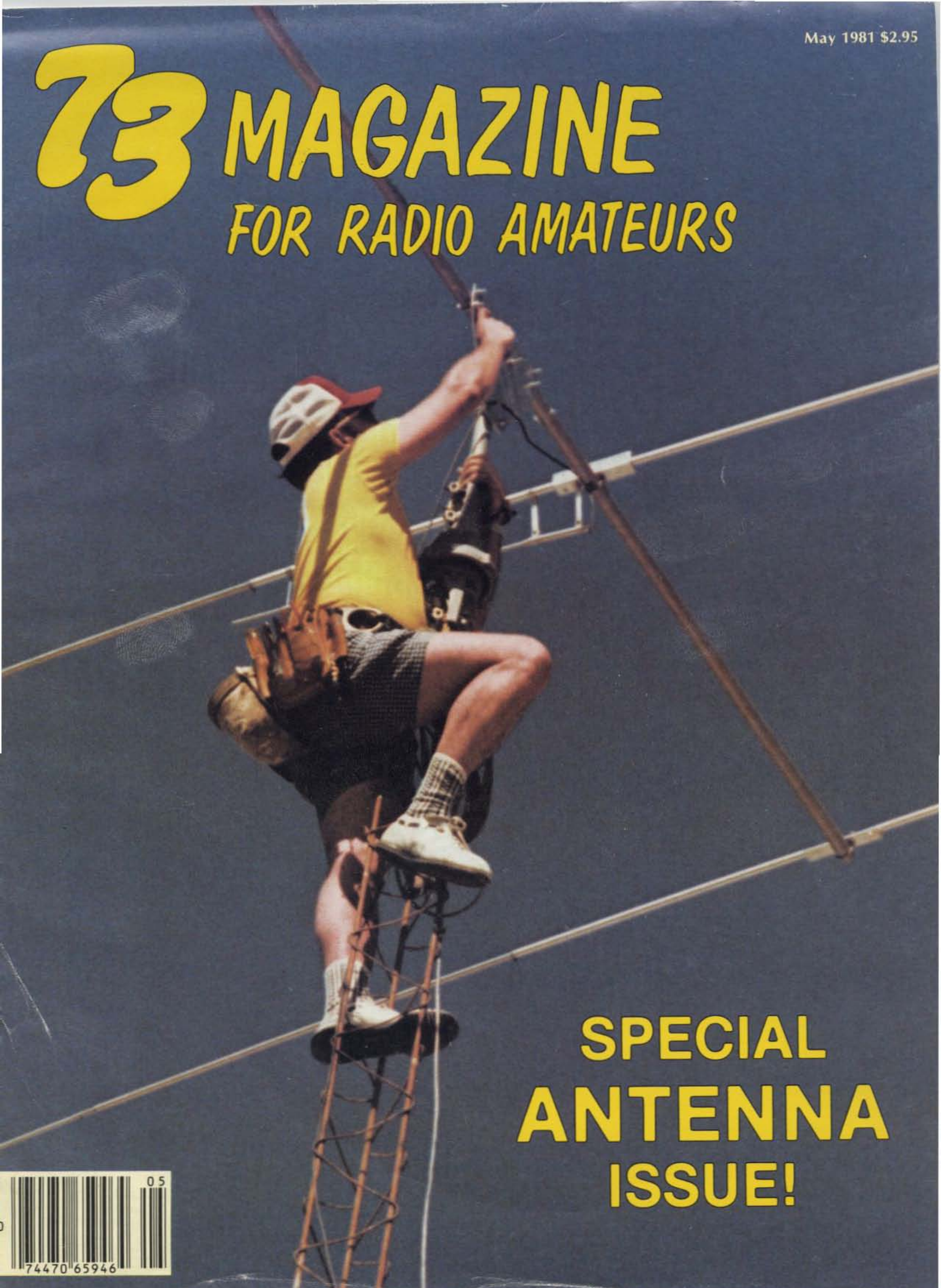
May 1981 $2.95

73 MAGAZINE
FOR RADIO AMATEURS



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- All amateur bands, 1.8-30MHz plus new future bands.

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Unequalled selectivity. 3 cascaded xtl filters • 6 digit LED freq. readout • Built-in power supply • Full break-in CW (vacuum relays) • 16¼"W, 7½"H, 14"D, 40 lbs.

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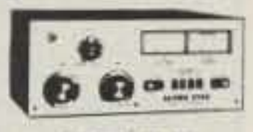

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Cover: Photo submitted by Bill Richards WB5ZAM, San Angelo TX.

W2NSD/1
NEVER SAY DIE

editorial by Wayne Green

MAGAZINE PERSPECTIVE

With much of the ham industry hurting badly for sales, the need for new hams and perhaps for some new interests in amateur radio is apparent. Dealers have been dropping like the fall leaves and manufacturers have been retrenching . . . or going to the SBA for additional loans to tide them over. Over into what is problematical.

In these days of confusion, how are the ham magazines doing? We publishers sit around counting the pages of ads, the pages of articles, the number of articles, and all that sort of thing. That's part of the publishing biz. You may be interested in the counts.

First, looking at 1980, we find that *73* had 290 feature articles to *QST*'s 132. Over twice as many. *73* had 871 pages of articles to *QST*'s 416, again over twice as many. Presumably it is the articles which are of major long-term importance to you rather than club activities and contests. In advertising, *73* averaged 94.8 pages per issue and *QST* 94.9. *HR* came in third with 38.7 pages, then *CQ* with 35.4 pages, and HRH with 22.0 pages, which may help you understand its demise.

Looking at the 1981 January issues of the four remaining ham magazines, we find that the ad count is almost exactly the same as 1980 January . . . which is odd, if the recession in ham sales is true. *73* had 87 pages of ads, *QST* 101 pages, *HR/HRH* 53 pages, and *CQ* 46. *CQ* is up two pages this year, *QST* the same, and *73* down four pages (we have cancelled several pages of ads for slow payments and poor customer service).

Where are things as far as articles are concerned this year? That's what you are buying for the most part . . . not club news and ads. *73* had 25 articles against nine each for *QST* and *HR*, with 8 for *CQ*. In pages of articles, *73* ran 73 pages, *QST* 28, *HR* 44 and *CQ* 18. That does not include monthly columns. Interesting that *73* should run more pages of articles . . . and more articles . . . than *HR* and *QST* combined. It might even make someone think . . . though I doubt it.

PROPINQUITY

If you let your daughter go out with creeps . . . she will marry a creep. And if you have a son and let him date a punk rock weirdo girl, you stand a good chance at having to adjust to this cretin as a daughter-in-law. It all has to do with the not-very-well-understood concept of love.

You've heard about love being blind. Well, you'll believe it when it hits you through one of your children. Of course, how it hits you has a lot to do with how much you control your teenager . . . and control in this sense has to do not so much with trying to stop him or her from dating nerds as preventing the propinquity which gets all of this started. Propinquity is being together . . . nearness . . . such as a being in the same class in school or belonging to the same club. Much as a baby duck will pick whatever it first sees moving as its mother, teenagers, when struck with the right hormones, fall madly in love with almost the first thing they see of the opposite sex.

So, if you have your teenagers in a school full of losers, you might as well start adjusting yourself to accept that whatever they have in class with them is going to get dragged into your life.

I bring this up not to get you to move to Peterborough or to rush your pre-teens to a better class private school, but to make a point about amateur radio. In the love affair a lot of us have with hamming, propinquity is *all*. A basic fact is that before you are going to have many more hams, you are going to have to see that you get a lot of teenagers near to it.

One lousy exposure in a mall on a Sunday is not potent enough in the propinquity department. If you or your club are going to sell amateur radio in this day, you are going to have to bring teenagers into contact with it as much as you can. Remember, you're up against a lot of other interests such as Boy Scouts, roller skating, after school games like baseball . . . things like that. It is most fortunate for us that the amateur radio susceptibility hormone does not hit after puberty, otherwise we'd have no hobby. Luckily for us, this period of impressionability hits hardest at around 13 and 14, before girls start to really look good.

Another nasty competitor for teenage affections is the microcomputer, so you have your work cut out for you. Remember that more and more high schools are getting computers right into class . . . and darned few (if any) are getting ham rigs into class. You are up against a mighty foe in the computer, so you'd better reckon with it and get your act together. It appears that the same faulty brain circuitry which tends a teen to become a ham also can flip him into computers.

We can win this battle only if we are aware of the enemy and play every trick we can to ensnare our share of teenagers . . . or even more than our share. It is time to be greedy and pull our hobby out of the slump it is in.

The key to how to do all this lies in that word, propinquity. It is up to *you* to see that teenagers are exposed repeatedly to amateur radio. Their natural immunity will finally be beaten down and we'll have 'em . . . trapped for a lifetime, for the most part. Insidious hobby we have, when you think about it.

NEWSLETTER CONTEST

To encourage publication of club and group newsletters which, in turn, help spread ham radio interest around the world, *73* is initiating a newsletter competition. So, make sure that *73* is on your mailing list.

Our judges will evaluate each one and pick a monthly winner to be announced in *73*. Each winner will receive our Novice Class Study Guide and theory tapes *or* their choice of three books from the Radio Bookshop. Please address newsletters to *73 Magazine*, Pine Street, Peterborough NH 03458, Attention: Newsletter Contest.

A FREE BOOK FOR YOUR QSL?

That's right. Send us your QSL and we'll enter you in *73*'s QSL of the Month Contest. If yours is selected, it will appear in *73* and you'll be given your choice of a book from our Radio Bookshop. We're looking for clever, colorful, beautiful, neat, interesting, etc., QSLs. Please address your entry to *73 Magazine*, Pine Street, Peterborough NH 03458, Attention: QSL of the Month.

ICOM IC-730

ICOM's Go-Anywhere HF Rig for Everyone's Pocketbook

Compact.

Only 3.7 in (H) x 9.5 in (W) x 10.8 in (D) will fit into most mobile operations (compact car, airplane, boat, or suitcase)

Affordable.

Priced right to meet your budget as your main HF rig or as a second rig for mobile/portable operation.

Convenient.

- Unique tuning speed selection for quick and precise QSY, choice of 1 KHz, 100 Hz or 10 Hz tuning.
- Electronic dial lock, deactivates tuning knob for lock on, stay on frequency operation.
- One memory per band, for storage of your favorite frequency on each band.
- Dual VFO system built in standard at no extra cost.

Full Featured.

- 200W PEP input—powerful punch on SSB/CW (40 W out on AM)
- Receiver preamp built-in • VOX built-in
- Noise blanker (selectable time constant) standard
- Large RIT knob for easy mobile operation
- Amateur band coverage 10-80M including the new WARC bands
- Speech processor—built-in, standard (no extra cost)
- IF shift slide tuning standard (pass band tuning optional)
- Fully solid state for lower current drain
- Automatic protection circuit for finals under high SWR conditions
- Digital readout • Receives WWV • Selectable AGC
- Up/down tuning from optional microphone
- Handheld microphone standard (no extra cost)
- Optional mobile mount available

ICOM

2112 116th Avenue N.E., Bellevue, WA 98004
3331 Towerwood Dr., Suite 307, Dallas TX 75234


Communications Specialists TE-64

Power up.

40 W, 15 memories/offset recall, scan, priority, DTMF touch-pad

TR-7850

Kenwood's remarkable TR-7850 2-meter FM mobile transceiver provides all the features you could desire, including a powerful 40 watts RF output. Frequency selection is easier than ever, and the rig incorporates new memory developments for repeater shift, priority, and scan, and includes a built-in autopatch touch-pad (DTMF) encoder. A 25-watt output version, the TR-7800, is also available.

TR-7850 FEATURES:

- **Powerful 40 watts power output**
  Selectable high or low power operation. High 40-watt output provides reliable signal for wide area coverage.
- **15 multifunction memory channels, easily selectable with a rotary control**
  M1-M13...memorize frequency and offset (±600 kHz or simplex). M14...memorize transmit and receive frequencies independently for nonstandard offset. M0...priority channel, with simplex, ±600 kHz, or nonstandard offset operation.
- **Internal battery backup for all memories**
  All memory channels (including transmit offset) are retained when four AA NiCd batteries (not Kenwood supplied) are installed in battery holder inside TR-7850. Batteries are automatically charged while transceiver is connected to 12-VDC source.
- **Extended frequency coverage**
  143.900-148.995 MHz, in switchable 5-kHz or 10-kHz steps.
- **Priority alert**
  M0 memory is priority channel. "Beep" alerts operator when signal appears on priority channel. Operation can be switched immediately to priority channel with the push of a switch.
- **Built-in autopatch touch-pad (DTMF) encoder**
  Front-panel touch pad generates all 12 telephone-compatible dual tones in transmit mode, plus four additional DTMF signaling tones (with simultaneous push of REV switch).
- **Front-panel keyboard**
  For frequency selection, transmit offset selection, memory programming, scan control, and selection of autopatch encoder tones.
- **Autoscan**
  Entire band (5-kHz or 10-kHz steps) and memories. Automatically locks on busy channel; scan resumes automatically after several seconds, unless CLEAR or mic PTT button is pressed to cancel scan.
- **Up/down manual scan**
  Entire band (5-kHz or 10-kHz steps) and memories, with UP/DOWN microphone (standard).
- **Repeater reverse switch**
  Handy for checking signals on the input of a repeater or for determining if a repeater is "upside down."
- **Separate digital readouts**
  To display frequency (both receive and transmit) and memory channel.
- **LED bar meter**
  For monitoring received signal level and RF output.
- **LED indicators**
  To show: +600 kHz, simplex, or -600 kHz transmitter offset; BUSY channel; ON AIR.
- **TONE switch**
  To actuate subaudible tone module (not Kenwood-supplied).
- **Compact size**
  Depth is reduced substantially.
- **Mobile mounting bracket**
  With quick-release levers.

More information on the TR-7850 is available from all authorized dealers of Trio-Kenwood Communications, Inc., 1111 West Walnut Street, Compton, California 90220.

KENWOOD
...pacesetter in amateur radio

Matching accessory for fixed-station operation:
- KPS-12 fixed-station power supply for TR-7850

Other accessories not shown:
- KPS-7 fixed-station power supply for TR-7800
- SP-40 compact mobile speaker

TR-7850 is subject to FCC approval.

Specifications and prices are subject to change without notice or obligation.

Despite parents' efforts to deprogram our converts, most teenagers go right on to fruitless careers in electronics and communications.

So you get a demo station into your local high school and run it for a few weeks, handing out seductive literature to anyone foolish enough to get sucked into watching. Then you figure out some small bribe to get 'em into your club license classes. You charge 'em enough for the set of classes so their natural stinginess (part of the ham ethic) will prevent them from dropping out. Salt your classes with references to the incredible fun they are going to have once they get their ticket. They're *yours*.

The mall demo won't hurt... and the exercise is good for club members. It's fun to be the center of attention in a mass setting like that...and you'll be able to get a few more into your classes. This will also give you a second flanking attack on the teens, if you have some fast-food stores in the mall. Teens tend to be attracted to fast-food purveyors. Maybe we should approach McDonald's about demo ham stations? I prefer Wendy's myself...it's the salad bar, not the greasy (juicy, they call it) hamburgers.

If you can get teenagers near ham stations enough, we'll have plenty of 'em getting licenses and perhaps amateur radio will get back into a growth mode again.

WAR COLLEGE

Definitely flattering...and tough to turn down. The invitation was to join a group of 70 noted civilians for five days of workshops with the Air War College. This is a group of high-ranking Air Force officers who have gone back to school to bone up on the latest in military hardware, tactics, intelligence, and so on. At the end of the course they have five days of discussions with selected civilians.

The problem was the five days. I don't *have* five days. Of course, not having been to one of these affairs, I don't know how much interest there is in getting ideas from the civilians and how much is brainwash from the military. All of my visits to the Pentagon so far have given me the impression that none of the military services wants input...they just want to lay propaganda on the media for their own benefit.

If they do have any interest in getting some of their problems solved, I think I have some ideas for them which will go a long way. For instance, it is no secret that all of the military services are hurting for technical people. Well, getting 'em

Continued on page 139

Well...I Can Dream, Can't I?

by Bandel Linn K4PP

"I understand there's a big ham radio contest going on this weekend! I suggest you take a week off—with double pay—to rest and get ready for it!"

Food for thought.

Our new Universal Tone Encoder lends it's versatility to all tastes. The menu includes all CTCSS, as well as Burst Tones, Touch Tones, and Test Tones. No counter or test equipment required to set frequency-just dial it in. While traveling, use it on your Amateur transceiver to access tone operated systems, or in your service van to check out your customers repeaters; also, as a piece of test equipment to modulate your Service Monitor or signal generator. It can even operate off an internal nine volt battery, and is available for one day delivery, backed by our one year warranty.

- All tones in Group A and Group B are included.
- Output level flat to within 1.5db over entire range selected.
- Separate level adjust pots and output connections for each tone Group.
- Immune to RF
- Powered by 6-30vdc, unregulated at 8 ma.
- Low impedance, low distortion, adjustable sinewave output, 5v peak-to-peak.
- Instant start-up.
- Off position for no tone output.
- Reverse polarity protection built-in.

Group A

67.0 XZ	91.5 ZZ	118.8 2B	156.7 5A
71.9 XA	94.8 ZA	123.0 3Z	162.2 5B
74.4 WA	97.4 ZB	127.3 3A	167.9 6Z
77.0 XB	100.0 1Z	131.8 3B	173.8 6A
79.7 SP	103.5 1A	136.5 4Z	179.9 6B
82.5 YZ	107.2 1B	141.3 4A	186.2 7Z
85.4 YA	110.9 2Z	146.2 4B	192.8 7A
88.5 YB	114.8 2A	151.4 5Z	203.5 M1

- Frequency accuracy, ± .1 Hz maximum - 40°C to + 85°C
- Frequencies to 250 Hz available on special order
- Continuous tone

Group B

TEST-TONES:	TOUCH-TONES:		BURST TONES:			
600	697	1209	1600	1850	2150	2400
1000	770	1336	1650	1900	2200	2450
1500	852	1477	1700	1950	2250	2500
2175	941	1633	1750	2000	2300	2550
2805			1800	2100	2350	

- Frequency accuracy, ± 1 Hz maximum - 40°C to + 85°C
- Tone length approximately 300 ms. May be lengthened, shortened or eliminated by changing value of resistor

Wired and tested: $79.95

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Two-Meter Antennas: Facts and Fables

—the truth about omnidirectional antennas on two

Vertical antennas, especially for VHF, come in a wide variety of shapes, sizes, specifications, and price. Manufacturers' gain claims have created such confusion that one of the popular magazines does not allow an antenna manufacturer to publish gains in their ads, and magazine reviews rarely say more than "the antenna worked great." This only exacerbates the problem because we, the users/consumers, have no way of getting reasonable relative performance information short of listening to someone tell us how wonderful his great new XY-999**!* antenna is, or through the grapevine of information formed by our "oral tradition." This is where the fable part comes in. We all know how well a joke gets passed around a room when one person whispers it into the ear of the next. It usually is unrecognizable after passing through as few as a half-dozen people. This is the same way we get our information on antennas, and often the quality of that information resembles a joke!

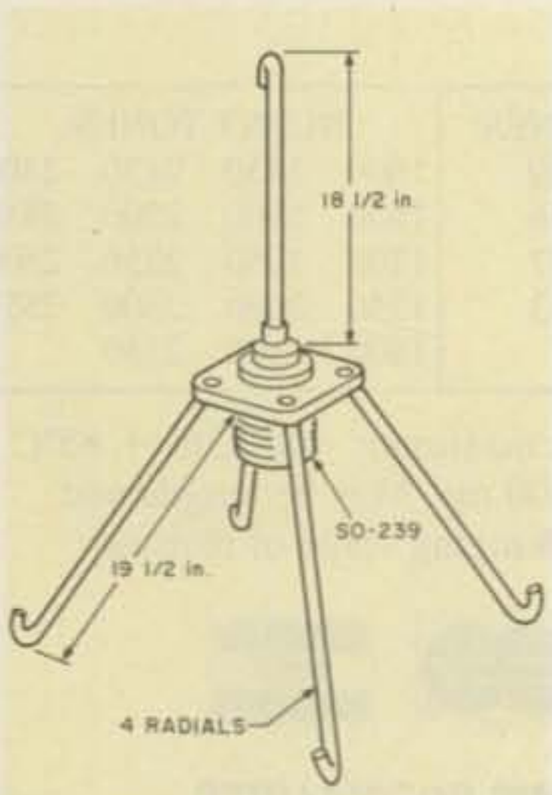

Fig. 1. Simple 1/4λ 2-meter ground-plane antenna.

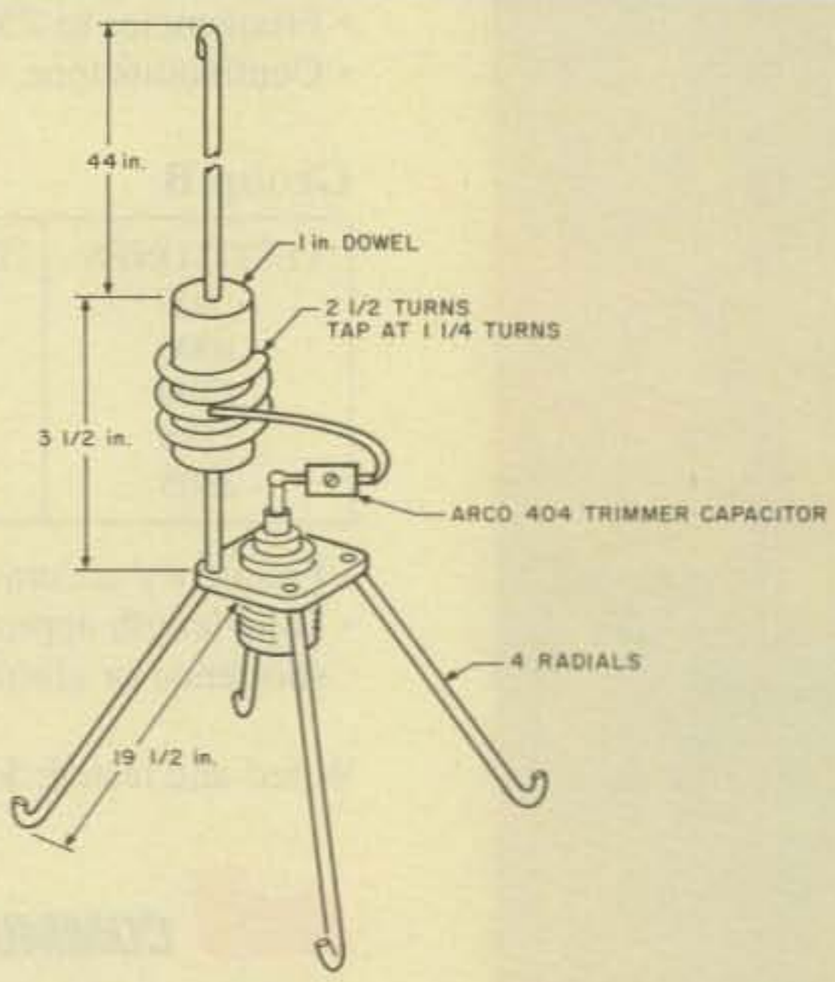

Fig. 2. Experimental 5/8λ vertical with 1/4λ ground plane.

I realized this recently when I was selling an old 2-meter rig to a friend and I wanted to make up a simple antenna so that he could use it right away. I have used the makeshift 1/4λ ground-plane antenna shown in Fig. 1 several times (it costs one SO-239 plus a few cents worth of old house wiring) and I was about to make one for him when I remembered something "we all know"—a 5/8λ antenna has 3 dB gain over a 1/4λ ground plane. Now, having purchased one of those more years ago than I

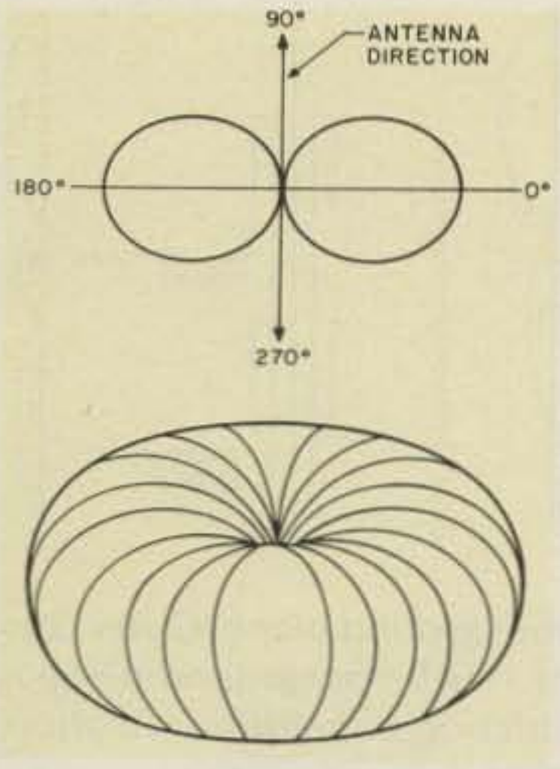

Fig. 3. Radiation pattern representations of 1/2λ dipole antenna. Top—typical plot, cutaway; bottom—three dimensional sketch of toroidal radiation pattern.

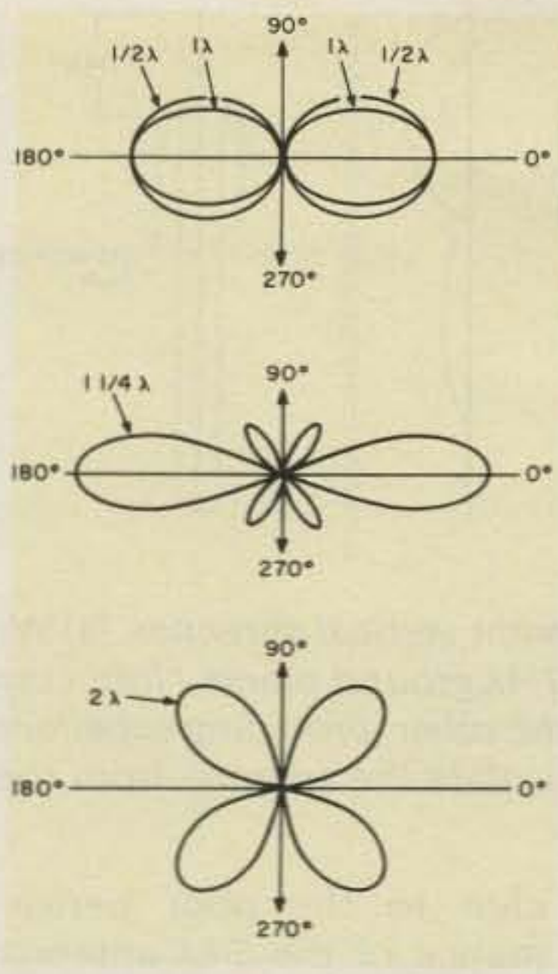

Fig. 4. Radiation patterns for vertical dipole antennas of different lengths. The narrower major lobes of the 1λ and 1-1/4λ antennas imply gain over the 1/2λ antenna.

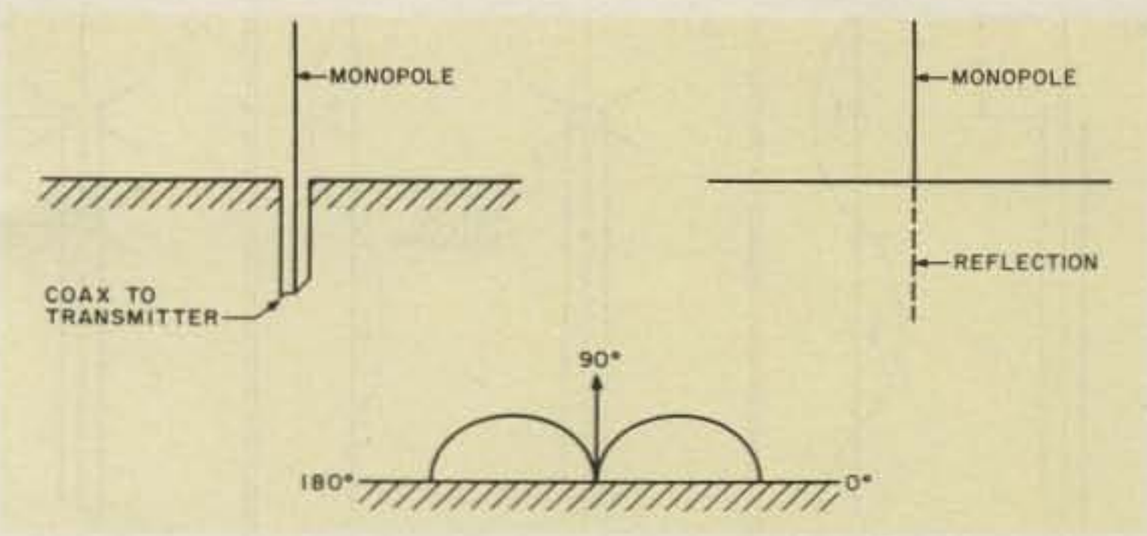

Fig. 5. Ideal vertical and its radiation pattern. Left—vertical monopole over infinite perfectly-conducting ground. Note that the coax shield is in electrical contact with the ground. Right—electrical equivalent is a virtual dipole whose other half is a reflection in the mirror formed by the ground. Bottom—theoretical radiation pattern for 1/4λ vertical monopole over ideal ground plane.

like to admit, I noted that it had four 1/4λ radials, a matching section, and a 5/8λ radiator, so I built the antenna shown in Fig. 2. It tuned up to 1:1 swr so quickly that I was sure it was working great. I put it on the air, and sure enough I was getting out. But, since I live on a fair-sized hill not all that far from repeater alley in the Boston area, I had no way of knowing for sure whether this antenna was really better than the 1/4λ ground plane.

Of course, everyone knows that the 5/8λ is better than a 1/4λ—even some of the antenna manufacturers' literature says so—but isn't that part of our fable? Anyway, I decided to perform a simple experiment by comparing the two antennas in exactly the same place using the signals from the various repeaters and the meter on my KDK 2016A to measure the relative performance. (I later discovered that this is called reciprocal testing: using a distant signal source and the antenna under test in the receive mode.)

The results of this test were baffling—the 1/4λ outperformed the 5/8λ in every direction! Surely something was wrong with my test, so I asked some of the guys in the area to give me signal reports with the two antennas. I used the same feedline and mount for each, so I had to run out and physically remove one antenna and install the other to do the comparison. The results were the same; reciprocity was proved again! (The reciprocity principle states that the relative performance of an antenna as a transmitting antenna and as a receiving antenna is identical.) Was our oral tradition wrong? Something surely was, so I dug into manuals and textbooks to find out the answer. Here is some of what I discovered.

The Applicable Antenna Theory

First, consider the question: How can an antenna have gain? In order to answer this one must also ask: What is our reference for measuring an antenna's gain? Two references are used as a base for measuring an antenna's gain. The first, an abstract notion used in theoretical computations of antenna performance, is the so-called isotropic radiator. This is a hypothetical device which radiates energy equally in all directions simultaneously with a spherical pattern. However, to make real measurements with real antennas, the usual reference is a half-wave dipole in free space.

The free-space dipole has a figure 8 radiation pattern in the plane perpendicular to the antenna and a circular pattern of equal radiation in all directions radial to the axis of the dipole as shown in Fig. 3. Now, the gain of an antenna is defined as the ratio of the magnitude of the maximum radiation to average radiation from the antenna in all directions if the losses in the antenna are negligible. The maximum lobe for gain measurement is independent of the direction of that lobe. The gain is diminished by the amount of losses in the antenna. (G = maximum radiation intensity divided by average radiation intensity.)

Note that the average radiation in all directions is the same as that from an isotropic radiator, which is why it makes such a good conceptual reference. The dipole has a theoretical gain of 2.15 dB as defined above, so we can say that a dipole has 2.15 dB gain over an isotropic radiator. (An isotropic radiator is only a theoretical notion and cannot be built anyway.) Now, when we use a dipole as a reference when studying some other antenna, we only need to add 2.15 dB to our measurements to reference our subject antenna's performance to an isotropic radiator. The gain or loss in decibels of a reference antenna with respect to a dipole is often written as dBD.

Before we consider verticals specifically, let's look at the radiation patterns generated by dipoles whose lengths are greater than 1/2λ as shown in Fig. 4. Note that the pattern radial to the axis of the antenna is symmetrical. The longer the antenna gets up to 1-1/4λ the narrower the major lobes get, which means higher gain. Beyond 1-1/4λ there are four major lobes which point more towards the ends of the antenna than perpendicular to it.

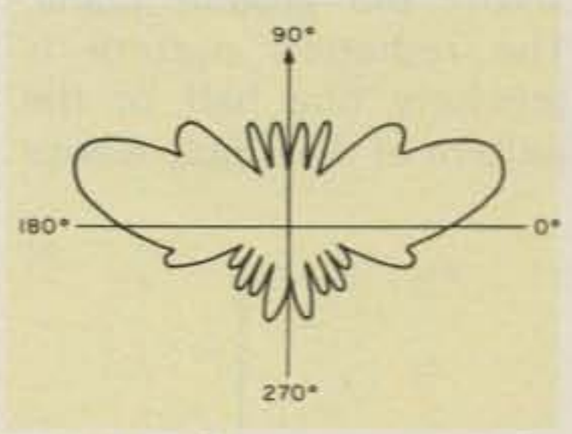

Fig. 6. Radiation pattern of a monopole approximately 1/4λ long over a 6λ circular ground plane. Note that the major lobe is above the horizon.

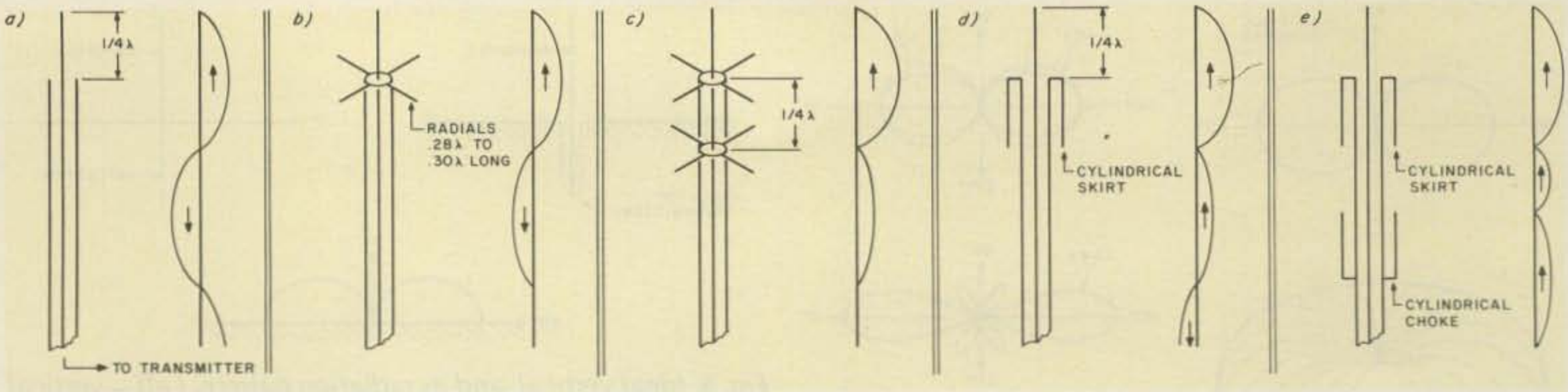

Fig. 7. Configurations and current distributions for several different vertical antennas. (a) Without ground plane. Outer conductor of coax provides radiating return path for rf. (b) With 1/4λ ground plane. Note current 1/4λ below ground plane is mostly in image. (c) With two ground planes, one 1/4λ below the other, providing excellent isolation of feedline radiation. (d) Coaxial 1/2λ dipole. (e) Coaxial 1/2λ dipole with choke to isolate the antenna from the mast.

Now, one can also erect a vertical dipole and consider the 0°-180° line as the horizon and reconsider the patterns in Fig. 4. It should be clear that the 1-1/4λ dipole puts more energy on the horizon than the other length vertical dipoles. Maximum lobes on the horizon are generally assumed to be the most desirable for both DX and VHF communications. The 1-1/4λ dipole has a typical measured gain of 3 dB over a 1/2λ dipole.

Now let's look at the classical description of a monopole or single-element vertical. A single vertical radiator must have a path through which the antenna return currents can flow, so a monopole is usually described with respect to an infinite, perfectly-conductive sheet or ground plane. See Fig. 5, top left. The ground plane carries the other half of the antenna current and mirrors the monopole (Fig. 5, top right), creating a virtual dipole across the ground plane. The radiation pattern is precisely one half of the pattern of the dipole whose leg length is the same as the length of the monopole as in Fig. 5, center. Thus, the 1/4λ monopole has the upper (or lower) 1/2 of the radiation pattern of a 1/2λ dipole.

All this is well and good, but how many infinite, perfectly-conductive sheets are there and what happens if the sheet is not infinite or not perfectly conducting? There have been no reports, to my knowledge, of the discovery of an infinite, perfectly-conductive sheet, so let's examine what happens if the ground plane is merely some finite, physically-realizable size. Interestingly, the size of the conductive sheet has little effect on the impedance of the antenna but has a significant effect on the radiation pattern. As the size of the ground plane gets smaller, the mirror for the monopole gets "cloudy" and the reflection of the image diminishes. The result is a higher angle of maximum radiation than that supplied by an infinite ground plane as shown in Fig. 6 for a 1/4λ monopole over a 6λ-diameter conductive sheet.

This provides the first clue to the poor performance of the 5/8λ antenna over a 1/4λ set of radials. It also raises some questions concerning the use of an auto body as the ground plane for any antenna on bands below 1296 MHz. In fact, the pattern and gain for any auto antenna needing a ground plane is very unpredictable—you get what you get! There are auto antennas which do not use the auto body as a ground plane which do provide predictable radiation patterns and gains for VHF use. On the other hand, a ground-mounted antenna over a large number of buried radials is indeed a reasonable approximation to an ideal monopole over an infinite ground plane, but ground losses can reduce the performance over that of a dipole if the ground is lossy and/or there is an insufficient number of radials.

AM broadcast stations use ground-mounted vertical antennas very effectively with ground systems of at least 120 wires at least 1/4λ long buried radially from the base of the antenna and connected to the shield of the coaxial feedline at the base of the monopole. The larger the number and the longer the length of the radials, the lower the ground system resistance and hence the lower the ground losses. The resistance of a good ground system is about 2 Ohms which, for an antenna whose radiation resistance is about 40 Ohms, is not an insignificant loss. So, if your trap vertical sitting in your back yard isn't getting out as well as you would like, try adding more and/or longer radials where the trade-off is usually for more rather than longer. Better yet, put it on the roof as high as possible to reduce ground losses and do better on the high frequencies as well.

For VHF, say 2 meters, we all know that the height of the antenna is very important (although it has been my experience that on all bands above 160 meters the height of the antenna is more important than any other single parameter) so we prefer to mount our antennas on tops of buildings, towers, poles, trees, etc., to get them as high as we can. One could mount a vertical radiating element on the end of the feedline as in Fig. 7 and depend on the mounting structure and feedline for the ground return. This kind of an antenna will work, but its performance is unpredictable since it depends on the lengths and positions of both the feedline and mounting structure for the radiation pattern it provides. This is because the feedline and mounting structure carry the radiating ground-return currents.

A typical current distribution on the outside of the

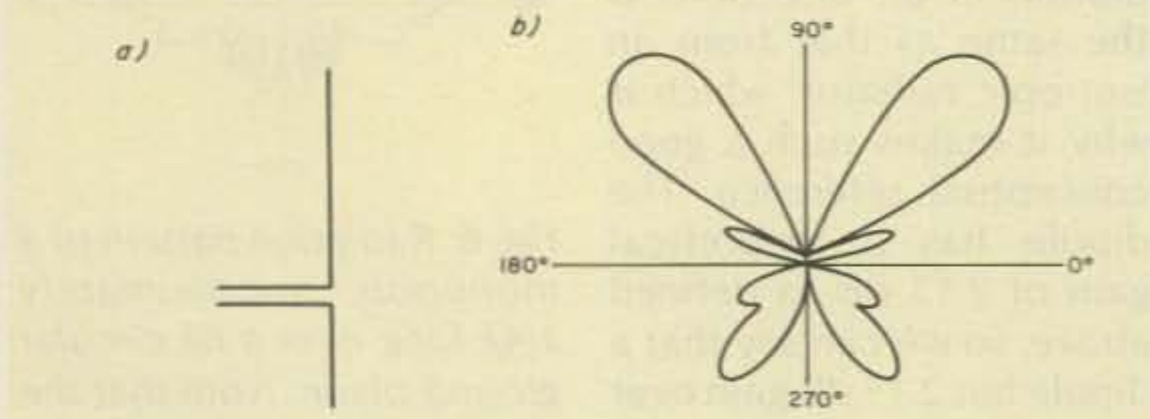

Fig. 8. Asymmetrical dipole and typical radiation pattern.

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coax feedline is also shown in Fig. 7. Note that the phase of the current on the outside of the coax reverses at 1/4λ below the top element. This will tend to cancel the effect of the top half wave of the antenna and distort the pattern from that of either the ideal vertical or a dipole in free space. The conductive sheet or mirror can be simulated by wires extending horizontally from the base.

The concept of a mirror formed by wires can be understood easily by first considering a vertical 1/4λ element with a single 1/4λ radial. This forms a bent dipole, a rotated inverted vee, with both horizontal and vertical polarization. If we distribute three or more radials symmetrically about the base of the vertical element, the horizontal components of the radiation from the ground plane will cancel leaving only the vertical component of the radiation. The ground plane performs two key functions. It forms a mirror for the vertical radiating element and provides some isolation of the outside of the feedline from the radiating currents.

Typically, four radial wires slightly greater than 1/4λ long form the ground plane, as in Fig. 7(b). Also, the radials are often bent down to pull the radiation pattern more towards the horizon, as in Fig. 1. This also raises the impedance a bit closer to 50 Ohms. A properly adjusted vertical ground-plane antenna looks very much like a 1/2λ dipole with respect to its radiation pattern and gain—approximately 0.1 dB less. A further refinement of the ground-plane antenna, shown in Fig. 7(c), places an additional ground plane 1/4λ below the first one to act as a choke, which improves the radiation pattern by further reducing the current on the outside of the feedline. A similar result can be obtained by using 1/4λ sleeves instead of a ground plane, as shown in Figs. 7(d) and 7(e) to create a coaxial or sleeve antenna.

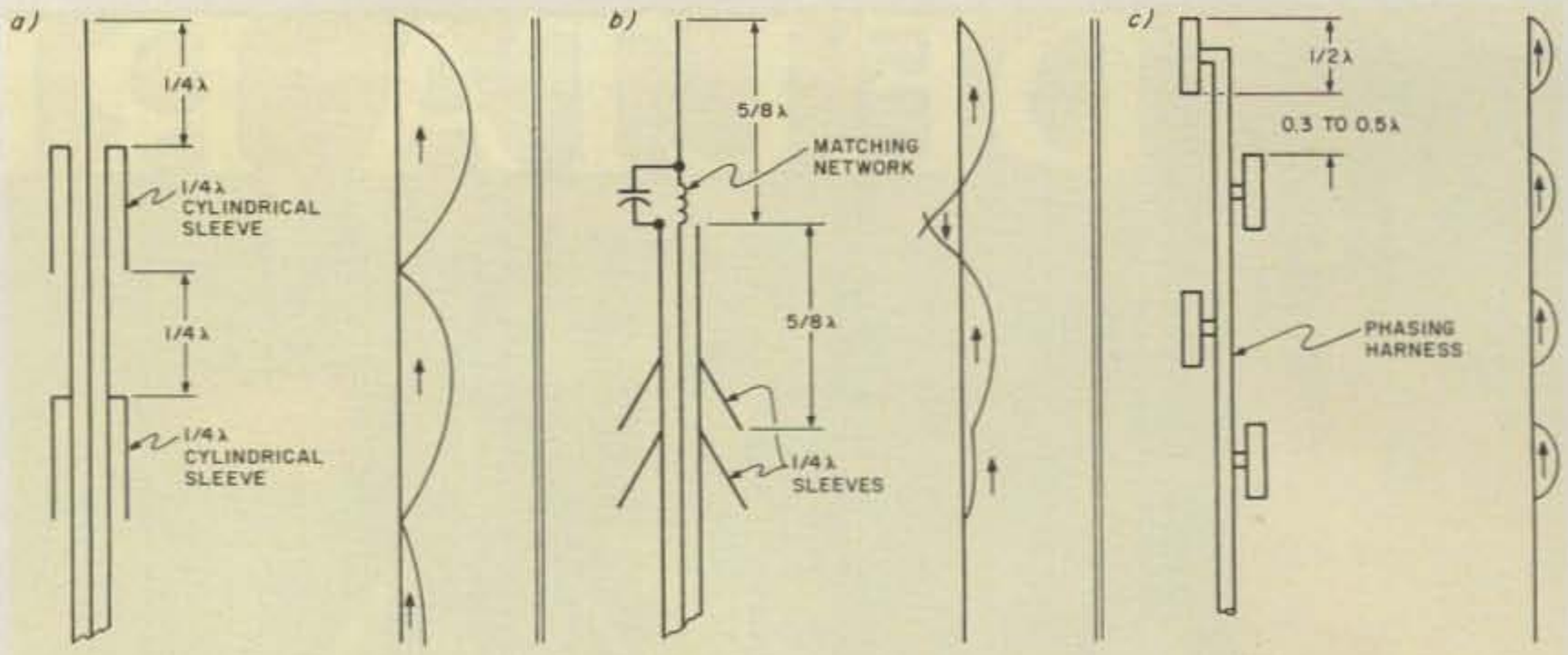

Fig. 9. Several omnidirectional vertical gain antennas and their current distributions. Arrows show phase of current; antennas with the most current in phase have the highest gain. (a) Skirted, to phase feedline currents to form a collinear antenna—1-2 dBD. (b) Isopole, using sleeves to phase feedline currents to form 1-1/4λ dipole and to isolate it from the mast and feedline—3 dBD. (c) Four collinear folded 1/2λ dipoles fed with a phasing harness. Four elements provide 6 dBD omnidirectionally and 9 dBD unidirectionally. (d) Ground-mounted collinear. The 1/2λ sections are insulated from both ground and each other. An LC network provides the phase shift needed to get currents in phase in the two sections—2 dBD. (e) Franklin antenna—dipole and coaxial versions. The 1/2λ stubs provide the phasing for current in adjacent sections. Three sections above—3 dBD. (f) Coaxial collinear uses sections of coax arranged so that the radiation from the outside of the coax is properly phased. Gain is proportional to the number of 1/2λ sections. Eight 1/2λ sections—6 dBD.

The outside of the sleeve acts as a conductor for the return signal while the inside is a shorted 1/4λ transmission line with a high impedance at the open end. The current distribution for both the ground-plane and sleeve antennas is identical to that for the vertical dipole. If one mounts a longer vertical element such as a 5/8λ on the 1/4λ ground plane or 1/4λ sleeve, then we have an asymmetrical dipole equivalent which has a pattern with multiple high-angle major lobes as shown in Fig. 8. This antenna does not work well to the horizon and we have the truth—the end of our fable. Then how do we get the 3-dB theoretical gain from a 5/8λ antenna? We probably do get it but in a direction above the horizon which doesn't do much good. Then how do we get the signal where it does do some good?

First, we *know* that we get 3-dB gain over a 1/2λ dipole with a 1-1/4λ dipole, so a vertical dipole which is 1-1/4λ long will do it in a direction which gets out where we want it. An equivalent can also be obtained by using an appropriate ground plane which properly mirrors the radiator. For example, ground-mounting a 5/8λ element over ground with high conductivity as well as a good ground radial system is one way. A ground plane with 5/8λ radials will also provide the 3-dB gain. Another approach, taken by AEA with their Isopole™, uses a 1-1/4λ sleeve dipole with a second isolation sleeve, as illustrated in Fig. 9(b).

The 1/4λ sleeve on the sleeve antennas and the

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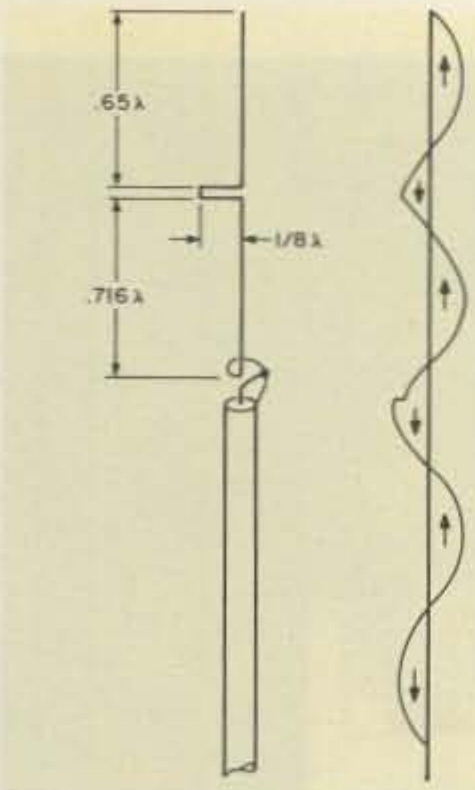

Fig. 10. Ringo Ranger and its current distribution on both the monopole and the feedline.

Isopole ensures the proper phase for the remaining current on the outside of the coax while minimizing that very current, thus ensuring that the radiation pattern is both predictable and on the horizon. The double-sleeve antenna, Fig. 9(a), is a simple collinear which provides 1- to 2-dB gain over a 1/2λ dipole because of the proper phasing of the small current which does flow on the outside of the coax. The addition of more than two sleeves does little to improve the gain because the current below the second sleeve is very small. Other types of collinear antennas can provide additional gain as shown in Fig. 9, with the gain over a dipole, dBD, provided in the caption. The basic objective for obtaining gain is to provide multiple radiating elements

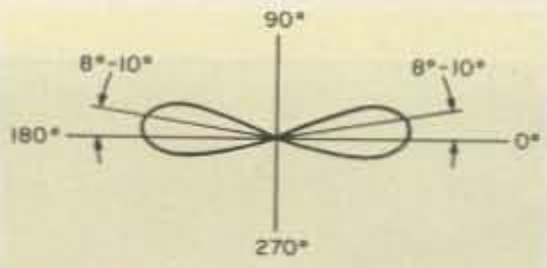

Fig. 11. Radiation pattern of the Ringo Ranger, from the manufacturer's literature. Note that the major lobes are 8°-10° above the horizon.

in which the currents are as large as possible and in phase.

The phasing can be obtained by:

- Using feedline currents as in the sleeve collinear in Fig. 9(a), as described earlier.
- Spacing the radiating elements as in the collinear dipole in Fig. 9(c).
- Using lumped L and C phasing networks as is done for the low-frequency ground-mounted antennas in Fig. 9(d).
- Folding a half wave of wire or cable up as in the Franklin antenna in Fig. 9(e). Note that folding is also used to provide loading in beams, in particular 40-meter beams and the KLM KT34A and KT34XA triband beams.
- Using alternate 1/2λ sections of coax connected so that the current on the outside of the coax elements is radiating in phase, as in the coax vertical in Fig. 9(f).

Some comments on these various phasing techniques will illustrate the relative merits and trade-offs in these different designs.

Number of 1/2λ Elements	A Close Spacing	B Optimum Spacing
2	2.0 dB	3.1 dB
3	3.0	
4	4.0	6.2
5		
6		
7	5-7	
8	6-8	9.3

Table 1. Gain of collinear antennas consisting of 1/2λ sections for close and optimum, 0.3λ to 0.5λ, spacing for different numbers of 1/2λ sections. The close-spaced numbers are approximate and depend on the type of antenna.

First, spacing four or more folded dipoles as in Fig. 9(c) is a straightforward way to provide phased current flow. The optimum spacing for collinear arrays, between 0.3λ and 0.5λ, is easily obtained by placing the dipoles on a vertical mast. This type of antenna will provide single directional gain of 9 dBD by placing all the dipoles on that side of the mast, or 6 dBD omnidirectional gain by distributing the dipoles around the mast. A phasing harness is required to distribute power to the dipoles in the proper phase. (Details for building such an antenna for 2 meters are given in Reference 2.)

Gain from a low-frequency ground-mounted vertical with a radial system may be obtained by either making it 5/8λ long or by stacking two 1/2λ sections on top of each other, with insulators between the sections. The sections are coupled through an LC network so that the currents in the two sections are in phase; see Fig. 9(d). Since the spacing between the 1/2λ sections is not optimum, the gain is less than one would get if they were spaced 0.3λ to 0.5λ apart. The gain of collinears for different numbers of 1/2λ elements for close and optimum spacing is given in Table 1.

The Franklin antenna uses a folded section in the monopole so that the radiation from that length is cancelled and the currents on the radiating parts of the antenna are in phase. The outside of the coax feedline carries the radiating return currents. The coax is also folded to ensure that currents on all sections of the coax are in phase with each other and the radiating sections of the monopole. Again, the spacing between sections is not optimum, so approximate gain is given in column A of Table 1.

The coaxial collinear, Fig. 9(f), is an antenna that has become very popular as a repeater antenna because it can provide good omnidirectional gain (6-9 dBD) and is relatively easy to make. It can be thought of as the ultimate in using the feedline as a radiator. The goal of the design is to propagate the signal through the coax in 1/2λ sections so that the outer conductors of the coax sections carry a current which radiates. Remembering that electrical 1/2λ in coax depends on the propagation velocity of the cable and is always less than the free-space length, this is accomplished by connecting the 1/2λ sections of coax so that the shield of one section connects to the center conductor of the adjacent section, thus ensuring that the coax radiates a signal which is in phase with that in the adjacent section. Any number of 1/2λ sections can be used with more sections providing more gain. The gain is limited, however, by the fact that the current diminishes as the signal propagates up the antenna, since each section radiates some of the applied energy. Also, the close spacing of the sections further limits the gain. Thus, the gain shown in Table 1 for this antenna can be obtained by considering the number of 1/2λ sections only and not counting the top and bottom sections even though they do radiate. The bottom 1/4λ section ensures the proper phasing for the current fed to the first 1/2λ section. The 1/4λ ground plane on the bottom, which often is replaced by a balun, provides an image for the 1/4λ section and isolates the feedline from the antenna. The top section terminates the wave propagating up the antenna so that the phasing is preserved and the last 1/2λ of radiation occurs.

Coaxial collinears can be mounted either in fiber-

glass radomes on top of a mast or suspended from the side of a tower inside plastic drain pipe. The only difficulty is that the lower sections which carry the greatest radiating current are closest to the ground. See Reference 2 for further information on this antenna.

Performance

Now that the theoretical basis for the poor performance of my homemade 5/8λ antenna was established, I decided to test some of the other popular 2-meter antennas on my simple test setup. Probably the most popular and easiest to use 2-meter base-station antennas are the Ringo™ and Ringo Ranger™ by Cushcraft. The Ringo is described by the manufacturer as a 1/2λ monopole while the Ringo Ranger is described as two 1/2λ elements in phase. The physical dimensions of the Ringo Ranger indicate that it is really a bit longer than 1/2λ, as shown in Fig. 10. Also, the phasing stub is 1/8λ rather than 1/4λ as in the Franklin collinear and is located so that the higher-current portions of the reverse antenna current are in the stub, also as shown in Fig. 10. Also note that the phasing is such that the feedline and/or mounting structure are carrying radiating current. Since this current is not specifically phased, and because the phasing stub is 1/4λ rather than 1/2λ, some compromise in on-the-horizon performance appears to have been made to get a solid, simple antenna. The extra out-of-phase current is probably responsible for the slight elevation of the radiation pattern (about 9 degrees) as given in the manufacturer's literature reproduced in Fig. 11. Thus, one may expect that the Ringo and Ringo Ranger on-the-horizon performance would be less than that of some other antennas and that their performance may be improved by adding a ground plane.

Well, armed with my SO-239, 1/4λ ground plane, my home-brew 5/8λ on the 1/4λ ground plane, a Ringo, a Ringo Ranger, a Ringo Ranger with six 19-1/2-inch radials drooping at 45°, and an Isopole, I went out in the cold of February to find out what worked best.

Note that radials made from aluminum ground wire can be added to the Ringo or Ringo Ranger easily by bending three 40-inch pieces of aluminum ground wire around self-tapping screws in the base of the antenna making six 19-1/2-inch radials. The radials have a negligible affect on tuning.

I used the same testing techniques I had used earlier—measuring the relative received strengths of repeaters and locals in all directions and getting signal reports from locals. The data taken for each station were then normalized by dividing the reading for the best antenna into the readings for each antenna. I then averaged the normalized numbers for all stations for each antenna. This allowed me to get an unbiased relative performance metric across each antenna. The results are plotted in Fig. 12 for received signals from both repeaters, which tend to be at higher elevations around me, and local stations. The averaged values in each direction for signals from repeaters also are plotted. Basically, Fig. 12 indicates that neither direction nor elevation affects the relative performance of these antennas tested at my location, and that the Isopole is the best of the antennas tested. The rest of the antennas were tested with the original four and the results in both receiving and transmit modes are given in Fig. 13. Again, the results are consistent.

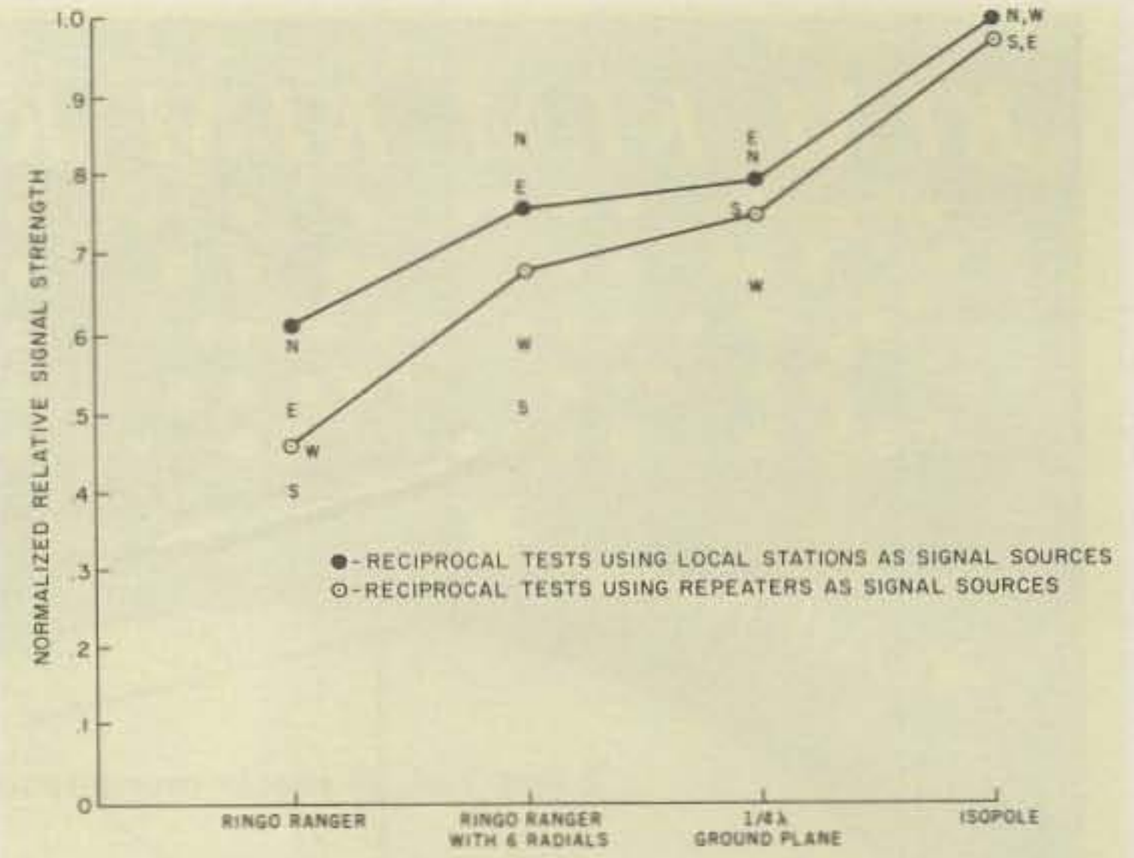

Fig. 12. Relative signal strength of four antennas for repeaters and local stations in different directions. Normalized strengths for each direction are given by N, S, E, and W.

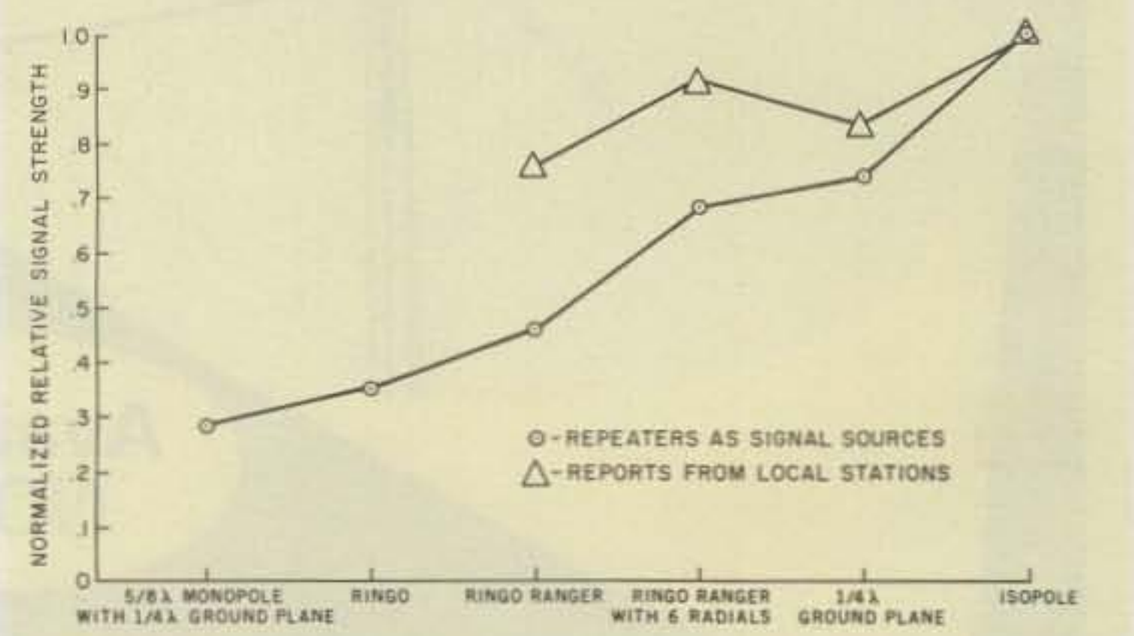

Fig. 13. Relative signal strengths of six antennas in both transmit and receive modes. Wider variance from reports from other stations is expected because S-meters are independently calibrated.

Conclusions

From these tests it is clear that:

1) The 5/8λ radiator on a 1/4λ ground plane is a poor antenna—do not bother with it.

2) The 1/4λ cheap (less than $2.00) SO-239 groundplane antenna of Fig. 1 is a very cost-effective antenna.

3) Radials do improve the performance of the Ringo Ranger.

4) The Isopole performed better than all the other antennas in almost every case.

It is interesting to note that since these tests were run, Cushcraft has come out with a decoupling kit consisting of a ground plane which mounts some distance below the base of the Ringo Ranger to improve its performance. I will try it as soon as I can get one to my test site.

Acknowledgements

I thank the following for their help in running these tests: Roy K1GSK, George W1DA, Dick AB1F, Bob W1QMN, Russ WA1RKO, Tom WA1MBA, Bruce WBØOFC, Shawn WB1AEL, and Tom KA1AIG.■

References

1. Jasik, Henry, *Antenna Engineering Handbook*, McGraw-Hill, 1961.
2. ARRL, *The ARRL Antenna Book*, 1977.

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The 440-MHz Curtain

—hang this broadbanded two-bay collinear on your tower and get 22 dBi to play with

I had been experimenting for several years with various antennas on a UHF repeater, trying to obtain reliable coverage over a 50-mile path. Initially, I used arrays of commercially manufactured yagis with good but not spectacular results, eventually ending up with an array of eight 14-element yagis stacked vertically up the side of the tower.

I began to suspect that something was amiss after removing four, then six, yagis from the array, leaving just two and discovering that signals didn't drop the expected 6 dB. In fact, I observed closer to a 3-dB difference between two and eight yagis.

Experimenting further, I found little effective signal gain between four and eight yagis. I was stumped over this discrepancy until I thought of the losses at 440 MHz of four additional baluns, a four-way splitter, a two-way splitter, some 30' of RG-8, and ten coax connectors!

While mulling over different ways to pick up those elusive dBs, an antenna with a whole lot of relatively inexpensive gain came to mind. This was a broadband, high-gain (21.3-22.8-dBi) curtain array used by the VOA in the 9- and 11-MHz shortwave bands for optimum signal into overseas locations.[1] The VOA dumps about 200 kW into such an array and the resulting 20-megawatt erp usually gets the message across. This antenna is a two-bay collinear, with eight half waves per bay, spaced a quarter wave in front of a screen reflector.

When scaled to UHF, the proportions become entirely manageable. I'll be describing an array based on this design consisting of three bays of six elements, occupying a space of about 3-1/2' × 8' and a total material cost of about $20. As opposed to a yagi, a collinear is easy to tune and is almost guaranteed to work well right off the bat.

The framework for the array is made of 2" × 2" pressure-treated lumber for weatherability—redwood or cedar would be excellent alternatives. Assemble the frame using a sufficient number of corner irons and screws to impart rigidity to the structure. The plane reflector is made of so-called chicken wire fencing stapled to the front of the frame. This material is galvanized, light weight, strong, a near-perfect UHF reflector, and has low wind resistance.

Don't substitute ordinary window screening or hardware cloth in temperate climates as the holes will fill with snow and ice causing one heck of a windloading problem. Either the antenna mount would fail during a winter storm or you might find your tower becoming a giant fly swatter. You want to stretch this fencing as much as possible while stapling it to the perimeter of the frame so that it won't flap in the wind.

Once the framework is assembled, the next step is to attach the pre-drilled struts that hold the driven elements in place. I used 3/4" × 1/2" stock in a crossbar arrangement. No insulation is required in mounting the elements this way as the rf voltage at the center of the elements is minimal. The elements are made of #12 copperweld antenna

Photo A. Construction details.

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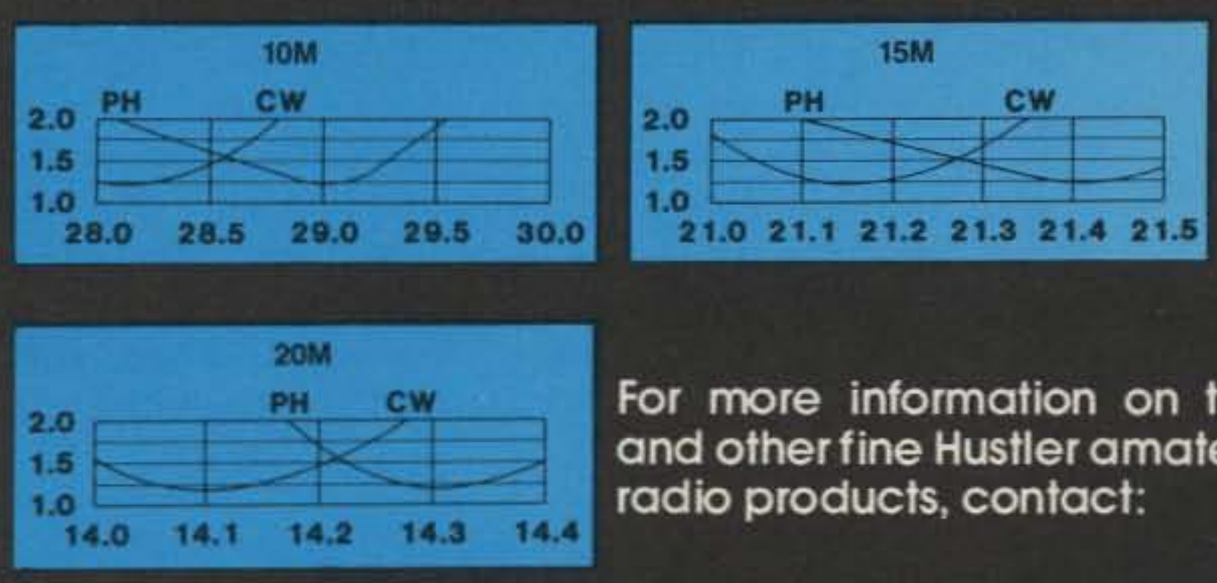

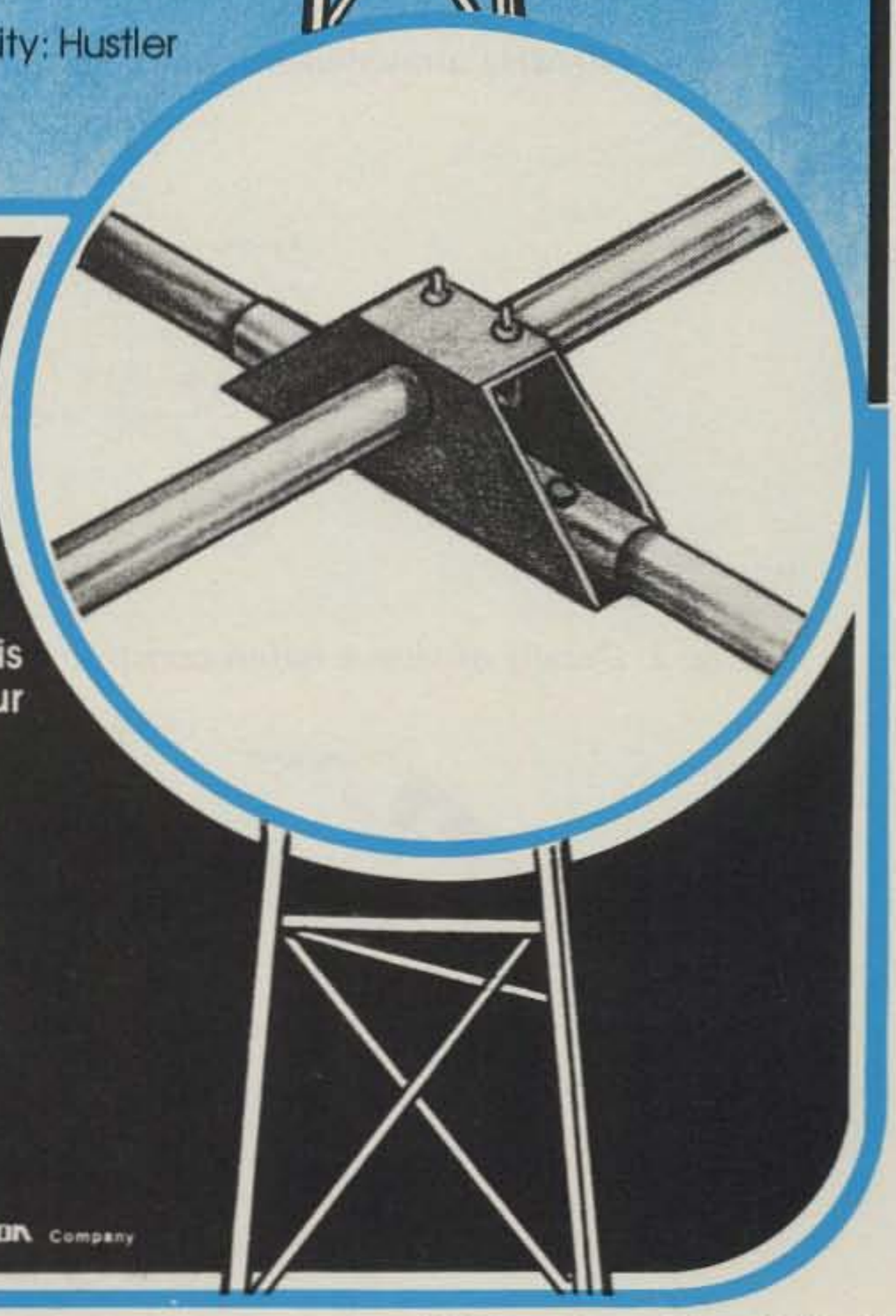

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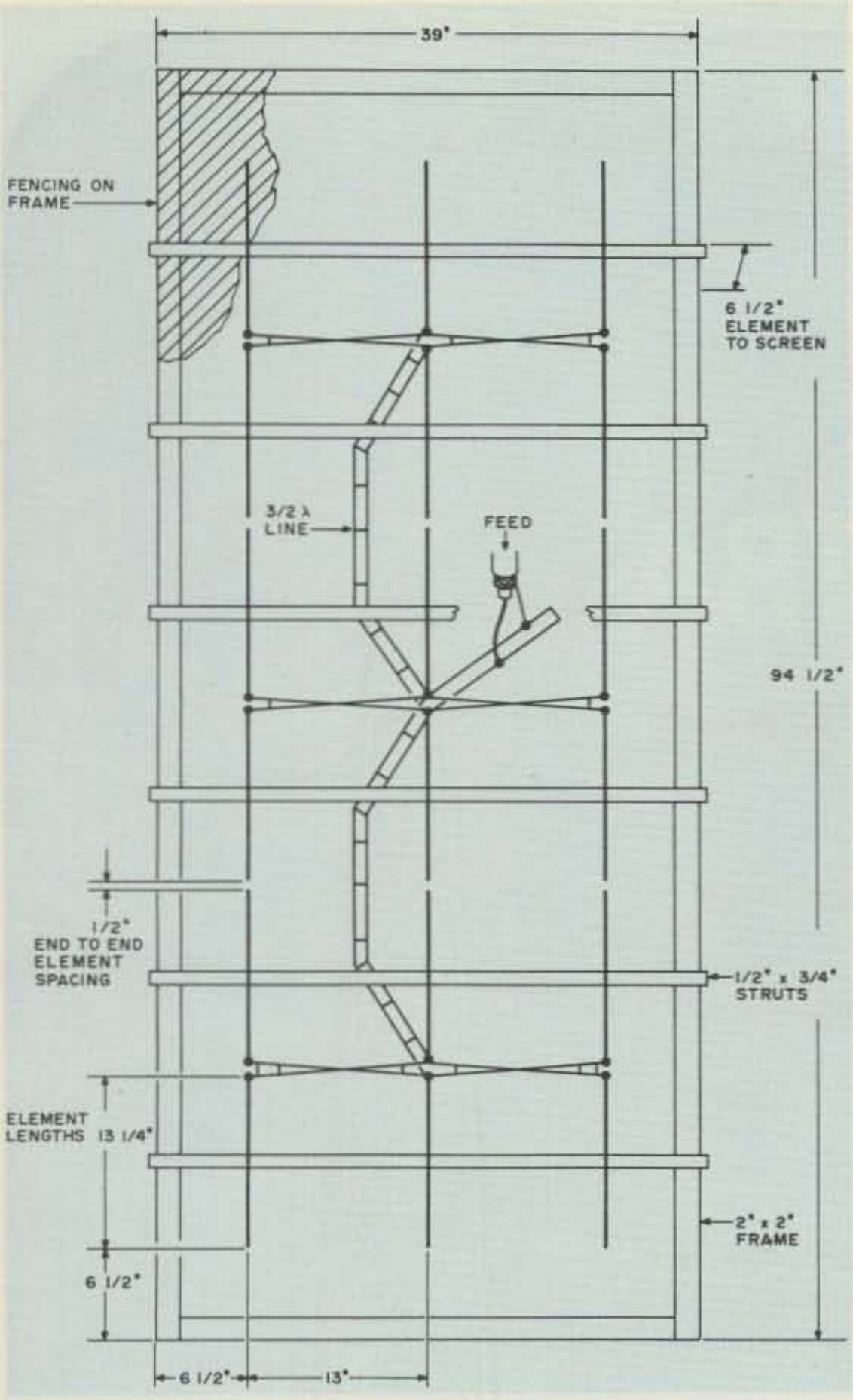

Fig. 1. 440-MHz array construction details.

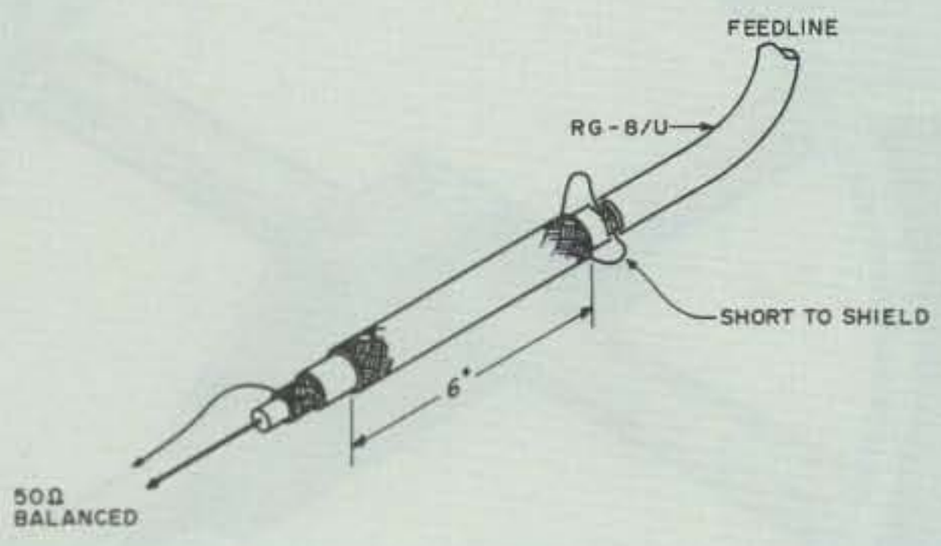

Fig. 2. Details of sleeve balun construction.

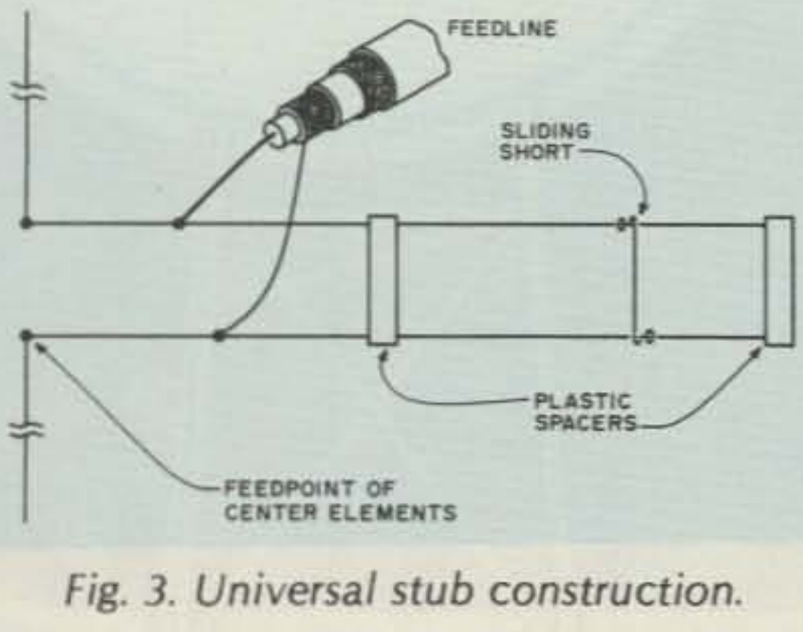

Fig. 3. Universal stub construction.

wire inserted through drilled holes in the cross-bars and held in place with silicone RTV. Center the elements in the struts and apply the RTV. Let the RTV dry for a day or so before proceeding further. It's worth applying several coats of urethane or spar varnish to the struts at this point.

Now you should cut the phasing lines to length that connect the elements and bays together. This is the most critical part of construction and requires attention to detail. I made my phasing lines from 300-Ohm Saxton open-wire transmission line, available from several retailers of amateur equipment. This line is #18, spaced 1/2", and I measured its velocity factor as 0.985 in small sections at UHF frequencies.

Please don't use any kind of ordinary twinlead for a harness and expect a decent swr in wet weather. If you must, make your own open-wire line with low-loss spacers. You need three 1λ lines, one for each bay, and two 1-1/2λ lines to interconnect the bays. The 1λ lines are cut to a length of 26-1/4" and the 1-1/2λ lines were cut to 39-3/8" long. Measure carefully!

Solder the phasing lines to each bay. Find the exact center point of a 1λ line and solder this point to the center two elements in a bay. Put a 180° twist in the free ends and solder these to the outside elements, doing the same for all three bays. Now interconnect the three bays with the 3/2λ lines. Loop these lines between the bays and the reflector and don't forget the 180° twist in them before soldering. It's not a bad idea to use a couple of plastic standoffs on these lines, supporting them about 2" above the reflector to keep them from flapping in the wind. Check that the spacing between line conductors is constant and that the lines are generally balanced and symmetrical with respect to the reflector.

This antenna is fed with a 1/2λ universal stub and coaxial sleeve balun. If you're into Q-sections, one also could be used to match a coax line to this antenna's approximately 100-Ohm feedpoint impedance as an alternative. The sleeve balun (Fig. 2) is constructed by cutting off a 6" piece of braid from some RG-8, tinning the ends to prevent unraveling, and slipping it over the end of the coax feeder. The inside end is soldered to the shield of the RG-8 feedline at a point about 6-1/2" from the end where a 1/4" section of jacket has been removed.

Slather some RTV over this connection and the open end of the coax to prevent moisture penetration after stripping and tinning about 1/2" of the coax end. The 1/2λ stub (Fig.3) is 13-1/2" long and can be conveniently made out of the same copperweld that the elements are made of and some spacers from the open-wire line. Heat the wire with a hot soldering iron and the plastic spread-

Gain Calculation

Calculating the gain of a collinear with a large number of elements can be as complicated as you want to make it. A general rule of thumb for the gain of a collinear aimed at the horizon is 4N, where N is the number of half-wave elements. For instance, a 12-element antenna would have a power gain of 48, or 16.8 dB. (Add 3 dB if a reflector is used.) This figure is strictly a rough estimate, and factors such as ground-reflection gain (or loss) or dielectric and resistance losses can change things considerably. (See *Antenna Theory and Design*, Williams, 1950.)

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ers can be easily pressed on or off. A sliding short is made from a piece of #18 tightly twisted around both stub lines. A loose fit here will cause erratic readings while tuning.

You must tune this antenna outdoors aiming it up at the open sky. I had this antenna aimed out at the road in front of my house and every time a car went by the swr went up and down! The tuning process consists of alternately sliding the attachment point for the feedline and the short up and down the stub until the best match is obtained. The optimum point for the short will be near the far end of the stub, and the coax will attach to a point about 1" from where the stub connects to the antenna. A 1.5:1 swr was easily obtained. The antenna's bandwidth is excellent and exhibits a good swr over 5 MHz.

Put simply, this antenna is a real band smoker. Using a calibrated signal generator as a reference and the S-meter of a Drake UV-3 60 miles from a repeater using this array, I made some comparison checks. I measured a 12- to 13-dB improvement over a commercially manufactured 20' long, 10-dB gain fiberglass-type omni on the same tower! This is the difference between a signal just barely opening squelch and one of perfect readability with a little background hiss. The beamwidth appears to be on the order of 20° to 25° and the front-to-back and front-to-side ratios are superb. The close bay spacing produces a very clean pattern.

Now, let's see. A half wave on 29.6 is . . . ■

Reference

1. Jasik, *Antenna Engineering Handbook*, chapter 21.

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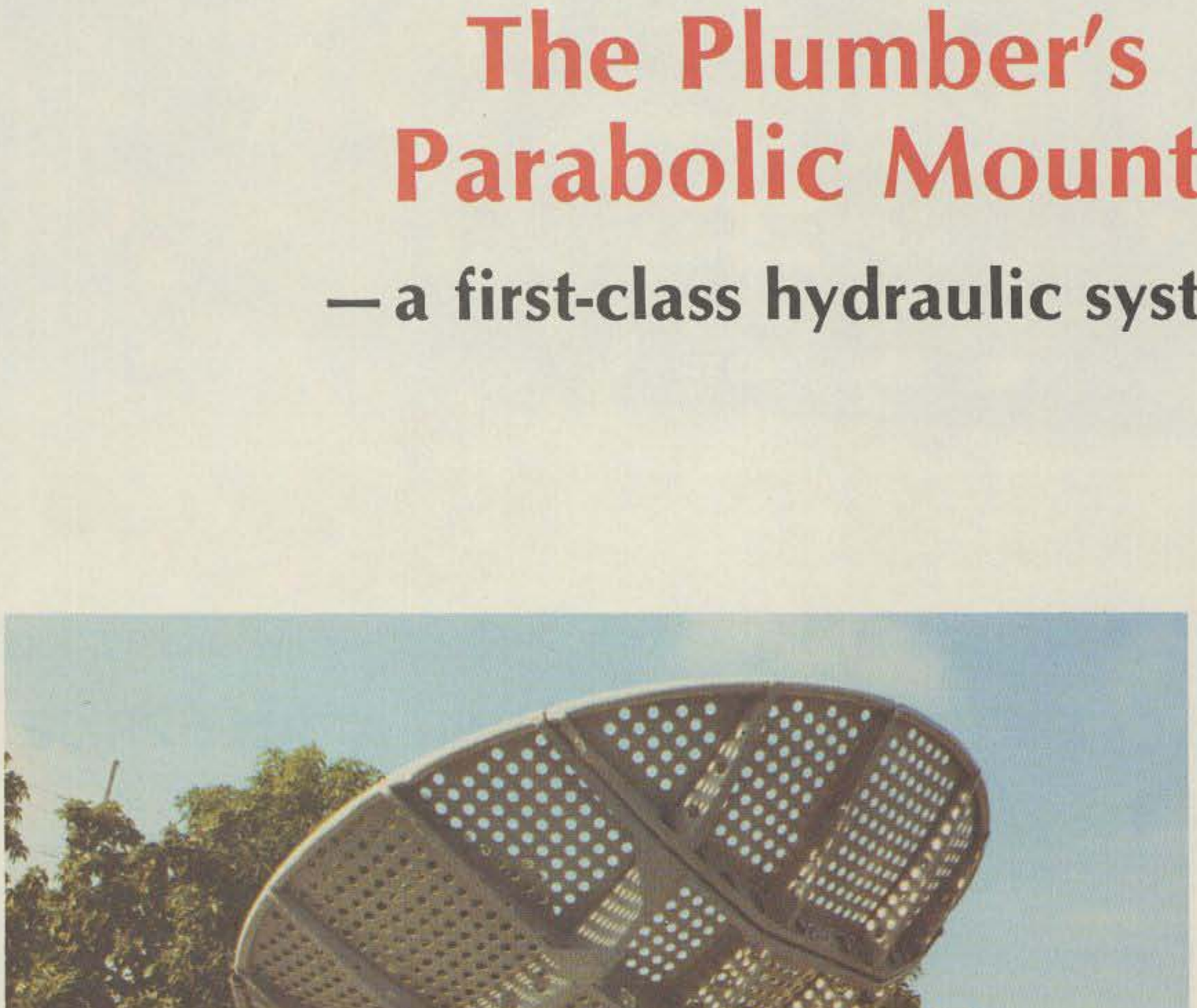

Photo A. Completed mount and two-meter (7-foot) dish after assembly on our roof. The elevation cylinder is at far right. Rooftop portion of controls, housing pump and valves can be seen near the far leg.

Interest in reception of microwave signals from geostationary orbiting satellites has spread rapidly throughout the amateur community. Some amateurs wish to receive TV programs directly from satellites such as Satcom.[1] Others, like my son and I, are more fascinated by receiving weather pictures from the meteorological satellite, GOES.[2]

Wherever your interest may lie, sooner or later we

all encounter the same problems. To receive weak microwave signals, first, a large parabolic reflector, or dish, must be used for an antenna.[3] Second, this dish must be positioned with a fair degree of accuracy and must be mounted securely enough so that it cannot be blown over by an energetic wind. Finally, for the avid experimenters trying to work more than one satellite, one must be able to move the aim of this unwieldy saucer from one point in the sky to another.

Considering that eventually we would use our newly acquired dish for more than one satellite, my son and I decided to build a steerable mount that could be remotely controlled from our electronics lab in the house.

The final product of several designs provided a mount that can be reproduced easily by the average amateur. Costs will vary, depending on your resourcefulness, but with careful shopping this mount can be constructed for less than $500.

The mount is hydraulically operated with an elevation range from 46° to 59° and an azimuth scan of 96°.

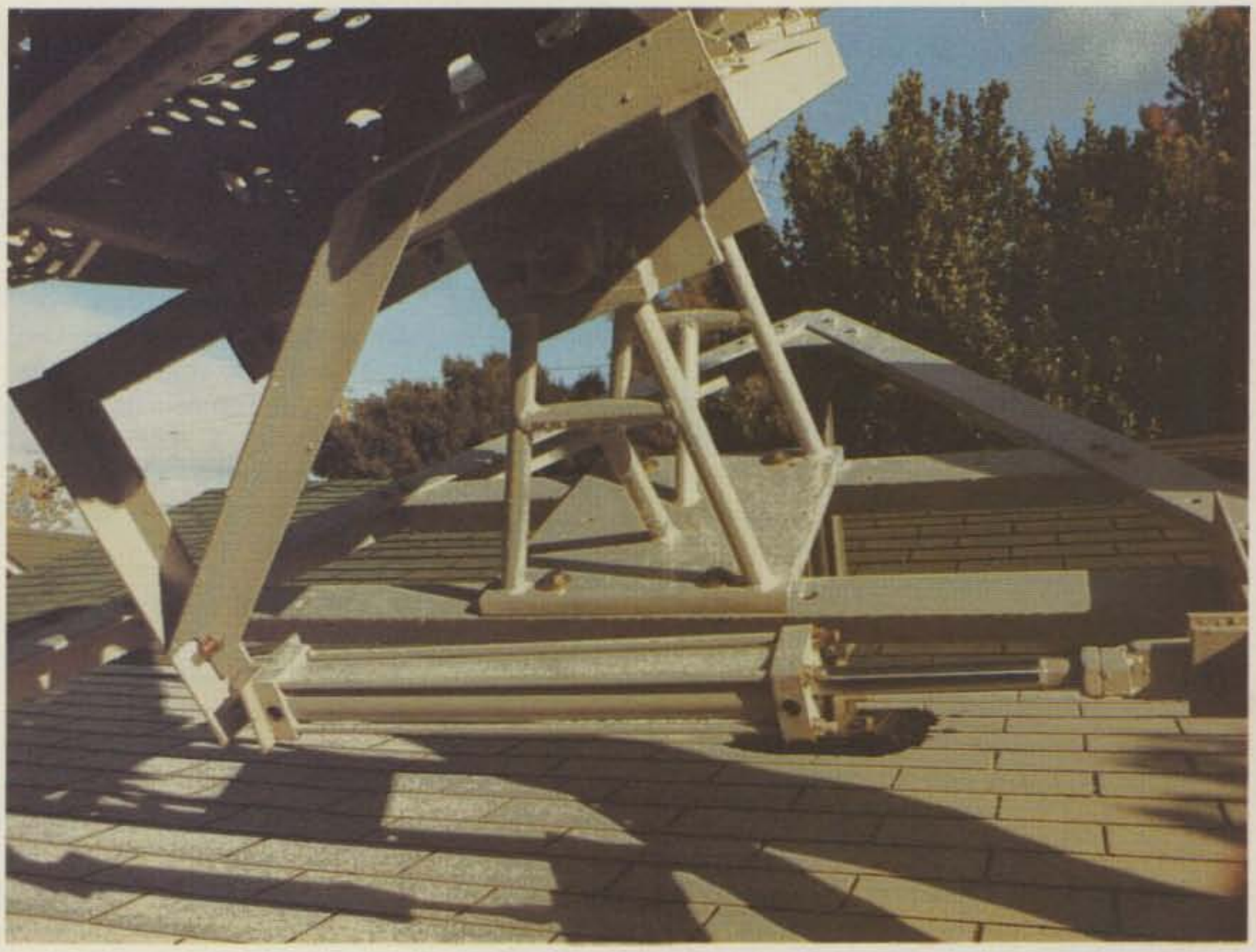

Photo B. Close up of the azimuth steering arm and control cylinder.

This range of travel covers most of the usable area of view for equatorial satellites from our location. Photos A and B show the completed mount holding a two-meter (7-foot) dish at our station. The remote control panel, located in the electronics lab, is shown in Photo C.

This article will provide complete construction plans for the mount and controls. Although this project can be built using only hand tools and an electric drill, having access to a power hacksaw and a welder will greatly expedite construction and save many kilocalories worth of elbow grease.

A-Frame

The major portion of the mount is constructed of 3" × 3" × ¼" angle iron. Two eight-foot, and one seven-foot length are bolted together to form an A-shaped frame. The lower ends of this A-frame pivot on two pads that serve as the eleva-

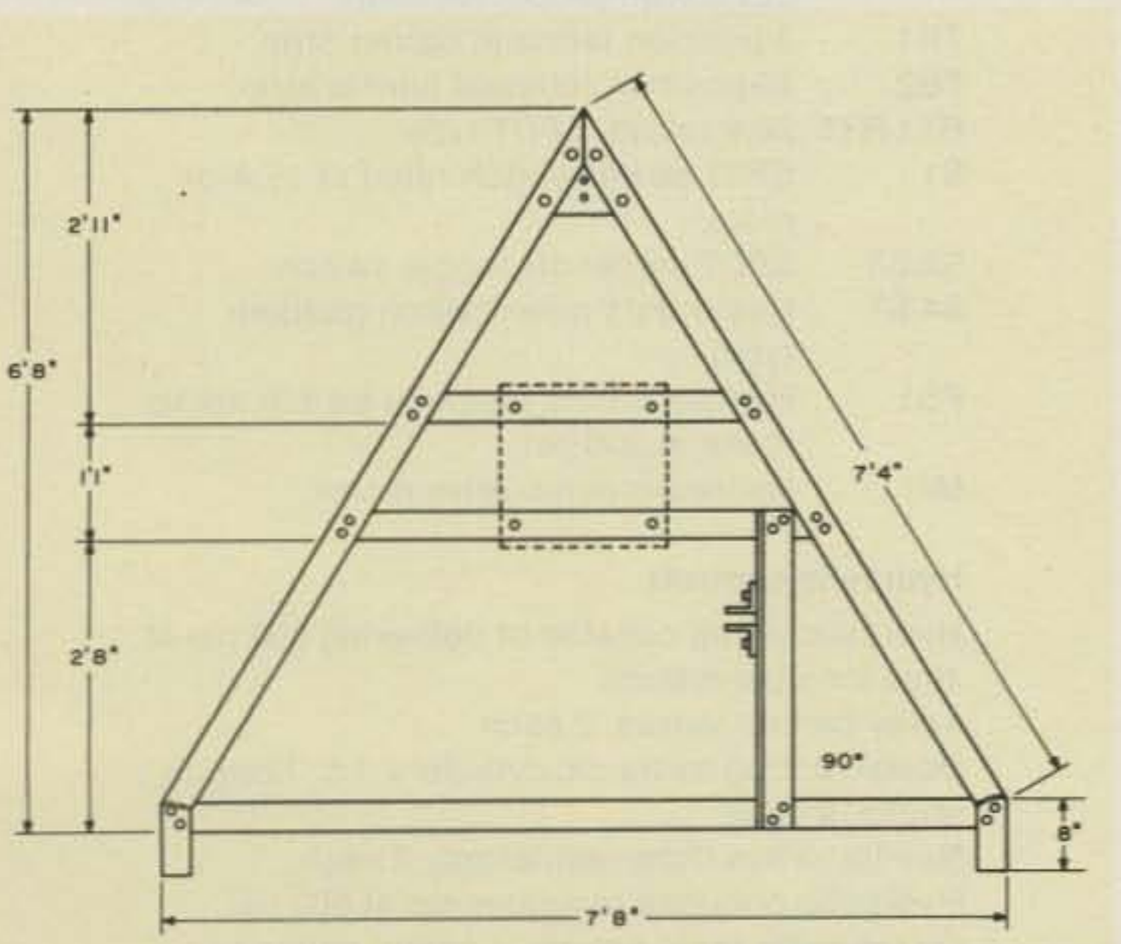

Fig. 1(a). Top view of the A-frame assembly. The dotted line is the location of the pivot frame mounting surface.

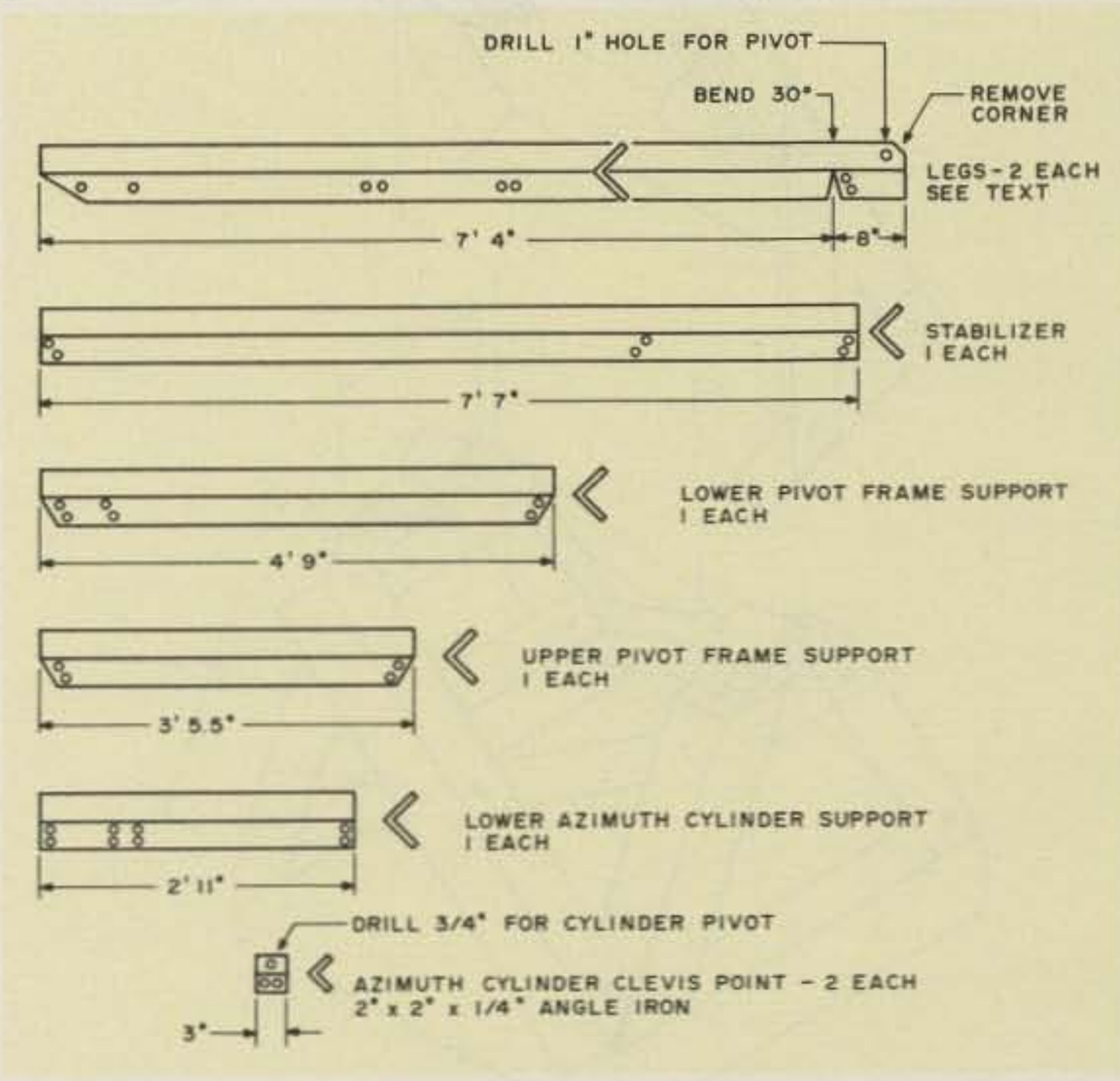

Fig. 1(b). Cutting detail for the A-frame members (see text). All angle iron is 3" × 3" × ¼" unless noted. All bolt holes are ½" unless noted.

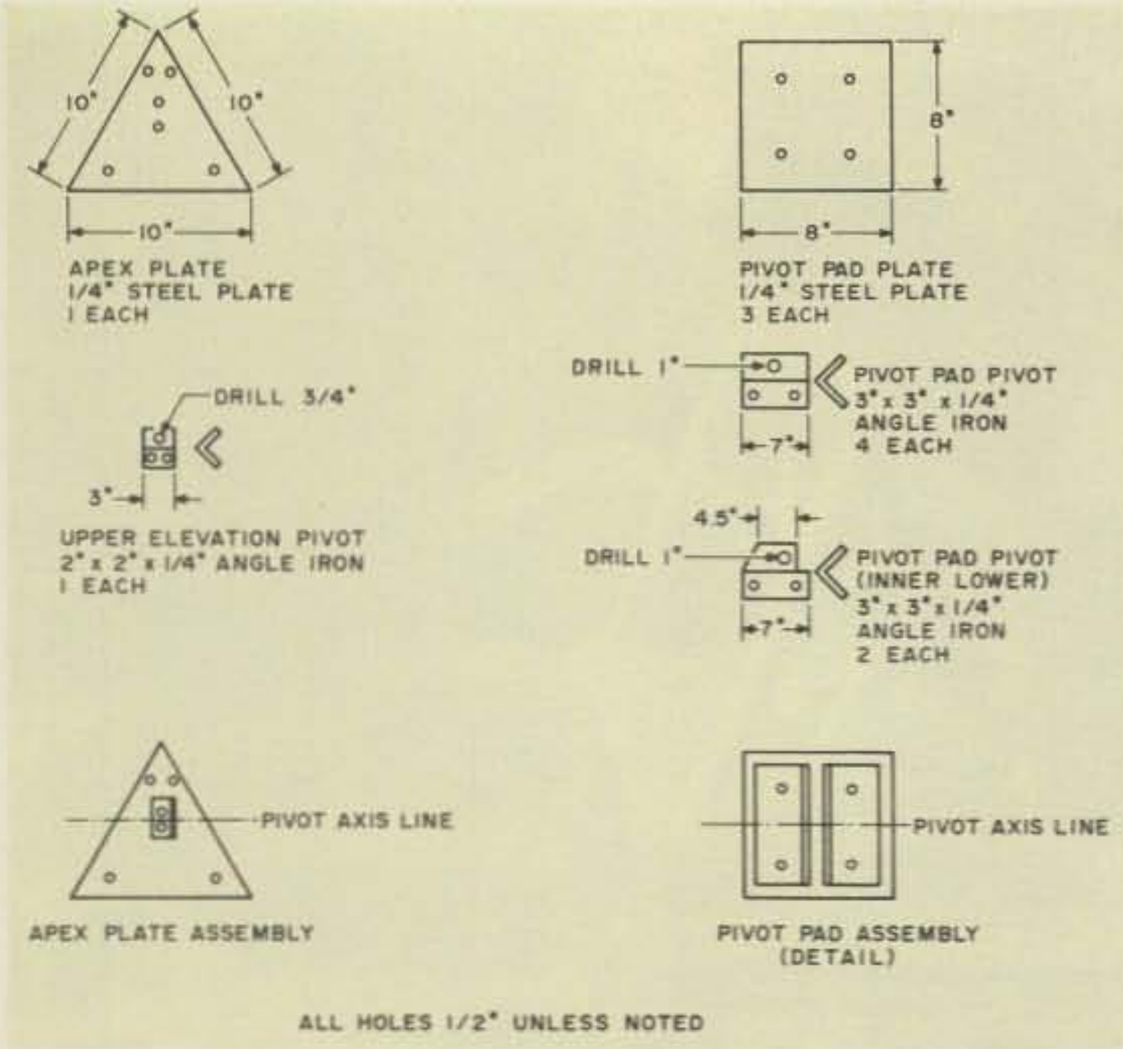

Fig. 2. Apex plate and pivot pad cutting and assembly detail.

tion pivot points. Elevation motion is provided by a hydraulic cylinder extending from the apex of the legs to a third pad. Fig. 1 shows cutting and assembly details for the A-frame. Pivot pad detail is shown in Fig. 2.

A 30-degree wedge must be removed from one side of each of the two legs at a point 8" from one end. The short ends are then bent to close the opening left by the removed wedge. The seams formed at these bends must be closed by welding or by the addition of a web plate bolted over the seams. *Remember*: The cuts must be made so that one leg is the mirror image of the other. The seven-foot length is used as a stabilizer across the bottom of the A-frame.

The pivot pads are constructed from three pieces of ¼" steel plate 8" square and six pieces of 3" × 3" × ¼" angle iron 7" in length. See Fig. 2. Two of these pivots are located at the foot of each leg and one at the lower end of the elevation cylinder.

At the apex of the A-frame a triangular plate of ¼" steel 10" on each side is used for the dual purpose of joining the upper ends of the A-frame and providing an upper pivot point for the elevation cylinder.

Three additional lengths of angle iron are used for the support of the pivot frame and the lower support of the azimuth control cylinder.

Keep in mind that these dimensions are for a two-meter dish. A slightly larger dish could be accommodated, but if your dish is much larger, the A-frame will have to be made longer.

It would be well to mention a valuable construction hint at this time. Although it is theoretically possible to drill all the necessary holes accurately by being very exact in your measurements, in reality it is somewhat difficult. As you may have noticed in cutting-detail Figs. 1, 2, and 3, no measurements are given for hole placement. Ex-

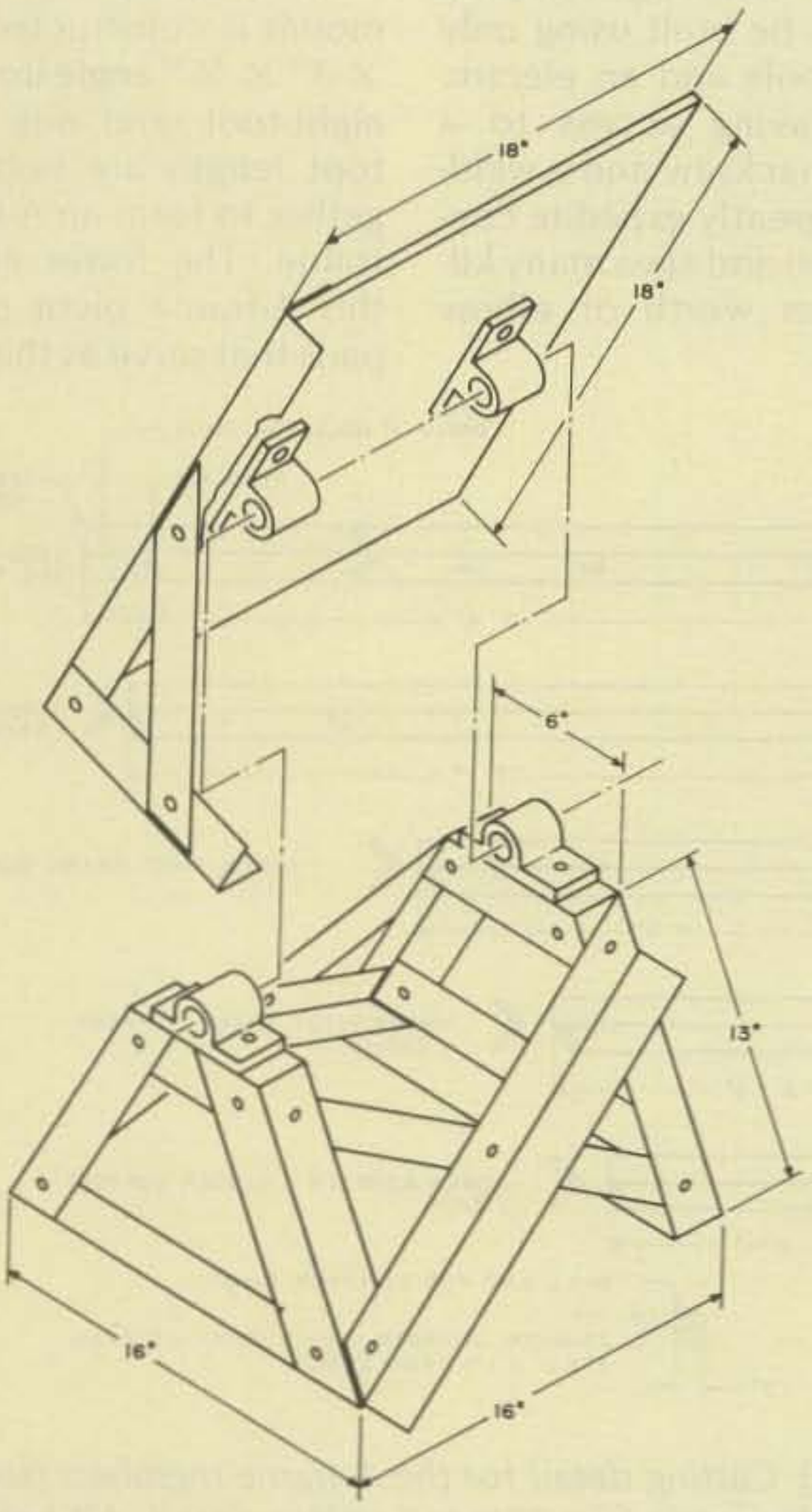

Fig. 3(a). Assembly detail for the pivot frame.

Parts List

Electrical controls

P1	110-V, 15-A ac plug with ground
F1	15-A fuse and holder
F2	5-A fuse and holder
T1	24-V, 5-A transformer
D1	5A, 50-V power diode
C1	1000-uF, 50-V dc electrolytic capacitor
I1-I5	24-V indicator lamps (may substitute LEDs with proper resistor)
TB1	3-position terminal barrier strip
TB2	10-position terminal barrier strip
RY1-RY5	24-V relays, SPDT type
S1	SPST power switch rated at 15 A or more
S2,S3	SPDT center-off toggle switch
S4-S7	Heavy duty microswitch (outdoor type)
PS1	Hydraulic-type pressure switch set to make at 300 psi
MI	Hydraulic pump drive motor

Hydraulic controls

Hydraulic pump capable of delivering 500 psi at .5 gallons per minute
4-way control valves, 2 each
Double-acting hydraulic cylinders, 1.5" bore, 18" stroke, 2 each
Needle valves (flow restrictors), 2 each
Hydraulic pressure regulator set at 500 psi
Oil reservoir tank, approx. 1 gallon capacity
Hydraulic accumulator (optional)

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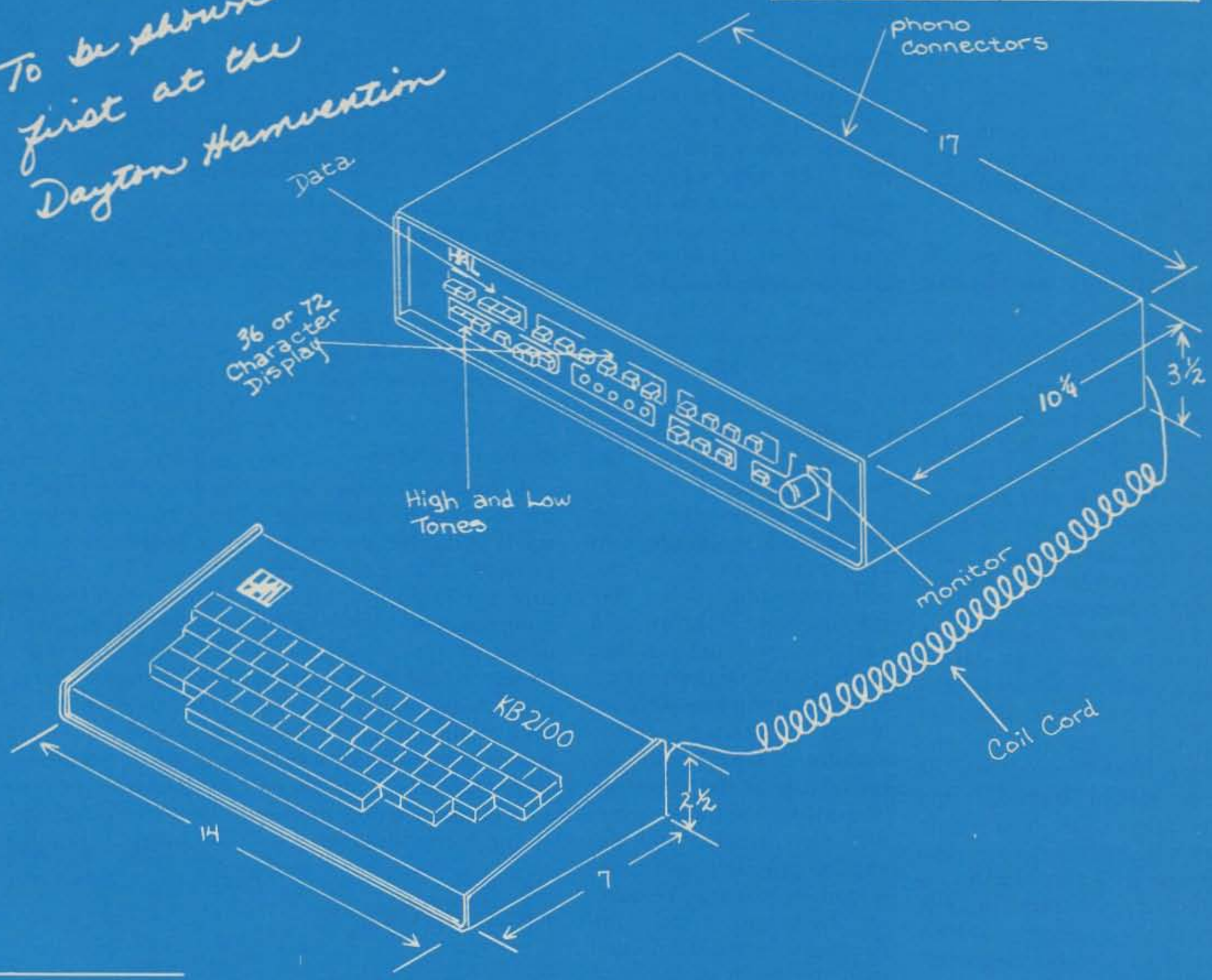

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perience has shown us that the easiest way to drill these holes is to clamp all the pieces for a particular section together first. Then the holes can be drilled through the mating sections. This alignment of all the pieces and their holes will ensure accurate and easy assembly.

Pivot Frame

The pivot frame is mounted in the center of the A-frame and provides the azimuth axis and support for the dish.

The prototype shown in all the photos has the pivot frame constructed of three-quarter-inch pipe welded to form the frame. This is because the frame was built for another use but fit so well in this project that I just could not pass it up. My new design is just as good, however, and can be built without any welding. See Fig. 3. Two trapezoidal upright frames are constructed of 2″ × 2″ angle iron. A bronze bearing pillow block with a one-inch bore bolts to the upper short bar of each trapezoid. To prevent lateral movement of the upright frames, cross members of 2″ × 2″ angle are bolted between the frames. This sawhorse-shaped pivot frame mounts on the two center cross bars of the A-frame described earlier.

A length of 1″ steel shafting runs through the two pillow blocks atop the pivot frame and forms the azimuth axis.

At this point we are ready to mount the dish. If your dish has a center-type mount, you probably can use our system with no changes. However, if your dish has a different type of mount, some modifications may have to be made. We used an 18″ square of 3/8″ steel plate as a mounting surface for the dish. Two additional pillow blocks are bolted to this plate on the side opposite the dish. This plate is one half of the hinge formed between itself and the pivot frame.

The same "clamp and drill" method of construction used in the A-frame should be used for the pivot frame.

Steering

As mentioned earlier, all positioning of the antenna is done with hydraulic controls. This type of system was chosen because it provided accurate positioning ability and simplified mechanical design; most of all, however, a hydraulic system was the easiest to make weather resistant.

Azimuth steering is accomplished with a hydraulic cylinder attached between a piece of 3″ × 3″ angle iron on the main A-frame and a steering arm attached to one edge of the dish mounting plate. This steering arm is shown in a partially extended position in Photo B. The dimensions of the steering arm were selected so that the maximum amount of travel could be realized with the available hydraulic cylinder size. Both the azimuth and elevation cylinders were obtained from surplus sources. The length of the cylinder we selected combined with the pitch of the roof the antenna is mounted on gave us the necessary elevation angle for the antenna at our location.

Depending on your geographic location, you may need to change the length of the elevation cylinder or the vertical position of its mount to achieve your correct elevation angle. Positioning data for your location can be computed from the formulas given in Dr. Ralph E. Taggart's excellent article in *73 Magazine*.[4] The cylinders we used have a stroke length of 18″ and are double acting; that is, they

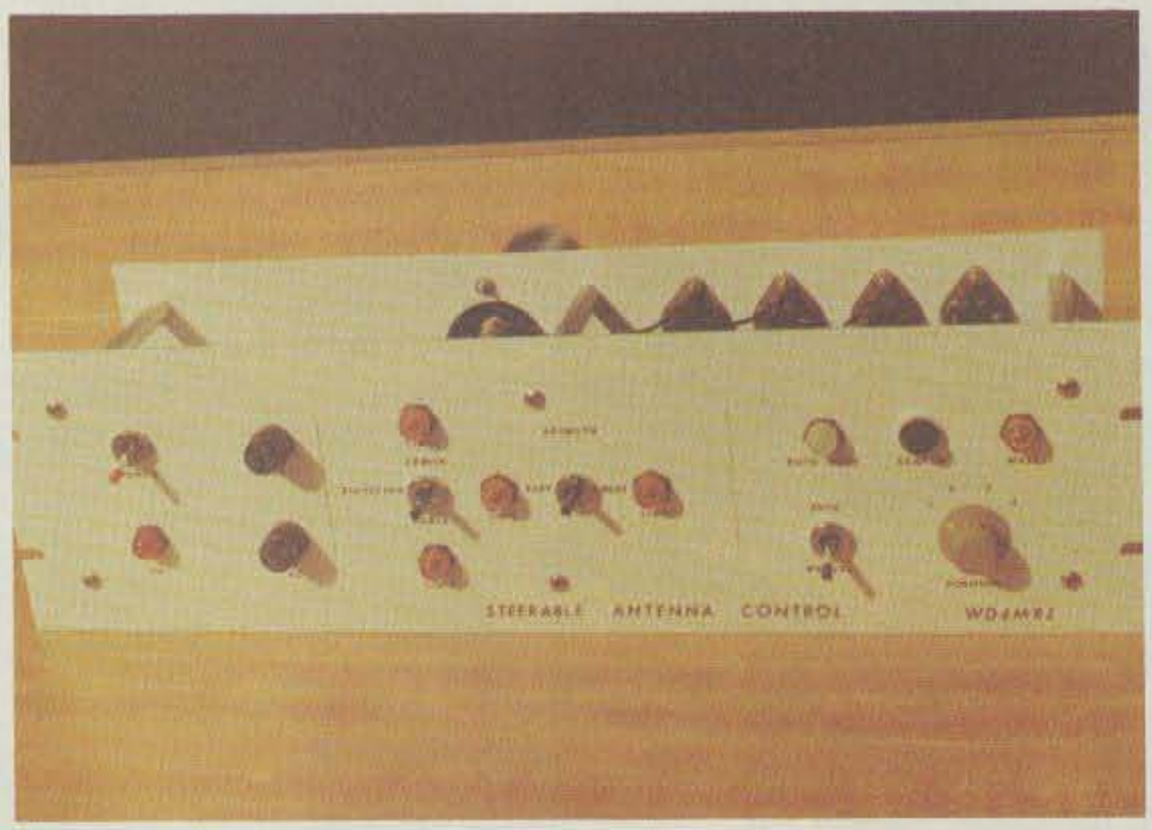

Photo C. Control panel for the steerable mount. Note that the controls on the right third of the panel are for the future installation of automatic positioning controls.

can push or pull, depending on which end of the cylinder is receiving fluid pressure.

Hydraulic System

A half-horsepower electric motor is used to drive a small hydraulic pump that provides 500 psi of oil pressure. See Fig. 4. This type of pump as well as the cylinders and control valves can be purchased from sources such as those listed at the end of this article.[5,6] Pressure is controlled by a pressure regulator with all excess oil returned to the reservoir. Normally-open pressure switch PS1 (Fig. 5) closes at 300 psi and actuates relay RY1 allowing the control circuits to become active. The purpose of PS1 and RY1 is to ensure that hydraulic pressure is up before any operation can begin. More on this later.

Oil at 500 psi then flows through two flow-restrictor needle valves that control the velocity or rate of position change of the antenna. These needle valves must be adjusted for a flow that will allow accurate control of the dish position. The electric four-way valves are the hydraulic equivalent of

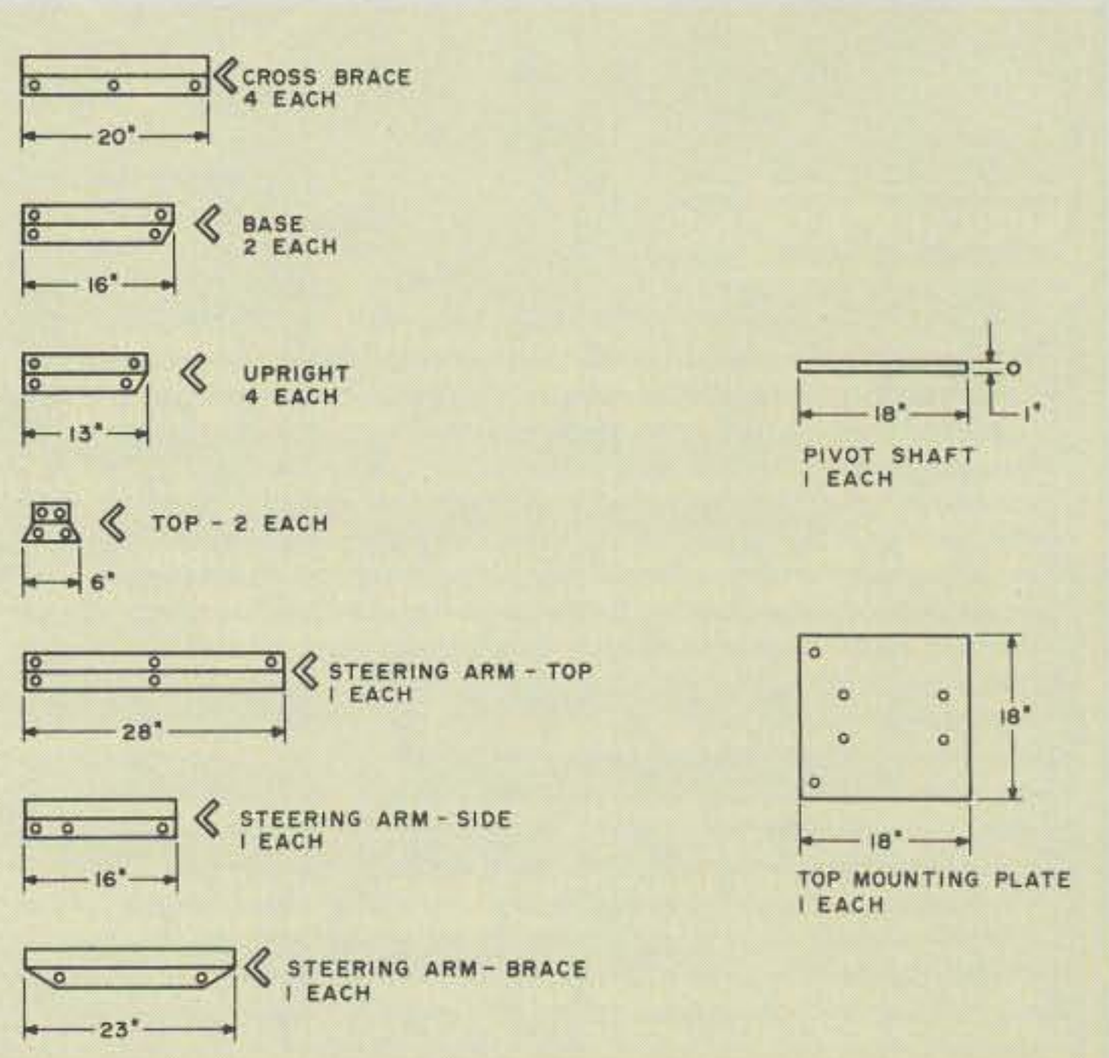

Fig. 3(b). Cutting detail for the pivot frame. All angle iron is 2″×2″×¼″ and all holes are ½″.

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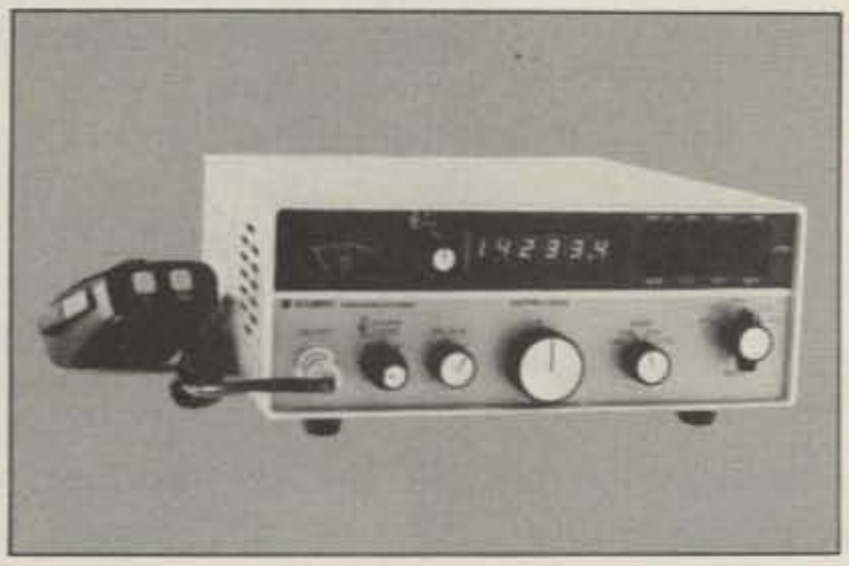

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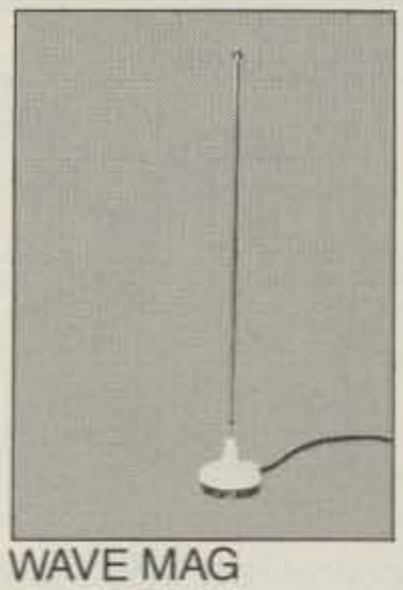

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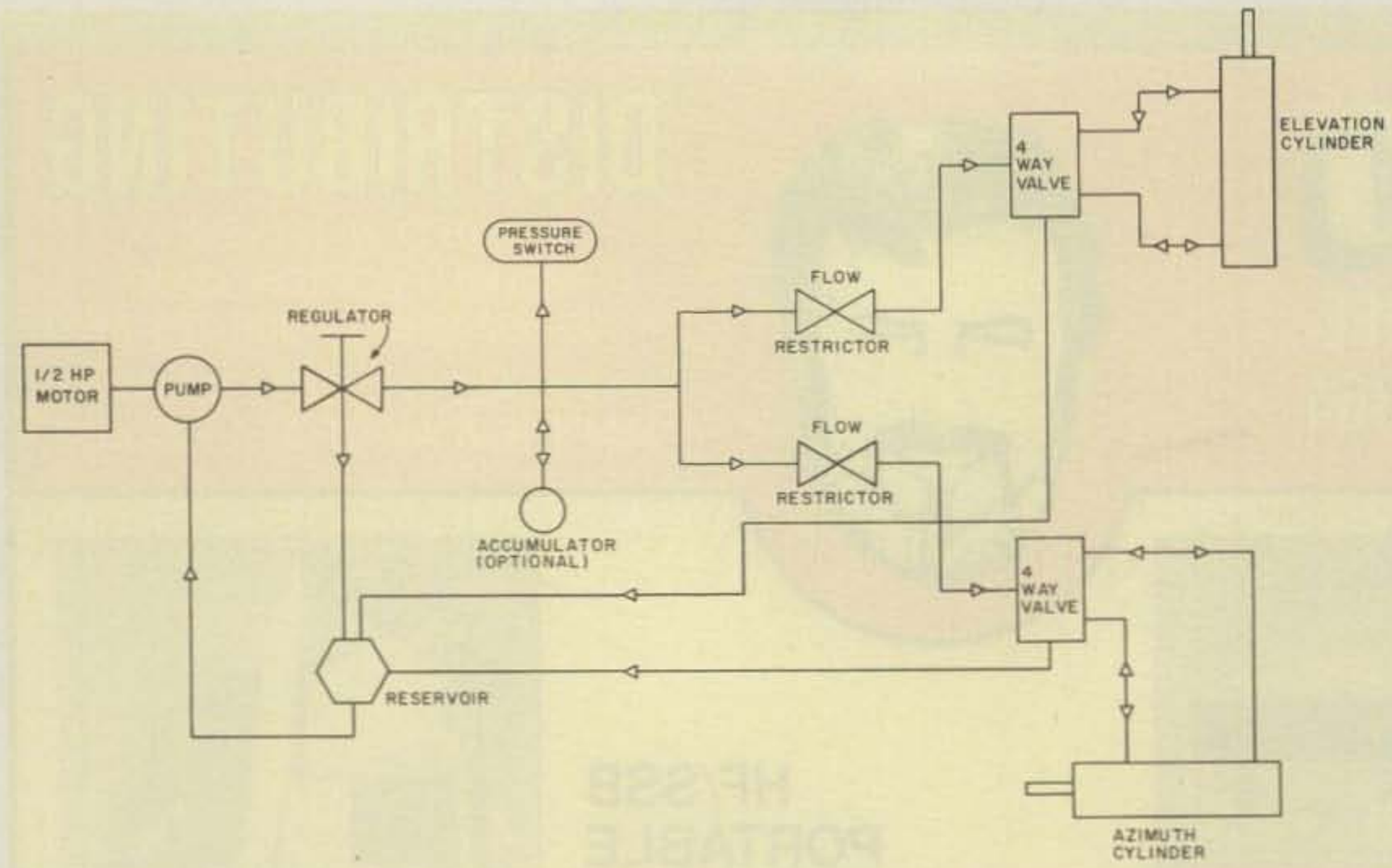

Fig. 4. Hydraulic system diagram. Due to the varying availability of surplus hydraulic components, your system may have to be somewhat different, but the same basic design should be followed.

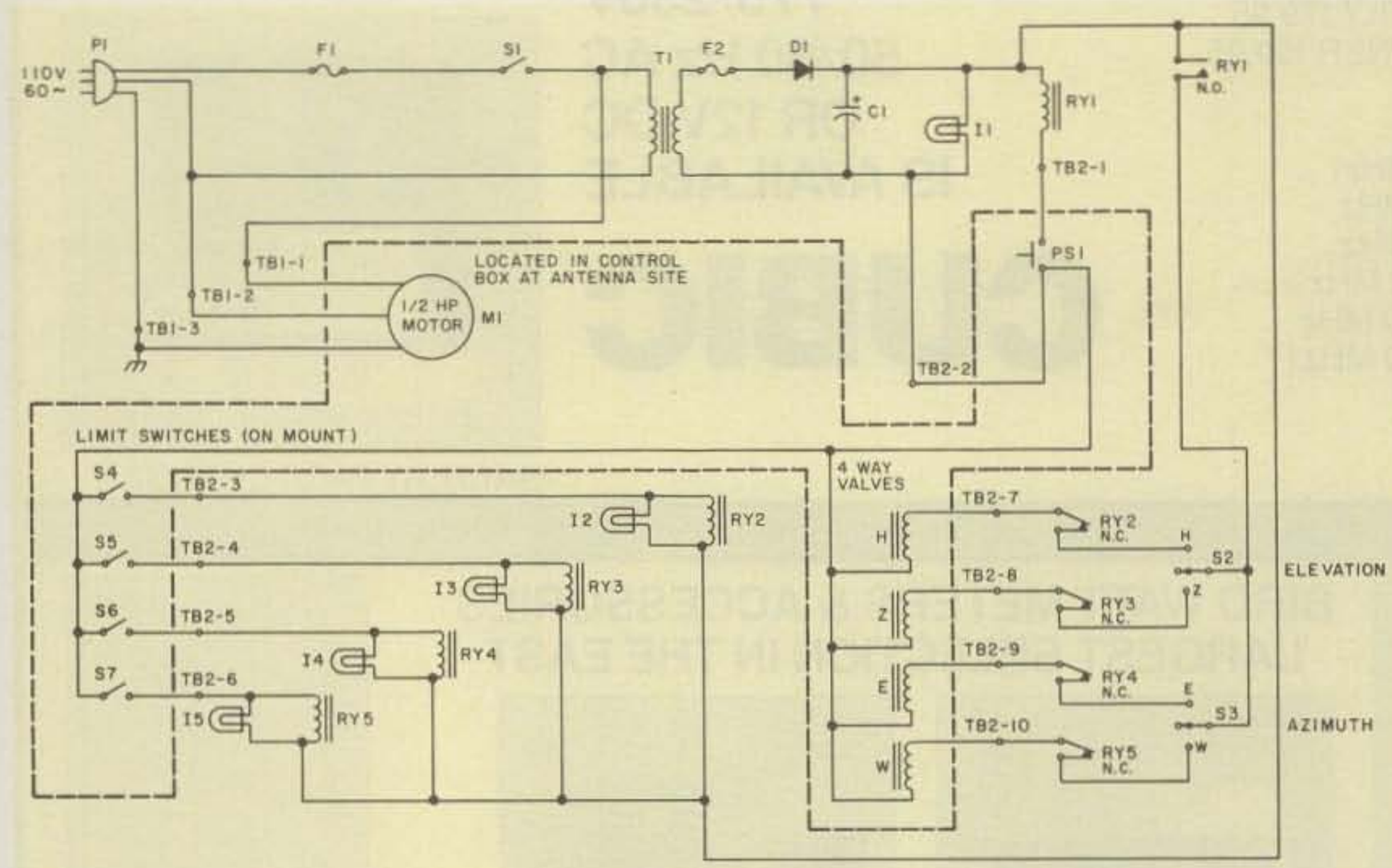

Fig. 5. Control panel wiring diagram.

a center-off SPDT switch. With no power applied to either coil, no fluid will flow to either side of the cylinder. With power applied to one coil, pressure will be applied through the valve to one side of the cylinder, thus moving the piston. Oil on the other side of the piston is returned through the valve to the reservoir. Conversely, if power is switched to the other coil, the piston will move in the opposite direction. An accumulator, a hydraulic cushion, can be installed as shown in Fig. 4 if the system "clangs" or shocks every time the four-way valves operate.

Control Panel

Currently, the electrical controls are only manual. Later, we plan to design a steering control that will input coordinates in degrees latitude and longitude and automatically position the antenna. For now, though, the circuit is simple and straightforward. Fig. 5 shows the circuit currently in use. Power is controlled by S1. Turning on S1 will start the hydraulic pump motor and apply power to the 24-V dc power supply. When hydraulic pressure is up to at least 300 psi, PS1 will close and actuate RY1 applying 24-V control to the position control switches, S2 and S3. These two switches are center-off SPDT type.

Transferring S2 to the horizon position will apply 24 V through RY2 NC to pick the four-way valve coil. This will apply motion to the antenna towards the horizon. If motion is attempted beyond the possible travel limits of the elevation cylinder, a limit switch will be closed. This switch is operated by a lever on the A-frame. Closing the limit switch will actuate RY2 thus opening RY2 NC. The four-way valve coil will drop out and cannot be re-energized until the over-travel condition is cleared. This same system applies to the other directions as well.

Summary

The development of this mount required several months of work before a design was arrived at that provided a well-balanced, sturdy, and easily reproduced device.

Actual construction time involved almost two months of weekend work, but has given us an antenna and mount with which we can enjoy many years of satellite signal reception.

We will be glad to answer any questions you may have about this project if you will please send an SASE. ■

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5. Airborne Sales Co., 8501 Steller Drive, Culver City CA 90230.
6. C and H Sales Co., 2176 East Colorado Blvd., Pasadena CA 91107.

Eric Shalkhauser W9CI
527 Spring Creek Road
Washington IL 61571

The History of Ham Radio

—part XIV

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

Radio conferences, now commonly referred to as the Hoover Conferences, became yearly affairs and the assembly of 1925 was no exception. The conferences were called to bring about a degree of cooperation between various branches of the developing radio industry. Primarily to cope with the ever-increasing proliferation of interference problems in the interest of the listener and to mediate the differences between broadcast license applicants, government regulation became of paramount importance.

This, the fourth conference, was to be the last one called by the Secretary of Commerce. Radio's destination would be completely revolutionized in the subsequent two years by bringing about the needed legislation to replace the 1912 law.

Convening in Washington on November 9th, 1925, some 700 participants from all sections of the United States were present—and only for three days. They soon came to unanimous agreements on all major issues. The spirit in which various questions were approached signified common understanding of the direction which radio broadcasting was to take in the future.

By the end of 1925, there were some 600 radio broadcast stations operating in the United States with no enforceable regulations. The opinions of the conferees were practically unanimous in favor of not limiting the number of broadcasting licenses issued, but actually to diminish the stations on the air so that the radio listener would benefit from the reduced interference generated.

What was the radio amateur's position? At the conference, the question of greatest interest to amateurs concerned the retention of the 150- to 200-meter band. Its takeover was threatened by the broadcasters. However, after serious consideration, no additional channels were allocated for the broadcast service.

Several recommendations were promulgated for the amateurs:

1. The opening of a 100-kHz band from 83.3 to 85.7 meters (3500 to 3600 kHz) to amateur phone operation, the usual quiet hours applying.
2. The opening of the so-called amateur 80-meter band to naval aircraft.
3. The prohibition of spark to all waves below 200 meters.

These recommendations were to take effect after formal announcement by the Department of Commerce. Meanwhile, the regulations of the past year remained for amateur guidance.

Mr. Hoover, in his opening remarks at the conference, referred in particular to the progress radio had made during the few years of development.

"It has been suggested that the remedy [for congestion] lies in widening the broadcasting band, thus permitting more channels and making it possible to provide for more stations. The vast majority of receiving sets in the country will not cover a wider band. Nor could we extend it without invading the field assigned to the amateurs, of whom there are thousands and to whom constant experimentation in radio development is so greatly indebted. Radio in this branch has found a part in the fine development of the American boy, and I do not believe anyone will wish to minimize his part in American life. And if we did absorb the upper amateur band from 150 to 200 meters, it would not even solve the immediate difficulties . . ."

The conference went on record recommending the following:

1. That no new stations be licensed until, through discontinuance, the number of stations is reduced and until it shall be in the interest of public service to add new stations.
2. That public interest as represented by service to the listener as opposed to private desire be the basis for the broadcasting privilege.
3. That further division of time among stations is not in the interest of public service and that the Department decline to grant any more licenses until the present number of stations is substantially reduced.
4. That duplication of frequencies not be permitted in the case of stations of greater than 500 Watts of power.
5. That advertising efforts via the broadcast be confined to the providing of meritorious programs which build goodwill for the sponsor.
6. That in issuing licenses, the Department uses dis-

crimination looking toward the location of all broadcasting stations outside of congested centers.

7. That Congress be requested to enact new radio legislation vesting the administration of radio in the Secretary of Commerce, subject to approval of an appropriate court.

With the unanimous adoption of the many reports and resolutions at this conference, the radio industry at last came to the realization that a new law was a pressing necessity and new legislation must be prepared as the next big effort by Congressman White, and as was indicated by the report of Hoover's committee on legislation, could now receive unanimous affirmative consideration.

Fourteen Years of Haphazard Growth Come to an End

Without a change in radio legislation in 14 years, especially since the end of World War I, Herbert Hoover had been in control and guided the radio developments as Secretary of the Department of Commerce. These were chaotic years for radio. The radio amateur was in the forefront of practically all major progress made in radio, especially with the support and cooperation of the Commerce Department.

With radio neglected by Congressmen, and court cases looming on the horizon, Herbert Hoover was not only willing to drop out, but also was certainly justified in surrendering the control of radio guidance. Hoover was now willing to surrender further attempts at assigning wavelengths and regulating times of operation and power of stations. He was ready to renounce the absolute control of broadcasting. ■

✓ Reader Service—see page 130

Stan Gibilisco W1GV
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The Skeptic's Multiband Ground Plane

—This antenna flies in the face of accepted theory. Do you think it will work?

The idea of feeding a vertical antenna—more specifically, a ground-plane antenna—with balanced transmission line is not new. Balanced, open-wire line lends itself well to multiband antenna applications because of its low loss in comparison with prefabricated coaxial lines. The transmission line used with the antenna described here is designed to have the least possible attenuation within reasonable limits.

How can balanced line possibly work well with an unbalanced antenna? Won't there be radiation from the line, and won't this cause horrible TVI and other problems? Well, since hams have been using unbalanced line (coaxial cable) to feed balanced antennas (dipoles and beams) for a long time and it has been shown that this is a perfectly satisfactory practice, one might be inclined to ask whether the situation should be any different the other way around. In the case of the antenna at W1GV/4, balanced line is being used with success to feed a ground-plane antenna.

Let's take a look at some of the theoretical considerations of balanced transmission lines and antennas before I describe a multiband ground-plane antenna without coils or traps that has proved very effective.

Parallel-Wire Line

In the old days of radio, the type of transmission line most often used was of the open-wire variety. The reason this kind of line works is that at every point along the line the currents in the two wires are always equal in magnitude and opposite in direction. Since the two wires are very close together with respect to the wavelength, they may be considered to occupy the same space. The field produced by one wire therefore cancels that produced by the other wire, and no radiation takes place.

For the currents in the two wires to be exactly equal and opposite, the antenna must have certain characteristics. If one side of the antenna presents a different impedance than the other, the currents in the two feedline wires will not be exactly equal or exactly out of phase. This may occur because one side of the antenna is longer than the other, or because one side of the antenna presents a different capacitance with respect to ground. See (a) and (b) in Fig. 6.

There is a third reason for radiation from a parallel-wire line: antenna currents. If one side of the antenna is closer to the line than the other side, the electromagnetic fields from the two halves of the antenna will not cancel each other in the vicinity of the line. This will induce a current in the line equal in magnitude in both wires but in the *same*

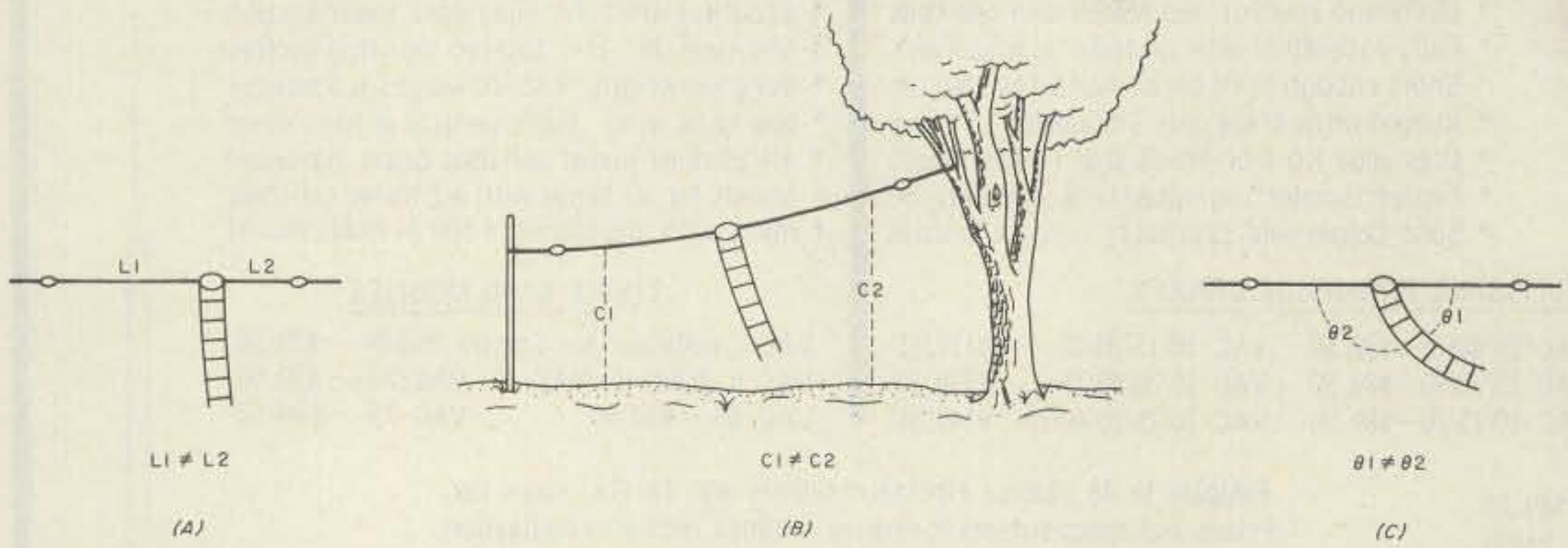

Fig. 1. Causes of feedline radiation. At A, antenna not fed at center; at B, one side of antenna closer to ground or obstructions; at C, feedline brought away from antenna in a non-symmetrical position. These factors can cause radiation from coaxial as well as parallel-wire lines. A perfectly balanced system is, fortunately, not usually necessary for satisfactory antenna performance.

direction (C in Fig. 1). Consequently, the line radiates because this current produces its own electromagnetic field. These antenna currents cause the net current flow in the two wires not to be equal and opposite, and this can result in trouble with an all-too-familiar gremlin for hams: rf in the shack!

Usually, a small amount of radiation from a transmission line is not a great handicap. This is fortunate because it is almost unavoidable. We certainly would want to minimize line radiation if we were using a highly directional antenna where front-to-back ratio is important. But with a simple antenna such as a dipole or ground plane, we need not worry about some deviation from theoretical perfection.

Coaxial Line

Many hams got it into their heads that coaxial line is shielded and therefore cannot radiate. This is not the case! Coaxial lines are just as susceptible to radiation-causing factors as parallel-wire lines. Antenna currents, induced in the outer conductor of coax, will produce electromagnetic fields and rf in the shack. These currents can be caused by any of the three situations shown in (a), (b), and (c) in Fig. 1.

Coaxial line has the advantage of being easy to install. It can be run close to or directly over metal objects such as gutters and pipes, and its attenuation characteristics and impedance will not be affected. This is not true with parallel-wire line. Metal objects very close to the latter type of line will cause "impedance bumps" and possible imbalance.

The main disadvantage of coaxial line is that it has relatively high attenuation. The swr becomes important at high frequencies or with long runs of line. Generally, the antenna must, impedance-wise, be fairly well matched to the line if coax is to be used with maximum success. Any time the swr is 2:1 or better, the line will function at essentially full efficiency. But an swr of, say, 20:1 will almost always cause significant signal loss. Furthermore, such a severe mismatch can cause conductor or dielectric breakdown because of extreme currents and voltages at nodes along the line.

A heavy-duty, balanced transmission line such as is used at W1GV/4 can be operated at amateur power levels with utter disregard for the swr. Thus, all the matching can be done conveniently at the operating position by means of a transmatch.

The Ground Plane

A full-size ground-plane antenna consists of a quarter-wave vertical radiator and several quarter-wave radials (usually three or four), and the base is at least a quarter wavelength above the ground. Such an antenna exhibits excellent low-angle radiation characteristics and consequently is good for DX work. It is less effective for local communication where the angle of radiation must usually be nearly 90 degrees with respect to the horizon. However, the low-angle reputation of vertical antennas has been somewhat overemphasized. Even at a radiation angle of 45 degrees the field strength is nearly as great as it is parallel to the horizon—see Fig. 2. The ground plane is an uncomplicated and versatile antenna.

As the base is lowered to heights of less than 1/4 wavelength above ground, losses begin to occur because the *ground currents,* which should be confined to the radial system, will begin to flow in the lossy earth. Three radials comprise a nearly perfect

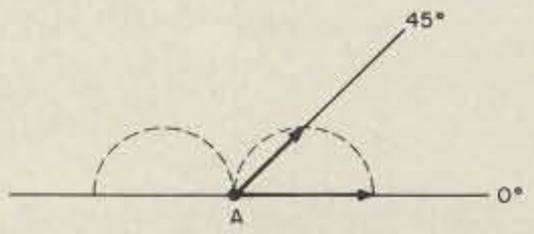

Fig. 2. Vertical-plane radiation pattern for a quarter-wave ground-plane antenna. Although it is generally thought that such an antenna radiates only at very low angles, we can see that it radiates quite a lot of energy at high angles. Only near the zenith is the radiation level very low.

ground if the base is sufficiently elevated. At a height of 1/8 wavelength, some of the ground currents will flow in the earth unless radials are added. The closer the base gets to the ground, the more radials are necessary.

Suppose we tune a full-size, 20-meter ground plane by means of loading coils so that its resonant frequency becomes 7 MHz. If the antenna was 1/4 wavelength above the ground on 20 meters, it will be 1/8 wavelength above the ground on 40 meters. The radial system will not be as good at the lower frequency because of the lower height. Also, the radials are not 1/4-wavelength long on 40. Although they are an *electrical* quarter wave in length, their *physical* length is just 1/8 wavelength. This fact, too, will cause more of the ground currents to flow in the soil. But suppose it is impractical to make the radials any longer; how are we to improve the efficiency without raising the antenna?

The answer is, of course, to add radials. More radials will be required if their physical length is 1/8 wavelength than would be necessary at the same height with 1/4-wavelength radials. I did not try to mathematically figure out how many radials I would need. I just decided, arbitrarily, that eight would be a good number.

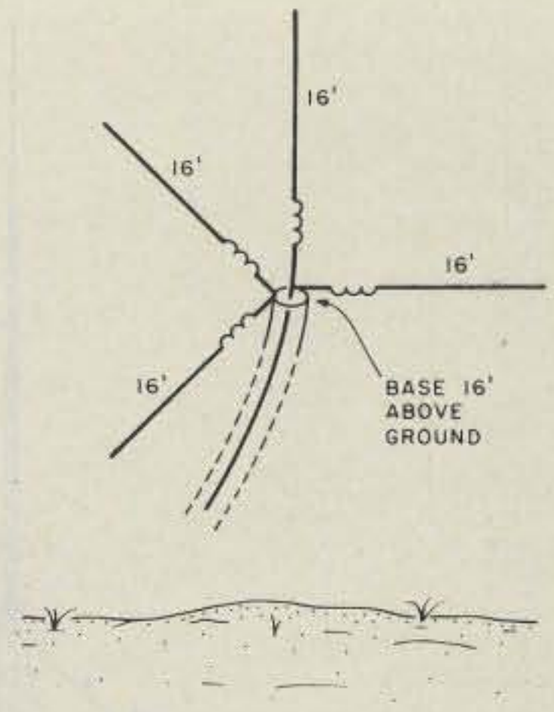

Fig. 3. Inductive loading of a 20-meter ground plane for use on 40 meters. Because of the lower electrical height and radial length, ground currents are no longer confined to the radial system. To restore a good image plane, we must either raise the antenna or add radials.

But maybe I'm getting ahead of myself. The loading system I used did not require any coil winding; this would have restricted me to 40 meters, anyhow. I wanted a 40-through-10 system without any traps or coils or stubs or multiple radiators. The mission was accomplished simply by feeding a 20-meter ground plane with open-wire line.

The Feed System

The actual installation is roughly illustrated in Fig. 4. The antenna acts as a full-size, quarter-wave ground plane on 20 meters. On 15 and 10 meters there is some gain at low radiation angles and correspondingly less radiation at higher angles. This works out very nicely since only low-angle radiation will be returned to Earth by the ionosphere on these bands; the skip distance is usually so long that high-angle radiation will pass through into space.

On 40 meters, the antenna is the equivalent of that shown in Fig. 3, except that there are eight radials rather than three. The radiation resistance at the feedpoint is very low on 40, so it is im-

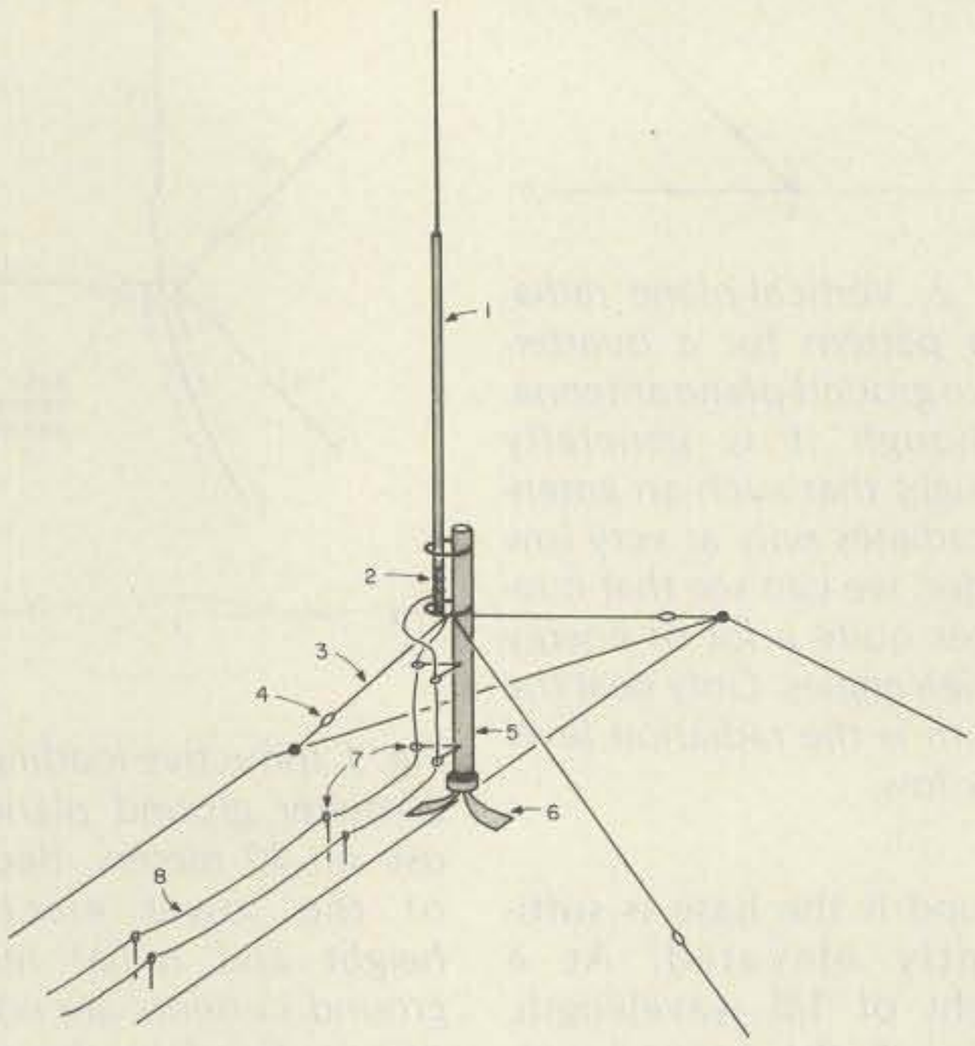

Fig. 4. The system at W1GV/4. Only three radials are shown, but there are actually eight. A feeder-wire spacing of 5 inches is maintained. (The viewing angle may give the impression that they are unevenly spaced.) Illustrated by number: 1—16-foot vertical radiator; 2—hose clamps attaching feeder to vertical radiator; 3—radial wire, 16 feet long, no. 8 solid aluminum ground wire; 4—strain insulator; 5—mast, 5 feet long; 6—TV base plate; 7—TV standoff insulator; 8—feeder wire, #8 solid aluminum ground wire.

portant that the connections between the feedline and the antenna be excellent. The feedline is constructed of #8 soft-drawn aluminum TV ground wire, which can be found in most hardware stores. The spacing used at W1GV/4 is five inches, but any spacing between three and six inches is satisfactory. Since the dielectric is air and the wire is very heavy, this line has just about the least attenuation possible. All connections are aluminum-to-aluminum, avoiding any corrosion problems that might result from contact between dissimilar metals. (Perhaps immersing the entire system in liquid helium would reduce the attenuation still further!)

The antenna itself is unbalanced; the current is different in the radial system than in the vertical radiator. This is true on all bands. Furthermore, the antenna is non-symmetrical with respect to the transmission line, and some feeder radiation is thus inevitable. It should be noted, though, that coaxial line also will suffer from the non-symmetry of the ground plane.

This non-immunity of coax to radiation-causing effects has already been discussed. How much difference, if any, is there in practice? This was determined by means of a field-strength meter. Originally the system was a coax-fed 20-meter monoband antenna. Tests were conducted at various locations in the vicinity of the feedline on 20 meters both before and after the changeover to balanced line. There is a little bit more radiation from the open wire, but the difference is hardly noticeable. Radiation levels in the shack are the same with both types of line (at the same power level, of course).

On 40 meters, the antenna is "tuned" by the feed system rather than by coils as in Fig. 3 (The 1/8-wavelength section of line closest to the antenna has replaced the inductors.) On 15 meters, the feedline also "tunes" the antenna. On 10 meters, the feedline has no actual tuning effect; the antenna is theoretically voltage-fed on this band.

We can be pretty sure that the swr is very high on all bands. But the line has such low attenuation that the swr is of no practical concern. We haven't even paid any attention to the characteristic impedance (Z_0) of the line! It is probably about 500 Ohms. Assuming the feedpoint impedance is 40 Ohms resistive on 20 meters, the swr is about 12:1 on this band. It is no doubt quite high on 15 and 40 meters also, because of the reactance at the feedpoint on these bands. On 10 meters, the feedpoint presents a pure resistance, but its value is difficult to predict. There is a possibility that the line is nearly flat on 10. But it doesn't really matter.

Construction Details

In order to minimize losses, every effort was made to ensure that there are no electrically "weak" points in this antenna system. The feedline spacing is five inches; long TV stand-off insulators are used to support each wire individually at 10-foot intervals. The wire is wrapped with electrical tape until it fits tightly in the large opening in the plastic part of the stand-off insulator. No splices should be made in the line; soft-drawn no. 8 aluminum wire is usually available in lengths that are any multiples of 50 feet.

The wires should be positioned so that they do not come within five or six inches of metal objects. If the wires must be run parallel and close to a metal pipe or downspout, both wires should be kept at the same distance from the object. If the feedline must cross over such an obstruction, it should cross at a right angle. These precautions minimize chances of imbalance.

The connections at the antenna are made in such a way that the primary electrical contact is aluminum-to-aluminum. One feeder wire is clamped directly onto the vertical radiator at the base, using three hose clamps spaced one inch apart. The other wire is connected to the aluminum base mount, using the nut on one side of the lower U-bolt holding the base mount to the mast. (The base mount at W1GV/4 comes from a 14AVQ that has been mutilated from experimentation.)

The eight radials, each 16-feet long, also are made of #8 aluminum ground wire. The radials double as guy wires; strain insulators are used to obtain the correct lengths for radial purposes. The mast is five feet tall. This, in additon to the height of the house, puts the base about 16 feet above the ground.

It should not be necessary to go into much more construction detail. The builder can put the antenna together to suit particular needs and passions. The radials should be the same length as the vertical radiator, but 16 feet is not a magic length. Actually, the longer the better. However, any length over about 18 feet will raise the radiation angle on 10 meters; lengths greater than 25 feet also will raise the radiation angle on 15 meters. This may or may not matter, depending on band preferences.

The length can also be less than 16 feet. However, as the length is shortened from this value, the radiation resistance will decrease markedly on 40 meters and will rapidly become so small that losses will occur no matter how

hard we try to prevent them. I can't tell you an exact minimum length because there is no real cutoff. You'll probably be able to make some contacts on 40 even if the length is four feet, but if you opt for this size antenna, you can rest assured that it will not be very efficient.

Performance

As of this writing, the antenna described here has been in use at W1GV/4 for about four weeks. Many contacts have been made, both long and short haul. Several thick DX pileups were cracked on the first or second attempt. Europe and Japan have been worked on 40 meters, where the antenna is half-size. Since it is a vertical antenna, we should expect that the low-angle radiation will be good even on 40 meters, so this is not too surprising. The antenna seems to work exceptionally well on 10 meters; including the image, it acts as a vertical 2-element collinear on this band.

Mostly out of curiosity, I decided to try tuning the antenna on 80 meters and found that the transmatch did provide about 1.5:1 match at 3.5 MHz. The tuning was quite sharp, and I was indeed surprised to work a midwestern station and get a report of 589! Several other midwestern and northeastern stations have been worked on 80 with good reports. (Even so, I really can't believe that this antenna is very efficient at that frequency.) The antenna was designed with 40 through 10 in mind. Performance has been eminently satisfactory considering the unobtrusiveness, small expense, and simplicity of the open-wire-fed ground plane. ■

✓ Reader Service—see page 130

Clyde B. Lee W4NK
117 Woodmore Ave.
Louisville KY 40214

Dish It Out

—home-brewing a parabolic reflector, with the focus on cost

Some months ago, I began searching for a parabolic reflector to augment some gear for the reception of GOES weather satellite transmissions on 1691 MHz. A reflector on the order of 6 to 8 feet in diameter seemed like a good compromise, so the search went on . . . and on. After looking over some "finds" that several more fortunate hams had made, I began to realize that if you did locate a dish this size, you'd better have a fat wallet and a strong back.

Luckily, I happened upon an article by Norm Foot WA9HUV, in a May, 1975, issue of *Ham Radio* on open-grid parabolic reflectors.[1] This excellent article, along with some others (references 2, 3, and 4), and suggestions and formulae from Roy Cawthon who has had numerous articles in *73* regarding weather satellite pictures during the past several years, started me on this project. I'm grateful to both sources. You won't find any theory here—no proof of performance curves, etc. This is more in the nature of a nuts and bolts kind of article to encourage you along the same route. I can assure you that with a generous amount of diligence and average amount of dexterity (and little over $100 at this date), you'll have a good parabolic reflector. See Photo A.

Photo A. 8-ft. parabolic reflector. Elements are 5/8" aluminum tubing spaced 3". Reflective surface is reinforced with ¼" hardware cloth. The cylindrical horn is a 2-lb. coffee can with probe.

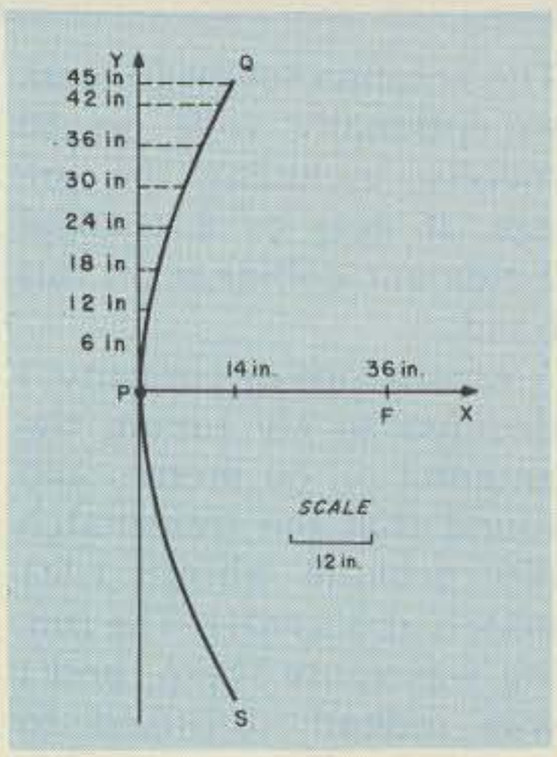

Fig. 1. Parabolic curve generated using $x = y^2/144$. Results are shown in Table 1.

A word about materials: This reflector is 2.3m (7½') in diameter. 8-foot lengths of 5/8" o.d. aluminum tubing (.049" wall thickness) were used. The tubing is the type found in hardware store do-it-yourself displays, a type that is easily bent and remains so after being bent. More rigid material, 5/8" electrical conduit, was used for the two main supporting members to which the elements are attached.

An F/D (focal length to diameter) ratio of 0.4 had been recommended as opti-

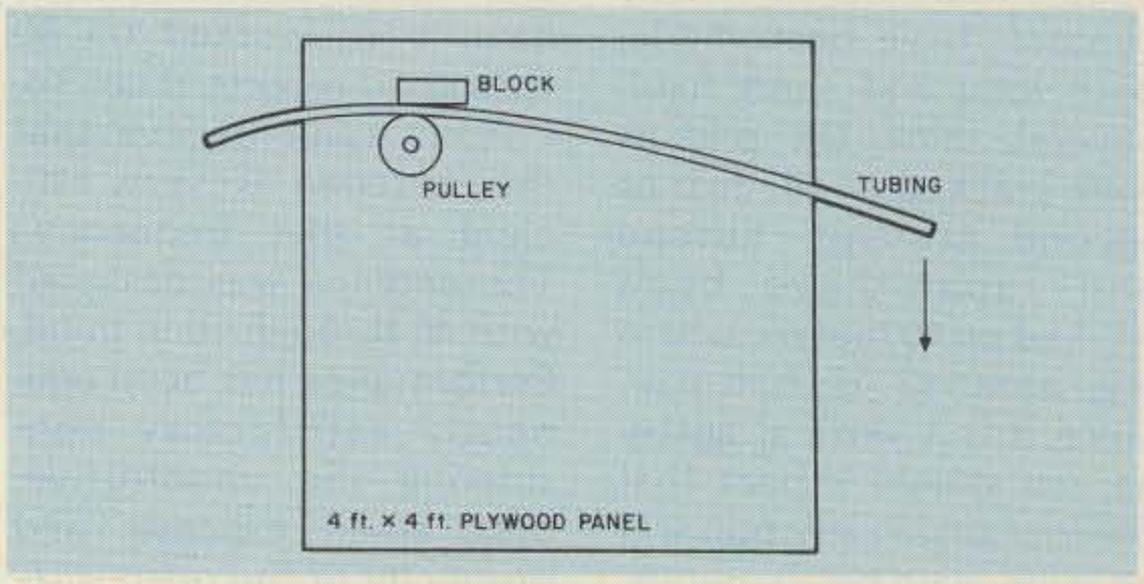

Fig. 2. Tube bending jig.

mum to facilitate illumination of the parabolic reflector. Following this, I chose a focal length of 36" and a diameter of 90". Element spacing is 3" on center (close to the 0.439 wave figure for 1-dB loss in Mr. Foot's data). To get at the business of element cutting (and use tubing cutters, by all means!), Fig. 1, Table 1, and the relations shown in the Math Box were used.

Element lengths, together with number required, are shown in Table 2.

Reflector Construction

A template will be needed to check bending and forming of the aluminum elements to fit the parabolic curve. Assigning 36 inches for focal length and solving $x = y^2/144$ produces the results shown in Fig. 1 and Table 1. Nails or screws at the x and y points will define the curve. The principal tool in the project is a tubing bending jig—that is homemade, too. I used a 4′ × 4′ sheet of 1/2-inch plywood and mounted a 5-inch pulley and hardwood block according to the scheme shown in Fig. 2.

Mark the center of each of the elements. Slip the end in between the block and pulley, advancing the tubing in small bites and gentle bends. The pulley will aid in keeping the tubing parallel to the plywood surface. After just a few bends (even on the very first element), you'll get the feel of it.

I began with one of the longer (95") elements, fashioning it to the parabolic curve, then using it for a pattern for the remaining elements. After all the aluminum elements are formed, proceed to the two conduit supporting members. These will require a little more "tug," but you'll be a pro by that time.

The two supporting pieces (conduit) now are ready to be marked for drilling. An easy way to mark the center line is to make a scribe, using a wooden block and finishing nail. Drill a pilot hole in the block at half the tubing o.d., then insert the finishing nail. Place the conduit member on a level surface (the bending jig) and scribe the center line. Starting at the center of the conduit piece and working toward each end, mark off 3-inch intervals. Punch and drill these intersections with the center line, using a 7/64" bit. Drill through just the front wall. A 9/64" bit will be needed for the aluminum elements.

x	y
¼	6
1	12
2¼	18
4	24
6¼	30
9	36
12¼	42
14	45

Table 1. Curve coordinate dimensions (inches).

Number 6, 1-inch zinc chromate tapping screws (pan head) are used to fasten the aluminum elements to the conduit supports. Begin with the 32-inch end elements. Measure in 4 inches from each end of the 32-inch elements and using the 9/64" bit, drill through the elements. Attach the elements to the conduit supports, squaring up the assembly. From now on it's just a matter of centering each element on the frame, marking and drilling the elements, and attaching them with tapping screws. (A pair of sawhorses can be used to hold the frame, making the job easier on the back.) After all elements are in place, the conduit supports are prevented from sagging by inserting small "S" hooks in each end and connecting these with supporting lines of number 18 galvanized wire.

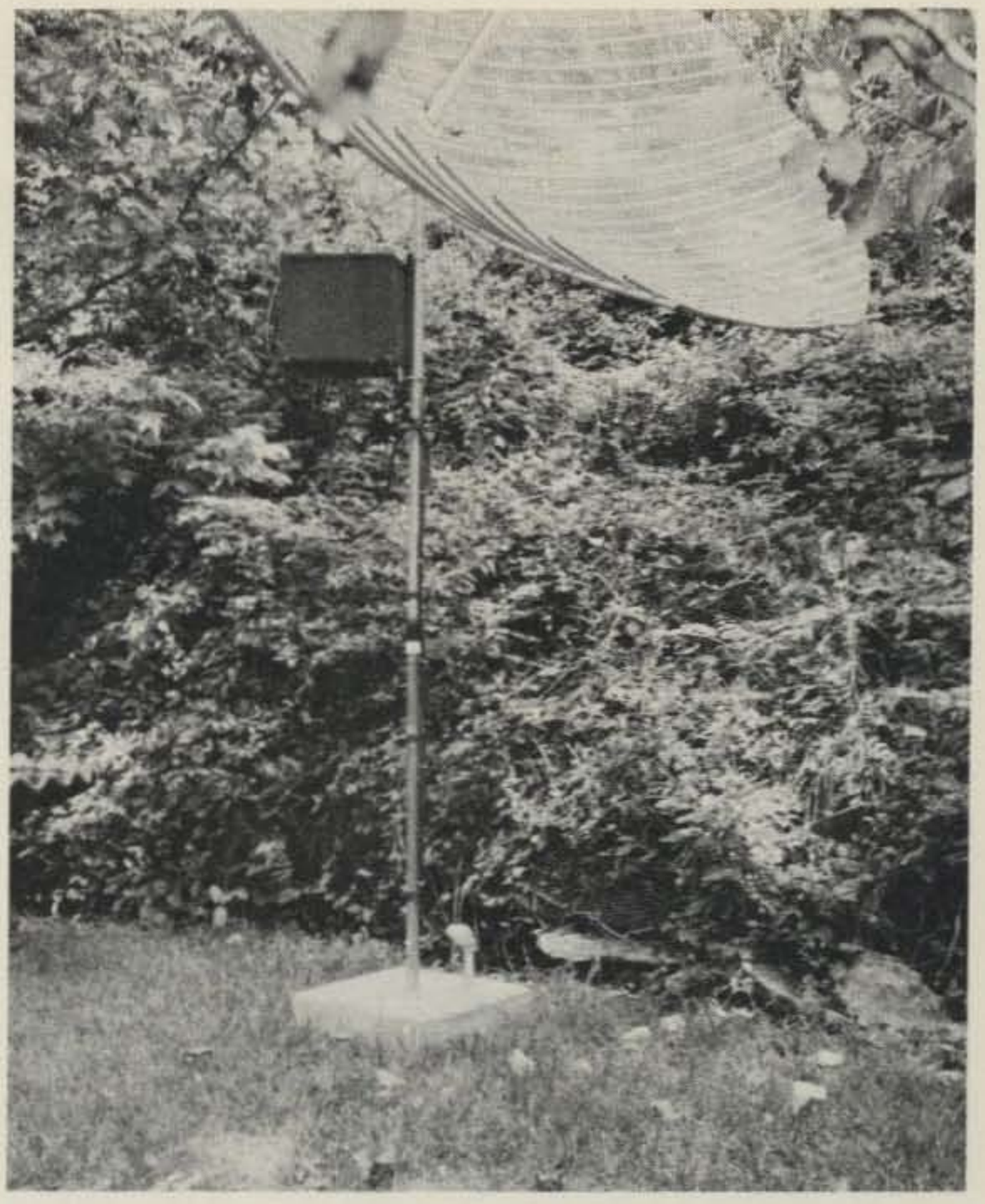

Photo B. Pedestal mount.

Boom Construction

A 26-inch length of 2 × 4 (treated with several coats of redwood preservative stain) is used for the top member of the boom. The assembled reflector is centered on the boom and attached with U-brackets and brass screws, using two brackets for each conduit support. See Fig. 3.

Install a 1-inch floor flange at the center of the boom to accept the cylin-

2 each (lengths rounded to nearest inch)

32	84
46	87
55	90
63	92
69	93
78	95
80	95

1 central section, extending to 96 inches, to be made of two 46-inch lengths installed on either side of a 1-inch floor flange centered on the boom. (27 lengths of tubing should do it.)

Table 2. Element lengths and number required.

Math Box

1) $r^2 = x^2 + y^2$—for sides and hypotenuse of right triangle.
2) $y^2 = 4Fx$—parabola at origin.
3) Arc QPS $= \sqrt{4x^2 + y^2} + \frac{y^2}{2x} (\log_e) \frac{2x + \sqrt{4x^2 + y^2}}{y} -$

length of arc of parabola.

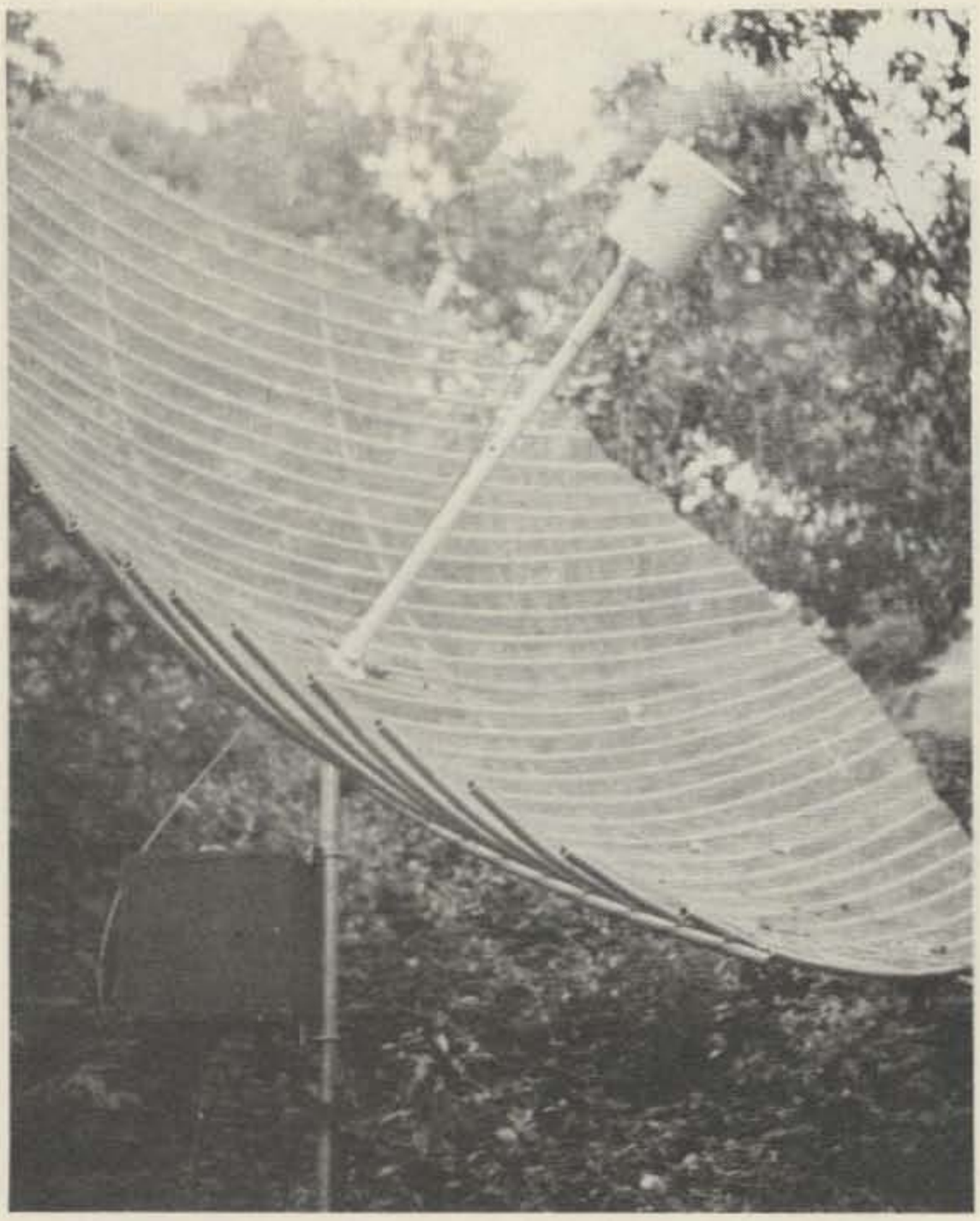

Photo C. Downconverter housing mounted on mast.

drical horn assembly. The horn support is made of 1-inch PVC (plastic) pipe. Cut a 24-inch piece of pipe and install a 1-inch male adapter at one end, using PVC cement. Cut a 12-inch length of 1-inch dowel rod, give it several coats of redwood stain, and install it in the open end of the PVC pipe section so that about 8 inches of dowel extends from the pipe. Attach this assembly to the floor flange.

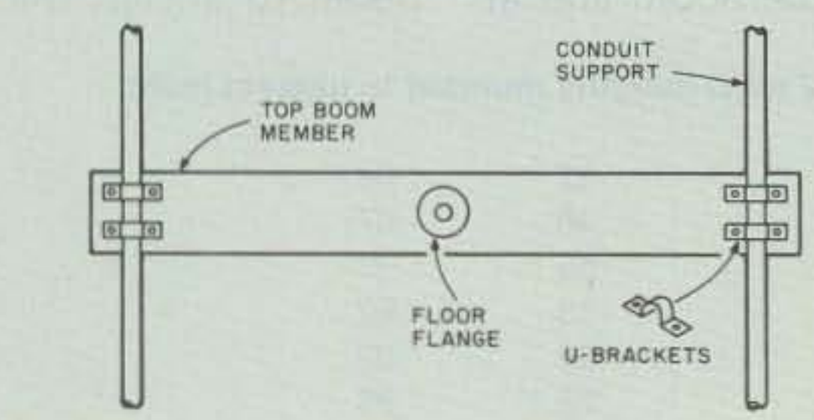

Fig. 3. Boom construction details.

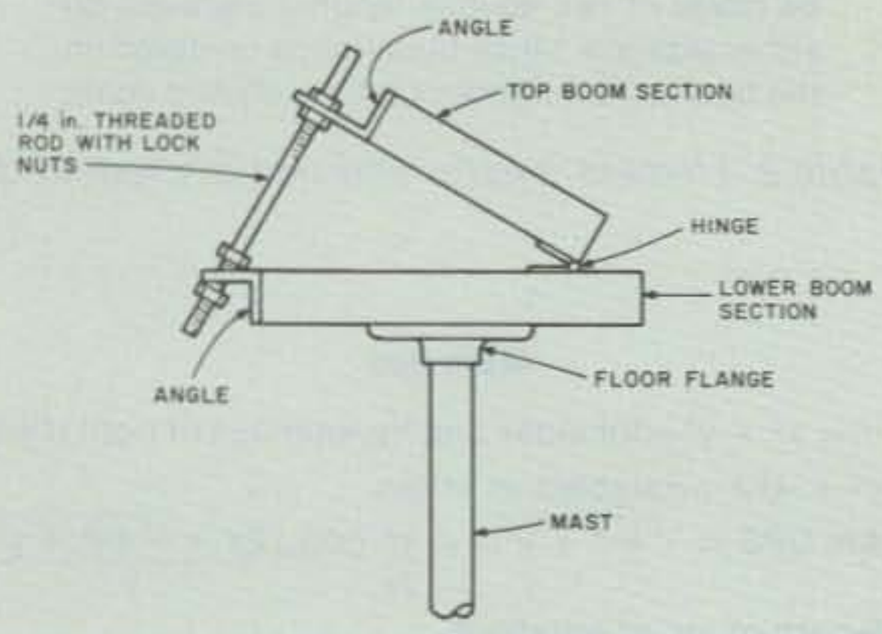

Fig. 4. Elevation adjustment details.

Elevation adjustment is provided by two pieces of 2-inch aluminum angle, 2 inches long, coupled by a 6-inch length of 1/4-inch threaded rod. See Figure 4. The lower boom section is a 26-inch length of 2×6 (treat with perservative stain). Another 1-inch floor flange is fastened to the bottom center of this member (use brass screws). The two boom sections are joined by 3-inch brass butt hinges. Attach the elevation control assembly as shown.

The completed parabolic (open-grid) reflector should weigh about 40 pounds. In order to thread it onto the mast, I inserted a 1/4-inch lag screw about 4 inches long into the center of the lower floor flange. This "pins" the assembly to the mast, making assembly a lot easier.

Pedestal

Posthole diggers were used to a depth of about 2 feet, then a form for the pedestal 18 inches square by 6 inches deep was constructed. A 10-foot length of 1-inch galvanized pipe, along with a section of 1-inch conduit (containing RG-8/U and 24 V ac lines) was set in the form. The block was poured, using several bags of ready mix. See Photo B.

Cylindrical Horn

The horn was constructed according to Taggart's article.[5] Using 3/8-inch Plexiglas™, a disk is cut to fit the open end of the 2-lb. coffee can (about 5.9 inches). Using an expansion bit, cut a hole in the center of the disk large enough to accept a 1-inch male PVC adapter. Cut a 1-inch PVC union into two parts. Install a 1-inch male adapter at one end of a 10-inch section of 1-inch PVC pipe. Insert this into the disk and snug it up with the piece of union just cut. Install the disk in the open end of the coffee can, drilling and tapping the Plexiglas disk for six 4-40 screws.

Downconverter Housing

A weatherproof box (11"×12"×15") of 1/2-inch outdoor plywood houses a MicroComm RX1691 downconverter. The box was treated with preservative stain and caulked with a generous amount of clear silicone seal. Actually, it's a box within a box, the converter being further enclosed by sections of 1-inch thick styrofoam. A regulated 12-volt dc supply shares the housing with the downconverter. See Photo C.

I used the open-grid reflector for several months, getting good results (usually full quieting) on the two GOES satellites I monitored: GOES Central and GOES East. Recently, I covered the reflector, installing sections of 1/4-inch hardware cloth (24-inch width) to the inside of the reflector with loops of number 18 galvanized wire; I'll admit that there has been some slight improvement in performance. I will certainly say that the open-grid performance was well within what one could expect from Mr. Foot's data.

The project looks much more formidable than it really is and the method easily could be extended to the fabrication of larger dishes, say, for TVRO satellite use. ■

References

1. "Open-grid Parabolic Reflectors," Norm Foot WA9HUV, *Ham Radio*, May, 1975.
2. "Cylindrical Feed Horn," Norm Foot WA9HUV, *Ham Radio*, May, 1976.
3. "12-Foot Open-grid Parabola, "Norm Foot WA9HUV, *QST*, June, 1971.
4. "Simple and Efficient Feed for Parabolic Antennas," Vilardi, *QST*, March, 1973.
5. "Be A Weather Genius," Taggart WB8DQT, *73*, November, 1978.

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The Earth Mover

—would you believe that this antenna changes its height above ground without moving?

A few years back I was listening to a W8 station in West Virginia tell about how he put a reflector under his 80-meter dipole and his close-in signal improved so much that he sold his linear. He talked only with amateurs within a couple of hundred miles, and he was very pleased with the results. It greatly reduced interference, too.

Recently, I had an inverted vee 40-meter dipole at 60 feet which was very good into places like Australia and Europe, but which was not really good into the USA up to 1500 miles. Since I had a pair of phased verticals for DX use, I decided to lower the vee to 30 feet and found that it was much better into New Orleans and Florida but only fair into California.

I got to thinking about the West Virginia ham and also remembered that when I used to run Antarctic traffic with K1GZL he had tried what he called "a gadget," which was a reflector under his 20-meter driven element with three elements at 66 feet. We both had been talking to KC4VOS one night and he was shocked to get a report of S-6 when I was 20 over 9. Then he remembered that he still had his reflector up, and he ran out and lowered it. When he came back he also was 20 over 9 in the Russian Antarctic Station at Vostok.

His superb 20-meter, full-size, three-element wire beam thought it was only 20 feet above ground and became a high-angle radiator.

Now, what do you do if you have room for only one antenna and yet want to have both DX and local coverage? The answer is the old half-wave line trick.

A half-wavelength line will repeat the impedance at the load that is present at the source. Thus, if you short a half-wavelength line it will show a short at the opposite end.

Let's take an inverted vee as in Fig 1. The apex is at 60 feet, and this is a good height for DX. Actually, since a half-wave height would be 68′ 4″, that would be best for a low angle, but since your electrical ground may be anywhere from 3 to 10 feet below the surface, 60′ is good economical compromise.

Now let's place a reflector which is 5% longer than the driven element ¼-wavelength below it. This is about 34′. Fig. 2 shows the difference between the radiation angle at 60′ both with and without the reflector.

The length of the coax line should be ½-wavelength multiplied by the velocity factor of the coaxial line. This is .66 for polyethylene line. Thus, the length of a half-wave line at 7.2 MHz is 492/7.2 × .66, which is 45′ 1″. If this is not long enough to reach the transceiver, use twice that, or 90′. Forget about the inches since you probably won't be operating exactly at 7.2 MHz most of the time.

Now, at the station end, install a SPST switch, perhaps a toggle, with which to short the line.

Remember that we are talking about a separate line to the reflector and *not* the feedline from the transmitter to the driven element. (See line A in Fig.1; the feedline to the transmitter is at B.)

When you throw the switch closed, the reflector is in operation. When you open the switch, the reflector splits into two 20-meter lengths and has no effect on the antenna at 40 meters. Thus, you have a high-low antenna. Open switch—low angle; closed switch—high angle.

Be sure to run the coax down the tower at right angles to the reflector and

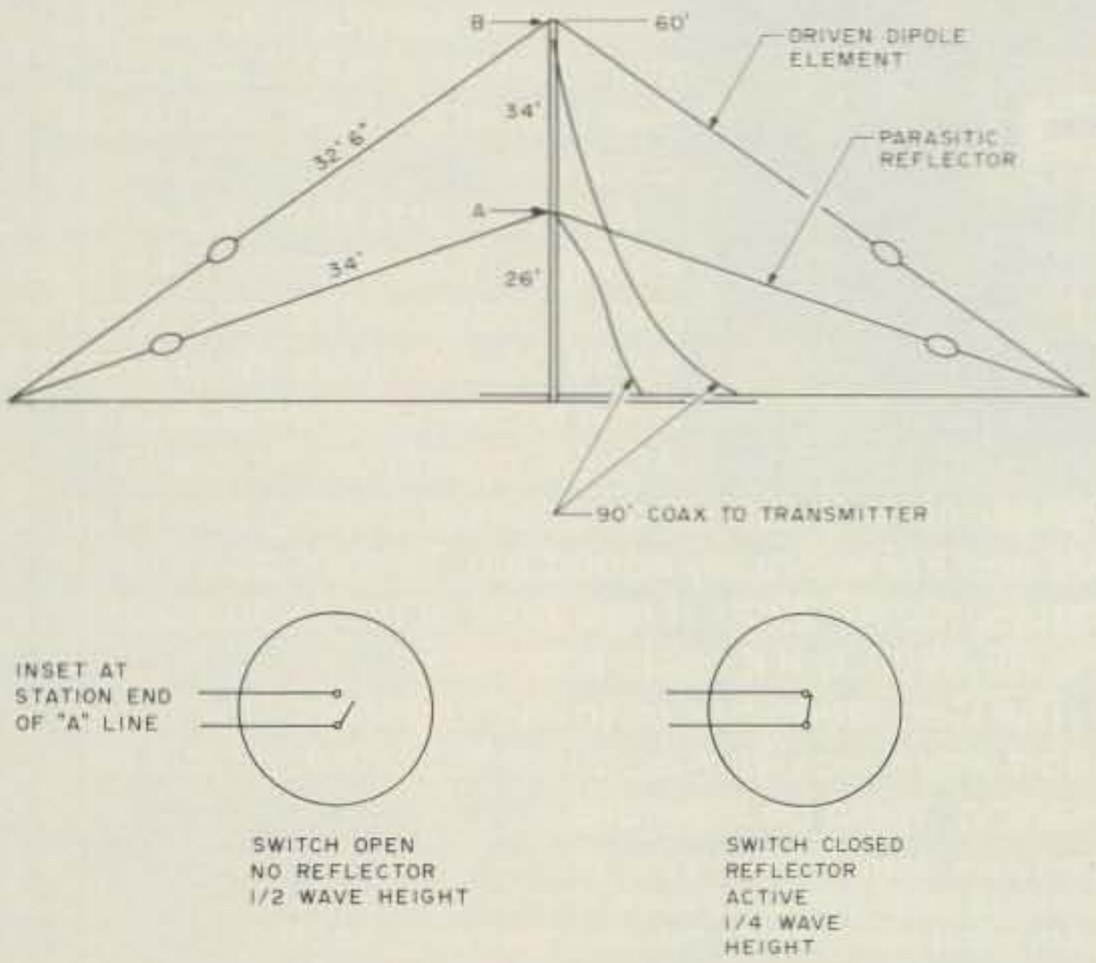

Fig. 1.

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Shown with Rack Mount

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- Power Capability: 2500 W PEP.
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- Power requirements are 115/230 VAC 50-60 Hz, 10 W operating/5 W standby; or 13.5 VDC, 1 A operating/.5 A standby.
- Antenna tuner packaged in cabinet 17"W x 5¼"H x 14"D (Front panel handles or rack mount optional).

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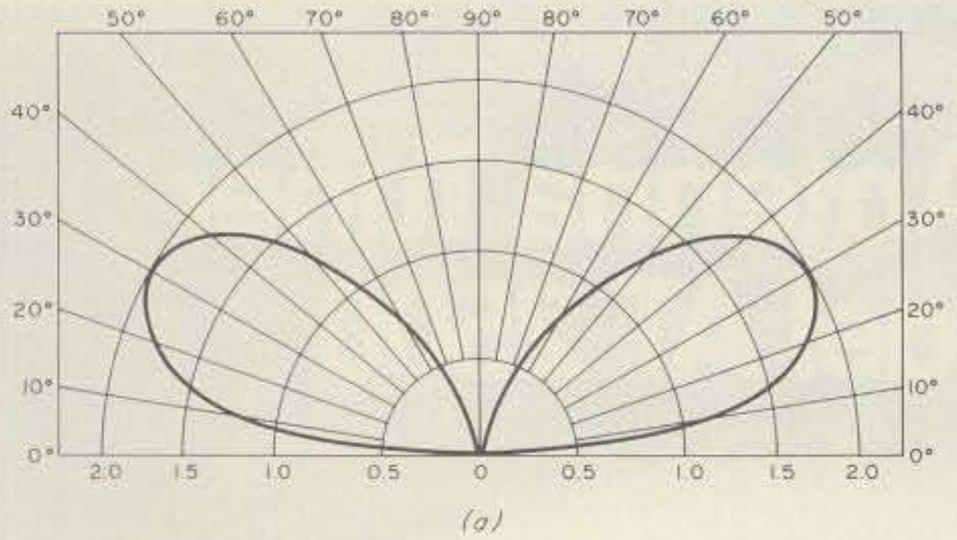
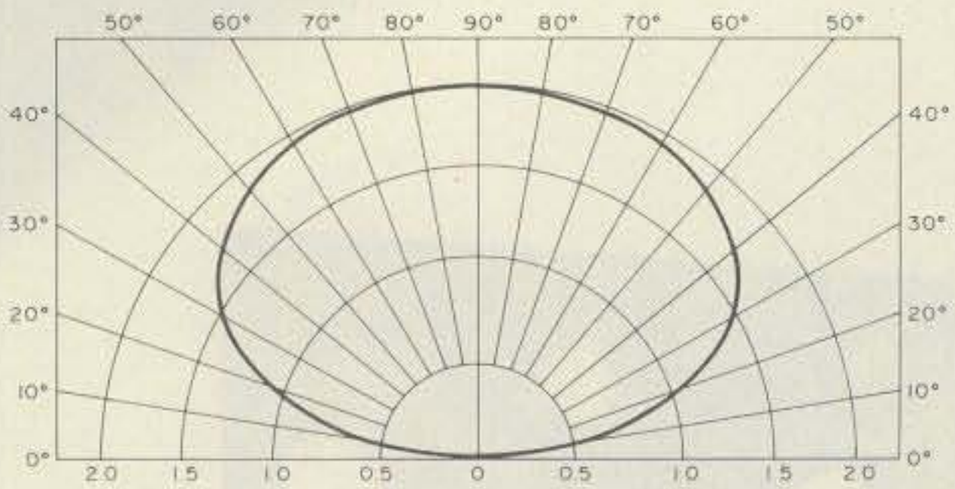
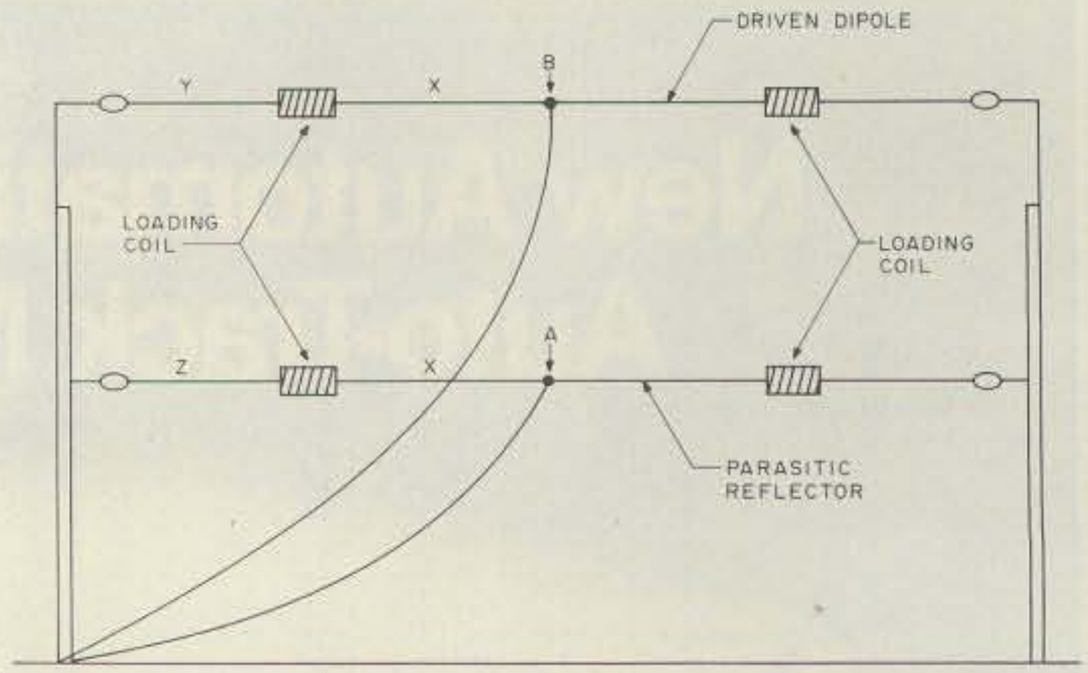


(a)



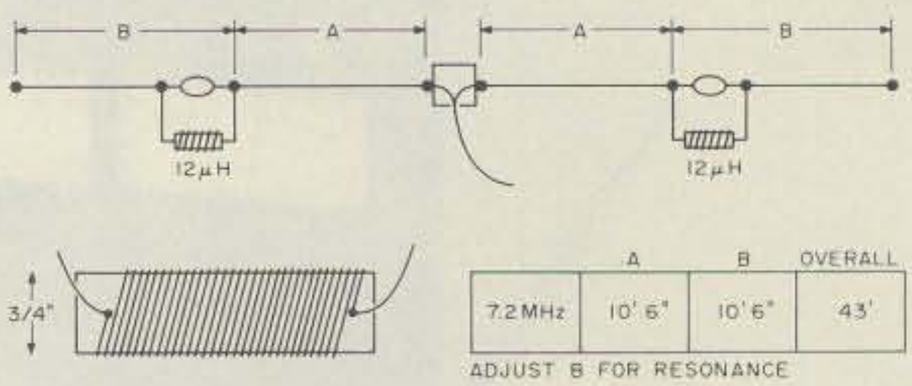
(b)

Fig. 2. (a) The radiation pattern with the reflector ¼-wavelength below the dipole. (b) The pattern of a dipole ½-wavelength above the ground without reflector.



	OVERALL LENGTH	
DIPOLE	43'	X = 10' 6"
REFLECTOR	45'	Y = 10' 6"
		Z = 12'

Fig. 3. All loading coils are identical.



	A	B	OVERALL
7.2 MHz	10' 6"	10' 6"	43'

ADJUST B FOR RESONANCE

Fig. 4. Loading coil construction details. Inductance required is 12 uH. Close-wind 52 turns of #16 enameled wire on a ¾"-diameter plastic form. Windings should be 2¾" long. Hang coil across insulator at distance A from center of antenna as shown.

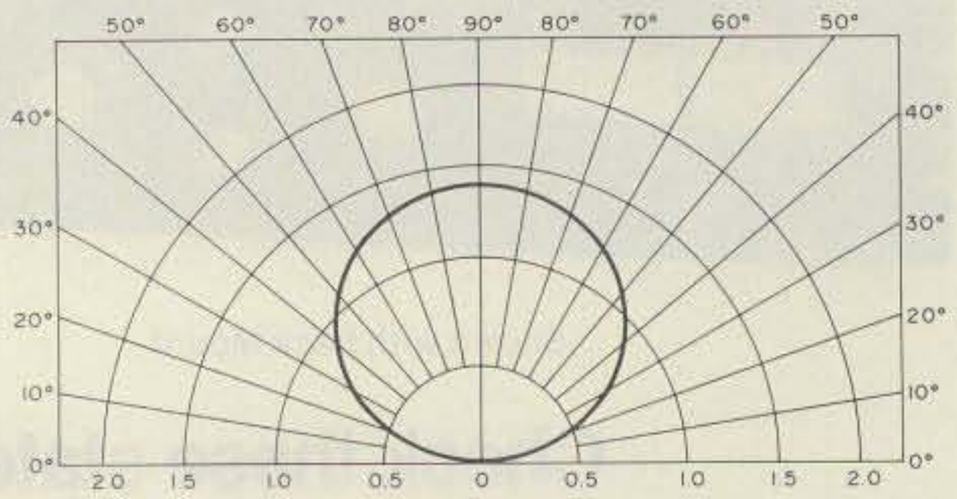


Fig. 5. The radiation pattern with the reflector 1/8-wavelength below the dipole.

antenna to keep them out of the field as much as possible. Running them down inside the tower is the best way.

At this spacing there will be little or no change in the swr since the elements are a quarter-wave apart, and at that distance reflectors have little effect on the impedance of an antenna.

By the way, you can use RG-58 or RG-59 for the switching line to the reflector as there will be little power in the line. When the line is shorted it will take no power, and when the line is open it is detuned and still will take no power worth mentioning. As a matter of fact, you can use even twin-lead as long as you allow for the correct velocity factor of .82 and have a half-wave multiple.

This same principle will work for a flat-top dipole, of course, and will work fine on 75 meters if you have the space and that is your band.

If you are short of space and have two supports, you might try the method shown in Fig. 3. I have two towers 48 feet apart, and this is not room enough for 40-meter dipoles. I want to put up a low pair of 40-meter dipoles using a set of four traps which Bill Pace of Pace-Traps designed for me. Then I will put an 80-meter vee on the tower where the 40-meter vee is now.

Pace-Traps will build a set of coils for you for whatever space you have available. Write them at Box 234, Middlebury CN 06762. They do beautiful work, but if you want to wind your own the information is in Fig. 4, for 40 meters. Be sure to weatherproof them so that snow or rain will not change the inductance. (Pace-Traps are completely enclosed and do not need the external insulator shown in Fig. 4.) They have now added this coil series to their line of traps, for shortened dipoles. My two sets are for 40 meters, 43 feet, and 80 meters, 63 feet.

I expect to have good signals out to about 1000 miles with the 40-meter dipole at 35 feet, and a strong signal out to about 500 miles with the reflector working. This will keep out distant interference when I am working in nearby states, as I do in the daytime.

The reflector will be 17' below the driven dipole—1/8 wave. Even at higher dipole heights the reflector can be 17' below it for even higher angle radiation. Fig. 5 shows the expected radiation pattern.

Some amateurs find that two to five reflectors about one or two feet above the ground below the antenna make a good substitute for a poor ground condition. This would be especially good if you are a local rag chewer on 75 meters. You will not need high power, and will get less QRM for emergency work.

High antennas aren't the answer to all problems. One large manufacturer of commercial equipment says that this is a common mistake of his customers—the use of high antennas for short distance work, such as close-in ship-to-shore operation. ■

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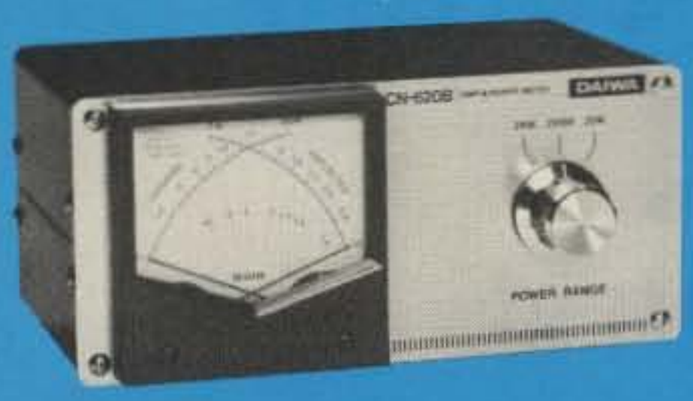

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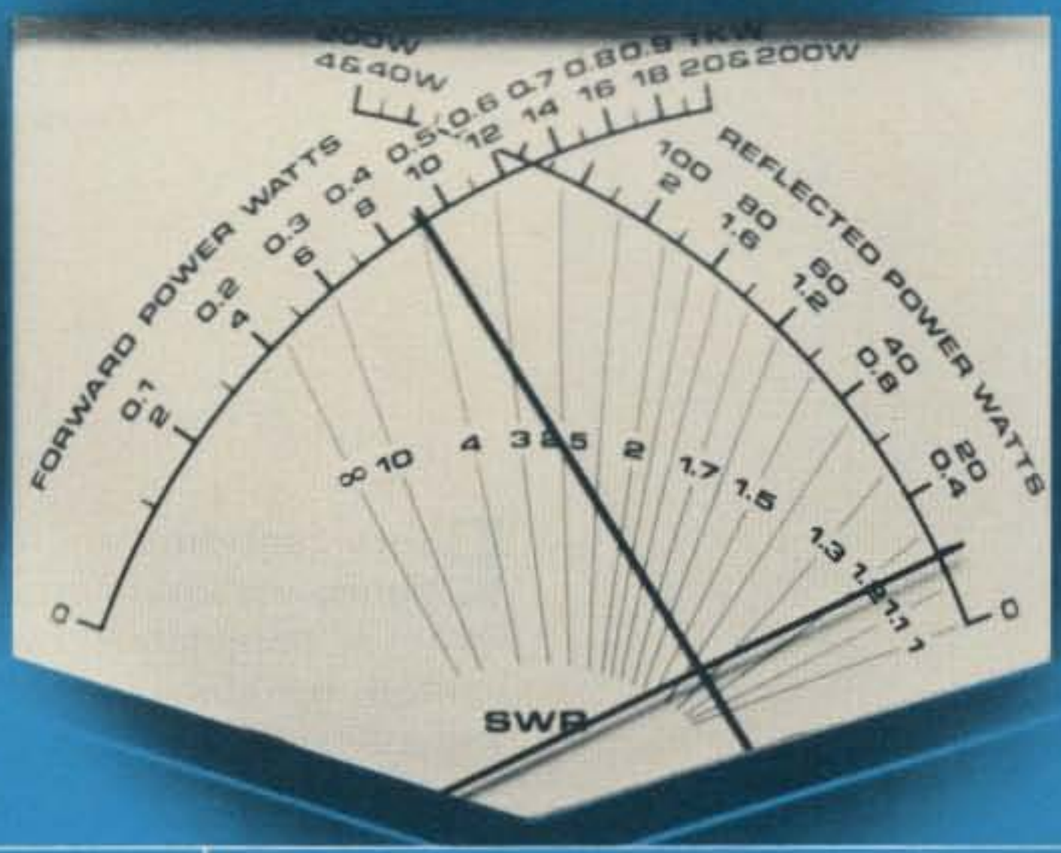

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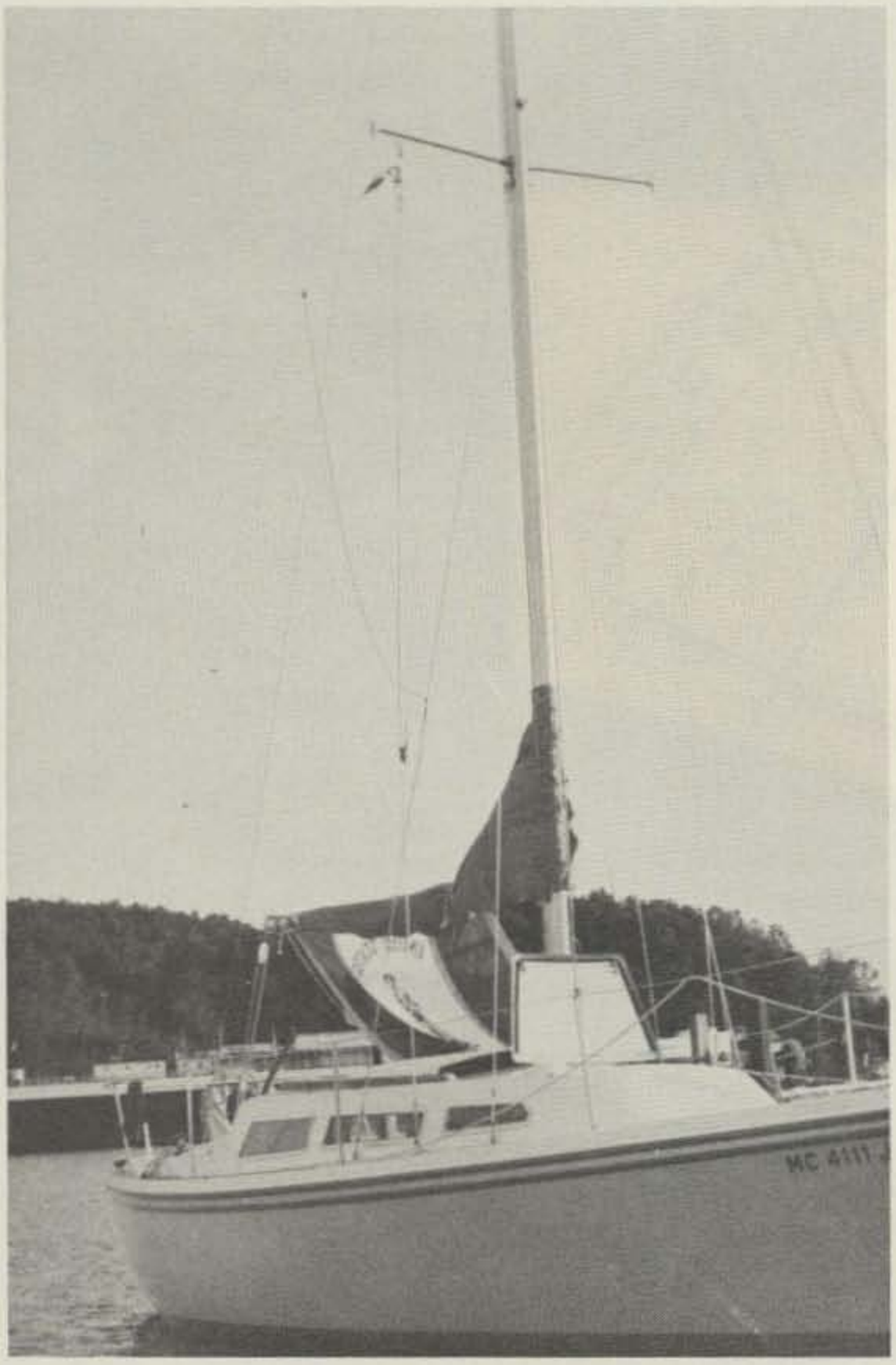

Photo A. The author's sailboat, a 27' Catalina, dockside at Frankfort, Michigan. The sloper dipole is the wire visible on the extreme left side of the picture. The two toggle switches on the lower end of the antenna and the coax feedline are clearly seen. Other wires constitute the rigging of the boat and support the aluminum mast.

Every antenna is designed within a particular set of parameters. I was limited by some specific and inflexible guidelines.

I needed an antenna that was absolutely portable. It had to work on the three most popular DX bands. Finally, its length could not exceed 36 feet.

The antenna was to be primarily used aboard my 27-foot sailboat. It would spend the winter as a back-up antenna at my home QTH but had to be small enough to accompany me, my wife, and a TS-120S transceiver on a winter sailing vacation in the Caribbean.

Since 36 feet seemed very short, I did not consider a longwire antenna. But a half-wave dipole for 20 meters would be approximately 32 feet long. When coiled, such an antenna can be easily stored even with its coax lead attached.

There is only one convenient attachment point with any height on a sailboat—the mast. That made the sloping dipole particularly attractive since only one end had to be raised. The sloping dipole also promised a small gain in signal strength compared to a loaded vertical or short longwire; the criteria favored experimenting with a portable sloper. I wanted to be able to use the antenna on 15 and 10 meters as well as 20. Traps were out of the question because of their bulk. I also wanted to keep the cost of the antenna down.

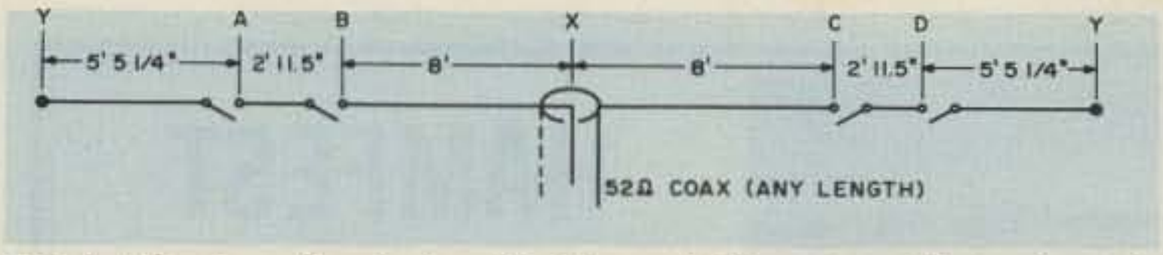

Fig. 1. Sloping dipole for 10, 15, and 20 meters. Using length = 468/f(MHz), total lengths were 16' for 29 MHz, 21' 11" for 21.3 MHz, and 33' 9½" for 14.25 MHz. A, B, C, D are SPST toggle switches. X is a center insulator or balun and Y are end insulators.

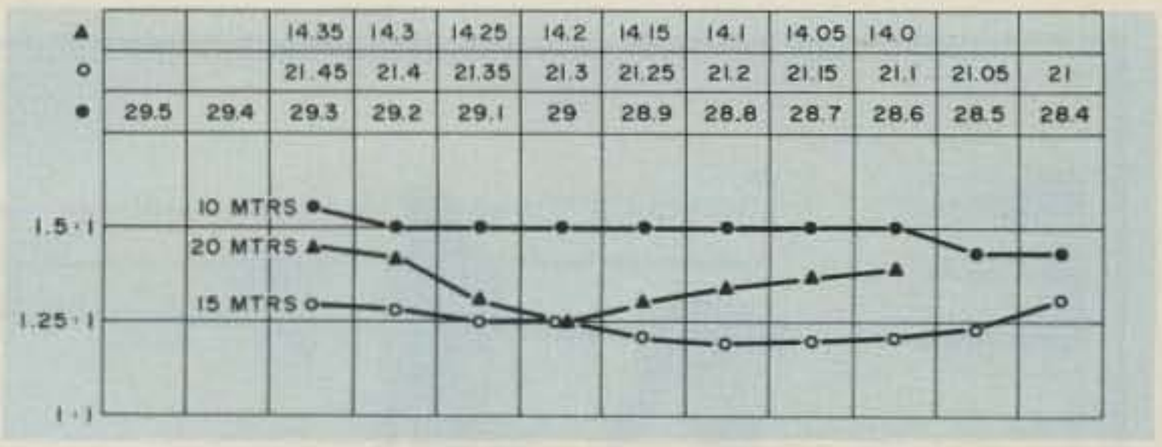

Fig. 2. Swr curves for triband sloper.

Multiband wire antenna designs I had seen described in various books suggested using insulators in the dipole at the required locations and adding clip leads to short across the insulators. In those designs, it is necessary to clip or unclip shorting leads to resonate the antenna on particular frequencies.

I didn't like the idea of using seven insulators; I liked clip leads even less. Since the antenna was to be used in a marine environment, I could predict that rigging or a sail rubbing against any clip leads would either cause the clips to work loose, chafe the sails, or both.

I was still looking for solutions when I wandered through a local Radio Shack store. I browsed through the varieties of toggle and knife switches. A knife switch could work both as an insulator to hold the antenna parts together and as a mechanism to electrically lengthen or shorten the antenna.

But an even smaller, lighter switching arrangement is available if the antenna is built using four toggle switches. The Radio Shack SPST toggle switch (#275-701) features a plastic body and wide brass contacts. I bought four, along with a package of insulators (#270-1518), and started building the sloper that night.

Fig. 1 shows the dimensions I used to build an antenna which resonates in the low end of the DX phone bands. The formula 468/f(MHz) was used to determine the lengths of three dipoles.

Starting with an old ceramic insulator from the junk box and some #14 stranded wire, I cut a 10-meter dipole to length, 8 feet on each side of the insulator. Those who advocate using baluns may find it more convenient to use one in place of the center insulator. Toggle switches were soldered to the ends of the antenna. I calculated the length of a 15-meter dipole, divided by two, and added the second length of wire (another 2' 11.5") to the first set of toggles. A second set of toggle switches was then soldered to the ends of the dipole and the final length of wire added to resonate the antenna on 20 meters (5' 5¼"). Dimensions given are finished dimensions and do not include the additional inches of wire wrapped onto toggles or insulators.

Attach the feedline to the center insulator. I used RG-58/U and I learned, through experience, that there must be strain relief for the coax. Since I reattached my feedline by passing it around the insulator and taping it to itself before soldering, I have had no further trouble. The antenna will *not* load if either side of the coax breaks! In the past, I have used 72-Ohm twinlead for feedline and I am sure that that would work well on this antenna. It would be even lighter than the coax, of course.

The Radio Shack toggles have brass contacts which I bent at 90 degrees to the switch body. There is probably not enough tension to distort them in an antenna this short, but it seemed more aesthetic to keep the contacts in line with the antenna.

Using a VOM, I determined whether the toggles were opened or closed. The Radio Shack switch is large enough to allow space for a label on the side of the toggle body. In the open position, toggles B and C (Fig. 1) act as insulators and the antenna becomes a simple 10-meter dipole. After identifying the open position, I used a soldering pencil to write "10" on the side of the plastic switch housing op-

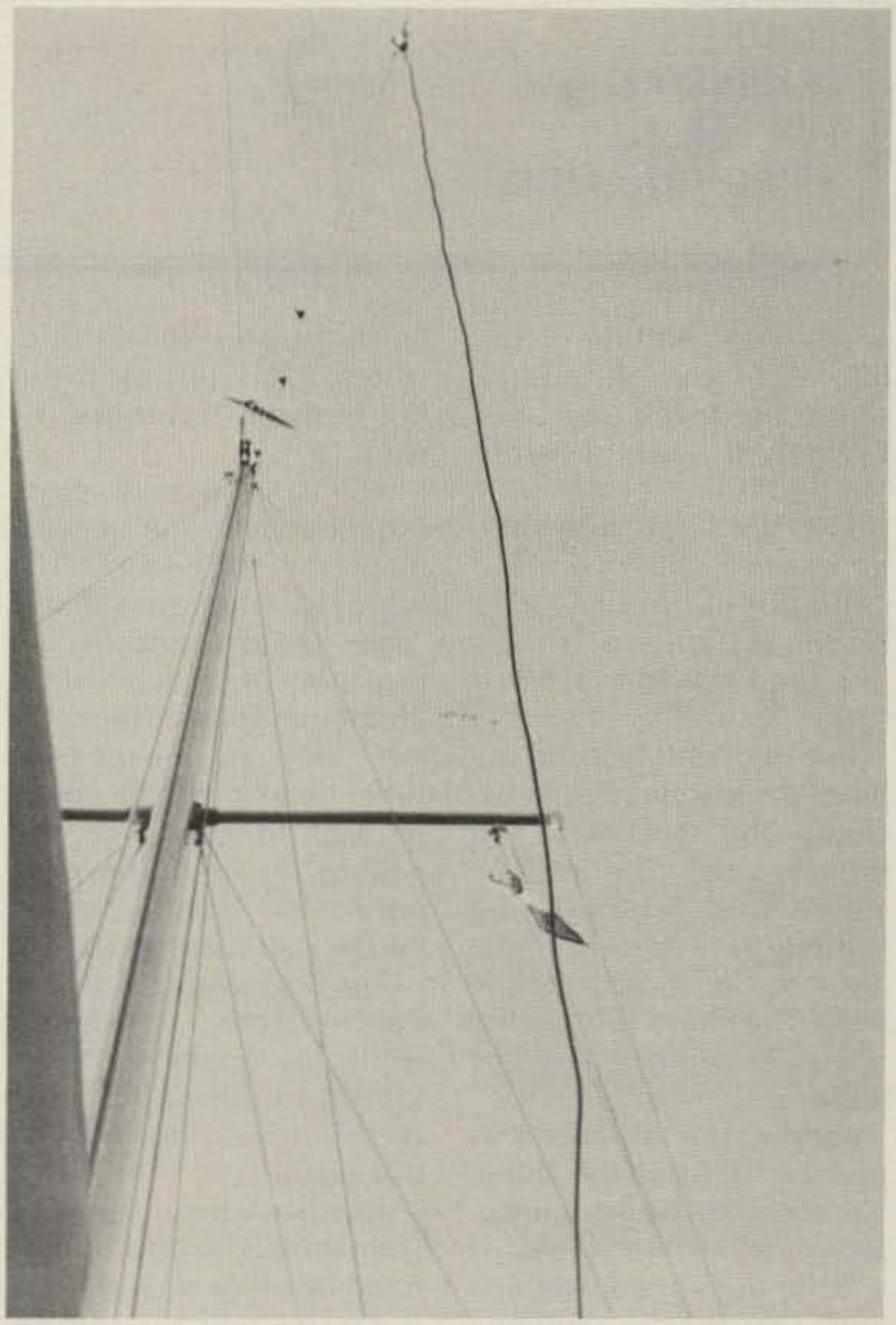

Photo. B. Looking directly overhead from the cockpit of the sailboat, the top half of the antenna from the center insulator to the mast is visible. Two toggle switches can be seen. Other wires are rigging.

posite that position of the toggle. In the closed position, the toggle indicates 15 meters. There I wrote "15".

Use the same procedure to identify the open and closed positions of toggles A and D. Open is labeled "15" and closed is labeled "20".

When operating from my boat, the antenna slopes between the masthead and the stern rail. The angle is steeper than 45 degrees and sometimes I describe the antenna as a vertical dipole. The slope is probably about 30 degrees from the mast.

During fair weather it is possible to leave the antenna erected while sailing. However, when I sail I usually untie the lower end and secure the antenna parallel to the shroud which supports the mast. Most of my operating occurs when at anchor or at dockside. Since I carry the Hustler system, I am still able to put out a signal underway if I want to.

The antenna is quite broadbanded, and in operating from the home QTH it loads without an antenna tuner. On the sailboat, the proximity of rigging and the aluminum mast affects the swr and an inexpensive tuner helps bring the antenna back to resonance. The rigging seems to have no noticeable adverse effect on the radiation pattern.

Fig. 2 is a graph of my swr calculations, computed while the antenna was attached to the 45-foot level of my tower in Okemos, Michigan.

Bandswitching is not instantaneous, as on a trap triband beam or trap vertical. But on my sailboat, I am only a few steps away from the halyard at the mast and I can lower, reset the switches, raise the antenna, and be back at my operating position on another band in less than two minutes. It is not as convenient to walk into the backyard to change bands when the antenna is in use at home but halyards on the tower make it as easy, if not as quick.

Okay, you say, simple to make—but does it work? It works beautifully. Obviously, it is not a beam, but transmitted signals seem to be stronger in the direction of the slope—as they should be. In other directions such as 90 degrees to the slope, it acts like a simple dipole, as near as I can determine.

I had dozens of satisfying rag-chews with stateside stations on the three DX bands during the summer of 1980. I easily worked into Europe and the Caribbean from Lake Michigan while running only 80-100 Watts output with the TS-120S. Signal reports confirmed the sloper worked better than the Hustler vertical mobile whips.

The sloper does not need the ground or counterpoise that is required of a vertical. My vertical, although grounded to the keel of the sailboat and with a pair of radials attached, would probably perform much better in salt water than it does on my sailboat in the Great Lakes. I have talked with sailor/hams operating in the ocean who report that the Hustler whips make fine seagoing antennas.

The sloper dipole went with me on a sailing vacation/casual DXpedition to Tortola in the British Virgin Islands in early December, 1980. If you talked to me as W8KXW/VP2V, you heard the TS-120S operating into the sloper dipole from aboard the 37-foot sailboat we chartered. ■

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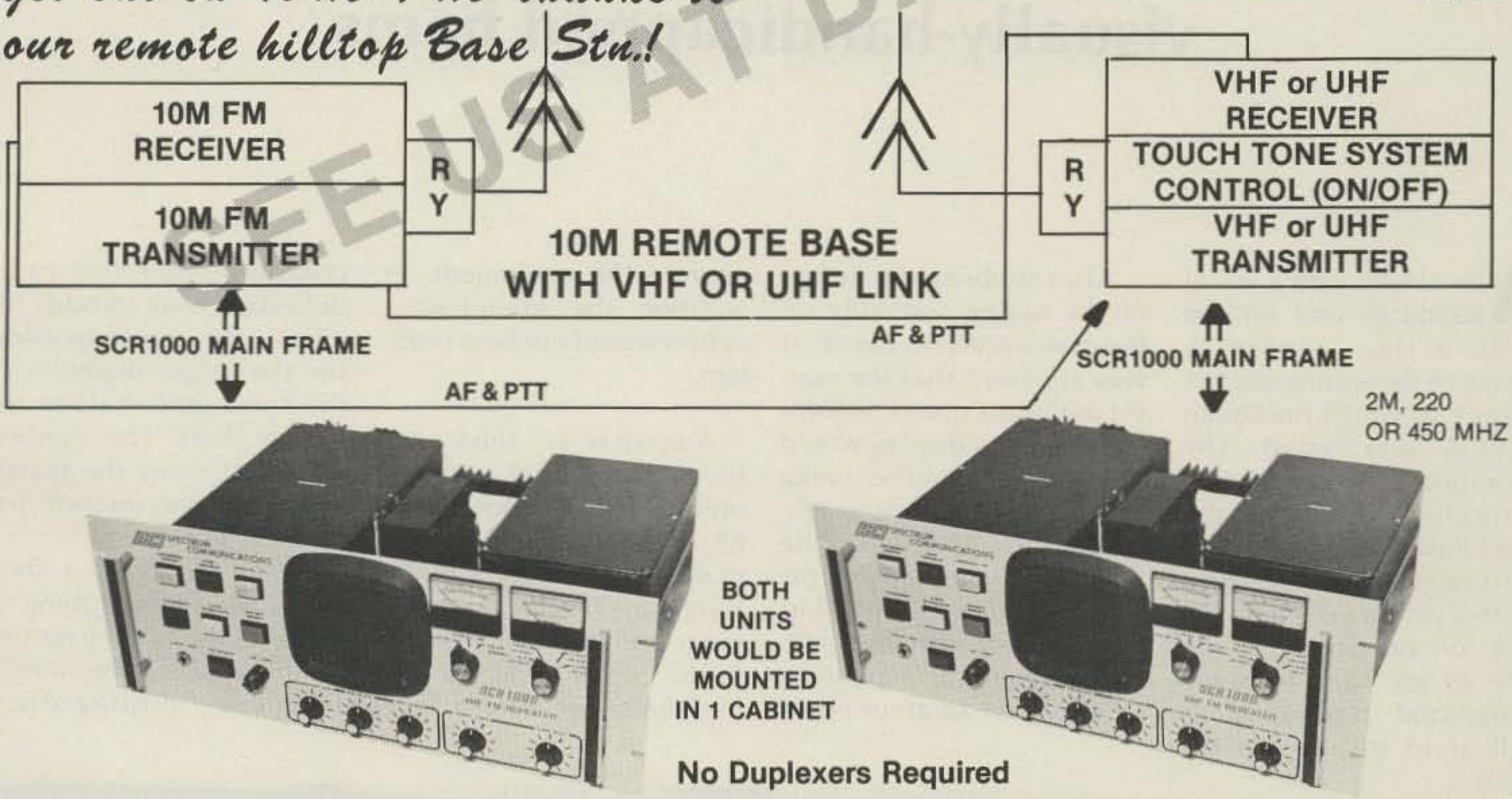

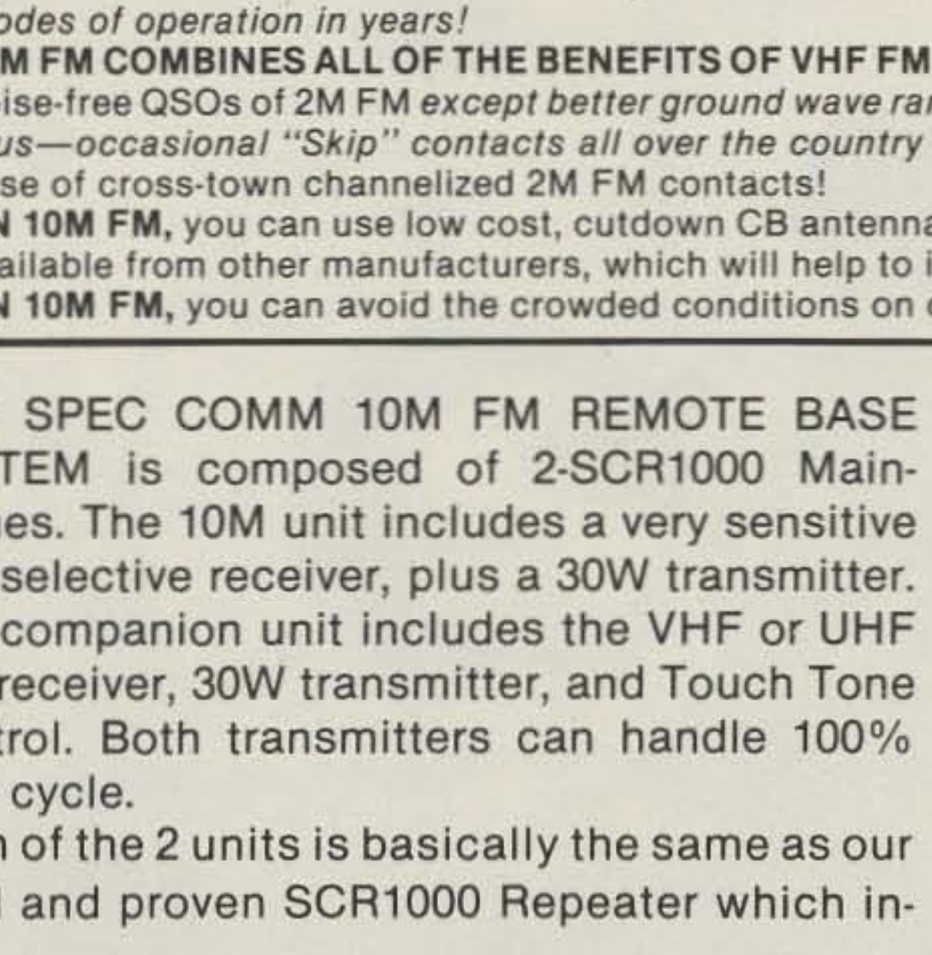

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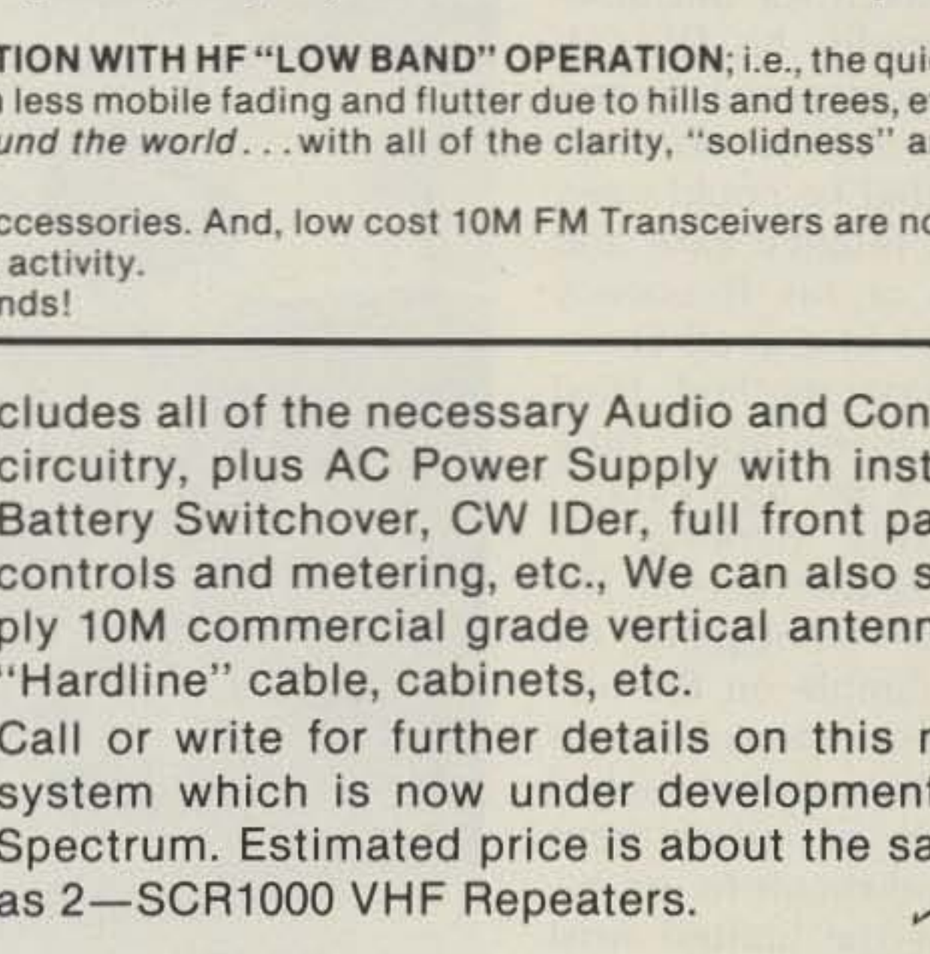

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A local ham with a visual handicap and limited wrist action needed a means to determine the frequency to which his Drake TR4-CW was tuned. The limitations of his license naturally determine the band limits within which he must operate. And he must do this with a very high degree of precision—to be able to go back to some designated frequency as well as to stay within the limits.

This article covers the approach taken for this amateur to modify his TR4-CW (it can be returned to normal with little or no problem) so that he could operate with relative ease and be sure of his frequency within ±1 kHz at all times.

The first method tried was to use label tape (Dymo™ or equivalent) with braille markings attached to the face of the transceiver front panel, using the dimple on the tuning-knob skirt as a reference point. This method lacked precision of adjustment and was difficult to use because of the limited wrist action of the ham. The markings can be seen under the new plastic disk in Photo A.

After studying the design of the tuning assembly on the transceiver in detail, it was apparent that the easiest and most practical form of frequency display would be a disk behind the tuning knob, in place of the graduated skirt. If the braille markings were on the peripheral edge of the skirt and the skirt were transparent, then either a sightless or a sighted amateur could operate the equipment. In addition, the limited wrist action would not be a problem.

A scrap of ¼"-thick plastic, such as Plexiglas™, was obtained from a local supply house at a very low cost. A local machinist turned a 3½" disc from this piece and drilled a ¼" hole in the center to fit the tuning shaft. See Photo C. A concentric hole had to be drilled partway through the disc at the center to allow for the larger diameter of the concentric shaft on the tuning shaft. This concentric shaft turns the plastic discs on the interior frequency display.

Drake has used a short piece of rubber tubing to transmit the turning motion of the knob to the interior frequency display discs.

Photo A. Overall view of the TR4-CW with modification in place.

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74LS21	.30	74LS174	1.19
74LS22	.34	74LS175	1.09
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74LS30	.35	74LS192	.88
74LS32	.39	74LS193	.98
74LS33	.54	74LS194	1.80
74LS37	.78	74LS195	1.39
74LS38	.39	74LS196	.82
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74LS51	.35	74LS242	1.89
74LS54	.35	74LS243	1.89
74LS55	.32	74LS244	1.79
74LS73	.44	74LS245	2.89
74LS74	.48	74LS251	1.32
74LS75	.58	74LS253	.89
74LS76	.50	74LS257	.89
74LS78	.59	74LS258	.89
74LS83	.90	74LS259	2.89
74LS85	1.23	74LS260	.68
74LS86	.45	74LS266	.68
74LS90	.70	74LS273	1.69
74LS92	.82	74LS275	3.39
74LS93	.71	74LS279	.59
74LS95	1.11	74LS283	1.03
74LS96	.86	74LS290	1.25
74LS107	.43	74LS293	1.89
74LS109	.49	74LS295	1.09
74LS112	.48	74LS298	1.24
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7410	.19	7483	.65	74161	.79
7420	.19	7486	.35	74163	.89
7430	.19	7490	.49	74164	.89
7432	.29	7491	.69	74173	1.39
7440	.19	7492	.59	74174	.89
7442	.49	7493	.49	74175	.89
7445	.69	7496	.74	74176	.89
7446	.69	74100	1.19	74192	.79
7447	.59	74107	.34	74193	.79
7448	.69	74121	.34	74196	.79

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14 pin ST	10/1.29	14 pin WW	.69
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18 pin ST	10/1.29	18 pin WW	.99
20 pin ST	10/1.29	20 pin WW	1.09
22 pin ST	10/1.29	22 pin WW	1.39
24 pin ST	10/1.29	24 pin WW	1.49
28 pin ST	10/1.29	28 pin WW	1.69
40 pin ST	10/1.29	40 pin WW	1.99

ST = SOLDERTAIL — WW = WIREWRAP

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7805T	.89	7905T	.99
7812T	.89	7912T	.99
7815T	.99	7915T	1.19
7824T	.99	7924T	1.19
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
78L05	.69	79L05	.79
78L12	.69	79L12	.79
78L15	.69	79L15	.79

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2N3904	10/1.00	100/8.99
2N3906	10/1.00	100/8.99
2N3055	.79	10/6.99

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Jumbo Green	6/1.00
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5082-7760 .43"CC	.79
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74S74	.80	74S260	1.80	74S570	7.80
74S113	.79	74S287	4.75	74S571	7.80

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4001	.35	4024	.99	4070	.49
4002	.39	4025	.29	4071	.49
4007	.25	4027	.65	4072	.49
4009	.49	4040	1.29	4081	.39
4010	.49	4042	.99	4093	.99
4011	.35	4046	1.79	4098	2.49
4012	.29	4047	2.49	4503	.69
4013	.49	4049	.49	4508	3.95
4016	.59	4050	.69	74C04	.39
4017	1.19	4060	1.39	74C14	1.49
4020	1.19	4066	.79		
4023	.29	4069	.39		

LINEAR

LM301v	.34	LM556	.69	LM1488	1.39
LM308v	.98	LM565	.99	LM1489	1.39
LM309K	1.49	LM566v	1.49	LM1800	1.99
LM311v	.64	LM567v	1.29	LM1889	2.49
LM317t	2.29	LM723	.49	LM3900	.59
LM318v	1.49	LM733	.98	75451v	.39
LM323k	4.95	LM741v	.29	MC1330v	1.89
LM324	.59	LM747	.79	MC1350v	1.29
LM339	.99	LM748v	.59	MC1358	1.79
LM377	2.29	LM1310	1.90		
LM380	1.29	LM1414	1.59		
LM555v	.39	LM1458v	.69		

T = TO-220 — V = 8 pin — K = TO-3

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Photo B. Close-up of plastic disk and rubber spacer mounted on the tuning shaft.

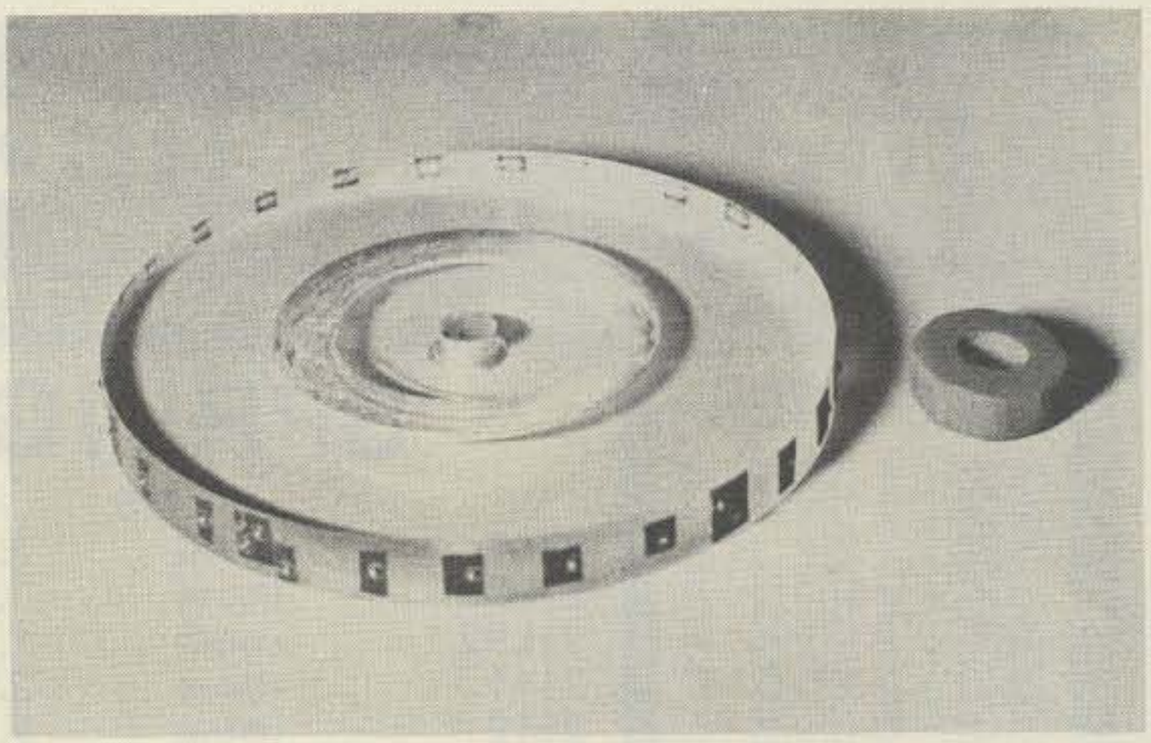

Photo C. Detail of plastic disk and rubber spacer.

Since our design for this modification precluded changes which would prevent returning the set to normal for possible later resale, a piece of ruby-red eraser was used to make a new pad that was not as thick as the original piece of tubing (see Photo C).

When the new parts, rubber pad, and plastic disc were assembled on the tuning shaft, it was discovered that the tuning-knob set screw would not engage the tuning shaft. This minor problem was overcome by machining a 3/16" × 1/8" circular flat-bottom groove. This groove allowed the knob to be inset into the new plastic disk far enough for the set screw to engage the shaft and its rough bottom to increase the friction between the knob and the new plastic disc. This machining must be done very slowly, or the plastic will chip along the edges or melt under the cutter. The original aluminum knob skirt was saved, along with the rubber coupling, so that the transceiver could be returned to normal configuration at a later date, if necessary.

Now that the mechanism was working, some method had to be derived so that frequency could easily be determined. Since the tuning system was designed so that one complete turn of the knob was 25 kHz, the perimeter of the new disk was divided at 25 equidistant points (perimeter divided by 25), representing 1 kHz per division. The braille system was used to mark the divisions. The dots were put on label tape, using a braille typewriter that the sightless ham owned. These small pieces of tape were then attached to the periphery of the disk at the appropriate places.

The 1-kHz points were simply marked with a dot while the 5-, 10-, 15-, 20-, and 25-kHz divisions were marked with the appropriate braille symbol and the left-most column of dots aligned as the marker. The starting and ending points were the same and were indicated with the 25-kHz braille tape. In order to establish a reference mark on the transceiver face, a simple column of dots was put on a piece of label tape and attached above the window of the face plate (see Photo A).

Since Drake does not specify the amount of overtravel of the PTO, each transceiver dial will stop at a different frequency. By determining the frequency of the stop (by a sighted ham) and counting the number of turns necessary to get to the edge of the subband, the amateur was able to establish one edge of the subband limit. The set screw hole in the knob can be set so that it is vertical when the edge of the subband is reached, thereby giving the amateur an additional point of reference for counting the number of turns from the PTO stop. The primary reference line is the left-hand edge of dots on the braille 25-kHz mark. With the subband located, the amateur now can stay within the band or operate on a predetermined frequency by aligning the dots used as reference on the front panel with the braille markings on the periphery of the disk. Using this method, the amateur can dial the desired frequency with an error of less than 1 kHz.

The system has now been in use for several months and is working very satisfactorily. The braille dots on the tape attached to the disk edge seem to stay much better than expected. In applying these markers, it is extremely important that the edge of the disk be absolutely clean and that the adhesive on the tapes not be touched with your fingers during application. Small pin heads could be used in the future, but they must be very small so that the ham can feel the entire braille digit without having to hunt around for it.

This scheme could be used on any equipment that uses an external tuning knob with enough shaft so that the knob can be reinstalled after the disk is installed behind it. Also, the frequency-tuning knob frequency-per-revolution must be something that is easily determined.

I would like to thank Jim Devilbiss WA3FUJ for machining the plastic, Bob Hurwitz K3DLC for the photographs, Joe Fincutter W3IK for his help in preparing this article, and Harry Mossberg WB3LFD for the opportunity to devise the system. ■

✓ Reader Service—see page 130

coil taps should cover progressively more turns, such as 3, 7, 15, etc., to utilize the full 12-position capacity of the coil-tap switch. Going up towards the kW level, one could use a 350-pF capacitor spaced for several thousand volts (E. F. Johnson 154-10) and 3"-diameter coil stock having 4-6 turns/inch to make up the inductance.

A problem at this power level, however, becomes that of finding a suitable coil-tap switch since, especially if low impedances are being matched, considerable amperage will flow through the switch contacts. It might be just as economical to use a roller inductor at the kW level. One suitable type would be the E. F. Johnson #229-203, 28-μH inductor, although various other surplus units which are available on the market also are usable as long as they have 18-28 μH of inductance.

The simple L-tuner is meant for use with an external swr bridge. However, one could combine it with the home-brew swr circuit described for the next tuner if one wanted a completely self-contained unit. Also, it should be noted that the normal/reverse switch arrangement shown could easily be expanded into an antenna-selector switch if desired.

The tuner diagrammed in Fig. 2 is dubbed the "six-square" tuner because it fits into a 6-inch-square aluminum utility box. It will match a far wider range of impedances than the simple L-tuner and, as shown, will handle 500 to 600 Watts PEP of transmitter output. It has been used with multiband antennas, loops, and random-length longwires with equally good results.

The circuitry used is that of a pi-network except that an extra series-capacitor arm has been added on the output side. The added capacitor allows a better matching range and also does not make the coil-tap points so critical. A commercial version of this circuit uses fixed, switched capacitors in place of the variable capacitor to ground on the antenna side of the circuit. One could experiment with this idea if one wants to save a variable capacitor by using five or six fixed capacitors to cover the range approximately from 50 to 300 pF.

Although a coil-tap switch is used, the coil taps are made adjustable by implementing them via spring clips rather than by soldering tap leads to the coil. This method requires a bit more work, locating a source for the spring clips (surplus ones were used), but the advantage is that one can experimentally determine the best coil-tap position for each band and then leave the taps set until an antenna is changed. Since the top cover of the tuner can be removed easily to access the coil, the whole arrangement becomes quite practical and costs far less than using a roller inductor.

As dimensioned, the tuner is mainly useful for the 10/15/20-meter bands. It can be dimensioned easily for the lower frequency bands by using coil stock with a turns/inch dimension which produces up to 28 μH inductance (e.g., 3"-diameter stock, 6 turns/inch, 5 inches long). However, on the lower frequency bands, the 300-pF variable capacitor to ground on the output side will usually not have enough range. One usually will have to parallel fixed capacitors to it so that a total capacitance of 1200-1500 pF can be achieved. The extension of the tuner to the kW level would not require changing the coil but the usage of a suitable coil-tap switch and wider-spaced variable capacitors as suggested for the circuit of Fig. 1.

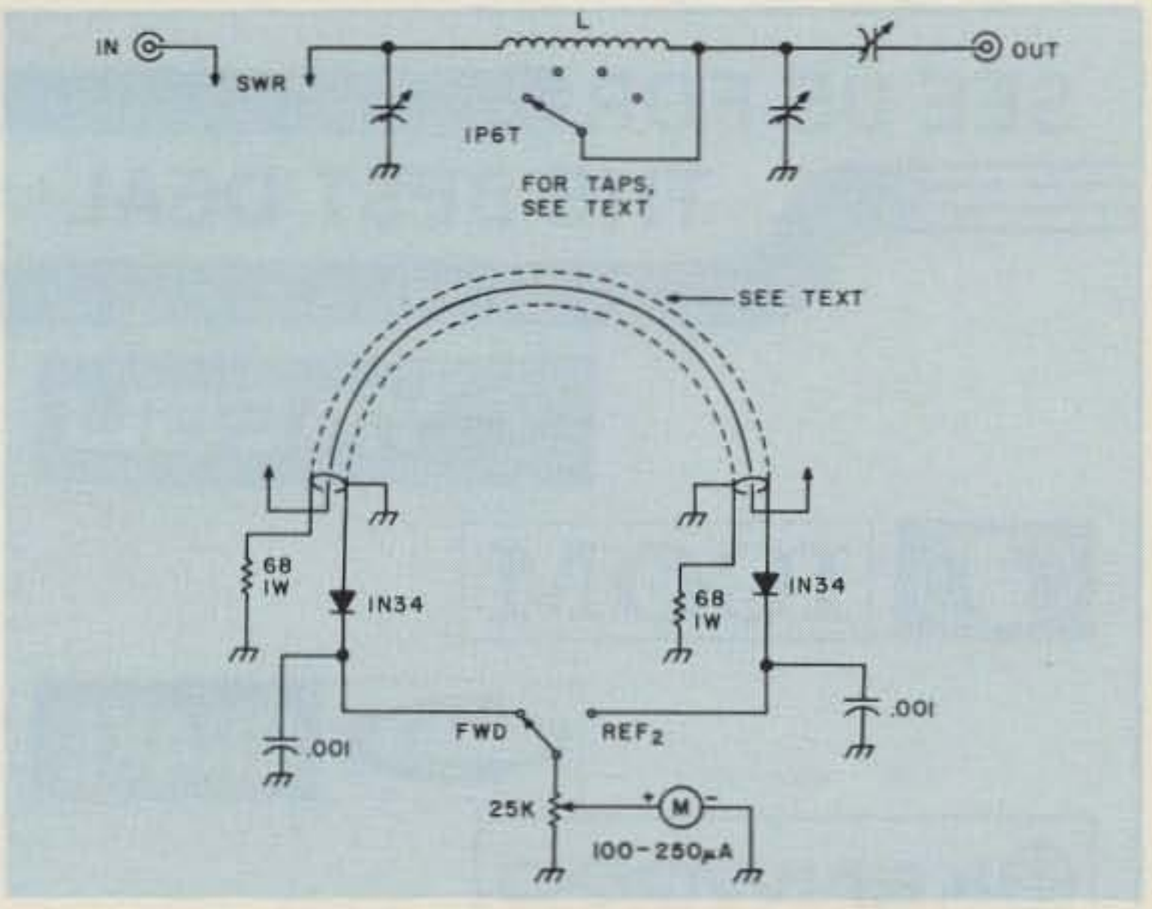

Fig. 2. Circuitry of the "six-square" tuner. The simple swr bridge which is built around a piece of RG-58 can also be used with any of the other tuners described. L is 2½" diameter, 4 turns/inch, 4" long. Capacitors are 300-pF, 2-kV surplus type.

The swr circuit used in the tuner is just about the simplest one that can be home-brewed, yet it is very effective. To construct it, one first strips the vinyl jacket off approximately 5½ inches of RG-58. The braid is bunched slightly and slipped off. Two lengths of enameled wire of any small gauge (e.g., #22) are then placed over the insulated center conductor and the braid replaced over the assembly. A 4½" length of shrink tubing is then placed over the braid and heated. The result is a 4½"-long pickup section with ½" left on each end for connections. The assembly can be bent into a U-form, and all the components for the swr circuit (except the sensitivity potentiometer and forward/reverse switch), can be mounted on a multiple-lug terminal strip.

The circuit will operate well over the 80-to-10-meter range with transmitter output powers of 25 Watts to 800 Watts. The meter used was a CB surplus one which happened

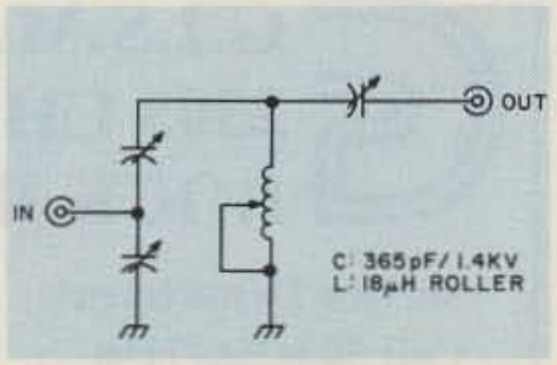

Fig. 3. A T-network type of tuner popularly called a transmatch.

to have an swr scale. Normally there is no need to use a meter with a calibrated scale since usually one will simply be adjusting the tuner for minimum swr in the "reflected" position with the sensitivity potentiometer set at maximum.

There is no special construction care required in putting together the six-square tuner. To provide easy coil access, however, the capacitors were mounted on the bottom cover of the utility box. The one capacitor which has to be above ground was mounted on a suitable piece of Bakelite and, of course, an insulated shaft coupling was used. It was centered between the two other capacitors so that its control shaft could pass between them to the front panel. There is still sufficient room in the enclosure to add an anten-

na-selector switch or 100-Watt-class, dummy-load resistor, if desired.

The final tuner unit is diagrammed in Fig. 3. Most amateurs have come to regard this type of tuner circuitry (which is a variation of a T-network) as the best of the "match anything" variety. Of course, it will not "match anything" any more than any other single-circuit configuration will do, but it does seem to have a wide enough matching range to satisfy most needs ranging from Field Day random wires to the usual fixed-station antennas.

A particular advantage of the circuit is that it does not require unusually large values of capacitance even on the low frequency bands. With the values shown in Fig. 3, the tuner will cover 80-10 meters. By changing only the roller inductor to a 28-μH unit, its range will be extended to 160 meters. With the components listed, the tuner will easily handle 300 to 500 Watts output. It can be made into a kW-level tuner just by substituting variable capacitors with wider plate spacing (e.g., E. F. Johnson 154-10 or equivalent with .075-inch or more plate spacing). The roller-inductor type does not have to be changed.

The unit is constructed in an LMB enclosure, #CR-864, which measures 8" × 6" × 4½" inches. The variable capacitors are all mounted on a Bakelite panel placed in the middle of the enclosure. The panel is fastened to the rear and bottom of the enclosure by means of 4-40 hardware using holes drilled and tapped into the panel where it butts against the enclosure.

Two of the variable capacitors are joined by a shaft coupler to make up the dual-variable capacitor shown in Fig. 3. It is not absolutely necessary, however, to use a dual variable if one doesn't mind having an extra control to tune when two separate variable capacitors are used. A standard J. W. Miller turns counter is used with the roller inductor, but anything that one can improvise that will give the approximate location of the contact roller on the coil will suffice. It is hardly necessary to have a turns indicator that reads out to 3 digits! The antenna-selector switch and indicator LEDs on the front panel were intended for later use to remotely switch antennas by passing a dc voltage of different polarity down a coaxial transmission to control remotely-located relays. The basic scheme is shown in Fig. 4.

Each tuner can be expanded as desired and provisions made to work into a balanced transmission line by adding a balun. The #5 balun kit from Amidon will suffice for power levels of a few hundred Watts, and it comes complete with instructions on how to put together either a standard 1:1 or 1:4 balun. For a kW-level balun, one can follow the same basic instructions but use two or three Amidon T-200-2 cores stacked and covered with some form of good insulating tape, preferably a glass-cloth type.

The tuners are all used in a conventional manner. That is, tuning them so the swr on a coaxial line between a transceiver and the tuner is as close to 1:1 as possible. A general rule of thumb is to use settings on the tuners on each band so that the maximum capacitance is engaged. Some of the tuner circuits, particularly that of Fig. 2, will provide some useful harmonic attenuation. On the other hand, the circuit of Fig. 3, for some settings, will act as a high-pass filter and provide no useful harmonic attenuation.

The best approach probably is not to expect dual benefits from a tuner. If harmonics are a problem, a good low-pass filter should be used and the tuner left to function solely as a matching device.

Can a kW-level tuner be built for $25? One would never think so if one priced all new components, since a simple variable capacitor can run from $20 to $30. The key to building any of the tuners economically is to find good but low-cost parts. It can be done if one is willing to spend a bit of time looking around. The variable capacitors for the tuner of Fig. 3 cost $25 from a new component dealer. The same capacitors, unused but 20 years old, cost $3.95 from a surplus parts dealer who advertises widely in the amateur radio magazines. ■

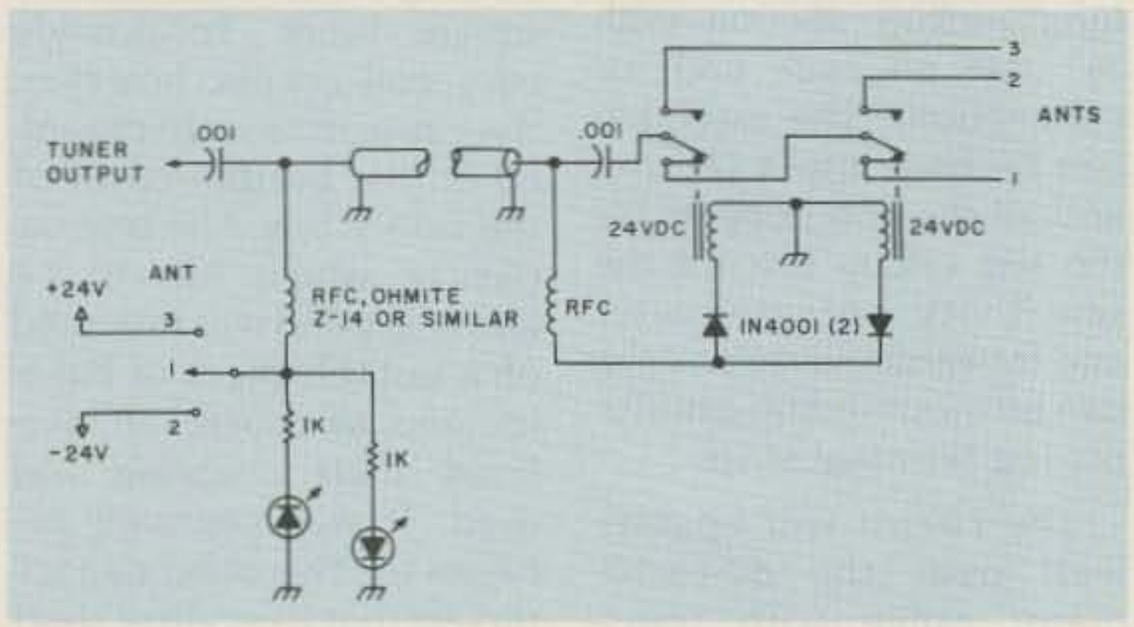

Fig. 4. The antenna-select switch shown with the last tuner was meant to implement a remote relay-switched antenna-selector scheme of the type shown here. Many good surplus 24-volt relays are available which could be used.

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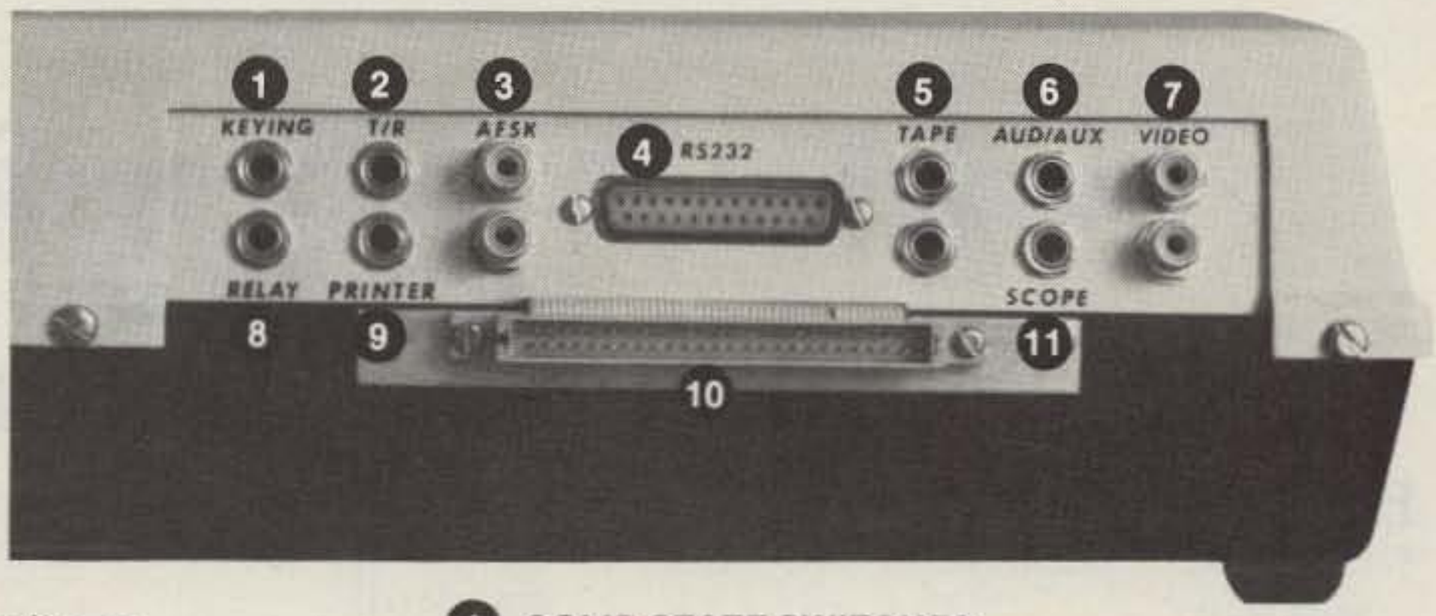

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✓314

✓ Reader Service—see page 130

Jeff DeTray WB8BTH
73 Magazine *Staff*

Kenwood's New 830S

— evolution, not revolution

Having long been a fan of Kenwood's TS-820S, I looked forward with great anticipation to the arrival of its successor, the TS-830S. The 830S, I knew, promised a number of improvements and additions, among them more flexible receiver controls, smaller size, and the capability of operating on the three new WARC bands. I was both surprised and pleased that Kenwood chose to produce a new radio with a tube-type final amplifier, given the current trend toward solid-state finals. My general impression, after living with the TS-830S for about six weeks, is that Kenwood has kept the best features of the 820S, improved the weak areas, and added controls which make the rig more fun to operate.

The Receiver

On receive, the TS-830S covers all nine ham bands, present and future, from 160 through 10 meters. Sensitivity is rated at 0.25 uV, and side-by-side comparisons with other hot receivers show the 830S to be their equal in this area. Typical of Kenwood gear, the audio is superb, even when heard through the small internal speaker. Kenwood engineers must borrow a colleague from the company's high fidelity sound department when designing the audio stages of their ham equipment.

Some of the most obvious differences between the 830S and the 820S involve receiver features. While the basic dual conversion design scheme with i-fs at 455 kHz and 8.83 MHz remains intact, Kenwood has given 830S owners an impressive array of easy-to-use receiver controls, some of which are not present on the 820S. Three of these controls deserve special mention.

Foremost among these is the Variable Bandwidth Tuning (VBT) control. VBT allows you to change the width of the i-f passband from the normal 2.4 kHz all the way down to 500 Hz, if desired. Among other things, this control makes possible some serious CW operation, even without the optional crystal filters. The narrowing of the passband is accomplished by slightly raising the center frequency of one i-f filter, while slightly lowering the frequency of the second i-f filter. The net result is the narrowing of the i-f passband with no change in the center frequency.

The i-f shift function is a holdover from the 820S. This control actually moves the center frequency of the receiver passband by ±1.2 kHz. When used alone, it allows you to shift the whole passband up or down

Kenwood's TS-830S.

slightly to avoid bothersome interference. What really makes this function a winner, however, is its use in conjunction with the VBT control. By narrowing the passband and at the same time shifting it, some rather remarkable feats of reception can be accomplished. On phone, weak signals which might otherwise be buried by off-channel garbage can be brought up to intelligible levels. On CW, it's possible to reduce the passband width to 500 Hz using VBT, then adjust the Shift control to select one of three or four CW signals, all without touching the tuning dial. It's not as complex as it sounds, of course, taking a lot less time to do it than to describe it.

Notch filters are now standard issue on several modern transceivers. Each manufacturer seems to have a different idea about what hams want on this score. As a result, we have several different types of notch filters on current rigs, all of them useful in their own way. Kenwood's notch on the 830S is moderately deep—a bit better than 40 dB—and very easy to find. It does a good job on all single-tone type (carrier) interference and is especially beneficial during phone operation. It has proven less useful than expected on CW, mostly because there always seems to be more than one station I want to notch out. The notch filter gets only a small fraction of the use that the VBT and Shift controls get.

Once you are past the three controls mentioned above, the receiver portion of the 830S becomes more familiar.

Standard equipment includes a good noise blanker with adjustable threshold. The threshold level is a rather touchy adjustment.

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✓ *Reader Service—see page 130*

Gerald Haas WA2JSR/4
Lennar Center—Suite 204
8720 North Kendall Drive
Miami FL 33176

Azden's PCS-3000

—the 2-meter rig of the future is available now

Meet the newest Azden 2-meter rig, the PCS-3000. Many of you are no doubt familiar with the original Azden. The new "Series II" unit has a completely different microcomputer system. It covers an 8-MHz range (142 to 149.995 MHz), has eight memory channels, a backlighted keyboard, provision for three auxiliary offsets (CAP and Air Force MARS are already included), selectable frequency steps of 5 or 10 kHz, and a nicad battery for memory backup. The radio also comes with a free touchtone™ pad kit.

Interesting, you say? Well, there's more. The above are self-explanatory, but some of the features will have to be described in detail. These include the microcomputer acquisition tone, discriminator scan stop, programmable band scan, auto-resume with delay, memory retention of offsets, and repeater input monitoring. Let's look at these one at a time.

Microcomputer Acquisition Tone

When you first switch on the PCS-3000, it will make a short "tweep" sound. Each time you press one of the buttons on the 12-key microcomputer control keyboard, you'll hear the same sound. The first time I experienced this, I found it to be quite entertaining. But it's very informative as well. Once you get used to it, it's hard to feel comfortable without it. I sup-

The PCS-3000 measures 6-3/4 inches wide by 2-3/8 inches high by 9-3/4 inches deep. The unit comes apart into two pieces: the "control head" (which houses the microcomputer and displays and is 6-3/4 inches wide by 2-3/8 inches high by 2-5/8 inches deep) and the "main unit" (containing the transmitter and receiver circuits). In my car, only the control head is actually mounted under the dashboard, saving much space. The main unit is under the passenger seat. An optional interconnecting cable provides the electrical interface between the two units.

pose it provides some kind of psychological reinforcement, removing all doubt that the microcomputer has gotten the message. All psychoanalysis aside, though, I like this feature.

Discriminator Scan Stop

The PCS-3000 makes use of an exclusive circuit which requires two conditions for the scanner to stop: presence of carrier and frequency centering. Unless the carrier is within a certain range of center frequency, the scanner will keep on going. This circuit allows the radio to scan in steps of 5 kHz without stopping one channel too soon. (Although the carrier is inside the passband when the receiver is 5 kHz below frequency, it isn't centered, so the scanner does not stop.)

Programmable Band Scan

Any section of the frequency range 142 to 149.995 MHz can be scanned in increments of either 5 kHz or 10 kHz. The lower- and upper-limit frequencies are stored in memory channels 7 and 8, respectively. In general, it's probably best to program the lowest commonly used channel into memory 7 and the highest one into memory 8. I programmed 146.52 into memory 7 and 147.00 into memory 8.

The offset in the band-scanning mode is determined by the offset written into memory 8, except for the lower-limit frequency offset, which is the offset stored in memory 7. In my case, channel 7 was programmed for simplex and channel 8 for −600 kHz. The rig was thus set up for simplex at .52 and −600 split at all the other scanned channels.

Auto-Resume with Delay

There are three scanning modes, F, B, and V, chosen by the front-panel Scan/Offset switch. These letters

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designate free sampling, busy, and vacant scanning modes.

In the F position, the scanner goes along until it hits a busy channel, and then it stops for about 5 seconds. During this time, you can choose either to remain on frequency (by pressing a certain keyboard or microphone button) or to continue scanning (by just waiting). If you decide to continue scanning, the unit will start up again after the 5-second delay and continue until it gets to the next busy channel, where it will stop again for 5 seconds, and so on.

In the B position, the radio scans until it hits a busy frequency and then stops. If the carrier drops out, the unit will start scanning again after a delay of a second or so. Again, you can choose whether or not to stay on frequency by means of the same stop command buttons.

Sometimes I have wanted to stay on frequency but forgot to press a stop command button. The short delay before the radio resumes scanning is very helpful here, because the repeater will usually come back up again before the delay time is up.

In the V position, the radio skips over busy channels and stops at vacant ones. If a signal comes on, the radio moves up to the next vacant channel right away, unless a stop command key has been pressed.

General:	
Semiconductors	IC 18, FET 7, Tr 36, Di 61
Frequency Band*	142.000 – 149.995 MHz
Ambient Temp. Range	– 10 to + 50 degrees C
Antenna Impedance	50 Ohms, resistive
Power Supply	+ 13.8 V ± 15% negative ground
Current Consumption*	0.7 A maximum (receive) 5.0 A maximum (transmit)
Dimensions, overall*	HWD 62 × 158 × 246 mm 2.4 × 6.2 × 9.7 in
Dimensions, head only*	HWD 62 × 158 × 65 mm 2.4 × 6.2 × 2.6 in
Weight*	Approx. 2.5 kg 5.5 lbs
Transmitter:	
Carrier Output*	25 Watts (high), 5 Watts (low)
Emission Type*	F3 by varactor modulation of vco
Frequency Deviation	± 5 kHz maximum
Spurious Output	Down at least 60 dB from fundamental
Microphone	500 Ohms, dynamic
PL Tone Frequency	67 to 250 Hz, adjustable
PL Tone Deviation	0 to ± 1 kHz, adjustable
Receiver:	
Receiving System	Double conversion superheterodyne First i-f: 16.90 MHz Second i-f: 455 kHz
Sensitivity	0.28 uV or better, 20-dB NQ 0.19 uV or better, 12-dB SINAD
Selectivity	± 6 kHz or more at 6 dB down ± 15 kHz or less at 60 dB down
Audio Output	2 Watts or more into 8 Ohms, 10% THD
Accessories, Standard:	
Auxiliary Offset Provision*	Three available
Auxiliary Offset Built In*	Air Force MARS: – 1.305 MHz CAP: – 4.250 MHz
Dynamic Microphone*	500 Ohms
Built-In Speaker*	8 Ohms
Mobile Mounting Bracket and Hardware*	
Accessories, Optional:	
Auxiliary Offset Crystals	Parallel resonant 20 pF, HC18-U holder
CS-ECK 15-foot Remote Cable	$35.00
CS-6R 6-Amp ac Supply	$59.95
CS-AS 8-Ohm Remote Speaker	$18.00
CS-TTK Touchtone Microphone Kit	$39.95

Table 1.

Memory Retention of Offsets

Each of the eight memory channels retains a frequency and one of three offsets (simplex, −600 kHz, or +600 kHz). Programming is simple. Just dial up the desired frequency and offset, set the memory address to the appropriate channel, and press M WRITE. When that channel is recalled, the receiving frequency is displayed while receiving and the transmitting frequency is displayed while transmitting. Pure and simple!

Repeater Input Monitoring

There is a little switch on the side of the microphone labeled "CH LOCK." When this switch is actuated, the *receiver* goes to the *transmit* frequency. If you transmit, the transmitter frequency remains as programmed. This feature is useful if you want to listen to the repeater input frequency instead of the output frequency.

Keyboard Operation

It takes quite a while to learn the operation of this very advanced and sophisticated radio, and I certainly am not going to try to cover all the details here. What I'd like to do, though, is give you some idea of how the thing works, and some idea of how versatile it really is. So let's look at the keys, briefly, one at a time.

The MHz UP key advances the MHz figure only, in the range of 2 to 9, in upward steps of 1 MHz. That is, as this key is pressed over and over, the MHz figure changes in the sequence 2, 3, 4, 5, 6, 7, 8, 9, 2, 3, and so on. No other digits are affected.

The 100K UP key advances the 100-kHz digit upward without changing the MHz figure or the unit kHz figure. Example: You have the frequency 6.940 displayed and actuate the 100K UP key, giving a new display of 6.040. Actuate the 100K UP key again, and the display becomes 6.140. The 100K DOWN key reverses this, so if you have 6.140 and hit the 100K DOWN key twice, you will be back on 6.940. It takes a little getting used to.

The 5/10K UP key advances the unit kHz digit by either 5 or 10 kHz, depending on the setting of a push-button lock switch on the front panel. Suppose this switch is set for 5-kHz steps and you are on 6.940. Hit the 5/10K UP key and you go to 6.945. If you actuate this key over and over, the frequency will increase by 5 kHz steps until you are at 6.995, and then it will go down to 6.000. The frequency is thus tunable within a 1-MHz range using this key. By holding the key down, the radio will move upward very rapidly in 5-kHz steps. This gives a "vfo" feeling. The 5/10K DOWN key just reverses the process of the 5/10K UP key.

The BAND SCAN key causes the radio to scan in steps of 5 or 10 kHz (as selected by the push-button lock switch I mentioned above) between two limit frequencies which can be selected at will by the operator. The lower-limit frequency is the channel in memory 7 and the upper-limit frequency is the channel in memory 8. Band scanning starts at the lower limit and moves upward.

The ±600 SHIFT key puts the radio in the simplex, −600, or +600 offset modes by repeated actuation. Just to the left of the frequency display, small LEDs indicate the offset.

The five keys M ADRS, M SCAN, M1 CALL, M CALL, and M WRITE accomplish memory programming, re-

call, and scanning. The functions of these keys are pretty much self-explanatory. Memory can be easily reprogrammed. When power is turned off, memory is held by a nicad battery that is constantly charging while the radio is on. You can therefore put the radio away for a few weeks, put it back on the air, and you'll still have the same memory channels and offsets.

Inside the Radio

The PCS-3000 uses modular construction (as any state-of-the-art radio does nowadays, after all). Interior layout is neat and rugged. Circuit boards are secured to the heavy-duty chassis with several screws. The vco/PLL section is isolated electrically by means of a shielded enclosure and is padded with wax to minimize microphonics. The layout is orderly and the component designations are marked on the boards.

All circuit boards are easily removed and replaced, since all interconnecting wires unplug and their pin positions are clearly marked. Taking one of the boards out of the radio and visually examining the underside, it is apparent that the manufacturers have taken care to do a neat job of soldering. There are no sloppy connections, bridges, or cold joints.

The control-head section of the PCS-3000 is greatly miniaturized, but the logical modular construction will make it easy to service.

Internal adjustments of PL tone frequency, PL tone deviation, high power and low power, as well as auxiliary offset crystals, are located on the PC board on the top of the main unit. PL tone frequency is adjusted by a blue pot, VR412; PL level is adjusted by VR411 (these are both near the

Continued on page 112

Roy Moses WD5ICY
2002 Cindy Lane
Denton TX 76201

Battlewagon

— tales of a mini-expedition to the USS Texas

Photos by Smitty Kiker KB5UM

Confirming your contact on _____ - meter single sideband with members of the North Texas High Frequency Association operating portable on the quarterdeck of The Battleship TEXAS from 1700Z May 17 to 1700Z May 18, 1980. Equipment included a Yaesu FT7 with 100 watt amplifier on 20 meters and a Kenwood 520 and Swan 500C on 15 and 40, working into inverted Vee antennas strung to the ship's superstructure. Thanks for the contact and 73 from all NTHFA members.

For those of you who missed out on last year's happening, these crazy people will return (with more equipment!) to the USS Texas *for Armed Forces Day weekend, this May 16 and 17. Look for the pileups on 10 through 40 meters, around* 28,550-75, 21,375, 14,300, and 7.245. A special QSL *will be available, but please include an SASE. All visitors are welcome, and if you would like to operate, stop by and say hello. Listen for WB5TSB (Texas State Battleship).*

The ship's "crew:" Kneeling, from left, Smitty Kiker KB5UM; Phil Huckaba KB5VX; Rudy Littrell N5BKQ; Robin Wilson N5BTU; C. J. Taylor N5BKA. Standing, from left, George Watkins WD5FNI; Fred Opaskey WB5TSB; Gary Fellers K5LQP; Al Faubion KA5HLS; Roy Moses WD5ICY; Dennis Jump WB6OCQ/5; J'Nevelyn Faubion KA5HJS; George Lindley WA5HKW; Capt. Robert Martin; and Pat Brannon N5AIZ. Not pictured, Duncan Engler WD5IKY and Dale Gant WB5TWO.

The eight-car caravan of amateur radio operators drove the last 100 miles to Houston in a steady rain, ranging from light showers to torrential downpour punctuated with cloud-to-ground lightning, hail, and gusty winds. The earth, subjected to double-digit rainfall the preceding two days, could absorb no more. Every creek and ditch was bank full and then some.

The National Weather Service predicted more of the same for the next 24 hours, offering grim prospects, indeed, for the success of the event scheduled to kick off at noon the next day.

Those in the caravan were members of the North Texas High Frequency Association of Denton, Texas, some 300 miles to the northwest, and their objective was the battleship *Texas*. Purpose: A mini-expedition to operate portable for 24 hours from the decks of the old warship. It was a hastily-planned operating event that was to capture the imagination of hundreds of hams around the world.

But whatever gods watch over hams, keeping them from falling headlong off antenna towers or frying their body parts with uncontrolled ac, must have had their eyes on these amateurs, too. They arrived in Houston in rain and returned to Denton in rain, but in between they were favored with bright sun, blue skies, and gentle Gulf of Mexico breezes, offering operating conditions nothing short of superb.

Only one small glitch marred the entire three-day outing. A communications breakdown made the dockside arrival of the Denton hams a total surprise to the battleship *Texas* crew, but that temporary setback proved so minor as to become totally inconsequential.

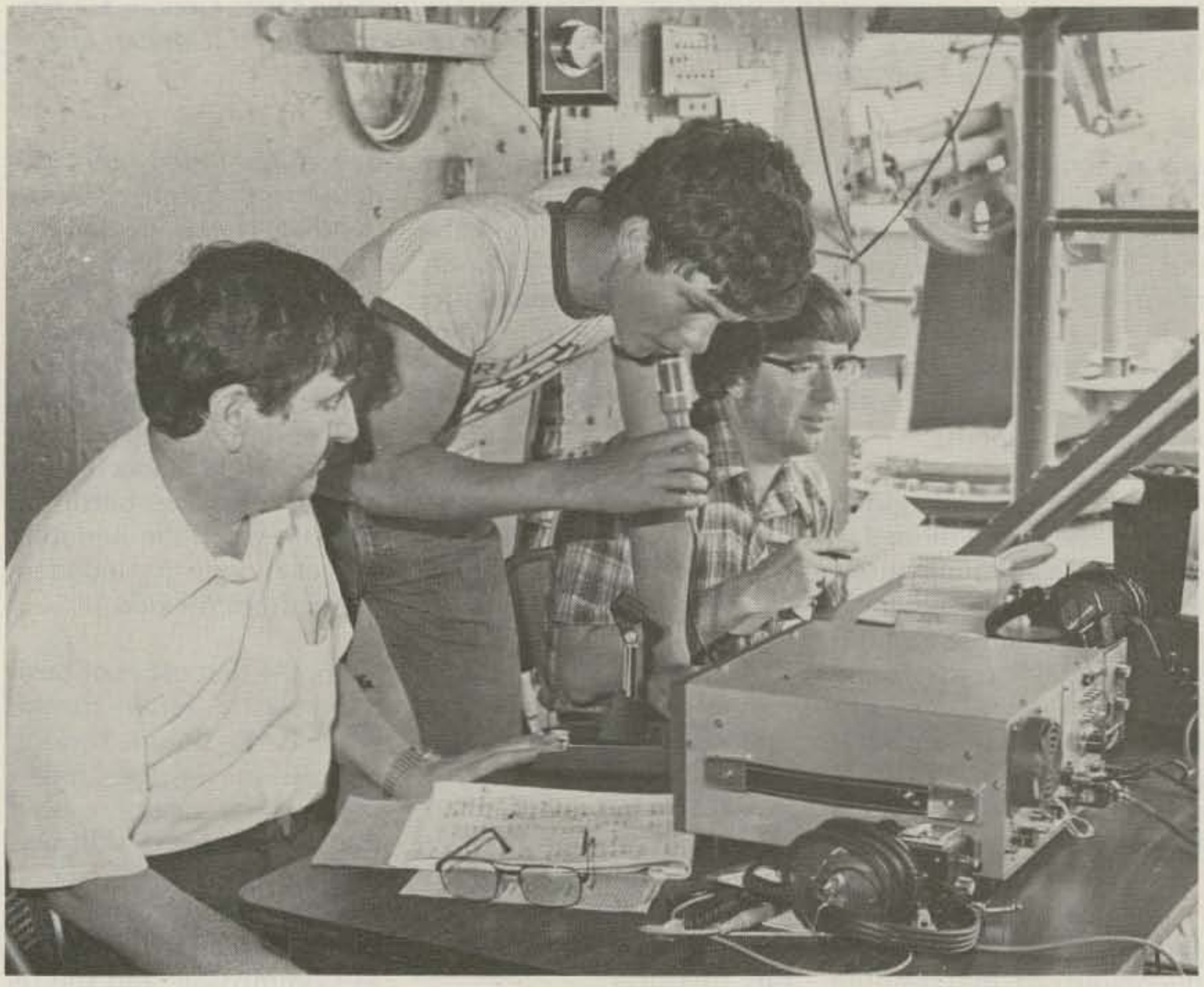
The idea for the battleship mini-expedition, like the brainstorm that resulted in the group's first mini-expedition in the fall of 1979 (Working 'Phone From Telephone, Texas), was hatched one night over post-meeting coffee and doughnuts. As with the first expedition, the idea smouldered a bit at first, but soon caught fire, and by the time final plans were being made, almost half of the Association's 45 members had signed up to go. Last-minute complications cut that number to 16 licensed hams with a total traveling party of 33, counting wives and children.

As with all of the club's special activities, an ad hoc operations chairman was appointed to head the event. This job was filled admirably by George Watkins WD5FNI ably assisted by George Lindley WA5HKW, the organization's secretary-treasurer.

The *USS Texas* was commissioned in 1914, served in two world wars, then was decommissioned and donated to the state of Texas in 1948. It was declared a State Historical Monument and permanently berthed on the edge of the Houston Ship Channel in San Jacinto State Park, an area southeast of downtown Houston. That location marks the site of the decisive battle in 1836 in which the Republic of Texas won its independence from Mexico.

So, the first order of business was a letter to the State Parks Board, seeking permission for the undertaking. The response said that although the ship was berthed in a state park, it was operated under auspices of the Battleship *Texas* Commission, and the request was forwarded to that body. Another short wait and the response said such an operation was certainly

Stringing antennas, from left, are C. J. Taylor N5BKA, George Lindley WA5HKW, club secretary-treasurer, and George Watkins WD5FNI. In background is Dennis Jump WB6OCQ/5. Shortly after the mini-expedition, Watkins was elected president of the North Texas High Frequency Association for 1980-81.



Bob Dills W5RWW of Dallas, left, was vacationing in Houston when he got put to work. It was Bob's first operating on the HF bands in quite a while, since he sold his HF gear some years ago. Pat Brannon N5AIZ is about to hand the mike over to Bob while Gary Fellers K5LQP handles the logging.

permissible and should be coordinated with the *Texas*'s skipper, Capt. Robert Martin. A follow-up phone call to Capt. Martin put the operation on the front burner.

The target date was set for the weekend of May 17, which turned out to dovetail quite nicely, albeit accidentally, with Armed Forces Day. By mid-April, most logistical plans had fallen into place, even though Watkins complained, "This whole operation will probably be a failure—we're doing too much planning." The NTHFA, which has grown from eight to almost 50 members in less than two years, has more or less prided itself on "organized disorganization" and improvisation. Three telephone calls to Houston seemed a little much.

As the date drew nearer, certain firm decisions were made: Operate two rigs on 15, 20, and 40 meters as band conditions dictated, from noon Saturday, May 17, to noon Sunday, May 18, local time; use inverted-vee antennas strung to the ship's superstructure; use the call of member Fred Opaskey WB5TSB (*T*exas State *B*attleship, phonetically); operate primarily in the lower portions of the General class phone bands; no QSL or SASE required (the club would finance printing and mailing confirmations); and make as many contacts as possible. But, operations would not emphasize contest-style contacts—ragchewing would be permitted at the operator's discretion.

The wisdom of that last decision was to become evident. It was surprising how many former *Texas* crew members, Navy veterans, and just plain ship buffs wanted to ask about the old battlewagon, her armament, and her present

condition. About mid-way through the 24-hour operation, Treasurer Lindley made a quick check of the two logs, then issued the tongue-in-cheek order, "Stretch out each contact; the postage is going to kill us!"

The Denton group arrived at dockside at 9:00 am Saturday morning, an hour before the ship is routinely opened to the public, to encounter that minor setback—nobody knew they were coming that weekend! Watkins, with the charm of a Rhett Butler at an Atlanta ball, conferred briefly with the executive officer, who made a quick phone call to Capt. Martin ("those shortwave guys are here"), and the red carpet was rolled out.

Almost as if planned, but totally by intuition, members undertook the various tasks of unloading vehicles, setting up tables, plugging in radios and accessories, cutting and stringing antennas, and running to a store for the only forgotten item: some screw-in electrical plugs. At 12:02 pm the first station went on the air, on 15 meters, and at 12:03 the first contact was made, with Curt WD6CUN in Anaheim, California. The next contact, a prearranged schedule which was hoped would be the first contact, was with W6RO (*R*olling *O*cean)—the *Queen Mary* in Long Beach, sort of "maritime immobile to maritime immobile."

The 20-meter antenna required a bit more pruning and the second station went on the air about 12:30 pm. It required a few minutes to find a hole in the heavy QRM, and the first contact came at 12:33, with Norm KB4VM, in Powell, Tennessee. That station operated steadily for the next 23½ hours with the frequency never varying more than 5 kHz in either direction from the spot of the

Fred Opaskey WB5TSB operates the 15/40-meter station while Rudy Littrell N5BKQ does the logging. Phil Huckaba KB5VX, left, lends moral support while waiting his turn.

Duncan Engler WD5IKY enjoys watching James "Abe" Abel WD5BIS work a pileup on 15 meters. Abe, who lives in Houston, served aboard the USS Texas as an apprentice seaman in 1936-37. He cut short his vacation to be on hand for the mini-expedition.

Jan (KA5HJS) and Al (KA5HLS) Faubion were among those who got a special tour of the Texas's radio room, which is not open to the public. Much of the gear is still in place in apparently well-preserved condition.

first contact.

The battleship *Texas* is open daily, 365 days a year, to the public, from 10:00 am to 5:00 pm, and since the two stations were operating in the open on the quarterdeck, they became centers of interest for many of the tourists—hams and non-hams alike—visiting the ship.

The equipment consisted of a Yaesu FT-7 with a companion 100-Watt amplifier for the 20-meter station, and a Swan 500C running barefoot through a Den-Tron Super Tuner Plus for 15 and 40 meters. In the wee hours of Sunday morning, when the Swan showed symptoms of losing its spunk, a Kenwood 520 was substituted, although the problem later proved to be one of metering rather than output. The Yaesu and linear were operated on an automobile battery connected to a 6-Amp charger and the Swan and Kenwood rigs were plugged into the ship's power system.

Most non-ham visitors indicated a vague awareness of amateur radio, but their intrigue became considerably more evident when they heard QSOs in progress, especially with stations several thousand miles distant. One of the most enthralled was Toni Tucker, a teenage clerk in the ship's gift shop. She utilized her afternoon coffee break to visit one of the stations and didn't bat an eye when operator Dennis Jump WB6OCQ/5 handed her the microphone and said, "Talk to this guy in North Carolina." But the *Texas*'s PA system shortly terminated her third-party operations with the announcement, "Will Toni Tucker please report back to the gift shop . . . immediately."

Numerous questions were asked by visitors, but the most prevalent seemed to be, "Why are you doing this?" About the best answer the amateurs could come up with was, "Because it's never been done before."

Of the amateurs who dropped by, a few were quickly put to work, and none enjoyed it more than James "Abe" Abel WD5BIS of Houston, or Bob Dills W5RWW of Dallas. Abe had learned of the mini-expedition a few weeks earlier in a 40-meter QSO with Duncan Engler WD5IKY. He was excited because he had served on the *Texas* as an apprentice seaman in 1936-37, but he was disappointed because he had made vacation plans and would be in Tennessee that weekend. But he couldn't resist the opportunity. Abe cut short his vacation and drove nonstop from Tennessee to spend several hours visiting and operating on the *Texas* Saturday afternoon.

Bob had been inactive on HF since he sold his HF gear a few years ago. He was vacationing in the Houston area, heard about the battleship operation via 2-meter repeater, and made it a point to drop by. His arrival came late Sunday morning, when operators' energies were ebbing rapidly, and somebody shoved a mike into his hand and said, "Talk to 'em." He did, for about the last hour that the 15/40 station was on the air. Bob's wife, Barbara, sat patiently in a shady spot nearby. She said with a smile, "He's having the time of his life."

At noon, Sunday, operators at both stations were still working pileups, so it was with considerable reluctance that apologies were made to those still standing by, and Willie Baker Five Texas State Battleship signed clear. The NTHFAers hated to disappoint those who had waited so patiently for a contact, but the seven-hour drive home loomed large in the red-rimmed eyes of the weary operators, especially the 11 who had spent the night on board.

The convoy home was uneventful, and the inter-vehicle chatter on .52 simplex became more and more subdued as the miles rolled by. Highlight of the return was qualifying three hams for "Worked All Denton" awards for working five or more members of the Association. The first two were Charles WA5FMK and Agnes WB5VWB Ellisor of Houston, who passed the group near the outskirts of the city and became curious about a convoy of so many Texas amateur radio operator license plates. They struck up a conversation on .52 and, since they were near home, subsequently got on their fixed station and continued the QSO for several miles, working each vehicle, in order, down the convoy.

The other WAD award went to Jimmy McCarter WD5DFQ of Mesquite, Texas, when he passed the convoy on Interstate 45 about 100 miles south of Dallas. He, too, was curious about the license plates, but a convoy member made the first call to inquire about an unusual-looking homebrew mobile HF antenna on Jimmy's bumper.

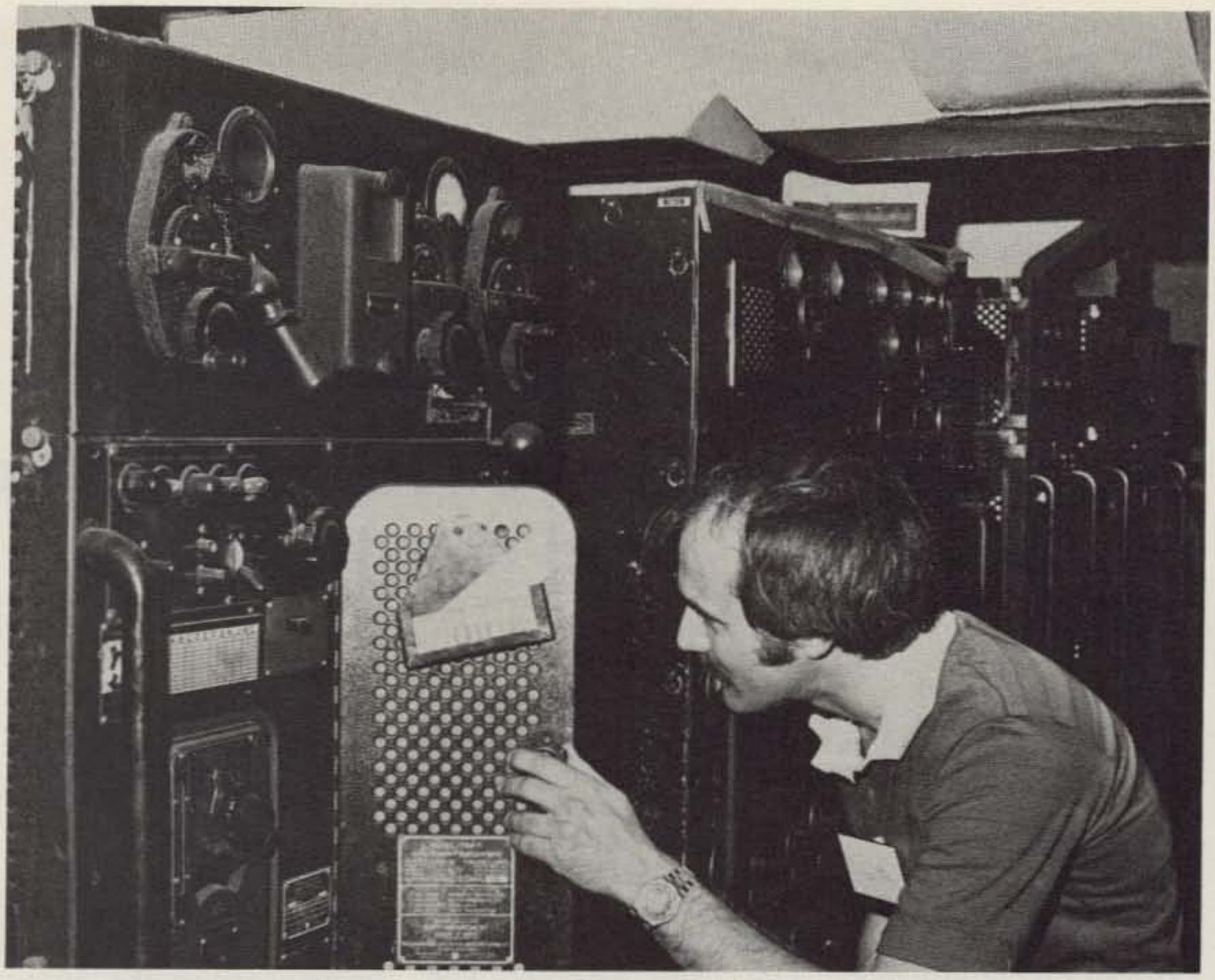
The box score for the mini-expedition went like this: 771 total contacts, plus a couple of SWLs. The total could have easily gone over 1,000 had the operation been handled contest-style. The contacts included 46 states, two VEs, nine foreign countries, and three maritime mobiles.

A special QSL card was printed and mailed to all contacts, except for a few whose addresses could not be verified, and return cards and letters trickled in to NTHFA members for weeks. One operator sought the battleship confirmation so fervently that he wrote one letter and two cards because he had antenna problems and was unsure if his brief contact was logged. "I'll understand if I'm not in the log," he wrote, "but at least send me an SWL card . . . please."

It was surprising how many contacts were made with amateurs who had a firsthand knowledge of the old ship, having served on her, worked on her, or at least been on or around her at one time or another.

"I remember the *Texas* well," said one contact. "She was escorting a convoy that I was in across the North Atlantic in the early forties, and it sure was a good feeling to look out on the horizon and see that battlewagon steaming along beside us. I remember her well."

So will members of the North Texas High Frequency Association.■



Rudy Littrell N5BKQ examines some of the old gear in the Texas's radio room, which is not open to the public. A battleship crew member gave several of the visiting hams a special tour of the below-decks area.

Dennis Jump WB6OCQ/5, a transplanted newcomer to the club, was told that sixes have to work harder—and he did. Dennis finally managed a short nap about daylight, Sunday morning.

Dr. Ken Jenkins WB6MMV/7
1801 Cedar St.
Newberg OR 97132

Inside Coax

—know what you're buying in quality and construction

Coaxial cable seems to be one of those products where any old brand will do. Just use RG-8/U for high power and RG-58/U for low power. Yet, few hams realize that a typical 300-Watt rig can lose more than 100 Watts in certain types of coaxial cable. Also, few realize that RG-8/U varies from manufacturer to manufacturer in TVI prevention capability.

The fact is that RG coaxial cables are different, varying in performance from one manufacturer to another. Cost should not be a major consideration in selecting coaxial cable. Many hams will spend thousands of dollars on a rig, tower, and beam and then scrimp on cheap coaxial cable which eats up transmitter power or S-units!

Prior to World War II, coaxial cable was unheard of. Open-wire balanced line was the standard transmission line. However, with the advent of television, open-wire line was a liability—it radiated rf into many places where it was unwanted. Open-wire feedlines also had a nasty habit of radiating weak harmonics. The solution was to design a transmission line that did not radiate rf itself, so coaxial cable was developed. These early cables were given RG designations and usually manufactured to military specifications.

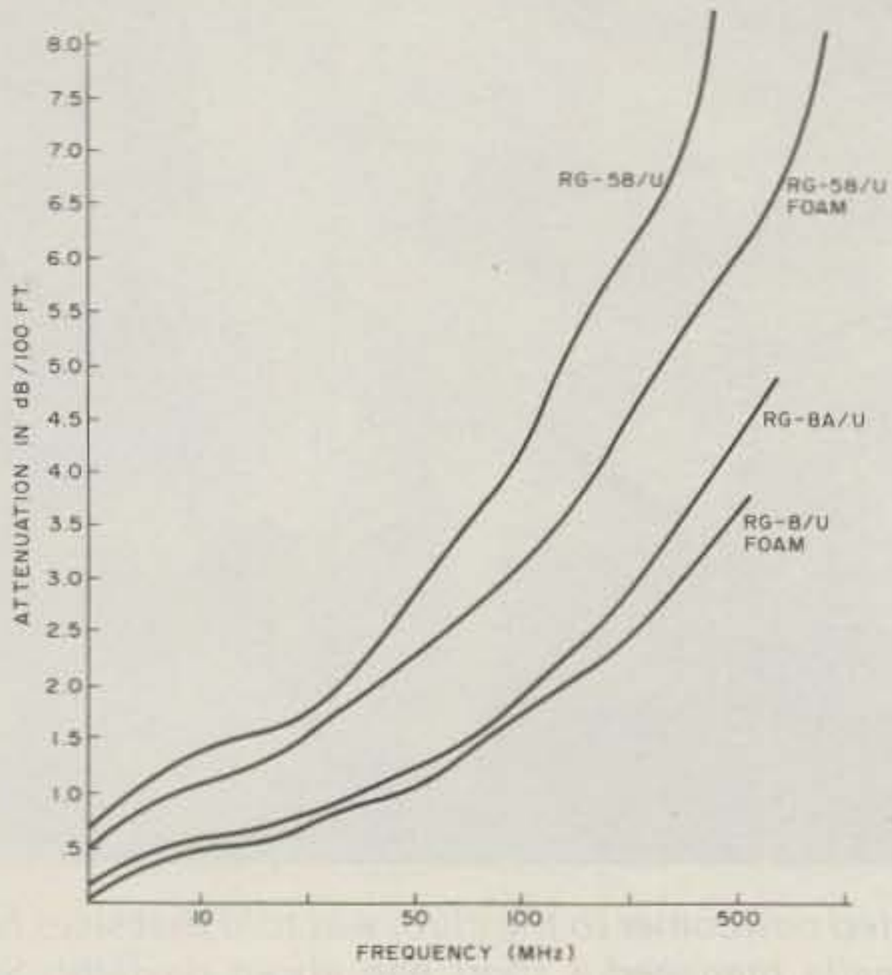


Fig. 1. Attenuation with regard to frequency.

Cable Selection

Since coaxial cable now is taken for granted, few amateurs realize the differences between one cable and another. If a construction article calls for RG-8 or RG-58 coaxial cable, most amateurs assume that any brand so labeled will do the trick. Nothing could be further from the truth. Just what does the RG- /U designation mean? The RG- /U designation refers to a standard military designation for cable which meets certain specifications and test requirements. A new set of updated standards was released by the military in 1978. The new requirements were designed to provide improved coaxial cable standards and are referred to as MIL-C-17E specifications. The basic specifications advanced by the military are covered in the following:

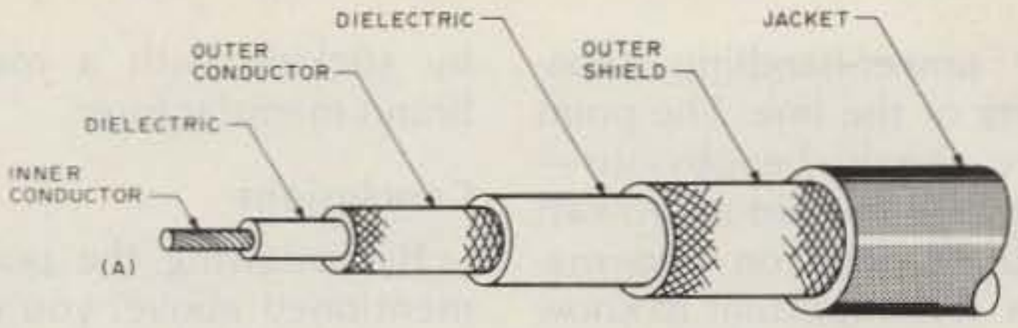
1) Center conductor—type, diameter.
2) Dielectric—composition, diameter, tolerance.
3) Outer conductor—type, number of braid layers, gauge of braid wire, percent braid coverage.
4) Outer jacket—composition and diameter.

If a cable meets the requirements and tests as outlined in the military specifications above, it is designated as meeting an RG specification. However, just because a cable is labeled as RG-8/U by the manufacturer does not ensure that it meets any of the criteria spelled out in MIL-C-17E.

Because coaxial cable is taken for granted, it is well worth spending some time evaluating which cable is best for you. The only reliable means of selecting cable is to evaluate the test data supplied by the manufacturer. There are manufacturers who do not have test facilities or the skills to actually test the cable they produce. Some don't even know what the impedance of their cable is! The military specifications provide a good set of items to evaluate your needs.

Center Conductor

The center conductor of RG-8/U-type cable should consist of seven 21-gauge bare copper wires. RG-58/U variations come with either 19 tinned 33-gauge copper wires or a single 20-gauge bare copper wire. The choice between stranded and solid conductors is easy; if the transmission line is subject to twisting or flexing, then use stranded



TRIAXIAL EQUIVALENTS

RG58A	RG50
RG59	RG73
RG11	RG75
RG8	RG57

Fig. 2. Triaxial cable construction.

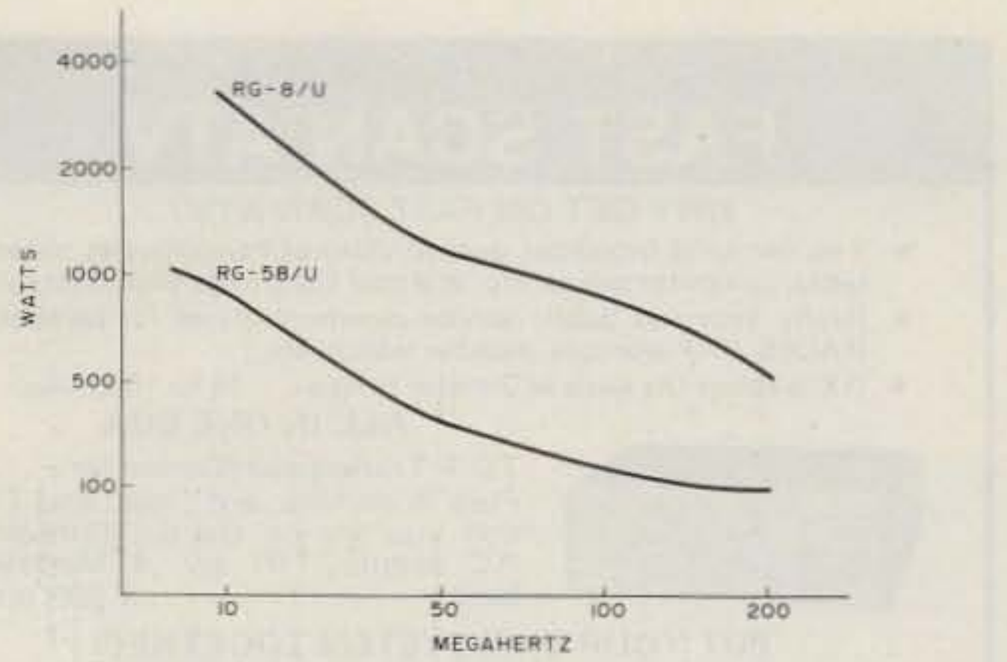


Fig. 3. Power handling capability with respect to frequency.

conductor. Typically, stranded conductor is less efficient than using a single-wire center conductor.

Dielectric

Currently there are a variety of materials being used for dielectric material. The two most common are polyethylene and cellular polyethylene or "foam." Polyethylene cable should be constructed of solid virgin polyethylene. Cable with an amber or gray color was probably made from reclaimed polyethylene scrap. Often there are bubbles in a cross section of this type of cable. This causes line imbalances, creating "loss points" along the line.

The newer and more popular dielectric material is formed by expanding virgin polyethylene with a special foaming agent. This foam dielectric has a dielectric constant of 1.5, compared to 2.26 for regular polyethylene dielectric material. The dielectric constant is very important because the closer the dielectric constant coefficient of a given cable is to 1.0, the lower the attenuating ability of that cable. The dielectric constant is also important for another reason. The dielectric between the center conductor and the outside braid forms a capacitor, and this capacitance can amount to a significant quantity. Consider the typical ham with 100 feet of RG-8/U feedline. RG-8/U has 29.5 pF capacitance/foot, while the foam coax version of RG-8/U has 24.5 pF/foot. This difference alone amounts to 500 pF. This capacitance is equivalent to a large loading capacitor across the pi network of a transmitter. This difference becomes important when evaluating coax cable for VHF work.

There is another consideration with respect to attenuation. As can be seen from Fig. 1, the attenuation of coax cable rises with frequency.

Every time you boost your radiated signal strength by 3 dB, it is the equivalent of doubling transmitted power. A simple example will help here. Compare 100′ of RG-58/U with 100′ of foam RG-8/U on two meters. The RG-58/U will lose almost 6 dB, while the RG-8/U foam cable will lose a little more than 2 dB. In other words, you would need to more than double the power with RG-58/U to achieve the same results as with foam RG-8/U.

Outer Conductor or Braid

The most visible area for spotting defective coaxial cable is in the percent of braid coverage. A good grade of coaxial cable will have at least 95% of the dielectric covered with a braid of 36-gauge copper wire. Good braid coverage is essential for TVI prevention. Double shielded coax cable can be purchased to provide 100% braid coverage. Belden 9888 is an example of double-shielded RG-8/U. Another reason to select cable with good braid coverage is because reduced attenuation occurs for cable that has the shielding characteristics of a metal tube.

An exotic variation of double-shielded cable is triaxial cable, which consists of a second dielectric between the first and second braid (see Fig. 2). This type of cable is very effective at preventing TVI from being radiated and, unfortunately, is also very expensive.

Jacket Composition

Perhaps one of the most crucial factors affecting the average coax's ability to radiate a signal is the chemical composition of the outer jacket of the cable. Most coax cable jackets are composed of black or grey polyvinylchloride. However, there are two types: type I and type IIa. The only way to distinguish between these two is to look for an "A" after the numbers in the cases of RG-8/U (RG-8A/U) and RG-59 (RG-59A/U) cable. For RG-58/U, a "C" will indicate a type IIa jacket (RG-58C/U). RG-213/U is a 50-Ohm version of RG-8A/U that has a type IIa jacket.

Type-I jackets work well until the temperature rises. When the temperature rises, the "plasticizer," a chemical added to the outer jacket to keep it soft and flexible, begins to leach through the outer braid and into the dielectric. This changes the electrical characteristics of the coax cable. Attenuation coefficients increase, characteristic impedances change, and, of course, so will swr. This leaching effect can be seen if you have any old RG-8/U or RG-58/U cable around. Strip off the outer jacket and the copper braid. If the dielectric material has a hazy black tint, then the leaching process has occurred. Good dielectric material will have a characteristic milky-white color, without a trace of black coloring. This leaching process occurs with or without heat, but heat accelerates the leaching process. Thus, buying old, unused coaxial cable is rarely the bargain it might appear to be. Old cable with a type-I jacket is probably useless as an rf carrier.

Type-IIa jackets, on the other hand, use a different method of plasticizing the jacket, with the result being the virtual elimination of the leaching effect. Thus, cable with a type-IIa jacket will last longer as transmission line. The point is simple—don't purchase coax cable unless it has a type-IIa jacket.

Power Ratings

Power ratings, like attenuation characteristics, are affected by frequency (see Fig. 3). These ratings assume a low swr which, if not present, will further reduce

the power-handling capability of the line. The point here should be obvious—don't try to feed a kilowatt into RG-58/U on two meters. It is important to know the power-handling capabilities of the cable you use, not just in general, but for the specific frequencies you plan to use.

Impedance

The critical question here is tolerance. Factors such as percent braid coverage, diameter and composition of dielectric material, and the type of outer jacket material all affect cable impedance. If a power-consuming mismatch is to be avoided, then the cable should be within 10% of its specified impedance. Usually, the tolerance of a cable can be found in the manufacturer's specification sheets. Often, when you go to the local store, specification sheets aren't available. You can play it safe in this situation by sticking with a major brand manufacturer.

Conclusions

By following the points mentioned above, you can usually avoid purchasing second-rate coaxial cable. The best cable you can buy will meet MIL-C-17E specifications. You probably won't find MIL-C-17E cable in your local ham store, and if you do, its price might shock you. The usual high quality cable in your local ham store will probably meet the previous MIL-C-17*D* specifications and won't cost as much as MIL-C-17E cable. However, MIL-C-17D specification coax cable will be adequate for most average ham use. ■

Note: Another cable worth considering is RG-8X. This grey coax is half the diameter of RG-8, displays similar attenuation and power handling characteristics (75%), and is an excellent buy.—Ed.

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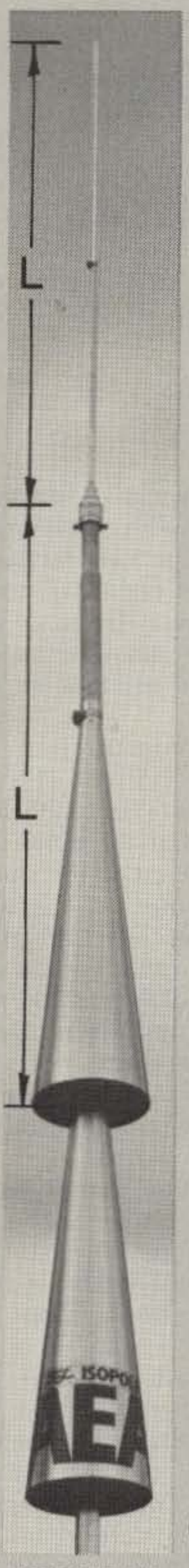

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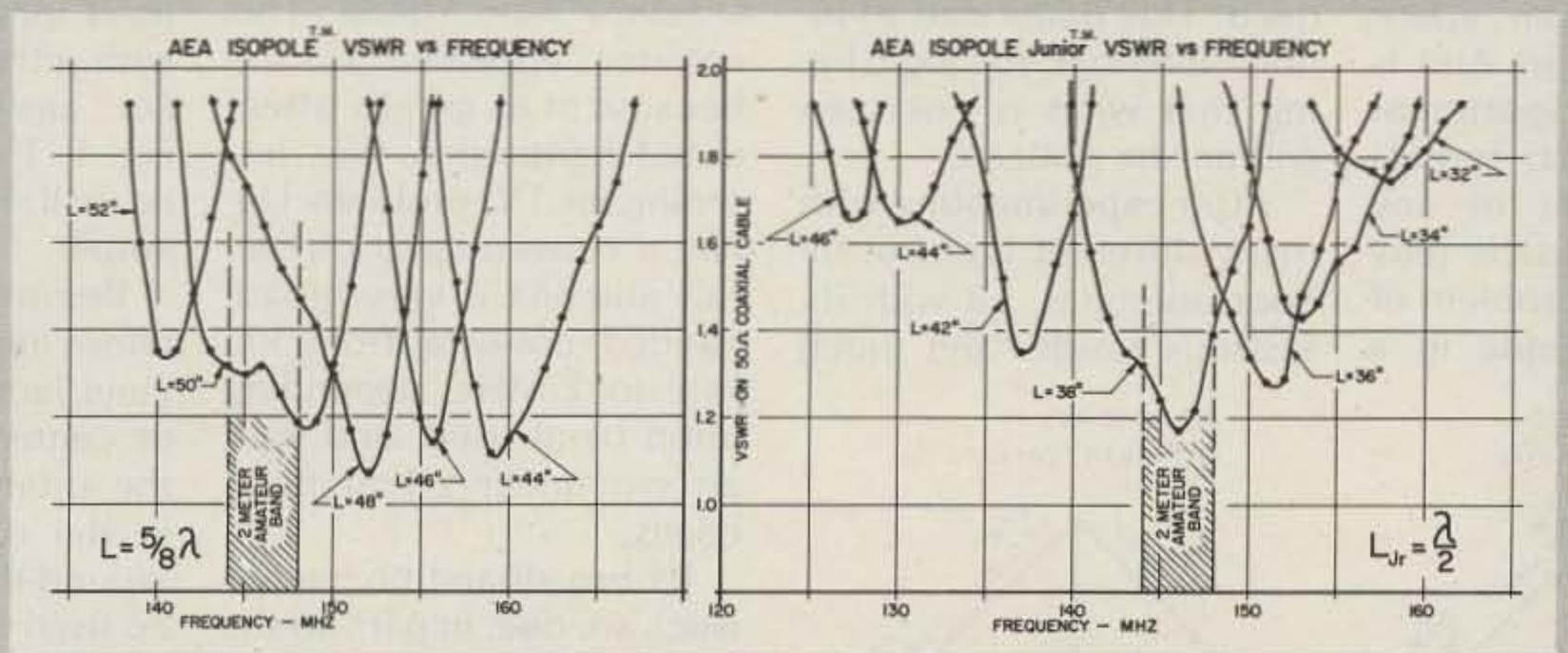

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The "No Antennas" Antenna

—a coaxial dipole is one woman's solution to problems with pesky landlords

Are you one of the unfortunate few who happens to be an apartment dweller ham? And is your landlord or apartment manager one who forbids outdoor antennas of any sort? If so, this article may be for you. The problem of erecting an antenna in a "no antennas outdoors" situation is a tricky one, indeed. This limits one to indoor antennas, the logic being that what is not seen will not be noticed.

After experimenting with many different types of indoor antennas, all with disastrous results and much TVI, I finally came upon a coaxial dipole suggested by a fellow ham friend. This antenna appealed to me because of its greatly attenuated harmonics, thus lessening the TVI problem. Unlike a conventional dipole, this antenna is very broadbanded, covering from 500 kHz to 1 MHz, depending upon band used, and with an swr under 2:1 at band edges.

Its broadband characteristics are due, in part, to the feedline being matched to the antenna and the electrical incorporation of its own balun, with the result that no add-on antenna tuner or balun is required. The coaxial dipole has a slight amount of gain over a conventional dipole, and since the vinyl jacket covers the entire antenna, it reduces static charge build-up considerably, which causes a popping noise in the receiver when discharged. Thus, the coaxial dipole is a very "quiet" antenna with slightly stronger signal punch than a conventional dipole.

Construction of the antenna is simple. One may use either RG-8/U or RG-58A/U coax, the latter being lighter in weight and easier to work with. Maximum legal power can be used with either choice of coax. For antenna lengths, see Fig. 1. The 40-meter antenna will be used as an example.

Begin construction by removing 2.5 cm (1") of vinyl jacket (1/2" each side of center) at the center of the antenna. Cut the shield in the center all the way around the coax. Care must be used so that you do not cut the dielectric or the center conductor. Next, form two leads with the shield as shown in Fig. 2. This is the feedpoint of the antenna.

From this center feedpoint, measure out each side of center 5.1 m (16' 9") and cut the coax at that point. Remove approximately 2.5 cm of vinyl jacket from each of the ends and fold back the shield so that the dielectric is exposed. Cut and remove about 2.5 cm of this insulation, being careful not to cut the center conductor. Then twist the shield and center conductor together and solder. This must be done at both ends and forms the 52-Ohm match-

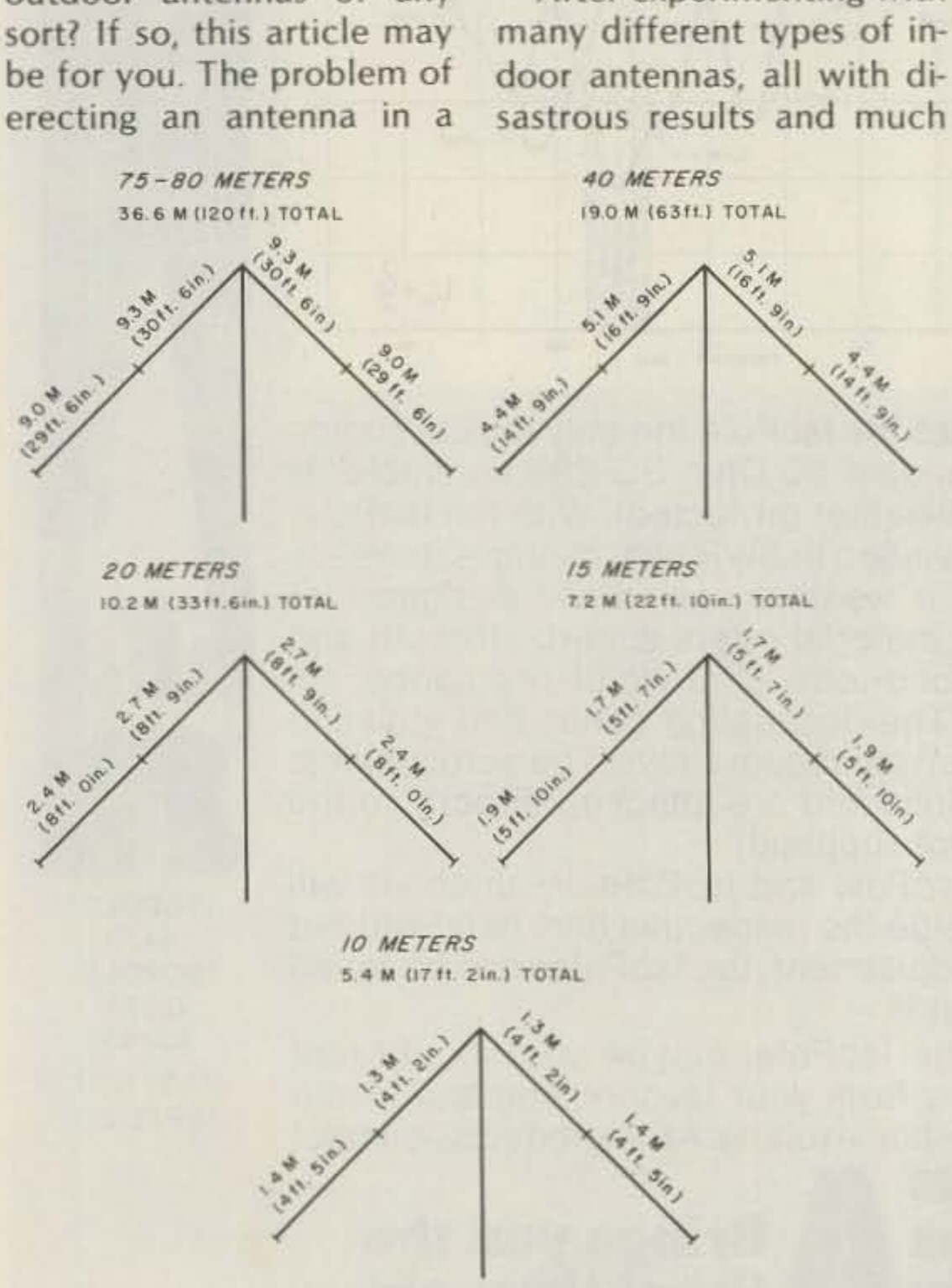

Fig. 1. Antenna lengths.

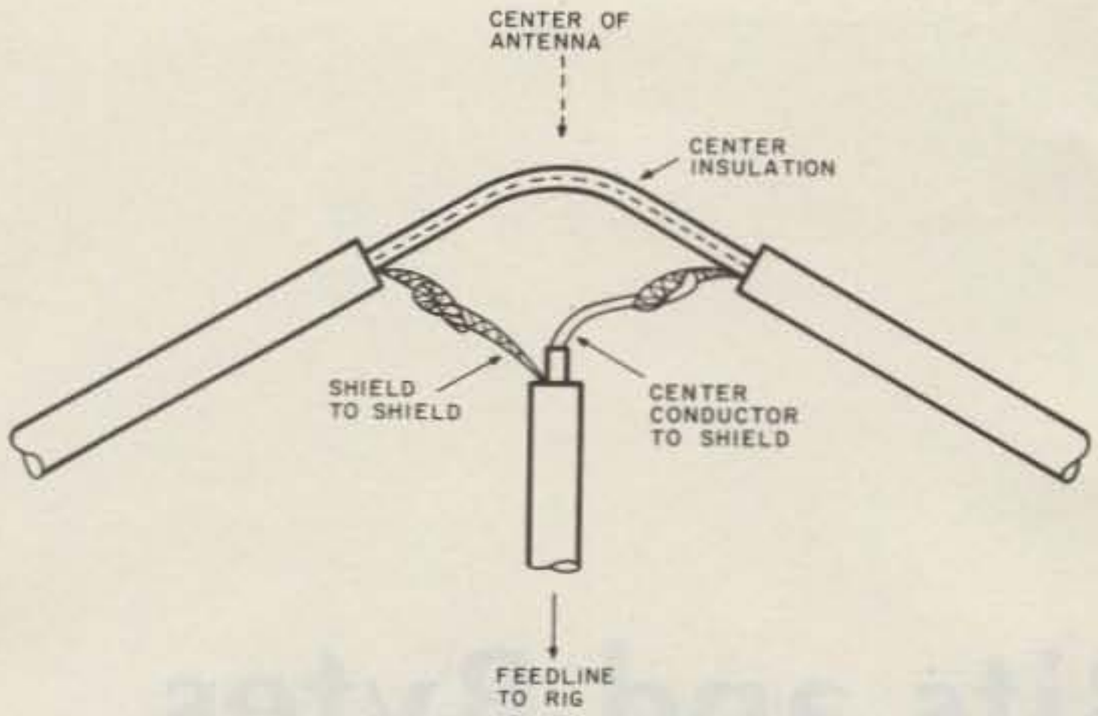

Fig. 2. Feedpoint connection.

ing section and balun.

Next, cut two lengths of coax, each 4.4 m (14′ 9″) long. Then remove 2.5 cm of vinyl jacket from all four ends, fold back the shield, remove center insulation, and twist shield and center conductor together as before. This forms the end sections of the antenna. Attach one of these end sections to one end of the matching section by twisting together the prepared ends and soldering. In the same manner, solder the remaining end section to the other end of the matching section. Waterproof these joints as best you can. Waterproofing of the ends will be done later, for they may need cutting for tuning purposes.

The next step is to attach the feedline. Any random length of coax will do, but it must be of the same type used for construction of the antenna. Remove approximately 2.5 cm of vinyl jacket from the end of feedline, fold back the shield, and remove center insulation. Form two leads with the shield and center conductor. At the feedpoint of the antenna, connect the feedline by soldering the feedline center conductor to one of the feedpoint leads. Then solder the feedline shield to the remaining lead. You may wish to waterproof this area, making sure that the feedpoint leads do not touch each other and short out. Follow this procedure for antennas on other bands.

Erecting the antenna is next. If you have access to an attic or crawl space in the roof of your apartment building, so much the better. Using monofilament fishing line as anchor ties, a series of half hitches along the vinyl jacket ends of antenna will do nicely for anchoring the antenna. The monofilament line will bite into the vinyl as it is pulled taut.

If you are not fortunate enough to have access to an attic, the antenna may be stapled to a living room or bedroom ceiling using plastic cable ties or any other non-conducting material as support. Wrap the cable ties around the antenna at intervals and staple the free end(s) of the ties to the ceiling. Do not staple directly through the antenna itself.

This antenna can be used as a dipole or inverted vee. If used as a dipole, try to erect as much of it as possible in a straight line, keeping it as far away from large metal objects as feasible. The ends may hang down as long as they don't touch any nearby metal objects. More than one antenna may be erected in the same area, providing they are run at angles to each other rather than being parallel. The reason for this is that the inactive antenna could absorb some signal from the active antenna, thereby attenuating the signal output.

After erecting the antenna, check swr and trim the ends if needed. Be sure to twist the ends of the antenna as before (shield to center conductor), then recheck swr. The antenna will interact with any hidden wiring in walls, so a considerable amount may have to be trimmed from each end. Once you have gotten the swr down to an acceptable level, solder the ends of the antenna and waterproof them if desired. This completes construction.

Aside from a low-pass filter, no other add-ons are needed, the filter being only a safety precaution. And, since the antenna is basically omnidirectional, orientation can be determined by the space available at your location.

Once you start enjoying the pleasures of operating from your apartment with this antenna, you will be amazed at what you can work and the signal reports you get with it. I have used coaxial dipoles on 10, 15, 20, and 40 meters from an apartment, and all are stapled to a ceiling in "inverted-U" fashion rather than as an inverted vee. Signal reports received vary from S-6 to 60 dB over S-9. TVI is minimal, considering my TV is only a mere ten feet from the antenna and I run 200 Watts PEP.

With these coaxial dipoles in use for over two years now, I have gotten Worked All Continents, Worked All States, and DXCC with 121 countries worked to date. So there's no telling what you can do with this antenna and you may be pleasantly surprised at the results. It sure beats non-operating just because you live in an apartment! Happy DXing! ■

Clayton W. Abrams K6AEP
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San Jose CA 95124

Slow-Scan in Bits and Bytes

—microprocessors and plug-in cards can give you flexibility on SSTV

When starting on my first slow-scan television (SSTV) project back in 1977, little help was available. To initiate even the most primitive functions required a significant effort. The microprocessor industry has advanced far in these past few years, however, to a point where hardware is available off the shelf for many applications. A home experimenter can create an entire computer system in a few hours simply by selecting cards and plugging them into a common bus where the bus is just a number of common connectors mounted on a PC board.

The concept of picking and chosing components is not a new one. This technique is standard in hi-fi systems. One can buy speakers from one manufacturer, a turntable from another, and an amplifier from a third. Why not apply this technique to computers?

You may ask, how does all of this apply to amateur radio SSTV? In this article I will discuss two components, or cards, which can plug into a common bus to create a microprocessor-based SSTV system. A system of this type, unlike its hardware-only counterpart, has great flexibility. If your ham shack is as congested as mine—see Photo A—you don't have room to install a box which is devoted only to SSTV. With these cards and a general-purpose microcomputer system, an SSTV system with unbelievable flexibility and features can be created. The system can be used for other amateur radio modes, i.e., RTTY or CW, by simple program changes.

Before plowing ahead into pages of technical details, I think a short

Photo A. Computer installation of K6AEP.

review of SSTV is appropriate.

SSTV Description

SSTV is a scheme to transmit and receive television pictures over amateur radio. The pictures have reduced resolution and are slow, hence the name.

SSTV has a bandwidth low enough to be compatible with all amateur transmitters. The pictures are received and generated from audio tones which are varied proportionately to the television rates. Typical tones are 1500 Hz for black and 2300 Hz for white, with in between tones for various gray levels. To synchronize these video frequencies, a tone (1200 Hz) must be provided. All that has to be done to interface SSTV to the amateur equipment is to plug the transmitted SSTV into the microphone jack and the received SSTV directly into the microprocessor.

The Hardware

To make a system like this possible requires the four components shown in Fig. 1. Each component is a product of modern technology and is difficult for the non-computer expert to understand. However, if you treat each component simply as a black box and don't worry about how it functions, interfacing can be easy.

I'll discuss each of the components individually, starting with the two fast-scan interfaces.

1. *The Digisector Television Camera Interface.* The Digisector is an interface card for any standard (NTSC) or non-standard (industrial) television camera. The card is available from a firm in southern California called Microworks.[1] The card is available in three configurations, allowing attachment to a number of microprocessor systems, i.e., IEEE-696 (S-100), SS-50, and Apple. All cards function in a similar manner, as follows: The cards section the TV picture up into a maximum of 256 X and Y coordinates. You can address up to 65k picture locations with the card. The card will respond to the programmed coordinates with a 6-bit (64) gray-level pixel. The card responds very quickly, within 12 microseconds maximum.

The card accomplishes this trick by using a fast sample-and-hold and a medium-speed successive approximation analog-to-digital converter. You program where you want the card to digitize a pixel by loading the X and Y coordinates in their respective ports. The port is connected to two 8-bit comparators which are in turn connected to two counters. The counters are driven by pulses derived from the camera's vertical and horizontal sync. When the programmed count equals the counter, you have a match and the video signal is digitized.

The Microworks people did this using 23 ICs for the DS-68 (SS-50) and 25 ICs for the DS-80 (IEEE-696). They did a great job with the DS-68 in cramming so much circuitry onto a small SS-50 I/O card (Photo B). The card has only two adjustments: brightness and width. The brightness is used to compensate for the camera room lighting. The width is used to adjust the maximum right-hand X coordinate location of picture digitization.

2. *The Fast-Scan TV Display Interface.* This board is one of the most recent additions to the Microworks product line. The board can be used for three unique functions:

- Fast-scan gray-level display interface. (Display has a density of 128 pixels on 128 lines with 16 gray levels.)
- Fast-scan high-resolution graphics display interface. (Display has a density of 256 pixels on 256 lines with two gray levels.)
- Static RAM board, 8K.

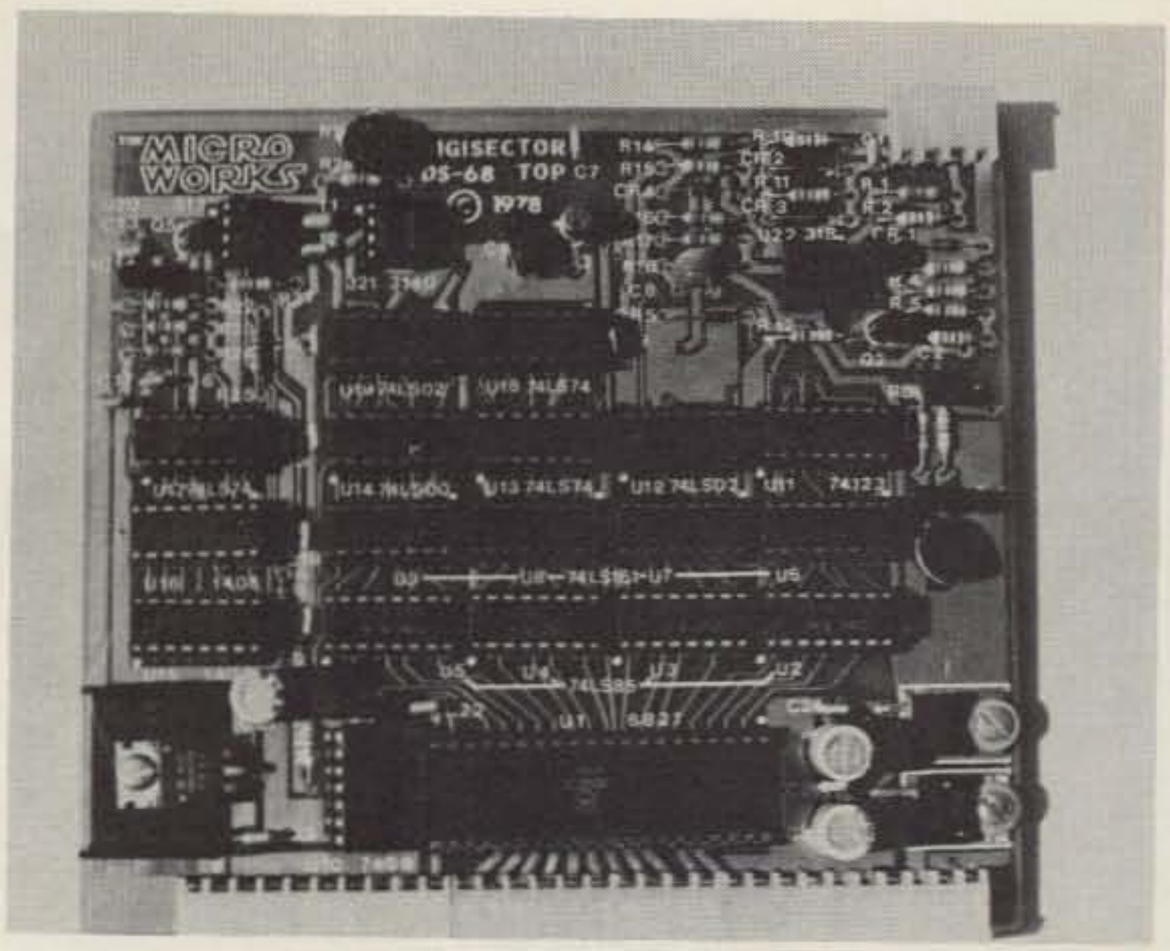

Photo B. Digisector card.

Since the purpose of this article is SSTV, the fast-scan gray-level display mode is of the most interest. To display a gray-level picture, all that has to be done is to address the card for any 8K free RAM area and connect the TV display to the appropriate output. The board has two composite video outputs, one for high-resolution graphics, the other for the gray-level display. I found it convenient to mount a switch on the top of the card to switch be-

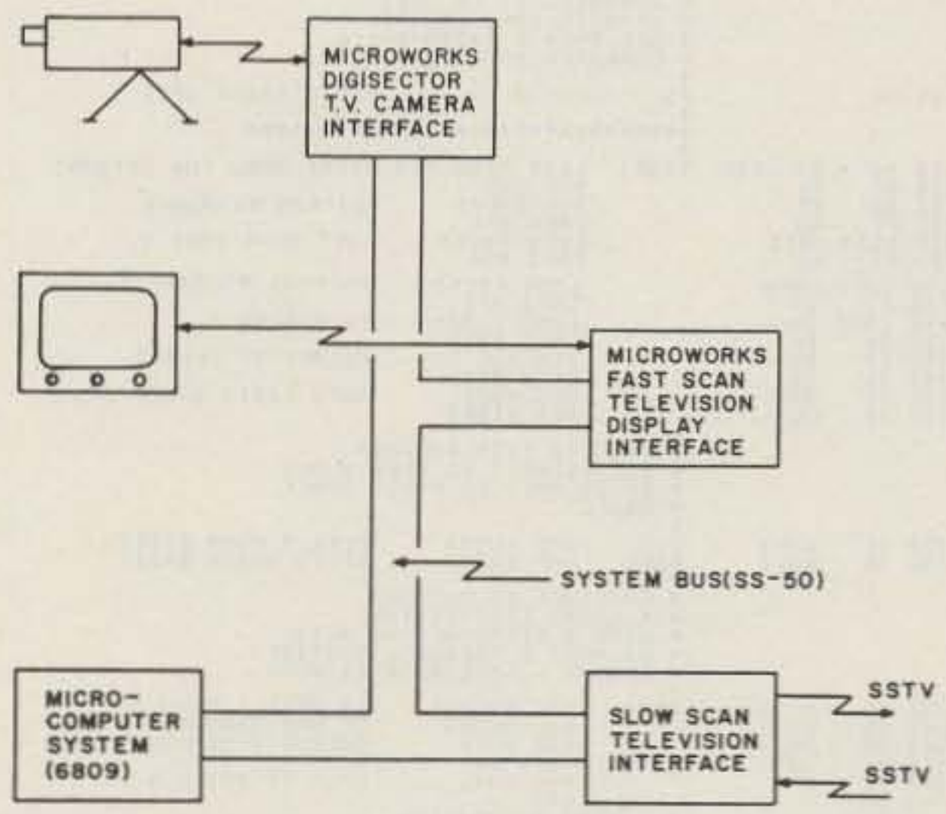

Fig. 1. Block diagram of a microprocessor-based SSTV system.

Gray-Level RAM Formatting

	MSB				LSB			
Byte in RAM	X	X	X	X	X	X	X	X
	pixel 1				pixel 2			

High-Resolution Graphics RAM Formatting

	MSB							LSB
Byte in RAM	X	X	X	X	X	X	X	X
Pixel #	1	2	3	4	5	6	7	8

Fig. 2.

Program Listing.

```
                        *
                        * SSTV PROGRAM FOR THE RECEPTION
                        * DISPLAYING AND TRANSMISSION
                        * OF AMATEUR RADIO SSTV PICTURES.
                        * THE PROGRAM IS WRITTEN IN 6809
                        * ASSEMBLER LANGUAGE AND IS WRITTEN
                        * TO RUN ON EITHER A SWTPC 6809 SYSTEM
                        * OR THE RADIO SHACK COLOR COMPUTER.
                        * THREE INTERFACE CARDS ARE REQUIRED
                        * FOR OPERATION OF THIS PROGRAM.
                        * TWO OF THE CARDS ARE AVAILABLE FROM
                        * THE MICROWORKS, THE THIRD WAS
                        * PUBLISHED IN "73 MAGAZINE" NOVEMBER
                        * 1978.
                        * PROGRAM WRITTEN BY: CLAYTON W. ABRAMS
                        * 1758 COMSTOCK LANE,SAN JOSE, CALIF
                        * 95124 (AMATEUR CALL K6AEP)
                        * DECEMBER 15,1980
                        *
                              OPT PAG
                              NAM SSTV71 FOR MICROWORKS CARDS
                        *
                        * TEMPORARY LOCATIONS IN RAM
                        * RELATIVE TO USER STACK
                        * SYSTEM STACK IS PLACED
                        * BELOW USER STACK
                        *
FFFF                    RECVC   EQU -1          RECEIVE DELAY CONSTANT
FFFD                    LINE    EQU -3          NUMBER OF PICTURE LINES
FFFB                    RPIXC   EQU -5          RECEIVED PIXELS
FFF9                    PIXC    EQU -7          PIXELS IN A PICTURE
FFF7                    MASK    EQU -9          KEYBOARD ENTRY MASK
FFF5                    INDEX   EQU -11         INDEX STORAGE
FFF3                    RLINE   EQU -13         RECEIVED LINES
FFF1                    FAST    EQU -15         CAMERA BYTE STORAGE
                        *
                        * PROGRAM EQUATES FOR
                        * I/O ADDRESSES AND VIDEO
                        * CARD
                        *
E000                    PIADA   EQU $E000       BASE ADDRESS FOR DIGISECTOR
E001                    PIACA   EQU PIADA+1
E002                    PIADB   EQU PIADA+2
E003                    PIACB   EQU PIADA+3
                        *
                        * SSTV INTERFACE BOARD
                        *
E010                    PIA     EQU $E010       BASE ADDRESS FOR SSTV CARD
                        *
                        * FAST SCAN VIDEO BOARD
                        *
8000                    VIDBEG  EQU $8000       BEGINNING OF VIDEO CARD RAM
9FFF                    VIDEND  EQU $9FFF       END OF VIDEO CARD RAM
                        *
                        * ACIA CONTROL PORT
                        *
E004                    PIACTL  EQU $E004       ACIA FOR TERMINAL
                        *
1000                          ORG $1000
                        *
                        * MAIN LINE ROUTINE TO
                        * SELECT PROGRAM OPTIONS
                        *
1000 1F 43              BEGIN   TFR S,U         PLACE U STACK SAME AS SYSTEM
1002 32 E8 EC                   LEAS -20,S      PLACE S BELOW USER STACK
1005 20 00                      BRA START
                        *
                        ************************************
                        * PROGRAM CONSTANTS FOR
                        * DELAY ROUTINES AND LOCATIONS
                        * IN RAM,ASSUMING A 1MHZ CLOCK
                        ************************************
                        *
                        * FAST SCAN RECEIVE ROUTINES
                        *
1007 21                 FRE60   FCB $21         60 HZ DELAY
1008 14                 FRE50   FCB $1A         50 HZ DELAY
                        *
                        * FAST SCAN SSTV XMIT DELAYS
                        *
1009 0044               FDELX   FDB $0044       TRANSMIT DELAY
100B 02C6               FHORX   FDB 710         HORIZONTAL SYNC PULSE (5 MSEC)
100D 1B8C               FVERX   FDB 7100        VERT SYNC (50 MSEC)
                        *
                        * MICROWORKS VIDEO
                        * CARD ADDRESSES
                        *
100F 8380               VIDEO   FDB $8380       SSTV RAM START ADDRESS
1011 84F0               VIDEO1  FDB $84F0       CAMERA RAM START ADDRESS
                        *
                        * BYTE TO TELL IF A RADIO
                        * SHACK OR SWTPC TYPE
                        * COMPUTER IS IN USE.
                        * IF BYTE IS 0 (SWTPC) IF
                        * $FF THEN A RADIO SHACK
                        * COMPUTER IS IN USE
                        *
1013 00                 RS      FCB 0           RADIO SHACK BYTE
                        *
                        ********************************
                        *
1014 30 8D 028D         START   LEAX MENU,PCR   PRINT MENU FOR OPTIONS
1018 8D 24                      BSR OUT
101A 8D 3E                      BSR INEEE       GET K/B RESPONSE
101C 81 46                      CMPA #'F
101E 1027 0176                  LBEQ FASTX      FAST SCAN XMIT ?
1022 81 52                      CMPA #'R
1024 1027 0058                  LBEQ RECFST     RECEIVE PICTURE ?
1028 81 43                      CMPA #'C
102A 1027 01F4                  LBEQ CAMER      TV CAMERA ?
102E 81 18                      CMPA #$18
1030 27 06                      BEQ ESC         ESCAPE TO FLEX 9
1032 81 08                      CMPA #$08
1034 27 05                      BEQ RSBS        GOTO RADIO SHACK BASIC
1036 20 DC                      BRA START
                        *
                        * KEYS TO EXIT PROGRAM
                        * ESC ESCAPES TO FLEX 9 DOS
                        * BS ESCAPES TO RADIO SHACK
                        * BASIC
                        *
1038 7E C003            ESC     JMP $C003       FLEX 9 WARM START
1038 7E A027            RSBS    JMP $A027       RADIO SHACK BASIC
                        *
                        * ROUTINES TO SUPPORT
                        * A SWTPC LIKE SYSTEM
                        * WITH A TERMINAL AND ACIA
                        * ON PORT 1 ($E004). ROUTINES
                        * ASSUME A 6850 ACIA IS USED.
                        *
103E 6D 8C 02           OUT     TST RS,PCR      IS BYTE A ZERO ?
1041 26 2A                      BNE OUTRS       IF NOT BRANCH
1043 80 05                      BSR OUT1        OUTPUT A STRING
1045 81 04                      CMPA #4
1047 26 F5                      BNE OUT         LOOP IF NOT A 4
1049 39                         RTS
                        * OUTPUT SUBROUTINE
104A 34 04              OUT1    PSHS B
104C A6 80              OUT2    LDA 0,X+        GET BYTE FROM RAM
104E F6 E004                    LDB PIACTL      TEST STATUS
1051 C5 02                      BITB #2
1053 27 F9                      BEQ OUT2        TRY AGAIN IF BUSY
1055 B7 E005                    STA PIACTL+1    OUTPUT BYTE
1058 35 84                      PULS PC,B
                        * INPUT ROUTINE
105A 6D 8C B6           INEEE   TST RS,PCR
105D 26 1C                      BNE INRS
105F B6 E004                    LDA PIACTL      TEST FOR BUSY
1062 85 01                      BITA #1
1064 27 F4                      BEQ INEEE
1066 B6 E005                    LDA PIACTL+1    GET K/B ENTRY
1069 34 04                      PSHS B
1068 20 E1                      BRA OUT2        ECHO BYTE
                        *
                        * ROUTINES WHICH ASSUME
                        * THAT A RADIO SHACK COLOR
                        * COMPUTER IS USED. PROGRAM
                        * USES CALLS FROM THE BASIC
                        * ROM (VERSION 1.01) ROUTINES
                        * ARE VECTORED THROUGH I/O
                        * VECTORS LOCATED AT THE BEGINNING
                        * OF THE BASIC ROM.
                        *
                        * OUTPUT A STRING
106D 8D 05              OUTRS   BSR OUTRS1      OUTPUT TILL $4
106F 81 04                      CMPA #4
1071 26 FA                      BNE OUTRS
1073 39                         RTS
                        * OUTPUT ROUTINE
1074 A6 80              OUTRS1  LDA 0,X+        GET BYTE FROM RAM
1076 AD 9F A002                 JSR [$A002]     OUTPUT THROUGH BASIC
107A 39                         RTS
                        * INPUT A BYTE TO A
107B AD 9F A000         INRS    JSR [$A000]     INPUT THROUGH BASIC
107F 40                         TSTA            IS IT A ZERO ENTRY ?
1080 27 F9                      BEQ INRS        KEEP LOOKING UNTIL NOT ZERO
1082 39                         RTS
                        *
                        * RECEIVE FAST SCAN
                        *
1083 A6 8C 81           RECFST  LDA FRE60,PCR   GET DELAY CONSTANT
1086 A7 5F                      STA RECVC,U     SAVE IT IN RAM
1088 86 40                      LDA #64         128 LINES/PICTURE
108A A7 50                      STA LINE,U
108C 86 6F                      LDA #111        111 PIXELS/LINE
108E A7 58                      STA RPIXC,U     SAVE IN RAM
1090 A7 57                      STA MASK,U      MAKE MASK NOT ZERO
1092 80 28              RFST1   BSR FPIXR       RECEIVE PICTURE
1094 6D 57                      TST MASK,U      IS MASK ZERO ?
1096 27 02                      BEQ RFST2       IF NOT GET ANOTHER PICTURE
1098 20 F8                      BRA RFST1
                        *
                        * LOCK FOR FAST SCAN OPTION
                        *
109A B6 E005            RFST2   LDA PIACTL+1    LOCK FOR A K/B ENTRY
109D 81 35                      CMPA #'5
109F 27 07                      BEQ RFST3       50 HZ RECEIVE
10A1 81 36                      CMPA #'6
10A3 27 00                      BEQ RFST4       60 HZ RECEIVE
10A5 16 FF6C                    LBRA START
                        *
                        * 50 HZ VIDEO
                        *
10A8 A6 8D FF5C         RFST3   LDA FRE50,PCR   GET DELAY CONSTANT
10AC A7 5F                      STA RECVC,U
10AE A7 57                      STA MASK,U      RESET MASK
10B0 20 E0                      BRA RFST1
                        *
                        * 60 HZ VIDEO
                        *
10B2 A6 8D FF51         RFST4   LDA FRE60,PCR   DELAY CONSTANT
10B6 A7 5F                      STA RECVC,U
10B8 A7 57                      STA MASK,U
10BA 20 D6                      BRA RFST1
                        *
                        * RECEIVE FAST SCAN PIX
                        *
10BC 17 00CA            FPIXR   LBSR INITC      INITALIZE PIA
10BF 6F 50                      CLR LINE,U      CLEAR COUNTERS
10C1 6F 59                      CLR PIXC,U
10C3 80 38                      BSR FVERT       WAIT FOR A VERT SYNC PULSE
10C5 AE 8D FF45                 LDX VIDEO,PCR   GET RAM LOACTION TO STORE PIX
10C9 AF 55                      STX INDEX,U     SAVE IT IN INDEX
10CB 86 C8                      LDA #8          DELAY FOR  FIRST PIXEL
10CD 17 0098                    LBSR DEL3
10D0 80 78              FPIXR1  BSR STORE       FORMAT BYTES AND SAVE IN RAM
10D2 30 88 40                   LEAX 064,X      SET X TO NEXT PIXEL
10D5 6C 59                      INC PIXC,U      ADD 1 TO COUNTER
10D7 A6 59                      LDA PIXC,U
10D9 A1 58                      CMPA RPIXC,U    IS IT THE LAST ?
10DB 27 07                      BEQ FPIXR2      BRANCH IF LAST
10DD A6 5F                      LDA RECVC,U     DELAY FOR NEXT PIXEL
10DF 17 0086                    LBSR DEL3
10E2 20 EC                      BRA FPIXR1
10E4 6F 59              FPIXR2  CLR PIXC,U      CLEAR PIXEL COUNTER
10E6 6C 50                      INC LINE,U      ADD ONE TO LINE COUNTER
10E8 A6 50                      LDA LINE,U
10EA AE 55                      LDX INDEX,U     GET NEXT ADDRESS IN RAM
10EC 30 01                      LEAX 1,X        ADD ONE TO IT
10EE AF 55                      STX INDEX,U     SAVE IT FOR NEXT LINE
10F0 A1 53                      CMPA RLINE,U    IS IT THE LAST LINE ?
10F2 27 08                      BEQ FPIXR4      IF SO QUIT
10F4 80 2C                      BSR FHORIZ      WAIT FOR A HORIZ SYNC PULSE
10F6 6D 57                      TST MASK,U
10F8 27 02                      BEQ FPIXR4
10FA 20 D4                      BRA FPIXR1
10FC 39                 FPIXR4  RTS
                        *
                        * WAIT FOR VERT SYNC
                        * PULSE
                        *
10FD B6 E012            FVERT   LDA PIA+2       LOOK FOR PULSE
1100 48                         ASLA            IS A PULSE PRESENT
1101 24 FA                      BCC FVERT       IF NOT KEEP LOOKING
1103 6D 8D FF0C                 TST RS,PCR      RADIO SHACK COMPUTER ?
1107 26 10                      BNE FVERT3      IF YES BRANCH
1109 B6 E004            FVERT1  LDA PIACTL      LOOK FOR A K/B ENTRY
110C 44                         LSRA
110D 25 07                      BCS FVERT2      IF AN ENTRY BRANCH
110F B6 E012            FVERT4  LDA PIA+2       LOOK FOR FALL TIME OF PULSE
1112 48                         ASLA
1113 25 FA                      BCS FVERT4      BRANCH IF STILL PRESENT
1115 39                         RTS             PULSE IS NOW GONE
                        *
1116 6F 57              FVERT2  CLR MASK,U      CLEAR MASK K/B ENTRY
1118 39                 FVERT3  RTS
                        * TEST FOR RADIO SHACK
                        * COMPUTER
1119 AD 9F A000                 JSR [$A000]     HAS A KEY BEEN STRUCK ?
111D 40                         TSTA            IS A ZERO
111E 27 EF                      BEQ FVERT4      A=ZERO, NO K/B ENTRY
1120 20 F4                      BRA FVERT2
                        *
                        * WAIT FOR HORIZ
                        * SYNC OR KEYBOARD
                        *
1122 B6 E012            FHORIZ  LDA PIA+2       LOOK FOR HORIZ SYNC PULSE
1125 84 40                      ANDA #$40
1127 27 F9                      BEQ FHORIZ      NONE PRESENT,BRANCH
1129 B6 E012            FHOR1   LDA PIA+2       LOOK FOR PULSE END
112C 84 40                      ANDA #$40
112E 26 F9                      BNE FHOR1       BRANCH UNTIL NO PULSE
1130 6D 8D FEDF                 TST RS,PCR
1134 26 0E                      BNE FHOR4       BRANCH IF RADIO SHACK
1136 B6 E004                    LDA PIACTL      LOOK FOR K/B ENTRY
1139 44                         LSRA
113A 25 05                      BCS FHOR2       K/B HAS BEEN STRUCK
113C 86 20              FHOR3   LDA #32         DELAY FOR FIRST PIXEL
113E 8D 28                      BSR DEL3
1140 39                         RTS
                        *
1141 6F 57              FHOR2   CLR MASK,U      SET K/B MASK
1143 39                         RTS
                        * TEST FOR RADIO SHACK COMPUTER
```

tween the two modes.

The board functions by allowing the on-board RAM to be refreshed at a video rate continuously. If you wish to read or write to RAM, the video-refresh process is halted for the period of reading or writing while the CPU gains control of the on-board RAM. This has a noticeable effect on your monitor as a small black line called a "sparkle." Otherwise, the picture is flawless, with a quality compatible with any commercial SSTV scan converter.

An experiment which I enjoy is running memory tests on the board. You can see how your memory test is performing. The patterns on the TV display are striking.

To understand how the pixels are formatted in memory, Fig. 2 can be used as a guideline.

You can see that if somehow the picture was placed

```
                        *
                        * ROUTINE TO GET A SSTV BYTE
                        * FROM THE INTERFACE CARD AND
                        * PLACE IT INTO RAM
                        *
1140 8D 10      STORE   BSR GETA        GET A BYTE FROM ADC
114F 48                 ASLA            FORMAT BYTE
1150 48                 ASLA
1151 84 F0              ANDA #$F0       MASK OUT GARBARGE
1153 34 02              PSHS A          SAVE IT ON STACK
1155 A6 5F              LDA RECVC,U     WAIT ONE PIXEL TIME
1157 8D CF              BSR DEL3
1159 8D 11              BSR GETA        GET ANOTHER BYTE
1158 44                 LSRA
115C 44                 LSRA
115D 84 0F              ANDA #$0F       RIGHT JUSTIFY BYTE
115F 35 04              PULS B          GET OLD PIXEL BACK
1161 34 04 ABE0         ABA             ADD THE TWO TOGETHER
1165 A7 84              STA 0,X         SAVE THEM BOTH IN RAM
1167 39                 RTS
                        *
                        * GENERAL PURPOSE DELAY
                        *
1168 4A         DEL3    DECA            DELAY TILL A ZERO
1169 26 FD              BNE DEL3
1168 39                 RTS
                        *
                        * GET A PIXEL FROM ADC
                        *
116C 34 10      GETA    PSHS X          SAVE X
116E 8E E010            LDX #PIA        PUT X AT PIA ADDRESS
1171 86 3F              LDA #$3F
1173 A7 03              STA 3,X         PUT VALUE IN SAMPLE AND
1175 86 37              LDA #$37        HOLD
1177 A7 03              STA 3,X
1179 86 38              LDA #$38        ISSUE A START ADC PULSE
117B A7 01              STA 1,X
117D 86 30              LDA #$30
117F A7 01              STA 1,X
1181 86 05              LDA #5          WAIT FOR CONVERSION
1183 8D E3              BSR DEL3        MAY VARY WITH ADC
1185 A6 02              LDA 2,X
1187 35 90              PULS X,PC       GRAY LEVEL IS NOW IN  A
                        *
                        * ROUTINE TO INITALIZE
                        * SSTV PIA
1189 8E E010    INITC   LDX #PIA        PUT ADDRESS IN X
118C CC FF30            LDD #$FF30
118F ED 84              STD 0,X         MAKE A AN OUTPUT,SET UP CTL
1191 6F 02              CLR 2,X         MAKE B AN INPUT
1193 86 37              LDA #$37
1195 A7 03              STA 3,X         SET UP B CTL REGISTER
1197 39                 RTS
                        *
                        * FAST SCAN XMIT PIX
                        * ON SSTV
                        *
1198 30 8D 0189 FASTX   LEAX MENU1,PCR FAST SCAN XMIT MENU
119C 17 FE9F            LBSR OUT        PRINT IT
119F 17 FEB8            LBSR INEEE      GET K/B ENTRY
11A2 84 0F              ANDA #$0F       CONVERT TO HEX
11A4 34 02      FASTX1  PSHS A          SAVE IT ON STACK
11A6 8D C8              BSR FTRAN       XMIT PICTURE
11A8 35 02              PULS A
11AA 4A                 DECA            DECREMENT COUNT
11AB 26 F7              BNE FASTX1      BRANCH IF NOT LAST XMIT
11AD 16 FE64            LBRA START      GO BACK TO MAIN LINE
                        *
                        * XMIT SSTV PIX
                        * SUBROUTINE
                        *
11B0 86 69      FTRAN   LDA #105        XMIT 105 PIXELS/LINE
11B2 A7 50              STA LINE,U
11B4 86 40              LDA #64         XMIT 128 LINES
11B6 A7 59              STA PIXC,U
11B8 AE 8D FE53         LDX VIDEO,PCR   SET X TO RAM POINTER
11BC AF 55              STX INDEX,U
11BE 8D 0E      FTRAN1  BSR FTRAN3      XMIT ONE PICTURE LINE
11C0 8D 0C              BSR FTRAN3      XMIT SAME LINE AGAIN
11C2 AE 55              LDX INDEX,U     SET UP FOR NEXT PICTURE LINE
11C4 30 01              LEAX 1,X
11C6 AF 55              STX INDEX,U     SAVE NEW LINE LOACTION
11C8 6A 59              DEC PIXC,U
11CA 27 29              BEQ FTRAN2      LAST XMIT LINE ?
11CC 20 F0              BRA FTRAN1      IF NOT DO IT AGAIN
                        *
11CE 34 10      FTRAN3  PSHS X          SAVE X
11D0 A6 84      FTRAN4  LDA 0,X         GET BYTE FROM RAM
11D2 1F 89              TFR A,B         SAVE IT IN B
11D4 84 F0              ANDA #$F0       MASK OUT LOW NIBBLE
11D6 30 88 40           LEAX 64,X       SET X UP FOR NEXT PIXEL
11D9 8A 01              ORA #$01        TURN OFF SYNC PULSE
11DB B7 E010            STA PIA         XMIT GRAY LEVEL
11DE 58                 ASLB            SET UP FOR NEXT NIBBLE
11DF 58                 ASLB            BY SHIFTING LEFT 4X
11E0 58                 ASLB
11E1 58                 ASLB
11E2 CA 01              ORB #$01        TURN OFF SYNC
11E4 8D 12              BSR FDEL        DELAY ONE PIXEL TIME
11E6 F7 E010            STB PIA         XMIT GRAY LEVEL
11E9 6A 5D              DEC LINE,U      DECREMENT PIXEL CNTR
11EB 26 E3              BNE FTRAN4      IF NOT LAST BRANCH
11ED 8D 13              BSR FXHOR       SEND A HORIZONTAL SYNC PULSE
11EF 86 69              LDA #105        RESTORE PIXEL COUNTER
11F1 A7 50              STA LINE,U
11F3 35 90              PULS X,PC       GO BACK TO MAIN LINE
                        *
11F5 8D 1B      FTRAN2  BSR FXVER       XMIT A VERTICAL SYNC PULSE
11F7 39                 RTS             PICTURE COMPLETED
                        *
                        *
                        * FAST SCAN PIXEL XMIT
                        * DELAY (7 MACHINE CYCLES/LOOP)
                        *
11F8 10AE 8D FE0C FDEL  LDY FDELX,PCR GET PIXEL DELAY TIME
11FD 31 3F        FDEL1 LEAY -1,Y       DECREMENT BY ONE
11FF 26 FC              BNE FDEL1       DO IT AGAIN IF NOT ZERO
1201 39                 RTS
                        *
                        * HORIZONTAL SYNC.( 5 MILLI SECONDS)
                        *
1202 7F E010    FXHOR   CLR PIA         SEND A SYNC PULSE
1205 10AE 8D FE01       LDY FHORX,PCR GET HORIZONTAL SYNC
120A 31 3F      FXHOR1  LEAY -1,Y       COUNT DOWN TILL ZERO
120C 26 FC              BNE FXHOR1
120E 7C E010            INC PIA         TURN OFF SYNC PULSE
1211 39                 RTS
                        *
                        * VERT SYNC. ( 50 MILLI SECONDS)
                        *
1212 7F E010    FXVER   CLR PIA         SEND SYNC (1200 HZ)
1215 10AE 8D FDF3       LDY FVERX,PCR COUNT DOWN
121A 31 3F      FXVER1  LEAY -1,Y
121C 26 FC              BNE FXVER1
121E 7C E010            INC PIA         TURN OFF SYNC (1500 HZ)
1221 39                 RTS
                        *
                        * TV CAMERA PICTURE FROM DIGISECTOR
                        * INTERFACE CARD
                        *
1222 8D 6E      CAMER   BSR INITCA      INITALIZE PIA ON CARD
1224 8D 5F              BSR CLFST       MAKE RAM AREA TOTAL BLACK
1226 86 01              LDA #1          FIRST X COORDINATE
1228 C6 01              LDB #1          FIRST Y COORDINATE
122A AE 8D FDE3         LDX VIDEO1,PCR GET RAM AREA FOR PICTURE
122E 6F 51              CLR FAST,U      CLEAR TEMP STORAGE BYTE
1230 B7 E000    CAMER1  STA PIADA       PLACE X ADDRESS IN PIA
1233 F7 E002            STB PIADB       PLACE Y ADDRESS IN PIA
1236 34 02              PSHA            SAVE X ADDRESS
1238 86 FF              LDA #$FF        PIA MASK
123A 7D E001    CAMER2  TST PIACA       IS PIA ZERO ?
123D 2A FB              BPL CAMER2      IF NOT BRANCH
123F B7 E000            STA PIADA       RESET PIA
1242 B6 E000            LDA PIADA       GET PIXEL VALUE FROM CAMERA
1245 43                 COMA            MAKE IT COMPATABLE WITH PROG.
1246 48                 ASLA
1247 48                 ASLA            THROW AWAY TWO LSB OF PIXEL
1248 84 F0              ANDA #$F0       GET RID OF GARBARGE
124A A7 51              STA FAST,U      SAVE IT IN RAM FOR LATER USE
124C 35 02              PULA            GET OLD X ADDRESS IN PICTURE
124E CB 02              ADDB #2         LOOK AT LINE AFTER NEXT
1250 C1 F8              CMPB #251       IS IT THE LAST LINE ?
1252 27 24              BEQ CAMER4      IF SO GIVE UP
1254 B7 E000            STA PIADA       SET X ADDRESS FOR NEXT PIXEL
1257 F7 E002            STB PIADB       SET UP Y ADDRESS
125A 34 02              PSHA            SAVE A ADDRESS
125C 86 FF              LDA #$FF
125E 7D EC01    CAMER3  TST PIACA
1261 2A FB              BPL CAMER3
1263 B7 EC00            STA PIADA
1266 B6 E000            LDA PIADA       GET THE PIXEL FROM THE CAMERA
1269 43                 COMA            FORMAT THE PIXEL
126A 47                 ASRA
1268 47                 ASRA
126C 84 0F              ANDA #$0F
126E AA 51              ORA FAST,U      ADD BOTH NIBBLES TOGETHER
1270 A7 80              STA 0,X+        STORE THE WHOLE MESS IN MEMORY
1272 35 02              PULA            GET X ADDRESS BACK
1274 CB 02              ADDB #2         LOOK FOR LINE AFTER NEXT
1276 20 B8              BRA CAMER1      DO IT AGAIN
                        * NEW X COORDINATE
                        * ADD 3 FOR ASPECT
                        * RATIO ON FAST SCAN
1278 C6 01      CAMER4  LDB #1          SET UP Y COORDINATE
127A 30 02              LEAX 2,X        ADD 2 TO THE RAM ADDRESS
127C 8B 03              ADDA #3         CAN BE CHANGED TO 2 (ASPECT)
127E 81 FD              CMPA #253       LAST A ADDRESS ?
1280 26 AF              BNE CAMER1
1282 16 FD8F            LBRA START      PICTURE IS IN RAM
                        *
                        * CLEAN OUT FAST SCAN
                        * RAM AREA FOR NEW
                        * PICTURE
                        *
1285 108E 8000  CLFST   LDY #VIDBEG     GET RAM BEGINNING ADDRESS
1289 6F A0      CLFST1  CLR 0,Y+        MAKE IT BLACK (0)
128B 108C 9FFF          CMPY #VIDEND    IS IT THE LAST ADDRESS ?
128F 26 F8              BNE CLFST1      IF NOT DO IT AGAIN
1291 39                 RTS
                        *
                        * INITALIZE CAMERA INTERFACE
                        *
1292 7F E001    INITCA  CLR PIACA       SET UP X COORDINATE
1295 7F E003            CLR PIACB       SET UP Y COORDINATE
1298 8E FF04            LDX #$FF04
129B 8F E000            STX PIADA
129E 8E FF2C            LDX #$FF2C
12A1 8F E002            STX PIADB
12A4 39                 RTS
                        *
                        * MENUS  TO PROMPT OPERATOR FOR VARIOUS ACTION
                        *
12A5 0A0D       MENU    FDB $0A0D
12A7 46 41 53 54        FCC /FAST SCAN SSTV PROGRAM (K6AEP)/
12AB 20 53 43 41
12AF 4E 20 53 53
12B3 54 56 20 50
12B7 52 4F 47 52
12BB 41 4D 20 28
12BF 4B 36 41 45
12C3 50 29
12C5 0A0D               FDB $0A0D
12C7 52 3D 52 45        FCC /R=RECEIVE FAST SCAN/
12CB 43 45 49 56
12CF 45 20 46 41
12D3 53 54 20 53
12D7 43 41 4E
12DA 0A0D               FDB $0A0D
12DC 44 55 52 49        FCC /DURING RECEIVE 5=50HZ 6=60HZ/
12E0 4E 47 20 52
12E4 45 43 45 49
12E8 56 45 20 35
12EC 30 35 30 48
12F0 5A 20 36 30
12F4 36 30 48 5A
12F8 0D0A               FDB $0D0A
12FA 46 3D 58 4D        FCC /F=XMIT FAST SCAN PICTURE/
12FE 49 54 20 46
1302 41 53 54 20
1306 53 43 41 4E
130A 20 50 49 43
130E 54 55 52 45
1312 0A0D               FDB $0A0D
1314 43 3D 43 41        FCC /C=CAMERA INPUT/
1318 4D 45 52 41
131C 20 49 4F 50
1320 55 54
1322 0A0D               FDB $0A0D
1324 04                 FCB 4
                        *
1325 0A0D       MENU1   FDB $0A0D
1327 54 52 41 4E        FCC /TRANSMIT LOOPS 1 TO 9/
132B 53 40 49 54
132F 20 4C 4F 4F
1333 50 53 20 31
1337 20 54 4F 20
133B 39
133C 0A0D               FDB $0A0D
133E 04                 FCB $4
                        *
                        END BEGIN
0 ERROR(S) DETECTED

SYMBOL TABLE:

BEGIN   1000    CAMER   1222    CAMER1  1230
CAMER2  123A    CAMER3  125E    CAMER4  1278
CLFST   1285    CLFST1  1289    DEL3    1168
ESC     1038    FAST    FFF1    FASTX   1198
FASTX1  11A4    FDEL    11F8    FDEL1   11FD
FDELX   1009    FHOR1   1129    FHOR2   1141
FHOR3   113C    FHOR4   1144    FHORIZ  1122
FHORX   1008    FPIXR   10BC    FPIXR1  1000
FPIXR2  10E4    FPIXR4  10FC    FREQ0   1008
FREQ0   1007    FTRAN   11B0    FTRAN1  11BE
FTRAN2  11F5    FTRAN3  11CE    FTRAN4  11D0
FVERT   10FD    FVERT1  1109    FVERT2  1116
FVERT3  1119    FVERT4  110F    FVERX   1000
FXHOR   1202    FXHOR1  120A    FXVER   1212
FXVER1  121A    GETA    116C    INDEX   FFF5
INEEE   105A    INITC   1189    INITCA  1292
INRS    1078    LINE    FFFD    MASK    FFF7
MENU    12A5    MENU1   1325    OUT     103E
OUT1    104A    OUT2    104E    OUTRS   1060
OUTRS1  1074    PIA     E010    PIACA   E001
PIACB   E003    PIACTL  E004    PIADA   E000
PIADB   E002    PIXC    FFF9    RECFST  1083
RECVC   FFFF    RFST1   1092    RFST2   109A
FST3    10A8    RFST4   1082    RLINE   FFF3
RPIXC   FFFB    RS      1013    RSBS    103B
START   1014    STORE   1140    VIDBEG  8000
VIDEND  9FFF    VIDEO   100F    VIDEO1  1011
```

in memory, it would automatically be displayed. When you first look at the Microworks board, you will be surprised at the small number of components (Photo C). (This card is not a production model. I include the photo even though it is not representative of the final, professional-looking product.)

3. *The Slow-Scan Television Interface.* The SSTV interface card is the only non-commercially-available interface card that I use in the system. I still use the same card which was described in *73 Magazine*.[2] I would like to redesign the card some day and use more state-of-the-art components.

This card functions by taking a dc voltage proportional to the SSTV frequency, sampling the voltage with an analog-to-digital converter, and then placing the pixel into memory. The SSTV-output inter-

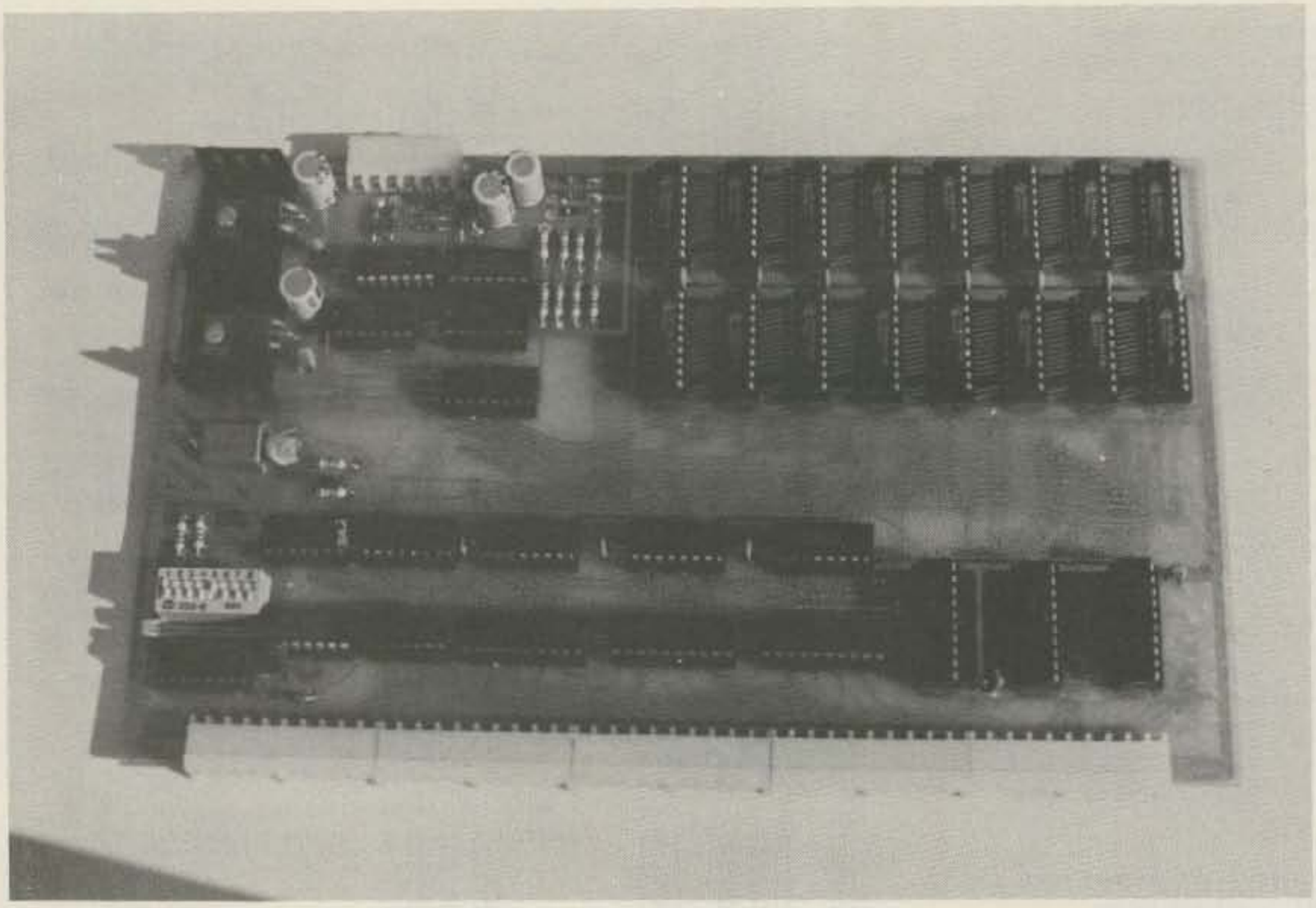

Photo C. Microworks fast-scan display card.

face takes the output from a digital-to-analog converter and feeds it into an SSTV modulator.

4. *The Microprocessor Component.* Remember to treat the microprocessor as just another system component. It can consist of a CPU card, a serial port, and a terminal. (The microprocessor also could be a more complex device such as a single-board computer.) The software which I will present later in this article can provide a software package which could be used for both system configurations.

The Microworks cards which I tested for this article are all SS-50 boards. Therefore, a motherboard must be acquired to plug in the cards if you wish to duplicate my work. The SS-50 bus has been used by a number of manufacturers since 1976. This computer bus structure is a good low-cost approach for system construction. Card costs in most cases tend to be lower than the IEEE-696 (S-100) or Apple bus. The manufacturers and numbers of cards available for this bus are large.

Another approach to interface the Microworks cards is to use a single-board-computer component which can attach to the SS-50 bus. An exciting product which will be very popular in the 1980s is the Radio Shack Color Computer. This computer was introduced in late 1980 and is the first commercial single-board computer which uses the Motorola 6809 processor. The 6809 is a very advanced processor which provides compute power which exceeds that of any of the existing 8-bit processors now available.

One of the interesting features of the color computer is the ease of interfacing. An adapter could be constructed between the side game cartridge connector and the SS-50 bus. Pins on the cartridge connector go directly to the 6809 CPU chip. All that has to be done is to add buffers on a small prototype card. Run short wires to the SS-50 bus. You can then add the Microworks cards and you have a working SSTV system.

I understand that a manufacturer will soon offer such a SS-50 adapter. For those of you who wish to construct your own adapter, Table 1 is provided. This gives a detailed description of each pin on the Radio Shack computer and the equivalent pin on the SS-50 bus.

You may ask if it is possible to adapt older Z80-based Radio Shack computers to the SS-50 bus. It is possible, but probably would take a significant effort. Since the color computer is so cost-competitive, it would be considerably easier to obtain one than to spend the time and effort adapting an older-generation Z80-based machine.

The Software

To glue all the pieces together, what is needed is a software package. The program is a software package which makes a complete SSTV system. It is written to run on either an SWTP 6809-type system or a Radio Shack color computer. The package is less than 1K in size and is written to be position-independent. This feature is available only with the 6809 processor. This means that you can key the program into any place you like in your RAM memory and it will run.

Since the program is well commented, I will not provide flowcharts but will discuss the programming of the Microworks cards in some depth.

Systems Programming. At the start of the program is a listing of program equates and constants. The program assumes that the following is the configuration of the SS-50 cards:

Keyboard Selection	Program Function
F	Transmit the picture displayed on the Microworks display on SSTV. The program will ask for the number of loops desired.
R	Receive SSTV pictures and display them until a key is struck on the keyboard. If a key other than 5 or 6 is struck, the routine will end. If the key is a 5, 50-Hz SSTV will be received. If the key is a 6, 60-Hz SSTV will be received.
C	Capture a TV image from the Microworks Digisector Card. The image is displayed on the Microworks Fast-Scan Display card.
ESC	Jump to TSC FLEX 9 DOS warm start.
Backspace	Jump to Radio Shack BASIC cold start.

Fig. 3.

Program Constant	Function
VIDEO	Picture RAM start of upper right-hand corner
Pixels/line	Constant #111 loaded in RECFST
FRE60	60-Hz delay constant
FRE50	50-Hz delay constant

Fig. 4.

✔Reader Service—see page 130

Photo D. SSTV picture via amateur radio—live shot of WB3APB on 10 meters, December 22, 1980.

TRS-80C Pin	Name	SS-50 Pin
1	−12 volts	(note 1)
2	+12 volts	(note 1)
3	Not HLT	45
4	NMI	35
5	Reset	42
6	E	39(phase 2)
7	Q	(note 2) 40 (VMA)
8	Rom init	none
9	+5	(note 1)
10	D0	1(note 3)
11	D1	2(note 3)
12	D2	3(note 3)
13	D3	4(note 3)
14	D4	5(note 3)
15	D5	6(note 3)
16	D6	7(note 3)
17	D7	8(note 3)
18	R/$\overline{W}$	41
19	A0	24
20	A1	23
21	A2	22
22	A3	21
23	A4	20
24	A5	19
25	A6	18
26	A7	17
27	A8	16
28	A9	15
29	A10	14
30	A11	13
31	A12	12
32	Select $C000-FF00	none
33	Gnd	25,26,27
34	Gnd	25,26,27
35	Audio input	none
36	Select $FF40-FF5F	none
37	A13	11
38	A14	10
39	A15	9
40	Disable BASIC ROM	none

Notes: 1. All SS-50 bus voltage must be developed on the bus.
2. VMA is developed by ANDing E and Q.
3. Data lines must be inverted on the SS-50 bus.

Table 1. Radio Shack Color Computer pinout vs. SS-50 bus.

Digisector base address	—$E000
Serial terminal	—$E004
Fast-scan display RAM	—$8000
SSTV interface	—$E010

The object code can be patched to accommodate any configuration you have. If you are using a Radio Shack color computer, the byte labeled RS should be changed to a $FF. With this change, all communications messages to and from program are routed through the BASIC ROM. One other change should be made with the Radio Shack computer. The base address of $8000 is in conflict with the extended BASIC ROM. If this is changed to $6000, the computer should be happy.

You may ask, how do I load this program into my Radio Shack computer? Well, Microworks can help out again. They can provide a monitor program called "CBUG" which will load from audio cassette tape or run in a single 2716 EPROM. The 2716 will plug directly in the Radio Shack computer in the extended BASIC ROM socket. You then will have a program in which you can use machine-language programming to load/save from the built-in audio cassette interface.

Eight bytes of program delays are placed as constants at the beginning of the program. These delays were empirically derived on my home-brew 6809 system with a 1-MHz cycle time. The Radio Shack computer operates at a 0.8949-MHz rate; therefore, all constants have to be increased slightly.

Eight program variables are defined with equates of minus numbers at the program start. These variables can be located anywhere in the memory space. Their location is defined by the location of the system stack when the SSTV program was executed. The system stack is transferred to the user stack and then decremented by 20. All references to these variables are made referenced to the user stack. This is a common programming technique which is used on advanced processors like the 6809 for program-position independence. The user stack is left at this location throughout program execution.

Main Line Software. After initialization of the user and system stacks, the START program is executed. This routine displays a menu on the terminal or TV set in the case of the Radio Shack computer. Five program options are possible, as shown in Fig. 3.

Receive Software. The receive software is very similar to two previously published articles.[2,3] Therefore, I will not discuss the basic principles in this article. One major difference between this program and the others is the formatting of pixels in memory. The memory in this case is the fast-scan display card.

A problem exists with all SSTV display systems—aspect ratio. SSTV has an aspect ratio of 1:1 where a normal TV is 4:3. Another factor which must be addressed is the type of TV which you are using. Some displays underscan the picture while others overscan slightly. In this software package, I chose to slightly overscan the SSTV picture on both the right- and left-hand borders. On the vertical, I decided to lose about 8 scan lines off the bottom of the picture. This appeared to be a satisfactory compromise. A typical SSTV picture received via ham radio appears in Photo D.

You may have to modify slightly the video-scan area to achieve optimum results. This is accomplished by modifying program constants in the areas listed in Fig. 4.

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Select alphabetic or alphanumeric plus punctuation. You can even pause and then resume.

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Photo E. TV camera picture displayed on the fast-scan card.

The only other difference in the receive routine from others published is the keyboard polling routine. During a vertical and horizontal sync pulse, the keyboard is polled to see if the keyboard has been struck. If so, the program is ended or a new program delay selected.

Transmit Software. The transmit SSTV picture software is similar to the same two referenced articles. The only major difference is in how the picture is accessed from memory. The picture in the conventional sense is rotated in memory by 90 degrees. This transmit routine accesses bytes from memory in a manner to rotate the picture and transmit it in a correct format.

Camera Software. The software to capture an SSTV picture from the Digisector card was a fun routine to write. The software is extemely time-dependent and functions as follows.

The CAMER routine grabs a picture from the TV camera in a format of 85 pixels/line on 128 lines with 16 gray levels. Why such a strange format? Well, the entire format is based upon a number of compromises of picture appearance, ease of programming, and aspect ratio. The Digisector card is great in that any type of format can be digitized from 256 pixels on 256 lines, with 64 gray levels. You can modify the format to any configuration you like by slight program changes.

Back to the Programming

What I tried to accomplish in this program was to:

- Display the entire camera frame on the fast-scan TV display.
- Make the aspect ratio as accurate as possible on the display.
- Place a black border around the picture to block out any unwanted garbage.

Photo E is a result of the programming. I might add that the lighting and the quality of my TV camera is not the greatest. In any case, you can get an idea of how it looks.

The Digisector is first initialized with the starting X and Y coordinate position in the picture. The program then waits for a response from the card. When the analog-to-digital conversion is completed, the gray level is loaded in the accumulator, formatted, and saved in a constant called FAST. This entire operation must be completed within 2 scan lines or 128 microseconds. The routine in this program takes about 56 cycles or 56 microseconds on my 1-MHz clock processor. The process is then repeated for the next pixel. This time the pixel is ORed with FAST and saved in the video RAM.

The whole process takes about 2 seconds. I was a little concerned with the grab time at first, but I found it quite easy to sit still for 2 seconds while the picture was digitized. Therefore, this condition did not present a problem.

The formatting of the picture may vary depending on the TV camera, the width setting of the Digisector, and the TV display. If you wish to change the aspect ratio for 128 pixels/line, change the $03 at location $127D to $02. You may have to adjust the constant VIDEO1 to a lower value.

Conclusions

The use of the Microworks cards to create an SSTV system is an excellent choice. Unlike the hardware-only SSTV scan converters, the cards and software approach make a versatile and expandable system. Routines can be written to create a software-only SSTV keyboard which mixes graphics and pictures. Picture enhancements can be programmed to achieve many interesting effects. You are limited only by your programming skills and time.

I would like to thank Bob Lentz of Microworks for his help in this project.

If you decide to drop me a line to ask any specific questions, please include an SASE or IRCs for my reply. ■

References

1. The Microworks, Inc., 1942 El Camino Real, Encinitas CA 92024; phone (714)-942-2400.

2. "SSTV Meets SWTPC," *73 Magazine*, November and December, 1978.

3. "Display SSTV Pictures on a Fast Scan TV," *Ham Radio*, July, 1979.

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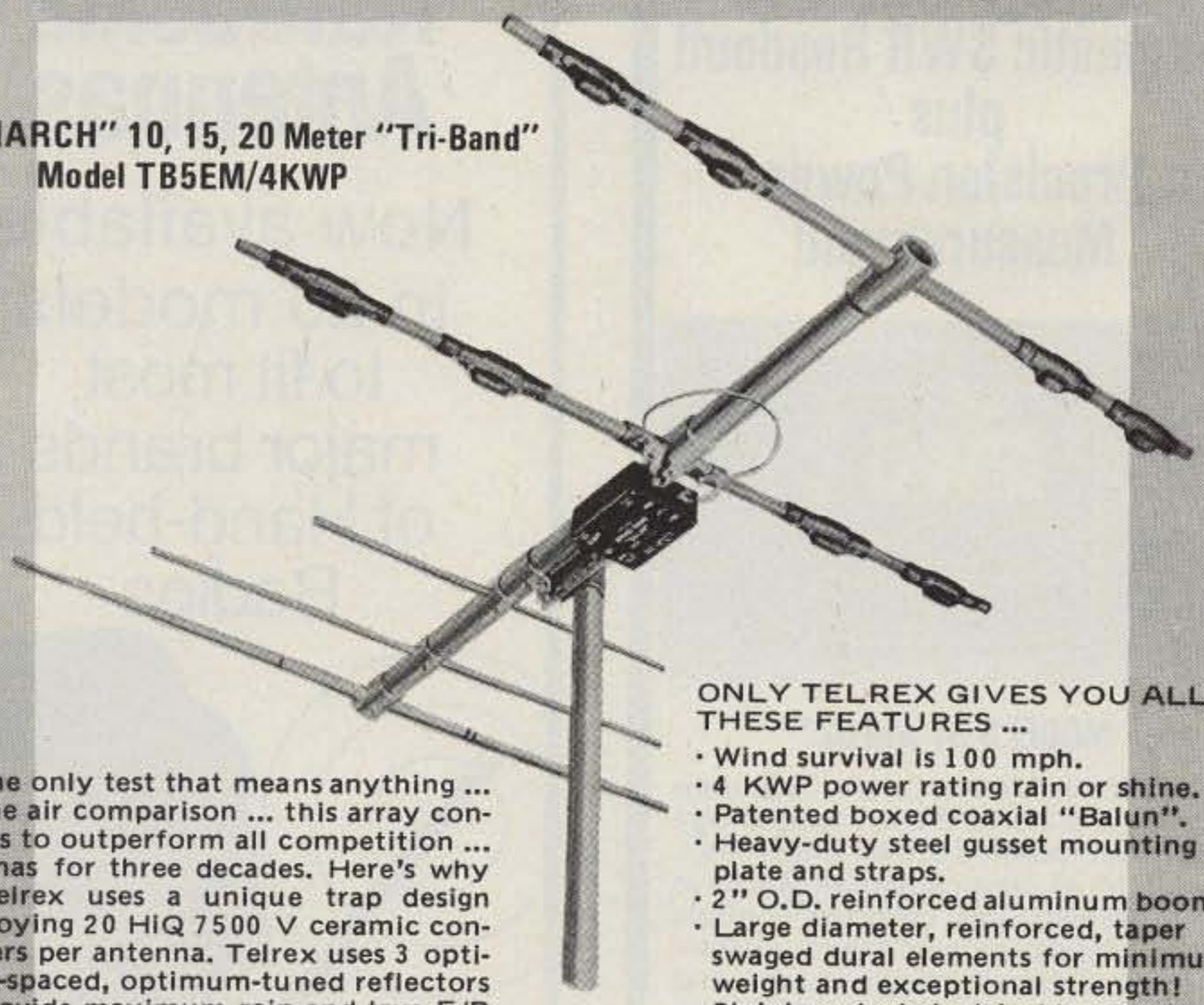

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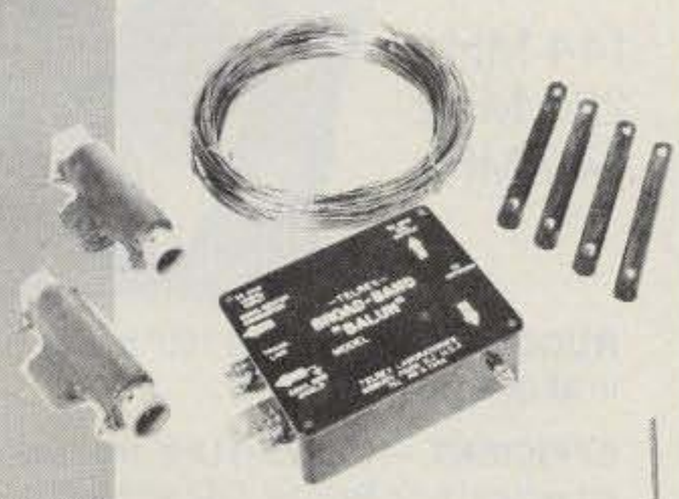

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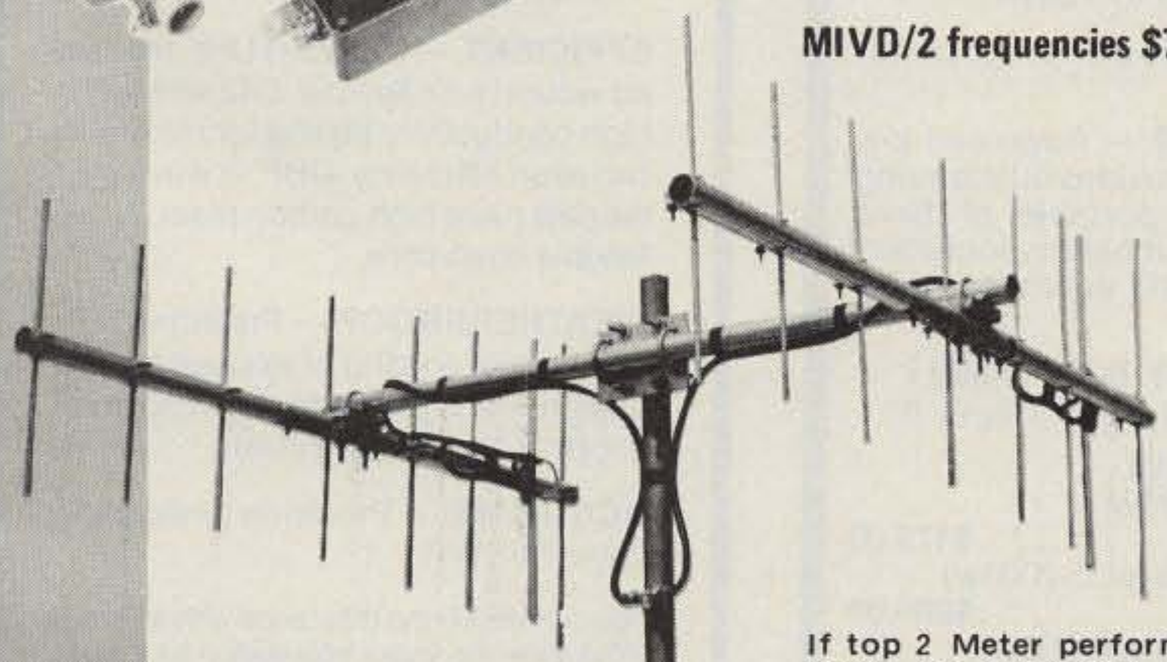

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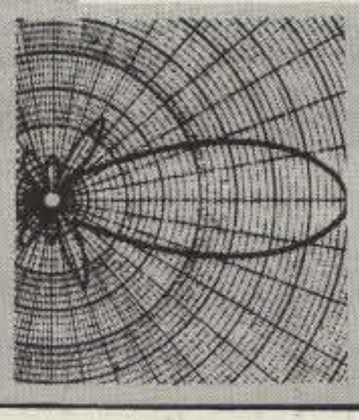

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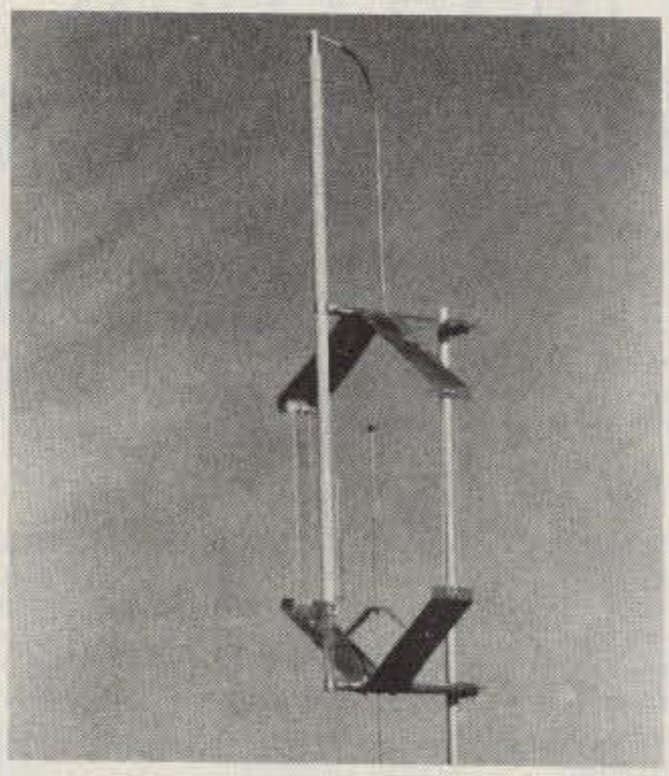

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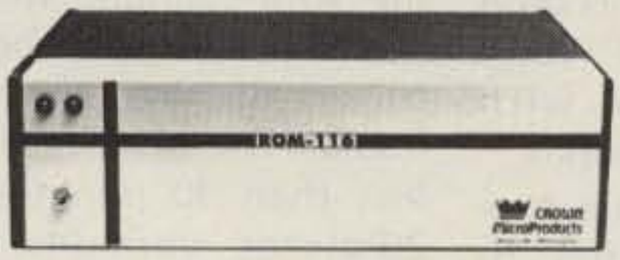

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✓Reader Service—see page 130

Jeff DeTray WB8BTH
73 Magazine Staff

Cushcraft's Skywalkers
—performance through computer-aided design

Last summer, during what has become the annual antenna renewal at W2NSD/1, a pair of four-element Cushcraft "Skywalker" monoband beams for 10 and 20 meters was added to the antenna farm. Named for *Star Wars* hero Luke Skywalker, they are but two of the six members of Cushcraft's HF monoband family, a family which includes three- and four-element versions for 10, 15, and 20 meters. Like that other Skywalker, these antennas have had a helping hand from computers, being among the first Cushcraft antennas to be designed with the aid of a new computer program.

The Dry Statistics

Cushcraft rates the forward gain of the four-element Skywalkers at 10 dB and that of their three-element relatives at 8 dB. Front-to-back ratio is 30 dB or better for all six antennas.

The 3-dB beamwidth of the Skywalker line averages about 58°. In practical terms, this means that your beam heading can be in error by half that amount, or as much as 29°, and your signal at the other end of the circuit will be down by just 3 dB. That's only half an S-unit, which all goes to show that pointing one's beam with micrometer precision probably isn't worth the trouble.

Monobanders are surprisingly light in weight, for those of us used to triband beams. The four-element 10-meter Skywalker weighs in at a paltry 18 pounds. Even the big 20-meter version tips the scales at only 55 pounds, despite its rugged construction. Wind loadings are 3.1 and 8.1 square feet, respectively. The boom of the 10-meter beam is 16 feet long, while the four elements of the 20-meter Skywalker reside on a boom 32'8" long.

Computer-Assisted Design

The Skywalkers share a common heritage in that all six antennas are the product of computer-assisted design (CAD), using a complex FORTRAN program running on a large IBM computer. With this program, an antenna designer can perform a complete analysis of a projected antenna. The program generates an accurate prediction of the performance of each new design. If an antenna looks good in the computer analysis, a prototype can then be built and subjected to real-life testing.

The advantages of CAD are several. First, considerable research and development time is saved, since a designer using the computer can analyze many potential antenna designs in a short period of time. Unproductive avenues of research can be quickly eliminated from further consideration. With the computer to do much of the tedious work, the designer can spend his time doing what's most valuable—coming up with ideas for better antennas.

Since the computer program makes it easier to check out different designs, it is more likely that unusual or unorthodox configurations will be evaluated. The four-element Skywalkers are direct beneficiaries of this. The computer program figured very significantly in the placement and dimensions of the second director. This particular combination of length and placement very likely would not have been suggested had it not been for the availability of computer analysis.

By the way, if you were thinking it might be fun to run this program on your friendly neighborhood microcomputer, think again. The program is a monster and requires the large amounts of on-line memory available only on large systems.

Assembly and Installation

Although monobanders are usually sold on the basis of their performance, the Skywalkers could be marketed on their ease of assembly alone. One reasonably bright ham can take the four-element 10-meter Skywalker from box to tower in less than two hours. Assembly itself takes less than 90 minutes. The 20-meter version, being twice as large, is more easily assembled with the aid of a helper. Still, the two of you will be able to do the job in a couple of hours.

One firm in our hobby, Heath Company, is famous for its wonderfully complete instruction manuals. Cushcraft has gone them one better, at least in a sense. The Skywalkers are so easy to assemble, you hardly even need the manual at all! Since the boom and the elements are all composed of several sections of telescoping tubing, Cushcraft has sim-

ply marked each piece with a black line to indicate how far it should be inserted into the tubing of the next largest size. You merely insert each piece as far as the black line, tighten the hose clamps, and you have yourself a monoband beam that is resonant at the bottom end of the phone band. Should you wish to be resonant in some other portion of the band, you'll need to adjust the length of the tips of the elements per a table supplied in the manual.

The antenna is matched to the feedline by something called a Reddi Match. This is Cushcraft's name for its variant of the classic gamma match. Here again, adjustment couldn't be simpler. The manual gives the proper position of a sliding bar on the matching unit. If you set this bar to the recommended dimension, a low swr is practically ensured. In the W2NSD/1 installation, this measurement to set the Reddi Match was the *only* measurement required in the assembly of either the 10- or 20-meter four-element Skywalkers.

Cushcraft recommends that antennas of similar size be mounted at least half-a-boom-length above or below a Skywalker when it is stacked with other antennas on the same boom. We initially tried a tribander just six feet above the 20-meter Skywalker, but neither antenna performed well. When the tribander was replaced with the 10-meter Skywalker, both Skywalkers came on like gangbusters.

Both antennas have just endured one of the windiest winters in recent memory, without serious problems. After a very heavy late-February snowstorm, the reflector of the 20-meter antenna was pulled askew by snow and ice accumulating at one end. This was caused by a loose hose clamp on one section of the boom. The problem turns out to be rather common with the Skywalkers, but, fortunately, there is an extremely simple, yet permanent fix. You can drill a small hole through both layers of tubing near the end of each boom section, then insert a 1/2" sheet metal screw. The screw ensures perfect alignment of the boom sections, but is easily removed if the antenna must be disassembled.

Performance vs. Cost

There is little argument that a set of monobanders will outperform a tribander, but what about the cost? Are monobanders really affordable? Well, consider this. For less than $90 above the cost of Cushcraft's ATB-34 tribander, you could own three-element Skywalkers for 10, 15, and 20 meters. Granted, you might need a heftier rotator to turn the three monobanders, but the point is that monobanders don't have to be outrageously expensive.

Should everyone go for monoband beams, then? Of course not. A triband beam is less expensive, easier to install, and probably will require less maintenance than three monobanders. However, when and if you become attracted to the competitive aspects of ham radio, monobanders may be in your future. When you get the urge, the Skywalkers from Cushcraft are a good bet.

For further information, contact *Cushcraft Corporation, 48 Perimeter Road, PO Box 4680, Manchester NH 03108*. Reader Service number 490.■

Lee Hornstein AE3S
9079 Meadow Heights Rd.
Randallstown MD 21133

Avanti's 10-Meter Quad

It was my intent to have an outstanding signal on 10 meters with a small and light antenna before the band went to sleep for the next couple of years. My present 10-meter yagi loaded well but performed like a dummy load. The yagi was interlaced on a 21-foot boom with 4 elements on 15 meters. The 15-meter yagi was an excellent performer, but the 10-meter antenna just didn't do the job. Below this setup was a 5-element monobander for 20 meters. Obviously, there was not much room for another supersized yagi.

For the past couple of years I had been hearing good things from the 11-meter boys about the PDL II by Avanti Communications. Many stations on the CB band were using this quad-like antenna because they could easily switch from horizontal polarization to vertical or vice versa. Contacts were much more solid because of this unusual ability. It was noticed that as band conditions shifted and signal polarity changed from vertical to horizontal, the PDL maintained transmitting and receiving capabilities.

With all this in mind, I went to see my local amateur radio dealer and asked if he had one of those Avanti PDLs on the shelf. To my surprise, he had a 10m one ready to go. The 10- and 11-meter antennas are identical except for minor changes on the element wires and the gamma match dimensions.

That evening, I read through the Avanti manual to familiarize myself with the materials and construction of the PDL. There were lots of instructions and illustrations, and many parts. The actual assembly went rather quickly; in fact, before I realized what had happened, the whole superstructure was almost completely assembled before me. Part of the antenna had to be disassembled before I could get it through the

back door to the yard.

Once out in the yard, I put the pieces back together and began measuring the copper wire for the two quad loops. The wire elements mounted easily and the tension on each side was adjustable. For the first time since I have been building quads (22 years), the loops were beautifully symmetrical.

The only detail which proved to be tricky was adjusting the antenna for lowest swr. I tried to match the vertical and horizontal to the same point of resonance as well as the lowest swr. Maybe I didn't have to go through all the exercise of standing on the picnic table with the PDL, but I felt it might make my signal a bit better.

With the antenna mounted at 65 feet, swr was almost the same as when it was tested on the ground. The highest swr was 1.9:1 and the lowest was 1.2:1 between 28.550 and 28.700. The highest swr in the entire band from 28.0 to 29.6 was only 1.9:1, which is quite unusual. I was very pleased that the PDL resonated exactly where it is supposed to.

The Avanti 10-meter PDL uses quality materials, although it's my normal practice to replace any stock hardware with stainless. The construction details and illustrations were quite adequate. Actual on-the-air tests prove I now have a performer. The Avanti consistently gets through. In a recent test with my neighbor Al K3BVC, comparing his 3-element tribander with my PDL, a PY2 gave me 59+10 and Al a 57. Most Japanese called are now answering my first call, and that's not easy from the east coast! I have also received reports of 10-dB increases when switching from vertical or horizontal feed on the PDL. It is a good feeling to know that I have selected a performer instead of the dummy load that used to be up there!

For more information, contact *Avanti Communications, 340 Stewart Ave., Addison IL; (312)-628-9350.* Reader Service number 477.■

Karl T. Thurber, Jr. W8FX
317 Poplar Drive
Millbrook AL 36054

VoCom's Collapsible Whip for HTs

— 5/8-wave from 144 to 450 MHz

Handie-talkies (HTs) are great fun, but their low power output and typically inefficient rubber ducky antennas limit their range and effectiveness. There are basically three ways to increase range: (1) stand on a hill or other unobstructed location; (2) add a power amplifier; or (3) hook up the unit to a more efficient antenna.

The first solution is fine if you can always manage to operate from a good location, but unrealistic for on-the-go HT work. The second will do the trick, but you end up converting your portable hand-held to a *semi*-portable when bulky externals are added. The third seems to hold the most promise and is much easier and less expensive to accomplish than adding an external amp to your HT.

Adding a *quarter-wave* whip to an HT is no big deal and usually entails cutting a length of small-diameter stainless steel rod stock to about 19" and slapping it into an appropriate connector. The problem, if any, that ensues is a mechanical one—that of finding a way to secure the rod stock in a small BNC, PL-259, or F-type connector.

Harnessing a *5/8-wave* whip to an HT is another story. A base-matching network is required to ensure that the transceiver "sees" a 50-Ohm load. Doing this presents problems, both electrical and mechanical, since the whip must be fastened to the matching coil, and the coil must in turn be mounted to the connector. Several designs have been suggested in the amateur literature, but most require some fancy machining or else result in mechanically inferior "Rube Goldberg"-like products. Another problem is that of tuning and matching: How does one insert an swr bridge at the base of the antenna without seriously affecting the measurements? In most cases, one *doesn't*; he or she cuts the antenna and builds the matching network as closely as possible to spec as he can, hoping that any mismatch will not be serious enough to damage the HT's final rf output transistors or trip the swr protection circuit.

Having wrestled with these kinds of problems before, I was attracted to VoCom's ready-to-go 5/8-wave HT antenna, the ads for which claimed that the device was "...just like adding a 10-Watt amp to your 2-meter hand-held." I sent for one and found the product that arrived to be a very good one.

The VoCom antenna, which was shipped via UPS in a small cardboard mailing tube, is a 10-section collapsible whip, somewhat similar to those found on CB handie-talkies and portable AM-FM radios, but of heavier design. The antenna, designed to permit extension to a full 5/8-wavelength (47") on 2 meters, collapses to 8"— about the same length as a rubber ducky. A pretuned matching network is included, and the base spring/tuned coil protects the whip and radio from various "accidents." At present, the antenna is offered only with a BNC connector, but the firm is working to overcome the mechanical problems associated with using other connectors. Claimed swr is better than 1.5:1 over the

entire 144-148-MHz band. (The HT should not be operated with the antenna collapsed, as the whip would no longer be resonant and an excessive swr would be presented to the HT. This could cause damage to the rf output transistor(s).)

As furnished, at full extended length the whip is designed for optimum performance on 2 meters. However, the antenna will resonate at any frequency from about 143 MHz to 450 MHz simply by changing the length of the collapsible whip. The company has produced a chart of the required resonant lengths for various frequencies, which is available on request.

Wondering just how the very good swr figures reported were measured, I contacted the manufacturer. Fred Glenn K9SO, president, advised that VoCom uses production test fixtures the same approximate size and shape as amateur hand-held radios. These test fixtures are fed through Bird wattmeters to determine the resonant point and swr. Fred also advised that a fairly good approximation of resonance could be obtained by mounting the antenna directly to a wattmeter/swr bridge as long as other objects were kept at least one-half wavelength from the radiating portion of the antenna to avoid distortion in the measurements.

Obviously, using an HT-mounted antenna of any kind results in less-than-perfect ground-plane effects. These effects markedly influence antenna pattern and thus overall results—as much or more so than do matching considerations. VoCom found that the HT itself and the operator's body capacitance provide an adequate ground plane for the 5/8-wave antenna; an ideal ground plane would yield optimal results. Nevertheless, the firm reports tests which measured a 5.6-dB improvement over the standard quarter-wave HT-mounted whip, and a nearly 10-dB improvement over the common rubber ducky.

In evaluating the little antenna's on-the-air performance, I immediately noticed the difference between it and the stock ducky. Tested under a variety of conditions, repeaters that were marginally readable at my QTH on the ducky were very nearly full-quieting, and it was frequently possible to access machines that were unusable before because of inadequate signal from the HT.

Partially extended VoCom 5/8-wave 2-meter HT antenna is shown here installed atop an Icom IC-2AT transceiver. Ten-section antenna is base-matched and boasts a 5.6-dB gain over a 1/4-wavelength whip and as much as a 10-dB improvement over stock rubber ducky antennas, according to the manufacturer's measurements. (Photo courtesy of VoCom Products Corp.)

All things considered, at $24.95, supported by a 1-year warranty, the antenna is a very nice range-extending accessory to have.

For more information, contact *VoCom Products Corporation, 65 E. Palatine Rd., Suite 111, Prospect Heights IL 60070; (312)-459-3680.* Reader Service number 476. ■

✔Reader Service—see page 130

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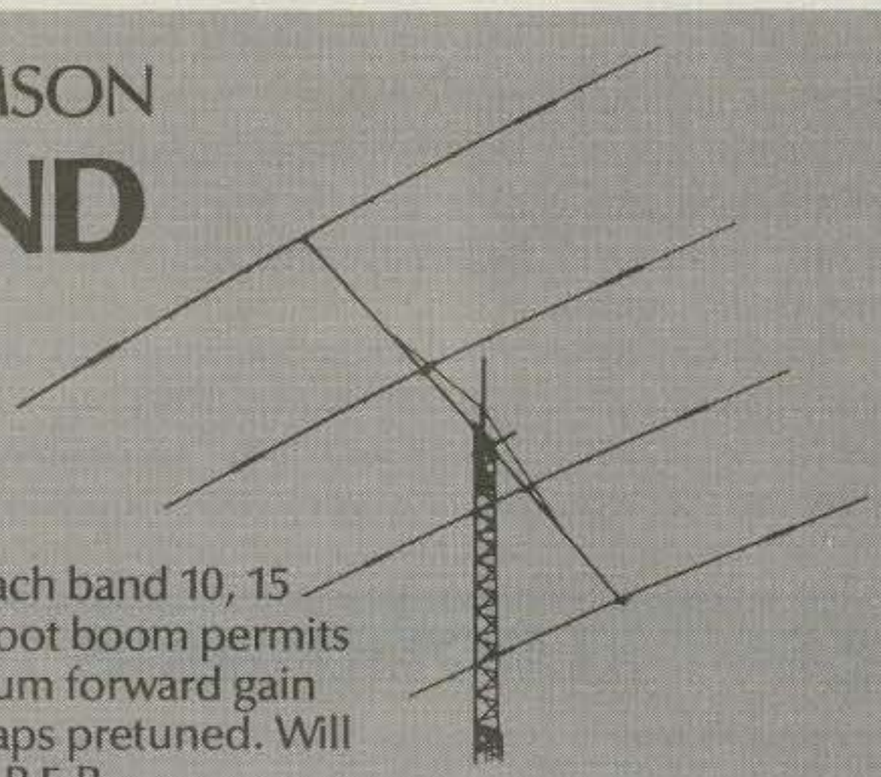

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I am in need of a schematic for a Dumont 224A oscilloscope of World War II vintage. I will gladly pay.

Gordon Fulp
Rte. 3, Box 572A
Placerville CA 95667

I'm looking for a schematic for the Edgecom FMS-25. Thanks.

Mark M. Maddox KL7IWT
Rte. 3, Box 46
Rapid City SD 57701

After several years of trying to complete my collection of *73 Magazine* through scrounging at hamfests and trying to keep up a subscription through years of military service, I need help for the final few issues. I desperately need the January, February, March, and April 1961 and November 1960 issues to complete my private collection! I have many extra issues between 1965 and 1974 to swap or sell at 50¢ each. I also need a power transformer for a Heath HO-10 monitor scope.

Bill Ward W4PCK
5521 Ashwood Drive
Anniston AL 36201

I need diagrams for the following: GBC Electronics (Japan) type VR-621 and Packard Bell Model 920 "Sync-Lok" TV cameras; Precision Aparatus Co. series 858 VOM; Jackson Electronic Model TVG-2 TV sweep generator; G.E. "Accent 450" mobile model EU-EG48ST8. I will pay reasonable fee and postage.

Joel Jones W4JQB/7
PO Box 745
Airway Heights WA 99001

I need manuals and/or schematics for the following pieces of equipment. Copy yours and return or state price: Aerovox Model 97 LC checker; Precise Development Corp. oscilloscope, Model 300; Anadex Counter, Model CF-203-4R; ME-74/U electronic voltmeter type RUQ; VHF-AM receiver (Collins); Chadwick Helmuth sweep sync, Model 201R.

Anthony T. Lux KC4MI
1421 Eastern Avenue
Rocky Mount NC 27801

I am a high school Spanish teacher and a General class ham. In order to improve my operating skills in Spanish, I am searching for technical and practical materials written in Spanish. Could anyone provide me with a source of such materials?

Patricia Knasinski WD9FQA
Winchester Community
High School
700 North Union St.
Winchester IN 47394

I need a schematic and/or manual for a Hallicrafters S-38E. I'll pay copying and mailing costs.

Paul Grupp KA1LR
RFD
Marlborough NH 03455

I have a Sears and Roebuck CB radio, model 934 36772600, which I would like to convert to 10 meters. This is an ac/dc 23-channel SSB rig. I would appreciate any info on converting this rig. Thank you.

D.L. Hecox WA7IRT
6517 Brookview Lane N.E.
Cedar Rapids IA 52402

I need service info/diagram on Collins KWS-1 transmitter. Will pay reasonable cost for info, copies, etc.

Harold D. Wright K4MFN
Rte. 1, Box 259
Chancellor AZ 36316

Just a note to say thanks to all of you at *73 Magazine* for placing my request for Ham Help in your January, 1981, issue. I quickly received many offers of help and obtained the manuals and schematics I needed. It's this kind of service provided by your magazine and the friendship of those who responded that makes our hobby so enjoyable. Thanks for a great magazine, keep up the good work.

Phillip R. Lofton
Collierville TN

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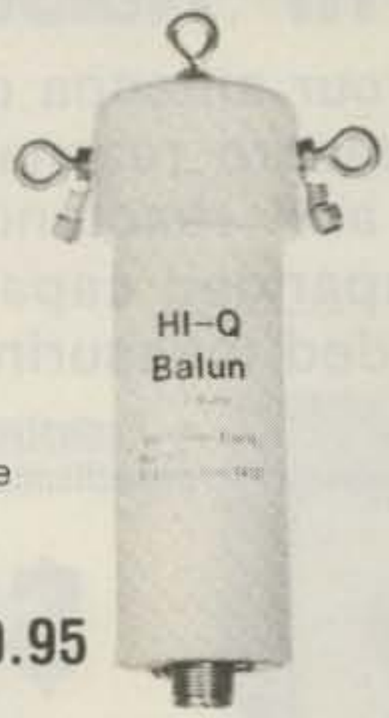
- Helps eliminate TVI
- With SO-239 connector



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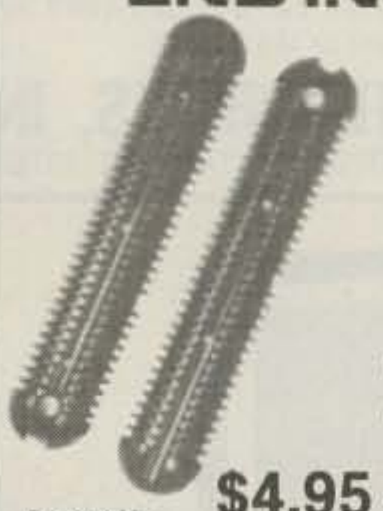

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D-10	10	16'	22.95	18.95
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SD-80	80/75	90'	31.95	27.95
SD-40	40	45'	28.95	24.95
Parallel dipoles				
PD-8010	80,40,20,10/15	130'	39.95	35.95
PD-4010	40,20,10/15	66'	33.95	29.95
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PD-4020	40,20/15	66'	29.95	25.95
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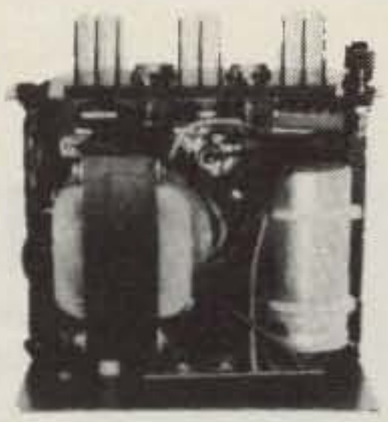
RS-4A	3	4	3¾×6½×9	5	$ 43.95



Inside View — RS-12A

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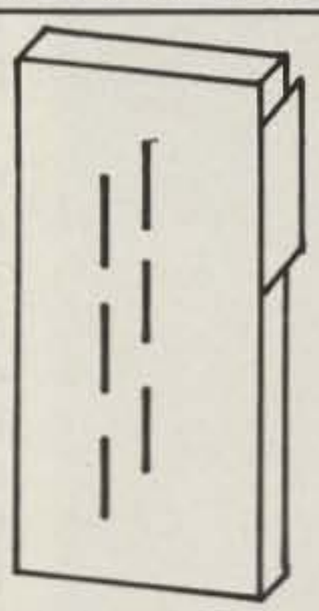

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Karl T. Thurber, Jr. W8FX
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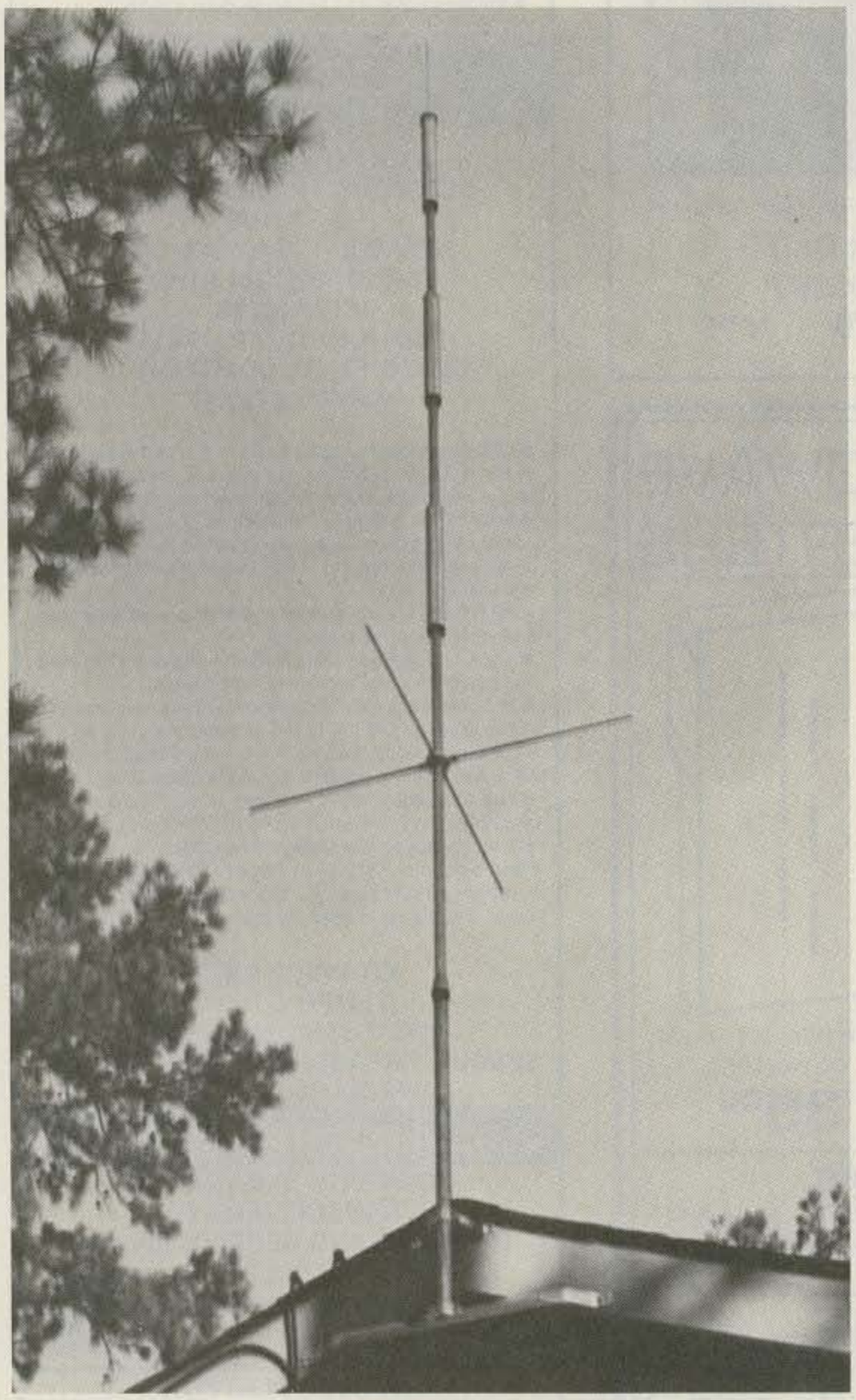
Kreco's SC-150A 2-Meter Collinear

— a commercial-quality antenna built to take it



Kreco four-element collinear antenna gives an approximate 6-dB gain on 2 meters. A quarter-wave radiator, three quarter-wave sleeves, and a ground-plane section constitute the antenna's main components.

In the infancy of this writer's amateur radio experience, back in the seemingly prehistoric 1950s, heavy, massive "plumber's delight" beams were all the rage. Indeed, you were "in" if your tower sported an array that appeared to be crafted by no less than a master plumber. I was, therefore, fondly reminded of the "good old days" by recent ads showing the line of VHF antennas sold by the Herb Kreckman Company of Cresco PA.

The Kreckman catalog displays a line of antennas for the ranges 25-50 MHz, 72-75 MHz, and 108-470 MHz that is geared for the commercial FM two-way trade. Most of the firm's sales are to installers for taxicab fleets, police and fire departments, government agencies, paging services, and related applications. For obvious reasons, the antennas furnished these users must be rugged, maintenance-free, and require little or no tune-up or other installation adjustments.

Most of the Kreco antennas are not particularly useful to hams, and they tend to the expensive side due to their exceptional ruggedness. However, I was intrigued by one particular stacked VHF antenna in the catalog, the SC-150, which is a four-element vertical collinear delivering a stated gain of about 6 dB. It can be factory-set to any frequency within the range 108 to 174 MHz, which includes the two-meter band.

Three versions of the antenna are available, with varying degrees of ruggedness. The relatively lightweight (3-1/2 lbs.) SC-150A is built of aluminum and requires a threaded 3/4" support pipe. The intermediate-duty SC-151A is similar electrically, but is made of slightly heavier materials and weighs 4 lbs.; 1" pipe is required for the supporting mast. A third and extremely durable version is the SC-155, which weighs 4-1/2 lbs. and requires a 1-1/4" support pipe. Several brass versions are available for premium installations. (Weights given do not include the weight of the user-furnished supporting pipe.)

I opted for the SC-150A, the lightweight aluminum version, which I thought would be equivalent in construction to typical amateur-grade VHF antennas, and also in the same price category (cost of the SC-150A is about $66). I or-

dered the antenna factory-cut for 146.5 MHz.

After assembling the antenna (which is UPS shippable) and mounting it on a length of 3/4" pipe, I found that I now had a plumber's delight of my own (the pipe forms an integral part of the antenna). The radiator itself is a quarter-wavelength of sturdy aluminum rod, which is supported by a special ceramic insulator into which the user-supplied pipe threads, along with the PL-259 connector for the feedline, which runs down the pipe. A quarter-wave sleeve drops down over the pipe at this point, forming a coaxial antenna. Two more coaxial quarter-wave sleeves are used for decoupling and gain-enhancing purposes at appropriate intervals down the mast, and a ring supporting the four quarter-wavelength radials is located at a point down the mast which is six quarter-waves (or 1-1/2 wavelengths) from the feedpoint.

The antenna performed well, when compared with my Cushcraft Ringo Ranger. Gain claims were not verified, but seemed to be reasonable, and the antenna offered a good match to RG-8/U coax. Particularly impressive was the antenna's obvious physical strength. Though living in a relatively benign climate, I can picture this antenna much more than some defying the elements at a mountaintop repeater or remote base location.

In trying to be objective, I should emphasize the fact that the antenna must be mounted on pipe. Regular galvanized types are fine, but stay away from aluminum or steel TV mast sections. The antenna feedpoint insulator assembly is threaded for 3/4" pipe, and it will not accept an unthreaded TV mast. Also, the antenna's coaxial sleeve sections are designed around the pipe o.d. (outside diameter), which affects the resonance of the cavity between the skirt i.d. (inside diameter) and the pipe o.d. I purchased and had threaded a 12-foot length of 3/4" pipe (the minimum required), plus an adapter to 1" pipe and a 3-foot section of 1" pipe used to attach the assembly to a standard TV-type eave mount. All this plumbing set me back nearly $18, which added to the total cost of the antenna.

Practically all of the Kreco antennas use the pipe as an integral part of the antenna. Most models are available in aluminum or brass, and each is equipped with a female UHF connector so that a one-piece feedline may be used between the antenna and the transmitter. Type N connectors are also available. Lightning protection is automatically provided by a gap inside the insulator assembly. All models are designed to handle any reasonable power level, being limited only by the power-handling capability of the coaxial transmission line feeding the antenna.

Several particularly interesting antenna designs surface in the Kreco catalog. These include a number of low-VHF band *shunt-fed* coaxial antennas; these boast excellent lightning protection since external surfaces are all at ground potential. A large round cap at the tip of the vertical rods on these antennas conducts electrical discharge down through the pipe and to ground via the tower or supporting structure. Two *folded* ground-plane antennas, one for 25-100 MHz and the other for 108-175 MHz use, are available that offer considerably wider bandwidth than ordinary ground planes; they also afford improved lightning protection by virtue of the grounded radiator element. Several unusual 3-element yagis are also made by Kreco, using folded ground-plane driven elements. Most of the antennas can be retuned to the 6-, 2-, or 1-1/4-meter bands, and some are adaptable for 10 meters.

For the "wideband specialist," for the lack of a more suitable term, the firm also sells a group of commercial discone antennas that boast swrs below 2:1 over an 8-to-1 frequency range. Several models are available, including ones for the ranges 30-240 MHz, 100-800 MHz, and 150-1200 MHz. In these models, the disc and cone are not continuous, but rather are fabricated of 12 radials each. A note in the Kreco catalog advises that the discone antennas can be furnished for various frequencies starting at *4 MHz!*

The company also sells a very modestly priced ($19.95 delivered) 2-meter 1/4λ coaxial antenna, the CO-2A, also designed for pipe mounting. For more information on this antenna, see the "Review" section in the January, 1981, issue of *73*.

All things considered, the SC-150A I evaluated represents a good antenna choice. It's a bit expensive and heavy for the typical amateur installation, but in those instances where ruggedness, durability, dependability, and freedom from maintenance are paramount, it would be a hard choice to beat. For repeater or remote base use, it looks close to ideal.

For more information, write to the *Herb Kreckman Co., Spruce Cabin Road, Cresco PA 18326.* Reader Service number 478. ■

TS-830S *from page 67*

Too low and the noise is not eliminated; too high and audio distortion may occur. Once the happy medium is found, the blanker works quite well on pulse-type noise such as faulty power line transformers and automobile ignitions.

A 20-dB rf attenuator is selectable from the front panel. It becomes useful when you operate the rig in the presence of strong local signals while still hoping to hear the weak ones.

The RIT control has a ±2-kHz range. There is a separate XIT for offsetting the transmitted frequency.

One receiver function leaves me completely cold. This is the Tone control, which is concentric with the VBT knob. To my ears, the audio sounds mushy when the Tone knob is set to any position other than full treble. The manual has almost nothing to say on this control function, causing me to wonder if it was included merely to occupy an otherwise unused control position. I'd like to hear from anyone who has found a use for this control!

The Transmitter

Compared to the receiver, the transmitting portion of the 830S is simple and straightforward. It uses a proven combination of vacuum-tube final amplifiers with solid-state supporting circuitry. The tubes used are a 12BY7 driver and a pair of 6146B finals, both common varieties.

The conventional design of the output stage means that the transmitter must be tuned up, a relatively rare skill these days given the profusion of broadbanded solid-state rigs on the market! Fortunately, a "tune" position on the mode switch allows tune-up to be performed at reduced power, protecting the final

tubes from undue wear and tear. Once learned, tune-up is a 30-second procedure.

The speech processor in the 830S is an rf clipper with two stages, one in the VBT circuit and one in the i-f. A small front-panel knob allows adjustment of the compression level. This setting is rather critical, with about 10 dB of compression on voice peaks being about right. More than 10 dB of compression results in a less-than-pleasing voice quality. Incidentally, when headphones are being used, you can listen to your transmitted audio by pushing the "MONI" switch on the front panel, just to the left of the main tuning dial. I find this indispensable in properly setting the compression level.

VOX controls for gain and delay are also located on the front panel, with anti-VOX on the rear panel. The range of adjustment is wide enough to accommodate almost any microphone you're likely to use with the 830S. A high impedance mike is recommended.

The 830S features semi-break-in operation on CW, with the VOX circuitry and controls performing the task. Hams with electronic keyers should be advised that the 830S employs negative keying, with −65 V at the key jack.

As the 830S is delivered from the factory, the three new WARC bands are enabled only on receive. Getting the rig to transmit on the WARC bands is a relatively simple procedure, requiring the clipping of diodes on the rf circuit board.

The Manual

Kenwood's instruction manual for the 830S contains all of the basic operating information, a small section on maintenance and alignment, and little else. Hams planning to do any serious work on their 830S will be advised to purchase a service manual from Kenwood. The lack of even a rudimentary "Theory of Operation" section in the manual is especially annoying, particularly to anyone attempting to write a review of the rig! The manual does contain a set of small but serviceable schematics, although you may need a magnifying glass to read them.

On the Air

On the theory that competition is an excellent test of machines as well as men, the 830S was pressed into service in the CW section of the 1981 ARRL DX Contest. The rig was operated, mostly on 20 meters, for 48 straight hours. Since our 830S is not equipped with CW filters, we debated whether it should be used at all. We finally decided to try it, cranking the VBT control to the minimum bandwidth of 500 Hz, in an effort to get the selectivity needed for contesting. The results were very gratifying. Not only did the 830S go the whole weekend without missing a beat, but also it turned out to be a fine CW rig even without the accessory filters. I imagine that dyed-in-the-wool CW operators will opt for the crystal filters, but even without them, the 830S does a nice job.

One thing becomes clear after you've operated this rig for a while. That is that Kenwood did some heavy thinking about how best to "human-engineer" the TS-830S. Take the knobs on the front panel, for instance. There are 5 distinctly different shapes and sizes. The result is that your mind quickly becomes attuned to seeking out the "small, flat knob" when selecting a meter function, or looking for the "tall, round knob" when going for the VBT. This difference in physical appearance is coupled with a very thoughtful layout, in which the most-used controls are placed in the most convenient positions. Compared to brand-new radios from other manufacturers, and even compared to the old 820S, the TS-830S gets high marks on human-engineering.

Summary

What we have here is an HF ham rig that is evolutionary, as opposed to being revolutionary. Kenwood obviously wanted to produce a worthy successor to the 820S, and they have done so, with a price tag that is lower than the 820S. The aspects of the 820S that endeared that rig to its admirers have been retained in the 830S, while more modern receiver attributes have been added and the layout of controls improved a great deal. If, in these days of the solid-state avalanche, you still feel more comfortable with a pair of nice, friendly 6146Bs, then Kenwood has a radio for you—the TS-830S. It's destined to become an industry standard.

For further information, contact *Trio-Kenwood Communications, Inc., 111 West Walnut, Compton CA 90220.*■

PCS-3000 *from page 71*

rear). High power is adjusted by VR408 and low power by VR407, both near the center of the board. Auxiliary offset crystals are near the front, and can be "pulled" to move the offset up or down, via adjacent inductors, by as much as 15 kHz.

Performance

Of course, all this microcomputer convenience is great. But how does the unit perform? I connected my new PCS-3000 to a fixed outdoor antenna and wattmeter/swr bridge, and after getting acquainted with the microcomputer, I ran some tests.

My radio, on my particular wattmeter, puts out 27 Watts in high power and 6 Watts in low power with a 1.1:1 swr on the antenna. (The PCS-3000 is swr protected to the point that you can transmit into an open or short circuit; high swr will no doubt result in lower power output, but you don't have to worry about burning out the final amplifier.) The low-power level is internally adjustable by means of a potentiometer, VR407, in the center of the board on top of the main unit, over a range of zero to 25 Watts.

Other stations reported excellent audio quality, without exception. Realizing that folks sometimes tend to be overly courteous, especially when they know you've just bought a new rig, I pressed the issue. I asked them specific questions, such as "Does it sound tinny or bassy? Is there any background noise or distortion on modulation peaks?" Still, nobody had anything bad to say.

Received audio quality was also superior. I connected my own external speaker up to the rig via the 1/8-inch phone plug on the rear of the main unit. I haven't heard a better FM rig.

My PCS-3000 uses five Amperes in high power. My supply delivers six Amperes, so this is no problem. A couple of lantern batteries in series probably won't do it, though.

I also conducted tests for microphonics. While talk-

ing to a friend, I literally pounded on the radio and dropped it from a height of a few inches onto the table (which was protected by a placemat!). In both receive and transmit, there was no detectable noise on the signal, except for the noise in transmit that was picked up by the microphone ("What are you doing to that radio, man?").

Mobile Operation

You'd better get acquainted with the microcomputer before you go out and try to operate this radio while driving. Once you're familiar with it, it's easy and convenient to use; it'll almost operate itself.

Here in Miami, the interior of an automobile can rise to formidable temperatures even in the winter. Would this have any effect on the audio quality? Tests with other stations indicated it didn't, other than to produce intermittent gasps and a rather sleepy sound on the part of the operator.

I made a special point to inquire about alternator whine or ignition noise on the transmitted signal. I've never had any trouble of this kind in the past with previous rigs, so I guess my car is pretty quiet in that respect. There wasn't any of this kind of problem with my PCS-3000. Other stations reported the same excellent audio quality in mobile operation as in fixed operation. What about background-noise pickup? Well, going 55 mph into a stiff breeze with all the windows rolled down and a semi truck passing me, I have to confess that other stations noticed quite a bit of background noise. But I was still "solid copy."

The digital "S"-meter, consisting of five red bar-type LEDs, is very sensitive. A full-quieting signal always lights all five of them. If a signal is so weak that none of them is lighted, it's almost unreadable. (Incidentally, even the weakest of weak signals will stop the scan.) The meter reacts very rapidly to changes in signal strength such as "picket fencing." No mechanical meter could possibly follow this.

In an unfamiliar area, the programmable band-scan feature is very convenient. You may want to scan the entire 2-meter FM band, but it is useless to waste scanning time covering a bunch of frequencies you know won't have any FM signals. I program 145.11, the lowest repeater output frequency in the United States, into memory 7 and 147.39, the highest, into memory 8, before going on long trips. The PCS-3000 scans about five channels per second, which is roughly 25 kHz per second using 5-kHz increments and 50 kHz per second using 10-kHz increments. To cover the above range, the scanner takes one minute and 29 seconds in 5-kHz steps and 44 seconds in 10-kHz steps.

Interesting Quirks

One thing that I discovered, after several hours of operation, is that this radio actually has a hidden memory channel. What's more, it is instantly available at any time, just like the priority channel, memory 1. The PCS-3000 remembers the frequency you're on just before you go into memory mode. When you leave the memory mode, you're back on that frequency.

I usually set my rig to 146.52 before I go into memory mode, so that I can instantly go back to this important simplex frequency. Usually, I have 146.52 programmed into memory 7 as the lower limit of the band scan and don't want to duplicate it in memory 1.

If you program the band-scan limits in backwards—that is, the upper limit in memory 7 and the lower limit in memory 8—the scanner won't work. In this case, as soon as you hit BAND SCAN, the microcomputer will go to memory channel 7 and stay there, blinking just a bit as it scans that one channel over and over!

The "channel lock" switch, located on the microphone and used for monitoring the repeater input frequency, operates by making the microcomputer think the radio is transmitting when it is actually receiving. Since the keyboard is disabled in transmit mode, the channel lock switch also has this effect. You can still transmit on the repeater input frequency when this switch is activated.

It's almost as if this microcomputer radio has its own personality traits. I already feel as if I "know" it!

Specifications

I was able to actually check only a few of the specs on my PCS-3000, and have marked those with an asterisk, in the list of vital statistics given in the literature—see Table 1.

Introductory price for this rig (at the time of this writing) is $339 with the free touchtone pad kit. All accessories such as power cord, fuse, microphone, and mobile mounting bracket/hardware are included. Optional accessories include an external speaker, extra dc cord and plug, extra mobile mounting bracket, 15-foot cable for remote-head operation, 6-Amp ac power supply, and touchtone microphone back kit. The PCS-3000 is distributed by *Amateur-Wholesale Electronics, Inc., 8817 S.W. 129 Terrace, Miami FL 33176;* call toll-free, 1-(800)-327-3102. Reader Service number 479.■

✓ Reader Service—see page 130

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73 ON THE AIR

Starting this month, W2NSD/1, our station here at *73 Magazine*, will be on the air each Tuesday evening between 8:00 pm and 11:00 pm EDT (0000 and 0300 UTC Wednesday). An operating schedule is provided for May and June.

In order to meet as many of our readers as possible, we will be operating in the General class portion of most bands. You will find us somewhere within the first 25 kHz of each General class segment, so on 20-meter phone look for us between 14.275 and 14.300, on 40 meter CW find us between 7.025 and 7.050, etc. Our Novices and Technicians will be operating in the first 25 kHz of the Novice bands on 80, 40, and 15 meters.

We will be operating on two bands per night, using the higher frequency band for the first half of the operating session and the lower frequency band for the second half of the session.

The operator could be any of our licensed staffers, and don't be surprised if the OM himself answers your call some Tuesday evening.

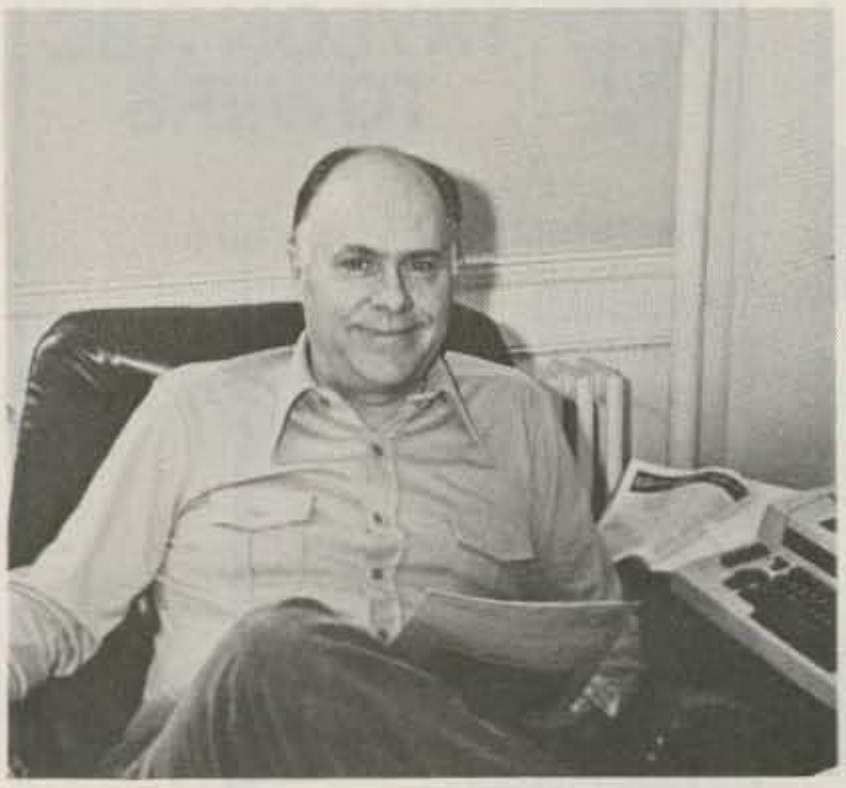
We are looking forward to speaking with our readers and hope to meet many of you in the coming months. To help you get to know us better, here is a brief look at who we are and what we do at *73*.

*Wayne Green W2NSD/1—Wayne is the founder of the 73 organization. In addition, he publishes two computer magazines (*Kilobaud MICROCOMPUTING *and* 80 Microcomputing*), two industry newsletters, and heads up Instant Software, Inc., a microcomputer software publishing house.*

Wayne's interests include travel, economics, sports cars (a Jaguar XJ6, Datsun 280Z, and Mazda RX-7 owner), gourmet cooking, and technology. He'd enjoy talking about any of these with readers.

THE SCHEDULE

May		June	
5	15m-20m phone	2	15m-20m phone
12	40m-80m CW	9	15m (Novice)-20m CW
19	20m-40m phone	16	40m-80m phone
26	80m-160m phone	23	20m-40m phone
		30	15m-40m phone



Wayne W2NSD

Jeff DeTray WB8BTH—Jeff is second in command at 73 and has a full range of administrative and technical responsibilities. He's known as "The Wizard" around here due to his ability to patch together ham radio and computer projects from a bottomless junk box of LEDs and 741 ICs.

Jeff, a transplanted midwesterner from Napoleon, Ohio, is the driving force behind the NSD contest effort. Under his tutelage, the station amassed over 1 million points in the phone portion of the 1980 CQ Worldwide DX Contest (multi/single) and 195,000 points and a clean sweep in Phone Sweepstakes (single operator). If you work NSD during a contest, the impatient voice at the other end of the exchange will be Jeff's (unless he's managed to trick some fellow staffers into operating with him).

His interests include computers, astronomy, and motorsports (NASCAR, Formula 1, and Indy).

Jeff WB8BTH

Penny Brooks KA1GAW—Penny, one of our newest Novices, is in advertising space sales for 80 Microcomputing. *She is a Navy veteran with two years of service under her belt who's been known to copy CW at over 30 wpm. Look for her clean fist on the 80, 40, and 15-meter Novice bands, hopefully not at 30 wpm.*

Chris Brown KA1D—Chris is a contributing editor with 73 and also shares his time with the computer magazines. He handles feature writing assignments and enjoys operating out of the mainstream—160 CW for instance. His interests include running (Boston Marathon survivor), mountaineering, astronomy, and reading. He can often be found on 80 and 40 meters in the still of night.

Ed Ferman WA1UFY—Ed is our director of publications. He keeps the magazine's printers honest and our editorial and art departments on deadline. He's on his feet so much he doesn't even have a chair in his office.

His outside interests include raising championship Golden Retrievers, gourmet cooking, sailing his 36-foot Choey Lee,

Penny KA1GAW

Chris KA1D

Ed WA1UFY

Jim W1XU

Alyson N1BEJ

Paul KA1LR

and blacksmithing. Ed, an Air Force vet with many hours of jet time, plays jazz bass and hopes to have his own haute cuisine restaurant some day.

Jim Gray W1XU—Jim is the Advertising Manager for 73 Magazine. He spends his time on the phone with advertisers past, present, and future trying to convince them of the benefits of four-color versus two.

Jim is a licensed pilot (private/single engine, commercial/glider) and flies whenever he can. He also does a lot of walking in the hills of New Hampshire, rides a motorcycle in all weather, plays tennis, and shoots 35mm photos. Jim has been hamming for 31 years and has a special place in his heart for CW.

Alyson Grupp N1BEJ—Alyson works in our data processing department. She thrives on DX and wants the 73 station to acquire a bigger tower and more monobanders. Aly plans to upgrade to Advanced shortly, without using the Bash book.

She enjoys kit-building and writing, and has penned several reviews for 73. When she's not DXing, Alyson is likely to be canoeing with husband Paul. Together they've paddled most of Minnesota's Boundary Waters hauling ham gear and generators with them.

Paul Grupp KA1LR—Paul is our Product Review Editor. He pores over ham magazines and catalogs looking for likely review prospects and enjoys evaluating new equipment. He is a hopeless DXer and operates phone almost exclusively, pretending that he can't find the CW position on the new rigs that come into the shack.

When he's not building repeaters or chasing DX, Paul enjoys photography, working in his recording studio, and playing his guitars. He was raised in Egypt and hopes to organize a DXpedition to the Mid-East.

Knud Keller KV4GG—Knud, our accounting manager, is the money man at 73. He is the one who ends up with the invoices for the ham shack equipment that the rest of us have ordered. He then tracks down the perpetrator to find out why we have yet another new rig, and how we intend to pay for it. Everyone avoids Knud at invoice time.

Besides being good with figures, Knud is an accomplished musician specializing in strings and keyboards. He's also one of the few licensed piano tuners in New Hampshire and the best Volkswagen mechanic on staff.

Ross Kenyon KA1GAV—Ross is the manager of 73's printing department. He spends his time working on QSL cards and a host of other ASAP projects in the 73 print shop. He is both a new ham and a new daddy, and his Novice ticket arrived at about the same time his new daughter did. His hobbies include fishing, photography, and child rearing. Ross is also a member of the Masons.

Gene Smarte WB6TOV—Gene wears a few hats at 73. He is the News Editor and also the Acquisitions Editor. Gene separates the wheat from the chaff in the newspages and is on the horn with authors when 73 wants to cover a hot topic and needs a story written, pronto.

Gene is a rare bird, a native Californian living in New England. He copes with the puritans in a laid back and mellow manner and, were it not for his collections of weird, flower-print California shirts, we'd almost believe he was a Bostonian by birth.

Gene is interested in beekeeping, astronomy, scrounging flea markets, banjo picking and, by his own admission, California dreamin'. He'd enjoy speaking with sixes.

Tim Daniel N8RK (not shown)—After serving two summer internships with the 73 organization, Tim has finally come on staff full-time. Tim graduated from the Rose-Hulman Institute of Technology in Terre Haute, Indiana, in February with a B.S. degree in Electrical Engineering; he will be in charge of special projects at 73. He has authored our new Novice and General class study guides and enjoys writing almost as much as engineering and design.

Tim is an enthusiastic contester. He operated with Jeff DeTray from Turks and Caicos in March during the ARRL International DX contest under the call VP5TDX.

A transplanted flatlander (Oxford, Ohio), Tim is now getting used to biking up and down New Hampshire's hills and valleys. He also enjoys hiking in the White Mountains, reading, and travel.

Knud KV4GG

Ross KA1GAV

Gene WB6TOV

NEW PRODUCTS

SUPER LOG™ II

Whether you're a rag chewer, contester, award hunter, or DX operator, the new Super Log II is the radio operator's ultimate dream come true! Created by MICRO-80 programmer Joe Richey, this "machine language" software is compatible with both the TRS-80 Model I and Model III computer systems.

How many times have you had to search through all your logs trying to find a record of a particular contact made? If you're an award hunter or DX operator, you already know the nightmare of sorting through all those QSOs trying to satisfy various award requirements. If you're a contester, we don't need to remind you of the awesome task of keeping an accurate and legible log to be able to determine if a contact is a duplicate or not. Now you can eliminate all those frustrations and enjoy keeping a log once again.

Super Log II will instantaneously retrieve information about a previous contact with its special "Lightning Search & Sort."

Super Log II initializes popular column headings found in conventional radio operator logbooks: date, beginning and ending QSO times, callsign worked, QTH, RST sent and received, mode and frequency of operation, and a special section is reserved for entering comments relative to the contact made.

For a limited time only, all customers purchasing Super Log II will also receive free from MICRO-80 the very popular amateur radio program Super Duper II. With this program, the operator can keep calls sorted by band or mode. The computer immediately alerts you to duplicate contacts as they occur and allows the option to delete them from the log. Now contesters can eliminate the drudgery that has taken the fun out of their competitive hobby!

Both programs are available now for the price of one.

For further details about MICRO-80 products and services, write *MICRO-80, Inc., S-2665 North Busby Road, Oak Harbor WA 98277.* Reader Service number 489.

NEW MFJ 3-KW TUNER WITH ROLLER INDUCTOR

The new MFJ-989 "Versa Tuner V" uses a roller inductor with a 3-digit turns counter and a spinner knob for precise inductance control to get swr right on down to minimum.

This new tuner has a big 3-kW PEP rating that you won't outgrow and smaller, more compact, size to match the new smaller rigs.

For convenience, the MFJ-989 gives you several products in the same compact cabinet. First of all, it's a 3-kW antenna tuner, roller inductor and all, that matches coax, balanced line, and random wire from 1.8-30 MHz. Second, it's a six-position antenna switch (2 coax lines, through the tuner or direct, random/balanced line, and dummy load). Third, it contains a 300-Watt, 50-Ohm non-inductive dummy load. Fourth, it's a wattmeter using a lighted meter with 2% accuracy (requires 12 volts for lighted meter). This wattmeter reads both forward and reflected power on 2 scales (200 Watts and 2000 Watts), plus it reads swr directly. Finally, it has a built-in 4:1 balun for balanced line.

It's amazing that all these features can fit into such a small package (just 10-3/4" W × 4-1/2" H × 14-7/8" D). The deluxe aluminum low-profile cabinet has a subchassis for RFI protection. It has a black front panel with raised brushed aluminum lettering, and the cabinet has a black finish. There is also a bail to raise the front for easy viewing.

Versa Tuner V from MFJ.

If ordered from MFJ, there is a 30-day money-back trial period. If you are not satisfied, you may return it within 30 days for a full refund (less shipping). MFJ also provides a one-year limited warranty.

For more information, write *MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762, or phone toll-free 1-(800)-647-1800.* Reader Service number 487.

COMM-X FROM VALOR

A forerunner in the Valor Enterprise family of new products for 1981 is the "Communications Extender" antenna series. Known as "COMM-X," the series presently includes two models. Model CX-144 is designed for 144-148 MHz and is 52" in length. At 35" in length, the CX-220 model operates in the 220-225 MHz range.

Both models feature adjustable whips designed to allow field tuning for optimum vswr, typically 1.5:1 or less at resonance, and typical gain of 3 dB over a 1/4 wave standard. In addition, two stainless steel set screws secure the heavy-duty whips to provide double-locked protection. The ferrule is attached with adhesive, besides being mechanically staked to ensure integrity.

The COMM-X is power rated at 200 Watts and is made of quality materials. These materials include 17-7 taper-ground stainless steel whip, 16-gauge copper matching coil, and standard 3/8-24 chrome-plated brass base. This combination provides excellent wear resistance for long-lasting service.

Valor Enterprises specializes in communication products. Additional information may be obtained by writing *Valor Enterprises, West Milton OH, or calling (513)-698-4194. Outside Ohio call toll-free 1-(800)-543-2197.* Reader Service number 480.

HUSTLER INTRODUCES NEW TEN-METER YAGI ANTENNA

The new beam from Hustler, designated 10-MB-4, is the conclusion of extensive design refinements of previous beam technology.

The result is a four-element yagi optimized for best directivity, excellent front-to-back ratio, and maximum gain through selective element spacing and precisely resonated element length.

The 10-MB-4 employs a gamma-match feed system and is fully adjustable for a 1.2:1 or better swr at resonance.

The mechanical structure of the Hustler 10-MB-4 is ruggedly designed to withstand severe weather, yet is light enough to be accommodated by a TV antenna rotor.

The entire antenna is constructed from high-strength aluminum tubing and can be easily grounded for lightning protection.

For further information, write *Hustler, Inc., 3275 North B Avenue, Kissimmee FL 32741.*

NEW ZAP TRAPPER™ PROVIDES SUPERIOR PROTECTION FOR ANTENNAS, CABLE, AND COMMUNICATIONS EQUIPMENT

The new Zap Trapper™ (patent pending), introduced by PolyPhaser Corporation, significantly outperforms previous lightning protection apparatus for communications antennas,

CORRECTION

The price for Benjamin Michael Industries' 24-hour clock was incorrectly listed in our March "Review" section. The correct price is $29.95.

cable, and equipment, according to Roger R. Block, PolyPhaser president.

The new Zap Trapper impulse suppressor utilizes controlled atmospheric technology. "This process is field-proven in the telephone industry and ensures a microsecond response to lightning impulses, plus multiple impulse suppression which is especially critical for the protection of today's solid-state communication equipment," Block stated.

"Typical air-gap type arrestors will shunt the first of many impulses within a single strike safely to ground and then become useless due to contact vaporization for the remaining impulses." In effect, Block remarked that "arrestors" or air-gap devices do little more than provide a sense of false security beyond the initial energy impulse.

PolyPhaser's Zap Trapper installs quickly, directly into the transmission feedline, and is available with either type N or UHF connectors.

The Zap Trapper will handle up to 750 Watts of rf power with an insertion loss of 0.1 dB at 1000 MHz. Vswr is less than 1.15 with a constant 50-Ohm impedance. Turn-on voltage is 280 V dc and it will handle a 10,000-Amp surge.

For more information, contact *PolyPhaser Corporation, 1500 West Wind Boulevard, Kissimmee, FL 32741, telephone (305)-846-1807.* Reader Service number 482.

MSB-1 AUDIO FILTER FROM M & M

The MSB-1 audio filter from M & M Electronics utilizes four basic filters arranged to provide the maximum in flexibility and effectiveness during SSB, CW, or RTTY reception. The fixed high-pass filter, tunable notch filter, six- and eight-pole tunable low-pass filter are engaged at all times. The tunable bandpass filter can be switched in for further shaping of the audio. This means that all three tunable filters can be engaged at the same time and tuned independently.

For more information, contact *M & M Electronics, PO Box 1206, Brewton AL 36427.* Reader Service number 488.

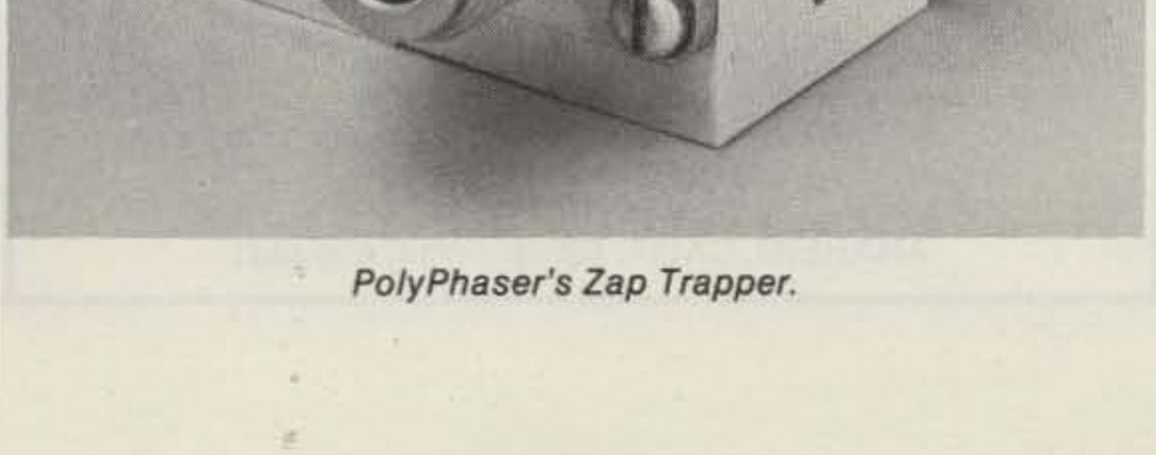
NEW BASE STATION ANTENNA FROM VALOR ENTERPRISES

Joining Valor Enterprises' most recent announcement of the "Omni-Gain" mobile antenna is the "Omni-Gain" base station antenna. Designed to complement its mobile counterpart, the base station antenna features the same unique construction and power rating of 200 Watts.

Made of 17-7 stainless steel whip, 6061-T6 electro-polished aluminum coaxial matching section, and chrome-plated brass 3/8-24 ferrule, the "Omni-Gain" has no copper coil.

The base station antenna is 5/8 wavelength, has a 3-dB gain, and is available for 2-meter and 220-MHz amateur bands. The series is field tunable to a typical vswr of less than 1.5:1 at resonance.

Valor Enterprises is a manufacturer of personal and amateur communication products and accessories. For more information and complete product catalog, write *Valor Enterprises, West Milton OH or call (513)-698-4195; residents outside Ohio dial toll-free 1-(800)-543-2197.* Reader Service number 481.



PolyPhaser's Zap Trapper.

New audio filter from M & M.

MFJ INTRODUCES NEW LOW-COST VHF OPERATING AIDS

The new MFJ-812 is a VHF swr/wattmeter/field-strength meter combination. It keeps you informed about your antenna and feedline as well as you rig's output. It reads swr at lower power levels from 14 to 170 MHz, and also reads forward and reflected power from 144 to 148 MHz on two scales (30 and 300 Watts). Easy push-button operation switches from forward to reflected power.

Binding posts are provided on the back panel for easy field-strength antenna connection. The MFJ-812 reads field-strength level from 1 through 170 MHz.

The MFJ-812 measures 4-1/4" W × 2-1/4" H × 2-3/4" D. The all aluminum cabinet has an egg-shell white front panel with black top and sides.

MFJ provides a 30-day money-back trial period. If you are not satisfied, you may return it within 30 days for a full refund (less shipping). MFJ also provides a one-year unconditional warranty.

The MFJ-810 is like the MFJ-812, less the field-strength function.

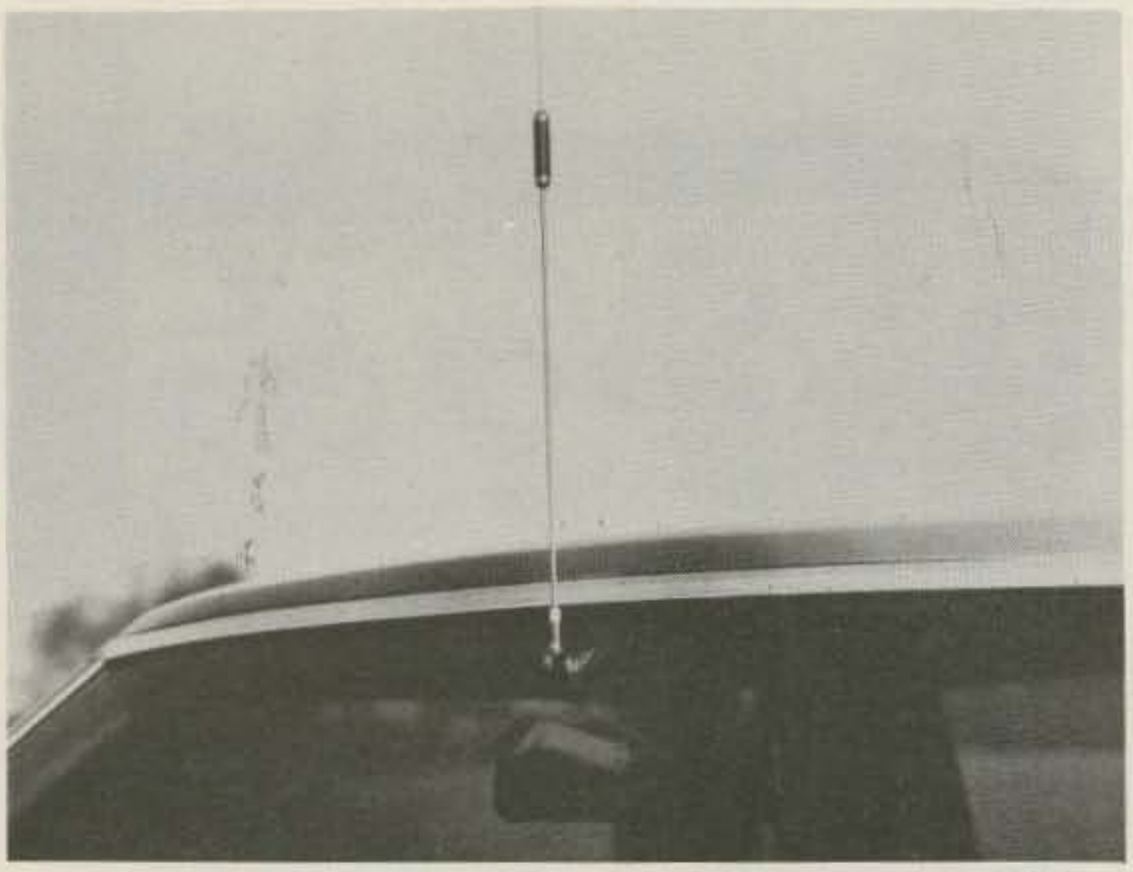
For more information, write *MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762, or call toll-free 1-(800)-647-1800.* Reader Service number 486.

NEW 5 dB-GAIN MOBILE ANTENNA FROM AVANTI

Avanti Communications has recently modified its 5-dB gain on-glass mobile antenna designed for use in two-way and amateur radio communications.

The new 3/4-meter 410-512 MHz AP450.5G features a straight 30-inch whip with a small center-positioned phasing coil. By popular request, the former loop section has been eliminated and replaced by a small, sleek coil measuring only

New swr/wattmeter/field-strength meter from MFJ.



Avanti's AP450.5G antenna.

1-1/2 inches in length and a maximum diameter of 3/8", making it the smallest UHF 5-dB gain whip and phasing coil combination on the market.

As with each of Avanti's on-glass communications antennas, the new AP450.5G offers improved performance, requires no holes to be drilled, features shorter installation time, and requires no metal ground plane, thus allowing it to be used in many more applications than conventional mobile antennas.

For more information, contact *Avanti Communications, 340 Stewart Avenue, Addison IL 60101; phone (312)-628-9350.* Reader Service number 483.

New tuner from Grove Enterprises.

SHORTWAVE/ LONGWAVE TUNER

Designed to enhance reception in the 10-kHz through 30-MHz spectrum, this new shortwave/longwave antenna tuner claims the widest frequency coverage of any tuner on the market.

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The wideband tuner is guaranteed to improve reception on any shortwave or longwave receiver.

For more information, write *Grove Enterprises, Inc., Dept K. Brasstown NC 28902, or call toll-free 1-(800)-438-8155.* Reader Service number 485.

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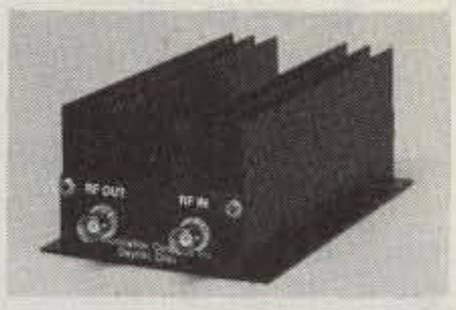

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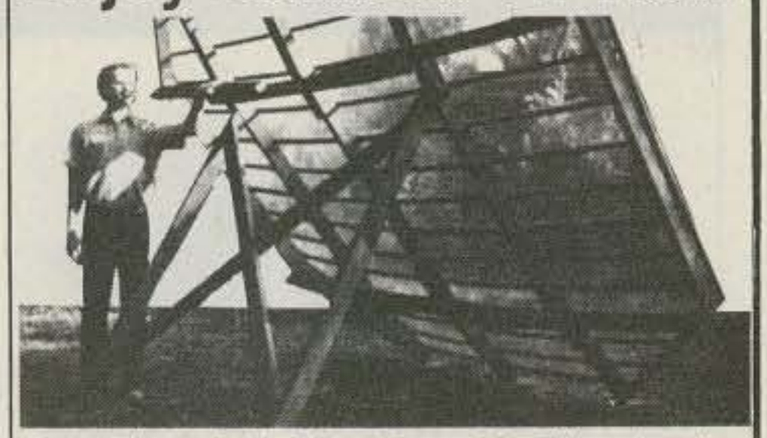

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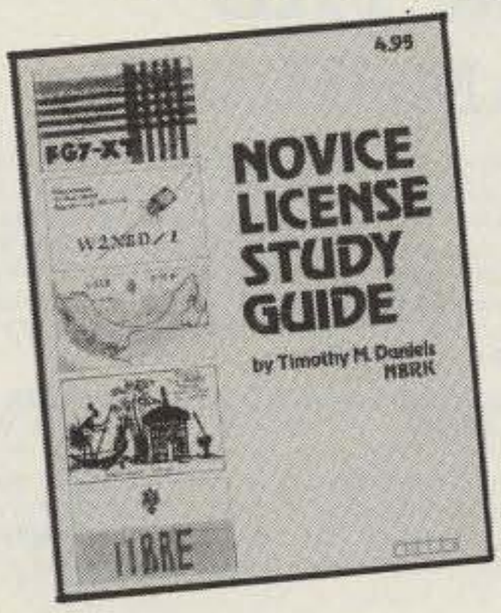

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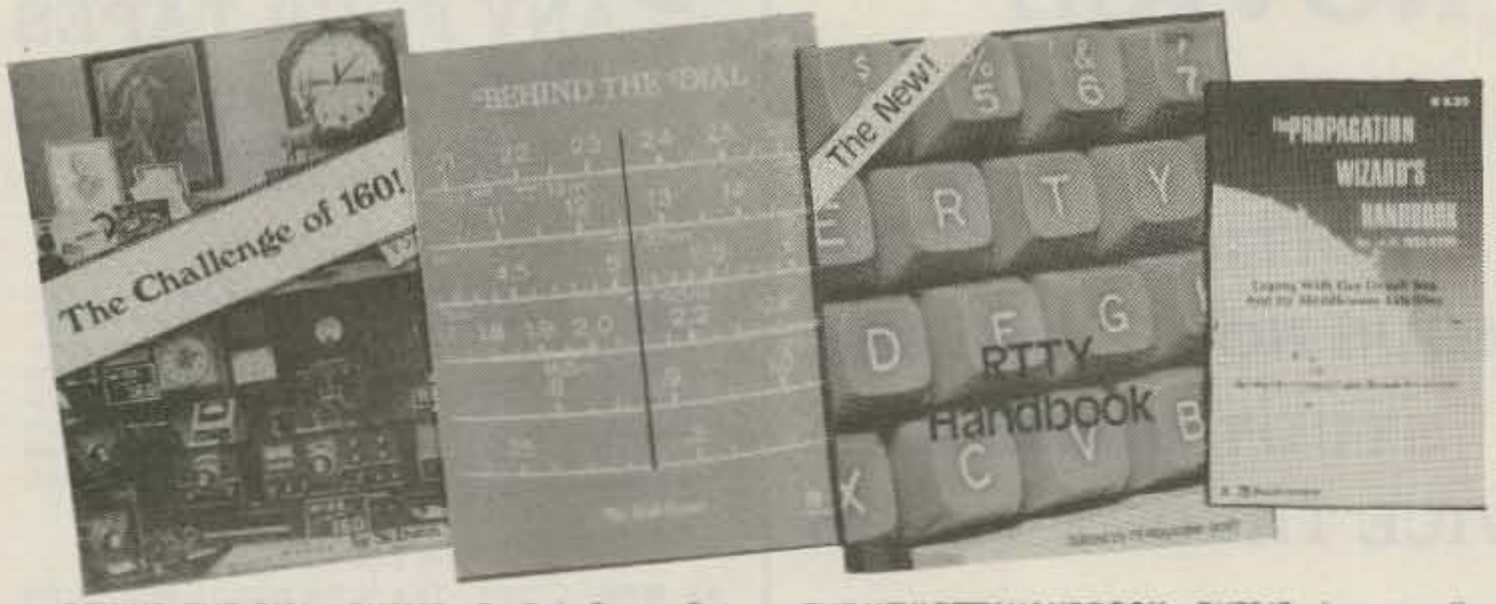

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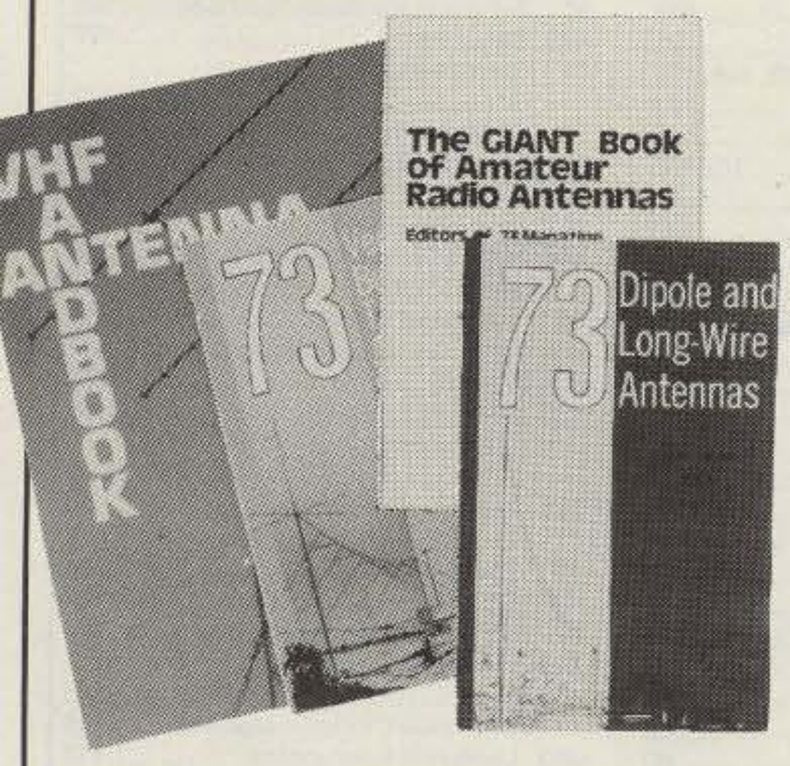

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BK7347	RTTY HANDBOOK	$ 5.95
BK1059	RTL COOKBOOK	$ 6.50
BX1000	SHELF BOX—1	$ 2.00
BX1001	SHELF BOXES—2-7	$1.50 each
BX1002	SHELF BOXES—8 AND UP	$1.25 each
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BK7351	SSB THE MISUNDERSTOOD MODE	$ 5.50
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SG1080	STUDY GUIDE—EXTRA CLASS	$ 5.95
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BK7368	VHF ANTENNA HANDBOOK	$ 5.95
BK7370	WEATHER SATELLITE HANDBOOK	$ 2.50
BK1184	WORLD RADIO TV HANDBOOK	$16.50
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CONTESTS

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

COUNTY HUNTERS SSB CONTEST

Contest Periods:

0001 to 0800 GMT May 2
1200 GMT May 2 to 0800 GMT May 3
1200 to 2400 GMT May 3

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

EXCHANGE:

Signal report, county, and state or country.

FREQUENCIES:

Suggested frequencies are as follows: 3920-3940, 7220-7240, 14275-14295, 21375-21395, 28625-28650. There will be a "mobile window" of 10 kHz on the following frequencies: 3925-3935, 7225-7235, 14280-14290. Mobiles will be in this 10-kHz segment and fixed stations are asked to refrain from calling "CQ Contest" in the mobile window. After working mobiles in the window, fixed stations are requested to QSY outside the window to work fixed stations in the contest. This will allow the mobiles running lower power a chance to be heard and worked in the contest. There will be a special effort to work DX on 28.636 by mobiles.

SCORING:

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

AWARDS:

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

ENTRIES:

Logs must show date and time, station worked, reports exchanged, county, state, band, claimed QSO points (1, 5, or 15), and each new multiplier must be numbered. Logs and summary sheets are free for a #10 SASE or SAE and appropriate IRCs. Write to: John Ferguson W0QWS, 3820 Stonewall Ct., Independence MO 64055. All entries must be received by June 15th to be eligible for awards. DX entries should use air mail. Winners will be announced at the 1980 Independent County Hunters Convention during July and in the MARAC newsletter.

ALEXANDER VOLTA RTTY DX CONTEST

Starts: 1200 GMT May 2
Ends: 1200 GMT May 3

This is the 16th contest sponsored by the SSB and RTTY Club of Como and the Associazione Radioamatori Italiani. Use all amateur bands from 80 through 10 meters. Operating classes include single operator, multi-operator/single-transmitter, and SWLs. Stations may not be worked more than once on any one band. Additional contacts may be made on different bands.

EXCHANGE:

RST, QSO number, and zone number.

SCORING:

All 2-way RTTY contacts between stations of the same country are not valid. Contacts with stations outside your zone count for points in accordance with an Exchange Points table (available from Associazione Radioamatori Italiani). Any RTTY contacts made on 80 or 10 meters are worth double.

A multiplier is given for every country worked on each band worked. An extra multiplier is given for each intercontinental country worked on at least 4 bands. Use the ARRL Country List and count each USA, Canadian, and Australian district as separate countries.

SWLs use same scoring rules but based on stations and messages copied.

CALENDAR

May 2-3	County Hunters SSB Contest
May 2-3	Alexander Volta RTTY DX Contest
May 9-10	Rocky Mountain Division QSO Party
May 10	DARC Corona—10-Meter RTTY Contest
May 16	Dogwood Festival QSO Party
May 16-17	Florida QSO Party
May 16-18	Michigan QSO Party
May 16-18	Massachusetts QSO Party
May 23-24	Europe and Africa Giant RTTY Flash
Jun 6-7	VK/ZL/Oceania RTTY DX Contest
Jun 6-7	New York State QSO Party
Aug 8-9	European DX Contest—CW
Aug 15-16	SARTG Worldwide RTTY Contest
Aug 22-23	Ohio QSO Party
Sep 12-13	European DX Contest—Phone
Sep 12-13	G-QRP-Club CW Activity Weekend
Sep 12-14	Washington State QSO Party
Sep 26	DARC CORONA—10-meter RTTY Contest
Nov 8	DARC CORONA—10-meter RTTY Contest
Nov 8	OK DX Contest
Nov 14-15	European DX Contest—RTTY
Dec 26-31	G-QRP-Club Winter Sports

RESULTS

3rd DARC CORONA CONTEST

These are results of the 3rd DARC Corona Contest held on 27th September, 1980. Congratulations to N8ES for a really convincing win, and to G3HJC for being top "G".

Call	Score	QSO	Countries	Prefix
CLASS A:				
1. N8ES	2340	45	15	37
2. DL5GAS	1739	37	16	31
3. WB2UEF	1548	36	13	30
4. OZ1CRL	1209	31	13	26
5. DF6ZV/A	1120	28	12	28
6. WA6WGL	962	26	12	25
7. AD0V	945	27	11	24
8. G3HJC	851	23	15	22
9. I5CBF	851	23	15	22
10. SL5AR	828	23	14	22
CLASS B:				
1. H. Ballenberger	972	27	13	23
2. Werner Ludwig	580	20	10	19
3. OK1-20677	252	12	09	12
4. Y2-7111/A	144	09	07	09

AWARDS:

Usual awards to top stations in each class.

ENTRIES:

Use one log per band. Logs must be received by June 20th to qualify, so it is advisable to use air mail. Logs should contain band, date/time in GMT, callsign, exchanges sent and received, points, and multipliers. Enclose a summary score sheet along with any comments. Address entries to: G. Vulpetti I2VTT, PO Box 37, I-22063 Cantu, Italy.

ROCKY MOUNTAIN DIVISION QSO PARTY

Starts: 1800 GMT May 9
Ends: 2400 GMT May 10

The contest is sponsored by the Arapahoe Radio Club of Littleton CO. Stations outside the Rocky Mountain Division may work any station. The same station may be worked once per band, although mobile stations may be worked each time they change counties. Novices will indicate as "/N", club stations with "/C", and mobiles with "/M". RM states are: Colorado, Wyoming, Utah, and New Mexico.

EXCHANGE:

RS(T) and state; Rocky Mountain Division stations will also send their county.

FREQUENCIES:

3560, 7060, 14060, 21060, 28060, 3900, 14300, 21370, 28570, 3725, 7125, 21125, 28125.

SCORING:

Phone QSOs count 1 point; CW QSOs count 2 points; QSOs with club stations count 3 points. RM entries multiply QSO points by number of states, RM counties, and DX countries (not to exceed 5 DX multipliers). Others multiply QSO points by the number of RM states and counties worked per band. All stations add following bonus points after multiplying by the appropriate multiplier. Working 5 RM Division Novices—add 50 points. RM mobiles operating from 3 or more counties—add 100 points. RM club stations with at least 5 operators (minimum 10 QSOs per operator)—add 100 points.

ENTRIES AND AWARDS:

Awards will be issued to the high scorer in each state and DX country, high Novice in each state, and to high-score mobile in each RM Division state. Club stations in the Division will compete by state for the Silver Dollar Award.

Submit logs, with large SASE, by June 15th to: Buster Boatman KAØCLS, 8973 W. Harvard Drive, Lakewood CO 80227.

DARC CORONA 10-METER RTTY CONTEST

Contest Period: 1100 to 1700 GMT May 10

This is the second of four tests during the year sponsored by the DARC eV to promote RTTY activity on the 10-meter band. Each of the four tests is scored separately. Use the recommended portions of the 10-meter band.

EXCHANGE:

RST, QSO number, and name.

SCORING:

Each station can be contacted only once. Each completed two-way RTTY QSO is worth 1 point. Multipliers include the WAE and DXCC lists and each district in W/K, VE/VO, and VK. The final score is the total number of QSOs times the total multiplier.

AWARDS:

Plaques will be awarded to the leading stations in each class with a reasonable score present. Operating classes include: Class A for single- or multi-op and Class B for SWLs.

ENTRIES:

Logs must contain name, call, and full address of participant. Also show class, times in GMT, exchange, and final score. SWLs apply the rules accordingly. Logs must be received within 30 days after each test. Send all entries to: Klaus K. Zielski DF7FB, PO Box 1147, D-6455 Erlensee, West Germany.

The remaining contest periods are on September 26th and November 8th.

DOGWOOD FESTIVAL QSO PARTY

1300 to 2200 GMT May 16

The annual Dogwood Festival celebrated in Fairfield CT will also be observed on the air by members of the Greater Fairfield Amateur Radio Association with a Dogwood Festival QSO Party. Members of the club will operate on six bands with the club call WB1CQO. A special commemorative QSL card will be available to confirm each QSO upon receipt of an SASE or IRCs to QSL manager Grace von Stein KA1JT, 248 Euclid Avenue, Fairfield CT 06432.

Dogwood Festival stations will operate on SSB using 3975, 7235, 14330, 21420, and 28710. FM operation will be on 146.55 simplex.

The Dogwood Festival marks the blossoming of 30,000 pink and white dogwood trees in the town of 55,000 persons. The Festival began in 1936, although the original trees were imported from Japan in 1895 and earlier.

FLORIDA QSO PARTY

Contest Periods:
1400 to 1900 GMT May 16
0001 to 0500 GMT May 17
1500 to 2300 GMT May 17

This is the 16th annual Florida QSO Party sponsored by *Florida Skip*. All amateurs worldwide are eligible and invited to participate. All amateur bands may be used. All stations will separate phone and CW logs; phone and CW are separate contests. A station may be worked once on each band mode. Neither crossband nor crossmode contacts will count for contest credit.

RESULTS

3rd VK-ZL-OCEANIA RTTY CONTEST

Single Operator

1. DJ6JC	793,282	(101)
2. VK5RY	774,996	(117)
3. JA6GIJ	611,038	(79)
4. VK3KF	539,435	(72)
5. VK8HA	481,184	(82)
6. VK4AHD	388,080	(84)
7. F8XT	352,432	(54)
8. I1TXD	320,082	(59)
9. W5HEZ	266,900	(34)
10. DF2OK	253,680	(60)

Multi-Operator Stations

1. VK2TTY	1,207,340	(135)
2. VK3DGA	520,352	(46)
3. HB9Z	422,900	(88)
4. DKØMM	180,420	(58)
5. OZ8JYL	99,200	(60)
6. LZ1KDP	95,300	(60)
7. OK3VSZ	79,308	(60)
8. DF5LK	37,555	(31)

SWL Stations

1. Horst Ballenberger DL SWL	64,472
2. Dedic Jaroslav	62,864

RESULTS

15th ALEXANDER VOLTA RTTY DX CONTEST

	Points	QSOs	Mult.	Bonus	Score
1) I3FUE	2.904	186	84	-	45.372.096
2) I5MYL	2.033	165	96	-	32.202.720
3) W4CQI	3.167	125	50	50.000	19.843.750
4) I5FZI	1.500	158	83	-	19.671.000
5) I2OLW	1.633	133	70	-	15.203.230
6) I7FKO	1.172	184	62	-	13.370.176
7) 3B8RS	2.985	101	41	26.000	12.386.885
8) G3UUP	1.141	159	58	56.000	10.578.302
9) I2WEG	1.022	147	69	-	10.366.146
10) I2DMI	1.552	105	60	-	9.777.600

SWLs

1) Horst Ballenberger DL-SWL
1.448 173 72 51.000 18.087.288
2.) Dedic Jaroslav OK1-11857
1.227 178 64 49.000 14.026.984
3.) Vaclav Cesak OK1-20677
1.640 134 49 19.000 10.787.240
4.) Kurt Wustner DL-SWL 095-1694785
772 105 45 41.000 3.688.700
5.) Eichler Helmut DM-2814/M
433 119 40 23.000 2.084.080

AWARDS

I3FUE—Silver plaque and certificate
I5MYL—Plaque and certificate
W4CQI—Plaque and certificate
Horst Ballenberger—Plaque and certificate

Florida stations may work other Florida stations, but for contest points only. Out-of-state stations may not work each other for contest credit. Contacts made on repeaters do not count for credit.

Florida stations will be divided into two classes. Class A stations are those operating portable or mobile on emergency power and running 200 Watts or less (CW or PEP phone) inside Florida but outside of their home counties. Class B stations are all other stations operating in Florida.

Each entrant agrees to be bound by the provisions of the contest announcement, the regulations of the applicable licensing authority, and decisions of the *Florida Skip* Contest Committee, which are final.

EXCHANGE:

Florida stations send RS(T) and county of operation. Others send RS(T) and US state, Canadian province, or country.

FREQUENCIES:

Phone—3945, 7279, 14319, 21379, 28579, 50.2, 146.52.

CW—3555, 7055, 14055, 21055, 28055.

SCORING:

Florida stations count one point per QSO with out-of-state or other Florida stations. Multiplier is the sum of states (49 maximum), provinces (12 maximum), and DX countries (27 maximum) actually worked; maximum multiplier is 88. Others count 2 points per QSO with each Florida station. Multiplier is the number of different Florida counties worked (67 maximum). Final score is the product of QSO points and the multiplier. Class A stations *only* multiply score by 1.5 to obtain final total.

AWARDS:

Certificates for phone and CW to the top single-operator score in each state, province, DX country, and each Florida county. There are also 5 plaques to be awarded as follows: high single operator in Florida and out-of-state, CW and phone, and to the Florida club with the highest aggregate score.

ENTRIES:

Phone and CW entries *are to be separated*! Along with legible logs in chronological order, a summary sheet is required with each entry. The summary sheet must contain score, number of QSOs, multiplier, station's callsign, entry class, and number of Florida counties, power source for Class-A entries; county, state, province, country, or region of operation, callsigns of all operators/loggers if multi-op; name of club if part of a club aggregate score; name and address TYPED or PRINTED in BLOCK LETTERS; and a signed declaration that all rules and regulations have been observed. All stations making more than 200 QSOs should also include a dupe sheet. Include a 15-cent stamp for contest results from a future issue of *Florida Skip*. At the discretion of the contest committee, stations and/or operators may be disqualified for improper reporting, excessive dupes, errors in multiplier lists, unreadable logs, obvious cheating, etc. Anyone disqualified in this year's Florida QSO Party will be barred from the contest next year. All entries must be received on or before June 15th; late DX entries will be accepted within reason. Mail all entries to: *Florida Skip* Contest Committee, PO Box 501, Miami Springs FL 33166.

MASSACHUSETTS QSO PARTY

Starts: 1600 GMT May 16
Ends: 0200 GMT May 18

Sponsored by the Greater New Bedford Contesters. A station may be worked once per band. Phone and CW are considered separate bands. No crossband or repeater contacts are permitted. Mobiles and portables may be contacted each time a county change takes place.

EXCHANGE:

RS(T) and state, VE province, or Massachusetts county.

SCORING:

All stations count 2 points for each completed SSB exchange and 4 points for each completed CW exchange. Massachusetts stations then take the total QSO points and multiply by the total number of Massachusetts counties, states, and provinces worked to compute the final score. Others multiply the total QSO points by the total number of Massachusetts counties worked. Add a 50-point bonus to the total score for each sponsor worked; each can be worked only once for bonus points. The sponsors are W1FJI, N1AS, and K1KJT. DX stations count for QSO points only.

FREQUENCIES:

Phone—1820, 3960, 7260, 14290, 21390, 28590, and 50.110.

CW—1810, 3560, 7060, 7120, 14060, 21060, 21120, 28060, and 28120.

Use of FM simplex is encouraged. Please use CW in CW bands only!

AWARDS:

Certificates will be awarded to 1st, 2nd, and 3rd place winners in each Massachusetts county as well as each state. Two special awards will be given out: one to the amateur radio club with the highest aggregate score in Massachusetts with a minimum of three logs, and a 2nd award to the station in Massachusetts who submits the all-time highest number of QSOs. The current record is held by K1GSK with 1483 QSOs in the 1979 Massachusetts QSO Party. In addition, a certificate will be given to stations working all 3 sponsors.

ENTRIES:

Logs must show date, time, band, mode, callsign, state and province worked, and exchange RS(T). Submit a separate summary sheet along with the logs. Summary sheet should include name, call, mailing address, club affiliation for aggregate score, total QSO points, multipliers claimed, and total score. Deadline for mailing is June 30th. For awards and results include $0.30 postage (no envelope). Address entries to: Larry Purcell N1AS, 146 Armour Street, New Bedford MA 02740.

MICHIGAN QSO PARTY

Contest Periods:
1800 GMT Saturday, May 16 to 0300 GMT Sunday, May 17
1100 GMT Sunday, May 17 to 0200 GMT Monday, May 18

This year's QSO party will be sponsored by the Oak Park ARC. Phone and CW are combined into one contest. Michigan stations can work Michigan counties for multipliers. A station may be contacted once on each band/mode. Portable/mobiles may be counted as new contacts each time they change counties.

EXCHANGE:

RS(T), QSO number, QTH as state, country, or Michigan county.

FREQUENCIES:

Phone—1815, 3905, 7280, 14280, 21380, 28580.

CW—1810, 3540, 3725, 7035, 7125, 14035, 21035, 21125, 28035, 28125.

VHF—50.125, 145.025.

SCORING:

Multipliers are counted only once. Michigan stations score 1 point per phone QSO and multiply by the total number of states, countries, and Michigan counties. Each CW contact counts 2 points; KL7 and KH6 count as states; VE counts as a country. Maximum multiplier is 85.

Others take QSO points times the total number of Michigan counties. QSO points are 1 point per phone QSO and 2 points per CW QSO. Maximum multiplier is 83.

All stations score 5 points for each club station contact with W8MB.

VHF only entries: same as above except multipliers per VHF band are added together for total multiplier. Score 5 points for each OSCAR QSO. No repeater contacts are allowed.

AWARDS:

Only single-operator stations qualify. Michigan trophies to high Michigan score, high Michigan (Upper Peninsula) score, high aggregate club score. Plaque to high VHF only entry and high mobile. Certificates to high score in each county with a minimum of 30 QSOs. Out-of-state high trophy and certificates for high score in each state and country.

ENTRIES:

A summary sheet is requested showing the scoring and other pertinent information, name and address in BLOCK LETTERS, and a signed declaration that all rules and regulations have been observed. Michigan stations include club name for combined club score. Party contacts do not count toward the Michigan Achievement Award unless one fact about Michigan is communicated. Members of the Michigan Week QSO Party Committee are not eligible for individual awards. Decisions of the Contest Com-

mittee are final. Results will be final on July 31st and will be mailed to all entries. Mailing deadline is June 30th to: Mark Shaw K8ED, 3810 Woodman, Troy MI 48084.

MICHIGAN ACHIEVEMENT AWARD

This will be the 23rd year that hams have had their own program to publicize Michigan and its products. Just as for the past years, the Governor will award Achievement Certificates to hams who take part in telling the world of Michigan's unlimited resources, opportunities, and advantages. Certificates are awarded on the following basis:

1. A Michigan ham submits log information and names and addresses (if possible) of 15 or more contacts made to out-of-state or DX hams with information regarding Michigan.

2. An out-of-state ham, including Canada, submits log information and names and addresses (if possible) of at least 5 Michigan hams who relate facts to him about Michigan.

3. A foreign ham, excluding any resident of Canada, submits the call letters and name/address plus log information for at least one Michigan ham who has told him about Michigan.

Only QSOs made during Michigan Week, May 16-23, will be considered valid. All applications for certificates must be postmarked by July 1st and mailed to: Governor William Milliken, Lansing MI 48902.

EUROPE AND AFRICA GIANT RTTY FLASH

Contest Periods:
1400 to 2400 GMT May 23
0800 to 1800 GMT May 24

This is the 13th annual contest by the IATG Radiocommunications as part of a new promotional program for RTTY. The basic purpose of this contest is to increase interest in RTTY, but even more to increase interest in intercontinental contacts. The contest committee is open to and welcomes suggestions which might improve future contests.

Use all bands from 80 to 10 meters. Remember that all contacts must be on RTTY! Each station may be contacted once per band.

EXCHANGE:

RST, QSO number, and your continent.

SCORING:

QSO points are as follows: QSO on 80 or 40 meters = 2 points; QSO on 20 meters = 3 points; QSO on 15 meters = 6 points; QSO on 10 meters = 8 points.

No points or multipliers for contacts with one's own country. Only 2-way RTTY contacts are valid.

Multipliers are given for countries and continents. Use the DXCC Country List plus count each call area of VE/VO, W/K, VK, PY, LU, JA, and UAØ/9 as separate countries. A multiplier is given for each country worked on the 20 through 10 meter bands. No multipliers for contacts on 80 or 40 meters with one's own continent. A separate multiplier may be claimed for the same country if a different band is used (maximum of 3 times). Only countries which appear in at least 3 other logs will be valid multipliers. One's own country is not valid as a multiplier. For contacts with Europe and Africa, both the sender and the receiver will receive 100 points as a multiplier. Each of the remaining continents receives 50 points. An additional 100 points will be given for each contact with Europe and Africa on 15 or 10 meters.

The final score is the total QSO points times the total number of countries times the total number of continents plus the total points for EU and AF stations worked. Example: 600 QSO points times 10 countries worked times 100 continent points equals 600,000 plus 20 stations of EU and AF worked on 15-10 meters giving a grand total of 602,000 points.

ATTENTION! Two promotional periods are included in the contest: 1700 to 1800 GMT May 23 and 1000 to 1100 GMT May 24. Stations operating from North America, South America, Australia, Oceania, and Asia contacting EU and AF during these hours will double their points for these periods.

Beginner handicaps are offered to RTTYers entering logs in the contest who have not participated in previous contests. They will receive an additional 5% of their final score. Additional handicaps are offered as 10% of the total final score for the winner of previous RTTY Championships or 8% of the total final score for the winner of one or more preceding RTTY contests.

SWLs may also enter and they should use the same scoring rules. A separate results table will be made for these entries.

AWARDS:

Prizes, as usual, are reserved for the four first place winners. Consolation prizes will also be awarded.

ENTRIES:

Use separate log sheets for each band. Logs must contain date/time in GMT, callsign, RST and QSO number sent/received, country and continent multipliers, points, and final score. The contest disqualification criteria used by the ARRL in its contest apply also to this contest. Failure to observe any rules will result in exclusion of the entry for the final results and any such log will be considered as a check log. Logs compiling errors exceeding 10% of the final score will also be excluded from the final standing. Each log received becomes the property of the IATG Radiocommunications and will not be returned. The decision of the organizing committee in any dispute will be final and any subsequent controversy may not be referred to the Civil Court. Remember, the contest is valid towards the final standing of the 5 Continent World Championship.

In order to qualify, all logs must be received no later than June 30th and sent to: Prof. Franco Fanti, Via A. Dallolio n 19, Bologna 40139, Italy.

FUN!

John Edwards KI2U
78-56 86th Street
Glendale NY 11385

When I mentioned to a friend that I was going to do a column on the American Radio Relay League, his reaction was, "Don't do it; they're too easy a target!"

True, but it's also too great a temptation. Few topics supply as much grist for the old puzzle mill as our friends in Newington. When it comes to creating offbeat, unusual, and downright strange tidbits of ham radio trivia, the ARRL provides your "FUN!" columnist with a veritable field day (if you should pardon the term) of material. (For instance, how many nongovernmental organizations do you know that once had their own "Department of Defense?")

All in all, the ARRL should make for a very entertaining column. Even more interesting, one might say, than evaluating the League's financial status from their annual report.

ELEMENT 1—CROSSWORD PUZZLE
(Illustration 1)

Across

1 League's original QTH
5 What incentive licensing made many hams
7 Propagation form (abbr.)
8 ARRL message service (abbr.)
9 League "breakthrough" (abbr.)
11 Pin or spike
12 Over
13 Interference type
15 League often gets this in its bonnet
16 ARRL constituents
17 League state (abbr.)
18 Bigwig's initials
19 Choose
21 Pacific prefix
23 Oceanian prefix

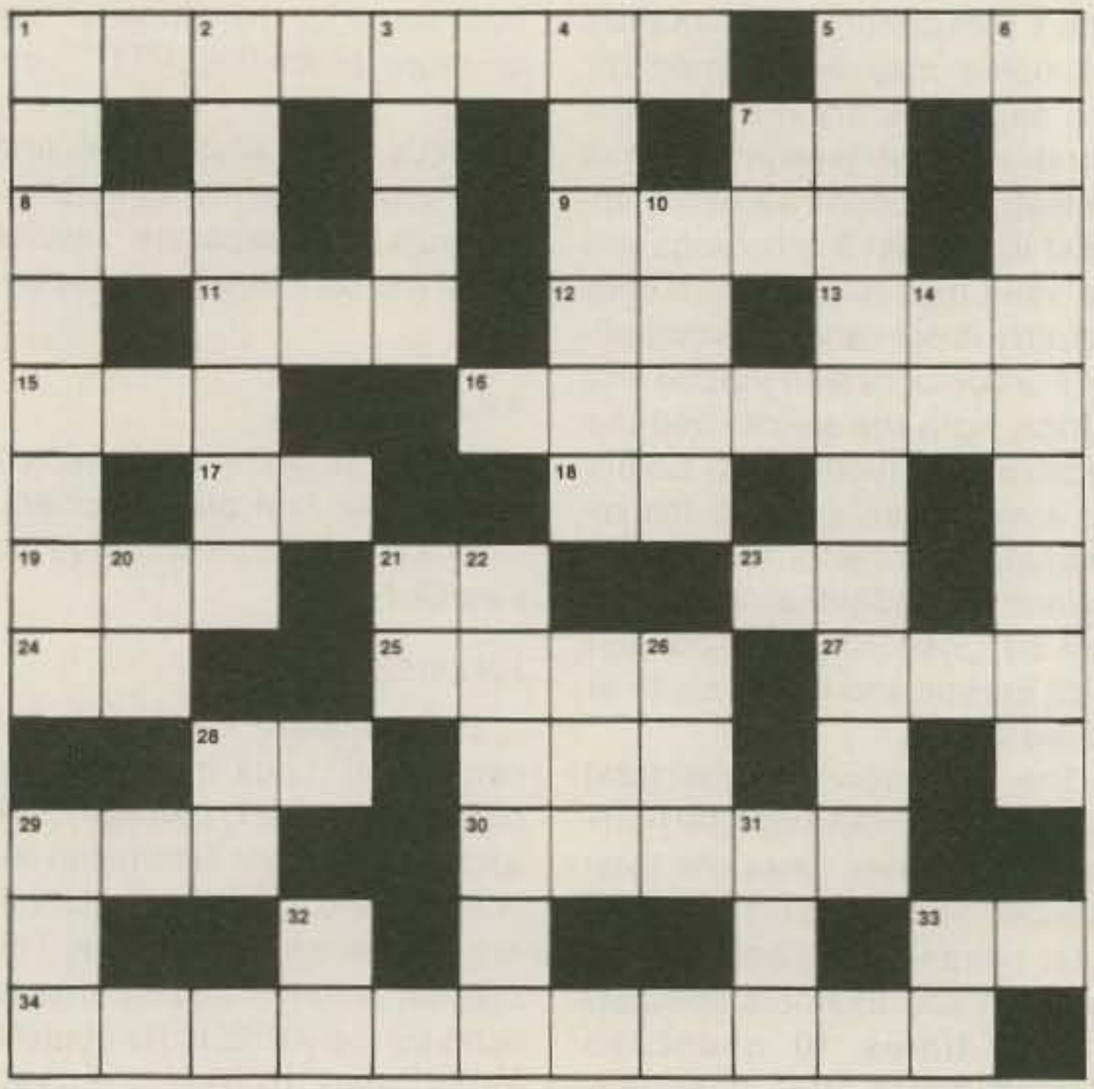


Illustration 1.

24 Old island prefix
25 Opposite of short path
27 Charged particle
28 Double dash
29 League watchdogs (abbr.)
30 British tube
33 Morse mode (abbr.)
34 League headquarters (2 words)

Down

1 ARRL publication
2 League seeks this
3 League banner
4 Old rig
5 Long-term Leaguer (2 words)
6 ARRL areas
7 Slow scan (abbr.)
10 Code of Ethics description
14 Guinea-Bissau prefix
20 Night (abbr.)
21 Midnight sun prefix
22 Former League president
26 Late *QST* cartoonist
28 League forum byproduct (abbr.)
29 ARRL award (abbr.)
31 Af gain (abbr.)
32 Morse slash
33 Personal radio service (abbr.)

ELEMENT 2—MATCHING
"Who Am I?"

Below are self-descriptions of various people associated with the ARRL. Match these statements with the names listed.

1) In 1914, I co-founded the ARRL with Hiram Percy Maxim. _____
2) Although I drew the cartoons and illustrations that became an integral part of all League publications, my death was all but ignored by *QST*. _____
3) Back in 1953, when W1AW caught fire and suffered severe damage, I was the last operator on duty. The fire burned a hole through the floor directly behind the main operating console. _____
4) After being a sales representative for Motorola, I joined the ARRL as *QST*'s managing editor in 1956. Today, I am the day-to-day boss of the League, having even more direct power than President Dannals. _____
5) I write those "folksy" humor articles for *QST* that you have to read twice to "figger out" what I'm saying. _____
6) In 1971, I led the ARRL delegation to the ITU Space Conference—a conference that took away 99.99684% of our satellite frequencies. _____
7) I wrote *QST*'s "How's DX?" column for over 30 years. Since my retirement, *QST*'s had a problem finding anyone to write the column for more than 30 hours. _____
8) I was the League's first general counsel and the author of its "Amateur's Code." _____
9) For many years, I was *QST*'s VHF columnist. In 1946, I took part in the first 6- to 10-meter crossband transatlantic QSO. _____
10) In the June 1964 *QST*, I wrote an article extolling the virtues of incentive licensing. However, by the beginning of the 1980s, I still hadn't achieved my Extra-class ticket. _____

A) Robert W. Denniston W0DX B) John Troster W6ISQ C) William Orr W6SAI D) Rod Newkirk W9BRD E) Richard Baldwin W1RU F) Michael Samanka KA2AEV G) Edward Tilton W1HDQ H) Paul Segal I) Murray Powell W1QIS J) Phil Gildersleeve W1CJD K) Clarence Tuska 1WD

ELEMENT 3—MULTIPLE CHOICE

1) W1AW pays its operators. Since hams are not allowed to accept material compensation for their radio efforts, how is this legal?
   1) It isn't
   2) By the grace of FCC Part 97.112, which allows compensation to operators of club stations under certain restricted circumstances
   3) W1AW operators may be paid only when the station isn't actually transmitting
   4) W1AW operators aren't paid

2) According to the ARRL's "Amateur's Code," to whom does a ham "owe his amateur radio to"?
   1) The FCC
   2) Radio pioneers
   3) The credit company
   4) The ARRL

3) Back in 1977, when Jack Anderson ripped amateur radio apart in his column, how long did it take the League to form its reply?
   1) 24 hours
   2) 1 week
   3) President Dannals met with Anderson to discuss the column 2 weeks after it appeared
   4) The ARRL never formally responded

4) Under ordinary circumstances, how much does *QST* pay writers of top-notch construction articles?
   1) Nothing
   2) $50
   3) $200
   4) A 2-year ARRL membership

5) What did the ARRL "slay" in 1977?
   1) 220-MHz CB
   2) Amateur radio
   3) The "Russian Woodpecker"
   4) Mobile logging requirements

ELEMENT 4—TRUE-FALSE

		True	False
1)	W1AW is a club station.	_____	_____
2)	The 1980 ARRL Hudson Division Convention was actually held in the Atlantic Division.	_____	_____
3)	The ARRL's goodwill is worth only one dollar.	_____	_____
4)	In 1979, out of the 2,238 people who applied for ARRL code proficiency certificates and stickers, only 90 failed.	_____	_____
5)	Under a special agreement with the FCC, W1AW is allowed to run up to five kilowatts of dc input power.	_____	_____
6)	The ARRL is in favor of giving phone privileges to Novices.	_____	_____
7)	When the FCC raised Novice power restrictions from 75 to 250 Watts in 1976, the League expressed its disapproval.	_____	_____

8) The League's headquarters in Newington CT stands on the site of a former mental hospital. ____ ____

9) Eugene C. Woodruff was the founder of "Amateurs for Action," an anti-ARRL organization of the 1950s. ____ ____

10) "The American Radio Relay League" was almost named, at its inception, "The American Amateur Radio League." ____ ____

ELEMENT 5—MISSED QUOTES

Below are misquotes of familiar League slogans, titles, and expressions. Your task is to restore them to their correct form.

1) "You'll find RIT in a League publication."
2) "Of, by, and against the amateur."
3) "Devoted entirely to itself."
4) "Calling some radio amateurs; this is W1AW."
5) "The World Above 50 kHz"
6) "Ham's Wild World"
7) "Silent Key Night"
8) "Kinky Hints for the Radio Amateur"
9) "YL Views and News"
10) "Frequency Estimating Test"

THE ANSWERS

Element 1:
See illustration 1A.

Element 2:
1-K, 2-J, 3-I, 4-E, 5-B, 6-A, 7-D, 8-H, 9-G, 10-C

Element 3:
1-2 The so-called "W1AW clause."
2-4 Who else?
3-4 Instead, they asked members to write their local newspapers.
4-1 You get what you pay for.
5-1 To paraphrase Mark Twain: The reports of 220-MHz CB's death are greatly exaggerated.

Element 4:
1 True It's actually licensed to the "ARRL Headquarters Operators Club."
2 True For convenience of division members, no doubt.
3 True That's what it says in their Annual Report—I think it's an overestimate.
4 True Gee, and who says code is hard to learn?
5 False W1AW must live with the same rules as the rest of us. Serves them right.
6 True They've even filed a petition with the FCC to allow Novices phone on 220 MHz. See Element 3, question 5.
7 True W2HD got so mad, he even wrote a letter.
8 False No comment.
9 False Not likely, since Woodruff was League president from 1936-1940.
10 True It would have made a better name, but could you imagine griping about the AARL?

Element 5:
1 "You'll find it in a League publication."
2 "Of, by, and for the amateur."
3 "Devoted entirely to amateur radio."
4 "Calling all radio amateurs; this is W1AW."
5 "The World Above 50 MHz (mc.)"
6 "Ham's Wide World"
7 "Straight Key Night"
8 "Hints and Kinks for the Radio Amateur"
9 "YL News and Views"
10 "Frequency Measuring Test"

SCORING

Element 1:
Twenty points for the completed puzzle, or ½ point for each question correctly answered.

H	A	R	T	F	O	R	D	■	M	A	D
A	■	E	■	L	■	A	■	T	E	■	I
N	T	S	■	A	■	N	B	V	M	■	V
D	■	P	E	G	■	G	O	■	B	C	I
B	E	E	■	■	M	E	M	B	E	R	S
O	■	C	T	■	■	R	B	■	R	■	I
O	P	T	■	K	H	■	■	Z	L	■	O
K	M	■	■	L	O	N	G	■	I	O	N
■	■	B	T	■	O	■	I	■	F	■	S
O	O	S	■	■	V	A	L	V	E	■	■
T	■	■	D	■	E	■	■	O	■	C	W
C	O	U	N	T	R	Y	C	L	U	B	■

Illustration 1A.

Element 2:
Two points for each correct answer.

Element 3:
Four points for each correct answer.

Element 4:
Two points for each correct answer.

Element 5:
Two points for each quote corrected.

Think you know your League? Let's see.

1-20	points—Received a congratulatory form letter from W2HD after passing Novice test
21-40	points—Once threw away a League promotional mailing
41-60	points—Ardent member
61-80	points—You wear your 25-year pin to work
81-100 +	points—Charter Life Member

By the way, about the ARRL "Department of Defense" mentioned at the start of this column: That was the League's World War I plan to organize an amateur civil defense network in the event of an enemy invasion. It's a good thing the Kaiser never tried invading Connecticut; his forces would have been no match against dozens of amateurs carrying hand-held spark rigs.

HAM HELP

The Sinclair/Microace Amateur Users' Group has located a source for those impossible-to-find connectors for the ZX-80 computer. Amateurs wishing to trade amateur-related programs and information such as this source may contact me at the address below.

Marty Irons K2MI
46 Magic Circle Drive
Goshen NY 10924
(914)-294-9462 after 9:00 pm

I have just completed a Signetics 2650 microcomputer (2650 motherboard with S-100 expansion to 64K) and would like to send RTTY and CW with this unit. I can't, however, find anything on a demodulator from my rig to the micro. Can anybody help? Thank you.

Max Sims VK5NHM
19 Stuart Tce.
Port Lincoln, S606
Australia

LOOKING WEST

Bill Pasternak WA6ITF
c/o The Westlink Radio Network
Suite 718
7046 Hollywood Blvd.
Hollywood CA 90028

Last month, I presented the Lew Collins W1GXT letter in which he expressed his reaction to the proposed six-meter band plan. This month you can read my reply.

I finally have the time to properly answer your letter. Many apologies for the delay, but as my earlier quick note explained, the "bug had me down for a bit." Enough on that. On to six meters and your letter. I will try at this time to respond on a point-by-point basis, addressing the points on which we seem to disagree.

First, I am far from a "casual" six-meter user. Rather, I have been on that band almost constantly since 1959 when I was first licensed in New York as WA2HVK. I believe this was detailed in depth in the column. By "user," I think you mean one who engages in day-to-day two-way operation. To me, the term "user" means anyone who spends any time concerned with the band. Going with my definition, and, again referring to what I have printed on the subject in regard to my own six-meter operation, I can say with assurance that my interest is far from casual.

I see that the one major point we do agree on is that six meters is by and large a "dead band," mainly due to the TVI problem. Two meters was a good out, and most amateurs took it. I am, however, well aware of the die-hards and their DX record this past year. In fact, I make it a point to try to call Ray Clark K5ZMS at SMIRK at least once a month for news updates. The 50-to-72-MHz "across the pond" activity was something else again. I can remember back in the early 1960s when many of us were trying for such QSOs, most of the time with no success. If only "C.C. & R's" didn't exist out here! Three elements in one's attic leaves a lot to be desired, especially when your attic is surrounded by rather high hills.

I think our greatest disagreement seems to lie in the area of technical parameters. In your analysis, you view only the operation of today's "minority" who inhabit the band on FM, using some excellent equipment. Something akin to the two-meter band about 15 years ago. The era of the 80D, RCA LD-150, and alike. In that day, the FMer on two meters was a "minority." He was the technically competent amateur who had the ability to take a piece of high-quality land-mobile FM equipment and convert it to amateur use. But it was not until the amateur manufacturers came along with off-the-shelf, ready-to-use equipment that FM activity really began to grow on two meters. Radios like the Drake TR-22 and Regency HR-2 are what "made" two meters. Not the converted Motracs and Mastrs. For the average amateur, the latter were just too limited in scope of operation to gain widespread acceptance.

Keep in mind that not every amateur is a technological wizard. A goodly number of today's hams have no interest whatsoever in building or converting. Maybe it's a sad commentary, but it's true, nonetheless. Hams today want off-the-shelf, ready-to-use radios. They want the type of features that no converted land-mobile radio can ever give. They are willing to sacrifice the extreme quality found in land-mobile equipment in favor of something small enough to carry in a briefcase, yet giving them total access to an entire band. Look at the equipment marketed for two meters. What sells best? The answer is self evident.

If six meters is to grow, it must be made easy for the average amateur to gain access to the band. This means mass-appeal amateur radio equipment, available off-the-shelf. Again, it's in the same situation as two meters was back a few years ago. I remember well the way that those of us using our Big-M radios felt toward the newcomer with his rice-box special. Even today, there are amateurs in my area who will not talk with another station on two-meter FM unless he knows for sure that he is in QSO with another amateur using a converted land-mobile radio.

But for a band to grow, it takes people. For people to come onto an amateur band takes being able to walk into a local radio store, plunk down his hard-earned bucks, and buy the rig of his dreams. And, for the rig of his dreams to be made available in the first place means that we amateurs must give definite assurance to those who build the equipment we use that we will purchase their wares. The only conceivable way for this to happen in relation to the six-meter band, especially in regard to FM, is for this nation to adopt one specific bandplan—and then stick to it.

It matters not who writes the bandplan. It does matter that it be one that lends itself to the ease of manufacture of equipment directly oriented toward the general amateur populace. This, so that a lawyer, doctor, or anyone, technically oriented or not, can turn it on and get on the air. Yes, it means going against one of the traditions of amateur radio. The tradition of believing that when one's amateur license arrives in the mail, he or she is automatically elevated to the exalted position of electronic wizard, par excellence. Reality says that those days are gone and probably will never return. How often does one find a U.S. DXer operating with home-built equipment these days? Very, very seldom.

I take a simple view. The bands belong to the majority, not any specific finite minority. I foresee any mass inhabitation of six meters taking place when and only when the equipment manufacturers begin to offer the type of equipment that the average amateur wants. Equipment that operates "out of the box." This is today's world of amateur radio, for better or worse.

For six meters, or any band, to be safe from outside attack means population and use. Not just casual use by a select few, which I think you and I qualify under, but, rather, it means use by the masses, the availability of the band, on a day-to-day basis akin to today's use of two meters. It means further deregulation and internal voluntary standards from the amateur community. It means that we start today and select a bandplan. A plan that is best for Joe Ham and Joe Ham Equipment Manufacturer. It will also mean the same sort of confrontation developing between those with commercial land-mobile radios and others who will be the newcomers. The latter is but human nature. If you have something all to yourself and you know how good it is, you might not be inclined to want to share it with others. This was the way it was in regard to the early days of FM on two meters and the way it is in regard to FM on six these days.

It is not for me to argue the merits of any specific bandplan. My only call is that we stop the procrastination and move forward now, lest we wait and find that "10-4, Good Buddy" has made his move, and it's too late for us to make ours. When I published the bandplan, I invited readers to pick it apart and put it back together. Thus far, yours has been the only in-depth letter received, and I am sincerely grateful that you took the time and trouble to do so. Maybe it will encourage others to do likewise.

As to the modelers' channels, I had expected a flurry of mail on that and was surprised that little was received at first. A few weeks later, I learned the possible reason. As you are aware by now, the Academy of Model Aeronautics had requested a hearing before the Commission in the hope of gaining permission for non-amateurs to use six meters for model control, under the supervision of an amateur. I suspect that many modelers felt that this would go through as requested, so they didn't bother to write.

I began to receive very negative commentary from the modelers the week of November 12, 1980. As you are probably well aware, on November 6, 1980, the Commission not only turned the request down, but went so far as to question the rationale of permitting anyone, amateurs included, the use of six meters for radio remote control of models. While I have yet to get a copy of the proposed plain-language amateur regulations (P.R. Docket 80-279), I have heard rumors that the latter is the case. I have ordered a copy and

Continued on page 154

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 8

isn't all that difficult if you go about it the right way. I think I could set up a system which would bring in tens of thousands of technicians for the military . . . and it wouldn't cost all that much either.

Also, the military seems to have had some problems with winning wars in recent years. The Vietnam conflict comes to mind in this respect. If I could have gotten my ideas on the subject where they would have done some good, we might have saved 99% of the money we threw into that silly war . . . saved tens of thousands of lives . . . and beat the hell out of communism. Before you decide without a trial that I'm a nut, I might explain that I have written about my scheme in *73* and gotten compliments on it. The plan, which I'll cover again if anyone is interested, is an oriental approach to outsmarting the enemy instead of trying to outfight him. New concept.

Much of my life is spent in solving problems, so I tend to think in those terms. Often I find it helpful to take ideas from many different fields and put them together to form a new concept. My grandfather made his fortune as an inventor and I think a lot the way he did. Fantastic man. Multipledisciplinarianism, they call it.

One of the reasons that I read as widely as I do is so that I will have ideas from many fields. I whip through some 200 magazines a month, covering not only the ham, electronics, computer, CB, radio, autosound, hi-fi, radar, satellite, microwave, and other associated fields, but also things like skin diving, photography, UFOs, psychology, politics, news, skiing, cars, premiums, business, stock market, travel, and so on.

The idea for outsmarting the North Vietnamese came from a mixture of ideas which I found in New Caledonia, Yugoslavia, and Singapore. Once I had the idea, I explored it with friends when I was visiting other countries such as Burma, India, Thailand, and so on. They all thought it would have to work.

That's one of the beauties of amateur radio . . . anywhere you go in the world you have friends . . . people you can sit down with to talk about ideas like that.

Lately, in the interests of saving time, I've been giving some of my talks at shows via video tape. I did offer to send a tape to the War College with my ideas. We'll see how that goes over.

HOW WOULD YOU LIKE TO *BE* DX?

Early on in my ham publishing career, I managed to get a taste of working from the DX end of things. I'd gotten particularly bitten by the DX bug back in 1946, immediately after the war. My first move after getting out of the Navy was to spend one summer on vacation in my home town in New Hampshire, complete with a kilowatt ham station and an enormous vee beam. What a summer *that* was!

Then, on returning to college in the fall, I moved my ham station there and set it up in the basement of the fraternity house. There was room in the yard for a pair of Twin-Three beams, so I began to set the world on fire, knocking off new countries as fast as they surfaced. I will never forget some of those exciting contacts.

One morning I was up early and heard a very weak station calling CQ. He was in the DX band, so I called him blind. It was a W7-something, portable something. I only called once because I felt so foolish calling a station when I hadn't heard the callsign. He came right back, with his signal gradually improving. It was W7IMW/C7 in Tientsin, China. He was running ten Watts and a very long wire . . . and I was the *only* station he was hearing. I got the QSL card for the contact, too!

After I became the editor of *CQ*, I managed to get on a DX-pedition to Navassa Island in 1958. That was an exciting trip for me, though it was a sort of last minute change from our original plan to go to Clipperton. I'd managed to get a license for Clipperton, but transportation fell through. I then got a license for Navassa . . . KC4AF . . . so we went there. Years later, when I was in Tahiti for a few days, I checked and found that my FO8AS ticket was still good, so I operated from Tahiti with it in 1966.

Down through the years, I've been on several DXpeditions . . . even going again to Navassa in 1972. I've also visited almost one hundred countries now and operated from over half of them . . . usually using the gear of a local ham. I've been on the hot end of the pileups hundreds of times . . . and it *is* a thrill.

Some of the more interesting places I've operated from were Afghanistan as YA1NSD, Teheran from the American Embassy, Beirut, Damascus, Nairobi, Katmandu, Delhi, Amman, Suva, New Caledonia, Western Samoa, American Samoa, Wake Island, Korea, including the DMZ at Panmunjom, Australia, New Zealand, and many, many more. Each is a story . . . and I have the slides to show for most of them. I'm working toward being able to put some of these stories on video cassette, so that they may be available for club showings soon. I'll let you know.

Even with the responsibility of running four monthly magazines plus Instant Software, I still manage to get away occasionally for a visit to some relatively rare spot. During the last year I managed to visit Japan, Korea, Taiwan, Hong Kong, Macao, China, Guatemala, Hawaii, Germany, France, Belgium, Netherlands, Luxembourg, Berlin (East and West), England, Ireland, and Northern Ireland. I met with hams in most of those countries and gave talks in Wiesbaden, Paris, Hawaii, Taiwan, and Tokyo.

You may be sure that *73* will always reflect my personal interest in both working DX and DX-peditioning . . . as well as my other ham interests such as RTTY, SSTV, OSCAR, microwaves, VHF, repeaters . . . etc.

WORK WAYNE WRAGGED

After operating for a few days in the Turks and Caicos Islands in March . . . partly during the DX contest . . . I found that this was a great way to sort of keep in touch with the readers of *73*. I can do this to some degree from Peterborough, but it really takes a location in the Caribbean to reach all of the US . . . and, besides, it is more fun that way.

My present plans call for me to be able to get away for a few days in May . . . so I'm hoping to get down to St. Lucia (J6L) and get on the air for a couple of days . . . probably May 16-17th. Look for me around 21.380 during the day, 28.70 if 10m is open, 14.210 and 14.285 in the evenings, and 3.820 during the late evenings. I'll try to be around those frequencies so you can find me.

While I obviously am not able to talk business over the air, I will welcome any questions . . . on just about any subject. I'll also cook up a special QSL for the expedition. I'm going to try to arrange further such trips, so we might eventually come up with a certificate if you can work me in N-places.

That brings up an idea. I wonder how many of you have QSL cards from me from more than ten locations? We might come up with some sort of recognition for those who have managed to contact me in a number of different spots. In the past I've been on the air from something near 50 countries.

Keep in mind that I am also an avid scuba diver, so I'll be out in the mornings checking out the reefs with an underwater camera. I had a couple fine dives at Providenciales Island in the Turks and Caicos. I'll write about that more when the pictures come back.

WIN A FREE BOOK!

We are reviving the "Circuits^2" feature in *73*. Just send in your favorite circuit, along with a *brief* description of its operation or intended use. (Make sure that it works!) If we print it, you'll get your choice of a book from our Radio Bookshop. Be sure to include your book choice with your circuit.

AWARDS

Bill Gosney WB7BFK
Micro-80, Inc.
2665 North Busby Road
Oak Harbor WA 98277

COLONIAL AMERICAN AWARD

To qualify for a very beautiful red, white, and blue award, applicants must work all the original thirteen colony states. In case you need help to identify which states they are: Connecticut, Delaware, Georgia, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, and Virginia.

Have your list of contacts verified by at least two amateurs or a local radio club secretary. Enclose your application and $1.00 award fee to: Certificate World Awards, Rte. 2, Box 72, Fulton MS 38843.

THE OLD SOUTH AWARD

Depicting a scroll listing the eleven states of the Old South, this award is made available to amateurs of the world who make one contact with each of the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia.

Have your list of contacts verified by two amateurs and enclose this list with an award fee of $1.00 or six IRCs to: Certificate World Awards, Rte. 2, Box 72, Fulton MS 38843.

VIRGINVILLE

1981 marks the 50th anniversary of the founding of the Reading Radio Club. This year, many events will be held commemorating their Golden Jubilee.

The first event is a Special Events operation with the club traveling to Berks County's foremost spot, Virginville. Station W3BN will operate on 3.950, 7.250, 14.300, 21.400, 29.500, and 146.31/.91 MHz phone and 7.125 and 14.045 MHz (alternating between phone) CW from 1300 to 2200 UTC on May 3. Special commemorative QSL cards are available—QSL club direct. For info, write Reading Radio Club, Inc., PO Box 124, Reading PA 19603.

WINDMILL ISLAND

Amateur radio station K8DAA will be operating from Windmill Island in Holland, Michigan, on Saturday, May 16, during the annual Tulip Time Festival. Certificates will be sent to amateurs contacting K8DAA between 1400 and 2300 UTC. Approximate frequencies will be 7.125, 7.275, 21.125, and 21.425 MHz. Please send QSL and 75¢ to Jack Van Voorst WD8RNQ, 8737 Summit Court, Zeeland MI 49464.

FIDDLERS' PICNIC

The Alamance Amateur Radio Club, K4EG, will operate a special events station at the Alamance County Historical Museum during the Fiddlers' Picnic fund-raising event for the museum. The Historical Museum building is the birthplace of Edwin M. Holt, a pioneer in textile manufacturing in the South.

Operation will be on May 16-17, 1981, from 1600 to 2300 UTC. Frequencies of operation will be 7.260 and 21.360 MHz, General phone. An attractive certificate will be issued on receipt of QSL and legal-size SASE. For information and QSL submission, contact Alamance ARC, c/o Gary Hills KA4KJI, 2416-C Huntington Rd., Burlington NC 27215.

DISAPPEARING SUN

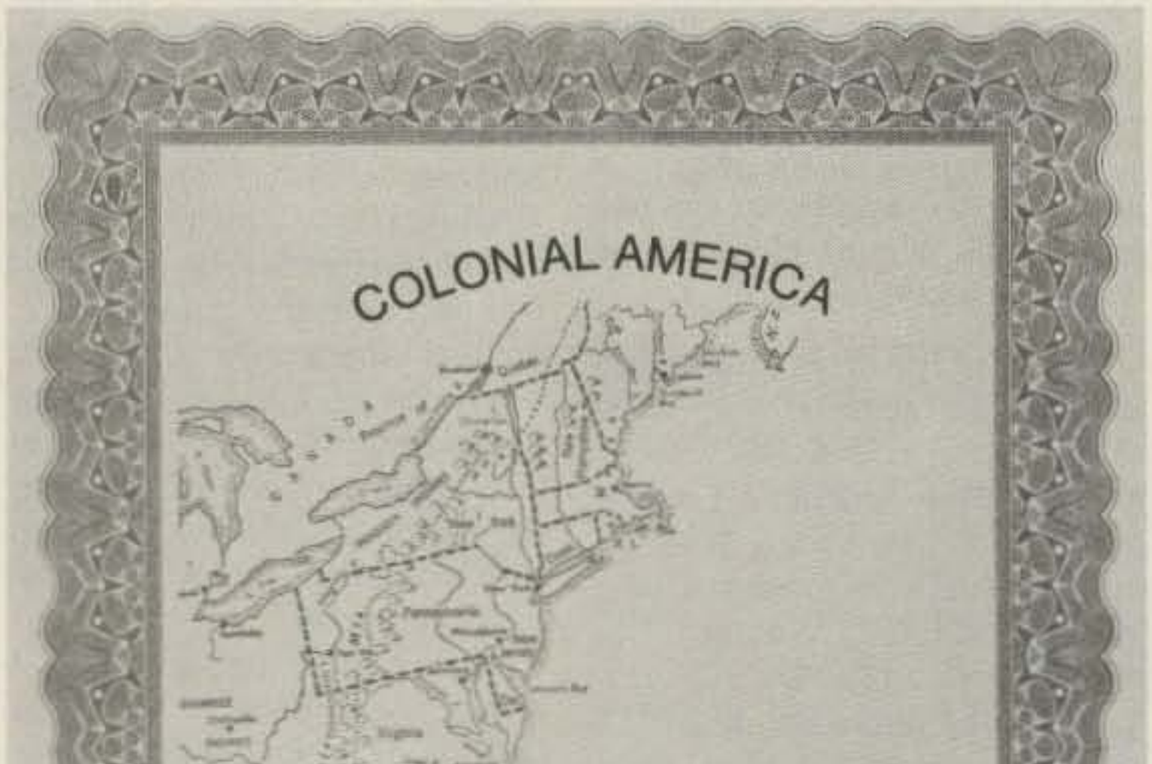
W7AQ, the Yakima Amateur Radio Club, will run a commemoration of The Day the Sun Disappeared, which occurred on May 18, 1980, when Mount St. Helens erupted. Yakima, Washington, which is 80 miles N.E. of the volcano, saw the sun disappear by 10:30 am and did not see the light of day until 7:00 am the next morning. May 18th was "black as midnight" by 12:00 noon.

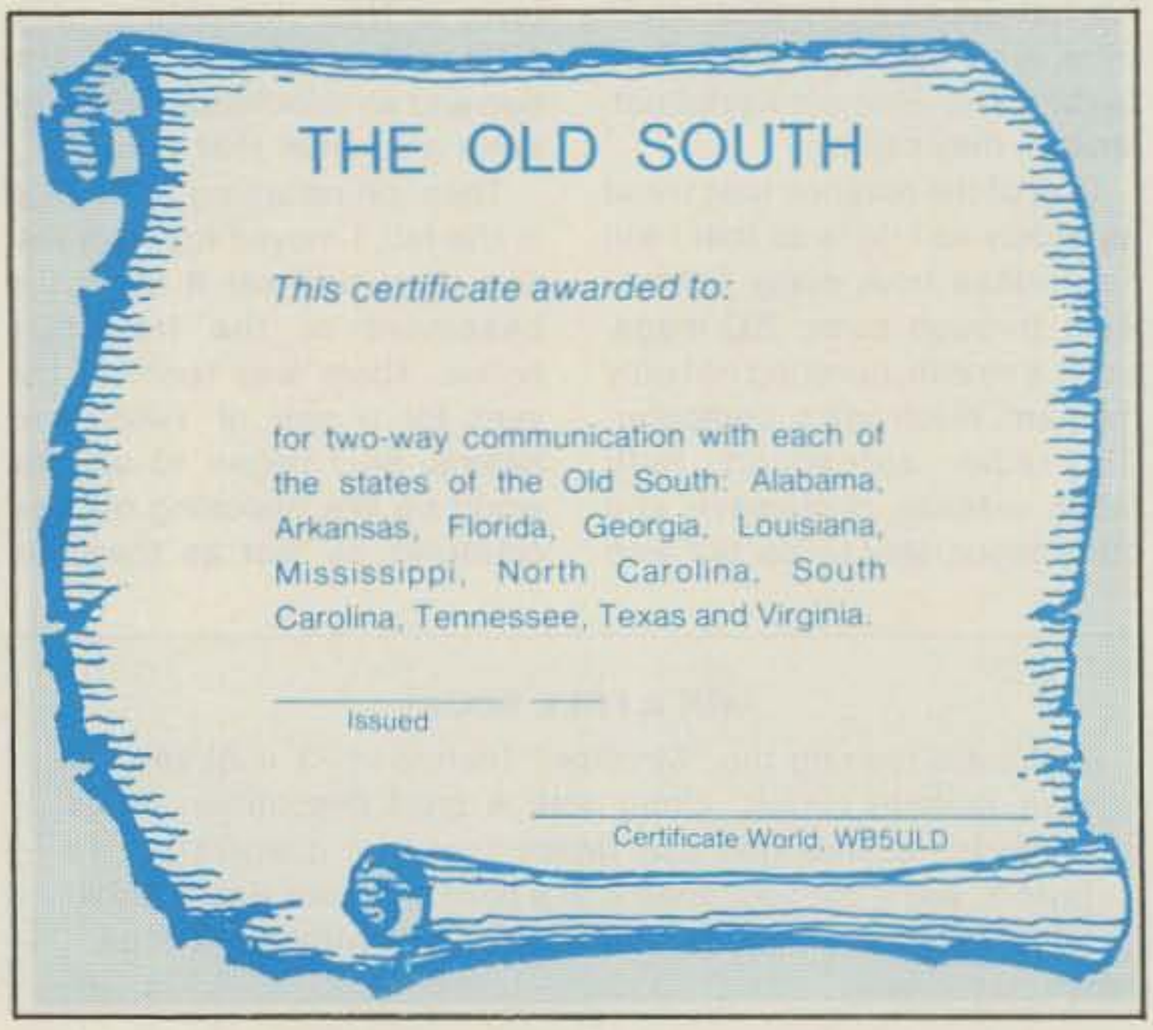
W7AQ was celebrating its 50th year of existence with its hamfest that morning. At 8:38 am, word was received that the mountain had a major eruption. Near 9:30, they watched a "thunderstorm front approach out of a clear blue sky." Then the rain of dust started. Over 600,000 tons of volcanic dust fell within the city of Yakima alone. Everything was covered with up to one inch of dust and ash. Local and visiting amateurs provided emergency communications and handled information traffic for the next three days.

Commemorate with them from 1700 to 0200 UTC on May 17-18. Listen for W7AQ on 28.660, 21.370, 14.280, 7.285, and 3.940 on SSB, and 28.120, 21.130, 14.040, 7.140, and 3.740 for CW. A special-event QSL card will be available: Send an SASE to W7AQ, Yakima Amateur Radio Club, PO Box 9211, Yakima WA 98909. For further information, contact Kenneth Sahn KA7DWH, PO Box 9211, Yakima WA 98909.

MACKINAC ISLAND

The Blossomland Amateur Radio Association will sponsor a bicentennial expedition to Mackinac Island (Mackinac





County) during the Michigan QSO Party, May 16-17. Operation on 80-10 CW and SSB, with 2-meter SSB is planned; look for W8MAI. Enclose an SASE for special certificate and mail to PO Box 175, St. Joseph MI 49085. For additional information, contact Dale H. Cole KA9FKU, 52480 Winding Waters, Elkhart IN 46514.

STORK TOWER AWARD

A new award from the Canadians in West Germany is called the Stork Tower Award. Sponsored by the Lahr Amateur Radio Club, all contacts must be made on or after July 1, 1980.

Contact 5 club members and the club station, DA2CF, using all bands or modes. Mail a list with full name, call, and US$1 or 5 IRCs to LARC, PO Box 2771, CFPO 5000, via Belleville, Ontario, Canada KOK 3R0. Remember—only members of the Lahr Amateur Radio Club count for this award.

MOSCOW OLYMPICS?

The Mid-South VHF Association will operate a special-event station on May 22-25, 1981, at the "Moscow Olympics" in Moscow, Tennessee. This event is a spoof of the Moscow, USSR, Games and will include cowchip throwing, skillet tossing, and tobacco chewing contests, among others. Proceeds from the "Moscow Olympics" will go to the establishment of an educational fund for the children of those men killed in the attempted hostage rescue in Iran. A special QSL commemorating the event is planned. Look for the "Olympics" on 40, 20, and 15. The station call will be KU4K (closest Russian-looking call). QSL to Ervin Ables KU4K, PO Box 88, Moscow TN 38057. For further info, contact Jo Ann Wilder at (901)-523-5310.

OE SERIES AUSTRIAN AWARD

WAOE. To qualify for the Worked All Austria Award, stations in OE, DL, OK, HA, YU, I, HB, and HB0 must contact all nine call areas of OE-land with three stations in each call area using at least two bands, one of which must be on either the 40- or 80-meter band. Call areas OE4 and OE9 count as one call area. Stations in other European countries require the same amount of contacts on at least two bands without the 40- and 80-meter restriction. Stations outside Europe need one contact with any eight of the nine call areas.

Awards are available for all CW, all phone, 2 × SSB, 1.8 MHz, VHF, and mixed modes. To be valid, all contacts must be made on or after April 1, 1954.

To apply, prepare a list of contacts and have it verified by a local radio club secretary. Enclose your application with an award fee of 10 IRCs to: OE1FMC, Awards Manager, Postfach 999, A-1014 Vienna, Austria.

WAOE/160. This one separates the men from the boys. Stations in Austria require two contacts in eight of the nine call areas. Stations in Europe outside Austria require one contact with eight of the nine call areas. Stations outside Europe need only to contact one station in four of the nine call areas. Remember, each of these contacts must be two-way communications on the 160-meter band. A real toughie for us west coast boys!

To apply, have your list of contacts verified by a local radio club secretary. Enclose this list with 10 IRCs and forward to: OE1FMC, Awards Manager, Postfach 999, A-1014 Vienna, Austria.

SAN BENITO COUNTY

The Gabilan ARC will put San Benito County, California, on the air on Sunday, May 31. Times of operation will be from 0800 to 1600 PDT, and will be extended if activity is good. Operating frequencies will be 28.775 and 21.400 USB, and 28.175 and 21.175 slow-speed CW.

A special certificate and QSL card will be sent to those who confirm with an SASE. QSL to John Daudet KB6IT, 2001 Scenic Circle, Hollister CA 95023.

LIECHTENSTEIN DXPEDITION

The Wiesbaden Amateur Radio Club will sponsor its sixth annual DXpedition to Liechtenstein during May 23-31, 1981. The callsign will be DA1WA/HB0. The QSL Manager is DJ0LC. His address, which is good in the DX *Callbook*, is Dr. Hugo Jakobljevich, Am Weinberg 10, 6200 Wiesbaden-Auringen, West Germany. Stateside QSLs, along with an enclosed SASE, may be sent to Mr. Stephen Hutchins, Box 4573, APO New York 09109.

Continued

NINE DRAGONS AWARD CORRECTION

Phil Weaver of the Hong Kong Amateur Radio Transmitting Society writes to tell us that the fee for the Nine Dragons Award is US$3 or 25 IRCs *not* the US$2 as listed in the February Awards column. Sorry for the inconvenience, Phil.

✓ *Reader Service—see page 130*

This year's operating modes will be: CW, phone (SSB), and RTTY on all bands; OSCAR Mode A; CW and SSB on 160 meters; and 6-meter/10-meter crossband operations. For American Novices, CW operations will be attempted at 3.725 and 21.120 MHz, ±5 kHz, between 1900 and 2100 hours EST.

The object of this year's DXpedition, besides having fun, is to provide amateurs around the world the opportunity to work "HB0". For further information, contact Hugo about CW operations, Steve about 160-meter operations, or Claude R. Matchette DA1PN/WB3CEA, HHC V Corps (G-2), APO New York 09079.

A DEEP SUBJECT

The month of May provides us with the opportunity to work three submarines in *three* different locations. The *USS Croaker, USS Ling*, and *USS Cod* will be activated for at least one weekend each. Can you fathom this? Read on.

USS CROAKER

The Amateur Radio and Electronics Association of New Jersey (AREA-NJ) radio club will conduct a mini-DXpedition to Groton, Connecticut, on May 2 and 3. The club will operate from the radio room of the submarine *USS Croaker* which will be moored in the Thames River. This event will commemorate the anniversary of the sub's commission into service during WWII. A special QSL card will be issued to all amateurs establishing contact with the submarine. The following is a schedule of the activities:

Time (UTC)	Band	Frequency
1400-1600	15m phone	21.355-21.375
1600-1800	15m CW	21.035-21.045
1800-2000	15m CW	21.110-21.120
2000-2200	15m phone	21.355-21.375
2200-2400	20m CW	14.035-14.045
0000-0200	80m phone	3.900-3.920
0200-0400	80m CW	3.73-3.75
0400-0600	40m CW	7.035-7.045
0600-0800	40m phone	7.235-7.255
0800-1000	20m phone	14.300-14.320
1000-1200	40m CW	7.130-7.140
1200-1400	15m phone	21.355-21.375
1400-1600	15m CW	21.035-21.045

During the entire operation, 2-meter FM will be conducted on both local as well as simplex frequencies. For information, contact Charles Burke WA2SLK, Box 164A, RD #1, Georgia Tavern Road, Farmingdale NJ 07727.

USS LING

On May 16, Armed Forces Day, the Meadowlands Amateur Radio Association will be on board the *USS Ling* (SS 297) docked on the Hackensack River in Hackensack, New Jersey, and will be operating under club station call N2BMN. Possible frequencies are: 14,280-285, 21,360-365, and 7,230-235 kHz, and 146.520 and 146.550 MHz from 1500 to 2000 UTC. For further information, contact Ralph Francavilla N2BMN (MARA), 154 Redneck Ave, Little Ferry NJ 07643.

USS COD

Once more, the members of the Parma Radio Club will be operating from the WWII submarine *USS Cod*, using the club call, K8UZW. The *USS Cod* is on permanent display in Cleveland, Ohio. Operations will start on May 30 and run through September 6 every weekend with the exception of Field Day weekend.

An attractive certificate will be awarded for 2-way contacts from the ship upon receipt of a QSL card and 30¢ for postage. All bands will be operated, 10 to 80; band conditions will dictate band of major activity. Send QSLs to WD8RZG. For info, contact Don Winner WD8RZG, 8927 Torrance Ave, Brooklyn OH 44144.

SCHOLARSHIP INFO

The Atlanta Radio Club announces the third annual competition for two $500 cash scholarships. Each scholarship will go to a licensed amateur entering college in the fall of 1981. Deadline for completed applications is May 31, 1981; request an application from ARC Scholarship, 259 Weatherstone Parkway, Marietta GA 30067.

NEBRASKALAND DAYS

A week-long statewide celebration, Nebraskaland Days, an event held the third week of June every year in North Platte, Nebraska, the home of Buffalo Bill Cody, features the Buffalo Bill Rodeo. This rodeo is named after North Platte's famous resident, who started rodeo as we know it today in North Platte.

In honor of Buffalo Bill and to celebrate Nebraskaland Days, the North Platte Amateur Radio Club will operate a special station, W0CXH, from 1800 to 0000Z on June 13-14. Frequencies used will be 21.400, 14.290, and 7.250 MHz SSB, and 21.150 CW plus or minus QRM.

A handsome certificate will be available for contact with the station. Send a legal-size SASE to North Platte Amateur Radio Club, PO Box 994, North Platte NE 69101.

OLD MAN RIVER AWARD

A very unique award can be yours by meeting the requirements of the Old Man River achievement award. The certificate pictures the mighty Mississippi River and the ten states bordering this river. To qualify, applicants must make two-way contact with all ten states: Arkansas, Illinois, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Tennessee, and Wisconsin.

Prepare a list of contacts and have it verified by at least two amateurs. Enclose an award fee of $1.00 or six IRCs to: Certificate World Awards, Rte. 2, Box 72, Fulton MS 38843.

PODUNK CENTER

On the weekend of May 9, Podunk Center, Iowa (yes, there is such a place!), will be back on the air. Air time not known yet, but all bands, SSB and CW, are contemplated. 146.52 FM simplex will also be monitored. Calls are W0YBV, CW; W0ANZ, SSB.

A Novice band might be used. CW operation will occur 25 kHz up from bottom, split frequency. Most SSB operation should be in the General class portion of the band.

QSL requests must be accompanied by an SASE or proper postage (or IRC equivalent). A special QSL will be sent in answer to such requests. Cards should be sent to the *Callbook* address of either station.

For more information, write Charles J. Ellis W0YBV, 2304 Storm Street, Ames IA 50010.

WORKED ALL BERMUDA AWARD

Sponsored by the Radio Society of Bermuda, this award is made available to licensed amateurs throughout the world.

To qualify, applicants must work one station in each of the nine parishes of Bermuda. Only one mobile or portable station may be claimed for credit. The rest must be fixed stations. The city of Hamilton is in Pembroke Parish and not in Hamilton Parish as you would be led to believe.

WORKED ALL CHILE AWARD

Sponsored by the Radio Club of Chile, applicants who wish to meet the requirements of this award will have to confirm contact with eight of the ten call districts in Chile.

To be valid, all contacts must be made after November, 1945. While there are no band or mode restrictions, special endorsements will recognize band or mode accomplishments if request is made at the time of application.

To apply, prepare a list of contacts and submit this list with your QSL cards to the awards manager. Enclose with your application and cards an award fee of 6 IRCs to cover return postage of your cards. Forward to: Radio Club of Chile, Casilla 13630, Santiago, Chile, South America.

CE 25-P AWARD

Also sponsored by the Radio Club of Chile, this award requires South American applicants to make contact with 25 of the 31 divisions of Chile. Ap-

plicants outside South America need only to contact 20 out of the maximum 31 divisions.

Do not send QSL cards! Have your list of contacts verified by at least two fellow amateurs. Enclose your list with 3 IRCs to: Radio Club of Chile, Casilla 13630, Santiago, Chile, South America.

The Divisions for the CE 25-P Award are: CE1—Tarapaca, Antofagasta, Atacama; CE2—Coquimbo, Aconoagua, Valparaiso; CE3—Santiago; CE4—Taloa, O'Higgins, Colchagua, Curico, Linares, Maule, Nuble; CE5—Concepcion, Arauco, Bio Bio, Malleco; CE6—Cautin, Valvidia, Osborno; CE7—Llanquihue,Chiloe, Aysen; CE8—Magel Lanes, Tierra Del Fuego; CE9—AA-AM Antarctica, AN-AZ South Shetland Islands; CE0Z—Juan Fernandez Archipelago; CE0A—Easter Island; and CE0X—San Felix and San Ambrosio Islands.

ISLAND DX AWARD

On the DX scene, the Whidbey Island DX Club is proud to announce the continuation of the world renowned Island DX Award.

Sponsored by the Whidbey Island DX club, the Island DX Award is available to all licensed amateurs and SWL stations throughout the world.

This award is offered for CW, SSB, SSTV, RTTY, OSCAR, and single and multiband accomplishments. A total of 50 islands is required for the basic award. Endorsements are given in increments of 50 islands, up to and including the maximum number of islands possible.

The *73 Magazine* Work the World DX Listing is used as the basis for determining what is or what is not a DX country. Only DX countries which are bona-fide islands will count. See the list of countries.

To be valid, all contacts must be made after October 1, 1977. There is no mode or band restriction but endorsements will be recognized if requested at the time of application.

To apply, prepare a list of contacts in prefix order. Applications received in any other order will be returned to sender. Include on your list, the station callsign, IDX island name, band, mode, date, and GMT. Do not send QSL cards! Have your list verified by at least two amateurs or a radio club secretary. You must have QSL cards in your possession at the time application is made.

Forward your verified list, an award fee of $3.00, and a business-size SASE to: Whidbey Island DX Club, 2665 North Busby Road, Oak Harbor WA 98277.

NORTH DAKOTA/ SOUTH DAKOTA

Two activities are made available courtesy of the Central Iowa DX Association.

On the weekend of 30 May, two special-event stations will be on the air from one or the other or both of these states. Which one (or both) will not be known until the day of operation. 80-10-meter operation is

A3	HK0 (Bajo)	S9,CR5	VS6
A9X	HK0 (Malp)	SV (Crete)	VS9 (See 8Q)
BV	HK0 (San An)	SV (Dodecanese)	VS9K
C2	IS	T2,VR8	VU7 (Andaman)
C6	J3,VP2G	TF	VU7 (Laccadive)
CE0A	JA-JR-KA	TI9	XF4
CE0X	JD,KA1 (Mina)	UA1,UK1 (Franz Jo)	XP
CE0Z	JD,KA1 (Ogasa)	VE1 (Sable)	YB,YC,YD
CO,CM,KG4	JD,7J1 (Okino)	VE1 (St. Paul)	YJ
CT2	JW	VK (Lord Howe)	YV0
CT3	JX	VK9 (Willis)	ZD7
D4	KG4 (See CO)	VK9 (Christmas)	ZD8
D6	KH1,KB (Baker)	VK9 (Cocos)	ZD9
DU	KH2,KG6 (Guam)	VK9 (Mellish)	ZF
EA6	KH3,KJ	VK9 (Norfolk)	ZK1 (North)
EA8	KH4,KM	VK9 (Heard)	ZK1 (South)
EI, GI	KH5K,KP6 (King)	VK9 (Macquarie)	ZK2
FB8W	KH5,KP6 (Palmy)	VP2A	ZL
FB8X	KH6,WH6,AH6,NH6	VP2D	ZL (Auck-Camp)
FB8Z	KH6,KH7 (Kure)	VP2E	ZL (Chatham)
FC	KH8,KS6	VP2G (See J3)	ZL (Kermadec)
FG (Gaud)	KH9,KW	VP2K	ZM7
FG,FS	KH0,KH2,KG6 (Mari)	VP2L	ZS2 (Marion)
FH8	KC6 (West)	VP2M	1S
FK	KC6 (East)	VP2S	3B6,3B7
FM	KP (Desoth)	VP2V	3B8
FO (Clip)	KP1 (Navassa)	VP5	3B9
FO	KP2,KV	VP8 (Falkland)	3C0
FP	KP3,KS4,HK0 (Ran-Ser)	VP8,LU (Ork)	3D2
FR (Glor)	KP4,NP4	VP8,LU (Geo)	3Y
FR (Juan)	KX	VP8,LU (Shet)	4S
FR (Reun)	OH0	VP8,LU (Sand)	5B,ZC
FR (Trom)	OJ0	VP9	5R
FW	OX,XP	VQ9	5W
G,GM,GW	OY	VR1 (Br. Phoenix)	6Y
GC,GU	P29	VR1 (Gilbert)	8P
GC,GJ	PJ (Neth Ant)	VR3	8Q,VS9
GD	PJ (St. Martin)	VR4 (See H4)	9H
GI,EI	PY0 (Fernando)	VR6	9M6,9M8 (See VS5)
H4,VR4	PY0 (Peter & Paul)	VR7	9V
HC8	PY0 (Trinidade)	VR8 (See T2)	9Y
HH,HI	S7	VS5,9M6,9M8	

Island DX Listing. The IDX Award program depicts DXCC countries which are bona-fide "islands" as recognized by the National Geographic Society. First criterion, however: They must be a DXCC country as stated on the ARRL DX Countries List. Any qualifying DXCC countries either omitted from this list by error or those which have been recognized for DXCC after the release of this listing will be added to the IDX List when it is printed next.

contemplated. SSB and CW modes will be used and 144.52 simplex FM will be monitored. Calls will be W0YBV, CW, and W0ANZ, SSB.

Novice band operation is possible. Most CW operation will occur 25 kHz from the low end of the band and split frequencies will be used. Most SSB operation will occur in the General class band.

QSLs will not be sent to stations flagrantly violating ethics of good operating or failing to respond positively to suggestions made by these special event stations. Stations calling on the transmitting frequency will not be answered. QSL requests must be accompanied by an SASE or proper postage (or IRC equivalent). Cards should be sent to the *Callbook* address or either station.

County Hunters—Attention! En route to the site, these two stations will operate mobile. The route will pass through several Iowa counties from Des Moines to I-29. From there, I-29 will be followed to the North Dakota/South Dakota line.

WORKED ZAMBIA AWARD

Available to licensed amateurs of the world, the Worked All Zambia Award is sponsored by the Radio Society of Zambia.

To qualify for the award, applicants in zones 36, 37, and 38 require 20 points while all other stations need to accumulate a total of 10 points. Each 9J2 station counts 1 point on 7, 14, 21, and 28 MHz. On 1.8 and 3.5 MHz, 9J2 contacts will count 2 points. The same station may be worked on different bands for award credit. Other prefixes used by Zambian stations will count double points.

To apply, do not send QSL cards! Have your list of confirmed contacts verified by at least two fellow amateurs or a local radio club secretary. It should be mentioned that separate award classes are available for all CW, all phone, all AM, and mixed modes.

Enclose your verified list of contacts with an award fee of $2.00 or 7 IRCs to Awards Manager, RSZ, Daniel Soko, Box 1831, Ndola, Zambia.

EL GULFO DE MEXICO AWARD

This award, in the form of an old map showing the Gulf and Spanish exploration, is available to those amateurs making contact with the states of Alabama, Florida, Louisiana, Mississippi, and Texas. There are no band or mode restrictions nor any time limit.

To apply for the El Gulfo de Mexico Award, have your list of contacts verified by two amateurs or a local radio club secretary. Enclose your application along with an award fee of $1.00 or six IRCs to: Certificate World Awards, Rte. 2, Box 72, Fulton MS 38843.

WORKED ALL YUGOSLAVIA AWARD

To be valid, all contacts must be made on and after February 1, 1950. To qualify, YU applicants must confirm contact with 10 stations in each of the six YU republics. European stations require confirmation for contact with three stations in each of the six republics, while all other stations require two station contacts within each of the six Yugoslav republics. In all three categories, applicants must utilize at least two amateur bands. YU7, YU0, 4N, 4O, and YT count for the republic from which the QSO was made.

To apply for this award, prepare a list of contacts and have it authenticated by a radio club secretary. Enclose this verified list and award fee of 5 IRCs to Awards Manager, SRJ, Box 48, 11001 Belgrade, Yugoslavia.

ESPANA DIPLOMA

From Spain comes word of the Worked All Spain Award. To be valid, all contacts must be made on or after January 1, 1952.

To qualify, award applicants must work 125 different EA stations in eight call districts and have a minimim of three contacts from each of the eight districts. The same station may be worked only once regardless of band or mode. The Spanish provinces and call areas include: EA1, EA2, EA3, EA4, EA5, EA6, EA7, and EA8.

To apply, have your list of contacts verified by a local radio club official. Do not send QSL cards! Forward your verified list and the award fee of 10 IRCS to URE, PO Box 220, Madrid, Spain. We are told that SWL stations may also apply under the same award requirements on a heard basis.

MOUNT ST. HELENS AWARD

The Clark County Amateur Radio Club, W7AIA, announces the Mount St. Helens Award to commemorate the 1980 eruption of this active volcano in the Cascade range of North America. A unique full-color photographic award of the awesome eruption on May 18, 1980, is available to all radio amateurs throughout the world. Two opportunities, with no mode or band restrictions, are provided to qualify for the award.

1) Contact eight or more stations in the Mount St. Helens area of southwest Washington State (Clark, Cowlitz, Skamania, or Lewis counties) after March 27, 1980, the date of the mountain's first eruption in the past 123 years.

2) Make one contact with W7AIA (Clark County Amateur Radio Club) during its operation from 0200 UTC May 16 until 0200 May 18, 1981, to mark the first anniversary of the disastrous eruption which took the life of Reid Blackburn KA7AMF who was a member of this club.

Send log information (no QSLs, please) including call of station worked, date, signal report, and $2.00 or 9 IRCs to Award Manager, CCARC, PO Box 1424, Vancouver WA 98668.

Proceeds from this fund will go to the Reid Blackburn Memorial Scholarship Fund which has been established by *The Columbian,* a Vancouver newspaper. A brief resume of the mountain's volcanic activity and a short report of Mr. Blackburn's involvement will be included with the award.

LION CITY AWARD

Available to amateurs worldwide, this DX award requires that contacts be made on and after September 10, 1969, to be valid. Stations in zone 28 require a minimum of 40 station contacts in Singapore. All other stations in the world require only 20 individual contacts with Singapore.

Once confirmation is received, have your contacts verified by at least two amateurs and forward this list with 10 IRCs to the award manager: MARTS, PO Box 725, Penang, Malaysia.

WORKED ALL MALAYSIA AWARD

Also sponsored by the Malaysian Amateur Radio Transmitting Society (MARTS), the requirements of the Worked All Malaysia Award are quite challenging. Applicants must work 10 9M2 stations, 10 9V1 stations, 1 VS5 station, 1 9M6 station and 1 9M8 station. There are on band or mode requirements but endorsements are available.

To apply, forward a verified list of contacts and an award fee of 5 IRCs to: MARTS, PO Box 725, Penang, Malaysia.

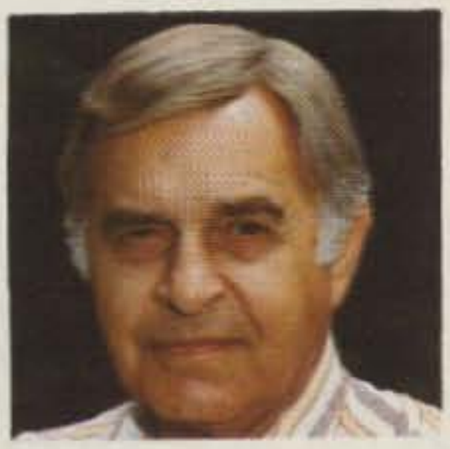
SAMUEL F. B. MORSE ANNIVERSARY

The Chelsa Communications Club of Chelsea, Michigan, is sponsoring a special event from May 18 to May 24, 1981, to celebrate the anniversary of Samuel F. B. Morse's first coded telegraph message. The message was sent in 1844 between Baltimore, Maryland, and Washington, DC, a distance of 41 miles.

Frequencies of operation are: phone 3.900, 7.235, 14.285, 21.360, and 28.510, and CW 15 kHz up from top of all Novice frequencies.

A special certificate will be sent to all those who send a QSL card with contact number and a #10 SASE envelope to Chelsea ARC Manager N8AYY, 5191 Esch Road, Manchester MI 48158.

LEAKY LINES



Dave Mann K2AGZ
3 Daniel Lane
Kinnelon NJ 07405

The traditional concept of avoiding controversial subject matter while on the air is becoming markedly weakened; people seem to feel that because standards have become measurably looser in other areas of public communications (television, films, books, theater, etc.), there is no need to preserve those taboos which, after all, are no longer consistent with our present level of sophistication and are relics of a bygone puritanical age.

As strong as the ham liberationists have become, however, there is still a sizable number of amateurs who feel that we must not drop certain standards of morality. Those who have allowed a loosening to occur in their own operations are frequently importuned by anonymous fellow amateurs (who rarely identify themselves by callsigns) to steer clear of touchy subject matter. The proscribed topics, usually, are politics, religion, and sex, not necessarily in that order.

Of course, when dealing with large numbers of individuals of varying backgrounds, one finds an enormous range of opinion stretching from one extreme to the other. What you consider acceptable may only raise my hackles, and what I may find perfectly innocent may give you apoplexy! If this is carried far enough, you come to the inevitable conclusion that there is no such thing as a topic that is not anathema to someone or other. Thus, if you were to accede to all the demands of the self-styled censors, you would scarcely be able to discuss anything at all!

We live in an era with fewer restrictions on speech and behavior than ever before. At no former time can I recall such phenomena as "streakers" and people "mooning" in the windows of automobiles. And the language that spews forth into the living rooms from TV sets is unprecedented. It is not difficult for the impressionable to infer that nowadays anything goes, bar nothing.

But just because there is a plenitude of foul four-letter Anglo-Saxonisms in books, movies, magazines, and television, it doesn't mean that they have now taken their place alongside of mother, apple pie, and Old Glory!

A writing colleague recently sent me some cassettes, transcribed off the air. I believe they were recorded on the frequency of one specific repeater in a large city on the west coast. I have listened to them carefully and have come to the conclusion that even though I am a strong proponent of free speech, I have to take a firm stand against the sort of unbridled filth on those cassettes. Just because Oliver Wendell Holmes' famous quotation on this subject is restricted to the hollering of "Fire!" in a crowded theater, some bubble-heads have concluded that it's perfectly legitimate to say anything else. They have also concluded that civil rights gains of recent decades have validated the theory that an individual has the right to do practically anything, and that this right must be defended against the "tyranny of the majority." They hold that individual freedoms are more precious than collective rights.

This view is quite a distortion, to say the least.

But let's not talk about obscene language alone. After all, foul language is nothing new; it has been on the scene almost as long as language itself. I can recall that when I was in the Army there was a certain universally applied adjective. It was so common that nobody paid any attention to it.

"Pass the -----butter, willya buddy?"

"Sure. Watcha doin' this -----weekend?"

"Gonna go home and see my -----family. How about you?"

"Nah! I'm gonna stay on the -----base."

As I say, it became so ubiquitous that it lost its offensiveness. And perhaps that is what has happened while we weren't looking. Someone once said that eternal vigilance is the price of liberty. Well, obviously, it is also the price of the maintenance of high behavioral standards. If they are not watched and guarded, they can deteriorate right under our very noses.

There is another element, however, that may be a good deal worse than foul language, something that has been building for a long time. Like dry rot in foundation timbers, it has spread virtually unnoticed, and it could threaten not only the microcosm of ham radio, but the entire society itself.

Someone has passed along a letter written by a licensed amateur, a diatribe which he sends as his QSL. It is one of the most scurrilous pieces of racist propaganda and filth that I have ever seen, and believe me, I have seen plenty! Like most of its type, this one masks its venomous poison behind a facade of phony patriotism and religiosity. It uses well-documented deliberate slanders to construct a tissue of mendacious and malicious lies, and propagandizes in exactly the same way that similar pieces of fascist material were spread during the height of the fifth column activity immediately preceding our entry into World War II. The line is the same old Hitlerite garbage that once plunged humanity into a global conflict that snuffed out millions of lives before it was quelled!

The letter itself is awful enough. But the disclosure that this same vile filth is being regularly transmitted on our amateur frequencies is an abomination! Apparently there are nets being operated by this seditionist and his confederates. According to the letter there are also two publications which are pushed by these people as well, tracts designed for the purpose of spreading the false gospel of racism and religious intolerance. And in the classic manner of most such groups, this one relies upon the traditional fear and distrust of communism to whip up the passions.

Steps have been initiated to bring the matter to the attention of authorities so that it can be determined whether radio regulations are being violated. But I fully expect that when and if a hearing takes place, these extremist lunatics will bombard the FCC with all sorts of arguments claiming that their civil rights are being violated. They will accuse their adversaries of persecution and will righteously and piously scream that they are victims of a communist plot. And they will call upon "real Americans" to join them in a common crusade against the forces of Satanic bolshevism.

The question poses a paradox. We who believe in freedom of speech generally oppose all limits and boundaries. Yet, there is such a thing as a "clear and present danger." Much to our disadvantage we learned that no matter how small and seemingly weak such groups may seem, they can gain unbelievable strength and power. Hitler began with a small group of tavern rowdies. Castro's insurgence started with just a few revolutionaries, perhaps fifteen or twenty. Khomeini's circle consisted of a few fanatics quartered in a cheap room in Paris, thousands of miles away from Teheran!

Let no one dismiss such carryings-on as inconsequential trifles simply because they seem ineffectual and their advocates are few in number. At the same time, we can rely, I feel, on the common sense of the overwhelming majority of our ham colleagues, and can be confident that such appeals to prejudice will fall on deaf ears. There is little to suggest that any but the most ignorant and those already infected with the virus of racism would be foolish enough to be swayed by such arrant nonsense.

It does present us with a dilemma, however, and that is simply this. Should the amateur frequencies be available as a base of operations and a sanctuary for those whose ultimate aim is the destruction of traditional democratic concepts? Do we want our ham bands used as an avenue for alien propaganda programs, and if we do not, how can they be stopped without we ourselves violating the principles of free speech which we hold dear?

RTTY LOOP

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

A couple of years back, I acquired something called an "EPUT meter." Taking up about a foot of vertical space in a nineteen-inch rack, it had over a score of tubes and sported its own cooling fan. Its face was adorned with many knobs and switches, central to which were six columns, each composed of ten neon bulbs which shone through a mask to display the numerals zero through nine. EPUT? That stood for Events Per Unit Time. Yes, this power-hungry monster was my first frequency counter, able to count up to 100 kHz, and originally costing several thousand dollars.

Despite its limitations, the EPUT meter proved invaluable when setting up my RTTY station. AFSK tones, filters, an ST-6, and countless other projects were aligned with its help. But it was big and power-hungry, and its 100-kHz frequency limit put quite a crimp in its applications.

Then, at a hamfest, I saw a little box for sale, the likes of which I just could not believe. A frequency counter the size of one of the EPUT meter's readout modules, that could literally run rings around the old unit.

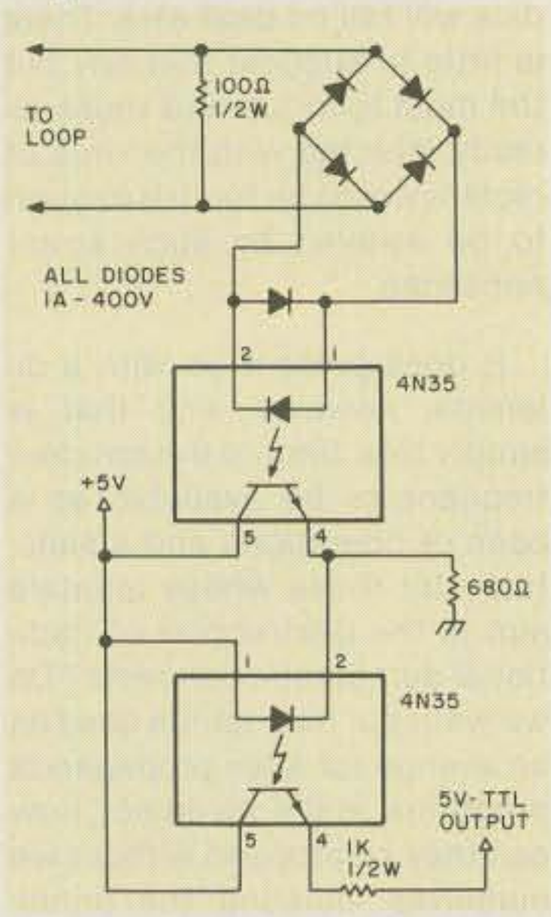


Fig. 1. Sixty-mA loop-to-TTL conversion . . . with inversion.

The Ramsey Electronics Model CT-70 frequency counter, advertised right here in the pages of *73*, was what caught my eye. Let's take a look at what it does. The basic counter's range is from 10 Hz to 5.5 MHz. Within that range, sensitivity is under 50 mV and resolution with a one-second gate is to one Hertz. The stated accuracy of the straight counter is to within one part per million at normal operating temperatures. That is the equivalent of .0025 Hz at a 2500-Hz tone frequency, or 3.6 Hz when tuning up on 3620-kHz RTTY. Close enough for my standards.

A shift in the input circuit extends the range ten times to 55 MHz with the loss of only one digit of resolution. Sensitivity and accuracy stay the same, only now the readout is within 10 Hz. Since the stated accuracy at, say, 50 MHz would be within 50 Hz, the units digit would not be significant and it would make little sense to show one.

As if all that were not enough, at the flick of a switch a divide-by-ten prescaler is placed in the line. This extends the range through 550 MHz, with a stated sensitivity under 150 mV. Now the resolution is to within 100 Hz, again consistent with the accuracy of the device.

If you need faster updates than once per second and are willing to take a ten-percent penalty for doing it, a one-tenth-second gate is available. Some math will show that with a one-tenth-second gate what you gain in time you lose in accuracy, so no useful information is lost when the display is truncated to a bottom limit of 10 Hz, 100 Hz, and 1000 Hz on each of the three ranges, respectively.

Input to the counter is through a front-panel BNC jack; very convenient and easy to get to. Power is supplied by four internal AA-size cells. I chose to purchase the counter equipped with nickel-cadmium rechargeable cells and a wall-plug charger. Makes a very convenient package.

Also, a couple of accessories are available to make life easier. A short antenna mounted on a swivel-BNC plug allows easy rf monitoring. I didn't get one and, after the third antenna I jury-rigged fell apart, I wished I had. Several probes also are offered, all of which look like good deals.

How much, you wonder? The counter itself comes in just under $100, assembled and tested. If you are on a tight budget, you can order it as a kit and save fifteen bucks. The nicads and charger will run another thirteen dollars, and the antenna another eight. All in all, a very good value for the money. (Ramsey offers several other counters, by the way, both higher and lower in price. Check their ad in the back of the book for current details. If you write them, be sure to mention RTTY Loop, OK?)

So, why am I so hepped up on a counter, here in a RTTY column? Do you have an idea how many ways a counter can be used in a RTTY station? We can start with the obvious, measuring the tones put out by the AFSK generator to be sure it is accurate. Are you using direct rf FSK? Put the counter on the speaker leads of your receiver and zero beat your mark signal. Now send a space, and will you look at that! The counter shows your shift, directly!

Are you involved in nets? I have been, and there is nothing so aggravating to a net control of a RTTY station than to see stations spread up and down a few hundred Hertz. Boy, it really does! Hurt, that is. Now when I am on a MARS net where the mean frequency is 4035 kHz and the control station says to put your mark on 4035.085 kHz, straddling the center frequency with 170-Hz shift, that is exactly where I am.

Digitally inclined? An easy way to set up the baud rate of the RTTY program you have been working on is to run a bit chain to the counter. Remember that bit rate is related to baud rate, and that means frequency. Sixty words per minute is 45.45 baud; see if yours comes close.

Need more ideas? Just look at the number of counter-related articles in the pages of *73* over the past few years and you may get more of a feel for it.

Our circuit this month comes from Vince Vielhaber KA8CSH and Joe Stragea KA8GOS. They needed a TTL-level signal to key an AFSK generator off a 60-mA loop. Only one problem—the logic high, +5 volts, needed to be present during space rather than mark. The need to isolate the AFSK unit from the line, as well as the unusual biasing requirement, resulted in the circuit in Fig. 1. Two optoisolators are cascaded, with the second one operating as an inverter to the first. If you need the signal out in the conventional, mark-high fashion, the second optoisolator could be eliminated and the signal derived only from the first. Looks like a nice piece of work, fellows, and thanks.

Regards also to Alfred Giuliano K3QJO, who passes along his interest in the 6800-related RTTY articles. More are certainly on the way, both here and in the rest of the magazine. Remember, *73* is the leader in articles of technical interest to the active amateur, and the place to start for RTTY is right here, in RTTY Loop.

LETTERS

RADIO SHACK CLASSES

I had to write to congratulate you on your great idea for ham classes through Radio Shack. I have often wondered why more stores don't use this as a valuable advertising tool as well as a way to gain numerous new customers. I have taught Novice classes at a local community college with good results, but I think your idea is by far a better approach.

I would like to offer any support or services I could to help this idea advance. I will approach the local owner of the 5-6 Radio Shack stores in the Spokane area with the idea or will let you approach the company as a whole.

I am looking forward to hearing how this idea develops. If the company isn't interested for its 6000+ stores, how about its computer centers in many large cities? These already have training facilities for use so would be ideal with no new expense to the company.

For ease in starting, the Radio Shack book *From 5 Watts to 1000 Watts*, their code oscillator on a board, plus a cheap speaker and code key could be put together in a small package. I think a $25 fee would be plenty unless you anticipate paying the instructor. If so, I would say not more than $100 for a 10-week class.

Again, it's a great idea, and let me know if I can be of any help in making it a success.

Dan Robinson WB7PSO
Spokane WA

ARRL SWINDLE

To All Indiana Amateur Radio Clubs and Interested Hams:

As you probably are aware by now, the present leadership of the ARRL has swindled Central Division League members out of their right to be represented on the ARRL Board by the candidate of their choice. In good faith, Central Division League members recently cast secret ballots for their choice to serve as Central Division Director for the next two years. However, two days before the votes were to be counted, one of the candidates, Director Don C. Miller W9NTP, was summoned to appear before the ARRL Executive Committee the following day to answer charges of alleged election misconduct. Upon his arrival at League headquarters on this incredibly short notice, Don was ushered into a private meeting with President Harry Dannals. After being browbeaten and verbally abused by Dannals, and other League officials for over two hours, Don, at Dannals' direction, signed a letter of resignation as Director for the term ending December 31, 1980. Two other points about this meeting should be noted. First, prior to his signing the resignation, but unbeknownst to Don, the League's Executive Committee (out of Don's presence) had reviewed all of the various allegations of misconduct that had been made and voted to dismiss them and to proceed with the previously scheduled November 20 ballot count. The second and most significant is that Don Miller never withdrew as a candidate in the pending election nor was given a hearing on the question of his alleged disqualification.

Upon his return from Connecticut, Don reported the above cited events to the Officers and Directors of the IRCC. The undersigned then directed our attorneys to conduct a complete investigation of the situation. A report of that investigation and advice on potential future action was delivered to a special meeting of the IRCC Directors held on December 16, 1980, in Indianapolis. The two conclusions reached at that meeting were, one, that Don was clearly not guilty of any wrongdoing that would disqualify him from office, and two, that if Don was willing to participate in any necessary legal action, the IRCC would raise the necessary funds and sue to vindicate our members' rights to have their votes counted and results certified. Several phone calls and letters to the ARRL and their attorneys made it absolutely clear that they would not accede to our demand unless ordered to do so by a court. If ordered by a court to seat Don Miller as Director, they would then initiate proceedings to oust him as a Director on frivolous charges. When Don was notified of this situation, he advised the IRCC that he appreciated our efforts but did not wish to become a party to the lawsuit. Our attorneys have advised us that without Don, we have no real chance to win a case. So, reluctantly for this term, our hands are tied—legally at least.

Although the League has apparently won the battle, the war is not over; in fact, it has just begun. By their patent disregard for the rights of our members in the Central Division, the current League leadership demonstrated to us the acute necessity to take immediate action to protect our rights from this type of outrage in the future. Our first task is obvious: We must do everything we can to strengthen the one statewide organization that can and will speak for the interests of hams in our state and in the entire Division. We must not be cheated again—our strength lies in numbers. If you are presently a member of a Radio Club or know of *any* Indiana radio club or organization who is not yet a member of the IRCC, please seek their support in becoming a constituent member of the Council. The annual dues for clubs is $7.50. Individual members may subscribe to the *Bison*, the Council publication, for $5.00 annually. Our membership chairman is George Ransford W9VMT, 6015 Forest View Drive, Indianapolis IN 46208, phone (317)-255-6180. Remember, your right to have anything is solely dependent on your resolve to do something about it. Help us help all Indiana hams.

T. James Barnes K9TFJ
Indiana Radio Club Council
Secretary/Treasurer
Greenwood IN

GETTING A JOB

Last week I sent your personnel department a resume describing my virtues, but this week I have second thoughts and wonder if I would be a good staff member considering my experience of the last two weeks.

I thought I would write and give you a few facts which have been evident to me during the last few days regarding the hiring of middle-aged technicians in their fifties. Do they retire? Do they start new careers? Or do they just fade away like WWII surplus until there just ain't no more?

I'm pretty typical. I worked in radio stations and two-way shops most of my life, and finally started my own shop in 1962. After 18 years of grappling with the pressure of customers, government, and raising children, I sold my shop to a young man who is now doing real well with it. I realized enough from the deal to retire—for one year.

The relief from the pressure is great, but the not working is awful. Some began to say, "If he would eat, let him also work." This is a true saying, so I hit the streets, made phone calls, and filled the mail boxes with resumes. My goal was to connect with an industrial outfit who needed a competent electronics man.

Now, when I say competent, I don't mean brilliant, but rather consistent, loyal, and industrious. The kind of fellow I would hire would also be imaginative and empathetic to his fellow workers, not necessarily brilliant. The brilliant technicians are called "hot shots" around here, and, though having more smarts than Bill Buckley, they cannot be trusted to come in from a hail of halavah or to wipe when finished. Additionally, the really bright technicians have a kink somewhere and either ride fast bikes, fly planes, collect poisonous snakes, chase women (or men), are super religious or super atheist, or live in filth that would rival the ghettos of Babylon.

So, being competent (but not brilliant) and with a good record that stretches back 35 years, I began to collect rejection slips from the job market. After contacting many electronic firms, I can say, without false modesty, that my resumes have entered the finest companies in the state and exited in a dumpster.

Interesting results of the experience: Technical jobs come in four categories. First, the standard technician (tv, audio, two-way, industrial) can make $135 to $175 in forty hours but

must climb towers, pull stubborn coax through conduits, pull control cables under trucks with greasy dirt falling in his face, and repair his supervisor's stereo on his day off. The next step is the experienced technician of 10 to 20 years who makes $200 to $275 a week and has majored in the local technology of his company while taking a healthy minor in its politics. The $275 to $400 slot is filled with Phi Beta Kappa double-Es who are willing to work 15 hours a day and will relocate in Nome, Rome, or Khomeini's home.

Above $400 a week is reserved for a unique group of technicians who must be led to work, told when to breathe and how, wound up in the morning and pointed toward their simple tasks, and escorted to the john when they begin to wear a pained expression, wave their arms aimlessly, and grunt urgently. This seeming contradiction of classification is understandable when you realize that the above $400 category is reserved for the boss's kin and buddies, the kin and buddies of his Secretary of Carnal Knowledge, minority groups he is compelled to hire, and individuals skilled in sexual perversion and narrowly specialized in the kissing of feet. Result: many staff positions filled by LPNs (Limited Productivity Nuisances).

A lot of people think I am retired, and, temporarily, they are right. It's like the business that didn't intend to be nonprofit. Strangely, I couldn't find technicians when I was hiring and now, from the other side of the situation, jobs are as scarce as virgins in the brothels of Hong Kong. Uncle Wayne, why are there no tooth fairies, Santas, and jobs for old radio men?

For a moment, accessing the real world, I can answer my own question. Picture, if you will, a large balance scale such as the one held aloft by Blind Justice (sister of Talmage Justice, pickpocket, porn dealer, and CB operator); in the left pan picture a neat stack of attractively wrapped parcels labeled Experience, Morality, Integrity, Imagination, and Good Record, which represent the offerings I make to the labor market. In the other pan imagine a dimunitive box labeled simply "54 and choosy." Now, to complete the picture, imagine the left pan with its burden of many boxes high in the air while the right pan with its single box is flat on the ground, heavy as neutronium from a dwarf star.

There are several options for a rejected technician: I could join IRTRTFSFMALAIPT, or "I reserve the right to feel sorry for myself as long as I pay taxes." Feeling sorry for myself is a valley I like to visit, but I don't want to live there. Another option is to run away with the fat lady across the street who makes obscene gestures at me from her front window, a result of identifying me with the phallic-symbol antennas on my old Ford. But if I can't afford the tastes of my little cute present wife, how can I afford a king-sized one? Besides, summer is coming on and poverty precludes either air conditioning or Arrid, both necessary when living with a blimp. So I stay put with my little cute XYL who has geography like Dolly Parton, cooks like a French chef, and thinks hams are cute.

While pondering these alternatives the other day, a still, quiet voice said, "Well, isn't this what you wanted—freedom from pressure?" I said, "Yes." The still quiet voice said, "Why not be satisfied?" I said, "Say, who are you, still, quiet voice? Where is your QTH. What mode? FM, SSB, or AM?" And the voice said, "I am the Spirit of Things Put Off, Sotpo to you, fellow." And I said, "So send me a resume, yet," and it said, "I am all the great books you were going to write but flunked senior English ogling at Theresa Higgens low neckline. I am all the splendid music you were going to write but didn't know your A flat from first base. I am all the marvelous inventions you were going to birth, anti-gravity, fusion power, humanoid robots, a decent domestic automobile. I am all these things you neglected while you were rag-chewing on 3930. I am all the businesses you were going to start, but found that mongoloids scored better on management skills. I am..."

"Spare me, spirit," I said. "I am indeed guilty of all you say, and more. But don't tell me what I really am."

Relentlessly the spirit continued, "You are," it thundered, if indeed a still quiet voice can thunder, "You are a tinker."

So I replied, as did Abou ben Adhem when waking from his dream, "Shade, I dig thee not, for thou hast come so close to the truth that I must now close my ears. A human trait, I am afraid."

I told the spirit to split and pondered this revelation. It was true: With all my good traits, I am a tinker and, as such, have probably tinkered my way into a tough situation—unemployment.

Warn your readers, Wayne—a good job is hard to find.

I hope this letter will repay you for the many fine editorials over the years. I feel a little indebted for the good thoughts you share with us.

John Townsend
Wilson NC

John, you have been caught up in the fruitless job-hunting syndrome. It is all too easy to do, spurred on by the stupid system set up by the government employment service (and most firms), which thinks in terms of jobs they have open. The middle-aged person has a difficult time breaking through the usual personnel departments. They don't want youngsters because they have neither the specific needed training nor the experience in how to work. And older people are not appreciated because their training is seldom exactly what is wanted and they have a strong tendency to want to do what they already know how to do, whether it is really appropriate or not in their new job.

Rather than fight this situation, I would suggest not even trying to find a job opening. Rather, you decide what it is you are best at doing. Then you figure what firm might be able to use your abilities and talents. The next step is to do some detective work and find out what the company needs...what things are not being done for them that would help. Then you can go in and show how you can benefit them if they create the job you want to fill. It is far easier and better to create a job which calls for your abilities than to try to find the open job which fits you.

To give you an idea of this, let me say that almost without exception when I get letters asking for work, they always are wanting to know what jobs I have open. Never do they write and tell me that if I hire them they will be able to do thus and so for me, a job which will easily pay for itself in added income or savings to the firm.

My publishing firm is growing and I have a serious need for a lot of new people. For example, at this writing I need an experienced PR man, an ad manager to create and produce our in-house ads, ad salesmen for the magazines, a DP manager, a general manager, and a statistical department manager to get data and prepare reports for the computer industry which we would sell. I need several more people to work in our book department, some for the two new magazines we will be starting this year, a couple of electronic draftsmen, a good photographer to help us prepare our covers, people with video experience to help us prepare video training programs, more staffers for 80, which is growing incredibly, people to help us get amateur radio growing again as we did ten years ago, programmers to help us convert programs from one computer system to another, more staffers for Instant Software which has a projected 500% growth over the next year, marketing people, programmers to write in-house needed programs, technicians to keep our computer equipment working and set up new systems, lab people to work on prototypes of new equipment for articles and for industry, teachers to help train our people in all phases of publishing and computing, school administrators to help us found a college of computing, a financial advisor to help us pay for all this...and so on.

Jobs? I've got plenty, if I can find the people. And I think we can provide a lot of benefit by this growth. A school to teach computing would help the micro industry to grow. It would also help American computer firms compete with Japan. An electronic school would also help American industry to compete with Japan. A growth of Instant Software in the international markets could bring millions or even billions of dollars to the U.S. as this market grows.

Getting amateur radio into a strong growth mode, which I am convinced we could do if I had a few enthusiastic people to help me, might even reverse the technological advantages that

Japan has over America at present. There are so many fantastic possibilities for amateur radio over the next few years that it is incredible that we are just standing still, rag-chewing and working DX as usual instead of getting ourselves busy with inventing the next generation of ham gear...and bringing in hundreds of thousands of new hams. We can do it, if we decide it is important. I will be delighted to help...but I sure can't do it alone.

Does that answer you, John? —Wayne.

FACE THE WALL

The Wayne Green view of the ARRL makes a lot more sense since the Don Miller fiasco. I never did find out the real reasons behind this mess, only that Dannals and Baldwin appeared to be afraid of him. As I suppose you have detected, many of us in Indiana consider Don Miller a giant, as a man, a ham, and an engineer. He has helped scores of people get started. Many ATVers and slow scanners have received good advice from Don. He has the delightful facility of being able to deal with skilled technical people at their level of understanding and also help some rank beginner grasp the mysteries of Ohm's Law without putting him down. I contributed to the ARRL building fund and sent in a check for the WARC fund. However, after this distasteful display of power politics on Don Miller, I have turned my ARRL Life Membership plaque to face the wall.

Ronald C. Williams
W9JVF/ZB2CS
Indianapolis IN

Fair-weather friend.—Wayne.

YES ON CW

Just dropping a line to say hi and keep up the good work. I may not agree with all of your comments and opinions, but I keep an open mind to them. I can always change.

One of the things bugging me lately is the outcry for eliminating the CW requirements for amateur licensing. I cast my vote to keep CW as a requirement for *all* amateur license classes.

For those who wish to get rid of the CW, I ask this: Just why do you wish to get rid of the CW requirement? Is it so someone you know can get on amateur radio? Is this "someone" a person who shows no interest in learning CW? I can't buy the "I can't learn" line. I had all sorts of problems learning CW, and still do. I am at about 16 wpm now, slowly working up to 22.

If that is your basis for eliminating CW, get on your feet and teach the code. If you have to, learn it well yourself. Teaching a class will do wonders for your CW, as well as theory. It is easy to sit back and complain about how hard it is to get people interested in our hobby, but to get out and do something about it is not so easy. I have taught one class, onboard the Coast Guard Cutter *Sherman*, while on patrol in Alaska (sort of a captive class!). The schedule we had and my transfer did not allow me to see the people in the class to their Novice, but I did get one person to get his General (N6DDF). I realize one is not enough, but it is a start. So, instead of complaining about the code, go and teach it. I find very few people with General class or above who hate the code to the point of wanting it eliminated.

Rick Mainhart WB3EXR/6
San Francisco CA

HAM SCHOLARSHIPS

The Foundation for Amateur Radio, Inc., a non-profit organization with its headquarters in Washington DC, plans to award eight scholarships for the academic year 1981-82. All amateurs holding a license of at least the FCC General class or equivalent can compete for one or more of the awards if they plan to pursue a full-time course of studies beyond high school and are enrolled or have been accepted for enrollment in an accredited university, college, or technical school. The scholarship awards range from $300 to $900, with preference given in some of them to residents of various areas.

Additional information and application forms can be requested by a letter or postcard, postmarked prior to May 31, 1981, from: FAR Scholarships, 8101 Hampden Lane, Bethesda MD 20014.

The Foundation is devoted exclusively to promoting the interests of amateur radio and to scientific, literary, and educational pursuits that advance the purposes of amateur radio.

Foundation for Amateur Radio
Washington DC

A NEW PROPOSAL

This letter is in response to the appeal in the December issue of *73* for a code-free licensing proposal. I have been a subscriber to *73* for a few years now and have enjoyed and kept every issue and have built dozens of projects from your construction articles.

If there ever was a victim of the Incentive Licensing plan, I am one. I built my first broadcast band receiver from instructions in a Cub Scout handbook at age 9 in 1958. Over the next few years, I followed my new hobby through *Popular Electronics* and borrowed electronics books (I had not heard of *73* until the late 1970s). In the early 1960s, I met my first amateur, the father of a school classmate. I'll never forget being mesmerized while listening to him talk to the end of the universe (to me), some foreign country called Argentina.

I began visiting the father more than my classmate and began studying to get my license, but a strange thing happened to my amateur friend. Something new he called Incentive Licensing had just been approved, and he went on and on about everything that had been lost and how some of his amateur friends couldn't operate as before. I never did quite understand what he was talking about until I subscribed to *73*. He lost considerable interest in his station and turned more and more to public and Civil Defense type weather radar and police communications. I quit going over so much, and I soon moved to Kansas City where I built my first three-band tube receiver from a kit I bought at a local store I had been using as a mail-order house when I lived out of state. B/A had all kinds of electronic goodies, including my favorite device at the time, the CK722. It is hard for me to realize that in the last 22 years of my life, I have experimented with everything from blue razor blades and a pencil lead for a detector through tubes and now microprocessors and am still just 31 years old.

I have started but never received my amateur's license for almost 20 years now, all because of the code requirements on the exam. I never had the feeling of mystique or curiosity about the Morse code and never saw any need for it, as voice made for a more personal contact and teletype was a perfect form of data-coded messages, not to mention the ASCII of late.

I feel that without the code requirement, I could have become a radio amateur long ago, and by now would know the code and could have possibly helped with development of some form of communication through the amateur bands. Instead, I teach basic electronics and kit building at my daughter's school through a community education program that pays me less than $8.00 a course, but is worth a million dollars when I see the kids' eyes light up when they turn the switch on and their first hand-made project works.

My proposal for a code-free licensing program would be to select some band or bands where no commercially available rigs are built, making admission to the band possible only through building or altering equipment that is available on a nearby band. FCC-type theory and rules tests should be used, but not even a code recognition test. This would defeat the point, as code recognition is about 5 wpm, which can get you a Tech license after taking the General theory test now.

Have a small portion of each band code only, and this portion of the band would be the only portion of the band where General class or above incentive ticket holders could use the otherwise closed band. This would give the non-coders a desire to try to learn the code to contact needed areas and possibly to upgrade to General or higher tickets later on. Power should be limited to 250 Watts or less, and all forms of emissions could be used or leave several small bands with one or two emission forms in each.

Now I realize that this proposal is a little offbeat, but I feel that the basic idea could be used to form a new class of electronic experimenter amateurs that would more than likely

learn the code and upgrade much faster and in greater numbers than what we have now.

I don't know whether or not we should keep the present form of licensing also so that non-electronically-inclined people can memorize the theory and practice in groups until they become programmed to take and pass their incentive plan and become appliance operators. These people don't know the difference between a microprocessor and an op amp; maybe so, we could always use a few more good net controllers. If you don't believe this, listen in on some of the "technical" discussions on the air, and listen to the cries for help on simple modifications to modern-day CB rigs to go onto 10 meters to enjoy an almost vacant band.

I've read letters condemning CBers in your letters column, and then tuned in on a DX contest only to hear the same CB type of operators, only on legal amateur bands with amateur call letters, full FCC support, and League encouragement. There is no wonder that the amateur ranks are falling; after all, so did the CBers. It is too easy to just buy a rig, plug it in, and know nothing about how it works or even how to make simple repairs or modifications.

I have the *73* 5 wpm tape and the 6+ tape and have loaned them to people that express an interest in amateur radio. I even helped a man at work with his theory so that now he is an amateur. The main thing is, he is starting (because of my insistence) to experiment with kits so that now he knows the difference between a diode and a resistor. He didn't have to know it to get his ticket, he just had to know the code and a few rules. Is this the way to keep the undesirables out of the ranks of radio amateurs and off the air? Somehow I think it would be better to build your way up to be an amateur instead of memorizing the present system.

J. Olsen
St. Louis MO

Olsen. . . no clickee, no tickee. —Wayne.

ANY YO-YO

With regard to the letter from Verle D. Francis W0SZF (March, 1981): Just wait a minute! Mr. Francis "proposes" to allow "code-free, test-free licensees" to use all amateur phone bands with a code test the only requirement for CW operation. I think that no regulations is carrying deregulation a bit far.

I also suggest that if my wife, who is about as technically competent as a flashlight, can earn, yes, earn, her Technician class license (that's the General written test, group), then any yo-yo can, Mr. Francis included.

Bill Hocutt KC4P
Birmingham AL

Right, Bill; let's go to Novice at 50 wpm and see if we don't get a better class of ham.—Wayne.

LIKES THE PRICES

I, too, dislike advertisements which fail to mention an item's price, and as much as possible I refuse to buy anything from a manufacturer or distributor who is so ashamed of his prices that he will not print them. You, as editor of the amateur radio magazine with the most advertising copy, could do all amateurs a great service by refusing ad copy which didn't contain prices.

Also, you have been singing the praises of Casio watches in recent issues. I own a Casio F-80 which I bought in September. Two months later, several functions failed. I returned the watch for in-warranty service to the manufacturer's service center. I received the watch back yesterday, well scratched, a prompt 83 days after I sent it for repairs.

Blair Bates K3YD
Hazleton PA

Okay, phooey on Casio.—Wayne.

CALL FOR PAPERS

For the past 26 years we have held an amateur VHF conference at Western Michigan University. It started when Emeriti Professor of Physics, Walter Marburger W8CVQ, recognized the need for a radio amateur conference to promote VHF activity.

Through the years we have had some outstanding presentations of new designs and techniques, construction, testing, and the announcements of new products. Ed Tilton W1HDQ ("The World Above 50 MHz"), Doug DeMaw W1CER; Dave Hallock (Collins on FET Front Ends), Dr. D. M. Chen ("Free Space Antennas"), Dr. John Lyons ("Ferrite Antennas"), Dr. J. McMechan ("Two Meter Antenna Systems"), Dr. Gooch ("Three Phase SSB on Two Meters"), Chris Frank (Hallicrafters), Robert Groh (Heathkit "Microprocessors in VHF Transceivers"), Jim Kearman, Tom McMullen, Ted Hartson, Clarke Green, and many others have all contributed. To them we give our thanks.

Now we are endeavoring to go a step further. For the past two years the conference non-amateur attendance has increased while the amateur attendance has decreased. We are now appealing to the practicing radio engineer as well as the amateur who is interested in an educational conference rather than a social swap-and-shop session. We are getting the technical-minded amateur and professional rather than "operator-types."

As a university sponsorer, this is as it should be; we would like to raise the quality of the conference and at the same time give young pre-professionals experience in paper presentation. One way to do this is to call for papers. We may still have to invite papers, as we have done in the past, but we still feel that a call for papers to all sectors, both amateurs and other VHFers, will produce some results.

The 27th Annual VHF Conference will be held on Saturday, October 17, 1981, from 2:00-5:00 pm at Western Michigan University, Kalamazoo MI. Papers are invited for the 1981 Annual VHF Conference sponsored by the Electrical Engineering Department. Principal emphasis will be placed on engineering developments applied to radio communication, design, and construction on the frequencies of 30 to 1200 MHz.

Papers are solicited from a wide range of areas including, but not necessarily limited to, those listed below:

Antennas and Transmission Lines
Audio Frequency Equipment Used With VHF Transmitters and Receivers
Beginner and Novice Topics
Contests and Operating Activities
Emergency Operation and Gear
Grounding and Shielding
Keying, Break-in, and Control Circuits
Measurements and Test Equipment for VHF
Mobile and Portable Equipment and Operating
Picture Transmission and Reception
Power Supplies
Propagation
Receiving
Recent Equipment/New Apparatus
Regulations
RTTY
Satellites
Transceivers
Transmitting

One of the basic purposes of this conference is to provide a maximum opportunity to present findings by those experimenting, designing, constructing, testing, and inquiring into problems and methods applicable to VHF radio.

This is an opportunity for beginning or mature researchers to report their findings to their peers. We especially encourage the unexperienced inquirers to obtain some experience by presenting a paper at our VHF Conference.

Authors wishing to present papers should send a synopsis (typically one or two pages with diagrams) describing the paper to: Dr. Glade Wilcox W9UHF/8, Program Chairman, VHF Conference, Department of Electrical Engineering, Western Michigan University, Kalamazoo MI 49008.

Deadline for submission of synopses is June 30, 1981. Speakers will be notified of acceptance by October 1, 1981. Final drafts may be given to the Chairman the day of the Conference. Awards of papers and the possibility of publication are being explored.

Glade Wilcox W9UHF/8
Kalamazoo MI

Well, Glade, while I'm all for your conference, I suspect that one of the reasons your attendance and participation have been dropping on the ham end has to do with the lack of media attention. Advertising still pays. You don't have to pay for ads for such a conference, just see that some of the more interesting papers are made available for publication. There are thousands of hams who would be interested in some of the material presented at your conferences, but they have no way to get it. I attended a similar conference at the University of New Hampshire and I was dismayed at the

wealth of material presented which never really reached more than the few attending the conference. Pity. Perhaps your letter will bring in some ham response. I suspect that if you were to make arrangements for some of the material to reach us for publication, you'd soon be getting a lot more interest.—Wayne.

FCC COMMISSIONER?

It has occurred to me that there has never been an FCC Commissioner who has been an amateur. We have never had a voice in the inner circle of that agency. As it happens, there will be several appointments to the FCC by June of 1981. I am an amateur as well as a working broadcast engineer. I think I have a feel for both broadcasting and amateurs. In considering who usually occupies those offices on "M" Street, I am reminded of the old Mexican curse —"May your life be filled with lawyers." We need a change from that.

I have communicated my idea to both Senator Tower because he is my Senator and to Senator Goldwater for three reasons. First, he is an amateur; second, he will be Chairman of the Subcommittee on Communications; and third, because I have a special, non-obligatory, relationship with him since in 1964 I was a member of a slate of electors pledged to Goldwater/Miller which was elected in Mississippi. Also, I wrote to both because they are influential members of the Republican Party. As yet, there has been no response, but that is not unusual; they get so much mail.

Perhaps a few letters from your readers on the subject to either or both would bring this idea more forcefully to their attention. Of course, if there are readers who know other persons high in the party, letters to them, too, would help.

While I am putting myself forward, I must, in all honesty, admit that there are others in the broadcasting and amateur fraternity who are more qualified than I. If anyone has others to propose, I would be happy to support them because I feel we should have a voice—mine or another amateur's.

Should anyone want to know where I stand philosophically on the specific issues, amateur or otherwise, facing the FCC, I would be most happy to correspond with them.

G. D. Causey
3641 North 11th Street
Abilene TX 79603

Wrong, GD...we did have a ham commissioner and it was he who got us the Novice license, over the badly wounded body of the ARRL. Up until George Sterling, the ARRL had its own way with the FCC.—Wayne.

VIDEO TRAINING

I've just read your editorial goal of gearing up a quarter-million hams in the near future. I am impressed, and excited. I am a high school chemistry teacher, and I have been looking for some assistance in setting up a ham station at the school.

We have over 500 students, including three active hams, all capable and interested. They all get over three hours a week on Apple II computers, of which we drive eight, with double disk. I believe I can interest at least 10% of these kids to try amateur radio, and surely half of those would get their ticket.

The notion of video training sessions seems to me a godsend. I have had a Technician license for two years, but have not been active enough to consider myself a good model of operation. Having video tapes for training would overcome this problem. I am already familiar with your code tapes, and consider them excellent.

Please let us all know when the video tapes are ready. My check for a course set would be in the next post. Other high school teachers I know would do the same.

Jim McSherry N3AMF
Philadelphia PA

ENJOYS EVERYTHING

I would sure like to see you blast the ARRL contest organization in your Never Say Die editorial.

When a contest is on—for example, the Novice Roundup—all of the Novice band sections are pure QRM, teaching and encouraging complete disregard for courtesy on the air. A *small* portion of the entire Novice/Technician population hogs all parts of the bands and creates havoc for those with skeds, etc.

Why can't contests be limited to a portion of each band where they can enjoy(?) the QRM and know where to find their other contestants? I bet that if you were an official in the ARRL, you would do something like I suggest.

Sel Carlson KA6ERF
Napa CA

No, I'd only make it worse. I happen to enjoy contests, QRM, frustration, aggravation, and such, while not liking skeds.—Wayne.

HAM HELP

I am trying to locate anyone having back issues of *Kilobaud*, *73*, *Ham Radio*, or other similar magazines who would be willing to either donate or sell them to a young Indian ham.

Raj VU2UT is a college student in India, and is very interested in radio and microcomputers. He currently has a 6502-based micro called the Junior Computer, with a 1K RAM made by the publishers of *Elecktor* in Germany. Any information and help for him with this unit would also be appreciated.

H. Christopher Ayers WB7TXY
2914 SW 116th
Seattle WA 98146

I'm looking for paperwork or an actual working model of a digital readout for the HW-101. Thanks.

L.D. Dickerson N4DBS
12453 Northwood Road
Savannah GA 31406

I need a schematic and/or other info on a 450-MHz solid-state transceiver, "Trans-Com" model 940, manufactured by Communications Company, Coral Gables FL (no longer in business). I will pay for a Xerox, etc. Thanks.

Harlan Goodsell W7LTH
70 South 2nd East
Hyrum UT 84319

I need a manual or schematic for an Omron Systems Model 8025 CRT terminal. A photocopy is fine. I will be glad to pay for any copying costs.

Roger Eslick KB4VT
29 Elmora Avenue
Goose Creek SC 29445

I am looking for anyone interested in forming an 1802 users net on 20 meters. Any info, comments, or suggestions about this would be welcomed.

Bernie Murphy
102 McCraney Street
Oakville, Ontario
Canada L6H 1H6

Would someone be willing to help a lad who is working his way through high school as well as helping a widowed mother, younger sister, and brother? An uncle gave a several years subscription to *73* as a birthday present to help future ham exam aspirations, but the lad's hatred of scrounging keeps him quiet on a further wish. If someone has no further use for a set of *Callbooks* (one issue) from last year, these would be gratefully received, as his own homebuilt receiver is in use. In return, postcards or a souvenir of ZL-land, or your requirements, could be sent. Please sent to:

B. Wilson
PO Box 1082
Hamilton, Waikato
New Zealand

I want to thank you for your help in getting a much needed schematic for a frequency counter I have. One week after I received my copy of *73*, I received a letter from Gil Desvernine W2PKZ who offered to copy it for me. Thanks again.

Dennis Cornell WD4HRO
Millington TN

KAHANER REPORT

Larry Kahaner WB2NEL
2301 Cathedral Ave. NW
Washington DC 20008

PLAIN TRUTH ABOUT PLAIN RULES

Highlighting my first column from Washington DC, the center of the empire, is perhaps the most important FCC action since ham radio began. The Commission has chosen amateur radio rules and regulations for plain-language revision. Following the FCC's success with the plain-language rewrite of Citizens Band rules—which, incidentally, changed the name to Personal Radio Service—it decided to continue the process with amateur radio.

The legal stuff happened last year. A notice of proposed rulemaking was adopted by the Commission in November and released the following month. That NPRM laid the groundwork and said, in part, "We chose the Amateur Radio Service rules as our latest plain language revision because the existing rules are unnecessarily complex and difficult to understand. This is especially a problem in the Amateur Radio Service since many of our applicants and licensees are young persons."

Amateurs will benefit from the rewrite in many ways. The darn rules will be written in English, so we can all understand them. In fact, the format will be question and answer. It's not beautiful prose, but it's easy to understand. In addition, some rules will be relaxed, others brought up to date.

First of all, the Service's new name is "Amateur Telecommunications Service." In its own subtle way, the Commission hopes that this will make us think of ourselves as more than just voice and Morse code people. The name change reflects growing interest in digital communications.

Second, good old Part 97 will be divided into four sections: (a) Amateur Radio rules, (b) RACES rules, (c) Amateur Satellite rules, and (d) Standards, for all three.

Now the good part. Most changes are just in wording, altering lawyerese to American. But while the FCC clutched its pen, some deregulation crept in. Here are some bright points.

The FCC proposes eliminating all logging requirements. In its place, you must keep the following when you operate: your license or photocopy, copies of letters in which you informed the FCC of address changes, copy of the Amateur Telecommunications Service rules, any written permission you received from the Commission, and copies of letters from the FCC about your station or operator's license.

For repeaters, you must keep these items: computations for average height above average terrain and external power. For remote control operations, you need: control operators' names, calls, and addresses, block diagram and technical explanation of link, description of measures for shutting down the station if control link fails, and, finally, measures for monitoring transmission frequency.

You must retain these records for your license term.

Not bad. The FCC shows a lot of class with these changes. And not only are the new rules easier to understand, they're easier to read. The old rules were written in super-small type that looked like a cut-rate washing machine warranty. New rules are in typewriter-size type.

The FCC isn't doing this in a vacuum, mind you. If you harbor comments about plain language rules, let the Commission know. You may respond to the proposal by reading the text, or just the parts you're hot about, and letting them know if they're on the right track. Positive comments carry as much weight as negative ones.

For information on how to contact the FCC about Docket PR 80-79 (the PR means Private Radio Bureau, 80 is the year it was written, and 79 means it was the 79th issue from the bureau), call John Johnston at (202)-254-6884. Or you can write him at FCC, Private Radio Bureau, 1919 M St., Washington DC 20554.

Comments are due by June 19. Replies to those comments must be in by August 19. And, if you believe, or your group believes, that the Commission is making a huge mistake and you have some ideas of your own but need more time to get them organized, you may ask for a deadline extension. If the reason is important enough, the FCC will grant extra time.

NO NEW LICENSES FOR CLUBS, SO FORGET IT

On occasion, the FCC will issue statements on subjects that seem to cause a lot of concern or misunderstanding. Sometimes they are just rehashes, sometimes gentle reminders, sometimes clarifications.

The FCC has received loads of queries about new licenses for clubs, military recreation, and RACES stations. Last May, the Commission amended rules pertaining to these stations, and the folks in Washington want you to know they haven't changed their minds. No new licenses for clubs, military recreation, or RACES stations will be issued. Period.

Only renewals or modifications are allowed. However, changing a trustee or club name is considered a modification, and that is allowed. If you still don't believe it or you want to argue, call the Consumer Assistance Staff in Gettysburg PA at (717)-334-9167.

CALLSIGNS: CAN'T SEEM TO GET ENOUGH

In keeping with hams' insatiable hunger for call-letter roulette, the FCC published a chart of issued call letters. Callsigns listed in Table 1 are the *last* ones mailed, as of February 1.

MARINE GRAB FOR 220?

Contrary to rumors floating around in ham circles, the FCC never seriously considered placing the automated inland waterways communications system in the 220-MHz band. The system, which will be used for ship-to-shore communications only, was slated for 216-220 MHz or 806-890 MHz.

Similar to the proposed cellular mobile-telephone service, the inland waterways service places repeaters all along the Mississippi River and its major tributaries. To contact a boat, you dial a central number and it connects to the repeaters. Instead of the old system of trying to find the marine operator nearest your vessel—and maybe taking several radio calls from various operators—it takes only one dialing. It works the other way, too. Instead of vessels calling the nearest marine operator, the crew simply dials a conventional telephone and the nearest repeater is keyed up. The system also transmits data and facsimile and will be used mostly by commercial vessels such as barges and tugs.

The FCC decided to allot 216-220 MHz for the service.

Radio District	Group A	Group B	Group C	Group D
0	KI0H	KB0VU	N0CIH	KA0KJK
1	KC1F	KA1NX	N1BIM	KA1GOB
2	KK2H	KB2WU	N2CHL	KA2LHO
3	KC3L	KB3NS	N3BQZ	KA3HAU
4	NJ4C	KC4WP	N4EEF	KA4TJL
5	KO5X	KC5GT	N5CTW	KA5KXS
6	KV6F	KD6QO	N6DYT	KA6OMB
7	KG7A	KB7TT	N7CHS	KA7JQJ
8	KK8L	KC8AI	N8CJW	KA8MCJ
9	KE9H	KB9VC	N9BYW	KA9KEG
N. Marina Island	AH0A	AH0AA	KH0AC	WH0AAE
Guam	AH2K	AH2AH	KH2AO	WH2ACT
Johnston Island	None	None	KH3AB	WH3AAB
Midway Island	None	AH4AA	KH4AC	WH4AAF
Hawaii	NH6I	AH6CK	KH6LN	WH6ANX
American Samoa	AH8A	None	None	WH8AAK
Wake, Wilkes, Peale	None	None	None	WH9AAA
Alaska	NL7T	AL7BS	KL7LU	WL7APC
Virgin Islands	KP2B	KP2AC	NP2AH	WP2ACK
Puerto Rico	NP4E	KP4BZ	NP4BV	WP4BTG

Table 1. Callsigns issued February 1, 1981. Group A = Extras; B = Advanceds; C = Techs and Generals; D = Novices.

WELL, THERE GOES THE NEIGHBORHOOD

Whether the FCC is definitely moving across the Potomac to Rosslyn VA is still a tough one to call. In the long run, the FCC could save money, and instead of being spread out over three downtown buildings, they would be in one. Amid all the controversy and alleged under-the-table dealings, Congress is balking at the move because it's never happy when federal agencies leave the District.

ONE OF THE OK GUYS LEAVES

Charles Ferris, FCC top banana, retired last month. Heavy-duty broadcasters didn't like Ferris because of his yearning for broadcast deregulation.

Under Ferris' rule, low-power TV was proposed, cable companies flourished, and satellite superstations grew. Networks, which for years had the only wheel in town, wanted to keep it spinning their way. The more players in the game, the less each player gets. And the big guys couldn't handle it.

At presstime, his replacement wasn't named, but smart money is on Mark Fowler, a communications lawyer. To be an FCC commissioner (the chairman is also a commissioner), you don't need a high-school diploma or any discernible skills. It's strictly by presidential appointment. Even money won't help you get the job unless it finds its way into the right politician's pocket.

FCC

Reprinted from the Federal Register

Changes in Procedures for Approval of Proposed Antenna Structures in the Amateur Radio Service

AGENCY: Federal Communications Commission.

ACTION: Final rule.

SUMMARY: The Commission is amending Parts 17 and 97 of its rules to simplify its procedure for processing requests for approval of Amateur Radio station antenna structures with regard to possible hazard to air navigation. The Commission is also making an editorial change to conform a rule section in Part 97 to a parallel rule section in Part 17.

EFFECTIVE DATE: The amendments being adopted are subject to the clearance of reporting requirements by the General Accounting Office, the effective date of this action will be announced by public notice in the near future.

ADDRESS: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT: John B. Johnston, Private Radio Bureau (202) 632–4964.

SUPPLEMENTARY INFORMATION:

In the matter of changes in procedures for approval of proposed antenna structures in the Amateur Radio Service.

Adopted: January 8, 1981.

Released: January 21, 1981.

By the Commission: Chairman Ferris absent.

1. Section 303(q) of the Communications Act of 1934, as amended, provides that the Commission shall "have authority to require the painting and/or illumination of radio towers if and when in its judgment * * * there is a reasonable possibility that they may constitute, a menace to air navigation." Part 17 of the Commission's rules sets forth criteria and procedures by which the Commission exercises this authority.

2. In the Amateur Radio Service, an antenna structure which would exceed certain height limitations (set forth in § 97.45) may not be erected or used unless prior approval by the Commission has been obtained. Currently, amateur radio operators obtain this approval by filing FCC Forms 610 and 714 with the Commission and FAA Form 7460–1 with the FAA. These requests for antenna structure approval are processed partially at the Private Radio Bureau licensing facility in Gettysburg, Pa. and partially at FOB Antenna Survey Branch in Washington, D.C.

3. We are amending Parts 17 and 97 of our rules to allow amateur radio operators to file a single form to obtain approval of proposed antenna structures, instead of the two forms (610 and 714) currently required. By this action, we are simplifying the antenna approval process for both Amateur Radio licensees and the Commission. All antenna structure approval requests filed on the new form will be processed entirely in Washington, D.C. by the Antenna Survey Branch.

4. We are also amending paragraph (a) of § 97.45 to agree with the current wording of § 17.7 of the rules. Since Amateur Radio Service licensees are subject to the provisions of Part 17, this amendment is editorial in nature and imposes no new requirements.

5. Since the rule changes herein ordered concern the Commission's antenna approval procedures and practices, and also involve an editorial amendment to conform Part 97 Amateur Radio Service Rules to Part 17 antenna requirements, we are dispensing with the prior notice and public procedure provisions of the Administrative Procedure Act (see 5 U.S.C. 553(b) (A) and (B)). However, as the amendments being adopted are subject to the clearance of reporting requirements by the General Accounting Office, the effective date of this action will be announced by public notice in the near future.

6. For information on these rule changes contact John B. Johnston, (202) 632–4964.

(Secs. 4, 303, 307, 48 Stat., as amended, 1066, 1082, 1083; 47 U.S.C. 154, 303, 307).

Federal Communications Commission.

William J. Tricarico,

Secretary.

Appendix

PART 17—CONSTRUCTION, MARKING, AND LIGHTING OF ANTENNA STRUCTURES

I. Part 17 of Chapter I of Title 47 of the Code of Federal Regulations is amended, as follows:

In § 17.4, paragraph (a) is revised, and a new paragraph (h) is added:

§ 17.4 Commission consideration of proposed antenna structure with respect to possible hazard to air navigation.

(a) Except as provided in paragraph (h) of this section, all applications are reviewed to determine whether there is a requirement that the applicant file a Notice of Proposed Construction or Alteration (FAA Form 7460–1) with the Federal Aviation Administration.

* * * * *

(h) Applications for amateur radio station licenses and RACES station licenses are not reviewed for antenna structure approval. Applicants and licensees in those services may not erect or use an antenna which exceeds the height limitations contained in §§ 17.7 and 17.14 of this chapter unless notice has been filed with both the FAA on FAA Form 7460–1 and with the Commission on FCC Form —— and prior approval by the Commission has been obtained.

PART 97—AMATEUR RADIO SERVICE

II. Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended, as follows:

In § 97.45 paragraph (a) introductory text and subparagraph (3) thereof are revised as follows. Also, a new subparagraph (4) is added to paragraph (a).

§ 97.45 Limitations on antenna structures.

(a) Except as provided in paragraph (b) of this section, an antenna for a station in the Amateur Radio Service which exceeds the following height limitations may not be erected or used unless notice has been filed with both the FAA on FAA Form 7460–1 and with the Commission on FCC Form ——, and prior approval by the Commission has been obtained for:

(1) * * *

(2) * * *

(3) When requested by the FAA, any construction or alteration that would be in an instrument approach area (defined in the FAA standards governing instrument approach procedures) and available information indicates it might exceed an obstruction standard of the FAA (§ 17.7(c) of this chapter).

(4) Any construction or alteration on any of the following airports, including heliports (§ 17.7(d) of this chapter).

(i) An airport that is available for public use and is listed in the Airport Directory of the current Airman's Information Manual or in either the Alaska or Pacific Airman's Guide and Chart Supplement.

(ii) An airport under construction, that is the subject of a notice or proposal on file with the Federal Aviation Administration, and except for military airports, it is clearly indicated that the airport will be available for public use.

(iii) An airport that is operated by an armed force of the United States.

LOOKING WEST

from page 138

hope to be able to discuss the important points of the proposed rules in the column the next few months. At this time, everything is just innuendo and rumor except the already well-publicized points. I guess there will be some who say that this latest "bug" in the FCC's eye was caused by the modelers. I doubt it. If there is anything to it, and if amateurs eventually lose R/C privileges on six meters, it will probably be the result of internal FCC policy more than anything else.

Oh, yes, lest I forget: It seems that there are many differing interpretations of Carson's Rule as there are engineers. I suspect that all are correct in some way. Not being an engineer myself, I hazard to venture any further guesses. I learned of the existence of Carson's Rule during the time I was heavily involved in two-meter repeater coordination activities here in the southwest, this during the time we were considering whether to go upright or invert the 15-kHz tertiary channels. When applied, both the definition you give and that utilized by the then SCRA seem applicable. Another result of the bandplan article has been a myriad of interpretations of the aforementioned Carson's Rule. The basic differences are semantic in nature.

Again, Lew, thanks very much for taking the time for writing the detailed letter. As I said in the note of two weeks back, I will endeavor to see that it appears in print.

The last two Looking West columns might be described best as a discourse between two amateurs who have sincere concern for the future of an important amateur band. There is no doubt that our end objectives are the same. We differ only in the way we approach solving the dilemma.

SOCIAL EVENTS

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place. They should be sent directly to Editorial Offices, 73 Magazine, Pine Street, Peterborough NH 03458, Attn: Social Events.

SUNNYVALE CA
MAY 1-3

The West Coast UHF Society and Project OSCAR, Inc., will hold the 26th Annual West Coast UHF Conference on May 1-3, 1981, at the Sunnyvale Hilton, 1250 Lakeside Drive, Sunnyvale CA 94086. There will be registration Friday night and a social in the hospitality room. Saturday registration will begin at 8:15 am and be followed by orientation, technical sessions, a barbeque cookout luncheon, prize drawings in the afternoon, and dinner. Saturday night will also include noise figure measurements. Sunday morning will feature a show-and-tell of homebrew projects, as well as antenna measurements tests. Pre-registration is $5.00; cost at the door will be $8.00. For more information or pre-registration send an SASE to West Coast UHF Conference, PO Box 5283, San Mateo CA 94402.

GRAY TN
MAY 2-3

The Bristol Amateur Radio Club, the Johnson City Amateur Radio Association, and the Kingsport Amateur Radio Club will hold their first annual Tri-Cities Hamfest on May 2-3, 1981, at the Appalachian Fairgrounds, north of Johnson City (off Highway 137), Gray TN, from 9:00 am to 5:00 pm on Saturday and from 8:00 am to 4:00 pm on Sunday. The dealer space charge at the door is $30.00 for the weekend for a 10 × 12 space. The dealer charge also includes security and admission for five employees. There are approximately 40 RV spaces with complete hookups renting for $5.00 per night inside the fairgrounds. Motels are available nearby. Dealers can set up anytime after Friday noon or after 6:00 am Saturday and Sunday. Further information can be obtained by writing Mary S. Biggs KA4EXP, Secretary-Treasurer, Tri-Cities Hamfest, PO Box 3682 CRS, Johnson City TN 37601, or phoning either (615)-928-1818 or (615)-282-1711-x380.

GREENVILLE SC
MAY 2-3

The Blue Ridge Amateur Radio Society will hold its annual hamfest on May 2-3, 1981, at the American Legion Fairgrounds, Highway 25 bypass, Greenville SC. On Saturday, FCC exams will be given at Greenville Tech from 10:00 am till 3:00 pm. Other features will include dealer exhibits, inside flea markets, chicken/pork plates, prizes, overnight RV parking, and motel rooms available at the Ramada Inn (1-800-228-2000).

WOODBRIDGE NJ
MAY 2

The DeVry Technical Institute Amateur Radio Club (WA2MDT) will hold its fifth annual amateur radio and computer flea market on May 2, 1981, at DeVry Technical Institute, 479 Green Street, Woodbridge NJ. The flea market will begin at 9:00 am and for those who wish to set up tables, a fee of $3.00 will be charged. Talk-in on 146.520 beginning at 8:00 am. For further information, call Frank Koempel WB2JKU at 634-3460 or Steve Hajducek KA2IFX at 727-5962.

MEADVILLE PA
MAY 2

The seventh annual Northwestern Pennsylvania Hamfest will be held on May 2, 1981, at the Crawford County Fairgrounds, Meadville PA. The gates will open at 8:00 am. Admission is $3.00; children under 12 will be admitted free. Indoor table spaces are $5.00 per space and outdoor car spaces are $2.00. Bring your own tables. Refreshments will be available. Commercial displays are welcome. Talk-in on .04/.64, .81/.21, and .63/.03. For information, write CARS, PO Box 653, Meadville PA 16335, Attention: Hamfest Committee.

LYNCHBURG
MAY 3

The Lynchburg Amateur Radio Club will hold its third annual swapfest at Brookville High School in Lynchburg on Sunday, May 3, beginning at 10:00 am. Tables, food service, and plenty of free parking will be available. Talk-in on 146.01/.61 and 146.52 simplex. For further information, contact Kenneth D. Grimm K4XL, 505 Hayes Dr., Lynchburg VA 24502.

STIRLING NJ
MAY 3

The Tri-County Radio Association will hold its annual indoor hamfest flea market on May 3, 1981, at the Passaic Township Youth Center, Valley Road, Stirling NJ, from 9:00 am to 4:00 pm. A donation is $2.00 and the tables are $5.00. Hot food and refreshments will be served. An Icom IC-2AT will be one of the many door prizes. Talk-in on 147.855/.255 or 146.52. For information, write TCRA, Box 412, Scotch Plains NJ 07076, or call Herb Klawunn W2CHA at (201)-647-3461.

PENNS PARK PA
MAY 3

The Warminster Amateur Radio Club will hold the 7th annual Ham-Mart on Sunday, May 3, 1981, from 9:00 am to 4:00 pm (rain or shine) at a new location, Middleton Grange Fairgrounds, just minutes from I-95 or the Pennsylvania Turnpike on Penns Park Road, Penns Park PA. Featured will be door prizes, plus a grand prize to be drawn at 3:00 pm, a flea market, a free FM Clinic, and an auction. There will be refreshments, rest rooms, and shelter available. Registra-

tion is $3.00 per person, which includes one ticket for door prizes. YLs, XYLs, and children under 14 will be admitted free. Seller (tailgater) spaces are $2.00 (with tables available). Talk-in on 146.52 or WARC 147.69/.09. For additional information, write WARC, PO Box 113, Warminster PA 18974, or call Mark Hinkel WA3QVU at (215)-657-7295.

SULLIVAN IL
MAY 3

The 20th annual Moultrie Amateur Radio Klub Hamfest will be held on May 3, 1981, at the Moultrie County 4-H Center Fairgrounds, located 5 miles east of Sullivan IL, on Cadwell Road. There will be a heated indoor and a large, covered outdoor flea market. There is no charge to vendors. Space is available on a first-come, first-served basis. Talk-in on 146.94 and 146.055./.655. For more information, write MARK, PO Box 327, Mattoon IL 61938.

EAST HARTFORD CT
MAY 3

The Pioneer Valley Radio Association will sponsor its fourth annual flea market on Sunday, May 3, 1981, at a new location in the George Penny High School, East Hartford CT, from 10:00 am to 4:00 pm. The admission donation is $1.00 and tables are $8.50. For advance table reservations or information, contact Arnie K1NFE, PO Drawer M, Plainville CT 06062.

DEERFIELD NH
MAY 9

The Hosstraders will hold their eighth annual tailgate swapfest all day on Saturday, May 9, 1981, at the Deerfield Fairgrounds, Deerfield NH. Admission is $1.00, which includes tailgating and commercial dealers. Profits will benefit the Boston Burn Unit of the Shriners' Hospital for Crippled Children. Last year we donated $2,058.16. Talk-in on .52 and 146.40/147.00. For more information, send an SASE to Joe K1RQG, Star Route, Box 56, Bucksport ME 04416; Norm WA1IVB, RFD Box 28, West Baldwin ME 04091; or Bob W1GWU, Walton Road, Seabrook NH 03874.

CEDARBURG WI
MAY 9

The Ozaukee Radio Club will hold its annual indoor swapfest on Saturday, May 9, 1981, at the Cedarburg Community Center Gym, Washington Avenue, Cedarburg WI. Cedarburg is 22 miles north of Milwaukee. Doors will open at 8:00 am for the general public and 7:00 am for table setup. Admission is $2.00 in advance and $3.00 at the door. Tables are $3.00 per 6 feet (advance purchases are recommended). Features will include door prizes, food, refreshments, and free parking. Talk-in on 146.37/.97 and 146.52. For more information or advance tickets, send an SASE to Ozaukee Radio Club, PO Box 13, Port Washington WI 53074.

CADILLAC MI
MAY 16

The Wexaukee Amateur Radio Association will hold its 21st annual Swap Shop & Eyeball QSO on Saturday, May 16, 1981, at the Michigan National Guard Armory, Haynes Street, Cadillac MI from 9:00 am to 4:00 pm. Admission is $2.00, and 8-foot tables are $3.00. There will be a grand prize, a Yaesu FT-207R hand-held transceiver, plus many smaller prizes. A lunch counter and parking will be available, as well as camping in the immediate area, and free transportation for flying to and from the Wexford County Airport. Talk-in on 146.37/.97. For further information, contact the Wexaukee Amateur Radio Association, Box 163, Cadillac MI 49601.

SILOAM SPRINGS AR
MAY 16

The Northwest Arkansas Amateur Radio Club, Inc., will hold its 1st annual hamfest/swapmeet on Saturday, May 16, 1981, at the Siloam Springs Community Building, Siloam Springs AR, from 8:00 am to 5:00 pm. It will be all indoors and commercial exhibitors' tables are free. Flea market tables are $2.00 each. Doors open at 6:00 am for setting up tables. Great prizes will be available, including a TS-830. There will be refreshments and free parking. Talk-in on .16/.76 or .52 simplex. For more information, send an SASE to Bob Harmon W5SEP, Route 1, Box 13E, Elkins AR 72727.

KEY WEST FL
MAY 16-17

The annual Conchfest will be held on May 16-17, 1981, in Key West FL. Activities will include an all-you-can-eat conch dinner on Saturday night, a social hour, a free conch train tour, a free conch trolley ride, a conch shell blowing contest, and prizes. A discount book for many Key West attractions will be available. Conchfest tickets are $25.00 per person, tickets for harmonics (12 and under) are $15.00 each, and rooms at the Sportsmen's Inn are $34.00. Tickets include Saturday night dinner, three free drinks at the social hour, the Sunday morning continental breakfast at the Sportsmen's Inn, and the discount book. For more information and advance reservations, write Key West Amateur Radio Club, Inc., PO Box 2371, Key West FL 33040.

DURHAM NC
MAY 16-17

The Durham FM Association will hold its Durhamfest '81 on May 16-17, 1981, at South

✓Reader Service—see page 130

Square Mall, Durham NC. There will be a large covered flea market, and rental tables will be available. General admission is $3.00 with no additional charges for tailgaters or dealers' spaces. On May 17 there will be ladies' bingo. Talk-in on 147.825/.225, 146.52, and 222.34/223.94. For further information and advance tickets, write Durham FM Association, PO Box 8651, Durham NC 27707.

EASTON MD
MAY 17

The seventh annual Easton Amateur Radio Society hamfest will be held on May 17, 1981, rain or shine, from 10:00 am to 4:00 pm at the Easton Senior High School cafetorium on Route 50, just south of Easton at mile marker 66. Donation is $2.00, with an additional $2.00 for tables or tailgaters. Talk-in on .52 simplex and 146.445/147.045 on the repeater in Easton. For more details, write R. C. Thompson KA3BKW, PO Box 1473, Easton MD 21601, or Easton Amateur Radio Society, Inc., Box 781, Easton MD 21601.

EVANSVILLE IN
MAY 17

The Tri-State Amateur Radio Society will hold its annual hamfest on May 17, 1981, at the Vanderburgh County 4-H Center, Evansville IN. There will be an air-conditioned indoor flea market, and over 70 indoor tables will be available. Adult admission is $1.00. An outdoor flea market will also be featured. Talk-in on 147.75/.15 or 146.19/.79. For further information, contact Tom WA9QDZ, 2851 Wayside Drive, Evansville IN 47711.

ATHENS OH
MAY 17

The Athens County Amateur Radio Association's annual hamfest will be held on Sunday, May 17, 1981, at the Athens City Recreation Center, East State Street, Athens OH, from 8:00 am to 4:00 pm. Tickets are $1.00 in advance, $1.50 at the gate. There will be a free flea market for electronics-related items in a large outdoor, paved area. Some indoor space will be available on a first-come, first-served basis. Setup will be at 7:00 am. Food and plenty of free parking will be available. Several restaurants and a recreation area are adjacent to the Athens Mall. Talk-in on .34/.94. For further information, send an SASE to ACARA, c/o Jeff White WD8OXK, PO Box 767, Athens OH 45701, or telephone Joe Follrod WB8DOD at (614)-797-4874.

WEBSTER MA
MAY 17

The Eastern Connecticut Amateur Radio Association will hold its seventh annual hamfest and flea market on May 17, 1981, rain or shine, at Point Breeze Restaurant, Webster MA. For more information, contact Richard Spahl K1SYI, Lake Parkway, Webster MA 01570, or call (617)-943-4420 after 8:00 pm.

BOULDER CO
MAY 17

The Rocky Mountain VHF Society will hold the annual spring hamfest on Sunday, May 17, 1981, from 9:00 am to 4:00 pm, rain or shine, at the Boulder National Guard Armory, 4750 North Broadway, Boulder CO. The admission donation will be $2.00 per family, and there is no seller's charge. Setup starts at 8:30 am and we suggest you bring your own table. The door prizes will include a synthesized FM transceiver, and extra raffle tickets will be available. In addition to the big ham swap, there will be formal technical demonstrations and seminars, covering topics such as fast-scan ham TV, microwaves, satellite communications, etc. Food and drink will be available. Talk-in on 146.16/.76 and 146.52. For more information, contact Richard Ferguson KA0DXM, 1150 Albion Road, Boulder CO 80303, or phone (303)-499-2871.

WABASH IN
MAY 17

The Wabash County Amateur Radio Club will hold its 13th annual hamfest on Sunday, May 17, 1981, from 6:00 am until 3:00 pm at the Wabash County 4-H Fairgrounds, Wabash IN. Admission will be $3.00 at the gate or $2.50 in advance. There will be plenty of food and parking available, as well as camping space for Saturday night. Talk-in on 7.63/.03 or .52. For tickets or more info, send an SASE to Dave Spangler N9ADO, 45 Grant Street, Wabash IN 46992.

MARSHALL MO
MAY 17

The Indian Foothills Amateur Radio Club will hold its 6th annual hamfest on May 17, 1981, at the Saline County Fairgrounds building, Marshall MO. Tickets are $2.00 each or 3 for $5.00 at the door, or 4 for $5.00 in advance. There is no charge for tables but reservations are requested. Registration will be at 8:00 am and coffee and breakfast rolls will be served from 8:00 am to 10:00 am. Lunch (all you can eat) will be at 11:30 am and the drawing will be held at 2:30 pm (with a first prize of an Icom IC-2AT). Talk-in on .52, .28/.88, and 147.84/.24. For information and advanced tickets, contact Phyllis French W0WIE, Route 4, Box 168, Sedalia MO 65301, or phone (816)-826-8319 after 5:00 pm or K0BVB at (816)-886-2837.

ISLIP LI NY
MAY 17

The Long Island Mobile Amateur Radio Club, Inc., will hold the ARRL Hamfair '81 on May 17, 1981 (rain date June 7th), at the Islip Speedway, 2 blocks south on Islip Avenue (Rte. 111) or Exit 56. General admission is $2.00 for all hams, with family members admitted free. Each exhibitor space is $4.00 and admits one person. Features include the LIMRUN at 11:00 am, over 350 computer and ham exhibitors along with general merchandise and swap 'n shop, food and refreshments, and many awards presented throughout the day. Talk-in on 146.25/.85. For more information, call Sid Wolin K2LJH at (516)-379-2861, or Hank Wener WB2ALW at (516)-484-4322 in the evening.

PITTSBURGH PA
MAY 17

The 27th annual Breeze Shooters Hamfest will be held on May 17, 1981, from noon to 5:00 pm at the White Swan Park, Rte. 60 (Parkway West), near the Greater Pittsburgh International Airport, Pittsburgh PA. Registration is $2.00, or three for $5.00. Activities will include a large free flea market, prizes, contests, and a family amusement park. Sheltered tables for vendors are available by advance registration only. Talk-in on .28/.88 or 29.0. For further information, contact Don Myslewski K3CHD, 359 McMahon Road, North Huntingdon PA 15642.

NEWPORT RI
MAY 18

The Newport County Radio Club will hold an auction on Monday, May 18, 1981, at 7:00 pm at the club headquarters in the Seamen's Church Institute Building, 18 Market Square, Newport RI. Talk-in on 147.96/.36.

GASTONIA NC
MAY 23

The Gastonia Amateur Radio Society will hold its fifth annual hamfest on Saturday, May 23, 1981, beginning at 9:00 am, at Karyae Park near Gastonia NC. Pre-registration is $2.50 and tickets at the gate are $3.00. Flea market tables are $5.00 each, with a limit of 4. Flea market as well as rag-chew space will be provided. Tailgating is invited. Exhibitors may set up at 7:00 am. Features include refreshments, a grand prize of a Kenwood TS-520SE (plus other prizes), a bingo hour, plus plenty of parking facilities. Talk-in on 147.72/147.12 and 146.52 simplex. For more information, contact the hamfest chairman, Glenn Varner W4PBQ, 1322 Poston Circle, Gastonia NC 28052, or phone (704)-866-8339.

HAMBURG PA
MAY 24

The Reading Radio Club will hold its third annual hamfest on May 24, 1981, rain or shine, at the Hamburg Field House, Pine Street, Hamburg PA. Adult admission is a $2.00 donation. Outside space is $2.00 and an inside table is $3.00. Doors will open at 7:00 am for tailgaters and 8:00 am for the public. Door prizes will consist of cash and equipment. For more information and reservations, write Box 124, Reading PA 19603.

ST PAUL MN
MAY 30

The North Area Repeater Association will sponsor a swapfest and exposition for radio amateurs and computer hobbyists on May 30, 1981, at the Minnesota State Fairgrounds, St. Paul MN. There will be free overnight parking for self-contained campers on May 29th. Exhibits, booths, and prizes will be featured. Admission is $3.00. For information or reservations, write Amateur Fair, PO Box 30054, St. Paul MN 55175.

COLUMBIA SC
MAY 30

The Columbia Amateur Radio Club will sponsor the 4th annual Columbia Hamfest on Saturday, May 30, 1981, at Midlands Tec College, Beltline Campus, Co-

lumbia SC. Doors will open at 9:00 am. There will be plenty of room available for the outdoor flea market in the south parking lot. Dealer displays will be indoors, and the food stand will be on campus. Talk-in on .34/.94. For more information, please contact Mr. Bob Burks KC4LB, CARC, PO Box 5802, Columbia SC 29250, or phone (803)-776-9054.

GORHAM ME
MAY 30

The Portland Amateur Wireless Association and the University of Southern Maine/Gorham will hold an amateur radio flea market on May 30, 1981, from 8:00 am to 5:00 pm at the gym and the parking lot (inside if it rains) at the University of Southern Maine, Gorham ME campus. The cost is $1.00 per person. Food and drinks will be available. For more information, contact John A. Taylor N1SD, 44 Mitton Street, Portland ME 04102, or phone (207)-773-2651.

HARTWELL GA
MAY 30-31

The Anderson, Hartwell, and Toccoa Amateur Radio Clubs will hold the 3rd annual Lake Hartwell Hamfest on May 30-31, 1981, at the Lake Hartwell Group Camp, located on Highway 29, 4 miles north of Hartwell GA. Features include free admission, free camping, and free flea-market spaces. Activites include live musical entertainment, tours of Lake Hartwell dam and power house, a left-footed CW contest, a horseshoe tournament, and many other activities for the whole family. Fishing, swimming, and camping are available at the site. The campgrounds opens at 6:00 pm Friday and the main prize drawing will be held at 2:00 pm Sunday. Talk-in will be on 146.19/.79, 147.93/.33, and 146.895/.295. For further information, contact Carl Davis KY4T, 203 College Avenue, Hartwell GA 30643.

RANCHO CORDOVA CA
MAY 31

The North Hills Radio Club will hold its 9th annual Sacramento Valley Radio Ham Swap on Sunday, May 31, 1981, from 9:00 am to 3:00 pm at the Machinists' Hall, 3081 Sunrise Boulevard, Rancho Cordova CA. There will be table rentals, food, club auctions, and prizes. Admission is free. Talk-in on 144.59/145.19 and 223.18/224.78. For further information, contact NHRC, W6BWZ, PO Box 41635, Sacramento CA 95841.

WEST FRIENDSHIP MD
MAY 31

The Maryland FM Association will hold its annual hamfest/computer show on Sunday, May 31, 1981, at the Howard County Fairgrounds, West Friendship MD, from 8:00 am to 4:00 pm. Admission is a $3.00 donation, tailgating is $2.00, and tables are $6.00. Talk-in on 146.16/.76. For more information, write MFMA, c/o Heru Walmsley, Post Office, Harmans MD, or phone (301)-766-3545.

TRENTON TN
MAY 31

The Humboldt Amateur Radio Club will hold its annual hamfest on Sunday, May 31, 1981, at Shady Acres City Park, Trenton TN. Featured will be a flea market, prizes, ladies' activities, and light lunches. There are restaurants available nearby; also available will be overnight parking for a limited number of RVs. There is no admission charge. Talk-in on 146.37/.97. For further information, contact Ed Holmes W4IGW, 501 N. 18 Avenue, Humboldt TN 38343

GRAND RAPIDS MI
JUN 6

The Independent Repeater Association will hold the Grand Rapids Spring Swap & Shop on Saturday, June 6, 1981, at the National Guard Armory, 44th Street, just 1/4 mile west of US 131. There will be door prizes, dealers, food, and indoor swap area, forums, and trunk sales. Reserved dealer area is available. Doors open at 8:00 am. Tickets are $2.00 and indoor tables are $5.00. Talk-in on 147.765. For further information, contact David Jenista WD8NZZ, 437 Airview SE, Wyoming MI 49508.

MANASSAS VA
JUN 7

The Ole Virginia Hams Amateur Radio Club, Inc., will hold its annual Manassas Hamfest on Sunday, June 7, 1981, at the Prince William County Fairgrounds, Route 234, Manassas VA. Booths are available. Admission is $3.00, children under 12 will be admitted free, and tailgaters will be charged an additional $2.00. Features will include a ladies' program, indoor and outdoor exhibit areas, a full breakfast and lunch, children's entertainment, CW proficiency awards, and QSL bureaus. Talk-in on 146.37/146.97 repeater (W1CRO) and 146.52 simplex. For booth reservations, contact Joseph A. Schlatter K4FPT, Ole Virginia Hams ARC, Inc., PO Box 1255, Manassas VA 22110.

CHELSEA MI
JUN 7

The Chelsea Swap and Shop will be held on Sunday, June 7, 1981, at the Chelsea Fairgrounds, Chelsea MI. Gates will open for sellers at 5:00 am and for the public from 8:00 am until 2:00 pm. Admission is $1.50 in advance or $2.00 at the gate. Children under 12 and non-ham spouses are admitted free. Talk-in on 146.52 simplex and the 147.855 Chelsea repeater. For more info, write to William Altenberndt, 3132 Timberline, Jackson MI 49201.

SHARONVILLE OH
JUN 12

The Hamilton County Amateur Radio Public Service Corp. will sponsor the first annual Cincinnati ARRL '81 Convention at the Scarlet Oaks Vocational Campus, Sharonville OH, on Saturday, June 12, 1981. This event will *not* be replacing the Cincinnati Hamfest which will be held on Sunday, September 20, 1981, at the usual location at Stricker's Grove, Ross OH.

MIDLAND MI
JUN 13

The Central Michigan Amateur Repeater Association will hold its seventh annual hamfest on June 13, 1981, from 8:00 am to 2:00 pm at its new location in the "Great Hall" in the Valley Plaza complex, just off US Rte. 10 in Midland, Michigan. Tickets are $3.00; children under 12 will be admitted free. Tables are available for $6.00 ($3.00 for half a table). Trunk sales will be $2.00 in a designated area. There will be plenty of free parking. The Valley Plaza Complex offers motel accommodations, RV hookups, swimming, dining, a bowling alley, theaters, and a picnic area. The major prize drawing will be at 1:30 (for an HT); there will be hourly drawings for other prizes. Videotapes of the Saturn fly-by will be shown. Talk-in will be on 146.13/.73 and 146.52 simplex. For information, contact Carol Hall WD8DQG, 4651 Cardinal Drive, Mt. Pleasant MI 48858; (517)-772-0363.

GUELPH ONT CAN
JUN 13

The Guelph Amateur Radio Club will hold the 6th annual Central Ontario Amateur Radio Fleamarket and Computer Fest on Saturday, June 13, 1981, at the Centennial Arena, College Avenue West, Guelph, Ontario, Canada. Admission is $1.00, with children 12 years and under admitted free. Admission for vendors is an additional $2.00. Tables are $5.00 each on a first-come basis. The hours are 8:00 am to 4:00 pm; vendors may begin setting up at 6:00 am. There will be commercial displays, computer software and hardware, surplus dealers, indoor and outdoor displays, and door prizes. The refreshment concession will open at 12:00 noon. Talk-in on .52/.52, .37/.97 (VE3KSR), and .96/.36 (VE3ZMG). For further information, contact Dennis Gore VE3DGA at (519)-836-6226 or Andy Janosik VE3GDY at (519)-824-3227.

WILMINGTON OH
JUN 14

The Clinton and Highland County Radio Clubs will sponsor their annual hamfest and flea market on June 14, 1981, rain or shine, at the Clinton County Fairgrounds, State Route 22, Wilmington OH, from 1200 to 2100 UTC. Admission is $3.00 and flea market space is free with admission ticket. There will be a sheltered display area, a food concession, an auction, and door prizes. Camping is available at nearby Cowan Lake State Park, as well as at private campgrounds and motels. King's Island Park is also nearby. Talk-in on 147.72/.12, 147.81/.21, or 146.52. For further information, contact Bob Lewis KE8E, 192 Northview Road, Blanchester OH 45107, or phone (513)-783-2740 evenings.

SANTA MARIA CA
JUN 14

The Satellite Amateur Radio Club will hold the Santa Maria Amateur Radio Swapfest at the Newlove picnic grounds (Union Oil Company), Santa Maria CA. For information on prizes, swap tables, dinner tickets, etc., mail inquiries to Santa Maria Swapfest, 1600 E. Clark #49, Santa Maria CA 93455.

OSCAR ORBITS

Courtesy of AMSAT

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 MAY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
29545	1	0050:33	90.6
29558	2	0144:47	104.2
29570	3	0044:06	89.1
29583	4	0138:20	102.7
29595	5	0037:39	87.5
29608	6	0131:53	101.1
29620	7	0031:12	85.9
29633	8	0125:26	99.5
29645	9	0024:45	84.4
29658	10	0118:59	98.0
29670	11	0018:18	82.8
29683	12	0112:32	96.4
29695	13	0011:51	81.2
29708	14	0106:05	94.8
29720	15	0005:24	79.7
29733	16	0059:38	93.3
29746	17	0153:53	106.8
29758	18	0053:11	91.7
29771	19	0147:26	105.3
29783	20	0046:44	90.1
29796	21	0140:59	103.7
29808	22	0040:17	88.6
29821	23	0134:32	102.1
29833	24	0033:50	87.0
29846	25	0128:05	100.6
29858	26	0027:23	85.4
29871	27	0121:37	99.0
29883	28	0020:56	83.9
29896	29	0115:10	97.4
29908	30	0014:28	82.3
29921	31	0108:43	95.9

OSCAR 8 ORBITAL INFORMATION FOR MAY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
16076	1	0018:54	63.5
16090	2	0023:40	64.7
16104	3	0028:26	65.9
16118	4	0033:11	67.1
16132	5	0037:57	68.3
16146	6	0042:43	69.5
16160	7	0047:28	70.7
16174	8	0052:14	72.0
16188	9	0057:00	73.2
16202	10	0101:45	74.4
16216	11	0106:31	75.6
16230	12	0111:16	76.8
16244	13	0116:02	78.0
16258	14	0120:47	79.2
16272	15	0125:33	80.4
16286	16	0130:18	81.6
16300	17	0135:04	82.8
16314	18	0139:49	84.0
16327	19	0001:23	59.4
16341	20	0006:08	60.6
16355	21	0010:54	61.8
16369	22	0015:39	63.0
16383	23	0020:24	64.2
16397	24	0025:09	65.4
16411	25	0029:55	66.6
16425	26	0034:40	67.8
16439	27	0039:25	69.1
16453	28	0044:11	70.3
16467	29	0048:56	71.5
16481	30	0053:41	72.7
16495	31	0058:26	73.9

OSCAR 7 ORBITAL INFORMATION FOR JUNE

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
29933	1	0008:01	88.7
29946	2	0102:16	94.3
29958	3	0001:34	79.2
29971	4	0055:49	92.7
29984	5	0150:04	106.3
29996	6	0049:22	91.2
30009	7	0143:36	104.8
30021	8	0042:55	89.6
30034	9	0137:09	103.2
30046	10	0036:27	88.0
30059	11	0130:42	101.6
30071	12	0030:00	86.5
30084	13	0124:15	100.1
30096	14	0023:33	84.9
30109	15	0117:48	98.5
30121	16	0017:06	83.3
30134	17	0111:21	96.9
30146	18	0010:39	81.8
30159	19	0104:53	95.4
30171	20	0004:12	80.2
30184	21	0058:26	93.8
30197	22	0152:41	107.4
30209	23	0051:59	92.2
30222	24	0146:14	105.8
30234	25	0045:32	90.6
30247	26	0139:47	104.2
30259	27	0039:05	89.1
30272	28	0133:19	102.7
30284	29	0032:37	87.5
30297	30	0126:52	101.1

OSCAR 8 ORBITAL INFORMATION FOR JUNE

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
16509	1	0103:11	75.1
16523	2	0107:56	76.3
16537	3	0112:41	77.5
16551	4	0117:26	78.7
16565	5	0122:12	79.9
16579	6	0126:57	81.1
16593	7	0131:42	82.3
16607	8	0136:27	83.5
16621	9	0141:12	84.7
16634	10	0002:45	60.1
16648	11	0007:30	61.3
16662	12	0012:15	62.5
16676	13	0017:00	63.7
16690	14	0021:44	64.9
16704	15	0026:29	66.1
16718	16	0031:14	67.3
16732	17	0035:59	68.5
16746	18	0040:44	69.7
16760	19	0045:29	70.9
16774	20	0050:13	72.1
16788	21	0054:58	73.3
16802	22	0059:43	74.5
16816	23	0104:27	75.7
16830	24	0109:12	76.9
16844	25	0113:57	78.1
16858	26	0118:41	79.3
16872	27	0123:26	80.5
16886	28	0128:11	81.7
16900	29	0132:55	82.9
16914	30	0137:40	84.1

HAM HELP

I've been reading over my old copies of *73 Magazine* this evening and thought I should write to *73* and thank everyone for the fine magazine I have had the opportunity to be reading these past months.

Now for the good news: As of Feb. 13, 1981, I was granted a parole. The man told me I got it not because I earned it, but because of my medical problem. To clarify that: I had an operation in November, 1980, for a pancreatoduodenectomy, a malignant tumor in the distal common bile duct. The good doctors gave me an expected chance of survival at less than 30% at five years.

But even with the bad news I'm trying to keep my head and still plan ahead. A good, very good friend will be helping me soon after I get home with the CW portion and will try to do all he can to help me get my Novice license; at least it will be something I've been trying to do in the 16 months I've been in this place.

Also, I've met many amateurs through the mails from a letter in Ham Help of May, 1980. These new friends have helped me more than I can express in mere words, and hopefully I can still keep in touch when I get home and later on the bands with my very slow CW. I was told by one good doctor to live my life the best I can and have fun. Only one knows when I'll leave this Earth, and that one is God alone.

I should be leaving the institution in 7-10 days; my papers say I'd be unemployable. But, somehow, I have to find a job or I will go stir crazy doing nothing. I will sure try to get even a part-time job some place, and may also do some work on gas engines (lawn mowers and cycles) to keep myself busy on the farm. If I do pass the test on the Novice, I'll surely get my feet wet, so to say, and jump in and listen on the bands and later try my fist with my lousy CW. Hopefully, I may even get good enough to go ahead and try for the Technician license later this year. Strange, though I can remember schematics, rules, regs, formulas, and electronic knowledge, I have trouble with CW. All I've got down so far is: E, A, T, SOS, and M and N. More and more practice is surely needed—maybe my brain is dense or something. I've read all I can on amateur radio, and have got a lot of books here to take home. Also, I've gone through the Novice *73* book 4-5 times since being here.

I reread the magazines as much as I can and think hopefully soon I'll get that license for sure.

I would like to thank everyone who wrote to me here and all the doctors and nurses at Iowa City, Iowa's University Hospital for everything while I was a patient there. I sincerely do appreciate it very much. I especially thank *73 Magazine* for putting my letter in Ham Help last May and Wayne Green, without whom *73* wouldn't be such a great magazine as it is today. Again, thank you all.

Richard Hollingshead
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✓ *Reader Service—see page 130*

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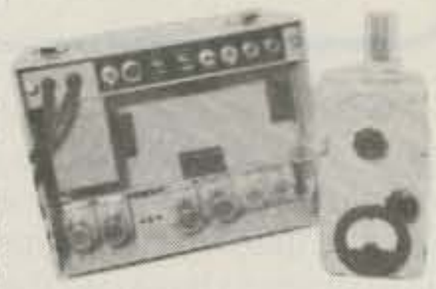

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AU-26A/	801162 Variable Attenuator	100.00

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X638S	Horn 8.2 - 12.4 GHz	60.00
601-818	X to N Adapter 8.2 - 12.4 GHz	35.00
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4013C-10/	22540A Directional Coupler 2 to 4 GHz 10db Type SMA	90.00
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3033	Coaxial Hybrid 2 to 4 GHz 3dB Type N	125.00
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784/	22380 Variable Attenuator 1 to 90dB 2 to 2.5 GHz Type SMA	550.00
22377	Waveguide to Type N Adapter	35.00
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185BS1	7.05 to 10 GHz Variable Attenuator 0 to 40dB	100.00
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109J,I	Fixed Attenuators	25.00
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2114L3	1K x 4 Static RAM 350ns	7.99
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4060/2107	4K x 1 Dynamic RAM	3.99
4050/9050	4K x 1 Dynamic RAM	3.99
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2112A-2	256 x 4 Static RAM	3.99
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LM320K-12	1.35	CD4027	.55
LM320K-15	1.35	CD4028	.85
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LM320T-8	.95	CD4030	.45
LM320T-12	.95	CD4035	1.00
LM320T-15	.95	CD4040	1.35
LM323K-5	5.95	CD4042	.85
LM324N	1.00	CD4043	.85
LM339N	1.00	CD4044	.85
LM340K-5	1.35	CD4046	1.67
LM340K-8	1.35	CD4049	.45
LM340K-12	1.35	CD4050	.60
LM340K-15	1.35	CD4051	1.13
LM340K-24	1.35	CD4060	1.42
LM340T-5	.85	CD4066	.71
LM340T-8	.85	CD4068	.40
LM340T-12	.85	CD4069	.40
LM340T-15	.85	CD4070	.50
LM340T-18	.85	CD4071	.45
LM340T-24	.85	CD4072	.45
LM350	5.50	CD4073	.45
LM377	2.95	CD4075	.45
LM379	5.00	CD4076	1.45
LM380N	1.00	CD4078	.40
LM381	1.60	CD4081	.35
LM382	1.60	CD4082	.35
LM709H	.59	CD4116	.47
LM723H/N	.59	CD4490	3.50
LM733N	.85	CD4507	1.00
LMT41CH	.35	CD4508	2.85
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14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin wire .28

WIRE WRAP LEVEL 3

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DL747/750	CA/CC	.600	1.95
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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 R&D.

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.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

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. 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 $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was 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 operations.

New improved faster version including **renumber** and essentially **unlimited variables.** Also, an exclusive user expandable command library.

Serial and Parallel I/O included.

Super Basic on Cassette $55.00.

PROM Eraser

assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$69.50** (with timer **$94.50**).

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00. Tiny Basic $30.00**

S-100 Computer Boards

8K Static Godbout Econo IIA Kit	149.00
16K Static Godbout Econo XIV Kit	269.00
24K Static Godbout Econo XX-24 Kit	414.00
32K Static Godbout Econo XX-32 Kit	537.00
16K Dynamic RAM Kit	289.00
32K Dynamic RAM Kit	328.00
64K Dynamic RAM Kit	399.00
Video Interface Kit	**$139.00**

80 IC Update Master Manual $39.00

Comp. IC data selector, 2700 pg. master reference guide. Over 51,000 cross references. Free update service through 1980. Domestic postage $3.50.

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included. Bd. only $17.00.

LRC 7000+Printer $389.00

40/20 column dot matrix impact, std. paper. Interface all personal computers.

64/40/32/20 version **$405.00.** Optional cables available.

LRC 7000 printer interface cable for Super Elf with software $35.00

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.95**

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. **$405.00.** 4K version **$450.00.** 4K Assembler **$85.00**, 8K Basic Interpreter **$100.00**.

Special small power supply for AIM65 assem. in frame **$54.00.** Complete AIM65 in thin briefcase with power supply **$499.00.** Molded plastic enclosure to fit both AIM65 and power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$625.00.**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $9.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option, ±5v, ±12v are regulated. Basic Kit **$29.95.** Kit with chassis and all hardware **$43.95.** Add $4.00 shipping. Kit of hardware **$14.00.** Woodgrain case **$10.00.** $1.50 shipping.

Ohio Scientific Computers

CIP Series 2 **$455.00.** Like an Apple at less than half the price! CIPMF Series 2 **$1199.00.** Minifloppy version with additional RAM/ROM. Complete software and peripherals available. Send for free brochure.

Gremlin Color Video Kit $69.95

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. No high res. graphics. On board RF Modulator Kit **$4.95**

1802 16K Dynamic RAM Kit $149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$63.00**

Tiny Basic Extended on Cassette $15.00 (added commands include Stringy, Array, Cassette I/O etc.) S-100 4-Slot Expansion $ 9.95
Super Monitor VI.I Source Listing $15.00

Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

Super Color S-100 Video Kit $129.95

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.

Dealers: Send for excellent pricing/margin program.

Editor Assembler $25.00
(Requires minimum of 4K for E/A plus user source)
1802 Tiny Basic Source listing $19.00
Super Monitor V2.0/2.1 Source Listing $20.00

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
$10.00 min. BankAmericard and Master Charge accepted. $1.00 insurance optional.
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- Low profile
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  (*Minimum of 10 microinches gold (also on gold sockets))
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GOLD INLAY SOLDER TAIL Min. 50 Microinches Gold

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  (*Minimum .30 microinch gold inlay on gold sockets)
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TIN PLATED WIRE WRAP Min. 200 Microinches Tin

GOLD INLAY WIRE WRAP No. 16 Microinches Gold

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CONTROL PANEL PACK Part No. 921580-8 $1.69

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$14.95

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Digital LCD Clock Module

- Operates from a single 1.5V Battery
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- User selectable 12 or 24 hour mode
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Catalog No.	Description	Cost
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USER PROGRAMMABLE FOR:

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- Fixed or Floating point format
- 12V, 60 Hz Line Frequency operation

Instruction included with all orders

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- Liquid X-Y read — 4 digit LED display with red lens
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Cat. No.	Description	Cost
MA1032M	MA1032A Clock Module (Assembled and tested)	$19.95
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MA1032T	Special Transformer for MA1032	2.95
MA1032B	Alarm Buzzer for MA1032	3.00
MA1032K	includes MA1032M, P. C. B.'s	28.95
MA1032C	Conventional switch set for applications where MA1032P is not used, includes one SPDT and one DPDT	2.70
MA1032T	Clock Module Conventional switches, Transformer	28.95

MA1070 — 0.84" HIGH DIGITS

Cat. No.	Description	Cost
MA1070M	MA1070 Clock Module (Assembled and tested)	$ 19.95
MA1070P	Dig-Key Switching Panel Kit for MA1070 (includes P. C. Board, Switches, Hardware, Components)	7.95
MA1070T	Special Transformer for MA1070M	3.25
MA1070B	Alarm Buzzer for MA1070M	3.00
MA1070K	includes MA1070M, P. C. B.'s	28.95
MA1070C	Conventional switch set for applications where MA1070P is not used, includes one SPDT and one DPDT and a 2M ohm resistor, trimmer, battery snaps	3.50
MA1070B	Includes MA1070M, MA1070C & MA1070T	28.95

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Be Sure to Order the Proper Adapter for Your Digital Clock

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4202	Universal PC Board Mounting Adapters	.69
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THE "PROGRAMMABLE" CLOCK MODULES

USER PROGRAMMABLE FOR:

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NEW! Two Giant Sizes — 0.7" and 0.84"

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100 VDC plus minus 10% TOLERANCE

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CAPACITANCE TOLERANCE: 20%
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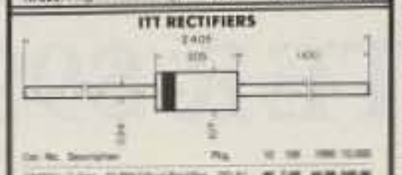

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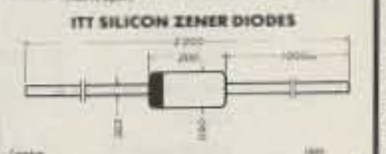

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Part Number	Capacitance	Tolerance	Voltage	10	100	1000

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140 CAPACITORS

Price includes convenient divided plastic box with bar guide for easy storage and quick access.

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Price includes convenient divided plastic box with bin guide for easy storage and quick access.

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Precut Prestripped 100 Wire Package — Bulk Wire Wrap Wire

Wire Assortment No. WK-1-A	Wire Assortment No. WK-2-A
900 Precut/Prestripped No. 30 Wire Wrap Wire. Assortment consists of following lengths and quantities.	2800 Precut/prestripped No. 30 Wire Wrap Wire. Assortment consists of following lengths and quantities.
250—3" 100—4½" 100—5" 100—6" 10—8"	250—3" 250—5" 500—3" 250—4" 300—4" 100—6" 250—4½" 100—7"
Catalog No. WK-1-A $17.95	Catalog No. WK-2-A $42.95

Wire Stripped 1" both ends

PRECUT / PRESTRIPPED WIRE 100 Wires/Package

Part No.	Color	Length	Cost
B2	30-AWG Blue Wire, 2" Overall Length		$2.25
Y3	30-AWG Yellow Wire, 3" Overall Length		2.25
W3	30-AWG White Wire, 3" Overall Length		2.25
R3	30-AWG Red Wire, 3" Overall Length		2.25
B4	30-AWG Blue Wire, 4" Overall Length		2.40
Y4	30-AWG Yellow Wire, 4" Overall Length		2.40
W4	30-AWG White Wire, 4" Overall Length		2.40
R4	30-AWG Red Wire, 4" Overall Length		2.40
B5	30-AWG Blue Wire, 5" Overall Length		2.63
Y5	30-AWG Yellow Wire, 5" Overall Length		2.63
W5	30-AWG White Wire, 5" Overall Length		2.63
R5	30-AWG Red Wire, 5" Overall Length		2.63
B6	30-AWG Blue Wire, 6" Overall Length		2.90
Y6	30-AWG Yellow Wire, 6" Overall Length		2.90
W6	30-AWG White Wire, 6" Overall Length		2.90
R6	30-AWG Red Wire, 6" Overall Length		2.90
B7	30-AWG Blue Wire, 7" Overall Length		3.50
Y7	30-AWG Yellow Wire, 7" Overall Length		3.50
W7	30-AWG White Wire, 7" Overall Length		3.50
R7	30-AWG Red Wire, 7" Overall Length		3.50
B8	30-AWG Blue Wire, 8" Overall Length		3.75
Y8	30-AWG Yellow Wire, 8" Overall Length		3.75
W8	30-AWG White Wire, 8" Overall Length		3.75
R8	30-AWG Red Wire, 8" Overall Length		3.75

30 AWG Kynar Insulated in Bulk Continuous Length

Part No.	Color	Length	Cost
100-BR	Red	100 feet	$ 5.10
100-BK	Black	100 feet	5.10
100-BU	Blue	100 feet	5.10
500-RD	Red	500 feet	15.30
500-BK	Black	500 feet	15.30
500-BU	Blue	500 feet	15.30
1000-RD	Red	1000 feet	25.75
1000-BK	Black	1000 feet	25.75
1000-BU	Blue	1000 feet	25.75

The Digi-Key volume discount and Service charges are simple to apply. Most items sold by Digi-Key may be combined for a volume discount. Items that are not discountable are identified by the suffix-ND following the part number. After writing your order, total all of the discountable items and apply the appropriate discount. To this subtotal, add the non-discountable items. Then add the Service charge. We pay all shipping and insurance to addresses in the U.S.A., Canada and Mexico when payment accompanies order.

SERVICE CHARGES	VOLUME DISCOUNT
$ 0.00-$ 9.99 ..... Add $2.00	$ 0.00-$ 99.99 ..... NET
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$ 25.00-$49.99 ..... Add $0.50	$ 250.00-$499.99 .... Less 15%
$ 50.00-$99.99 ..... Add $0.25	$ 500.00-$999.99 .... Less 20%
$100.00 & Up ..... No Charge	$1000.00 & Up ..... Less 25%

WHEN ORDERING BY PHONE, CALL: 1-800-346-5144 (Mn., Ak., Hi., call 218-681-6674) By mail send your order to: DIGI-KEY, Highway 32 South, Thief River Falls, MN 56701

You may pay by check, money order, Master Charge, VISA or C.O.D. ***DIGI-KEY GUARANTEE:*** Any parts or products purchased from Digi-Key that prove to be defective will be replaced or refunded if returned within 90 days from receipt with a copy of your invoice.

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9 DIGITS 600 MHz $129.95 WIRED

PRICES

CT-90 wired, 1 year warranty	$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally; an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
MINI-100 Kit, 90 day part warranty	59.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current:	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	10.1% basic DC volts
Power:	4 'C' cells

AUDIO SCALER

For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

ACCESSORIES

Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

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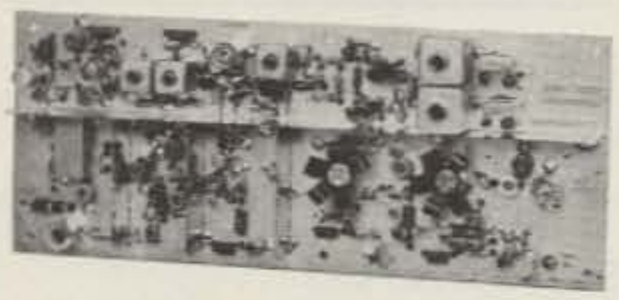
These Low Cost SSB TRANSMITTING CONVERTERS

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.



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
XV4 Wired and tested $149.95

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

XV2 Wired and tested $109.95

XV28 2M ADAPTER KIT - $24.95

Converts any 2M exciter to provide the 10M signal required to drive above 220 or 435 MHz units.

NEW! COMPLETE TRANSMITTING CONVERTER AND PA IN ATTRACTIVE CABINET

Far less than the cost of many 10W units!

Now, the popular Hamtronics® Transmitting Converters and heavy duty Linear Power Amplifiers are available as complete units in attractive, shielded cabinets with BNC receptacles for exciter and antenna connections. Perfect setup for versatile terrestial and OSCAR operations! Just right for phase 3! You save $30 when you buy complete unit with cabinet under cost of individual items. Run 40-45 Watts on VHF or 30-40 Watts on UHF with one integrated unit! Call for more details.

MODEL	KIT	WIRED and TESTED
XV2/LPA2-45/Cabt (6,2,or220)	$199.95	$349.95
XV4/LPA4-30/Cabt (for UHF)	$229.95	$399.95

Easy to Build FET RECEIVING CONVERTERS

Let you receive OSCAR and other exciting VHF and UHF signals on your present HF or 2M receiver

- NEW LOW-NOISE DESIGN
- ATTRACTIVE WOODGRAIN CASE
- Less than 2dB noise figure, 20dB gain

MODEL	RF RANGE	OUTPUT RANGE
CA28	28-32 MHz	144-148 MHz
CA50	50-52	28-30
CA50-2	50-54	144-148
CA144	144-146	28-30
CA145	145-147–or–144-144.4	28-30 27-27.4 (CB)
CA146	146-148	28-30
CA220	220-222	28-30
CA220-2	220-224	144-148
CA110	Any 2MHz of Aircraft Band	26-28 or 28-30
CA432-2	432-434	28-30
CA432-5	435-437	28-30
CA432-4	432-436	144-148

Easily modified for other rf and if ranges.

STYLE	VHF	UHF
Kit less case	$34.95	$49.95
Kit with case	$39.95	$54.95
Wired/Tested in case	$54.95	$64.95

Professional Quality VHF/UHF FM/CW EXCITERS

- Double tuned circuits for spurious suppression
- Easy to align with built-in test aids

T51-30	10 Meter, 2W Kit	$44.95
T51-50	6 Meter, 2W Kit	$44.95
T51-150	2 Meter, 2W Kit	$44.95
T51-220	220 MHz, 2W Kit	$44.95
T450	450 MHz, 3/4W Kit	$44.95
T451	450 MHz, 3 W Kit	$59.95
A14T	5 Chan Adapter (T51&T451)	$9.95

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.

LPA2-15	6M, 2M, 220; 15 to 20W	$59.95
LPA2-30	6M, 2m; 25 to 30W	$89.95
LPA2-40	220 MHz; 30 to 40W	$119.95
LPA2-45	6M, 2M; 40 to 45W	$119.95
LPA4-10	430MHz; 10 to 14W	$79.95
LPA4-30	430MHz; 30-40W	$119.95

See catalog for complete specifications

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.

- NEW LOW-NOISE DESIGN
- Less than 2 dB noise figure, 20 dB gain
- Case only 2 inches square
- Specify operating frequency when ordering

MODEL P-30 VHF PREAMP, available in many versions to cover bands 28-300 MHz.

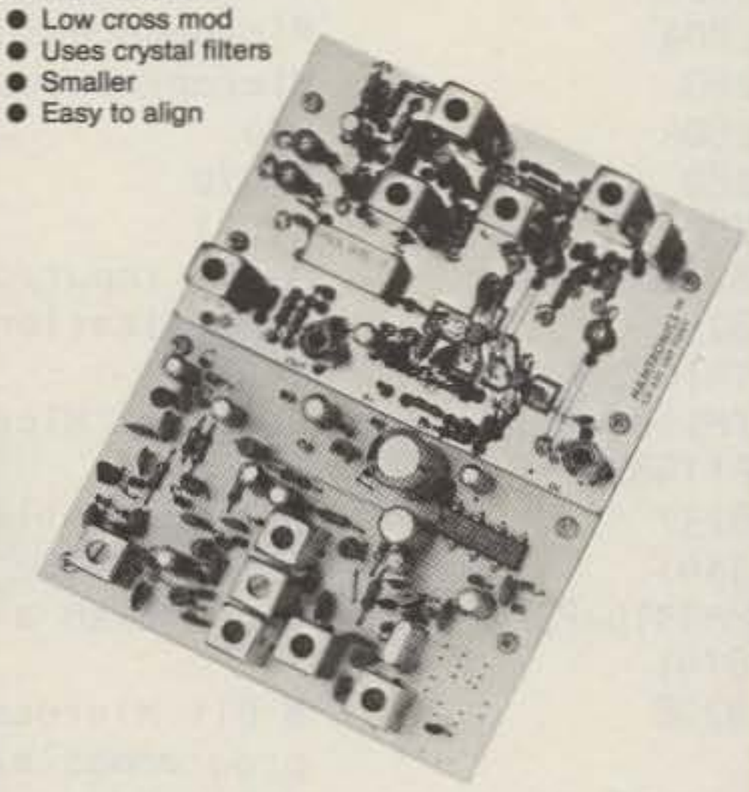
MODEL P432 UHF PREAMP, available in versions to cover bands 300-650 MHz.

STYLE	VHF	UHF
Kit less case	$12.95	$18.95
Kit with case	$18.95	$26.95
Wired/Tested in Case	$27.95	$32.95

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.

R450( ) UHF FM Receiver Kits, similar to R75, but for UHF band. New low-noise front end. Add $10 to above prices. (Add selectivity letter to model number as on R75.)

A14 5 Channel Adapter for Receivers.....$9.95

NEW R110 VHF AM RCVR

AM monitor receiver kit similar to R75A, but AM. Available for 10-11M, 6M, 2M, 220 MHz, and 110-130 MHz aircraft band $74.95. (Also available in UHF version.)

IT'S EASY TO ORDER!

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4027	4K x 1 Dynamic Ram	2.99
2117/4116	16K x 1 Dynamic Ram	5.00
2732-6	32K Eprom	39.95

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MC68B21P	PIA	6.99
MC6845P	CRT Controller	25.00
MC6850P	ACIA	4.99
MC6852P	SSDA	5.00
8008-1	Microprocessor	5.00
8080A	Microprocessor	5.00
Z80A	Microprocessor	10.99
Z80	Microprocessor	8.99
Z80A	PIO	9.99
Z80	SIO/0	22.50
Z80	SIO/1	22.50
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TR1602/AY5-1013	UART	6.99
TMS1000NL	Four Bit Microprocessor	4.99
PT1482B	PSAT	5.99
8257	DMA Controller	8.99
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8741		60.00
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TYCO 001-19880 Same as 2194F
10.7 MHz narrow band
3 dB bandwidth 15 KHz min.
20 dB bandwidth 60 KHz min.
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Ultimate 50 dB insertion loss 1 dB max.
Ripple 1 dB max. Ct. 0+/-5 pf 3600 Ohms
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80 Watts output, 12 dB gain $17.95 each

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for PCB Boards
5 mix for $5.00

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J310 N-CHANNEL J-FET 450 MHz
Good for VHF/UHF Amplifier,
Oscillator and Mixers 3/$1.00

AMPHENOL COAX RELAY
26 VDC Coil SPDT #360-11892-13
100 Watts Good up to 18 GHz
$19.99 each

78M05 Same as 7805 but only ½ Amp @
5 VDC 49¢ each or 10/$3.00

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K-32B	28 VCT @ 100 MA	4.99 ea.
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36 in. long x ½ in. $4.99 each

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MRF422A	38.25
MRF422	38.25
MRF428	38.25
MRF428A	38.25
MRF426	8.87
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MRF449	10.61
MRF449A	10.61
MRF450	11.00
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MRF452	15.00
MRF453	13.72
MRF454	21.83
MRF454A	21.83
MRF455	14.08
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MRF472	2.50
MRF474	3.00
MRF475	2.90
MRF476	2.25
MRF477	10.00
MRF485	3.00
MRF492	20.40
MRF502	.93
MRF604	2.00
MRF629	3.00
MRF648	26.87
MRF901	3.99
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MRF904	3.00
MRF911	4.29
MRF5176	11.73
MRF8004	1.39
BFR90	1.00
BFR91	1.25
BFR96	1.50

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BFW92	.79
MMCM918	14.30
MMCM2222	15.65
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MWA110	6.92
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4CX250R	69.00
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4CX350A/8321	100.00
4CX350F/J/8904	100.00
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6360	4.69
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Phenolic type 6/$1.00

UHF/VHF RF POWER TRANSISTORS
CD2867/2N6439
60 Watts output
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1900 MHz to 2500 MHz DOWNCONVERTERS
Intended for amateur radio use
Tunable from channel 2 thru 6
34 dB gain 2.5 - 3 dB noise
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Complete Receiver and Power Supply
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Bogner down converter, industrial version. 1 year guarantee $225.00

86 PIN MOTOROLA BUS EDGE CONNECTORS
Gold plated contacts
Dual 43/86 pin .156 spacing
Solder tail for PCB $3.00 each

CONTINUOUS TONE BUZZERS
12 VDC $2.00 each

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New $11.95 Used $5.95

PL-259 TERMINATION 52 Ohm 5 Watts
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✔ Reader Service—see page 130

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69¢ each or
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HEP170 1000 PIV
2.5 Amps 25¢ each or
100/$15.00

HIGH VOLTAGE CAPS
420 MFD @ 400 VDC OR
600 MFD @ 400 VDC
$6.99 each

NEW ROTRON BISCUIT FANS
Model BT2A1 115 VAC
$12.99 each

TORIN TA700 FANS NEW
Model A30340
230 VAC @ .78 Amps
Will also work on 115 VAC
$29.99 each

DOOR KNOB CAPS

470 pf @ 15 KV	$3.99 each
Dual 500 pf @ 15 KV	5.99 each
680 pf @ 6 KV	3.99 each
800 pf @ 15 KV	3.99 each
1000 pf @ 20 KV	5.00 each
2700 pf @ 40 KV	5.99 each

NEW & USED BCD SWITCHES
3 switch with end plates
New $8.99
Used $6.95

ORDERING INSTRUCTIONS

Check, money order, or credit cards welcome. (Mastercharge and VISA only) No personal checks or certified personal checks for foreign countrys accepted. Money order or cashiers check in U.S. funds only. Letters of credit are not acceptable.

Minimum shipping by UPS is $2.35 with insurance. Please allow extra shipping charges for heavy or long items.

All parts returned due to customer error will be subject to a 15% restock charge.

If we are out of an item ordered, we will try to replace it with an equal or better part unless you specify not to, or we will back order the item, or refund your money.

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. Prices superseade all previously published. Some items offered are limited to small quantities and are subject to prior sale.

We now have a toll free number but we ask that it be used for CHARGE ORDERS ONLY. If you have any questions please use our other number. We are open from 8:00 a.m. - 5:00 p.m. Monday thru Saturday.

Our toll free number for orders only is 800-528-3611.

JUMBO LED's		MEDIUM LED's	
Red	8/$1.00	Red	6/$1.00
Clear	6/$1.00	Green	6/$1.00
Yellow	6/$1.00		
Green	6/$1.00		
Amber	6/$1.00		

NEW G.E. OPTO COUPLERS 4N26
69¢ each or 10/$5.00

MICRO-MINI WATCH CRYSTALS
32.768 Hz $3.00 each

NEW 2 inch ROUND SPEAKERS
100 Ohm coil 99¢ each

PLASTIC TO-3 SOCKETS 4/$1.00

NO ORDERS UNDER $10

RAMSEY ELECTRONIC'S Inc.

✓62

PARTS WAREHOUSE

We now have available a bunch of goodies too good to bypass. Items are limited so order today

2575 Baird Rd.
Penfield, NY 14526
716-586-3950

Call Your Phone Order in Today

TERMS: Satisfaction guaranteed or money refunded. C.O.D. add $2.00. Minimum order $6.00. Orders under $10.00 add $1.50. Add 5% for postage, insurance, handling. Overseas add 15%. N.Y. residents add 7% tax.

MINI KITS - YOU HAVE SEEN THESE BEFORE NOW HERE ARE OLD FAVORITE AND NEW ONES TOO. GREAT FOR THAT AFTERNOON HOBBY.

FM MINI MIKE

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit **$14.95**
FM-3 Wired and Tested **19.95**

Color Organ

See music come alive! 3 different lights flicker with music. One light each for, high, mid-range and lows. Each individually adjustable and drives up to 300 W. runs on 110 VAC.

Complete kit, ML-1 **$8.95**

Video Modulator Kit

Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 **$7.95**

Led Blinky Kit

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts. Complete kit, BL-1 **$2.95**

Super Sleuth

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

CPO-1

Runs on 3-12 Vdc 1 wall out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit **$2.95**

CLOCK KITS

Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5 **$24.95**
Clock with 10 min. ID timer, 12/24 hour, DC-10 **$29.95**
Alarm clock, 12 hour only, DC-8 **$29.95**
12V DC car clock, DC-7 **$29.95**

For wired and tested clocks add $10.00 to kit price.
SPECIFY 12 OR 24 HOUR FORMAT

FM Wireless Mike Kit

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit **$3.95** FM-2 kit **$4.95**

Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC.

Complete kit, WL-1 **$6.95**

Tone Decoder

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts. Complete kit, TD-1 **$5.95**

Car Clock

The UN-KIT, only 5 solder connections

Here's a super looking, rugged and accurate auto clock which is a snap to build and install. Clock movement is completely assembled — you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell — assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify)

DC-3 kit, 12 hour format **$22.95**
DC-3 wired and tested **$29.95**

Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit **$5.95**

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC

MB-1 Kit **$4.95**

Siren Kit

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.

Complete kit, SM-3 **$2.95**

60 Hz Time Base

Runs on 5-15 VDC. Low current (2.5ma) 1 min/month accuracy. TB-7 Kit **$5.50**
TB-7 Assy **$9.95**

Calendar Alarm Clock

The clock that's got it all: 6-.5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size: 5x4x2 inches. Complete kit, less case (not available)

DC-9 **$34.95**

Under Dash Car Clock

12/24 hour clock in a beautiful plastic case features 6 jumbo RED LEDS, high accuracy (.001%), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer atuomatically adjusts display to ambient light level.

DC-11 clock with mtg. bracket **$27.95 kit**
DM-1 dimmer adapter **$2.50**
Add $10.00 Assy. and Test

Video Terminal

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 6416 is 64 char. by 16 lines with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 6416, terminal card kit (add $60.00 for wired unit) **$189.95**
Lower Case option **$13.95**
Power Supply **$14.95**
RF Modulator kit **$7.95**

PARTS PARADE

IC SPECIALS

LINEAR

301	$ .35
324	$1.50
380	$1.50
555	$ .45
556	$1.00
565	$1.00
566	$1.00
567	$1.25
741	10/$2.00
1458	$ .50
3900	$ .50
3914	$2.95
8038	$2.95

CMOS

4011	.50
4013	.50
4046	$1.85
4049	.50
4059	$9.00
4511	$2.00
4518	$1.35
5639	$1.75

READOUTS

FND 359 .4" C.C.	$1.00
FND 507/510 .5" C.A.	1.00
MAN 72/HP7730 .33" C.A.	1.00
HP 7651 .43" C.A.	2.00

TRANSISTORS

2N3904 NPN C+F	15/$1.00
2N3906 PNP C+F	15/$1.00
2N4403 PNP C+F	15/$1.00
2N4410 NPN C+F	15/$1.00
2N4916 FET C+F	4/$1.00
2N5401 PNP C+F	5/$1.00
2N6028 C+F	4/$1.00
2N3771 NPN Silicon	$1.50
2N5179 UHF NPN	3/$2.00
Power Tab NPN 40W	3/$1.00
Power Tab PNP 40W	3/1.00
MPF 102/2N5484	$.50
NPN 3904 Type T+R	50/$2.50
PNP 3906 Type T+R	50/$2.50
2N3055	$.80
2N2646 UJT	3/$2.00

TTL

74S00	$ .40
7447	$ .65
7475	$ .50
7490	$ .50
74196	$1.35

SPECIAL

11C90	$15.00
10116	$ 1.25
7208	$17.50
7207A	$ 5.50
7216D	$21.00
7107C	$12.50
5314	$ 2.95
5375AB/G	$ 2.95
7001	$ 6.50

FERRITE BEADS

With info and specs **15/$1.00**
6 Hole Balun Beads **5/$1.00**

Sockets

8 Pin	10/$2.00
14 Pin	10/$2.00
16 Pin	10/$2.00
24 Pin	4/$2.00
28 Pin	4/$2.00
40 Pin	3/$2.00

Diodes

5.1 V Zener	20/$1.00
1N914 Type	50/$1.00
1KV 2Amp	8/$1.00
100V 1Amp	15/$1.00

25 AMP
100V Bridge
$1.50 each

Mini-Bridge 50V
1 AMP
2 for $1.00

Resistor Ass't

Assortment of Popular values - ¼ watt. Cut lead for PC mounting, ½" center, ½" leads, bag of 300 or more. **$1.50**

Switches

Mini toggle SPDT **$1.00**
Red Pushbuttons N.O. **3/$1.00**

Earphones

3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc
5 for $1.00

Mini 8 ohm Speaker

Approx. 2¼" diam. Round type for radios, mike etc.
3 for $2.00

Slug Tuned Coils

Small 3/16" Hex Slugs turned coil. 3 turns. 10 for $1.00

CAPACITORS

TANTALUM Dipped Epoxy	ALUMINUM Electrolytic		DISK CERAMIC	
1.5 uF 25V 3/$1.00	1000 uF 16V Radial	$.50	01 16V disk	20/$1.00
1.8 uF 25V 3/$1.00	500 uF 20V Axial	$.50	1 16V	15/$1.00
.22 uF 25V 3/$1.00	150 uF 16V Axial	5/$1.00	001 16V	20/$1.00
	10 uF 15V Radial	10/$1.00	100 pF	20/$1.00
			047 16V	20/$1.00

DC-DC Converter

+5 vdc input prod. -9 vdc @ 30ma
+9 vdc produces -15 vdc @ 35ma **$1.25**

Ceramic IF Filters

Mini ceramic filters 7 kHz B.W. 455 kHz $1.50 ea.

25K 20 Turn Trim Pot **$1.00**
1K 20 Turn Trim Pot **$ .50**

Trimmer Caps

Sprague - 3-40 pf Stable Polypropylene **.50 ea.**

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge **$.75**

Mini RG-174 Coax

10 ft. for $1.00

Coax Connector

Chassis mount BNC type **$1.00**

9 Volt Battery Clips

Nice quality clips **5 for $1.00**
⅜" Rubber Grommets **10 for $1.00**

Parts Bag

Asst. of chokes, disc caps, tant., resistors, transistors, diodes, MICA caps etc
sm. bag (100 pc) **$1.00** lg. bag (300 pc) **$2.50**

Connectors

6 pin type gold contacts for mA-1003 car clock module price **.75 ea.**

Leds - your choice, please specify
Mini Red, Jumbo Red, High Intensity Red, Illuminator Red **8/$1**
Mini Yellow, Jumbo Yellow, Jumbo Green **6/$1**

Varactors

Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range - **.50 each or 3/$1.00**

Audio Prescaler

Make high resolution audio measurments, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit **$29.95**
PS-2 wired **$39.95**

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. specify -10 or -100

Wired, tested, PS-1B **$59.95**
Kit, PS-1B **$44.95**

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit **$22.95**
TR-1, RF sensed T-R relay kit **6.95**

MRF-238 transistor as used in PA-1 8-10db gain 150 mhz **$11.95**

RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay TR-1 Kit **$6.95**

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V @ 1 A and 24 VCT.

Complete kit, PS-3LT **$6.95**

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 compatible, but 500,000 MEG input z, super low 50 pa input current, low power drain.

50 for only $9.00 **10 for $2.00**

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size: 1" x ¼" shrink to ⅛" Great for splices. **50/$1.00**

Mini TO-92 Heat Sinks

Thermalloy Brand **5 for $1.00**
To-220 Heat Sinks **3 for $1.00**

Opto Isolators - 4N28 type **$.50 ea.**
Opto Reflectors - Photo diode + LED **$1.00 ea.**

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets. **20 strips for $1.00**

CDS Photocells

Resistance varies with light, 250 ohms to over 3 meg **3 for $1.00**

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P.O. BOX 401244 E
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Microprocessor Station Clock

✓12

New

I D
ACTIVATES, RESETS, and turns off ID circuit

SET SWICHES
Short-throw POSITIVE CLICK Keyboard switches allow quick and accurate TIMESETTING

SECONDS
RESET/HOLD provides easy SYNCRONIZATION with WWV

TEMP
Addition of optional TEMPERATURE components (available seperately) will allow remote temperature display

ZONE CHANGE
Selects one of THREE WORLD TIMEZONES Local time (12hr format) and TWO 24hr zones of your choice

I D INDICATOR
Comes on when ID,er is activated. FLASHES at 10 minutes. Different AUDIO TONES are pro duced Momentarily at 8 and 9 minutes with continuous TUNE at 10 minutes

YOUR CALL HERE

HIGH IMPACT MOLDED CASE

RFI PROTECTED

ZONE INDICATORS
3 COLORS of LEDs show which timezone is being displayed

AUXILLARY TIMER OUTPUT
Provides one ON and one OFF setpoint per 24 hour period on LOCAL ZONE. Will drive relay or triac to control external appliances.
Backpanel Switch included

.6 INCH HIGH INTENSITY ORANGE LEDs
Readable at 20 FEET or MORE!

12 VOLTS AC OR DC

ADJUSTABLE BRIGHTNESS

FILTERED REGULATED
ON BOARD POWER SUPPLY

QUARTZ CRYSTAL
TIMEBASE and BATTERY BACKUP Makes unit immune to power fades, line noise or AC failure!

QUALITY PC BOARDS
SOLDER MASKED Parts locations printed on top

READOUT BOARD mates directly with clock board
Only FOUR WIRES required

ZULU 3TZ™

is a full blown MICROPROCESSOR and ROM that unlike other standard Clock IC's it allows exceptional flexibility. Almost a year in development, it makes obsolete other clock designs. Own the most advanced Station Clock on the market at our amazing low price! DEVELOPED AND SOLD ONLY BY BULLET ELECTRONICS AND OUR AUTHORIZED DEALERS.

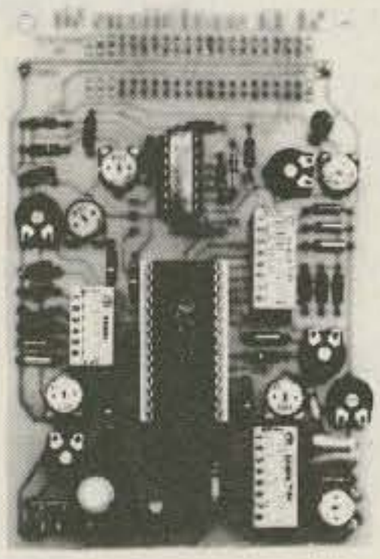
49.95
COMPLETE KIT INCLUDING CASE & WALLPLUG XFMR FOR 117VAC OPERATION.

79.95
WIRED AND TESTED

92.50
WITH REMOTE TEMP. OPTION ON WIRED UNIT. (INCLUDES CALIBRATION).

Remote Temperature Option $9.95
Consists of: V to F IC, Ultra stable Voltage Reference, Multiturn calibration pots precision resistors and misc. components -20F to -120F RANGE Coax cable (RG174) required for runs over 10 feet (not included)

Sound Effects Kit $18.50



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). **76477 is included.** Available separately for **$3.15** each

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.

$12.95 W/Basic Spec Sheet (4 pages)
60 page manual with S-100 interface instructions and several programming examples, **$3.00 extra**

MANY OTHER COMPONENTS AND KITS AVAILABLE IN OUR COMPLETE CATALOG. CALL OR WRITE FOR FREE CATALOG.

New! Doomsday Alarm

If you have trouble sleeping and you would like the rest of the neighborhood to share your misery then this little kit will be for you! There is no way to accurately describe the unearthly howls, screams and tones that come out of this kit. Four separate tone oscillators are mixed, cancelled and stepped at a varying rate. 10 Watts of crazy sounds. A great fun kit or a practical burglar alarm. Complete with PC board and all necessary components less speaker. For 6–12 VDC.

9.95 KIT ORDER DA–01

7 Watt Audio Amp Kit $5.95

SMALL, SINGLE HYBRID IC AND COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP. LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT.

Overvoltage Protection Kit $6.95

Protect your expensive equipment from overvoltage conditions. Every computer should have one! **Works with any fused DC power source** from 10 to 20 volts up to 25 amps.

Super Value Power Transformer

Well made, open frame transformer with mounting ears. Build a +5 and ±12 supply with inexpensive parts. **Free schematics of several designs. Primary 117VAC. SEC #1** 15VAC @ 5A **SEC #2** 15 VAC @ .5A **SEC #3** 8VAC @ 2.5A.

ORDER:
BET-0005
$2.95 Each

SPECIAL BONUS: *Order 2 Get free 723 voltage regulator IC!*

- NO C.O.D.'s
- SEND CHECK M.O. OR CHARGE CARD NO.
- PHONE ORDERS ACCEPTED ON VISA AND MASTERCHARGE ONLY
- ADD 5% FOR SHIPPING
- TX. RES. ADD 5% STATE SALES TAX
- ALL FOREIGN ORDERS ADD 30% FOR SHIPPING CHARGES. U. S. FUNDS ONLY.

(214) 278-3553

The Greatest Breakthrough In Electronic Music Ever!

The Super Music Maker
REVISION 2
$24.95
(Basic Kit)
Does not include speaker switches or 2708 ROM.

Now you can play hundreds of songs using the Bullet **Super Music Maker.** The unit **features a single factory programmed microprocessor IC** that comes with 20 pre-programmed short tunes. By adding the additional PROMS (2708's) the system can be expanded to play up to **1000 notes per PROM.** Just think . . . a compact electronic instrument that will play dozens, hundreds or even thousands of selections of music. The kit comes with **all electronic components (less the PROM),** and a drilled, plated and screened PC Board which measures 4" x 4¾". The **7 watt amplifier** section is on the same PC board and drives an 8 ohm speaker (not included), from a whisper to ear splitting volume. Since the unit works on **12 VDC** or **12 VAC*,** vehicle or portable operation is possible. **What do you get for $24.95? Everything but a speaker, transformer, case, switches,** and **PROM.** Additional 2708 albums containing popular tunes are available for **$15.00** each or you can program your own PROMS using information provided with the kit instructions. Lists of available PROM albums are available on request. *(Note: Unit plays electronic music one note at a time, it is not possible to play chords or a melody with harmony simultaneously.)*

★ Envelope control gives decay to notes.
★ "Next tune" feature allows sequential playing of all songs.
★ On board inverter allows single voltage (+12) operation.

OPTIONAL ACCESSORIES

DIP Switches One 8 pos., One 5 pos. **2.00/Set**
(Can be **directly soldered** to PC Bd. to access tunes)

Rotary Switches Two 5 position ***2.50*/Set**
(For **remote wiring** to PC Bd. to access tunes)

Attractive Plastic Case **6.50**

Wallplug Transformer **3.00**
(For operation on 117VAC house voltage)

✓ Reader Service—see page 130

DEALER DIRECTORY

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Bay area's newest Amateur Radio store. New & used Amateur Radio sales & service. We feature Kenwood, ICOM, Azden, Yaesu, Ten-Tec, Santec & many more. **Shaver Radio, Inc., 1378 So. Bascom Ave., San Jose CA 95128, 998-1103.**

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Preston ID

Ross WB7BYZ, has the Largest Stock of Amateur Gear in the Intermountain West and the Best Prices. Call me for all your ham needs. **Ross Distributing, 78 So. State, Preston ID 83263, 852-0830.**

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The ham store of N.E. you can rely on. Kenwood, ICOM, Wilson, Yaesu, DenTron, KLM amps, B&W switches & wattmeters, Whistler radar detectors, Bearcat, Regency, antennas by Larsen, Wilson, Hustler, GAM. **TEL-COM Inc. Communications & Electronics, 675 Great Rd., Rt. 119, Littleton MA 01460, 486-3040.**

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Experimenter's paradise! Electronic and mechanical components for computer people, audio people, hams, robot builders, experimenters. Open six days a week. **Gateway Electronics Corp., 8123-25 Page Blvd., St. Louis MO 63130, 427-6116.**

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Waveguide & coaxial microwave components & equipment. Laboratory grade test instruments, power supplies. Buy, sell & trade all popular makes, HP, GR, FXR, ESI, Sorensen, Singer, etc. **Lectronic Research Labs., 1423 Ferry Ave., Camden NJ 08104, 541-4200.**

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Featuring: Kenwood, Yaesu, ICOM, Drake, Ten-Tec, Swan, DenTron, Alpha, Robot, MFJ, Tempo, Astron, KLM, Hy Gain, Mosley, Larsen, Cushcraft, Hustler, Mini Products. You won't be disappointed with equipment/service. **Radio World, Oneida County Airport-Terminal Building, Oriskany NY 13424, 337-0203.**

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AMATEUR RADIO REPAIR

Professional service, reasonable rates, all brands, USA KDK repair center. **Amateur Radio Repair Center, 1020 Brookstown Ave., Winston-Salem, NC 27101, 725-7500.**

Columbus OH

All major brands featured in the biggest and best ham store for miles around. Come in and twist the knobs before you buy. **Universal Amateur Radio, Inc., 1280 Aida Dr., Reynoldsburg (Columbus) OH 43068, 866-4267.**

Scranton PA

ICOM, Bird, CushCraft, Beckman, Fluke, Larsen, Hustler, Antenna Specialists, Astron, Avanti, Belden, W2AU/W2VS, CDE, AEA, Vibroplex, Ham-Key, CES, Amphenol, Sony, Fanon/Courier, B&W, Ameco, Shure. LaRue Electronics, 1112 Grandview St., Scranton PA 18509, 343-2124.

Houston TX

Experimenter's paradise! Electronic and mechanical components for computer people, audio people, hams, robot builders, experimenters. Open six days a week. **Gateway Electronics Inc., 8932 Clarkcrest, Houston TX 77063, 978-6575.**

San Antonio TX

Complete 2 way service shop. Call Dee, W5FSP. Selling Antenna Specialists, Avanti, Azden, Bird, Hy-gain, Standard, Vibroplex, Midland, Henry, CushCraft, Dielectric, Hustler, ICOM, MFJ, Nye, Shure, Cubic, Tempo, Ten-Tec and others. **Appliance & Equipment Co., Inc., 2317 Vance Jackson Road, San Antonio TX 78213, 734-7793.**

DEALERS

Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the July issue must be in our hands by May 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Nancy Ciampa.

PROPAGATION

J. H. Nelson
4 Plymouth Dr.
Whiting NJ 08759

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14A	14	14	7	7	14	21	21A	21A	21A	21
AUSTRALIA	21	14	14	7B	7B	7B	7	14	14B	14	14	21A
CANAL ZONE	21	14	14	7	7	7	14	21	21	21A	21A	21
ENGLAND	14	7A	7	7	7	7A	14	14A	21	21	14	14
HAWAII	21	14	7A	7	7	7	7	14	14	14	14A	21
INDIA	14	7A	7B	7B	7B	7B	14	14	14	14	14	14
JAPAN	14	14	7B	7B	7B	7B	7	7	14	14	14	14
MEXICO	14A	14	14	7	7	7	7	14	14	14	21A	21
PHILIPPINES	14	14	7B	7B	7B	7B	7B	14	14	14	14	14
PUERTO RICO	14	14	7	7	7	7	7A	14	14	21A	21	21
SOUTH AFRICA	14	7	7B	14	14	14	14A	21	21A	21A	21	14A
U. S. S. R.	7	7	7	7	7	14	14	14	21	21	14	14
WEST COAST	21	14	14	7	7	7	7A	14	14	21	21	21

CENTRAL UNITED STATES TO:

ALASKA	14	14	7A	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14A	14	14	7	7	14	14A	21A	21A	21A	21
AUSTRALIA	21	14	14	14	7B	7B	7	14	14B	14	14	21A
CANAL ZONE	21	14	14	7	7	7	14	14	21	21	21A	21A
ENGLAND	14	7	7	7	7	7	14	14	14	21	21	14
HAWAII	21	14	14	7A	7	7	7	14	14	14	21	21A
INDIA	14	14	7B	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	7	7B	7B	7	7	14	14	14	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14A	14A
PHILIPPINES	14	14	14	7B	7B	7B	7B	7A	14	14	14	14
PUERTO RICO	21	14	14	7	7	7	7A	14	21	21A	21A	21
SOUTH AFRICA	14	7	7B	7B	7B	7B	14	14	14	21	21	14
U. S. S. R.	7	7	7	7	7	7	7	14	14	14A	14A	14

WESTERN UNITED STATES TO:

ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21A	21	14	14	7	7	14	14	21A	21A	21A	21A
AUSTRALIA	21A	21	14A	14	14	14	7	14	14B	14	14	21A
CANAL ZONE	21A	14	14	7	7	7	14	14	21	21	21A	21A
ENGLAND	14	7B	7	7	7	7	7	14	14	14	14A	14A
HAWAII	21A	21A	21	14	14	14	7	14	14	14	21	21A
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	14A	14	14	14	7	7	7	7	14	14	14	14A
MEXICO	21	14	14	7	7	7	7	14	14	14	21	21
PHILIPPINES	14A	14	14	14	14	7B	7B	14	14	14	14	14A
PUERTO RICO	21	14A	14	7	7	7	7	7A	21	21	21A	21A
SOUTH AFRICA	14	7	7B	7B	7B	7B	7B	14	14	14A	21	14
U. S. S. R.	7	7B	7	7	7	7	7B	14B	14	14	14	14
EAST COAST	21	14	14	7	7	7	7A	14	14	21	21	21

First letter = day waves Second = night waves
A = Next higher frequency may also be useful
B = Difficult circuit this period F = Fair
G = Good P = Poor * = Chance of solar flares

may

sun	mon	tue	wed	thu	fri	sat
					1 G/G	2 G/G
3 G/G	4 G/G	5 G/F	6 G/F	7 F/F	8 G/F	9 G/G
10 G/G	11 G/G	12 G/F	13 G/G	14 G/G	15 G/F	16 G/F
17 G/G	18 G/G	19 G/G	20 G/G	21 G/G	22 G/G	23 G/G
24 G/F 31 G/G	25 G/F	26 G/F	27 F/F*	28 F/P*	29 F/P*	30 G/F

The New Yaesu FT-902DM

What's so new about the 902?

- **WARC Bands Factory Installed!**
  Your FT-902DM won't be "obsoleted" when the new bands become available.
- **True Reading Frequency Counter!**
  No need to recalibrate when changing bands or modes.
- **Diode Ring Receiver Front End!**
  The industry-standard dynamic range of the FT-901DM is now better than ever.
- **Curtis 8044 IC Keyer!**
  Full dot and dash memory are now provided on the built-in keyer.

What's more, the FT-902DM retains these great features of the '901:

* Variable IF Bandwidth
* Built-in memory system
* Audio peak CW filter
* IF rejection tuning
* SSB, CW, AM, FM and FSK
* Digital plus analog readout
* RF speech processor
* Highly stable PLL local oscillator
* Plug-in modular construction
* AC and DC operation built in

The FT-902DM . . . designed to give you the competitive edge!

Price And Specifications Subject To
Change Without Notice Or Obligation

YAESU
The radio.

83 181

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Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 • (513) 874-3100

"Cents-ational."

IF shift, digital display, narrow-wide filter switch

TS-530S

The TS-530S SSB/CW transceiver is designed with Kenwood's latest, most advanced circuit technology, providing wide dynamic range, high sensitivity, very sharp selectivity with selectable filters and IF shift, built-in digital display, speech processor, and other features for optimum, yet economical, operation on 160 through 10 meters.

TS-530S FEATURES:

- **160-10 meter coverage, including three new bands**
  Transmits and receives (LSB, USB, and CW) on all Amateur frequencies between 1.8 and 29.7 MHz, including the new 10, 18, and 24 MHz bands. Receives WWV on 10 MHz.
- **Built-in digital display**
  Large, six-digit, fluorescent-tube display shows actual receive and transmit frequencies on all modes. Backed up by analog subdial.
- **IF shift**
  Moves IF passband around received signal and away from interfering signals and sideband splatter.
- **Narrow/wide filter combinations**
  Any one or two of three optional filters . . . YK-88SN (1.8 kHz) SSB, YK-88C (500 Hz) CW, YK-88CN (270 Hz) CW . . . may be installed for selecting (with "N-W" switch) wide and narrow bandwidths on CW and/or SSB.
- **Wide receiver dynamic range**
  Greater immunity to strong-signal overload, with MOSFET RF amplifier operating at low level for improved IMD characteristics, junction FETs in balanced mixer with low noise figure, and dual resonator for each band.
- **Built-in speech processor**
  Combines an audio compression amplifier with change of ALC time constant for extra audio punch and increased average SSB output power, with suppressed sideband splatter.
- **Two 6146B's in final**
  Runs 220 W PEP/180 W DC input on all bands.
- **Advanced single-conversion PLL system**
  Improved overall stability and improved transmit and receive spurious characteristics.
- **Adjustable noise-blanker level**
  Pulse-type (such as ignition) noise is eliminated by built-in noise blanker, with front-panel threshold level control.
- **RF attenuator**
  The 20-dB RF attenuator may be switched in for rejecting IMD from extremely strong signals.
- **Optional VFOs for flexibility**
  VFO-240 allows split-frequency operation and other applications. VFO-230 digital VFO operates in 20-Hz steps and includes five memories and a digital display.
- **RIT/XIT**
  Front-panel RIT (receiver incremental tuning) shifts only the receiver frequency, for tuning in stations slightly off frequency. XIT (transmitter incremental tuning) shifts only the transmitter frequency, for calling a DX station listening off frequency.

More information on the TS-530S is available from all authorized dealers of Trio-Kenwood Communications, Inc., 1111 West Walnut Street, Compton, California 90220.

KENWOOD
. . . pacesetter in amateur radio

Matching accessories for fixed-station operation:

- SP-230 external speaker with selectable audio filters
- VFO-240 remote VFO
- AT-230 antenna tuner/ SWR and power meter
- MC-50 desk microphone

Other accessories not shown:

- VFO-230 remote digital VFO with 20-Hz steps, five memories, digital display
- TL-922A linear amplifier
- SM-220 Station Monitor
- KB-1 deluxe VFO knob
- PC-1 phone patch
- HS-5 and HS-4 headphones
- HC-10 digital world clock
- YK-88C (500 Hz) and YK-88CN (270 Hz) CW filters and YK-88SN (1.8 kHz) SSB narrow filter
- MC-30S and MC-35S noise-canceling hand microphones

Specifications and prices are subject to change without notice or obligation.