. The circumstances surrounding its role in the amateur world has both current and historical implications.

Long before the first amateur test of NBVM, the system received careful scrutiny by the FCC. VBC, in cooperation with Stanford University and the FCC, tested NBVM as a possible means to reduce the size of channels needed for commercial VHF communication. In this scenario, the present FM land mobile systems would be replaced by SSB using narrow band voice modulation. This would allow between three and six times the current number of users.

Conflicting reports were presented to the Commissioners. The one referred to in the *QST* articles supported the NBVM claims and suggested further study. A second report raised a number of questions about the effectiveness of SSB/NBVM. It said there was a need for far greater frequency stability and that many intermod problems may occur if a narrow channel scheme is used. Although the report did not totally dismiss the idea of SSB/NBVM, it raised a number of objections. The industry reaction to NBVM has been cool, at best.

The current NBVM system is not the final version. VBC is developing a pilot carrier system that will automatically take care of frequency and gain control. It should be stressed that this is a substantial improvement over what is available now, but it is not readily applicable to HF

Listening to NBVM

If you do not own a frequency compandor, it still is possible to listen to the gang on NBVM. The results will depend on the receiver you use and your ability to comprehend less than ideal audio. The two formants of speech lying between 1000 and 2500 Hz are inverted into the spectrum lying between 600 and 2100 Hz. In the case of the narrow frequency compression, usable speech will be found between 600 and 1600 Hz. By tuning your receiver to the opposite sideband, it is possible to listen to these two translated formants. Tune slowly; a 20-Hz difference in frequency can be enough to make the signal unintelligible. If your receiver has a tunable passband filter, it may be possible to eliminate the first formant, below 600 Hz. It is in the other sideband and acts as QRM when you are trying to tune in the 600-to-2100-Hz segment. The 2100-Hz mode is not too difficult to eavesdrop on. The 1600-Hz mode requires you to have a good receiver and sharp ears. Remember, use the opposite sideband.

The best results for receiving NBVM obviously occur when you have a frequency compandor. If possible, establish contact on conventional sideband first. Carefully tune your receiver for the most natural sounding audio. If the transmitting station is using an amplitude compandor and you have an expander, adjust the receiver af gain (volume) so that no difference in the audio output level is heard when you switch the expander in and out. Then set the volume on your NBVM unit to a pleasant level. If the signal seems to blank out the expander, reduce the drive.

Now go to the frequency-companded mode. It will be possible to copy a compressed signal using either the 1600- or 2100-Hz filter in your expander, but the best results occur when your mode matches the transmitted signal. It may be necessary to make slight adjustments in frequency. This is best accomplished using RIT, a separate vfo, or a receiver/transmitter pair. It is essential to be able to tune within 20 or 30 Hz of the other station's frequency. Older receivers and some of the new synthesized rigs may present problems.

Readjust the rf and af gain controls on your receiver to obtain the best sounding audio. It may be necessary to turn off the agc if there is a strong signal on an adjacent channel. The i-f filtering in different rigs can influence the quality of the NBVM. Remember that a frequency-companded system will not offer the same intelligibility found on conventional SSB. Experimentation is the name of the game.

Following are some frequencies where NBVM activity is centered. The number of users is very small, so don't be surprised if there isn't much activity.

80 meters

3.850 MHz, Wednesdays at 0000 UTC (Tuesday night). This net meets prior to the East Coast AMSAT net on the same frequency.

40 meters

7.175 MHz, Saturdays at 0030 UTC (Friday night). This is an informal net of eastern stations.

20 meters

14.210 MHz—International calling frequency for NBVM.

14.235-14.242 MHz—Stateside NBVM QSOs can sometimes be found between these frequencies.

15 meters

21.302 MHz—Several DX NBVM stations have reported using this frequency.

amateur use.

Careful readers will remember that VBC has a system patent for parts of the NBVM system. At least one major corporation disputed the claim that Harris's frequency compandor design was original. It is easy to sympathize with VBC in its David vs. Goliath battle with the FCC and the big corporations, but the stakes are high. An FCC follow-up grant totalled $54,000, while production of 25 units a week for amateur use means a gross of $455,000 a year if all the units are sold. The private land mobile industry represents a potential market on the order of $12 billion if the FM gear currently in use is replaced. Obviously, VBC is very interested in being the sole supplier of NBVM hardware.

NBVM Is Dead and the ARRL Slew It?

It is easy to see how NBVM differs from earlier amateur radio developments like SSB and FM repeaters. The American Radio Relay League's involvement (or lack of it!) in these previous breakthroughs provides an interesting comparison to their NBVM affiliation. It was clear in the beginning that the ARRL would be the major backer of NBVM. Early publicity stressed that this was an experimental system that could be built and tested by amateurs. The much awaited *QST* "technical" information tarnished those claims. Since then, the Newington-based spokesmen for ham radio have quietly dropped NBVM.

Rumors abound concerning the League's involvement. It is clear that the initial support was based on a VBC demonstration tape which was not necessarily the most unbiased source. The *QST* articles and the *Handbook* chapter were published before the League staff had seen or tested a prototype. When tests were finally conducted, the inability to achieve the claimed benefits apparently left the ARRL in a corner. No W1AW tests have been conducted for the membership, and the League has turned its attention to other spectrum-saving techniques.

Despite the lack of independent supporting evidence, ads are appearing which claim that NBVM is the "most important innovation in amateur radio since SSB." Even though no concrete numbers showing the actual benefits to an HF amateur user are available, we are assured that the system is bound to succeed. Conflicting reports are given about the number of Model 3000s owned by hams. It is clear that many of the units are being tested by non-amateur users. The approach by those people commercially involved with NBVM is characterized by a lack of organization, poor technical documentation, and, in some cases, evasion.

Although early NBVM publicity urged us to exercise the ham tradition of experimentation, Model 3000 owners are cautioned by VBC not to "attach improvised circuitry anywhere on the printed wiring board." Despite the appliance operator's approach taken by VBC, there is amateur involvement in baseband communications experimentation. At least one ham has built an NBVM unit based on digital filters, and there are several designs being tested that don't rely on single-source chips.

Conclusions

During our on-the-air testing with other amateur stations equipped with the VBC Model 3000, we did not encounter a single situation in which NBVM was superior to ordinary SSB, although a few of the operators we contacted said they had found an advantage to using NBVM under certain conditions. Another point to remember is that the spectrum-saving frequency-companded mode is useful only when the stations at both ends of the QSO are equipped for NBVM.

Reception of frequency-companded signals on an ordinary receiver is possible, as outlined in the accompanying "Listening to NBVM" box, but the process is cumbersome and the fidelity is quite poor. A successful contact between an NBVM station and a non-NBVM station is an extremely unwieldy method of communication. It's doubtful that amateurs without NBVM will have much interest in participating in NBVM testing. Although such participation was suggested in the September, 1978, issue of *QST*, there is little useful information which non-NBVM stations can gather by listening to frequency-companded signals.

It would be shortsighted simply to dismiss a technology that promises more efficient use of the amateur bands. However, it is equally shortsighted to jump at the first new technique to come along and begin promoting it as the most important innovation since single sideband. This tends to discourage exploration of other promising methods such as digitalized speech, time multiplexing, and synchronous detection.

Regardless of the methods used to achieve a savings in spectrum, the advantages of reduced bandwidth, power savings, and signal-to-noise ratio improvement must be weighed against the increased complexity, loss in fidelity, and higher cost. When SSB was introduced, most amateurs were skeptical of the new mode, much as they are now skeptical of NBVM. In the case of SSB, though, its clear superiority over AM convinced the skeptics; the benefits obviously outweighed the costs. After our tests, we at *73* do not believe that NBVM, as applied in the VBC Model 3000, offers that same clear superiority over our present modes of communication.

More experimentation with reduced-bandwidth techniques is needed. Also, it's important that ideas be shared among experimenters. If you are having success with any reduced-bandwidth system, including VBC's Model 3000, be sure to document your work, write it up, and send it to us for publication in *73*. Let's all work together to develop a viable system.■

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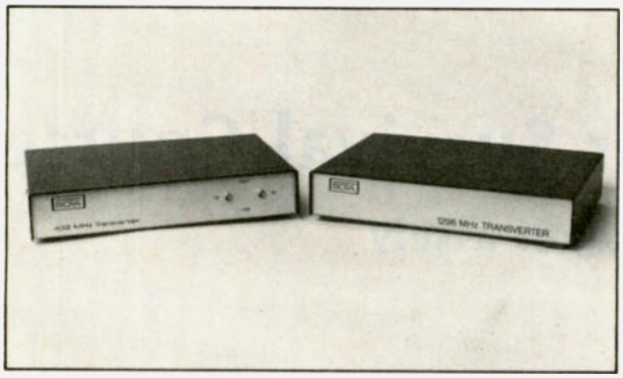

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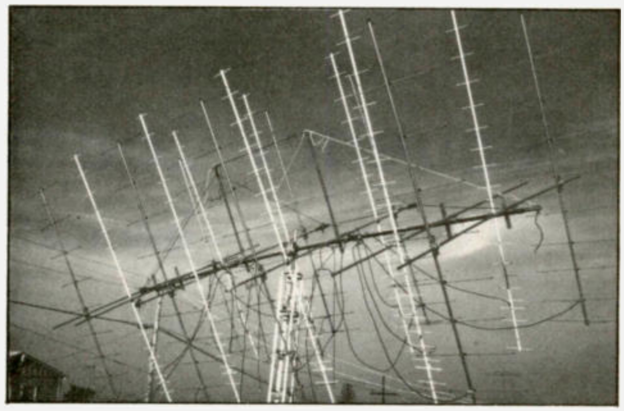

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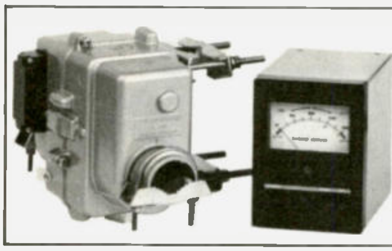

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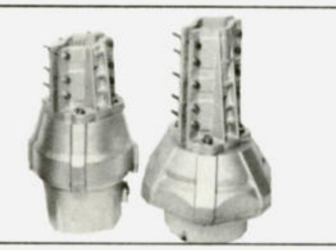

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Frequency Counter Survival Course

—use that gadget wisely

My article in *73*, "DMM Survival Course," (May, 1978, page 62), was so well received that I thought a continuation of the articles on test equipment would be helpful to the public. I was (and still am) surprised at how much ignorance there is in using modern test equipment; however, that may not be the fault of anyone but the people who write the equipment operating manuals! This is true in the industry where test-equipment manufacturers assume that the user already knows how to use, at least basically, a DMM, counter, scope, or whatever. So the manuals are usually very general, and that doesn't help out the average ham-radio user, an occasional test-equipment user, very much! Anyhow, that's my impression of some manuals I have seen on new test equipment, plus the general consensus of a lot of input from hobbyist users. Since those new test instruments cost so much more than in the old days, but do so much more for the money, it pays you to learn about your equipment! And that is what this article is about. We will primarily deal with the pitfalls seldom discussed in operating manuals and learn how to get the most in performance out of our frequency counter.

The shape of things to come. . . a pocket-sized 135-MHz counter.

If you are one of those who just bought a counter, congratulations! Congratulations, that is, for surviving all those advertising blitzes for units with nearly every feature and for buying a device you'll wonder how you ever did without. Counters are popular to make because they are easy to build (Intersil makes a 2-chip counter set) and easy to calibrate. That means a relatively low overhead investment is possible for the manufacturer.

Counters are pretty easy to use on the surface; just connect power, a signal to be measured, and read off the frequency. Great! That is where your troubles can begin. First, let's look at your power supply. If the unit is battery-powered, a slight error can be introduced by weak or overcharged batteries. Usually, this is on the order of a few parts per million (ppm) or, say, 1-2 Hz out of 1 MHz. The counters using the Intersil chip set, widely used in ham counters, are stable to within 1 ppm, but I have evaluated other counters with errors of 10 ppm (10 Hz/1 MHz) and worse. This is especially apparent with weak batteries. Also, your input sensitivity (sensitivity to the input signal being measured) may drop with weak batteries. This can cause errors in your measurement if you are measuring a weak signal. The input picks up only *part* of the signal being measured; your frequency reading will be *low*. Play it safe and always keep your batteries fully charged! Or use the charger to power your counter. Ac-powered units are less prone to power problems, but there is one type of counter that is sensitive to the line frequency. You don't see many of these counters anymore; they are cheapies, but, for a time, Hewlett-Packard and several surplus dealers offered units that derived their clock timebase (determines the accuracy of your counter) from the power line. These units are only about ±0.033% accurate when powered from a wall outlet, and accuracy is zilch if the unit is powered from a generator or inverter in the field. Needless to say, if you have one of these units, power it off the ac line or build a crystal-controlled clock generator for it.

The signal you apply to your counter is important, too. In fact, I could write a book on the subject. But I'll cover only the most important areas that will affect you in this article.

The type of signal is very important. If you feed your counter a signal that is varying in amplitude, or contains some FM, you will get a changing, often inaccurate reading. That is because your counter measures or counts the number of cycles in your unknown signal in a given length of time. The time is called "gate time" and is usually 1 second, 0.1 second, and so on. Some counters even have a 10-second gate time for audio signal measurement.

The point is, your accuracy depends upon the stability of your signal to be measured! If your are measuring the frequency of a transmitter, you must use the *CW* position. No AM, FM, or SSB allowed. Modulation causes changes in the signal and a shifty reading on your counter. Also, play it safe and use a dummy load on your transmitter to prevent QRM. I might add that there are special counters with phase locked loops that will track FM signals, but they are still too costly for home use. If you are experimenting with circuitry on the bench, such as with an oscillator circuit, you may find the counter causes drift when it is connected directly to the circuit. In this case, couple your counter to the output of the circuit with a small value capacitor/resistor combination (I found that a 5-pF/100-Ohm combination is okay at VHF frequencies). Or, if your frequency is below about 60 MHz and your counter has a 1-meg input impedance, use a x10 oscilloscope probe. You'll lose sensitivity, but you'll make a big gain in stability. The idea here is to couple your circuit as loosely as possible to the counter (a dummy load) to reduce drifty readings. Coax cable becomes a load as the frequency goes up, so try to avoid using cable between your oscillator and the counter. Instead, put the coupling cap/resistor between the circuit and your counter's input cable. Luckily, this type of stability problem doesn't come up often, but you should be aware of it.

The amplitude of your signal is important, too. It must not be too low or your counter will count only part of it, or worse, noise on it, and give a false reading. At the same time, the signal must not be too great or you'll run the risk of damaging the input of your counter. Since a sick counter generally must be sent to the factory, fixed, and returned, you'll be saving yourself a lot of trouble if you pay attention to the level of the signal you apply to your counter!

Weak signal can be quite a problem, first in the fact that you must be aware of it. Most counters will display a frequency *higher* than the true frequency—if they read at all. This is due to noise spikes that ride on top of the signal. Needless to say, a weak signal can fool you.

The secret of success is to be sure you have enough signal! On most counters, this is a level above 50 to 100 mV rms. If you aren't sure, increase the signal level to the counter by coupling better to the source. If you are measuring a transmitter and using a whip antenna on your counter, move the whip closer to the feedline or transmitter antenna. If you are experimenting with a circuit, try another pickup point and compare readings. You will find that increasing the signal beyond a certain point determined by the counter will cause no further change in your readings.

I can't emphasize too strongly how important your minimum signal level is; it plays a big factor in the accuracy of your measurements! The signal level must not be too great or you will damage the front-end circuitry in your counter. This is very easy to do around transmitters (more to follow).

Ideally, the owner's manual will spell out the maximum signal voltage to apply to your counter. You should find that it is related to frequency; 120 volts ac, 60 Hz, and on down to 20 volts at 30 MHz is a typical spec. If you aren't sure how much the maximum level is, use 10 volts rms as a rule of thumb. Also, any dc offset in that signal must be tolerated; most counters are limited to about 100 volts dc plus the signal peak value. Check your manual for any info on dc offsets; if there is no mention that the counter will take dc voltages, put a 0.1 uF capacitor in series with the input lead whenever you measure signals at the collector of a transistor, or anyplace else dc-plus signal would be present. If you don't block out the dc component, the counter input stage may be biased on so hard that it won't count your signal. This is especially important as most service/hobby grade (the ones in the plastic cases) counters are affected by dc offset.

An area that must be explored is the relation between counters and radio transmitters. Usually, the operating frequency is measured by sampling off a signal in a low-powered stage in the transmitter, which is run in the CW (tune-up) mode. Since it usually isn't practical to do this with existing transmitters, you must do the next best thing and use a whip antenna on the counter. This works well, but noise pickup can be a problem with high-impedance inputs. This problem shows as random counting with no signal, and the cure is to tie a 1-mH rf choke across the input. With low-impedance inputs, this is no problem, however. In operation, the counter/whip is placed near the transmitter or its antenna, if possible, and the frequency is read off the counter display when the transmitter is keyed. This is easy and convenient to do. However, someone is sure to connect the counter directly to the transmitter. Don't!

Let me illustrate what happens: Several years ago I was an NCO in an instrument shop at an Army post. One of the troops connected a counter to a 1 kW linear and transceiver under repair. When he pressed the mike button, both the linear *and* the counter went up in a big cloud of smoke. Needless to say, that was a very expensive accident! And the Fort Huachuca instrument lab lost a budding (but misguided) technician!

Never make the costly mistake this guy did. And one more thing: Use a dummy load whenever possible.

After you have power and a signal to be measured, you are set to read the frequency off the display. To get the most accurate reading, you must take full advantage of all digits you have. Try to fill up as much of the display as possible; a readout of, say, 60.0000 MHz is much more accurate than 0060.00 MHz. Remember that the larger the number, the more accurate your reading will be. This is because you will have several forms of error in the two right-most digits; there is a ±1 count error (or ±1) in the right-most digit, and any errors in your timebase will show up in this and the next digit. So, if you refer to the frequency illustration just made, the errors would show up in the 1k and 100 Hz positions, and that is better than having your errors show up in the 100k and 10k positions. To fill up the display, just set your timebase switch for longer gate time, which gives you more numbers. Generally, a 1-second gate time will provide optimum accuracy in your measurements. Also, most non-switchable counters have this gate time built in, so you are all set. However, this holds true only for rf signals. If you are measuring audio or other low-frequency signals, you will run into trouble with a 1-second gate time. Why? Suppose you are measuring 100 Hz. With a 1-second gate time, you will measure "100". In reality, you will see readings like "099", "100", "101", "100", and so on. This is the result of the ±1 count error mentioned earlier. That is a ±1% error! If you can live with 1%, fine! But if you are fussy like me, you'll switch your counter to the 10-second timebase position and read "100.0" Hz and get an error of only 0.1%. Of course, if you don't have a 10-second timebase position, you are stuck. But more counters have them, and better yet, many have a method for even greater accuracy —*period measurement*. In this mode, you measure frequency in terms of period, then convert from time back to frequency. If your frequency is stable, you can push out your accuracy at least to 0.001%. If you have a counter-timer with period measurement, use it for speedy, accurate measurements of frequencies below 10 kHz.

As an interesting sidelight, I worked with an interesting application of time-period counters several years ago. Digital watches must be calibrated after they are assembled. The watch is placed over an electrostatic pickup and energized. The "noise" from the LED display (*LCD* watch in my case) is picked up and counted. It is then measured on a period counter and converted to numbers showing % deviation from the correct frequency. The operator adjusts the watch so that the reading is 00. And the result is a very accurate watch! This idea isn't new; I believe it was used with analog watches, but it is still simple and clever. And fast, too. We built a unit like this in 1973 thinking the idea was original, but it wasn't.

Now that you have a good idea of how to get the most accuracy out of your counter and have read about the pitfalls most counters have, let's concentrate on other areas that affect the performance of your counter.

First, the operating temperature your counter is used in affects accuracy. Ideally, that counter should be used as close to the temperature it was calibrated at as possible. Why? The crystal used to generate the clock or timebase is temperature sensitive. Also, the oscillator circuit used in conjunction with it is, as well. If you use the counter at a different temperature than what is calibrated at (hopefully 25° C.), error will creep into your readings. The amount of error can be as high as 20 ppm, enough to affect your readings. And the effects of the error really show up when you are measuring low frequencies. Also, at VHF frequencies, the error can throw you off. So the best thing for you to do is operate your counter as close to 25° C. as possible. I might add that the more expensive counters have temperature-compensated oscillators (medium-cost units) or temperature-controlled ovens (high-priced units). The oven-controlled counters are normally left plugged in with the oven and oscillator left running at all times, so accuracy is optimized. Regardless of what type of counter you own, it should be turned on for at least a half hour before use. This will allow the internal temperature to rise and stabilize, allowing the best accuracy. If you own a battery counter, this isn't possible, of course, but using it at room temperature will still give you the best accuracy.

You should know that the crystal in your counter is also subject to aging. That means that with time and use its frequency will drift. Also, changes in the oscillator components will probably result in the same effect, in even greater magnitude. So, if you are going to be making a highly-accurate measurement, calibrate the counter on a frequency standard first, then use it as soon as possible (hopefully without turning it off if the counter is ac-powered). This one step can often "buy" you an extra 20 Hz of accuracy or so. It's an important step! This mag-

Square-Wave Input Signals and Your Counter

This is one section that deserves special mention and that is why it is in a section of its own. Sooner or later, most counter users try to measure square-wave signals with a counter. The result is error in the readings, with a display of double the correct frequency being typical. There are several reasons for this, the most important being the fact that most counters will trigger on both the positive and negative edge of each half cycle of the waveform, effectively giving a reading of double the correct value.

Also, the harmonic-rich signal can cause ringing in your cables and, in some cases ringing in your input circuitry. The counter may trigger on these "rings" and give you a completely false reading.

The solutions to these problems are fairly simple and straightforward. If your problem is cable ringing, connect (terminate) the *counter end* of the cable with a 50-75-Ohm resistor. The value is to match the characteristic impedance of the cable. Or use the low-impedance input (often VHF prescaler input) on your counter for best results. If the resistor drags down your signal too much, eliminate or sharply reduce the size of the cable; longer cables aggravate ringing. If your counter front end is at fault, and at HF frequencies this will often be the case, try to "soften" the *edges* of the waveform you are measuring by using a x10 scope probe between the counter input and your signal. This simple step will often work with high-impedance counter inputs and TTL level signals. Try it!

azine has described several methods of calibrating counters using the TV chroma subcarrier ("In Search of the Ultimate Counter Calibrator," R. Bloom, April, 1978, *73*), and I can't think of a better use for a TV. Pick a show you hate for best accuracy. Note that it must be a *live* network show!

Surprisingly, the place in which you keep your counter can affect accuracy. Most hams love to stack their equipment, and that may mean the counter goes on top of a hot receiver or transmitter. The result is a slow drift in the displayed frequency as the counter case warms up. Try not to do this!

There are a number of miscellaneous hints for you to remember in using your counter. First, place the counter in a place where it can easily be seen, and yet is not likely to fall on you or into a live piece of equipment. If the counter is dropped, always recheck its accuracy, as shock changes the crystal-frequency and oscillator-trimmer settings. Use a x10 probe, or set the counter's attenuator for x10 if it has one, when measuring large signals over a few volts. And keep the counter display away from sensitive pieces of equipment. Modern counters have multiplexed displays and the noise they generate can drive a receiver up the wall!

Let me sum this up by saying it is always worth your time to use the suggestions I have made and to avoid the pitfalls I have mentioned. By doing so, you should be able to get longer life and better accuracy from your counter. ■

DX with a Difference: the Utility Stations

—when the ham bands get frustrating, give SWLing a try

W. Page Pyne WA3EOP
PO Box 1062
Hagerstown MD 21740

With the recent emergence of general frequency coverage added to high quality ham transceivers, we hams may find ourselves drifting the dials beyond our band edges. In fact, our ability to listen and our right to listen to anything we please may bring us to stop the dial on what are known as utility stations.

A utility station is any station (excluding ham radio) which does not beam its transmissions for the general public. These broadcasts are limited to specific audiences and may be run by worldwide government or commercial enterprises.

By now, we all know of public service broadcasts of fire, police, and ambulance services which, by nature, are best trapped in the VHF and UHF world, where mostly they have migrated. However, there is a world of interest and excitement hiding between the ham bands on the commercial and military channels, available on any general-coverage transceiver or receiver.

One note of warning: Although you are allowed to listen as you please, Secrecy of Communication laws generally prevent you from revealing what you have heard.

What can you hear? There are at least four distinct types of services which make up the utility stations. These are time- and frequency-standard stations, aeronautical and weather stations, coastal stations, and fixed point-to-point stations.

Time- and Frequency-Standard Stations

Most of you are familiar with the transmissions from WWV and CHU. These are the main North American time and frequency stations. In the case of WWV, propagation and weather information to a degree is included with the regular time information. There are, however, other stations, near and far, which operate like "clockwork." A list of some of the more interesting ones (some easy, some hard to hear) is included with this article (see Table 1).

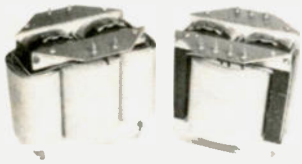
The Aeronauticals

The aeronautical stations, especially the weather stations, utilize announced frequencies on a time-shared basis. It is quite possible, given the right propagation condi-

Call and Location		Frequency	Air Schedule (GMT)
BPV	Shanghai, China P.R.	9368	5 min. before 0600, 1100, 1300, 1500, 1700, 2100, 2300
CCV	Valparaiso, Chile	8558	5 min. before 2000, 0100
CHU	Ottawa, Canada	3330, 7335, 14670	24 hours French & English
FTK77	Pontoise, France	10775	5 min. before 0800, 2000
DAM	Elmshorn, Germany F.R.	8638.5, 16980.4	1155-1206
NPN	Mariana, Guam	4955, 8150, 13380	5 min. before 0600, 1200, 1800, 2400
PLC	Jakarta, Indonesia	11440	5 min. before 0100
VWC	Calcutta, India	4286	5 min. before 1630
		12745	5 min. before 0830
NSS	Annapolis, Maryland	5870, 8090, 12135	5 min. before 0500, 1100, 1700, 2300

Table 1. Interesting time stations.

CUSTOM TRANSFORMERS



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DRAKE L4B Plate	$165	HENRY 2K-4 Power	$165
GONSET GSB-100 Power	$ 95	HENRY 3K-A Plate	$165
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PLATE XFMR:	6000 VCT @ 0.8A CCS 115/230 PRI-41LB	$150
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FILMT XFMR:	7.5 VCT @ 21A 117 PRI-9.5LB	$ 30
FILMT XFMR:	7.5 VCT @ 55A 115/230 PRI-14.6LB	$ 65
FILMT XFMR:	7.5 VCT @ 75A 115/230 PRI-20.2LB	$ 95
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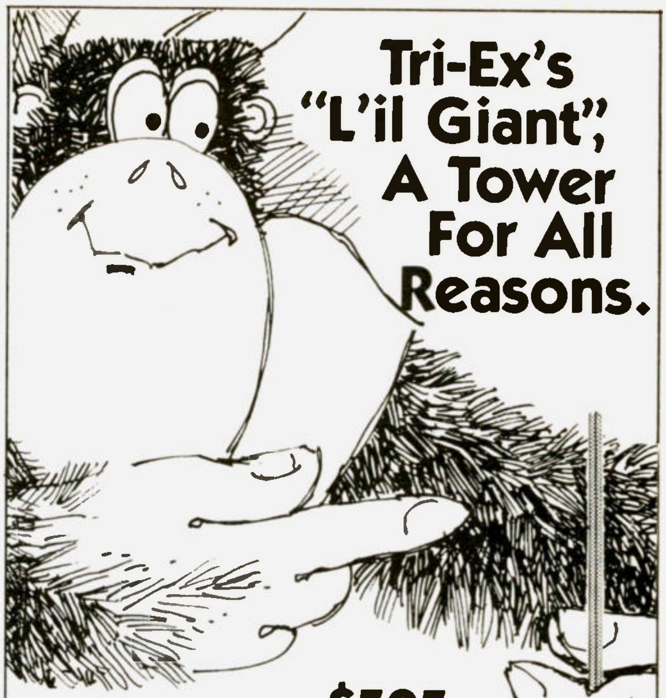

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tions, to hear several different aviation weather stations on a single shared frequency within an hour's time. Gander, Newfoundland, and New York aeroradio share four common frequencies. Each signs on immediately after the other signs off. (See Table 2.)

Call and Location	Frequencies (kHz)	Time Past the Hour (mins.)
WSY70 New York, N.Y.	3001, 5652, 8868, 13272	00-20 & 30-50
VFG Gander, NFD, Canada	3001, 5652, 8868, 13272	20-30 & 50-60
KSF70 Oakland, Calif.	2980, 5519, 8903, 13344	05-10 & 35-40
JMA Tokyo, Japan	2980, 5519, 8903, 13344	10-15 & 40-45
- - Hong Kong	2980, 5519, 8903, 13344	15-20 & 45-50
KVM70 Honolulu, Hawaii	2980, 5519, 8903, 13344	20-25 & 50-55
KIS70 Anchorage, Alaska	2980, 5519, 8903, 13344	25-30 & 55-60

Table 2. Aviation weather for Atlantic and Pacific areas.

In addition to the easy catches, some African broadcasts may be heard on 8896 and 11279 kHz—and try listening on 5561, 8819, or 10017 for a broadcast from Asia. These are by no means all the frequencies used, but if fate is kind, you may hear Singapore or Beirut and a host of others.

One other fact is that most of these stations will QSL if approached politely and return postage is included with your report. Sometimes it is advisable to include a prepared form QSL so that someone at the station can simply fill in a few blanks, sign the card, and drop it in the mail.

It may be helpful to include return postage from the country heard back to you. US stamps are not valid for this purpose in most countries. All is not lost for the QSL hunters, however. George Robertson is a gentleman who conducts a DX stamp service for hams and SWLs. For an SASE, George will send you a listing of prices and countries for which he stocks stamps. His address is DX Stamp Service, 7661 Roder Parkway, Ontario, New York 14519. Tell him that *73 Magazine* sent you.

While on the subject of weather broadcasts, I might mention that the US Coast Guard also transmits broadcasts of about 10 minutes duration several times daily. The station at Portsmouth, Virginia, has been known to use 6505, 8765, and 13113 kHz (approximate), and you should listen around 0400, 1130, 1600, 1730, and 2200 GMT.

Again, these are just some of their broadcasts, but if you stay tuned, you may hear others at different times.

Getting back to strictly aeronautical stations, we find that most long-haul international air traffic is still conducted on the high frequencies. Airports, aircraft, and beacons all can be heard within certain bands. Some of these stations, such as San Juan on 8945 and Piarco Trinidad on 8847, have been known to QSL usually by the prepaid-form card method. Listen especially in the bands 6525-6765 and 8815-9040 kHz for this air traffic.

The Coastal Stations

Coastal stations also are either commercial or military. The commercial stations may relay telephone communications, telegrams, weather, or other information for the ships in the merchant fleets, or even to pleasure vessels still in harbor. Whereas many stations of an aeronautical nature use phone only, the coastal stations use phone and CW fairly equally. Like us hams, their bands have been divided into separate CW and phone segments. The phone usage may be either AM or SSB. For CW, expect speeds of 15 wpm and up. Try listening in the bands 6345-6495, 8459-8705, and 12690-13070 kHz. For phone transmissions, the best bets are 6515-6525, 8725-8815, and 13170-13200 kHz.

The entire world is represented by coastal stations. Some of the more readily heard are CUL, Lisbon, Portugal; DAN, German Federal Republic; WSL, New York; IAR, Rome, Italy; WCC, Chatham, Mass; GKE, Great Britain; and VCS, Halifax, N.S., Canada.

The CW band on 8 MHz is perhaps the most active. Sometimes these stations will send marker transmissions. These markers take two or three recognizable forms.

Look first for the V marker. A typical exchange might give 3 Vs followed by the call of the station. Sometimes a chain of calls might be heard. In this case, several stations are hooked electronically to a master operator, human or otherwise, and several transmitters are being keyed at once, on different frequencies. Usually, each frequency is licensed with a different assigned call. It is done this way so that stations with traffic may tune into the best signal receivable for band conditions. Often a V marker by the same basic station may be heard on several bands at once. This also makes for more use of our radio spectrum and is one of the reasons that commercial interests will be attempting to secure more and more frequencies at future World Administrative Radio Conferences. Many of the coastal commercial stations will QSL if the prepared-form card method is used.

The military also has its share of the coastal stations. In the United States, the Coast Guard handles the military coastal traffic. The Guard regularly schedules broadcasts on 2670 kHz. Depending on location, you may hear weather advisories, including ice conditions. Sometimes vessel operators are told of naval operations in specific geographical areas. (Listen then for the Navy on 6723 kHz.)

Some of the popular Coast Guard frequencies are 6506, 8710, 8765, and 13113 kHz. Other types of coastal station markers include the popular CQ when actually looking for a call and the simple DE identification marker. The DE marker is used for transmitter adjustments and sometimes is used interchangeably as a V marker. Often the CQ marker will say QSX and give reference to the band being tuned by the station for responding calls. Some of the popular coastals like WSL generate so much QRM on the return calls that you would sometimes think they are rare DX in a contest!

FPTP or Else

Our final category of stations are those in the fixed point-to-point service. These stations offer a real variety of listening and are sometimes challenging because it may be difficult just to be able to copy such a feed. These utility stations, as the name implies, are directing their transmissions to one particular receiving site.

These stations are operated by commercial, aeronautical, or military sources. (Even spies, I guess!) The vast majority

✓ Reader Service—see page 195

Selected Air Bases	kHz
Andrews—Forrestville, Maryland	6756, 13247
Clark—Manila, Philippines	8993, 11226
MacDill—Florida	8989, 8993
Yokota—Tokyo, Japan	8967, 11236

(Note: Above frequencies mostly SSB, but some AM may be used yet on all frequencies. Some other USAF frequencies in general worldwide use include 6738, 6753, 11179, 13201, and 18019.)

Table 3. Aeronautical calling frequencies, USAF.

of them don't appreciate our reception reports, but legally they can't stop you from listening.

Some of the international shortwave broadcasters use point-to-point feeders to give programming to their relay stations around the world. Some communist nations may refuse to admit they are on the air on feeder frequencies, yet they want the world to hear it all as relayed. (The games people play!) Although there must be 30 specific bands allocated to the point-to-point service, these bands are spread out over the HF radio spectrum. I have had a fair amount of fun listening for these stations in the range of 10-13 MHz.

Help Is Nearby

If I have got you to the point of being interested in doing a little tuning between the ham bands, good! — as I'm sure you will find it great listening. There is more information available for the person who wants to get into the serious side of utility listening.

At least 3 US radio clubs give fair coverage in their bulletins to the utility stations. The oldest of these clubs is the Newark News Radio Club, P.O. Box 539, Newark, New Jersey 07101, which was founded over 50 years ago and currently devotes four of its 36 pages monthly exclusively to utility DXing. The *NNRC Bulletin* often contains information on other utility reference works and identifies many of the popularly-heard utility stations by frequency, mode, type, call, and, when available, station location.

Another organization with an excellent utility section is SPEEDX, P.O. Box E, Lake Elsinore CA 92330. Utility coverage could run as high as eight pages monthly with military station information, publication notes, QSL reports, and station loggings. It should be noted that SPEEDX is shortwave broadcast and utility coverage only, while the *NNRC Bulletin* covers all major shortwave listening interests, including ham radio and TV/FM.

One other club with utility station coverage is the American Shortwave Listener's Club, 16182 Ballard Lane, Huntington Beach, California 92649. ASWLC's coverage may run to four pages monthly. Any of these clubs will be happy to send you a sample bulletin for one dollar shipping and handling charge. All of these clubs are accredited through the Association of North America Radio Clubs (ANARC), 557 North Madison Ave., Pasadena CA 91101. For an SASE, ANARC will send a listing of all clubs in the association along with a list of publications offered by the various clubs.

Books and Things

The main reference book for utility DXers has to be the *SPEEDX Utility Guide*. This book has 239 pages of detailed utility station information, including 40 pages devoted to the US Coast Guard and listings of high frequency beacon stations, and, perhaps most important for the serious utility DXer, station addresses. Present cost is about $7.00 shipped prepaid.

Another reference aid (for those who can afford it) is the ITU's International Frequency List. The list is in several volumes and the cost is a modest $1500.00, or more by the time you read this. These rather large books are divided into frequency spectrum groupings, and the first four volumes take you from 10 kHz all the way through 28 MHz.

The ITU has many other publications for sale at substantially lower prices. Some of these include lists of coastal stations, lists of ship stations, *The Telecommunication Journal*, and more. If interested in further information on these, write directly to ITU, Place de Nations, Geneva 20, Switzerland, asking for their *List of Publications* catalog.

The Superintendent of Documents, Government Printing Office, Washington D.C. 20402 also publishes several books listing beacons and US Coast Guard radio stations. These are divided into US geographical areas and may be purchased separately. Write the GOP for availability and prices before ordering.

Communications World Magazine, Davis Publications, 229 Park Ave. South, New York NY 10017, often has valuable information for the utility DXer.

Finale

It doesn't take a great receiver or a super antenna to cash in on the fun of utility DXing. And when the ham bands are phooey from too many stations, it might be just the ideal time to spin the receiver dial and discover for yourself what lies beyond. You might be glad you did. ■

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Calvert City KY 42029

How to Write a RTTY Program

—machine language is easier than you think

As a result of my article published in the April, 1977, issue of *73* ("CW for the 6800"), one of the letters I received assumed that I was into ham RTTY. This caused me to wonder if I was missing something. I was. A large percentage of the RTTY operators are running micros or discrete logic gear for the generation and reception of Baudot. Furthermore, very few of these operators are totally dedicated to signal reports and QSL cards. Most of them are hacking away at the frontiers of microcomputer applications in general. So you could learn quite a bit with a RTTY receiving setup, even if you do not have a ham license.

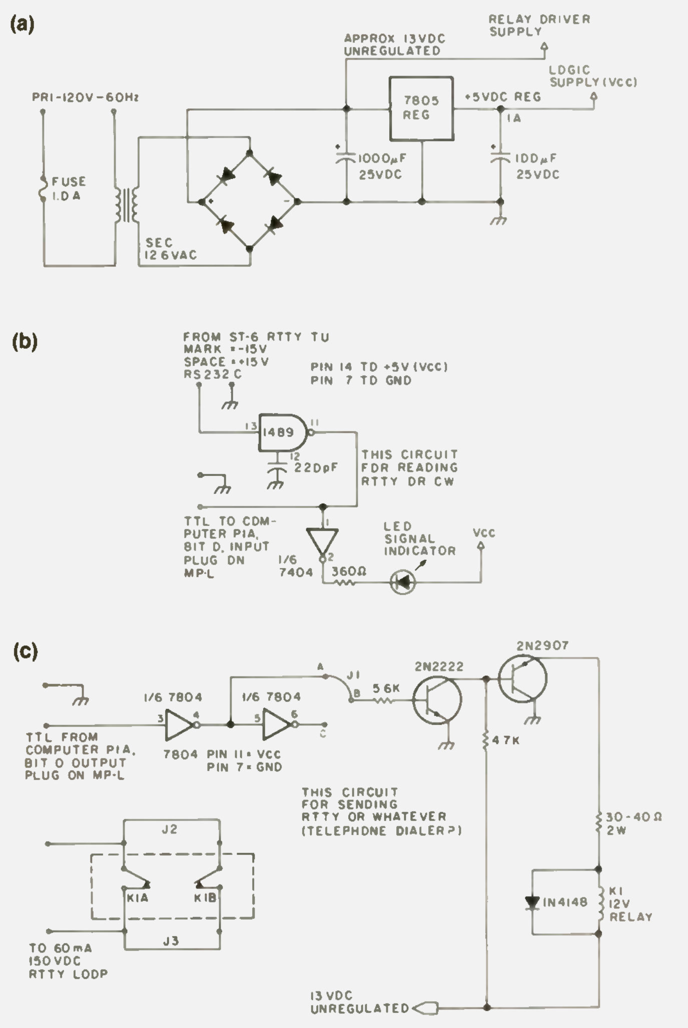


Fig. 1. Interface box with power supply. (a) Power supply. (b) Input switching. (c) Output switching.

Machine-language programming is not as difficult as it looks! In fact, if you can program in BASIC, you can program in machine language. There are two major attributes of machine language that make it immediately worthwhile:

1. It is more efficient in its usage of memory space because it doesn't have to go through a series of lookup tables just to determine what you have commanded it to do.
2. Because of reason #1, it can execute programs with fantastic speed and accuracy.

No, I am not suggesting that interpreter basics should be junked. In fact, at my place of employment, I have installed a microcomputer as a plant demand monitor/controller (millions of Watts) and have it running a BASIC program.

In writing any program, M/L, BASIC, or whatever, I think it necessary as a first step to write out the programming objectives, or a general description of what the program is to accomplish. From the description, a flowchart should be drawn next. From the flowchart, a program can be written. The program must, of course, address specific items of hardware for input/output (I/O), so a brief description of my setup follows:

1. Old model SWTPC M6800 mainframe.
2. 16K of 21L02 memory.
3. One parallel interface card (PIA) at location 8000.
4. One serial interface card (ACIA) at location 8004.
5. MIKBUG has been replaced by SWTBUG.
6. A C-30 cassette interface.
7. CT-1024 terminal system, 16 lines, 32 characters.
8. 12-inch black and white Zenith, modified for composite video entry.
9. HAL ST-6 RTTY terminal unit (MOD/

DEMOD).

10. Small interface box, RS232-C to TTL for input to computer, also contains a computer-driven relay with two paralleled sets of NC contacts in series with the 60-mA RTTY local loop for output. (See Fig. 1.)

11. Ancient Model 19 Teletype™.

12. Drake TR4-C transceiver (with a muffin fan positioned directly over the finals).

Now let's define what we want to do:

1. The program is to accept interrupt from the ASCII keyboard via the ACIA interface.
2. Convert the incoming ASCII character to Baudot and store it in a "circular buffer," that is, a page of memory from XX00 through XXFF. By doing this, when a character is eventually stored at XXFF and the storage pointer is incremented, the storage pointer then contains 00, and we are back at the start of the buffer area.
3. Get the Baudot character pointed to by "Print next pointer" and send it out via the PIA.
4. Utilize the Baudot stop bit as a delay between characters by making it much longer than normal.
5. Enable IRQ only during the stop bit, allowing the delay to be interrupted, the incoming ASCII character stored, and then the delay finished.
6. Print something at the end of each delay period. If no characters remain to be printed, print a Baudot blank.
7. Keep count of the characters stored in the buffer. After (decimal) 67 characters, look for the next incoming space character, then store a carriage return line feed immediately following the space in the buffer.

There are any number of other goodies we could have this program do, but beyond this it would tend to get lengthy. You will note that we don't use any of the computer's resident monitor routines. This means the program should run on any 6800-based machine, possibly requiring a bit of adjustment on the delays in the "bit timer" and maybe relocating the IRQ vector.

This brings up another point: You might have to adjust the delays in any case, because the loop-keying relay requires a small, but finite, time for armature travel. Your relay armature might be heavier or lighter than mine, the contact gap might be more or less, etc. No problem; change the delay constants up until the printer garbles, then down until it garbles, and then set the number between these two values.

I have installed a switch that allows my CT-1024 to be switched to either 300 or 1200 baud. This program runs equally well on either baud rate. If you want your keyboard input to be displayed on your video display, you should enable your data terminal's internal "echo," as this program does not contain routines to accomplish this.

Now let's do a flowchart to accomplish all the things we have described, not necessarily in the order they were enumerated.

A few words about Fig. 1: Since I am not an engineer, these circuits are probably somewhat unorthodox, but they are working in my

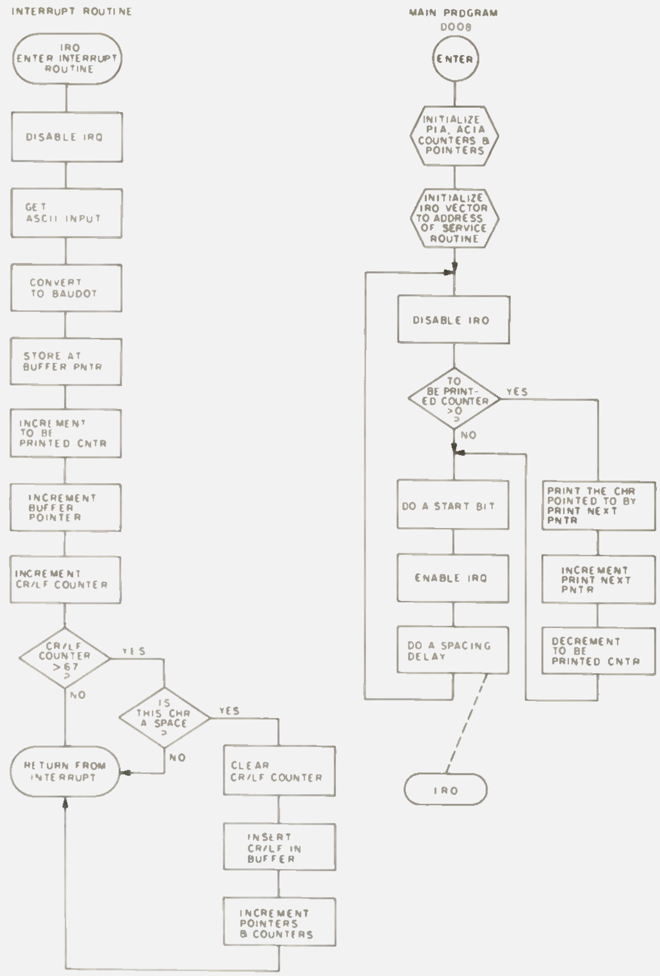


Fig. 2. Flowchart.

gear. Unless I have let a drawing error slip by, they will work in yours.

If you can't find a small 12-volt relay that will stand interrupting 150 V dc at 60 mils, try one with a higher coil voltage. In most cases, 12 or 13 volts will operate a 24-volt relay. If you have a 6-volt relay with sufficient contact rating, all you need change in this circuit is the power transformer. Change to a 6.3-V ac secondary, and you will have approximately 9 volts dc unregulated. Use a heat sink on the voltage regulator. The transistor pair is a circuit that I have used quite a bit; I feed them with supply voltages that have ranged from +5 to +15 volts. They are quite inexpensive, 5/$1.00 at James Electronics.

Paralleling the two normally-closed sections of K-1 has the apparent effect of reducing contact bounce, in addition to increasing current capacity.

I do not recommend connecting either of the RTTY loop lines to interface board common, the goal being to keep that 150 volts out of my computer!

My interface is assembled on perfboard and housed in a small Radio Shack cabinet. Don't forget a fuse in the transformer primary. I always use sockets for all ICs, even on perfboard.

Machine Code

The M6800 CPU, like other CPU chips, has what is called an instruction set. This is simply a list of commands that the chip will recognize and execute. For most microprocessors, these are one-byte (8-bit) numbers. These commands are sometimes called op codes, and the instruction

PROGRAM LISTING, RTTY OUT.

Program entry point: 0008

ADDR.	OP-CODE	DATA	MNEMONIC	REMARKS
0000		00	RMB	Buffer storage pointer.
0001		00	RMB	To be printed counter.
0002		00		Not used.
0003		00	RMB	CR/LF counter.
••••	••	•• ••	•••	•••••••
0008	86	FF	LDA-A	Initialize PIA for output
000A	B7	80 00	STA-A	to model 19.
000D	86	04	LDA-A	
000F	B7	80 01	STA-A	
0012	86	95	LDA-A	Initialize ACIA to
0014	B7	80 04	STA-A	generate IRQ.
0017	CE	03 00	LDX	Set up IRQ vector to
001A	FF	A0 00	STX	service routine.
001D	7F	00 36	CLR	Print next pointer.
0020	7F	00 01	CLR	To be printed counter.
0023	01	01 01	NOP	No operation, not used.
0026	7F	00 03	CLR	CR/LF counter.
0029	7F	00 00	CLR	Buffer storage pointer.

•••••••••••••••

START PRINT

ADDR.	OP-CODE	DATA	MNEMONIC	REMARKS
002C	OF		SEI	Disable IRQ.
002D	B6	00 01	LDA-A	Get to be printed counter.
0030	27	05	BEQ	If zero, branch to 0037.
0032	CE	02 00	LDX	Set index reg. to start of buffer.
0035	A6	00	LDA-A	Get chr. at index plus prnt. nxt pntr.
0037	36		PSH-A	Save A reg.
0038	7E	03 20	JMP	Do a start bit.
003B	36		PSH-A	Save A again.
003C	7E	00 6D	JMP	To bit timer.
003F	7C	00 63	INC	Increment bit counter.
0042	44		LSR-A	Shift lsb out of A reg.
0043	24	07	BCC	If lsb=0, BRA to out a space.
0045	C6	01	LDA-B	Else out a mark.
0047	F7	80 00	STA-B	
004A	20	05	BRA	To bit count check.
004C	C6	00	LDA-B	Out a space.
004E	F7	80 00	STA-B	
0051	F6	00 63	LDA-B	With bit counter.
0054	C1	06	CMP-B	To hex 06.
0056	26	E3	BNE	Back to 003B if not zero.
0058	7F	00 63	CLR	Finished, clr bit counter.
005B	B6	00 01	LDA-A	More chrs. to print?
005E	27	25	BNE	
0060	7E	00 7F	JMP	To stop bit timer and spacer.
0063	00		RMB	Bit counter.

•••••••••••••••

BIT TIMER

ADDR.	OP-CODE	DATA	MNEMONIC	REMARKS
0064	01	01	NOP	
0066	01	01 01	NOP	
0069	01	01	NOP	
006B	3C			Timer constants.
006C	35			
006D	B6	00 6B	LDA-A	Timer
0070	F6	00 6C	LDA-B	
0073	5A		DEC-B	
0074	26	FD	BNE	
0076	4A		DEC-A	
0077	26	F7	BNE	
0079	32		PUL-A	
007A	7E	00 3F	JMP	Go finish this chr.

•••••••••••••••

STOP BIT TIMER AND SPACER

ADDR.	OP-CODE	DATA	MNEMONIC	REMARKS
007D	01		NOP	
007E	01		NOP	
007F	7A	00 01	DEC	Dec. to be printed counter.

Program listing.

set for an M6800 chip will not produce the same results when input to an 8080 chip. However, a chip called the Z-80 will properly execute all of the 8080 instruction set, plus several more instructions that the 8080 cannot execute.

When writing machine code for my SWTPC 6800, I make frequent use of two reference listings, the *Motorola M6800 Microprocessor Programming Manual*, pages A-1 through A-69, and an article from *73* by T. H. Hunter called "Backward Branch the Easy Way" (Holiday, 1976, page 90).

Machine code, when deposited by hand, commonly utilizes one of two methods, depending on the configuration of the computer. Computers similar to the older model Imsai 8080 having a complete front panel permit data entry in binary format by manipulation of a row of toggle switches located on the front panel. By means of these switches you can examine (display contents of) any memory address, change the contents thereof, start program execution from the displayed address, examine the next sequential address, etc.

Computers similar to the SWTPC 6800 have no switches for data entry. Their front panels usually contain only a power on-off switch and a system reset button. This type of computer has what is called a "system monitor" program stored in permanent memory (ROM). When the power is turned on or the reset button depressed, the CPU's program counter is automatically initialized to the beginning of this program and the program begins running. This means that in addition to the computer, you must also have a terminal unit consisting of a keyboard that produces ASCII characters and a display. If you have a video display, you must also have a display refresh memory consisting of a memory byte (usually less than 8 bits) for each position on the screen that is to be printed into, plus logic circuitry to generate the necessary timing, decoding, and synchronizing signals. This display refresh could be accomplished inside the computer, but it would use up a good bit of the computer's time and memory.

The system monitor program establishes communi-

	ASCII "A" =	0100	0001	(41 in hex)	
		0100	0001	(ASCII "A")	
Plus	0000 0001	0000	0000	(hex 0100, start of decode table)	
Equals	0000 0001	0100	0001	(hex 0141)	

Fig. 3.

```
0082   7C   00 36   INC     Inc. print next pointer.
0085   C6   01      LDA-B   Out a stop bit.
0087   F7   80 00   STA-B
008A   0E           CLI     Enable interrupt request.
008B   86   AF      LDA-A   Timer constants
008D   C6   FF      LDA-B
008F   5A           DEC-B   Timer
0090   26   FD      BNE     To 008F if not zero.
0092   4A           DEC-A
0093   26   F8      BNE     Count B down again if not zero.
0095   7E   00 2C   JMP     Finished, print another one.
                    ••••••••••••••
0100   XX   XX XX   XXX     Insert DECODING TABLE beginning here.
                    •••••••••••••

0200   XX   XX XX   XXX     Reserved for operating buffer,
02FF   XX   XX XX   XXX     no initial data necessary.
                    ••••••••••••••

                        SERVICE IRQ
                    LOAD, DECODE, AND STORE
0300   B6   80 05   LDA-A   Get data from ACIA
0303   B7   03 0A   STA-A   In decode table index.
0306   CE   01 00   LDX     With decode table start.
0309   A6   00      LDA-A   Indexed by contents of 030A.
030B   CE   02 00   LDX     Buffer start.
030E   D6   00      LDA-B   From loc.0000 (Storage pointer)
0310   F7   03 14   STA-B   In buffer index.
0313   A7   00      STA-A   Indexed by contents of 0314.
0315   7C   00 00   INC     Increment storage pointer.
0318   7C   00 01   INC     Increment to be printed counter.
031B   7E   03 3C   JMP     To CR/LF routine.
                    ••••••••••••••

                      DO A START BIT
0320   C6   00      LDA-B   Out a start bit.
0322   F7   80 00   STA-B
0325   20   02      BRA     Around constants.
0327   3C                   Timer constants.
0328   35
0329   B6   03 27   LDA-A   Timer.
032C   F6   03 28   LDA-B
032F   5A           DEC-B
0330   26   FD      BNE
0332   4A           DEC-A
0333   26   F7      BNE
0335   32           PUL-A
0336   7E   00 3F   JMP     Go finish this chr.
                    ••••••••••••••

                    CR/LF ROUTINE
0339   01   01 01   NOP
033C   7C   00 03   INC     Increment CR/LF counter.
033F   C6   43      LDA-B   With decimal 67.
0341   F1   00 03   CMP-B   To CR/LF counter.
0344   22   2B      BHI     To 0371 if CR/LF less than 67.
0346   C6   04      LDA-B   Load B with Baodot space.
0348   11           CRA     Compare B to A; is space?
0349   01   01      NOP
034B   26   24      BNE     To 0371 if not space.
034D   CE   02 00   LDX     With buffer start.
0350   D6   00      LDA-B   With contents of buffer sto. pntr.
0352   F7   03 58   STA-B   In temporary.
0355   C6   08      LDA-B   With Baudot CR
0357   E7   00      STA-B   Indexed by temporary.
0359   7C   00 00   INC     Increment buffer sto. pntr.
035C   7C   00 01   INC     Increment to be printed counter.
035F   D6   00      LDA-B   With buffer storage pointer.
0361   F7   03 67   STA-B   In another temporary.
0364   C6   02      LDA-B   With Baudot LF.
0366   E7   00      STA-B   Indexed by temporary.
0368   7C   00 00   INC     Increment buffer sto. pntr.
036B   7C   00 01   INC     Increment to be printed counter.
036E   7F   00 03   CLR     Clear CR/LF counter.
0371   3B           RTI     Return from interrupt.
                      END
```

cation between you and your computer via the keyboard and display. Input is in hexadecimal notation, which is a condensed cousin of binary. Two hex digits can express any number that you can write with eight binary digits.

A system monitor program contains several small programs (routines) that the designer thinks will be useful, such as:

- Examine (display) a specified memory location.
- Change the contents of the displayed location, then display the next sequential location.
- Jump to a specified location and start execution.
- Display contents of the stack.
- Load cassette data through the control port.
- Record data on cassette from specified memory, etc.

Several companies now offer system monitor boards for S-100 systems, which greatly simplifies the task of establishing communication with a computer of the front panel type.

The RTTY Program

Looking at the program listing, you will see that the first few memory locations contain zeros. These locations are used by other parts of the program as temporary data storage locations. Out in the main program at their point of use, you will also see several NO-OPS which, if executed, cause only the program counter to be incremented. These were put there to replace unnecessary code and could be used as jump-points to other routines if you want to expand the program. We start the program by typing J 0008 (with SWTBUG system monitor; all numbers in hex unless otherwise stated). Remember that I spoke of an instruction set or op code? At 0008, the op code 86 means load accumulator A with the next byte. The program counter is incremented as each byte is processed, thereby keeping track of what location comes next.

How does the computer know the difference between op codes and data? It doesn't! So, to avoid a spectacular program wipeout, the first byte in your program had better be a valid op code followed by the number of bytes of data that that particular op code requires. All subsequent lines of code must follow the same general pattern—op code followed by enough data to satisfy the op code you have used. The first few lines of code are used as the flowchart says, to clear all pointers and counters, to set the PIA for output, and to set the ACIA to generate an interrupt request when new data comes in

ADDR.	DATA	ADDR.	DATA	ADDR.	DATA
0100	00	0132	13	014C	12
****	**	0133	01	014D	1C
0107	05	0134	0A	014E	0C
****	**	0135	10	014F	18
010A	02	0136	15	0150	16
****	**	0137	07	0151	17
010D	08	0138	06	0152	0A
****	**	0139	18	0153	05
0120	04	013A	0E	0154	10
0121	0D	013B	1E	0155	07
0122	11	013C	1F	0156	1E
0123	14	013D	00	0157	13
0124	09	013E	1B	0158	1D
0125	00	013F	19	0159	15
0126	1A	0140	00	015A	11
0127	0B	0141	03	015B	00
0128	0F	0142	19	015C	1F
0129	12	0143	0E	015D	00
012A	00	0144	09	015E	1B
012B	00	0145	01		
012C	0C	0146	0D		
012D	03	0147	1A		
012E	1C	0148	14		
012F	1D	0149	06		
0130	16	014A	0B		
0131	17	014B	0F		

Subtract 0100 from any of these addresses, and you get an ASCII chr. The data there is the Baudot equivalent.

Decoding table.

from the keyboard. We also store the address of the interrupt service routine at location A000-A001 (0300). At 0300, the service routine reads the incoming character, converts it to Baudot, and stores it in the buffer. It increments the proper pointers and counters, then checks to see if you have stored enough characters to need a CR/LR. If so, it adds them to the buffer after the next space and avoids hacked or hyphenated words this way.

The Baudot conversion works in the following manner: The binary value of the ASCII character, plus the binary value of the start of the decoding table, produces addresses where we have stored Baudot translations. See example in Fig. 3.

Hex 0141 is the address at which this program contains the Baudot equivalent of the letter "A", 000 0011. And so it goes for the entire Baudot-printable sequence, with the numerical value of each ASCII character serving as a pointer to a memory location where we have stored the Baudot equivalent. This method is much faster than trying to do a character-by-character comparison through alphanumeric tables.

The ltrs/figs shift is set up to decode a less than (<) as figs and a greater than (>) as ltrs. This seems a trifle unhandy, since to get these characters one must also depress the shift bar. My date entry keyboard has ∧ and \ as the two topmost right-hand keys, so these are also decoded as figs/ltrs, respectively. My keyboard prints these without shifting.

At this point, I won't bore you further with a line-by-line explanation of the program. You should get into machine-language programming; it's great fun and unlimited in its applications. If I can be of any help in your implementation of this program, drop me a line (with an SASE, please) and I'll do what I can to help. ■

Tim Ahrens WA5VQK
7405 Ladybug St.
Austin TX 78744

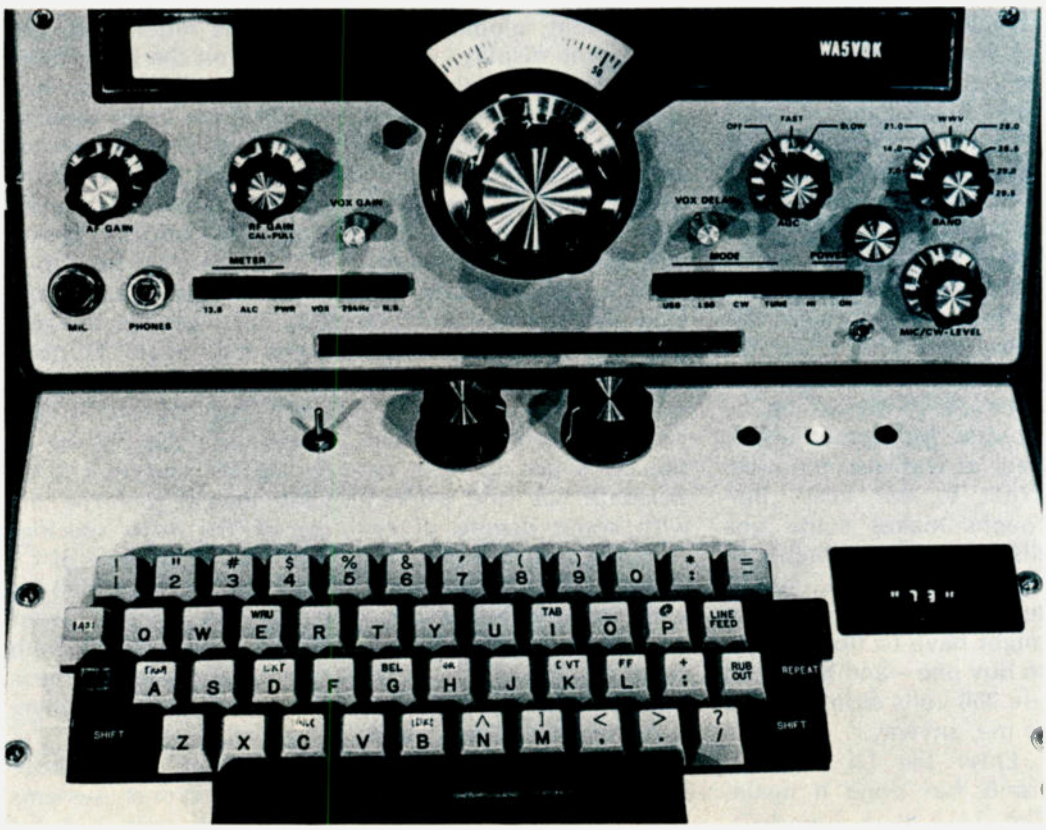
The Perfect Morse Machine

—send and receive CW with a dedicated micro

Author's note: I will supply a photocopy of the PC board artwork for $4.00. I will also program reader-supplied 2708s for $6.00. Both are payable by money order or certified check. I also wish to thank Mike Hadley WA7NLM for his audio filter design.

Have you seen all of the ads coming out for "automatic" Morse keyboards and readers with one big alphanumeric "eye" that gives you a readout as someone is sending code? Then there are the "complete" stations which will do both on a TV screen for only $600. The item I am about to describe can do all of this and more, with many possible options, for less than $100.

About three years ago at the Dayton Hamvention, I picked up a program for a computer-controlled Morse code station. This program was written with the MC6800 computer in mind and was fathered by Don Jackson W7GKU and Jim Bainter WA7VKZ. The computer and the program in our story have changed significantly, but still are based on their algorithms. The original program was designed for use with the old Mikbug® evaluation module, and used the on-board ACIA (Asynchronous Communications Interface Adapter) serial port for communications with a TTY or CRT terminal.



Well, after I finally got to the point where I had a little knowledge of the 6800, I decided to try to make this thing work. Keep in mind that a little knowledge is dangerous! I had to do some work, but after a while, a wire-wrapped version appeared on a card within my computer. I didn't believe it, but it really worked. The only problem I had with it was the way it copied code. It was so perfect that all of those with sorry fists would really mess it up. With all of the means available to generate decent code, whether keyer or keyboard, there is really no excuse for a poor fist.

Well, enough of my soapbox. With this gizmo, everybody can have perfect CW capabilities. After the original version, wire-

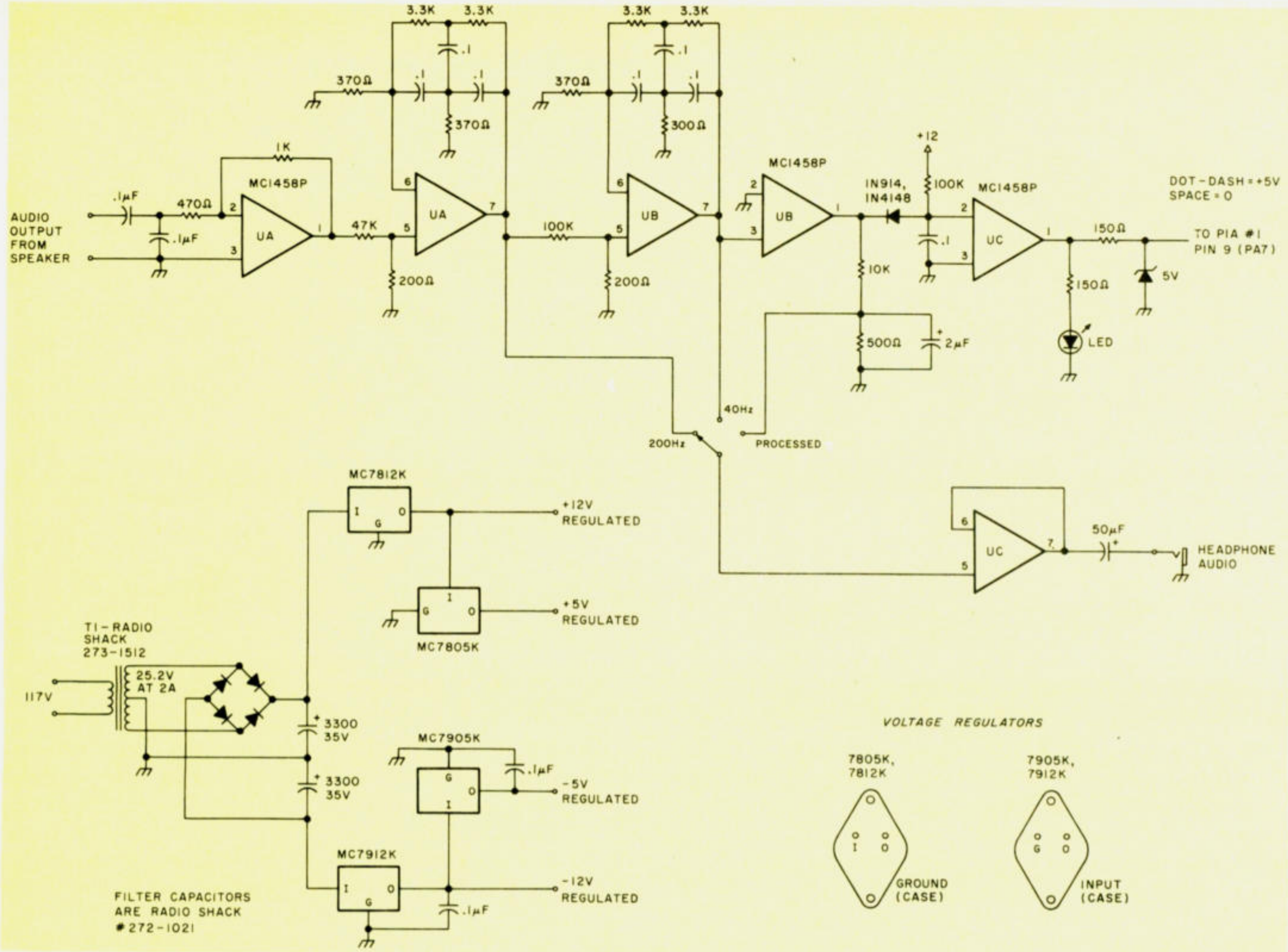


Fig. 1. This is the audio filter and recommended power supply. The input audio is filtered by the op amps and turned into dc to be fed into the PIA. Vcc = pin 8 (+12); Vee = pin 4 (−12).

wrapped deep within the bowels of my mainframe, worked, the next thought was to make it a fully self-contained system with a dedicated CPU to work with. The most logical choice was to use the MC6802—son of 6800. With clock and RAM all on silicon, at least three packages could be saved over the original 6800 design. The age of the small dedicated system has arrived.

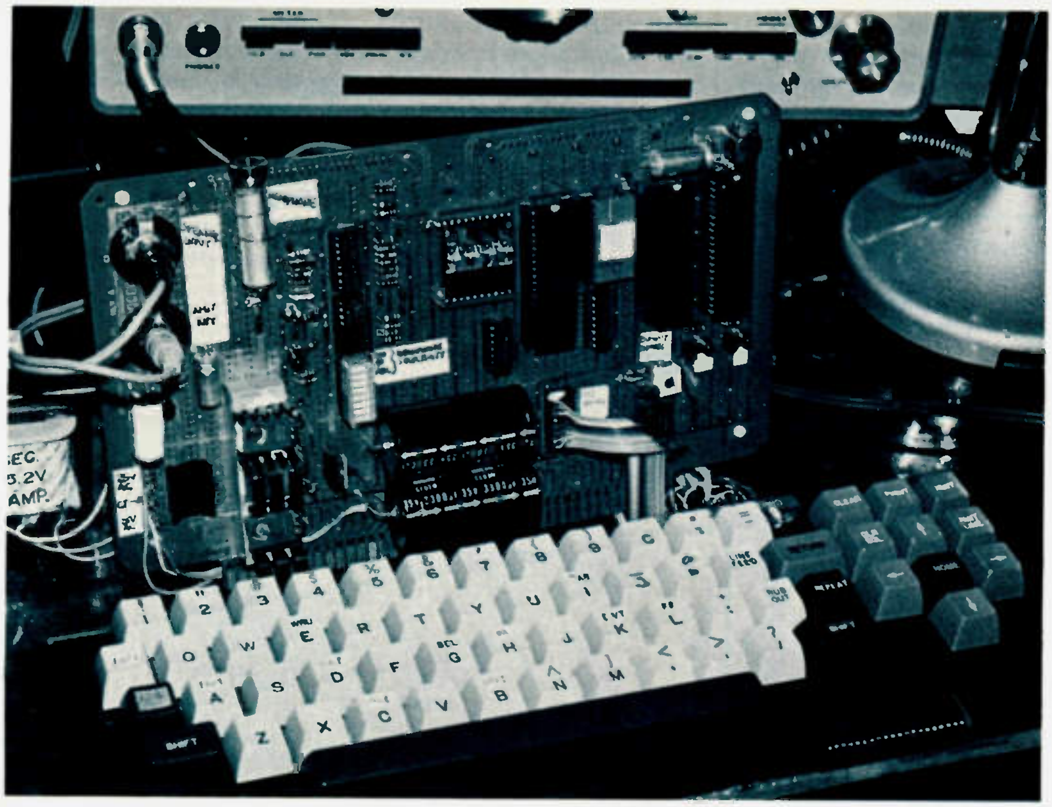
The following evening was spent on wire-wrapping a small board with the system. The program was, of course, stored in an EPROM for automatic "boot" and for more additions later. The two biggest drawbacks that I could find were that it still required a terminal which was both large and expensive, and it had a switch to go from receive to transmit, and so forth. The last time I saw one of those things was as a Novice with my Globe Scout and S100!

So, these little things had to be fixed. OK, the switch could be replaced with a different polling routine within the software. No sweat, but what about the terminal? Well, plugging in a keyboard would be no trouble, but something to peer at was also required. What to do? Well, Burroughs makes some fine display panels which can display about 30 characters on a line, but you might have to float a loan to buy one—and having to use 250 volts didn't appeal to me, anyway.

Enter the DL-1416. Litronix has done it again. The 1416 is a four-digit, 16-segment, alphanumeric intelligent display, which, when fed parallel ASCII, will display the most-used 64 characters of the ASCII set. It is a five-volt-only device, and by placing it directly on the CPU bus, will appear as "write-only RAM." Unfortunately, the slow setup times and the need to have data valid before Read/Write comes out present a few problems. The first version had the LEDs just hanging on the data bus and worked with some degree of reliability. But when Rs started coming out as Ps, I knew that the timing specifications were being violated.

After much manipulation of the clock and stretching of the E pulse, I determined that too much glue (peripheral hardware) would be required to just leave it on the bus. Then I remembered that only half of PIA 2 was being used, so the most logical choice was to put the 1416 on the peripheral data bus. By setting the control register within the PIA first to a \$34 and then to a \$3C, the CB2 line would go low and come high again, all done while the data was latched onto the output lines. Great—use this for the $\overline{W}$ (write) line, and tie it to $\overline{CE}$ (chip enable), too! The timing of the 1416 specifies that the falling edge of $\overline{CE}$ must be at least 500 ns before the rising edge of $\overline{W}$. So having them both come in at the same time is permissible. See the timing diagrams.

According to Appnote 9A from Litronix, systems which use only a 6-bit



ASCII code can still utilize the 1416 by inverting D5 and feeding it into D6. By doing it this way, two "spare" data lines on the PIA are saved. These two lines are used for addressing either of the four digits to be written to. All of the work writing to the LEDs is now being accomplished in software.

The clock within the 6802 is really a strange beast. It can accept any parallel-resonant crystal from 1 to 4 MHz. Of course, the crystal is divided by four, so remember this when selecting your crystal. In this program, the CPU will work fine even when running at its minimum frequency (100-kHz bus speed, 400-kHz crystal frequency).

A funny thing happened

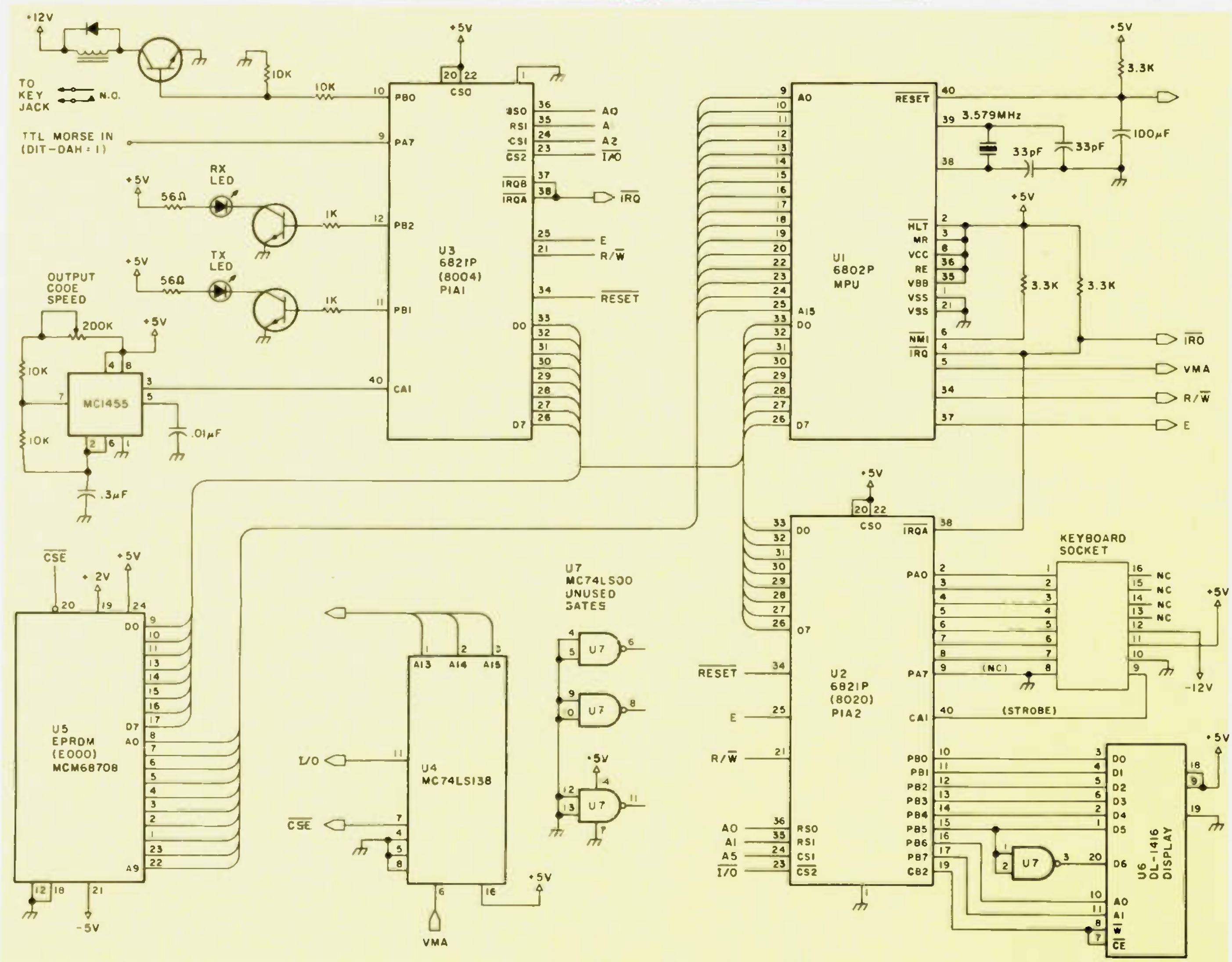


Fig. 2. The main processor, composed of the MC6802 MPU, two PIAs, and an EPROM.

while experimenting with different crystal types; the thing oscillated even without a crystal! The frequency was really slow and quite unstable, but it worked. Even after power down and up, it continued to oscillate. Since the 6802 is not specified for use without a crystal, Motorola won't guarantee it to work without one, but, just for fun, why not try it out on yours when you build it?

You might think that having only four digits a little bigger than a calculator display would be a real hassle to use. Not so! The program takes the incoming data or keyboard data and puts it in the right-hand display. As the next character comes in, it is shifted left one digit. Instant "Times Square" display. I was a bit hesitant to use on-

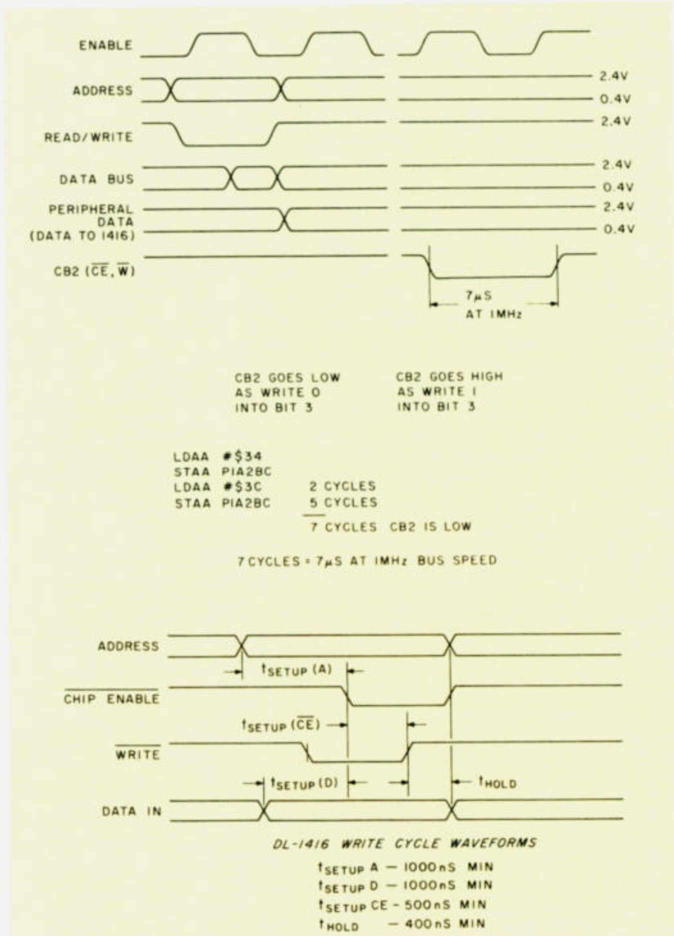


Fig. 3. PIA write-timing to displays, and Litronix-recommended write-cycles for the DL-1416.

POWER SUPPLY NOTES

The total current requirements for the reader/talker are given below. These figures are the absolute maximums for the individual components, so don't expect them to be that high, but, just in case, go ahead and plan for it.

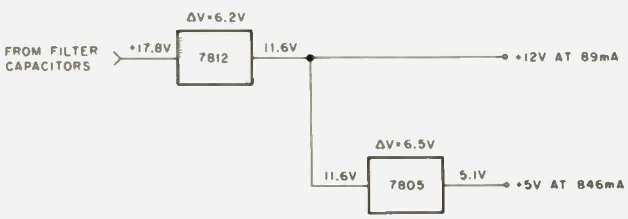
Current requirements for the reader/talker. All values are in milliamps and are absolute maximums.

	+5 V	+12 V	−12 V	−5 V
MC6802	240	—	—	—
MC6821	110	—	—	—
MC6821	110	—	—	—
MCM68708	10	65	—	65
MC74LS138	6.4	—	—	—
MC74LS00	15	—	—	—
DL1416	100	—	—	—
MC1458	—	8	8	—
MC1458	—	8	8	—
MC1458	—	8	8	—
3 LEDs	30	—	—	—
Average Keyboard	225	—	45	—
Maximum Totals	846.4	89	69	45

As can be seen in the totals, all currents can be handled with the three-terminal-style regulators. The following calculations are to determine what the power dissipation for each device is. For the three-terminal regulators, the power dissipation can be expressed by the following equation:

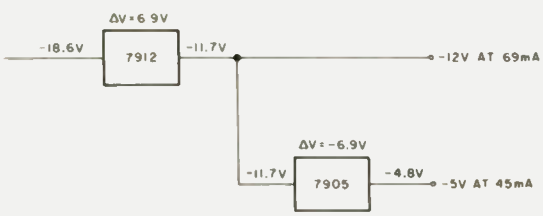
$P_D = (\Delta E_{IN})\, I_{OUT} + E_{IN}\,(I_Q)$, where: P_D = Power dissipation, E_{IN} = In-Out voltage, I_{OUT} = output current, and I_Q = current through ground lug.

For the positive voltage regulators, the following schematic is used, and the voltages are labeled. These were typical, using the values of transformers and capacitors specified in Fig. 1.



$$7812\ P_D = (6.2\ V)(.935\ A) + 17.8\,(.008) = 5.94\ W$$
(Note: .935 A = .846 A + .089 A)
$$7805 P_D = (6.5\ V)(.846\ A) + 11.6\,(.008) = 5.34\ W$$

In the same light, the minus voltage regulators can be also calculated:



$$7912\ P_D = (6.9\ V)(.114\ A) + (18.6)(.008) = .935\ W$$
$$7905\ P_D = (6.9\ V)(.045\ A) + 11.7\,(.008) = .404\ W$$

By taking the input of the 7805 from the output of the 7812, the power dissipation of the 7812 was raised from about ½ Watt to almost 6 Watts. But by taking the 7805 input directly at the capacitor output, its P_D would have been 10.75 Watts! This would be very difficult to heat sink, so by doing it as shown, the total power dissipation is about the same, only divided between two parts.

According to the *Motorola Linear IC Data Book*, to dissipate the required power (5.9 and 5.3 W), a heat sink which can dissipate 15 °C/Watt will be required. The minus voltage regulators are not as critical, as they have a lesser current demand on them. I recommend the use of the -K suffix regulators (TO-3 case), because their thermal resistance (junction-to-case vs. junction-to-air in the plastic package) is so much better. Heat sink them with an appropriate sink, preferably to a metal case, and no problems should be encountered. The negative regulators' requirements can be satisfied by simply bolting them to the chassis. (Be sure to insulate their cases!)

The voltage regulators shown in the pictures are of the plastic style and get quite hot even with the heat sinking shown. When the project is put into an enclosure, TO-3-style regulators will replace them.

ly four digits, but after using it, I find that 4 is really not too few, and the faster the code is sent, the easier it is to read. The new design now automatically transfers from receive to transmit and back again after all characters have been sent. The algorithm used in the code conversion is set up so that it automatically senses speed changes and adjusts itself for the correct speed. This can be anywhere between about one-half wpm to 300 wpm. Changing speed requires only about 2 characters to be lost, so it is quite efficient. Neat, eh?

Back before I built the keyboard/reader, I thought that it would be "cheating" to use one; it had been done manually for such a long time, who was I to change any preconceived ideas? Anyway, I have found just the opposite to be true! Number 1, the computer is not foolproof. It can be messed up by zero-beat QRM, sloppy fists, or high noise levels. So, when you start your QSO, try not to get carried away and go too fast, because if one of these should happen, you might be stranded by sending faster than you can receive. Another thing is that you are seeing a character appear on the display at the same time you are hearing it. No better way for associative learning than to get the code into your eyes and ears simultaneously. I've found my speed to be dramatically increasing following the use of it for a couple of weeks. Also, you have a tendency to follow the conversation along in your head—the only way to do it for above 15 or 20 wpm. The final plus is that you hear perfect code being sent by your keyboard, and it makes you wish that everyone had one of these things! So, it's not really cheating, but only another progressive learning device provided by the computer.

As this design recognizes a single input to determine a character and a single output for code, why couldn't it also be used for Baudot or ASCII teletype™? This is just a bug in your ear—look for some further programs in later articles. Wouldn't it be nice to have a truly portable TTY "machine"?

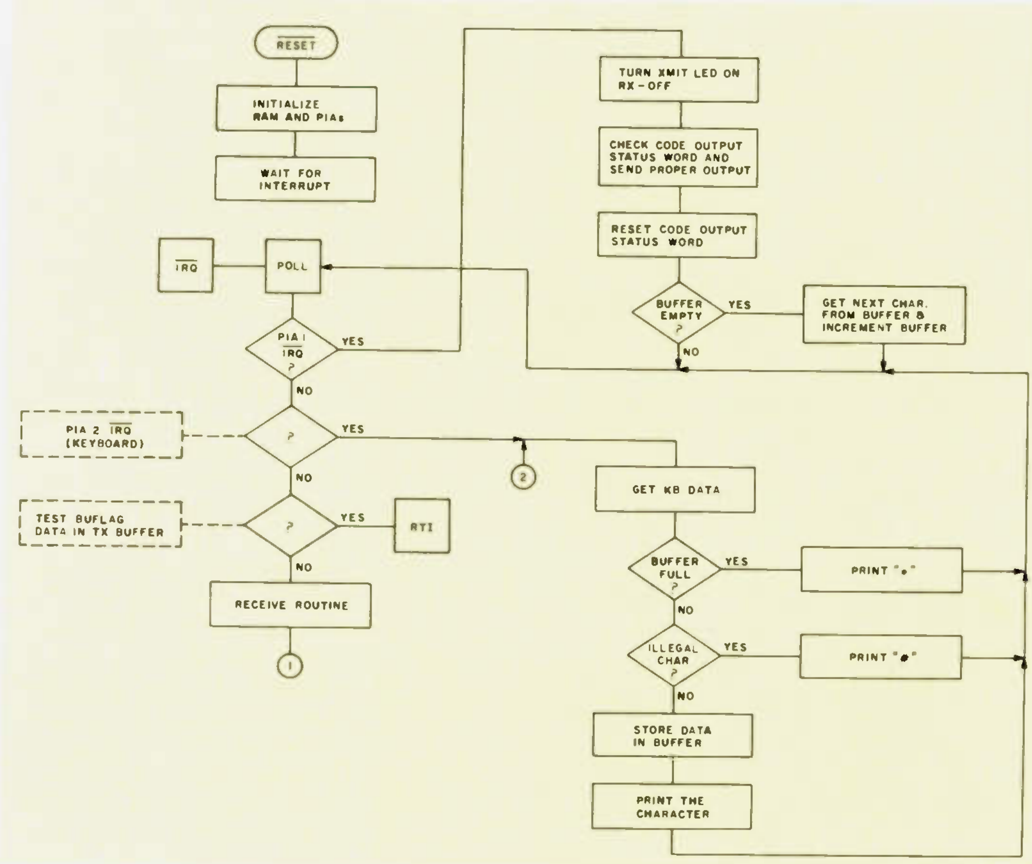


Fig. 4. Flowchart, part 1.

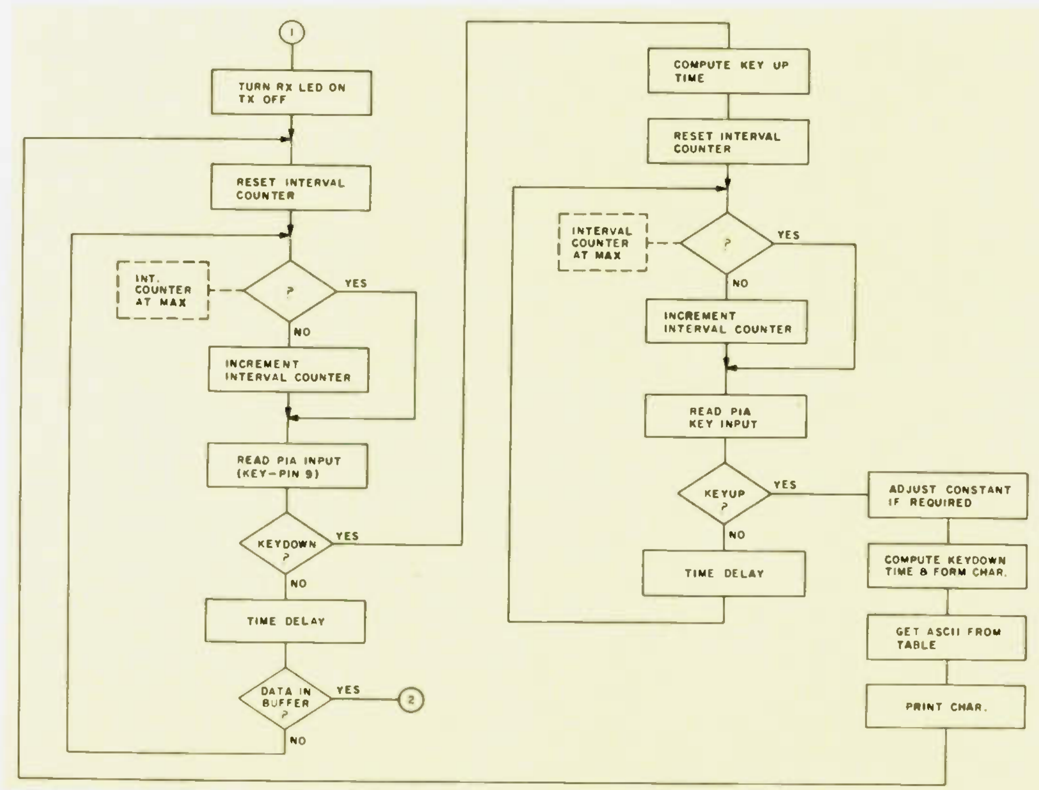


Fig. 5. Flowchart, part 2.

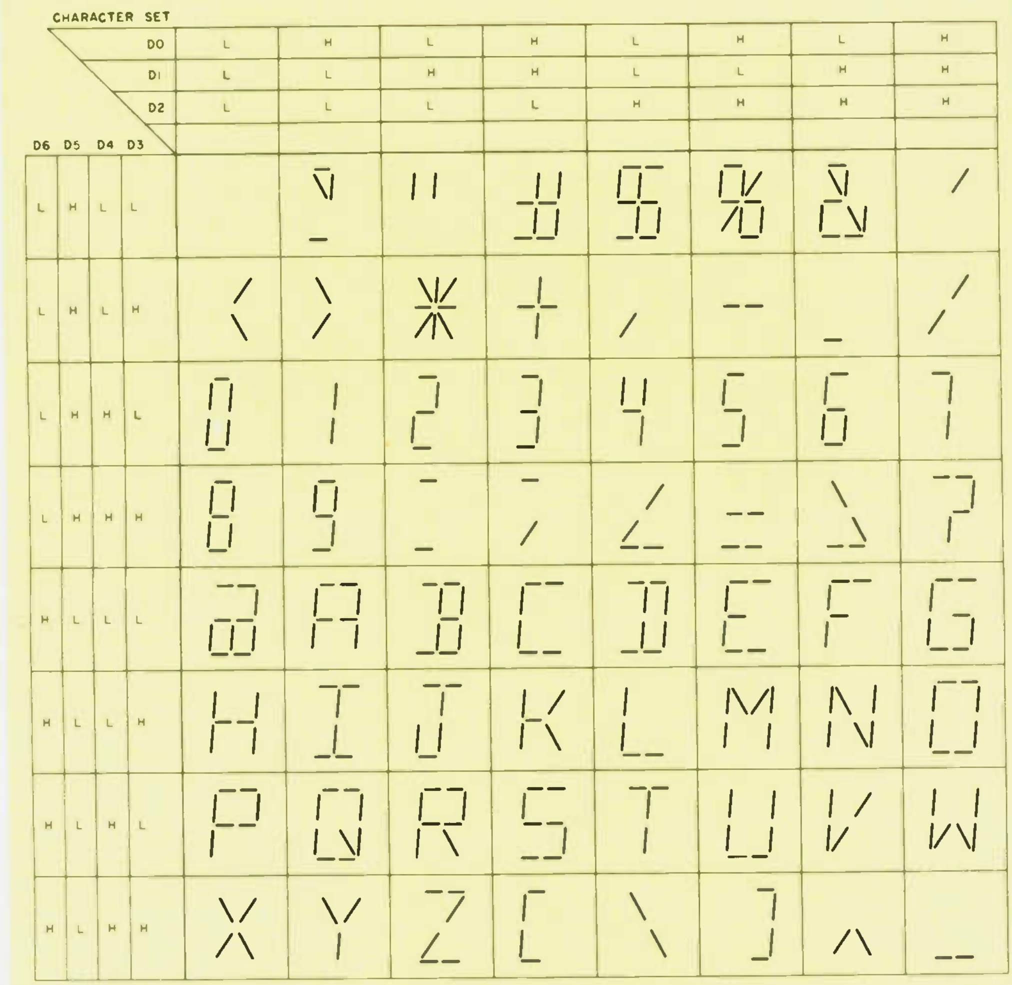
Construction

As you can see in Fig. 1,

the audio from a headphone jack or speaker tie-in goes into a filter-processor where it is converted from audio tones to TTL-compatible levels. This audio input is fed into an op amp preamplifier, so not a whole lot of audio is required. You might want to pad it if your receiver overdrives the device. You also can plug your headphones into the jack on the board and use it for a filter. The first switch position provides selectivity down to about 200 Hz, the second to 40 Hz, and the third to processed audio—this is a really fun feature. After it is tuned in correctly, all you hear is a tone. No QRM, no static, no garbage, only a pure representation of the sent character. This is a really weird feeling, especially if you have never used it before. If you don't want to build the computer, at least build the filter—it works great for CW by itself.

After this processed audio is converted to a voltage level, it is fed into a single bit of a PIA (Peripheral Interface Adapter) parallel port. Two of these PIAs are used on the board, one for Morse in and out, transmit speed timing, and indicator LEDs. The second PIA is for the keyboard and LED display unit. The 555 circuit is set for the desired speed at which you wish to transmit. In this design, a relay is provided for Morse code output. Although my HW-104 uses positive voltage keying and worked great with just a single keying transistor, a reed relay provides a more versatile interface for use with any type of keying, from grid-block to cathode.

The EPROM in the circuit is used to hold the pro-



LOADING DATA

$\overline{CE}$	$\overline{CU}$	$\overline{W}$	ADDRESS A_1	ADDRESS A_0	DATA INPUT D6	D5	D4	D3	D2	D1	D0	DIGIT 3	DIGIT 2	DIGIT 1	DIGIT 0
H	X	X	X	X	X	X	X	X	X	X	X	N/C	N/C	N/C	N/C
L	H	L	L	L	H	L	L	L	L	L	H	N/C	N/C	N/C	A
L	H	L	L	H	H	L	L	L	L	H	L	N/C	N/C	B	A
L	H	L	H	L	H	L	L	L	L	H	H	N/C	C	B	A
L	H	L	H	H	H	L	L	L	H	L	L	D	C	B	A
L	H	L	L	L	H	L	L	L	H	L	H	D	C	B	E
L	H	L	H	L	H	L	L	H	L	H	H	D	K	R	E
L	H	L	—	—	—	—	—	—	—	—	—	SEE CHARACTER SET			

LOADING CURSOR

$\overline{CE}$	$\overline{CU}$	$\overline{W}$	ADDRESS A_1	ADDRESS A_0	DATA INPUT D6	D5	D4	D3	D2	D1	D0	DIGIT 3	DIGIT 2	DIGIT 1	DIGIT 0
H	X	X	X	X	X	X	X	X	X	X	X	D	K	B	E
L	L	L	X	X	X	X	X	L	L	L	H	D	K	B	.
L	L	L	X	X	X	X	X	L	L	L	L	D	K	B	E
L	L	L	X	X	X	X	X	L	L	H	L	D	K	.	E
L	L	L	X	X	X	X	X	L	H	L	L	D	.	B	E
L	L	L	X	X	X	X	X	H	L	L	L	.	K	B	E
L	L	L	X	X	X	X	X	H	H	H	H	.	.	.	.
L	L	L	X	X	X	X	X	L	L	L	L	D	K	B	E

Fig. 6. Litronix DL-1416 character set and truth table. X = don't care; N/C = no change.

6 Meters + ICOM + Sunspots = The best DX

ICOM's 551D is Essential to the 6 mtr DX Formula.

The IC-551D is the high powered brother to the ICOM IC-551. With an 80+ watt output, you have all the punch you need for that really good DX when the Sunspots are working for you. The 551D has the same no-backlash, no-delay dual VFO light chopper system, coupled to the microprocessor for split frequency as well as completely variable offsets.

For quick access to DX excitement, three memories are provided for programmed beacon watching, which can be scanned and programmed to stop on the first one heard. A room full of white noise is no longer a problem with ICOM. Pass band tuning and VOX are included at no extra cost.

SPECIFICATIONS

Frequency Coverage: 50~54MHz

Power Supply Requirements:
13.8V DC±15%, negative ground
Current drain 18A max.
(at 200W input). AC power supply speaker console is available for AC operation.

Emission Modes:
A3J SSB (USB/LSB)
A1 CW
A3H AM
F3* FM

Dimensions: 111mm (H)×241mm (W)×311mm (D)

Weight: 6.6kg

Sensitivity: SSB/CW/AM
Less than 0.5μV for 10dB S+N/N
FM* More than 30dB S+N+D/N+D at 1μV

Squelch Sensitivity: SSB/CW/AM 1μV
FM* 0.4μV

Selectivity: SSB/CW/AM
More than ±1.1 KHz at -6dB
Less than ±2.2KHz at -60dB
Adjustable to 1KHz at -6dB
FM*
More than ±7.5KHz at -6dB
Less than ±15KHz at -60dB

*Only when FM Unit is installed.

HF/VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT

ICOM

ICOM AMERICA, INCORPORATED

Sales Service Centers located at:

2112 116th Avenue NE
Bellevue, WA 98004
Phone (206) 454-8155

3331 Towerwood Dr., Suite 307
Dallas, TX 75234
Phone (214) 620-2780

ICOM INFORMATION SERVICE Q H
2112 116th Ave., N.E.
Bellevue, WA 98004 Z S

Please send me: ☐ **IC-551D specifications sheet;** ☐ **full color ICOM Product Line Catalog;** ☐ **List of Authorized ICOM Dealers.**

NAME ____________________ CALL __________

ADDRESS ____________________

CITY __________ STATE __________ ZIP __________

You may send a machine copy of this form

All stated specifications are subject to change without notice. All ICOM radios significantly exceed FCC regulations limiting spurious emissions.

Program listing. Software for reader in 6800 assembler source code.

```
                            NAM    MORSEMAX (LED VERSION)
0000                        ORG    $0000
                    ***************************************************
                    * MORSE CODE/ASCII SEND/RECEIVE PROGRAM
                    * FOR THE MOTOROLA 6802 MICROPROCESSOR
                    * FROM AUSTIN, TEXAS
                    * MICROPROCESSOR CAPITOL OF THE WORLD!
                    ***************************************************
                    * I/O HARDWARE CONFIGURATION:
                    *    PIA1 ADDRESS - $8004
                    *       CA1 - INTERRUPT TIMING FOR XMIT CODE,
                    *             2-50 HZ.
                    *       PA7 - RECEIVE CODE INPUT
                    *       PB0 - CODE OUT
                    *       PB1 - TRANSMIT LED
                    *       PB2 - RECEIVE LED
                    *    PIA2 ADDRESS (KBD) - $8020
                    *    LITRONIX DISPLAY DL-1416 4 DIGIT LED - $C000
                    *    MCM2708L EPROM - $E000
                    ***************************************************
                    * ALL COMMONLY USED MORSE CHARACTERS
                    * ARE AVAILABLE:
                    *
                    *      SPACE - SPACE
                    *      ESC   - AS
                    *      =     - BT
                    *    CNTRL A - KN
                    *          B - BK
                    *          C - AR
                    *          D - SK
                    *          F - SN
                    *          H - ERROR ( 8 DOTS )
                    *
                    ***************************************************
                    *
                    *** TEMPORARY STORAGE FOR VARIABLES AND BUFFER **
                    *
0000     0002     A CVCX   RMB    2          INDEX REG CONVERT STORE
0002     0002     A SAVEX  RMB    2          X-REG TEMP STORAGE
0004     0001     A COUNT  RMB    1
0005     0001     A RESMSK RMB    1          COSTA RESET MASK
0006     0001     A BUFLAG RMB    1          B7=1  DATA IN BUFFER
0007     0003     A TMPSVE RMB    3          TEMP SAVE AREA FOR LED DIS
000A     0001     A COSTA  RMB    1          CODE OUTPUT STATUS
                    *B7 DIT FLAG,B6 DAH FLAG,B5 ELEMENT SPACE FLAG
                    *B4 WORD SPACE FLAG,B3 CHAR. SPACE FLAG
000B     0001     A LETYPE RMB    1          LAST ELEM TYPE DOT=0 DASH
000C     0001     A HLETIM RMB    1          HALF LAST ELEM TIME
000D     0001     A TLETIM RMB    1          TWICE LAST ELEM TIME
000E     0001     A SPEEDK RMB    1          SPEED CONSTANT
000F     0001     A RCHAR  RMB    1          CHAR BEING RECEIVED
0010     0001     A LDATIM RMB    1          LAST DASH TIME
0011     0001     A TQLDAT RMB    1          3/4 LAST DASH TIME
0012     0001     A TLDAT  RMB    1          TWICE LAST DASH TIME
0013     0001     A KDTIM  RMB    1          KEYDOWN INTERVAL TIME
0014     0001     A KUTIM  RMB    1          KEYUP INTERVAL TIME
0015     0001     A CHCTR  RMB    1          REC. CHARACTER COUNTER
0016     0002     A RECX   RMB    2          REC. INDEX REG. TO ACCA.
0018     0055     A BUFBOT RMB    85         XMIT BUFFER BOTTOM
006D     0001     A BUFTOP RMB    1          XMIT BUFFER TOP

                    * PIA USED FOR I/O OF CW AND LED STATUS
8004                       ORG    $8004
8004     0001     A PIA1AD RMB    1
8005     0001     A PIA1AC RMB    1
8006     0001     A PIA1BD RMB    1
8007     0001     A PIA1BC RMB    1

                    * PIA USED FOR KEYBOARD INPUT AND LED DISPLAY OUT
8020                       ORG    $8020
8020     0001     A PIA2AD RMB    1          *KEYBOARD
8021     0001     A PIA2AC RMB    1
8022     0001     A PIA2BD RMB    1          *DISPLAY
8023     0001     A PIA2BC RMB    1

         007F     A STACK  EQU    $007F
         FFF8     A IRQVEC EQU    $FFF8
                    *
E000                       ORG    $E000
                    *                KN  BK  AR  SK   ACK
E000     00       A CODE   FCB    0,$B4,$8B,$54,$16,0,$14,0
                    *            ERR           SP
E008     01       A        FCB    1,0,0,0,0,$21,0,0
E010     00       A        FCB    0,0,0,0,0,0,0,0
                    *                    AS
E018     00       A        FCB    0,0,0,$44,0,0,0,0
                    *             SP    "
E020     21       A RTAB   FCB    $21,0,$4A,0,0,0,0,$7A
                    *             (   )          ,   -   .   /
E028     B6       A        FCB    $B6,$B2,0,0,$CE,$86,$56,$94
                    *             0   1   2   3   4   5   6   7
E030     FC       A        FCB    $FC,$7C,$3C,$1C,$0C,4,$84,$C4
                    *             8   9   :   ;     BT(=)  ?
E038     E4       A        FCB    $E4,$F4,$E2,$AA,0,$8C,0,$32
                    *               A   B   C   D   E   F   G
E040     00       A        FCB    0,$60,$88,$A8,$90,$40,$28,$D0
                    *             H   I   J   K   L   M   N   O
E048     08       A        FCB    $08,$20,$78,$B0,$48,$E0,$A0,$F0
                    *             P   Q   R   S   T   U   V   W
E050     68       A        FCB    $68,$D8,$50,$10,$C0,$30,$18,$70
                    *             X   Y   Z
E058     98       A        FCB    $98,$B8,$C8

                    ***RESTART ROUTINE***
E05B CE 007F      A RESRT  LDX    #$7F       CLR RAM 0-7F
E05E 6F 00        A L1     CLR    0,X
E060 09                    DEX
E061 26 FB E05E            BNE    L1
E063 CE 2020      A        LDX    #$2020
E066 DF 07        A        STX    TMPSVE     'CLEARS TMPSVE'
E068 DF 08        A        STX    TMPSVE+1
E06A CE 0F01      A        LDX    #$0F01
E06D DF 0E        A        STX    SPEEDK     INZ SPEED CONS & RCHAR
E06F 86 80        A        LDAA   #$80
E071 97 6D        A        STAA   BUFTOP     INZ BUFTOP
E073 09                    DEX
E074 CE E000      A        LDX    #CODE
E077 DF 00        A        STX    CVCX       INZ CVCX
E079 CE 006D      A        LDX    #BUFTOP
E07C DF 02        A        STX    SAVEX
E07E CE E0B4      A        LDX    #POLL      INZ IRQ VECTOR
E081 FF FFF8      A        STX    IRQVEC
E084 CE 8004      A        LDX    #PIA1AD
E087 6F 01        A        CLR    1,X        CLR PIA1AC
E089 6F 03        A        CLR    3,X        CLR PIA1BC
E08B 8E 0007      A        LDS    #$0007     CA1=+ & ALLOWED
E08E AF 00        A        STS    0,X        (PIA1AD & PIA1AC)
E090 8E FF34      A        LDS    #$FF34
E093 AF 02        A        STS    2,X        (PIA1BD & PIA1BC)
E095 A6 00        A        LDAA   0,X        CLR IRQA FLAGS
E097 A6 02        A        LDAA   2,X        CLR IRQB FLAGS
E099 86 00        A        LDAA   #$00
E09B B7 8020      A        STAA   PIA2AD
E09E 86 07        A        LDAA   #$07       CA1 NEG INPUT
E0A0 B7 8021      A        STAA   PIA2AC
E0A3 86 FF        A        LDAA   #$FF
E0A5 B7 8022      A        STAA   PIA2BD     SETS PIA2B FOR OUTPUTS
E0A8 86 04        A        LDAA   #$04
E0AA B7 8023      A        STAA   PIA2BC     SETS DDR
E0AD 8E 007F      A        LDS    #STACK     INZ STACK POINTER
E0B0 0E                    CLI               CLEAR INTERRUPT FLAG
E0B1 3E             EXEC   WAI
E0B2 20 FD E0B1            BRA    EXEC
                    *
                    ***JUMP FROM IRQ VECTOR***
E0B4 7D 8005      A POLL   TST    PIA1AC
E0B7 2B 0E E0C7            BMI    POLL2      (MC1455 IRQ)
E0B9 7D 8021      A        TST    PIA2AC
E0BC 2B 6A E128            BMI    COMMR1     (KEYBOARD IRQ)
E0BE 7D 0006      A        TST    BUFLAG
E0C1 2B 03 E0C6            BMI    NOTRCV     (DATA IN BUFFER)
E0C3 7E E1E9      A        JMP    REC
E0C6 3B             NOTRCV RTI

                    ***TRANSMIT ROUTINE***
E0C7 F6 8004      A POLL2  LDAB   PIA1AD
E0CA F6 8006      A        LDAB   PIA1BD
E0CD CA 02        A        ORAB   #2         XMIT LED ON
E0CF C4 FB        A        ANDB   #$FB       REC LED OFF
E0D1 F7 8006      A        STAB   PIA1BD
E0D4 96 0A        A        LDAA   COSTA      GET CODE OUTPUT STATUS
E0D6 2A 07 E0DF            BPL    CFDAH      CHECK FOR DAH
E0D8 C6 7F        A        LDAB   #$7F
E0DA D7 05        A        STAB   RESMSK     DIT RESET
E0DC 5F             CES1   CLRB              DIT BEING SENT
E0DD 20 29 E108            BRA    CKCNT      TEST COUNT
E0DF 48             CFDAH  ASLA              TEST FOR DAH
E0E0 2A 08 E0EA            BPL    CFES       CHECK FOR ELEMENT SPACE
E0E2 C6 BF        A        LDAB   #$BF
E0E4 D7 05        A        STAB   RESMSK     DAH RESET
E0E6 C6 04        A        LDAB   #4         DAH BEING SENT
E0E8 20 1E E108            BRA    CKCNT

E0EA 48             CFES   ASLA              TEST FOR ELEMENT SPACE
E0EB 2A 0A E0F7            BPL    CFWS       CHECK FOR WORD SPACE
E0ED C6 DF        A        LDAB   #$DF
E0EF D7 05        A        STAB   RESMSK     ELEMENT SPACE RESET
E0F1 8D 2C E11F            BSR    SOZERO
E0F3 C6 01        A        LDAB   #1
E0F5 20 11 E108            BRA    CKCNT
```

gram permanently until it is desired to erase it. For a one-time shot, specify the plastic version. Much less expensive, but good only once. On the ceramic types, be sure to keep the adhesive paper over the quartz lid, as it might start to forget if exposed to ultraviolet light. The MC6802 processor contains an on-board clock generation circuit and 128 bytes of RAM. This RAM is used by the processor for temporary storage and for the 85-character keyboard buffer. You can type in up to 85 characters, sit back, and drink your coffee while the code dribbles out. Additional memory could be added—up to 65 thousand characters, and that's what I call a big buffer. With only a little more memory, canned messages could be inserted and held for a later call-up (before power is turned off)—CQs, tests, QTHs, for example. As the program is right now, only what is typed will be sent out.

Almost any crystal between 1 and 4 MHz can be used, so the old junk box can be used for some of the components. Look in an old color TV set—the 3.58-MHz crystal works well, too. Reset is provided by the resistor-capacitor combination automatically upon power-up conditions. If for any reason the computer does something strange or just quits, turn the power off and back on again. This will reset everything and start over. A note about the keyboard: The program is set up to recognize any keyboard that provides the ASCII code

```
E0F7 48            CFWS   ASLA
E0F8 2A 08 E102           BPL    CFCS     CHECK FOR SPACE
E0FA C6 EF      A         LDAB   #$EF
E0FC D7 05      A         STAB   RESMSK   WORD SPACE RESET
E0FE C6 C8      A         LDAB   #8       WORD SPACE BEING SENT
E100 20 06 E108           BRA    CKCNT

E102 C6 F7      A  CFCS   LDAB   #$F7
E104 D7 05      A         STAB   RESMSK
E106 C6 04      A         LDAB   #4
E108 D1 04      A  CKCNT  CMPB   COUNT
E10A 27 06 E112           BEQ    CK1
E10C 7C 0004    A         INC    COUNT
E10F 7E E0B4    A  RETRN  JMP    POLL

E112 7F 0004    A  CK1    CLR    COUNT
E115 96 0A      A         LDAA   COSTA
E117 94 05      A         ANDA   RESMSK
E119 97 0A      A         STAA   COSTA
E11B 26 F2 E10F           BNE    RETRN
E11D 20 14 E133           BRA    GNEL

                   ***SEND OUT A ZERO***
E11F B6 8006    A  SOZERO LDAA   PIA1BD
E122 84 FE      A         ANDA   #$FE
E124 B7 8006    A         STAA   PIA1BD
E127 39                   RTS
E128 20 64 E18E    COMMR1 BRA    COMMR

                   ***SEND OUT A ONE***
E12A B6 8006    A  SOONE  LDAA   PIA1BD
E12D 8A 01      A         ORAA   #1       SET BIT ZERO
E12F B7 8006    A         STAA   PIA1BD
E132 39                   RTS

                   ***GET NEW ELEMENT FOR OUTPUT***
E133 96 6D      A  GNEL   LDAA   BUFTOP
E135 81 80      A         CMPA   #$80     TEST FOR CHAR END
E137 26 26 E15F           BNE    GNEL1
E139 86 08      A         LDAA   #$08     SEND OUT CHAR. SPACE
E13B 97 0A      A         STAA   COSTA
E13D 8D E0 E11F           BSR    SOZERO
E13F DE 02      A         LDX    SAVEX
E141 8C 006D    A         CPX    #BUFTOP
E144 26 09 E14F           BNE    GNELR
E146 96 06      A         LDAA   BUFLAG   BUFFER EMPTY
E148 84 7F      A         ANDA   #$7F
E14A 97 06      A         STAA   BUFLAG   RESET FLAG
E14C 7E E0B4    A         JMP    POLL
                   *
E14F 8D 2D E17E    GNELR  BSR    MOVUP
E151 96 6D      A         LDAA   BUFTOP
E153 81 21      A         CMPA   #$21     LOOK FOR SPACE
E155 27 1A E171           BEQ    SWS
E157 7D 000A    A         TST    COSTA
E15A 27 03 E15F           BEQ    GNEL1
E15C 7E E0B4    A         JMP    POLL
                   *
E15F 78 006D    A  GNEL1  ASL    BUFTOP
E162 25 04 E168           BCS    SODAH    SEND OUT DAH
E164 86 A0      A         LDAA   #$A0     SEND OUT DIT & ELEMENT SPA
E166 20 02 E16A           BRA    SOEL
                   *
E168 86 60      A  SODAH  LDAA   #$60     SEND OUT DAH &ELEMENT SPAC
E16A 97 0A      A  SOEL   STAA   COSTA    SET STATUS
E16C 8D BC E12A           BSR    SOONE
E16E 7E E0B4    A         JMP    POLL
                   *
E171 86 80      A  SWS    LDAA   #$80
E173 97 6D      A         STAA   BUFTOP
E175 86 10      A         LDAA   #$10
E177 97 0A      A         STAA   COSTA    SEND OUT WORD SPACE
E179 8D A4 E11F           BSR    SOZERO
E17B 7E E0B4    A         JMP    POLL
                   *
E17E CE 0055    A  MOVUP  LDX    #BUFTOP-BUFBOT
E181 A6 17      A  MOV1   LDAA   BUFBOT-1,X
E183 A7 18      A         STAA   BUFBOT,X
E185 09                   DEX
E186 26 F9 E181           BNE    MOV1
E188 DE 02      A         LDX    SAVEX    UPDATE INPUT POINTER
E18A 08                   INX
E18B DF 02      A         STX    SAVEX
E18D 39            MOVRT  RTS

                   ***COMM REC INTERRUPT ROUTINE***
E18E DE 02      A  COMMR  LDX    SAVEX
E190 B6 8020    A         LDAA   PIA2AD   GET KB DATA
E193 8C 0018    A         CPX    #BUFBOT
E196 27 49 E1E1           BEQ    BUFFUL   MEMORY BUFFER FULL
E198 81 5A      A         CMPA   #$5A
E19A 22 49 E1E5           BHI    BADCH    ILLEGAL CHAR
E19C 97 01      A  STM    STAA   CVCX+1
E19E DE 00      A         LDX    CVCX
E1A0 E6 00      A         LDAB   0,X      DATA CONVERTED TO MORSE CO
E1A2 27 41 E1E5           BEQ    BADCH    KICK OUT BAD CHAR'S
E1A4 DE 02      A         LDX    SAVEX
E1A6 09                   DEX
E1A7 E7 00      A         STAB   0,X      STORE DATA IN BUFFER
E1A9 DF 02      A         STX    SAVEX    MOVE POINTER DOWN
E1AB D6 06      A         LDAB   BUFLAG
E1AD CA 80      A         ORAB   #$80     SET FLAG BIT 7
E1AF D7 06      A         STAB   BUFLAG
E1B1 8D 03 E1B6    PRNT   BSR    OUTCH    PRINT CHARACTER
E1B3 7E E0B4    A         JMP    POLL
                   ***PRINT CHARACTER ROUTINE***
E1B6 36            OUTCH  PSHA            SAVE LSB CHARACTER
E1B7 C6 C0      A         LDAB   #$C0
E1B9 CE 0009    A         LDX    #TMPSVE+2
E1BC A6 00      A         LDAA   0,X
E1BE 8D 10 E1D0    OUTCH1 BSR    STROBE
E1C0 09                   DEX
E1C1 A6 00      A         LDAA   0,X
E1C3 A7 01      A         STAA   1,X
E1C5 C0 40      A         SUBB   #$40
E1C7 26 F5 E1BE           BNE    OUTCH1
E1C9 32                   PULA
E1CA 84 3F      A         ANDA   #$3F     STRIPS BIT 6 AND 7
E1CC 97 07      A         STAA   TMPSVE
E1CE 20 00 E1D0           BRA    STROBE
E1D0 1B            STROBE ABA
E1D1 B7 8022    A         STAA   PIA2BD   WRITE INTO APPROPRIATE DIG
E1D4 86 34      A         LDAA   #$34     BIT 3 = 0
E1D6 B7 8023    A         STAA   PIA2BC   PULSES CB2 LOW
E1D9 86 3C      A         LDAA   #$3C     BIT 3 = 1
E1DB B7 8023    A         STAA   PIA2BC   AND BACK AGAIN FOR
E1DE 39                   RTS             WRITE PULSE
E1DF 20 AD E18E    COMMR2 BRA    COMMR
                   *
E1E1 86 2A      A  BUFFUL LDAA   #'*      PRINT '*' FOR BUFFER FULL
E1E3 20 CC E1B1           BRA    PRNT
                   *
                   *
E1E5 86 23      A  BADCH  LDAA   #$23     PRINT '#' FOR BAD CHAR
E1E7 20 C8 E1B1           BRA    PRNT

                   ***START OF RECEIVE ROUTINE***
E1E9 B6 8006    A  REC    LDAA   PIA1BD
E1EC 8A 04      A         ORAA   #4       REC LED ON
E1EE 84 FD      A         ANDA   #$FD     XMIT LED OFF
E1F0 B7 8006    A         STAA   PIA1BD
E1F3 86 FF      A  KEYUP  LDAA   #$FF     RESET INTERVAL COUNTER
E1F5 81 FE      A  KULOOP CMPA   #$FE     INTERVAL COUNTER AT MAX?
E1F7 27 03 E1FC           BEQ    NOINC    DO NOT INCR IF MAX
E1F9 4C                   INCA            INCREMENT INTERVAL COUNTER
E1FA 20 0A E206           BRA    KUCONT

E1FC 97 14      A  NOINC  STAA   KUTIM    SAVE KU INTERVAL TIME
E1FE D6 0F      A         LDAB   RCHAR    GET RCVD CHAR
E200 C1 01      A         CMPB   #1       ANYTHING THERE?
E202 27 02 E206           BEQ    KUCONT
E204 8D 4C E252           BSR    COMPKU
E206 F6 8004    A  KUCONT LDAB   PIA1AD   CHECK INPUT
E209 2B 09 E214           BMI    KD       BRANCH IF KEYDOWN
E20B 8D 36 E243           BSR    TIMER    TIME DELAY

E20D 7D 8021    A         TST    PIA2AC   TESTS BIT 7 TO SEE IF DATA
E210 2B CD E1DF           BMI    COMMR2   IF DATA THN XMIT
E212 20 E1 E1F5           BRA    KULOOP
E214 97 14      A  KD     STAA   KUTIM    SAVE KU INTERVAL TIME
E216 8D 3A E252           BSR    COMPKU
E218 86 FF      A  KEYDWN LDAA   #$FF     RESET INTERVAL TIMER
E21A 81 FE      A  KDLOOP CMPA   #$FE     INTERVAL COUNTER AT MAX?
E21C 27 01 E21F           BEQ    MAXKD    DO NOT INCR IF MAX
E21E 4C                   INCA            INCREMENT INTERVAL COUNTER
E21F F6 8004    A  MAXKD  LDAB   PIA1AD   CHECK INPUT
E222 2A 04 E228           BPL    KU       BRANCH IF KEYUP
E224 8D 1D E243           BSR    TIMER
E226 20 F2 E21A           BRA    KDLOOP

E228 97 13      A  KU     STAA   KDTIM    SAVE KD INTERVAL TIME
E22A 81 04      A         CMPA   #$4      KD INTERVAL TIME TOO LOW?
E22C 24 05 E233           BCC    CKHI     BRANCH IF NOT TOO LOW
E22E 96 0E      A         LDAA   SPEEDK
E230 44                   LSRA            DIVIDE SPEED CONSTANT BY 2
E231 20 07 E23A           BRA    UNZERO

E233 81 7F      A  CKHI   CMPA   #$7F     KD INTERVAL TIME TOO HIGH?
E235 25 07 E23E           BCS    CMPTKD   BRANCH IF OK
E237 96 0E      A         LDAA   SPEEDK
E239 48                   ASLA            MULTIPLY SPEED CONSTANT BY
```

Continued

set and a negative-going strobe. There are many available from wholesale houses for $20.00 and up.

Key Characters Available

The computer will generate all of the Morse characters plus some special function keys which can be generated by the use of the CNTRL key. A list of them follows:

Control A	KN
B	BK
C	AR
D	SK
F	SN
H	ERROR (8 dots)
=	BT
ESC	AS
SPACE	SPACE

A "space" will insert a space in the buffer to be transmitted along with the code, thereby making perfect Morse every time. While typing, if you should reach the top of the buffer, the character you try to enter will be displayed as an *, meaning that it did not get entered and you should reenter it after one character has been sent.

Any illegal character typed will appear as a # and will not get sent. Any received character which the computer cannot figure out—like run-together characters—will be displayed as an __, and an error (8 dots) will be an @.

Parts Procurement

All parts (with the exception of the DL-1416) can be obtained from your local Motorola distributor, and the 1416 comes from a Litronix distributor. All of the parts should tally to

```
00363A E23A 8A 01     A UNZERO ORAA   #1         ASCERTAIN SPEED CONSTANT I
00364A E23C 97 0E     A        STAA   SPEEDK     NOT SET TO ZERO
00365A E23E 8D 31 E271 CMPTKD  BSR    COMPKD
00366A E240 7E E1F3   A        JMP    KEYUP

00368                   ***SUBROUTINE TO CREATE TIME DELAY***
00369A E243 37          TIMER  PSHB              SAVE B
00370A E244 36                 PSHA              SAVE A
00371A E245 D6 0E     A        LDAB   SPEEDK
00372A E247 86 40     A DELOP2 LDAA   #$40
00373A E249 4A          DELOOP DECA
00374A E24A 26 FD E249         BNE    DELOOP
00375A E24C 5A                 DECB
00376A E24D 26 F8 E247         BNE    DELOP2
00377A E24F 32                 PULA              RESTORE A
00378A E250 33                 PULB              RESTORE B
00379A E251 39                 RTS

00381                   ***SUBROUTINE TO COMPUTE KU***
00382A E252 91 11     A COMPKU CMPA   TQLDAT
00383A E254 25 1A E270         BCS    MOREL      BRANCH IF KUTIM ` TQLDAT
00384A E256 96 0F     A        LDAA   RCHAR      GET CHAR BEING RECEIVED
00385A E258 81 01     A        CMPA   #1
00386A E25A 27 09 E265         BEQ    CKFSP
00387A E25C 8D 4A E2A8         BSR    GAFT       GET ASCII FROM TABLE
00388A E25E BD E1B6   A        JSR    OUTCH      PRINT CHARACTER IN ACCA
00389A E261 86 01     A        LDAA   #1
00390A E263 97 0F     A        STAA   RCHAR      READY FOR NEW CHAR
00391A E265 96 12     A CKFSP  LDAA   TLDAT      GET TWICE LAST DASH TIME
00392A E267 91 14     A        CMPA   KUTIM      COMPARE WITH KU INTERVAL
00393A E269 24 05 E270         BCC    MOREL      BRANCH IF TLDAT `= KU INTE
00394A E26B 86 20     A        LDAA   #$20       ASCII SPACE
00395A E26D BD E1B6   A        JSR    OUTCH      PRINT SPACE
00396A E270 39          MOREL  RTS

00398                   ***SUBROUTINE TO COMPUTE KD***
00399A E271 96 0D     A COMPKD LDAA   TLETIM     GET TWICE LAST ELEM TIME
00400A E273 91 13     A        CMPA   KDTIM      COMPARE WITH KD INTERVAL
00401A E275 25 10 E287         BCS    DASHEL     BRANCH IF TLETIM ` KD INTE
00402A E277 96 0C     A        LDAA   HLETIM     GET HALF LAST ELEM TIME
00403A E279 91 13     A        CMPA   KDTIM      COMPARE WITH KD INTERVAL
00404A E27B 24 04 E281         BCC    DOTEL      BRANCH IF HLETIM `= KD INT
00405A E27D 96 0B     A        LDAA   LETYPE     CHECK LAST ELEMENT TYPE
00406A E27F 26 06 E287         BNE    DASHEL     BRANCH IF LAST ELEM WAS DA
00407A E281 7F 000B   A DOTEL  CLR    LETYPE     MAKE LAST ELEM TYPE=00=DOT
00408A E284 0C                 CLC
00409A E285 20 14 E29B         BRA    ADDEL
00410A E287 7C 000B   A DASHEL INC    LETYPE     MAKE LAST ELEM TYPE=DASH
00411A E28A 96 13     A        LDAA   KDTIM      GET KD INTERVAL
00412A E28C 97 10     A        STAA   LDATIM     STORE IN LAST DASH TIME
00413A E28E 16                 TAB               SAVE IN ACCUM B
00414A E28F 44                 LSRA              DIVIDE KD INTERVAL BY 2
00415A E290 97 11     A        STAA   TQLDAT     SAVE 1/2 KD
00416A E292 44                 LSRA              DIVIDE 1/2 KD BY 2
00417A E293 9B 11     A        ADDA   TQLDAT     ADD 1/2 TO 1/4 KD INTERVAL
00418A E295 97 11     A        STAA   TQLDAT     STORE RESULT
00419A E297 58                 ASLB              MULTIPLY KD INTERVAL BY 2
00420A E298 D7 12     A        STAB   TLDAT      STORE RESULT
00421A E29A 0D                 SEC
00422A E29B 79 000F   A ADDEL  ROL    RCHAR      ADD NEW ELEM TO CHARACTER
00423A E29E 96 13     A        LDAA   KDTIM      GET KD INTERVAL
00424A E2A0 16                 TAB               SAVE IN ACCUM B
00425A E2A1 44                 LSRA              DIVIDE KD BY 2
00426A E2A2 97 0C     A        STAA   HLETIM     STORE 1/2 KD INTERVAL
00427A E2A4 58                 ASLB              MULTIPLY KD BY 2
00428A E2A5 D7 0D     A        STAB   TLETIM     STORE TWICE KD INTERVAL
00429A E2A7 39                 RTS

00431                   ***SUBR. TO GET ASCII CHAR FROM CODE TABLE***
00432A E2A8 0D          GAFT   SEC               CHANGE FORMAT OF RCHAR.
00433A E2A9 49                 ROLA
00434A E2AA 48          GAFT1  ASLA
00435A E2AB 24 FD E2AA         BCC    GAFT1
00436A E2AD CE E05A   A        LDX    #RESRT-1
00437A E2B0 A1 00     A STAB1  CMPA   0,X
00438A E2B2 27 09 E2BD         BEQ    TABM       FOUND MATCH
00439A E2B4 09                 DEX
00440A E2B5 8C E021   A        CPX    #RTAB+1    END OF TABLE?
00441A E2B8 26 F6 E2B0         BNE    STAB1      NO!
00442A E2BA 86 5F     A        LDAA   #'_        RETURN "_" FOR NO MATCH
00443A E2BC 39                 RTS
00444                   *
00445A E2BD DF 16     A TABM   STX    RECX
00446A E2BF 96 17     A        LDAA   RECX+1     X(LOW) TO ACCA.
00447A E2C1 39                 RTS

00449                   ***INITIALIZATION AND RESTART VECTORS***

00451A E3F8                    ORG    CODE+$3F8
00452A E3F8    E0B4   A        FDB    POLL       IRQ
00453A E3FA    E05B   A        FDB    RESRT      SWI
00454A E3FC    E05B   A        FDB    RESRT      NMI
00455A E3FE    E05B   A        FDB    RESRT      RESET
00456                          END
TOTAL ERRORS 00000
```

```
E29B ADDEL  00409 00422*
E1E5 BADCH  00273 00277 00315*
0018 BUFBOT 00059*00257 00258 00259 00270
E1E1 BUFFUL 00271 00311*
0006 BUFLAG 00042*00150 00227 00229 00282 00284
006D BUFTOP 00060*00115 00119 00218 00225 00233 00240 00251 00257
E0DC CES1   00165*
E102 CFCS   00183 00189*
E0DF CFDAH  00162 00167*
E0EA CFES   00168 00174*
E0F7 CFWS   00175 00182*
0015 CHCTR  00057*
E112 CK1    00193 00197*
E108 CKCNT  00166 00172 00180 00187 00192*
E265 CKFSP  00386 00391*
E233 CKHI   00354 00359*
E23E CMPTKD 00360 00365*
E000 CODE   00081*00117 00451
E18E COMMR  00209 00268*00309
E128 COMMR1 00149 00209*
E1DF COMMR2 00309*00339
E271 COMPKD 00365 00399*
E252 COMPKU 00333 00342 00382*
000A COSTA  00044*00161 00198 00200 00222 00236 00246 00253
0004 COUNT  00040*00192 00194 00197
0000 CVCX   00038*00118 00274 00275
E287 DASHEL 00401 00406 00410*
E249 DELOOP 00373*00374
E247 DELOP2 00372*00376
E281 DOTEL  00404 00407*
E0B1 EXEC   00142*00143
E2A8 GAFT   00387 00432*
E2AA GAFT1  00434*00435
E133 GNEL   00202 00218*
E15F GNEL1  00220 00237 00240*
E14F GNELR  00226 00232*
000C HLETIM 00048*00402 00426
FFF8 IRQVEC 00077*00122
E214 KD     00335 00341*
E21A KDLOOP 00344*00350
0013 KDTIM  00055*00352 00400 00403 00411 00423
E218 KEYDWN 00343*
E1F3 KEYUP  00323*00366
E228 KU     00348 00352*
E206 KUCONT 00327 00332 00334*
E1F5 KULOOP 00324*00340
0014 KUTIM  00056*00329 00341 00392
E05E L1     00106*00108
0010 LDATIM 00052*00412
000B LETYPE 00047*00405 00407 00410
E21F MAXKD  00345 00347*
E270 MOREL  00383 00393 00396*
E181 MOV1   00258*00261
E18D MOVRT  00265*
E17E MOVUP  00232 00257*
E1FC NOINC  00325 00329*
E0C6 NOTRCV 00151 00153*
E1B6 OUTCH  00285 00288*00388 00395
E1BE OUTCH1 00292*00297
8005 PIA1AC 00065*00146
8004 PIA1AD 00064*00123 00156 00334 00347
8007 PIA1BC 00067*
8006 PIA1BD 00066*00157 00160 00205 00207 00212 00214 00319 00322
8021 PIA2AC 00072*00135 00148 00338
8020 PIA2AD 00071*00133 00269
8023 PIA2BC 00074*00139 00305 00307
8022 PIA2BD 00073*00137 00303
E0B4 POLL   00121 00146*00195 00230 00238 00248 00255 00286 00452
E0C7 POLL2  00147 00156*
E1B1 PRNT   00285*00312 00316
000F RCHAR  00051*00330 00384 00390 00422
E1E9 REC    00152 00319*
0016 RECX   00058*00445 00446
0005 RESMSK 00041*00164 00170 00177 00185 00190 00199
E05B RESRT  00105*00436 00453 00454 00455
E10F RETRN  00195*00201
E020 RTAB   00088*00440
0002 SAVEX  00039*00120 00224 00262 00264 00268 00278 00281
E168 SODAH  00241 00245*
E16A SOEL   00243 00246*
E12A SOONE  00212*00247
E11F SOZERO 00178 00205*00223 00254
000E SPEEDK 00050*00113 00355 00361 00364 00371
E2B0 STAB1  00437*00441
007F STACK  00076*00140
E19C STM    00274*
E1D0 STROBE 00292 00301 00302*
E171 SWS    00235 00250*
E2BD TABM   00438 00445*
E243 TIMER  00336 00349 00369*
0012 TLDAT  00054*00391 00420
000D TLETIM 00049*00399 00428
0007 TMPSVE 00043*00110 00111 00290 00300
0011 TQLDAT 00053*00382 00415 00417 00418
E23A UNZERO 00357 00363*
```

less than $80-$90, including the display, which is $30 in quantities of one.

Operation

Operation of the reader-talker is quite simple. Hook up the required power supplies, the cords to the speaker and key jacks, and go to town. The easiest way to tune in a signal is to use the on-board headphone jack and set the selectivity to 40 Hz. When you hear the signal, watch the LED, and when it starts to blink at the incoming CW rate, switch the filter to the processed mode and tune for the cleanest signal. An RIT control is almost a must as the input tuning is quite sharp, and if you tune the other guy for the best signal each time he gives it back to you, you could walk right up or down the band!

The only drawback I have found is that when copying at fast speeds, the display will run words together, since most operators do not leave enough space between them. I understand that most of the keyboard keyers do not have a space key on them, and this will explain some of the problems. The others are self-explanatory. As I said earlier, the lack of more digits on the board is not a hindrance, and after you use it a while, you'll agree. Whether you use a PC board or wire-wrap this project, it will be a great addition to any ham shack and do a lot for cleaning up the airways. ■

Microcomputers and Your Satellite Station

— part 1: calculating orbital crossing data

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In case you haven't noticed, microcomputers have really begun to come of age. Units such as the Radio Shack TRS-80 are available with built-in BASIC language (in ROM) and a reasonable amount of RAM workspace. The availability of such machines, with capability for later expansion, has shifted the emphasis from small computers as an engaging hobby to their real utility as data processing terminals in science, business, and a number of other areas of application. I purchased a TRS-80 computer to handle a number of important jobs in my research lab, with an eye toward its possibilities in my weather satellite operation as well. I have been completely happy with the computer and have been working up innumerable programs, some of which involve the satellite operation.

There is little doubt that one of the most tedious tasks facing satellite station operators is keeping track of equatorial crossing data for polar orbiting spacecraft. Such information is absolutely essential in generating tracking data for the OSCAR communications satellites and the various polar orbiting weather satellites. There are several ways to keep track of this information. The most direct procedure is to monitor the W1AW bulletins on a daily basis to get reference orbit data for the next day. This is time-consuming and still requires that you calculate crossing dates for passes not covered with the reference orbit data. You can get similar reference orbit data from the various magazines, AMSAT bulletins, and other sources, but again you often are faced with calculating crossings for additional passes, since most of these sources list only one or two reference crossings for a given day.

My usual situation is that I will decide on short notice that I want to copy a few weather satellite passes. I then will root around looking for some old crossing data, usually finding something up to several weeks old written on the back of a matchbook cover or something equally pretentious! I then sit down and quickly project the data with the pocket calculator (something that usually is anything but quick), only to discover that I have just missed the best pass or that I have made an error and none of the carefully-generated numbers means anything for that particular day.

One of my first programming tasks when I had the TRS-80 on line, was to develop a program to provide orbital crossing data, given information on any single reference crossing. This program is shown in Fig. 1. The program is written in Radio Shack Level I BASIC and incorporates the various abbreviations that are possible with that dialect—P for PRINT, for example. With minimal work, the program could be modified to run in almost any of the small BASIC dialects. As written, the program occupies 2062 bytes of memory and fits comfortably within the 4K capacity of the most inexpensive member of the TRS-80 family. Even with modifications to run on another system, it is safe to say that the program easily could be accommodated in 4K of memory and thus be usable on virtually all small systems.

Let's look at the use of

the program, and then we can consider some highlights of the program structure for those of you who can't resist making modifications.

Using the Program

You can load the program at the keyboard using Fig. 1 and then save it on cassette for later use after debugging the inevitable typos! Once the program is loaded, simply enter RUN (R), and the display should show the program ID header (ah, vanity!) and request the name of the spacecraft. Here, you simply enter the name of the bird you are tracking. Let's take a fictitious example and enter NOAA 6. It then will request the orbital period in minutes. You should use the most accurate figure you can obtain for the period as this and the number of significant figures the machine can handle are the primary limitations in the accuracy of long-term predictions. For the sake of example, let's enter a period of 115.16 minutes.

The computer then will print:

ENTER MONTH, DAY, YEAR OF REFERENCE CROSSING:
?

Each part of this data must be entered separately. For example, if the date of the reference crossing is 1/23/78, you would perform the following input operations:

1 ENTER
23 ENTER
78 ENTER

The machine will ask for the reference orbit number. This tells us the number of orbits since initial insertion and is handy for making long-distance OSCAR schedules (both stations can be assured that they are using the satellite during the proper pass) and for cataloging satellite pictures in the case of the weather birds. If you don't care about orbit numbers, simply enter 0. If you use them, then simply enter the number of your reference orbit. Let's say, for the sake of our example, that the reference orbit number is 7248—we would enter that number when requested.

The computer now will request the hours, minutes, and seconds of the reference crossing. Like the date, these items are entered separately and in sequence. If the crossing is at 20:15:48, we would enter 20, enter 15, and enter 48. A note here: If the reference data are GMT times and dates, the printout will be so referenced. If you want printout in local times and date, make the appropriate conversions in the reference data prior to entry.

The computer now will ask for the crossing point in degrees W. If your reference data has a crossing in degrees E longitude, convert this to degrees W using the formula:

```
1   CLS
1Ø  P."ORBITAL CROSSING PROGRAM"
15  P."BY DR. RALPH E. TAGGART"
2Ø  P.
25  IN."WHAT IS THE NAME OF THE SPACECRAFT";A$
3Ø  CLS:IN."ENTER THE ORBITAL PERIOD (IN MINUTES)";P:CLS
35  P."ENTER MONTH, DAY, AND YEAR OF REFERENCE CROSSING"
4Ø  IN.L:IN.J:IN.K:GOSUB 9ØØ:D=W:Z=W:CLS
45 IN."REFERENCE ORBIT NUMBER";N:X=N:CLS
5Ø  P."ENTER HR., MIN., SEC. OF REFERENCE CROSSING"
55  IN.H:IN.M:IN.S:A=(6Ø*H)+M+(S/6Ø):G=A:CLS
6Ø  IN."REFERENCE CROSSING POINT (DEG W)";C:Y=C:CLS
65  P."ENTER MONTH, DAY, YEAR FOR DISPLAY"
7Ø  IN.L:IN.J:IN.Q:GOSUB 9ØØ:T=W:CLS
75  IF (Q<K)+(T<D) THEN GOSUB 93Ø:GOTO 65
8Ø  IF Q=K+1 THEN T=365+T
85  IF T>D+5 THEN 5ØØ
9Ø  GOSUB 94Ø
1ØØ A=A+P:N=N+1
11Ø IF A>144Ø THEN A=A-144Ø
12Ø C=((P/144Ø)*36Ø)+C
13Ø IF C>36Ø THEN C=C-36Ø
14Ø IF D=T THEN 2ØØ
15Ø IF D>T THEN 3ØØ
16Ø GOTO 1ØØ
2ØØ H=INT(A/6Ø)
21Ø M=INT(A-(H*6Ø))
22Ø S=A-((H*6Ø)+M):S=INT(S*6Ø)
23Ø E=C+.Ø5:E=INT(E*1Ø)/1Ø
24Ø P.N,H;":";M;":";S,E
25Ø GOTO 1ØØ
3ØØ IN."DO YOU WANT ANOTHER DAY'S DATA (Y=1 N=Ø)";R
31Ø IF R=Ø THEN 4ØØ
32Ø P."ENTER MONTH, DAY, YEAR FOR DISPLAY"
33Ø IN.L:IN.J:IN.Q:GOSUB 9ØØ:T=W:CLS
34Ø IF (Q<K)+(T<Z) THEN GOSUB 93Ø:GOTO 3ØØ
35Ø IF Q=K+1 THEN T=356+T
36Ø IF T=D-1 THEN GOSUB 95Ø:GOTO 3ØØ
37Ø IF T=D THEN GOSUB 94Ø:GOTO 2ØØ
38Ø IF T>D+5 THEN 5ØØ
385 IF D>T THEN D=Z:A=G:C=Y:N=X:GOTO 75
39Ø GOSUB 94Ø:GOTO 1ØØ
4ØØ CLS:IN."ANOTHER SPACECRAFT";R
41Ø IF R=1 THEN CLS:GOTO 25
42Ø END
5ØØ D=Z:A=G:C=Y:N=X
5Ø5 B=(T-1)-D:I=144Ø*B:B=INT(I/P)+1
51Ø A=(B*P)-I
52Ø V=B*((P/144Ø)*36Ø):U=INT(V/36Ø):C=V-(U*36Ø)
53Ø D=T-1:N=N+B
54Ø GOSUB 94Ø:GOTO 1ØØ
899 END
9ØØ W=Ø
9Ø1 IF L=1 THEN W=J:RET.
9Ø2 IF L=2 THEN W=31+J:RET.
9Ø3 IF L=3 THEN W=59+J:RET.
9Ø4 IF L=4 THEN W=9Ø+J:RET.
9Ø5 IF L=5 THEN W=12Ø+J:RET.
9Ø6 IF L=6 THEN W=151+J:RET.
9Ø7 IF L=7 THEN W=181+J:RET.
9Ø8 IF L=8 THEN W=212+J:RET.
9Ø9 IF L=9 THEN W=243+J:RET.
91Ø IF L=1Ø THEN W=273+J:RET.
911 IF L=11 THEN W=3Ø4+J:RET.
912 IF L=12 THEN W=334+J:RET.
93Ø P."SORRY - PROGRAM DOES NOT COMPUTE DATA"
931 P."PRIOR TO REFERENCE CROSSING":RET.
94Ø CLS:P."DATE ";L:"/";J;"/";Q;"  ";A$
941 P."ORBIT","TIME","DEGREES W":RET.
95Ø CLS:P."YOU JUST PRINTED DATA FOR ";L;"/";J;"/";Q
951 RET.
999 END
```

Fig. 1. TRS-80 program for computation of satellite equatorial crossings. Given a single reference crossing, the program permits the computer to display crossings for any subsequent day for a period of up to two years from the date of the reference crossing.

```
DATE:  1/24/78        NOAA 6
ORBIT            TIME             DEGREES W
 725Ø            Ø:6:7            157.8
 7251            2:1:16           186.6
 7252            3:56:26          215.4
 7253            5:51:35          244.2
 7254            7:46:45          273
 7255            9:41:55          3Ø1.8
 7256            11:37:4          33Ø.5
 7257            13:32:14         359.3
 7258            15:27:23         28.1
 7259            17:22:33         56.9
 726Ø            19:17:43         85.7
 7261            21:12:52         114.5
 7262            23:8:2           143.3
DO YOU WANT ANOTHER DAYS DATA (Y=1 N=Ø)?
```

Fig. 2. Sample printout for 1/24/78, given a reference crossing for NOAA 6 on 1/23/78 at 20:15:48, crossing the equator at 100.23° W (assuming a period of 115.16 minutes).

Numeric Variables

A	The current crossing time in minutes.
B	Scratchpad variable in the 500 block routines.
C	The current crossing point (degrees W).
D	The current numerical day.
E	Rounded value for the crossing point used for display.
F	Not used.
G	Not used.
H	Hours—used for input and display.
I	Scratchpad variable in the 500 block routines.
J	Day of the month (used for input).
K	Year of the reference crossing date.
L	Month of the year (used for input).
M	Minutes—used for input and display.
N	Current orbit number.
O	Not used.
P	The orbital period.
Q	The year of the display date.
R	Interactive question replies.
S	Seconds—used for input and display.
T	Display day number.
U	Scratchpad variable in the 500 block routines.
V	Scratchpad variable in the 500 block routines.
W	Output value from the date conversion subroutine.
X	Orbit number for the reference crossing.
Y	Reference orbit crossing point (degrees W).
Z	Day number of the reference crossing.

String Variables

A$	The name of the spacecraft.
B$	Not used.

Fig. 3. Variable assignments in the orbital crossing program.

Longitude (°W) = 360 − (Longitude °E).

Let us assume a crossing point of 100.23° W and enter it. The computer will ask for the month, day, and year for display. This is entered in three parts, as before. Let's take the next day—1/24/78—and enter 1, then 24, and then 78. Quick as a wink the computer will print out the display shown in Fig. 2, showing *all* of the passes for 1/24/78.

It certainly beats messing with the calculator, doesn't it? Note that you are not necessarily finished, for at the bottom of the listing you are asked if you want another day's printout. If you do, simply enter 1 and the computer will request the new date. Just for the fun of it, enter 12/31/78—a projection of almost a year! Notice that for all intents and purposes you get the readout right away, regardless of the length of the projection. The program will handle dates up to one full year beyond the year of the reference crossing, to handle the cross-year transition. You can demonstrate this by requesting a printout for any date in 1979. Remember, however, that although the machine will crunch the numbers for you, the period must be known with some precision for long-term projections!

The program also permits you to back up in time. Try entering a date of 1/23/78 for example. The computer will print out the single orbit (number 7249) that will start on the day of the reference crossing. For the sake of your own edification, you might type in a date prior to the reference crossing. The computer will politely inform you that it won't respond to that and will give you a chance to request another date!

OK—enough with imaginary data. Enter 0 when you are asked if you want another day's data (NO = 0). The computer will ask if you want another spacecraft. Enter 1 (YES) and plug in some actual crossing information as requested, and you will be off and running with real data.

Program Notes

The following is not an exhaustive analysis of the program structure, but does provide sufficient information for you to dive into the program—in company with your Level I BASIC user's manual—if you are interested in how it works.

With a few exceptions, lines 1-65 are devoted to interactive data input. A few mathematical operations are included here to convert data from a convenient-form-for-user input to a convenient-form-for-machine processing. One example is line 50, where you input data on the hour (H), minute (M), and seconds (S) for the reference crossing. It is most convenient in terms of orbital calculations to keep track of the current crossing time in total minutes (A). The mathematical routines in the remainder of line 50 simply convert the time to total minutes.

A similar situation is encountered in line 35, where you input the month (L), day (J), and year (K) of the reference crossing. The month and day are converted to the day of the year using the subroutine that runs from line 900 to 912. A numerical day of the year is far more convenient than attempting to keep track of days of a certain month. A similar situation exists in line 70, where the identical conversion is made for the desired day for printout.

Line 75 checks to ensure that the requested date is actually on or after the date of the reference crossing, while line 80 updates the desired display day number (T) if the year of the display date (Q) is the year following the year for the reference crossing date (K).

Line 85 requires some additional explanation. The basic approach to computing orbital data is iterative, in that the orbital period is simply added to the time of the last orbit to determine the time of the next crossing, with a similar approach taken for the crossing point. If we are projecting forward in time beyond a few days, this requires an increasingly greater interval for the computer to repeat these calculations again and again until it arrives at the day for printout. If the desired day for printout is more than 5 days beyond the reference crossing day, line 85 bypasses the iterative mode (which begins with line 100) and jumps to a moderately-complicated mathematical routine in lines 500 through 540 that will quickly derive data for an arbitrary single orbit on the day prior to the day requested. Once this has been done, the machine jumps back to line 100 to begin the iterative calculations leading up to the first orbit of the desired day.

You could leave out 85 and the routines in the 500 block, but if you did, you would require lots of time for long-term projections. With the program as written, for example, a one-month projection requires just two seconds to start cranking out data. This two-second delay is all that is required for any projection beyond reference day +5. If we eliminate 85 so that we don't use the routines in the 500 block, a one-month projection would require about 30 seconds to initiate printout, and a one-year projection would require six *minutes* to initiate printout. The iterative approach is the surest way to avoid missing an orbit, but does take time over a long haul.

The iterative sequence is fairly straightforward. Line 100 adds the period to the previous time to get the new time and also updates the orbit number by 1. Line 110 checks the new time against 1440—the total minutes in a day—and, if required, corrects the time to the new day and updates the current day number (D). Line 120 computes the increment of longitude for a single orbit and adds this to the last crossing point to derive the crossing point for the new orbit.

Line 130 compares this value with 360 degrees and corrects it if required. Lines 100 through 130 thus generate the data for a new orbit; lines 140 through 160 simply compare the current orbit day (D) with the day for display (T). If D is smaller than T, we haven't arrived yet, and the computer shuffles back to 100 to compute data for the next orbit. If D is larger than T, we have gone through all the orbits of interest and we are shuffled off to 300 for additional display options. If, however, D=T, we want to display the data and thus move along to the display routines in the 200 block.

Lines 200 through 220 convert the orbital crossing time in minutes back to hours (H), minutes (M), and seconds (S) for display. Line 230 rounds out the crossing point to one decimal place (to make a more pleasing display), and then 240 prints out the data. Line 250 then sends the computer back to the iterative routine to compute the next orbit. These display routines will be repeated as long as the orbits fall on the target day, after which it quits and goes to the 300 block to give you the option of another day. If you take the option, the date for the new day is processed and checked, just as it was at the beginning.

There are a few new wrinkles, however. Line 370 is a special routing designed to avoid missing the first orbit when the new day is the one immediately following the day for which you have displayed data. Line 360 takes care of the situation in which you inadvertently ask for a new day which is identical with the day for which you have just received data, and 385 catches situations where we must backtrack. If D is larger than the new day you request (T), it means that we must backtrack in our calculations—a clumsy process. The easiest approach is simply to reassign the reference crossing values to the orbit number (N), time (A), crossing point (C), and day (D), and start over again—something accomplished in 385.

```
21     IN. "REFERENCE ORBIT DATA ON FILE (Y=1 N=0)"; R
22     CLS: IF R=1 THEN 600
600    A$=... insert name of spacecraft
610    P=... insert orbital period in minutes
620    L=... insert reference month
621    J=... insert reference day
622    K=... insert reference year
623    GOSUB 900: D=W: Z=W:
630    N=... insert reference orbit number
640    H=... insert reference orbit hour
641    M=... insert reference orbit minute
642    S=... insert reference orbit seconds
643    A=(60*H)+M+(S/60) : G=A
650    C=... insert reference crossing point (degrees W)
651    Y=C
660    GOTO 65
```

Fig. 4. Program modifications for repeated use of data for a single reference crossing. Depending upon the accuracy of the period (P), the data in lines 620-622, 630-642, and 650 should be updated every few weeks or months with new crossing data to maintain accuracy. If you update for a new satellite, you should then change the data in lines 600 and 610 as well. Be sure to save the modified program on cassette so that you don't lose the reference data.

The 900 block is devoted to subroutines, including conversions of dates to numerical days of the year and various printing routines. As a guide to understanding the program or making creative modifications, Fig. 3 is provided to summarize the variable assignments used in the program.

Program Modifications

Aside from inspirations that may come to you, there are two major modifications that you may find desirable to make at one time or another. The program as written does not accommodate leap years (29 days in February as opposed to the normal 28). For use during a leap year, each number in lines 903 through 912 should be increased by 1. Thus, for example, line 906 would read:

906 IF L=6 THEN W=152+J: RET.

Another modification is useful if you will be working primarily with just a single satellite. If you know the period with some precision, you may want to work with a single reference crossing over a period of weeks or months and avoid the hassle of inputting reference data at the start of a run. Fig. 4 shows the additions required to accomplish this. Be sure, however, to dump the modified version back on to cassette so that you don't lose the reference data.

Summary

Over a period of years, I have tended to concentrate on the geostationary weather satellites primarily, to avoid the orbit-computation hassle associated with polar orbiters. This program was developed to minimize the strain of dealing with the new TIROS N satellite that became operational in 1978. The program is so useful that I could probably justify the purchase of the TRS-80 for that alone. The beauty of a computer, of course, is that it is a general-purpose problem-solving machine, and need not be limited to any one task.

Part II of this mini-series will demonstrate how to use the TRS-80 to calculate antenna bearings for geostationary spacecraft. Why not try a microcomputer? Even if you hate computers, you soon will wonder how you ever got along without one! ■

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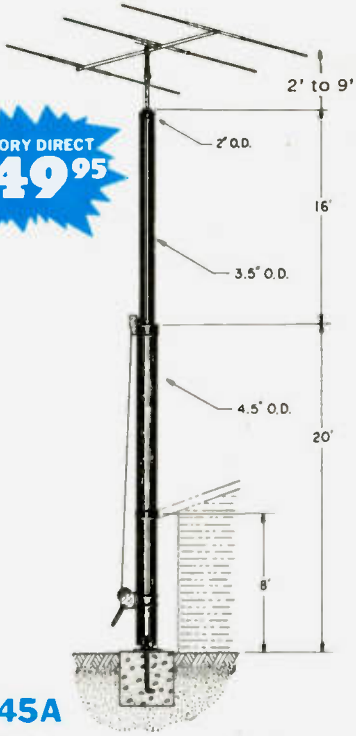

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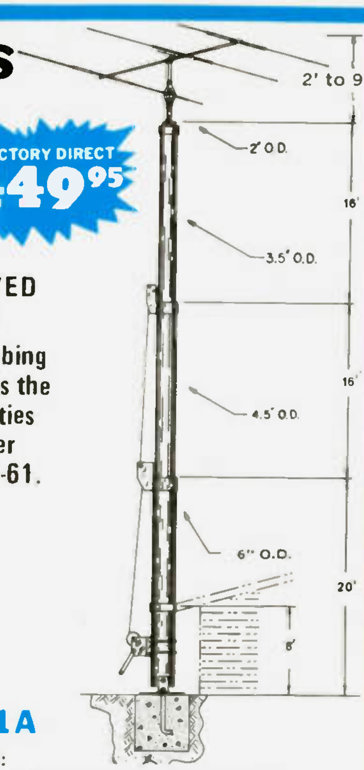

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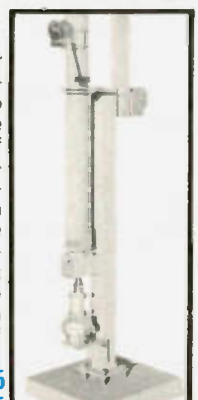

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A Brasspounder Improves Heath's HR-1680

—add a crystal CW filter, bfo, noise blanker, and more

The Heathkit® HR-1680 is a distinct rarity: a ham-bands-only receiver in kit form for a tad more than $200. It is a fine piece of equipment and is almost the answer for a low-budget station. Why almost? Low budget usually means CW using a home-brew or swap-meet-special transmitter and low power at that. The SSB capabilities of the HR-1680 are good, but CW is sort of tacked on. What the HR-1680 needs is a narrow CW filter, and a bfo placed correctly for CW operation, and maybe even a noise blanker. It so happens that Heath makes these items for other products in their line, and for a reasonable price.

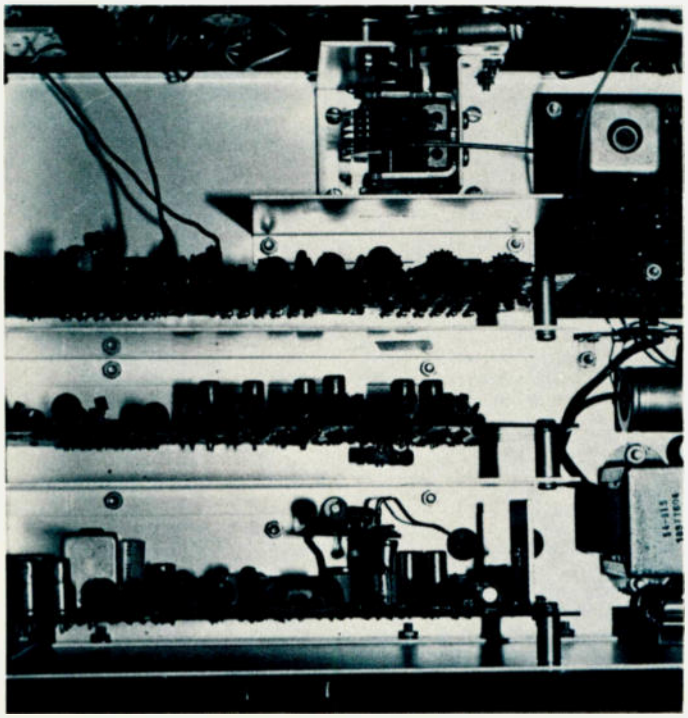

Photo A. Top interior view of the HR-1680 shows the new bfo board (near middle of bottom board) and new connecting wire to pilot lamps (upper right).

I hate modifications that wreck the appearance of a piece of gear and reduce its resale value to zero. Many modifications not only prove to be far less useful than the author promises, but unfortunately, irreversible. This article describes how to add a crystal CW filter, bfo, noise blanker, and a couple of other worthwhile modifications to your HR-1680 without having to attack the set with drills, saws, and other sharp instruments. All modifications are reversible, require a minimum of rewiring, and the drilling of one little hole on one circuit board. Purists can attach the bfo board to the AUD/REG board with silastic rubber.

Modifications

The modifications will be presented in the following order:

1) changing the dial lamps to reduce voltage regulator heating; and to a type more readily available.
2) modification of the spinner knob for 1-kHz resolution;
3) addition of an SBA-301-2, 400-Hz crystal filter;
4) addition of a separate bfo for CW; and
5) addition of an SB-104-1, noise blanker.

The crystal filter and noise blanker are housed in a small utility cabinet (Radio Shack 270-253 is an ideal size), or they could be fitted into the HR-1681 speaker cabinet if desired. The bfo board is attached to the HR-1680's AUD/REG PCB. Total cost of all mods should be about $75.

Pilot Lamps

At this writing, I have been using my HR-1680 for over two years without any component failures, and this mod may be due in part to something that annoyed me no end when I discovered it. The pilot lamps in the HR-1680 operate from the regulated supply. This represents two Watts of unnecessary power for the regulator series pass transistor (Q201) to handle, and causes its heat sink to reach to over 100°C after only a few minutes of operation. Besides, nobody seems to stock type 1813 bulbs.

The solution is simple: Disconnect the red wire supplying 13.8 volts to the pilot lamps. Run a new wire across the top of the chassis and connect it to the junction of D1, D2, and C2 at one end and the lamp sockets at the other. Arch the wire up and over and avoid getting it too close to the vfo (see Photo A). Remove the two type 1813 bulbs and replace them with type 1819 bulbs (28 volts, 40 mA). The new lamps will provide just about the same amount of light, you will save 120 mA of total current, and the regulator will now operate at a reasonable temperature even when we borrow 50 mA to operate the crystal filter amplifier and the noise blanker.

A small drawback exists with this modification: The lamps won't light when external power is used. If you use external power very often, you might want to install some sort of switching arrangement. My feeling is that if you are really on emergency power, can you afford those wasted Watts? Buy a flashlight.

Spinner Dial

Another thing that bothered me about the HR-1680 was the dial calibration. When the vfo is properly adjusted, the HR-1680's dial is reasonably linear, but there are calibration marks only at every five kHz. It seemed that the spinner knob could be inscribed to give at least one-kHz markers. I spent about a week of fooling around and gluing pieces of cardboard to the spinner. To spare you the cussin', I found that each revolution of the spinner was equivalent to 15.625 kHz or 23.04 degrees of arc per kHz. It does not take a mathematician to see that there is no way to calibrate the spinner in a whole number of one-kHz increments. After spending all that time, I was not about to give up. I removed the skirt from the spinner and glued a thin flat plate (a 3½-inch diameter dial plate from an old stereo receiver) to the back side of the spinner knob. I then scribed lines on the plate to make pies of 23.04 degrees, and when I ran out of plate, I stopped. I then filled the scribed lines with black ink and coated the plate with clear nail polish (acrylic spray made the ink run). Now the spinner is calibrated in one kHz increments with one .625-kHz increment left over. The construction sounds terrible, but it works fine. See Photo B.

Photo B. Front view of modified HR-1680 (with completed filter-blanker on top) shows details of modified spinner knob.

Crystal Filter and Amplifier

Anyone who has ever operated CW must surely have desired "single-signal reception." The audio filter of the HR-1680 does not have anything like the needed selectivity. I feel sure that the people at Heath know this, but they had to keep the price down. Heath makes two 400-Hz filters, the SBA-301-2 and the newer SBA-401-1. As far as I can determine, the filters are

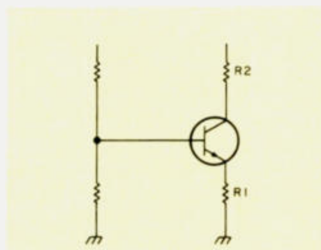

Fig. 2. In a common-emitter bipolar amplifier, the voltage gain of a stage with an un-bypassed emitter resistor is approximately the ratio of the collector resistor to the emitter resistor: Gain ≈ R2/R1. This relationship holds over one or two decades (sometimes more) assuming that the gain of the transistor is adequate for the bandwidth of interest. As an example, consider a phase-splitter circuit where R1 = R2 and the gain is unity. In the amplifier used in this article, R1 = 470 Ohms and R2 = 2200 Ohms. R2/R1 = 2200/470 = 4.68 or 4.68 x 20 log 10 = .670 x 20 = 13.4 dB. Naturally, when 10% components are used the approximation suffers.

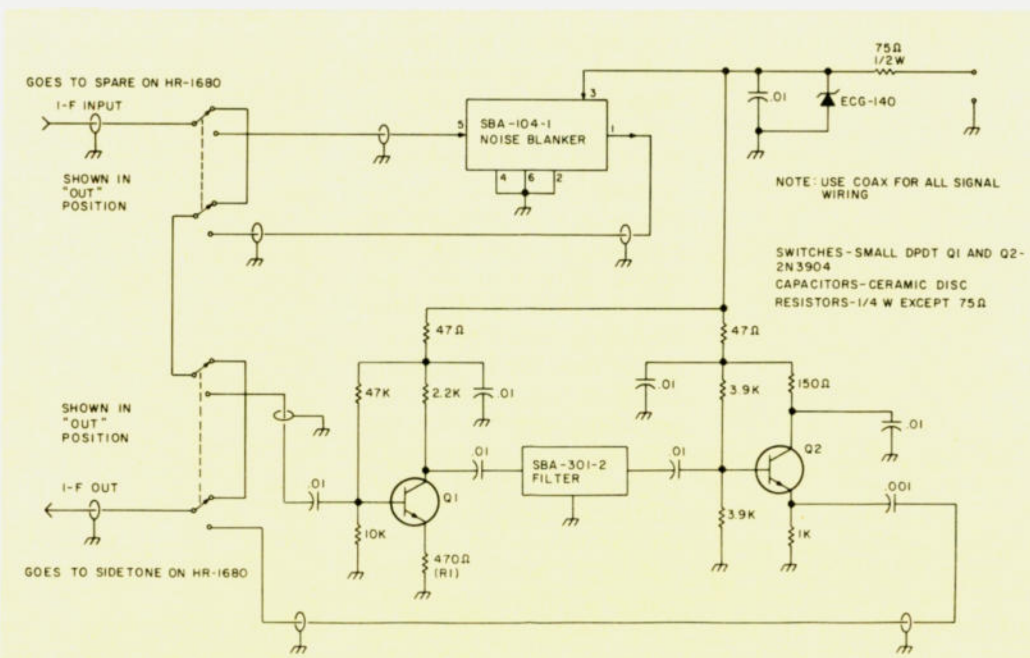

Fig. 1. Filter-blanker interface schematic diagram.

the same, and the different part numbers reflect the additional coils, diodes, etc., included in the SBA-401-1 for use in the SBA-104A transceiver. I am sure that either one would work. Buy the cheaper SBA-301-2.

The crystal filter has some insertion loss which must be made up, and it must be presented with the correct (2k Ohms) input and output impedance in order to perform correctly. I used a circuit that I found in *Amateur Radio Techniques* by the RSGB for the filter amplifier. The amplifier has a gain stage for input to the filter and an emitter-follower output (see Fig. 1). It does not use any inductive components, but it allows for a proper match into and out of the filter. The gain of the input stage is set by selecting the value of emitter resistor R1. Details on gain calculation are shown in Fig. 2. With the values indicated, the first stage gain is approximately 13.4 dB (voltage) and this results in unity gain through the filter-amplifier combination. The nice thing about this circuit is that there is nothing to tune. The filter and its amplifier are mounted on a piece of copperclad board using the board fabrication method outlined in the bfo section.

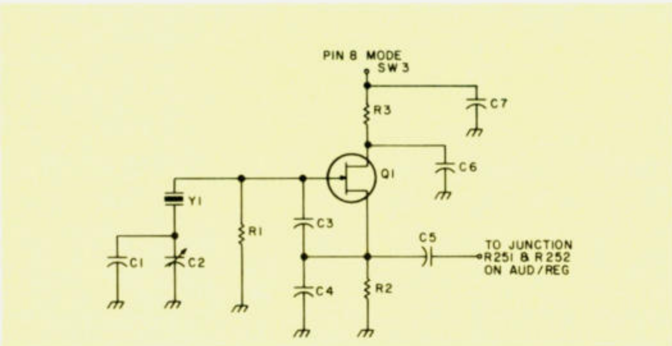

Fig. 3. Bfo schematic diagram.

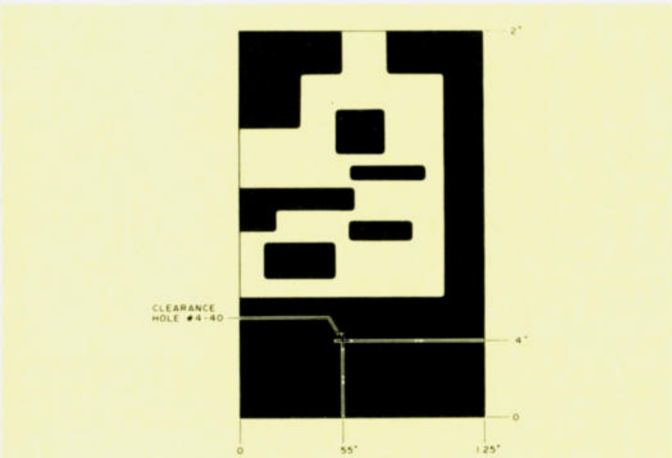

Fig. 4. PCB layout.

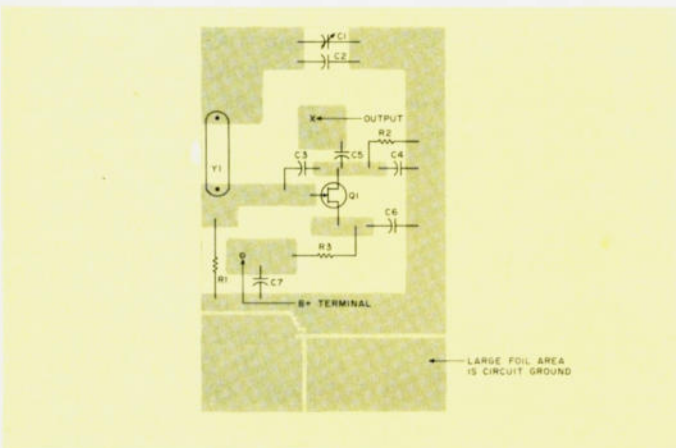

Fig. 5. Component location. Note: crystal and FET are mounted on the component side. All remaining components are mounted on the foil side.

Bfo

To obtain maximum benefit from the crystal filter, the bfo needs to provide a beat note of about 750 Hz to be within the bandpass of the HR-1680's audio filter. The frequency of the bfo should be 3395.4 kHz (filter center frequency), plus or minus 750 Hz. Several solutions suggested themselves, but I wanted to retain full SSB capabilities; so, fooling with one of the existing bfos was out. I built a new bfo using a 3395.7-kHz crystal (Heath part number 404-549, about $5.70) in a slightly modified copy of the HR-1680 bfo circuit (See Fig. 3). The trimmer (C2) allows the crystal to be pulled upwards in frequency by as much as 700 Hz, so you can place the bfo signal for the most pleasing tone or to fit the peak of the audio filter. The injection level is the same as the original bfo's and the new bfo works as well as the original. If you don't care about SSB, you can just pad the USB-CW bfo down to the correct frequency.

The new bfo is built on a piece of single-sided copperclad board. The foil pattern shown (Fig. 4) should be followed rather closely so the finished board will fit properly onto the AUD/REG board. For small one-of-a-kind PC boards, I find that it is faster and easier to grind off the unwanted foil with a Dremel Moto-Tool® or to score the foil with an X-acto® knife and peel off the unwanted foil, rather than to do all the things involved with etching. I used a Moto-Tool on the board that I built and it took less than an hour to produce a completed bfo.

The crystal and the FET are on the component side of the board (Fig. 5) and holes are drilled for their leads. All other components are on the foil side and no holes are required. Use a leftover PCB pin (Heath part 432-121) for the 13.8-volt connection.

The completed bfo board is mounted to the AUD/REG board using 4-40 hardware and one ¼-inch standoff. A small clearance hole must be drilled in the AUD/REG board just to the right of the connector sockets (viewing component side) that are below the existing bfo crystals (see Photo C). The exact location of the hole depends on your board, but the main idea is to have the new crystal snug against Y205 (and upsidedown) so as to create a compact piggyback fit.

Solder a small piece of bare wire from the new crystal to Y205 in the same fashion as was done for

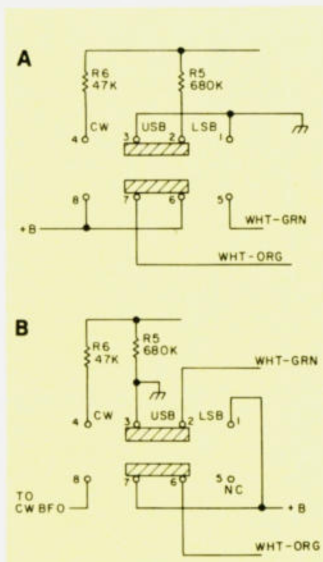

Fig. 6. MODE switch arrangement. (a) Original wiring. (b) After modifications.

Y203 and Y204 during the original assembly of the HR-1680. Connect an insulated wire between the ground foil on the new board to connector socket pin 13 of the AUD/REG board. Make sure that you do not get solder in the spring clips. Solder an insulated wire to the junction of R251 and R252 and solder the other end to the output land of C5 of the bfo board.

Mode Switch Wiring Changes

The MODE switch must be rewired so that the new bfo will be energized when the switch is placed into the CW position. Fig. 6 shows the original and modified connections.

Remove all connections to the MODE switch except for R6 (pin 4). Solder the end of R5 which was connected to pin 2 to the adjacent ground lug. Solder the red wire (originally connected to pins 6 and 8) to pin 7 and connect a short insulated jumper from pin 7 to pin 1. Solder the white-orange wire to pin 6. Solder the white-green wire to pin 2.

Secure a piece of #20 or #22 stranded insulated wire about two feet long. Solder one end of the wire to pin 8 of the MODE switch and dress the wire along the harness branch which contains the white-orange and the white-green wires to the AUD/REG board. Pull the free end of the wire through the ventilation hole which is almost directly under Q201. This wire is the 13.8-volt source for the CW bfo. Cut the free end to leave about three inches above the chassis, and install a leftover PCB connector (Heath part 432-120) or a pin removed from an old miniature tube socket at the free end of the wire.

Breaking the I-f Signal Path

The normal i-f signal path in the receiver must be broken in order to insert the crystal filter and the noise blanker. The best and most convenient place to break the path is between the output of the FRONT END board and the AUD/REG board's input.

Disconnect the shielded cable with violet color coding from pins D1 and D2 of the AUD/REG board chassis socket. Dress the cable to the SPARE phono-type connector at the rear of the receiver. Solder the inner conductor to the inside terminal of the phono connector and the shield to the ground terminal.

Disconnect the 10k resistor from the SIDETONE phono connector and either remove it altogether or secure it so that it does not short to anything. Cut a piece of the shielded cable supplied with the blanker kit (or RG-174/U) long enough to reach from D1 and D2 of the AUD/REG board to the SIDETONE jack. Solder the inner conductor to the inside terminal and the shield to the ground terminal of the SIDETONE jack.

The SPARE jack is now i-f out and the SIDETONE jack is i-f input. This change disables the sidetone feature of the receiver. If you want to retain the sidetone capability, you will have to install another connector somewhere. My sidetone comes from my keyer and the loss did not bother me. I assure you that the filter is worth a little trouble.

Noise Blanker

The SBA-104-1 noise blanker is very effective for some types of noise, notably automotive ignition noise and other types of short duration impulse noise. It does not do much good with long-term "grinding" noise like summer static and some types of power line noise. Since the HR-1680 does not have any noise limiter at all, the SBA-104-1 is a worthwhile improvement.

Build the noise blanker according to Heath's instructions, except change the value of R3 from 33

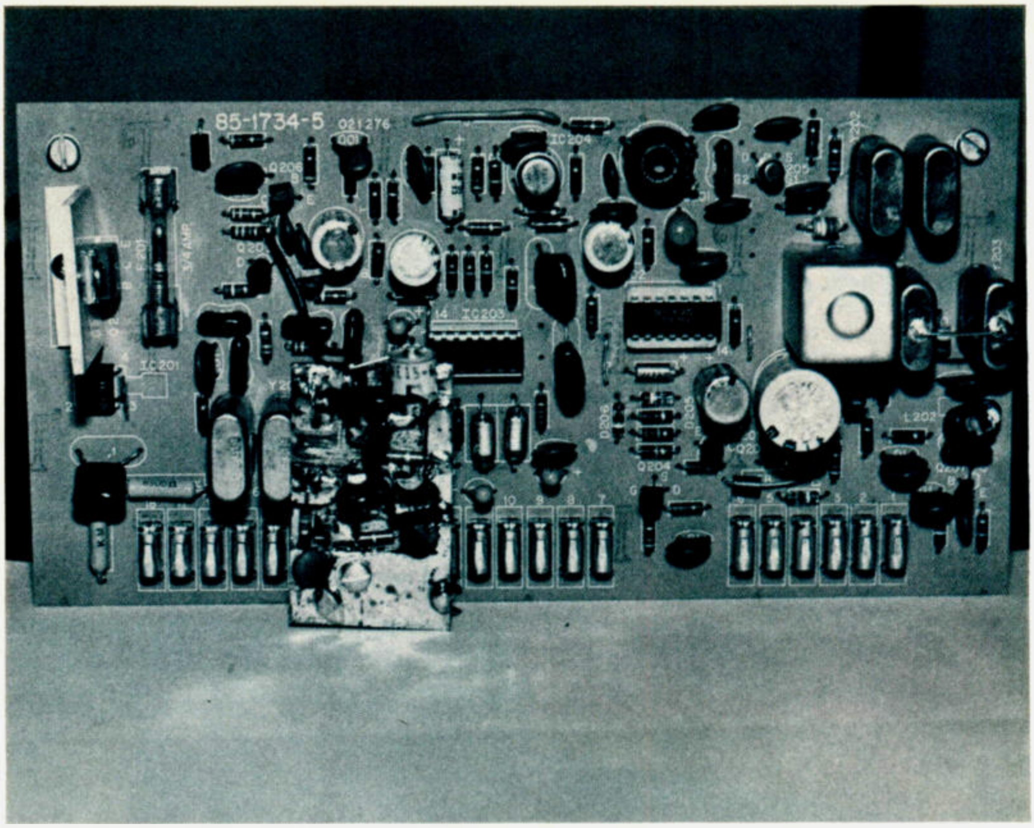

Photo C. Component-side view of AUD/REG board with new CW bfo board attached.

Parts List

C1—47-pF silver mica
C2—15—60-pF ceramic trimmer (Erie 528 type)
C3—33-pF silver mica
C4—330-pF silver mica
C5—10-pF silver mica or ceramic
C6,7—.01 ceramic disc, 100 volts
R1—47k, ¼ Watt
R2—330 Ohms, ¼ Watt
R3—1.5k, ¼ Watt
Q1—2N3819 or similar junction FET
Y1—3395.7-kHz Heath part 404-549

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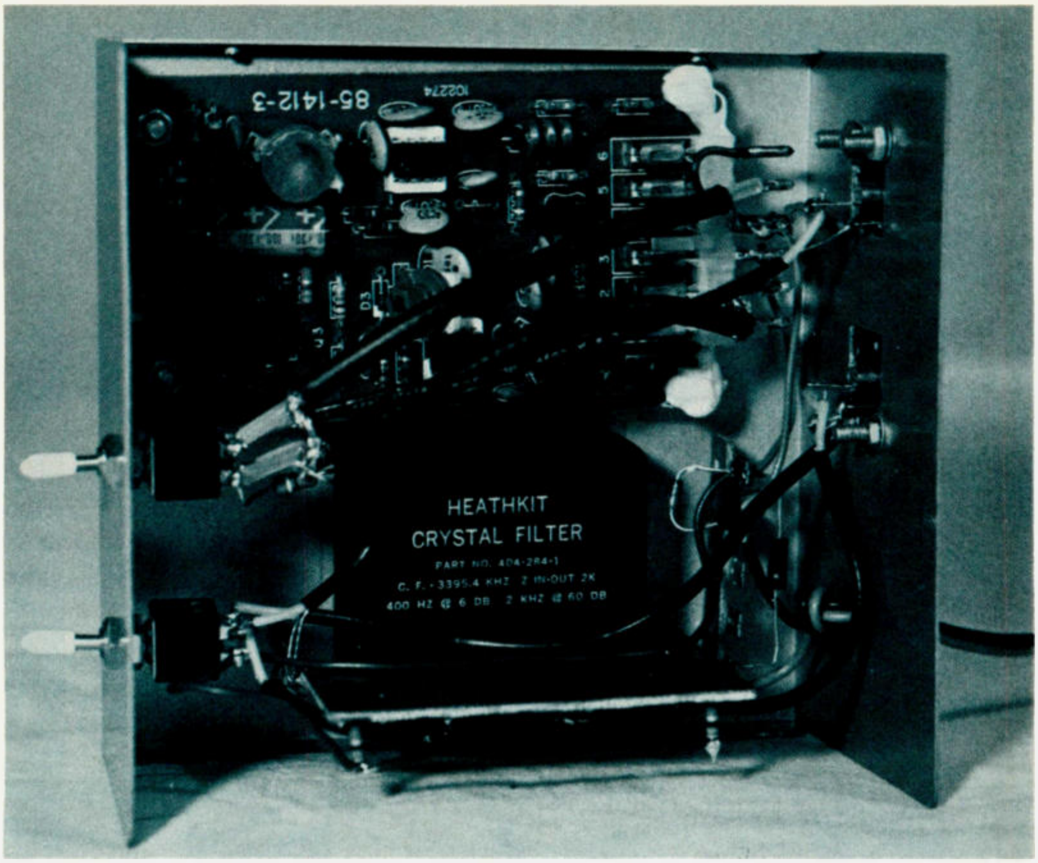

Photo D. Interior view of filter-blanker cabinet. Note globs of silastic rubber used to secure connector to PCB.

Ohms to 390 Ohms. The 390-Ohm resistor is included in the kit for use in the SB-104A and is not needed in the HR-1680. I could not see that the 560-Ohm resistor and the 2.2-uH coil were needed in the HR-1680, so I left them out.

The Heath manual discusses the increase in the IMD (intermodulation distortion) when the blanker is installed, and I noticed that a whole flock of "birdies" fly across the dial when the blanker is in the signal path. When you really need the blanker, all this does not matter, but it is not to be lived with when there is no noise. The best solution is to switch the blanker completely out of the circuit when it is not being used. The circuit diagram reflects this switching.

Filter-Blanker Power

13.8 volts is available at the external power connector at the rear of the set. This connector goes directly to series pass transistor Q201, and care should be exercised when using it because the fuse is ahead of the regulator. The blanker is normally connected to 11 volts, so I used one of several ECG-140s (10-volt) zeners that I had as a simple shunt regulator. The blanker and crystal filter work well with a 10-volt supply.

Checkout

Connect the filter-blanker combination to the HR-1680 using RG-58 coax with phono-type connectors at each end. The length of the cables is not critical, but they should not be too long. My cables are about 20 inches each and I could not measure any loss through the cables and switching arrangement.

Use Heath's instructions for checking and adjusting the blanker, except just switch the blanker out for "initial" readings.

To check out the crystal filter, switch out the blanker, switch the MODE switch to USB, and switch the FUNCTION switch to CAL. Find one of the 100-kHz calibration signals (any band) and switch to CW to see if the new bfo is operating. The beat note will change pitch when the new bfo is switched in. Switch in the crystal filter and verify that it is working. Switch to WIDE and USB and find a strong CW signal or use the spot function on your transmitter. Switch to NAR and peak the signal on the audio filter of the HR-1680. Switch in the crystal filter and switch to CW and adjust the bfo trimmer for a beat note which is peaked at the audio filter center frequency. You should now be able to switch the filter and blanker in and out without changing the S-meter reading.

With the crystal filter switched out and the receiver in the WIDE position, an S-9 signal can be heard over three or four kHz. With the crystal filter switched in, the same signal can be heard over less than one kHz and the signal falls off sharply outside the passband of the filter. The audio filter is helpful in eliminating some of the higher frequency noise that the crystal filter passes.

The normal SSB filter is always in the signal path and this helps improve the overall shape of the passband of the receiver. With the circuit shown, the crystal filter is properly terminated and does not have the "ringing" often associated with sharp filters. In fact, at first I did not think that it was working correctly because the audio was so natural sounding. I purposely mismatched the filter and the typical "ringing" was there. With the new bfo and using only the wider SSB filter, you can now actually zero-beat a signal. This is extremely handy at times.

Conclusion

With the modifications that I have outlined, the HR-1680 becomes a superb CW receiver which outclasses almost every secondhand set and is equal to many new and much more expensive sets. ■

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Gary McClellan
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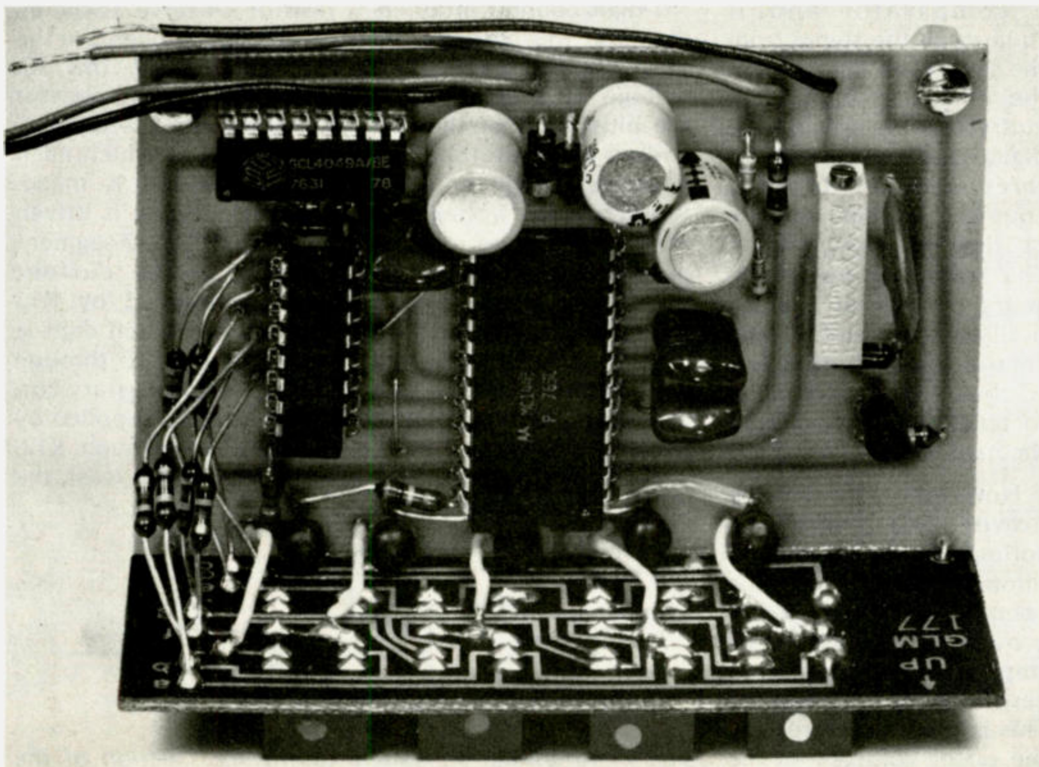
Fullerton CA 92631

The Dollar-Saver DVM

—3½-digit unit features autopolarity, auto-zero, and a $30 price tag

Thanks to a new integrated circuit, there has been a dramatic drop in the cost of the digital voltmeter. If you have held off buying or building a simple digital voltmeter because the parts cost too much, you are in for a pleasant surprise with this one! The parts will cost about $30.00 or less, and a kit is available to save you the effort of rounding up all of the components. Needless to say, the price is right! The voltmeter is easy to build, too. The bulk of the components are on a 24-pin IC from Motorola. All you have to add to this chip is a display circuit, a voltage reference, and power supplies. The circuit is, as a result, quite simple. And PC board layouts are included to make this project as easy to build as a simple kit!



The completed DVM.

So how about the features? This voltmeter has at least all the features of digital panel meters on the market, and, in fact, more features than several meters that sell for at least twice the price! You get features such as auto-zero (no more zero-adjust—Hooray!), auto-polarity with minus sign display, and overrange indication. You have your choice of a 0 to 199.9 mV range or 0 to 1.999 V range by simply changing one resistor. As you just might have guessed, this meter has a 3½-digit display of 0.33" LEDs, and backing the display up is a voltmeter chip with ± 0.05% accuracy. Of course, the accuracy you get depends upon how well you calibrate your instrument, but it can be darn good! Input impedance is greater than 1000 megohms, minimizing circuit loading and making the design of input attenuators much easier. In short, this voltmeter is built around a terrific IC chip, and one that represents a major breakthrough in features and price.

This article will show you how to build a simple, super low-cost voltmeter. It's so cheap you can permanently install one in such equipment as power supplies, etc. Perhaps in a future article, we can show you how to add ac volts, Ohms, and current ranges to your existing instrument. None of these additions are especially expensive, but they will dramatically increase the versatility of your voltmeter.

How It Works

The heart of this digital voltmeter project is a single CMOS IC made by Motorola. It contains all the critical circuitry necessary for a simple digital voltmeter. Fig. 1 shows a block diagram of the basics. All you have to add to it is a dc-to-dc inverter, which converts the positive 5-volt power to minus 5 volts, a 2-volt reference supply, a display driver, and a display. This sounds like a lot of parts, but in reality there aren't that many. And they are cheap, anyhow. Note that this voltmeter will measure dc volts only. Other functions require a few more parts which must be added to this basic voltmeter, and that must wait for another article.

The Motorola IC is what is known as a dual-ramp A/D converter. This is a technique of converting analog signals to digital logic and is probably the most widely used method of A/D conversion. Dual-ramp (or dual-slope, if you prefer) voltmeters feature high accuracy (0.1% to 0.05% is common) and high resistance to noise which might be on the voltage you are trying to measure. Noise read on inferior meters causes jitter in the readings. The dual-ramp technique has been taken one step further by Motorola in that there is an auto-zero step before each measurement, eliminating the zero-adjust control forever!

Let's look at some of the circuitry inside the DVM IC. Fig. 2 shows a simplified version of the A/D converter. There are three CMOS op amps, as you can see, and they function as follows: Dc signals are applied to the input of the first op amp, which serves as a buffer, isolating the influences of the outside world from the sensitive A/D converter. It has a gain of one. The second op amp serves as a ramp generator. It generates linear sweeps upon command. The signal applied at the noninverting input (+ input) and the position of the switch across the capacitor determine the size of the ramp. This is the part of the circuit that does the actual bulk of the A/D conversion. The third op amp serves as a comparator and it squares up the signal from the second op amp so that the remaining digital circuitry can be driven. The digital section consists of three decades of BCD counters, latches, and the "1" digit/polarity-sign logic. The remaining digital circuitry consists of a clock oscillator, multiplex, and control logic. Quite a few IC chips would be required to build this DVM circuit the hard way!

Now let's turn on the power and trace the voltage to be measured through the IC chip. The complete analog-to-digital conversion is done in six steps. The first step is to zero the A/D converter. This is done by correcting the offset voltages on the first two op amps of Fig. 2, or in other words, by setting their output voltages to zero. The capacitor across op amp number two is also shorted. The second step stores the number of counts equivalent to the input offset voltage (corrected by step 1) for later use in the auto-zero process. Step 3 uses the information to again re-zero the A/D converter. Then in step 4, the switch across the capacitor of the second IC opens, the plus input is grounded, and a positive ramp results. This ramp is for measuring positive voltages. The ramp starts at the voltage being measured, and then goes to its limit. This generates a series of pulses which are squared by the third op amp and go on to drive a 3½-digit counter array, indicating the voltage. In step 5, the reference voltage is substituted at the plus input of the second op amp, resulting in a negative ramp for measuring negative voltages. It works the same as the positive ramp. Finally, in the sixth step, the signals are squared up by the third IC and counted by the digital section. This process takes place about four times a second.

Let's take a look at the rest of the DVM circuit (Fig. 3), now that the Motorola IC has been discussed. Looking at the input, resistor R1 and diodes D1 and D2 serve as input protection, saving your DVM chip in the event of a gross overload. The hex inverter, IC1, is wired as an oscillator/buffer. It produces a 900 Hz square-wave signal, which is voltage-doubled by D3-D4 and C2-C3, and that provides the minus 5 volts required by the DVM chip. There is a 2.000-volt reference voltage source consisting of C5, D6, Q1, R5, and R6. FET Q1 serves as a constant-current source, making the reference voltage more stable. Capacitor C4 and resistor R4 serve as the integrator components in the A/D section of the IC. Capacitor C6 and resistor R7 set the clock frequency, or the rate at which each A/D conversion is made. The LED display is driven by IC3, a BCD-to-7-segment decoder, with current limiting supplied by R13 through R19. Each digit is switched by Q2 through Q5, and the necessary current limiting is supplied by resistors R8 through R12. And last, but not least, the

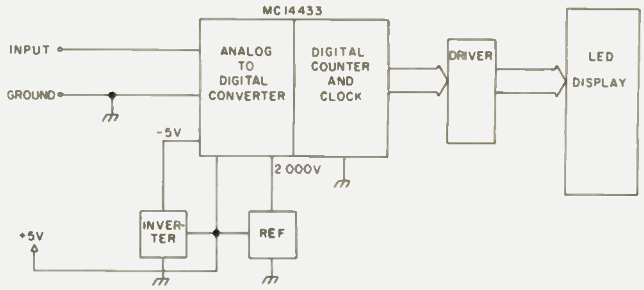


Fig. 1. Block diagram of the DVM.

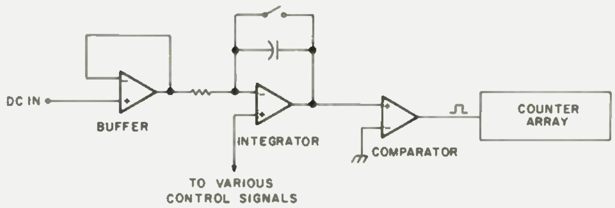
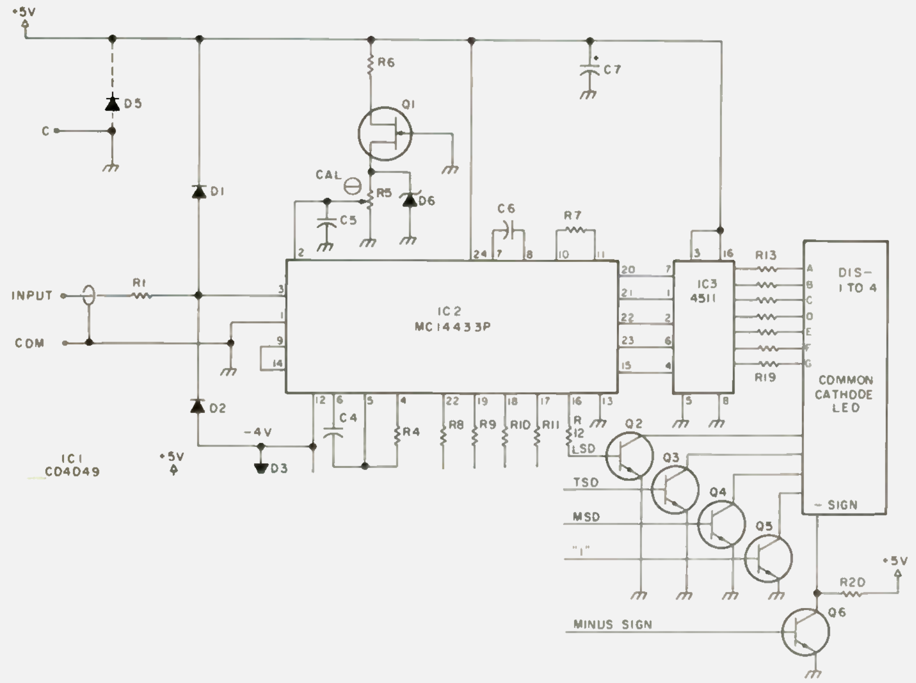


Fig. 2. Simplified schematic of the A/D section of the Motorola chip. The digital counter array is a standard 3½-digit configuration.



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sitive as this one. A poor layout will result in noise pickup and, thus, diminished accuracy. If you are reasonably well-versed in DVM construction, fine! You can design your own layout, and it will work fine as long as you are careful of what you connect to the analog ground (pin 1, IC2). If you are not so knowledgeable in DVM construction, play it safe. Either copy your boards from our illustrations, or buy the kit from the author.

A good place to start is with the display board. Fig. 4 shows the front view of this board, which you can wire directly from this illustration. Just place the board in front of you so that the row of 8 holes along the edge is to your left, then stick in each of the displays, solder, and trim the wires. Next, add the three jumpers below the displays. Check this board for properly soldered connections, solder bridges, etc., and set it aside.

Now you can start on the main board. Cut up Molex Soldercons® into strips of four 8-pin, and two 12-pin. You can use ordinary 16-pin sockets for the two small ICs, but you *must* use Molex for the 24-pin IC because parts run underneath this IC! Insert the strips into the proper holes as shown in Fig. 5. Be sure that the board is oriented properly. The "c", "5V", and "in" markings on the foil side should be closest to you. Solder the pins in place, but do not remove the tab from each row of pins. Next, add the four jumpers. You can use bare wire but be careful to allow a little clearance on the jumper that goes under IC1. You don't want this wire to touch any IC pins. Install trimmer pot R5 on the board. Follow suit with the rest of the resistors, but temporarily leave off R13 through R19. They go on when you add the display board. As you install R12 and R8, you may want to put spaghetti tubing on these resistor leads to prevent them from shorting against the pins of IC2. When you finish with the resistors, install the five diodes. Diode D5 is optional—it provides reverse polarity protection for the DVM. It kills the power supply if the DVM is improperly powered, saving the $15 DVM chip. If you want this feature, mount the diode on the foil

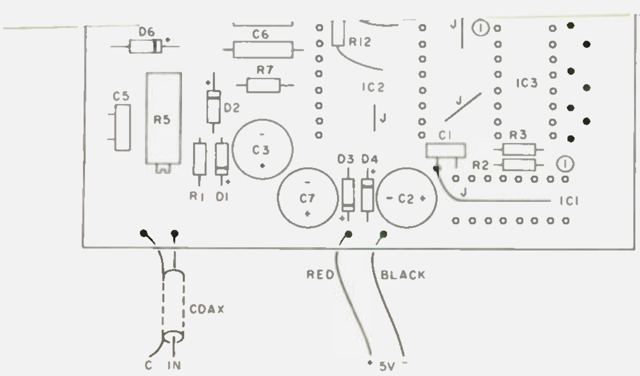


Fig. 5. Top of main board.

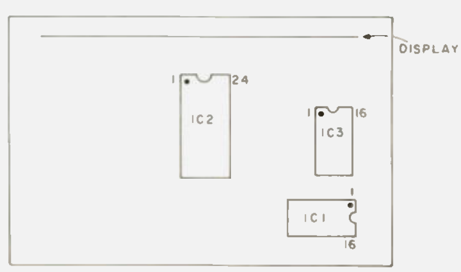


Fig. 6. IC location diagram.

side of the board between the "c" terminal and the "5V" terminal. Do not run the leads through these holes, as wires will later be connected here. Instead, solder directly to the foil. Make sure that the diode polarities are correct and then go on to the capacitors. When you are done, be sure to check the polarity of C2, C3, and C7. Add the FET, Q1. Notice how it is mounted in the illustration. If you have trouble finding a TIS-75, you may get it from S.D. Sales of Dallas, Texas. They call them "FETS" by Texas Instruments" and they have sold at 5 for a $1.00. Add transistors Q2 through Q6, orienting them as shown. Notice that the emitter leads of these transistors are bussed together. Finish up the board by cutting up a piece of hookup wire into five one-inch pieces. Strip and tin each end, then solder one each to the collector pads of Q2 through Q6.

Now it's time to install the display board and clean up a few odds and ends. The display board mounts flush against transistors Q2 through Q6. You can mount it with two homemade "L" brackets, or just epoxy it. We did the latter after wiring up the display. If you want to do the same, start by wiring the drivers first. Simply solder the free end of the wire coming from Q2 to the cathode of the display *directly* above it. Follow with the other transistors. Note that the minus sign driver, Q6, lead goes to the pad marked "−" on the edge of the board. When you are done with the drivers, turn to the segments. Seven 180 Ohm resistors serve as the leads here, so no more wire is necessary. You will notice that there are pads around IC3 marked "a" through "g". These are the segment letters, and they are duplicated on the display board. Install the resistors in this order: c, d, e, a, b, f, and g. Leave extra lead length on each of these resistors so they can be positioned without touching. Add short lengths of hookup wire to the holes marked "c" and "5V". These are the power supply leads. Then add a short length of shielded cable between the "c" and "In" holes. This is the signal lead. Finish up by breaking the tabs off the IC sockets and inserting the ICs. Fig. 6 shows IC placement. Be patient with IC2! It may take several tries to get all the pins in the socket.

Calibration

After you have checked over your wiring, and have corrected any problems, you are all set to test your meter. Connect the supply leads to a source of regulated 5 volts dc. If you don't have a power supply handy, or expect to be needing one with this meter, build the simple one of Fig. 7. Apply power and you should see a flash of light from the display and then it should blank. This is normal with open-circuited input leads. Then short the

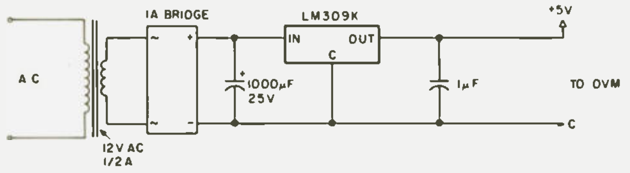


Fig. 7. DVM power supply.

input leads together and the display should light and read "000" with the minus sign flashing slowly. These two tests tell you that your overrange feature (blanked display) and auto-zero feature, as well as the rest of the unit are working properly.

Now you can calibrate your meter. There are several ways to do this and one is shown in Fig. 8. The best way is to use a commercial meter calibrator, such as the Datel, Fluke, and other "low-cost" units. But these are commercial units and the cheapest is about $300.00! If you have access to one of these, fine! Just be sure that the calibrator is at least 5 times more accurate than your meter is, or ± 0.01%. Nearly all commercial calibrators are better than this. However, don't dispair. There are other ways to calibrate your meter. If you can get a hold of a good 3½-digit, or better, voltmeter you can cali-

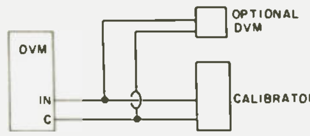
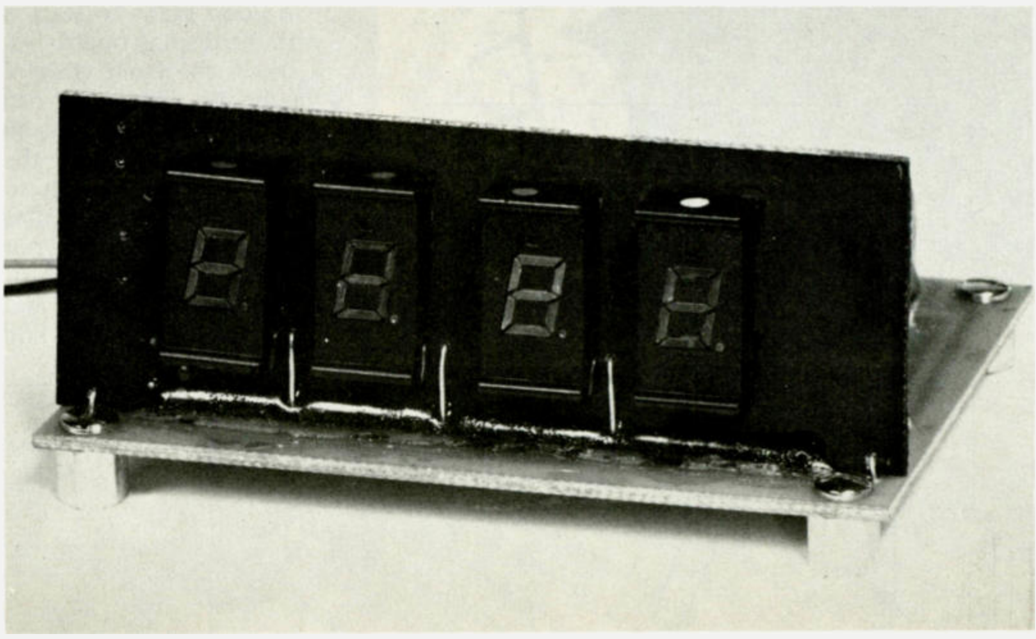


Fig. 8. Calibration setup.

brate your meter against it. Of course the accuracy you get from your meter will be reflected by the unit you calibrate against. Do not calibrate against any analog meter, even the best, if you expect accuracy better than 1 to 5%. The last method is to calibrate it against a mercury battery. If you build our kit, you can return it to us and we'll calibrate it for a fee. So one way or another, you can get your meter calibrated!

The actual calibration procedure is quite simple. Remember, there is only one adjustment! If you are using a commercial calibrator, set it to 1.99900 volts, and adjust R5 for a reading of 1.999 volts. If you are calibrating against another digital meter, ad-



The display board may be held in place with epoxy.

Parts List

C1, C4, C6—0.1 uF, 50-volt miniature mylar capacitors
C2, C3—50 uF, 16-volt electrolytic capacitors
C5—0.1 uF to 0.2 uF, 10-volt disc capacitor
C7—100 uF, 16-volt electrolytic capacitor
D1, D2—1N4148 switching diodes
D3, D4, D5 (optional)—1N4002 diodes
D6—1N703 zener diode
DIS 1 to DIS 4—Litronix DL-704 LED displays
IC1—CD 4049 hex inverter IC
IC2—Motorola MC-14433P DVM IC
IC3—Motorola MC-14511CP display decoder IC
Q1—TIS-75 FET or equivalent
Q2 to Q6—2N2222 transistors or equivalent
R1—100k, ¼-Watt, carbon-film resistor
R2, R4—470k, ¼-Watt resistors
R3—4.7k, ¼-Watt resistor
R5—10k, multi-turn trimmer potentiometer
R6, R13 to R19—180 Ohm, ¼-Watt resistors
R7—270k, ¼-Watt resistor
R8 to R12—10k, ¼-Watt resistors
R20 270 Ohm, ¼-Watt resistor
Misc.: PC boards, wire, solder, etc.

A kit of all the above parts is available from: Beckman Instruments, 2500 N. Harbor Blvd., Fullerton CA 92638, for $29.95. California residents include $1.80 sales tax. All orders include $2.00 postage and handling. A set of PC boards and construction manual are also available for $4.50, postpaid.

just R5 until the meters read the same. You can use a flashlight battery here for the voltage source and it works fine. And finally, if you are calibrating against a mercury battery, adjust R5 to read 1.340 volts and you will be in the ballpark. After tweaking R5 in any of these methods, reverse your meter's input leads. The minus sign will light and you will get the same reading, plus or minus a millivolt.

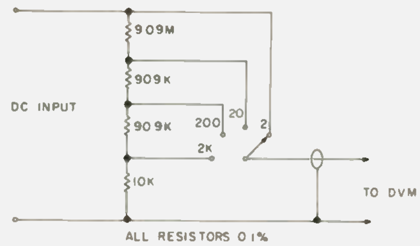


Fig. 9. Voltage divider for additional voltage ranges.

Operation

There are many uses for this meter and it's up to you to find them. Do you have a regulated power supply? Why not add a DVM to it. Fig. 9 shows a simple voltage divider you can use in this or other applications. Of course, you can incorporate it into a nice case and use it as a bench voltmeter. Or, power it with a set of nicad batteries and make your meter portable. The possibilities are endless!

One last thing: You will probably want a decimal point and perhaps a 0 to 199.9 mV range. To get that decimal point, it is recommended that you place a series combination of any small LED lamp and a 2.2k resistor between the appropriate readouts. Attach the leads to the 5-volt power supply. This addition will give superior performance to the built-in decimal points. Need a 200 mV range? Just change R4 to 27k and recalibrate. That's it! ■

Palomar, Pipo Communications, Regency, Robot, Rohn, Sharp, Slinky, SST, Stinger, Swan, Teletower, Telex,

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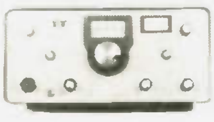

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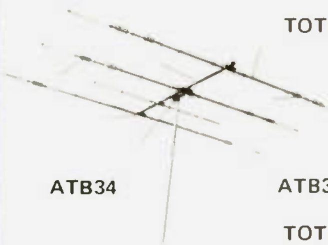

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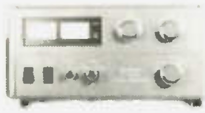

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Reader Service—see page 195

Personalize Your Repeater with a Voice ID

— low-cost design uses 8-track decks

Bob Heil K9EID
411 S. Main
Marissa IL 62257

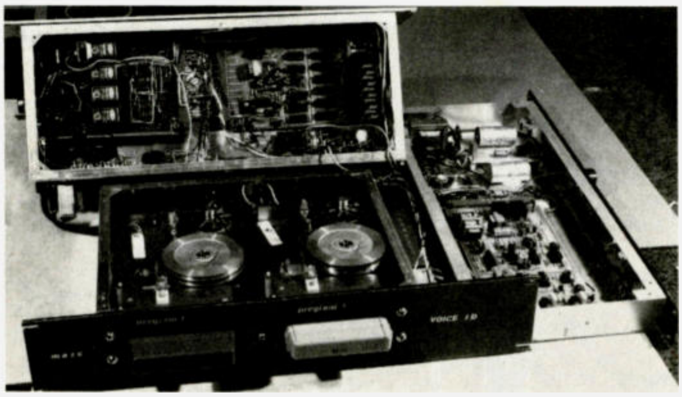
With the great increases of repeater systems on the air today have come all kinds of ideas for hardware to personalize each system and projects offering ideas for clubs to get new members involved with the building and maintaining of these systems.

Here is a voice identification system using easy-to-obtain parts, simple straightforward circuitry, and such easy construction practices that any repeater group can build it with a minimum of problems.

Circuit Description and Planning

The system consists of a 16-digit function decoder feeding an address field of gates which, in turn, drive five relays that simply turn on or off an 8-track tape-player deck.

The function decoder used here is the Data Signal TTD-226, but any function decoder will



This is the M.A.R.C. voice ID system. Two of the four tape decks are shown, mounting into one chassis with access to the tapes from the front. The underneath view of the electronics shows the function decoder board on the right and the address field-motor switching on the left. The audio patch is on the extreme right of the picture.

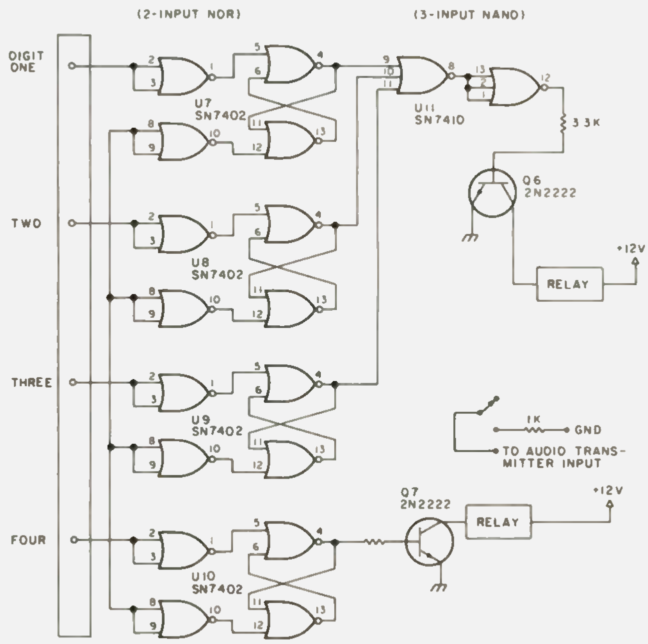


Fig. 1. A multi-digit access board is incorporated, and can be used whenever you desire more than one or two entries. The circuit described here is a 4-digit input, with an audio clamp circuit that will turn off the audio fed to the transmitter. During the digit-accessing, no audio is fed out over the air. When the fourth digit is accessed, the audio clamp circuit is released and the transmitter is again fed audio.

HOW IT WORKS

Audio from the receiver is fed to the function decoder. An agc circuit is used to feed the eight 567 tone decoders. Their outputs feed various gates to give a total output of each digit corresponding to a 16-digit pad. As a digit is sent, a low signal appears at the corresponding pin of S1. This signal is sent to the input of the address field board, which contains five SN7402 QUAD NOR gates wired as flip-flops. Applied low signals to the two inputs will cause the circuit to turn on and drive Q1 into conduction, which then turns the relay on. Proper connection of low signals from the tone decoder to the address field board will give you all kinds of variety with respect to access codes and types of operation.

The relays turn 110 volts on and off to the series of 8-track stereo tape-player decks which feed the repeater audio system. The relays can be used to control any number of functions needed for your particular repeater control.

work. (The repeater handbook has an excellent function decoder described which will work well, also.) The number of digits is up to your group. Great thought has to be put into your input access codes, unless you desire a completely "open" system accessible with one digit.

If your repeater has an autopatch, it will be very important to disable the tape ID decoder system so that dialing phone numbers will not access any tape messages. This can be accomplished very easily by shorting the audio input signal feeding those decoders. At the same time the patch is brought back "down," this audio short is lifted and audio is allowed to feed the decoders once again.

This system uses a three-digit input and a single-digit cancel, or an automatic cancel fed by the tape deck.

Operation

The signal path starts at the repeater receiver speaker. This audio line feeds the repeater transmitter, and we bridge it to feed the function decoder audio input. An agc (automatic gain control) amplifier is used to limit the audio coming into the decoder ICs, so that the audio signals do not distort and overload the circuit. The function decoder then uses 567 PLL chips to decode two-tone audio tones and gives a low or high signal to drive the address field.

The address field board can be thought of as a very simple memory storage board, using 7402 TTL chips. The decision was made to use this method so that one can use inexpensive chips (usually less than 50¢ each) which do not require any special handling or give serious voltage problems.

7402 R-S Flip-Flops

The 7402 is a two-input quad NOR gate. It can be connected as a set-reset flip-flop. A high to pin 5 will cause pin 4, the output, to latch high. Sending a low to pin 3 will reset pin 4 to a low state. We actually have a storage for recall of information at any time. This has to be addressed with another 7402 so that the clocking is uniform.

Alternative IC

As with any electronic circuit, there are many ways to achieve the same function. A 7472, 7407, or 7476 J-K flip-flop latch IC could replace the 7402. Our decision, however, favored simplicity; it allows use of the same chip throughout the entire project, making parts replacement for servicing easier, should any problems arise.

The outputs of the flip-flops drive an NPN transistor, which buffers the 7402 output to control a 12-volt relay. This relay switches the 110 V to the 8-track tape-deck motors. The message tape has silver foil applied at the end of each message. This foil comes in contact with two metal fingers which are connected to the off pin of the flip-flop, thereby latching the 7402 off, which releases the relay and turns the tape-deck motor off. One set of contacts is used to key the PTT line of the transmitter, also.

Time Machine

One feature some of our members really wanted was a voice time machine that could be punched up to give the time of day. Our rural telephone system does not have the usual time-and-temperature public service number. However, in checking out the available time machines, it was found that the lowest-priced unit was over $2,000!

In checking around, a Panasonic "Talking Clock Radio" was found, however. This product was built over five years ago. It uses a series of magnetic discs that change position every minute and hour. A remote keying jack and audio output are already installed, so interface was very easy. The biggest problem was the addition of a timer to hold the PTT line on so that the transmitter remained keyed during the six seconds that it takes for the voice tape to announce the time. This was accomplished with a 555

Fig. 2. Interface for the TTD-226. Connect pins of S1-P1 to correspond with the particular access code you desire. Program 1 needs two digits to turn the program on. The tape sensor will turn it off. Select the digits you prefer from S1, to correspond with P1. Example: Connect terminals 3 and 4 of S1 (TTD-226) to terminals 1 and 2 of P1 (address field board). Connect terminal 3 of P1 to the tape-deck sensor switch. When digits 3 and 4 are sent in sequence, U1 turns the program 1 tape deck on. When the message is finished, the aluminum tape sensor on the tape cartridge activates the tape sensor switch, turning off pin 3 of P1, which reverses the U1 flip-flop.

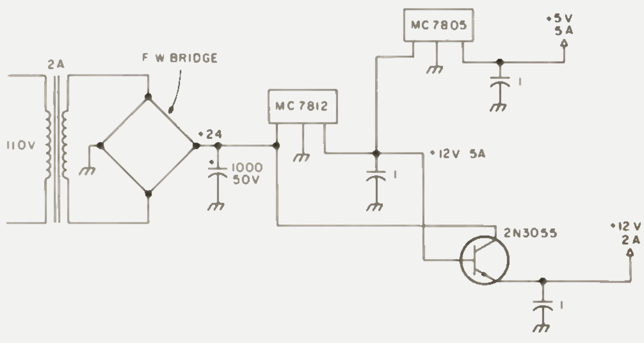


Fig. 3. Power supply.

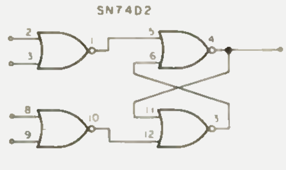


Fig. 4.

timer IC turning on a reed relay to ground the PTT line.

Tape-Player Hardware

As with all repeater groups, our cash was in short supply, so the acquisition of tape decks got to be expensive in the planning stages. We ran across an ad from Poly Paks, however, for 8-track players for $9.00! They worked out great! It was inconceivable to use one of those players, with that head jumping up and down, to select the various programs, so we used two players and removed all of that solenoid nonsense. We mounted the playback head solid and eliminated many problems.

One player is programmed for ID announcements. The other player can be used for club messages, announcements, and so on. We have a third player that comes on every tenth time the CW identifier is called upon. This produces a low level voice ID automatically. The other tapes are accessed by touchtone™ pads only. Each message is about 6 to 8 seconds, average, with a piece of silver foil sensing tape ½" long at the end of each message. Most of our tapes contain 15 different messages on a continuous loop. The sensing foil stops the machine at the end of each. This ensures greater tape life and gives you much more program source.

Chassis Work

The entire unit is built into two aluminum chassis. One, 17" x 6" x 3", houses the electronic keying board, regulated supplies, and relays. The other, 17" x 12" x 3", contains the tape players and associated 110-volt switching. Ninteen-inch standard-rack front panels are mounted on the front of each chassis. The clock radio can be mounted on a shelf inside the repeater cabinet. Proper shielding and single point rf grounding should, of course, be done to prevent any interference. LED indicators are mounted on the front panel to show which program is on the left side of the panel, for the regulated power supply.

PCB

The main address field board, a double-sided board, includes all of the 7402 devices, four tape-player relays, the 6-second timer, and the keying relay for the time machine. A 20-pin edge connector interfaces the board to the output terminal strip mounted on the chassis and connects to the output of the TTD-226 date signal decoder board. A lot of point-to-point wiring is done on the circuit board, so that should you want different access codes at any time, you can simply unsolder the various wire jumpers and re-connect at the desired spots. The relay contacts are hard-wired to the edge connectors so that 18-gauge wire can be used to carry the current. The relays are mounted right on the PC board and use the encased-type relays to keep contacts free of dirt. This point-to-point wiring also makes the circuit very versatile as to how your interface gets connected to the output of the function decoder.

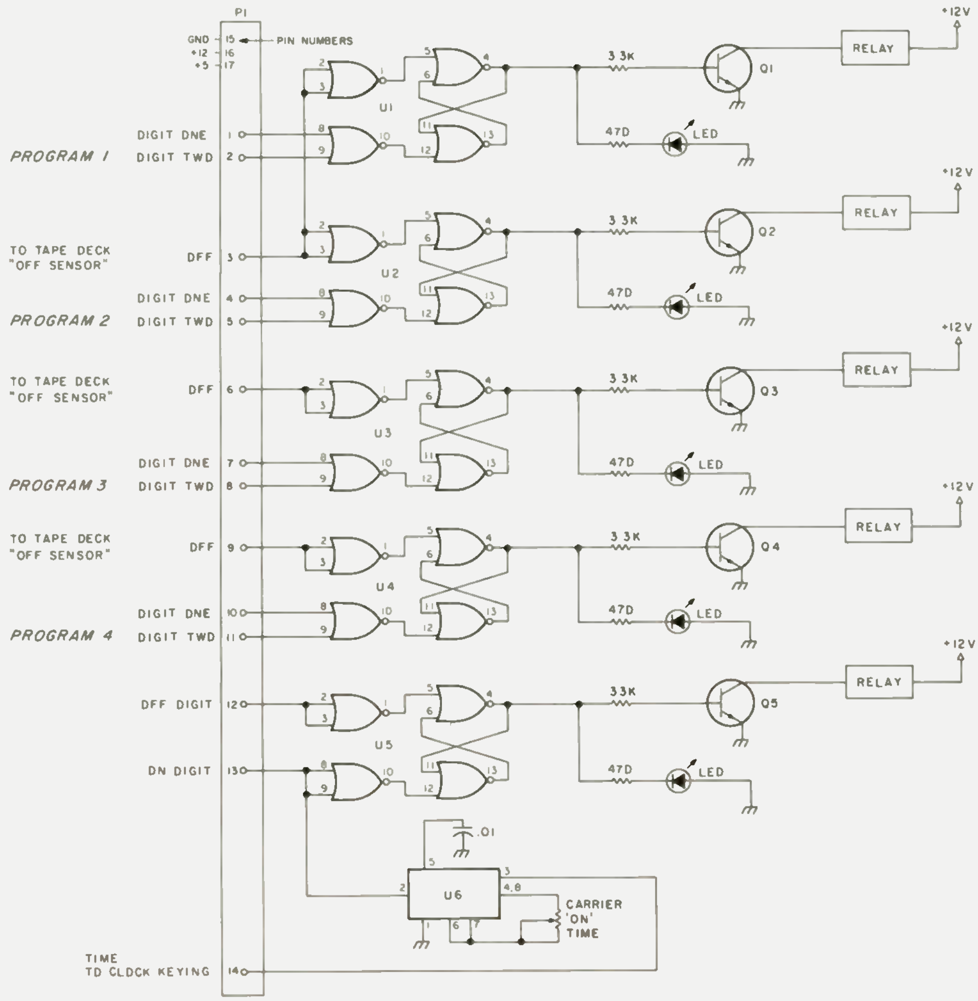


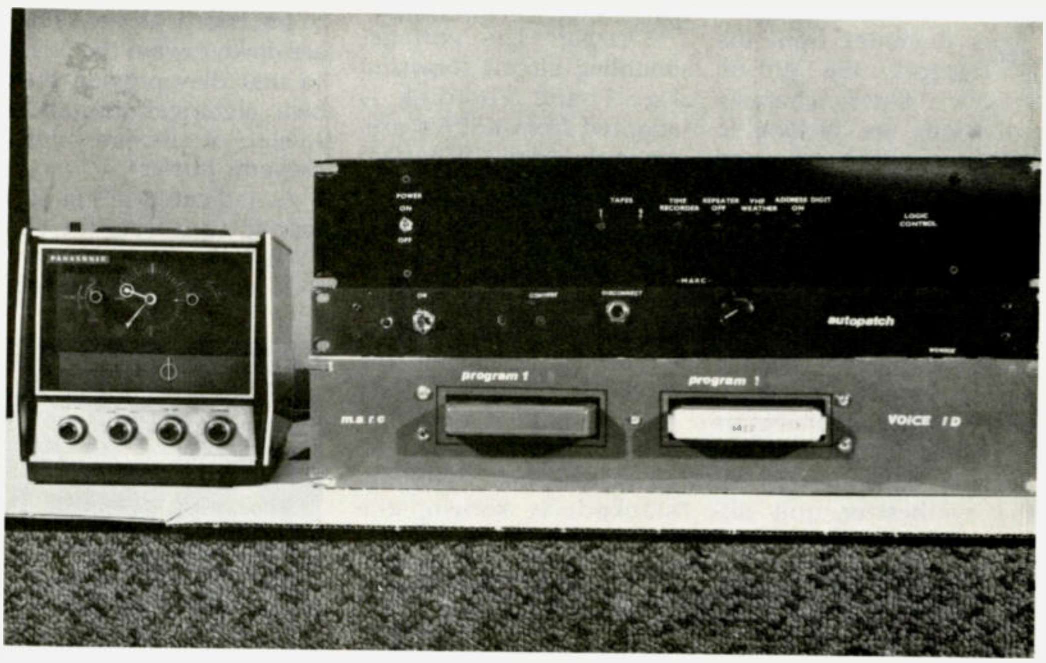
Fig. 5. Address field board.

Power Supplies

Two regulated supplies are necessary for the system. A single transformer feeds both of them. Straightforward practice in filtering and grounding has to be observed.

Tape-Deck Modification

The tape decks used were built by RCA and were purchased from Poly Paks. They are of excellent quality and have held up without any problems. They contain an audio preamp that interfaced very well with our audio system, and the on-air quality is remarkable. The track-selection solenoid was removed from the entire unit. Mount the head bar solid to the tape-deck chassis. This ensures almost foolproof operation and cures that terrible "tape-eater" problem that so many 8-track players seem to have. The wiring of the tape decks is a very simple process of elimination after all of the unused parts are removed. The motors are 110-volt and are wired with regular 18-gauge lamp cord. Proper bypass capacitors are used to minimize any spikes or hash injected into the power lines. The preamp assemblies remain where they were originally and are wired with +12 volts dc for proper operations. Two holes may be drilled on the chassis bottom to give access to the audio level controls of the preamp cards.



The front view before rack-mounting shows the Panasonic RC 6800 Talking Clock Radio used as the time machine. The stack on the right consists of the logic control, autopatch, and two of the four tape machines.

Message Content

The system described here has been in use since November, 1977, on the Marissa (southwestern Illinois) 147.81/147.21 repeater. Ed Bolton WA3PUN cut most of the voice tapes with some of his best imitations of Amos 'n Andy, John Wayne, Henry Kissinger, and a host of others, giving travel, club affiliation, frequency, and other informative messages. A lovely-voiced lady from a St. Louis radio station did several station ID tapes, also.

Needless to say, the system makes the Marissa Machine (the double M) a very popular system and allows visiting operators to acquire useful information as well as great enjoyment as they use it. ■

The Nearly Perfect WE-800

—add an on-board charger, a TT pad, and . . .

H. R. Worthington K1OTW
17 Fremont St.
Oxford MA 01540

As it comes from the factory, the Wilson WE-800's battery-charging provisions are lacking in that it cannot be used while its nicads are being charged. My solution is an on-board charger with no switching or holes required. A shutoff switch could be added by believers in deeply cycling nicads; there is space at the 9-volt battery connectors at the rear panel. With the current consumption of the synthesizer, full discharge occurs often enough without trying. The Wilson can still be charged as the designer intended, if desired.

Charger: The voltage-doubling circuit shown in Fig. 1 and Photo A is adapted from K5PA's article in the April, 1978, *Ham Radio*, p. 36. It charges at 45 mA anytime the rig is on external power. The 555 is in the standard astable mode and the 7805 is the standard current-limiting circuit as found in the *Motorola Linear I.C. Data Book*. I built it on 1" × 1-3/4" vectorboard. If the transistors and 7805 are stacked as shown, the assembly is 5/8" high and fits neatly into the space next to the diode matrix board as in Photo B. I epoxied the stack together and to the board; all heat sinks are down toward the board so that they provide their own electrical insulation. A blob of silicone rubber prevents rattles.

As indicated in Fig. 2, I tapped 12 V from the EXT PWR jack so that, in the INT position, the nicads don't try to charge themselves. I grounded the charger by soldered it to a nearby shield partition. Charging current is put into an unused terminal of the EXT-INT-CHG switch. This terminal is at the top—viewing the terminals with the chassis upright. When road tested, I found that the original 1400-Hz note was getting into the low-level audio circuits on receive and transmit, so I

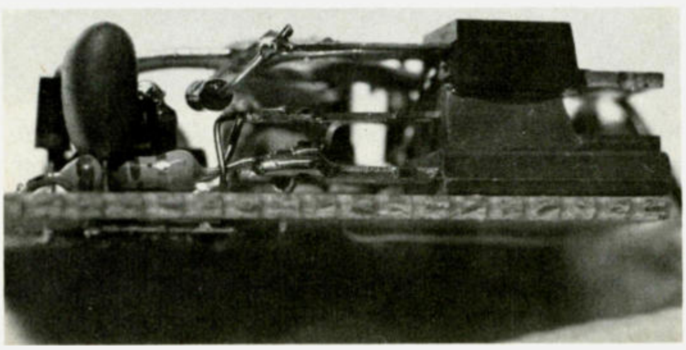


Photo A.

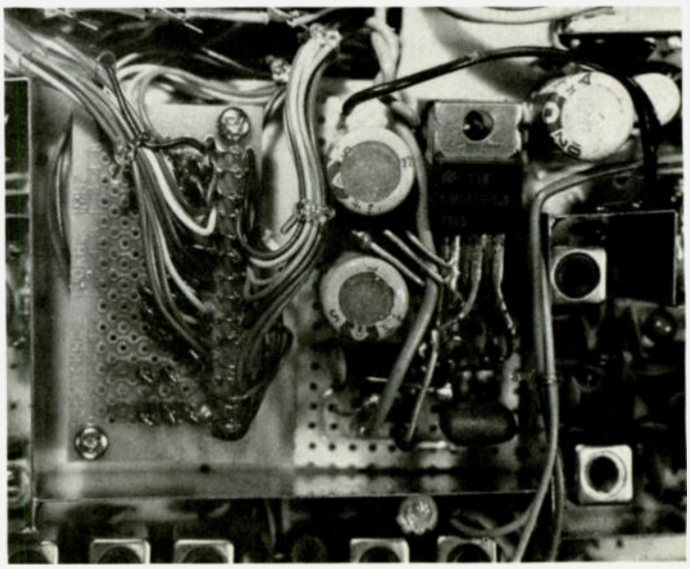


Photo B.

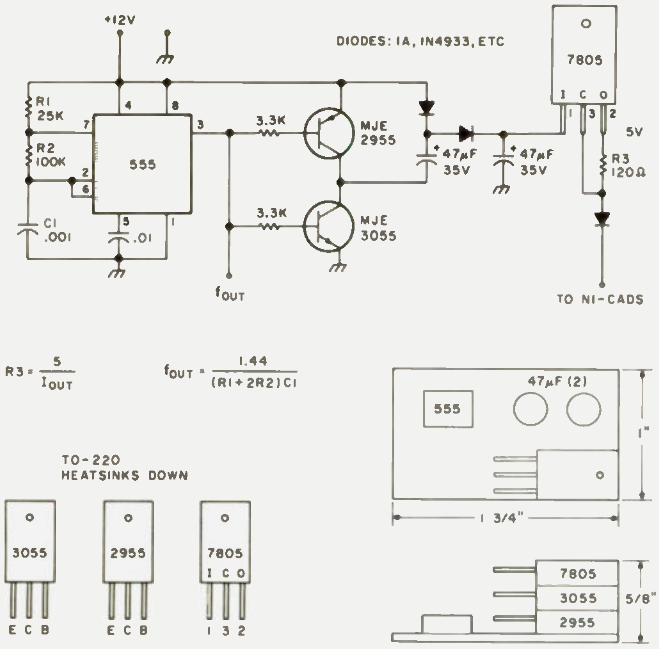


Fig. 1.

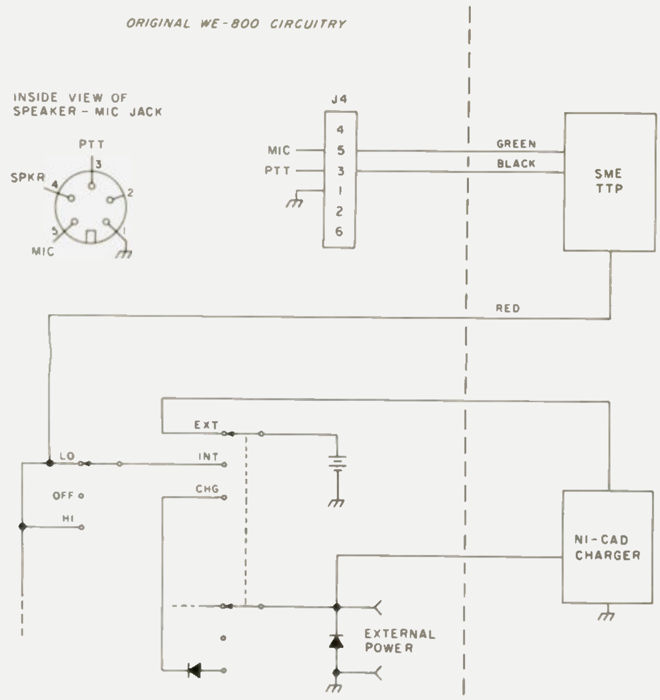


Fig. 2.

changed R1 and R2 to 25k and 100k respectively to increase the 555's frequency to about 6400 Hz. That cured this problem by being above the audio frequency response of the rig (just my theory). R3 of 120 Ohms produced 45-mA charging current. Tolerances of components account for this discrepancy from the formula. The charger draws 130 mA, which produces some heat, but evidently this is not detrimental.

TTP: There is no factory-installed Touchtone™ pad available so I decided upon the Data Signal SME circuitry with the reliable Digitran™ keyboard (type "F" from Data Signal). Since this rig is used sitting on a bench or transmission hump, the keyboard was mounted on top of the case symmetrically with the dummy speaker grille per Photo C. This location is above the battery compartment, so a friendly machinist milled a 1/4" through slot for the 8-pin terminals and a .030" deep × 1/4" slot inside the case to guide the eight leads off the side of the battery compartment. I drilled and countersunk 1/32" on the inside four holes for the plastic mounting pins and melted and filed them flush. I cut the 8-pin terminals flush, soldered the eight leads and secured them into their slot with electricians' tape. I stuck the circuit board onto the side of the case with thin foam tape so that it neatly rests beside the battery enclosure.

I ran the 12-volt, ground, and audio-out leads thru a .062" 3-pin Molex connector so that the case can be removed easily. As shown in Fig. 2, I took 12 V from the HI-OFF-LO switch, soldered the ground lead to pin 3, and soldered the audio lead to pin 5 of the MIC/SPKR jack.

The Data Signal factory-set audio level turned on the local 99/39 autopatch first shot. An unexpected side benefit is that the tones can be monitored in the MIC/SPKR.

As shown in Photo D, I epoxied two automotive distributor cap tower nipples to the bottom surface of the case toward the front to jack it up for a convenient operating angle. They also prevent slippage on a desk. These are for sale at $10 per pair installed, but no clients so far; hi!

Why just "nearly" perfect? The thumbwheel switches should be lighted, but I can't think of anything that doesn't resemble a plumber's nightmare.

Appreciation is due to K1ICU for his photography, WA1VVS for his machining, and WA1WPX for use of her Wilson as the guinea pig. ■

Photo C.

Photo D.

How to Make Your Own Crystal Filters

—requires considerable patience, but very few bucks

73 Magazine *Staff*

Everyone knows that good, high-frequency (3-9 Mhz) crystal filters for use in SSB exciters or accessory CW filters for transceivers are expensive. However, if one has a bit of test equipment and is short on cash but long on patience, it is possible to home-brew very good crystal filters using relatively simple circuitry and without the need for complicated coupling networks.

The crystal filter circuit of Fig. 1 has a number of advantages. First of all, no tuned circuits are involved. The crystals are simply paralleled, and from one to six crystals can be used, depending upon whether one wants to construct a simple CW filter with a very sharp response or an SSB filter with a specific bandwidth. The frequency spacing of the individual crystals used is critical; this will be covered later in detail. The crystals are driven from a low-impedance source by the first-stage emitter-follower. At the series-resonant frequency of the crystals, the signal voltage will be developed across the .001-uF capacitor and drive the output amplifier. At frequencies other than those where the crystals exhibit series resonance, the capacitor serves as a bypassing element and helps sharpen the skirts of the filter response. Some signal leak-through will occur because of stray capacitance across the crystals; this is compensated for by coupling some signal from the collector of the first amplifier around the crystals via the 100-pF variable capacitor. A number of general-purpose transistors can be used in the circuit. With those shown, the circuit will have about 10-dB gain.

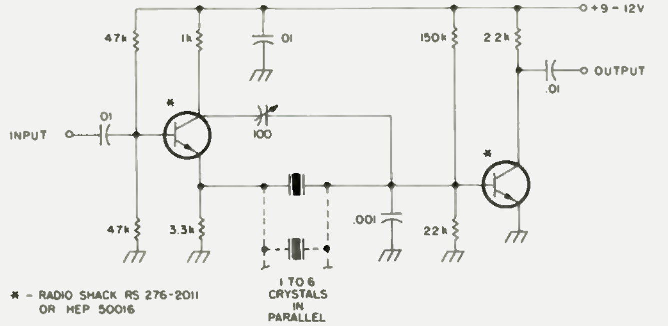


Fig. 1. Simple crystal filter circuit does not require any tuned circuits.

To make the circuit work properly, the series resonance of the crystals used must be carefully controlled. The only exception might be if one decides to use only a single crystal to form a simple CW filter. However, even for CW reception, the bandwidth provided by one crystal is too sharp and provides uncomfortable reception. Therefore, a controlled bandwidth of 200 to 500 Hz should be used. Such a filter can be constructed using at least two crystals spaced in frequency by the desired bandwidth and centered on the i-f frequency desired. For an SSB filter, at least six crystals should be used. This is because the individual crystal series-resonant frequencies should not differ by more than about 300 Hz. Otherwise, the passband of the filter will not be smooth, as it is just a composite of the highly selective passband of each individual crystal.

The type of overall response one might expect from this type of filter is shown in Fig. 2. The ultimate rejection that one can achieve with the circuit depends on how carefully the circuit is constructed to prevent stray coupling around the crystals, and on how carefully the 100-pF variable is adjusted. Values of 40 dB can be achieved before the skirts of the filter response start to flare out. Admittedly, this is nothing like the 80-dB out-of-passband rejection of an expensive 8-pole commercial crystal filter. It is sufficient, however, for a simple SSB exciter, and more than adequate for an accessory CW filter in a transceiver when the SSB filter is also left in operation to sharpen the skirts of the overall i-f response.

One may ask how there can be anything inexpensive about a circuit which might require up to six crystals. The answer is to use the old-style FT-243 crystals. These crystals are available for $1.00 or less each from various suppliers (JAN Crystals, for instance), and they allow easy disassembly and access to the crystal itself. The latter is important since there is no easy way of specifying the series-resonant frequency for the crystals to be used in the circuit. So, one has to obtain crystals which are marked approximately for the i-f frequencies of interest, disassemble them, and grind them to the exact frequencies needed. This operation, particularly the "grind" part, is not as terrible as it sounds. In fact, the whole operation is relatively simple.

The circuit of Fig. 3 is used to find the series-resonant frequency of a crystal. A signal is applied from a signal generator or vfo. The voltage across the crystal is monitored by any high-impedance instrument which will respond at the frequency being used. Usually an oscilloscope is the most suitable instrument. The "bandwidth" of the oscilloscope may be far below that of the test frequency being used, since only an indication of the voltage change across the crystal is necessary. A "5-MHz oscilloscope," for instance, will easily respond to signals up to 10 MHz or more in frequency (although, of course, it cannot be used to analyze the waveform of 10-MHz signals).

As the test frequency is varied, there will be a sharp drop in the voltage across the crystal when its series-resonant frequency is reached, producing a short circuit. The voltage drop is very sudden, and one must vary the test frequency slowly. The series-resonant frequency should be within a few kHz of the frequency stamped on the crystal holder. The FT-243 crystals are easy to disassemble, and the rest of the job now consists of taking the crystal apart, grinding it slowly to raise its frequency, and then testing it back in its holder until one collects the desired number of crystals with the proper series-resonant frequencies.

Although acids can be used to "grind" crystals, it is usually better to use a very slightly abrasive material such as 3M "Trimite" silicon carbide paper (with a fineness of 400 or greater). This paper is obtainable at large hardware stores and comes in 9" × 11" sheets. The paper is taped to any flat surface, and the crystal held flat with a finger and rubbed on the paper with a circular motion. The grinding should be done "wet." That is, the crystal should be kept moistened with water. After grinding, the crystal is carefully cleaned with rubbing alcohol and, avoiding any finger marks, put back in its holder.

To go back for a moment, it should be mentioned that although the FT-243 holders are easy to disassemble with just a screwdriver, the operation should be done carefully. The contact plates and spring should be kept in the same order for reassembly. Also, the crystal should be marked on one corner so that it is set back in the holder in its original orientation.

The amount of grinding a crystal needs to change its frequency depends on the pressure used while grinding, the number of passes while grinding, and so on. However, it takes very little practice to get some "feel" for the changes which take place in the crystal frequency as one grinds it. For instance, with an 8-MHz crystal, one circular pass on the abrasive paper might change the crystal frequency by 150 Hz. One hundred passes might change it as much as 20 kHz. For lower-frequency crystals, more passes will be required for a given frequency change. A 4-MHz crystal might change 60 Hz in one pass and 7 kHz in 100 passes.

Obviously, as one approaches the desired crystal frequencies, the grinding has to be done slowly and patiently. If one goes slightly too far in the grinding process, the crystal frequency can be lowered slightly with a very soft lead pencil. Lightly rub the surface of the crystal with the pencil and then use a soft cloth and a drop of rubbing alcohol to distribute the coating. With a bit of patience between grinding times and possible corrections, one can easily come "right on" with regard to frequency.

Although the acid approach is not really recommended, those amateurs who have access to the chemicals required and who can be careful in their application may want to try it. If so, one should use an ammonium biflouride solution diluted with two parts of water. The crystal is simply placed in the solution (using a small pair of tweezers) for 30 to 60 seconds at a time, removed and rinsed with water, and dried. The crystal frequency is checked and the process repeated as many times as necessary. The whole process is quite easy, but it must be emphasized that the chemical solution is very corrosive and must be used *and* disposed of carefully. ■

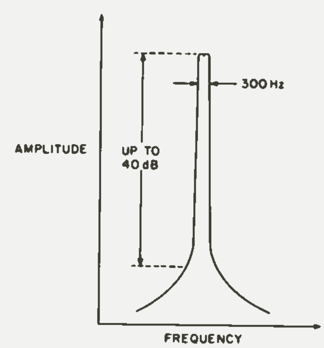


Fig. 2. A typical response one could expect from the crystal filter circuit shown in Fig. 1. In this case, it would be for a two-crystal circuit with the crystals' frequencies (series-resonant frequencies) separated by about 300 Hz.

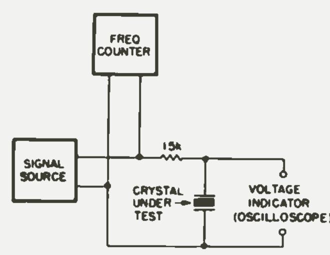


Fig. 3. A test setup for measuring the series-resonant frequency of a crystal. Capacitance effects across the crystal must be avoided, so short leads which go directly to the plates of the oscilloscope must be used. A suitable low-capacitance probe may also be used with the oscilloscope or a suitable VTVM.

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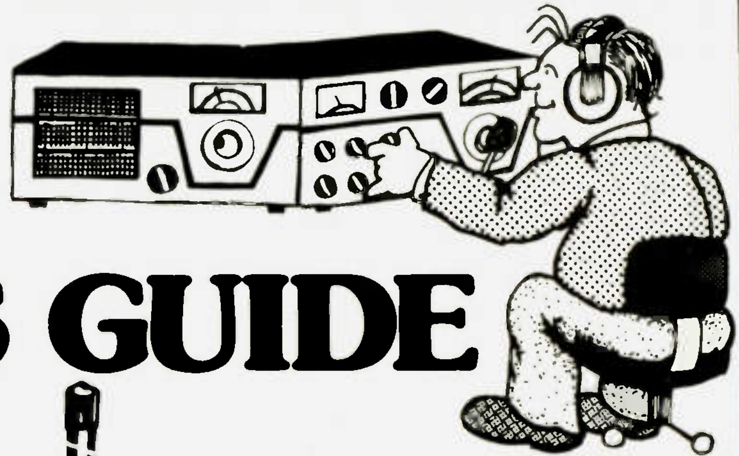

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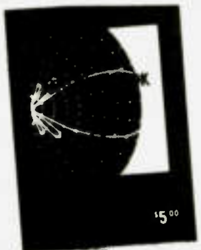

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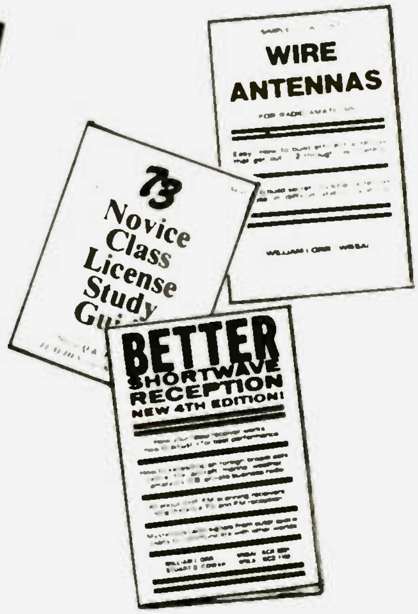

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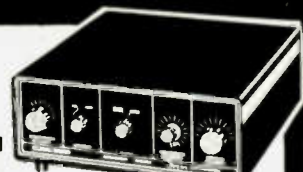

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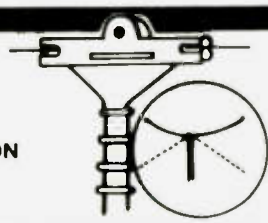

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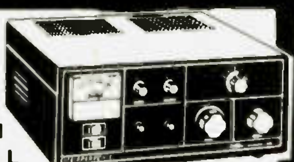

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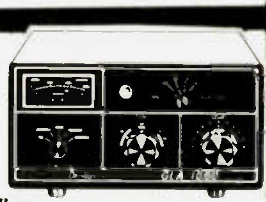

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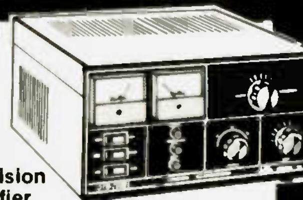

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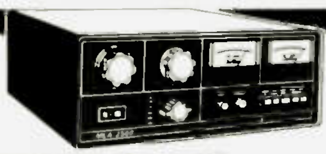

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100W	100H	100A	100C	100D	100E
250W	250H	250A	250C	250D	250E
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The Procrastinator's Special: A Simple Six-Band Antenna

—this 10-160 endfed vee goes up in a jiffy

There is really nothing new about this type of antenna, but I'm *using* it as an inverted vee. Many years ago it was called a Fuchs antenna (pronounced "Fooks"), but it's easy to see why that name didn't stick. Later on, it was (and is) variously called an endfed Hertz, a directly-fed, self-fed, voltage-fed, straight-wire, or random-length antenna. That last name is applicable only when you really don't know or care what length it is.

Pre-TV, some of the more daring hams would simply clip one end of the antenna to the hot end of the final amplifier tank coil at a point where the final loaded up reasonably well, and they were on the air—never mind the harmonics and parasitics. Using a capacitor at the tank circuit, in series with the aerial, kept anyone who might touch the wire from getting fatally zapped with dc, so the more prudent operators opted for that approach.

Later on, things became more sophisticated and, in the late 1930s, something known as the Universal Antenna Coupler was developed. This enabled link-coupling of an antenna to the amplifier, thus eliminating the dc shock hazard and minimizing spurious radiations.

The ARRL *Antenna Manual*, in its 1949 Fifth Edition, called antennas without feedlines "... the simplest and probably least effective multiband antenna." Untrue. Simple, yes. Ineffective, no.

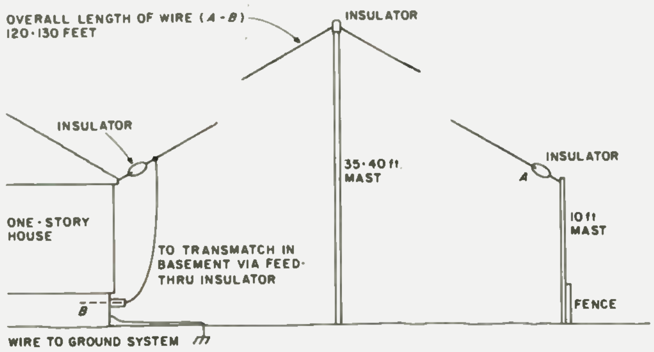


Fig. 1. Directly-fed inverted vee antenna, as installed at W6TKA/Ø. Layout and dimensions can be varied somewhat to suit individual installation requirements.

Those graybeards among you who can remember back to over 20 years ago may recall an article written by me and published in the February, 1956, issue of CQ under the title, "The Drooping Doublet." To the best of my knowledge and research, that was the first article to appear in an amateur publication pertaining to what we call today the inverted vee. That antenna, as was the one I am about to describe, evolved out of necessity.

After many years of using the inverted vee—usually fed, in my operations, with open-wire feeders (or tuned, as many call them)—I found myself in a situation where it just was not too convenient to bring the feedline from a centerfed antenna into the radio room. Having moved from California to Missouri, I now had more land but the shape of my God's Little Half Acre meant that the optimum means of feeding the inverted vee was at one end. What to do? No problem. The ham shack was now in the basement, so I planted my 40-foot telescoping TV pole out in the middle of the backyard, attached an insulator to the top, ran approximately 130 feet of wire through the insulator, hoisted up the mast, and guyed it.

I then extended half of the wire out to a 10-foot pole (which I no longer needed for not-touching-things-with) which was located at the rear fence and attached it with a large insulator. The other end of the wire drooped nicely down to the eaves of the house, where I anchored it with another insulator and then brought it in through an access hole in the wood just above the concrete basement wall. Inside it was attached to a transmatch with, of course, coaxial cable running from there to my transceiver or amplifier.

Having gotten you thoroughly enthused about this miracle of modern science, I must inject a note of caution: A good ground system is most helpful when using this antenna. Even if you have only a small backyard, the antenna and ground system are still feasible. Among other things, I used a large quantity of #18 copper wire (copperclad steel or aluminum electric-fence wire is cheap and comes in rolls ranging from small to huge) and simply sliced the lawn with—now, don't laugh—a pizza-cutting wheel, poked the wire about an inch into the soil with a large screwdriver, then stomped the grass back in place. No one could tell where I had buried wires.

Somewhat like a groundplane antenna, the ground system forms a reflecting, conductive plane—the other half of the antenna system, as it were. This is especially important on 160 meters, where the directly-fed inverted vee functions as a quarter-wave or slightly longer radiator.

A good ground helps on all bands to prevent "rf from floating around the shack," as the old expression goes. And it makes quite a difference in the kind of signal others, at distant places, hear from your station. Here in this part of Missouri, soil conductivity is pretty good, according to a soil conductivity map issued by the FCC for use by broadcast stations. To make sure I had the best possible ground, I got a half dozen five-foot ground rods (they really should have been eight feet long), spotted them at various places around the 100- x 100-foot backyard, and wired them together with #12 copper wire. Tied to all of this is the #18 wire I mentioned earlier and the radial system employed for my allband vertical (that antenna is yet another story). From this conglomeration, a couple of stout copper wires run to a chain-link fence which borders the back of my lot (plus several other lots) and is about 600 feet in total length. All ground rod and wire connections were carefully spliced and soldered. (See Fig. 2.)

This antenna was put up in something of a hurry in the fall of 1977, just before the weather turned nasty. My main concern was to have an allband radiator up for the winter; a classy, super-efficient installation was secondary to me at that time. But, to my surprise, the thing seems to radiate as well as any inverted vee I have ever used and is still in use with only minor modifications.

I have three home-built transmatches, so I use one on 160 meters, another on 80/75, and the third on 40 through 10. (See Fig. 3.) One transmatch might work as well if you don't mind retuning it each time you change bands. The transmatches are separated from the radio room by a wall and are located in the unfinished furnace area of the basement. A remote meter on the swr meter and a remote transmitter keying circuit enable me to adjust the transmatches from the furnace room without having to be in two places at once.

Just in case you happen to be curious about the resonant frequency of your directly-fed inverted vee, here's a hint that may help you. Just on a hunch, I connected the center conductor of the RG-8/A coax running from my Kenwood TS-820S to the end of the vee and the shield to the ground system. Switching the transceiver to 160 meters and placing it in the "tune" mode (about 10 Watts of output), I carefully tuned the band for a dip in reflected power. Minimum swr occurred at 1.810 MHz. The swr was about 2.0:1, but it was a pronounced dip, so I knew the antenna was quarter-wave resonant at that frequency. Some simple calculations (234/f) told me that the antenna was—electrically, anyway—just over 129 feet long—a quarter wavelength at 1.810 MHz. It is a bit long for 75 meters, representing a half wavelength at 3.610 MHz. It is a full wavelength at 7.220 MHz, two wavelengths at 14.440, three wavelengths at 21.660, and four wavelengths at 28.880 MHz. It provides some gain in those bands over the basic half-wave antenna. Obviously, the antenna presents a variety of input impedances, and hence the need for an antenna tuner (or transmatch) to match the transmitter to the antenna.

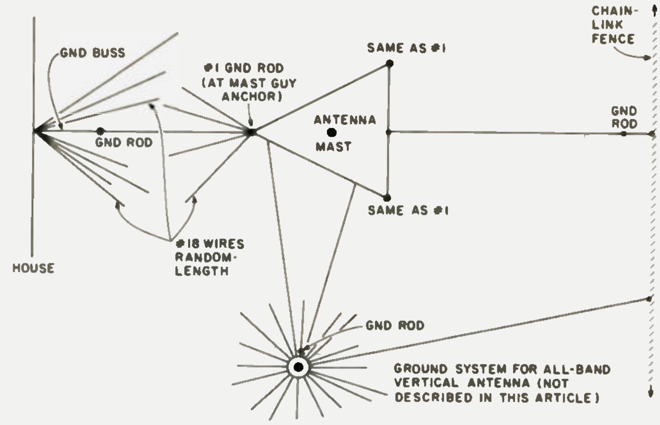


Fig. 2. Ground system in use with directly-fed inverted vee at W6TKA/Ø, shown only as an example of how an efficient ground system can be installed. Many variations are possible and acceptable. (The vertical antenna shown is not described in the article—it is included only to illustrate the total ground system being used.) Both hot and cold water pipes in the basement also are included in the ground system.

I've been very pleased with the results this antenna has provided on all bands, especially 160, 75, and 40 meters. I feel that it is a much more versatile system than a conventional single band, coaxial-fed inverted vee. Advantages include the convenience of allband operation, no cost for feedline, and no worry about where to run the feedline to keep it from getting too close to the antenna or other structures. It seems to work as well as any inverted vee I have used in the past twenty-five years. It is inexpensive, and you can put it up in a few hours. ■

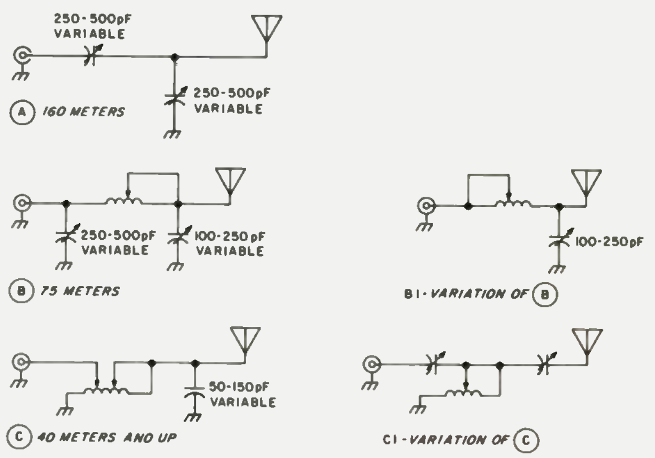


Fig. 3. These transmatch circuits, or other variations of pi, pi L, L, T, et cetera, can be used with the directly-fed inverted vee antenna.

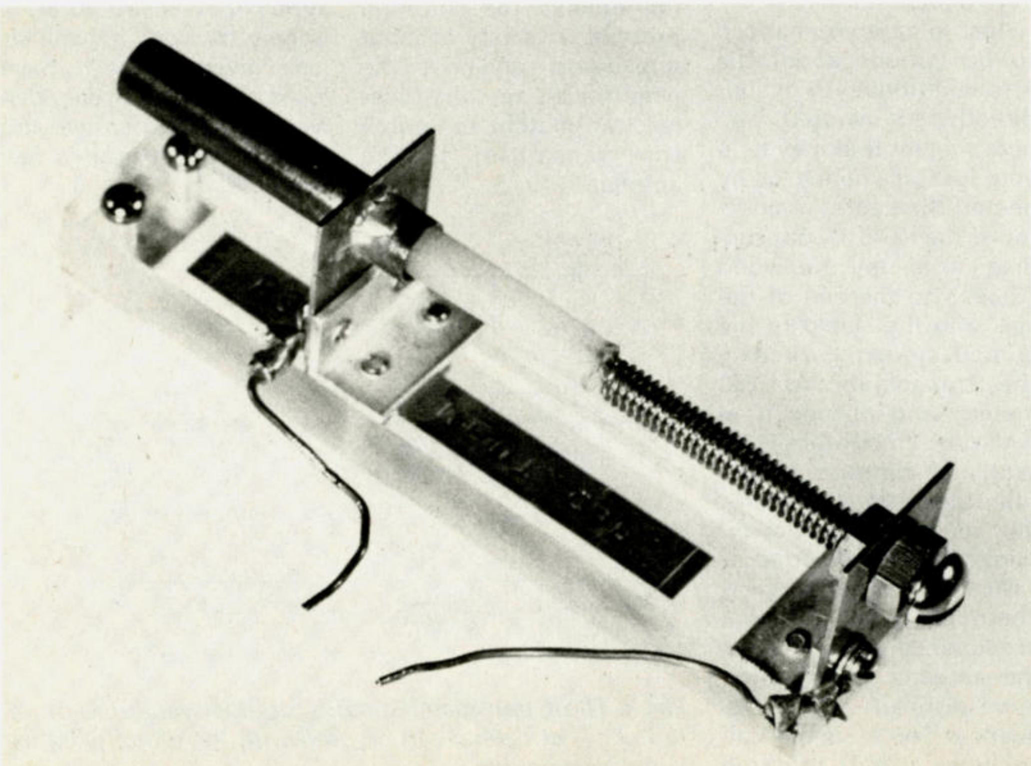
They Don't Make 'Em Like They Used To

—home-brewing a hard-to-find neutralizing cap

Neil Johnson W2OLU
30 Harwich Road
South Orleans MA 02662

My old amplifier was getting tired; it had a bad case of flat feet, low emission . . . or something. So I accumulated all the parts for a new PA. Parts were all ready to go, except for the neutralizing capacitor. So, down to the big city. Big Apple, maybe, but big parts supplier, no.

The first clerk just did not understand what a neutralizing capacitor was. The next guy looked at me as if I had been recently turned loose from the funny farm. Finally, I made it to a shop where they once sold such items . . . only they hadn't seen any for years. I refused to be insulted for a fourth time and returned home to reconsider.



Why not roll my own? I pondered this. Old-timers used to do it . . . but now? As you know, there are two main classes of so-called neutralizing capacitors. The first type has half-round plates, the same as an ordinary variable capacitor, and the second utilizes a plunger-type of mechanism. Some of the older handbooks show examples of the first type, but I have yet to see home-brew examples of the in-and-out style.

Even so, I chose the second type. This construction roughly follows the capacitors developed by Millen, except that solid dielectric is used. This makes for a more compact design. A second advantage lies in the fact that the screw-in type of construction allows for easier calibration, if such be desired. Finally, the procurement problem is easily overcome. Please don't laugh at that last item. The final design allows for anyone, anywhere, to make such a capacitor—even those hams in far-off lands. All that is needed are a brass nut and bolt, a few pieces of scrap metal, and a small piece of lucite or similar insulation approximately 5 inches long.

The materials list for the prototype follows:

1 base or plastic support form, 1″ x ½″ x 5″;

3 pieces, right-angle dural or brass, ½″ x ½″ x 1/16″, 1 inch long;

6 5/8″ 6-32 nickel-plated brass screws, with copper lox;

4 ¼″ 6-32 nickel-plated brass screws, with copper lox;

1 brass bolt 2″ long (US ¼-20 thread or similar);

2 brass nuts, to match above screw;

2 pieces of brass (or copper) 1″ x 1″ x .050″ thick;

1 piece of copper tubing, 2″ long x ¼″ inside diameter.

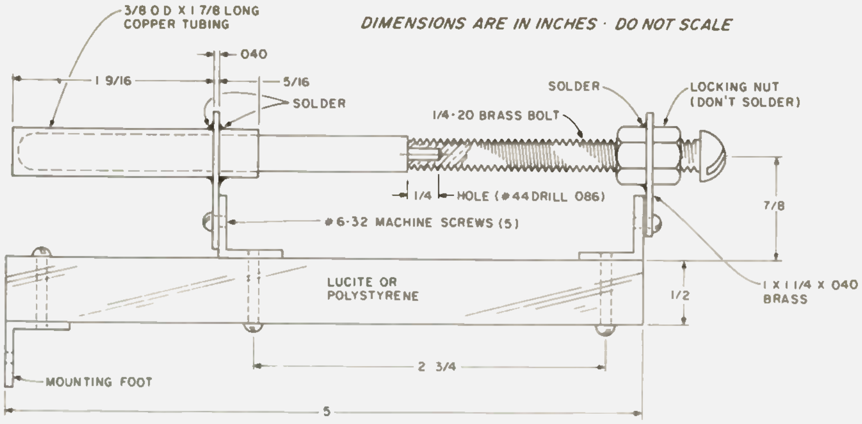


Fig. 1. Neutralizing capacitor.

You can see that all the conductive parts should be made from brass, copper, or aluminum. Certain parts should be made only from brass or copper, since they require soldering. Oh, yes—I almost forgot! You will require a short piece of RG-8/U coaxial cable, about 3 inches long, for the rotor.

It is well to remember that all of the soldered pieces must be finished before assembly to the plastic base, which melts easily. You will be best served if you stick to the following schedule of assembly:

(1) Cut the base section to size—5 inches, suggested minimum.

(2) Cut the 2 pieces of right-angle material to size, then drill and tap to meet with the base and the brass 1″ x 1″ pieces.

(3) Drill holes through the plastic base to allow 3 right-angle brackets to be mounted.

(4) Drill 3 holes in the brass 1″ x 1″ pieces: two holes to meet with the holes in the right-angle pieces, and one hole to accept inserts (which are soldered in later).

(5) Carefully enlarge one hole to accept copper tubing. Solder it in (at right angles) with about 5/16 inch protruding from one end.

(6) Solder one brass nut to the proper spot on the other 1″ x 1″ piece of brass.

(7) Remove ¼ inch of insulation from a 3-inch piece of inner section of RG-8/U coaxial cable.

(8) Drill a small hole in the center of the brass screw, ¼″ deep at most.

(9) Join the brass bolt and the brass nut to one brass 1″ x 1″ plate.

(10) Carefully insert and solder the exposed copper wire from RG-8/U cable into the small hole in the brass screw.

(11) The balance of construction follows. Just use common sense.

Your finished capacitor will have a capacity of 3.65 pF minimum up to 6.9 pF, a difference of 3.27 pF. These are actual figures. Capacity changes, per turn, are essentially linear. This may suggest its use as a tuning capacitor with very small changes in capacity for each complete turn of the feed screw. Capacity change was 0.103 pF for each turn.

Voltage breakdown? Forget it. A pal of mine fanned back the braid one foot from each end of a sample of RG-8 cable and then applied a test voltage of 100 kV with no ill effects. Personally, I helped to install a section of RG-8 cable between the power supply and the visual amplifier of a commercial TV rig. It's still working OK 10 years later, without a whimper, at 6500 volts.

So, try your hand at making such a capacitor, whether it be for neutralizing or for some other purpose, perhaps as a high-precision vernier capacitor having a small change of capacitance for each turn—approximately 0.103 pF. And please remember: All metal should be nonferrous. ■

The Europa-B Two Meter Transverter

—work OSCAR and 2m SSB with this British import

Joe Kasser G3ZCZ
11532 Stewart Lane
Silver Spring MD 20910

What is smaller than a six pack, will put you on two meter sideband or on OSCAR, and is not made in the USA? The answer is, of course, the British-made Europa-B two meter transverter. This unit converts both received and transmitted signals on ten meters to the two meter band, with enough power to work both OSCAR 7 and OSCAR 8. You can also use it to work up to about 200 miles or so direct, using FM, AM, SSB, RTTY, CW, or any mode that you have an exciter for on ten meters.

The Europa-B comes in a package only nine inches wide, four and three-quarters inches high, and four and a half inches deep. It comes complete with a power cable for the Yaesu FT-101, FT-200, FT-277, or FT-250. It can be used with any rig having a 12-volt heater chain. A transformer is available for rigs with a 6.3-volt heater chain. In fact, a whole power supply in a package the same size as the Europa-B is also available, but it is not included in this review.

The Europa-B two meter transverter.

Construction

The receive side of the Europa-B is all solid state. There is a dual-gate MOSFET rf stage followed by a dual-gate MOSFET mixer. The converter is specified as having a noise figure of 2 dB and a gain of 30 dB.

The transmit side uses tubes. A maximum of 200 mW of ten meter drive is applied to a 6360 mixer. The resultant two meter energy is amplified by a second 6360 used as a driver for the final (which is a 5894). The final amplifier runs at about 200 Watts input and is specified as being at least 50% efficient. This is more than enough signal output to work through both the OSCAR spacecraft.

The selectivity of the tuned circuits is such that both the mixer and the driver plate circuits need tuning when a change of frequency of more than about 100 kHz takes place. The whole tuning operation takes about five seconds and is no bother to do. The narrow passband also acts to suppress unwanted mixer products.

The unit is well built. A double-sided printed circuit board is used as a chassis for both the transmit and receive converters, keeping the rig nice and small.

The ON/OFF switch is wired such that when the switch is in the ON position, the unit is powered and the heater chain to the exciter finals is broken. Putting the switch in the OFF position removes the 12 volts from the Europa and reconnects the heater chain to the finals of the exciter. This feature allows the exciter to be used on both HF and VHF without having to remove the power cord to the transverter. An accessory socket is provided on the rear of the Europa-B to supply voltages for a preamp or an rf relay for automatic switching of the rf input to the exciter between HF and VHF.

The manual supplied with the Europa explains the operation of the unit and is well written in a straightforward manner. It is also written in English. A schematic is supplied, as are operating voltages, in the event that troubleshooting is required. In fact, the operation of the unit is so straightforward that it can and was put on the air without reference to the manual.

Bad Points

The only undesirable features that I have found with the unit are that it gets very hot in use, and there is no way of removing power from the tube filaments when I want to use it in the receive-only mode. These features can and will be cured by fitting a fan to the top of the unit. A suitable one is that supplied by Yaesu for the FT-101. A small toggle switch can also be fitted to disconnect the tube heaters when required.

Results In Use

On opening the package that arrived by mail, I found that although the Europa is advertised as coming with all cables necessary to put it on the air with an FT-101, that only applies to dc power. There were no rf cables included in the package. The Europa-B uses British television-type coax connectors for the receiver output and transmitter input cables. These are commonly known as Belling-Lee connectors after a well-known manufacturer. As I didn't have any of these connectors, I was stuck. As luck would have it, a local friend did have some of them. Two nights later, the Europa-B was on the air driven by my FT-101.

I worked a couple of stations via OSCAR 6 and OSCAR 7 using a dipole mounted on my balcony. Then, after that, I tuned down to the low end of two to see what was doing there. At about 144.1 MHz, I heard a weak station in QSO. Choosing my moment, I gave him a quick call. He acknowledged my break (the G3 gets them every time) and told me that I was "lots of dB over nine." I could hardly hear him.

Further investigations showed that I was copying signals even though I had a dead MOSFET in the rf stage of the converter. I replaced it with a ubiquitous 40673. Now received signals were much louder and I was able to give out reports of the same order as I was getting. I compared the converter to my "Rochester" one and found that signals were slightly better on the Europa-B. The OSCAR 7B downlink is also pretty good. Later that evening, using only the dipole on the balcony, I worked SSB stations in New Jersey, Maryland, and Pennsylvania, receiving excellent audio reports.

How To Get One

The Europa-B is not readily available over the counter in the USA. It may be ordered by mail from the manufacturer in England and paid for by means of your VISA card, just as if you were ordering the unit by mail from a dealer in the USA. I ordered my unit in this manner and it came within ten days.

The price of the Europa-B is £87.50 complete or £75.00 without the tubes. It is sold without the tubes to let long-time VHF nuts who already have a supply of these tubes (6360s and 5894s, or QQV-03-10s and QQV-06-40s as they are called over there) to upgrade to the Europa-B at a minimum of expense. At the time of this writing, the British pound is worth about $2.00 and is rising. The cost for air parcel post is £7, and US customs will want a few dollars. The postman will collect their share COD.

The Europa-B may be ordered from Solid State Modules, 63 Woodland Road, Solid, Lockwood, Huddersfield, England.

The Europa-B is in use all over the world. In some places, the receive section is never used because there is only one active station on two meters and he is working OSCAR. It is about time that this fine piece of equipment was available and used in the USA. ■

Neil Johnson W2OLU
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So. Orleans MA 02662

Zero In on Zero Beat

— an easy-to-make vernier for your tube-type oscillator

The recent article[1] in *73,* with respect to high-accuracy frequency measurements, brought to mind a method developed at W2OLU which is mechanical and somewhat simpler than the CRO technique. While the frequency standard described here is a tube-type affair, the precepts to be outlined apply equally well to all configurations, whether vacuum tubes, transistors, or integrated circuitry.

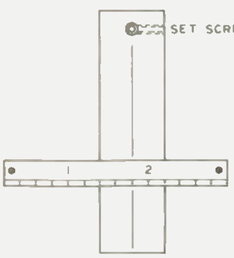

Fig. 1. Actual size of plastic arm in prototype is 5/8" wide, 1/4" thick, and 4" long.

A relatively small trimmer capacitor with a shaft is used for the purpose of "zeroing in" the local crystal-controlled oscillator with respect to the WWV emissions. Since the human ear is unable to respond to audio tones lower than 30 Hertz, we must conclude that there is a no-man's-land, so to speak, of some 60 Hertz. To obtain higher accuracy with respect to true zero beat, some method must be employed to attain this end. Most methods to obtain this require additional apparatus.

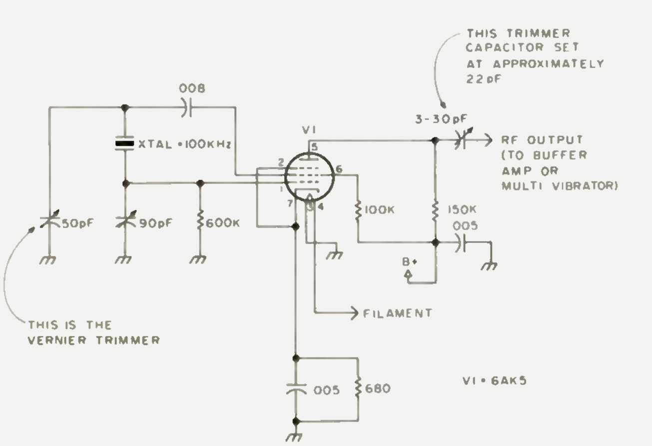

Fig. 2. Circuit of W2OLU, a crystal oscillator with vernier control for frequency variation.

The relatively simple solution outlined will not completely satisfy all purists, but it should enable any home brew artist to improve frequency measurements by several orders of accuracy. Furthermore, it does not require any additions or modifications to existing circuitry.

The shaft of the variable capacitor, having to do with shifting the crystal oscillator frequency, is fitted with a fairly long arm made from some kind of clear plastic. Near one end, a small hole is drilled. In our particular case, this was ¼ inch in diameter in order to fit the shaft of the trimmer condenser involved. Adjacent thereto, at right angles, a small hole is drilled so that a set screw may be installed. Kindly note that this hole must be drilled undersized, and subsequently threaded for the set screw. In our case, a 6/32 screw was used for this purpose.

Next, I scribed a straight line down the middle of the plastic arm. This may be lightly inked in order to form an indicator, or "cursor." This line should appear on the lower or "chassis" side of the plastic arm, next to the fixed indicator strip. This will help to avoid parallax and results in a higher order of accuracy. See Fig. 1.

Underneath the movable arm, I mounted a short piece of ruler which is graduated in fine divisions. General Hardware No. 616 is an ideal candidate for this role. It is relatively low in cost and graduated in fractions of an inch on one side and in hundredths on the reverse. There was insufficient space on the chassis for the entire 6-inch ruler, so I chose to use the upper end of the ruler, leaving the first part, zero to 3 inches, available for other uses.

Now to put the combination to work: With both the receiver and frequency standard suitably warmed up in the interests of stability, the coarse frequency adjustment to zero beat is made, preferably with the ruler-delineated capacitor at the midpoint of the high accuracy ruler. It then becomes a simple matter to move the marker arm slowly back and forth over the ruler. If the first audible tone appears at 16 markers on one side of

what appears to be center frequency, and the opposite direction of the swing arm shows first audibility to come in at 18 units on the ruler, then by averaging the two, e.g., 16 plus 18 equals 34, which divided by two, results in 17, a very close indication of absolute zero beat is obtained. A small plastic magnifying glass, costing about half a dollar, can be mounted over the plastic arm if desired. This will enable these measurements to obtain even greater accuracy.

Several amateurs have asked me where to obtain the plastic strip which is used for the indicator arm. A thorough search of catalogs generally available to amateurs and experimenters showed nothing. The best all-around answer probably will be found in the yellow pages of your telephone directory, under the heading "Plastics—Rods, Tubes, and Sheets." Other sources might be found in the local hobby shop. Possibly the plastic might be salvaged from various items found around the home, some of them broken.

And finally, it is possible to come up with a bare-bones type of indicator arm. This can be made from a piece of wood. Additional components are simple. A 6-32 nut and bolt, a small piece of brass (or two solder lugs), and a small nail or brad, which is used for the pointer. This alternate design can be put together anywhere in the boondocks, so I have named it "The Robinson Crusoe Special."■

Reference

1. "A WWV Primer," Thurber, *73*, August, 1978, p. 84.

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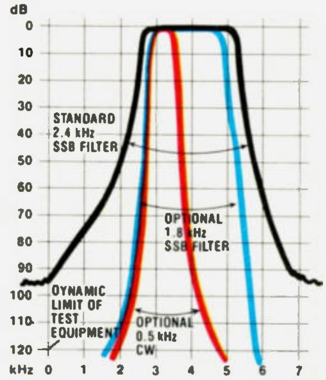

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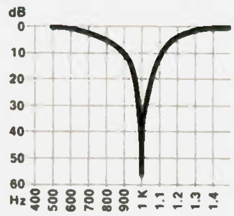

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Robert Stielau W1WRO/N2XN
20 Hillcrest Ave.
Middletown CT 06457

CB-to-10 FM

—best conversion yet?

While in the final stages of writing this article, we could just hear the moans: "Not another CB-to-10 conversion! When will it end?"

But look again; this is CB-to-10 *FM*. Why not try something different as suggested by Steve Herman WA7WYF in his article, "Try FM on 29.6 MHz?"[1] A channelized band complete with repeaters, a national calling frequency, beacons, and long-distance skip exists less than a megahertz above the proposed 10-meter CB-to-10 band.

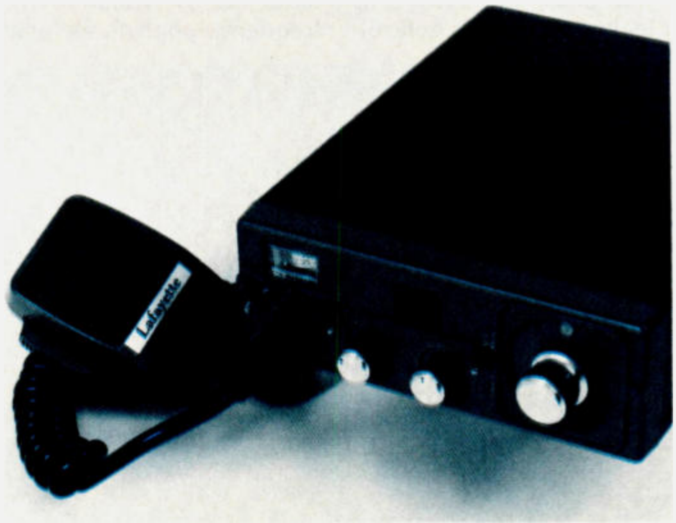
But what about equipment for 10 FM? The Yaesu FT-901D and the newly-introduced Comtronix FM-80 are the only radios available from amateur manufacturers, so the FM portion of the 10-meter band from 29.0 to 29.7 MHz has long been occupied by a few hearty individuals specializing in surplus commercial 2-way FM conversions.

Many wideband, tube-type boat anchors still live on. Within the last few years, repeaters, remote bases, and beacons have appeared as band occupancy has increased. Unfortunately, 95% of this activity has fallen on the national calling frequency at 29.6 MHz. Recently, a band plan has been generally accepted by those operating on the 10-meter FM band. The national calling frequency at 29.6 MHz is the pivotal simplex frequency. Another simplex channel at 29.5 MHz is included as a secondary direct channel, and four repeater inputs fall at 29.52, .54, .56, and .58 MHz. Their respective outputs are 100 kHz higher at 29.62, .64, .66, and .68 MHz.

You say, "Enough! I'm convinced to try 10 FM, but how do I get on the air?" Until now, the conversion of CB radios to 10-meter FM has been entirely overlooked in the haste to make rapid conversions of amplitude-modulated radios to 28.965 MHz. This article will present a simple method of converting a phase-locked loop Citizens Band radio to a state-of-the-art frequency-programmable narrowband FM transceiver having a 0.5 uV/20 dB quieting receiver and 5-Watt output power transmitter.

The units chosen for this conversion are available from several manufacturers but share the same printed circuit board. Fortunately, these radios are the $30 to $40 "loss leaders" at many discount houses. Recently, large quantities of Hy-Gain PC boards for these transceivers have come on the surplus market[2,3]. They offer all the electronics for this conversion minus front-panel controls, enclosure, microphone, and speaker. They are available in the $5-to-$15 range. A listing of the manufacturers and model numbers are included in Table 1.

Many CB conversion articles apply to early, unobtainable 23-channel



Front view of converted Lafayette rig. The CB channel switch has been replaced with a 10-position rotary. A pair of 7-segment LEDs have been added for direct frequency readout. Three toggle switches provide display on/off, simplex/repeat, and add 10-kHz to operating frequency.

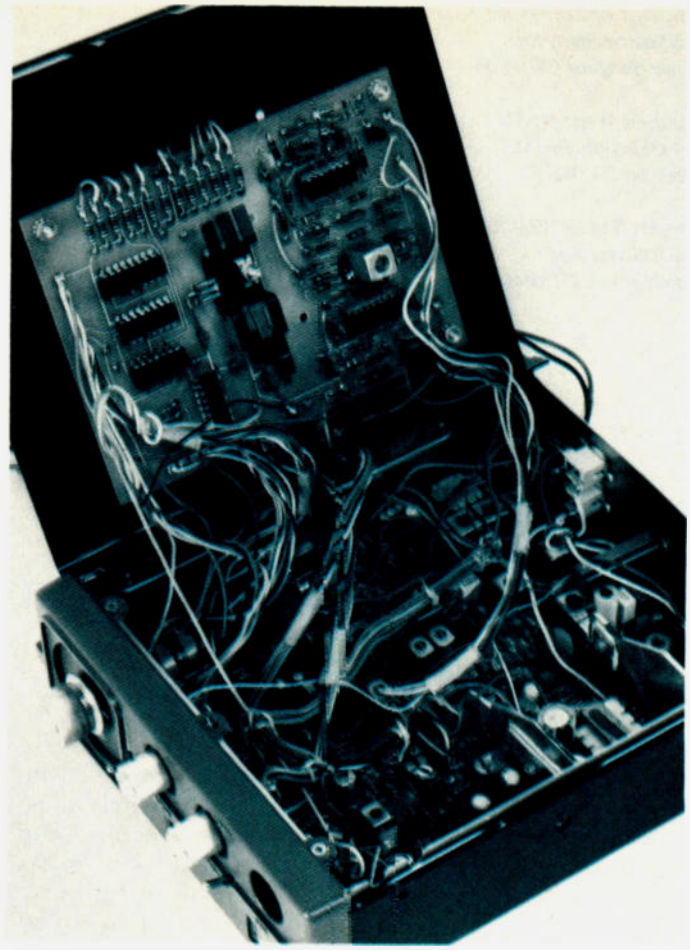
models. An advantage of this conversion is the large number of radios found available. The conversion is basically the same as described by Clay Walsh W1PI[4]. He gives an excellent set of instructions for converting these radios to AM operation. The addition of an FM discriminator and movement of a few wires to frequency-modulate the PLL oscillator are all that is needed to FM the radio.

Phase-Locked Loop Frequency Synthesizer

The following is a description for the existing Citizens Band programming. Understanding this operation is not necessary to accomplish the conversion, but may be helpful during tune-up or trouble-shooting. The heart of the CB transceiver, shown in a block diagram in Fig. 1, is the phase-locked loop frequency synthesizer or PLL. It enables precise, multiple-frequency generation and can be audio-modulated to produce high-quality FM.

The control integrated circuit (IC101) provides three functions. It contains the frequency divider for the reference oscillator, a programmable frequency divider, and the phase-sensitive detector. The three functions of the chip operate as follows. The 10.24-MHz signal from oscillator #3, the reference oscillator, is divided by 1024, providing a 10-kHz reference signal to the phase detector. The programmable divide-by-N counter is programmed (in binary) by nine control lines from the front-panel channel-selector switch. Programming is accomplished by applying positive 5 V dc to the appropriate pin on IC101 through the programming switch. Pull-down resistors are provided internally in the IC to hold the inputs at a logic low level when a line from the programming switch is in an open position. The phase detector compares the outputs of the two counter channels and provides a dc output which is proportional to the phase difference of the digital input signals. The phase detector is analogous to a frequency discriminator in an analog circuit.

During start-up operation of the PLL Q101, the voltage-controlled oscillator (vco), is running at some non-phase-locked frequency in the 40-MHz region. This signal is mixed with the 37.955-MHz from oscillator #1 at Q102 (mixer #1). The difference frequency (approximately 2 MHz) is low-pass filtered and amplified to logic levels by the Q103 stage. The 2-MHz signal is applied to the input of the divide-by-N counter at pin 6 of PLL02A (IC101). The frequency is counted down by the programmed divide-by-N ratio, and the output of this counter is fed to the internal phase detector. This counted-down signal is compared in frequency and phase with the 10-kHz reference signal. If the two signals are not coincident, a dc error signal is generated at pin 5 of IC101 by the phase detector. This error signal will force the vco to the correct frequency. The dc signal is filtered by a passive, low-pass filter section to remove the 10-kHz component on the output of the phase detector. Any rf leakage on the dc control voltage would show up as sidebands on the carrier. This dc error, plus an offset voltage, is applied as reverse bias to the varactor diode, D101, which is the frequency-control element



Lafayette rig with bottom cover removed to show printed circuit board mounted. The speaker has been removed to make room.

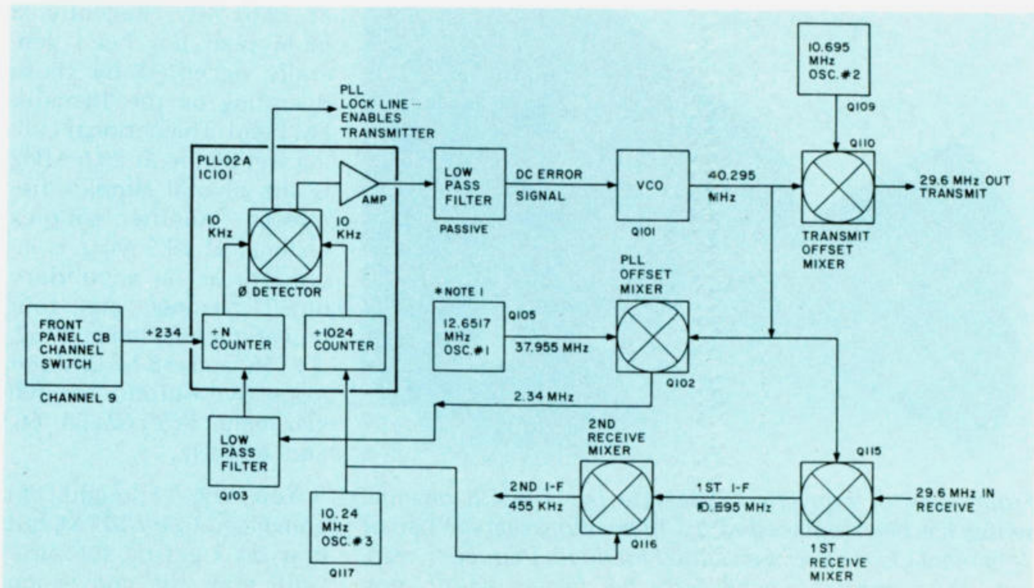


Fig. 1. FM frequency generation block diagram.


MERRY
CHRISTMAS
from
DSI
5500
LC 5000
100 HH
500 HH
5600 A

of the voltage-controlled oscillator. Transformer T101 makes up the inductive part of the vco parallel-resonant circuit and provides coupling of the vco signal to the rest of the transceiver. T101 is adjusted to keep the tuning voltage on the varactor diode, as measured at TP8, in the 1.5-to-3.5-volt range across the operating band of interest. If the voltage swings beyond these limits, the vco will latch, causing the PLL to lose lock, which also disables the transmitter to prevent out-of-band transmissions.

Transceiver Description

The transceiver has been designed to obtain maximum performance at minimum cost. Fig. 1 shows the frequency-generation schemes for the transmitter and the two receiver local oscillators. An operating frequency of 29.6 MHz is shown for the example. The existing 11.8066-MHz crystal at oscillator #1 has been replaced with one at 12.65167 MHz. The front-panel channel selector switch is set at channel 9. The output of the voltage-controlled oscillator in the PLL is at 40.295 MHz. The programming switch has a divide-by ratio of 234 entered to the PLL control, IC101. During transmit, the output of the synthesizer is mixed with a 10.695-MHz signal from oscillator #2 (Q109). The difference frequency is 29.6 MHz. The transmitter is enabled by the PLL "locked" output and keyed by a switch on the microphone. High-level amplitude modulation is applied from the integrated circuit audio amplifier to the driver and final transmitter transistors. The transmitter has four gain stages and is capable of a power output in excess of 5 Watts into a 50-Ohm load.

The receiver is a dual-conversion superheterodyne with intermediate frequencies of 10.695 MHz and 455 kHz. The received signal at 29.6 MHz is mixed with the frequency-synthesizer output of 40.295 MHz at Q115, the first mixer, to give a difference frequency of 10.695 MHz, the first i-f. The output of this stage is filtered to remove the unwanted sideband and applied to mixer #2, Q116, along with the 10.24-MHz signal from oscillator #3 which was previously mentioned in the phase-locked loop description. The difference frequency is 455 kHz, the second i-f, which is amplified and diode-detected. The detected output is fed to the same audio amplifier used for transmitter modulation, but now the output is coupled to a loudspeaker.

There are many accessory functions in these transceivers, such as squelch, noise limiter, noise blanker, rf gain controls, delta tune, and others. All units, no matter who the manufacturer or what the level of sophistication is, can be updated to include these functions. All the printed circuit boards are identical, so the added functions can be wired into existing holes on the boards and interfaced to the appropriate switches and potentiometers on the front panel. In FM operation, the only two controls

Parts List—Synthesizer Programmer

Item	Description
C1	0.01-uF disc ceramic
C2, 3	15-uF, 35 V dc tantalum, Mallory TDC156MO35GL or equivalent
D1	1N270 germanium diode
Dis. 1, 2	7-segment common-cathode LED readout
IC1	74LS147 TTL 10-line-to-BCD decoder
IC2	74LS04 TTL hex inverter
IC3	74185 TTL binary-to-BCD decoder
IC4	74LS48 TTL BCD-to-7-segment decoder
IC5	7805 3-pin monolithic, 5-V dc voltage regulator with small heat sink
R1-13	470-Ohm, ¼-Watt composition resistor
R14	10-Ohm, 1-Watt composition resistor
R15	1k-Ohm, ¼-Watt composition resistor
R16	1.5k-Ohm, ¼-Watt composition resistor
S1	2-pole, 2-deck, 10-position rotary switch, Grayhill 44D36-02-2-AJN or equivalent (Rotate rear deck to facilitate wiring.)
S2-5	Miniature SPDT toggle switch, Alco MST-105D or equivalent

Parts List—455-kHz FM i-f strip

Item	Description
C1	15-uF, 35 V dc tantalum, Mallory TDC156MO35GL or equivalent
C2-5	0.47-uF monolithic, Centralab CY20C474M or equivalent
C6	0.01-0.02 uF disc ceramic, selected for proper squelch action
C7	As required to resonate T1 to 455 kHz
C8	22-pF disc ceramic
C9, 10	0.001-uF ceramic
C11	0.005-uF disc ceramic
C12-19	0.01-uF disc ceramic
C20	0.02-uF disc ceramic
C21	0.1-uF disc ceramic
D1, 2	1N270 germanium signal diode
IC1	LM3065 (National) limiter/discriminator, or MC1358P (Motorola) limiter/discriminator, or C6063 (HEP) limiter/discriminator
IC2	MC3403 (Motorola) quad op amp, or SK3594 (RCA) quad op amp, or C6129P (HEP) quad op amp
Q1	2N3904 transistor or equivalent NPN switching type
R1	51-Ohm, ½-Watt composition
R2, 3	560-Ohm, ¼-Watt composition
R4	1.8k-Ohm, ¼-Watt composition
R5-8	2.2k-Ohm, ¼-Watt composition
R9	4.7k-Ohm, ¼-Watt composition
R10	8.2k-Ohm, ¼-Watt composition
R11, 12	12k-Ohm, ¼-Watt composition
R13	15k-Ohm, ¼-Watt composition
R14	39k-Ohm, ¼-Watt composition
R15	100k-Ohm, ¼-Watt composition
R16	1 megohm, ¼-Watt composition
T1	455-kHz miniature i-f transformer

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FACTORY WIRED 500 MHz • 1 PPM TCXO • 8 DIGITS

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FREQUENCY COUNTER STRAIGHT TALK

There are only three functional requirements for a frequency counter: 1. Good accuracy over temperature 2. Resolution 3. Sensitivity

Good accuracy over temperature. Crystal oscillators drift with temperature changes. This change is specified in parts per million (PPM). The 5500 TCXO (temperature compensated crystal oscillator) holds an accuracy of 1 PPM from 17° to 40°C. This corresponds to ± 450 Hz at 450 MHz. Counters with 2 PPM accuracy would read to ± 900 Hz at 450 MHz. Counters with 10 PPM accuracy would read to ± 4500 Hz and so on.

Resolution. What is the value of the least significant digit displayed? A counter with 10 Hz resolution would display 146.52000 MHz as 146.52000 i.e. with the last digit left off. A counter with 100 Hz resolution would display 146.5200. The 5500 with *8 Digits* is capable of resolving 1 Hz from 50 Hz to 50 MHz and 10 Hz from 50 MHz to 500 MHz. Counters with only 7 digits usually can only resolve 10 Hz to 50 MHz and 100 Hz to 500 MHz. The above effects, accuracy and resolution are cumulative. Example: a seven-digit counter with 1.5 PPM accuracy reading 450 MHz would only be accurate to ± 675 Hz ±100 Hz (last digit error) or ± 775 Hz. The 5500 with eight full digits and 1 PPM accuracy would be accurate to ± 450 Hz ± 10 Hz (last digit error) or ± 460 Hz maximum. Not bad for $99.95. You really need that eighth digit to achieve real accuracy.

Sensitivity. The 5500 requires only 10-15 mv of signal to stabilize and achieve an accurate reading. A one watt hand-held can be read with accuracy at a distance of 15-20 ft. from the counter using the T600 antenna. Counters with 150 mv sensitivity will only stabilize at distances of less than a foot.

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Model	Price	Frequency Range	Accuracy Over Temperature	SENSITIVITY @ 100 Hz - 25 MHz	SENSITIVITY @ 50 - 250 MHz	SENSITIVITY @ 250 - 450 MHz	Number of Readouts	Power Requirements	Size H W D
5500	$99.95	50 Hz - 512 MHz	TCXO 1 PPM 17° - 40°C	10 - 15 MV	10 - 15 MV	15 - 50 MV	8	*115 VAC or 8.2 - 14.5 VDC	1½" x 5" x 5½"

*With AC-9 Adaptor.

5500 wired factory burned-in 1 year limited warranty. Prices and/or specifications subject to change without notice.

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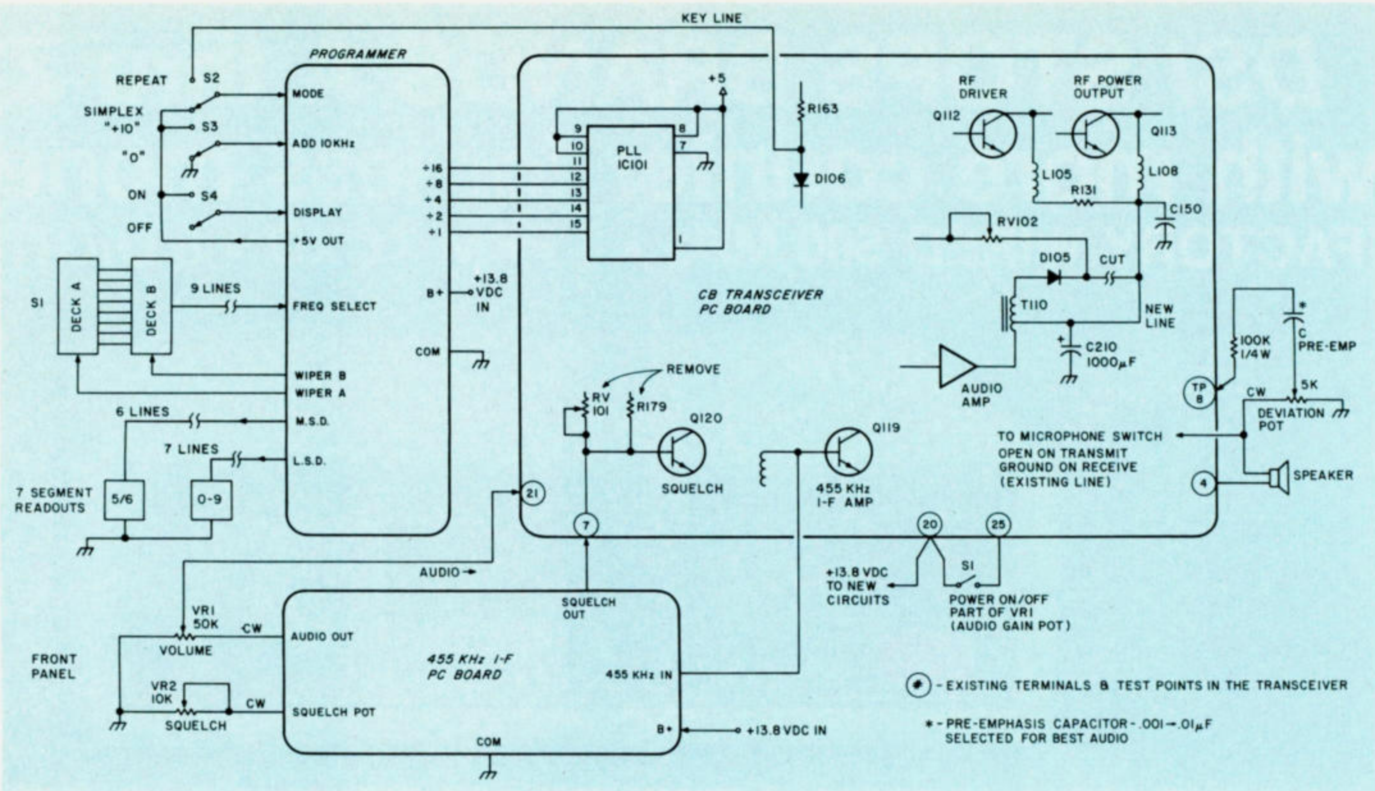

Fig. 2 Interconnection diagram.

which are useful are a noise blanker in the wide-bandwidth section of the receiver and the squelch. Unfortunately, the existing squelch is level activated. This is changed to a noise-activated circuit later in the conversion. The wisest course is to buy the cheapest models since extra features are wasted in the FM conversion.

Transceiver Conversion

The CB-to-10-meter FM conversion is only slightly more difficult than converting a CB for 10-meter AM operation and can range in complexity from a simple bare-bones modification to a deluxe treatment with digital readout and repeater capability. The conversion can be done in stages starting with the basic modification to whet your appetite and adding the additional features as time permits. A warning should be given here. As soon as you have one of these radios converted and operating on 10 FM, you may not be able to turn it off and add the remaining modifications.

Below is a list of four conversion steps with possible options. The steps will be described in detail later in the text It should be noted that all four steps must be completed, but only one option per step is required.

Conversion Steps and Options

1) Change the vco offset crystal, X101, and retune the transceiver to 10 meters.

2) Modify the transmitter for FM.

3) Modify the receiver for FM.

(a) Slope detect and use the existing level-activated squelch.
(b) Add the 455-kHz FM detector/squelch board.

4.) Select the frequency programming scheme

(a) Use the existing CB channel-selector switch.
(b) Install thumbwheel BCD programming switches.
(c) Construct the frequency-programming board without the 7-segment LED readouts.
(d) Construct the frequency-programming board with LED readouts.

The above steps are listed in the order in which the first conversion was accomplished. The transceiver was first converted to the high end of 10 meters and tuned for AM operation. The vco was then audio-modulated to produce FM in transmit. The receiver was operated with

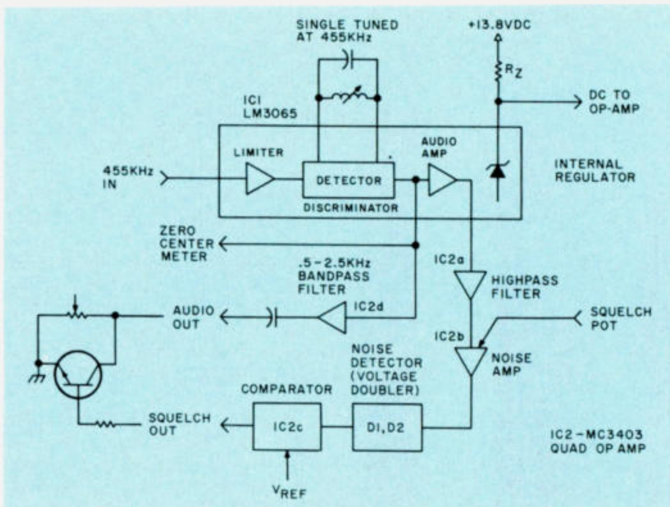

Fig. 3. Block diagram, 455 kHz limiter, discriminator, and squelch PC board.

Model	Manufacturer
2310B	Kraco
4010B	Kraco
2320B	Kraco
4020B	Kraco
Micro 223	Lafayette
HB 650	Lafayette
HB 750	Lafayette
HB 950	Lafayette
#1	Hy-Gain
#2	Hy-Gain
#9	Hy-Gain
Tiger 40A	Pierce Simpson
13-888B	Midland
13-882C	Midland

Table 1. CB transceivers suitable for this conversion.

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The Model LC 5000 is factory assembled and tested in the USA. DSI has designed in Precision Laser Trimmed Resistor Networks to provide maximum accuracy, resulting in long time periods between recalibration and a simple two adjustment calibration procedure. The LC 5000 incorporates a fused input circuit to help prevent damage to the DMM. The large .5 inch LCD Readouts are easy to read even in the brightest sunlight and allows for very low battery drain, normally only two battery changes a year is required. The LC 5000 is the perfect lab quality instrument on the bench or in the field — you can depend on DSI LC 5000 to meet all your needs. Buy Quality — Buy Performance — Buy Reliability — Buy DSI.

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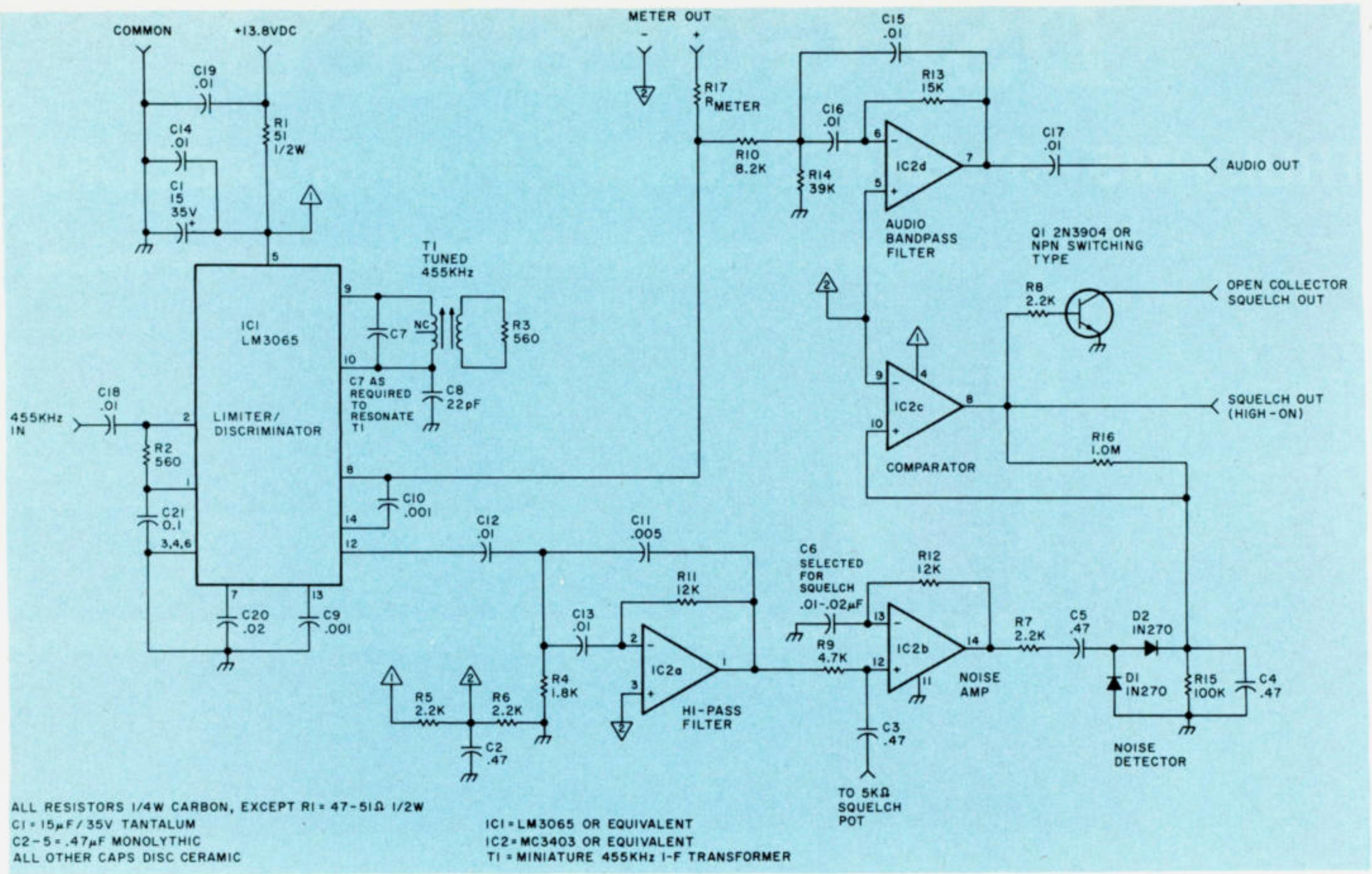

Fig. 4. 455 kHz FM i-f strip.

slope detection on receive; however, this proved to be unsatisfactory. A PC board with limiting amplifiers, FM detection, and noise-activated squelch was developed to provide improved FM reception. The final step was the evolution of frequency-programming techniques.

Step 1. Change the Vco Offset Crystal

Crystal Selection

The offset-crystal frequency is tripled and subtracted from the vco frequency. Thus, to raise the vco operating frequency, one can simply raise the offset-crystal frequency by 1/3 of the vco frequency increase desired. Looking ahead to step 4, one can see that selecting the correct offset crystal is important. If a crystal is special-ordered, 12.65167 MHz is recommended. This will permit later modifications to be made without purchasing another crystal. This crystal puts CB channel 1 on 29.5 MHz. For example, 29.5 MHz is 2.535 MHz higher than channel 1 (26.965 MHz). Thus, X101 is increased from 11.8066 MHz by 2.535 MHz divided by 3, or .845 MHz, to 12.65167 MHz. The transceiver can be operated from 29.5 (channel 1) to 29.690 (channel 16) with 29.6 MHz on channel 9 without changing the CB programming switch.

A crystal in the 37.9-MHz range can also be used for the offset crystal. A source of such crystals is older, crystal-synthesized, 23-channel CB sets. Many of them contain six crystals in the 37.6-to-37.9-MHz range. This is an inexpensive source for conversions using the existing CB channel switch.

Tune-Up

Install the new frequency-offset crystal in place of the 11.8066-MHz crystal at X101. The transceiver tune-up follows.

Vco Alignment

a) Set the frequency programmer to 29.5 MHz, or channel 1.

b) Monitor the voltage between TP8 and ground at the junction of R114 and R115.

c) Adjust T101 to obtain 1.5 volts.

d) Set the frequency programmer to 29.69 MHz (channel 16). The voltage should be approximately 3 volts.

Transmitter Alignment

a) Set the transmit frequency to 29.6 MHz.

b) Connect the output to a 5-Watt, 50-Ohm dummy load.

c) Connect an oscilloscope or receiver tuned to 29.6 MHz to the junction of T102 and C141.

d) Adjust L103, L104, and T102 for maximum signal at 29.6 MHz.

e) Monitor the signal on the base of Q112 and adjust T102 and T103 for maximum amplitude.

f) Monitor the output power for the remaining steps.

g) Adjust L106, L109, and L110 for maximum output.

h) Repeat the above, tuning for maximum power out.

i) Check output frequency and power out at 29.5 MHz and 29.69 MHz (channels 1 and 16).

j) Set the exact operating frequency by adjusting CT101, a trimmer capacitor in the offset-oscillator circuit.

Receiver Alignment

a) Set the receiver frequency to 29.6 MHz.

b) Connect a 29.6-MHz signal source to the input.

c) Adjust T104 and T105 for maximum signal.

Alignment Hints

Care should be taken in tuning these miniature transformers. Make sure you have the correct size non-metallic tuning tool and don't force them. All slugs will tune as you turn counter-clockwise out of the can. Less inductance is

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5600A-K	$149.95	50Hz-550MHz	Proportional Oven	5-10MV	5-10MV	5-50MV	9	*115 VAC or	3¼" x 9½" x 9"
5600A-W	$179.95		.2 PPM 10° - 40° C					8.2-14.5 VDC	
5500 Wired	99.95	50Hz-550MHz	TCXO 1 PPM 17° - 40°C	10-15MV	10-15MV	15-50MV	8	*115 VAC or 8.2-14.5 VDC	1½" x 5" x 5½"
500HH Wired	$149.95	50Hz-550MHz	TCXO 1 PPM 17° - 40°C	25MV	20MV	75MV	8	*115 VAC or 8.2-14.5 VDC or NICAD PAK.	1" x 3½" x 5¾"

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needed at the higher frequencies. If a slug is broken and unremovable, the i-f transformer can be unsoldered from the board and the slug removed from the bottom of the can.

Step 2. Modifying the Transmitter for FM

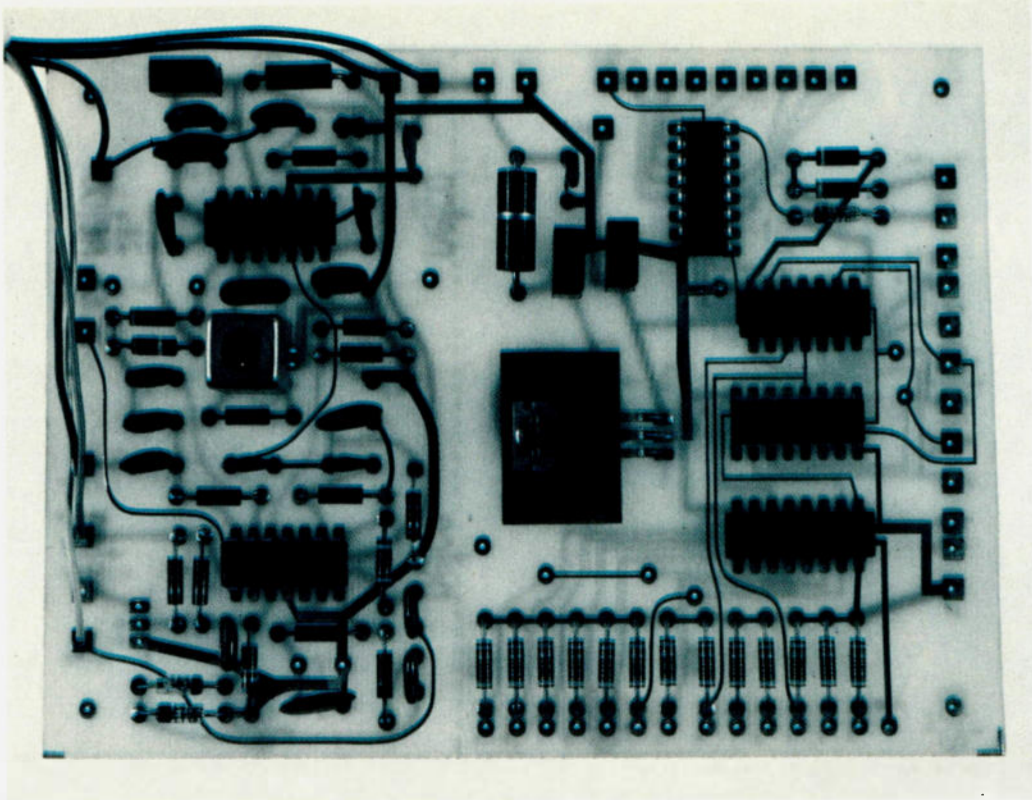
a) Disable the amplitude-modulated power-supply line that feeds the driver and rf power amplifier. This originates at D105 on the high end of the audio output transformer. Cut the circuit board conductor connecting the cathode of D105 to the junction of C150 and R131. Next, connect the junction of C150 and R131 to the positive side of C210, a 1000-uF electrolytic, to obtain pure dc for the transmitter.

b) Introduce FM to the phase-locked loop. Wire the transmit audio circuits as shown in Fig. 2, and drive TP8 which will FM the vco and likewise the output transmit frequency.

Step 3. Modifying the Receiver for FM

a) Slope detection can be accomplished by using the existing receiver delta tune which offsets the receiver frequency. The existing level squelch can also be used, but neither of these techniques can be recommended since all of the reasons for operating on FM are lost if no limiters and noise-activated squelch circuits are employed. The limiter will improve the signal-to-noise ratio and maintain constant volume. The noise-activated squelch will operate only on real signals, muting the receiver for any noise bursts which do exist on 10 meters.

b) The 455-kHz FM detector/squelch board replaces the level-activated squelch and slope detection which were not adequate for useful FM communication. To complete the FM conversion, a PC board consisting of two integrated circuits and 40 discrete components was designed to provide i-f limiting, FM discrimination, receive audio shaping, and a noise-activated squelch control output.



Top view of combination printed circuit board. The i-f strip is to the left and the frequency programmer is to the right. The board can be divided near the middle to separate functions or to make use of just one. The finished boards now have silk-screened component and lead identification.

A National LM3065 integrated circuit was used for the limiter/discriminator section of the circuit.[5] This IC was designed for 4.5-MHz TV sound service, but works well at 455 kHz for NBFM. The IC has an internal temperature-compensated voltage regulator which also is used to provide regulated dc to the remaining portions of the circuit. A Motorola MC3403 quad op amp is the second integrated circuit on the board. It is an excellent choice for this type of service since it is designed to operate from a single-ended power supply. The op amps are functionally equivalent to the standard 741 types.

The block diagram of the circuit board, Fig. 3, shows the major functions of the FM i-f strip. The schematic diagram of the circuit is Fig. 4. The 455-kHz bandpass-filtered signal from the last i-f amplifier in the receiver is applied to the input of IC1. The signal is amplified by three differential limiter stages. The 3-dB limiting point is about 200 microvolts. The FM signal is detected by the internal differential peak detector which is set to the i-f frequency by a single-tuned 455-kHz LC parallel network. Standard miniature i-f transformers were used. The secondary was resistively loaded. We obtained a bagful of transformers from Poly Paks® which were unmarked.[3] Two types were usable. The LF-115 resonates with 100 pF across the primary and the LF-116 with 220 pF. Silver-mica capacitors are recommended for temperature stability in the tuned network.

An output can be taken from this stage to drive a zero-center "frequency" meter. This is useful for netting off-frequency stations. Resistor R17 connects to the positive side of the meter. Resistors R5 and R6 provide a reference voltage at one-half the supply voltage. This point biases the negative side of the meter. The zero-frequency output of the discriminator is nominally at this potential. The meter should be a 100-0-100 uA movement. Potentiometers can be used in place of the fixed resistors to provide for gain and zero-adjust in the meter circuits.

The output of the detector is fed to section 2d of the quad op amp. This is an active bandpass filter with minus 3-dB points of 500 Hz and 2.5 kHz. The audio level at this section's output was sufficient to drive the existing audio amplifier in the CB set to full output. The output of the detector also is fed to an internal audio amplifier with 20 dB

Channel #	÷ N Ratio	Frequency (MHz)
1	224	26.965
2	225	.975
3	226	.985
4	228	27.005
5	229	.015
6	230	.025
7	231	.035
8	233	.055
9	234	.065
10	235	.075
11	236	.085
12	238	.105
13	239	.115
14	240	.125
15	241	.135
16	243	.155
17	244	.165
18	245	.175
19	246	.185
20	248	.205
21	249	.215
22	250	.225
23	253	.255
24	251	.235
25	252	.245
26	254	.265
27	255	.275
28	256	.285
29	257	.295
30	258	.305
31	259	.315
32	260	.325
33	261	.335
34	262	.345
35	263	.355
36	264	.365
37	265	.375
38	266	.385
39	267	.395
40	268	.405

Table 2. Channel number, PLL divide-by-N ratio, and original CB operating frequency using the CB programming switch. For both 23- and 40-channel models.

of gain. The output of this stage is high-pass filtered by section 2a of the quad op amp. This signal path is used to amplify the noise component of the input signal. The output of section 2a is fed to section 2b which is a noise amplifier. The input to this stage is attenuated by the squelch-level potentiometer on the front panel to provide the proper squelch level for the receiver.

The output of section 2b is fed to the noise detector consisting of diodes D1 and D2. The detector is configured as a voltage-doubler whose output is filtered by R15 and C4 which also provides a time constant to discriminate against nuisance tripping of the squelch circuit. The detected and filtered noise signal is fed to section 2c of the quad op amp to be compared with the fixed reference voltage developed across the R5-R6 voltage divider. As the receiver is quieted by an input signal, the detected-noise components level falls below the comparison level and the output of section 2d falls to ground level. The output of 2d is at nearly supply voltage when the squelch is on. The squelch action is adjusted by varying the value of C6 so a 2- to 3-microvolt signal cannot be squelched out with the squelch control pot set fully clockwise. A typical value of C6 is 0.01 uF.

The existing squelch transistor can be keyed by the new squelch line or a transistor can be switched to ground potential at the volume-control potentiometer as shown in the block diagram, Fig. 3. Individual preferences determine the placement of the squelch switch in the circuit for the best listening comfort.

To convert the receiver to FM detection, install the FM i-f strip and run 13.8 volts and common to the board. Run a lead from the base of Q119 on the main transceiver to the "IF-IN" connection on the new i-f strip. Disconnect the squelch pot from TP7 and run it to "SQ-POT" on the new pc board. Run a lead from "SQ-OUT" to TP7 on the main board. Remove the lead from the top of the volume control pot to TP19 and run the lead to the "AO" (audio out) port on the new i-f board. A zero-center microammeter can be connected between M-Plus and M-Minus on the new board to monitor the discriminator.

Step 4. Select Frequency Programmer

a) Use the existing CB channel-selection switch with no changes to the transceiver. This requires no effort at all, but has some limitations since the CB switch skips certain frequencies which may be desired. For example, if the 12.65167-MHz offset crystal were to be installed, 29.68 MHz would not be obtainable directly with the CB switch. Since no effort was required for this step, why not look to the other options for more capability.

b) Install thumbwheel, octal, or BCD programming switches. This option requires some additional construction, but permits complete frequency coverage and, with the addition of a second set of programming switches, allows multiplexing transmit and receive frequencies for repeater operation. The switches can be BCD, octal, or individual toggle switches. Fig. 5

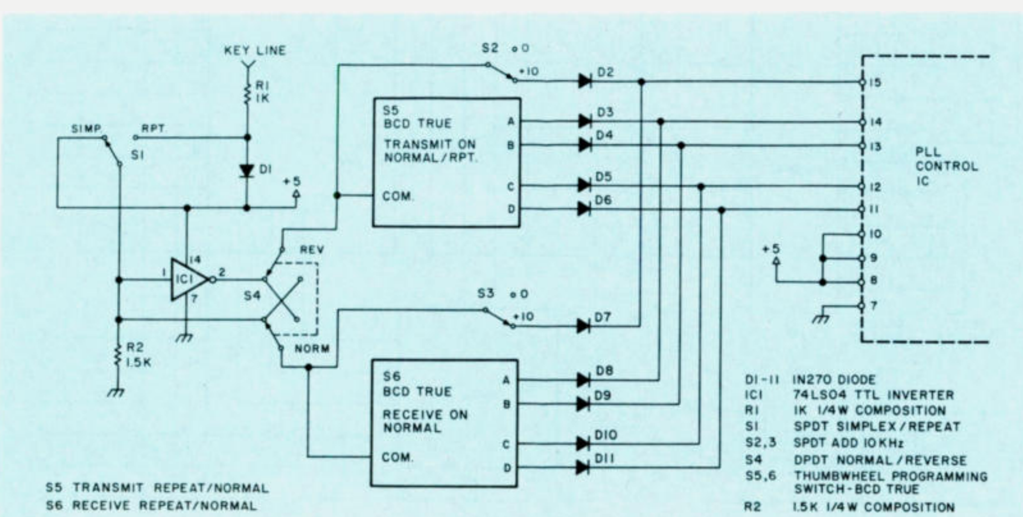


Fig. 5. BCD switch frequency programmer.

shows a programming scheme consisting of separate BCD-coded switches for receive and transmit. A toggle switch is included to add 10 kHz to either frequency. Steering diodes are used to logically OR the outputs of the switches to the PLL input. A key line in the transceiver is sensed to alternate between receive and transmit while in the repeat mode. It will be described in more detail in the following section. This is the simplest complete frequency-coverage scheme, but has a few problems. The non-direct frequency-reading switches, with each BCD digit equaling 20 kHz, leads to confusion. Repeater operation is not automatic. Both switches have to be set.

c) Construct the frequency programming board without LED readout. This step can be accomplished by omitting the readouts and 7-segment decoder chips from step 4d.

d) Construct the frequency-programming board with LED readouts. We finally bit the bullet after going through several generations of simple programmers, and designed a digital encoder that included 10-kHz steps from 29.5 to 29.7 MHz, automatic coverage of all the 100-kHz repeater splits and their reverses, one-switch frequency selection, and a 7-segment LED readout of the operating frequency.

The circuit in Fig. 6 was designed with low-power Schottky TTL. Five integrated circuits, a 10-position, 2-deck rotary switch, and 3 miniature SPDT toggle switches are needed for the design. To make use of this programmer, a 37.955-MHz crystal is used in the offset oscillator (12.65167 MHz × 3). The 5 least-significant divide-by lines are digitally programmed to the PLL control IC. The divide-by-32, -64, and -128 lines are fixed-programmed by connecting them to plus 5 V dc. The divide-by-256 line is disabled by leaving it open or grounding it. A divide-by ratio of 224 is entered to the PLL chip with no input from the programmer. The transceiver operates at 29.5 MHz at this no-input setting.

S1 is the front-panel programming switch. It is a 2-deck, 10-position rotary switch which was modified by rotating the rear deck by 180 degrees. This was done to make the wiring easier. Two single-deck switches could be used if repeater splits of other than 100 kHz are desired. S2 is the simplex/repeat switch. In the simplex position, 5 volts is applied to section F of IC2. This inverts the 5-volt signal to a TTL logic low and applies it to the selected input of IC1 through deck A of S1. This 74LS147 is a 10-line-to-BCD decoder which responds to a low-level signal on one of its inputs. A zero condition is decoded when the 9-input lines are high. No pull-up resistors are needed on the disconnected inputs since they will bias themselves to a high (off) state.

With S2 in the repeat position, the 9-volt transmitter key line in the transceiver is monitored at the junction of R163 and D106. This point is clamped to the 5-volt supply through R1 and D1 to make the signal TTL-compatible. The signal is a logic high in receive and a low in transmit. The logic low signal to IC1 will now toggle between the two wipers of S1, deck A on receive, and deck B on transmit. Each switch position adds 20 kHz, therefore a 100-kHz change is introduced with the 5-position switching in the repeater mode. 100 kHz is subtracted on transmit while receiving above 29.6 MHz and added on transmit while listening below 29.6 MHz. The output of IC1 is inverted from the true high logic needed to program the PLL IC. The 4 output lines are run through 4 sections of the 74LS04 inverter (IC2) to get the signal back to the true form. These 4 lines program the divide-by-2, -4, -8, and -16 inputs to the PLL IC. S3 will add 10 kHz to the operating frequency. It programs the least-significant digit (pin 15) of the control IC.

The plus 10-kHz line from the wiper of S3 and the four inverted outputs of IC1 are run to IC3 and IC4. These are the 7-segment display decoders. IC3 is a binary to BCD decoder. Its most-significant digit appears on pin 4. This output, when in the high state, is equal to an entered count of 100 kHz or more from the programmer, or 29.6 MHz and above. Only two segments of the most-significant digit 7-segment readout need to be changed to go from a 5 to 6. These are segments a and e. The switching to accomplish this change is done by section E of IC2. the least-significant digit (0-9) is decoded by the 74LS48, a BCD-to-7-line decoder.

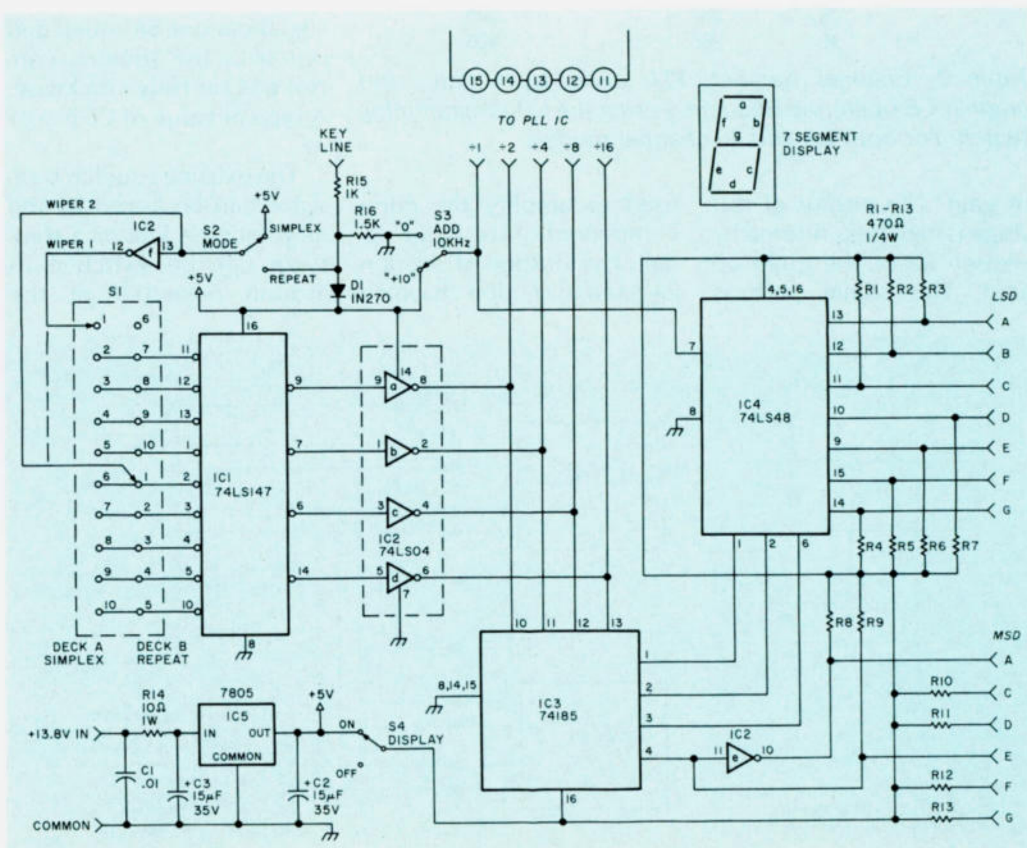


Fig. 6. Frequency programmer.

Since common-cathode 7-segment readouts were used, pull-up resistors are needed on each segment drive line to the displays. A DIP resistor package containing 13 resistors, with one side of each internally connected, could be used to save space on a printed circuit board. All of the logic is static, so there is no digital noise pickup in the receiver. Switch S4 will disable the display electronics as a power-saving measure.

IC5 is the monolithic 3-pin, 5-volt voltage regulator which powers this circuitry. It should be mounted on a small heat sink. Resistor R2 is used for dropping the unregulated voltage to the regulator to keep its power dissipation down. The internal speaker in the transceiver was removed to make space for the two added printed circuit boards. The internal speaker was unusable for mobile work anyway, due to its directionality.

Antennas, Amplifiers, and Such

We placed many of these transceivers in mobile service, so vertical polarization is a necessity in our local operating area. Any of the CB antennas can be used on 10 with some judicious pruning. A favorite of ours is the Antenna Specialists' "Star Duster" series. It is a ¼-wave vertical groundplane type that resonates across the entire 10-meter band by chopping 6 inches from the vertical radiator and each of the groundplane elements. Standard 8-foot whips are used in the mobile installations.

Five Watts of power was not adequate for mobile operation with our New England hills, so we put many CB "trucker special" 50- and 100-Watt, solid-state linear amplifiers to good use in mobile service before the FCC took a dim view of the goings-on at 11 meters. These amplifiers were all of excellent quality, and with the addition of a low-pass section on the output, met all the relevant spurious and harmonic specs.

A Few Closing Comments

Since the spring of 1977, approximately 40 of these rigs have been completed, and we are just scratching the surface of conversion possibilities. This is the first time a modern solid-state, synthesized transceiver has been available for pennies. We hope this article will force a few dormant soldering irons out of retirement.

Let's get some club projects going using these rigs for emergency communications. A split-site portable repeater using a microwave link looks like duck soup. How about a CW Novice rig using the printed circuit boards? A zero-to-30-MHz general coverage receiver, anyone?

Many thanks to Denny Dittrich WA1VKS[6] for the printed circuit layouts. Denny has combined the i-f strip and the programmer on one PC board to save space and cost. The board is available for $7.00, which includes the postage. See you on 29.6 FM! ■

References

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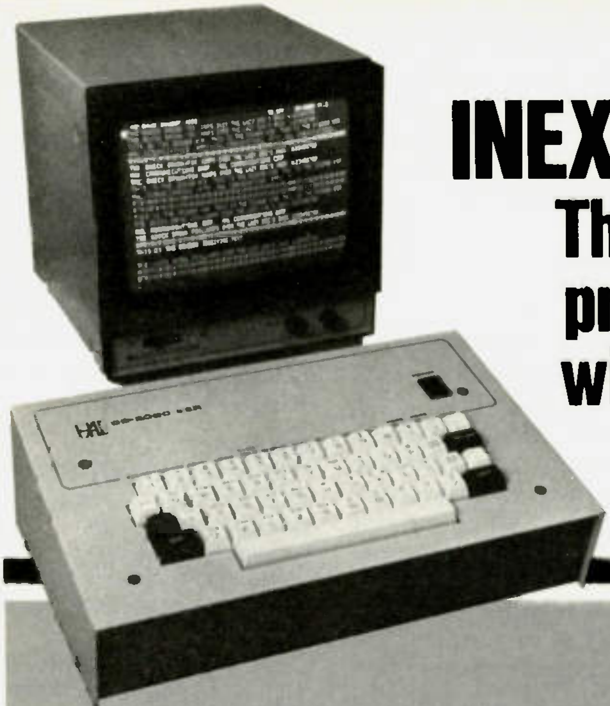
4. Clay Walsh W1PI, "CB to 10, Part XII," *73 Magazine*, October, 1978, pp. 254-255.
5. National Semiconductor Corp., *Linear Data Book*, 1976, pp. 10-138 and 10-139.
6. Dennis Dittrich WA1VKS, RFD #3, Box 88, Willimantic CT 06226.



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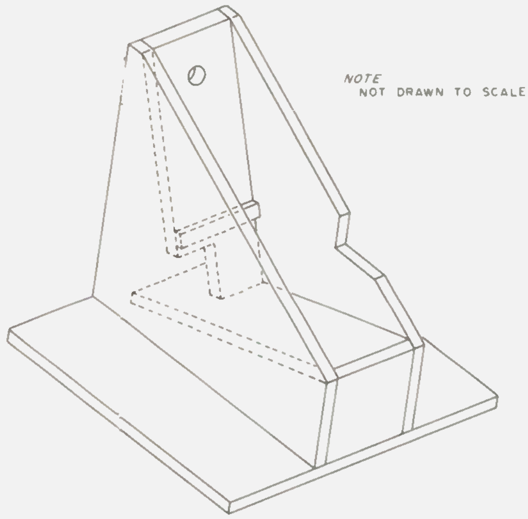
The Icom IC-502, IC-202, and IC-215 are popular transceivers. Although they were designed mostly to hang on a strap, many are in use as base station units or portable units on desks, car seats, etc. Operating them as such is difficult enough without having them topple over on their sides at times due to their narrow base width (less than 2-1/2 inches).

A wooden holder (such as shown in Fig. 1) made out of 3/8″ pine plyboard makes the units convenient to operate from a desk or car seat because of its wide base width and slanted position. Anyone with even a very little knowledge of woodworking can construct one. Make and put a mike holder on the right side if you care to. Finish the holder with varnish or perhaps flat black enamel paint to match the units.

If desired, one can go further with modifications, moving the holder part to one side of the base board and building a slanted external speaker box alongside to match the holder. Another idea is to build a holder extending further to the right or left to accommodate mounting a key for those units with CW operation capability.■



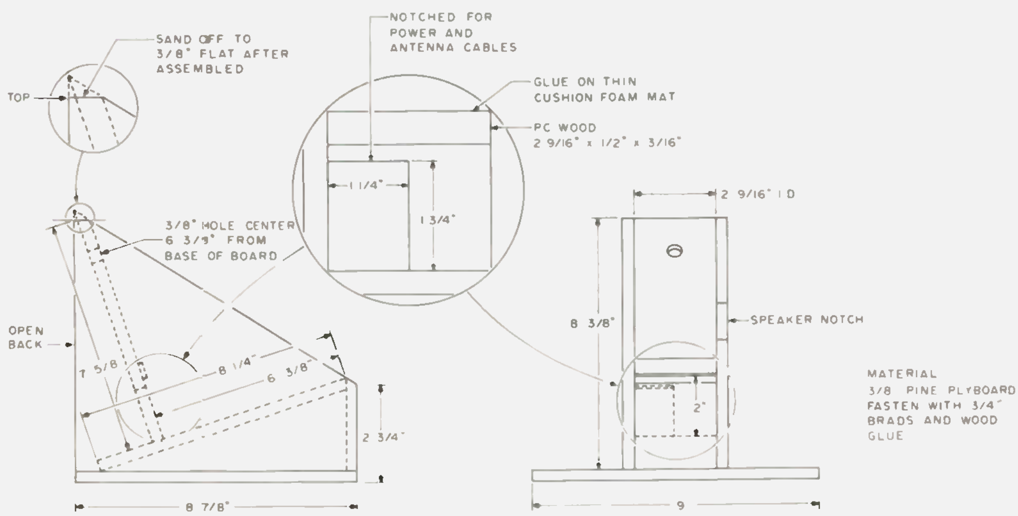


Fig. 1.

Terry L. Wirth K7ACN
4708 N. 54th Ave.
Phoenix AZ 85031

Catch You on the Flip-Flop

—add a handy repeater reverse switch to your Memorizer

The Yaesu FT-227R Memorizer two-meter transceiver is fast becoming one of the more popular rigs heard on the band these days. Like many of its predecessors, it lends itself to many modifications. This modification, the repeater reverse switch, is very simple to install, requiring only a DPDT switch and some wire, yet it greatly enhances the operational capabilities of the rig.

Let me start by explaining what the repeater reverse switch does: It simply reverses the transmit and receive frequencies of the rig when used in repeater operation. For example, when you are using the local .34/.94 machine, you are transmitting on 146.34 MHz and receiving on 146.94 MHz. By throwing the repeater reverse switch, the rig would then transmit on 146.94 MHz and receive on 146.34 MHz.

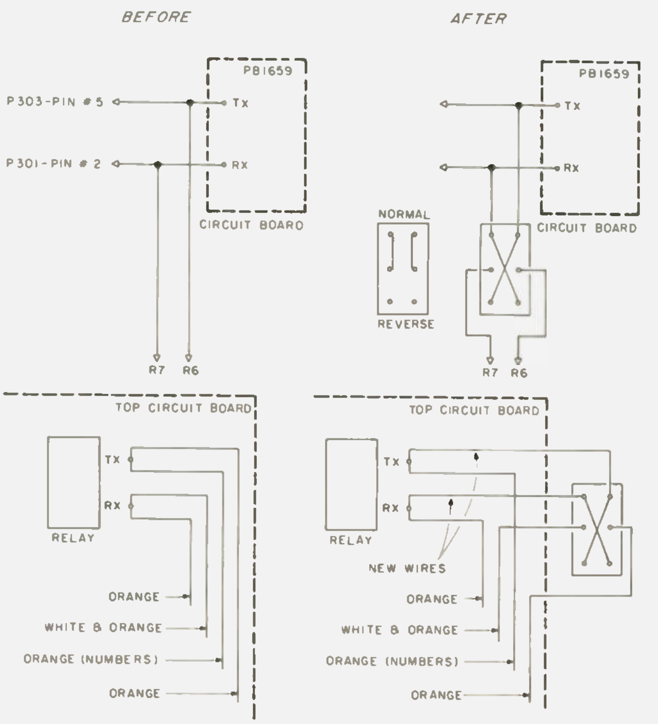


Fig. 1. The top shows how to change your rig schematic to conform to the modification, and the bottom shows wiring.

Imagine the following situation: You are mobile and have just contacted a friend on a long-range repeater, but wish to go to a different simplex frequency to continue the QSO so as not to tie up the machine. Your friend is also mobile, so you throw the reverse switch momentarily to check his input (direct) signal to see if simplex operation is possible. You find that he has a good signal, but before you can get back to him, your long-winded buddy times out the repeater. So you again use your reverse switch and listen direct to the rest of his transmission, never missing a word. Then, for some unexplained reason, the repeater fails to come back on so you leave the switch in the reverse position and transmit back to him direct on his listening frequency and arrange to QSY. He acknowledges, never realizing the machine is out. As you can see, the repeater reverse switch can be a great help to your everyday operation.

But wait a minute, you say; why not just use the memory function of the Memorizer to work repeater reverse? You can, of course, and this would be fine if you use only one repeater. If you use several repeaters as most of us do, you must reprogram the memory each time you change frequencies. This is not only time consuming, it is very difficult, if not dangerous, when working mobile. With the repeater reverse switch installed, you can change to any frequency and switch instantly to the reverse mode. Also, you have the added bonus that the rig's memory is now free to remember your favorite channel.

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IF Rejection: 70dB
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AM 6 kHz at −6dB, 12 kHz at −60dB
Variable IF Bandwidth
20dB RF Attenuator
Peak/Notch Audio Filter
Audio Output: 3 watts (4-16 ohms)
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SP-107 Matching Speaker
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Spurious Radiation: −50dB.
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Transmitter: 3rd IMD −31dB neg feedback 6dB
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of the switch is very simple. The Memorizer's phase lock loop is controlled by a crystal that is selected electrically from six crystals (X301-X306) depending on the position of the 5 UP switch, the function switch, and the T-R relay. This modification simply reverses the crystals selected for transmit and receive. It therefore reverses all frequency combinations that can be selected, including any non-standard repeater pair that is programmed into the memory. Simplex operation remains unaffected.

Prior to wiring up the modification, you should decide where to locate the switch. I mounted mine on the bottom cover just to the right of the meter. In this location it is out of sight and easy to operate. The modification is at dc level, so switch and wire placement should present no problems.

Start by wiring up the switch: Connect two short jumper wires from the terminals at one end to the terminals at the other end—making sure to cross them as shown in Fig. 1—and solder the terminals at one end only. Next, cut a pair of wires approximately 10 inches in length and solder one each to the terminals at the unsoldered end. Now set the switch aside for a moment, and locate the relay on the right rear of the top printed circuit board. Just to the right of the relay are several pins, two of which are marked Rx and Tx. Each has two wires attached: Rx has an orange and orange/white wire while Tx has two orange wires, one marked with printed numbers and one without. Unsolder the orange/white wire from Rx and the plain orange wire (no numbers) from Tx. Pull these two wires out of the cable harness, working toward the front of the printed circuit board, until you have four or five inches of loose wire. Shorten these wires, if necessary, depending on where you have decided to locate the switch, and solder the orange wire to one center terminal of the switch. Likewise, solder the orange/white wire to the other center terminal. It makes no difference which wire goes to which center terminal. Now take the unused ends of the two new wires previously soldered to the switch, cut them to the correct lengths, and solder one to Rx and one to Tx. Again, either wire to either pin. The wiring is now complete.

Next, you must determine which switch position is normal and which is reverse. After briefly checking your wiring, turn the rig on and leave it in the receive mode. Put the reverse switch in either position and leave it. Put the function switch to simplex. Program one frequency of your choice into the memory, and then manually dial up any different frequency, leaving the second frequency showing on the readout. Now, turn the function switch from simplex to MEM. If the readout remains the same, the reverse switch is in the normal position, but if the readout changes to the memory frequency, the switch is in the reverse position.

Now you can correctly label the switch. If you wish to reverse positions, simply reverse the switch center terminal wires, or, if you are using a toggle switch, simply turn it around.

The modification is now complete. I think you will find, as I have, that it makes a good rig even better. ■

✓ Reader Service—see page 195

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All repeater systems in use today are compelled to have some type of identification every three minutes during operation to satisfy the FCC. 99% of these systems use CW idents, generated very easily by CMOS or TTL packages.

Some of the more progressive technical groups are going to great pains to have voice identification instead of the CW, but in many cases there have been disasters in efforts to get the tape machine synchronized and reliable.

This article describes a simple, one-night project that will give a new dimension to your repeater system. It can be built to add on to the VHF Engineering, or similar, CW generation board.

The VHF Engineering CW identifier board produces a "high" pulse every three minutes (or thereabouts, as set by R6). This pulse is picked off at pin 13, output of the U1 flip-flop, and fed to IC1, a 7490 decade counter. If the repeater remains in use for 30 minutes, the U1 flip-flop will have sent 10 pulses to the 7490. On the tenth pulse, gate IC2 will receive proper information to turn on Q1 and turn RLY1 on, which switches OFF the CW audio to the transmitter, turns on the motor of the tape player, and also keeps the PTT line grounded during the duration of the tape message.

At the end of the message, a short piece of metal sensing tape is used to short the two sensing fingers of the tape player to ground, reversing the flip-

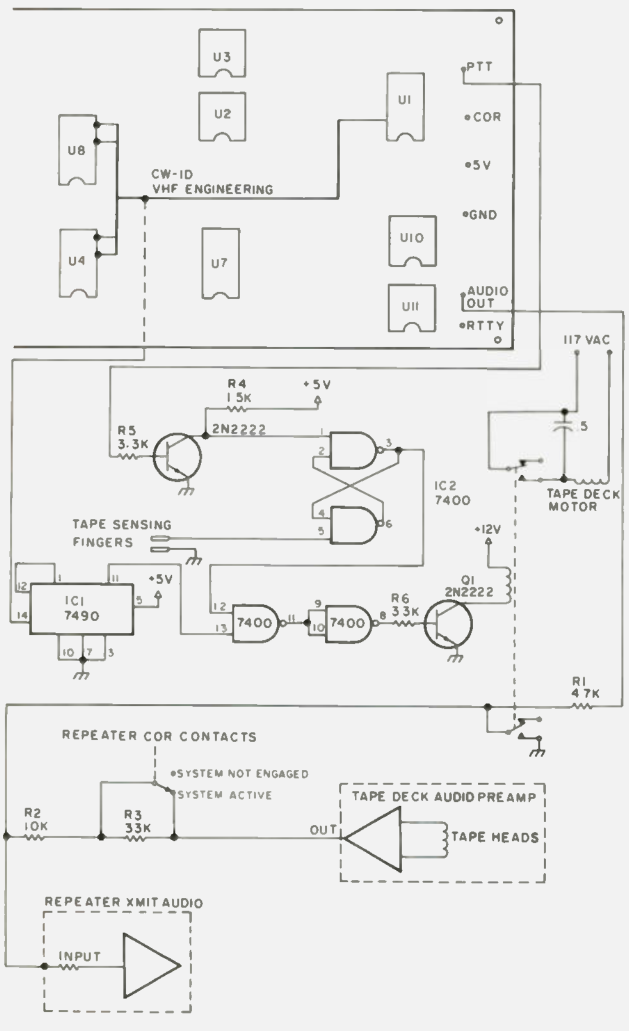

Fig. 1.

flop of IC1, which turns off the RLY1, causing the entire tape system to stop and begin counting those ten pulses produced by the CW identifier.

This gives you a voice identification once every 30 minutes, *if* the repeater remains in use. The length of the message is left up to you, since we use the sensing foil to shut the tape system off.

COR Controls Audio Level

One of the unique aspects of this voice ident system is that the audio fed from the tape heads is fed through R2 and R3. A set of contacts of the COR are connected in such a manner that should someone be using the repeater (meaning the COR would be activated), both resistors are in series with the tape head. If the repeater is not in use (COR de-activated), the COR contacts short out R3.

What this accomplishes is that if someone is talking through the system and the logic brings up the tape message, the audio level of the tape will be 30 dB below the user's own audio. If someone releases the system allowing the COR to de-activate, the tape message will come through the system at full deviation.

Construction

A simple method to properly house the voice ident system is to mount the tape player mechanism and the small PC logic board in a 17″ x 3″ x 9″ chassis. Mount a 19″ x 3″ rack panel on the front of the chassis. You have the option of making a cutout in the front panel so that the tape cartridge can be changed easily without removing the unit from the rack. (In some systems, the technical crew may want everything totally enclosed, without access to any functions or the tapes.)

Tape Machine

The tape deck used here was purchased from Poly Paks for $12.95. These are excellent units, built by Motorola, which work very well. They have their own preamp audio boards with level controls.

I elected to remove all of that head switching solenoid business and mounted the playback head solid to the chassis. This ensures trouble-free service and more reliable head alignment.

The tape can be a 3- or 4-minute loop with many different 5-second messages. Use a piece of sensing foil at the end of each message. This will shut the system down as the foil passes over the sense fingers. If you had only one message on the 8-track loop, tape wear would be excessive. By using several minutes of tape, a variety of messages can be used and the tape wear will be greatly reduced.

The system has been in use since the spring on the massive Marissa, Illinois, 81/21 system and has been trouble free. The voices used to give the short idents were imitations of John Wayne, Amos and Andy, Henry Kissinger, and many others. These voices were done for the club by Ed Bolton WA8PUN, host of 3920 kHz each evening.

The voice idents add a lot of versatility to the repeater system and take some of the boredom out of its operation. If you or your club are interested, send a #10 SASE for information on a complete kit of parts available from Melco, PO Box 26, Marissa IL 62257. ■

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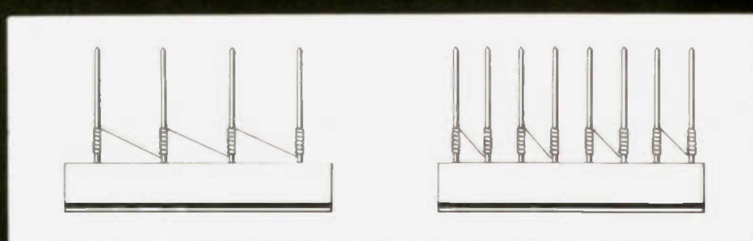
RED	R-JW-R	2.98



DAISY CHAIN   POINT TO POINT

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A Better Overvoltage Protection Circuit

—the original was good . . . this version is better

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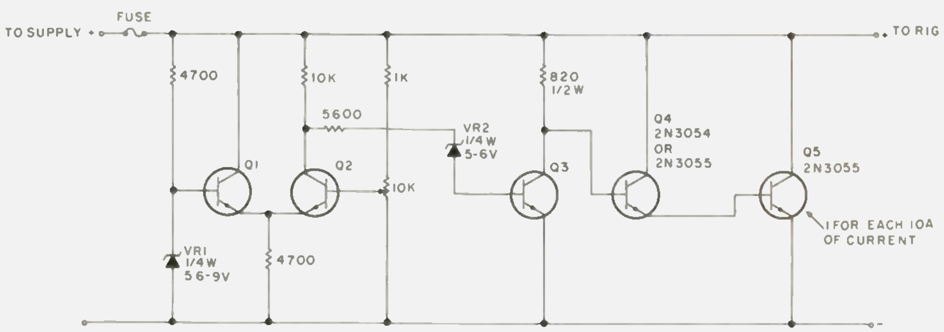

Fig. 1. The original overvoltage protection circuit.

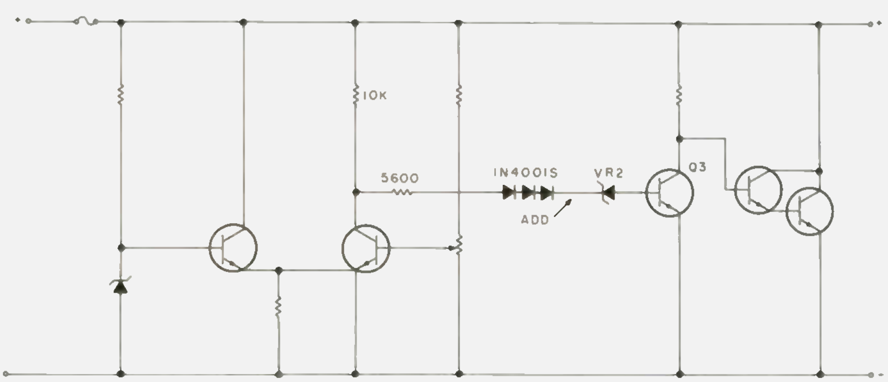

Fig. 2. Improved overvoltage protection circuit.

The following is in response to the requests for more information about the overvoltage protection circuit which appeared in the March, 1978, issue of *73*.

Let me begin by stating that the system was carefully tested *before* it was written up and submitted for publication. Since that time, it has come to my attention that one component could prove troublesome and somewhat improved performance can be obtained by making two rather minor changes.

VR_2 is listed as 5-6 volts and noncritical. However, it is the basis of the abrupt turn-on/turn-off characteristic found in this system. VR_2 suppresses the 5- to 6-volt offset voltage at the collector of Q_2.

At the low current level found in this circuit, the zener diode may not show a sharp enough turn-off

SWITCHES CRYSTALS CONNECTORS HEAT SINKS FUSEHOLDERS TEST CLIPS BOOKS KITS DIP JUMPERS CABLE ASSEMBLIES SWITCHES CRYSTALS CONNECTORS HEAT SINKS

INTEGRATED CIRCUITS MICROPROCESSOR LED'S SOCKETS CAPACITORS DIODES TRANSISTORS RESISTORS POTENTIOMETERS

Reader Service—see page 195

characteristic. This property will be helped along in the right direction by connecting 2 or 3 1N4001s (or other cheap silicon diodes) in series with VR_2 as shown in Fig. 2. An alternative solution would be to use a 6.8- to 8.2-volt zener for VR_2.

If voltage is applied to this circuit and *slowly* increased from about 5 volts to whatever level was intended, the system will malfunction. The voltage set/trip control will exhibit some unusual properties. This malfunction will happen only under the above stated conditions. It may be prevented by making the following simple changes:

1. Disconnect the 10k and 5600-Ohm resistors from Q_2 collector.
2. Disconnect Q_1 collector from B+.
3. Connect Q_2 collector to B+.
4. Connect Q_1 collector to the junction of the 10k and 5600-Ohm resistors that used to be tied to Q_2 collector. See Fig. 2.

At this point you are almost there. As it stands, after completing the above operation, the fuse will clear if the input voltage is *below* the intended set point. In order to correct that malady and finish the project, it is necessary (and highly desirable) to make the final modification.

Disconnect the zener diode, VR_2, from the base of Q_3, and connect it to the base of Q_6 (another 2N3414, etc.). Connect one end of a 1500-Ohm, ¼-Watt resistor to B+, and the other end of it to the collector of Q6 and the base of Q3. Connect the Q_6 emitter to ground. That's it! See Fig. 3.

The initial adjustment is done in the same manner as in the original, and it is very smooth and very resettable. This modification was checked out using a power supply that went from 5-25 volts with excellent results. The trip point could be set anywhere from 8 volts to 25 volts and it would consistently fire at the trip point ±0.25 volt.

I do regret any difficulties that may have been encountered in the construction and testing of the circuit. Either version (original or modified) should prove to be a reliable means of protecting your equipment. ■

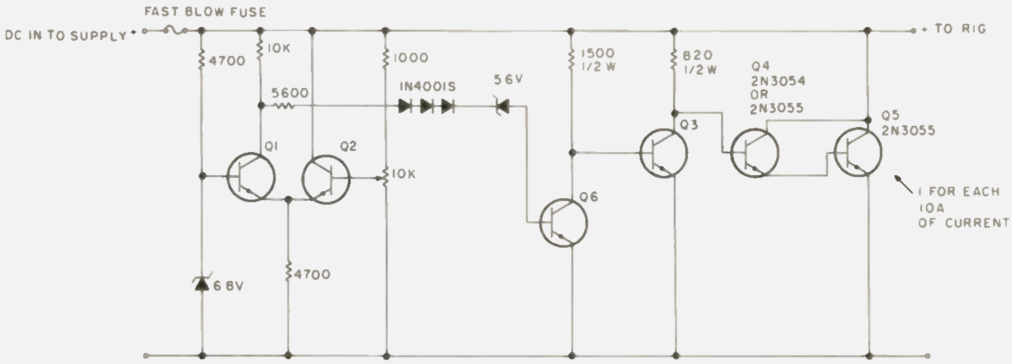

Fig. 3. The final modification.

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Of course, the SCR1000 VHF unit is still available in 2 Mtr. and 220 MHz versions along with a complete line of options and accessories for all of our repeaters . . . such as: Full Autopatch/Reverse Patch/Land-Line Control; Touch-Tone Control of various repeater functions; "PL" - CTCSS; "Emergancy Pwr. I.D."; various Courtesy Tone and Timer units, etc. PLUS—the finest Duplexers, Cabinets, Antennas, Cables, etc.

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✓ *Reader Service—see page 195*

Contests

from page 24

counted separately. Multi-operators may participate, but each prefix must be listed in the log. Use all bands 80 through 10 meters. The call should be made as "CQ TEST LIONS." Participating Lions or Leos should identify their club name. Only one QSO with the same station in each band will be counted. Phone and CW are counted separately as previously stated.

SCORING:

Score 1 point for QSOs within the same continent, 3 points between different continents. Score 1 extra bonus point for a QSO with a member of a Lions Club or Leo Club and 5 extra bonus points for a QSO with a member of Rio de Janeiro ARPOADOR Lions Club. Contacts between Brazilian stations and members of the Lions Club Rio de Janeiro ARPOADOR will count only 2 extra points. Contacts between members of the ARPOADOR Club will not count any bonus points.

ENTRIES:

One log should be kept for each mode. Each participant will note in his logs the callsign, report, and the sequential number of the QSO. When contacts are made with Lions or Leos, the name of the Lions Club or Leo Club contacted should be clearly identified in the log. Confirmation of contacts will be made by comparing the logs of the participants. Participants should send their log sheets, postmarked by air mail not later than 30 days after the contest, to: Lions Club of Rio de Janeiro ARPOADOR, Rua Souza Lima #310, Apt. 802, Rio de Janeiro 22081, Brazil, South America. Various medallions, trophies, and certificates will be awarded winners in each class, etc.

FREEZE YOUR ARCTIC OFF EXPEDITION

On January 19th, the Ford Tin Lizzy Club, North Metro Chapter, will have the second annual Freeze Your Arctic Off Expedition. The club will be operating from the frozen wastes of Lake St. Clair near the US-Canadian border. Operations will be from 2000 GMT January 19th to 1500 GMT January 20th using the callsign AD8R. Operating frequencies will principally be 7275 on SSB plus 21380 if propagation allows. Also, 2-meter operation will be on 146.52, .55, and .58.

All QSLs will be acknowledged with an 8 x 10 certificate commemorating this event. No SASE necessary; just QSL to Box 545, Sterling Heights MI 48078.

NORTH AND SOUTH AMERICA RTTY FLASH CONTEST

Operating Periods:
1800 GMT January 19 to 0200 GMT January 20
1200 GMT to 2400 GMT January 20

The contest is sponsored by the IATG Radiocommunications and is open to all RTTY stations operating on 80 through 10 meters. The DXCC list will be used for country status except that the VE/VO, W/K, VK, PY, LU, JA, and UAØ/9 call areas will be considered as separate countries. Operating classes include single- or multi-operator stations using a single transmitter and SWLs.

EXCHANGE:

Messages will consist of RST, QSO number, and the station's continent.

SCORING:

Exchange points are as follows: 80 and 40 meters = 1 point per QSO, 20 meters = 2 points per QSO, 15 meters = 8 points per QSO, 10 meters = 12 points per QSO. No points or multipliers are counted for contacts with one's own country. Only two-way RTTY contacts are valid. Multipliers are given for countries and continents worked. A multiplier is given for each country worked on 20 through 10 meters, but no country multipliers are given for 80- and 40-meter contacts. A separate multiplier may be claimed for the same country if a different band is used (max. 3 times). Only countries which appear in at least 5 other contest logs will be valid as multipliers. The continents are also valid as multipliers. For contacts with North and South America, the sender and receiver will each be assigned 100 points as multipliers. 50 points will be assigned for each of the remaining continents as contacted. An additional 100 points will be given for each contact with North and South America on 15 or 10 meters. Final score is the total QSO points times the number of countries times the number of continent points plus the total points for North and South American stations worked. Example: 600 points for total x 10 countries worked x 100 continent points = 600,000 plus 20 stations of North and South America worked on 15 and 10 meters giving a great total of 602,000 points.

Two promotional periods are included in the contest: Saturday, January 19th, from 1900 to 2000 GMT, and Sunday, January 20th, from 2100 to 2200 GMT. Stations operating from Europe, Africa, Australia-Oceania, and Asia contacting North and South America during these hours will *double* their points for these periods.

RTTYers entering logs in this contest who have not participated in previous contests will receive an additional 5% of the final score as a handicap. The contest is open to RTTY SWLs using the same scoring rules.

LOGS AND ENTRIES:

Use one log for each band. Logs must contain date and time in GMT, callsign, RST, number of QSO, continent sent and received, country and continent multipliers, points, and final score. Each station may be contacted only once on any band; additional contacts may be made with the same station if a different band is used. In order to qualify, all logs must be received no later than February

Results

RESULTS OF THE 1979 FRENCH CONTEST

CANADA—CW

Call	*Points*	*QSOs*
VE1MX	159,238	157
VE1AIH	90,288	104
VE2WA	8,712	37
VE3DAP	214,964	179
VE3KZ	59,092	89
VE6LU	30,618	77
VO1KO	189,635	167

CANADA—PHONE

VE2RV	1,542,752	737
VE2AFC	145,137	149
VE2EML	30,078	61
VE3KZ	1,592,730	605
VE3BR	5,400	20
VE4SW	8,100	30
VE7VP	35,345	68
log: VE1AIH		

USA—CW

K1SA	343,360	245
W1BWS	51,220	83
WA1FCN	29,798	65
W1OPJ	2,040	17
W1PWK	819	9
W1CFZ	490	7
K2SX	323,175	212
W2GKZ	41,528	73
K2MQ	31,878	78
K2PF	22,770	52
W2NCG	22,386	54
W3ARK	328,600	222
W3HDH	105,892	120
K3NR	29,100	61
N3RL	640	8
WA4OML	104,960	128
WB4ENI	101,994	116
W4UNO	66,654	98
WB4YGL	3,888	25
N6AW	55,575	89
N6TW	2,002	15
N6OB	90	3
W8UVZ	284,994	210
N8DE	240,909	186
W8DSO	55,815	96
W8VSK	8,060	31
K8NMG	3,360	21
W9OA	302,085	228
K9FD	56,792	93
WBØGOB	54,780	83
WØWDW	10,730	37

USA—PHONE

WB1CRG	25,080	57
W1BWS	3,570	21
F2YS/W2	501,835	304
K2JFV	129,612	155
KB2DE	41,440	74
HI3DJP/W2	11,070	41
W2QKJ	7,752	33
W2UL	1,680	14
N4NX	75,190	103
W4KMS	39,200	70
WA4AXT	27,280	88
WB5MSU	1,200	12
W6HX	68,884	102
N6TW	720	9
N7DF	12,383	43
KA8BAC	52,780	91
WA9FZQ	109,736	129
W9OA	105,469	118
K9HDE	79,725	107
W9QWM	16,502	48
WØCDC	13,200	40
WØPKO	1,820	14

20th. Send logs to: Prof. Franco Fanti, Via A. Dallolio n 19, Bologna 40139, Italy. For SWLs only, the same station is valid only one time on all bands.

AWARDS:

Grand prizes are reserved for the four first place winners. Consolation prizes along with medals and certificates will also be awarded. Remember that this contest is valid towards the final standing of the 5 Continent World Championship.

FRENCH CONTEST
CW
Starts: 0000 GMT January 26
Ends: 2400 GMT January 27
Phone
Starts: 0000 GMT February 23
Ends: 2400 GMT February 24

This contest is open to single-operator stations only and all contacts must be made with French countries (see list below).

EXCHANGE:

RS(T) and sequential QSO number.

SCORING:

Score 3 points per QSO within the same continent and 10 points per QSO with another continent. Multiplier is the number of French units from the list below on each band. Final score is total QSO points times the total multiplier.

ENTRIES:

Logs must be sent with a recap sheet; all multipliers should be listed for checking on each band. Entries should be mailed to REF French Contest, sq. Trudaine 2, 75009 Paris, France.

FRENCH UNITS:

95 French departments (2 figures). DA1/2 station of F forces in DL. French overseas countries—Mayotte FH, Reunion FR, Europa FR/E, Juan de Nova FR/J, Glorieuses FR/G, Tromelin FR/T, Guyane FY, St. Pierre et Miquelon FP, Martinique FM, Guadeloupe FG, St. Martin FG, St. Barthelemy FG, Clipperton FO, New Caledonia FK, I. Loyaute FK, Chesterfield FK, Wallis FW, Futuna FW, New Hebrides YJ, I. du Vent FO, I. sous le Vent FO, I. Australes FO, Rapa FO, Marguises FO, Gambier FO, Touamotou FO, Terre Adelie F/FB8Y, Kerguelen FB8X, St. Paul et Amsterdam FB8Z, I. Crozet FB8W.

CLASSIC RADIO EXCHANGE
Starts: 2100 GMT Sunday, January 27
Ends: 0400 GMT Monday, January 28

The contest is sponsored by the Southeast ARC of Cleveland, Ohio, and is open to all amateurs. The object is to restore, operate, and enjoy older equipment with like-minded hams. A classic radio is any equipment built since 1945 but at least 10 years old, an advantage but not required. The same station may be worked with different equipment combinations and on each mode on each band. General call is "CQ CX" on CW and "CQ Exchange" on phone. Non-contestants may be worked for credit.

EXCHANGE:

Name, RS(T), state/province/country, receiver and transmitter type, and other interesting pleasantries.

FREQUENCIES:

CW—up 60 kHz from low band edges.

Phone—3910, 7280, 14280, 21380, 28580.

Novice/Tech—3720, 7120, 21120, 28120.

Listen on the half hour to 20 for coast-to-coast DX and on the three-quarter hour on 15.

SCORING:

Add the numbers of different transmitters, receivers, and states/provinces/countries worked on each band. Multiply by total number of QSOs on all bands. Multiply that total by the classic multiplier: the total years old of all transmitters and receivers used with 3 QSOs minimum per unit. For transceivers, multiply the years old by two.

ENTRIES:

Send logs, comments, anecdotes, etc., to: Stu Stephans K8SJ, 1407 Hollywood Rd., Sandusky OH 44870. Include an SASE for copies of the *Classic Radio Newsletter* and results.

Awards

from page 18

(USKA).

Walter Blattner HB9ALF writes to present us with their awards program in more detail.

HELVETIA 26 AWARD

This award has been instituted by the Union of Swiss Short Wave Amateurs (USKA) with the object of furthering friendly relations and the competitive spirit between its members and radio amateurs abroad.

Foreign amateurs must submit QSL cards showing evidence of contacts with stations in each of the 26 cantons and half-cantons of the Swiss Confederation on any bands between 1.8 and 30 MHz.

All contacts claimed must be made on or after January 1, 1979. Crossmode contacts will not be valid. Awards will be offered for all phone, all CW, phone/CW mixed mode, radioteletype (RTTY), and slow-scan television (SSTV).

QSL cards submitted must clearly show the location (canton) of the Swiss station at the time of contact. Any QSL card from a Swiss station operating from a temporary or portable location at the time of the contact must show the canton of such location in order to be recognized as a valid contact.

In addition to QSL cards, applicant must submit a signed list of all contacts in alphabetical order by canton. Include the station's callsign, date and time in GMT, band and mode of operation, and RS(T).

The 26 cantons are as follows:

AG	Aargau
AI	Appenzell Inner Rhoden
AR	Appenzell Outer Rhoden
BE	Berne
BL	Basle Country
BS	Basle City
FR	Fribourg
GE	Geneva
GL	Glarus
GR	Grisons
JU	Jura
LU	Lucerne
NE	Neuchatel
NW	Nidwalden
OW	Obwalden
SG	Saint Gall
SH	Schaffhausen
SO	Solothurn
SZ	Schwyz
TG	Thurgau
TI	Ticino
UR	Uri
VD	Vaud
VS	Valais
ZG	Zug
ZH	Zurich

Applications for the award must have sufficient postage enclosed in the form of IRCs to allow the safe return of your QSL cards.

Mail your application to the attention of: Walter Blattner HB9ALF, PO Box 450, 6601 Locarno, Switzerland.

The awards custodian for the Newark News Radio Club, WB2MRA, sent me information regarding their new State Capitals Award. This award is not to be confused with the State Capitals Award being offered by the 3.905 Century Club Net.

STATE CAPITALS AWARD

The Newark News Radio Club of Newark, New Jersey, takes pleasure in announcing its sponsorship of the SCA—State Capitals Award—which is available to licensed amateurs throughout the world for working stations located in state capital cities of the United States on or after January 1, 1960. This award is also available to shortwave listeners on a "heard" basis.

The purpose of this award is to offer recognition for operating achievements and to offer still another worthwhile contribution to the field of competitive radio amateur operation.

It is hoped by the directors, officers, and members of NNRC that amateurs everywhere will accept the award as a gesture on the part of the sponsor to further promote and expand goodwill and better understanding among amateur operators and shortwave listeners.

The State Capitals Award is offered in three (3) classes. Class C—work 30 state capital cities; Class B—work 40 state capital cities; Class A—work 50 state capital cities.

There are no band or mode endorsements. Crossmode contacts will not be valid.

To apply, applicants should prepare a list of contacts claimed, listing them in alphabetical order by US state. Include the usual logbook information for each contact. Have this list verified locally by two amateurs, a local radio club

secretary, or a notary public. Do not send QSL cards. Have your verified list sent along with the $1.00 award fee to: S. J. Knox WB2MRA, 212 North Jerome Avenue, Margate, New Jersey 08402.

Checking my files, I find that information about foreign DX award programs outnumbers that of the domestic type four to one. Stateside clubs, societies, and organizations are encouraged to utilize this no-cost service to publicize your awards program. As you know, thousands of amateurs join our ranks annually and most are not aware of the various operating incentives available to them. It is the intent of this column to share the many achievement programs the amateur community has to offer. Why not research your local area. Perhaps your club doesn't sponsor an award. Maybe this is an area you might consider to bring worldwide recognition for your fraternity and help build your club's treasury.

As you know, January 1st marks a new year. Those pursuing the *73* Awards Program realize all contacts claimed for the *73* DX Country Club and the Worked All USA Award are based on a single calendar year. Get in on the ground floor and pursue these operating incentives and be the first in your area to proudly possess the beautiful awards being sponsored by the editors of *73 Magazine*.

We now have a supply of *73 Magazine* Awards Program booklets on hand. Send for your copy today. Be sure to enclose a large SASE with your inquiry. See you next month. Continue to climb the ladder of recognition.

Corrections

Please note the following corrections to "The MICROSIZER: Computerized Frequency Control," which appeared in the October, 1979, issue.

Parts List:

•C35 was listed as C31—there is no C31.

•R46, R26, and R33 are missing; they should be 10k, ¼ Watt.

•R40 was listed as 4.7k; it should be 1.5k, ¼ Watt.

•CR10 was listed twice.

•U10, U11, U12, and U13 are missing; they should be CD4510s. CD4029s can be used if power-up reset to 0000 is not required.

•C24 was listed as .47; it should be 47 μF.

•The values for U17 and U18 were interchanged.

Fig. 6:

•The unmarked IC in the lower right-hand corner is U14.

•The unmarked resistor between U16 and U15 is R34.

•The unmarked resistor between U7 and U15 is R32.

•R33 should be mounted in holes directly above pins 13 and 11 of U15. Note that the "Z"-wire placement in Fig. 7 shows "Z" wires here—this is incorrect.

•The heat-sink tabs on U17 and U18 are shown on wrong side. In and out leads are correct.

Fig. 7:

•In addition to the above problem, nine "Z" wires were omitted. The correct layout is shown here.

Additional notes:

•Jumper U16-4 to U10-12 on the back side.

•Connect the top and bottom sides of the PCB together with pieces of wire, using 4 pieces on each side.

•There are two unused pads: One is to the right of U12-16 and the other is just above the left pad for jumper 9.

•All drilled holes are #65. Some may need to be slightly enlarged to accommodate variations in certain component leads.

•Make sure there is a good ground between MICROSIZER and transceiver; otherwise, some roughness of the CW note may occur.

•R43 should be adjusted to give vfo injection at the same level as the internal vfo. Too much level will cause spurious response problems.

Fred Studenberg W4BF
Tampa FL

Revised Fig. 7, "The MICROSIZER."

I would like to point out some items that need correcting in my article "Yes, You Can Build This Synthesizer!", which appeared in the October, 1979, issue.

There are four parts on the PC board layout on page 61 which have the incorrect values marked on them. R8 (180Ω) is correctly listed in the schematic and parts list, but is incorrectly shown as 270Ω on the parts layout. R22, located to the left of the 4059, is marked as a 2.2k; it should be a 1.8k. R19, located to the right of the 4001, is marked as a 270Ω; it should be 180Ω. Finally, C42, located in the lower right-hand side of the board, is marked as a 33 μF; it should be a 2.2 μF.

Z4 is incorrectly drawn in the schematic as a quad NAND gate; in reality, it is a quad NOR. However, since all of the gates are used as inverters, a CD4011 will also work as a pin-for-pin substitute.

I have also received numerous inquiries concerning the availabilities of the PC board and Y3, the 26.667-kHz crystal. Both items are available through me for fifteen dollars apiece.

Michael Di Julio WB2BWJ
Maplewood NJ

from page 26

first to offer "Soft Partitioning"TM of the memory unlike the "hard partitioning" utilized in all other keyers. "Soft Partitioning" means no wasted memory space. All of the memory can be allotted to one message location, or it can be divided up into as many as ten locations.

The memory can be loaded in automatic mode for perfect message formatting or it can be loaded in the real-time mode for individualizing a message. Memory can also be loaded in the automatic keyer mode (any dot and dash ratio) or in the semi-auto (bug) mode. Any message can be played back with any selected dot and dash ratio. Hence, the user can send a sloppily loaded bug mode message back with perfect 3-to-1-dash-to-dot ratio. Conversely, a perfectly loaded 3-to-1 dash-to-dot ratio message can be replayed later with as much as an 8-to-1 dash-to-dot ratio (sounding like a bug).

The MorseMatic can be used to key the transmitter for tuning purposes. The operator need only hit any keypad button or the key paddle to defeat the tune mode.

Editing a memory loading mistake is a simple task. If you are near the end of loading a message into memory and a mistake is made, it only takes seconds to erase the mistake and then continue with an error-free message.

The MorseMatic includes a sophisticated Morse trainer. It is the only trainer that will automatically increase the speed of the practice characters so that your brain is "fooled" into thinking it is still copying the starting speed.

For further information, contact *Advanced Electronic Applications, PO Box 2160, Lynnwood WA 98036; (206)-775-7373.* Reader Service number A94.

POCKET SHORTWAVE RECEIVER

Measuring only 45 mm W x 73 mm H x 25 mm D, the Model EP-8 is believed to be the smallest AM/SW 2-band receiver available in the US. In addition to the standard "broadcast" band (AM), the Model EP-8 receives shortwave frequencies from 3.9 to 12 MHz (ideal for receiving WWV time signals on 5 and 10 MHz). Controls include a band-select switch, tunable dial for AM and SW, and volume control coupled with an ON-OFF switch. Audio output is via the supplied earphone only, and the receiver is powered by two hearing-aid type batteries (included).

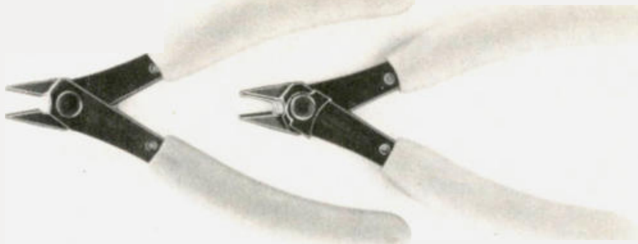
The Model EP-8 has built-in ferrite rod antennas for both bands. While shortwave reception is satisfactory for powerful stations such as the BBC, Radio Canada International, Radio Nederland, Deutsche Welle, and others, better SW sensitivity can be obtained by placing the receiver near a telephone or ac line outlet. No direct antenna connections are necessary.

For further information, contact *Radios International, PO Box 6053, Richardson TX 75080; (214)-784-0862.* Reader Service number R39.

Radios International's EP-8 shortwave receiver.

MINI-SHEARS

OK Machine and Tool Corporation has introduced two new flush-cutting mini-shears. Model MS-20 features a handy safety clip which retains cut leads, preventing them from flying and injuring the operator or contaminating the work. Model MS-10 is identical except that it has no safety clip. Both will shear component leads up to 16 AWG as well as wires as small as 30 AWG. The shears feature precision hardened and ground jaws for long life as well as comfortable cushioned grips to minimize operator fatigue. For further information, contact *OK Machine and Tool Corp., 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.



OK's new mini-shears.

KEYER ADD-ON PROVIDES PRACTICE AND MEMORY

An add-on accessory provides both random code practice and message storage for the Curtis Electro Devices EK-480 series. Called IM-480, this device will automatically send Morse code in random groups at speeds from 6 to 50 wpm. It also allows variable extra spacing between letters and groups to allow slow-speed copy with letters being formed at a higher speed. This feature enhances learning in the 6-10 wpm beginners range. A meter display of code speed allows accurate speed settings.

The IM-480 also includes a message memory function yielding four messages of approximately 32 characters each with an automatic repeat function. The messages are programmable from the paddle key on an asynchronous basis.

The IM-480 is the same size as the EK-480 (7" x 4½" x 2½"); the two units attach via a short length of 14-pin-DIP plug-terminated ribbon cable. Use of the Curtis 8046 and 8047 LSI ICs allows the compact packaging.

For further information, contact *Curtis Electro Devices, Inc., Box 4090, Mountain View CA*

Curtis Electro Devices' IM-480.

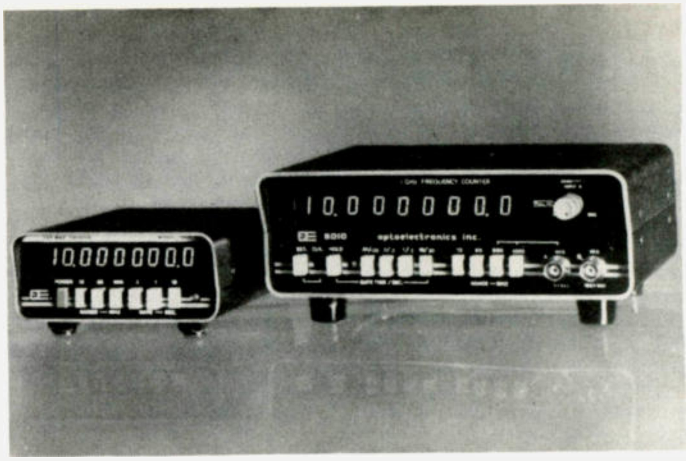
94040; (415)-494-7223. Reader Service number C90.

THE MODEL 299 TALKING COUNTER

The Model 299 Talking Counter from Ten-Tec is a self-contained frequency counter, speech synthesizer, and audio amplifier/speaker system which enhances operating convenience and pleasure for the blind ham operating in the HF spectrum. It can be used with any HF transceiver, analog or digital, or with any VHF transceiver with an appropriate prescaler. Also, it can be used with any signal generator below 22 MHz as a test instrument. When used with Ten-Tec transceivers employing a 9-MHz i-f, special built-in presets allow proper megahertz readout of the operating frequency, even though the counter is reading vfo output. The Model 299 will be available in February. For further information, contact *Ten-Tec, Inc., Sevierville TN 37862.*

TWO NEW HIGH-PERFORMANCE, LOW-COST FREQUENCY COUNTERS

Brand new from Optoelectronics, Inc., are the Model 7010 series miniature 600-MHz counters and the Model 8010 series 1 GHz/1.3 GHz counters. Both units include features such as rf-shielded, black anodized aluminum cases, 9-digit resolution, 1 ppm TCXO or (optional) 0.1 ppm precision TCXO 10-MHz timebases with external clock input, .4" red LED digits, and excellent sensitivity. 50-Ohm input sensitivity on the 7010 series is 5-40 mV from 25 MHz to 600 MHz; on the 8010 series it is 5-25 mV from 25 MHz to 1 GHz. Both units are offered with self-contained (optional) rechargeable nicad battery packs.



Optoelectronics' new counters.

For additional information, contact *Optoelectronics, Inc., 5821 NE 14th Avenue, Ft. Lauderdale FL 33334; (305)-771-2050/1, (800)-327-5912.* Reader Service Number O3.

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 6

When I heard about the EIA plan to try to take the amateur 220-MHz band away and make it a CB band, I contacted Andy and talked with him about it. I told him I thought it was pretty crummy, him being an amateur and the head of one of the largest of the ham manufacturing firms, to bankroll the loss of a ham band. He said that business was business and that, after all, amateurs were not using the band, so if he didn't get it away for CB, some other service would grab it. He pointed out that we were weak because we had no lobby, such as the EIA, that money talked when it came to government, and that they had support from people at the highest level of the FCC for this move.

I countered, suggesting that we push for a code-free ham license for 220 MHz and thus keep it a ham band, rather than lose it permanently to CB. He felt that would be too restrictive, that they would settle for nothing less than CB for 220 MHz and thus be able to sell millions of people another radio. With the amateurs having virtually no clout in Washington, he felt it was just a matter of time before they got 220 MHz for CB.

There was no way to really write about this plot and name names, so I mulled it over and decided to go about this obliquely. First I put together a petition for a code-free ham band at 220 MHz and filed that with the FCC. I figured that the firms behind the 220 CB push would at first reject this, but if I could bring enough pressure, perhaps they would support it and this would serve the dual purpose of saving the band for hams and also act as a nice entry level experience for new hams. And we certainly did need new hams at this time (1969).

Next, when the EIA proposal for 220 CB was filed, I got after my friends in Canada and Mexico and got them to put on the pressure for a rejection of the plan on the basis that it would interfere with their amateur operations across the border. This was a key approach because this band was designated as amateur with ITU and thus our government would have to be sensitive to the complaints from other governments if we were proposing a non-permitted use for the band.

Despite the high level support within the FCC claimed by Andy, the protests of Canada and Mexico did in fact cool the CB proposal . . . a bit.

The manufacturers who were involved with this situation were convinced that the EIA had it made. If you remember, Regency came out with a 220-MHz transceiver. Well, this was not really for amateur radio; this was for CB. And ditto several others (Cobra, Midland, etc.) which appeared at that time. I was invited to visit Regency to preview the 220 rig and the president of the firm was willing to make a very substantial bet with me that the FCC was going to okay the 220 CB proposal soon. He already had the expense of the 220 ham rig on the line, so I decided not to venture any bets.

Things cooled a little bit more when the chairman of the FCC left and went onto the Nixon White House staff. Then we found pressure building up shortly after that via the White House Office of Telecommunications Policy. This obviously was pressuring the FCC, so I called the OTP and said I would start making a big stink over the White House connection if they didn't pull back. I don't know whether that did any good or not, but the pressure did seem to abate at that time.

Well, getting back to the CB screw-up. The manufacturers, via the Electronic Industries Association, were putting on the pressure for 50 CB channels. It looked as if they were going to get it through. Then someone got to worrying about possible interference to any radio equipment using a 455-kHz i-f if two CB rigs happened to be 455 kHz apart in frequency. Ooops. No one had considered that before.

The FCC ran some hasty tests and found two things. First, they verified that two CB rigs 455 kHz apart would indeed cause a mess with radios and other CB units. They also discovered, this apparently being the first time that they had ever tested the CB rigs being sold, that many were sending out all sorts of spurious emissions . . . they were dirty. Anyone living near a CBer could have told them that . . . but apparently no one did.

This killed the 50-channel plan, but it was quickly replaced with a 40-channel CB plan which would not permit two CB channels to be 455 kHz apart. Then came the blow which the industry never counted on . . . and the one which brought down the multi-billion dollar industry in flames. The Commission, under great pressure from the EIA and the White House OTP, okayed the 40-channel plan . . . but put off the sale of the new rigs for six months . . . until January first.

Up until that time, CB was going strong. We had CB movies one after the other . . . CB television programs . . . a whole bunch of CB records . . . the country was being CBed at every turn and was responding by buying CB sets as fast as Japan could make them and ship them over. CBers were getting on the air by the millions . . . asking about smokey and generally rag chewing. As one drove down the highway, just about every tenth car had sprouted a CB whip.

The announcement that there would be 40 channels, but that the new sets could not be purchased for six months, put an instant freeze on sales. Those shiploads of 23-channel sets were still coming in from Japan and the factories were turning them out by the hundreds of thousands. Within days, the shelves of dealers in the US became loaded and orders were frantically being cancelled. It took several months to shut down the flood of equipment being made in Japan and get the ships unloaded into warehouses all over our country. It was a disaster.

The bright side was that

come January, the industry would be allowed by the FCC to sell the new, cleaner 40-channel sets and then everything would be alright again. The manufacturers cheered each other up at meetings with plans for setting the prices high at first in order to make up for the losses. Other firms kept telling each other that it wasn't as bad as it looked. I went to some of these industry meetings and I have tapes of the self-delusion which was going on.

The manufacturers tried to get the FCC to move the deadline ahead so they could at least start selling their new sets during the Christmas rush, but the FCC was not to be moved . . . nor were the CB sets. You could now buy 23-channel sets for half their parts costs almost anywhere. I saw nice sets going for $10 and $20, and going begging. This was when I got started with the idea of hams buying them and converting them for 10m use. Unfortunately, only a few thousand were converted. Pity; I think hams missed out on a good and very inexpensive new band as a result. But this was at the bottom of the sunspot cycle and ten was stinko, so the 10m AM band did not catch on.

January finally arrived and suddenly the industry discovered that CB was no longer a fad. The movies were forgotten . . . the TV shows cancelled . . . even the hit CB songs were now oldies and CB joined the hula hoop in unpopularity. The great plans for making a killing on the new sets evaporated as prices skidded in a desperate effort to drum up sales. It didn't work and we then saw the major manufacturers folding up, one after the other. Pride collapsed. Johnson suffered terribly, but their commercial radio sales kept them in business. Hy-Gain disintegrated, with the ham end of things being picked up by Telex . . . and doing quite well, thank you.

Like millions of others, I have a CB set in my car, but I don't use it very much. It's handy when there are traffic problems or I am going on a trip and want to know if there are radar checkpoints ahead, but other than that it is just there in case of need.

The greed of the industry brought about its collapse. Unfortunately, this has had some effects upon amateur radio . . . and I've written about them recently. The CB craze also supported the HF band sales of ham gear, making hams have to wait to get equipment. Then, when CB sales . . . and HF sales, too . . . faded away, hams bought a lot of HF equipment and this caused many ham dealers to expand their business. Our ham clubs had set up classes and these were fed by CBers and HFers, making recruitment of new hams easy. Then, when CB went away, so did the recruits, and the result is that today amateur radio newcomers are few and our population is again decreasing . . . and ham dealers are hurting.

Fortunately, I think there are some things which we can do to get newcomers coming into amateur radio again . . . and I think I have some ideas which will bring amateurs back into building gadgets and buying new equipment. I will be discussing my plans for reviving amateur radio at the January Aspen Ham Industry Conference. I'll go into more details on this in future issues of *73*. I can't do this alone . . . but I can provide support for those who want to do something.

The FCC recently asked for comments on the proposed CB use of 900 MHz and I wrote up a lengthy proposal for that band. I do think that it will be possible to generate billions of dollars in sales of CB equipment for this band if it is established as I have proposed. I'll try to get my proposal for this into *73* in the near future for those interested in the concept. I have not proposed a service anything like the present CB eleven-meter mess. My idea is to provide a communications service more like the one originally intended by the FCC for CB. It would provide personal communications virtually anywhere at any time wanted. It would interface with the telephone, with computers, with beeper callers, etc.

Well, I'm sort of sorry about the drop in imports, but not too sorry. I do think that we should pester the hell out of our representatives in Washington to get rid of the capital gains tax so we will have investment money to rebuild our high technology industries. And we need to do this before we lose the last of them . . . microwaves and microcomputers.

THAT BANDWIDTH PROBLEM

An eon or two ago we suffered through a well-intentioned effort by the FCC to fix up our rules and permit some experimentation. But, as usual, there was more misery in the proposal than benefit, so amateurs overwhelmingly voted the proposal down.

We do have some ham frequencies where we have congestion. Ask any Novice about that. But, on the whole, we don't have any serious problems with finding frequencies to use for communications. We've built up something on the order of 4,000 or more repeaters for VHF communications . . . with a bit of a tight fit here and there, but accommodated overall. On the low bands, we do run into more signal packing than we like on weekends and during contests, but if you are even slightly adventurous, you know that we have lots of open channels.

During much of the day and night, the 20-meter band—at least the Advanced portion of it—has room for more signals. The General part is often filled with bunches of nets and presents more of a problem in finding open channels. I defy you to find a time when 15 meters is open and you are unable to find an empty channel . . . ditto ten meters. Lots of 'em.

But when we start talking in terms of getting more hams, we have to start thinking in terms of eventually solving a crowded band situation. To a large degree, we can spread out our hamming, using the off-hours for more interference-free contacts. But if we are going to think in terms of doubling or tripling (or more) the ham population of our country, then we have to start thinking in other terms.

I do have some technical ideas which may forever change amateur radio. I'll be developing these in conjunction with the ham industry and I think you'll like what I have in mind. I think it may revolutionize much of our operation.

Before we get into serious technical developments, I think we can look more carefully at amateur radio and the frequencies it requires. Of course, the concept of frequency is deceptive since we are actually talking about a factor which might be considered to be frequency x time. If you look at amateur radio communications as using a resource which is the product of frequency channels and time . . . what in computer terms is called "throughput" . . . we can get a better grasp on what is happening and what we may be able to do to improve the situation.

There are sampling techniques which remove about 80% or more of speech and you can't tell the difference. We may eventually get into some sort of time multiplex system which would enable us to stack five to ten contacts all on one channel without serious interference between them.

Then there is the redundancy of the English language. There are many techniques for compacting English messages so they will take much less time to transmit. But, speaking of redundancy, how about the average ham contact? Think how much that could be compacted with little, if any, loss of intelligence.

We do have several different basic types of ham communications. Some are much more adaptable to compacting than others. Take the average DX contact for the purpose of getting a new country . . . the callsign, report, and a confirmation are all that is needed. Now, obviously, that could be made a good deal more efficient than it is at present, list operations notwithstanding.

It may be possible for future DXpeditions to conduct a two-way contact with eager DXers, all within two seconds per contact. The bandwidth might be a bit more than we are using today, but the goal is exchanging information efficiently, and in this we want to take advantage of every minute that the band is open to a certain area. We can afford to expend frequency spectrum to buy time. If we are transmitting our callsigns at a speed of, say, one hundred words per minute, then it will take about one one-hundredth of a minute to send a callsign . . . that's about a half second.

By automating these DXpedition contacts and contacts with rare countries, we could salvage a good deal of the low end of 20 meters. This would provide more channels and time for hams to swap basic station information . . . which seems to take up a good deal of the ham spectrum. Again, this could easily be automated and most of the station data communicated within one second or two with some encoding standards.

But what about the rag chewers, you may ask. Well, if we are able to streamline the DX contacts, the hello-goodbye contacts, and contests, wouldn't that leave a lot more time and frequencies for rag chewing? But, you may argue . . . and I wouldn't blame you . . . rag chewers don't talk about anything much anyway. Well, maybe *you* don't, but *I* do. The fact is that I enjoy talking. I'm not quite so good on listening, but then neither are you. So I'll put up with you talking a lot as long as you'll put up with me doing the same.

Oh, I enjoy DX contacts, too, and I will get just as excited as you when the day comes and my printer occasionally prints out a line to let me know that my station has made another rare DX contact. Perhaps I would like to have a bell which would announce every ten new countries contacted.

Seriousness aside, I think we are going to be able to accommodate a lot more hams on our bands if we start thinking more in terms of throughput and automating those functions which can best stand the gaff.

OBJECTIVE RADAR REVIEW

Last May, Judge Nesbitt of Miami apparently got fed up with the police assurances that radar evidence against a motorist was unimpeachable evidence of speeding. He called in both the proponents of radar and the opponents and heard nine days of testimony from engineers. This is the first known time when both sides of this field have had an opportunity to put their evidence on the line.

The judge's opinion was clear: Police radar, as now used, is unreliable and was not admissable in his court as evidence in speeding cases. He went into considerable detail about this, citing poor radar equipment and poor officer training as being the major problems. He found that certain types of radar could be dependable if used by knowledgeable officers under light traffic conditions.

Testimony on the cost of radar units surprised the judge (and me). He found that a $2,395 list price unit could be had in quantity for $375 . . . with the manufacturer still making a good profit. That would mean a manufacturing cost of around $100 . . . which might explain why so many radar units are not dependable. It was found that perhaps 30% of the speeding tickets go to the wrong person, leading more and more people to have less and less enthusiasm for supporting our system of police and justice.

The judge suggested some changes which, if implemented, might make radar evidence of more value. He said that the width of the radar signal should be narrowed considerably. Present units run to as much as 24°, which means that officers often have to just guess which car they are trying to read. Engineers testified that beamwidths could be brought down to around 2° without great expense.

Next, the judge suggested it was time to get rid of the buzzers, which were very undependable, and use direct reading systems. All of the gadgets which have been added make the systems less reliable. He said police should stop using moving radar, phase locked loop detectors, automatic speed locks, and beam interrupters. With the moving radar, it was testified that no matter how well trained an officer is, a certain percentage of the tickets handed out will be incorrect.

He recommended that police departments set up their own training and not depend upon manufacturers for this . . . or hire a consultant. Officers should be trained to understand how the equipment works *and* its limitations.

The judge felt that our judicial system will only work when people are treated fairly . . . and the present use of radar is defeating this concept.

My thanks to W2JTP for sending in this item.

SATELLITE TV FANS — GOOD NEWS!

Though many experimenters were not bothering to get one, until recently the FCC required a license for receiving signals from the TV satellite. The Commission moved recently to eliminate this requirement, so the lid is off on receiving these signals.

Considering the popularity of this . . . we might call it a hobby . . . I suspect we will be seeing better and better receivers coming available for this service . . . and at lower and lower prices. I noticed an ad by International Crystal (ICM) for a satellite receiver priced at $1995. It does take a fair-sized dish plus a low noise receiver to pull in these signals.

The receiver for the MDS signals we published in the August issue of *73* created quite a stir . . . and all sorts of attacks on us by the Common Carrier Association of Telecommunications (CCAT). They petitioned the FCC to take away the ham licenses of everyone involved in the publishing . . . plus asked the FCC to go for criminal action and assorted fines. I'll try to publish the public record on this in fine print for those who enjoy legal matters. The whole thing is nonsense.

CCAT backed up the petition to the FCC with a suit in a federal court, which is a big pain in the . . . er . . . neck. I sure hope that this attempt at what I think of as legal terrorism backfires and ends up with a clear statement by the courts that there are no restrictions on receiving satellite or MDS signals . . . which I know has to be the case. This might turn hundreds of firms loose with receivers for these signals and really give them trouble.

The FCC action on the satellite reception appears to open up the possibility for experimenters to not only receive the signals, but also to relay them via cable to friends on a nonprofit basis.

POLITICIANS . . . UGH!

The other night, while listening to a talk by New Hampshire's Senator Humphrey . . . one of those things one gets into as a member of the Chamber of Commerce . . . I got to thinking about politicians. Somewhere, in an article published recently, there was a description of the politicians we had back during the formative years of our country. It seems that in those days we did not have professional politicians . . . just people who were interested enough in their country or state to offer their time . . . usually for one term.

One of the results of this was that politicians of those days were not faced, immediately upon being elected, with the goal of getting reelected. This meant that they could be a lot more objective and vote for things which seemed in the best interests of their constituents.

Humphrey brought this to mind when one of the people present asked him how he was able to vote the way he thought best rather than follow popular emotions the way most senators do. He said that he had run for office because he wanted to try to do something about the mess things were in and that since he didn't really care whether he was reelected or not, he was completely free to do what seemed best.

We get so swept up in the power of the vote that we tend to forget that we have not yet decided to put all matters of public interest to a vote . . . only the election of our representatives. Most of us are so busy with making a living, with problems of loving, and with all the other factors which make or break our day, that the rush of major events is reduced to news—entertainment on television or in the newspaper.

There is no practical way that all of us . . . or even most of us . . . can find out enough about what is going on—and recognize the myriad of contributing factors—to be sure of coming up with the best solution to these problems on every occasion. If we are realistic about this, it is a tough job even for the people we've chosen to look out after these interests. But what do we do? We elect someone to office and then we try to put on the pressure to get him (or her) to vote according to our emotions or according to our own far-from-well-informed understanding of what is going on.

Congressmen, ever vigilant to pressures from the voters who will reelect them, bend in the winds of public emotion, trying to outshout each other to agree with the largest group. As a result, we are in one hell of a mess.

Heck, I see this to some extent even in the world of amateur radio. I've been around long enough and been in a position to know, probably better than anyone else, what has happened in the past to mold the way things are now . . . and to see how present emotions are molding the way things are turning. I've watched the great majority of amateurs take little interest in what is happening until something comes along which hits home . . . and then there is a blast of emotion, usually in the wrong direction because they have not been paying attention.

Senator Humphrey spoke on SALT and oil company profits. In both cases, it was clear that he had done a good deal of research and had a very good understanding of the situations. It seems to me that this should be the purpose of paying a senator . . . to get the facts on situations and then represent us as an expert and vote appropriately. He should do that even if I am sending him telegrams to do the opposite. The time for my input is when I have facts for him . . . facts he has no way of getting elsewhere . . . and when it comes time for me to assess his ability to see through the baloney and vote in the best interests of those of us who elected him.

The media . . . and I include television in particular . . . are out selling their product. If you are able to get the facts through all that emerdement, then you are a surprising person. When I see acts of terrorism, I also see money and power going to the media, for they play to our emotions with their coverage. Without television and the press, I doubt if there could be terrorism as we see it today. Terrorist groups have studied our media and know how to take advantage of it to get the maximum play.

Do you think that the Iranians would have taken US hostages if the whole thing would have been known only to our government? No, they knew that this would be on television all over the world . . . in special editions of the papers . . . in whole special issues of news magazines. We are in a time of the media and we are a prisoner of it. Oh, I'm watching the damned television news, too . . . cursing myself as I do it. I wonder if it is much different from going to the arena in Rome to watch the Christians get exercised by the lions.

No, I don't have any alternative to offer. I'm not in favor of censorship of the press, as much as I think their freedom is causing great changes in the world . . . and not necessarily for the better.

But perhaps, if we look at the TV news and recognize that each of the networks is battling for a tenth of a point increase in the ratings, we will better understand that we are being used by them to make money. They know exceedingly well how our emotions work and they are hard at it to produce the most reaction . . . and are succeeding. There is probably no way to keep us from turning on the news and watching in growing horror as they interview the relative of a victim, wondering if we should give in to terrorism and do what they want . . . not realizing that it is the media which is making the terrorism work . . . and our watching which feeds the media. We are the ones who agree to be terrorized.

Getting back to our representatives and their obsession with getting reelected . . . I wonder what changes it would make if all senators and reps were allowed just one term in office. Sure, we might lose some good talent, but it would make a big change in the type of people running for office and it might free us from the entrenched interests which have been running things for so many years. We might even be able to cut down on government. The few good people who would be lost to us would be more than compensated for by the garbage which would get thrown out.

Senator Humphrey was perhaps a bit more candid than he should have been when he spoke so contemptuously of the great majority of congress . . . but he sure is in a spot to know.

WAYNE'S PICTURE ALBUM

Every now and then, I look through some of the piles of pictures I've taken down through the years and I suspect that some readers may be interested in seeing some of them. I'll try to put a few into the magazine now and then, covering events which are recent . . . or long ago.

This is a picture of Bill Godbout (Godbout Electronics) which I snapped at NCC in New York last year. I think they conned Bill into attending NCC by getting him to participate in a panel discussion on the future of personal computing. Unfortunately, the several important things that came through as a result of this panel seem to have been lost in the rush of wind from many other talks and discussions. I get the impression that revealing anything important at an NCC session is a sure way of keeping it a secret from the world. Yes, I know about the mighty volumes published which contain the printed record of these talks, but I haven't seen any sign that these are ever opened by anyone.

The key here may be that these talks are for free and there is the concept that free things are not usually worth much. One of the same papers, published in a magazine as an article, would get maybe a thousand times the recognition. I suspect that a lot of talent and work has been virtually thrown away on papers for the technical talks at computer shows such as NCC and the Faires.

Well, getting back to Bill, take a good look at him here . . . before the telephone implant which is certain to be made. Bill spends about 26 hours a day on the phone. Bell, I understand, is planning on dedicating the new wing of their Oakland office to Bill. But, if you want to know what is going on in the microcomputer field, ask Bill. He's better than any newsletter. And if you want any hard-to-find IC, you can bet that he either has a ton of them or knows where they are. He's been building up a dealer network handling his ICs by virtue of his infallibility in finding sources.

When Bill gets together with George Morrow and Tom Mullen, hold onto your intellectual stirrups. The ideas flow thick and fast . . . enough to supply a dozen companies with products.

The NCC panel was chaired by Portia Isaacson (left), now of Innovision and EDS. This may soon be the largest mail-order and direct mail firm in the microcomputing industry. Next to her is Richard Kuzmack, who did much of the work of organizing the personal computing aspect of NCC. Then we see Bill Godbout, opining. Next is Larry Stein, then Les Soloman of *Popular Electronics*, who came up with the Altair name for MITS . . . and for whom the Processor Tech SOL was named. And last, but least, me, on the right.

Chuck Martin WA1KPS, here seen with Judy Waterman, our bulk sales manager, and Sherry Smythe, our executive vice president, is enjoying a massive amount of southern fried chicken, biscuits, gravy, Smithfield ham, and all the fixin's at Aunt Fanny's Cabin in Atlanta. This is a yearly pilgrimage during the Atlanta Hamfestival.

While Chuck is out eating, we see Eric Williams WA1HON hold down the Tufts Electronics exhibit at the Hamfestival. That's Eric pulling out a pair of crystals for an HT. Eric, by the way, is one of the regulars at the yearly Aspen ham industry conference.

Another regular at Aspen is Steve Murray K1KEC, here seen (with beard) taking a meal break during the VHF contest atop Pack Monadnock mountain, about three miles from downtown Peterborough.

Yep, there I am, speaking at the ARRL New England Convention! The announced topic was microcomputers, but this was a thinly disguised stratagem to thwart the general manager. There have been years when the manager had enough clout to prevent *73 Magazine* from even exhibiting at an ARRL convention . . . and for years there was no way that a convention committee would be permitted to put me on the speaking program.

In this case I am, in the picture, showing one of the 10-GHz transceivers which I used to make the contacts with Chuck Martin WA1KPS (of Tufts Electronics) with seven different states. The fact is that Chuck did most of the work . . . getting the rigs to work and repairing them every few days as they would break down. It does look as if it is going to be a while before we have dependable 10-GHz communications.

While I did manage to talk a good deal about microcomputers and the state of that hobby, I also was able to answer some questions about WARC and overcome, at least perhaps for the group present, some of the propaganda which has been painting me as a "purveyor of doom," as it says in so many director newsletters. I'm pragmatic about WARC, feeling that a prudent person would do everything possible to achieve success there, rather than just rely on luck.

SEPTEMBER WINNER

It pays to be honest! "Confessions of a Teenage HFer" was voted by our readers the most popular article in our September issue, so author Hans Peter will be receiving that month's $100 bonus check.

OSCAR Orbits

Courtesy of AMSAT

Any satellite placed into a near-Earth orbit suffers from the cumulative effects of atmospheric drag. The much publicized descent of the Skylab space station was a graphic demonstration of these effects.

The OSCAR satellites are subject to atmospheric drag, of course, and the present period of intense solar activity has accentuated the problem. During this period, our sun has been expelling huge numbers of charged particles, some of which find their way into the Earth's upper atmosphere, increasing the density (and thus the drag) there. It is through this region that the OSCARs must pass. OSCAR 8, in a lower orbit than OSCAR 7, is the more seriously affected of the two.

If the drag factor is not considered when OSCAR calculations are performed, long-range orbital projections will be in error. For example, by the end of 1979, OSCAR 8 was more than 20 minutes ahead of some published schedules. The nature of orbital mechanics is such that extra drag on a satellite causes it to move into a lower orbit, resulting in a shorter orbital period. Thus, the satellite arrives above a given Earthbound location earlier than predicted.

Using data supplied to us by Dr. Thomas A. Clark W3IWI of AMSAT, the equatorial crossing tables shown here were generated with the aid of a TRS-80™ microcomputer. The tables take into account the effects of atmospheric drag and should be in error by a few seconds at most.

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

At press time, OSCAR 7 was scheduled to be in Mode A on odd numbered days of the year and in Mode B on even numbered days. Monday is QRP day on OSCAR 7, while Wednesdays are set aside for experiments and are not available for use.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 8 is in Mode A on Mondays and Thursdays, Mode J on Saturdays and Sundays, and both modes simultaneously on Tuesdays and Fridays. As with OSCAR 7, Wednesdays are reserved for experiments.

OSCAR 7 ORBITAL INFORMATION FOR JANUARY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
23456	1	0005:48	69.0
23469	2	0100:05	82.6
23482	3	0154:21	96.2
23494	4	0053:40	81.0
23507	5	0147:56	94.6
23519	6	0047:16	79.5
23532	7	0141:32	93.1
23544	8	0040:51	77.9
23557	9	0135:07	91.5
23569	10	0034:27	76.4
23582	11	0128:43	89.9
23594	12	0028:02	74.8
23607	13	0122:18	88.4
23619	14	0021:38	73.2
23632	15	0115:54	86.8
23644	16	0015:13	71.7
23657	17	0109:29	85.3
23669	18	0008:49	70.1
23682	19	0103:05	83.7
23694	20	0002:24	68.6
23707	21	0056:40	82.1
23720	22	0150:56	95.7
23732	23	0050:16	80.6
23745	24	0144:32	94.2
23757	25	0043:51	79.0
23770	26	0138:07	92.6
23782	27	0037:27	77.5
23795	28	0131:43	91.0
23807	29	0031:02	75.9
23820	30	0125:18	89.5
23832	31	0024:38	74.3

OSCAR 8 ORBITAL INFORMATION FOR JANUARY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
9295	1	0035:54	57.6
9309	2	0040:54	58.8
9323	3	0045:54	60.1
9337	4	0050:54	61.4
9351	5	0055:54	62.6
9365	6	0100:54	63.9
9379	7	0105:54	65.2
9393	8	0110:54	66.4
9407	9	0115:54	67.7
9421	10	0120:54	69.0
9435	11	0125:54	70.3
9449	12	0130:54	71.5
9463	13	0135:54	72.8
9477	14	0140:54	74.1
9490	15	0002:41	49.5
9504	16	0007:40	50.8
9518	17	0012:40	52.1
9532	18	0017:40	53.3
9546	19	0022:39	54.6
9560	20	0027:39	55.9
9574	21	0032:38	57.1
9588	22	0037:38	58.4
9602	23	0042:37	59.7
9616	24	0047:37	61.0
9630	25	0052:36	62.2
9644	26	0057:36	63.5
9658	27	0102:35	64.8
9672	28	0107:35	66.0
9686	29	0112:34	67.3
9700	30	0117:33	68.6
9714	31	0122:33	69.8

OSCAR 7 ORBITAL INFORMATION FOR FEBRUARY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
23845	1	0118:54	87.9
23857	2	0018:13	72.8
23870	3	0112:29	86.4
23882	4	0011:49	71.2
23895	5	0106:05	84.8
23907	6	0005:24	69.7
23920	7	0059:40	83.2
23933	8	0153:56	96.8
23945	9	0053:16	81.7
23958	10	0147:32	95.3
23970	11	0046:51	80.1
23983	12	0141:07	93.7
23995	13	0040:27	78.6
24008	14	0134:43	92.1
24020	15	0034:02	77.0
24033	16	0128:18	90.6
24045	17	0027:37	75.4
24058	18	0121:53	89.0
24070	19	0021:13	73.9
24083	20	0115:29	87.5
24095	21	0014:48	72.3
24108	22	0109:04	85.9
24120	23	0008:24	70.8
24133	24	0102:40	84.3
24145	25	0001:59	69.2
24158	26	0056:15	82.8
24171	27	0150:31	96.4
24183	28	0049:50	81.2
24196	29	0144:06	94.8

OSCAR 8 ORBITAL INFORMATION FOR FEBRUARY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
9728	1	0127:32	71.1
9742	2	0132:31	72.4
9756	3	0137:30	73.6
9770	4	0142:29	74.9
9783	5	0004:16	50.4
9797	6	0009:15	51.6
9811	7	0014:14	52.9
9825	8	0019:13	54.2
9839	9	0024:12	55.4
9853	10	0029:11	56.7
9867	11	0034:10	58.0
9881	12	0039:09	59.2
9895	13	0044:08	60.5
9909	14	0049:06	61.8
9923	15	0054:05	63.0
9937	16	0059:04	64.3
9951	17	0104:03	65.6
9965	18	0109:01	66.8
9979	19	0114:00	68.1
9993	20	0118:59	69.4
10007	21	0123:57	70.6
10021	22	0128:56	71.9
10035	23	0133:55	73.2
10049	24	0138:53	74.4
10062	25	0000:39	49.9
10076	26	0005:37	51.1
10090	27	0010:36	52.4
10104	28	0015:34	53.7
10118	29	0020:33	54.9

Ham Help

Several months ago, a letter was printed from Dick Jastrow, a blind would-be ham in California (August, 1979, p. 168). He asked for help in preparing for his exams in the code as well as theory. Apparently, there were a number of responses, but, in moving from one hospital to another, most of these letters got lost.

Dick recently answered my own letter and requested that I write to see if some hams in the Los Angeles area would reestablish contact. I am sure that contact with blind amateurs would be especially valuable.

Although I am now inactive on the air, I am happy to help prospective hams if they ask me.

Dick's address is Richard Jastrow, Long Beach General Hospital, ward 800-A, 2597 Redondo Avenue, Long Beach CA 90806, (714)-427-9951, ext. 247.

Bill Withrow W5BZY
211 N. 8th Avenue
Teague TX 75860

I need the following states for my WAS award: Alaska, North Dakota, Nevada, and Delaware. If anyone would like to exchange cards, it would be appreciated. I have a General class license and can operate on 10-40 meters, CW or SSB.

Paul Gonicberg N1APW
265 Blackstone Blvd.
Providence RI 02906

I need to borrow for a few days the operating manual and the maintenance manual for a Dumont scope, type 329. I will return it promptly with reimbursement for postage.

Lloyd H. Yost K2YJP
Telecommunications
Technology Center
1 Research Drive
Shelton CT 06484
(203)-929-7341, Ext. 746

I need a schematic for a Heath general coverage receiver, the GR-91, with a 1961 copyright. The manual number is #595-492-01. I also need to know the specs on part #40-396, the band D antenna coil for the same rig, if at all possible.

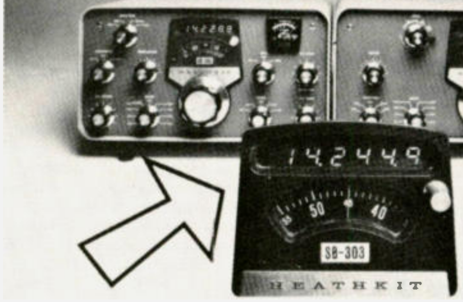
I will be glad to pay copying expenses and postage. Thanks very much for any help.

Dr. Richard Sanchez
1805 Adeline
Hattiesburg MS 39401

I need a schematic or manual for a Hallicrafters model S-38. I will pay copying costs or copy myself.

Chuck Bennett WB8GQW
5667 Nike Drive
Hilliard OH 43026

NEW DIGITAL READOUT



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SB-300 use DMK-300	SB-400 use DMK-400
SB-301 use DMK-301	SB-401 use DMK-401

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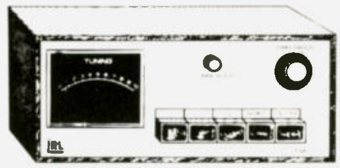

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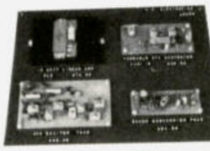

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FCC

Reprinted from the Federal Register.

Eliminating Applicability From the Six Meter Frequency Band (50–54 MHz)

AGENCY: Federal Communications Commission.

ACTION: Notice of Proposed Rule Making.

SUMMARY: The Commission issues a Notice of Proposed Rule Making which proposes to allow frequency modulation telephony (F3) operation with more than 6 kHz over a greater segment of the 50 to 54 MHz (6 meter) amateur radio band. Deletion of the 6F3 limitation from the 6 meter band would offer much more flexibility for the amateur radio community.

DATES: Comments must be received on or before December 10, 1979 and Reply Comments must be received on or before December 26, 1979.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT: Federal Communications Commission, Private Radio Bureau, Personal Radio Branch, Roy C. Howell (202) 254-6884.

In the matter of amendment of § 97.65(c) of the Commission's rules and regulations governing the Amateur Radio Service.

Adopted: October 25, 1979.
Released: October 31, 1979.

By the Commission:

1. On September 11, 1978, the Southern California Repeater and Remote Base Association (SCRRBA) petitioned for amendment of Part 97 in RM-3207 to allow frequency modulation telephony (F3) operation having an occupied bandwidth with more than 6 kHz over a greater segment of the 50 to 54 MHz (6 meter) amateur radio band. Subsequently, on January 16, 1979 the American Radio Relay League (ARRL) petitioned for a similar but not identical, rule change in RM-3313.

2. Frequency modulation is permitted now from 50.1 to 54 MHz (§ 97.61(a)), along with A1, A2, A3, A4, A5, F1, F2 and F5. However, § 97.65(c) requires ". . . between 50.1 and 52.5 MHz, the bandwidth of an F3 emission (frequency or phase modulation) shall not exceed that of A3 emission having the same audio characteristics . . .". Since an A3 emission (amplitude modulation telephony), in this instance is normally considered to occupy a bandwidth of approximately 6 kHz, F3 operation between 50.1 and 52.5 MHz is limited to an occupied bandwidth of 6 kHz (6F3).

3. In support of its request, SCRRBA states that permitting occupied bandwidths greater than 6F3 would result in increased occupancy between 52 and 52.5 MHz by amateur stations using repeaters. Moreover, they claim it is possible some non-repeater operation using 16F3 (16 kHz occupied bandwidth standard) would occur between 51 and 52 MHz. SCRRBA requests the 6F3 limitation be stricken entirely from applicability to the 6 meter band.

4. Numerous comments were filed in support of SCRRBA's petition by various amateur radio groups. However, the Six Meter International Radio Club filed comments claiming the proponents of RM-3207 have overlooked the rapid expansion in single sideband operation (A3J) in the six meter band. They question the need for additional repeater operation.

5. In support of its request, ARRL also states that permitting occupied bandwidths greater than 6F3 would permit ". . . the fullest possible use . . . of the repeater subband 52.0–54.0 MHz . . .". ARRL requests the 6F3 lower limit be moved only from 52.5 MHz to 52.0 MHz. Comments from amateur radio groups were also filed in support of the ARRL petition, including comments from SCRRBA. However, SCRRBA takes exception to the ARRL's proposed new lower limit of 52 MHz, stating they strongly believe 52 MHz is not appropriate. They argue that a more useful lower limit would be 51 MHz, and go on to reiterate their own proposal (RM-3207), for striking the 6F3 limitation from applicability to the 6 meter band. They state they " . . . seek the same flexibility for usage of this band as ARS (Amateur Radio Service) operators enjoy on the frequency bands above 144 MHz". The 6F3 limitations does not apply to these bands. SCRRBA also claims the ARRL petition would " . . . not facilitate the optimum utilization for this frequency band".

6. We believe that deletion of the 6F3 limitation from the 6 meter band would offer much more flexibility for the amateur radio community. As technology and interest in the many types of modulation schemes evolves, resolving sharing arrangements by the participants themselves would seem to be the most expeditious means for fulfilling the purposes of the service. Apparently, such has been the case on the 144 MHz, 220 MHz, and 420 MHz amateur radio frequency bands. This should also be the case for the 6 meter band. For the most part, 50 MHz has many of the characteristics of the higher frequency bands. For these reasons, the Commission proposes to amend § 97.65(c), as shown in the Appendix, to delete the 6F3 limitation from the 6 meter band. Comments on the amateur radio operators' ability to effectively resolve sharing arrangements, in this instance, are particularly invited. The Commission also proposes to delete the phase " . . . and the purity of emissions shall comply with the requirements of § 97.73" in the interest of eliminating redundancy. The purity and stability requirements would remain in effect, as stated in § 97.73.

7. Authority for issuance of this Notice is contained in Sections 4(i) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i) and 303(r). Pursuant to procedures set out in Section 1.415 of the Rules and Regulations, 47 CFR 1.415, interested persons may file comments on or before December 10, 1979, and reply comments on or before December 26, 1979. All relevant and timely comments will be considered by the Commission before final action is taken in this proceeding. In reaching its decision, the Commission may take into consideration information and ideas not contained in the comments, provided that such information or a writing indicating the nature and source of such information is placed in the public file, and provided that the fact of the Commission's reliance on such information is noted in the Report and Order.

8. In accordance with the provisions of Section 1.419 of the Rules and Regulations, 47 CFR 1.419, formal participants shall file an original and 5 copies of their comments and other materials. Participants wishing each Commissioner to have a personal copy of their comments should file an original and 11 copies. Members of the general public who wish to express their interest by participating informally may do so by submitting one copy. All comments are given the same consideration, regardless of the number of copies submitted. All documents will be available for public inspection during regular business hours in the Commission's Public Reference Room at its headquarters in Washington, DC.

9. For further information concerning this rule making, contact Roy C. Howell, Rules Division, Private Radio Bureau, Federal Communications Commission, Washington, DC. 20554, (202) 254-6884.

Federal Communications Commission.
William J. Tricarico,
Secretary.

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

In section 97.65, paragraph (c) is modified to read:

§ 97.65 Emission limitations.

* * * * *

(c) On frequencies below 29.0 MHz the bandwidth of an F3 emission (frequently or phase modulation) shall not exceed that of an A3 emission having the same audio characteristics.

LETTERS

from page 26

you going to harp on incentive licensing? After being a ham dropout for many years, I studied up a bit and got my Extra class back in 1963, long before the days of special callsigns. I did this mainly because I wanted to get permission to try out a couple of special modes of operation and thought I would have a better chance of getting permission from the FCC. Another reason for the Extra was to be able to operate in a portion of at least a few bands that would not be so full of signals. I guessed right in both cases.

So what's the big hassle about? Too many fellows wanting something for nothing, and quite willing to fight for just that? Sounds like a labor union.

Keep hounding the ARRL—they need it . . . even if a lot of it looks like nitpicking from out here in the boondocks.

Dave Hardacker W7TO
Sheridan WY

RADAR DEFENSE

I just read on page 171 of the October issue about illegal radar and hasten to write to caution all hams not to jump to conclusions. Radar principles have been well established, but the DC courts seem to base decisions on intrusion into the rights of private citizens rather than faulty radar. I do not think this is the best approach for a defense to a radar ticket.

For now, readers will be well informed to know the tests for law enforcement equipment, since it is up to the state to prepare a proper foundation for the evidence.

Some courts have found adequate foundations in various combinations of the following three means of testing radar speedometers:

1) A "run through" in which another police car closes on the site while holding a given speedometer reading (Query: How do we know the testing vehicle has been checked?);

2) Use of *calibrated* tuning forks intended to produce frequencies which will cause the machine, if accurate, to read particular speeds;

3) Use of a signal generator within the machine for the same purpose.

I know that in Massachusetts some foundation requirement is appropriate per a recent decision of the Supreme Judicial Court.

Duncan Kreamer W1GAY
Attorney at Law
Vineyard Haven MA

QSL STAMPS

This may be an old idea, but it has just occurred to me: Why not start a drive with the US Postal Service to come up with a 31¢ airmail stamp commemorating amateur radio?

This is the stamp that is used on most direct QSL mail and would be sent to every country in the world over a very short period of time. It could be themed, "Peace Over All The World Through Amateur Radio Fellowship."

Loren Carlberg WB5WDG
Muskogee OK

UV-3 REVISITED

I had to comment on the review of the Drake UV-3, as printed in the October, 1979 (p. 31), issue.

The two features that the author noted as "could have been left out" are, in my opinion, most valuable. I think that any serious amateur who has these

Continued on page 159

4" x 2⅜" x 6"

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DX

from page 16

with help from several of the standard list-takers. A51PN and 9N1MM were welcome guests on both 20 and 15. YI1BGD still comes and goes and remains difficult for those strapped to a Monday-Friday work schedule.

New officers of the Iowa DX Association are: KØJSY, president; WØWP, vice president; KØLUZ, secretary-treasurer. The National Capitol DX Association also elected new leaders: N4MM, president; N4RA, vice president/activities manager; W3GG, secretary; and AA4M, treasurer.

The next team going to Macquarie will include VKØKH, to continue the work on the bands by VKØPK during 1979. P29JS has done yeoman service running the 14240 slot for these and others, around 0930Z.

More operations from Desecheo appear doomed; KP4AM's try for a /D fire-up for the *CQ* Phone Contest in October was thwarted by the US government and the signs are that no one will be allowed on the rock for amateur radio purposes. YASME's hopes were similarly dashed in October.

5NØDOG is a good catch this winter on 40 and 80 meters, now that the Nigerian rainy season has passed. Dave's company, TICAS (Falls Church VA), purchased a ticket for Kunle 5N2NAS to attend WARC in Geneva last fall.

Rick Dorsch plans to move to the Galapagos (HC8) late in 1980 or early in 1981. He is just back from a visit there. Rick hails from Michigan but has been signing HC5EE from Ecuador for several years. The last American visitor to the Galapagos was Chod Harris VP2ML in early 1979.

KH6IJ continues to recover from a stroke suffered in early 1979; radio operating is still difficult for him. He has resumed his column in the Honolulu *Star-Bulletin*.

As this is written (early November), WARC continues with little news coming out of Geneva. A press gag by Secretary-General Mili has inspired the American representatives to keep the news to themselves, and the amateur radio press suffers accordingly, not only in the US, but around the world. The main item of interest has been Article 41, concerning international Morse code requirements; apparently, CW will end up being a "recommendation" above 30 MHz, that is, each licensing authority (government) will have the option of requiring or not requiring CW proficiency above 30 MHz. Talk continues of an additional band at 24 MHz. 40 meters will probably not survive unscathed, with HF broadcast interests and their megabucks at work.

A reminder to contesters: Your *CQ* WW CW logs must be postmarked by January 15 and should be mailed to the new *CQ* address: *CQ* Publications, 76 North Broadway, Hicksville NY 11801. Do not enclose any correspondence, requests, etc., with your logs. This goes for sending contest logs to any organization.

HS1ABD out of Thailand operates on 40 and 80 meters; now is the time of the year to look for him, on 7005 and 3795 at 1300Z and 2200Z, respectively.

The East Germans begin using new prefixes this month; the callsign block is Y21A to Y99Z.

Careful about sending money overseas, please. Especially going to Africa and the Himalayan countries, your dollar bills may end up in some bureaucrat's pocket instead of in the pocket of the ham you just worked. FR7BP has mentioned this, as well as A51PN.

N6AR still collects old radio books to send to deserving hams and hams-to-be around the world. 20 *ARRL Handbooks* have gone to 9J2TJ, another ten to Eastern Europe via W6YY, and N6DX and N6ZV each took a handful on DXpeditions. *You* can send your unneeded books to N6AR and help another amateur.

Finally, the ARRL International DX Competition takes place next month. As we write this, there is talk of changing the format of this long-running activity again. An editorial in *QST*'s September "Operating News" column hinted at changes to come, and the administrators in Newington are toying with a new format more closely related to the *CQ* Worldwide style, i.e., everybody works everybody. This would drastically alter the ARRL competition from the standpoint of DXing, not to mention what it would do to the *contest* aspects of the activity. It hardly seems possible they could pull off a change this late, considering the time required to pass the word around the globe, but one would be well advised to watch closely for news before February.

Please send your input for this column to *73*. Photos are especially welcome. The material for this column came from *The DX Bulletin,* Vernon CT.

Leaky Lines

from page 22

situation, and that's the plain, unvarnished truth.

***

Is there, I wonder, a possibility that the relatively recent techniques of voice printing might be used to identify chronic malicious interferers? It is said that such prints are as dependable as fingerprints in establishing individual identity, and if some means were devised to extrapolate voice prints from audio signals, we could go a long way toward ridding ourselves of these nuisances. The very realization that the possibility of positive identification exists might prove to be a deterrent, and perhaps this would cause them to think twice about exposing themselves to discovery.

I know very little about this branch of acoustical science, but I imagine that there are some amateurs who possess the necessary expertise to come up with the answers. If so, I hope that they will consider investigating it and developing it to a practical level so that it can be used.

After all, forty years ago, who would have predicted the use of radar to detect violators of the highway speed laws? Why not voice prints to combat deliberate QRM?

RTTY Loop

from page 14

what, you may ask, is "specialty communications"? Well, only contacts made on RTTY, SSTV, or via EME (moonbounce) or OSCAR paths will be recognized. Two levels of operating achievement will be recognized: Class A will require working all fifty US states: Class A-1 requires working ten DX countries from the *73 Magazine* WTW list.

Application should be made by submitting a list containing date, time, band, and mode of each contact. Class A lists should be arranged in alphabetical order by state, and Class A-1 lists in order of callsign prefix. A signed declaration of the type and description of your equipment and antenna should also be included. This entire package should then be verified by two other amateurs, a local radio club secretary, or a notary public, and sent with $3.00 (or 8 IRCs) for each award to: Bill Gosney WB7BFK, Awards Editor, *73 Magazine*, 2665 North 1250 East, Whidbey Island, Oak Harbor WA 98277.

The mail is continuing to come in on Teleprinter Art, Ltd., and one thing is for sure, the "didn'ts" far outnumber the "dids." So far, as of this writing, in October, 1979, about a dozen of you report sending orders to Urbana and receiving nothing. One individual received his order as requested and notes he was pleased with the merchandise. I don't know if events subsequent to his order have changed things, but I am preparing all of the material I have been sent for forwarding to the proper authorities.

So as not to end this month on a sour note, let me take a moment to highlight one of *73*'s advertisers who appears to be doing a good job. Selectronics, in Philadelphia PA, has been running ads for years featuring component parts useful in the construction of video terminals and the like. A recent order from this QTH was filled promptly, with receipt of the merchandise via UPS in just a few days. One slight problem was handled quickly and efficiently by phone following receipt of the merchandise. A RTTY Loop-de-Loop to Selectronics.

Some more basics next month for those of you who have requested them, and remember to enclose that SASE if you wish a reply directly from me or any other *73* author.

RIPPED OFF?

If you have a serious problem with a ham firm, send them a letter with all the facts in detail, plainly and simply . . . and send a copy to Wayne Green W2NSD/1, c/o 73 MAGAZINE. 73 protects its readers more than any other magazine.

Looking West

from page 8

to travel through Baja; most listen to the advice and have the time of their lives amid the splendor that is Baja California. Some people don't listen and are lost in the wilderness. Each year, the local LA newspapers and TV stations carry stories of vacationers who didn't follow the rules and found themselves lost in a territory they did not know. Many have died before would-be rescuers could find them.

Baja is not immune from the rampages of Mother Nature herself. Her annual rainfall equals or exceeds that of southern California, and in this type of area, it means that communities are easily cut off from one another. Overall communication in Baja is not the greatest. It is for these reasons and others that the amateur community of Baja has undertaken to tie the area together using many existing amateur repeaters.

Phase one of the intertie involves five existing northern Baja repeaters: .93/.33 in Tijuana, .34/.94 some 40 miles south of Tijuana, .31/.91 in Mexicali, 145.34/144.74 in Ensenada (remember that Mexican amateurs have an advantage in that they are not restricted by repeater subbands as we are in the USA), and .37/.97, which sits about 8,000' above average terrain and can be worked from as far north as Santa Barbara, California, even though it's better than 200 miles south of the US-Mexican border. What you are reading about is not a dream. It already exists, giving hand-held saturated coverage throughout northern Baja.

Phase two involves linking further south about 200 miles to XE2ERD on 145.5/144.9 and then to Cedros Island, where a new system will have to be established using some form of "nature power," i.e., wind, solar, etc. There is no place to just "plug in" a repeater at that location. Once accomplished, about ¾ of Baja will have linked coverage and it won't end there. Alex also informed us that long-range plans call for linking to the Mexican mainland from someplace near Mazatlan and that amateurs in Mexico City are already at work creating plans for a nationwide interlink. What's truly amazing about the Baja story is that what has thus far been accomplished has been the work of about six dedicated amateurs.

What about Americans using the interlink? Is it legal? Only if you access it from the US side of the border or have obtained a Mexican amateur license to operate in Mexico. At present, no reciprocal licensing exists between the US and Mexico, although it is hoped by amateurs on both sides that someday it will. Meantime, to operate in Mexico, you must pass a Mexican amateur exam, and Mexican amateurs wishing to operate in the US must pass our exam. Exceptions are made during certain special events, such as off-road rallies, but remember that these are exceptions rather than the rule. As already stated, it is legal for US amateurs operating from US soil to talk with Mexican amateurs through Mexican-based repeaters. Many of the systems that lie near the US-Mexican border are accessible from a vast portion of southern California. If you are planning a visit to southern California, especially the San Diego area, you might try saying hello on one of the frequencies listed previously. I suspect you will find a warm welcome from our neighbors to the south.

Two final notes. Anyone interested in contacting Alex about the Baja intertie can do so through his *Callbook* address or through Looking West. Also, we will keep you posted on developments in this intertie as they occur.

Meanwhile, stateside, we received a letter from Ron Johnson WA5RON which reads as follows:

Dear Bill,

I always read your interesting columns in *73 Magazine*. I especially enjoyed the recent October issue where you suggest "growing" regional, and eventually national, VHF intertie systems by linking existing repeaters on UHF. I, too, am interested in intertie and am participating with others in a major UHF linking project in Texas. I would like very much to join in an information exchange program with other intertie builders around the country.

Since you quoted from the Texas VHF-FM Society *News* and W5OGZ, you may already be aware of our Texas Intercity Relay System project. TIRS will eventually link VHF simplex or repeater "dump" stations in major Texas cities. San Antonio and Austin are already connected. Equipment is being installed by local clubs in Dallas, Houston, and Beaumont at this time. Groups in other cities and towns have expressed interest in linking up. This intertie system is a grass-roots effort, local clubs or individuals providing the necessary equipment in their own area, with coordination and technical support from the state society. TIRS is a wide-open system, carrier operated, and any ham is invited and encouraged to use it. TIRS had a disaster communications objective, and its readiness for emergency use is best demonstrated and practiced by frequent recreational use. Teletype signals, as well as voice, are welcomed on the TIRS frequency. It is not an "elite group" or by-subscription-only system.

I had not thought in the past that Texas was "west" enough to catch your interest, but since you asked for input on the intertie subject, I am sending you this info about TIRS. If you like, I'll be glad to keep you posted on future developments.

I would enjoy reading about other successful intertie efforts, either in your column or as articles in good ol' *73 Magazine*. Why don't you dig something up on the CACTUS network? I have enjoyed a QSO or two on that system during trips west of El Paso and have seen not one technical publication on CACTUS, except for their user's manual. An article describing the CACTUS hardware, control circuits, pictures of mountaintop sites, maps showing coverage, would be very good. Can't you goad those fellows into letting go of the soldering iron for a few minutes and sitting down to a typewriter? Surely the network isn't considered "secret" anymore. An article or just a short description in "Looking West" would be nice.

Those of us working on the Texas Intercity Relay System would like to find out about other systems being built in states surrounding Texas, particularly those who might be interested in linking to TIRS. If you hear about anything like that within range, please let me know or give them my address. Also note that we have a weekly meeting on 80 meters LSB for planning and discussion, 2130 local (Central) time at 3830 kHz every Sunday night.

I will be watching future issues of *73* for more on this subject. Thank you.

Ron Johnson WA5RON
3524 Greystone #194
Austin TX 78731

Well, we cannot fulfill Ron's request to make the little-known details about the famed CACTUS Radio Network public unless there comes a day when CACTUS wants to go public. They are a truly phenomenal organization, but they value their privacy and we will always respect that. Maybe some day, Ron . . .

TIRS, as you have already learned, is quite public. Write to Ron at the above address for more information.

That's it this month on the Nationtie project. If more input arrives before we write next month's column, we will include it. Meanwhile, it looks as if things are beginning to take shape.

Our closing story also comes from an out-of-area amateur, Jim Eagleson WB6JNN of Watsonville, California. Jim wrote to tell us about a new 23 cm linear translator now in service in northern California. Jim writes:

"Project OSCAR, the northern California group that put together the first OSCAR satellites, just put a linear translator into service on Mt. Umunuhm in the 23 cm band (1296). Additionally, the NBC (Narrow Band Communicators) two-meter translator is nearly completed with only integration of modules, site evaluations, duplexer tune-up, and related areas left to do. It is an embryo system (as is the 1296 system), but that's where we all have to start. Some on-the-air tests will be run in a few weeks for the two-meter system. The 23 cm system has been up for about three weeks."

More on this also as it develops. In the meantime, I hope that Santa brought you your dream rig.

Ham Help

I am attempting to locate all Extra class husband and wife teams. Any Extra who had a late Extra class spouse is also eligible.

We now have a nucleus of names, so we can perhaps consider a name for the group, an occasional news bulletin, a net, a mini reunion in conjunction with other ham gatherings, and, perhaps, a charitable donation.

Those who are qualified should drop me a line with your thoughts regarding any activity that we should undertake. I will summarize the ideas in a bulletin and mail it to those eligible.

Again, thanks to all, including Chris AI6S, for helping me.

Betty Baldo KB6P
3 Eton Court
Berkeley CA 94705

I need a schematic for a Heathkit model GR-91 receiver for use with our junior high school amateur radio club.

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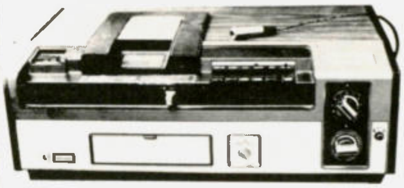

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LETTERS

from page 154

two features can, with little trouble, see that their value is one of the biggest features of the radio.

The scanning feature is great when applied to the situation of wanting to monitor another repeater for important DX news or an emergency channel. The ham listening to an active repeater for social reasons can be sure of not missing what might be of interest to him, or her, on another usually quiet repeater.

The second feature, programming capability, is a gift from the gods. Having owned the UV-3, I can vouch for the relative difficulty of changing bands or channels in the mobile mode. As the author explains, it is like a checklist in an aircraft. Being able to simply turn one knob and be in a specific channel, rather than having to set an offset frequency by removing one's eyes from the road, is a *most* valuable feature and adds to safe mobile operation with this radio.

The programming of the diode boards is quite prone to errors, but not impossible. As a matter of fact, Drake offers to send you a diode placement chart to use as a guide in placing the diodes in the proper spaces.

Wallace B. Shapiro N2WS
North Woodmere NY

TO THE HILT

I am writing to you about the constant attacks on the ARRL you levy almost every month in your Never Say Die column.

After reading many of these editorials, I have come to the basic conclusion that you are trying to help the League realize its mistakes. I personally do not think that you are trying to tear down the ARRL, although one must admit that you take some pretty good stabs at it.

Many times you make comments about the League publication, *QST*. I agree that eighteen dollars a year is a bit much for a magazine that has half the feature articles of *73*. Also, there are constant references to the subject of the top directors' salaries. I agree with your comments on this subject also.

One thing that I do not like about your editorial is the constant reference to yourself. It seems that you are constantly making references to what you would do had you been offered the top job at the ARRL. If you have such good ideas, maybe you should try to get the proposed IRL formed.

In conclusion, I would like to say that I support your magazine to the hilt because it does provide more articles for the money than any other ham magazine.

Mark L. Parrish WD0DXM
Aurora CO

EME INFO

The following information may be of use to EME enthusiasts.

The *1980 Nautical Almanac* is now available and may be obtained by writing to: US Government, c/o Superintendent of Documents, Washington DC 20402. Ask for the *1980 Nautical Almanac*, #008-054-00079-7. The current price is $8.75, which includes postage. Your check should be made payable to "Superintendent of Documents."

As you may know, "H.O. 214 — Tables of Computed Altitude & Azimuth" is no longer available. However, this series has been replaced with a newer version, "Pub. No. 229 — Sight Reduction Tables for Marine Navigation." Listed below are the volumes available and their current price.

Latitudes	Volume	Price
0-15	1	$6.00
15-30	2	$11.55
30-45	3	$9.40
45-60	4	$9.40
60-75	5	$6.00
75-80	6	$6.00

These volumes are available by writing to: Defense Mapping Agency, Office of Distribution Services, Attn: Code DDCP, 6101 McArthur Blvd., Washington DC 20315. Make your check payable to: "Treasurer of the United States." The volume prices also include postage.

Brian M. Manns K3VGX
Seven Valleys PA

OTHERS DWINDLE

The QRM Annihilator (October, 1979, p. 50) is well worth the price of a subscription to Novice or old-timer alike. It is easy to build and a joy to use.

I breadboarded one immediately to try it out and was amazed at the results. Number two was built with variable resistances at R1 and R4 and two speakers; the one on the input monitors what is going in, while the output speaker delivers the message.

W5FOE built a demonstration model for the entire club's inspection and it was well received.

Two suggestions are well worth incorporating for the CW purist: 1) Change the output to sinusoidal rather than square wave for a more pleasant tone and less tiresome listening. 2) Input and output can be fed through a fader (one-knob control) to the speaker for ease of operation.

This article, like many others, is what makes *73* grow while others dwindle.

Wayne O. Brewer W5KD
Tow TX

THANK YOU

I thought that you might be interested to know that your magazine is one of the most important reasons I studied for and passed the test for my ham ticket.

After thinking about it for years — even to the extent of subscribing to *QST* several years ago — I had decided that the ARRL and ham radio were out.

Then I saw a copy of your magazine on the stand. I read it and I subscribed to it because it made the hobby look interesting.

On September 19th, I took and passed my Technician exam. When my ticket comes, I should be ready to take the code test for General.

Once again, thank you.

Ed Grubgeld
Palo Alto CA

BIOFEEDBACK

"Blueprint for Biofeedback Experimentation" (September, 1979) is a nice rapid tour through brain-wave applications.

Please encourage experimenters to follow safety rules when they connect electrical devices to the body. Obtain a book on medical electronics from your library; *never* connect equipment to the ac line, *any* of it. If you want to see your name in lights, do it with LEDs! Thanks.

Mitch Cohen WB4RXB
Margate FL

DATONG UPDATE

In regard to the Datong FL1 filter review (October, 1979): Unfortunately, due to the weakening dollar in the world market, we were obliged to increase prices, effective July 16th, 1979, to $199.95 from $179.95. Also, Datong Electronics' address was shown in the review as the place to write for information. Readers who do write will, of course, receive responses or be directed to my office here at AR Technical Products. Anyone else seeking information should contact us directly.

Roger L. Moss, President
AR Technical Products Corp.
PO Box 62
Birmingham MI 48012
(313)-588-2288

Ham Help

I am very interested in contacting hams who have used a VK2AOU-type antenna (*Ham Radio*, May, 1979), either home brew or commercially built. Any information would be gratefully appreciated.

Gene Smarte WB6TOV/1
Nubanusit Road
Hancock NH 03449

Raynet (Radio Amateurs' Emergency Network) in the United Kingdom — sponsored by the Radio Society of Great Britain — needs help. A Symposium to be held in April, 1980, near London will discuss emergencies of various kinds involving amateur participation. Can anyone lend any slide/tape lectures concerning such matters? Offers of suitable materials should be made to me. Thank you.

T. I. Lundegard G3GJW
Raynet Committee
c/o Tebrax Limited
63 Borough High Street
London SE1 1NG
England

Can anyone supply me with a schematic or tech manual for a Dage tube-type TV camera, model 101-AF?

I will gladly reimburse for photocopies, but I would prefer to borrow the original for a short period of time. I will pay postage. Thank you.

Al Cikas
2112 Stonehenge
Springfield IL 62702

MHz electronics

2111 W. CAMELBACK • PHOENIX, ARIZONA 85015 • (602) 242– 3037

Manufacture	Model	Description	Price
General Radio	1216A	Unit IF Amplifier	50.00
General Radio	1236	IF Amplifier	150.00
General Radio	1269A	Unit Power Supply	100.00
General Radio	1363	Unit Oscillator 50 to 500Mc	200.00
General Radio	1390A	Random Noise Generator	100.00
General Radio	1390B	Random Noise Generator	150.00
General Radio	1391B/1392P2	Pulse,Sweep and Time Delay Generator and P/S	350.00
General Radio	1570ALS15P1	Line Voltage Regulator Control Unit	75.00
General Radio	1570ALS15P2	Line Voltage Regulator Regulator Unit	75.00
General Radio	1581A	Automatic Voltage Regulator	250.00
General Radio	1605A	Impedance Comparator	250.00
General Radio	1607P3	Vairable Capacitor For 1607A	50.00
General Radio	1652A	Resistance Limit Bridge	200.00
General Radio	1932A	Distortion Meter	125.00
Gertsch	SB-4C-4R	Synchro Bridge	100.00
Gertsch	ST-100	Transformer	25.00
Hewlett Packard	AC60	Matching Network	35.00
Hewlett Packard	120AR	Scope DC to 200KHz	150.00
Hewlett Packard	141A	Scope Main Frame Storage	500.00
Hewlett Packard	175A/1781B/1754A	Scope with Sweep Delay Plug In and Quad Trace	650.00
Hewlett Packard	175A/1780A/1752A	Scope with Singal Trace Plug In	400.00
Hewlett Packard	181A	Scope Main Frame Storage	1500.00
Hewlett Packard	200D	Audio Oscillator	50.00
Hewlett Packard	200TR	Audio Oscillator	50.00
Hewlett Packard	212A	Pulse Generator	50.00
Hewlett Packard	216A	Pulse Generator 100Mc	500.00
Hewlett Packard	222A	Pulse Generator 10Mc	200.00
Hewlett Packard	297A	Sweep Drive	100.00
Hewlett Packard	302A	Wave Analyzer	800.00
Hewlett Packard	330B	Distortion Analyzer 20Hz to 20KHz	150.00
Hewlett Packard	400DR	VTVM 10Hz to 4Mc	80.00
Hewlett Packard	403A	Solid State Voltmeter 1Hz to 1Mc	125.00
Hewlett Packard	412A	DC Meter	100.00
Hewlett Packard	412AR	DC Meter Rack Mount	100.00
Hewlett Packard	413AR	DC Null Voltmeter	100.00
Hewlett Packard	411AR	RF Millivoltmeter 500KHz to 1GHz	100.00
Hewlett Packard	416A	Ratio Meter	100.00
Hewlett Packard	417A	VHF Detector	200.00
Hewlett Packard	434A	Calorimetric Power Meter	450.00
Hewlett Packard	450A	Amplifier	50.00
Hewlett Packard	457A	AC DC Converter	100.00
Hewlett Packard	500BR	Frequency Meter	100.00
Hewlett Packard	508A	Motor	50.00
Hewlett Packard	540B	Transfer Oscillator 10Mc to 12.4Gc.	100.00
Hewlett Packard	606A	Signal Generator 50Kc to 65Mc	1000.00
Hewlett Packard	608D/TS510	Signal Generator 10 to 420Mc	300.00
Hewlett Packard	608D	Signal Generator 10 to 420Mc	400.00
Hewlett Packard	616A/B/TS403	Signal Generator 1.8 to 4.2Gc	300.00
Hewlett Packard	616A/B	Signal Generator 1.8 to 4.2Gc	400.00
Hewlett Packard	618A	Signal Generator 3.8 to 7.6Gc	200.00

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MHz electronics

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Manufacture	Model	Description	Price
Hewlett Packard	618B	Signal Generator 3.8 to 7.6Gc	300.00
Hewlett Packard	620A	Signal Generator 7.0 to 11Gc	500.00
Hewlett Packard	623B	6.6 to 7.1Gc Test Set	500.00
Hewlett Packard	H03-624C	10.7 to 11.7Gc Test Set	800.00
Hewlett Packard	624-01	10.7 to 11.7Gc Test Set	800.00
Hewlett Packard	683C	2 to 4Gc Sweep Oscillator	200.00
Hewlett Packard	692C	2 to 4Gc Sweep Oscillator	500.00
Hewlett Packard	1105A	Pulse Generator	75.00
Hewlett Packard	1111A	AC Current Amplifier	100.00
Hewlett Packard	1400A	Differental Amplifier Plug In	100.00
Hewlett Packard	1401A	Dual Trace Plug In	125.00
Hewlett Pachard	1411A	Sampling Vertical Plug In	400.00
Hewlett Packard	1415A	TDR Plug In	400.00
Hewlett Packard	1420A	Time Base Plug In	200.00
Hewlett Packard	1421A	Time Base and Delay Generator Plug In	250.00
Hewlett Packard	1425A	Sampling Time Base and Delay Generator Plug In	400.00
Hewlett Packard	1424A	Sampling Plug In	400.00
Hewlett Packard	1430A	DC to 12.4Gc Sampler	800.00
Hewlett Packard	1801A	Dual Channel Vertical Amp. Plug In	250.00
Hewlett Packard	1803A	Differental DC Offset Amp. Plug In	400.00
Hewlett Packard	1804A	Quad Channel Vertical Amp. Plug In	400.00
Hewlett Packard	1821A	Time Base and Delay Generator Plug In	300.00
Hewlett Packard	1825A	Time Base and Delay Generator Plug In	300.00
Hewlett Packard	1841A	Time Base and Delay Generator Plug In	500.00
Hewlett Packard	2650A	Oscillator Synchronizer	100.00
Hewlett Packard	3200B	10Mc to 500Mc Oscillator	500.00
Hewlett Packard	3301A	Auxiliary Plug In	25.00
Hewlett Packard	3441A	Range Selector Plug In	100.00
Hewlett Packard	3442A	Basic Plug In	100.00
Hewlett Packard	3443A	High Gain Auto Range Plug In	200.00
Hewlett Packard	3446A	AC DC Remote Plug In	200.00
Hewlett Packard	3450A	Digital Voltmeter	1000.00
Hewlett Packard	3521B		
Hewlett Packard	5382A	225Mc Frequency Meter	350.00
Hewlett Packard	5480A/5486A/5485A	Memory Display , Control , Two Channel	7000.00
Hewlett Packard	8005B	Pulse Generator	1000.00
Hewlett Packard	10407A	Plug In Extender	100.00
Hewlett Packard	10411A	Horizontal Gain Calibrator	100.00
Hickok	DP100	DC Voltmeter Plug In For DMS3200	25.00
Industrial Acoustics	SS-375	Audio Level Meter	100.00
ITT	74834SC	Distortion Measuring Equipment	175.00
Jerrold	H72A	Plug In 16 to 200Mc	35.00
Kay	P860	2 to 220Mc Plug In	100.00
Kay	570	Sweeper 10 to 80Mc	100.00
Keithley	200B	DC VTVM	50.00
Keithley	241	High Voltage Power Supply	100.00
Keithley	410C	Picoammeter	100.00
Keithley	600A	Electrometer	100.00
Keitel	202BR	DC Microvoltmeter	50.00
Krohn Hite	310ABR	Band Pass Filter 20cps to 200kc	150.00
Krohn Hite	350A	Ultra Low Frequency Rejection Filter .02hz to 2Khz	100.00
Krohn Hite	360ABR	Rejection Filter 20cps to 200kc	150.00

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MHz electronics

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Manufacture	Model	Description	Price
Marconi	TF791C	Carrier Deviation Meter 4-270Mc	300.00
Marconi	TF791D	Carrier Deviation Meter 4-1024Mc	500.00
Measurements	80	VHF Signal Generator 2-400Mc	150.00
Measurements	800	VHF Signal Generator AM/FM 19-520MC and Deviation Meter	750.00
Millivac	RM28B	RF Voltmeter 20KHz to 1.2Gc	150.00
Millivac	828	RF Microvoltmeter solid state	150.00
Narda	438	Klystron Power Supply	50.00
Narda	440	Microwave Power Meter	100.00
Narda	3040-20	20db 240 to 500mc Coaxial Directional Coupler	100.00
Narda	3041-20	20db 500 to 1000mc " " "	100.00
Narda	3042-20	20db 950 to 2000mc " " "	100.00
Narda	3043-10	10db 2000 to 4000mc " " "	100.00
Narda	3043-20	20db 2000 to 4000mc " " "	100.00
Narda	3044-20	20db 4000 to 8000mc " " "	100.00
Narda	3045-20	20db 7000 to 11000mc " " "	100.00
Narda	22006	20db 1700 to 4000mc " " "	100.00
Narda	22007	30db 1700 to 4000mc " " "	100.00
Narda	22011	10db 2000 to 4000mc " " "	100.00
Narda	22012	30db 2000 to 4000mc " " "	100.00
Narda	22574	10.5db " " "	100.00
North Atlantic	VM204	Phase Angle Voltmeter	150.00
North Atlantic	RB503C	Ratio Box	100.00
Polarad	SD-1	Multi Pulse Spectrum Analyzer	100.00
Polarad	1001M4	Modulator	200.00
Polarad	1107	Signal Generator 3.8 to 8.2 Gc	500.00
Polarad	1108M4	Signal Generator 6.95 to 11 Gc	500.00
Polarad	1206	Signal Generator 1.95 to 4.20 Gc	500.00
PRD	680/X670	Calorimetric Power Meter with 8.2 to 14.4 Gc Dry Calorimeter	250.00
RFL	107A	Magnet Charger	500.00
RFL	531	Crystal Impedance Meter 10 to 140Mc	500.00
RFL	541A	Crystal Impedance Meter 10 to 1100Kc	400.00
RFL	541C	Crystal Impedance Meter 2.5 to 1100Kc	500.00
RFL	942A-8/HB7778	Magnet Charger with Transformer	1500.00
Stoddart	NM10A	RFI Receiver 10 to 250KHz	100.00
Stoddart	NM40A	RFI Receiver 30Hz to 15KHz	200.00
Stoddart	431-1A/431-1B	Remote Control Unit and Antenna Coupler 150Kc to 32Mc	300.00
Stoddart	90078-4	Remote Meter	30.00
Stoddart	91226-1	Power Supply	200.00
Stoddart	91923-2	Power Supply	200.00
Systron Donner	1017FEE	Frequency Counter	150.00
Systron Donner	1255A	300mc to 12.4Gc Plug In	200.00
Systron Donner	1948A	Video Amplifier Plug In	100.00
TIC	T10A	DME Pulse Generator	200.00
TIC	T10M	DME Speed Indicator Adapter	200.00
TIC	T17A	ATC/DME RF Adapter	200.00
Telonic	L-3M	SM2000 Plug In	100.00
Telonic	SM2000	Sweeper	250.00
Tektronix	B	Plug In	42.50
Tektronix	CA	Plug In Dual Trace	112.50
Tektronix	K	Plug In	47.50
Tektronix	L	Plug In	67.50

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RF Transistors

2N1561	$15.00	2N1562	$15.00	MMCM918	$ 1.00
2N1692	15.00	2N1693	15.00	MMT72	.61
2N2857	1.50	2N2857JAN	2.45	MMT74	.94
2N2876	12.35	2N2880	25.00	MMT2857	2.68
2N2927	7.00	2N2947	17.25	MMT3960	6.25
2N2948	15.50	2N2949	3.90	MRF245	31.50
2N2950	5.00	2N3287	4.30	MRF304	43.45
2N3294	1.15	2N3301	.75	MRF420A	20.00
2N3302	1.05	2N3304	1.48	MRF450A	10.35
2N3307	10.50	2N3309	3.90	MRF454A/BLY568	25.00
2N3375	7.00	2N3553	1.45	MRF502	.49
2N3818	6.00	2N3866	1.09	MRF504	6.95
2N3866 JAN	2.70	2N3866 JAN TX	4.43	MRF509	4.90
2N3924	3.20	2N3925	6.00	MRF511	8.60
2N3927	11.50	2N4072	1.70	MRF901	5.00
2N4135	2.00	2N4261	14.60	MRF8004	1.44
2N4427	1.09	2N4429	7.50	PT3539B	3.00
2N4430	20.00	2N4440	7.00	PT4186B	3.00
2N4957	3.50	2N4958	2.80	PT4571A	1.50
2N4859	2.12	2N4976	19.00	PT4612	5.00
2N5090	6.90	2N5108	3.90	PT4628	5.00
2N5109	1.55	2N5160	3.34	PT4640	5.00
2N5179	.49	2N5184	2.00	PT8659	10.72
2N5216	47.50	2N5583	4.43	PT9784	24.30
2N5589	4.60	2N5590	6.30	PT9790	41.70
2N5591	10.35	2N5637	20.70	PT9847	26.40
2N5641	4.90	2N5642	10.00	SD1043	5.00
2N5643	14.38	2N5645	11.00	SD1116	3.00
2N5764	27.00	2N5842	8.65	SD1118	5.00
2N5862	50.00	2N5913	3.25	SD1119	3.00
2N5922	10.00	2N5942	46.00	TA7993	75.00
2N5944	8.50	2N5945	11.90	TA7994	100.00
2N5946	14.20	2N6080	5.45	40281	10.90
2N6081	8.60	2N6082	9.90	40282	11.90
2N6083	11.80	2N6084	13.20	40290	2.48
2N6094	6.75	2N6095	11.50		
2N6096	20.35	2N6097	29.00		
2N6136	19.70	2N6166	36.80		
2N6265	75.00	2N6266	100.00		
2N6439	43.45	BFR90	3.00		
BLY568C/CF	25.00	HEP76/S3014	4.95		
HEPS3002	11.30	HEPS3003	29.88		
HEPS3005	9.95	HEPS3006	19.90		
HEPS3007	24.96	HEPS3010	11.34		
HEPS5026	2.56	MM1500	32.20		
MM1550	10.00	MM1552	50.00		
MM1553	56.50	MM1601	5.50		
MM1602	8.65	MM1607	8.65		
MM1661	15.00	MM1669	17.50		
MM1943	3.00	MM2605	3.00		
MM2608	5.00	MM8006	2.15		

We will try to replace any RF Transistor not on our list. We Can also order many other RF Transistors Not Listed On OUR LIST. Please Let Us Know What Your Needs Are.

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Reader Service—see page 195

MHz electronics

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Solid Carbide Circuit Board Drill Bits

Drill Size	Decimal Size	Price
1.25mm	.0492	$1.85
1.45mm	.0571	$1.85
3.2mm	.1260	$3.58
35	.1100	$2.15
42	.0935	$2.15
47	.0785	$2.15
49	.0730	$2.15
51	.0670	$2.15
52	.0635	$2.15
53	.0595	$1.85
54	.0550	$1.85
55	.0520	$1.85
56	.0465	$1.85
57	.0430	$1.85
58	.0420	$1.85
59	.0410	$1.85
61	.0390	$1.85
63	.0370	$1.85
64	.0360	$1.85
65	.0350	$1.85
66	.0330	$1.90

Tyco Type 001-19880 Crystal Filter
10.7 Mc
3db Bandwidth 15 KHz Min.
20db Bandwidth 60 KHz Min.
40db Bandwidth 150 KHz Min.
Ultimate 50db;Insertion Loss
1.0db Max.
Ripple 1.0db Max
Ct. 0+/-5pf Rt. 3600 ohms $5.95

Tunnel Diodes And Back Diodes

1N2930	$6.00
1N3716	6.00
1N4395	6.00
TD261A	10.00
TD263A	10.00
BD4/4JFBD4	7.00

E F Johnson #122-0275-001 Tube Socket
These sockets are for the following tubes;

4-125A	4-250A	4-400A
3-400Z	3-500Z	5-500A
Ect.		$29.95/2

Murata	SFD455D	SFB455D
Center Freq.	455KHz+/- 2KHz	-------------
3db Bandwidth	4.5KHz+/-1KHz	8KHz+/-2KHz
Selectivity	26db Min. at -10KHz	---------
	20db Min. at +10KHz	---------
Ripple	1.5db Max	------------------
Insertion Loss	9db Max.	-------------------
	$4.00	$3.00

Murata Type CFM455E Ceramic Filter
455 KHz
Insertion Loss 5db Max.
Spurious Response 45db Min.
50db Bandwidth +/-16KHz Max.
6db Bandwidth +/-8KHz Min.
3db Bandwidth +/-5.5KHz Min.
Ripple 3bd max Bandwidth is 3db Max.
in 6db Bandwidth is 6bd Max.
$7.95

Murata 10.7 Ceramic Filter SFE10.7
3db Bandwidth 230KHz+/-50
20db Bandwidth 650KHz Max.
Insertion Loss 6db
Spurious Response 40db Min.
Input/Output Impedance 330 Ohms
$4.95

TRW Broadband Amplifier CA602/CA2601BU
Frequency Range ; 15 to 270Mc
Gain ; 30db Max.
Supply Voltage ; 30vdc
$14.99

CA615BR
Frequency Range ; 40 to 300Mc
Gain ; 16db Min 17db Max.
50 Mc 0 to -1db From 300Mc
Supply Voltage ; 24vdc
$19.99

Wisper Fans
This fan is super quite , efficient cooling where low acoustical disturbance is a must.
Size 4.68"x4.68"x1.50",Inpadance protected.
120vac 50/60cps
$9.99 or 18.00 pair

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Social Events

SOUTH BEND IN
JAN 6

A hamfest swap & shop will be held on January 6, 1980, at New Century Center, on US 31 by the river, South Bend, Indiana. Tables are $3.00 each. Food service, automobile museum, and art center are in the same building as the hamfest. Talk-in on 146.52/.52, .13/.73, .34/.94, 147.99/.39, .87/.27, and .69/.09. For information, write the Repeater Valley Hamfest committee, Wayne Werts K9IXU, 1889 Riverside Drive, South Bend IN 46616, or phone (219)-233-5307.

LANCASTER PA
JAN 7

A 10-week Novice code and theory class course will be held at the Willow Street Vo-Tech, Lancaster, Pennsylvania, beginning the week of January 7th, 1980. For further information, call (717)-464-3359.

OAK PARK MI
JAN 13

The Oak Park Amateur Radio Club will hold its annual Swap and Shop on January 13, 1980, at Oak Park High School, Oak Park Blvd., Oak Park, Michigan. Doors will open at 8:00 am.

RICHMOND VA
JAN 13

The Richmond Frostfest III, sponsored by the Richmond Amateur Telecommunications Society, will be held Sunday, January 13, 1980, at the Bon Air Community Center. There will be a home-brew contest with four awards: most original idea, best electrical work, best mechanical work, and most deserving work, and prizes. FCC exams start at 10:00 am and completed Form 610s must be received in the Norfolk Office of the FCC at 870 North Military Highway, Bank of Virginia Bldg., Norfolk VA 23502, no later than January 9th. Admission is $3.00, indoor flea market tables are $3.00, and tailgaters are $2.00. Talk-in on .28/.88 and .34/.94. For further information, contact the Richmond Amateur Telecommunications Society, PO Box 1070, Richmond VA 23208.

SHARON PA
JAN 19

The third annual Mercer County Amateur Radio Club seminar will be held at the Holiday Inn, West Middlesex, Pennsylvania, off I-80, from 9:00 am to 5:00 pm. Come to hear speakers on your favorite amateur radio topics. Advance admission is $2.00. There will be door prizes. For further details, write K3LA, PO Box 673, Sharon PA 16146.

WAUKESHA WI
JAN 19

The 8th annual Midwinter Swapfest presented by the West Allis Radio Amateur Club will be held on Saturday, January 19, 1980, beginning at 8:00 am at the Waukesha County Expo Center, Waukesha, Wisconsin. There will be food, refreshments, and cash prizes. Tickets are $1.50 in advance, $2.50 at door. Tables may be reserved at $3.00 per four-foot table till January 11 or until half of the available tables are reserved. For information, write 1980 Swapfest, PO Box 1072, Milwaukee WI 53201.

ARLINGTON HEIGHTS IL
JAN 27

The Wheaton Community Radio Amateur Club will hold its Wheaton Hamfest Portable Nine on Sunday, January 27, 1980, at the Arlington Park Expo Center, Arlington Heights Race Track, Arlington Heights, Illinois. Doors will open at 8:00 am sharp! 300 free flea market tables will be available, plus 100 commercial booths. There will also be hourly door prizes. Tickets are $3.00 at the door and $2.00 in advance. For information, send an SASE to WCRA, Box QSL, Wheaton IL 60187.

MANSFIELD OH
FEB 10

The Mansfield mid-winter hamfest and auction will be held on February 10, 1980, at the Richland County Fairgrounds, Mansfield, Ohio. Featured will be prizes, a flea market, and an auction to be held in large heated buildings. Doors will open to the public at 8:00 am. Tickets are $1.50 in advance and $2.00 at the door. Talk-in on 146.34/.94. For additional information or advance tickets, contact Harry Frietchen K8HF, 120 Homewood, Mansfield OH 44906, or phone (419)-529-2801 or (419)-524-1441.

LIVONIA MI
FEB 17

The Livonia Amateur Radio

Club will hold its 10th anniversary Swap 'n Shop on Sunday, February 17, 1980, from 8:00 am to 4:00 pm, at the Churchill High School, Livonia, Michigan. There will be plenty of tables, door prizes, refreshments, and free parking available, plus reserved table space of 12-foot minimum. Talk-in on 146.52. For further information, send an SASE to Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48150.

GLASGOW KY
FEB 23

The Mammoth Cave ARC will hold its annual Glasgow swapfest on Saturday, February 23, 1980, from 8:00 am to 5:00 pm at the Glasgow Flea Market, south of Glasgow on Highway 31E. There will be a large heated building with plenty of free parking. Spaces are available for $3.00 each. There will be no meetings or forums, just door prizes, free coffee, and a large flea market. Admission is $2.00. Talk-in on .34/.94. For additional information, contact WA4JZO, 121 Adairland Ct., Glasgow KY 42141.

LANCASTER PA
FEB 24

The Lancaster Hamfest will be held on February 24, 1980, at the Guernsey Pavilion, located at the intersection of Rtes. 30 and 896, east of Lancaster, Pennsylvania. General admission is $3.00, except children and XYLs. Doors will open at 8:00 am. All inside spaces are available by advance registration only and are $3.00 each for an 8-foot space, which includes a table. There will be free tailgating in a specified area outside, if the weather permits. There will be a two-hour Dutch Country tour by an advance registration of $4.00. Food will be served at the hamfest. Also, there are excellent restaurants and accommodations in the area. Talk-in on .01/.61. For information, write Sercom, Box 6082, Rohrerstown PA 17603.

DAVENPORT IA
FEB 24

The Davenport Radio Amateur Club will hold its ninth annual hamfest on Sunday, February 24, 1980, from 8:00 am to 4:00 pm, at the Davenport Masonic Temple, Highway 61 (Brady Street) and 7th Street, Davenport, Iowa. Tickets are $2.00 in advance; $3.00 at the door. Tables are $3.00 each, no limit, with a $2.00 additional charge for ac electrical hookup. Talk-in on 146.28/.88 W0BXR repeater. Advance tickets can be purchased by writing to club treasurer Clarence Wilson WA0OEW, 1357 W. 36th Street, Davenport IA 52806.

MARLBORO MA
FEB 24

The Algonquin Amateur Radio Club will hold its 3rd annual ham radio flea market on Sunday, February 24, 1980, at the Marlboro Jr. High School Cafetorium, just off Rte. 85 North, Marlboro, Massachusetts. Admission will be 50¢. The event will be held rain, shine, or blizzard. Food will be available. Tables will be $5.00 in advance or $7.50 at the door. Talk-in on .01/.61 and .52. For more information or reservations, contact Charles D. McCarthy W1BK, 128 Forest Ave., Hudson MA 01749, or phone (617)-562-5622.

BLACKSBURG VA
MARCH

Virginia Polytechnic Institute and State University Department of Chemistry will hold three short courses in March, 1980, at the Virginia Tech campus, Blacksburg, Virginia. The first workshop, entitled Digital Electronics for Instrumentation and Automation, will be held on March 10-11, 1980. The second workshop, entitled 8080-8085-Z80 Microcomputer Interfacing, Design, and Software, will be held on March 12-14, 1980. The third workshop, entitled TRS-80 Interfacing and Programming for Instrumentation and Control, will be held on March 17-18, 1980. These programs will be directed by Dr. Jonathan A. Titus, Dr. Paul Field, Dr. Christopher Titus, and Mr. David G. Larsen. These are hands-on workshops with the participants having the opportunity to retain the equipment. For more information, contact Dr. Linda Leffel, CEC, Virginia Tech, Blacksburg VA 24061, or phone (703)-961-5241.

CHRISTIANA DE
MAR 2

The Delaware Valley Amateur Radio Society will hold its Winter Fest and Computer Show on March 2, 1980, from 10:00 am to 4:30 pm at Christiana Memorial Hall, Rte. 273 and Old Baltimore Pike, Christiana, Delaware. Events include a transmitter hunt (Freedom Foundation Fox Hunters Sanction Number 80-1) and a frostbite tailgate section. Tables, food, and free parking will be available. Dealer inquiries are invited. Talk-in on 146.52, 223.36/224.96, and 146.355/.955. For information and advance tickets, write to DVARS, PO Box 426, New Castle DE 19720.

STERLING IL
MAR 9

The Sterling-Rock Falls Amateur Radio Society will hold its 20th annual hamfest on Sunday, March 9, 1980, at the Sterling High School field house, 1608 4th Ave., Sterling, Illinois. Advance tickets are $1.50; door tickets are $2.00. Over $2,000 worth of prizes will be given away. A large indoor flea market will be restricted to radio and electronic items only. There will be plenty of free parking, lots of bargains, and plenty of good food. Talk-in on .25/.85 (WR9AER). For tickets, write Don Van Sant WA9PBS, 1104 5th Avenue, Rock Falls IL 61071.

ALL BAND TRAP ANTENNAS!

Ham Help

I am wondering if anyone can help me beat the high cost of vacations. I have a three-bedroom home in Victoria BC and would like to visit the Disneyland area either at Easter break or in July/August. Easter would be preferred.

Don Ankersen VE7DHG
4142 Hawkes Avenue
Victoria BC V8Z 3Z1

I'm looking for the following manuals: NavShips 92175, MIL-R-12887, and documentation for the MD-141/GR and T-282D/GR units. Can anyone out there help me? I will gladly pay reasonable prices. Thanks.

Charles T. Huth WB8NLM
146 Schonhardt Street
Tiffin OH 44883

I desperately need manuals or schematic diagrams for the following equipment: Gonset G66B, Central Electronics 20A, and Knightkit tube tester, KG600B.

Jimmie R. Hall
820 Robert Ct.
Carlisle OH 45005

I'm looking for either an original manual or a copy for a Johnson model 240-122 vfo. The vfo was usable with many Johnson rigs and the manual for my Adventurer which I am using it on told how to get it hooked up, but I have no information on the vfo itself. Even a schematic would help.

I will pay a reasonable copying fee if required. Please advise by card first. Thanks.

Dave Brown W9CGI
R5, Box 39
Noblesville IN 46060

I need a schematic and parts list for an Ovenaire 1-MHz oscillator, type 15-10, used in Navy frequency counter AN/URM-207, circa 1963-64.

I also need a schematic for a Conar 223 tube checker and a Motorola D25 solid-state Dispatcher. I will copy and return.

Marvin Moss W4UXJ
Box 28601
Atlanta GA 30328

Does anyone have an instruction booklet for a Hallicrafters model TW 2000 (1952)? I will be happy to pay for a photocopy.

I would also like to know if any readers can suggest a source for spare parts and accessories for this same model. Thanks very much for any help.

Bob Freedman
686 Cragmont Avenue
Berkeley CA 94708

I am interested in building a "Morse-to-video" device that will sample the incoming CW signal from my rig, process it, and display it on a normal TV set.

Chuck Bowers WA6GZZ
3326 Sawtelle Blvd., Apt. 31
Los Angeles CA 90066

I would like to establish a ham radio club in my school. Our children are handicapped with language and hearing problems and we have very limited funds. Any useable equipment which could be donated will be greatly appreciated.

Robert Boykin WA2HUY
Industrial Arts Department
School for Language- and Hearing-Impaired Children
421 East 88th Street
New York NY 10028

A RTTY AMSAT information net is being started on Tuesday nights (Wednesday mornings, UTC) at 0230 UTC on 3620 MHz, 60 wpm, 170-Hz shift. I will be NCS.

Charles E. Martin AB4Y
PO Box 3370
Bowling Green KY 42101

I need a schematic of a high-serial-number Drake SC-6, 6-meter converter, or I will reproduce the manual and return.

You'll know the correct SC-6 by noting that it has 4 transistors. The rf stage is a pair of cascode J-FETs. Thanks.

Jack Ross W2NXC
1244 Crim Road
Bridgewater NJ 08807

For research purposes, I am interested in contacting anyone who has operated an amateur station from a "deleted country" as designated on the ARRL DXCC list.

Gary Mitchell WA1GXE
Box 1003
Fairfield CT 06430

I would like to get in touch with any amateurs interested in forming a net to learn the German language. We need some net members who are fluent in German to assist.

Robert E. Bunn WA0LKE
Rt. 3, Box 565
West Plains MO 65775

I would like to hear from anyone who has any modifications for a Swan 500. Thanks.

Hal Hansen N1APE
8 Abenaki Trail
Littleton MA 01460

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  If only a portion of the band is to be scanned, the lower and upper limits of the desired scan range can be programmed from the front panel.
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  All frequency control is done by a microcomputer, including memory and scanning. This results in a simple circuit with little chance for malfunction.
- **25 WATTS OUTPUT**
  A strong, clean signal minimizes "flutter" during mobile operation. A low-power function is included for short-range or battery-powered operation. The low-power level is adjustable from 3 to 25 watts
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  In certain areas with extraordinarily high signal levels, an rf attenuator provides improved reception with less chance for overload.
- **PROGRAMMABLE NON-STANDARD SPLITS**
  By using the memory channels in pairs, up to five sets of transmitting and receiving frequencies may be programmed. This allows up to five splits of any value, in addition to the usual -600 and +600 kHz offsets, which are switched in independently on all frequencies
- **PL TONE OSCILLATOR**
  Tone level and frequency are adjustable for accessing closed repeaters.
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  The sensitive initial stages of the receiver contain varactor-controlled tuned circuits for narrow bandwidth at the front end. This greatly reduces the susceptibility of the circuit to overloading and intermodulation — A KDK EXCLUSIVE.
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  The result is a transmitter completely free of mixing products.
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Super Color S-100 Video Kit $99.95
Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Gremlin Color Video Kit $59.95
32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. Not expandable to high resolution Graphics.

Elf II Adapter Kit $24.50
Plugs into Elf II providing Super Elf 44 and 50 pin bus plus S-100 bus expansion (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

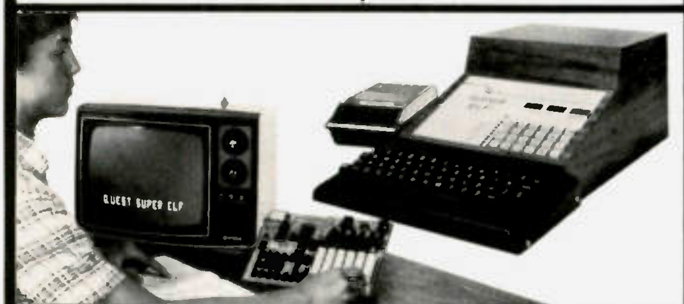
1802 16K Dynamic RAM Kit $149.00
1802/S-100 expandable to 32K, Hidden refresh w/clocks up to 4 MHz w/no wait states Addl. 16K RAM **$79.00.**

Quest Super Basic
Quest, the leader in inexpensive 1802 systems announces another first. Quest is the first company worldwide to ship a **full size Basic** for 1802 systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm .17E^{38}$), 32 bit integer ± 2 billion, Multi dim arrays; String arrays; String manipulation; Cassette I/O, Save and load, Basic, Data and machine language programs; and over 75 Statements, Functions and Operators.

Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user programs. Cassette version in stock now. ROM versions coming soon with exchange privilege allowing some credit for cassette version.

Super Basic on Cassette	$40.00
Tom Pittman's 1802 Tiny Basic Source listing now available. Find out how Tom Pittman wrote Tiny Basic and how to get the most out of it. Never offered before.	$19.00
S-100 4-Slot Expansion	$ 9.95
Super Monitor VI.I Source Listing	$15.00

Coming Soon: Assembler, Editor, Disassembler, DA/AD, Super Sound/Music, EPROM programmer.



RCA Cosmac Super Elf Computer $106.95
Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high** and **low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad** Battery Memory Saver Kit **$6.95.** All kits and options also completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00**, on ROM **$38.00**, original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00**, Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95
This is truly an astounding value! This board has been designed to allow you to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports with full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

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7414N	70
7420N	18
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7430N	20
7442N	50
7445N	69
7447N	60
7448N	69
7450N	18
7474N	35
7475N	49
7485N	88
7489N	1 85
7490N	43
7492N	43
7493N	43
7495N	69
74100N	90
74107N	35
74121N	34
74123N	59
74125N	45
74145N	69
74150N	95
74151N	69
74154N	1 00
74157N	69
74161N	87
74162N	87
74163N	87
74174N	96
74175N	90
74190N	1 15
74192N	87
74193N	85
74221N	2 00
74298N	1 65
74365N	66
74366N	66
74367N	66

74LS00 TTL	
74LS00N	35
74LS02N	35
74LS04N	35
74LS05N	35
74LS08N	35
74LS10N	35
74LS13N	55
74LS14N	1 10
74LS20N	35
74LS22N	35
74LS28N	41
74LS30N	35
74LS33N	75
74LS38N	55
74LS74N	1 25
74LS75N	1 00
74LS90N	85
74LS93N	70
74LS95N	1 10
74LS107N	45
74LS112N	45
74LS113N	35
74LS132N	89
74LS136N	45
74LS151N	85
74LS155N	85
74LS157N	85
74LS162N	1 15
74LS163N	1 15
74LS174N	2 00
74LS190N	1 06
74LS221N	1 95
74LS258N	67
74LS367N	1 35

LINEAR	
CA3045	90
CA3046	1 10
CA3081	1 80
CA3082	1 90
CA3089	2 95
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LM305H	87
LM307N	35
LM308N	89
LM309K	1 50
LM311H/N	90
LM317T/K	3 75
LM318	1 35
LM320K-5	1 50
LM323K-5	5 95
LM320K-12	1 50
LM320K-15	1 50
LM320T-5	1 60
LM320T-8	1 60
LM320T-12	1 50
LM320T-15	1 60
LM324N	1 15
LM339N	1 55
LM340K-5	1 35
LM340K-8	1 35
LM340K-12	1 35
LM340K-15	1 35
LM340K-24	1 35
LM340T-5	1 25
LM340T-8	1 25
LM340T-12	1 25
LM340T-15	1 25
LM340T-18	1 25
LM340T-24	1 25
LM343H	4 50
LM350	7 50
LM370	1 15
LM377	3 00
LM379	5 00
LM380N	1 00
LM381	1 60
LM382	1 60
LM703H	40
LM709H	28
LM723H/N	50
LM733N	67
LM741CH	35
LM741N	32
LM747H/N	75
LM748N	35
LM1303N	1 75
LM1304	1 10
LM1305	1 27
LM1307	2 00
LM1310	2 75
LM1458	47
LM1800	1 75
LM1812	7 50
LM1889	3 00
LM2111	1 75
LM2902	1 50
LM3900N	60
LM3905	1 75
LM3909N	89
MC1458V	50
NE540H	3 75
NE550N	1 00
NE555V	39
NE556A	85
NE565A	1 00
NE566V	1 50
NE567V	1 00
NE570B	5 00
78L05	60
78L08	60
78M05	85
75108	1 75
75491CN	50
75492CN	55
75494CN	89

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CD34001 Fair	50
CD4000	16
CD4001	28
CD4002	28
CD4006	1 10
CD4007	28
CD4008	28
CD4009	45
CD4010	45
CD4011	28
CD4012	28
CD4013	39
CD4014	1 00
CD4015	1 00
CD4016	45
CD4017	1 05
CD4018	94
CD4019	45
CD4020	1 02
CD4021	1 25
CD4022	1 10
CD4023	28
CD4024	75
CD4025	28
CD4026	2 00
CD4027	66
CD4028	85
CD4029	1 02
CD4030	45
CD4035	1 02
CD4040	1 02
CD4042	85
CD4043	85
CD4044	85
CD4046	1 67
CD4049	45
CD4050	49
CD4051	1 13
CD4060	1 42
CD4066	71
CD4068	40
CD4069	40
CD4070	50
CD4071	28
CD4072	28
CD4073	28
CD4075	28
CD4076	1 45
CD4078	40
CD4081	28
CD4082	28
CD4116	47
CD4490	5 50
CD4507	1 00
CD4508	4 25
CD4510	1 02
CD4511	94
CD4515	2 52
CD4516	1 10
CD4518	1 02
CD4520	1 02
CD4527	1 51
CD4528	79
CD4553	3 50
CD4566	2 25
CD4583	4 50
CD4585	1 10
CD40192	3 00
74C00	28
74C04	40
74C10	28
74C14	2 10
74C20	28
74C30	28
74C48	1 95
74C74	75
74C76	1 40
74C90	1 15
74C93	1 40
74C154	3 00
74C160	1 44
74C175	1 35
74C192	1 65
74C221	2 00
74C905	6 00
74C906	75
74C914	1 95
74C922	5 50
74C923	5 50
74C925	6 95
74C926	6 95
74C927	6 95

INTERFACE	
8095	65
8096	65
8097	65
8098	65
8T09	1 25
8T10	4 50
8T13	3 00
8T20	5 50
8T23	3 10
8T24	3 50
8T25	3 20
8T26	1 69
8T28	2 75
8T97	1 69
8T98	1 69

MOS/MEMORY RAM	
2101-1	3 95
2102-1	95
2102AL-4	1 25
2102AN-2L	1 60
21L02-1	1 18
21F02	1 25
2104A-4	4 95
2107B-4	3 75
2111-1	3 75
2112-2	3 95
2114L-1	7 40
2114L-3	7 90
4116	10 95
2513B	6 30
MM5262	40
MM5280	3 00
MM5320	9 95
MM5330	5 94
PD411D-3	4 00
PD411D-4	5 00
P5101L	13 95
4200A	9 95
82S25	2 90
91L02A	1 50
HD0165-5	6 95
MM57100	4 50
GIAY38500-1	9 95
MCM6571A	9 95
9368	3 50
4100	10 00
416	16 00

CLOCKS	
MM5314	3 90
MM5369	2 10
MM5841	14 45
MM5865	7 95
CT7001	5 80
CT7010	8 95
MM5375AA/N	3 90
MM5375AG/N	4 90
7205	16 50
7207	7 50
7208	15 95
7209	4 95
DS0026CN	3 75
DS0056CN	3 75
MM53104	2 50

MICROPROCESSOR	
6800	17 50
6802	18 75
8080A	8 95
8085	27 00
Z80	14 75
Z80A	19 75
8212	2 90
8214	8 00
8216	2 90
8224	2 90
8228	5 35
8251	8 50
8253	15 00
8255	9 25
8257	19 50
8259	19 50
1802CP plas	13 95
1802DP plas	17 95
1861P	11 50
CDP1802CD	19 95
CDP1802D	25 00
CDP1861	12 95
6820	9 95
6850	12 95
6502	12 50
6504	16 50
6522	13 60

UART/FIFO	
AY5-1013	5 50
AY5-1014	7 50
3341	6 95

PROM	
1702A	3 95
2708	10 50
2716T1	29 50
2716 Intel	48 00
2732	115 00
2758	22 50
8741A	85 00
8748	75 00
8748-8	60 00
8755A	65 00
N82S23	2 95
N82S123	3 50
N82S126	3 75
N82S129	3 75
N82S131	3 75
N82S136	8 75
N82S137	8 75
DM8577	2 90
8223	2 90

CONNECTORS	
30 pin edge	2 50
44 pin edge	2 75
100 pin edge	4 50
100 pin edge WW	5 25

IC SOCKETS
Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	15	22	30
14	14	24	35
16	16	28	42
18	27	36	58
20	29	40	57

2 level 14 pin ww 20

WIRE WRAP LEVEL 3

PIN		PIN	
14	32	24	86
16	33	28	1 00
18	57	40	1 23

CRYSTALS	
1 MHz	4 50
2 MHz	4 50
4 MHz	4 25
5 MHz	4 25
10 MHz	4 25
18 MHz	3 90
20 MHz	3 90
32 MHz	3 90
32768 MHz	4 00
1 8432 MHz	4 50
3 5795 MHz	1 20
2 0100 MHz	1 95
2 097152 MHz	4 50
2 4576 MHz	4 50
3 2768 MHz	4 50
5 0688 MHz	4 50
5 185 MHz	4 50
5 7143 MHz	4 50
6 5536 MHz	4 50
14 31818 MHz	4 25
18 432 MHz	4 50
22 1184 MHz	4 50

KEYBOARD ENCODERS	
AY5-2376	$12 50
AY5-3600	17 95
74C922	5 50
74C923	5 50
HD0165-5	6 95

D Connectors RS232	
DB25P	2 95
DB25S	3 95
Cover	1 50
RS232 Complete Set	6 50
DE9S	1 95
DA15P	2 10
DA15S	3 10

Hickok 3½ Digit LED multimeter	**69 95**
Stopwatch Kit	**26 95**
Auto Clock Kit	**17 95**

TRANSISTORS	
2N1893	40
2N222A	27
2N2369	30
2N2904A	20
2N2907A	25
2N3053	40
2N3638	25
2N3643	25
2N3904	18
2N3906	18
2N3055	69
2N4400	25
2N4401	75
2N4402	20
TIP31	60
TIP33A	1 00

RESISTORS ¼ watt 5%
10 per type 03 — 1000 per type 012
25 per type 025 — 350 piece pack
100 per type 015 — 5 per type 6 75
½ watt 5% per type 05

KEYBOARDS	
56 key ASCII keyboard kit	$67 50
Fully assembled	77 50
53 key ASCII keyboard kit	60 00
Fully assembled 70 00 Enclosure	14 95

LEDS	
Red T018	15
Green Yellow T018	20
Jumbo Red	20
Green Orange Yellow Jumbo	25
Cliplite LED Mounting Clips	8/$1 25

(specify red amber green yellow clear)

CONTINENTAL SPECIALTIES In stock
Complete line of breadboard test equip.
MAX 100 8 digit Freq Ctr $128 95

OK WIRE WRAP TOOLS in stock
Portable Multimeter $18 00

SPECIAL PRODUCTS	
MM5865 Stopwatch Timer	9 00
PC board	7 50
Switches Mom Pushbutton	27
3 pos slide	25
Encoder HD0165-5	6 95
3 Digit Universal Counter Board Kit Operates 5-18 Volt DC to 5 MHz typ 125" LED display	10 50
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Model 10 Trigger Expander Kit	$229 00
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Sinclair 3½ Digit Multimeter	$59.95
Clock Calendar Kit	$23 95
2 5 MHz Frequency Counter Kit	$37.50
30 MHz Frequency Counter Kit	$47 75

TRANSFORMERS	
6V 300 ma	3 25
12 Volt 300 ma transformer	1 25
12 6V CT 600 ma	3 75
12V 250 ma wall plug	2 95
12V CT 250 ma wall plug	3 50
24V CT 400 ma	3 95
10V 1 2 amp wall plug	4 85
12V 6 amp	12 95
12V 500 ma wall plug	4 75
12V 1 amp wall plug	6 50
12V 3 amp wall plug	8 50

DISPLAY LEDS			
MAN1	CA	270	2 90
MAN3	CC	125	39
MAN72/74	CA/CA	300	1 00
DL704	CC	300	1 25
DL707/DL707R	CA	300	1 00
DL727/728	CA/CC	500	1 90
DL747/750	CA/CC	600	1 95
DL750	CC	600	1 95
FND359	CC	357	70
FND500/507	CC/CA	500	1 35
FND503/510	CC/CA	500	90
FND800/807	CC/CA	800	2 20
3 digit Bubble			60
4 digit Bubble			80
DG8 Fluorescent			1 75
DG10 Fluorescent			1 75
5 digit 14 pin display			1 00
NSN69 9 digit display			60
7520 Clairex photocells			39
TIL311 Hex			9 50
MAN3640	CC	30	1 10
MAN4610	CA	40	1 20
MAN4640	CC	40	1 20
MAN4710	CA	40	95
MAN4740	CC	40	1 20
MAN6640	CC	56	2 95
MAN6710	CA	60	1 35
MAN6740	CC	60	1 35
MA1002A			8 95
MA1012A			8.95
102P3 transformer			2 25

ROCKWELL AIM 65 Computer
6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00.

Special small power supply for AIM 65 assem. in frame **$49.00.** Complete AIM 65 in thin briefcase with power supply **$485.00.** Molded plastic enclosure to fit AIM 65 plus power supply **$47.50.**

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Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled **$37.50**

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Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

79 IC Update Master Manual $35.00
Complete IC data selector, 2500 pg. master reference guide. Over 50,000 cross references. Free update service through 1979. Domestic postage $3.50. No foreign orders.

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24K Static RAM Kit	423.00
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64K Dynamic RAM Kit	470.00
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Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

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Indoor and outdoor. Switches back and forth. Beautiful. .50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, tenths of a degree, air or liquid. Beautiful woodgrain case w/bezel **$11.75**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax. BankAmericard and Master Charge accepted. Shipping charges will be added on charge cards.

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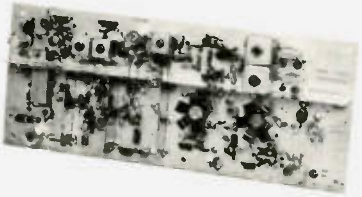
These Low Cost SSB TRANSMITTING CONVERTERS

Let you use inexpensive recycled 10M or 2M SSB exciters on UHF & VHF!

- Linear Converters for SSB, CW, FM, etc.
- A fraction of the price of other units; no need to spend $300 – $400!
- Use with any exciter; works with input levels as low as 1 mW.
- Use low power tap on exciter or simple resistor attenuator pad (instructions included).
- Link osc with RX converter for transceive.



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NEW XV4 UHF KIT – ONLY $99.95

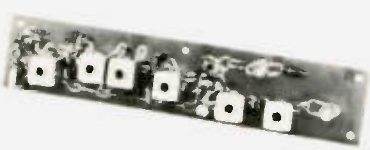
28-30 MHz in, 435-437 MHz out; 1W p.e.p. on ssb, up to 1½W on CW or FM. Has second oscillator for other ranges. Atten. supplied for 1 to 500 mW input, use external attenuator for higher levels.

Extra crystal for 432-434 MHz range $5.95

XV2 VHF KIT - ONLY $69.95

2W p.e.p. output with as little as 1mW input. Use simple external attenuator. Many freq. ranges available.

MODEL	INPUT (MHz)	OUTPUT (MHz)
XV2-1	28-30	50-52
XV2-2	28-30	220-222
XV2-4	28-30	144-146
XV2-5	28-29 (27-27.4 CB)	145-146 (144-144.4)
XV2-7	144-146	50-52



XV28 2M ADAPTER KIT - $24.95

Converts any 2M exciter to provide the 10M signal required to drive above 220 or 435 MHz units.

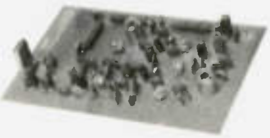
Easy to Build FET RECEIVING CONVERTERS

Let you receive OSCAR and other exciting VHF and UHF signals on your present HF or 2M receiver

VHF KIT STILL ONLY $34.95

MODEL	RF RANGE	OUTPUT RANGE
C28	28-32 MHz	144-148 MHz
C50	50-52	28-30
C50-2	50-54	144-148
C144	144-146	28-30
C145	145-147	28-30
or	144-144.4	27-27.4 (CB)
C146	146-148	28-30
C220	220-222	28-30
C220-2	220-224	144-148
C110 (less xtal)	Any 2MHz of Aircraft Band	26-28 or 28-30

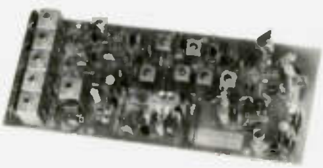
UHF KIT ONLY $34.95



MODEL	RF RANGE	OUTPUT RANGE
C432-2	432-434	28-30
C432-5	435-437	28-30
C432-4	432-436	144-148
C432-9	439.25	61.25

Professional Quality VHF/UHF FM/CW EXCITERS

- Fully shielded designs
- Double tuned circuits for spurious suppression
- Easy to align with built-in test aids



T50-50	6-chan, 6M, 2W Kit	$49.95
T50-150	6-chan, 2M, 2W Kit	$49.95
T50-220	6-chan, 220 MHz, 1½W Kit	$49.95
T450	1-chan, 450 MHz, 1W Kit	$49.95

See our Complete Line of VHF & UHF Linear PA's

- Use as linear or class C PA
- For use with SSB Xmtg Converters, FM Exciters, etc.

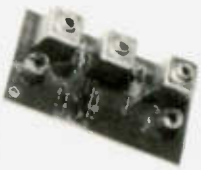
LPA 2-15 VHF PA. 2W in/15-20W out. Solid-state t/r switching. Kit $59.95

LPA 2-45 VHF PA. 2W in/40-45W out. Can also be used with 8-10W drive. Kit $109.95

LPA 4-10 UHF PA, ½W-1W in/8-10W out. Kit $79.95

FAMOUS HAMTRONICS PREAMPS

Let you hear the weak ones too! Great for OSCAR, SSB, FM, ATV. Over 14,000 in use throughout the world on all types of receivers.



P9 Kit $12.95
P14 Wired $24.95
Specify band when ordering

- Deluxe vhf model for applications where space permits ● 1½" x 3" ● Models available to cover any 4MHz band in the range 26 to 230 MHz ● 12 Vdc ● 2 stages ● Ideal for OSCAR ● 20 dB gain

P8 Kit $10.95
Specify band when ordering

- Miniature vhf model for tight spaces–size only ½ x 2 ⅜
- Models available to cover any 4MHz band in the range 20 to 230 MHz ● 20 dB gain ● 12 Vdc

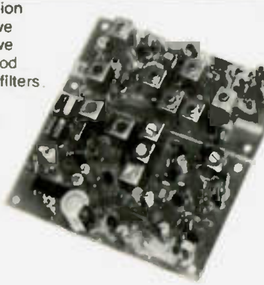
P15 Kit $18.95
P35 Wired $34.95

- Covers any 6 MHz band in UHF range of 380 to 520 MHz ● 20 dB gain ● 2 stages ● 12 Vdc

NEW VHF/UHF FM RCVRS

Offer Unprecedented Range of Selectivity Options

- New generation
- More sensitive
- More selective
- Low cross mod
- Uses crystal filters
- Smaller
- Easy to align



R75A* VHF Kit for monitor or weather sattelite service. Uses wide L-C filter. -60dB at ± 30 kHz $69.95

R75B* VHF Kit for normal nbfm service. Equivalent to most transceivers. -60dB at ± 17 kHz, -80dB at ± 25 kHz ... $74.95

R75C* VHF Kit for repeater service or high rf density area. -60dB at ±14kHz, -80dB ±22kHz, -100dB ±30kHz $84.95

R75D* VHF Kit for split channel operation or repeater in high density area. Uses 8-pole crystal filter. -60dB at ±9 kHz, -100dB at ± 15 kHz. The ultimate receiver! ... $99.95

* Specify band: 10M, 6M, 2M, or 220 MHz. May also be used for adjacent commercial bands. Use 2M version for 137 MHz WX satellites.

R85( ) UHF FM Receiver Kits, triple conversion, Include C432 UHF Front End Module. Add $20 to above prices. (Add selectivity letter to model number.)

A13-45A 6-Channel Adapter for receivers $13.95

IT'S EASY TO ORDER!

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UG-30C/U	3.00
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PL-259	.50
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PL-258	2.99
UG-106	.69
UG-177	.69
UG-274/U	3.27
UG-447/U	1.50
UG-492	3.69
UG-306/U	3.00
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UG-260B/U	1.59
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811A	12.95
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4X150A	15.00
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6939	5.95
7289/2C39	4.95
8072	45.00
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2N3553	1.80
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2N3866	1.09
2N3866JAN	2.70
2N2866JANTX	4.43
2N3925	6.00
2N3948	2.00
2N3950	26.25
2N3960	4.70
2N4072	1.70
2N4427	1.09
2N4877	2.57
2N4957	3.50
2N5108	3.90
2N5109	1.55
2N5179	.59
2N5589	4.60
2N5583	5.00
2N5590	6.30
2N5591	10.35
2N6080	5.45
2N6081	8.80
2N6082	10.75
2N6083	12.00
2N6084	13.20
2N6095	10.35
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SS2548	.75
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45¢ each or 10/3.50
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CHOKE (U252) 2.5mh

150ma 30MHz
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small enough to
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2N5248	.60 or 10/ 4.50
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2N4303	.45 or 10/ 3.50
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MFE2000	.90 or 10/ 8.00
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MFE2008	4.20 or 10/36.00
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1N23C	1.05
1N23CR	2.00
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1N23F	4.10
1N23WE	2.10
1N25	3.03
1N121WE	4.00
1N286	5.00
1N416E	5.00
1N446	8.00
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A449-6 6 ele UHF FM beam .... **24.95 c**
A449-11 11 ele UHF beam........... **34.95 c**
A432-11 11el 432MHz SSB/CW beam **34.95 c**
AFM4D 144-148MHz Four Pole ...... **69.95 c**
AFM24D 220MHz Four Pole.......... **64.95 c**
AFM44D 435-450MHz Four Pole..... **64.95 c**
ASQ-2 2M Squalo horiz ant .... **19.95 b**
LAC-1 Coax lightning arrester........ **4.95 a**
LAC2- Coax lightning arrester......... **4.95 a**
ATB34 ★ 4 ele 20-10mtr beam ..... **219.95 ★**
ATV3 20-10mtr trap vertical .... **49.95 e**
ATV4 40-10mtr trap vertical .... **69.95 e**
ATV5 80-10mtr trap vertical .... **89.95 e**
A50-3 3 element 6 meter beam ...... **39.95 d**
A50-5 5 element 6 meter beam ...... **59.95 e**
A28-3 ★ 3 element 10 meter beam .. **69.95 ★**
A432-20T 432MHz 20 ele twist....... **59.95 d**

AVERAGE SHIPPING COST GUIDE

(Continental U.S.) Items sent UPS whenever possible.

Please estimate the shipping charges for your order Any excess payment over 25c will be refunded or credited Underpayment will be billed or sent collect For insurance add 25c for each $100 00 value over the first $100 00

	W/K CALL AREA			
WEIGHT	1,2,3,4,5	6,7	8,0	9
1 lb.	.90	1.00	.90	.85
5 lbs.	1.50	2.00	1.35	1.20
10 lbs.	2.26	3.20	1.95	1.70
20 lbs.	3.80	5.60	3.20	2.60
30 lbs.	5.30	8.05	4.40	3.50
50 lbs.	8.40	12.90	6.80	5.35

ESTIMATED WEIGHT CODING

After the price of each item you will find a letter, i e , 19 95 **a**. To make it easier to figure shipping costs, these letters indicate the approximate weight of the item as follows

a. Less than 1 lb
b. 1-3 lbs
c. 4-6 lbs
d. 7-10 lbs
e. 10-20 lbs
f. 20-30 lbs
g. 30-40 lbs
h. 40-50 lbs

NOTE: INTERNATIONAL ORDERS write for Proforma Invoice. ITEMS MARKED ★ will be sent truck collect.

2M BASE ANT. PACKAGE

Here's what you get:

- Cushcraft AR2 Ringo South River.
- PFM71 Roof mount.
- A125-5P 5' alum mast.
- Lag bolts.
- 50' 8U foam coax.
- PL259 coax conn.

$59.95

Wt. 16 lbs.

FINCO

The most rugged 6 & 2 meter beams we've seen yet!!

A 2-10 10 ele, 2M beam .... **$44.95 d**
A 2-5 5 ele, 2M beam, 9.5db gain..... **27.95 c**
A 2-2 10 ele, 2M dual polarization.... **46.50 e**
A62 6&2M antenna on one boom .... **74.95 e**
A6-5 5 element 6M beam, 11db ...... **46.50 e**
A6-3 3 ele 6M beam, 7db gain .... **30.00 d**
A 1¼ 220MHz 10 ele, 13.8db .... **32.95 d**

HUSTLER

$9.95 "BUCK-BUSTER" SF-2 ANTENNA

Fits all Hustler deluxe mobile mounts 3/8"x24 base 5/8" wave two meters, 3 4 db gain SWR at resonance adj to 1 5 1 or better Bandwidth 6 MHz, 2 1 or better SWR 100 watts max

$79.95 NEW 4-BTV VERTICAL

One setting covers 10, 15, 20, 40M. Space restricted or unlimited you get top signal reports, consistent contacts and complete coverage Add 5th band with a 75M resonator Use one feedline, any length Requires no switching or matching devices 15 lbs

SF-2 4-BTV

MO1 Mobile mast .... **$22.95 c**
MO2 Mobile mast .... **22.95 c**
RM10 10 Meter resonator .... **6.95 b**
RM15 15 meter resonator .... **7.95 b**
RM20 20 Meter resonator .... **8.95 b**
RM40 40 Meter resonator .... **14.95 b**
RM75 75 Meter resonator .... **16.95 b**
RM80 80 Meter resonator .... **17.95 b**
RM10S 10M resonator 2KW PEP .... **11.95 b**
RM15S 15M resonator 2KW PEP .... **12.95 b**
RM20S 20M resonator 2KW PEP .... **13.95 b**
RM40S 40M resonator 2KW PEP .... **16.95 b**
RM75S 75M resonator 2KW PEP .... **31.95 b**
RM80S 80M resonator 2KW PEP .... **31.95 b**
CG144 5.2db 2mtr ant 3/8 x 24 stud ..... **26.95 b**
CGT144 Same but trunk lip mount... **42.95 c**
SF2 3db 2mtr ant 3/8 x 24 stud .... **9.95 b**
SF220 3db 220MHz ant 3/8 x24 stud .. **11.95 b**
4BTV 40-10mtr vertical .... **79.95 e**
G6-144 2mtr base ant 6db.......... **79.95 d**
BM1 Bumper mount 3/8 x 24 thread... **15.95 d**
RSS2 Mobile resonator spring .... **5.95 a**
QD1 Quick disconnect 3/8 x 24 .... **16.95 a**

hy-gain

VERTICAL ANTENNAS

Model 14AVQ/WB — **SAVE $10.00!** List $69.95
- 40 thru 10 meters
- Wide band performance
- New Hy-Q traps

Self-supporting automatic band switching vertical antenna Omni-directional performance Favorable L/C ratio High Q True ¼ wave resonance on all bands Low angle radiation pattern Taper swagged seamless aluminum construction 12 double-grip mast bracket Full circumference compression clamps at tubing joints Weight 8 2 lbs

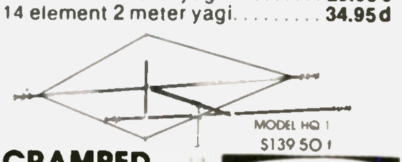
Model 14AVQ/WB — 59.95

Model 18AVT/WB — **SAVE $18.00** list $105.00
- Automatic band switching
- Completely Self-Supporting
- Omni-Directional Performance

Three beefed-up Hy-Q traps permit automatic switching 5 band capability Favorable L/C ratio Top loading coil Across the band performance with one furnished setting for each band (10 thru 40) True ¼ wave resonance on all bands SWR of 2 1 or less at band edges Low angle radiation pattern Extra heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at tubing joints Antenna can be mounted without guide wires 25' high Weight 10 7 lbs

Model 18 AVT/WB — 87.00

BN86 Ferrite balun for 80-10mtrs ... **$15.95 a**
155 Center insulator for doublet ...... **5.95 a**
156 End insul. for doublet (pair) ...... **3.95 a**
18HT ★ HyTower 80-10M vertical .. **289.95 ★**
18V Economy 80 tru 10M vertical .... **29.95 c**
12AVQ 20-10mtr trap vertical .... **39.95 c**
14AVQ 40-10mtr trap vertical .... **59.95 d**
18AVT/WB 80-10mtr trap vertical .... **87.00 d**
2BDQ Trap doublet for 80 & 40mtr ... **49.95 d**
5BDQ Trap doublet for 80-10mtrs .... **89.95 e**
TH3 MkIII ★ 3 ele 20-10 tribander .. **189.95 ★**
TH6DXX ★ 6 ele 20-10M tribander .. **264.95 ★**
TH3 Jr 3 ele tribander (750W PEP) .. **149.95 e**
HY QUAD ★ 2 ele quad 20-10 mtrs . **229.95 ★**
103BA 3 element 10Mtr beam .... **64.95 e**
153BA ★ 3 element 15mtr beam..... **79.95 e**
204BA ★ 4 element 20mtr beam .... **214.95 ★**
402BA ★ 2 element 40 mtr beam .... **204.95 ★**
64B ★ 4 element 6 meter beam ..... **49.95 b**
270 6db fiberglass 2M antenna ...... **49.95 b**
203 3 element 2 meter yagi .... **21.95 b**
205 5 element 2 meter yagi .... **17.95 c**
208 8 element 2 meter yagi .... **29.95 c**
214 14 element 2 meter yagi .... **34.95 d**



MODEL HQ 1
$139 50 f

CRAMPED FOR SPACE?

Mini-Products Inc.

Then you want the antenna that's known around the world for its small size and superior performance... The Multiband HYBRID QUAD for 6-10-15 & 20 meters

- WING SPAN-11 FT.
- BOOM-54 INCHES LONG
- WIND AREA-1.5 SQ. FT.
- 1200 WATTS P.E.P. INPUT TO FINAL
- FEED LINE-50 OHMS

MFJ

GIVE US A TRY ON YOUR MFJ NEEDS. MANY TIMES WE CAN GIVE QUICKER DELIVERY THAN WHEN YOU ORDER DIRECT.

✓ Reader Service—see page 195

IT'S . . . IT'S . . .
A FLOTSAM AND JETSAM SALE!!!

(Jet•sam, noun. Goods thrown overboard to lighten a vessel in distress.)

In this case the vessel is our warehouse, which is filling up with stuff and threatens to engulf us all. We didn't worry about it at first, but now we hear rumors of mutant semiconductors living in unexplored parts of the building . . . and just last week, a desperate group of mylar capacitors tried to kidnap our head packer (but luckily, he put up some resistance and that short-circuited their plans). So you can see we're getting pretty desperate, which is a tip-off as to why the prices are so ridiculously low. Well, I must end this message; it sounds like the mutant semiconductors are hungry, and I'd just as soon not be around when it's feeding time . . . oh yes, all items below are limited quantity, first come, first served and all that . . .

Packer Bill

RF POWER TRANSISTORS!

Limited quantities, there aren't all that many left by now. Choose from:

2NRF-1
2 GHz RF power transistor. Pd max 3.5W, Pout min 1.0W, Pin 310 mW, efficiency 30%, round shape, similar to RCA 2N5470 . . . **$4.95**

2NRF-3
2 GHz RF power transistor. Pd 21W, Pout 5.5W, Pin 1.25W, efficiency 33%, cross shape, similar to RCA 2N6269 . . . **$6.95**

2NRF-4
2 GHz RF power transistor. Pd 29W, Pout 7.5W, Pin 1.5W, efficiency 33%, cross shape, factory selected prime 2N6269 . . . **$7.95**

SOCKET SPECIAL!

Limited quantities. **LESS THAN A DIME APIECE:** 14, 16, 18, and 24 pin sockets are now only **20/$1.95!** 28 and 40 pin types are **10/$1.50**, which is also quite a price. **If there was ever a time to stock your lab with sockets, this is it.**

Our computer business is doing great, but that doesn't seem to be a universal state of affairs . . . which means you can now buy IMSAI type S-100ST soldertail edge connectors on **SUPER CLOSE-OUT** for **2/$5.** Not listed in flyer; limited quantity.

HOW ABOUT A NICE SET OF LEGS?

Hah! Had you going there for a second, didn't we? These are actually furniture legs, and we thought they were pretty much the most useless things in the world until some guy came in and said he wanted some. After determining for ourselves that this person was indeed mentally competent, we told him we'd **give** him the legs if he told us what he was using them for. "Why, to raise my speakers off the floor, of course," was his reply . . . and that's when we realized maybe they weren't so useless after all. These are finished, solid wood with a plastic tip at one end and a threaded steel stud at the other, and are about 6½" to 7½" long. Thanks, Marty Hoffert — wherever you are — for showing the world just one of the many things that can be done with surplus furniture legs.

Set of four legs: $5.00 **5 sets (20 legs total): $20.00**

OUR FIRST X-RATED SPECIAL!

We have a whole bunch of surplus motors, little jobbies that run off 1 to 5V DC. Rumor has it that these were originally used as . . . well, we really can't say, that's the X-rated part. But they could have just as easily come from toy models, toothbrushes, window displays, or other applications where a small, battery operated motor is needed to vibrate something vigorously. At **10/$2.95**, they are certainly inexpensive and we've got **lots** of 'em.

M61 CHERRY SWITCHES.

Alternate action, gold cross contacts, keyboard switch — but without keytop. **5/$2.00**

YOU TOO CAN BE TRULY OBNOXIOUS.

While millions are made by authors of little books that purport to tell you how to be liked and popular, we dare to be different and offer a way for you to be truly obnoxious. The secret? Hook up one of our 110 dB Buzzers to a 6.3V AC supply, and you'll make such an obnoxious sound that people, small animals, and perhaps even insects will run for cover (or at least earplugs). On the other hand, it does have legitimate uses such as alarms, signals, etc. **$8.95 each.**

TERMS: Cal res add tax. Add 5% shipping, excess refunded. VISA®/Mastercharge® call our 24 hour order desk at (415) 562-0636. COD OK with street address for UPS. Prices good through cover month of magazine or end of the world, whichever comes first. **Once again, quantities are limited!**

FREE CATALOGUE: Send for our free catalogue, you have nothing to lose and lots to gain.

GODBOUT

GODBOUT ELECTRONICS

BLDG. 725, OAKLAND AIRPORT, CA 94614 (415) 562-0636

7400 TTL

SN7400N	16	SN7470N	29	SN74160N	89
SN7401N	18	SN7472N	29	SN74161N	89
SN7402N	18	SN7473N	35	SN74162N	1 95
SN7403N	18	SN7474N	35	SN74163N	89
SN7404N	18	SN7475N	49	SN74164N	89
SN7405N	20	SN7476N	35	SN74165N	89
SN7406N	29	SN7479N	5 00	SN74166N	1 25
SN7407N	29	SN7480N	50	SN74167N	1 95
SN7408N	20	SN7482N	99	SN74170N	1 59
SN7409N	20	SN7483N	59	SN74172N	6 00
SN7410N	18	SN7485N	79	SN74173N	1 25
SN7411N	25	SN7486N	35	SN74174N	89
SN7412N	25	SN7489N	1 75	SN74175N	79
SN7413N	40	SN7490N	45	SN74176N	79
SN7414N	70	SN7491N	59	SN74177N	79
SN7416N	25	SN7492N	43	SN74179N	1 95
SN7417N	25	SN7493N	43	SN74180N	79
SN7420N	20	SN7494N	65	SN74181N	1 95
SN7421N	29	SN7495N	65	SN74182N	79
SN7422N	39	SN7496N	65	SN74184N	1 95
SN7423N	25	SN7497N	3 00	SN74185N	1 95
SN7425N	29	SN74100N	89	SN74186N	9 95
SN7426N	29	SN74107N	35	SN74188N	3 95
SN7427N	29	SN74109N	59	SN74190N	1 25
SN7429N	39	SN74116N	1 95	SN74191N	1 25
SN7430N	20	SN74121N	35	SN74192N	79
SN7432N	25	SN74122N	39	SN74193N	79
SN7437N	25	SN74123N	49	SN74194N	89
SN7438N	25	SN74125N	49	SN74195N	69
SN7439N	25	SN74126N	49	SN74196N	89
SN7440N	20	SN74132N	75	SN74197N	89
SN7441N	89	SN74136N	75	SN74198N	1 49
SN7442N	49	SN74141N	79	SN74199N	1 49
SN7443N	75	SN74142N	2 95	SN74S200	4 95
SN7444N	75	SN74143N	2 95	SN74251N	99
SN7445N	75	SN74144N	2 95	SN74279N	59
SN7446N	69	SN74145N	79	SN74283N	2 25
SN7447N	59	SN74147N	1 95	SN74284N	3 95
SN7448N	79	SN74148N	1 29	SN74285N	3 95
SN7450N	20	SN74150N	89	SN74365N	69
SN7451N	20	SN74151N	59	SN74366N	69
SN7453N	20	SN74152N	59	SN74367N	69
SN7454N	20	SN74153N	59	SN74368N	69
SN7459A	25	SN74154N	99	SN74390N	1 95
SN7460N	20	SN74155N	79	SN74393N	1 95
		SN74156N	79		
		SN74157N	65		

C/MOS

CD4000	23			CD4070	55
CD4001	23			CD4071	23
CD4002	23	CD4028	89	CD4072	49
CD4006	1 19	CD4029	1 19	CD4076	1 39
CD4007	25	CD4030	49	CD4081	23
CD4009	49	CD4035	99	CD4082	23
CD4010	49	CD4040	1 19	CD4093	99
CD4011	23	CD4041	1 25	CD4098	2 49
CD4012	25	CD4042	99	MC14409	14 95
CD4013	39	CD4043	89	MC14410	14 95
CD4014	1 39	CD4044	89	MC14411	14 95
CD4015	1 19	CD4046	1 79	MC14419	4 95
CD4016	49	CD4047	2 50	MC14433	19 95
CD4017	1 19	CD4048	1 35	MC14506	75
CD4018	99	CD4049	49	MC14507	99
CD4019	49	CD4050	49	MC14562	14 50
CD4020	1 19	CD4051	1 19	MC14583	3 50
CD4021	1 39	CD4053	1 19	CD4508	3 95
CD4022	1 19	CD4056	2 95	CD4510	1 39
CD4023	23	CD4059	9 95	CD4511	1 29
CD4024	79	CD4060	1 49	CD4515	2 95
CD4025	23	CD4066	79	CD4518	1 29
CD4026	2 25	CD4068	39	CD4520	1 29
CD4027	69	CD4069	45	CD4566	2 25

74C00

74C00	39			74C163	2 49
74C02	39			74C164	2 49
74C04	39	74C85	2 49	74C173	2 60
74C08	49	74C90	1 95	74C192	2 49
74C10	39	74C93	1 95	74C193	2 49
74C14	1 95	74C95	1 95	74C195	2 49
74C20	39	74C107	1 25	74C922	7 95
74C30	39	74C151	2 90	74C923	6 25
74C42	1 95	74C154	3 00	74C925	8 95
74C48	2 49	74C157	2 15	74C926	8 95
74C73	89	74C160	2 49	80C95	1 50
74C74	89	74C161	2 49	80C97	1 50

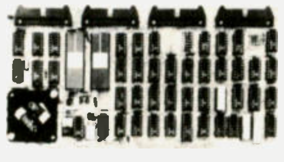
LINEAR

78MG	1 75			LM710N	79
LM106H	99			LM711N	39
LM300H	80	LM340K-18	1 35	LM723N/H	55
LM301CN/H	35	LM340K-24	1 35	LM733N	1 00
LM302H	75	LM340T-5	1 25	LM739N	1 19
LM304H	1 00	LM340T-6	1 25	LM741CN/H	35
LM305H	60	LM340T-8	1 25	LM741-14N	39
LM307CN/H	35	LM340T-12	1 25	LM747N/H	79
LM308CN/H	1 00	LM340T-15	1 25	LM748N/H	39
LM309H	1 10	LM340T 18	1 25	LM1310N	1 95
LM309K	1 25	LM340T-24	1 25	LM1458CN/H	59
LM310CN	1 15	LM358N	1 00	MC1488N	1 95
LM311N/H	90	LM370N	1 95	MC1489N	1 95
LM312H	1 95	LM373N	3 25	LM1496N	95
LM317K	6 50	LM377N	4 00	LM1556V	1 75
LM318CN/H	1 50	LM380N	1 25	MC1741SCP	3 00
LM319N	1 30	LM380CN	99	LM2111N	1 95
LM320K-5	1 35	LM381N	1 79	LM2901N	2 95
LM320K-5 2	1 35	LM382N	1 79	LM3053N	1 50
LM320K-12	1 35	NE501N	8 00	LM3065N	1 49
LM320K-15	1 35	NE510A	6 00	LM3900N(3401)	59
LM320K-18	1 35	NE529A	4 95	LM3905N	1 49
LM320K-24	1 35	NE531H/V	3 95	LM3909N	1 25
LM320T-5	1 25	NE536T	6 00	MC5558V	59
LM320T-5 2	1 25	NE540L	6 00	80388	4 95
LM320T-8	1 25	NE544N	4 95	LM75450N	49
LM320T-12	1 25	NE550N	1 30	75451CN	39
LM320T-15	1 25	NE555V	39	75452CN	39
LM320T-18	1 25	NE556N	99	75453CN	39
LM320T-24	1 25	NE560B	5 00	75454CN	39
LM323K-5	5 95	NE561B	5 00	75491CN	79
LM324N	1 49	NE562B	5 00	75492CN	89
LM339N	99	NE565N/H	1 25	75493N	89
LM340K-5	1 35	NE566CN	1 75	75494CN	89
LM340K-6	1 35	NE567V/H	99	RC4136	1 25
LM340K-8	1 35	NE570N	4 95	RC4151	3 95
LM340K-12	1 35	LM703CN/H	69	RC4194	4 95
LM340K-15	1 35	LM709N/H	29	RC4195	4 49

74LS00TTL

74LS00	29			74LS138	89
74LS01	29			74LS139	89
74LS02	29	74LS47	89	74LS151	89
74LS03	29	74LS51	29	74LS155	89
74LS04	35	74LS54	29	74LS157	89
74LS05	35	74LS55	29	74LS160	1 15
74LS08	29	74LS73	45	74LS161	1 15
74LS09	35	74LS74	45	74LS162	1 25
74LS10	29	74LS75	59	74LS163	1 15
74LS11	75	74LS76	45	74LS164	1 25
74LS13	59	74LS78	49	74LS175	99
74LS14	1 25	74LS83	89	74LS181	2 49
74LS15	35	74LS85	1 25	74LS190	1 15
74LS20	29	74LS86	45	74LS191	1 15
74LS21	35	74LS90	59	74LS192	1 15
74LS22	35	74LS92	75	74LS193	1 15
74LS26	35	74LS93	75	74LS194	1 15
74LS27	35	74LS95	99	74LS195	1 15
74LS28	35	74LS96	1 15	74LS253	99
74LS30	29	74LS107	45	74LS257	89
74LS32	35	74LS109	45	74LS258	1 75
74LS37	45	74LS112	45	74LS260	69
74LS40	35	74LS123	1 25	74LS279	75
74LS42	89	74LS125	89	74LS367	75
		74LS132	99	74LS368	75
		74LS136	49	74LS670	2 49

Cromemco
incorporated



TU-ART Digital Interface

Cromemco's TU-ART digital interface is a convenient interface for CRT terminals, line printers, modems, and other devices. Has 2 serial I/O ports, 2 8-bit parallel I/O ports, and 10 independent programmable interval timers. Baud rates are software-selectable from 110-76,800 baud. Has vectored prioritized interrupts so it is able to support the powerful vectored interrupt structure of a Z-80 microprocessor. 10 interval timers w/real-time capability.

Serial I/O Ports
No. of ports 2
I/O levels RS 232 or 20mA cur. loop
Low baud range 110-9600 baud (software selectable)
High baud range 880-76,800 baud (software selectable)
Parallel I/O Ports
No. of ports 2 Input ports 8 bits
Output ports 8 bits
Input load one TTL equivalent
Output Drive 20 TTL loads

Interval Timers
No. of timers 10
Time range 0.16-32 msec (software selectable)
Timer resolution 64 microseconds
Vectored Interrupts
No. restart locations (8080 mode) 8
No. restart locs. (Z-80 mode) 65,536
Prioritization of TU-ART ports internally prioritized
Prioritization for multiple TU-ARTs daisy chaining

General Information
UART Type 5501 Bus S-100
Power requirements +8V @ 1.0A, +18V @ 80mA, -18V @ 40mA
Operating environment 0-55 C

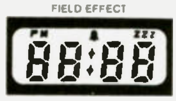
TRT-W (Assembled) **$295.00**

DISCRETE LEDS

.200" dia.			.125" dia.		
XC556R red	5/$1		XC209R red	5/$1	
XC556G green	4/$1		XC209G green	4/$1	
XC556Y yellow	4/$1		XC209Y yellow	4/$1	
XC556C clear	4/$1				
.200" dia.			.185" dia.		
XC22R red	5/$1		XC526R red	5/$1	
XC22G green	4/$1		XC526G green	4/$1	
XC22Y yellow	4/$1		XC526Y yellow	4/$1	
.170" dia.			XC526C clear	4/$1	
MV10B red	4/$1				
.085" dia.			.190" dia.		
MV50 red	6/$1		XC111R red	5/$1	
			XC111G green	4/$1	
			XC111Y yellow	4/$1	
			XC111C clear	4/$1	

INFRA-RED LED
1/4"x1/4"x1/16" flat
5/$1

TIMEX T1001
LIQUID CRYSTAL DISPLAY
CLASS II
FIELD EFFECT



4 DIGIT 5 CHARACTERS
THREE ENUNCIATORS
2 00" X 1 20" PACKAGE
INCLUDES CONNECTOR

T1001-Transmissive	$7.95
T1001A-Reflective	8.25

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	270	2 95	MAN 6730	Common Anode-red ÷ 1	560	99
MAN 2	5 x 7 Dot Matrix-red	300	4 95	MAN 6740	Common Cathode-red-D D	560	99
MAN 3	Common Cathode-red	125	25	MAN 6750	Common Cathode-red ÷ 1	560	99
MAN 4	Common Cathode-red	187	1 95	MAN 6760	Common Anode-red	560	99
MAN 7G	Common Anode-green	300	1 25	MAN 6780	Common Cathode-red	560	99
MAN 7Y	Common Anode-yellow	300	99	DL701	Common Anode red ÷ 1	300	99
MAN 72	Common Anode-red	300	.75	DL704	Common Cathode-red	300	99
MAN 74	Common Cathode-red	300	1 25	DL707	Common Anode-red	300	99
MAN 82	Common Anode-yellow	300	49	DL728	Common Cathode-red	500	1 49
MAN 84	Common Cathode-yellow	300	99	DL741	Common Anode red	600	1 25
MAN 3620	Common Anode-orange	300	49	DL746	Common Anode-red ÷ 1	630	1 49
MAN 3630	Common Anode-orange ÷ 1	300	99	DL747	Common Anode-red	600	1 49
MAN 3640	Common Cathode-orange	300	99	DL749	Common Cathode-red ÷ 1	630	1 49
MAN 4610	Common Anode-orange	300	99	DL750	Common Cathode-red	600	1 49
MAN 4640	Common Cathode-orange	400	99	DL338	Common Cathode-red	110	35
MAN 4710	Common Anode-red	400	99	FND70	Common Cathode	250	69
MAN 4730	Common Anode-red ÷ 1	400	99	FND358	Common Cathode ÷ 1	357	99
MAN 4740	Common Cathode-red	400	99	FND359	Common Cathode	357	75
MAN 4810	Common Anode-yellow	400	99	FND503	Common Cathode(FND500)	500	99
MAN 4840	Common Cathode-yellow	400	99	FND507	Common Anode (FND510)	500	99
MAN 6610	Common Anode-orange-D D	560	99	5082-7730	Common Anode-red	300	99
MAN 6630	Common Anode-orange ÷ 1	560	99	HDSP-3400	Common Anode-red	800	1 50
MAN 6640	Common Cathode-orange-D D	560	99	HDSP 3403	Common Cathode red	800	1 50
MAN 6650	Common Cathode-orange ÷ 1	560	99	5082 7300	4 x 7 sgl Digit-RHDP	600	19 95
MAN 6660	Common Anode-orange	560	99	5082-7302	4 x 7 Sgl Digit-LHDP	600	19 95
MAN 6680	Common Cathode-orange	560	99	5082-7304	Overrange character, (÷1)	600	15 00
MAN 6710	Common Anode-red-D D	560	99	5082-7340	4 x 7 Sgl Digit-Hexadecimal	600	22 50

RCA LINEAR

CA3013T	2 15	CA3082N	2 00
CA2023T	2 56	CA3083N	1 60
CA3035T	2 48	CA3086N	85
CA3039T	1 35	CA3089N	3 75
CA3046N	1 30	CA3130T	1 39
CA3059N	3 25	CA3140T	1 25
CA3060N	3 25	CA3160T	1 25
CA3080T	85	CA3401N	59
CA3081N	2 00	CA3600N	3 50

CALCULATOR CHIPS/DRIVERS

MM5725	$2 95
MM5738	2 95
DM8864	2 00
DM8865	1 00
DM8887	75
DM8889	75
9374 7 seg C A LED driver	1 50

CLOCK CHIPS

MM5309	$4 95
MM5311	4 95
MM5312	4 95
MM5314	4 95
MM5316	6 95
MM5318	9 95
MM5369	2 95
MM5387/1998A	4 95
CT7001	6 95

MOTOROLA

MC1408L7	$4 95
MC1408L8	5 75
MC1439L	2 95
MC3022P	2 95
MC3061P	3 50
MC4016(74416)	7 50
MC4024P	3 95
MC4040P	6 95
MC4044P	4 50

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	$.17	16	15	22 pin LP	$ 37	36	35
14 pin LP	20	19	18	24 pin LP	38	37	36
16 pin LP	22	21	20	28 pin LP	45	44	43
18 pin LP	29	28	27	36 pin LP	60	59	58
20 pin LP	34	32	30	40 pin LP	63	62	61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin ST	$ 27	25	24	28 pin ST	$ 99	90	81
16 pin ST	30	27	25	36 pin ST	1 39	1 26	1 15
18 pin ST	35	32	30	40 pin ST	1 59	1 45	1 30
24 pin ST	49	45	42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin SG	$ 30	27	24	24 pin SG	$ 70	63	57
14 pin SG	35	32	29	28 pin SG	1 10	1 00	90
16 pin SG	38	35	32	36 pin SG	1 65	1 40	1 26
18 pin SG	52	47	43	40 pin SG	1 75	1 59	1 45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin WW	$ 39	38	31	22 pin WW	$ 95	85	75
10 pin WW	45	41	37	24 pin WW	1 05	95	85
14 pin WW	39	38	37	28 pin WW	1 40	1 25	1 10
16 pin WW	43	42	41	36 pin WW	1 59	1 45	1 30
18 pin WW	75	68	62	40 pin WW	1 75	1 55	1 40
20 pin WW	.85	.79	.72				

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea	10 OHM 12 OHM 15 OHM 18 OHM 22 OHM 27 OHM 33 OHM 39 OHM 47 OHM 56 OHM	50 PCS	$1.75
ASST. 2	5 ea	68 OHM 82 OHM 100 OHM 120 OHM 150 OHM 180 OHM 220 OHM 270 OHM 330 OHM 390 OHM	50 PCS	1.75
ASST. 3	5 ea	470 OHM 560 OHM 680 OHM 820 OHM 1K 1.2K 1.5K 1.8K 2.2K 2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K 3.9K 4.7K 5.6K 6.8K 8.2K 10K 12K 15K 18K	50 PCS	1.75
ASST. 5	5 ea	22K 27K 33K 39K 47K 56K 68K 82K 100K 120K	50 PCS	1.75
ASST. 6	5 ea	150K 180K 220K 270K 330K 390K 470K 560K 680K 820K	50 PCS	1.75
ASST. 7	5 ea	1M 1.2M 1.5M 1.8M 2.2M 2.7M 3.3M 3.9M 4.7M 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	7.95
74C923	Keyboard Encoder (20 keys)	6.25

ICM CHIPS

ICM7045	CMOS Precision Timer	24 95
ICM7205	CMOS LED Stopwatch/Timer	19 95
ICM7207	Oscillator Controller	7 50
ICM7208	Seven Decade Counter	19 95
ICM7209	Clock Generator	6 95

NMOS READ ONLY MEMORIES

MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13 50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13 50
MCM6575	128 X 9 X 7 Alpha Control Char Gen	13 50

MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2 49
TL494CN	Switching Regulator	4 49
TL496CP	Single Switching Regulator	1 75
11C90	Divide 10/11 Prescaler	19 95
95H90	Hi-Speed Divide 10/11 Prescaler	11 95
4N33	Photo-Darlington Opto-Isolator	3 95
MK50240	Top Octave Freq Generator	17 50
DS0026CH	5MHz 2-phase MOS clock driver	3 75
TIL308	27" red num display w/integ logic chip	10 95
MM5320	TV Camera Sync Generator	14 95
MM5330	4½ Digit DPM Logic Block (Special)	3 95
LD110/111	3½ Digit A/D Converter Set	25 00/set
MC14433P	3½ Digit A/D Converter	13 95

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator
(Same as MCT 2 or 4N25)
49¢ each

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power - Programmable
$3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2 01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc **7.95/set**

EXAR

XR205	$8 40			XR2242CP	1.50
XR210	4 40			XR2264	4 25
XR215	4 40			XR2556	3 20
XR320	1.55			XR2567	2 99
XR-L555	1 50	JE2206KB	19 95	XR3403	1 25
XR555	39	XR1800	3.20	XR4136	1 25
XR556	.99	XR2206	4 40	XR4151	3 95
XR567CP	99	XR2207	3.85	XR4194	4 95
XR567CT	1 25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1 75	XR4212	2.05
XR1468CN	3 85	XR2211	5.25	XR4558	75
XR1488	1 95	XR2212	4.35	XR4739	1 15
XR1489	1.95	XR2240	3.45	XR4741	1 47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3 3	400m	4 1 00	1N4002	100 PIV 1 AMP		12/1 00
1N751	5 1	400m	4 1 00	1N4003	200 PIV 1 AMP		12/1 00
1N752	5 6	400m	4 1 00	1N4004	400 PIV 1 AMP		12 1 00
1N753	6 2	400m	4 1 00	1N4005	600 PIV 1 AMP		10 1 00
1N754	6 8	400m	4 1 00	1N4006	800 PIV 1 AMP		10/1 00
1N757	9 0	400m	4 1 00	1N4007	1000 PIV 1 AMP		10 1 00
1N759	12 0	400m	4 1 00	1N3600	50	200m	6/1 00
1N959	8 2	400m	4 1 00	1N4148	75	10m	15/1 00
1N965	15	400m	4 1 00	1N4154	35	10m	12 1 00
1N5232	5 6	500m	28	1N4733	5 1	1w	28
1N5234	6 2	500m	28	1N4734	5 6	1w	28
1N5235	6 8	500m	28	1N4735	6 2	1w	28
1N5236	7 5	500m	28	1N4736	6 8	1w	28
1N5242	12	500m	28	1N4738	8 2	1w	28
1N5245	15	500m	28	1N4742	12	1w	28
1N456	25	40m	6 1 00	1N4744	15	1w	28
1N458	150	7m	6 1 00	1N1183	50 PIV 35 AMP		1 60
1N485A	180	10m	5 1 00	1N1184	100 PIV 35 AMP		1 70
1N4001	50 PIV 1 AMP		12 1 00	1N1185	150 PIV 35 AMP		1 70
				1N1186	200 PIV 35 AMP		1 80
				1N1188	400 PIV 35 AMP		3 00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1 95
C36M	35A @ 600V	SCR	1 95
2N2328	1 6A @ 300V	SCR	50
MDA 980-1	12A @ 50V	FW BRIDGE REC	1 95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1 95

TRANSISTORS

C106B1	50			2N3904	4 1 00
MPSA05	30	2N3055	89	2N3905	4 1 00
MPSA06	5 1 00	MJE3055	1 00	2N3906	4 1 00
TIS97	6 1 00	2N3392	5 1 00	2N4013	3 1 00
TIS98	6 1 00	2N3398	5 1 00	2N4123	6/1 00
40409	1 75	PN3567	3 1 00	PN4249	4/1 00
40410	1 75	PN3568	4/1 00	PN4250	4 1 00
40673	1 75	PN3569	4 1 00	2N4400	4/1 00
2N918	4 1 00	MPS3638A	5 1 00	2N4401	4 1 00
2N2219A	2 1 00	MPS3702	5 1 00	2N4402	4 1 00
2N2221A	4 1 00	2N3704	5 1 00	2N4403	4/1 00
2N2222A	5/1 00	MPS3704	5 1 00	2N4409	5 1 00
PN2222 Plastic	7 1 00	2N3705	5 1 00	2N5086	4 1 00
2N2369A	4 1 00	MPS3705	5 1 00	2N5087	4 1 00
MPS2369	5 1 00	2N3706	5 1 00	2N5088	4 1 00
2N2484	4 1 00	MPS3706	5/1 00	2N5089	4 1 00
2N2906	4 1 00	2N3707	5 1 00	2N5129	5 1 00
2N2907	5 1 00	2N3711	5 1 00	PN5134	5 1 00
PN2907 Plastic	7 1 00	2N3724A	65	PN5138	5 1 00
2N2925	5/1 00	2N3725A	1 00	2N5139	5/1 00
MJE2955	1 25	2N3772	2 25	2N5210	5 1 00
2N3053	2 1 00	2N3823	1 00	2N5449	3/1 00
		2N3903	5 1 00	2N5951	3/1 00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
10 pf	05	04	03	001µF	05	04	035
22 pf	05	04	03	0047µF	05	04	035
47 pf	05	04	03	01µF	05	04	035
100 pf	05	04	03	022µF	06	05	04
220 pf	05	04	03	047µF	06	05	04
470 pf	05	04	035	1µF	12	09	075

100 VOLT MYLAR FILM CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
001mf	12	10	07	022mf	13	11	08
0022	12	10	07	047mf	21	17	13
0047mf	12	10	07	1mf	27	23	17
01mf	12	10	07	22mf	33	27	22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
1 35V	28	23	17	1 5 35V	.30	.26	.21
15/35V	28	23	17	2 2 35V	.35	.31	.27
22 35V	28	23	17	3 3/25V	.35	.31	.27
33 35V	28	23	17	4 7/25V	.33	.28	.23
47 35V	28	23	17	6 8 25V	.49	.45	.35
68 35V	28	23	17	15/25V	.75	.68	.59
1 0/35V	28	23	17	22/6V	.75	.60	.50

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead	1-9	10-99	100-	Radial Lead	1-9	10-99	100-
47/50V	15	13	10	47 25V	15	13	10
1 0/50V	16	14	11	47 50V	16	14	11
3 3/50V	14	12	09	1 0/16V	15	13	10
4 7 25V	15	13	10	1 0 25V	16	14	11
10/25V	15	13	10	1 0 50V	16	14	11
10/50V	16	14	12	4 7/16V	15	13	10
22/25V	17	15	12	4 7/25V	15	13	10
22/50V	24	20	18	4 7/50V	16	14	11
47 25V	19	17	15	10/16V	14	12	09
47 50V	25	21	19	10 25V	15	13	10
100 25V	24	20	18	10 50V	16	14	12
100 50V	35	30	28	47/50V	24	21	19
220 25V	32	28	25	100/16V	19	15	14
220/50V	45	41	38	100/25V	24	20	18
470/25V	33	29	27	100/50V	35	30	28
1000/16V	55	50	45	220/16V	23	17	16
2200 16V	70	62	55	470 25V	31	28	26

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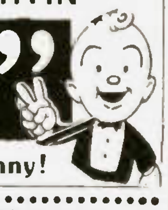

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1-LASCR OPTO COUPLER, type H11C3, mini dip, (#5700)	1.29	2 for 1.30
3-LINE CORDS, 6 ft. 18 gauge, 2 cond. white w/plug, (#3787)	1.29	6 for 1.30
15-SINGLE PIN MICRO RED LEDS, 100% material, 3 volts @ 10 mils, (#5896)	1.29	30 for 1.30
40-FEEDTHRU CAPACITORS, used for hams, RF, UHF circuitry, (#5847)	1.29	80 for 1.30
40-PLASTIC TRANSISTORS, asst'd untested and hobby, (#2604A)	1.29	80 for 1.30
6-6V INDICATORS, w/leads, test lamp manufacturers excess, (#5893)	1.29	12 for 1.30
40-METAL CAN TRANSISTORS, asst'd types, hobby, untested, (#2603A)	1.29	80 for 1.30
10-UPRIGHT ELECTROS, 100% asst'd values and voltages, (#5900)	1.29	20 for 1.30
40-SEMI-CON SUPRISE, zeners, rectifiers, transistors, etc, U-test, (#2226)	1.29	80 for 1.30
65-STABISTORS, axial, for regulators & computers, U-test, (#3140)	1.29	130 for 1.30
40-SQUARE PC COILS, uprights, assorted values, for PC applications, (#3188)	1.29	80 for 1.30
50-1 WATT ZENERS, 3.3,8,10,12,15V, etc., double plug, untested, (#1964)	1.29	100 for 1.30
4-ROCKER SWITCHES, DPDT, solder eyelet terminals, (#3302)	1.29	8 for 1.30
60-LONG LEAD DISCS, 100% prime, marked capacitors, (#5899)	1.29	120 for 1.30
6-MINI TRANSFORMERS, asst'd outputs, interstage & audio, 1" sq. (#3295)	1.29	12 for 1.30
1-TV/AUDIO SHIELDED CABLE, 2 cond. 15 ft. w/RCA phone plugs, (#5812)	1.29	2 for 1.30
25-DATA ENTRY KEYCAPS, ½" sq. #'s & functions, asst. colors, (#4013)	1.29	50 for 1.30
2-GE 3W AUDIO AMP, type PA-263 IC chip, mono, (#1522)	1.29	4 for 1.30
1-MERCURY TILT SWITCH, N.C. rated 24VDC @ .05A, w/leads, (#5686)	1.29	2 for 1.30
6-POWER TAB TRIACS, 100% prime, 100V, TO-220, (#5888)	1.29	12 for 1.30
6-POWER TAB SCR's, 100% prime, 100V, TO-220, (#5904)	1.29	12 for 1.30
2-WATCH LCD's, 3½ digit, asst. types, size: 1" x 1½" (approx.) (#5066)	1.29	4 for 1.30
4-TV INTERLOCK JACKS for TV/power mt. ctr, solder tab terms., (#5519)	1.29	8 for 1.30
4-MOS FETS, 3N128, by Fairchild & RCA, TO-18, some duals, (#1686)	1.29	8 for 1.30
4-PHOTO ELECTRIC DARLINGTON TRANSISTORS, 2N5777, (#3276)	1.29	8 for 1.30
6-AC "UTILITY" OUTLETS, for 1¼" mt. ctr., solder lugs, (#3582)	1.29	12 for 1.30
15-NE-2 LAMPS, neon red, for 110VAC, less resistor, (#1435)	1.29	30 for 1.30
20-1N4148 SWITCHING DIODES, 4nS, 100V @ 10mA, axial 100%, (#3000)	1.29	40 for 1.30
2-4 AMP SILICON BRIDGE RECTIFIER, 200V, block style, (#5928)	1.29	4 for 1.30
4-VARACTOR DIODES, var. tuner capacitance, 20-50 pf. (#5887)	1.29	8 for 1.30
50-PRECISION RESISTORS, ½, 1, & 2 watts. 1%, assorted types, (#363)	1.29	100 for 1.30
60-CERAMIC CAPS, asst'd val. & styles, incl; tubulars, NPO's, etc., (#590)	1.29	120 for 1.30
25-PLASTIC SCR's, incl; 200V, untested, high yield, TO-92, (#3192)	1.29	50 for 1.30
40-MOLDED CAPACITORS, tubular, asst'd volt. to 1 mf. axial leads (#348642)	1.29	80 for 1.30
60-MICRO ZENER & RECT. KIT, asst'd voltages, only 1/8" sq. U-test, (#1251)	1.29	120 for 1.30
1-LINE CORD, 8 ft. 2 cond, 16 gauge, vinyl molded plug & grommet (#3661)	1.29	2 for 1.30
6-SPDT MICRO SLIDE SWITCH, only 3/7" cube, for PC mount, (#3429)	1.29	12 for 1.30
10-PR.-RCE PLUGS & JACKS, for audio, speakers, etc., (#402)	1.29	20 for 1.30
5-2N3055 HOBBY TRANSISTORS, 100%, TO-3, (#3771)	1.29	10 for 1.30
10-ZENERS, 1 watt 9.1 volts axial leads 100%, (#5370A)	1.29	20 for 1.30
40-1N4148, 4 NANO, SWITCHING DIODE, axial leads untested (#5923)	1.29	80 for 1.30
2-RELAYS, BABCOCK 6VDC, SPST, plastic case (#5807)	1.29	4 for 1.30
1-25 AMP BRIDGE RECTIFIER, 50 volts, 100%, (#5948)	1.29	2 for 1.30
2-QUADRACS, 10 amp 200 PRV, TO-220 100%, (#5915)	1.29	4 for 1.30
60-MINI RESISTORS, 30-1/2W, 30-1/4 watt, axial, color coded, (#5922)	1.29	120 for 1.30
12-SCRS-TRIAC-QUADRACS, asst. volts. TO-220 case (#2087)	1.29	24 for 1.30
10-BULLPLATES, asst. resistor/capacitor networks, various styles, (#5880)	1.29	20 for 1.30
2-AIR TRIMMER CAPS, alum. plates, ¼" shaft, panel mt. solder lugs, (#5658)	1.29	4 for 1.30
30-MOLEX CONNECTORS, nylon, asst'd styles, colors, & # of cond. (#5835)	1.29	60 for 1.30
1-3 COND. LINE CORD, 8 ft. flat, w/ring terminals, 2 AC, 1 GND, (#5703)	1.29	2 for 1.30
4-12 VOLT LAMPS, w/leads, popular voltage, 100's of uses, (#5942)	1.29	8 for 1.30
25-TTL IC's, untested, asst'd gates, flip flops, etc. 14-16 pin, (#5955)	1.29	50 for 1.30
20-1000 PIV GLASS AMPS, micro-mini, axial, silicon, rated @ 1A, (#5903)	1.29	40 for 1.30
1-12 VCT 200 mA TRANSFORMER, 115 V prim., PC mount, (#5977)	1.29	2 for 1.30
20-400 mW 15V ZENERS, micro-style, asst. epoxy & glass, 100%, axial, (#5914)	1.29	40 for 1.30
100-UNMARKED CAPS, popular values, mylars & polystyrene, 100%, (#5892)	1.29	200 for 1.30
60-ONE WATT ZENERS, assorted voltages, glass pak, dbl plug, U-test, (#5947)	1.29	120 for 1.30
50-MICRO ZENERS, 1 watt, 2-30V, DO-7 & micro epoxy, axial, 100%, (#5905)	1.29	100 for 1.30
500pc-HARDWARE SURPRISE, asst screws nuts & washers, (#5891)	1.29	1000 for 1.30
60-GLASS AMPS, up to 1KV, 1N4000 series, glass encased, untested, (#5982)	1.29	120 for 1.30
200-PC BOARD PARTS, boards loaded w/100% parts, hobby bonanza, (#5946)	1.29	400 for 1.30
6-RF NPN TRANSISTORS, type-2N1059, BVcbo: 40V, TO-22, 100%, (#5895)	1.29	12 for 1.30
2-BRASS DOOR LOCKS, w/key, for doors windows, etc. 2-1/8" mt. ctr. (#5949)	1.29	4 for 1.30
1-PUSH-PUSH CB SWITCH, DPDT, 1 x ¾ x 3/8", 100's of uses, (#3463)	1.29	2 for 1.30
30-"CRIMP-ON" TERMINALS, rings and spades, for # 12-20 wire, (#3955)	1.29	60 for 1.30
5-CALCULATOR KEYBOARDS, multi-function, 17 keys and up, (#3774)	1.29	10 for 1.30
50-ONE-WATT RESISTORS, popular assort, some 5%ers, 100's of uses, (#3844)	1.29	100 for 1.30
50-METALLIC FILM ½ WATTERS, asst. values, marked, axial leads, (#1605)	1.29	100 for 1.30
4-RIBBON CABLE CONNECTOR, single-sided, 9 contacts, PC leads, (#5967)	1.29	8 for 1.30
3-"SUPER" 2N222's, NPN, ICBO:60V, hfe:100 1W @ 2A, TO-92, 100%, (#5952)	1.29	6 for 1.30
1-12 VDC MINI BLOCK RELAY, spdt, 1 x 3/4 x 5/8", 175 ohm, 1A, (#5937)	1.29	2 for 1.30
10-1.5V GRAIN-o-WHEAT LAMPS, 5/16", w/10" leads, lens: RED, (#6002)	1.29	20 for 1.30
10-IF-FM OP AMPS, by RCA, FM-UHF circuitry, TO-5, 10 leads, (#5951)	1.29	20 for 1.30
10-NPN SWITCHING TRANSISTORS, asst'd gen. audio & switching, (#2595)	1.29	20 for 1.30
1-12 VDC SOLENOID, similar to Guardian 16-P, w/plunger, ¼" stroke, (#6015)	1.29	2 for 1.30
10-HUMBUCKER CONTROLS W/KNOB, for TV vertical, horiz., etc. (#5882)	1.29	20 for 1.30
50-CAPACITOR SPECIAL, discs, mylars, and more, (#3775)	1.29	100 for 1.30
4-HOBBY VOLTAGE REGULATORS, LM-309, 320, 340's, TO-3, (#3330A)	1.29	8 for 1.30
12-PANEL SWITCHES, assorted slides, rotaries, modulars, etc. (#295)	1.29	24 for 1.30
60-RESISTOR SPECIAL, ¼ to 1 watt, carbons, carbo-films, etc. (#35B96)	1.29	120 for 1.30
65-HALF WATT RESISTORS, asstd. carbons, carbo-films, various values, (#454)	1.29	130 for 1.30
6-LM340T VOLTAGE REGULATORS, 5 to 24 volts, TO-220, (#5897)	1.29	12 for 1.30
40-POLYSTYRENE CAPACITORS, asst'd values and voltages, (#1052)	1.29	80 for 1.30
15-THERMISTORS, resistors that change with the temperature, (#2048)	1.29	30 for 1.30
65-¼ WATT RESISTORS, asst'd values, metal film, marked, (#5797)	1.29	130 for 1.30
1-12VDC SPDT RELAY, 180 ohm coil, 25 mA, 1x1x1½" (#5937)	1.29	2 for 1.30
15-VOLUME CONTROLS, asst. values, audio, and switch too! (#592)	1.29	30 for 1.30
60-PREFORMED DISC CAPS, handy assortment of values, marked, (#1181)	1.29	120 for 1.30
10-AXIAL ELECTROS, assorted values and capacitance, (#5901)	1.29	20 for 1.30
60-GLASS ZENERS, 400mW, untested, better than 50% yield, (#5889)	1.29	120 for 1.30
10-PC TRIMPOTS, screwdriver adjust, assorted values, (#3346)	1.29	20 for 1.30
25-4" CABLE TIES, plastic, like Ty-wrap style, (#5217)	1.29	50 for 1.30
5-CRYSTALS, may include; CB, ham various shapes and sizes, (#5716)	1.29	10 for 1.30
40-POWER RESISTORS, assorted types, includes 2 to 10 watters, (#228)	1.29	80 for 1.30
40-TWO WATT RESISTORS, carbo-films, carbons, some 5%ers, (#456)	1.29	80 for 1.30
50-TERMINAL STRIPS, asst'd solder and screw types, 2 lugs & up, (#334)	1.29	100 for 1.30
1-WATCH GUTS, LED, who knows how good, micro-digital bonanza, (#5115)	1.29	2 for 1.30
10-1000V 1A RECTIFIERS, 1N4007, epoxy case, axial leads, (#5926)	1.29	20 for 1.30
5-MULTI-DIGIT LED READOUTS, bubble magnifier, 2 to 6 digits, (#3624)	1.29	10 for 1.30
10-POWER TAB TRANSISTORS, NPN, plastic, TO-220, (#5629)	1.29	20 for 1.30
6-PRECISION TRIM POTS, asst'd singles and multi-turns, untested, (#3389)	1.29	12 for 1.30
50-1N4000 RECTIFIERS, epoxy, axial leads, untested, (#2594)	1.29	100 for 1.30
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5-PL-55 PHONE JACKS, standard bushing, for hams, communications, (#5868)	1.29	10 for 1.30
40-RED DEVIL CAPACITORS, handy assort. of pop. values, axial leads, (#3823)	1.29	80 for 1.30
50-MICAS asst. sizes-n-shapes, incl. "silvers" too! (#373)	1.29	100 for 1.30
10-TRANSISTOR SOCKETS, for npn and pnp types, (#5944)	1.29	20 for 1.30
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10-MV-54 MICRO-MINI LEDS, flat top style, diffused red lens, (#1789)	1.29	20 for 1.30
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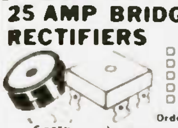

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63,000	@	15V	3"	x	5½"	4.00 ea
10,000	@	20V	1½"	x	53/4"	3.00 ea
2,700	@	25V	1¼"	x	2¼"	2.00 ea
2,900	@	25V	1¼"	x	2"	2.00 ea
3,000	@	25V	1½"	x	4½"	2.00 ea
18,000	@	25V	2"	x	4"	3.00 ea
21,000	@	25V	2½"	x	3"	3.00 ea
39,000	@	45V	3"	x	53/4"	3.00 ea
1,000	@	50V	1¼"	x	3¼"	2.50 ea
34,800	@	50V	3"	x	5½"	3.00 ea
450	@	75V	1¼"	x	2¼"	2.00 ea
500	@	100V	1½"	x	3½"	2.00 ea
240	@	300V	1¼"	x	3¼"	2.00 ea
50	@	450V	1¼"	x	2"	2.00 ea
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20 uF @ 15V
50 uF @ 15V
2.2 uF @ 25V
3.3 uF @ 25V
1 uF @ 35V
2 uF @ 150V
} 12 ea. for $1.00

25 uF @ 25V
3 uF @ 50V
5 uF @ 50V
10 uF @ 50V
} 15 ea. for $2.00

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100 uF @ 50V
50 uF @ 75V
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Power:	4 'C' cells, optional nicad pack, or AC adapter
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$99.95 WIRED

The CT-70 breaks the price barrier on lab quality frequency counters. No longer do you have to settle for a kit, half-kit or poor performance, the CT-70 is completely wired and tested, features professional quality construction and specifications, plus is covered by a one year warranty. Power for the CT-70 is provided by four 'AA' size batteries or 12 volts, AC or DC, available as options are a nicad battery pack, and AC adapter. Three selectable frequency ranges, each with its own pre-amp, enable you to make accurate measurements from less than 10 Hz to greater than 600 mHz. All switches are conveniently located on the front panel for ease of operation, and a single input jack eliminates the need to change cables as different ranges are selected. Accurate readings are insured by the use of a large 0.4 inch seven digit LED display, a 1.0 ppm TCXO time base and a handy LED gate light indicator.

The CT-70 is the answer to all your measurement needs, in the field, in the lab, or in the ham shack. Order yours today, examine it for 10 days, if you're not completely satisfied, return the unit for a prompt and courteous refund.

Specifications

Frequency range:	10 Hz to over 600 mHz
Sensitivity:	less than 25 mv to 150 mHz less than 150 mv to 600 mHz
Stability:	1.0 ppm, 20-40°C; 0.05 ppm/°C TCXO crystal time base
Display:	7 digits, LED, 0.4 inch height
Input protection:	50 VAC to 60 mHz, 10 VAC to 600 mHz
Input impedance:	1 megohm, 6 and 60 mHz ranges 50 ohms, 600 mHz range
Power:	4 'AA' cells, 12 V AC/DC
Gate:	0.1 sec and 1.0 sec LED gate light
Decimal point:	Automatic, all ranges
Size:	5"W x 1½"H x 5½"D
Weight:	1 lb with batteries

Prices

CT-70 wired + tested	$99.95
CT-70 kit form	75.95
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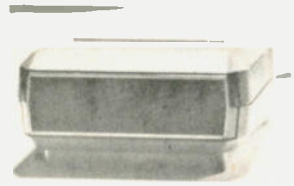

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A real jewel for those small projects Hinged top door allows you to hide your control area. O.D 4½" x 4" x 1 3/4"
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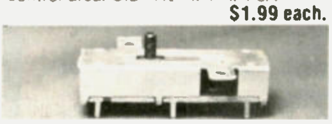

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Long through slide switch providing correct isolation for 300 OHM Twin Lead 35¢ ea 4 for ONLY $1 00

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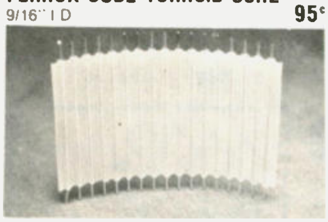

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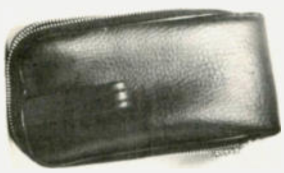

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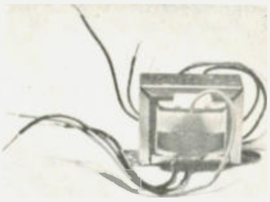

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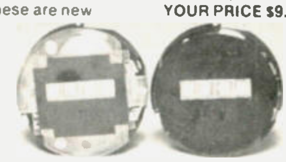

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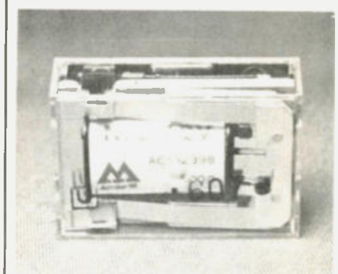

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AY3-8910 PROGRAMMABLE SOUND GENERATOR

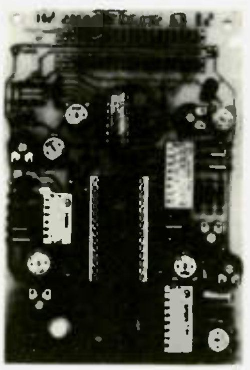
The AY3-8910 is a 40 pin LSI chip with three oscillators, three amplitude controls, programmable noise generator, three mixers, an envelope generator, and three D/A converters that are controlled by 8 BIT WORDS. No external pots or caps required. This chip hooked to an 8 bit microprocessor chip or Buss (8080, Z80, 6800 etc.) can be software controlled to produce almost any sound. It will play three note chords, make bangs, whistles, sirens, gunshots, explosions, bleets, whines, or grunts. In addition, it has provisions to control its own memory chips with two IO ports. The chip requires +5V @ 75ma and a standard TTL clock oscillator. A truly incredible circuit.

$14.95 W/Basic Spec Sheet (4 pages)
60 page manual with S-100 interface instructions and several programming examples, **$3.00 extra**

SE-01 SOUND EFFECTS KIT

• 76477 CHIP IS INCLUDED. EXTRA CHIPS $2.95 EACH

• $16.95 LESS SPEAKER & BATTERY



The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new **Texas Instruments SN76477 Sound Chip**, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3¼" x 5" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosions, Phasor Guns, Steam Trains**, or almost an infinite number of **other sounds**. The unit has **a** multiple of applications. The low price includes all parts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MW amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included)

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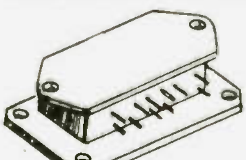
LAMBDA HIGH POWER REGULATOR 3205 MODULE



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LIMITED QTY.

- 5V @ 10A with 8-30VDC input.
- Current limiting, thermal shutdown and short protection.
- .2% Load regulation.
- Only 2 external components needed.

All you need to add is a transformer, rectifier, heatsink and filter cap to have a super regulated supply for 5 volts at 10 amps!
SPECIAL BONUS! Order the 3205 Module and get **FREE** a LAMBDA L-20-5 overvoltage protector that triggers at 6.6 volts up to 20 amps.

LAS15U - 1.5A Four Terminal Adjustable Regulator. 3-30V W/current limiting, short protection and thermal shutdown. TO-3 style. All units are prime. Spec sheets included. **$2.50**

4 DIGIT ½ INCH CHARACTER LED DISPLAY

Bowmar readout stick with colons. COMMON CATHODE ONLY. 100% Prime. All segments and colons brought out to edge pads. With pinout. LIMIT 5 PER CUSTOMER

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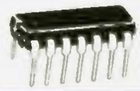

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7 SEGMENT
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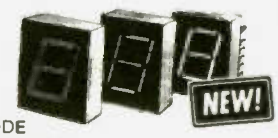
6640 COMMON ANODE
6920 COMMON CATHODE



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SMALL, SINGLE HYBRID IC AND COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12 VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP. LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT. **$5.95**

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ULTRASONIC RELAY KIT

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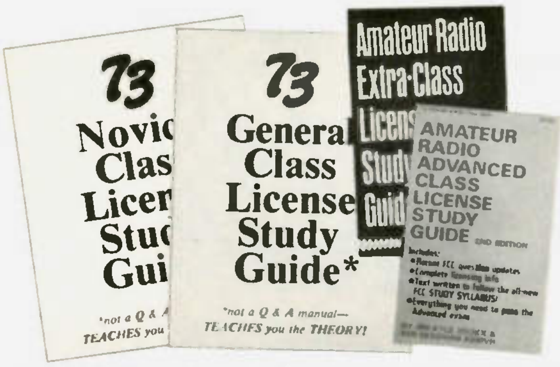

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NOVICE THEORY TAPES
Startling Learning Breakthrough

• **NOVICE THEORY TAPES**—CT7300—Startling Learning Breakthrough. You'll be astounded at how really simple the theory is when you hear it explained on these tapes. Three tapes of theory and one of questions and answers from the latest Novice exams give you the edge you need to breeze through your exam. *73* is interested in helping get more amateurs, so we're giving you the complete set of our tapes for the incredibly low price of **ONLY $15.95.***

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SSTV

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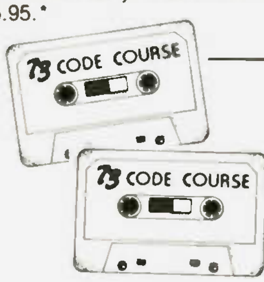
73 CODE SYSTEM TAPES



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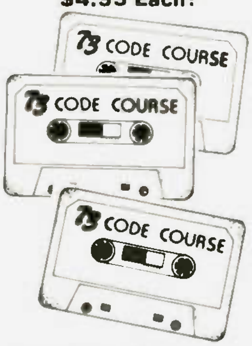


"GENESIS"

5 WPM—CT7305—This is the beginning tape for people who do not know the code at all. It takes them through the 26 letters, 10 numbers and necessary punctuation, complete with practice every step of the way using the newest blitz teaching techniques. It is almost miraculous! In one hour many people—including kids of ten—are able to master the code. The ease of learning gives confidence to beginners who might otherwise drop out.

"THE STICKLER"

6+ WPM—CT7306—This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly—under pressure—faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five.

"BACK BREAKER"

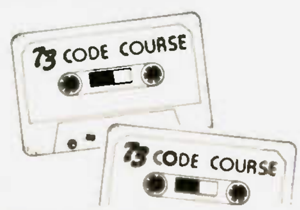
13+ WPM—CT7313—Code groups again, at a brisk 13 per so you will be at ease when you sit down in front of the steely-eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test, you'll thank heavens you had this back-breaking tape.

"COURAGEOUS"

20+ WPM—CT7320—Code is what gets you when you go for the Extra class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape.

"OUTRAGEOUS"

25+ WPM—CT7325—This is the tape for that small group of overachieving hams who wouldn't be content to simply satisfy the code requirements of the Extra Class license. It's the toughest tape we've got and we keep a permanent file of hams who have mastered it. Let us know when you're up to speed and we'll inscribe your name in 73's CW "Hall of Fame."



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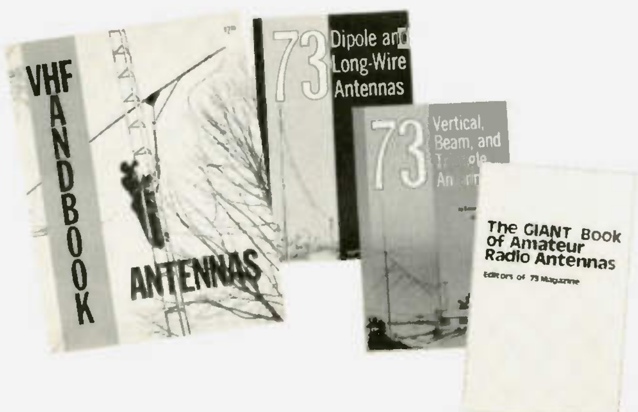

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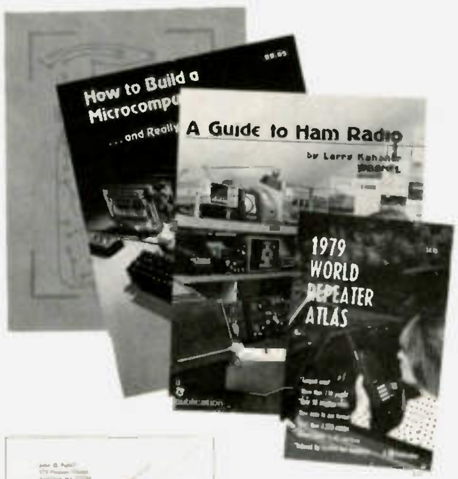

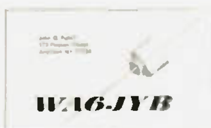

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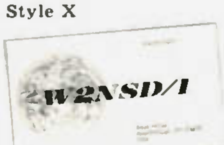

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F = Fair
G = Good
P = Poor
SF = Chance of solar flares

january

sun	mon	tue	wed	thu	fri	sat
		1 G	2 G	3 G	4 G	5 G
6 G	7 G	8 F	9 G	10 G	11 G	12 G
13 G	14 G	15 G	16 G	17 F	18 F	19 G
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FT-707 is shown with optional FV-707DM VFO & Scanning Microphone

THE FT-707 "WAYFARER"

The introduction of the "WAYFARER" by Yaesu is the beginning of a new era in compact solid state transceivers. The FT-707 "WAYFARER" offers you a full 100 watts output on 80-10 meters and operates SSB, CW, and AM modes. Don't let the small size fool you! Though it is not much larger than a book, this is a full-featured transceiver which is ideally suited for your home station or as a traveling companion for mobile or portable operation.

The receiver offers sensitivity of .25 uV/10 dB SN as well as a degree of selectivity previously unavailable in a package this small. The "WAYFARER" comes equipped with 16 poles of IF filtering, variable bandwidth and optional crystal filters for 600 Hz or 350 Hz. Just look at these additional features:

FT-707 with Standard Features

- Fast/slow AGC selection
- Advanced noise blanker
- Built-in calibrator
- WWV/JJY Band
- Bright Digital Readout
- Fixed crystal position
- 2 auxiliary bands for future expansion
- Unique multi-color bar metering—monitors signal strength, power output, and ALC voltage.

FT-707 with Optional FV-707DM & Scanning Microphone

- Choice of 2 rates of scan
- Remote scanning from microphone
- Scans in 10 cycle steps
- Synthesized VFO
- Selection of receiver/transmitter functions from either front panel or external VFO
- "DMS" (Digital Memory Shift)

Impressive as the "WAYFARER" is its versatility can be greatly increased by the addition of the FV-707DM (optional). The FV-707DM, though only one inch high, allows the storage of 13 discrete frequencies and with the use of "DMS" (Digital Memory Shift) each memory can be band-spread 500 KHz. These 500 KHz bands may be remotely scanned from the microphone at the very smooth rate of 10 Hz steps.

The FT-707 "WAYFARER" is a truly unique rig.
See it today at your authorized Yaesu Dealer.

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TS-520SE

"Cents-ability" in a quality HF Rig!

The TS-520SE is an economical new version of the TS-520S... the world's most popular 160-10 meter Amateur transceiver. Now anyone can easily afford a high quality HF transceiver, providing 200 watts PEP input on SSB and 160 watts DC on CW!

The TS-520SE is a high-quality 160-10 meter SSB/CW transceiver intended for ham-shack use. The following changes were made to produce the new "SE" model:

- Replaced the heater switch with a CW WIDE/NARROW bandwidth switch, for use with the optional CW-520 500-Hz CW filter. A big improvement for the CW operator!
- Removed DC converter terminals. Now it operates strictly on 120 VAC and is not intended for mobile use.
- Removed transverter terminals. Now it is strictly a 160-10 meter SSB/CW transceiver. (DG-5 Digital Display is optional).

Ask your Authorized Kenwood Dealer about the amazing TS-520SE...and its surprisingly affordable price!

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