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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

NAIVE IDEAS

It's been a long time since I've editorialized about my naive and idealistic ideas of what amateur radio should be like. Come with me to dream world.

We have several difficulties with amateur radio, and most of them stem from lousy rules and a lack of enforcement by the FCC. I get a bit frustrated when I see petitions being fed into the FCC hopper every time some amateur or club gets provoked by something that has happened. The first knee-jerk reaction is to demand a law against the bad thing.

We have TVI? Pass a law against it. We have jamming of nets? Pass a law. We have crowded bands? Pass a law. Fiddlesticks and bah humbug.

Any person who takes any kind of objective look at the use of laws to solve problems has to come to the conclusion that this is one of the worst ways to try and make things better. And this holds true in spades when it comes to the FCC. It takes them years to act on a proposal. In ten times out of nine, the problem is long gone by the time the rule comes out, and when it does emerge, it creates a whole new bunch of problems never envisioned by the idiots who demanded the law in the first place.

Since the bulk of our rule changes have been the result of the ARRL demanding them, I point my finger toward Newington as the source of much of our miseries. Yes, I know, there goes Wayne, trying to get more circulation by heaping abuse on the poor underpaid headquarters gang . . . all beloved by hundreds of thousands of loyal members.

Let's not rake over old coals the incredibly stupid rules we have had to endure at various times. One of these days I'll write at length for newcomers to acquaint them with some of the blundering history of amateur radio legislation. They won't believe it.

The entry into amateur radio has been made painful by three things—the code exam, the theory exam, and the FCC administration of these exams. Few amateurs have been through a painless FCC exam . . . it is a trauma for almost everyone. I don't think this is necessary. I would prefer to set up a whole new system, one which is not all that far from where we are right now.

A few years ago, I made a survey of the ham clubs to find out which were running training classes for newcomers. At that time, there were a maximum of 50 clubs with such classes in the country. I set about getting clubs to run classes by writing editorials and providing the best training aids which had ever been developed for making it easy for beginners—the *73* study guides and tapes. Today there are over 2000 ham clubs giving classes, and amateur radio is growing as never before.

The next step I'd like to see is the turning over of the licensing exams to clubs. We had problems with our Conditional class of ham license because it was set up with only one examiner. I'd like to see the clubs administer the license exams with a minimum of three licensed ham proctors present. You can have funny business with one chap, perhaps even with two, but with three in on it, there is too much likelihood for someone to spill the beans. I suggest that where someone blows the whistle and there is a good likelihood of mischief, the club should lose its licensing authority.

The club handling of license exams would not only take a lot of the pressure off those taking the tests, but it would also make it far less expensive for newcomers since they would not have to miss a day's work and drive to a city to take the exams. And think of what this would save the FCC in administration costs!

Okay for step one. Now, about our subbands. In this case, I'd like to see the FCC open all ham bands for any emission and let us draw up our own uses for the bands. It would be chaos, right?

I doubt it. We have gone through just such situations in the past, all without FCC rules, and we have come through every time with honor. One of the more recent major changes was from AM to SSB on the low bands. The two modes were not compatible, so there were often skirmishes between them. But, early in the game, a detente was achieved where the SSB gang started from the top of the 20m phone band and the AM from the bottom, thus keeping relatively out of each other's hair. It worked.

We called it a gentlemen's agreement. Sure, we had some hams who most definitely were not gentlemen. None of us who heard W2OY were inclined to think of him as a gentleman. But the good guys won out over the bad guys and eventually SSB took over because it was better.

We had a similar problem when repeaters started up. There were repeater wars at first and screams for the FCC to do something. By the time the FCC got something done, the repeater groups had organized into repeater councils, set up frequency coordinating committees, and had everything well in hand. Then the FCC used a sledgehammer to kill the fly. We are still getting out from under the mess the FCC made of that one . . . with the great help of the ARRL.

To facilitate the setting up of gentlemen's agreements, I suggest we have the interested ham clubs send representatives—two each—to a national ham conference, probably every two years. Funding this pilgrimage and the running of ham classes would be major functions of clubs.

The conference would break up into working groups to study proposed changes in band usage, bringing their committee reports to the whole body for a vote. The clubs would then see that these new agreements were observed by hams in their area, club members or not, using peer pressure to get compliance.

Would this mean that small groups interested in specialized modes would get the shaft? Not likely, for we have seen in every case that the repeater councils have really over-protected special interests. When setting up repeater channels, they leave more frequency space for CW, SSB, RTTY, and other groups than is really needed. Hams are

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R-820

A **S-METER** Easy-to-read, calibrated to S9 + 40 dB full scale and dB/µV

B **STANDBY/RECEIVE SWITCH** Disables audio circuits during transmit mode with associated transmitter

C **CALIBRATOR SWITCH** Built-in crystal calibrator, settable to WWV, provides signal every 25 kHz

D **NOISE-BLANKER SWITCH** A specially designed crystal filter eliminates noise pulses such as ignition-noise interference

E **MONITOR SWITCH** RF sampling allows user to hear his own voice when using associated transmitter

F **AGC SWITCH** Automatic-gain-control circuit switchable to slow or fast response, or completely off

G **RECORD JACK** Makes recording off the air simple.

H **HEADPHONE JACK** Provision for plugging in headphones

I **MODE SWITCH** Selection of AM, CW, upper or lower sideband, or RTTY

J **RF-ATTENUATOR SWITCH** 10 dB steps of attenuation from 0 to 40 dB, to prevent overloading from nearby stations, and for precise signal comparison

K **DIGITAL HOLD** Locks counter and display while VFO is tuned to another frequency. Helps return to "hold" frequency

L **VFO/CRYSTAL SWITCH** Permits VFO control or crystal control on four selectable frequencies

M **LED INDICATORS** Light-emitting diodes indicate activation of notch filter, crystal-controlled reception, VFO control, and RIT

N **DRS DIAL** Satin-smooth VFO tuning dial system provides easy analog frequency readout (useful when digital hold is activated). LSB, USB, and CW frequencies are accurately read from the same pointer

O **NOISE-BLANKER LEVEL CONTROL** Controls level of blanking, for maximum effect in eliminating noise interference

P **MONITOR CONTROL** Adjusts level of RF sampling

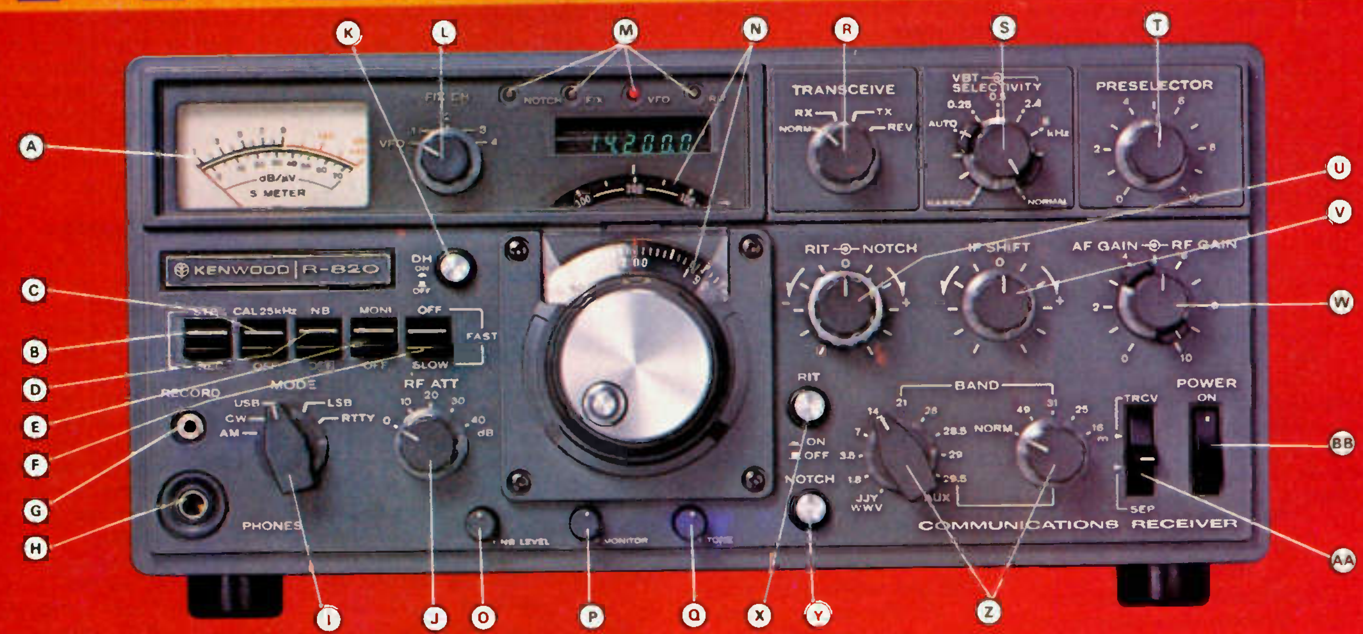
Q **TONE CONTROL** Varies audio-output frequency response

R **TRANSCEIVE SWITCH** Selects frequency tuning from either the receiver or TS-820 series transceiver

S **VBT/SELECTIVITY CONTROLS** Separate controls on the same shaft provide variable bandwidth tuning as well as selection of four IF filters: 250 Hz*, 500 Hz*, 2.4 kHz, and 6 kHz* (*optional). CW filters function in 455-kHz IF for superior shape factor.

T **PRESELECTOR** Peaks tuned circuits in RF amplifier stage for increased selectivity and sensitivity. RF amplifier coil is dual-tuned

U **RIT/NOTCH CONTROLS** RIT allows receiver to be tuned off frequency, while not affecting transmit frequency, when in transceive mode with TS-820. Notch control tunes notch within IF passband for eliminating interference. Notch frequency remains the same even when IF shift is utilized.



V **IF SHIFT** Varies (shifts) IF passband away from interfering signal.

W **AF GAIN/RF GAIN** Separate controls adjust volume and RF gain.

X **RIT SWITCH** Allows tuning off frequency with RIT control, and return immediately to VFO frequency by pushing switch.

Y **NOTCH SWITCH** Takes variable notch filter in and out of circuit.

Z **BAND SWITCHES** Selects frequency bands from 15 MHz (WWV), 160 through 10 meters, the 49, 31, 25, and 16-meter shortwave broadcast bands, and an auxiliary band.

AA **TRANSCEIVE/SEPARATE SWITCH** Enables receiver VFO to control the receiver and TS-820 (or TS-820S) frequency (or the TS-820 VFO to control both), or both can function independently.

BB **POWER SWITCH** Turns receiver on and off.

R-820 PERFORMANCE SPECIFICATIONS

Frequency Range:

160 meters (1.8-2.0 MHz)
80 meters (3.5-4.0 MHz)
40 meters (7.0-7.5 MHz)
20 meters (14.0-14.5 MHz)
15 meters (21.0-21.5 MHz)
15 meters (21.0-21.5 MHz)
10 meters (28.0-28.5 MHz)
10 meters (28.5-29.0 MHz)
10 meters (29.0-29.5 MHz)
10 meters (29.5-30.0 MHz)
19 meters (15.0 (WWV)-15.5 MHz)
49 meters (5.9-6.4 MHz)
31 meters (9.4-9.9 MHz)
25 meters (11.5-12.0 MHz)
16 meters (17.7-18.2 MHz)
Auxiliary band

Modes: AM, CW, USB, LSB, RTTY

Sensitivity: 160-10 m, 19 m, SSB, 0.25 µV at 10 dB S+N/N
AM, 1.5 µV at 10 dB S+N/N
49, 31, 25, 16 m, SSB, 0.5 µV at 10 dB S+N/N
AM, 3.0 µV at 10 dB S+N/N

Selectivity: CW (with optional 250-Hz filter), 250 Hz (—6 dB), 500 Hz (—60 db)
CW (with optional 500-Hz filter), 500 Hz (—6 dB), 850 Hz (—60 dB)
SSB (2.4-kHz filter), 2.4kHz (—6 dB), 4.4 kHz (—60 dB)
AM (6-kHz filter), 6 kHz (—6 dB), 12 kHz (—60 dB)

Image Ratio: 160-10 m, 19 m, 80 dB
49, 31, 25, 16 m, 60 dB

IF Rejection: 160-10 m, 19 m, 90 dB
49, 31, 25, 16 m, 50 dB

Power Requirements: 100/120/220/240 VAC, 50/60 Hz, or 12-15 VDC

Dimensions: 13-1/8" (333 mm)W x 6" (153 mm)H x 13-3/16" (335 mm)D

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fair people and in groups they are usually able to overcome self-interest and be helpful and considerate of others. I think that we might see a generation of experimentation and pioneering far beyond anything we have ever seen before if such a scheme could be implemented.

The number of anarchists in our midst is small and I think we can handle them. I think we can do it much better than we have so far because the normal response to a problem at present is to call the FCC for help instead of doing it ourselves. Was it really necessary to arrest and imprison the two hams in New Orleans who, for a lark, spent almost a year driving the repeater users bananas with foul language and interference? Wouldn't the shame of exposure to the club members and other local hams have been enough to solve the problem?

The FCC says it doesn't have enough money to do this, to do that, and I say we can do everything they are doing for us and a lot more, all at no expense to them whatever. For a couple of bucks a license, we could hire a commercial firm to set up a computer and issue ham tickets, with a copy to the FCC for their files. That way we could have special station calls, repeater calls, and anything else we felt like having and agreed among ourselves we needed. Special licenses cost more to process, so we charge more. Big deal. A $100 repeater license would be well worth the cost to most clubs . . . it would be a badge of pride. And $100 for a special call for a fair or big event would be peanuts.

Convinced?

Then start petitioning the FCC for the changes, and who knows, by the time our children are asking us to come babysit their kids, we might have some better rules. That is, providing there is any ham radio by then.

A NEW PROSPECT FOR SURVIVAL

Could the United States continue telecommunications on an international basis if it withdrew from the International Telecommunications Union? There would be massive problems, but it is possible that the U.S. could go its own way. This could destroy the ITU, so the prospect is not a happy one.

Yet that is what seems to be seriously under consideration as the U.S. heads into the WARC conferences at the ITU in 1979. Many of the other services are as concerned as amateurs over the possible losses of frequencies, and rightly so.

The present shortwave allocations were set up primarily at an ITU conference in Atlantic City in 1947. At that time, few countries had any extensive use for the shortwaves, so the major European countries and the U.S. grabbed the lion's share of them. This was okay for a while, but then the emerging nations found that they, too, had desperate needs for radio frequencies, few of which were available. By 1959, the major powers sensed that they had a losing battle on their hands, so, by the skin of their teeth, they voted to put off shortwave reallocations until the next conference. This was supposed to come in 1969.

When the African and Asian emerging nations took over control of the ITU in the early 60s, the major powers still had enough clout to prevent the 1969 conference. Small conferences in 1971 and 1973 on satellite frequency allocations and marine radio allocations made it clear that the new African countries had the ball, and these conferences were unmitigated disasters for the big countries. The small countries were now powerful enough to force the shortwave conference for 1979 and the big powers had no further way to stop them.

More and more I hear people whom I respect saying the unsayable—that the U.S. may well pull out of the ITU, that the one nation, one vote concept is no longer possible to accept. We've proven pretty well that this concept doesn't work with the UN. Why should a small African country with one ham (a white European visitor) and a need for maybe three broadcast radio channels have an equal vote with the U.S.? One reason is that no one has been able to come up with a better solution to the need for international agreements. If the U.S. had 10,000 votes and the African country one, why should the African country bother to come?

The U.S. worked out a solution to this same situation when it was formed. They set up *two* groups of representatives, one representing the political areas (the Senate) and one representing the proportions of the population (the House). Perhaps if the UN and its subbranch, the ITU, were rebuilt as a world democracy, the system could be made to work.

If the U.S. and several other major powers pull out of the ITU (say, does that mean we would have to pull out of the UN also?), it could bring this to a head.

WARC AND CB

One of the information bulletins being circulated to those participating in WARC discusses the hate between CB and amateur radio in Great Britain and cites as one of the primary causes several articles in *QST*. "Matters were not helped by the American amateur magazine '*QST*,' which is read by many English amateurs, printing several of the most anti-CB news stories that it could find each month."

SWISS WARC RECOMMENDATIONS

The Swiss group has recommended that the amateur 430-432 and 438-440 MHz bands be replaced with a mobile service. They also want to make 41-68 MHz into a mobile band (not amateur), as they do 174-235 MHz (whoops, there goes 220!).

BRITISH WARC PROPOSALS

Britain wants to double all shortwave broadcasting bands below 20 MHz; they also want an additional broadcasting band between 12-15 MHz (how about 14 MHz, fellas?). Amateurs should, they feel, be "relocated" from the 7.1-7.3 MHz band, but no suggestions are made for another home. They also propose a cut in the 220 MHz band, removing 220-223 MHz from amateur service.

THANKS TO MICHIGAN

The idea for the petition which ran in the February issue of *73* came from a group in Michigan who sent in such a petition to me. I dropped them a line thanking them for the idea and put it quickly into motion. The response to the petition has been gratifying, as I've mentioned. The stack of petitions is now almost a foot high, perhaps well over a thousand of them, most with five to fifty names.

Solidarity like this impresses even the obviously biased FCC Commissioners. I sure wish that I had had this pile of petitions when the oral hearing on amplifiers was held last November . . . the Commissioners might have listened to the amateur arguments a little more closely.

Cooper is still hard at work, though his life is complicated by the need to dodge a California court which charges fraud. Cooper is a wily chap and so far has been one step ahead of the pack at every turn.

WHY PETITIONS WORK

A letter from WA2RNG groused about my wasting space in *73* for a petition—after all, they don't work . . . everyone knows that.

Oh yeah?

I'm not putting RNG down, for I used to think that petitions were a waste of time and effort. That was before I did any groundwork in Washington, the place where politics is king. It didn't take long nosing around Washington, seeing how our government works, to discover that there is magic in a pile of petitions. Those names mean people and people mean votes, and votes mean congressional interest and enthusiasm, and that means action . . . and that's a fact.

The FCC, like any other arm of our government, is sensitive and responsive to political pressures, so they do perk up when someone comes in and lays a pile of petitions in front of them. They start hearing more clearly. If ARRL counsel Booth had laid a pile of petitions on the desks of the Commissioners instead of an endless monologue, we might still be able to buy ham amplifiers with a 10m band on them.

When we testified on the need for repeater rule changes in 1974, we laid a big pile of petitions on the Commissioners' desks and we got just about every rule change we asked for. Sure, it took months to get those petitions signed. We spent a large part of the *73* booth space and personnel at hamfests and conventions on getting petitions signed during 1973, and we put on an excellent presentation. The package did the job.

STOP COOPER

In addition to several thousand signatures on our petitions from hams and their friends, quite a bunch have been coming in from CBers. Surprised? Typical is a letter from Don Sweat of Crystal Springs REACT in San Mateo, California. He says that he and the 30 members of the REACT team are studying for their ham tickets and they are going all out to stop Cooper.

The biggest bunch of signatures received so far was sent in by Harold Wallich WØNAZ of Missouri—330 signatures! Congratulations for the hard work, Harold . . . those petitions are an impressive sight.

LEAGUE BLACKMAILS BEGINNERS

When I say the League, I am referring only to HQ in Newington, not the thousands of members, and there is a very distinct difference. The members are not consulted by HQ on anything (when was the last poll you've seen in *QST* asking your opinion?), so members should not feel defensive about things over which

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Specifications: ☐ Frequency Coverage: 1.8 MHz — 2.0 MHz; 3.5 MHz — 4.0 MHz; 7.0 MHz — 7.5 MHz; 14.0 MHz — 15.2 MHz; 21.0 MHz — 21.5 MHz; 28.0 MHz — 30.0 MHz ☐ Frequency Control: LSI based 100 Hz step Digital PLL synthesizer. Independent Transmit-Receive duplex on same band, standard with every radio. ☐ Frequency Readout: 6 digit LED 100 Hz readout ☐ Power Supply Requirements: DC 13.6 V ± 15% Negative ground current drain, 18 A max at 100 W output; AC power supply, speaker console for AC operation ☐ Antenna Impedance: 50 ohms unbalanced, VSWR 2.0:1 ☐ Weight: 7.3 Kg ☐ Size: (transceiver unit only) 111mm (h) × 241mm (w) × 311mm (d) ☐ RF Power Output: CW (A1), RTTY (F1), 100 W; SSB (A3J), 100 W PEP; Continuously adjustable 0-100W ☐ Emission Modes: A1, CW; A3J, SSB; F1, RTTY ☐ Harmonic and Spurious Output: more than 60 dB below peak power (meets FCC 97.73) ☐ Carrier Suppression: more than 40 dB down ☐ Unwanted Sideband: more than 40 dB down at 1000 Hz AF input ☐ Microphone Impedance: 600 ohms ☐ Receiving System: triple conversion, super heterdyne, with continuous bandwidth control (100 Hz — 2.4 KHz) ☐ Receiving Modes: A1, A3J (USB/LSB), F1 ☐ IF Frequencies: 1st & 3rd, 9.0115 MHz; 2nd, 10.7015 MHz; with continuous bandwidth control ☐ Sensitivity: better than 0.25 microvolts for 10 dB S+N/N ☐ Selectivity: SSB, RTTY, ± 1.1 KHz at −6 dB (adjustable to ± 0.5 KHz min), ± 2.0 KHz at −60 dB; CW, ± 250 Hz at −6 dB ± 700 Hz at −60 dB; CN-N, ± 100 Hz at −6 dB, ± 500 Hz at −60 dB (with Audio Filter) ☐ Spurious Response Rejection Ratio: better than 60 dB

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they have absolutely no control.

So what about all this blackmail business? I am in possession of a letter from C.J. Harris WB2CHO, the Clubs and Training Manager of ARRL, addressed to club instructors. In this letter C.J. says, "We are changing our former procedure of sending out large quantities of Operating Aids with this package (FCC 610 forms). Instead, your students will receive these operating aids when they sign and return the enclosed petition in support of the effort to expand the Novice 80 meter band."

Now, fellow ARRL member, and I've been a member of the League for 40 years now, have I exaggerated in any way when I call that blackmail? When the FCC people find that the League is forcing hams to sign a petition in exchange for goodies, what possible value do you think they will put on names gotten through such bribery and coercion? I wonder if anyone at the League thought this through and realized that by forcing people to sign a petition, they will effectively shoot down their Novice band expansion scheme. Or did they do this on purpose so it would merely look as if they were behind the band changes?

If you consider the above as anti-ARRL, what would you suggest as my response to the League letter to clubs? Would you, if you were editing *73*, just keep quiet about it? Do you feel that amateurs do not have a right to know what the League is doing?

Yes, I know that there are a few amateurs who are so pro-ARRL that they want every bad thing that goes on at the League to be kept secret. They feel that even the slightest critical mention of the ARRL is a personal attack on them. When some fellow amateur tries to get them to look at facts, they just get mad. Believe me, it takes great courage or great stupidity (your choice) to dare to say anything critical about the League, no matter how constructive the criticism. There are no rewards for those who speak out.

And now the good news: The percentage of hams who react emotionally at any critical mention of the League is small today. Today the majority of amateurs try to be realistic about the ARRL. They are frustrated by some of the things the League is doing or not doing, but they don't know what to do about it. They find it difficult to try and come up with ideas at club meetings because there are still a lot of "loyal" League members, with "loyal" meaning think no evil, permit no evil to be spoken, etc. It is a lot easier to blindly believe in the League than to live with the knowledge that we are essentially unprotected and at the mercy of forces over which we have little control.

MORE DECEPTION?

Speaking of C.J. Harris of the ARRL, you might, for laughs, check out the March-April issue of *Elementary Electronics*. In there you'll find a nice article on getting started in amateur radio, which is all well and good. However, the article is one long sales pitch for ARRL products, including their terrible code course, and no mention whatever of Harris being employed by the ARRL. Shame on *Elementary Electronics* and the ARRL for this deception.

The fact is that I was flipping through the magazine and spied the article. Since any objective evaluation of code courses would list the *73* tapes first, I looked for the reference . . . none! Hmmm . . . only the ARRL was pushed . . . hmmm some more. Then I looked at the author of the article and discovered that the manufacturer (ARRL) had written the article to sell the product. I wonder if I should start writing articles for other magazines telling newcomers how great the *73* cassettes are?

HAMS ARE NOT EXPERIMENTING

One of the club newsletters recently had quite a long diatribe on how most hams are not participating in pioneering efforts. This is true . . . guilty, but with an explanation.

We would have a lot more breakthroughs in communications techniques by amateurs if the FCC did not interfere at every turn . . . I think that is obvious. By dampening the climate for experimentation and pioneering, the FCC has thrown a pall over the entire amateur radio community. Pioneering is a work of enthusiasm . . . it is fun. When you have a bureaucracy sitting on top of you, it is difficult to have fun. Not many amateurs want to fight the FCC, nor do they want to have to conduct their experiments clandestinely. The end result is little in the way of progress as compared to what we could have if we were free of the deadening FCC yoke.

If amateurs were encouraged to experiment, we would find more and more articles in *73* on these ideas, and these in turn would spark more enthusiasm and ideas. Enthusiasm builds more enthusiasm just as gloom develops more gloom.

No, I think it is useless to castigate amateurs for not pioneering or to try and force them to do things on the basis of shame. Amateurs will work best if they are having fun and can brag a lot . . . then they spread their contagious enthusiasm. You'll get a thousand times the end result from an article on some new invention that is fun than you will from an article casting shame on those who are not experimenting.

Ham radio is a hobby, it is for fun. When it ceases to be fun, it will go away. We saw clearly what happened in 1963 when "incentive licensing" proposals by the League took the fun out of hamming—tens of thousands of amateurs went off the air and dropped out . . . permanently. The growth of the hobby stopped, invention just about stopped, and sales of ham gear dropped to about one-seventh what they had been, driving over 600 ham stores out of business and doing in all of the large manufacturers.

HAM PIONEERING

For as long as I can remember (and unfortunately I can remember a very long time), the FCC has been doing just about all it could to violate one of its most important rules—Part 97.1c, the one and only regulation which specifically outlines the responsibilities of the FCC. This regulation says the FCC shall follow the principle of: "Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art."

When the FCC denies amateur requests for special temporary authority (STA) to experiment with new techniques and ideas, and does this on a continuing basis, then they are clearly in violation of their own rules.

Am I making a big thing out of nothing? Here is where my long memory comes into play. I remember all too clearly the years of pressure it took for amateurs to fight both the FCC and the ARRL to get RTTY permitted on the low bands. In the early days, the FCC forced repeaters to close down and it took years to get them accepted by the FCC.

Many technical developments have been stopped cold because the FCC insisted that amateurs not transmit any type of signals their monitoring stations couldn't copy. How can you pioneer anything under that restriction? You can't!

The FCC is still at it, and if you doubt that, just ask any amateur who has requested an STA for testing ASCII on the ham bands. There is no known reason why amateurs should not be permitted to go ahead and use ASCII and start their development of systems using this modern technique. How can amateurs provide leadership to industry if they are hamstrung (pardon) at every turn by the FCC . . . in violation of their own regulations?

20 KHZ SPLIT PIONEERED

There are growing rumors of an attempt to change the historic 30 kHz two meter repeater channel split to 20 kHz. Since nobody asked my opinion of this, I feel free to comment.

Shades of eight years ago! There was a strong movement way back in the early days of repeaters to change to 20 kHz splits. Come to think of it, the chap who was at the heart of this movement then is, oddly enough, now living where the new thrust is taking place. Is this a coincidence?

To recap history briefly: The first repeater channels were set up on 60 kHz splits. This was in the early 60s and most hams were using hand-me-down police and taxi units set up for wideband (30 kHz) operation. Narrowband rules for the land mobile services had obsoleted a lot of FM equipment, which promptly fell into ham hands at a fraction of its previous cost. The wideband channels dictated the 60 kHz splits between repeaters.

Once the 60 kHz channels filled up, the pressure increased to shift to narrowband FM, a mode which, by the way, was pioneered by a ham back in the late 40s. As FMers narrowed their rigs down, it was possible to sandwich in more repeaters on the 30 kHz "splits."

In 1969, we brought things to a head by packing *73* with FM and repeater articles, running a series of FM symposiums around the country, and putting out an *FM Repeater Newsletter*. This helped get the country organized into using a common set of channels. Before this, only a handful of repeaters were set up on the now standard 600 kHz spacing, thus making the use of crystal-controlled rigs a problem. Along in 1970-71, the pressures forced repeater groups to get together and swap channels so they could move to 600 kHz spacing. With few exceptions, this is now the rule.

When all of the 146 MHz repeater channels in New York filled up (147 MHz was at that time only open to General class and above), the first of the 15 kHz "splinter" channels was tried. It worked, after a fashion, for some users. It became quickly apparent that either the state of the art of making two meter FM receivers was going to have to progress or else 15

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kHz would fail. Designers testified that it was just too much to expect a receiver to be able to not pick up a strong repeater 15 kHz off channel. This is when the move toward 20 kHz splits started, spearheaded by George Ledoux of WA2SUR (called the "sewer"), the most widely used repeater in New York City.

Even at that time it was considered too late to make the change . . . we were stuck with the splinter channel. It was several years before inspiration hit a California ham: Why not reverse the pair for 15 kHz splinters? It was tried and quickly found to be the best answer yet to the bothersome garbage usually spilling over from the next channel. There was no real problem in using a top-notch receiver at the repeater site, tuned to ignore the repeater output of the splinter channels on either side of its input. And the splinter outputs were only bothered by a very nearby user of the adjacent channel. In most cases, the interference was cut almost to zero. The frustrations of 15 kHz were effectively solved.

So much for history. With the 15 kHz splinter situation in hand, why are we again talking of 20 kHz splits? This would give us fewer channels and, in reality, create more interference between channels. The floor is open for any reasonable and concise arguments.

10m AM REPEATERS

We're so used to all repeaters being FM that many amateurs tend to forget that all of the early ham repeaters were AM, and that there is nothing seriously wrong with AM repeaters.

With the expanded use of CB sets on 10m, one service which should be brought back is the 10m repeater, though perhaps it's a bit different in operation than you may be thinking.

In the early days of FM repeaters, several were set up so they would not only provide repeater operation on 2m, but would also provide cross-band operation. Prose Walker got so uptight over the possibility of a Technician being able to talk on a General class band that he had the rules changed, for a while, to prohibit this terrifying possibility. Many of the early repeaters would change to cross-band mode every so often or could be controlled by a tone to make this switch from a straight 2m repeater.

In these cases, the control of the situation would reside with the 2m operator and the cross-band channel would be used for both transmitting from the repeater and listening. Typical of this type of service was the Concord, N.H., repeater W1ALE, which would act as an ordinary 2m repeater most of the time. Then, every 15 minutes, it would switch to provide cross-band contacts with anyone on 52.525 MHz. If no one stepped in and grabbed the channel during a one-minute period, the repeater would go back to 2m only. If a contact got going on 2-6m, the repeater would hold the cross-band mode until all was quiet.

Another test was set up and worked splendidly via my own repeater WA1KGO. Here we were able to cross-band from 2m to 10m SSB by means of a tone-operated control. Many a South American amateur was hard put to understand just what was happening as amateurs in New Hampshire, driving around or even wandering about with hand transceivers, were talking with them via the repeater link. There was some question in my mind as to whether I should classify myself as "mobile" just because I was rolling around my shack in a chair on casters with an HT in one hand.

I propose that we try setting up one of the 10m channelized frequencies for repeater access from 2m. Since we'll be using the lower channels for rag chewing, perhaps one of the higher channels would be better for this type of service. I suggest channel 19 at 29.185 for starters. If we find that this works well and need more in any one area, perhaps we could expand this to channels 25-26-27. These would be a bit more restricted since only 40-channel set owners would be able to use them.

RTTY

With the microcomputer explosion bringing us video terminals at lower and lower prices, these substitutes for the old noisy Teletype™ machines will, I hope, get thousands, perhaps tens of thousands, of hams into RTTY. There are enough advantages to make this happen.

For instance, on RTTY it is a simple matter to set up an autocalling system which will enable anyone to call your station and either alert you or at least leave a message for you. This is particularly simple with audio RTTY systems. It may come as a surprise to youngsters under 40 to know that we were using just such a RTTY system back in 1948. Indeed, we set up a RTTY repeater on top of the Municipal Building in New York for the purpose . . . on 2m AM. Yes, we had autocall, even to the extent of a simple system for having a station give an automatic roger for a message when the operator was not there. That was 30 years ago, fellows.

How did the "roger" work? Each operator in the RTTY net had one number assigned him. He would then set up a microswitch behind the printer so that the carriage would activate it when the carriage stopped at that spot; this switch would warm up the transmitter filaments and trigger another switch which would send two or three dots in response. That was the acknowledgement that the message had been printed.

With nearly 10,000 hams already computerized, and thousands more getting interested, the day when we have several thousand RTTY stations on the air is in sight. With computerized memories for "canned" messages and soon-to-come ASCII at some impressive speeds, we will be entering an age of sophistication that will be enormous fun. I don't know how far off the automatic WAS will be, but I do know that we need to plan for this service right now as one of our 10m channels.

POWER LIMITATIONS

Since most of us will be using low power on the 10m channels, I suggest a gentlemen's agreement be made not to run over 100 Watts on this part of the band. We really don't need kilowatt stations tearing up our rather fragile CB receivers. There is plenty of room for the higher power stations lower in the band, where the DX keeps them busy.

Further ideas on utilization of these channels is open for discussion.

Channel	Freq.(MHz)
1	28.965 . . . Listening & calling
2	28.975 . . . Autocall monitoring
3	28.985 . . . County hunting—not rag chew
4	29.005 . . . Beacon monitoring
5	29.015
6	29.025 . . . Rag chewing (lowest)
7	29.035
8	29.055
9	29.065
10	29.075
11	29.085
12	29.105
13	29.115
14	29.125
15	29.135
16	29.155
17	29.165
18	29.175
19	29.185 . . . Repeater channel
20	29.205 . . . RTTY
21	29.215 . . . Oscar coordination
22	29.225
23	29.255 . . . SSTV
24	29.235
25	29.245 . . . Repeater
26	29.265 . . . Repeater
27	29.275 . . . Repeater
28	29.285
29	29.295
30	29.305
31	29.315
32	29.325
33	29.335
34	29.345
35	29.355
36	29.365
37	29.375
38	29.385
39	29.395
40	29.405 . . . Oscar listening

VTR—PRESENT AND FUTURE

Having used the Quasar video recording system for a while, I feel free to speak with authority on it. To put it in one simple word: FANTASTIC!

While there are not very many television shows that I want to watch, there are a few, and those few I really hate to miss. Like you, I enjoy M*A*S*H and Barney Miller. 60 Minutes is frequently interesting. I have mixed feelings about the UFO show, but I watch it. Kojak, yes. It all adds up to a few hours a week of watching, which I justify on the basis that I have to do something while eating dinner . . . and, after all, I shouldn't feel guilty about taking a little time off from work. I do eat breakfast and lunch at my desk and usually work through until midnight, often getting up to half my work done.

Just because I have to go away for a weekend or even a week to a major industry show is no reason why I should miss what little TV I enjoy. That's where the video tape recorder (VTR) comes in. I try to leave a schedule of the programs I wish to have recorded and one of the people at *73* sees that they are taped for me. Then, after I get back, I can relax and recuperate from the trip, watching some great shows.

Even an evening away for a business dinner is simple now—leave the VTR with its clock to turn it on and off.

Oddly enough, even though I don't watch a lot of television, it seems as if the networks manage to run the two programs I want to see simultaneously, particularly on movies. When this happens, I watch one program and record the other. That fools those fiendish network schedulers.

Like television, once you have a VTR, you wonder how you ever got along without it and you use it constantly. Perhaps it would be more apt to compare it to a microwave oven. We got one of those from International Crystal over ten years ago and it is used by the *73* employees every day. It's still going strong! I use it for so many things, it is difficult to enumerate them: for a fast potato for dinner, to defrost a vegetable, to warm some of my homemade applesauce, to make a fast baked apple for dessert, to warm up leftovers. Though International Crystal no longer advertises with *73* (I haven't the faintest reason why), their microwave oven continues to be of daily help to all of us.

So it is with the VTR. It is in daily use and saves me time by

Continued on page 51

LETTERS

HAMBASSADORS

Your October, 1977, editorial comment posed the appropriate question, "Can the QCWA save amateur radio?" This timely inquiry has stuck in my craw ever since, and my curiosity has been building steadily. It's about time I wrote to see if anyone "answered the call."

Well? Haven't there been any encouraging results so far (see page 35 of the April, 1978, issue of *73*, column 1)? If there have been, they haven't been reported to us. I'd like to think that we can trust the QCWA to bear the full burden of supporting amateur radio by becoming "hambassadors" to developing countries (and leave it at that). But life has taught me not to count on *anything*—so I'd like to see what the average amateur can do to help.

The idea of ham ambassadors ("hambassadors" is the nickname I came up with) is great! It's a good idea to get them from the QCWA, the people whose knowledge of amateur radio is probably more than sufficient to get the job done right. It's also nice that since many of the QCWA members travel a lot anyway as part of their jobs, there would be no cost to anyone for the great service they would provide to amateur radio.

But—what can we "small fry" do? What can the average ham do to help keep amateur radio off the butcher's block at WARC '79? This is obviously a moot question (perhaps a good subject for an upcoming editorial?). The only thing that I can think of to help get the job done would be to provide the means by which any "qualified" amateur could become a "hambassador." After all, I would assume that not *all* of the QCWA members have expense accounts and make regular business trips to foreign countries. There may be many of these pioneers and innovators who would be itching to go and do something to benefit our hobby, but who don't have the means. Furthermore, there are probably those hams who are fully qualified to take the responsibility who are not QCWA members, and also lack the means to make this significant move to benefit our hobby. Anything we can do in the way of support would probably be much needed and greatly appreciated.

My first suggestion is to set up a fund from which "hambassadors" could draw to cover expenses incurred as a result of their "mission." Donations would come from the "average" hams all over the U.S., and money received would be controlled by a responsible administrator who would answer to a board or panel of trustees. These trustees would be responsible for determining who is or is not eligible for the job of "hambassador," and they would also act as coordinators, making sure each country is covered and following up on the results of each expedition.

My next suggestion is that whatever we do, let's do it fast! Let's not waste a bunch of time debating about it and wrap ourselves up in the politics of the thing. It's late in the game, and whatever any of us can do should be done immediately if we want to see amateur radio remain like it is instead of become an all-VHF/UHF/X-band affair!

Let's pool our thoughts, come up with a plan, and put it into action before another six months slips through our fingers!

Timothy M. Mrva WD8QLB
Elsie MI

Well, Timothy, the answer to your question is that I have not heard of anyone, QCWA or other, setting out to contact those countries which will decide on our ham bands at Geneva next year. The small African countries are the ones which will be able to vote whatever frequency allocations they desire. With one vote per country and few, if any, friends in Africa, how far do you think an "American" hobby is going to get as far as keeping incredibly valuable shortwave frequencies is concerned? When we lost 237,240 MHz of previously allocated satellite ham frequencies at the ITU satellite conference in 1971, it was clear that the handwriting was on the wall. That's right, we lost every single satellite frequency we had allocated above 450 MHz at that conference . . . that was a permanent loss. Then, when the same disaster fell on the maritime frequency users at the 1973 ITU conference, again brought about by the solid bloc voting of small African countries, it was even clearer. These shortwave frequencies are very valuable, whether for use by the country or for lease to other users (each channel is said to be worth about $10 million). The likelihood of these African countries being kind enough to voluntarily give up something they can rent for cold, hard cash so a bunch of Americans can play is not something I care to bet a lot on . . . remembering how popular the U.S. is with most African nations.

As I said in the October editorial, I think that these countries could be encouraged to save the ham bands for hams if someone were to go and visit the heads of the countries and acquaint them with the tremendous value amateur radio could have for their countries . . . a fact not one of them is familiar with.

Hambassadors might swing the difference, if we had any. As far as collecting money for such an effort goes, there isn't time to do this through any general collection from amateurs . . . that takes much too long. With the ARRL keeping mum on the whole situation, most amateurs would seize upon this as an excuse to let someone else pay to try and save amateur radio. After all, if there were any serious danger, the League would do something about it . . . right? Sure . . . just like they did about our satellite frequencies when they went to Geneva to represent us and lost every single kilohertz we had above 450 MHz—237,240 megahertz lost . . . forever.

The only other possibility is that the ham manufacturers may stop their political infighting and collect enough money to field some hambassadors. Right now some of the U.S. manufacturers seem to be more interested in battling Japanese ham importers than looking to next year at Geneva. The chaps running the importing firms are mostly old-time U.S. hams, and seem to be alone in their desire to do something about the situation. Weird.

If the ham industry were to immediately increase equipment prices by about 3%, they could gather about $250,000 a month from this "tax" and use it to get some hambassadors into the field right away. Most of us pay a lot more than that in sales taxes (except in New Hampshire, where we have no sales taxes). This way, all active hams could pay for the hambassador program. I've made this suggestion to the industry and asked that the firms get together at Dayton and stop the infighting . . . and try the 3% hambassador funding concept. Will it happen? Read next month and rejoice or weep.

Remember, I could be wrong about all this . . . but what if I am right?—Wayne.

QRPp?

It's my belief that any ham using more than 20 Watts on the bands today would use a sledgehammer to kill flies.

The fact is, there's not a country on this globe too remote to be accessible to a station running a half Watt and a dipole (under proper conditions, of course). Yet, our frequencies quake with shrieking thousand-watters beam-boosted to erp levels of 10^4 times that amount.

How come? Perhaps it's another manifestation of the same syndrome which, until recently, cluttered our highways with 500-HP, gas-guzzling behemoths. At any rate, the ad men behind this power tripping in hamdom surely deserve their due. Their campaign may go down as one of the most successful deceptions of an intelligent group of individualists ever perpetrated. Happily, though, it looks like "megawatt mania" has nearly run its course.

It used to be that the guy on the other end of the QSO came right out and told you that he had a gallon, a California kW, or a legal limit and then some. But things have changed. Notice how often now you hear, "rig here 900 Watts." Come on, fellas, even the most mathematically inept of our ranks recognize that as pretty darn close to the big K. But it does show where it's all headed.

The tide is turning to low power. But there will be the diehards, those few who may never fully appreciate just how boorish it is to plop down a big fat U.S. double gallon on a choice frequency during a DX contest and start calling, "CQ test." It simply salves one W's ego while forcing many foreign stations into the background instead of allowing them to efficiently work the hordes of other American hams anxiously waiting for a QSO. But then, I suppose the DX understands . . . after all, the specter of the ugly American is nothing new.

Once you experience the warm respect you receive from DX stations when they learn you're running QRPp, you

Continued on page 45

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

IARS/CHC/FHC/HTH QSO PARTY

Starts: 2300 GMT Friday, June 2
Ends: 0000 GMT Monday, June 5

An SASE to K6BX will bring detailed information. Contest is open to all amateurs and SWLs worldwide. Same station may be worked on each band and mode; SSB and AM are different modes.

EXCHANGE:

QSO number, RS(T), name, CHC/FHC number, US state and county or similar division. Non-members send HTH instead of CHC/FHC number.

SCORING:

CHCers—score 1 point per QSO with other CHCers, 2 points per QSO with HTHers; 1 additional point if YL, B/P, FHC, Novice, CHC-200, Merit or Club station, or if on VHF/UHF; double above points if QSO is outside own country. HTHers—contacts with other HTHers count 1 point, with CHCers count 3 points. Rest same as above. SWLs—use above depending on whether CHC member or not.

MULTIPLIERS:

Each different continent, country, ITU zone, and US state counted only once.

FINAL SCORE:

Multiplier times total QSO points is final score. Multi-operator stations divide score by number of operators.

FREQUENCIES (for US and DX as allowed):

CW—3575, 3710, 7070, 7125, 14075, 21075, 21090, 21140, 28090, 28125.

Phone—3770, 3775, 3790, 3943, 3960, 7070, 7090, 7210, 7260, 7275, 14320, 14340, 21360, 21440, 28620.

AWARDS:

Hundreds of certificates and trophies in all categories and divisions are awarded. An SASE will bring further information from K6BX. Send all requests and logs to: International Amateur Radio Society, K6BX, PO Box 385, Bonita CA 92002. Logs should be mailed within 15 days after the close of the QSO Party.

CALENDAR

June 3-4	IARS/CHC/FHC/HTH QSO Party
	VE-10 Contest
	Minnesota QSO Party
June 10-12	ARRL VHF QSO Party
June 17-18	West Virginia QSO Party
	Tin Lizzy International QSO Party
June 24-25	ARRL Field Day
	First REF Ten Day
July 1-2	Seven-Land QSO Party
July 4	ARRL Straight Key Night
July 8-9	IARU Radiosport Competition
July 15-16	10-10 Net Summer QSO Party
	VHF Space Net Contest
	Colombian Independence Day Contest
July 22-24	Rhode Island QSO Party
July 29-31	CW County Hunters Contest
	New Jersey QSO Party
Sept 9-10	ARRL VHF QSO Party
Sept 16-18	Washington State QSO Party
	Scandinavian Activity Contest—CW
Sept 23-24	Scandinavian Activity Contest—Phone
	Delta QSO Party
Oct 7-8	VK/ZL Oceania DX Contest—Phone and RTTY
Oct 14-15	ARRL CD Party—CW
	VK/ZL Oceania DX Contest—CW
Oct 21-22	ARRL CD Party—Phone
Nov 4-5	ARRL Sweepstakes—CW
Nov 11	OK DX Contest
Nov 18-19	ARRL Sweepstakes—Phone
	Second REF Ten Day
Dec 2-3	ARRL 160 Meter Contest
Dec 9-10	ARRL 10 Meter Contest

Please note the change in the New Jersey QSO Party date; it is now on July 29-31. The change was made to avoid conflict with the Can-Am contest that was scheduled on the same weekend last year.

MINNESOTA QSO PARTY

Starts: 1800 June 3
Ends: 2359 GMT June 4

Sponsored by the Heartland Amateur Radio Club. No restrictions as to mode or operating time; all bands 80-10 mtrs. Only one transmitter allowed in operation at one time; no crossband contacts. Novices compete against Novices, Techs against Techs. Net QSOs are not valid. Please do not interfere with nets or traffic sessions.

EXCHANGE:

RS(T), county (MN only), ARRL section or country (others).

SCORING:

One point per QSO, 2 points if on CW, 5 points if Novice or Tech. (Note: Novices and Techs must identify their license class each QSO, such as WBØXXX/N, or /T.) WBØ, the HARC station, counts 10 points per QSO per band. MN stations multiply number of ARRL sections plus DX countries (W/VE excluded) times QSO points. Others multiply QSO points by number of MN counties (max. 87). Phone and CW are one contest—please score as such.

ENTRIES/AWARDS:

Stations making 50 or more QSOs must include a check sheet for each band and mode used. Logs must include date/time in GMT, band, mode, and exchanges. Certificates to state winners as well as high Novice and Tech scorers in USA and DX stations. MN stations must have 10 QSOs from a county for county awards. SASE required for return of awards and summary. Usual disqualification criteria. Logs must be postmarked by June 30. Send logs to: HARC, c/o Steve Scott WDØEPE, 801 6th St. North, Staples, MN 56479.

VE-10 CONTEST

Starts: 0000 GMT June 3
Ends: 2400 GMT June 4

Sponsored by the Agassiz Chapter, Ten-X International Net, and the Tetrahedral Contest Circle of Manitoba and Saskatchewan, the contest is open to all. Stations may be single- or multi-op, but only one single signal is allowed. Canadian stations can work anyone and vice versa on 28 MHz. VE to VE is ok! Each station can be worked once on SSB, CW, and once on any mode using any satellite with downlink on 28 MHz. CW contacts (except via OSCAR) must be made below 28.5 MHz.

EXCHANGE:

RS(T) and multiplier area. Canadian multiplier areas are: NFLD, LABRADOR, PEI, NS, NB, QUE, ONT, MAN, SASK, ALTA, BC, NWT, YUKON, SABLE/ST. PAUL IS, and ITU regions 1, 2, 3 for VEØ stations. For others, state or country.

SCORING:

Multiply sum of contacts by sum of multiplier areas. No crossmode contacts.

ENTRIES:

Check sheets are required for stations making over 100 contacts. Log in UTC (GMT) and indicate multipliers in log. Awards to high scorers. An SASE will bring a copy of the results. Entries should be postmarked by July 1 and sent to: Derrick Belbas VE4VV, 505 Regent Ave. E., Winnipeg, Manitoba R2C OE1, Canada.

The Agassiz Chapter now has a certificate available for working one station with a 10-X number in each of the ten Canadian provinces (NFLD-LAB, NS, NB, PEI, QUE, ONT, MAN, SASK, ALTA, BC). A VE8 (NWT or Yukon) with 10-X number can substitute for any missing province. Send log information and 50¢ to: Bruce Taylor VE4ABT, 506 Stalker Bay, Winnipeg, Manitoba R2G OC8, Canada.

ARRL VHF QSO PARTY

Starts: 1900 GMT Saturday, June 10
Ends: 0600 GMT Monday, June 12

Check the May issue of QST *for any last minute changes!*

Entrants may operate no more than 28 of the 35 hours during the contest period. The seven hours off-time must be taken in increments of 30 minutes or more. Listening time counts as operating time. All contacts must be made on amateur bands above 50 MHz using authorized modes. Fixed, portable, or mobile operation under one call, from one location only, is permitted. Any transmitter used to contact a station may not be later used to contact another station during the contest period with any other callsign. Contacts made by retransmitting either or both stations (such as repeaters) do not count for contest purposes. Each contact exchange must be acknowledged by both operators before either may claim contact points. A one-way confirmed contact does not count.

EXCHANGE:

Exchange simply ARRL section.

SCORING:

On 50 or 144 MHz, count 1 point per contact; on 220 or 420 MHz, count 2 points per contact; on higher UHF bands, count 3 points per contact. Final score is then the total QSO points multiplied by the number of different bands for additional credits, but cross-band contacts are not allowed. Also, aircraft mobile stations cannot be counted for section multipliers.

ENTRIES:

All logs must be postmarked no later than July 7 and sent to: ARRL, 225 Main Street, Newington CT 06111. Logs and entry forms are available through this same address; please include an SASE. Usual awards will be issued and the standard disqualification rules will apply.

TIN LIZZY INTERNATIONAL QSO PARTY

Starts: 2400 GMT June 16
Ends: 2400 GMT June 18

This event commemorates the 75th anniversary of the "Tin Lizzy" and is sponsored by the Ford Amateur Radio League (FARL), an employees' organization of the Ford Motor Company. The event is open to all radio amateurs throughout the world with each entrant submitting a log receiving a special FARL commemorative certificate of participation. A special jubilee QSL card will also be sent to those stations contacting the FARL club station K8UTT.

All amateur bands from 160 to 10 meters may be used with only single-operator entries permitted. All contacts must be either SSB or CW with no cross-band or crossmode contacts allowed. Stations may be worked once per band per mode and successive contacts with the same station by changing modes or bands are not allowed.

Two categories of entrants will be used for the contest. "Member stations" are defined as any licensed amateurs employed by or retired from the Ford Motor Company. "Non-member stations" are defined as licensed amateurs who do not qualify as a member station. Member and non-member stations may work anyone, but multipliers can only be earned by contacting member stations. The general call for the contest will be "CQ Tin Lizzy" on SSB and "CQ TLC" on CW.

EXCHANGE:

Non-member stations send: RS(T), sequential QSO number, state, province, or country.

Members send: FARL, RS(T), QSO number, location code, and state, province, or country.

Retiree members send: FARL, RS(T), QSO number, and state, province, or country.

The location code for members in the USA and Canada will be a three- or four-letter code of the division of the Ford Motor Company they work for (i.e., AAD, FMCC, EED, etc.). Location codes for overseas members will be their three- or four-letter code, if known, or their international amateur prefix, if not known.

SCORING:

QSO points are as follows: each non-member QSO = 1 point, each member QSO = 2 points, each retiree member QSO = 5 points. Multipliers for this contest may only be earned by a contact with a member station. Multipliers are calculated as follows: QSO points times (number of location codes or international prefixes + number of states, provinces, or countries). Scores will be calculated by band and will then be totaled. Non-member stations may contact anyone for a QSO point, but multipliers are only earned by a contact with a member station. A bonus of 100 points which may be added to the total score may be claimed for a QSO with station K8UTT, the club station. An additional 50 points may be earned by any station whose operator signs a statement that all contacts were made with power input of less than 300 Watts dc.

AWARDS & ENTRIES

Separate awards will be made for member and non-member categories as follows: top score in US, Canada, and each country submitting entries; top SSB, CW, and Novice scores in each state, province, and each country submitting an entry; special jubilee QSL cards. QSL cards will be available for use by member and retiree member stations. Official logs, summary sheets, instructions, and suggested frequencies are available from: Tin Lizzy Contest, PO Box 932, Dearborn MI 48121. Include a #10 SASE with 26¢ postage (USA) or an IRC. For more information or answers to questions regarding this contest, please telephone or write: Wayne Wiltse K8BTH, 14468 Bassett Ave., Livonia MI 48154; telephone: home—(313)-464-9149, work—(313)-594-1779.

WEST VIRGINIA QSO PARTY

Starts: 2300 GMT Saturday, June 17
Ends: 2300 GMT Sunday, June 18

All amateurs are invited to participate in the QSO Party sponsored by the West Virginia State Amateur Radio Council. There are no operating time limits during the contest period. The same station may be worked on different bands for additional points, but only once per band regardless of mode. West Virginia stations may work each other.

FREQUENCIES:

35 kHz up from the bottom edge of each CW band and 10 kHz inside the general portion of each phone band.

EXCHANGE:

QSO number; RS(T); and county (if WVA), state, or country (others).

SCORING:

A power multiplier will be allowed as follows: 200 Watts or less dc input = 1.5; over 200 Watts dc input = 1.0. Out-of-state stations determine their score by multiplying the number of QSOs times the number of different West Virginia counties worked (55 max.). This total is then multiplied by the power multiplier as defined above for the total score. West Virginia stations multiply the total number of QSOs by the sum of the different WVA counties, US states, and ARRL countries worked. This result is then multiplied by the power multiplier to determine the final score.

AWARDS:

To be eligible for an award, a station may have only one unassisted operator. Awards will be issued to the highest scoring WVA station, 1st runner-up in WVA, 2nd runner-up in state, and the highest scoring station in each state and country. Decisions of the Contest Committee of the West Virginia State Amateur Radio Council will be final.

LOGS/ENTRIES:

Logs must indicate date, time, QSO number, callsign, QSO number received, signal reports, and county, state, or country of the station worked. Indicate the mode and band also. Logs should be sent to: West Virginia QSO Party, PO Box 299, Dunbar, West Virginia 25064. Logs should be received no later than July 15, and no logs will be returned.

ARRL FIELD DAY

Starts: 1800 GMT Saturday, June 24
Ends: 2100 GMT Sunday, June 25

Rules are generally lengthy (2 pages in *QST*); please refer to the May issue of *QST* for detailed information and for any changes since last year's rules. Briefly, the general rules are as follows:

The contest is open to all amateurs within the ARRL sections; foreign stations may be contacted for credit but are not eligible to compete. Each entry will be classified by type of operation: Class A—club group set up specifically for Field Day operation operating portable without commercial power; Class B—non-club stations set up portable without commercial power; Class C—mobile stations; Class D—fixed stations using commercial power; Class E—fixed stations using emergency power for transmitters and receivers.

All entries will further be classified by the number of transmitters utilized. Class A and B stations not beginning to set up before 1800 GMT on Saturday may operate the entire contest period. All others may not operate more than 24 hours total. Each station may be worked once on each band; voice and CW are considered different bands (all voice contacts are equivalent and RTTY = CW).

Class A, B, and C stations may contact anyone, but classes D and E must contact only classes A, B, or C.

EXCHANGE:

RS(T) and ARRL section or country.

SCORING:

Phone contacts count 1 point each and CW contacts count 2 points each. Final score is sum of QSO points times multiplier for highest power used at any time during the contest period, plus bonus points. Power multipliers: Multiply by 5 if 10 Watts or less dc input power and noncommercial main power source or motor driven generator; multiply by 2 if less than 200 Watts; multiply by 1 if over 200 Watts up to 1 kW; multiply by 0 if over 1 kW (note—dc power on SSB is half PEP power). Bonuses: (only for Class A or B stations) 100 points for 100% emergency power; 100 points for "natural" powered contact (only one QSO req'd); 50 points for public relations; 50 points for message origination for SCM or SEC; 5 points for each message received and relayed during FD period up to a maximum of 50 points; 50 points for completing at least one QSO on CW via OSCAR.

ENTRIES:

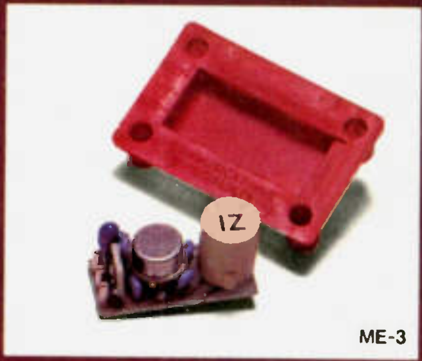
Standard disqualification rules apply. All entries should be sent to: ARRL, 225 Main Street, Newington CT 06111. Official log and entry forms are available from the same address for an SASE.

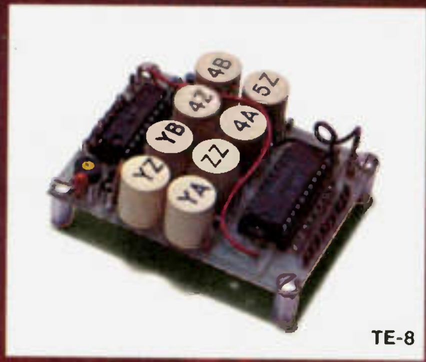
SEVEN-LAND QSO PARTY

Starts: 1200 GMT July 1
Ends: 2400 GMT July 2

Amateurs worldwide are invited to participate in the first annual 7-Land QSO Party sponsored by the NAS Whidbey Island ARC of Washington

Continued on page 188





OF A NEW AGE.

TS-1 Sub-Audible Encoder-Decoder • Microminiature in size, 1.25″ x 2.0″ x .65″ • Encodes and decodes simultaneously • **$59.95** complete with K-1 element.

TS-1JR Sub-Audible Encoder-Decoder • Microminiature version of the TS-1 measuring just 1.0″ x 1.25″ x .65″, for hand-held units • **$79.95** complete with K-1 element.

ME-3 Sub-Audible Encoder • Microminiature in size, measures .45″ x 1.1″ x .6″ • Instant start-up • **$29.95** complete with K-1 element

TE-8 Eight-Tone Sub-Audible Encoder • Measures 2.6″ x 2.0″ x .7″ • Frequency selection made by either a pull to ground or to supply • **$69.95** with 8 K-1 elements.

PE-2 Two-Tone Sequential Encoder for paging • Two call unit • Measures 1.25″ x 2.0″ x .65″ • **$49.95** with 2 K-2 elements.

SD-1 Two-Tone Sequential Decoder • Frequency range is 268.5 - 2109.4 Hz • Measures 1.2″ x 1.67″ x .65″ • Momentary output for horn relay, latched output for call light and receiver muting built-in • **$59.95** with 2 K-2 elements.

TE-12 Twelve-Tone Sub-Audible or Burst-Tone Encoder • Frequency range is 67.0 - 263.0 Hz sub-audible or 1650 - 4200 Hz burst-tone • Measures 4.25″ x 2.5″ x 1.5″ • **$79.95** with 12 K-1 elements.

ST-1 Burst-Tone Encoder • Measures .95″ x .5″ x .5″ plus K-1 measurements • Frequency range is 1650 - 4200 Hz • **$29.95** with K-1 element.

COMMUNICATIONS SPECIALISTS
426 W. Taft Ave., Orange, CA 92667
(714) 998-3021

New Products

LEGALIZING BUSINESS TALK

Do you sometimes get a little fed up with some of the fellows on the repeater who push the rules with calls to their office? They may not actually talk business, but you know the call is business oriented. Then there are the gray areas . . . like calling ahead to order a pizza . . . a restaurant reservation. Sure, it's idiotic to consider these a business use of a repeater, but then we've gotten all sorts of contradictory input from the FCC as to what is or is not "legal." The result is that many amateurs tend to be excessively conservative.

Wouldn't you like to have a repeater where you could talk business if you wanted to? Where you wouldn't have to worry about whether some use was legal or not? Where there would be no damned nitpickers to rain on your parade? Well, it's there and very few people know about it.

Old-timers, sitting there rocking and combing their beards, may remember the halcyon days of radio and the first CB channels . . . up at 460 MHz. It was a good place for CB, and just think of the headaches the FCC could have saved if they had listened to their men who advised against opening the 11m band. This "Class A" Citizens Band never really made it because there wasn't any decent yet low-priced equipment. Well, the remnants of this early band are still there and not a few amateur groups have been taking advantage of this to set up repeaters, complete with autopatch.

The beauty of these channels—and there are eight of them—is that they are not much used in many areas . . . and you can use them for business, if you want.—Wayne.

STANDARD GMR-1 BASE/MOBILE TRANSCEIVER

With the same capabilities for FM simplex/repeater operation as on the 70 cm amateur band, plus such additional advantages as being able to make business calls via autopatch facilities and unlicensed members of your family being able to legally operate, the 460 MHz range General Mobile Radio Service, formerly Class A CB, offers an attractive alternative to amateurs, particularly in the many parts of the country where amateur band repeater operation is already at the saturation point.

In practice, the GMRS provides pretty much the type of operation envisioned for the proposed Communicator class amateur license—with certain pluses.

Operated in essentially the same fashion as an amateur band repeater, a GMRS machine could provide a logical, legal, and very useful extension of any group's communications capabilities. And with its wider range of authorized communications and eight frequency pairs of increasingly scarce spectrum space, the General Mobile Radio Service should not be overlooked by existing or potential amateur repeater organizations with an eye to the future.

Now Standard Communications has entered the GMRS field with the GMR-1, a six-Watt, two-channel FM transceiver for operation in the 462-468 MHz range. The GMR-1 can be used as a mobile or for base station operation with the addition of a suitable 12-volt supply such as Standard's model 12/120-GMR, which includes a built-in speaker.

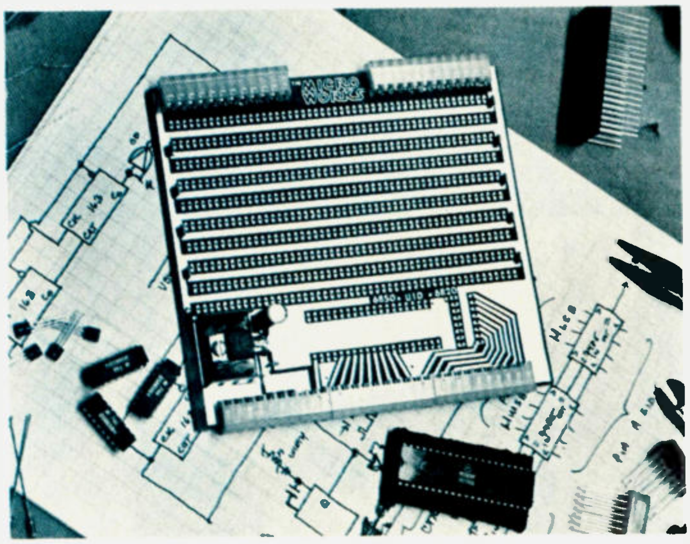
With a pair of GMR-1s, you can enjoy the same simplex and repeater coverage as you would have on the 70 cm amateur band and, additionally, carry on business communications including autopatch phone calls. However, the biggest advantage to most amateurs will likely be the provision that enables family members and others to operate without being individually licensed.

Priced at under $400, the GMR-1 offers amateurs the opportunity to expand their communications into a new and exciting area that complements their present VHF/UHF capabilities. Full details on the GMR-1 and the General Mobile Radio Service are available from the PerCom Sales Manager, *Standard Communications Corp., PO Box 92151, Los Angeles CA 90009.*

Morgan Godwin W4WFL
Peterborough NH

Standard's GMR-1 transceiver and 12/120-GMR supply.

UNIVERSAL I/O BOARD



Order out of chaos: The Micro Works Universal I/O Board.

The Micro Works Universal I/O Board is just the thing for custom interfaces. The board has space for a 40-pin wire-wrap socket into which you may plug any of Motorola's 40-or 24-pin interface chips; the data and control lines are connected to the appropriate edge connector pins. All other bus connections are brought out to a 16-pin socket pad. A + volt regulator and all molex connectors are provided; regulated + and ground are bused among the locations for up to 35 14-pin ICs. Price: $24.95.

The high quality Micro Works extender boards are double sided, with the bus extensions on the bottom and a ground plane on top. Both sides are solder masked. Silkscreened bus pin designations make debugging easy. Prices: X-50 (S-50 bus), $29.95; X-30 (S-30 I/O bus), $22.95.

All Micro Works 6800 computer accessories come fully assembled, tested, and burned in as necessary. They feature prime components, double-sided PC boards with plated-through holes, solder mask, and silkscreen component markings where appropriate. All software is fully source listed and commented; complete schematic diagrams are included. Delivery is from stock. *The Micro Works, PO Box 1110, Del Mar CA 92014, (714)-756-2687.*

WHAT'S THE WORLD SAYING?

Our ever-shrinking world and its multiplying problems have

The Yaesu FRG-7000 receiver.

resulted in a new hobby—listening to what countries all over the world are saying to us, and about us, to their own people.

Shortwave "DXing," as it is called, is rapidly mushrooming in popularity amongst people of all ages and in all walks of life.

To fill the need for an exceptionally stable and sensitive receiver capable of top performance, Yaesu Electronics Corporation has introduced its model FRG-7000. Tabletop in design, it offers stability, sensitivity, selectivity, and calibration accuracy rarely found in receivers offered to the general public.

The FRG-7000 will allow one to explore the far corners of the world from the comfort of the living room, with digital accuracy, using all modes of reception, single sideband, regular AM (broadcast), as well as code (CW). It provides complete and continuous coverage of all frequencies from .25 kHz to 29.9 MHz. This includes all Citizens Band channels, foreign broadcast, and amateur radio frequencies, with superlative performance in all modes of reception.

SWLers, mariners, and radio amateurs will find the FRG-7000 an invaluable communications aid of outstanding quality and workmanship.

For full details on technical specifications, contact: *Yaesu Electronics Corporation, 15954 Downey Avenue, PO Box 498, Paramount CA 90723.*

NEW RADIO SHACK MICROCOMPUTER CATALOG

Just issued by Radio Shack is their new 8-page TRS-80 Microcomputer System Products catalog.

The catalog features Radio Shack's $599.00 TRS-80 microcomputer system and provides information on upgraded systems, peripherals, and ready-to-use software developed specifically for the TRS-80.

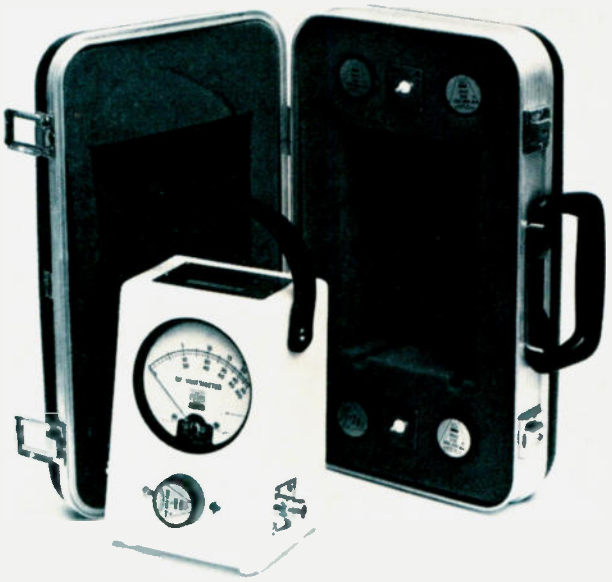
The basic TRS-80 system, described as the "beginner's choice," offers Level-I BASIC with 4K of ROM to produce a thorough and easy-to-understand computer language. Its 4K RAM is said to contain sufficient memory to accommodate many home, school, lab, or small business uses.

Expanded TRS-80 systems, including a 4K "Educator" system priced at $1198.00, a 16K "Professional" system selling for $2385.00, and a 32K "Business" system for $3874.00, are also featured in the catalog.

Also included in the new catalog is information on "How to Expand Your Existing TRS-80 System," with details of Level-II BASIC, and an Order Worksheet that helps the customer custom-tailor a TRS-80 system to his particular needs.

The new Radio Shack TRS-80 Microcomputer System Products catalog is available free, on request, from Radio Shack stores and dealers, nationwide. Items listed in the catalog may be ordered through any Radio Shack store or participating dealer.

New catalog from Radio Shack.


Watt-Kit from Dielectric Communications.

DIELECTRIC ANNOUNCES WATT-KITS

Dielectric Communications, a unit of General Signal Corporation, announces the availability of Watt-Kits, rf power measuring kits, catalog numbers 1000-K1, K2, K3, and K4. The kits consist of the type 1000 rf directional wattmeter and 100-Watt plug-in elements, enabling the user to measure 100 Watts full-scale from 25 MHz to 1 GHz. Also included is a quick-match UHF connector, two-foot patch cable with connectors, and a luggage-style carrying case to house the complete kit. The K3 and K4 kits also include a type 4100, 100-Watt dry terminating load. Prices for the kits range from $280 to $465, and they are available from stock. These kits make it possible to obtain everything required for the measurement of forward and reflected average rf power (and vswr, using a simple nomograph) by ordering a single catalog number. The cases are fitted with additional space for storage of manuals, vswr nomographs, additional plug-in elements, and connectors. *Dielectric Communications, a unit of General Signal, Route 121, Raymond, Maine 04071.*

NEW PRODUCTS: SST T-1, T-2, AND T-3

SST Electronics has introduced two new antenna tuners after six years of producing the SST T-1, the original random wire antenna tuner.

Every SST tuner is built with high quality components and workmanship. Yet SST tuners offer features not included in tuners costing more. All SST tuners use an efficient toroid inductor for maximum versatility and compact size.

Continued on page 190

The SST T-2 Ultra Tuner.

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

I hope I am mistaken. I really hope that the FCC knows what it's doing, but I have a feeling that this time they are wrong. I'm speaking about the announcement of March 23, 1978, that totally deregulated repeaters and dealt a death blow to special repeater callsigns. I hope that the FCC has not also dealt a death blow to voluntary coordination and thereby negated the many years of work done by great numbers of dedicated amateurs. I know some of you are going to say that ITF is playing the part of a pessimist, but the fact is that by the time you read this there will be only two criteria necessary to put a repeater on the air: a Technician class or higher license and a checkbook. Not so long ago, it took technical expertise, a desire to advance the state of the art, and this same desire to serve the needs of the amateur community. Out of this has come a national network of two meter repeater systems that spans the nation. It's almost impossible these days to travel anywhere within the 50 states and not be in range of a two meter repeater. Ten years ago, when I first drove across the country, the rule of the day was hunt and peck. Today, you can't get away from a QSO. Repeaters are everywhere and that's good.

However, I have to ask the following questions: How many repeaters are enough? What total number of systems will constitute fulfilling everyone's needs? Is the magic number 2,000? 5,000? 10,000? Will the "need for repeaters" keep going until every amateur has his own system for his exclusive use? Is there a real need for any more than we have now?

A repeater is of little use unless it is used. One that is placed into operation and winds up with one QSO every three days is of little value and is better taken out of service, since it is then nothing but an economic drain to its owner. There are exceptions to this. Repeaters serving areas such as our nation's wildernesses and deserts as lines of emergency communications and vehicles for friendly chit-chat are an entirely different thing. Their need is dictated by their service area. However, here in L.A. proper, for example, we have a myriad of repeater systems. You can hardly find a channel that does not have one or more (usually more) repeaters coordinated on it. Yet, although good quality, wide coverage repeaters of "open" format reside on these channels, you can sometimes listen for days on a channel and not hear one QSO take place. You can hear an occasional kerchunk without an identification other than that of the repeater itself, but not a QSO. The why's and wherefore's of this phenomenon are unknown to me, but it exists here and, I am willing to bet, in other big cities. There may be 25 or 50 repeaters available, but three or four account for the majority of activity.

If this is the case, why go ahead and put more repeaters on the air just to take up space? There is a far better way, but it takes implementation of a term that is very lacking in today's society: cooperation. Say your group decides that it wants the advantages of its own repeater and makes plans to put one up. Well, that's one way, the usual way. However, if you take the time to search around a bit, I am willing to bet that you will discover inactive operational systems in your area that can fulfill the needs of your organization. Should such be the case, you can save yourself the aggravation of repeater ownership by working out a cooperative venture with the system's owner to utilize the relay ability of the system in exchange for the ongoing support that a system needs. In this way, you have no initial investment and no ownership responsibilities—yet the relay ability of the repeater is yours. It's called "cooperative operation," and it works.

Let me cite an example. One of the nicest ways to operate on two meter FM in Los Angeles is through the WR6AHM repeater located atop Magic Mountain. This "box" seems to "talk forever," yet its operation is very clean and the people who operate on it regularly are some of the nicest to be found anywhere. Virtually everyone you speak to thinks that the WR6AHM repeater is owned and operated by the Santa Clarita Amateur Radio Club. While it's true that you find a lot of SCARC members on WR6AHM, the club does not own the radio. WR6AHM is owned by an individual amateur, and the Santa Clarita club acts as a user support organization for the repeater. Such has been the case for a good many years, and this relationship has worked well for both parties. Everyone has what he needs, and thereby the need for another repeater is negated. If such agreements can be made to work here in a political hotbed like Los Angeles, I can't imagine any place where they wouldn't.

Another problem that is arising is that of user allegiance. Simply put, a user can't be expected to financially support every repeater upon which he operates. As more systems come into being, financial support dwindles, since the average user cannot decide which particular repeater deserves his support. So he supports none. In the end, this will lead (and already has led) to "open repeater attrition." When a system owner finds that the ego trip is over, that it's costing him a bundle to keep "WR whatever" on the air, and that the majority of users are not "doing right" by the service he is providing, he has but two alternatives. He can either take the repeater out of service, or, as more and more system owners are doing, he can convert it to a "private" system with a select usership. Since the vast majority of "privates" require financial support as a part of system club membership, they have little in the way of user support problems. I'm not predicting that every open system in the nation is about to disappear, but it *has* happened already and will probably continue. I know that even mentioning "repeater support" is a sore spot for many, but we happen to live in a real world which requires real money.

If we regularly use a system, we have an obligation to do our share to keep it on the air. If we use five regularly, we have the obligation to support all five . . . or ten, or twenty, or what have you. This can really get expensive, and very few of us can afford to support all the open systems in an area like New York or Chicago. So how do we do it? Well, I have all sorts of ideas along these lines, such as a central support fund or a support fund set up through the local coordination council, but some people would always say that they were not getting enough. Therefore, I will leave the solution to your imagination. One thing is clear, though: If open repeaters are to survive, it's up to each of us in his own way and to the best of his ability to render the necessary support—be it financial or otherwise.

"REMOTE NOTE" DEPARTMENT

I recently received a letter from Bill Kleronomos WA9OZC in Westchester, Illinois. Bill owns WR9AMI, one of the few "California-style" remotes found outside of California. The letter concerned ten meter FM and establishing an international 10 meter remote intercom channel. Actually, Bill suggested a national channel, but, ten meters being the kind of band it is, any intercom channel would actually be international in nature. Well, 29.6 is the national FM calling channel, but when ten opens, 29.6 does get kind of hectic. Anything below 29.5 would interfere with OSCAR operations, and above that you have repeater channels. So by default, we have no place other than 29.5. I think that 29.5 might be what remotes need as a common meeting ground for channelized long-haul operations. Any takers?

Bill would also like to know of others involved in 10 meter remotes, especially on the air. To quote Bill's note: ". . . it kinda gets lonely being the only remote W6-style in this here corncob country."

"SOME NOTES ON 220" DEPARTMENT

I guess I must be on everyone's mailing list, since quite a bit of literature seems to arrive each month. In most cases, there is just far too much to mention in this column. However, once in a while something really special shows up, and this seems to be the case with a newsletter called *220 Notes*.

Published in Chicago by Lee Knirko W9MOL, *Notes* has quickly grown from a regional service publication to a bimonthly which has the ability to hold the interest of any amateur involved in 220 MHz FM and repeater operation. For example, a recent issue (February, 1978) contained a most interesting article that covered all of the currently available 220 MHz FM equipment, including antennas and accessories. It is probably the most complete listing of such information to be found anywhere, and it is obvious that Mike Sterling WA9QGY spent a lot of time researching his material. The same issue contained an article on improving repeater audio, and even a short piece on playing chess via amateur radio. *Notes* is just chock-full of all sorts of interesting material and is well worth the nominal $3.00 subscription fee that brings you a year's worth of enjoyment. To subscribe, send $3.00 to *220 Notes*, c/o Virginia Sterling WB9UFV, 9128 N. Lindner Ave., Morton Grove IL 60076.

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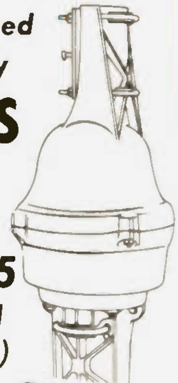

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HY-GAIN TH6-DXX	6-Element/2KW	$249.95	$224.95	$329.95
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MOSLEY TA-33	3-Element/2KW	$206.50	$185.00	$294.50
MOSLEY TA-36	6-Element/2KW	$335.25	$299.95	$399.95
MOSLEY CL-33	3-Element/2KW	$232.50	$209.00	$317.25
MOSLEY CL-36	6-Element/2KW	$310.65	$279.50	$384.50
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RTTY Loop

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

These days, no technical topic in amateur radio is "hotter" than microprocessors and computers, and perhaps nowhere else in our hobby is a computer more useful than in RTTY. This is evidenced by the growth of the I/O section in *73*, and the many related topics seen in *Kilobaud*, *Byte*, and other computer publications. What we will try to do this month is develop the logic for a RTTY receiving program, which can be implemented on about any microprocessor. Next month, detailed information for programming an SWTPC 6800 will be presented.

To begin with, let's define the problem. We must:

1. Input data to the computer from a 60 mA, Baudot encoded, 45.45 baud loop;
2. Transform that data to a machine-usable form;
3. Convert the Baudot code to ASCII;
4. Display the data to the operator.

There are several ways of getting information out of a loop at non-loop levels. Two of the more common are optoisolators and reed relays. Optoisolators are tiny, encapsulated units that have an LED shining on a photosensitive diode or SCR (LASCR). As the LED shines, the diode conducts, and TTL level voltages, which are the levels that make most computer inputs happy, can be controlled. The alternative, the magnetic reed relay, has been covered before in this column in the context of transmitting keyers. If you have such a relay installed, it can be used for this application directly, or another can be inserted. Whatever the technique (even a polar relay can be pressed into service), the object is to have a pair of wires *isolated* from the loop that are *shorted together* during MARK and *open* during SPACE.

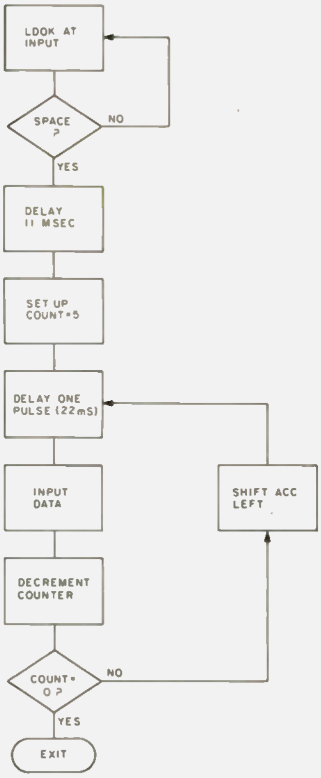

Fig. 1. Input Baudot data.

Once you have these wires, one of them should be connected to the computer *ground*, and the other to the least significant bit (LSB) of a *parallel* input port. A pull-up resistor to +5 V may be required, as with the Southwest MP-LA parallel board. Now, you may have noticed that we are taking serially encoded data and feeding it to a parallel input. That is because many of the UARTs normally used have two faults which make them unusable for our purposes. First, they cannot be configured for five bits, which Baudot is, and second, the available clock is normally faster than 45 baud. So what we will do is present the data to an open port, and let the serial-to-parallel conversion be done in software.

Fig. 1 is a diagram of just how that transformation takes place. Recall that the five bit Baudot code is really transmitted as a seven and one-half bit string. First comes the START bit—always SPACE— followed by the five DATA bits, then a STOP bit—always MARK—which is 1.5 times as long as any other bit. Keep this in mind as we scan the flowchart.

To begin with, the computer just sits there and waits for a SPACE to appear on the input line. This means that a character is on the way. The computer then delays for 11 milliseconds (remember that a pulse is 22 ms long), which makes it the center of the START pulse, then an additional 22 ms, putting it smack dab in the middle of the first data bit. Meanwhile, a counter is set up to count down the five data pulses. Each pulse is input into the accumulator, which has its contents shifted after each entry to build a replica of the character there. Again, a 22 ms delay is built in after each sample, to place the sampling time within the data pulse. As an aside, more complex programs could sample each data pulse multiple times, and logically decide whether a bit was MARK or SPACE, thus offering a good deal of noise immunity in the decoding. We come out of this routine, then, with a representation of the Baudot letter in the right side (LSB side) of the accumulator.

Our next task is to convert this Baudot data into ASCII. The method for this is diagrammed in Fig. 2. This is the "lookup table" method of code conversion, which is reliable and fast enough for such a transformation. Because Baudot contains no information as to whether the current character is upper or lower case, a case "flag" must be maintained to tell the program which of two tables, upper or lower case, to use. Receipt of the LTRS or FIGS characters can cause resetting of this flag. So, the incoming character is checked first to see if it is a LTRS or FIGS; if so, the flag is set accordingly. Next, it is tested for a space character which, if present, forces the letters table to be selected. This accomplishes a software "downshift-on-space." Also, carriage returns are decoded as an entire carriage-return/line-feed/erase-line string, and line feeds are trapped and not decoded. If none of the exceptions are encountered, the table looks up the character at the address pointed to in Baudot and supplies the ASCII equivalent.

Now it gets easy. Most, if not all, monitors have a routine to output a character in the accumulator to the terminal. It's called OUTEEE in Motorola MIKBUG™. All you have to do is call that routine and you're in business, right? *NO!* If you stop to think for a minute, realize that while all this looking up and converting has been going on, the next character has been warming up to come down the pike. In fact, you can consider that the time you have to send the character is from after you get the fifth bit and decode until the next START pulse is expected. That's approximately the width of the STOP bit: 31 ms! A 110 baud terminal, like an ASR-33, is just too slow to receive 60 wpm RTTY! The minimum speed for acceptable copy, with no margin of safety, is 300 baud; faster is better. This limits us to TVTs or rapid printers. An alternative is to put the text into memory while displaying it, and have it read back at 110 baud later, for the slowpoke ASR-33s in the crowd.

Next month I will cover the implementation of this program on an SWTPC 6800 system in some detail. For those of you anticipating trying it, I will tell you that you need the reed relay or equivalent installed, an MP-L or MP-LA parallel input port, and not very much memory. The whole shebang will run in under 2K of RAM. Those of you with other systems may take a stab at writing some programs. Send any good ones along and we may include them in future columns.

For those of you who cannot stand "one more article about dem blasted computers," bear with me next month. You've been outvoted by numerous letters. After that, we'll get back to answering many of the questions sent in.

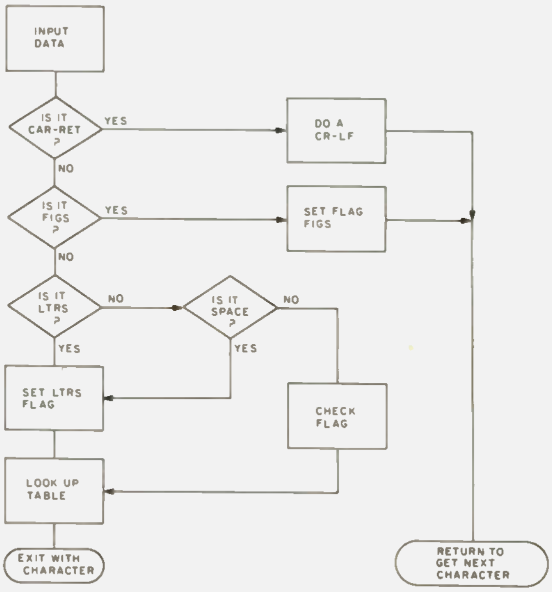

Fig. 2. Decoding.

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AMSAT

ANOTHER AMSAT-OSCAR IS IN ORBIT

Precisely on time and with all the characteristics of a textbook description of a rocket launch, a Delta 139 rocket lifted off from the NASA Western Test Range at Lompoc, California, on March 5 at 9:34 am PST. It was carrying AMSAT-OSCAR 8 as a secondary payload, with its primary mission the LANDSAT-C. There is a third payload aboard. It is the PIX, Plasma Interaction Experiment, devised by researchers at NASA's Lewis Research Center in Cleveland, Ohio. The experiment is designed to study the effects of the space environment on high voltage components in the presence of arcing. This is of significance for high voltage solar panels and ion propulsion systems in future spacecraft.

The eighth OSCAR replaces the capability that had been lost when OSCAR 6 went out of service in the latter part of June, 1977, due to battery failure. *Its demise was hastened by the selfish users who attempted accessing OSCAR 6 with powers many orders of magnitude higher than the recommended maximum of 100 Watts erp.* (A 10 Watt transmitter will get you into OSCAR 7 and also into the new OSCAR 8.)

In AMSAT-OSCAR 8 the mode A translator will provide the same capability that the 2 meter-to-10 meter translator did in OSCAR 6. The uplink passband is from 145.85 MHz to 145.95 MHz with an output from 29.45 to 29.55 MHz. The translation is linear so that an upper sideband input signal will also be upper sideband on the output. The mode A beacon frequency is at 29.402 MHz.

A capability not previously available in the circumpolar orbiting OSCARs is the 2 meter-to-70 centimeter translator with an input passband from 145.9 to 146.0 MHz. This is the mode-J translator with a downlink passband of 435.2 to 435.1 MHz. The descending order is to signify that the output passband is inverted with respect to the input. There is a beacon at 435.095 MHz.

The mode A translator was designed and built by Richard Daniels WA4DGU and Dr. Perry I. Klein W3PK (AMSAT President). The mode J translator was built by members of the Japanese affiliate of AMSAT, known as JAMSAT. JA1CBL, JG1CBL, JG1CDM, JA1JHF, and JR1SWB are among the calls listed as having contributed.

The beacons transmit Morse code telemetry data relating to the condition of the spacecraft and its components. The AMSAT-OSCAR 8 telemetry systems is a product of the efforts of John Goode W5CAY, Dick Daniels, and others. It measures six analog parameters in the spacecraft, and converts them into two digit Morse code values which are transmitted along with a third digit preceding each telemetered value to identify the channel number. The code rate is 20 wpm.

As this is being written, OSCAR 8 is in good health as determined by its telemetered data, and it is open for use by amateurs all over the world. AMSAT, the ARRL, and AMSAT affiliates are urged to prevail upon their members and users not to exceed the recommended power limit of 100 W erp when accessing OSCAR 8 (and OSCAR 7, as well).

It was a primary purpose in hurrying AMSAT-OSCAR 8 into orbit to give back to the schools a space communications vehicle which they could use in science classes to permit their students to have a hands-on experience with space communications, space technology, orbital science, and the computational and technical aspects of this new frontier. For this reason, at the present time the mode A translator will be in operation on Mondays, Tuesdays, Thursdays, and Fridays GMT. The Wednesday periods will be available for experimenters. The mode J translator will be in operation from zero hour GMT Saturday until 23:59:59 Sundays GMT. Orbit information is broadcast on W1AW and the AMSAT nets. For information, contact Bernie Glassmeyer W9KDR at ARRL headquarters, or AMSAT at PO Box 27, Washington, D.C. 20044.

Dr. Norman L. Chalfin K6PGX
Pasadena CA

AMSAT-OSCAR 8 LAUNCHED

A-O-D became AMSAT-OSCAR 8 on Sunday, March 5, 1978. A "textbook" launch fired LANDSAT-C and its passengers into orbit from the Vandenberg Air Force Base in California, 551 milliseconds into the launch window. Radio amateurs around the world followed the launch sequence in real time by means of the AMSAT Launch Day Operations Nets activated by W3ZM, WA3NAN, and others. The voice of Will Webster WB2TNC operating from WA3NAN at the Goddard Space Flight Center in Maryland echoed around the world as he relayed the launch and subsequent phases of the orbit injection sequences. Such was the level of interest that several times no signals were present on 14280 kHz for periods ranging up to 90 seconds at critical points in the mission sequence. These periods of silence on 14280 kHz took place right in the middle of the ARRL DX Phone Contest. Hundreds of stations checked into the nets; many more called in or just monitored the activity.

The flight of the launch vehicle was followed, the ejection of LANDSAT noted, the additional orbit correction burns noted, and then OSCAR was ejected. Then, WA3NAN announced that OSCAR was free. 14280 kHz was silent; then G2BVN called in with the first report of telemetry reception from the AMSAT-OSCAR 8 spacecraft. Minutes later, WØPHD reported the first American reception of signals. Stations reporting reception of the telemetry on the first two orbits included VE6SW, GM8BKE, and N6DD.

WB5MPU reported one frame of telemetry when the satellite was well below his horizon. DL3SX telephoned Washington, D.C., with telemetry data. Early telemetry showed that the spacecraft was spinning at the gentle rate of 1.3 rpm. It was then decided to extend the 10 meter antenna on the first pass over the eastern USA that night. Interest was high; everyone was available and the net opened up on 3850 kHz. Randy VE3SAT, the command station, relayed the sequence of events as he sent the commands to the spacecraft and the "beep, beep, beep" of 435.095 MHz as the antenna deployed was heard.

The initial telemetry data as reported by Roy Stevens G2BVN was: tone, 391 459 556 603 HI 173 251 389 459 556 606. During the first few orbits, the spacecraft stabilized. It should be noted that stations reporting from the USA indicated that channel 6 was showing counts of the order of 601-603, yet stations in Europe were reporting 618-623, showing that signals were present in the uplink passband in Europe.

Joe Kasser G3ZCZ/W3
Silver Spring MD

AMSAT-OSCAR 8 ORBITAL DATA CALENDAR

In cooperation with AMSAT, Skip Reymann W6PAJ expects to have available by the end of May an AMSAT-OSCAR orbital predictions calendar containing all orbits of the new AMSAT-OSCAR 8 satellite for the remainder of 1978.

The orbital calendar will be available postpaid for $5.00 U.S. funds or 30 IRCs ($3.00 to AMSAT members, and free *on request* to AMSAT life members). Overseas orders will be airmailed. Orders and payments should be made in U.S. currency to: Skip Reymann W6PAJ, PO Box 374, San Dimas, California 91773 USA. Orders may also be charged to VISA or Master Charge. (Be sure to provide your account number, expiration date, and other information on your charge card.)

For those still without an AMSAT-OSCAR 7 orbital calendar, a new printing is expected to be available shortly from Skip Reymann. Prices and ordering information are the same as for the OSCAR 8 calendar.

Important: To speed up handling of your order, please include a gummed, self-addressed label.

Proceeds from the orbital calendar benefit AMSAT.

Ham Help

I need a schematic for an RME 4350 receiver. Can someone help?

William Bragg
1424 College
Des Moines IA 50314

I need a manual or schematic for a Heath model OMI scope.

Mickey McDaniel W6FGE
940 Temple St.
San Diego CA 92106

I would like to hear from any amateur radio operator who is using a heart pacemaker.

Joseph Schwartz K2VGV
43-34 Union Street
Flushing NY 11355

I am looking for some information on using an 1821 transmitting tube as a final amplifier in a 2 meter SSB transmitter. I have checked through a lot of *73 Magazines* but have not come up with any articles using an 1821 tube.

John Flynn K3BDO
1925 Kansas Ave.
McKeesport PA 15131

FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Amendment of Part 97 of the Commission's Rules concerning operator classes, privileges, and requirements in the Amateur Radio Service.

Docket 20282

RM-1016, 1363, 1454, 1456, 1516, 1521, 1526, 1535, 1568, 1572, 1602, 1615, 1629, 1633, 1656, 1724, 1793, 1805, 1841, 1920, 1947, 1976, 1991, 2030, 2043, 2053, 2149, 2150, 2162, 2166, 2216, 2219, 2256, 2284, 2449

Second Report and Order

Adopted: March 22, 1978;
Released: April 6, 1978
By the Commission: Commissioner White dissenting.

1. On December 16, 1974, the Commission released a Notice of Proposed Rule Making in this proceeding which was published in the Federal Register on December 20, 1974 (39 FR 44042). A First Report and Order was released on June 15, 1976 (41 FR 25013). This Second Report and Order is a further step in the resolution of the very complex and far-reaching proposals of the Notice.

2. In the Notice, the Commission proposed to expand the frequencies available to Technician Class licenses. Presently, Technicians may operate in the bands 50.1-54.0 MHz, 145-148 MHz, and on all amateur frequencies above 220 MHz. The proposed rules would have permitted operation on all amateur frequencies above 50 MHz. This proposal was supported by the American Radio Relay League (ARRL) in its comments, and by numerous individual amateurs.

3. In light of actions now being taken in Docket 21033 concerning frequencies available for repeater station use, we believe the time has come to grant expanded frequency privileges to Technicians. Specifically, we will amend Section 97.7(d) of the Amateur Radio Service Rules to permit Technician Class licensees to operate on all frequencies above 50 MHz. We believe this action will give greater flexibility to such licensees who wish to do experimental and weak-signal work in the 50 MHz and 144 MHz bands.

4. In Docket 20282 the Commission also proposed to make the Novice Class operator license, which is currently a two-year nonrenewable license, a five-year renewable license. There was strong support for this proposal in the comments, and we are adopting it as proposed. We are amending Section 97.13 of the Rules accordingly. Licensees now holding Novice Class licenses may renew them upon proper application.

5. In view of the foregoing, we believe that the amended rules, as discussed above, are in the public interest. Accordingly, pursuant to authority contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended, it is ordered that Part 97 of the Commission's Rules is amended as set forth in the attached Appendix. It is further ordered that this proceeding is continued. The rule amendments adopted herein become effective May 15, 1978.

FEDERAL COMMUNICATIONS COMMISSION
William J. Tricarico
Secretary

APPENDIX

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is amended, as follows:

1. §97.7(d) is amended to read, as follows:
   §97.7 Privileges of operator licenses.

(d) *Technician Class.* All authorized amateur privileges on the frequencies 50.0 MHz and above. Technician Class licenses also convey the full privileges of Novice Class licenses.

2. In §97.13, paragraph (b) is deleted, paragraphs (c) through (f) are redesignated paragraphs (b) through (e), and paragraph (a) is amended, as follows:
   §97.13 Renewal or modification of operator license.

(a) An amateur radio operator license may be renewed upon proper application.

PART 97—AMATEUR RADIO SERVICE

[6712-01]

Amateur Radio Operation in the 220-225 MHz Band in Portions of the States of Texas and New Mexico per Previous Commission Order

AGENCY: Federal Communications Commission.
ACTION: Editorial order.
SUMMARY: The FCC is deleting a restriction on the operation of amateur radio stations in parts of Texas and New Mexico in the 220 MHz-225 MHz band. This action is being taken to make the FCC's amateur radio rules consistent with the FCC's Table of Frequency Allocations.
EFFECTIVE DATE: April 10, 1978.
ADDRESS: Federal Communications Commission, Washington, D.C. 20554.
FOR FURTHER INFORMATION CONTACT: Mr. Gregory Monroe Jones, Rules and Legal Branch, Personal Radio Division, Safety and Special Radio Services Bureau, 202-634-6619. (This is not a toll-free telephone number.)
Adopted: March 24, 1978.
Released: March 29, 1978.

Order. In the matter of Amendment of part 97 of the Commission's rules to delete §97.61(b)(6), concerning amateur radio operation in the 220-225 MHz band in portions of the States of Texas and New Mexico per previous Commission Order.

1. On November 22, 1977, the Commission adopted an Order which eliminated footnote NG 13 to the Table of Frequency Allocations, §2.106 of the Commission's rules. This footnote imposed restrictions on the use, by the Amateur Radio Service, of the 220-225 MHz band in certain areas of the United States.

2. The deletion of NG 13 removed the restriction on the use of the 220-225 MHz band by amateur stations between the hours of 0500 and 1800 local time Monday through Friday, inclusive, in those portions of the States of Texas and New Mexico in the area bounded on the south by parallel 31°53' N., on the east by longitude 105°40' W., on the north by parallel 33°24' N., and on the west by longitude 106°40' W. Amateur stations are now permitted to operate on the 220-225 MHz band in all portions of the United States subject to the continuing restriction of footnote U.S. 34, which prohibits harmful interference to the Radio-location Service.

3. Footnote NG 13 is duplicated in §97.61(b)(6) of the rules. The Commission's Order of November 22, 1977 only deleted Footnote NG 13, however. It did not eliminate §97.61(b)(6). This Order deletes §97.61(b)(6).

4. Since the amendment we are adopting is editorial in nature, the prior notice and public procedure provisions of the Administrative Procedure Act, 5 U.S.C. 553, are not applicable. Authority for this action is contained in sections 4(i), 5(d), and 303 of the Communications Act of 1934, as amended.

5. *Accordingly, it is ordered*, That §97.61(b)(6) of the rules is deleted as shown in the attached Appendix effective April 10, 1978.

FEDERAL COMMUNICATIONS COMMISSION
Richard D. Lichtwardt
Executive Director

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is amended as follows:

1. In §97.61, authorized frequencies and emissions, limitation (b)(6) is deleted and designated (Reserved) as follows:

§97.61 Authorized frequencies and emissions.
(a) * * *

Frequency band	Emissions	Limitations (see par. (b))
* * *	* * *	* * *
Megahertz		
* * *	* * *	* * *
220-225	A0, A1, A2, A3, A4, A5, F0, F1, F2, F3, F4, F5	5
* * *	* * *	* * *

(b) * * *
* * * * *
(6) [Reserved]
* * * * *

Ham Help

Help! I've purchased an oscilloscope at an auction and now I need a schematic/operation manual for it. Letters to the manufacturer are unanswered and phone calls end in no listings in Glendale, LI, NY. It is a Paco Electronics Co., Inc. (Precision Apparatus Co.), direct coupled dc to 5 MHz. wide band oscilloscope, model #S-55, serial #2772.

I will gladly pay reasonable copying/shipping, etc., costs for the information.

Donald M. Fielding W4FGT
2207 NW 61st Place
Margate FL 33063

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MIDLAND MI
JUN 3

The fourth annual Midland hamfest sponsored by C.M.A.R.A., Inc. (Central Michigan Amateur Repeater Association) will be held at the Midland County Fairgrounds in Midland, Michigan, on June 3, 1978. Camping Friday night will be $4.00 per trailer. The swap and shop on Saturday will be from 7:00 am until 3:00 pm. There will be a big computer demonstration with many systems on display running. The drawing for door prizes will be held at 2:30 Saturday. Tickets will be $1.50 in advance, $2.00 at the door. Kids under 12 are free with parent. Send an SASE with your check to: D. Zahm WB8SDJ, 3871 Monroe, Rte. 8, Midland MI 48640. For commercial exhibits, reserve in advance by contacting J. Gunsher W8JDW, 4307 Bluebird Dr., Midland MI 48640. Tables will be available at the door or by reservation now (approximately 3' x 6') for $2.00 each. Talk-in on 07/67 Midland and 13/73 Pleasant Valley, portables on 52. An auction sale will start at 1:00 for all the stuff you don't want to take home. Take I-75 north to U.S. 10 west (Midland) to the Eastman Rd. exit.

MINNEAPOLIS-ST. PAUL MN
JUN 3

Dakota's Division's largest swapfest and exposition for amateur radio operators and computer hobbyists will be held on Saturday, June 3, at the Minnesota State Fairgrounds. Free overnight parking for self-contained campers on June 2 only. Talk-in on 16/76 and 52/52. Sell from your car in the giant flea market. Inside space available. There will be many great prizes, and forums are scheduled on FM and microprocessors. Admission will be $2.00. For information or reservations for commercial exhibit space, call (612)-933-2823.

CHELSEA MI
JUN 4

The West Washtenaw swap and shop, sponsored by the Dexter Amateur Radio Club and the Chelsea Communications Club, will be held at the Chelsea Fairgrounds on June 4th, from 8:00 am to 3:00 pm. Donations are $1.50 in advance, $2.00 at the gate. Table space will be sold at $.50 a foot, and trunk sales are $1.00 per space.

ISLIP NY
JUN 4

The next hamfest sponsored by the Long Island Mobile Amateur Radio Club, LIMARC, will be held Sunday, June 4, 1978, at the Islip Speedway, Islip NY. The gate will be open from 9:30 am to 4:00 pm. General admission is $1.50. All licensed amateurs are expected to purchase a ticket, regardless of sex or age. Ladies and children 12 and under will be admitted free. Sellers' and exhibitors' spaces are available at $3.00 per space. Each space entitles you to have one person enter the grounds. All ticket holders will participate in the door prize drawings, so be sure to save your ticket. Food and refreshments will be available. Use your knowledge in the theory contest or your luck in the who-traveled-the-furthest-to-the-hamfest contest. LIMARC VHF tune-up clinic will be on hand to put you on frequency. Check FM deviation and spurious emissions. Be sure you bring a power cord. There will be a computer display, and ATV, satellite, and ARRL information. The speedway is located on Route 111 (Islip Ave.) one block south of exit 43 of the Southern State Parkway. Commercial vehicles must come via the Long Island Expressway to exit 56 and go south on Route 111 to the speedway. Talk-in on 146.25/85 and 146.52. For information and advance ticket sales write to Hank Wener WB2ALW, 53 Sherrard St., East Hills NY 11577. Please enclose an SASE. Call Hank—days (212)-355-0606, nights (516)-484-4322 or call Ken Denston WB2RYC, nights only, at (516)-379-6463.

WEST HUNTINGTON WV
JUN 4

The Tri-State Amateur Radio Association (TARA) will hold its 16th annual hamfest on Sunday, June 4, at 11:30 am at Camden Park, Rte. 60, West Huntington, West Virginia. Talk-in on W8CA/8, 04/64, 16/76, and 34/94. For information and tickets, write: TARA, PO Box 1295, Huntington WV 25715.

PRINCETON IL
JUN 4

The Starved Rock hamfest will be held on June 4, 1978, at the Bureau County Fairgrounds, Princeton, Illinois. Advance registration is $1.50 if postmarked before May 25; after that it's $2.00. Send a large SASE, please, for registration, map, information, etc., to W9MKS/WR9AFG/SRRC, RFD #1, Box 171, Oglesby, Illinois 61348, or phone (815)-667-4614.

ROME NY
JUN 4

The Rome Radio Club will host its 26th consecutive Ham Family Day on Sunday, June 4, 1978. This is a true ham family event, with a program tailored to the amateur radio operator and his family.

WEBSTER MA
JUN 4

On June 4, 1978, the Eastern Connecticut Amateur Radio Association will hold its 4th Annual Giant Fleamarket at the Point Breeze Restaurant, Webster, Massachusetts. For information, call (203)-928-5930.

MANASSAS VA
JUN 4

The "Ole Virginia Hams" A.R.C., Inc., Annual Hamfest will be held on June 4, 1978, at the Prince William County Fairgrounds, located ½ mile south of Manassas VA, on Rt. 234. Gates will open at 7 am for tailgating and 8 am for general admission. There will be fantastic prizes again this year—a Drake TR4CW transceiver with RIT and ac power supply, a monitor scope, a Bird wattmeter with element, and many others. General admission will be $3.00 per person, under 12 free. Tailgating will be $2.00 per vehicle, with over 300 spaces available. Breakfast, lunch, and refreshments will be served by

Continued on page 162

Ham Help

I would like to hear from anyone wearing a Teletronics pacemaker from an Australian-based company. I am wearing one.

C. F. Poole
116 Grandview Dr.
Fenton MO 63026

I recently purchased a Knight T-60 transmitter and a Knight model KG-650 rf generator. I am in a quandary as to where I might locate operating and servicing manuals, as well as schematics for both units. I would be willing to pay for the copies.

Thomas S. Thiesing
11005 Westonhill Drive
San Diego CA 92126

Please help! I have a Morrow radio system. I would like to have it operating when I get my Novice license. I need a schematic and manual for the MB-560-A transmitter and the FTR-2. I will pay copying, postage, and handling charges.

William R. Good
PO Box 73
Harborcreek PA 16421

I'd like to get in touch with someone who has an image intensifier tube, or who knows where they can be obtained for use in amateur astronomy.

George W. Smythe
POB 846
Stony Brook NY 11790

I need information on the DAVCO DR-30 receiver— toroid and coil specs, possible availability of parts and PC boards, circuit design, etc. The company was in Tallahassee, Florida, and went out of business about 10 years ago. Can anyone from the company still be contacted? I'm trying to restore a DR-30 which had been "redesigned" by a "technician."

Harry A. Winship K5HML/9
4256 Jamie Court
Indianapolis IN 46226
(317)-897-4568

Help! I need a speaker enclosure (with speaker intact) for my Hallicrafters SR-160 transceiver. I don't need the power supply with it (I already have that), but that's the only way amateur radio dealers I've phoned will supply it, and most of them want to sell the rig, too! Any help would be appreciated.

Timothy M. Mrva WD8QLB
PO Box 234
Elsie MI 48831

I am interested in locating and communicating with amateur radio operators handicapped or disabled. I would also like any information possible on clubs or radio nets of this nature.

Gary Mitchell WA1GXE
PO Box 1003
Fairfield CT 06430

I would like to acquire the January, 1975, issue of *73 Magazine* to complete my collection. Can anyone help?

Douglas McArtin
411 Bellevue Ave.
Yonkers NY 10703

I would like to know if there is a ham club in the Sunbury, Pa., area which helps people get their Novice licenses.

Kevin Shipe
Box 1714 HUB
Dickinson College
Carlisle PA 17013

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The radio.

Wayne Green W2NSD/1
Editor/Publisher

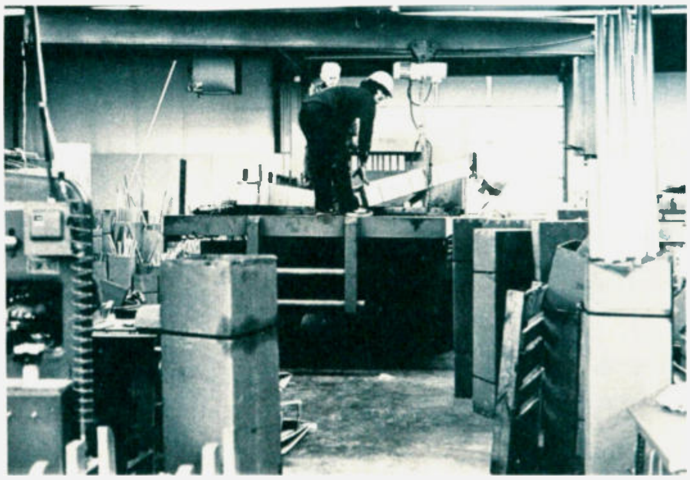
Happiness Is Being A Ham Manufacturer

—73 visits Cushcraft

It may come as a surprise that there is one firm in the ham antenna business which makes more antennas than all the other manufacturers combined. That firm is Cushcraft, operating out of Manchester, New Hampshire.

Just last year, Cushcraft built a brand new plant in order to try and keep up with the growth of the business. This plant was designed and planned by Bob Cushman WA1QFY, son of the founder, Les Cushman W1BX.

Les started Cushcraft in 1950, specializing in VHF antennas. At the time, he had three or four employees and was doing a lot of the work himself. Now, in new quarters with about 100 employees, Les is still keeping in close touch with everything.

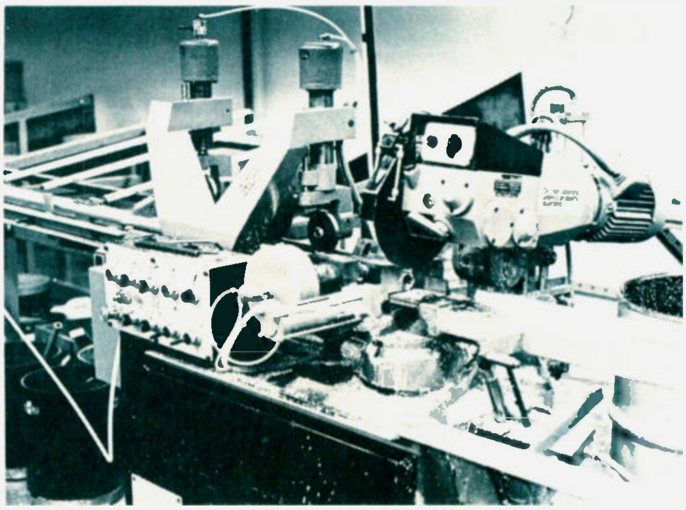


The plant is laid out so that a truck can drive right into one end of the place to deliver raw materials—aluminum tubing for elements and booms, stock for clamps, coils, etc. Here, Dick St. Hillaire is unloading a long box of tubing with an electric winch. Why bother to drive the truck inside? You haven't been through a New Hampshire winter, or you wouldn't ask.

When I needed some special VHF antennas for the *73* radio lab up on Mt. Monadnock, I naturally went to Cushcraft for them. We ended up with a 336-element two meter beam which laid a signal down the east coast that you wouldn't believe. A ham down in Hampton, Virginia, claimed that, when conditions were stinko, the W2NSD/1 signal was only down to S-7. The Cushcraft 16-element six meter collinear also put out a wicked signal, particularly when backed with a kilowatt.

Since I find it interesting to visit some of our manufacturers, I thought you might like to see where the Cushcraft antennas come from.

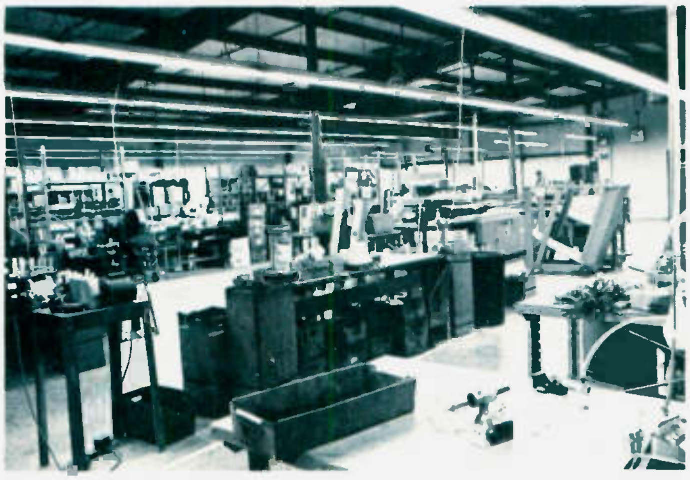
Looking at the Cushcraft antennas from the standpoint of a user, they have their pluses and their minuses. The minus is that the confounded things never wear out, so, once you put up an antenna, you are darned well stuck with it. The plus is a consistently



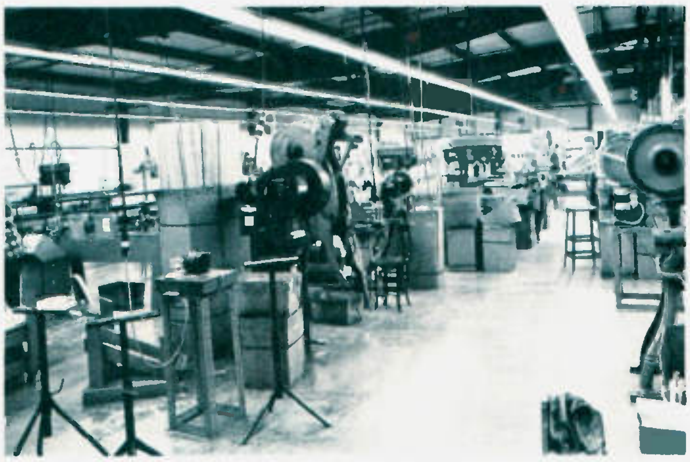
The larger tubing is cut into the right lengths by this automatic tubing saw.

Here's Ray Doville and Claire Jacob assembling baluns for the Cushcraft three-band beams.

Debbie Narcos is checking the pruning of a coil with an oscillator and frequency counter. They come to her a bit low in frequency, and she gets them right on with the coaxial cable "pencil sharpener" next to her hand.



As we progess through the long buildings, we find more and more parts being made for the antennas—special clamps, Ringo Ranger hardware and tuning stubs, and all those nice things that come pouring out of an antenna box when you open it for assembly. Toward the back of the plant are racks of shelves full of these finished parts, ready for packing.

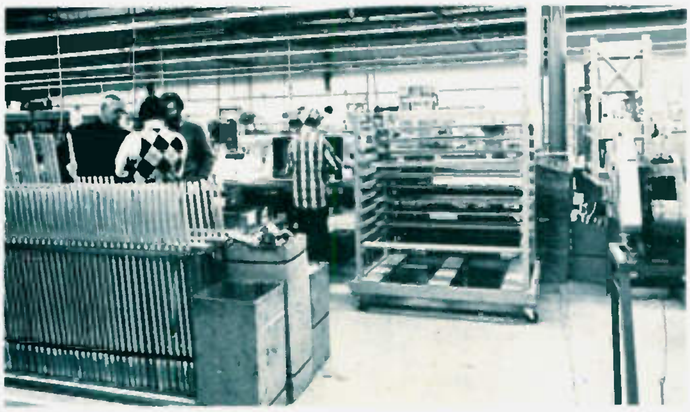


Here's the press department where elements of the various antennas are cut to length and drilled for mountings.

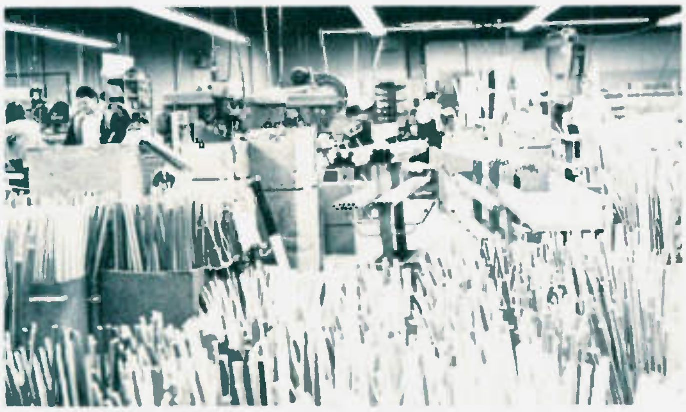
good signal.

I put a three-element 20m Cushcraft up in 1965 and immediately found myself banging heads with the top DXers . . . and winning. I got on one contest weekend and worked 100 countries on 20m sideband. Within one month, I had 200 countries and, within a year, 300. When I called them, they came back.

It was even more impressive on the other end. In 1966, I made a trip around the world, oper-

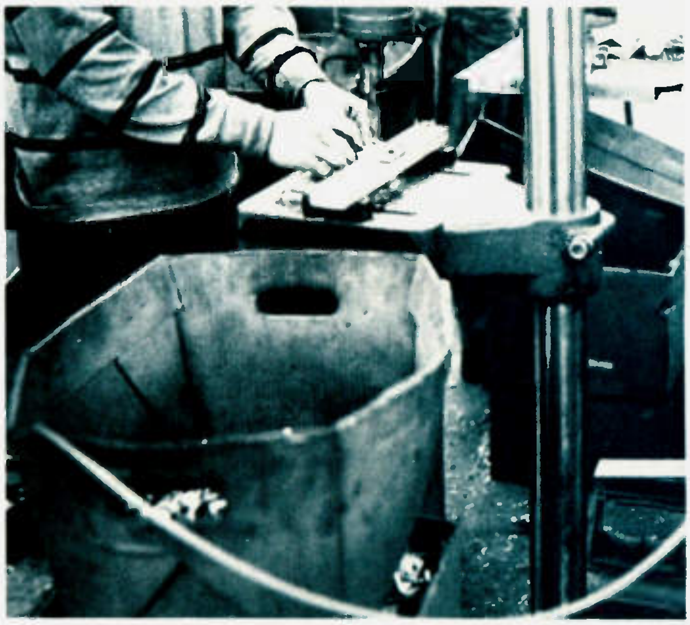


Once the coils are pruned and tuned, they go to the epoxy department so they'll be immune even to New Hampshire weather and California rains.



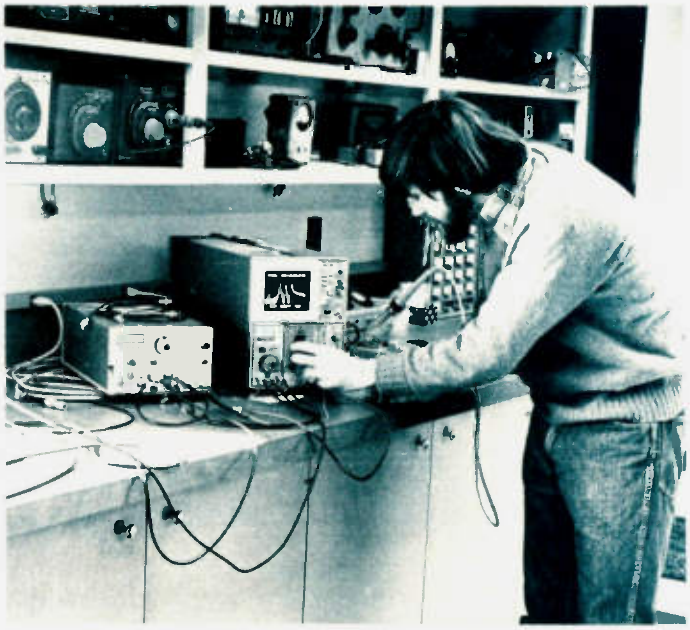
This is the prepackaging department where all of the parts for the antennas are gathered together for packing in the cartons.

Les Cushman talks with Bob Brown about a detail of a loading coil that he wants changed a bit. Les stays right on top of everything that's going on.



Element clamps and other small parts are machined with these drill presses.

Skin packaging is done here on antennas which will be sold through stores on display racks.



In the lab, where new antennas are developed and current designs are checked for performance, we see Dale Clement WA1FSZ checking the tuning of a three-band beam. The test setup is a ham's dream, with a motor-driven tower for changing antennas easily (well, relatively easily), a frequency sweep spectrum analyzer, and an antenna pickup range fed with hardline coax.

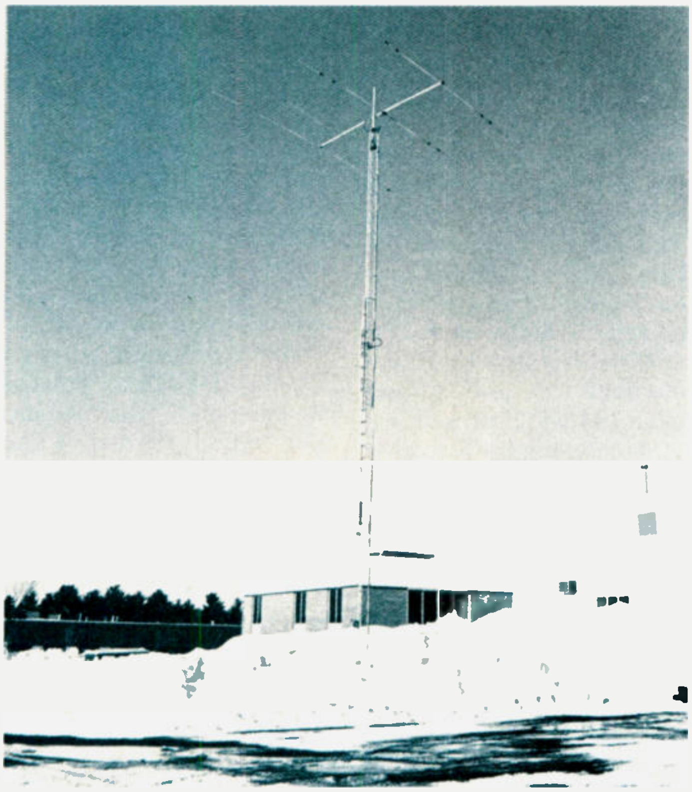
ating from some very rare spots such as 5Z, OD, YK, YA, VU, 9N, 9V, FK8, VR2, KS6, 5W, FO8, etc. No matter where I was, my home station signal would come boiling through.

Some big VHF beams which were first used in 1963 are still being used every year by a local ham group for the VHF contests. Those antennas first suffered massive icing on my mountain, and now they are trucked from Boston to a New Hampshire mountaintop and set up once or twice a year and they're still going! Cushcraft, you make them too good!

That 20m beam lasted for more than ten years before I replaced it with a new Cushcraft beam. Not bad, considering the rough New Hampshire winters.

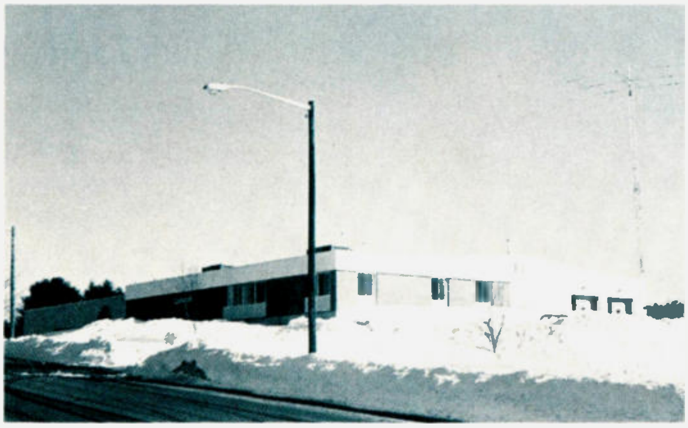
The next time you see a Cushcraft exhibit at a ham show, be sure to go over and say hello. Les doesn't get to very many shows; he prefers to stay in New Hampshire and give some of his new antenna ideas a workout on the ham bands. Bob gets around to some shows, but, other than that, he sticks close to the plant, keeping the antennas moving out to dealers. ■

Using a spectrum analyzer, the response of the three-band beam can be clearly seen . . . just in case there was any doubt in your mind about a three-band beam being tuned carefully. Zero frequency is at the left of the screen, with the first pip being the 20 meter response; then there's the 15m and, at the right, the 10m response. The little blips are shortwave stations putting in signals strong enough to show up. That blip way over to the very right is probably a local two meter repeater.



Here's the crank-up tower with a three-band antenna in place for testing. Yes, on rare occasions we do have snow in New Hampshire . . . we have to—the ski areas would raise all hell if we didn't.

Here are hundreds of Cushcraft antennas all set to be shipped out to dealers to fill orders. The manufacturing efficiencies of this new plant make it so Cushcraft can gear up and make a few hundred of a particular model within a few minutes, so it is not necessary to carry huge backlogs of antennas in order to quickly fill orders.



Overall view of the Cushcraft plant, located in an industrial park just south of Manchester, the largest city in New Hampshire.

By an odd coincidence, right across the street from Cushcraft is Infotecs, an innovative firm in the microcomputer field which was written up in the May issue of Kilobaud. Infotecs is the first firm to come along with a complete microcomputer package for an individual industry—the fuel oil delivery business. Their low cost and incredibly complete combination of computers and programs have been revolutionizing the fuel oil business in New Hampshire and have already spread to nearby states, with Infotecs' ability to meet the demand being the controlling factor in their growth.

Harry D. Hooton W6TYH
1420 Shamrock Lane
Lincoln CA 95648

Extended Double Zepp

—old-timer's delight still works

My first transmitting antenna, way back in 1929, was a full-wave centerfed radiator with open-wire line-tuned feeders, commonly known at that time as a "double Zepp." As amateur radio progressed, this antenna became known as a "pair of half waves in phase." Still later, another version appeared and was called the "extended double Zepp" antenna. The very latest version used 5/8-wavelength elements and had about 3 dB gain over a half-wave dipole. As any old-timer can tell you, these were potent DX antennas in their heyday, especially when you remember that 50 Watts was "high power" and the latest store-bought receiver was the National SW-3.

Strange as it may seem, the horizontal antennas to be described here were installed as part of a research project on phased and driven vertical arrays with which I was associated during 1976 and 1977. For this project, we needed several reference antennas with horizontal polarization and definitely known gain characteristics. It was desirable that the antenna gains were on the order of 0, 3, and 6 dB; it was essential for a "perfect" match to be obtained between each antenna, reference or otherwise, and its transmission line. The use of coaxial transmission lines was necessary so that we could switch the lines at the transmitter for "instant" comparisons between antennas. The first antenna installed was a half-wave dipole fed at the center with a 1:1 ratio toroidal coil balun and RG-11/U (75-Ohm) line. Since this antenna is not unusual in any way, it is not described here.

The Extended Double Zepp

The second reference antenna was the extended double Zepp with 5/8-wavelength elements. The design frequency for the 15 meter experiments was 21.3 MHz. Normally, the two 225° elements are each cut to a length equal (in feet) to 600/f, where f is in MHz. For 21.3 MHz, the elements L1 and L2 are each 28 feet, 2 inches long. Element lengths for other frequencies may be calculated or taken from Table 1.

In most handbooks, an open-ended stub is shown connected to this antenna at the center, as shown in Fig. 1 at "A". If the distance between the points "o"-"o" and "x"-"x" is equal to 1/8 wavelength, the impedance across the line at the "x"-"x" points will be about 120 Ohms. If you make the open-wire stub 3/8-wavelength long from points "o"-"o" to points "z"-"z", you can obtain any value of impedance along the line as you move from the open end of the stub (very high impedance) toward the point where the stub connects to the antenna elements (low impedance).

Since you need to use an RG-8/U (50-Ohm) coaxial line and a 4:1 ratio toroidal coil balun to match the line and antenna, you will find the appropriate 200-Ohm impedance point down the stub from the antenna at 6 feet, 10 inches. This point, marked "y"-"y" in Fig. 1, is correct for 21.3 MHz. For other frequencies, the distance between points "o"-"o" and "y"-"y" can be calculated from the formula in which the distance in feet equals 145.69/f, where f is in MHz.

If you use RG-11/U (75-Ohm) line, the correct

300-Ohm matching point will be a few inches further down the line in the direction toward the open end. It must be understood that these calculated points of attachment are intended to bring you within the ball park and, in some cases, may be exactly correct. However, the antenna must be resonated and matched as outlined below. The overall stub length for 21.3 MHz will be 15 feet, 4 inches. For other frequencies, use the formula in which the distance in feet equals 326.52/f, where f is in MHz.

The stub is constructed from two no. 12 copper conductors spaced 4 inches apart by means of porcelain spreaders. The two radiator elements are also made from the same size wire. Ordinary plastic-covered household electrical wire, obtainable at any hardware or electrical supply store, is suitable. If you cannot obtain the porcelain spreaders, use plastic rod or hardwood dowels to make the spreaders. In the "old" days, we used maplewood dowels and boiled them in linseed oil to prevent the absorption of moisture.

The Adjustments

The antenna system may be easily matched and resonated for optimum performance if you follow each step in order as follows.

Calculate the length of the two radiator elements and the matching stub from the formulas or select them from Table 1. Cut the wires about 2 or 3 inches longer than the calculated lengths to allow for trimming adjustments during the resonating process. Connect the stub to the antenna elements as shown in Fig. 1.

Calculate the distance of the 200-Ohm impedance point down the stub from the antenna. Once the point is located, peel the insulation from the two wires for a distance of about 4 inches on each side of the calculated and measured point. The output terminals of the balun are connected to the two bare stub wires with flexible leads not over 8 inches long and a pair of copper alligator clips.

Connect an swr meter in series with the coaxial transmission line and the balun input terminal (test point "A"). Raise the antenna at least 10 feet above the ground.

At the transmitter end of the coaxial line, apply a 21.3 MHz rf signal at a level of about 5 Watts. Adjust the swr meter sensitivity and/or the signal level until the swr meter indicator reads exactly full-scale "forward." Throw the swr meter selector switch to "reflected" or "reverse." The reverse indication should be much lower than that obtained with the switch in forward position, but the indicator may not read zero. Move the two alligator clips up or down the bare stub wires to locate the point where the reverse swr indication is the lowest.

The antenna should be pulled up to a half wavelength above ground while observing the swr meter reverse indication. If it is inconvenient to read the swr meter indication when the antenna is raised, connect a half-wavelength piece of coaxial line between the swr meter output terminal and the balun input terminal. Use any type of coax for the half-wave section and any impedance, but make sure that it is exactly a half-wave long. If it is, the swr meter readings will be the same as when connected to a balun input.

If you cannot obtain a complete null (zero indication) on the swr meter indicator by adjusting the two alligator clips, adjust the clips for the lowest indication. Now, trim an inch or so from the length of each radiator element and again adjust the alligator clips for a null. The clip adjustments are not very critical, but an inch or so removed from the radiators or the stub will have a very noticeable effect. By alternately trimming the radiator and stub lengths very carefully and sliding the alligator clips up and down the bare wires of the stub, you should be able to obtain a complete null on the swr meter indicator.

A complete null or zero reverse reading indicates a perfect match between the line and the antenna feedpoint, or an swr of 1:1. In our antennas, with a perfect match at 21.3 MHz, the swr was not more than 1.2:1 at the frequency extremes of the 15 meter phone band. The final adjustments are made so that the swr meter indicates zero reverse when the

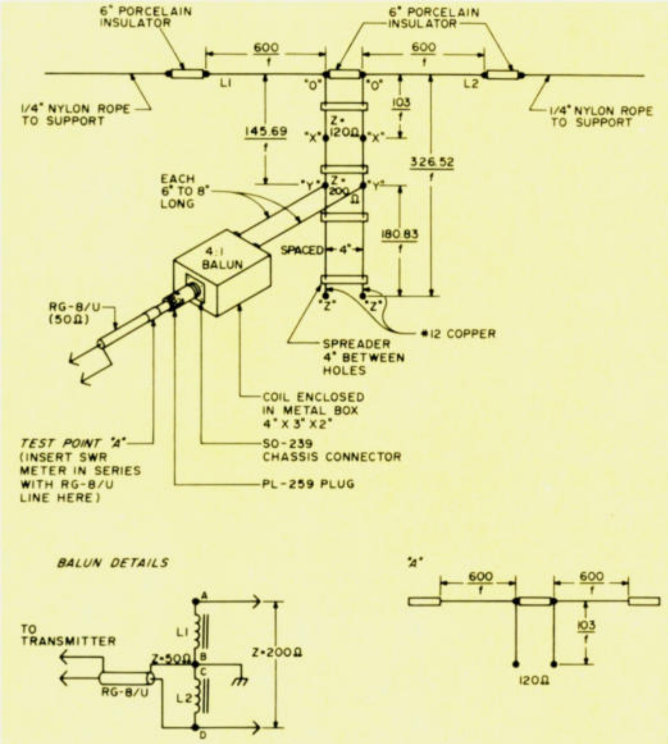


Fig. 1. Extended double Zepp antenna with coaxial line feed. Gain = 3 dB over half-wave dipole at same height; f = megahertz. Dimensions for 21.3 MHz—L1 = 28′2″; L2 = 28′2″; ""o"-"y" (200 Ohms) = 6′10″; "o"-"z" = 15′4″; adjust "o"-"z" dimension and "y" positions for lowest swr at test point "A". L1-2—two 13-turn coils #12 copper, Teflon™ insulated bifilar wound on 2″ powdered-iron core (T-2).

Frequency	L1	L2	o-x	o-y*	o-z
3.750 MHz	160′	160′	27.47′	38.85′	87.0′
7.150 MHz	84′	84′	14.41′	20.38′	45.67′
14.175 MHz	42.3′	42.3′	7.27′	10.28′	23.0′
21.300 MHz	28.17′	28.17′	4.84′	6.84′	15.33′
28.600 MHz	21.0′	21.0′	3.60′	5.09′	11.42′

*Table 1. These dimensions are for the antenna shown in Fig. 1. *Adjust as required. See text.*

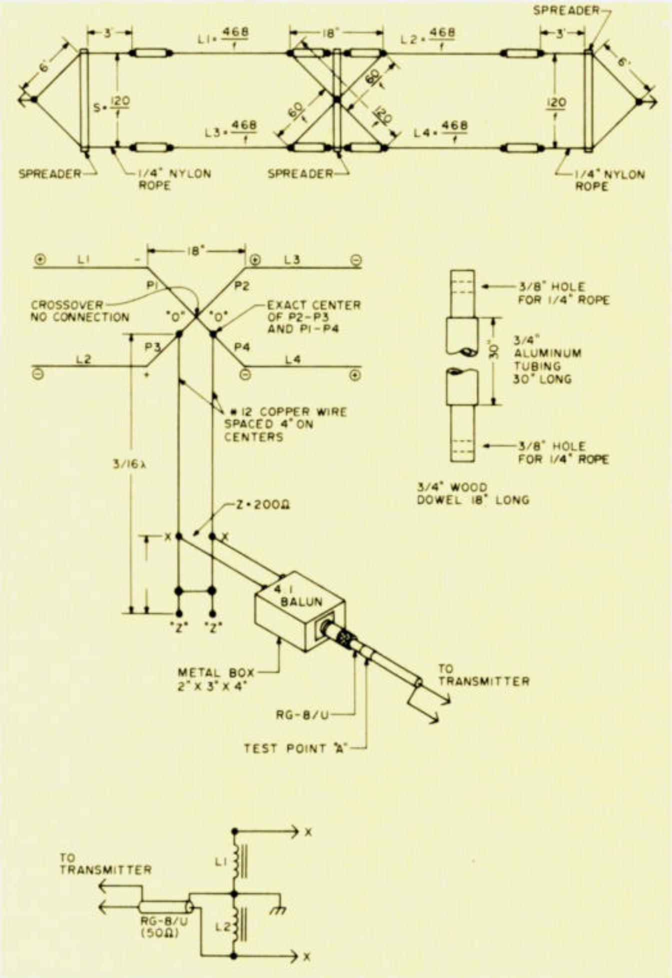


Fig. 2. Four-element array. Gain = 6.2 dB over a half-wave dipole at same height. Dimensions for 21.3 MHz—L1 = 22′; L2 = 22′; L3 = 22′; L4 = 22′;S = 5′7-1/2″; stub (3/16λ) = 8′5-1/2″ between point "o"-"o" and "z"-"z"; 200 point = 24″ between "x"-"x" and "z"-"z". For other frequencies, use the formulas. L1-2—13 turns each bifilar wound on 2″ powdered-iron (T-2) core. Use #12 or #14 copper wire with Teflon insulation. Enclose it in a 2″ × 3″ × 4″ metal box.

antenna is suspended a half wave (about 23 feet for 21.3 MHz) above the earth.

The Four-Element End-Fire Array

Back in the "stone age" of amateur radio, this antenna was generally called an "8JK beam" after the amateur (John D. Kraus W8JK) who originated and publicized it in the technical journals. The version shown in Fig. 2 consists of four half-wave elements—L1, L2, L3, and L4. When the phasing section is connected as shown, elements L1 and L4 will be excited in phase. Elements L2 and L3 are also excited in phase. However, the currents flowing in L1 and L3 and the currents in L2 and L4 will be out of phase by 180° (observe the instantaneous polarity symbols in Fig. 2).

This type of arrangement produces what is called an "end-fire" array. Maximum radiation will take place along a line through the plane of the radiators and at right angles to the four elements. The pattern is bidirectional, and the gain over a half-wave dipole at the same height is about 6.2 dB. Until now, the big drawback with this antenna was that all published designs showed the use of cumbersome tuned feeders or 600-Ohm open-wire lines. In this array, the method of feed is even easier to adjust than that of the extended double Zepp antenna previously described.

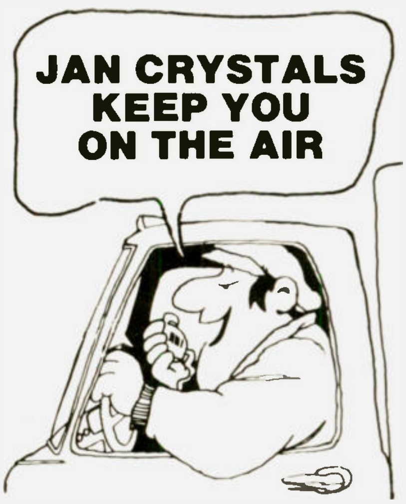
The four radiator elements must be exactly the same length. Use the half-wave formula in which length in feet equals 468/f, where f is in MHz. For 21.3 MHz, each element is 21.97 (22) feet long. If the elements are cut precisely to this length and the array is erected exactly one-half wavelength above electrical ground, no adjustments of the element lengths are necessary. The phasing harness conductors P1, P2, P3, and P4 must be exactly equal in length. The distance from each stub connection point out to the element connection must be precisely the same, or the array will be unbalanced and incorrectly phased. Incorrect phasing will reduce the gain and may cause other problems.

For stub design purposes, the distance from the stub connection on the phasing harness conductor to the element connection is considered to be 1/16 wavelength. The entire phasing harness is looked upon as two 1/16-wavelength transmission lines in parallel. Therefore, if you make the impedance matching stub equal to 3/16 wavelength as shown, you can connect an adjustable "short circuit" (jumper wire) across the lower end of the stub and use it to resonate the array. Since the 1/16-wavelength phasing harness plus the 3/16-wavelength stub equals 4/16 wavelength, or 1/4 wavelength, the "shorted" stub will have a low impedance value at the bottom and a high impedance value at the top. As a result, you can obtain any impedance value by tapping across the stub at the appropriate point along the line.

The 200-Ohm impedance point for the connection of the balun output terminals is about 24 inches up the stub from the jumper wire. Again, I want to emphasize that the impedance connection points are only approximations. Bare the stub conductors and slide the alligator clips up and down for lowest swr indication in the coaxial line at test point "A". If a complete null cannot be obtained with the alligator clip adjustments, move the jumper wire up or down the stub and readjust the clips until a reverse zero swr meter indication is obtained. Once the correct adjustments have been made, solder the jumper wire across the stub and clip off the unused ends of the stub. At the balun connection, remove the alligator clips and solder the balun output leads directly to the stub conductors at the exact points where the clips were attached. The final adjustments should be made with the elements suspended a half wavelength above ground.

Summary

These antenna systems are actually much easier to adjust than the above description might indicate. The only test equipment required is an swr meter and a low-power signal source whose frequency can be accurately controlled. The average Novice should be able to construct and adjust these "beam" antennas if the instructions are carefully followed. The extened double Zepp antenna will effectively double your radiated power. The 4-element job will give you an effective radiated power gain of four times. All references are to a half-wave dipole at the same height. ■



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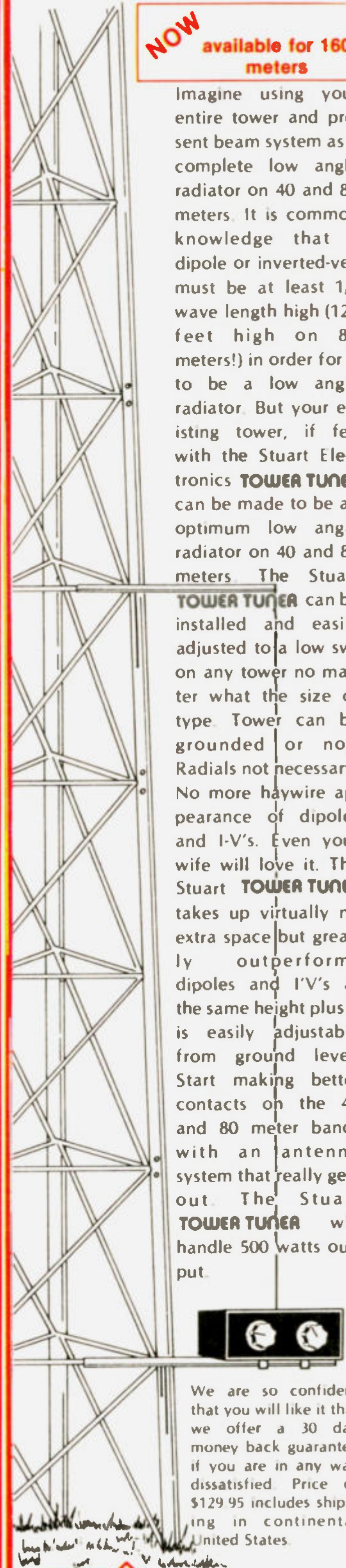

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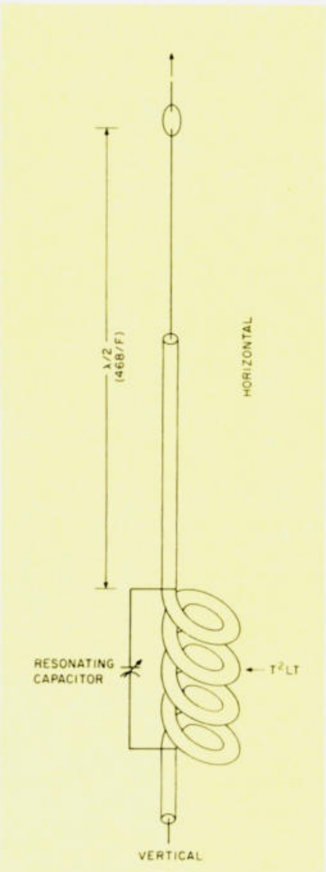

Fig. 1. The T²LT endfed antenna.

A previous article[1] of mine described the T²LT (Tuned Transmission Line Trap), its construction, and its use to prevent feedline radiation when used with a centerfed horizontal dipole. There are many applications for this unique device. The object of this article is to describe the use of the T²LT to end feed either horizontal or vertical dipoles.

Fig. 1 shows a sketch of the T²LT used to end feed an antenna. The coil is made of the shield of the coaxial feedline; the capacitor is the value required to resonate the coil at the operating frequency. The number of turns in the coil may be as few as one. With a low number of turns, the resonating capacitor will be large, the Q high, and the bandwidth narrow. The antenna performance increases with the Q of the T²LT.

The T²LT operates in this application because of the ability of coaxial cable to simultaneously carry differing currents on the inside and the outside of the shield of the coax. Usually, a current flowing on the outside of the shield of a coaxial cable is undesirable. However, in this case, this outer current is the antenna current of one side of a half-wave dipole, and it is required for the unit to operate as a half-wave antenna. Fig. 2(a) shows the current distribution in a half-wave dipole, and Fig. 2(b) shows the corresponding current distribution in the T²LT endfed dipole. To behave as a half-wave dipole, the T²LT endfed antenna must have the same current distrubution on the outside of the coax shield as the dipole of Fig. 2(a). In particular, this current must go to zero at the ends of the dipole. The end of the wire insures zero current at the far end of the half-wave antenna, but the characteristic of the current at the T²LT end depends upon the impedance of the T²LT.

Impedance is defined as the ratio of the voltage to the current. Since the current at each end of a dipole antenna is zero, the impedance at the

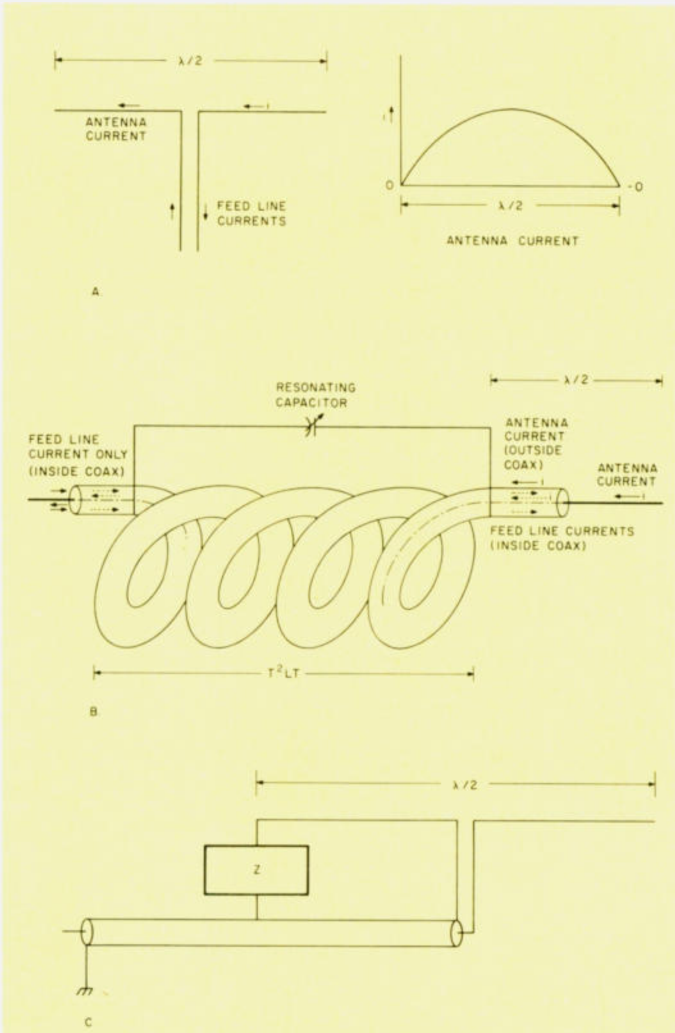

Fig. 2. Antenna current distributions. (a) Dipole currents. (b) T²LT currents. (c) Equivalent connection — endfed dipole.

ends of a dipole antenna cannot be defined. The only impedance that can be connected between the end of a dipole antenna and ground, without changing the current distribution of the antenna, is an infinite impedance. A parallel resonant tank circuit, theoretically, has infinite impedance across its terminals. Real, high-Q resonant tank circuits can have an impedance greater than 100,000 Ohms. A low-loss high-Q T^2LT can, therefore, approach the desired infinite impedance.

Fig. 2(c) shows, topologically, how the impedance of the T^2LT is connected to one end of the half-wave dipole antenna. Fig. 3 shows the radiated power, measured at a distance of 10 wavelengths, from a 20 meter dipole as a function of the impedance connected between ground and one end of the antenna. Here it can be seen that a very high impedance is required of the T^2LT if the antenna is to perform properly.

Some authors[2,3,4,5] have described an endfed dipole with an rf choke instead of a T^2LT. These authors incorrectly presumed that the impedance at the end of a half-wave dipole antenna was defined and was approximately 4,000 Ohms. This, however, is the impedance of a half-wave radiator fed against an ideal ground plane,[6] not the impedance at the end of a half-wave dipole. Fig. 3 indicates why these previously published designs of endfed dipoles have never become popular.

On the contrary, my T^2LT vertical antennas have given excellent DX performance. Using a 2-Watt HW-7 on 20 meters, I consistently receive an S-8,9 report from VE6s in Calgary. That must be where the first skip lands.

Captain Lee[7] discusses the advantages of a ground-isolated vertical dipole but adds, "How one is to feed this antenna from a practical standpoint is never mentioned." I say, do it with a T^2LT! The T^2LT-fed vertical is ground independent and thereby avoids the extensive ground system required for conventional verticals.[8] This antenna permits DX performance when using battery-powered, portable — even QRP — equipment. I have successfully used the T^2LT to feed shortened antennas, less than $\lambda/4$ in length, which answers the height problem associated with a half-wave vertical. The shortened antenna requires an appropriate unbalanced to unbalanced impedance matching transformer at the dipole center.[9]

Photos A and B show details of a T^2LT endfed antenna that was hastily constructed for OSCAR downlink communications. The T^2LT is simple to build, easy to adjust, and it outperforms conventional vertical antennas. ■

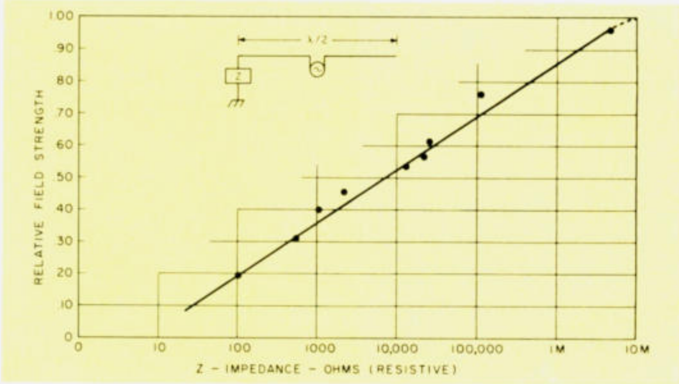

Fig. 3. Field strength as a function of impedance between dipole end and ground.

Photo A. T^2LT of 10 meter vertical dipole.


Photo B. Electrical center of T^2LT vertical antenna.

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New York NY 10010

The Cliff-Dweller's Delight

—*how to operate from an apartment*

For years, numerous hams have tried to solve the perennial problem of the apartment-dwelling amateur and the severe restrictions on antenna design and effectiveness which result from his environment.

Some of the more successful approaches have been published; however, I have invariably noticed something peculiar about most of them. It seems that in an attempt to meet all of the apartment dweller's requirements (invisibility, low cost, reasonable effectiveness, easily accessible materials, etc.), one finds a "hidden requirement." This is often in the last sentence of the article, where the author indicates that 18-karat gold was used throughout due to its fine properties (including conductivity), or that the author's apartment shack is located a short distance from Mt. Everest.

I have been faced with these same problems for many years and have discovered a completely satisfactory solution which has been in use for approximately two years. The primary design consideration was inconspicuousness, for getting involved with the landlord or superintendent was out of the question. Although the other criteria were relegated to lower priorities, this approach does satisfy all of them.

This antenna approach involves the use of a Hustler mobile antenna (and its associated resonators, for each band), horizontally polarized, working against the building as ground.

Early experimentation indicated that a quarter wavelength antenna, horizontally polarized and working against the building as a ground plane, was surprisingly effective. However, at 20 meters and lower frequencies, antenna length becomes a prohibitive factor. These results, coupled with my experiences working mobile stations, led me to try the Hustler. It (or another similar antenna) is ideal.

Mounting this antenna horizontally proved to be a reasonable challenge. At first, I used a swivel-type ball mount on a block of wood, swiveling the antenna against the building when not in use. This was crude and caused me great concern about structural integrity! I then stumbled upon the Hustler quick-disconnect mount. Success!

With the quick-disconnect mount, the entire antenna and resonator can be removed and kept indoors when not in use, satisfying my first criterion. I keep this quick-disconnect on a fixed ball mount, which is in turn fastened to an aluminum minibox (about 1" x 3" x 3") permanently attached to my windowsill. The ground side of the antenna is connected to my metal window frame, which, although small, works quite well. I have also used a counterpoise with equal success. My swr is about 1.3 to 1.

How effective can this crude, inexpensive, expeditious "apartment dweller's beam" be? Judge for yourself. My antenna is fed through fifty feet of extremely lossy RG-58U and is driven by a TS-520, barefoot. I spend little time DXing, yet still have been able to work about fifty countries over a few months. Surprised? So was I; however, consider the following: Before I had acquired the TS-520, my only rig was a Heathkit HW-7 (*2 Watts out*) and I logged ten states in just a few days using this same antenna! Prior to this antenna, DX meant working Staten Island (I live in Manhattan).

One other thing. If you're not comfortable letting the antenna "dangle" by its mount, you can support it further using nylon fishing line, fabricating non-metallic hooks for easy removal.

Needless to say, the overriding advantage of this antenna approach is that it is removable. By simply opening your window and twisting the quick-disconnect mount, it's gone. If you're daring, use it during the day. Otherwise, wait until the sun sets and fire up the rig.

In summary, let me say that there is a tremendous difference between a 5 by 7 from Queens NY and the sound of disbelief in the voices of the UKs and ZLs I've QSOed with recently when I've told them about my shack.

Try it. This may finally be your way out of the apartment dweller's dilemma. (No, I don't live at the top of the Empire State Building!!!)■

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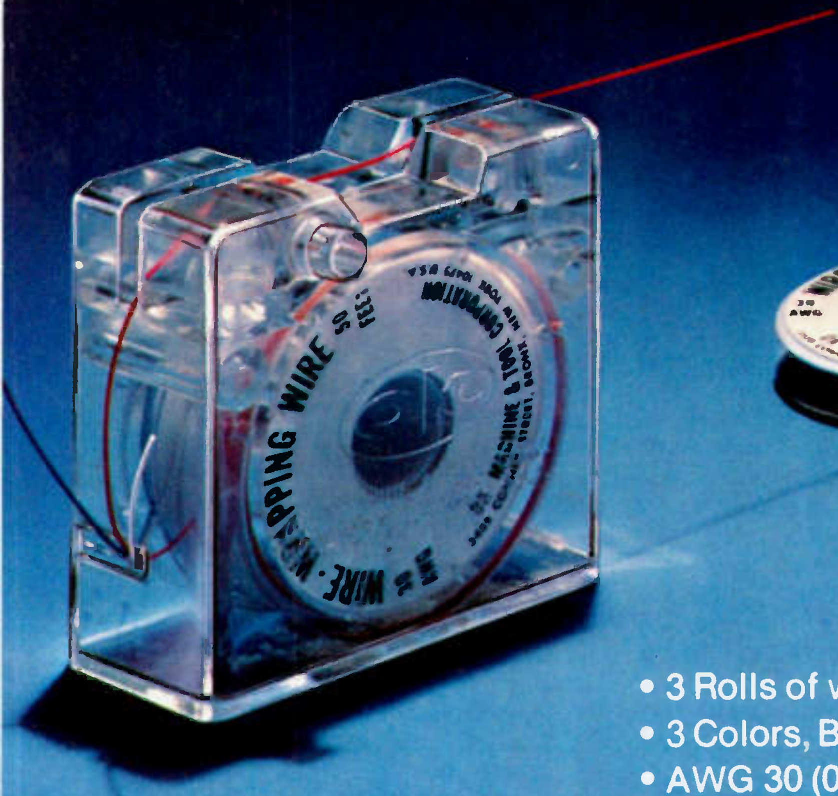

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The next problem was money. I did not want to spend a lot of money on a multi-element commercial beam.

Well, if I wasn't going to buy a beam, I would have to build one. So I started looking through the *ARRL Antenna Handbook* and many an old ham magazine. Nothing I saw seemed to fit my needs. Either the mounting hardware of the antenna elements looked too complicated to fabricate, or the antennas were designed for 300-Ohm feedline. Of course, 300-Ohm feedlines can be dealt with with baluns, but I wanted to use coax throughout, since I wasn't worried about the dB or so I might lose through the coax cable.

I finally found what I wanted in an article in *73 Magazine*, June, 1975.[1] The article described and even gave exact dimensions for 6- and 8-element 2 meter beams cut for operation at 146 MHz. Their construction methods and materials were simple and low cost (coat hangers and PVC pipe).

With a good design to work with, I could now tackle the materials problem. Our household always seems to be lacking coat hangers, so another antenna element material would have to be found. While visiting a local hardware store, I found some 3/16-inch-diameter medium steel wire in a 50-foot coil for less than $3.00. While at the same hardware store, I also decided to use 1-inch-diameter aluminum tubing for the boom, rather than use PVC pipe as was used by the authors of the antenna article.

With antenna materials in hand, it was time to start building the antenna. The first problem was to straighten out the coiled wire and cut it up into the lengths of each one of the antenna elements of the beam. For the first couple elements, I used a heavy pair of diagonal cutters to snip off the antenna element from the rest of the wire coil. With my hand cramping from cutting the wire, I decided that there must be a better way to cut the wire. After some thought, I decided to try a small tube cutter on the wire. This little tool turned out to work quite nicely and worked better than the diagonal cutters.

With all the antenna elements cut to size, the next problem to overcome was how to mount the antenna elements to the boom. I first thought about drilling a hole through the center of each element and then bolting the element to the boom. However, the single hole through the element seemed like it might not be very stable when mounted to the antenna boom. After some more thought, I came up with the mounting clamp arrangement shown in Fig. 1. The clamps

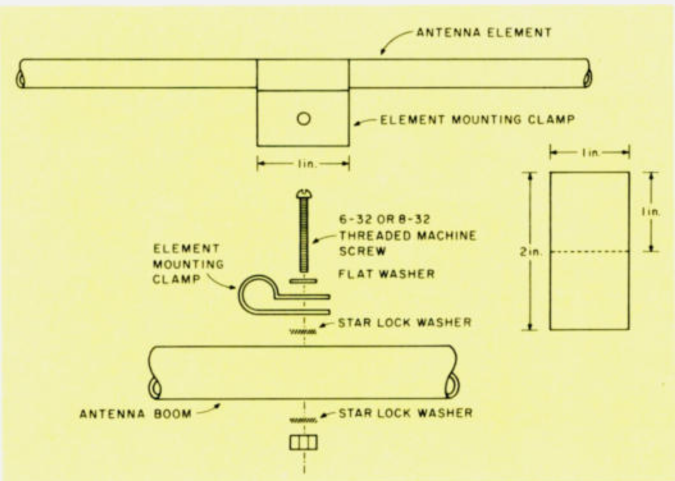


Fig. 1. Antenna element mounting details.

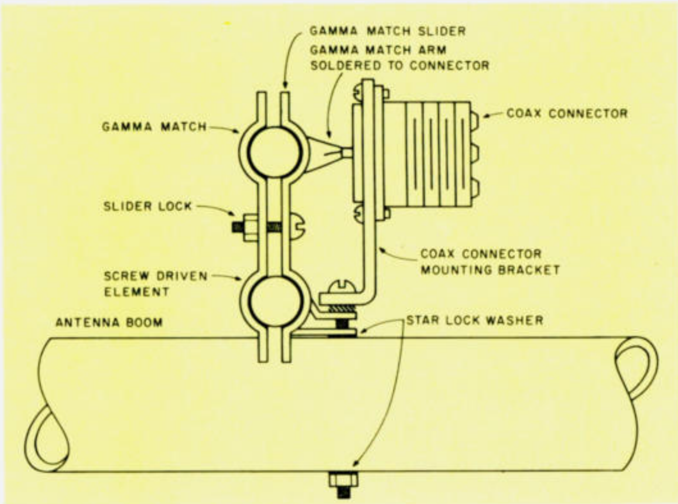
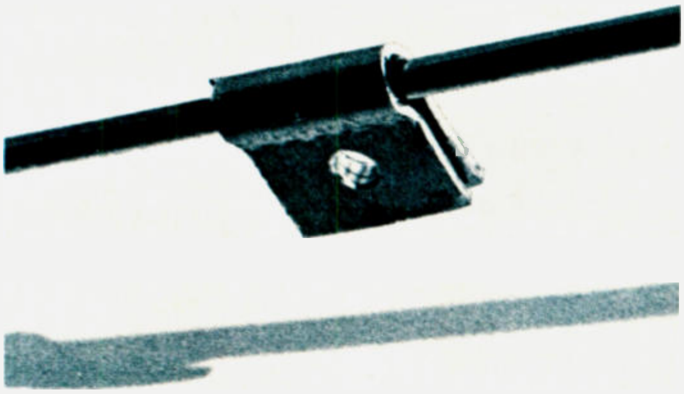
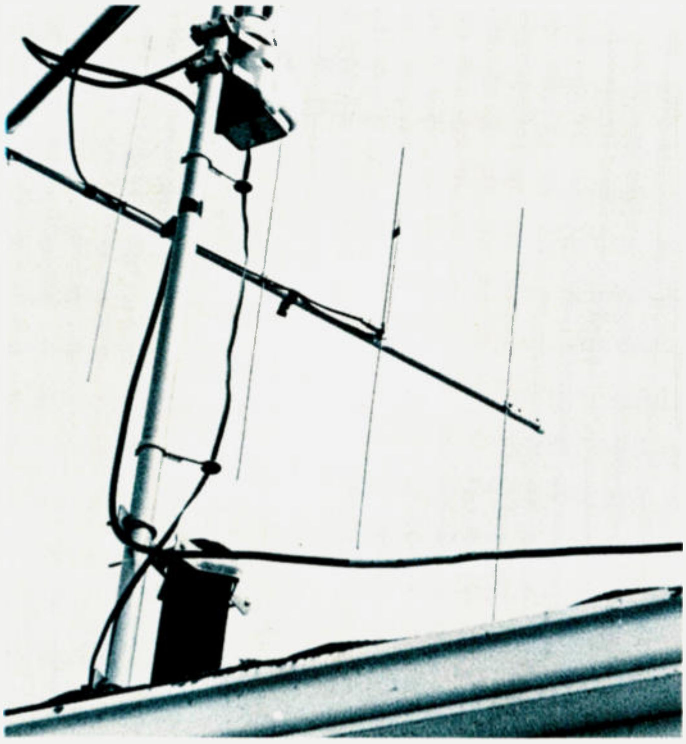


Fig. 2. Driven element — gamma match details.



Antenna element mounting clamp.



Driven element — gamma match arrangement.

are made by cutting a 1-inch by 2-inch by 1/16-inch strip of aluminum and bending it, from the middle, around the center of the antenna element. Each one is clamped tightly around the antenna element by pressing the clamp-element arrangement in a vice. Once the clamp has been formed over the antenna element, a mounting hole is drilled in the top of the center of the flat portion of the clamp. The hole drilled in the clamp should be just large enough to accommodate the mounting machine screw. Each element of the antenna is fitted with an element clamp, including the driven element, which should be cut as one piece rather than two dipole quarter-wave pieces, as was described in the original article.

Since a 10-foot length of 1-inch-diameter aluminum tubing is not too easy to find, two shorter pieces can be joined together to form the 10-foot boom. Joining the two pieces of tubing can be done in several ways. However, one of the better ways of doing it is to take a one-foot length of tubing of the same diameter and slice the tubing along its length. Then fold one of the sides along the cut under the other, which makes the tube diameter somewhat smaller than it was. Slide the length of tubing into one of the lengths of tubing to be joined until the smaller diameter tube is about halfway into the longer piece of tubing. Then slide the other half of the antenna boom over the smaller diameter tubing. Drill two holes through each end of the joined pieces of tubing so that the holes are spaced about four inches apart and are also drilled through the smaller diameter tubing now inside the boom pieces. Put machine bolts through the holes and tighten them down. The antenna boom is now assembled and rigid enough to be used for the antenna. As an alternative to an aluminum boom, a 10-foot length of 1 x 1 inch wood could be used for the boom after it is treated with several coats of varnish.

The antenna went together easily and took about eight hours to make. Now the only problems to tackle are the ones that will undoubtedly show up (courtesy of Murphy). Sure enough, the first problem appeared after the antenna was put together. I had originally built the driven elements as two separate quarter-wave sections, as per the design in the original article. Even though the driven element was of the proper length electrically and physically, its swr was very high (about infinity to one). This seemed to indicate that the driven-element impedance was no longer about 70 Ohms. A quick check with one of the local antenna design experts, Sam Brooker WB8RFA, via the local WR8ADH repeater, confirmed that the dipole driven element would not have a 70-Ohm impedance when it was mounted with the rest of

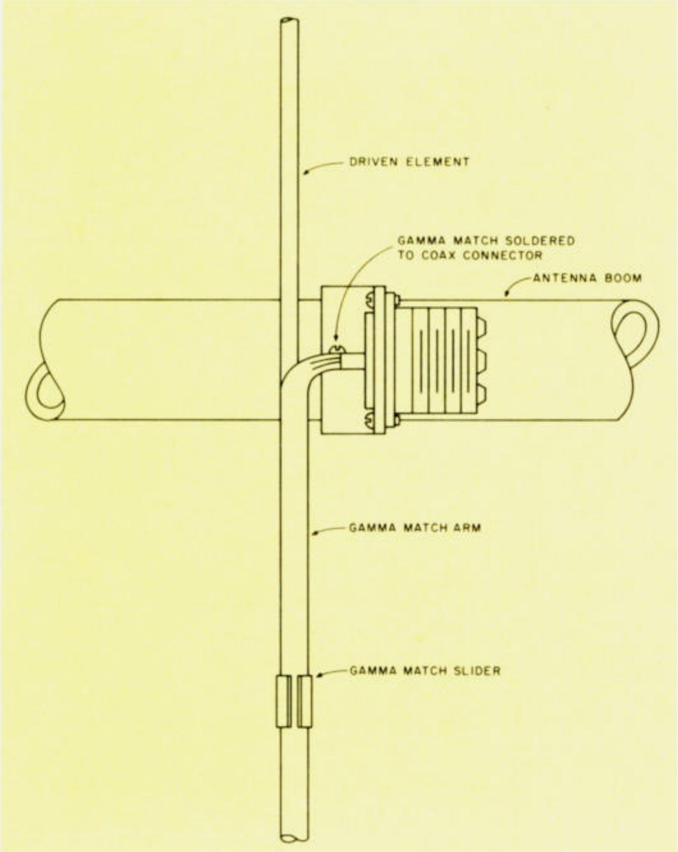
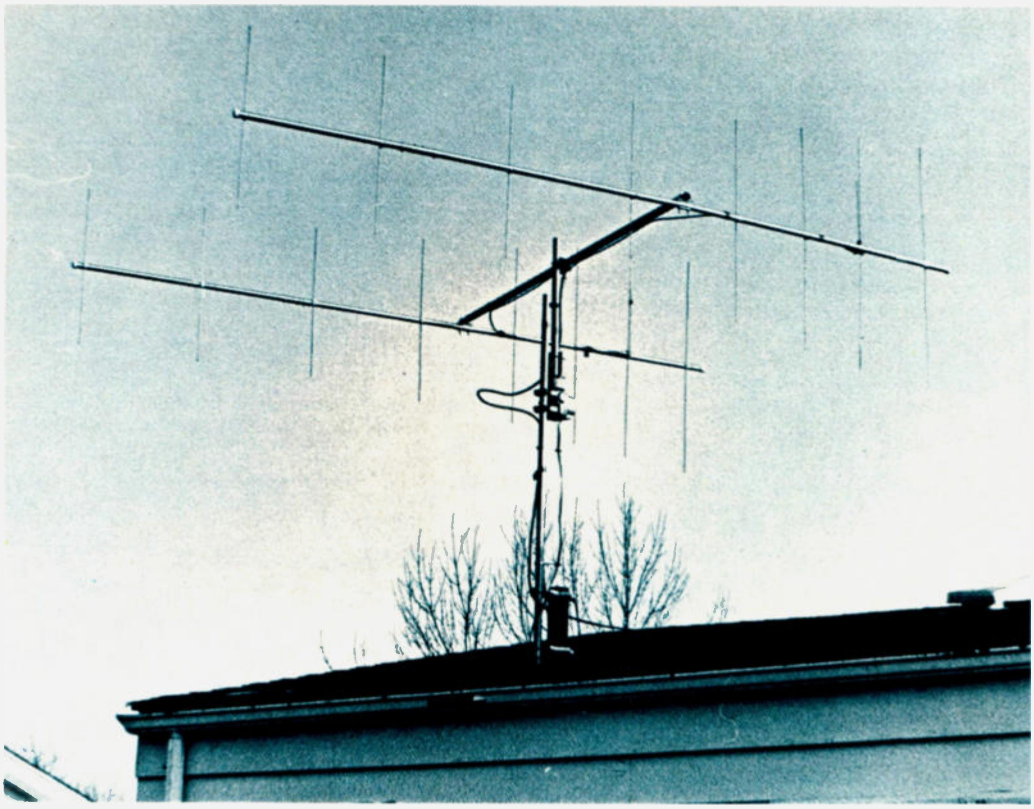


Fig. 3. Driven element — gamma match details.



The completed eight-element stacked antenna system.

the elements. So the driven-element design would have to be changed. I decided to use a single-piece half-wave driven element which used a gamma match for matching the feedline to the antenna. Figs. 2 and 3 give the details on the driven-element/gamma-match arrangement used in the antenna. The new driven-element/gamma-match arrangement worked well and had an swr of about 1.1:1 at 146.52 MHz and stayed below 1.5:1 over the 146.19-146.94 MHz frequency range.

The next problem was how far apart should the two beams be — a quarter, a half, five-eighths, or a wavelength? A look through the *ARRL Antenna Handbook* and the VHF manuals didn't turn up any definite stand on what spacing to use. Experience came to my rescue again. Another conversation with WB8RFA helped solve the spacing question, as well as some questions on phasing harness lengths. It seems that Sam had run into the same sort of decisions and questions when he put up his twin 11-element beams. It seems that common practice is to space the beams a wavelength apart; the theory and exact reasons are beyond the scope of this article. Fig. 4 gives the details of the beam spacing and mounting arrangement I used. This mounting arrangement seems to work out well, since it has survived mild icing and winds up to about 40 mph.

Interestingly enough, the *ARRL Antenna Handbook* and VHF manuals had very little on the added problems of stacking beams. The publications did mention open line feeders between arrays stacked at some optimal spacing. All the VHF antenna systems I have seen used coax for the phasing harness between each antenna and down to below the rotor. Below the rotor, I have seen both coax and 300-Ohm open feedline used for the run down to the shack. However, I could not find any information on how to calculate the length of each leg of the phasing harness. As I have previously mentioned, WB8RFA also gave me the necessary details on how to calculate the length of each leg of the phasing harness. Fig. 5 gives the details of the phasing harness arrangement and the calculations for the phasing harness leg lengths. The length of each leg of the phasing harness is calculated by: (.66) ($\lambda/4$) x odd multiples of $\lambda/4$. Since (.66) ($\lambda/4$) at 146 MHz is short, the value must be multiplied by an odd number of quarter wavelengths in order for the phasing harness to be long enough to reach from each antenna's driven element, along the antenna boom, and back to the feed coax cable at the support pole at the rotor. In my stacked antenna system, I needed 5 quarter wavelengths for each leg of the phasing harness, in order to route the cable along each antenna to the center support pole and T-connector. My proof that the phasing harness works is that the swr didn't change when the phasing harness was hooked

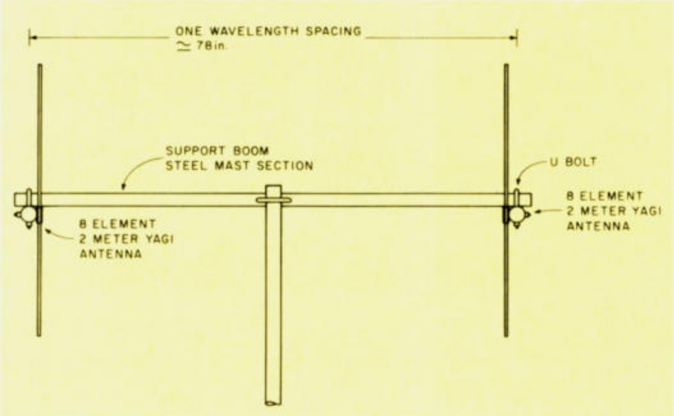


Fig. 4. 8-element 2 meter antenna stacking details.

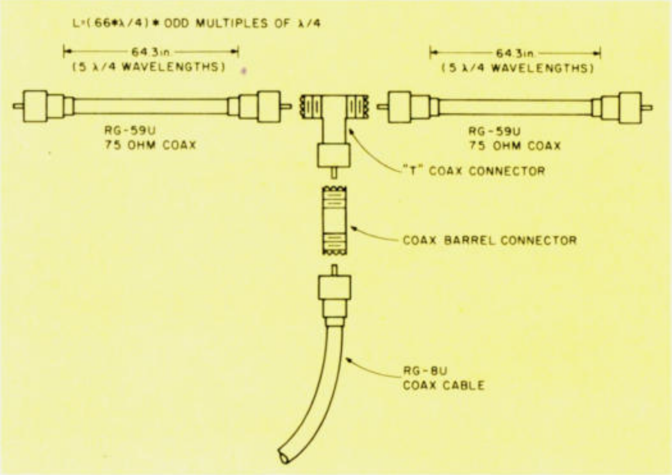


Fig. 5. Phasing harness details for stacking two 2 meter yagi beams.

up, which probably would not be the case if there was a mismatch in the phasing harness. I would like to point out that, once the antennas are stacked, each antenna's gamma match should be adjusted for minimum swr before the phasing harness is attached.

Conclusion

The antenna array (two stacked 8-element beams vertically polarized) is doing the job it was built to do, which was to put an acceptable signal into the 146.19-.79 Milford repeater from my new QTH, even though it is only 20 feet above the ground. Additionally, I now have extended simplex range so that I can move off a repeater frequency pair and rag chew with the locals running only low power (1 Watt).

View of the antenna system mounted on my QTH.

Since I have not run quantitative tests on the antenna system, I am not too sure what my actual gain and front-to-back ratio are. However, I can guess. The original article claimed 12 dB gain for the eight-element beam, with a front-to-back ratio of 14 dB. Assuming my antennas come close in performance to those of the authors, I should have about the same gain and front-to-back ratio for each antenna. Stacking beams is supposed to provide an additional 3 dB of forward gain, so my stacked beams should have a forward gain of about 15 dB. I tried putting a dipole and my commercial 4-element beam at the same height as the stacked beams and did a comparison of how well each would pick up the Milford repeater. With the dipole, I could not key up nor receive the Milford repeater. With the 4-element beam, the Milford repeater signal was pushing the transceiver's S-meter about 1/8 of the meter's full scale. When the stacked eight-element beams were hooked up to the transceiver, the S-meter went up to over 3/4 of the meter's full scale. I could key up the Milford repeater running 1 Watt (10 Watts was needed for reliable communications, though), as well as receive the repeater almost full quieting. So my attempt at building beam antennas seems to have been successful.

Although I feel my construction materials and techniques produced a mechanically better antenna than those of Anderson and Atkins, my costs were somewhat higher, also. Each eight-element beam cost about $10.00, which is about $8.00 more than using coat hangers and PVC pipe. The total cost of the stacked-beam system was about $30.00, which included the cost of each eight-element beam, the phasing harness materials, and the stacking support boom. This price, though, is much, much cheaper than the cost for a comparable commercial eight-element stacked antenna system. Additionally, my construction methods for the 2 meter beams would be suitable for building beams at 220 MHz and at 432 MHz.

But, best of all, I suppose, is that it continuously amazes me every time I come home and look at the good-looking 2 meter stacked beams on the roof of my house and realize that I made them. ■

Reference

1. "Build an 11 dB Coatrack," Kelly Anderson WBØDQC and Walter Atkins, Jr. WBØHKB, *73 Magazine*, June, 1975, page 111.

LETTERS

from page 12

realize just how obnoxious it must seem when we rob the rest of the world's hams of precious band room with our elephantine QRO signals.

And what do you lose when you go QRPp? Well, your station won't impress the CBer down the street unless he's really got his head together. And you won't crash through the QRM the way you once did. And you will really have to "go with the flow" of skip conditions if you want to make the trip to DX land. Perhaps that's just too great a sacrifice. You decide. I'm not saying that there is anything intrinsically immoral about high power. It is simply out of step with today's attitudes about energy efficiency. And the kind of operating that it seems to foster is simply unacceptable to hams of a gentler persuasion.

Troy Weidenheimer WØROF
Ballwin MO

As editor, I get first crack at Troy. I've been the QRP route and I agree that it is fun. But I've also been the kilowatt route and that's fun, too, if different. With low power, you frequently have to settle just for getting through for a fleeting minute or two... enough to get a QSL card. If this is your bag, fine. My own preference is to be able to talk at length with people in odd places and get to know them a bit... to strike up friendships. The chances of doing this on 20m with 20 Watts is small... I ran that power for a few years, so I know about it.

Another thing. When you are operating from remote areas, you find that radio conditions are such that you hear the big signal boys every night. The

Continued on page 56

Dan Umberger W8ZCQ
2753 Elliott Ave.
Columbus OH 43204

Working 15m With A 20m Beam

—by adding three more elements

Every amateur knows he is going to lose an antenna system sooner or later. My "later" came in the form of a terrific thunderstorm on Easter Sunday, 1974. The storm, brief but fierce, left the antenna system looking like a pop art creation. The top of the mast was bent 45°, the 20 meter monobander looked like it was trying a three-cushion moonbounce shot, the 10 meter beam was twisted 90° on the mast, and parts of the 15 meter beam were either blown away or pointed lengthwise with the beam.

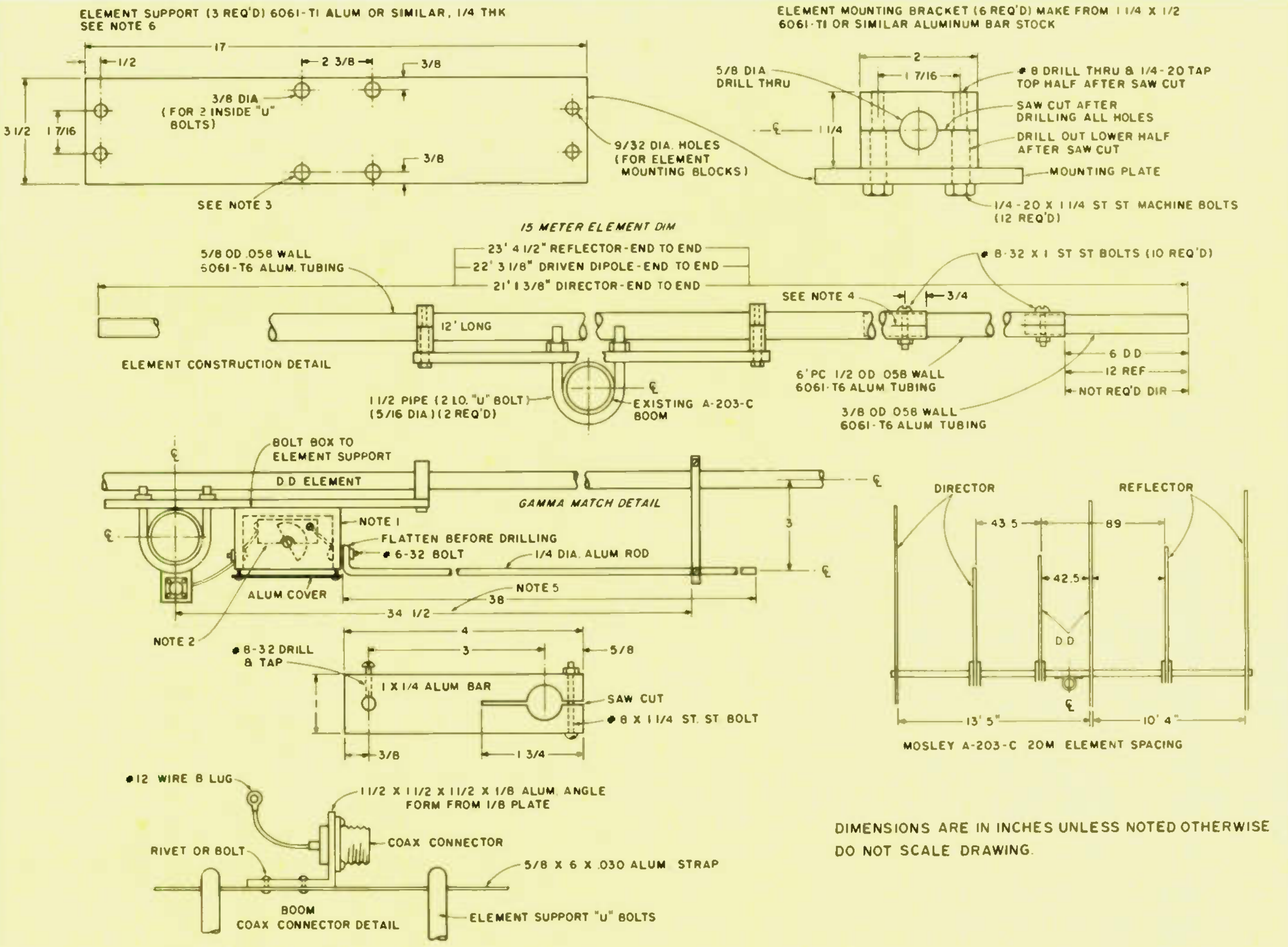
The 10 and 20 meter beams were not particularly damaged, but the 15 was "over the hill." It did not take long to replace the drive pipe and reinstall the 10 and 20 meter beams and I was back in operation on those bands.

My first idea was to build a 15 meter beam from scratch, but I looked at that nice long boom on the Mosley A-203-C and it seemed to be performing no particular function other than holding the elements apart. Why not put the middle of it to work and let it support a 15 meter beam? A look at the physics indicated it would do the job if the mechanical weight and wind load were kept at a minimum.

The primary consideration, and an absolute must, was that the addition of the 15 meter beam could not reduce the effectiveness of the 20 meter beam! Being of the "reverse engineering" type, I build first and design from the results. I was prepared to remove the 15 meter elements if there were the slightest ill effects on the operation of the 20 meter beam. Happily, this was not necessary. The effects on 20 were negligible.

The mechanical details were no problem. The wind load factor dictated that the element diameter be kept as small as feasible. A check with the aluminum department of a metals supply house disclosed that .058" wall thickness tubing was available in diameter increments of 1/8" across a wide range and this tubing telescoped snugly into the next size. This is in 6061-T6 alloy and is commonly referred to as "tempered aluminum." They demonstrated that it could be bent double and would spring right back into shape! Cautiously, I asked the price. It was selling for $4.51 a pound. The wind load factor took on increased importance! The standard length is 12 feet. I decided on 5/8" for the center and 1/2" for the extensions. Three pieces of each would be required. I went home with my bundle of tubing and the project was under way.

I dug into my antenna library and could find little or no reference to common boom antennas. I knew there were many factors involved after reading the work of Shanklin, Greenblum, and Gillison, relating to height, spacing, and element diameter. The complexity threw me. I had about decided to start with the formulas in the antenna handbook when the June, 1974, *QST* arrived with the writeup on the Wilson Electronics DB-54 Duo-Band Antenna by W1FBY in it. I was quite amazed that their element lengths were considerably



Notes

1. 2" x 6¼" x 3½" Bakelite™ box – Radio Shack stock 270 627.
2. Small variable capacitor about 150 pF medium spacing.
3. If boom diameter is other than 2", drill these holes to mate with the required U-bolts.
4. Saw slot to depth of 1¼" to permit the screw to clamp the tubing tightly.
5. Gamma match 26-5/8" for 2 element.
6. Supports sawed from plate. If necessary to purchase, stock width is either 3" or 4".

Fig. 1. Conversion of the Mosley A-203-C for 15 meter capabilities.

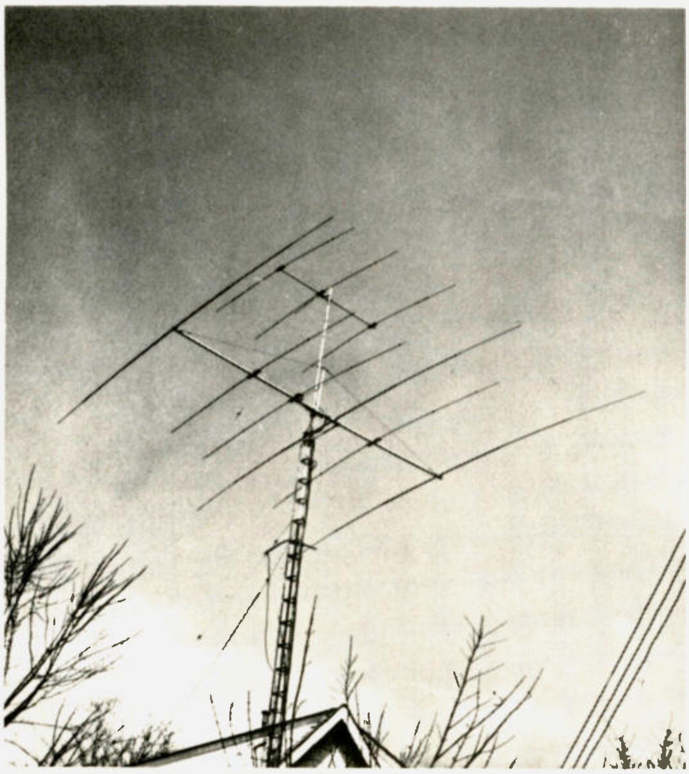
longer than those computed from the ARRL *Antenna Handbook.* Since spacing of elements was dictated by space available on the boom of the A-203-C, I decided to disregard the Wilson dimensions and use the figures calculated from the 1970 edition of the ARRL *Antenna Handbook* for a starter with 23' 4-1/2" for the reflector, 22' 3-1/8" for the driven element and 21' 1-3/8" for the director.

Since spacing was to be determined by how far I could reach from the tower to attach the elements, I decided to try only two elements at the outset. With these two elements in place, it was found that resonance was not at 21,150 kHz as desired, but 21,025 kHz! Decisions! Decisions! The first impulse was to shorten the two elements, but better judgment prevailed and it was decided to add the director and see what the influence would be. With the director in place, the resonance had shifted to 21,275 kHz! From past experience, I knew spacing had a pronounced influence on the resonant frequency of an array, but had no idea it would be so drastic! Yet, this was my first experience with a common boom, interlaced array. However, I concluded the dimensions for the Wilson DB-54 were acceptably accurate.

Any doubts about the mechanical strength and performance were quickly put to the test. The elements were installed before noon. While eating lunch, the weather bureau cooperated beautifully and sent a real howling, shingle-ripping storm worthy of any antenna's mettle. It broke limbs from trees all over the neighborhood, but the converted A-203-C shrugged it off in a most matter-of-fact manner.

The second test, that of performance, was provided by the Northern California DX Association's junket to Kingman Reef as KP6KR. After a local frontal system passed and static cleared enough to hear them, it took one hour, fifty-nine minutes to net them. Discounting local cockpit trouble, I considered the time involved completely reasonable. Performance test passed A-OK!

Not having range equipment to check the pattern, I had to settle for front to back and front to side. The performance as a 2 element did not look so good; it only had 10 dB front to back and 30 dB front to side. With it functioning as a 3-element array, it showed 22 dB front to back and 38 dB front to side. This was below desired performance but acceptable. I feel that with range equipment and careful element adjustment, much better performance could be achieved.

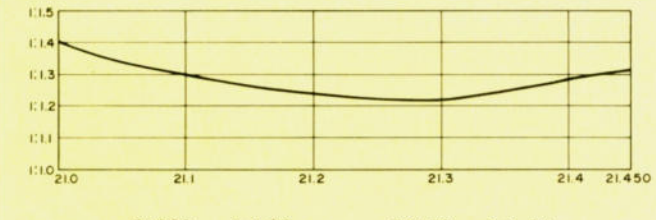


Construction

Element mounting clamps were drilled, sawed, and tapped. They were made from a solid bar of 6061-T1 aluminum 1-1/4" x 1/2" x 12". The 5/8" element mounting holes and the #8 holes were first drilled and the individual blocks sawed apart and sawed lengthwise through. The metal removed by sawing the blocks allowed a firm clamp on the elements. After sawing each block in half, the upper half was tapped 1/4" #20 and the bottom half was drilled out with a 9/32" drill to pass the 1/4" mounting bolts. It is advisable to matchmark the upper and lower half of each of the brackets before sawing them in half in case you haven't drilled them too accurately.

The element supports were sawed from a plate of 6061-T1 aluminum 1/4" x 17" x 10-1/2". The size was dictated by available material on hand. In checking with the aluminum supply house, I found bar stock is available in either 1/4" x 3" or 1/4" x 4". Either would suffice. All holes were laid out and drilled.

Next, cut the 1/2" x 12' tubing in the center. The director and driven element required no extension, but the reflector required extra length. This was accomplished with some 3/8" o.d. tubing salvaged from an old TV antenna. While I was at it, I extended the driven element also, in the interest of mechanical strength at the lap.



21000	1:1.36	21250	1:1.22
21025	1:1.35	21275	1:1.22
21075	1:1.34	21300	1:1.23
21100	1:1.31	21325	1:1.25
21125	1:1.34	21350	1:1.27
21150	1:1.30	21375	1:1.28
21175	1:1.28	21400	1:1.29
21200	1:1.24	21425	1:1.30
21225	1:1.23	21450	1:1.31

Fig. 2. Swr ratio measurements on 21 MHz beam on boom with Mosley A-203-C.

How to fabricate a capacitor for the gamma match presented a problem. I recalled that the local Radio Shack stores stocked Bakelite™ instrument boxes. I chose their stock #270-627, a 6-1/4" x 3-3/4" x 2" with aluminum cover that would house a 150 pF variable from my junk box. A hole was drilled to allow passage for a screwdriver to the shaft. After adjustment of the capacitor, the hole was plugged. I used a 1/4" aluminum rod for the gamma bar, but aluminum tubing would have worked equally well with appropriate modification to the gamma shorting bar. The capacitor box is. bolted to the bottom of the element support. A bracket was fabricated to mount an SO-239 standard coax connector. It is mounted on an angle bracket fabricated from scrap aluminum and has a 5/8" x 6" strap riveted to the angle and is secured to the boom by the "U" bolts that mount the element support to the boom. A short length of the #12 copper wire connects the center connector to a bolt through the side of the gamma capacitor housing box. A generous application of General Cement Corona Dope (Glyptal™) serves as weatherproofing.

Placement of Elements on Boom

The location of elements on the boom was determined by how far I could reach from the tower. Experience had shown it wise to keep the driven elements separated as much as possible to keep interaction to a minimum, with reflector and director placed out as far as I could reach with safety belt extended. I was unable to attain the .1 wavelength for the director and .15 for the reflector, so I had to settle for what I could get for spacing. I feel that improved performance could be attained with greater spacing and range adjustment of element length, but have reservations if improved performance would justify the effort in view of present success with the antenna operation.

Adjustment of Gamma Match

With gamma capacitor and shorting bar set at random, a swr curve is plotted to locate the lowest swr point, disregarding the overall swr picture. The resonance is indicated by lowest swr point. The swr meter is taken up the tower and connected at the antenna. A small signal is fed into the antenna at the resonant frequency and the gamma capacitor and shorting stub are adjusted for minimum swr. After adjustment, the swr was less than 1.5 to 1 across the entire band.

Hardware

It is suggested that stainless hardware be used if it is obtainable. If not, nonferrous hardware should be used. If neither is available, plated steel can be used with shortened life expectancy. If plated steel is used, fog it generously with clear plastic acrylic spray. ■

References

ARRL Antenna Handbook, 1970 and 1974 editions.

"Wilson DB-54 20 and 15 Meter Duo-Band Beam," W1FBY, *QST*, June, 1974, page 40.

Material

3 pcs. 5/8" x 12' x .058 6061-T6 aluminum tubing

3 pcs. 1/2" x 12' x .058 6061-T6 aluminum tubing

1 pc. 1/2" x 1-1/2" x 12" 6061-T1 aluminum bar stock

1 pc. 1/4" x 3" x 5'-6" 6061-T6 aluminum bar stock

1 6-1/4" x 3-3/4" x 2" Radio Shack Bakelite box, stock #270-627

6 ea. 1-1/2 pipe (2" i.d.) "U" bolts

1 lot miscellaneous hardware, a pc. of 1" x 1/4" x 4" aluminum, and capacitor from junk box

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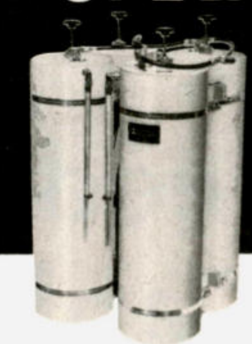

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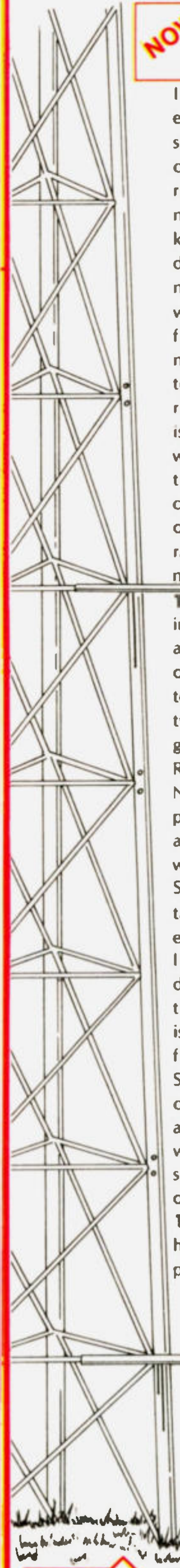

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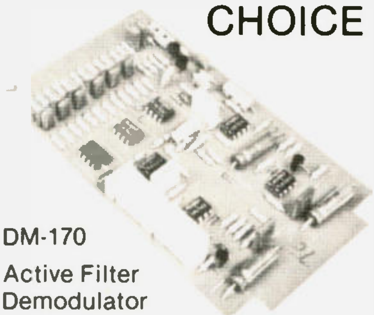

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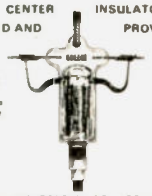

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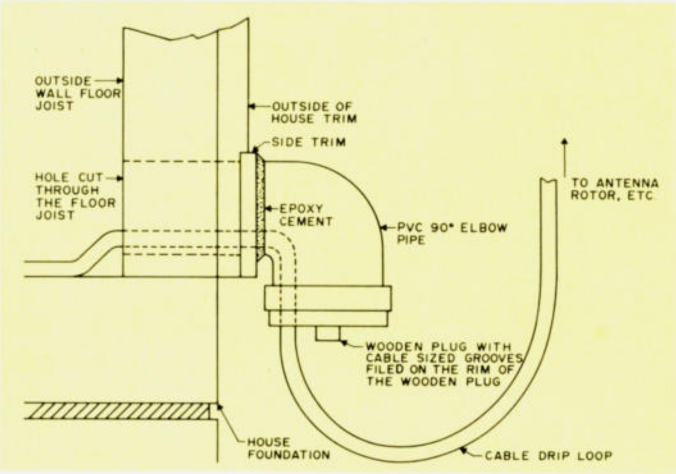

Fig. 1. Flexible method of passing antenna cables into a house.

It was now October, and almost everything had found its niche in our new house. It was now time to set up the ham gear. But how to run the antenna cables into the laundry room, or I mean ham shack, without a lot of work looked as if it would take some time to figure out. Although there have been several methods published for running antenna cables into a shack, none seemed to be flexible enough for my needs. That is, being a careful planner, nothing stays static in my ham shack for very long. So I needed a very flexible way of running antenna cables into the ham shack.

While wandering around a local department store, I found myself in the plumbing supplies department. While looking at some plastic PVC pipe, I suddenly realized that the 1¼-inch diameter 90° elbow I was looking at was the solution to my problem. Using the elbow, I could route several cables into the house and still add a cable or two more, PL-259 connector and all.

Fig. 1 and the accompanying photographs detail how the 90° elbow is mounted on the house. If the

Outside view of the 90° elbow installed with an antenna cable already routed through.

Inside-of-house view of the 90° elbow and the cables routed through it into the house.

house has a basement or lower level (like a bi- or tri-level), the hole for the elbow can be cut, with an appropriate size holesaw, so that the hole is cut through the center of the outside wall floor joist and between any interior floor joists which may be attached to the outside floor joist. The elbow is then coated with quick-setting epoxy around the tapered end and is inserted into the hole on the outside of the house with the elbow opening pointed down. Once the epoxy has cured, the elbow can be lightly sanded and then painted to match the color of the outside of your house.

To keep insects out, either a wooden plug with cutouts for the cables around the plug's edge or a piece of lightly oiled steel wool can be pushed up into the mouth of the elbow. Either way, use something to plug the mouth of the elbow, or you and your spouse will be continuously surprised by the number of creepy crawlies and flying thingies that will find their way into your house (and ham shack) through the unplugged opening of the elbow.

This method of routing antenna cables into the house has worked out quite well for me over the past several months, especially whenever I wanted to route another coax cable into the house. Also, if we should move, the PVC pipe elbow can just be capped with a PVC pipe plug or I could take out the elbow and put a wooden plug into the hole, filling in any cracks with plastic wood. Then sand and paint the repair spot, which should then look like there was never a piece of pipe mounted there. Additionally, this is a simple 2-hour project (depending on how your house was built) that is inexpensive (about \$2.00 for the PVC 90° elbow and epoxy) and not all that hard to do. ■

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 10

making it possible for me to see what I want to see when I want to see it, and to hell with the network schedulers. They run the Jean Shepherd shows at the darnedest hours, so I tape 'em. Jean, who is K2ORS, and an old, old friend, has a wonderful sense of humor. He keeps threatening to write a series for *73*, but each time he goes off on some other foolish tangent . . . like his current TV series, "Shepherd's Pie," shown on PBS. You've probably seen "Jean Shepherd's America" many times, or his "Phantom of the Open Hearth" film on PBS. Through the VTR, Shep's 2 am programs are available while I eat dinner. Sorry about that, Cronkite.

WHAT'S WITH THE COVER?

There isn't any one simple answer to this. Part of it is that I got fed up trying to think of different covers after seventeen years of frustration and deadlines. Sure, we plan ahead: "Hey, Wayne, the magazine goes to the printer this afternoon. What do you want on the cover?"

Another part has been the success of the *Kilobaud* covers, where we've put the table of contents on the cover. The one thing that makes *73* really different from all of the other ham magazines is the quantity and variety of articles published. I counted up the number of feature articles published in *73* vs. *QST* last year and found 429 in *73* as opposed to 164 in *QST*, and I had to count a lot of public service type articles in *QST* to even get that number. I wanted to get across the idea to newcomers that *73* is more like an ongoing encyclopedia of amateur radio than just a magazine. A year after publication, about 90% or more of the magazine is still as good as new, while *QST*, with its acres of operating news, is as dead as yesterday's newspaper.

I'm open for ideas. Frankly, I don't think much of the *QST* approach to covers, nor do I like the *HR* covers. *QST*, which is put together by a committee, *looks* like it is put together by a committee. *HR* manages to look exactly the same no matter how little they change. *CQ*, for those of you who have seen it, looks amazingly like *Poptronics*, *Radio Electronics*, *Elementary Electronics*, *Popular Science*, *Popular Mechanics*, and the rest of the popular tribe. Blah.

So, until someone comes up with something better in the way of an idea for the cover, we'll make do with a dash of color on top and the index to the articles. I have nothing against color covers; I'm just tired of trying to think them up.

WANT TO WRITE A BOOK?

There is little in amateur radio that can compare with having your name on a book. That beats making the Honor Roll, five band DXCC, and all those things. When you have your own book published, it puts you in a special class, for very few amateurs are so much of an authority on a subject that they can write a book.

But let's say that you are an authority and you have a book in you dying to come out and wow the world. Where should you turn for a publisher? There are dozens of publishers of technical books, and it is bewildering to the new writer. Actually, your choices are quite limited. Sure, there are lots of publishers, and there are lots of poor authors, too. If you have a little better understanding of the role of a publisher, you will be better able to make a choice.

A publisher has two functions for the writer. Firstly, he provides the money it takes to get a book set in type, made ready for printing, and then printed and bound. The money required for this is beyond the average author. To give you an idea of the magnitude of money involved, just the printing and paper bill for one issue of *73* comes to well over \$65,000, never mind the cost of setting the type, proofreading, pasting up the pages, getting the diagrams drafted, the photographs made and produced in halftones, etc. The whole process runs considerably over \$100,000 per month.

Getting the book printed is something almost any publisher can handle. The second function is the important one . . . distribution. This is where you separate the publishers. In this field, magazines have a tremendous advantage over other publishers since they have extensive distribution for the magazines all set up and running. They also have it a lot easier when it comes to running ads for a book, a whole lot easier. Magazine advertising is not trivial . . . ask any manufacturer. With ads running from \$1500 a page to over \$3000 in the electronics magazines, advertising can be a deadly expense for book publishers, yet where else can they go to sell their books? Few books make it very far without advertising.

With over a dozen books currently in publication and many more in the works, *73* has a very good distribution system, and the advertising. Thus, if you have a book which might interest amateurs or computer hobbyists, you can do a lot worse than contact the *73* book department. *73* can get your book into print and be sure it is in most of the radio stores and technical book stores, plus offer a substantial mail-order sale through Radio Bookshop.

Get in touch and start those nice royalty checks coming.

FEBRUARY WINNER

J. M. Mendelson W6AQM walked away with February's \$100 prize for the best article. If reader support for antenna articles like "Can A Miniature Antenna Work?" is any indication, this, our June antenna issue, should be a winner. Remember, your ballot is the reader service card at the back of the magazine—use it!

CLUB NEWSLETTERS NEEDED

Every now and then a manufacturer comes up with an idea which will benefit ham clubs and is interested in getting a list of clubs which have newsletters as a way to let clubs in on the special deal. When I hear of something which would really benefit ham clubs, I'd like to have a mailing list of all of the clubs with newsletters in order to pass along this information so these clubs can benefit. Send a copy of your club bulletin to Wayne Green, *73 Magazine*, Peterborough NH 03458.

DALLAS IN JUNE

It's been far too long since there has been a first-rate hamfest in Dallas. You can bet that I'm looking forward to getting back to Dallas for the hamfest on June 17-18th.

The hamfest will also be heavy with microcomputer activities and exhibits, so it should be a lot of fun. The whole works will be at the

Continued on page 187

Resurrecting the Beverage Antenna

—try this 55-year-old, low-noise, lowband antenna

Bill Smith W5USM
Route 2, Box 2281
McKinney TX 75069

One can derive considerable satisfaction from the friendly, leisurely-paced contacts often found on the 160 meter band, contacts which sometimes may be set up simply by erecting an inverted L or dipole antenna and using it both to transmit and to receive. More than likely, though, sooner or later the 160 meter operator begins searching for methods of reducing the level of man-made and atmospheric noise predominant on 1.8 MHz. The simplest solution is to place near the operating position a receiving loop antenna, which may be rotated to "null out" noise sources or interference from nearby stations while the outside antenna continues to be used for transmitting.

The loop will solve many receiving problems, and may well be the only such antenna used to satisfy the needs of the user. On the other hand, a good loop may whet the appetite for an even better receiving system. On 160 or 80 meters, the answer is likely to be a Beverage antenna, named after its primary developer, H. H. Beverage W2BML. Beverage wrote a now classic paper on the wave, or Beverage, antenna which appeared in the November, 1922, issue of *QST*. Even after more than five decades, his article remains the gospel of Beverage theory and practice. If low-noise receiving antennas interest you, locating a copy of the article is a must.

This article will dwell not upon the theory, however, but rather on the practical construction of Beverage and Beverage-type antennas for low noise reception on 160 and 80 meters.

Like most topics in amateur radio, there are as many opinions on how to construct an effective Beverage antenna as there are those offering them.

The substance of this article is drawn from more than two years of collecting articles and opinions and using this type of antenna. Although we are going to describe an antenna that requires a fairly large amount of real estate if constructed in true Beverage form, a satisfactory Beverage-type antenna can be built on a small lot and still provide low noise reception and a degree of directivity.

Admittedly, there are other ways to construct a Beverage antenna than those given in this article, but the ones here are likely to be the easiest and most foolproof.

What Is A Beverage?

In the most simplistic terms, a wave or Beverage antenna is a single straight length of wire at least one wavelength long viewed as a feedline, with one side the wire and the other side Earth.

Just as with a feedline, there is an impedance between the wire and the Earth. This impedance stays reasonably constant along the length of the antenna and with frequency. The antenna may therefore be used over a wide frequency range; a Beverage designed for the 1.8 MHz band will perform

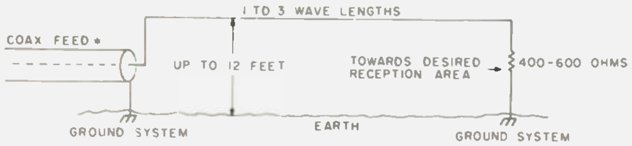

*Fig. 1. Basic Beverage antenna. Value given for termination resistance is approximate for normally conducting soil. Adjust as described in text. Preamplifier may be inserted at feedpoint. This is a terminated unidirectional Beverage with maximum response to signals arriving from the terminated end of the antenna. Signal voltage increases as radio wave sweeps the length of the antenna from right to left. Signals arriving from the left and traveling to the right are dissipated in the terminating resistor. See text for description of ground system. *See text for details of feedpoint matching.*

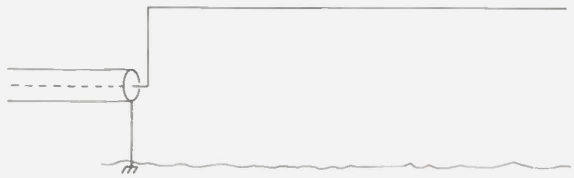

Fig. 2. This Beverage is similar to Fig. 1, but is not terminated. Signal response is nearly equal off either end, but slightly favors the non-fed end. Short, Beverage-type antennas are similarly constructed; see text.

well at 3.5 MHz.

For the Beverage antenna to be directional, and obtain maximum gain off the end of the antenna opposite the feedpoint, the Beverage must be terminated to ground through an impedance equal to that between the wire and Earth. In other words, the non-fed end is grounded through a carbon resistor. If you wish to receive off both ends of the antenna, omit the termination and let the far end float. There are ways to use a single Beverage for reception in either direction through a more-or-less complicated phasing system. This is beyond the scope of this article. For this information, the reader is directed to the June, 1977, *QST* article by Barry Boothe W9UCW, entitled, "Weak-Signal Reception On 160—Some Antenna Notes." The article is excellent and well worth reading.

A Beverage antenna receives the most response from signals arriving off the end(s) of the wire, not from broadside. The intensity of the signal builds as it travels along the length of the wire, reaching the maximum for a given length at the end(s). A Beverage erected in an east/west direction receives maximum signal energy from these directions.

In our east/west example, maximum signal energy arriving from the east is dissipated in a load, in this case the receiver, while signals arriving from the west are mostly dissipated on the east end through another load, a terminating resistor. The closer the termination resistor is in value to the impedance of the antenna, the more complete the dissipation of the west-arriving signal and the better the front-to-back rejection. See Fig. 1.

This is true in a terminated Beverage. A similar antenna left with the non-fed end floating (not terminated) will reflect signals back down the wire from the floating end to be dissipated in the receiver. In this case, much of the directivity of the antenna, if that is what is desired in addition to low noise, is destroyed, although signal intensity arriving broadside will still be reduced. See Fig. 2.

Some directivity of Beverage-type antennas will be noted with lengths as short as one half of a wave, but directivity becomes much more pronounced in true Beverages one wave or more long.

Logically, one might expect that the longer the Beverage, the better. This is not true. For reasons that will not be discussed here (see the original article by Beverage), it is possible to make the antenna too long. A Beverage of one to three wavelengths long is ideal; in the case of 160 meters, this is 550 to 1600 feet. A length of 800 to 1000 feet will give good performance on both 160 and 80 meters.

Short Beverage-Type Antennas

Thus far we have dealt with Beverages of some physical length. Available real estate and other considerations may preempt such construction.

A true Beverage is physically long, as explained, but don't rule out some Beverage advantages in short Beverage-type antennas. Although you will not achieve the gain and directivity of a true Beverage, you can still have the Beverage characteristic of low man-made and atmospheric noise pickup by constructing an antenna as short as 100 feet using the methods given in this article. See Figs. 1 and 2.

I have obtained good results from Beverage-type antennas as short as 100 feet laid upon the ground. Laying the wire upon the ground has the effect of decreasing its velocity factor—and therefore reducing the physical length for a given electrical wavelength.

As an example, in winter I have used a Beverage-type antenna 250 feet long laid upon the ground in an east/west direction. The antenna is terminated to ground on the eastern end through a 50-Ohm resistor. The antenna exhibits low noise and some directional pattern. From north central Texas, the pattern covers about 90 degrees, 45 degrees on either side of its axis. W4s and Caribbean stations within the pattern are typically 10 to 12 dB stronger than 8s, 9s, or Øs located more-or-less broadside to the antenna, referenced to a receiving loop. Stations to the west and northwest are very poor copy on the Beverage-type antenna.

The antenna does not have the directivity or gain of a similar antenna 1200 feet in length, but the shortwire is better than a loop and much, much better on noise rejection than my quarter-wave transmitting antennas.

There is no reason why similar antennas cannot be tried on city lots, laid upon the ground or suspended 6 feet or so in the air.

I should add that I am of the opinion that anyone who takes seriously his ability to hear well on 160 or 80 meters cannot possibly have too many receiving antennas ready to select at the flip of a switch. At the moment, I have available no fewer than 7 separate receiving antennas, including 3 loops and 4 Beverage or Beverage-type antennas, and none of them shows behavior identical to another's!

Height Above Ground

One of the interesting characteristics of the Beverage antenna is that it does not have to be located very far above ground and, in fact, may be laid upon the ground.

There are rather complex formulas relating several factors used to compute height above ground. In practice, however, a height high enough to permit passage of persons, animals, and vehicles below the antenna is a good choice. A height of 6 to 12 feet over "normally" conducting soil is an excellent choice. The impedance of the antenna changes very little between 6 and 12 feet. Greater heights will introduce unwanted noise pickup. See Table 1 for the antenna impedances for various heights above ground and wire sizes.

Regarding the wire itself, most any size may be used as long as it will support its own weight. The wire may be uninsulated if erected above ground, or insulated if laid upon the ground.

The wire may be supported in any number of ways, but if metallic supports are used, the wire should be insulated from them. Examples of supports are metal or wood fence posts, 1" x 1" wood stakes, convenient trees, and the like. The wire should be run at a nearly constant height above ground and in a straight line not varying more than 10 degrees. If the antenna crosses a gully, it should be run down into the gully at a nearly constant height above ground.

We have mentioned previously the possibility of actually laying the Beverage upon the ground. This has been tried by me and many others with excellent success, but it should be done in untraveled areas, for obvious reasons.

I live in an area of the country which is said to have excellent soil conductivity. There are those Beverage experimenters who say that in such areas it may well be an advantage to lay the Beverage wire upon the ground. I can neither prove nor disprove this. I have used Beverages both on the ground and up to six feet above ground without noticing any performance changes.

If the Beverage is laid upon the ground, obviously you will use insulated wire. If you choose to terminate the antenna, I would suggest doing so directly to ground or through a 50-Ohm resistor.

Providing Termination Ground

Undoubtedly the most difficult and uncertain construction aspect of an unidirectional terminated Beverage antenna is the ground itself.

While some Beverage users will argue that the ground is problematical at best, it can be clearly demonstrated that the proper selection of the terminating resistor in conjunction with the ground does have a definite effect upon the directional characteristics and the rejection of unwanted signals from the rear of the Beverage.

Even though the Beverage antenna may perform best when erected over poorly conducting soil, this same soil also accounts for more difficulty in grounding the terminated end. But unless you can ground your Beverage through a single stake in salt water or a marsh, it remains worthwhile regardless of soil conductivity to establish the best possible ground connection.

A single ground stake may be sufficient under the above mentioned conditions, but seldom will such conditions exist. So how is a low resistance ground established?

The answer is to put in contact with the soil the most practical amount of metal possible. Probably the minimum ground acceptable is a system of three copper ground rods as long as possible driven into the soil, spaced a minimum of two feet apart and bonded together. The bonding may be done with automobile battery grounding straps or with the shield removed from a discarded length of RG-8 or similar cable. Do not rely upon the clamps provided with the ground rods. Solder or braze all connections, first making sure the rods and strap material are free of grease, paint, or whatever. The same applies before driving the ground rods into the soil. A torch will be necessary to provide enough heat for proper bonding.

An indication of grounding quality can be determined from whether the termination resistor value changes as more ground is provided. If it does, you need more grounding or metal in contact with the soil. At some point you obviously reach a practical limit, but you should try to achieve the least possible change in the termination impedance. Proper determination of the correct resistor value is made by observing the strength of a signal arriving from the rear (fed end) of the antenna and selecting a resistor value which provides the deepest null or rejection of that signal. An AM broadcast station is a good signal source for this adjustment. Here is an application where a carbon potentiometer is useful for the termination resistor (as opposed to fixed-value carbon resistors).

What we are attempting to establish is the lowest possible resistance to Earth. Three ground rods provide 1/3 the resistance to ground as a single rod, and therefore a three times better ground connection.

In extremely poor soil conductivity areas, an elaborate ground system will be useful. Such a system was described by Roger Hoestenbach W5EGS in his December, 1976, *QST* article entitled, "Improving Earth-Ground Characteristics." This article is recommended reading.

A technique similar to that described by Hoestenbach would be to bury an old auto radiator obtained at low cost from a junkyard. A grounding strap should be bonded to the radiator, and the radiator filled with a heavily-concentrated brine solution. The brine solution is made by dissolving as much rock salt as possible in the quantity of water required to fill the radiator. The rock salt used in water

Height of Wire	4'	8'	12'
Wire Size #	Ohms Impedance		
10	460	493	520
12	474	507	534
14	488	521	548
16	502	535	562
18	516	549	576
20	530	563	590
22	544	577	604
24	558	591	618

Table 1. Impedance of Beverage antenna as a function of wire size and height of wire above ground. These values will vary some minor amount due to local soil conditions. You can also expect variations from day to day and season to season. The proper terminating resistance can be determined as given in the text, or an adequately close value for most locations can be selected from this chart.

softeners is an inexpensive source.

A similar brine solution may be poured on the soil around the ground rod system, but remember that the brine solution will kill all plant life for some area as it leaches into the soil. The condition will exist for several years. Repeat the brine solution application as needed, probably once every 30 to 90 days.

Wire mesh or screen also may be buried a few inches in the ground, equipped with a suitable bonding strap.

Another method of providing a low-resistance ground is through the use of a radial system extending away from the Beverage. Do not run the radial wires back towards the Beverage. The radials should be made of uninsulated wire, with the ends staked to ground through metal stakes as long as you wish. A larger number of short radials is better than a lesser number of long radials. Sixteen radials about 55 feet long, fanned about 11 degrees apart and distributed over the 180 degrees off the end of the Beverage, would be ideal. If this is impractical, use as many radials as possible (even though they may be but a few feet long each) fanned over the 180 degrees. Treating the soil with the brine solution may also be useful.

Providing a low-resistance ground may be carried to whatever extreme the builder wishes, but the point is to provide the best possible ground circumstances permit.

Similar grounding techniques must be used at the fed end of the Beverage where the shield of the coaxial cable is bonded to the ground system. This will prevent random signal pickup on the coaxial feedline, pickup which will destroy the entire Beverage antenna system by upsetting the directional characteristics.

This ground system business may seem like a lot of trouble and work, but the effort expended may be the difference between a mediocre receiving antenna system and one that will provide many enjoyable hours and the ability to hear the weak ones your competition does not. And whether you choose a terminated unidirectional Beverage or a bidirectional one (with no termination), be sure to provide a ground system for the coaxial cable at the fed end, even though it may be as unelaborate as one or more ground rods.

Feeding the Beverage

Ideally, the Beverage, like any antenna, should have its feedpoint matched to the feed or transmission line. Physically, it is unlikely that you will be able to bring the fed end of the Beverage directly to your receiver, especially without varying the axis of the wire less than 10 degrees. Even if you can, some type of a matching device should be used to lower the 400- to 600-Ohm antenna impedance to that of a typical communications receiver.

In most all cases, the Beverage is, or should be, isolated from the home or other antennas. This dictates the use of a feed or transmission line.

My suggestion is the use of RG-58 or RG-59 uncontaminating coaxial cable, double-shielded if available. Double-shielded RG-59 is available from cable television supply houses or CATV companies, and is commonly known as drop cable. The better the shielding, the better will be the rejection of unwanted signals picked up on the feedline. Beware of the RG-58 being sold in many CB stores and some ham outlets. I have seen some that would be doing well if it had 45 percent shielding.

Elsewhere in this article is a brief discussion on whether a preamplifier is necessary. If you choose to use one, then the input circuit will need to be designed for the high impedance feedpoint of the Beverage and the output made to match the coaxial cable impedance.

For the purposes of this section, let us assume that you are not going to use a preamplifier and therefore need to match the antenna directly to the feedline.

This may be accomplished in many ways: the common L-type network, a toroid autotransformer with a tapped selection of high impedance points, a common autotransformer made of coil stock,* or a 4:1 balun of the type used on the antenna input of a television set.

I am a believer in cutting the coaxial feedline to some multiple of an electrical half wavelength determined by the velocity factor of the coax, .66 for solid dielectric or .81 for foam. Free space half wave at 1.8 MHz is approximately 273 feet. A .66 velocity factor is 180 feet, or 221 feet with .81 velocity. Therefore, the feedline would be 180, 360, etc., or 221, 442, etc., feet long respectively.

Be certain to ground the coaxial cable shield at the feedpoint. Either bury the coax a few inches in the ground or lay it upon the ground—do not suspend in the air. These measures are taken to prevent stray pickup on the feedline.

Preamplifiers

It may be desirable to employ a preamplifier with the Beverage antenna, particularly in instances where long runs of coaxial cable feedline are necessary. Admittedly, signal losses per

*Though this is rather bulky, try about 3 inches of B&W coil stock #3062 with the low impedance tap up 3 or 4 turns from the ground and the high impedance tap 15 to 30 turns up—you'll have to experiment.

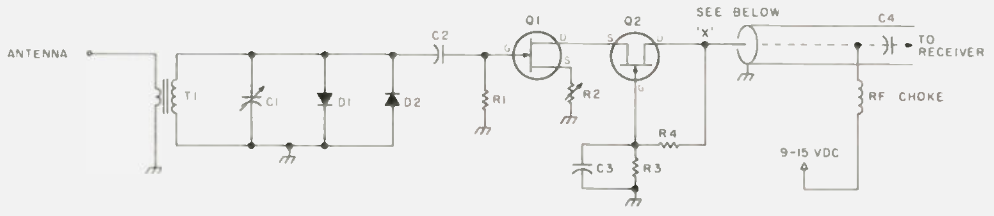

Fig. 3. 160 meter preamplifier suitable for Beverage use. T1: Amidon toroid, FT-82-61 or FT-114-61, primary (to antenna) of 2 turns #18 enamel, secondary of 25 turns #18 enamel. C1: miniature 365 pF air variable. D1-2: 1N914 or similar diodes. C2: 100-500 SM. R1: 220k. R2: 0-200 Ohms; adjust for preamplifier gain. R3: 6.8k. R4: 27k. C3: .01. Q1-2: MPF-102. Preamplifier may be powered at point "X" with a self-contained battery, 9-15 V dc, or by duplexing through the coaxial cable feedline, in which case the power may be inserted at the station end of the coaxial cable through an rf choke. C4 is a .001 blocking capacitor. If preamplifier is used at the feedpoint of the antenna, make certain of waterproofing. Preamplifier must be grounded to Earth, and may be built in a small minibox with short, point-to-point wiring. The entire assembly could be placed in a small plastic refrigerator box for weather protection.

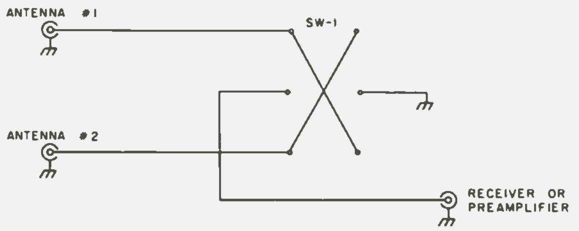

Fig. 4. Manual switch for grounding one of two antennas not in use to prevent reradiation; see text. SW-1 is a non-shorting double-throw double-pole toggle built inside a small minibox. Use leads as short as possible. Make certain all grounds are good. If used at the feedpoint, bond minibox to ground system. If used at the receiver, bond it to receiver chassis. Do not rely upon coaxial cable shield for ground.

hundred feet of coax are low at these frequencies. Whether a preamplifier is necessary is left to the user.

If one is deemed necessary, a simple circuit is described by Doug DeMaw W1FB, in his April, 1977, *QST* article, "Build This 'Quickie' Preamp." In this preamplifier, as in all others, I would suggest the use of back-to-back diodes such as 1N914s at the input to prevent rf and similar damage to the preamplifier.

Back-to-back diodes are included in the schematic of another suitable preamplifier within this article. Credit for this circuit apparently belongs to K1PBW. See Fig. 3.

If the preamplifier is used at the antenna, the most logical place, the device may be supplied power duplexed through the coaxial feedline, through a buried control cable that may also carry voltages for antenna selection relays, or from a battery contained within the preamplifier case.

Reradiation and Inter-Antenna Coupling

One undesirable characteristic of the Beverage antenna is its ability to reradiate large amounts of signal energy to nearby antennas, and to couple into them and cause variations of antenna pattern and other unwanted characteristics.

It is recommended that a Beverage antenna be physically removed from any other antenna by a minimum of half of a wavelength; more is desirable. This may not be possible due to space limitations, but whatever the situation, it is recommended that when two or more receiving antennas are used, some method of grounding the unused antenna be provided. A schematic of a suitable manual switch included in this article can be used, or a method of automatic grounding with electrically-controlled coaxial switches or relays can be devised. See Fig. 4.

Government-sponsored tests on Beverage antennas reveal that they may be crossed within a few feet of each other, provided they do so at angles of 60 degrees or more. Beverage antennas run parallel to one another, utility lines, wire fences, or the like should be separated by at least one wavelength.

Lightning and Static Discharge Protection

Beverage antennas are susceptible to collecting damaging voltages in the presence of certain weather conditions such as electrical, snow, and dust storms. Attention to the protection of receivers and preamplifiers is necessary. The ultimate protection is to disconnect the coaxial cable feedline at the antenna, or, if a preamplifier is used, to disconnect the antenna prior to the preamplifier's input stage. Various configurations are obvious, and are recommended to be at the antenna so as to not route the voltages into the home.

If two or more Beverage antennas with separate feedlines are being used and you insist on bringing the feedlines into the house, a Barker and Williamson model 376 coaxial switch, properly installed, is suggested. The switch could be installed at the entrance to the building.

If you are using a terminated Beverage, it is wise to inspect the termination resistor following any severe weather, as often the resistor will be damaged.

Play it safe: Disconnect the Beverage when a storm approaches and any time you will be away from home.

Conclusion

The Beverage is not a cure-all or all-purpose antenna. It is a directional antenna and should therefore be carefully aimed in the desired direction of reception. With a length of one to three wavelengths, the horizontal pattern will be approximately 45 to 30 degrees, centered on its axis. It is also primarily a DX antenna, not intended for general all-around use.

For serious DXing on 160 or 80 meters, several Beverages will be required if all compass points are to be covered. However, several Beverages and a good receiving loop will enable you to explore to the fullest the two lowest high-frequency bands. ■

LETTERS

from page 45

200-Watt medium power ops come through a couple of times a week. The 20-Watt stations are readable maybe once or twice a month, and then they are usually smothered by European QRM.

Of course, I also use a gas guzzler now. I used a very economical Datsun until I got fed up with the 55 mph speed limit. Now, as long as I can't enjoy driving any more, I go in a big van and work while someone else (Sherry) drives me. I just don't enjoy driving along at 55 mph in a 120 mph car, so we burn up the old gas along with the other American cars.—Wayne.

SELLING MORE MAGAZINES

Although I have been licensed for only a relatively short period, I feel that the time has come to vent some steam and offer some suggestions and comments aimed at improving our way of life.

I follow with interest and sometimes frustration what seems to be a never-ending battle between Wayne Green and the ARRL. Yes, probably most of the buyers of *73* are ARRL members. Any worthy organization such as the ARRL will solicit and accept suggestions aimed to improve its performance, but it seems to me that Wayne's constant downgrading of the League is aimed toward selling more magazines instead of helping amateur radio. Let us all offer our full support to the League by offering suggestions and improvements. If the elected officers fail to do their job, let's

Continued on page 59

IC-215 FM

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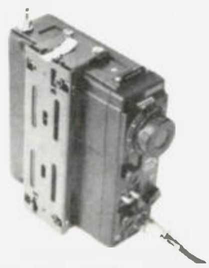

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How To Hang A Longwire

—*without a catastrophe*

When space permits, a long longwire can be a great improvement as an antenna, especially on the lower frequencies. However, what size wire is needed to prevent breakage?

The tension in a suspended wire depends on the span length, the sag in the wire, and the weight of the wire. A suspended wire will assume the shape called a "catenary," and the equations which describe the resulting tension are rather complex, involving hyperbolic sines and cosines. These equations have been solved and the results tabulated, permitting simple calculations for tension in the wire.

Fig. 1 gives the physical layout of a suspended wire antenna, showing the span length "S" and the droop "d". For a fixed span length, as the droop decreases (i.e., as the wire becomes more horizontal), the tension increases. We can thus calculate the tension in a particular span and compare this with the breaking strength of the intended wire.

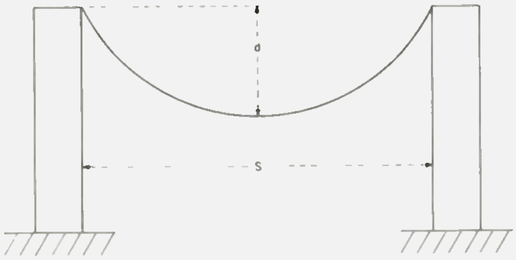

Fig. 1.

Table 1 provides the characteristics of soft-drawn copper wire, which is the type of wire commonly available, as well as the characteristics of hard-drawn copper and #12 copperweld, for comparison.[1]

As stated above, the tension depends in large part on the sag of the wire. The sag of the wire is defined as the droop "d" divided by the span length "S", or sag = d/S. Based on the sag of the wire, Table 2 (which is the tabulated solution to the catenary equations, and can be plotted as a smooth graph) provides the stress factor "F" and the length factor "L". The stress factor represents the increase in tension as the wire is drawn more horizontal, and the length factor represents the actual wire length in the span (which is always greater than the span length). The tension in any span can then be calculated from the equation T = F x L x W x S, where T = resulting tension, in pounds; F = stress factor (based on sag, from Table 2); L = length factor (based on sag, from Table 2); W = weight of the wire, in pounds per foot (from Table 1); and S = span length, in feet. For example, a 1000-foot span of #12 soft copper wire, with a

[1]All data for this article was drawn from the *Standard Handbook for Electrical Engineering*, McGraw-Hill, 1957.

droop of 50 feet, has a tension of T = 2.5 x 1.006 x .0198 x 1000 = 49.7 pounds, since this span has a sag of .05. Comparing this tension with the breaking strength of #12 wire (Table 1) of 197 pounds indicates this antenna would be safe. However, if the droop was decreased to only 10 feet, the sag would then be .01, and the tension would increase to T = 12.5 x 1.000 x .0198 x 1000 = 247.5 pounds, which exceeds the breaking strength of the wire!

Thus, by this relatively simple calculation, the tension in a given antenna can be computed and compared. But is there a more general answer to the question of what size wire to use? Notice that the breaking strengths for soft copper wire increase in exact proportion to the weight per pound. In fact, the breaking strength is always 10 times the weight of 1000 feet of wire. Hence, in a 1000-foot span, if the tension is to remain less than the breaking strength, the stress factor must remain less than 10, and thus the sag must be greater than .012 (from Table 2, when plotted as a graph). This fact is independent of the wire size! However, this antenna would have tension equal to breaking strength, and would not allow for wind loading, icing, etc. If we choose a safety factor of 2 (i.e., tension will not exceed half the breaking strength), we then find that for any span length, any size wire will support itself, provided the sag (hence droop) is greater than some distance. These calculations are summarized in Table 3. It should be realized that Table 3 is valid only for soft copper (bare) wire. If insulated wire were used, the breaking strength would not be increased appreciably, but the weight per pound would have increased, and hence the permissible stress factor would be reduced, requiring more sag (hence more droop) to prevent breakage. For a general span, the maximum permissible stress factor can be computed from the equation:

$$F = \frac{\frac{\text{Breaking Strength of Wire}}{2}}{(\text{Weight per foot}) \times (\text{Span length})}$$

Table 2 can then be used to determine what sag is required to ensure this stress factor is not exceeded. There is additional safety in this equation, since span length is used, which is always less than the true length of wire suspended.

Now, what if you happen to have supports 2500 feet apart, but only 150 feet high? Table 3 indicates a droop of 162 feet is required. The only solution is to acquire stronger wire, which will require less sag. For example, #12 copperweld in this span would require a sag of only 37.5 feet, as the half-breaking strength of this wire is 392 pounds.

So, if you just happen to have two supports 1400 feet apart, string your wire, using any size wire, but let the droop exceed 35 feet and you can rest assured the wire won't break! ■

Wire Size (AWG)	Weight per Foot (pounds)	Breaking Strength (pounds)	
		Hard drawn	Soft drawn
8	.0500	826	480
10	.0314	529	314
12	.0198	337	197
14	.0124	214	124
16	.0078	135	78
18	.0049	85	49
20	.0031	54	31
22	.0019	34	19
24	.0012	21	12
26	.0008	13	8
12 (copperweld)	.0200	785	---

Table 1. Physical characteristics of solid bare copper wire.

Sag	Stress Factor "F"	Length Factor "L"
.002	62.5	1.000
.005	25.0	1.000
.01	12.5	1.000
.015	8.3	1.001
.02	6.3	1.001
.03	4.2	1.002
.04	3.2	1.004
.05	2.5	1.006
.06	2.2	1.009
.07	1.9	1.013
.08	1.6	1.017
.09	1.5	1.021
.10	1.3	1.026
.15	.99	1.060
.25	.8	1.151

Table 2. Stress and length factors for various sags.

Span Length (feet)	Minimum Droop (feet)
250	1.5
500	6
1000	17
1500	37
2000	62
2500	162

Table 3. Minimum permissible droop versus span length.

LETTERS

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oust them next election.

Hans J. Miller
WB3DYH/WD4BFD
Camp Lejeune NC

You've made some good points, Hans. On one point you are in error. Criticism of the League does not increase subscriptions . . . to the contrary, it very markedly slows them down. You see, a great many amateurs feel as you do, that it is not nice to pick on the ARRL. To me, this is the same reaction we saw with many Republicans when the press started picking on Nixon for Watergate.

Perhaps I've been around much, much too long. My beliefs in the League were as bright as anyone's many years ago. I believed that the members were the backbone of the organization and that the directors brought the wishes of the members to headquarters, eventually bringing about changes. It's a lovely thought.

Sure, I know that most hams don't want to know about the political side of things . . . after all, it's only a hobby. It is so frustrating to hear about the things that are going on behind the scenes, things over which none of us has any control, that we would rather not know about them. It's easier to smile confidently and put Green down as being dumb or just trying to make money.

The ARRL is a long, long story . . . I've covered much of it down through the years, and I suppose I should take the time to write an article explaining what the ARRL really is and how it works. Few outside of HQ understand the League and how it got the way it is. Having

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West Germany

The "German" Quad

—*six bands with one antenna*

Technical development leads to new and better amateur radio devices all the time, but it seems that in the field of allband antennas a stagnation has been reached. The hams who work all five SW bands mostly have two antennas for this purpose: a longwire for 80 and 40 meters and some kind of a three-band beam (which means "ugly things" on a tower in the garden). From the ham's viewpoint this is ideal, but most do not want to give their neighbors a reason to move at least three blocks away.

In his weekend shack near Bremen (a harbor city in northern Germany), DL3ISA developed a new amateur radio allband antenna. He tested a lot of different configurations and forms until he found a solution which is simple and operates well on 80, 40, 20, 15, and 10 meters—and is even useful for 2 meters.

He took 83 meters of antenna wire and mounted it in the form of a big quad about ten meters (30 feet) above the ground in a horizontal position, so that the ground serves as a reflector for 3.5 and 7 MHz. Each leg of this big quad has a length of 20.7 meters. The feedline is a 60- or 75-Ohm coax cable which is connected to the beginning and the end of the antenna wire in one of the four corners of the quad.

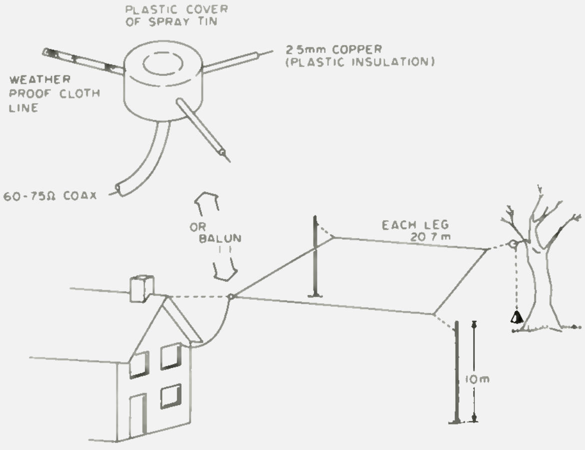

Fig. 1.

A balun (1:1) may be used at the connecting point in case of TVI/BCI, but a long or a deeply ribbed glazed porcelain insulator does an even better job, because it allows for no power loss. The whole connection point should be sprayed with acrylic or otherwise protected against corrosion. DL3ISA put the whole connection into a plastic cup to protect the end of the coax cable against wet weather. (See Fig. 1.)

The length of the transmission line is random, and impedance checks resulted in an impedance of 60 to 90 Ohms at the feedpoint, so that a 75-Ohm coax would be more favorable than 60-Ohm cable.

As a good material with sufficient strength, a 2.5 mm-diameter soft-drawn copper wire with an enamel coating was chosen for this antenna. The guy lines are weatherproof, rayon-filled, plastic clotheslines.

For a European amateur radio station, this antenna should be mounted in an east-west/north-south direction, because the four preferred directions are the extensions of the quad's diagonals. This way, QSOs can be made to the northeast (South Pacific, Japan, etc.), to the northwest (North America), to the southwest (West Africa, South America), and to the southeast (East Africa, Arabia). Of course, this antenna can be fixed in any other direction to work any desired country. On the 15 and 10 meter bands especially, several side lobes between the four main lobes were measured with a beamwidth of 10 to 20 degrees in the horizontal plane.

As a horizontal full-wave loop, this antenna receives only a negligible amount of electrical interference from the surrounding area.

The standing wave ratio was determined by DL3ISA and is shown in Fig. 2. There may be small deviations from the swr due to the local ground conditions. The influence of other antennas is negli-

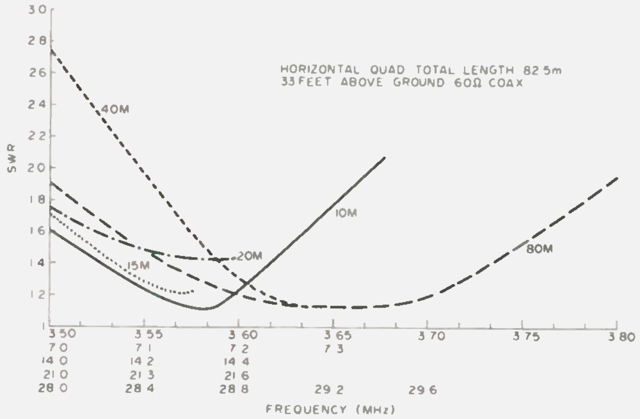

Fig. 2.

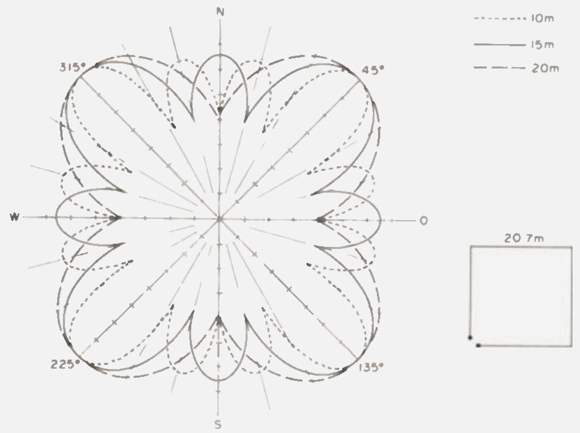

Fig. 3. Antenna height: 10m.

gible if these antennas are in the center of the quad. Parallel mounted antennas outside the quad gave a negative influence on the antenna data in the higher bands. Other antennas should be kept at a distance of at least seven meters from the quad.

The radiation pattern on, 80 meters generally is at a high angle, and a radius of 600 miles has been found to be the area covered under normal conditions. The gain relative to a dipole mounted at the same height is around 6 dB; the quad has no directivity on 80m. On 40 meters, the radiation pattern is actually at a lower angle than that on 80 meters, and has no directivity.

On the 20, 15, and 10 meter bands, the radiation pattern is at an extremely low angle (similar to a rhombic antenna). On these bands, four preferential directions have been figured out in poor-to-medium conditions, but with an open band no remarkable directivity has been observed. The horizontal angle of the main lobes is about 30 degrees; the gain was 6 to 10 dB better than a two-element three-band beam at the same height and 12 to 18 dB better than a ground plane antenna. (See Fig. 3.)

Most of the above is just theory. In my practice, the antenna has worked as described only on 10, 15, and 20 meters. On 80 and 40 meters, the radiation has to be almost as low as on the higher bands. My log shows that within a couple of days in December, 1977, I worked the following stations, all on 80 meters SSB: 4Z4, TA1, W3, YK, VO1, JA1, 9M2, CT3, EA9, and C31. The transmitter used had an rf output of about 40-50 Watts PEP, and no clipping or processing was used. The antenna worked just as well for short distances. A gain of at least 2-3 S-units could be observed as compared to a dipole. The antenna could not be tested in QSOs on 40 meters, but comparable results are probable.

DL3ISA found that the antenna works satisfactorily at a height of at least 5 meters above ground. However, the bandwidth on 80 meters becomes insufficient under these conditions.

Near Frankfurt-am-Main, this antenna had been mounted according to the instructions of DL3ISA around a little house at a height of 9 meters. Experimental measurements at this place showed the same results as we had before, even though there was a whole house with all its electrical wiring inside the antenna.

Due to the extremely low angle of radiation, it was possible to work 15 and 20 meter DX to the US east coast and Brazil at a time when Europe was expected to be down from the west for 30 minutes.

A 2 meters test was made with a swr of 1:1.2 to 1:2.0, so that the antenna could be declared as a "six bander" without even a balun. However, the test was only run from 144-146 MHz. The North American band portion running to 148 MHz was not tested.

Taking into account the fact that this allband antenna is good for DX work in the higher bands, works most favorably on 80 and 40 meters, and is no spectacular monster to your neighbor's eyes, it is a real gain for almost any ham. It's also not a bad idea for Field Day. ■

LETTERS

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been a member for 40 years and having personally known everyone involved with it for well over 20 of those years, my perspective is good . . . and despite what you may want to believe, not very biased.—Wayne.

CATCH 19

I read your editorial concerning CB infiltration into the ham bands with great interest. You suggested at one point that we track them down with DF equipment, an excellent idea with only one problem . . . what do we do if we catch one?

I had an interesting experience recently along these lines, and it may illustrate the problem we might encounter if we caught one of these interlopers.

I am the editor of New Hampshire's largest circulation newspaper. We are located in Manchester, and reach a wide circulation base. One of our readers called us recently to see if there was anything we might do to help clean up channel 19 in Manchester. It seems that there is one operator who is running more than legal power and splattering over two channels. This operator comes on every night and uses the most obscene, filthy language I have ever heard. He dominates the frequency for hours, and I assure you the language is disgusting.

I thought it might make a good story and, perhaps if something was done, it would serve as a warning to similar operators to avoid such practices. I called the FCC in Boston to see whether they

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Mobile In Disguise

—the invisible 3/8λ 2m antenna

About a year and a half ago, while I was attending a repeater club meeting, someone removed all my radio equipment from my car, doing damage and inconveniencing me. This got me upset! Fortunately, most of my gear was recovered because it had identification on it. Since that time, though, I have been nervous about gear in my car and the antennas that give it away. I removed the 5/8 antenna and went to a 1/4 wave, but it still wasn't the answer. Now it looks like I've got a scanner in my car, not a 2 meter rig.

While parking my car at work one morning, a Ford LTD pulled up next to me and I spotted a cowl-mounted antenna used for AM/FM car radios. I got out of my car and went to look at it. It was stainless steel, held on the fender, and easy to mount. The one-piece element was 31″ long. 31″ long is a 3/8-wave 2 meter antenna! It looked like a perfect disguise antenna for my GM car.

Now, how would I tune it? Looking at antenna pat-

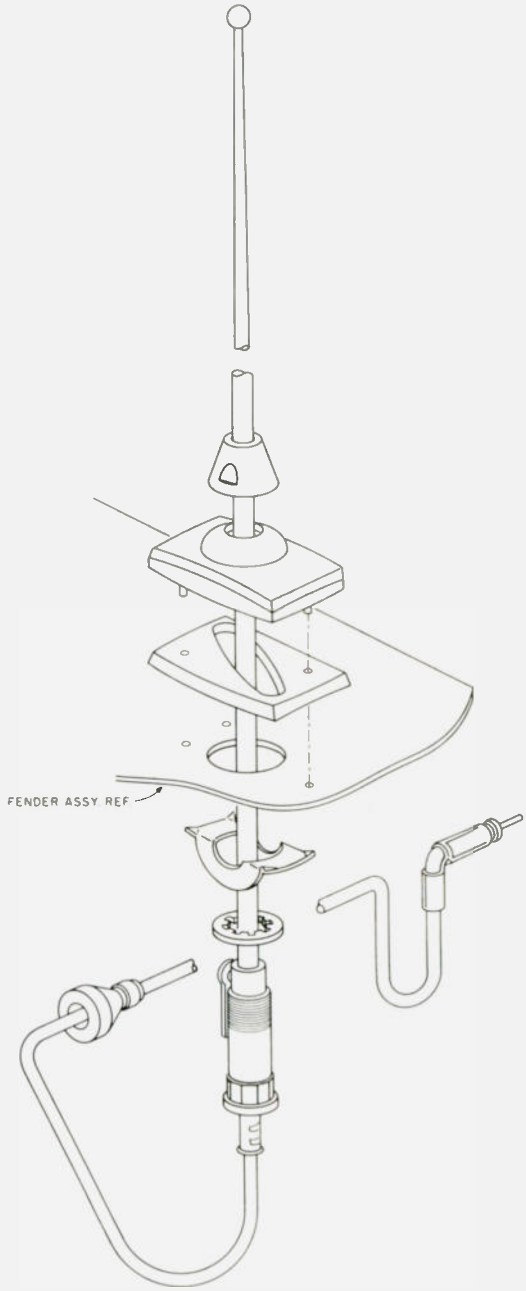

Fig. 1. Cowl antenna.

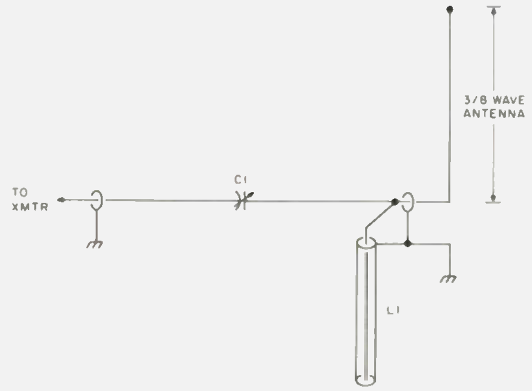

Fig. 2.

terns, it appeared that the 3/8 antenna looked like a pattern between a 1/4-wave and a 1/2-wave antenna. The untuned terminal impedance was about 200 Ohms reactive. I had to get the impedance down to 50 Ohms. After looking at a Smith chart (see the *ARRL Antenna Handbook*) to get an idea for an approach to tuning, I decided to use a modified L/C circuit.

The coax cable used on the antenna as it came from the factory is totally useless for a transmitting antenna feedline. The coax was trimmed short, leaving enough to attach a BNC connector (Fig. 3). A small aluminum box with two mating BNC connectors was used to house the matching circuitry. As illustrated in Fig. 2, use a 25 pF variable capacitor and a length of RG-174 or RG-58 5"-long coax. With the capacitor meshed 50%, take a small safety pin and puncture the coax. The pin should be allowed to short the shield to the center conductor. Starting at 5", move slowly toward the terminated end of the coax. At one point in this process, the swr meter will drop. Now adjust the capacitor to a minimum meter reading. If necessary, for a minimum reading, move the pin now in much smaller steps to find the exact point at which the minimum reflected power is indicated. Cut the coax at this point. Trim and solder the end and ground it to the aluminum box.

It is apparent you can get some gain from this antenna, although it is slight. With a 1/4 wave as a reference of O.D.B., an approximate gain of 1.2 dB will be noted. Small as it may be, it's still gain.

There are other antennas manufactured for the GM Corvette, the AMC autos, and Chrysler products. These will all work if modified as I've just described. I would like to thank Tom Rehm K9PIQ for his help on and off the air. ■

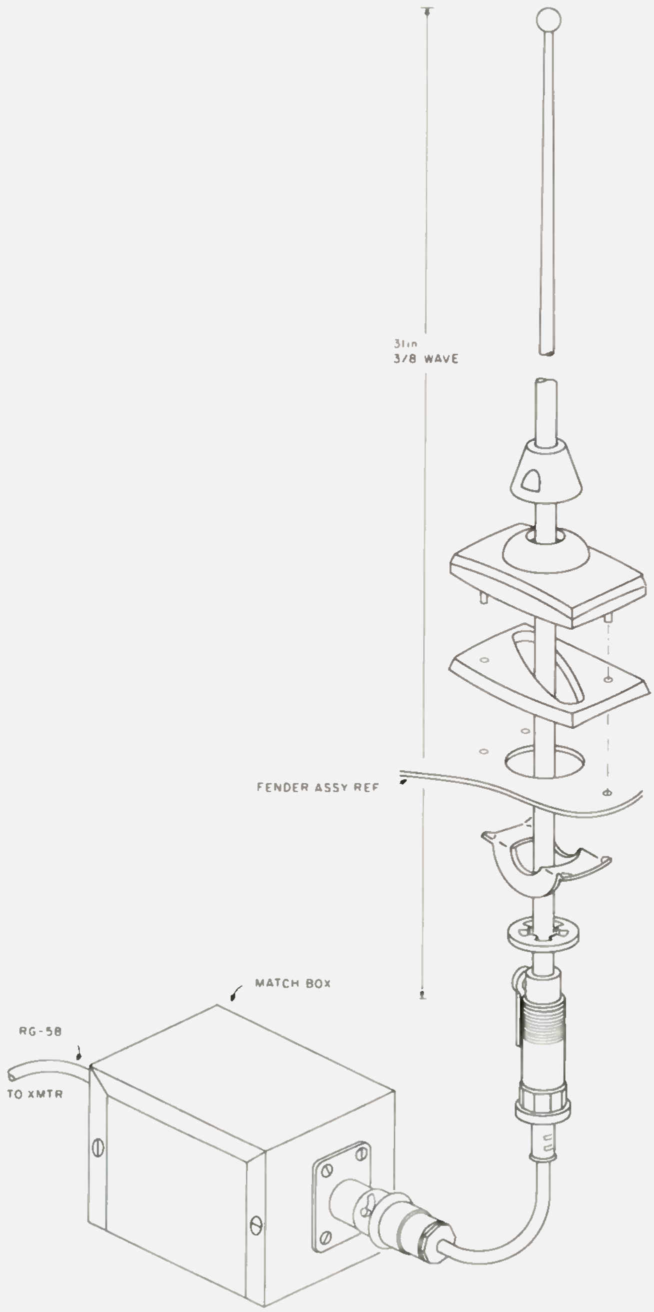

Fig. 3.

LETTERS

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might send someone up, as we wanted to do a story on the problem and how they would solve it. Not as easy as that, I found out. The FCC lacked the criminal jurisdiction, and the FBI would have to be contacted. OK, I said, and I called the Concord office of the FBI. They told me they needed authorization from the United States Attorney.

I placed a call to the US Attorney, who told me that he had received several complaints, including several from Senator McIntyre's office. He was going to authorize the FBI to investigate the case . . . fine, I said, and I called the FBI again.

I got the distinct impression from the FBI that dirtying the airwaves did not qualify as a "major crime," and that they would work on it at their leisure. There was one problem, however . . . they did not have the technical expertise to find the violator, so the FCC would have to become involved. The FCC told me that they had the technical expertise, but lacked the criminal jurisdiction. Ah, I said, Catch 22—so who would catch this person? The answer, unfortunately, was no one. He still operates on channel 19 almost nightly in Manchester.

You might say, "Who cares, CB is garbage band anyway . . ." The implications are far-reaching, however: If a CBer was to purchase a ham transceiver and begin operations on one of our bands, who would stop him? If this incident is any example, he might be on the band forever.

I am not sure that we have a problem with unauthorized per-

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Better Than A Quad?

—try a delta loop

It has been said that, before anything worthwhile can be done, there must exist a need. In my case, the need was for a good cheap directional antenna for 15 meters. It had to be something much better than a dipole, but about the same cost.

After weeks of searching for a ready-made low-cost beam and being stunned by prices in the one-hundred- to two-hundred-dollar bracket, the idea finally came to me that I must consider a home brew job or stay with the dipole. So the search for that just-right design began. A quick look through one handbook offered first a simple two-element yagi and then a two-element quad. For DX, this handbook says the quad is better, but it is also quite large, fairly heavy, and needs mounting high off the ground. I have neither a tower nor a heavy-duty rotator, so the search continued.

$$\text{Reflector total length} = \frac{1030}{f(\text{MHz})}$$

$$\text{Driven total length} = \frac{1005}{f(\text{MHz})}$$

$$\text{Element spacing} = \frac{\lambda}{0.17} \text{ to } \frac{\lambda}{0.20}$$

Table 1.

After reading on, I found a brief article about an antenna that some DX operators consider to be better than a quad. It was described as fairly small for 15 meters and also lightweight. But why had I never heard one on the air? Why had I never seen one advertised for sale? There had to be some disadvantage. But there it was, in clear print: "Some DX operators say the delta loop is better than a quad." There was only one thing to do — build it and give it a try.

The description of construction of "the delta" was not very clear, although there was a formula for element spacing and loop lengths. (See Table 1.) After calculating the reflector length for the middle of the band, I came up with 48.3' total length, or 16.1' per side (not bad). The reflector length turned out to be 47.1' total length, or 15.7' per side (not bad, either).

However, after calculating the spacing using λ/0.185', I found that the elements would need to be 248' apart. No wonder nobody ever used a delta; it would be a monster. A 248' boom would be a little bit of a problem. Something was wrong. I checked my calculations, and they were okay. So I thought it had to be a misprint in the formula — λ/0.17 to λ/0.20 should have been 0.17λ to 0.20λ, I guessed. Anyway, this is the formula I used. I came up with a boom length of 10'0" (not bad), so my delta was built using 10'0" element spacing on 15 meters. See Fig. 1 for parts and assembly.

Assembly time from start to finish was no more than six hours, and no special tools were required for construction.

After finishing building the antenna and mounting a TV antenna rotator on a short mast only about five feet above the roof, it was very little trouble for my XYL and I to lift the 12-pound structure to its final resting place. The total boom height after mounting was only 20 feet from the ground and about 80 feet below the tops of dozens of hardwood trees on my lot.

Adjustment of the antenna gamma match was another easy matter. With the help of a neighbor ham, tuning took only five minutes. With the clamp bar all the way to the top of the 36-inch gamma rod, just a half turn of the capacitor brought the swr down to a respectable 1.1 to 1. To my great pleasure, I found that at no point across the entire 15 meter band did it rise above 1.5 to 1. Everything had gone fine so far, and there was only one test left.

That test has been taking place over the past two months, using an HW-101 Heathkit barefoot, mostly in the phone portion of the band.

The first few days of operation with the delta loop were spent with the antenna

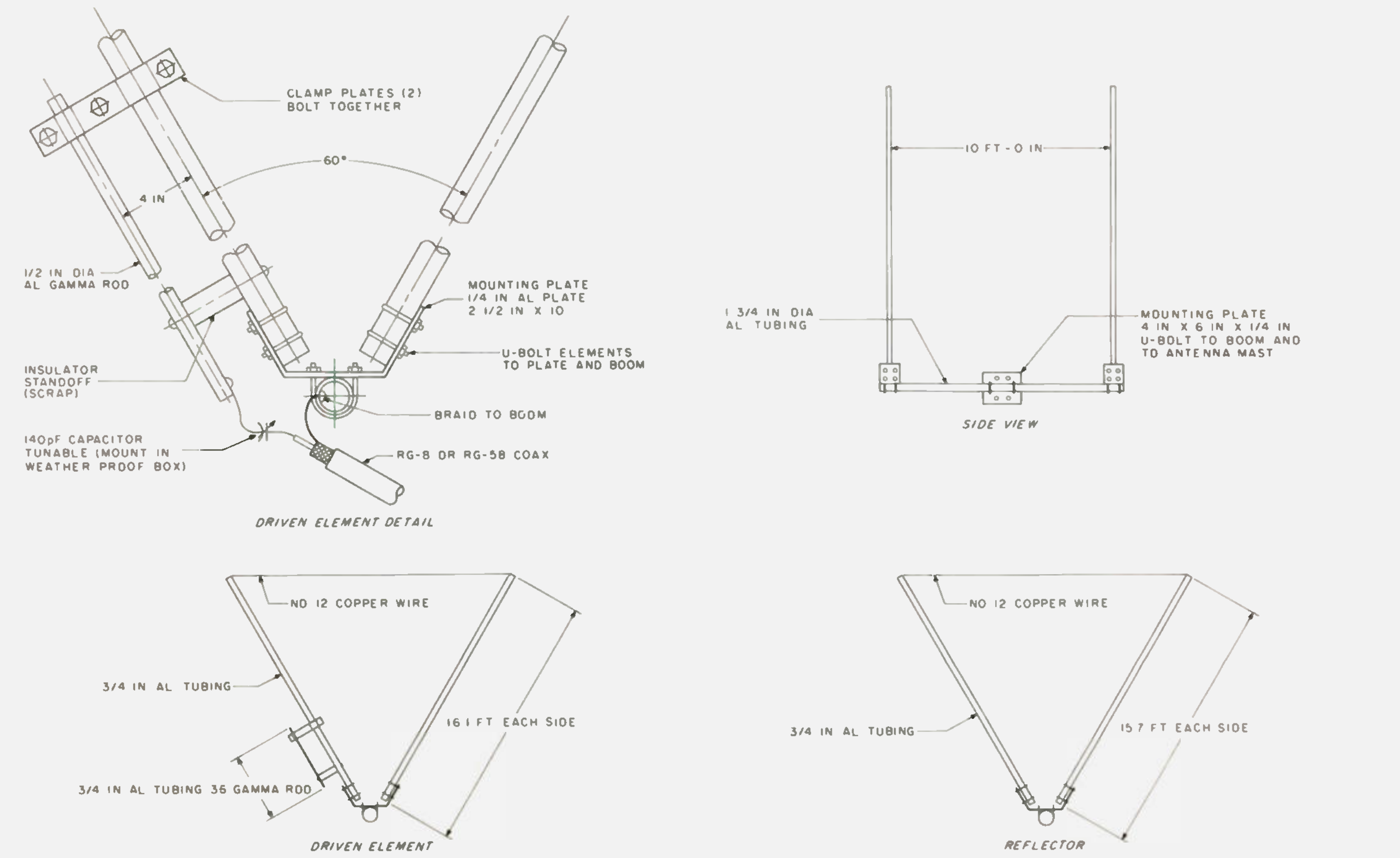

Fig. 1.

pointing west and with me enjoying compliments on the fine signal from Alabama which was reaching the west coast. One of the first good characteristics that I discovered about the antenna was that it was very directional, especially on receive. With a 30 dB over S9 signal from California being received, turning the loop off 90 degrees either way would knock the signal down to an S2 or S3 reading. So, with this in mind, I began searching for maybe just a little DX.

First a German field day station with an S9 report was added to my logbook. Then I had a first-time contact with Hawaii with another good report; then Alaska, another new one for me. So the delta loop was working, and I was well pleased.

More proof that the loop is a great DX antenna has come in the past few weeks. With not a lot of on-the-air time, mostly in the evenings after work, there have been contacts with Japan, Russia, and over 20 European countries, all with fine reports and with multiple contacts in most of them. My prize so far was a good contact with an Italian station running only three Watts on phone. My first CQ on the 15 Novice band netted Czechoslovakia and the Netherlands, also a low-power station.

If I sound thrilled, it is because I am. Of course, the performance of the delta would not seem so great to an operator who had been using a beam all along. But, for a fellow who has been using a dipole, it is a whole new world. It will give you a good chance in a big DX pileup, even if you are running low power with a low antenna height.

Three other local hams are now building delta loops for their own use, and, if you also would like to knock 'em for a loop, try the delta loop. It is better than a quad! ■

LETTERS

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sons operating on the ham bands, but if we did, then we might find that we would get little or no help from those charged with enforcing the Communications Act. Obviously, local authorities have no jurisdiction.

This incident has served to discourage me about the effectiveness of the Federal Communications Commission when it comes to violations of this nature. Sure, CB is bad, but it will never get any better without enforcement. I do not think that the CB part of the spectrum should simply be written off, but I am not sure what the solution is.

The implications of this incident reach far beyond one simple CBer who has a sick mind, and extend into our own bands as well. It is obvious to me that the FBI has better things to do then to get involved with radio complaints, be they CB or ham.

Thank you for such a fine magazine. I would subscribe to no other.

Dan Gingras WA1BLR
Manchester NH

MILES AHEAD

In the little over a year that I have been getting *73 Magazine*, I have read with interest your open and realistic editorials concerning amateur radio. Unlike the American Radio Relay League, which prints only for the betterment of "the League," you have demonstrated your concern for the amateur in general. There have been times when I thought that your attacks on the ARRL have been misguided, but after reading in *QST* about the

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The Perverted Double Vee Antenna

—double your pleasure from 40m through 10m

A 70-foot free-standing tower with multi-element yagis for 40, 20, 15, and 10 meters, plus a rugged rotator to handle the Christmas tree, is the dream of almost every ham. But, oh, the expense, the complications involved in erecting such a monster, and don't even mention the XYL's screams of terror at the thought of that half ton of aluminum and steel hanging heavy over the heads of her beloved family, threatening to crush everyone and everything come the next windstorm, tormado, or hurricane.

Be not of weak faith! The dream may become a reality, if what you actually want is an antenna system with gain, directivity, excellent front-to-back ratio, rotatability, low cost, and relatively simple and safe construction — the perverted vee is your answer. Here follows a description of a phased almost vertical/almost horizontal trapped multiband dipole, one which will satisfy all of the above criteria.

There is an abundance of information available on the theory and performance of phased (driven) arrays — vertical, horizontal, and inverted vee systems.[1-8] I cannot add substantially to these data, but I suggest that you review what may be conveniently available to you. It is important for you to know that phased arrays work and that there is nothing very mysterious or complicated about constructing and adjusting them. The perverted vee is a phased array.

The Antenna

A study of the diagram in Fig. 1 shows the array to consist of two trapped dipoles, ABC and EFG, supported at a common tie point at the top of a 50' mast or tower. Feedpoints B and F are held away from the mast by suitable nylon cord. The lower ends, A and G, are pulled back into the base of the mast. The resulting configuration is that of two vees lying on their sides, with their tops facing each other. The dimensions of each vee and the trap values are such that resonance can be attained on 40, 20, 15, and 10 meters.[9,10] Spacing between feedpoints B and F is approximately 34'. This represents ¼ wave on 40 meters, ½ wave on 20 meters, 3/4 wave on 15 meters, and a full wave on 10 meters — classic spacings for phased arrays. Without becoming too technical or too involved in the details concerning trap construction, a few words regarding the traps are in order. Accepted theory and practice indicate that the L/C values given here will allow each dipole to work on the frequencies of interest and with acceptable vswr indications. Home brew traps can be made using ordinary coil stock or by winding 12-gauge or 14-gauge wire on wooden dowels, plastic rods, tubes, etc. The capacitors can be of the ceramic doorknob variety, high-voltage disc ceramics, or about 10 inches of RG-8/U. Whatever your preference, they must be grid dipped or noise bridged to resonance at 14.1 MHz.

My original attempt at home brewing suitable traps with coil stock and RG-8/U was successful, but I was not confident about their long-term stability and durability. Adequate weatherproofing was a problem. But, very recently, there have become available ideal commercially-made traps which fill the bill perfectly. They are the model 4-FG traps by Pace-Traps, Middlebury CT. I replaced the original traps with the Pace-Traps, having only to make minor adjustments in the wire element lengths to restore resonance of the

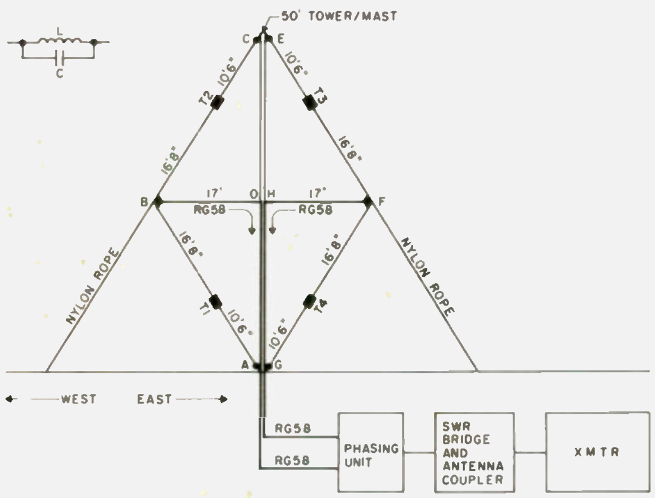


Fig. 1. Perverted vee phased array. Antenna #1 – ABC; antenna #2 – EFG. T1-4 – traps to resonate at 14.1 MHz; L – 10 turns, 6 tpi, 2½" diameter, 12 gauge; C – 25 pF (CL8505-25Z).

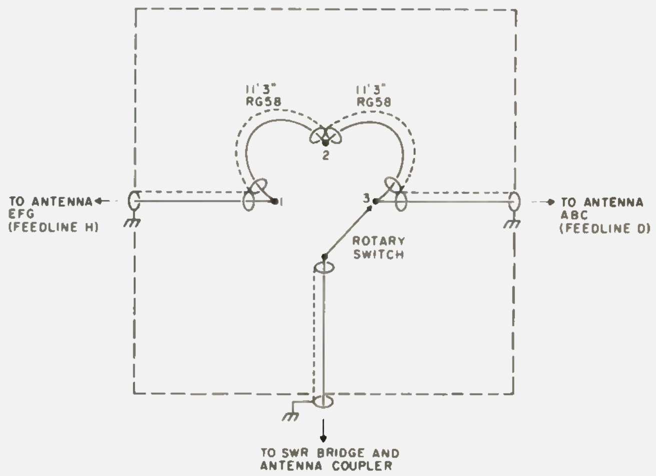


Fig. 2. Phasing unit.

antennas.

The Phasing Unit

The phasing unit (Fig. 2) is as simple a design as possible, requiring only a single-pole, 3-position switch, two 11'3" lengths of RG-58 solid (not foam) coaxial cable, 3 SO-239 chassis connectors, and a suitable small enclosure. An aluminum "Tite-Fit" box measuring 3½" x 6" x 8" is recommended.

The 11'3" lengths of phasing lines are not terribly critical. An inch, more or less, will not seriously affect the performance of the perverted vee. These lengths were arrived at from the formula for 1/8-wave coaxial phasing (delay) lines for 40 meters – 123 x .66/7.2 MHz. (.66 is the velocity factor for solid dielectric coax.)

The total of the two 11'3" lengths of coax, 22'6", provides electrical lengths of ¼ wave (90 degrees) on 40 meters, ½ wave (180 degrees) on 20 meters, 3/4 wave (270 degrees) on 15 meters, and 1 wave (360 degrees) on 10 meters. In switch position 2, Ø degrees phasing (broadside directivity) is accomplished, as both antennas are fed simultaneously in phase.

There is magic in the use of the two 11'3" phasing lines, giving the directive patterns shown in Fig. 3. You get all of that with only two short pieces of coax and one simple three-position, single-pole switch and no waiting for the rotator to grind its way around from east to west or north to south.

The Feedlines

Direct your attention once more to the RG-58 feedlines between the antennas and the phasing unit. Each of the two feedlines must be the electrical equivalent of the other. That is, they must be the same length. There can be no Mickey Mousing around on this point. It is strongly recommended that you use an antenna noise bridge or grid-dip meter to closely match the two lines once you have cut them to the same physical lengths. Although the total length of each line doesn't have to be more than just enough to reach the shack and phasing unit, I suggest that you make them multiples of 45 feet (½ wave at 40 meters). The reason for this suggestion is, of course, that it will make it possible for you to get valid vswr and resonance indications when you are adjusting the antenna wire lengths.

Don't be unduly concerned about using RG-58 (solid dielectric) coaxial cable, even if you are using a 2 kW PEP amplifier. Bear in mind that each feedline will be carrying only one-half the total output of your transmitter amplifier and that the average SSB or CW power in each line will be roughly half of that. In other words, if your 2 kW amplifier has an rf output of 1,200 Watts PEP, only 600 Watts PEP will be fed to each coaxial line. Since the average power is about half of the PEP power, each line will carry only about 300 Watts average power, which is well within the ratings of RG-58.

Swr Bridge and Antenna Coupler

Under the best of circumstances, no antenna will be perfectly flat – vswr 1:1; I guess I should say that most practical antennas will show some vswr other than 1:1. A pair of antennas, such as the perverted vee or any other phased array, will almost certainly show other than a "flat" condition to the transmitter output circuit, and the antennas will require a means of flattening out vswr ratios of as much as 2.5:1. If you already have a transmatch, matchbox, L-network, pi-network or some other such "line flattener" and swr bridge, use it between the phasing unit and transmitter (or linear amplifier), and adjust it whenever necessary for vswr 1:1 to the final rf stage.

A simple L-network will do the job. The circuit of one which I have used with excellent results is shown in Fig. 4. It will flatten out mismatches of up to 3:1.

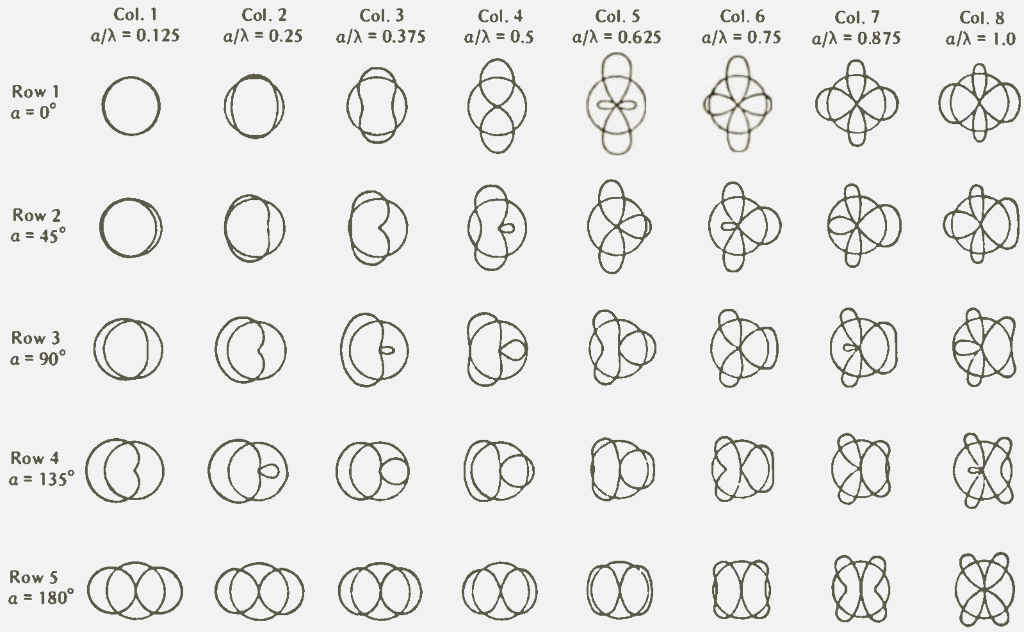
Construction

Because the perverted vee is a system composed of two trapped dipoles, usual procedures for trapped dipole construction should be followed. Materials which you will need for construction of the antenna elements are listed in the parts list.

Begin by cutting the appropriate lengths of antenna wire. You might as well cut all the lengths for both sides of the perverted vee at the same time, with an extra 3" at each end of each length for fastening to traps and insulators. So, you will cut 4 lengths of 11' each and 4 lengths of 17'2" each. Scrape or sand the coating off the ends of the wire lengths to a distance of about 6" for final soldering.

If you decide not to use commercial traps, refer to construction details in the *ARRL Handbook*.[11] Unless you are an excellent craftsman and have had experience building antenna traps, you will save a lot of time and possible trouble by buying a set of 4 traps.

Now put one dipole together and then the other, using the first as a model. I started mine by tying a short piece of cord to one of the end insulators and then to the farthest corner of my backyard fence. Then I put one



Switch Position	Approximate Horizontal Patterns			
	40 meters	20 meters	15 meters	10 meters
1	Col. 2, Row 3	Col. 4, Row 5	Col. 6, Row 3 Reversed	Col. 8, Row 1
2	Col. 2, Row 1	Col. 4, Row 1	Col. 6, Row 1	Col. 8, Row 1
3	Col. 2, Row 3 Reversed	Col. 4, Row 5	Col. 6, Row 3	Col. 8, Row 1

Fig. 3.

end of 11' precut length of wire through the insulator, pulling through the insulator 3" of wire and making the wrap. The other end of the wire is fastened to a trap in a similar manner. Next comes the 17'2" length. Fasten one end to the trap, as before, and the other end to the center insulator. Continue on the other side of the center insulator with another 17'2" length of wire, a trap, an 11' length of wire, and an end insulator. One dipole is finished, and, if you're lucky, you will find a convenient fence post to tie the finished end of the dipole to with a piece of cord, the same way as you started.

The other dipole can now be assembled right alongside, and it will be easy to make it identical to the first.

While the dipoles are hanging there taking a set, it would be a good time to prepare the RG-58/U feedlines — two feedlines, electrically identical to each other and long enough to reach from the antenna feedpoints to the shack. As I mentioned previously, it is a good idea for the feedlines to be multiples of half wavelengths at 40 meters — 45', 90', or 135' (I hope you won't need more than 90'; if you do, you should substitute RG-8/U).

The length of an electrical half wavelength of coaxial cable such as RG-58/U or RG-8/U (solid dielectric) is found by using the formula 492 x .66 (velocity factor)/F MHz. By substitution and solution for 7.2 MHz, the result is 45.1'. 45' is a good number to start with, as actual measurement with a grid-dip meter or antenna noise bridge usually shows this length to be slightly long. But, since it will take at least 42' of feedline to reach from the feedpoint of the dipole to the base of the mast, and it is unlikely that your shack is only 3' from the base of the mast, it is best to consider a minimum feedline length of 90'.

Assuming that this length will satisfy your need, cut a piece of coax to measure 90'. Measure it electrically and prune it to resonate as a full wave at 7.2 MHz. If the second feedline is of the same manufacture, you will be safe in cutting it to the same length as the first. Double check with the grid dipper or bridge to be sure. Remember, except for the convenience of being able to measure resonance of the antenna at some point remote from the feedpoint itself, length of the feedline isn't important, but predictability and reliability of performance of a phased array, such as the perverted vee, depend on the two feedlines being electrically identical to each other.

Once the feedlines are cut to final length, attach them to the dipole feedpoints, B and F, making sure that the coax shields are connected to the elements B-A and F-G and the coax center conductors to elements B-C and F-E. A piece of tape on the antenna wire next to the center insulator will help you identify the shield-fed side. It is a good idea to wrap a piece of tape around each length of coax 17' from the feedpoint. This will give you a convenient way to space the dipole centers 17' out from your mast. Tie a 35' length of nylon rope to each center insulator.

Now let's test and adjust the dipoles for resonance, one at a time, starting with dipole ABC. Raise end C (coax center conductor side) to the top of the mast (you do have a pulley or S-hook up there, don't you?), leaving a 4" to 6" space between the insulator and the pulley. Find the piece of tape you put at 17' down the coax from the center insulator and attach it to a place on the mast about 24' or 25' above the ground. A TV standoff insulator or a few wraps of electrical tape will serve the purpose. Take the other end of the 35' nylon rope tied to point B and walk away from the mast with it until the coax B-D becomes fairly horizontal. A little slack is okay, but make it as tight as good judgment says you should. Tie down the end of the nylon rope. Pick up the loose end of the dipole, A, and fasten it to the bottom of the mast with a short piece of nylon rope (4" to 6").

Dress the coax hanging from point D down the side of the mast, and use a few wraps of tape to secure it to the bottom of the mast. Take the rest of the coax to the shack and connect the end to your swr bridge, the bridge to your transmitter. Set the transmitter vfo to 14.2 MHz, load the transmitter for enough output to "drive" the swr meter to full scale forward, and check swr. From this point on, usual antenna adjustments for lowest swr indications should be followed, adjusting only the 16'8" lengths of the dipole at the feedpoint side of the traps.

Once the antenna is resonated at 14.2 MHz, set the transmitter to 7.2 MHz. Adjust the outer ends of the dipole, at insulators A and C, for lowest swr. The dipole should now be adjusted for resonance on 40, 20, 15, and 10 meters. It is not likely that the antenna will show 1:1 swr on any, much less all, frequencies; but the dipole will be resonant, and that is the important thing. Excessive swr will be flattened out in the antenna coupler.

Dipole EFG should be put up and adjusted in the same manner as dipole ABC, but you must take down, or at least collapse, dipole ABC while adjusting dipole EFG. If for no other reason, take this on faith.

Once dipole EFG is resonated, leave it in place and reerect dipole ABC. The two dipoles must be exactly opposite each other for predictable results, and the feedpoints should be about 34' apart, give or take a foot. For the sake of neatness and safety, tape the two feedlines together from the base of the tower to where they enter the shack. A couple of wraps of electrical tape every 8' or so will do nicely.

As I mentioned previously, the phasing unit is a simple but most effective device. I credit my good friend and mentor, Jerry Swank W8HXR, for first showing me this circuit. The only "tricky" thing about its construction is to be sure that you connect the shields of the two pieces of coax together and to ground. Use short pieces of RG-58/U between contacts 1 and 3 and the SO-239s. These pieces of coax should be the same length.

With the switch in position 1, dipole ABC lags dipole EFG. In position 2, both dipoles are fed simultaneously for in-phase operation. In position 3, EFG lags ABC. Fig. 3 shows directivity for the system on the various bands.

Performance

To state gain, front-to-back, and front-to-side figures in decibels for a practical antenna system can be, and usually is, misleading. Whenever I see such data, I wonder if the system in point is compared with an isotropic source, real dipole (horizontal or vertical), or vertical (ground plane, ground mounted with radials). And there is the consideration of angle of radiation of the main lobe(s). The best I can tell you about the perverted vee is that you can expect gain of 3 to 5 decibels in the main lobes and attenuation of 10 to 30 decibels in the nulls. The comparison is made against a single-element dipole such as ABC.

The perverted vee is an efficient radiator and an excellent DX system. As a vertical, it provides good low-angle radiation and directivity. Compared with ground-mounted or ground plane vertical phased arrays, it performs well with less dependence on Earth reflections, radials, etc. Compared with phased inverted vees or horizontal dipoles, it is far less complicated to put up, requiring only a single supporting mast or tower. And like an inverted vee, it will provide reliable middle- and short-distance communications.

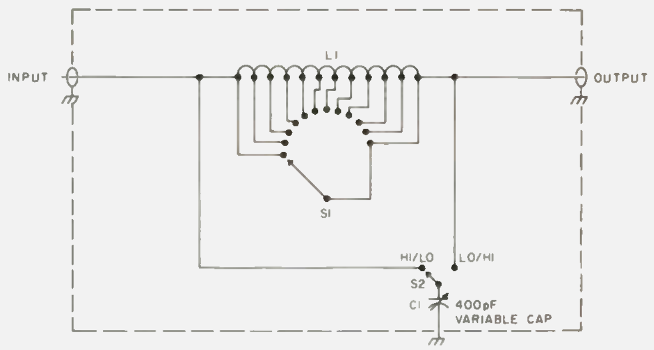


Fig. 4. L-network. C1 — 400 pF air variable capacitor; L1 — coil, 11 turn, 8 tpi, 2½" diameter, 11 gauge; S1 — 12-position rotary (phenolic okay to 300 Watts); S2 — SPDT rotary (phenolic okay to 300 Watts).

So, there it is, "an antenna system with gain, directivity, excellent front-to-back ratio, rotatability, low cost, and relatively simple and safe construction," with 4-band capability, as well. It's a whole lot cheaper than a linear amplifier (which does nothing to improve reception).■

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Parts List

120' antenna wire (I prefer 14-gauge enamelled copper. It is easy to handle, and the enamel coating prevents oxidation.)
70' nylon cord, 1/8" diameter
4 end insulators (ordinary 3" porcelain or 1" x 3" x¼" strips of Lucite,TM
2 center insulators to accommodate RG-58/U (B&W, Hy-Gain, Pace, Greene, etc., or your favorite home brew type).
4 traps, resonated to 14.1 MHz (Pace-Traps or home brew)
2 TV standoff insulators (mast type)
1 50' push-up TV mast (if you don't already have one, or a 50' tower or 2 50' trees to string a catenary between)

LETTERS

from page 65

League's killing of CB on 220, the League's Code of Ethics to be forced upon everyone, and the League's futile efforts toward WARC '79, I realized who stood for amateur radio and who stands for themselves.

Your March editorial is a good point. When forced to show how much impact the Code of Ethics has had considering the amount of publicity they gave it, the League couldn't! Only a few distributors of gear had joined up, the main group of manufacturers telling the League to go jump! Your editorial also brought out into the open some new facts concerning the group known as HFers. While the League warns us of the sinister intentions of this group, only you have the courage to raise the point that by far these operators are the cream of the crop. While their actions are illegal (which most of CB was until the FCC legalized it), these operators attempted to do something about crowded band conditions, idiotic and dangerous operations, and the general improvement of their surroundings. Unfortunately, they have been held back in their growth to bigger and better things by the policies expounded by the ARRL. Rather than encourage them to advance beyond what they have now, the League drives everyone into Novice courses, the end result being that they can now use legally their Yaesus, Kenwoods, etc., on small portions of intensely crowded bands. Does the League encourage them to advance to General and above? No, they petition the FCC to widen the Novice band on 80,

Continued on page 73

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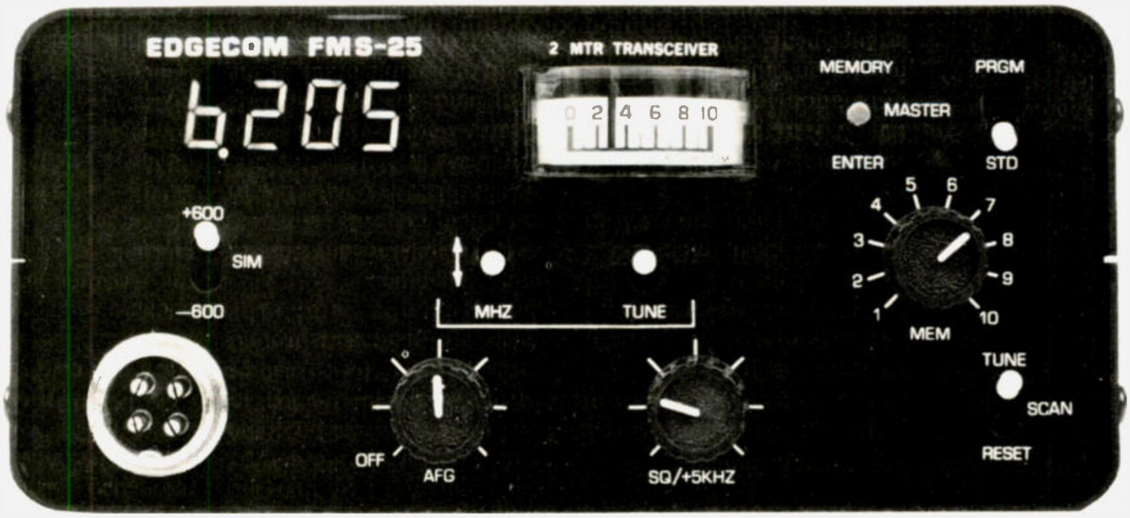

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Creeping Crud Got Your Signal?

—pollution is slowly destroying your beam

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One of the most often neglected items in an amateur setup is the triband beam antenna. Once this lone radiator is purchased and placed atop a tower or mast, it is seldom maintained, until signals deteriorate to unacceptable levels or until the QTH is moved. This course of action is somewhat natural because access to a tribander is usually difficult and because factory-preset traps are seldom checked. As a result, many neighborhood insects find the tribander an ideal sanctuary in which to live and eventually create carbonized paths in coils and insulators.

This article will describe some basic maintenance ideas and preservation measures which can be used with triband beams to insure their long life. Any of these concepts will prove quite helpful when refurbishing an aged beam or vertical antenna.

While some beams can be accessed from their location atop a tower, the usual procedure involves waiting until they can be moved to ground level for servicing. Before disassembling a trapped antenna, carefully mark each element's position and the connecting sections of each element. Colored strips of electrical tape are ideal for this coding step. Likewise, place all spacers and/or mounting blocks in an appropriate place to avoid losing them. Murphy's law always reigns supreme while working with antennas!

The first "rebuilding" step usually involves replacing the antenna's coaxial cable with a new length of the same impedance. If you aren't using a low-loss foam dielectric cable, now's an ideal time to make the change. Rest assured the small additonal cost of foam cable is worth its outlay. (One of the best all-around types of 50-Ohm coaxial cable that I've found is Belden's 8214. It's mildly expensive, and its loss at 28 MHz is quite low.)

The next logical operation is disassembling the various pieces of connecting tubing, cleaning their contact areas, and then reassembling them. While this step may seem somewhat trivial, it can make a noticeable difference in antenna performance. Should such connections appear at current loops on the antenna, a mere fraction of an Ohm could reduce signal

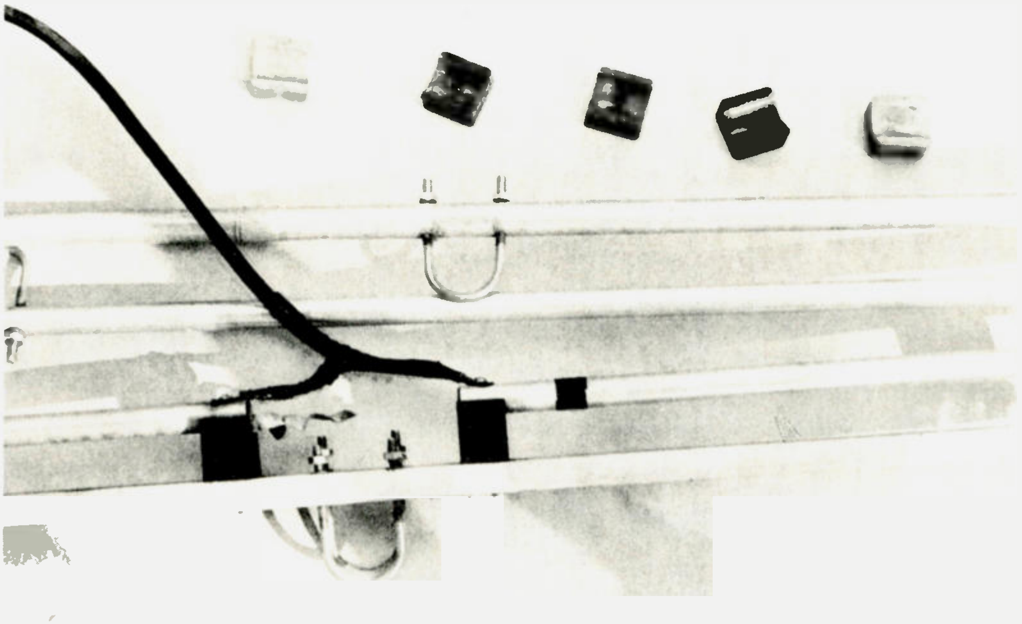

Photo A. Disassembled antenna elements are placed in a logical sequence and color coded with tape before rebuilding efforts begin. Remember to also color code the boom and keep track of the mounting blocks.

strength. As a (remote) example, you've probably noticed how cleaning the battery contacts on an automobile also reduces resistance and often permits a weak battery to crank a car. Although sandpaper cleans antenna elements very well, replacement packages of "contact grease" can usually be purchased from the antenna's original manufacturer. Clean the elements individually to eliminate any possibility of cross-connecting them during reassembly.

Next, disassemble the traps, and perform whatever maintenance is indicated by their condition (assuming, of course, that your unit doesn't employ hermetically sealed traps). Overlooking this step may render your rebuilding efforts worthless, so here's a trap-reworking guideline.

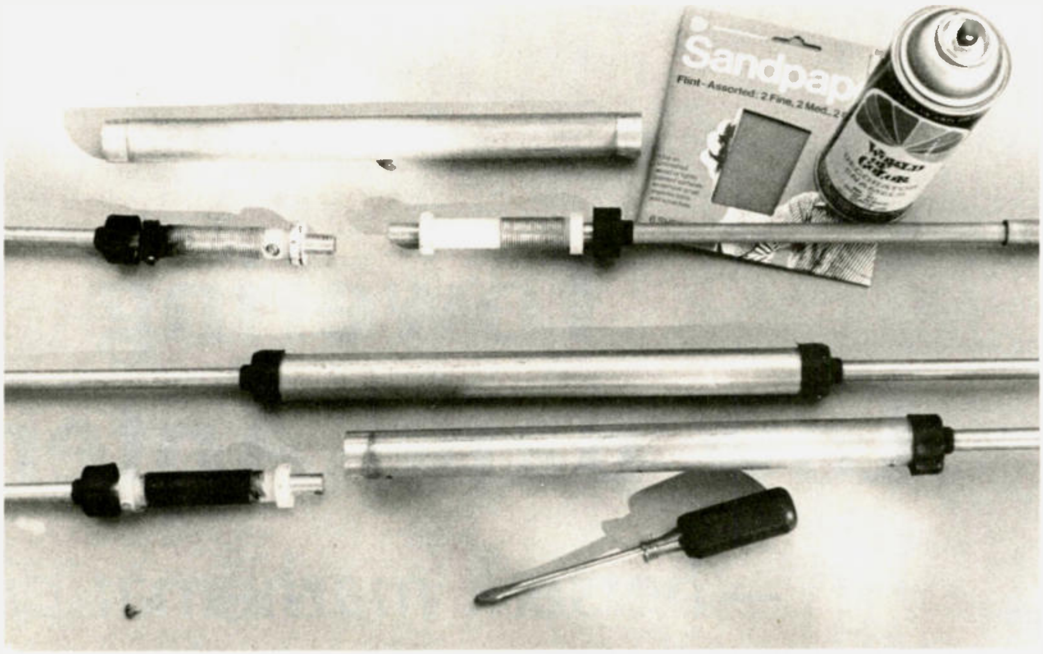

Photo B. This shows what's in a trap and how it's disassembled. The coil in the upper left was charred by a carbonized path, as described in the text. The driven-element coils are coated with Corona Dope to improve rf insulation.

First, spread a small amount of petroleum jelly near the boot on each end of a trap. Then, using a circular rocking motion, free the boot and slide it back slightly. This permits access to the coil's mounting screws. Carefully remove the screws and pull each end from the trap's outer tubing. Clean the coils with a soft brush, remove any foreign matter, and repair any unfortunate "surprises" which may be found.

One typical example of such a "surprise" is the carbonized path shown on the left top element of Photo B. Apparently, a spider crawled through a drain hole in the director's trap and became lodged there during transmissions (such accidents are well known among broadcast engineers). Eventually, the rf energy induced into this coil charred its polystyrene form and warped one end of the coil. This trap was rebuilt by carefully re-bending the coil, cleaning the form of all carbon deposits, and moving its screw connection 180 degrees on the form. A light coating of Corona Dope was also used to seal the damaged area.

The next step involves lightly coating the driven element's coils with Corona Dope. This will prevent dampness accumulation and will make the traps high-voltage proof. Although the coils are darkened by the Corona Dope, it doesn't adversely affect their performance.

Finally, the antenna is reassembled and sprayed with a liberal coating of Krylon™ clear plastic. Then, it's placed back atop the tower or mast.

I tried one other modification on my beam which proved very worthwhile. A W2AU 1:1 balun was installed at the driven element, and it improved performance appreciably. The swr also decreased, though that change could also have been due to the trap rebuilding efforts.

In conclusion, I would definitely say that reworking aged trap antennas (either beams or verticals) is truly worth the effort and time. Why not give it a try the next time you become displeased with that antenna you've enjoyed for several years? The results may amaze you. ■

LETTERS

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thereby keeping many from progressing further. With incentive licensing, courtesy of the League, the bottom three classes of American amateur licenses now have the majority of amateurs. Why should they continue when all they have to gain is more room to send CW, which is rapidly becoming an outdated mode of communications, and when they learn of the many witch-hunts such as intruder watches and the Code of Ethics which the ARRL tries to force down their throats.

Unfortunately for the United States, there are not more people like you, Wayne, who are willing to stand up for their rights and be counted. In Canada we have the same problem, only it goes by the name of the Canadian Radio Relay League. However, there is a second "national" group in Canada, the Canadian Amateur Radio Federation, which has been successful in thwarting many of the same stupid moves of the League in Canada. Recently, a CARF-sponsored symposium with the Department of Communications was held to plan for the future needs of the Canadian amateur. The DOC proposed a no-code VHF-UHF ticket (completely legal under international rules), which with some major adjustments appears certain to become a reality. To be sure, the League was there with its own proposal for a Novice ticket very similar to that in the U.S. today. Fortunately, this was shot down. Not to let a dead issue stay dead, the CRRL now wants to limit the existing "amateur" license in Canada for the first six months of operation to CW only. After six months, an en-

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Towering Low Band Antennas

—berserk mathematician figures impedance

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Recently there have been some articles written about verticals that explained the electrical parameters by mathematical expressions.[1,2,3] The main emphasis of one article was placed on a formula developed by Dr. Sergei A. Schelkunoff of Bell Telephone Laboratories.

$$Z_0 = 60\ [(\log_e \frac{2h}{a}) - 1]$$

The vertical is compared to an open-ended transmission line and its characteristic impedance is found. Once the characteristic impedance is known, the conjugate impedance values (resistance and reactance) are found by a transmission line formula. These conjugate values have also been tabulated in graphs cited in the reference material. To use the graphs, Z_0 values must be known, along with antenna height in electrical degrees.

This article addresses itself to determining the radius of irregular shapes, such as towers used in amateur radio. Why towers? Lately, there is a trend among amateurs to series feed or shunt feed their towers on 160 and 75 meters. If the above equation is to be used in solving for conjugate impedance of a tower, its irregular shape must be equated to a circle.

The example shown here will be a three-sided tower — Rohn model 25. This tower measures 12½ inches on each of the three sides. The next requirement is to find the center of the equilateral triangle.

To accomplish this, the following steps are necessary:

1. Get one piece of note paper, a right triangle, a ruler, and a compass.
2. The tower triangle is too large to be drawn on note paper, so divide the 12½ inches by 2, which equals 6¼ inches. Use this value from now on in this problem.
3. Construct line A 6¼ inches long, as shown in Fig. 1. Then divide the line in two, marking off the halfway point 3-1/8 inches (B) from each of the line ends.
4. Construct line C 7 inches long, perpendicular to line A.
5. Construct line D 6¼ inches long from the end of line A on the left side of the triangle to line C.
6. Construct line E 6¼ inches long from the end of line A on the right side of the triangle to line C intersecting with line D. This completes construction of the equilateral triangle. (Note that each angle is 60 degrees.)
7. On lines D and E, measure the halfway points or divide the line in two, as was the case in step 3 for line A.
8. On lines D and E, draw perpendicular lines F and G at the halfway points so that lines F and G intersect with line C.
9. At the center point, use a compass and draw a circle

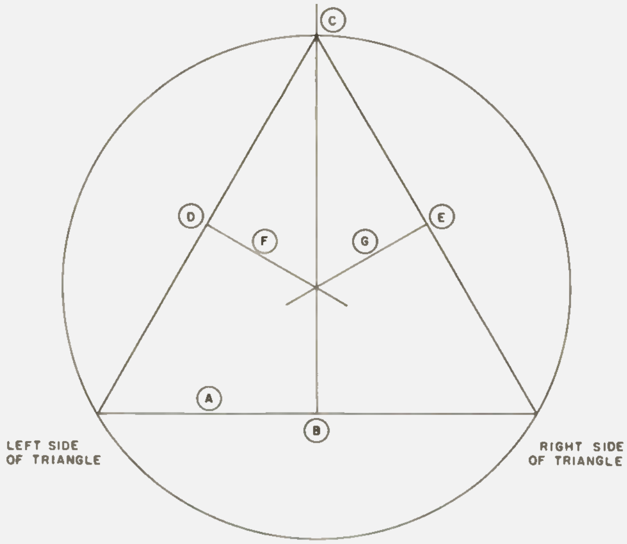

Fig. 1.

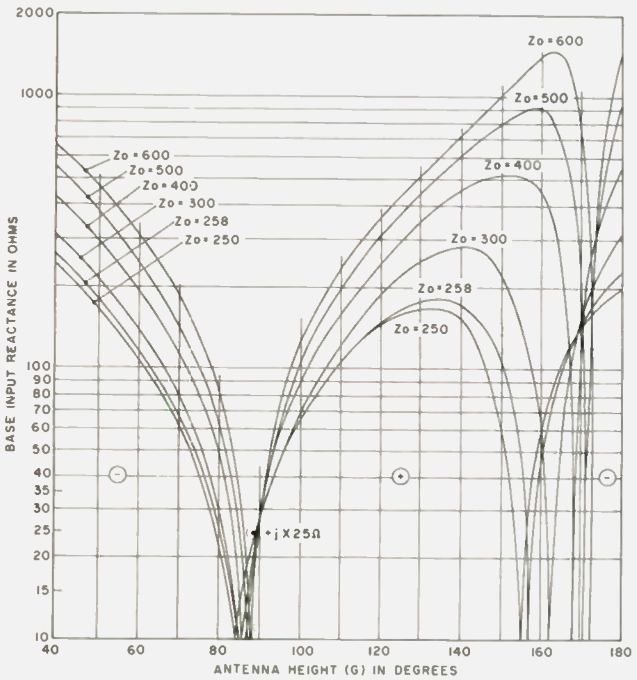

Fig. 2. Base input reactance of cylindrical antennas over a perfectly conducting ground plane.[6]

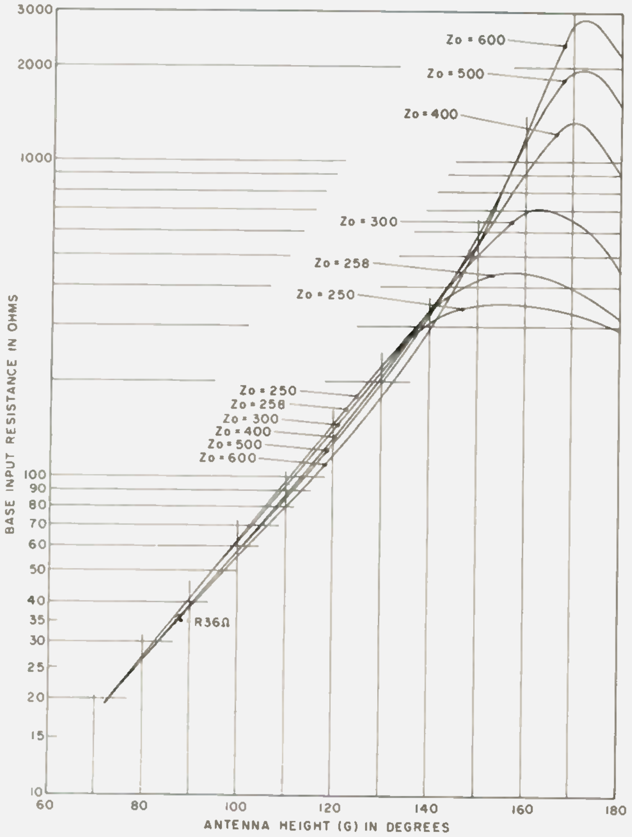

Fig. 3. Base input resistance of cylindrical antennas over a perfectly conducting ground plane.[6]

around the triangle points. The circle should touch all three triangle points, proving that the center is correct. Now measure the radius to each vertex, finding that the three values each equal 3½ inches.

10. The triangle dimensions were reduced by 2 to fit the drawing paper. Multiply 3½ inches by 2, which equals 7 inches. Seven inches is the real radius value.

The final step is finding the equivalent radius[4] represented by a three-sided figure now that the radius is known.

a = radius of outscribed circle

a_{eq} = equivalent cylinder radius in inches

$a_{eq} = a(0.4214)$

$a_{eq} = 7''(0.4214) = 2.95$ inches

Using Dr. Schelkunoff's equation, the characteristic impedance can now be found. Let h be the tower height (in this example, 60 feet); let a be a_{eq}, the equivalent radius.

$$Z_0 = 60\left[\left(\log_e \frac{2h}{a}\right) - 1\right]$$

$$= 60\left[\left(\log_e \frac{(2)\,(720'')}{2.95''}\right) - 1\right]$$

$$= 311.44\ \Omega$$

Note: If the example antenna operates on 4 MHz, the wavelength is 246 feet. To find electrical degrees, do the following:

$$\lambda = \frac{984}{f\ \text{MHz}} = \frac{984}{4}$$

$$= 246' \qquad \frac{(h)\,(360)}{\lambda}$$

$$= \frac{(60')\,(360)}{246'} = 87.8^\circ$$

Using the graphs in the reference list shows this tower's conjugate impedance value to be R 36 Ohms + jX 25 Ohms[5,6] over a perfectly conducting ground radial system.

Since I do not own a General Radio rf impedance bridge (916A or 1606B), this method saved me a lot of time and effort in series and shunt feeding towers. ■

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LETTERS

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dorsement can be obtained for operation on 10 meters and above. Thus, if they now have their way, no Canadian amateur will be allowed to use voice communication for the first six months of his first amateur license. In the U.S., at least one doesn't have to get his Novice certificate to proceed, but can get, for example, the General. Not so in Canada, if the League has its way. That's one hell of an incentive, when after studying and passing an exam harder than the General ticket in the U.S., the person must stay on CW for six months. Thank you ARRL-CRRL. Thanks for nothing!

Again, Wayne, thanks for being open-minded and for telling it like it is. I may not agree with everything that you say, but you're miles ahead of the American Radio Relay League.

William Leal VE3IHB
Windsor, Ontario

AFFORDABILITY

I have been a ham for almost two years now. When I first got into amateur radio, someone told me that it was a rich man's hobby. At that time I disagreed, but after looking at some of the prices of new HF equipment, I think he may have been right.

With the cost of raising a family, it is very hard to justify $700 for a transceiver, $200 for a beam, and several hundred more for an antenna support. OK, maybe you don't need all this, but who has a chance for making good contacts with all the high-power stations around? Sure, low power will get results, but I started on low

Continued on page 79

James E. Taylor W2OZH
1257 Wildflower Drive
Webster NY 14580

The 80 Meter Pile Crusher

—the ultimate vertical?

There is at least one advantage to operating exclusively on one amateur band — it encourages dreams of better antennas for that band.

At W2OZH, the band is 80 meters, and such hallucinations have led to a novel mobile configuration[1] and to an effective direction-switchable array using horizontal elements.[2] The satisfaction afforded by this latter configuration has led to speculation regarding direct comparison with a similar phased array using vertical elements.

"A Low-Frequency Phased Array"[2] described preliminary attempts to utilize the sixty-foot supporting masts as vertical radiators. However, subsequent attempts to improve this vertical system using additional ground radials were disappointing. Two factors contributed to this lack of success: (1) the undesired cross-coupling from the verticals to the horizontal elements, and (2) the proximity of the house, which interfered with the laying of a full symmetrical radial system. Thus, each radiator did not form a simple resonant circuit (for maximum current) and the radial system permitted a high degree of near-field ground penetration (with attendant ground losses).

As a result of these defects, I decided to start from scratch on a vertical array composed of two resonant radiators sixty feet ($\lambda/4$) apart in the rear lawn, sufficiently far from the house to permit a symmetrical ground radial system to be laid. This article describes the constructional details of these radiators.

Operating Principles

Sevick[3] and others have shown that vertical antennas which are much less than one-quarter wavelength long can be effective radiators if: (a) the losses in the antenna element and matching system are kept small, and (b) a low-loss image plane is provided using a large number of radials approximately a quarter wavelength long. Elwell[4] has pointed out that the current loop of a resonant vertical antenna can be moved upward away from the base by changing the tuning. The qualitative diagrams are shown in Fig. 1.

However, before you set about just copying what others have done, it is worthwhile to review some fundamentals in the light of where you want to go.

If you are to have low losses in the antenna element, you need only use large diameter conductors, including any loading coils which are used. However, you also need to consider what is necessary to achieve a low-loss image plane. Maxwell[5] has depicted clearly the rf current flow in the ground system of a typical vertical antenna (see Fig. 2).

The power loss in such a ground system occurs both in the resistance of the radial system and in the ground beneath the radial system (due to field penetration of the earth). Thus, if you wish to decrease these ground system losses, you should try to decrease the current flowing in the radial system near the base of the antenna. This will serve both to decrease the direct resistive losses and to decrease the penetrating field.

Referring to Figs. 1(c) and 2, you can see that Elwell is on the right track; the current at the base of the antenna and out into the radial system is small for this arrangement. However, his series feed at the base of the antenna presented matching problems due to the high impedance at this point. You need to retain the low base current, yet be able to feed the radiator directly from a low-impedance coaxial feedline without a matching network.

For guidance, let's review some antenna fundamentals. The basic rf resonance of a straight conductor is dipolar, that is, the instantaneous voltage at one end is (+) and at the other end (-). This is the mode shown in Fig. 1(b). It must be noted that, at resonance, the reactance is cancelled, and, at all points along the antenna, the impedance is a pure resistance. If you now look at Figs. 1(a) and 2, the so-called "$\lambda/4$ monopole," you see that the fundamental mode of resonance is still dipolar, that is, (+) to (-). The only difference is that the image plane acts like the other half of the $\lambda/2$ dipole. If you start with the situation at 1(a) and add top loading, you can arrive at the current distribution at 1(c).

Now, what does the impedance picture look like? In each of the three cases, the impedance has a high value at the top, marked (+), and at the dipolar image points, marked (-). At the intermediate position where the current is a maximum, the impedance has a minimum value — ~36 Ohms for the image plane antenna and ~72 Ohms for the ideal dipole, Fig. 1(b). The ideal way to feed such an antenna using

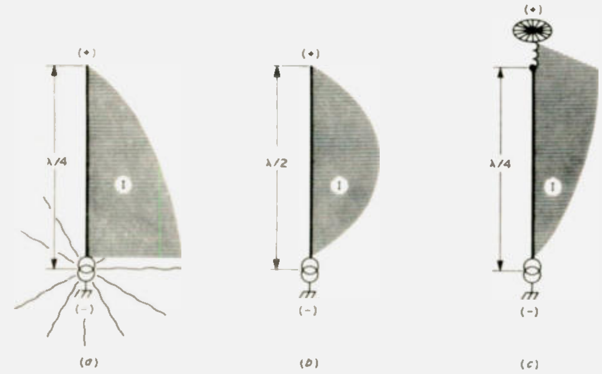
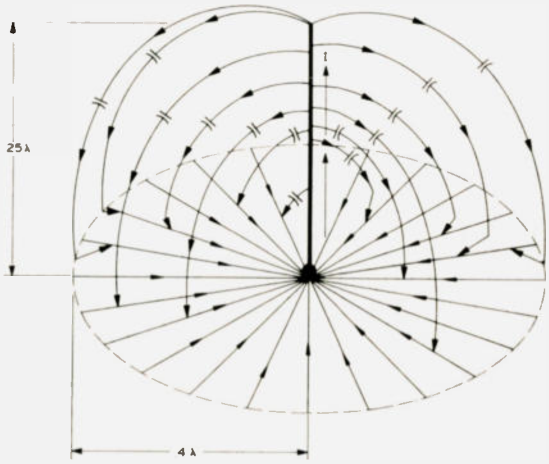


Fig. 1. Current distribution on three vertical antennas. The tuned circuit at C simulates ¼ wavelength.



52-Ohm coax would involve separating the antenna at a point near X, in Fig. 1(c), such that the impedance is 52 Ohms. But how can you avoid interaction with the shield of the coax? Read on!

Referring to Fig. 1(c), connect the bottom of the antenna directly to ground (eliminating the generator shown). Now assume that the bottom section of the antenna is in the form of a hollow pipe. If you place a coaxial feedline inside this pipe with the shield connected to the pipe at the top (point X) and the center conductor is then connected to the insulated top section, the feedpoint impedance, as described above, is presented across the feedline. If you choose the point X at an impedance level of 52 Ohms, the feedline will be exactly matched into 52 Ohms, resistive.

Thus, you have, in principle, arrived at a resonant vertical antenna configuration which has its current loop above the ground (thereby reducing current in the radial system) and which presents a perfect match to a low-impedance coaxial feedline. As a fringe benefit, the base of the antenna is at ground potential, a fact which offers simplified mechanical construction.

CONSTRUCTIONAL DETAILS

The Antenna

Two antennas were constructed following the principles outlined above. The antenna elements were assembled using aluminum irrigation pipe, as shown in Fig. 3.

There is, of course, a wide variety of constructional material available, but I have had such good luck using aluminum irrigation pipe for support of other antenna installations that this was an obvious choice in the present instance. The two vertical antennas were constructed at different times – the second approximately one year after the first. For this reason and because I wanted to experiment with different geometries (yielding different input impedances), I used different lengths of pipe for the two antennas. The compensating adjustable parameter is the coil inductance. The dimensions used for the two antennas are shown in Table 1.

The base section of each antenna is a length of three-inch-diameter irrigation pipe. The top sections are two-inch-diameter pipe. The top section telescopes inside the bottom section for a distance of three feet. Insulation is provided by PVC pipe fittings, as indicated in Fig. 3. The sections are anchored in position by hose clamps and by strategically positioned metal screws. Hose clamps are also placed at points of high stress to strengthen the base section.

The coil support is a 2-3/4-foot length of PVC pipe

Fig. 2. The hemisphere of current which flows as a result of capacitance of a λ/4 vertical radiator to the earth or a radial system. At frequencies above 3 MHz, rf currents flow primarily in the top few inches of soil, as explained in the text. Ground rods are of little value at these frequencies, and spikes or large nails are sufficient to secure the outside end of each radial wire. With a sufficient number of radials, annular wires interconnecting the radials offer no improvement in antenna efficiency, as the current path is radial in nature.

with an i.d. of 2 inches. The two-inch aluminum pipe telescopes into the ends of the PVC a distance of 12 inches, leaving a 9-inch length of insulation where the coil is located. The coil is approximately three inches long (30 turns, maximum) to provide an excess of turns for tuning adjustment. Since the coil fits loosely over the PVC pipe, it is supported by the connecting wires. After experimentation was completed, the coil was wrapped with 20-inch-wide fiberglass tape for additional support and protection.

The Adjustable Top-Loading

The key enabling device

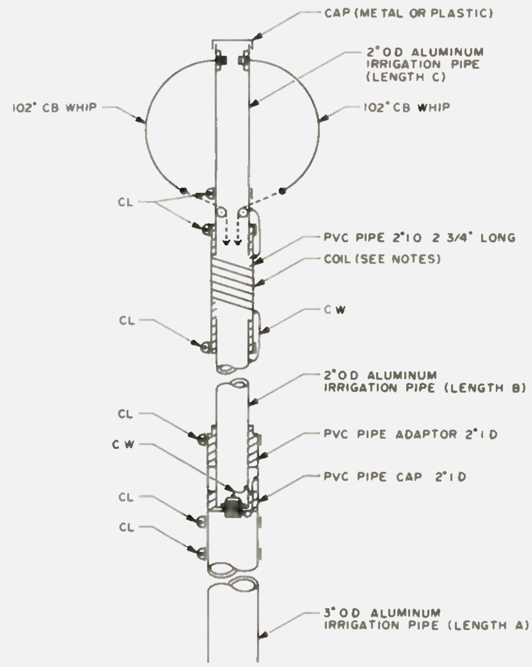


Fig. 3. Antenna construction details. Notes: C.W. – connecting wire to solder lugs; CL. – radiator hose clamp; Coil – Polycoil 2½" diameter #16, 10 turns per inch.

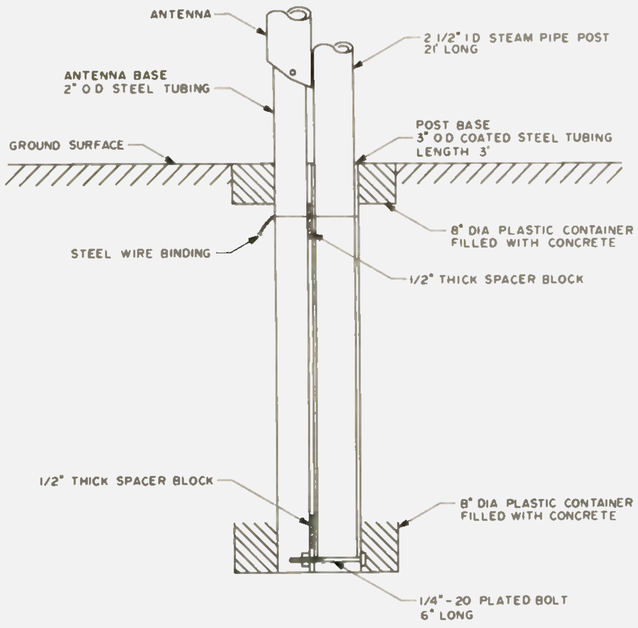


Fig. 4. Supporting base construction details.

which makes this antenna system practical is the method of tuning the radiator to resonance from the ground level. Usually, a roller inductor or other tuning method is necessary at the base of the antenna, which sacrifices mechanical and electrical flexibility. Remember, you want to have the antenna self-resonant so that, in effect, when the feedline is connected, it works into a resistive load.

The desired tuning is achieved by means of an adjustable top-loading arrangement made of two Citizens Band whips which project from either side of the top of the radiator. Lengths of nylon cord are attached to the ends of these whips and pass through awning pulleys which are supported from the mast by a hose clamp. A length of nylon cord runs down the mast to the ground level. Pulling on this cord flexes the whips from the horizontal positon to the circular configuration shown in Fig. 3, thereby producing the desired variation of capacitance between the top of the antenna and ground. This adjustment is sufficient to cover the entire 75 meter phone band without changing the coil inductance – a very useful capability.

The Antenna Support

It was desired that this vertical antenna be placed in an unguyed position in the back lawn of a typical suburban lot. Accordingly, a 21-foot length of 2½-inch (nominal) steam pipe (2-7/8 inches o.d.) was mounted in the ground to serve as a supporting post. Inasmuch as this was to be an adaptable installation for future experimentation rather than a fixed arrangement, the supporting pipe was mounted in such a manner that it could be removed without disturbing the buried system of radial ground wires. This was achieved by telescoping the supporting post into a three-foot length of three-inch-diameter coated steel tubing buried in the vertical position as shown in Fig. 4.

It will be seen that the antenna is pivoted at the base on a 5/16-inch-diameter bolt which passes through a length of two-inch-diameter steel tubing, which is attached to the base for the supporting post. This tubing, which projects approximately four inches above the ground surface, is assembled against the post base to form a rigid assembly before being cast in concrete as shown. Thus, when completed, this assembly forms a rigid buried

	Dimensions			Coil
	A	B	C	Turns
Antenna no. 1	30'	11½'	8½'	20
Antenna no. 2	20'	12'	12'	12

Table 1. Antenna dimensions.

support structure, made of the antenna mounting base and the post mounting base. The supporting post is raised to the vertical position and then lowered into the pipe base to complete the antenna supporting structure; this is a two-man job.

Antenna Erection

As shown in Fig. 4, the antenna is pivoted at the base on a 5/16-inch-diameter bolt. The antenna can be "walked up" – easily by two men or with greater strain by one (young) man. If I am that one man, I prefer to use a rope hoist. After erection, the antenna is held rigidly in place by two hose clamps which are tightened around the antenna and the supporting pipe.

The coaxial feedline passes upward through the antenna, and its shield is connected to the lower section of the radiator, both at the feedpoint and, by means of a length of flexible braid, at the base of the radiator. Here, it is connected to the center of the system of ground radials. The coaxial cable is then buried so that it becomes a part of the radial image plane.

The Image Plane

Sevick and others have shown that a large number of ground radials is required if an effective image plane is to be achieved in localities where the soil has but modest electrical conductivity.

Guided by this previous work and by the dimensions of the available plot, I chose to use for each vertical radiator 73 radials (5° radials plus the coaxial feedline), each having an approximate length of one-quarter wavelength. The image plane took the form shown schematically in Fig. 5. For clarity, not all of the wires are shown in the sketch. Since this vertical system was superimposed over the grid of parallel ground wires (spaced ten feet apart) which were used for the horizontal phased array,[2] the image plane is connected to this grid by soldered crossovers at the median grid wire, as shown.

ADJUSTMENTS

Resonance

After erection of the vertical radiators and completion of the image plane installation, it is only necessary to adjust the system to resonance. This is accomplished by means of a noise bridge. The two feedlines were first trimmed to an electrical length of one wavelength at the operating frequency (3.955 MHz). Since the feedline is an integral multiple of half waves, the measurements are as if made at the antenna feedpoints directly. The noise bridge was connected at one antenna input, while the other antenna was terminated in a 52-Ohm resistive load. The resonant frequency is measured by detection of the null of the noise bridge. This resonant frequency is then altered by pulling the rope which flexes the whips at the top of the antenna. For example, if the measured resonant frequency is too high, the whips are extended more, thereby lowering the resonance point. If there is, at first, not enough range in this adjustment, the antenna is lowered and the number of coil turns is increased. Once the desired resonant frequency is attained, this antenna is terminated while the other radiator is adjusted. A slight "tweaking" of the first antenna now completes the adjustments.

Matching

Referring to Table 1, it is seen from a comparison of

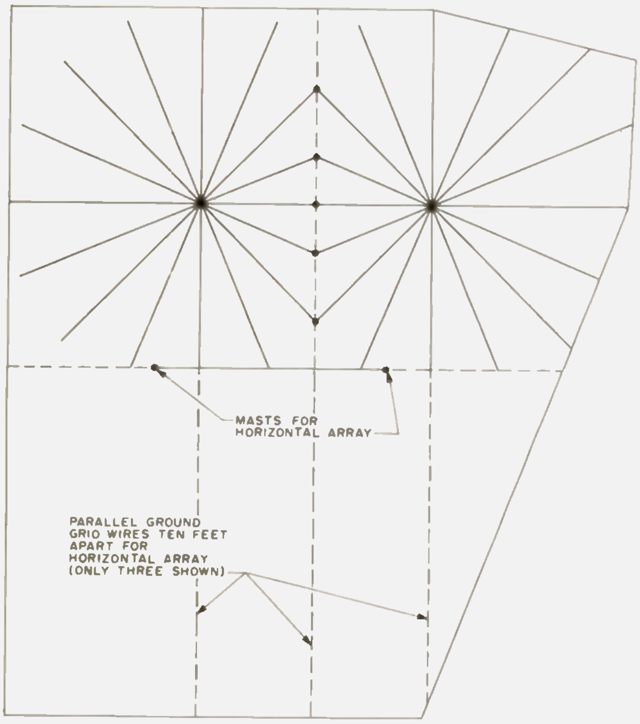


Fig. 5.

dimensions that probably the feedpoint impedance of antenna no. 1 will be greater than that of antenna no. 2. This is surmised because, viewed as a dipole-image antenna system, this feedpoint is probably further off center than is that for antenna no. 2. This proves to be the case — noise bridge measurements indicate this feedpoint resistance of no. 1 to be 70 Ohms, whereas that for configuration no. 2 measures 40 Ohms. Rather than change the antenna dimensions to realize an input resistance of 52 Ohms for each, it is simpler to utilize broadband toroidal transformers to match each antenna to the 52-Ohm source.

Since the frequency used is relatively low, the transformers were wound with 15 turns of zip cord on a 2-inch-diameter toroidal form (T-200). These units were connected in the autotransformer mode, and, for each, the tap was adjusted empirically using the noise bridge. Residual inductance was tuned out using series capacitors. The details for these transformer connections are shown in Fig. 6. The input resistances were each adjusted to 50 Ohms.

Operation

This antenna system has been operated as a two-element phased array using the same delay-line switching manifold as has been used with the horizontal system.[2]

Electrically, the operation is as expected. Swrs are below 1.1 for all combinations of the radiators. The front-to-back ratios are consistently above 10 decibels. The phasing is monitored by the Lissajous pattern on an oscilloscope. The in-phase, quadrature, and 45° patterns are as expected.

As mentioned earlier, detailed comparisons with the horizontal array are planned. Preliminary results indicate that, for short-distance (out to fifteen miles) ground wave, the vertical system is consistently stronger. For distances out to about 200 miles, the horizontal system is substantially stronger. For distances greater than 200 miles, the vertical system is stronger only if propagation conditions are favorable. It is my feeling that this will be strongly dependent upon the sunspot cycle. It would appear that the low-angle refraction for this relatively long wavelength radiation may depend upon the "smoothness" of the ionosphere. If this is true, one might expect inferior performance of the low-angle (vertical) system during sunspot lows when the ionization is "rough," producing excessive scattering during the oblique-angle refraction. As the sunspot cycle improves, one would expect the ionization to be more uniform, or "smoother," so that the low-angle antenna system would come into its own, perhaps producing substantially stronger signals than the higher-angle horizontal system. If this proves to be true, it would explain much of the conflicting data which has been reported down through the years regarding the effectiveness of vertical antenna systems on 75 meters. ■

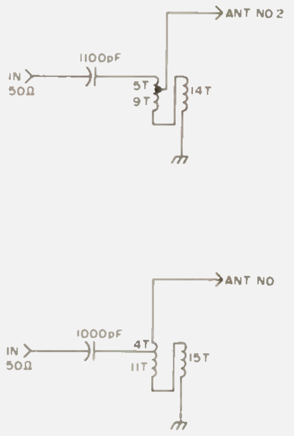


Fig. 6. Toroidal matching transformers.

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1. "The Mobiloop," J. E. Taylor, *QST*, November, 1968.
2. "A Low-Frequency Phased Array," J. E. Taylor, *73*, July, 1974.
3. "The W2FMI Ground-Mounted Short Vertical," J. Sevick, *QST*, March, 1973.
4. "Top-Loaded Vertical for 80 Meters," H. G. Elwell, Jr., *Ham Radio*, September, 1971.
5. "Another Look at Reflections," M. W. Maxwell, *QST*, April, 1974.

LETTERS

from page 75

power (5 Watts), because it was all I could afford, and nearly quit amateur radio. I guess I could fill page after page about lost contacts and no contacts because of QRM from the really "strong" stations on nearby frequencies.

It seems like this letter has started one way and is headed somewhere else, but the point is: "How can the average person afford an A-1 radio station?"

I enjoy amateur radio. I know it is growing because there are more hams in our area than there have ever been. With this growth, there have been growing pains. I have some suggestions for helping:

1. Manufacturers are putting more and more into each radio. Why not start with a radio that is one band (40 meters) and operates CW only? Then, as the amateur progresses, the radio would have add-on accessories to increase the number of bands and add SSB and other such items to upgrade the equipment.
2. Why don't they allocate band segments for low-power (QRPp) use?

These things will not solve *all* the problems of amateur radio, but I feel that they would help the Novice operator in two ways: He will be able to afford the equipment to operate and he will therefore retain his interest in amateur radio.

Maybe somebody agrees with me—maybe not. Anyway, I've said it and I believe it.

Lewis M. Todd WB5SYP
Natchez MS

I'd be interested in letters from readers with ideas on how to work DX without spending a lot

Continued on page 83

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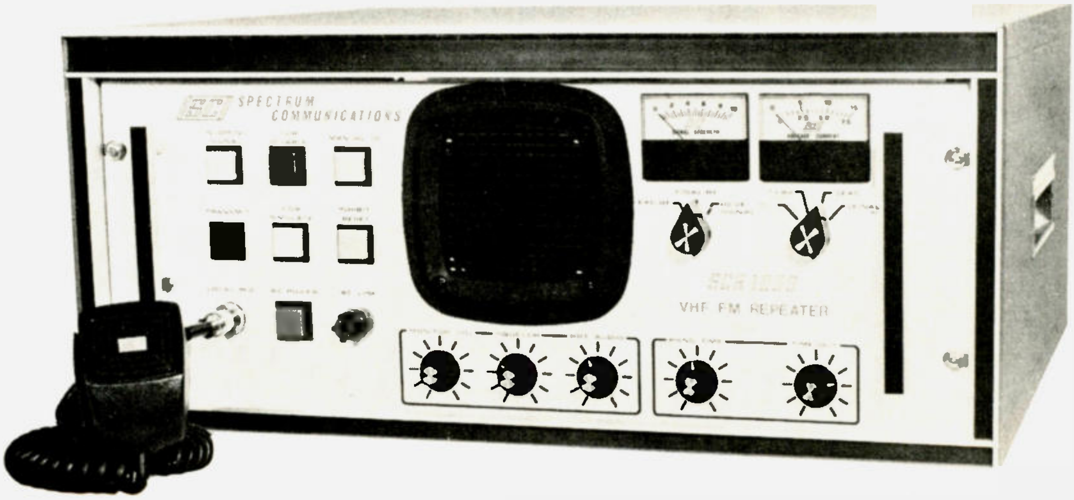

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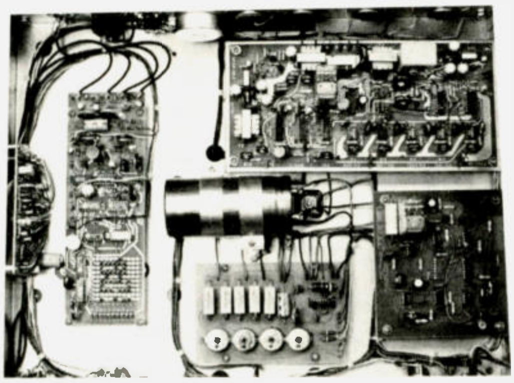

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Jim Wood W3WJK
Mars, PA 16046

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Jim Todd WA5HTT
Dallas TX

"The receiver is excellent: typically, if a 25-watt mobile can hear the machine (running 100 watts out of the duplexer), he can get into it. That's pretty good, I must say. Although I'm on a 15-kHz "splinter" between two BIG repeaters, we don't have any adjacent-channel problems with the SCR1000's receiver . . . although the "local" 19/79 group has headaches from their repeater's receiver whenever a mobile operating 146.205, (our freq.), in their area keys up. And their machine is totally "commercial"! Needless to say, the audio quality of the SCR1000 is pretty spectacular. Switching from input to output, even Melissa Manchester can't tell the difference — and neither can I."

S. Katz WB2WIK

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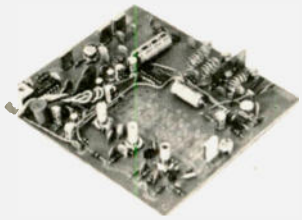

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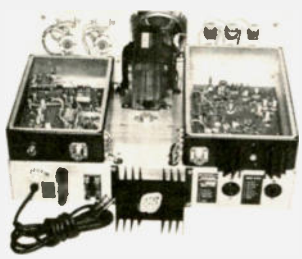

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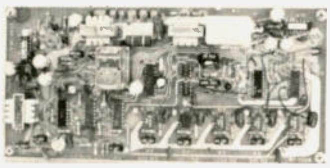

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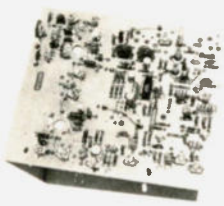

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Congratulations! Your General ticket has finally arrived from the FCC gods. Now you can operate those segments on 80, 40, 15, and 10. But most interesting is the privilege of operating on the 20 meter band.

After a few days of listening to the most interesting HF band, you will notice the following: Most of the boys who really work DX well will not be using a dipole. The most common antenna in this group is the famous three-element beam.

Now, you will think, "Boy, I'd really like a three-element beam! How much is one? Oh, that much?! ... How much used? ... That's just as bad! I'm a General with a Novice's bankbook. I can't pay that much! What I'd like is a nice inexpensive antenna which performs nicely on DX, say, for under twenty dollars. I'd like it to be easy to construct and operate."

Obviously, if you've taken a look at the prices for aluminum tubing, a three-element home brew yagi isn't the economical answer. And the neighbors might not appreciate a quad. If these two restrictions apply to you, my antenna is for you.

I'm talking about a pair of phased verticals. This antenna has a 3 dB gain over a dipole. (Doesn't even this amount of gain outperform those "bargain yagis"?) The main angle of radiation is vertical — very important for DX work. The directivity is bidirectional, in two directions. As an added attraction, the beam heading can be changed by 90°. This is done by phasing cables, but more on that later.

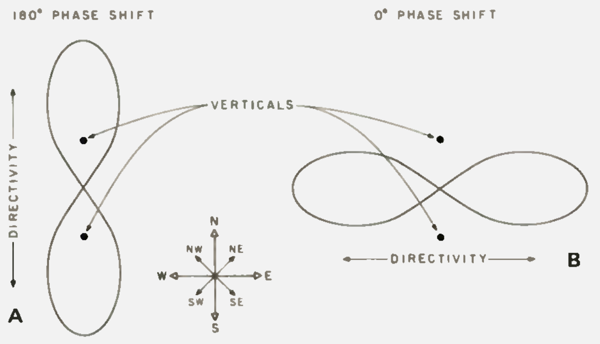

Fig. 1.

The Theory Behind the Antenna

As the name suggests, the phased verticals system utilizes two identical vertical radiators, which are either out of phase by 180°, thus producing the radiation pattern shown in Fig. 1(a), or are exactly in phase, producing the radiation pattern shown in Fig. 1(b). It can be said that the antenna can beam in four directions. For example, in Fig. 1(a), the verticals are lined up with the north, so you have the beam headings N/S. You can also select the pattern shown in Fig. 1(b), E/W.

The Coaxial Harnesses

1. See Fig. 2(a). The 180° phasing section of coax (piece of coax which creates the phase shift between the two verticals) is connected between each vertical. The length is ½λ on the operating frequency* for a phase shift of 180°. Another piece, any length, is connected to either vertical and run into the shack.

2. See Fig. 2(b). The phasing section of coax is connected between each vertical, as before, but the length is now 1λ on the operating frequency.* This will provide a phase shift of 0°, or, in other words, the verticals will be in phase.

3. For more elaborate systems, run two lines of coax, equal in length, from each vertical to the shack. Then you may either add a ½λ * piece of coax in one line, as in Fig. 3(a), for a 180° phase shift, or add nothing and connect the two lines then and there, for a phase shift of 0°, as in Fig. 3(b). The advantages of this system are that you may select the phase shift between the verticals and, therefore, the beam heading from the convenience of the operating position.

Erection of the Antenna

Any vertical antenna system should be used against a good ground system. The easiest way to achieve a ground system on a roof is to lay a system of radials (wires running out from the base of the antenna on the roof). For this antenna, the length of the radiators should be 17' 7" for best performance at 14.2 MHz. The antenna will operate both ends of the 20 meter band with the 17' 7" radials. Anywhere from 4 radials to 120 and up are acceptable. The antennas at LAØBP each have 7 radials. (The performance is quite good.) The radials should be laid out with the same angle between them (i.e., for 4 radials, the angle between should be 90°, for 6 radials the angle should be 360/6 = 60°, etc.). This is

*Keep the velocity factor in mind when cutting for RG-58/U or RG-8/U.

just a recommendation, and, if it is impractical to follow, it can be disregarded. Since each radial is 17' 7" and the antennas are spaced at about five meters, the possibility of 2 radials overlapping (one from each vertical) is good. If this is the case, by all means splice the two together. This should increase the size of the ground system for both verticals.

Construction

When getting together the materials for this project, I was careful to use very easily obtainable materials. I think I achieved this goal with some to spare.

The two verticals are identical in every respect. The vertical radiators are mounted on base boards, each board a four-foot 2" x 3". The "pipe" is fastened to the boards by cable straps spaced every six inches for three feet. (Heavy-duty brads are a good substitute for the cable straps.)

Now that each radiator is mounted on its own board, the next step is to mount all the other components wherever there is room. The coil should be mounted as close to the bottom of the radiator as possible, and an eyebolt (woodscrew type) should be placed six inches below the coil. At the bottom of the radiator, there should be a low-resistance clamp. A possibility is to use a properly sized hose clamp.

The next step is to solder one end of the coil to the radiator. Now the verticals are ready for mounting.

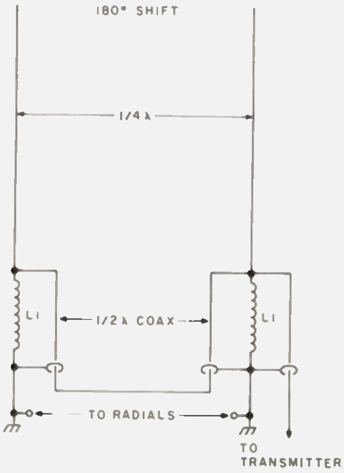

Fig. 2(a).

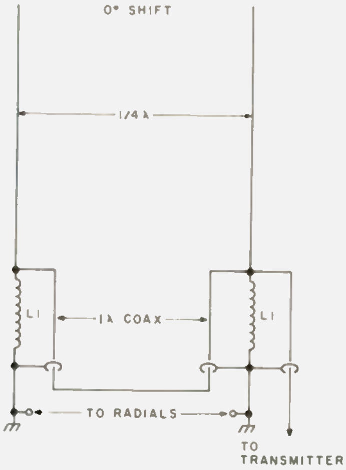

Fig. 2(b).

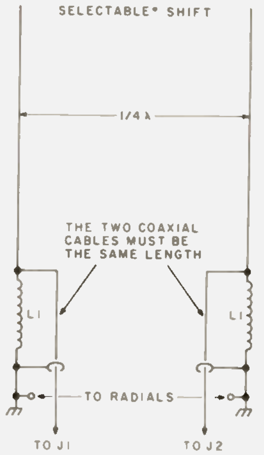

Fig. 2(c).

When mounting this system, the general rule of "the higher the better" applies. But if the optimum condition of a small, flat area of a roof is not obtainable, the system is perfectly at home on the ground. Give it a try!

The most important factor to keep in mind when selecting a place to mount is to keep the verticals ¼λ apart. Try to keep this as close to ¼λ as practical. Again, if ¼λ is not practicable, give whatever is practical a try!

Coaxial Wiring

The actual coaxial wiring should be delayed until the verticals are in their permanent berth. Then the line from the system (either vertical) to the shack can be custom cut. To be sure of accuracy, have the phasing section precut before you go up on the roof. Sometimes you don't get an accurate length when you are worrying about falling. If you want to be sure, cut the phasing section inside.

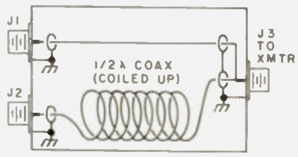

Fig. 3(a).

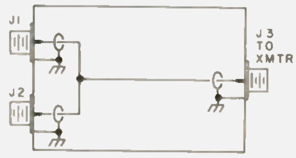

Fig. 3(b).

Since the center of the coaxial cable is directly connected to the coil, the coax should be tacked down to the baseboard to lessen the strain on the coax-to-coil connection. Don't forget to connect the coaxial shields to the remaining side of the coil along with the radials!

Conclusion

After four months of use at LAØBP, we found a 10 dB improvement in signal strength over the dipole. Also, with the beam lobes pointing at E/NE and S/SW, many Japanese stations have been worked along with VS6s and VKs. ■

Parts List

2	four-foot lengths of 2" x 3" stock or equivalent
24	heavy-duty cable straps or brads
2	five-meter pipes, ¼" in diameter or larger (aluminum, steel, or copper)
2	coil forms, 1" in diameter (6-1/3 turns, 6 turns per inch) (L1)
2	woodscrew eyebolts
1	approximately 120' of #20 or larger wire (radials)
1	required length of RG-58/U or RG-8/U

LETTERS

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of money. One good way is to stick to CW . . . some of the top certificate hunters and QSL nuts are running relatively low power and making out just fine. Until such time as manufacturers are able to make enough expensive equipment to saturate the demand, I suspect they will continue to concentrate on it. On the other hand, with it being so simple to make extra money, a fair percentage of the hams are able to buy just about anything they really want. Our recent reader poll showed that the average 73 reader spent almost $1,000 last year on ham gear . . . and that's an average! Perhaps I should write more about ways to use your ham smarts to make money . . . other than writing articles for 73.—Wayne.

CREDIT WHERE DUE

Many high schools in the country have amateur radio clubs as extracurricular activities, and many of these clubs offer code and theory classes to their members. Beginning in September of 1978, we at Cedar Cliff High School in Camp Hill, Pennsylvania, will be trying something which may be of interest to you and any teachers who are also hams.

A few months ago, Tom Rutland K3IPW and I came up with the idea that amateur radio need not be restricted to the ranks of extracurricular activities. It is a known fact that many people end up in certain vocations due to their involvement with amateur radio. We used this fact to propose that a

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Karl T. Thurber, Jr. W8FX/4
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Modernize the Matchbox!

—increased capability for a classic coupler

Certain pieces of ham gear simply never become outdated, becoming classics in their own right. They are items which it is wise to keep for their all-round utilitarian value. One of these is the Johnson Viking Matchbox.

The Matchbox series of antenna couplers was introduced in the mid-fifties to match practically any antenna impedance and line configuration (open wire, coax, or single wire) to a 50- to 75-Ohm transmitter and receiver. The 275-Watt and 1-kW models were produced, both with and without swr indicators. (Very similar units are available today from Nye Viking.) The Matchbox is a real gem, being capable of matching balanced lines of 50 to 1200 Ohms and unbalanced loads of 50 to 2000 Ohms, with an ability to tune out large amounts of reactance, the amount depending upon the line or antenna resistance and frequency.

Dating from my Novice days in 1955, I had an old, beat-up 275-Watt box (with swr bridge) which had seen much, much hard service and was in definite need of renovation. The first step in rehabilitating the unit was to clean up the cabinet interior and exterior (who needs a maroon cabinet?), remove all hardware, and carefully spray the cabinet with a dull-gloss gray enamel. The meter in my unit had seen better days, so I replaced it with a high-quality 100 uA meter obtained from a local surplus house for less than $4.

I also have a Tempo 2020 transceiver in use, meaning that the receive-transmit switching feature of the Matchbox is not required. Therefore, 115 V ac is continuously applied to the Matchbox T/R relay, whenever station power is applied, to lock the unit in the trans-

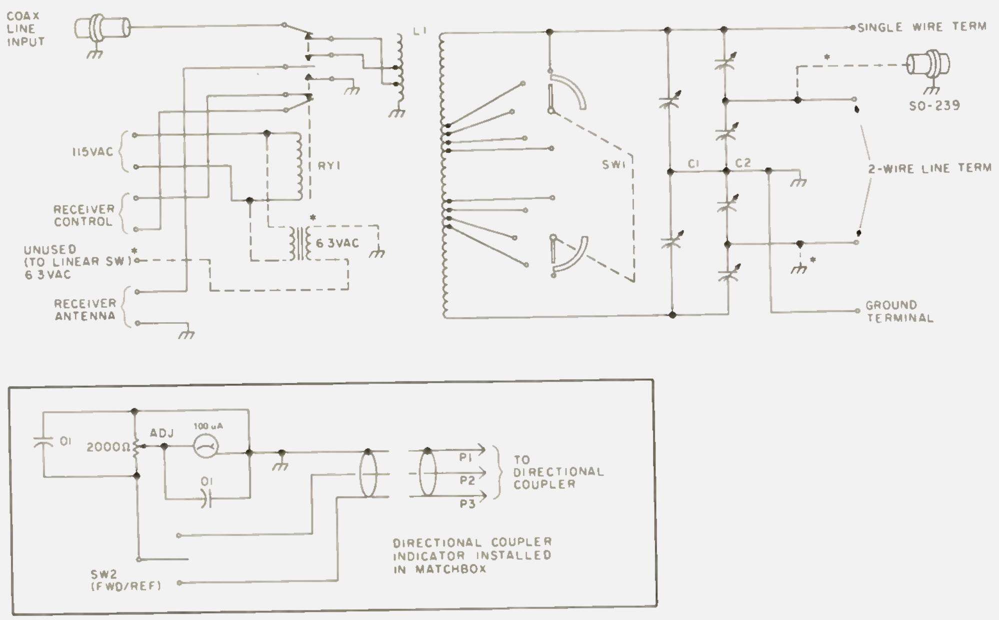

*Fig. 1. Matchbox showing added components. Relay, RY1, shown in the transmit position; Bandswitch, SW1, shown in 80 meter position. *Coax output, additional 6.3 V ac transformer added.*

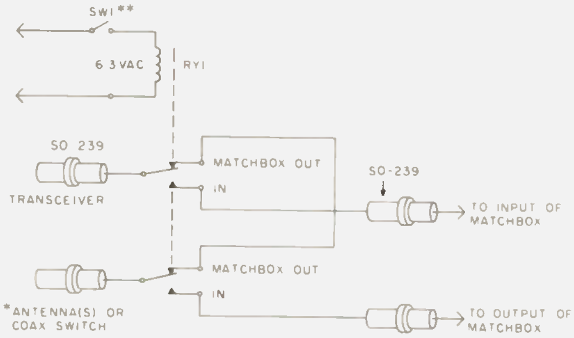

*Fig. 2. P & H Model AR-1 linear switch. *2- or 3-position coax switch may be installed to allow antenna or antenna/dummy load selection. **Allows selection of straight-through operation or routing antenna/dummy load through Matchbox coupler. (SW1 is an internal part of the P & H switch and is front-panel mounted.)*

mit mode. This also provides a source of 115 V ac inside the Matchbox for another purpose — see Fig. 1.

I have long possessed another classic, an old P & H Model AR-1 linear amplifier in/out switch, a handy little coax-switching box containing a 6.3 V ac relay. It is designed to provide selection of linear amplifier/"straight-through barefoot" operation. The unit can be provided with 6.3 V ac power from a small filament-type transformer mounted inside the Matchbox, receiving its power from the 115 V ac going to the T/R relay. The P & H unit is mounted atop the Matchbox and is used to provide tuner "in" and "out" switching. A coax switch, mounted at the antenna input coax connector of the P & H switch, allows switching of multiple antennas and/or a dummy load, either directly to the transceiver or through the Matchbox. Fig. 2 shows the diagram of the P & H linear switch.

If such a handy gadget as the P & H AR-1 unit is not available, there is sufficient room inside the Matchbox to install a DPDT ceramic transmitting-type rf switch to perform the Matchbox in/out switching. This would eliminate the need for the 6.3 V ac transformer which powers the P & H switch. A 2- or 3-position rotary rf switch can also be installed to select between antennas and/or a dummy load, if there is no objection to drilling the panels to install the rotary switches and additional coaxial connectors. (If the remote directional coupler is bolted onto the rear apron, blocking much of the rear panel space, the rotary selector switches would have to be mounted on the front or side panels.)

Fig. 3 shows the overall station rf wiring at my installation.

The resultant combination is rather satisfying and very versatile and is quite similar to the features of the Drake MN-4 Tuner, but with wide-range impedance matching capabilities. ■

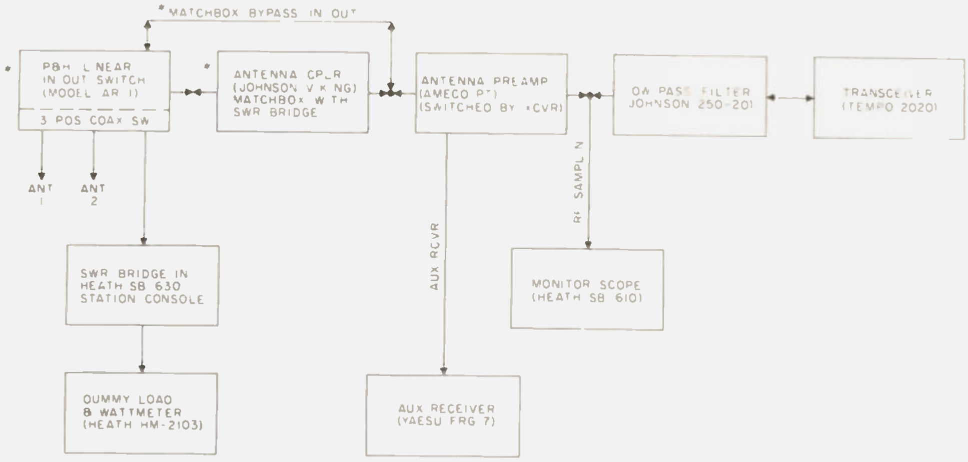

*Fig. 3. Author's rf station wiring. *See text for details.*

LETTERS

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new course be offered in our school's curriculum and, for the first time during the 1978-79 school year, we will offer a course entitled "Amateur Radio."

The course will meet for two class periods per week (47-minute periods) and will run for the entire school year. All students completing it successfully will receive 2/5 credit toward their graduation requirements. (A class meeting 5 periods per week for the entire year is worth 1 credit toward graduation.) All students will be given the Novice exam at the end of the first semester and, hopefully, many will progress to the Technician or General licenses by the end of the second semester.

We have budgeted for and expect to be using Heath equipment and the *73* code tapes and study guides.

Anyone wishing information on the structure of the course and our results with it can contact me at the school.

Fred D. Smith, Jr. K3MOA
Camp Hill PA

PERCENTAGE PLAY

In your March, 1978, editorial, you ask why hams feel a responsibility to get involved in cleaning up CB while we show no interest in CAP or the police frequencies. In the recent ARRL survey, half of all hams responding indicated that they are also CBers. I'm sure your 73 poll is producing similar results. I am confident that a similar survey would show that the number of hams who are policemen or CAP members is tiny by compar-

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Donald A. Chappell W2AZD
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The Miserly Magnetic Antenna

—make this sausage-can magnetic mount

Do you recognize one of these problems?

You just got a new 2 meter rig or finished building that Hot Water 202 and are anxious to go mobile. You're going mobile with that handie-talkie and want something better than the rubber ducky. Your rig is normally in a second car, but you're going on vacation in the family car and are looking for a temporary 2m antenna to work those repeaters across country. Perhaps your problem is the need for a mobile antenna until you can make up your mind whether it's going to be a 5/8λ or a collinear and where to mount it. Maybe you just don't want to drill holes in your car.

Whatever the problem, the solution could be the sausage-can antenna for 2 meters.

As a 1/4λ vertical groundplane antenna, it performs well. The swr will be acceptable from 146 to 148 MHz utilizing the instructions following, and, with a little cut and try, it can be reduced to 1.1:1. This is a construction project. The design is very basic and can be verified using an antenna book.

So often, it seems, construction projects make statements about costs in relation to what's in your junk box. Now, no two junk boxes are the same, and some hams lack the experience or knowledge to substitute. The building of the sausage-can antenna will only cost a couple of dollars even if you must buy all the materials.

Obtain the following:

one 5 oz. aluminum can of Armour Vienna Sausage from the supermarket;
two cabinet door magnetic latches from the hardware store;
one coaxial connector, chassis type, SO-239 from Radio Shack;
one 19-inch piece of music (piano) wire from a hobby shop, or one 19-inch piece of brass welding rod from an auto supply or repair shop;
screws and nuts and/or aluminum pop rivets, as required, from the hardware store;
spacers (if needed) from the hardware store.

Open the can of sausage, discard the lid, and eat the sausage (it's about time for a cold beer, also). Wash and dry the can. Drill a 3/4-inch hole in the center of the bottom of the can to accommodate the SO-239 connector.

Temporarily insert the threaded end of the connector into the can from the outside. Using the connector as a template, center punch the four connector mounting holes. Set aside the connector and drill the four 1/8-inch holes which you just marked in the can.

If your magnetic latches have mounting ears, bend the ears to conform to the inside of the can. For latches with a single mounting hole in the center, a couple of spacers will be required between the latch and the can to prevent distorting the shape of the can.

Magnetically attach the two latches to a narrow iron straightedge at approximately the distance apart equal to the inside diameter of the can. Lower the latches into the can with the straightedge resting across the rim. Adjust the latches so that the flat sides of the latches touch the inside wall of the can 180 degrees apart. Using an ice pick, mark the center of the latch-mounting holes with sufficient pressure so that you can see the marks from the outside of the can. Now, from the outside of the can, center punch and drill holes for the screws or pop rivets to be used in mounting the

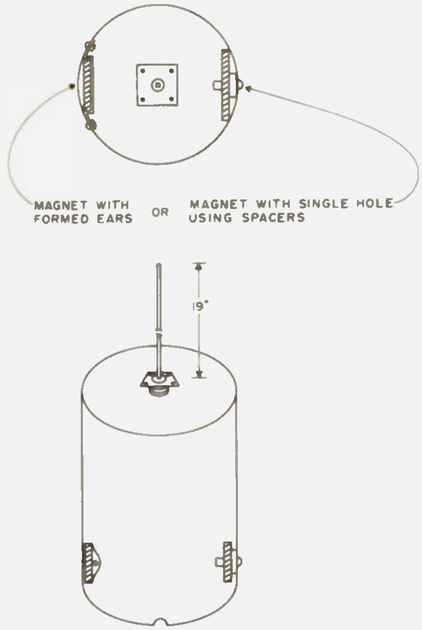

Fig. 1. Sausage-can antenna.

magnetic latches.

Next, file or cut away the rim on one side of the can halfway between the two magnets to allow the can to be set down on a flat surface with the coax in place.

You are ready for assembly.

Insert the threaded end of the SO-239 connector into the can from the outside and pop rivet or screw it into place. (Aluminum pop rivets won't rust. If screws and nuts are used, get nonferrous types.) Then fasten the magnetic latches on the inside with screws and nuts or rivets from the outside, again using your iron straightedge for correct positioning. Solder the music wire (a small brass welding rod won't rust) to the center lug of the SO-239 connector.

If music wire or other ferrous material is used, spray the wire after soldering with clear or nonmetallic paint.

Connect your coax to the connector inside the can using a PL-259 connector. Place the sausage-can antenna on top of the car, and run the coax through a window or fly to the 2m transceiver. When the radio is not in the car or, more importantly, when the car is parked, toss the antenna inside.

The sausage-can antenna has been made and used by a number of hams in my area with good success. The aluminum can does not rust, is lightweight, offers little wind resistance, and is easy to work with using the simplest of tools. The magnetic latches hold well on a variety of cars, from VWs bouncing across country to a wooded field day site to a full-size car at top highway speeds. This antenna has also been effectively used on a car with a vinyl top by mounting it on the trunk deck just behind the rear window.

For an easy one-evening project that will perform very satisfactorily, build a sausage-can antenna. ■

LETTERS

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ison.

In the same issue, WD0AUU suggests 10-Watt 10 meter voice privileges for Novices. To WD0AUU and others who may not be familiar with mail-order voice privileges, I recommend the September, 1976, editorial in *73*. The fact that 90% of all Conditionals called up for examination could not pass the General test should prove the incentive value of mail-order voice privileges. As for the 10-Watt power limit, a quick scan across 11 meters should demonstrate the FCC's ability to enforce power limits.

Robert A. Wiley WD9FQD
Peoria IL

The fact that 50% of ARRL members are CBers is no real surprise. The poll of 73 readers shows that about 10% are CBers. My call for hands at hamfest talks also shows that about 10% of the active hams are involved with CB. I did not believe the "fact" that 90% of the Conditionals called up for examination could not pass the General. I do believe that a lot of Conditionals . . . as well as most other hams . . . would have a difficult time passing the ham exams without going back and studying the material again. Much of that stuff just isn't used in everyday hamming, so we all tend to forget it. That's human nature and not worth a put-down.—Wayne.

GETTING OK

I have been an amateur since 1934; my WAS was issued in 1950. Nevertheless, I like to contact different US stations on CW—especially young peo-

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Carl H. Crumley N4VD
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Cary NC 27511

The 75m DX Chaser Antenna

—5/8λ works on 75m as well as 2m

Recently, I constructed a 1/4-wave vertical wire antenna for 75 meter DX work. The antenna worked fairly well, compared to my inverted vee at 50 feet, occasionally outperforming it on DX and generally falling far short on close stations (as would be expected).

My original 1/4-wave had 12 ground radials 60 feet long under it, as well as two ground rods separated by 40 feet and connected with a buried wire. I thought my ground-radial system was working well as a ground plane for the vertical radiator (a 61-foot wire suspended from a rope that hangs between two enormous pine trees).

On-the-air discussions of my antenna with 75 meter DX enthusiasts brought several snickers about my poor ground. It seems that serious 75 meter vertical users believe in well over 30 radials to lower the ground connection losses. One individual even startled me by saying that, even with 30 radials, I would have over 25 percent signal loss to the ground system.

Having already dulled one ax head down to a nub burying only 12 radials, I started searching for an easier way out to improve its performance. Digging around in old antenna books (the kind that talk about rhombics, windoms, and Zepps) turned up some interesting facts that led to what I have up in the trees now—a 5/8-wave top-loaded vertical.

Theory

The 1/2-wave dipole antenna carries maximum current at the center insulator if it is centerfed. The center is the minimum voltage point, which is why you can use practically anything for a center insulator. A 1/4-wave vertical is just half of a dipole, with the ground plane making up the missing half. Where current flow is highest in a wire antenna, maximum radiation occurs. Just as the center of a dipole does the most radiating, so does the bottom portion of a 1/4-wave vertical do the

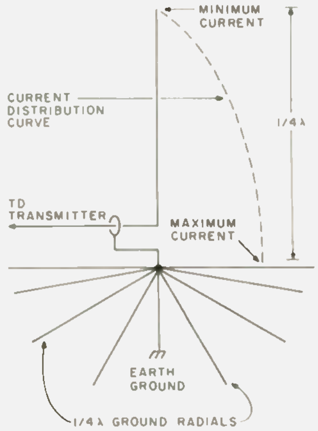

Fig. 1.

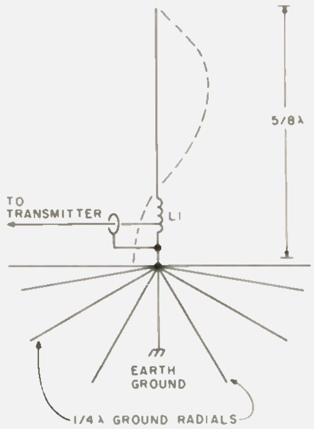

Fig. 2.

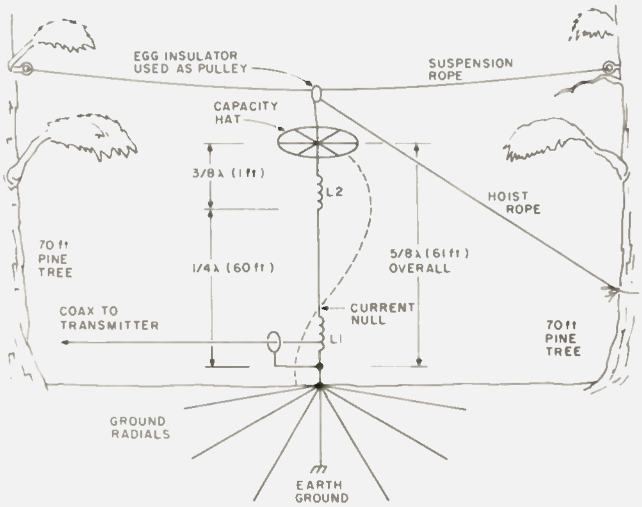

Fig. 3.

most radiating.

All that leads to the fact that the bottom of my vertical was doing most of the work down where ground losses were the highest. See Fig. 1. The idea, therefore, was to get the high current flowing at a point up higher in the wire, as in Fig. 2. That would make the radiating part of the wire further from ground and therefore reduce ground losses. This is an age-old idea hams have been using for years with 160 meter antennas where is is practically impossible to get a full-size vertical in the air.

Electrically lengthening low-frequency vertical wires is usually accomplished by the old "capacity-hat" and loading-coil method. Articles on this method tell you to stick the mess on top of a wire, and it becomes longer than a 1/4 wavelength and more efficient for the previously mentioned reasons. But how long is it and does it really matter?

I hated to just randomly toss up some top loading and hope that it was an improvement. Feeling a specific length would be preferable, I settled on 5/8-wave electrical length, since it would theoretically give some gain. My research turned up the fact that a 5/8-wave vertical is actually half of a "double-extended Zepp" (remember that antenna?) operated against ground.

Since no one can give you exact values for loading a shortened wire in any given situation, the following ideas show how I arrived at the values for my antenna. I feel confident that the mess in my backyard is a 5/8-wave vertical. My method doesn't require any sophisticated instruments, only an swr bridge and a cheap grid-dip meter.

A 1/4-wave grounded vertical is resonant (has a low impedance feedpoint). Therefore, a grid-dip meter will show a dip at the resonant frequency if the coax is removed and the antenna temporarily attached to the ground system. Sure enough, my grid-dip meter said that my vertical was resonant at 3.8 MHz. A little one-turn loop was twisted into the vertical wire in order to get sufficient coupling for the grid-dip meter.

I lowered the wire and placed a "capacity hat" (see Fig. 5) on top and hoisted it back up. Now my grid-dip meter said my vertical was resonant at 2.8 MHz. With success just around the corner, I then placed an inductance (see Fig. 3) between the wire and the capacity hat. Suddenly, I could not find the resonant point. I figured it had gone out of the low-end range of the meter (1.9 MHz). But I did find a dip at 5.4 MHz, which turned out to be the 3/4-wave point. Multiples of 1/4-wavelength vertical are resonant also, so, from this point on, I relied on the 3/4-wave dip to make my adjustments.

Parts List

L 1 12 turns no. 14 solid copper wound on 2½-inch form. Tapped 4 turns from bottom for coax feedline. Space wound to allow moving tap for minimum swr.

L 2 35 turns no. 14 solid copper wound on 4½-inch form. Space wound over entire length. A Tupperware™ juice container is satisfactory for form.

C 1 (if needed) 365 pF per section broadcast-type variable. All sections may need to be paralleled for maximum capacitance if resonance is not obtained with 1 or 2 sections.

C 2 (if needed) 10 pF to 250 pF wide-spaced variable.

Ground radials

Each radial approximately 60 feet long, buried about 1 inch underground in a furrow cut with an ax. All radials are brought together and soldered to a piece of copper strip. The radials do not necessarily have to be in perfect "spokes-of-a-wheel" configuration, but may be bent to fit available space.

A few more turns of wire added to the inductor and I had a good 3/4-wave resonant dip at 4.5 MHz. Now I had what I was looking for. If the antenna was 3/4 wavelengths long at 4.5 MHz, then, by applying the usual formulas, I found my antenna was 1/4-wavelength long at 1.5 MHz and 5/8-wavelength long at 3.8 MHz.

Just to test my theory, I ungrounded the antenna and found a dip at 3.0 MHz. That would be the 1/2-wave point, and, since ungrounded half-waves are resonant (dipoles, if you please), I had done everything correctly up to this point.

A 5/8-wave vertical being nonresonant (not presenting a low-impedance feedpoint), I had to put a little matching coil at the bottom and tap up the coil to get a suitable swr. My final results showed an swr of 1.4:1 at 3.8 MHz. (See Fig. 4.)

In some cases, it may be necessary to put a variable capacitor in parallel with the base coil and possibly even another in series with the center of the coax line. (See Fig. 4.)

Results

This was definitely the way to go! The antenna now should exhibit a little gain over the original 1/4-wave vertical. More importantly, the radiating part of the wire (the portion with the most current flowing in it) is up around the top instead of down on the ground. This makes the ground system not as important as when the current is near the bottom. There's no need to dig yourself to death burying

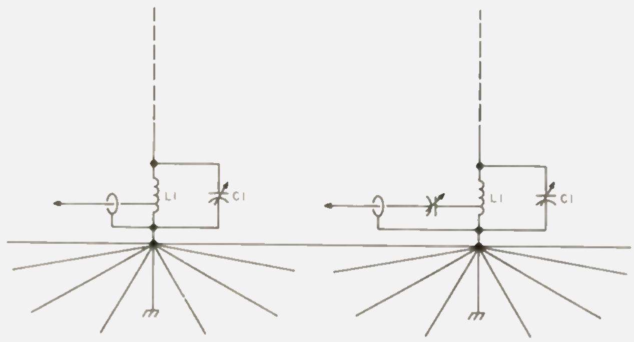

Fig. 4. Alternate feeding methods.

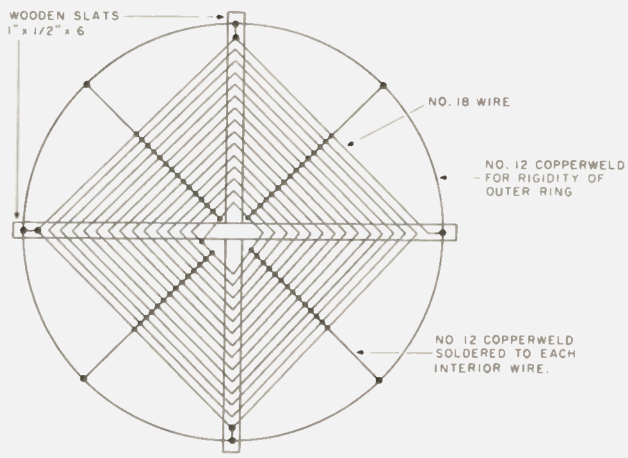

Fig. 5. Capacity hat. Tacks placed on wooden cross-members act as points to wind wire. Connect wire to loading (which hangs under capacity hat) near the center.

wire all around the yard and offending your dog.

Let me emphasize that I still believe that the ground system must be good for any vertical to be a good low-angle radiator. The radials should be no shorter than 1/4 wavelength. No 4-foot ground rods or cold-water pipes for this antenna, please!

An unexpected advantage is that the 5/8-wave isn't as prone to noise pickup as a 1/4-wave, since the 5/8-wave is physically grounded. The lower atmospheric noise level makes copy a lot easier on weak signals.

There's one minor disadvantage – it is fairly narrow on frequency bandwidth. My usable range of frequencies is only from 3.75 to 3.85 MHz. However this is where all the SSB DX is located, so who cares?

I have also found that this antenna works better than the old antenna when it comes to working nearby stations that are using antennas which transmit in the horizontal plane. Evidently, the capacity hat and loading coil have some pickup horizontally and help make this an all-around better choice than the 1/4-wave vertical.

The same principles can be applied to make a high-efficiency vertical for any LF band. Even on 160 meters, it would not be difficult to get enough loading to make it a 5/8-wave at 1.8 MHz. From my figures, you can see it didn't take much work to get an electrical 1/4-wave at 1.8 MHz while I was working my way down to a 1/4-wave at 1.5 MHz (which is what my 5/8-wave really is).

First on-the-air test on 75 meter SSB yielded a 5 by 8 plus 5 over S-9 report from G3KFT, and DJ6TK broke in to say I was 5 by 9.

Eureka, it works! ■

LETTERS

from page 87

ple who are grateful for the QSO. They often send a letter with their card, and are always asking for mine. Sometimes it is their first overseas or first OK contact.

I know most of them are beginners who are working 21100-21150 kHz. Their way of calling CQ is usually quite wrong, and we lose much time waiting for them. It seems like an eternity when you hear CQ or CQ DX 20 times or more and then a callsign twice at the end. When there is QRM—and there always is—we miss their call very easily.

So, please, a reminder to our young American friends: CQ (three times) de W. . . (also 3 times) or CQ (three times) DX de W. . . , etc., for two minutes is enough—when you don't do so, you lose many DX contacts.

Vlada Lausman OK2PDD
Brno, Czechoslovakia

ATTENTION, ANITA!

I would like to increase the membership of the newly-formed 40m gay CW net. We already have 58 members. Gay CW ops, please write for info.

Don Richman AA6GA
PO Box 384
Belmont CA 94002

PLAYING GAMES

I am writing to comment on Mark Herro's neat computer game, "The Klingons Are Coming!" (Apr., '78). To run this program on the TRS-80, a few small modifications are necessary: Line 210 LET Y =

Continued on page 94

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LM320T-12(7912)	LM1488N
LM320T 15(7915)	LM1489N
LM339N	LM1556V
LM340T-5 (7805)	XR2206
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LM556N	LM3900N (CA3401)

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10mfd 50V	470mfd 50V
22mfd 50V	1000mfd 25V
47mfd 50V	2200mfd 16V

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10pf 50V	.001mfd 50V
47pf 50V	.0047mfd 50V
100pf 50V	.01mfd 50V
220pf 50V	.022mfd 50V
330pf 50V	.047mfd 50V
470pf 50V	.1mfd 50V

Dipped Tantalum

.1mfd 35V	2.2mfd 25V
.22mfd 35V	3.3mfd 25V
.33mfd 35V	4.7mfd 25V
.47mfd 35V	6.8mfd 25V
.68mfd 35V	10mfd 25V
1mfd 35V	15mfd 25V
1.5mfd 35V	33mfd 25V

Polyester Mylar

.001mfd 100V	.022mfd 100V
.0015mfd 100V	.047mfd 100V
.0022mfd 100V	.1mfd 100V
.0047mfd 100V	.22mfd 100V
.01mfd 100V	

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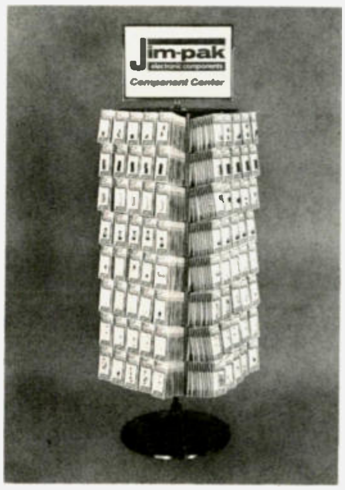

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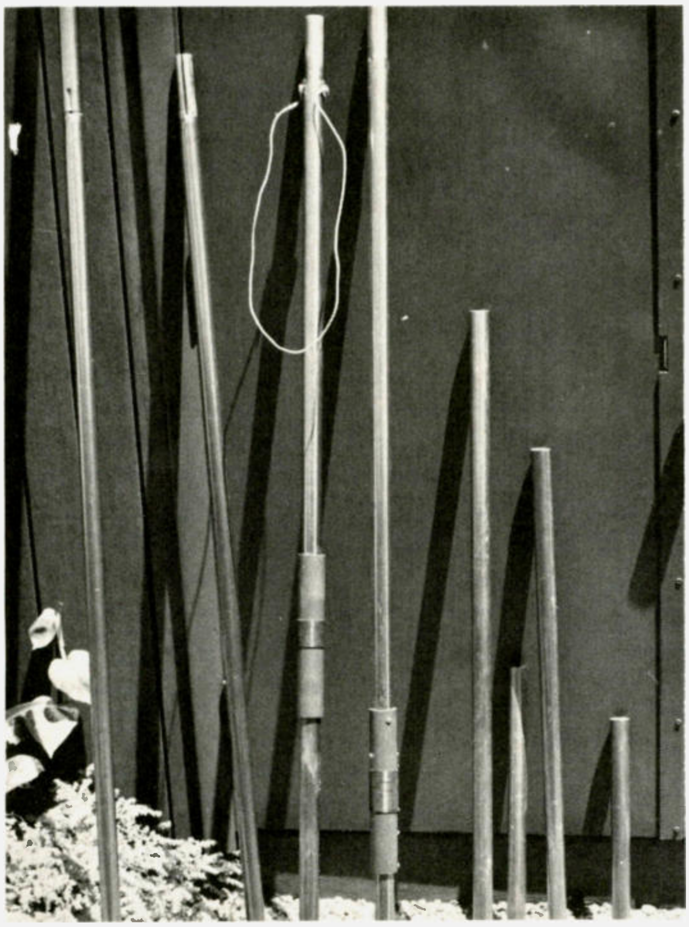
Gary Toncre WA4FYZ
13764 S.W. 54th Lane
Miami FL 33175

The Invisible Allband Antenna

—works DX, too

The townhouse is fast becoming a new style of housing in south Florida and in California. The young ham living with his family or just out on his own may think twice about living in a townhouse because of the antenna problem, wondering how he can fit a decent system into a backyard that may only be 18' x 35', like mine. Worse yet, what can you do when the townhouse association says no to any type of outdoor antennas? In my case, the restriction included TV antennas, which have to be installed in the attic. TVI, anyone?



Antenna in its disassembled form showing resonating sections for the different bands. The two sections with the traps fit together for operation on 80, 40, and 15 without changing sections.

When I lived in a house, I used dipoles strung about 10 feet off the roof, about 30 feet above the ground. I found two characteristics of the dipole to be true: 1) I could work only half the stations I heard, and 2) I couldn't hear much of anything, especially DX. This held true for my 15 meter inverted vee as well as the 20 meter dipole. After four years with dipoles, I was ready to try something new.

The Antenna

I found the answer in a catalog from Antenna Supermarket (PO Box 1682, Largo FL). After looking through their catalog, I decided on the Model ABC-1 allband vertical. Here was an antenna with no traps being used on 10, 15, or 20 that would stand no higher than 5 feet unassembled. The backyard fence is 6 feet high, so in unassembled form, it can't be seen!

What good is an unassembled antenna? Well, the beauty of this vertical is its construction. It is made simply of pull-apart TV mast. After the first 5-foot section is mounted on the base plate, the sections are slipped on the mounted mast. For 10, 15, and 20 meters, no traps are used; the sections form a full-size vertical on each band. The disadvantage is the need to go outside to the antenna and switch sections when changing bands. This is only a two-minute job, with the result that the antenna can easily be taken down when not in use.

The antenna's maximum height is 20 feet. This means that on 80 and 40 meters, traps are used to resonate the antenna. There is a resonating coil that can be adjusted by hand — straight out for 40 CW or down for 40 SSB. On 80 meters, short sections of mast are slipped on the top for any chosen segment of the band. Antenna Supermarket includes enough mast to cut two sections for any two segments of 80 meters between 3.5 MHz and 4.0 MHz. You can, of course, buy extra sections of mast and cut them so that you can cover the entire 80 meter band. The bandwidth on 80 is around 100 kHz and, on 40, 125 kHz for 2:1 swr points. Swr on 20, 15, and 10 meters never rises above 1.4:1. The rather noticeable sections that make the antenna resonate on 40 and 80 meters aren't seen because I only operate those bands at night. When the antenna is set for operation on 40 and 80 meters, it will also operate 15 meters without any section switching.

The Ground

The ground for a vertical is very important. In an article in the December, 1976, *QST*, author Stanley describes the amount of loss of radiation versus the number of radials.[1] The important point of the article is that a ground-mounted vertical doesn't require resonant radials. In fact, it would be better to put down 50 feet of wire in the form of five 10-foot radials rather than two 25-foot radials. The idea is to make the ground underneath the vertical as conductive as possible. The radiation efficiency for the number of radials versus the length of radials is given in the article.

Here's the shocker: I don't use radials at all. In my backyard, planting radials would be difficult at best – the ground becomes solid coral rock only 6 inches down. Since the idea is to make the ground as conductive as possible below the antenna, I decided to lay a piece of metal below the antenna. I went to the local hardware store and bought 3 square feet of plasterer's metal lath – a tightly-woven sheet of metal. It isn't a solid sheet, but it isn't as open as chicken wire. Placed directly below the antenna, it makes a dandy ground. Since we were ripping up the grass in the backyard and replacing it with stone, it was easy to dig down a few inches and lay the sheet down and cover it up.

If ripping up a 3-foot square piece of your backyard doesn't appeal to you, you can use radials. Just try to get a good density of wire below the antenna. Don't lay them all in one direction, either, unless you aren't interested in omnidirectional coverage.

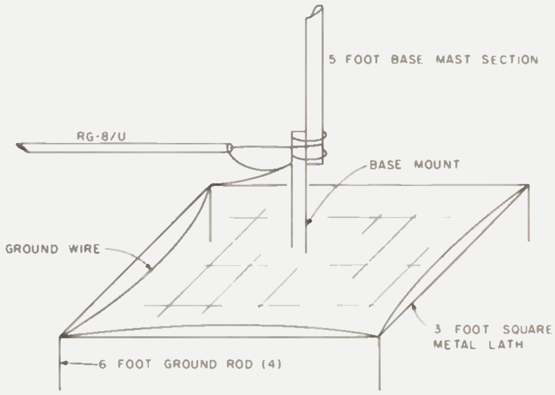


Fig. 1.

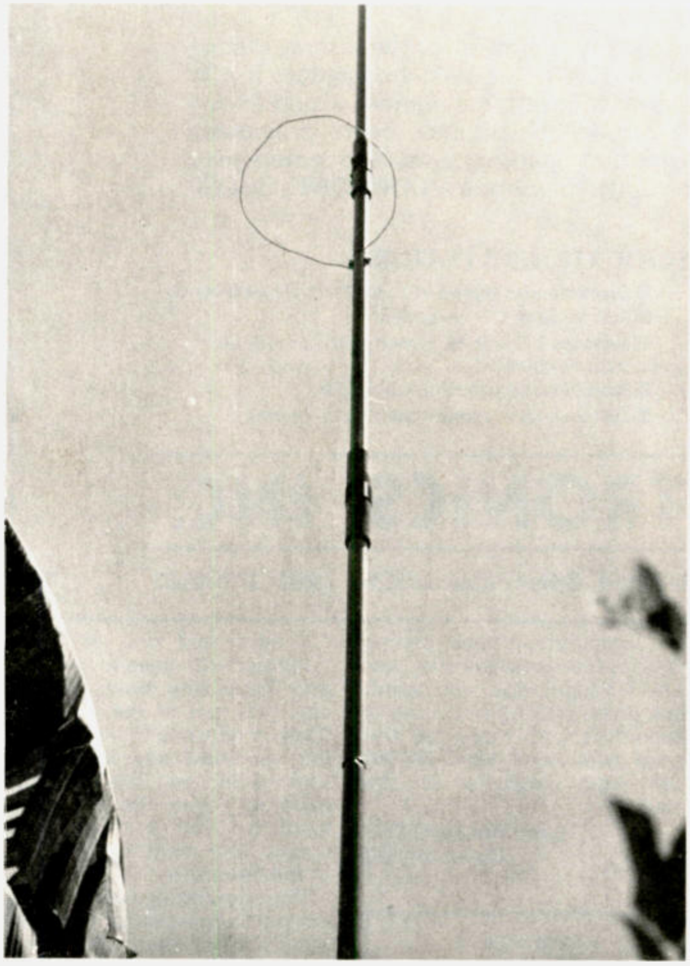
Fig. 1 shows the rest of the installation. The mount for the antenna is centered over the buried metal and hammered down into the ground and the metal lath. Four 6-foot ground rods surround the base and are hammered inside the corners of the lath. They are connected to the base with aluminum ground wire to the point where the braid of the coax is connected.

Some Tips and Construction Notes

Before you try slipping the sections together, sand them down so that they will slip together easily. You will be happy in the middle of some contest that you did.

Decide on what segments of 80 meters you want to operate. Cut the mast to the lengths required, as noted in the instructions that come with the antenna. Sand these sections where they join, too.

I would recommend



Vertical assembled for use on 20 meters. Operation before and after growth of the plants showed no noticeable difference in swr or effective radiation. Note that no traps are used on this band.

Top of vertical set for operation on 40 and 80 CW.

etching all of the resonating sections with a diamond-tipped pencil or an ice pick. You don't want to be measuring sections and looking them up in the instructions in the middle of the contest, either.

The base mast section mounts to the base using two U-bolts. This is nice when you want to totally disassemble the antenna. I used this vertical at field day last June, and it took just 5 minutes to loosen the U-bolts and pack them with the masts.

I feed the vertical with RG-8/U coax.

Performance

The general idea is that verticals "radiate equally poorly in all directions." I don't find this to be true. Unlike my dipoles, I can now work almost anything I hear, including most of the pileups on 20 SSB.

Another result of using a vertical is the lack of QRM from the local boys on 10 meters due to cross-polarization. This amounts to a difference of 7 or 8 S-units as measured at K4HYE, some 10 miles east of me. Believe me, after living in front of some of the guys running a kilowatt and a beam pointed at me, it's nice to be able to hear something else on the band!

Operating 80 meters can be tricky at times. Unless you used a lot of radials or a bigger lath, don't expect to compete with those with full-size antennas.

Plenty of DX is worked here. Europe, Africa, and South America are very strong on this antenna. Unlike my dipoles, DX stations are usually as strong or stronger than stateside stations.

The combination of easy breakdown and efficiency has made this system work for me. The system might just work out for you. Try it, and let me know the results.■

LETTERS

from page 90

INT (A*RND(1)) must be changed to 210 LET Y = INT(A*RND(0)). The same change must also be applied to lines 220 and 230. If the program is run on a TRS-80 without these changes, the Klingon base will be located at the coordinates of your search area. This is not a criticism of Mark's program, since he addresses this potential problem in this article.

In regard to playing games on computers, I look people right in the eye when they ask why I bought one, and admit that game playing was a major consideration! Keep up the good work, and keep *73* the best ham magazine on the market!

Larry Russo K3TFU
Columbia MD

CHIME POWER

I wish to add a small comment to your article on page 11 of the April issue of *73 Magazine*, concerning the Chroma-Chime.

I have had one of these "Chimes" for several months and like it very much. As you say, it is out of the ordinary. There is only one thing that you did not know and that takes time to find out: The batteries used to power the unit only hold up for a couple of weeks—not months, as stated in the literature.

The operating instructions say not to operate from a power supply. After using up several sets of batteries, I replaced them with a power pack, after putting a regulator on the output of the power supply.

Edward C. Carnes
Deming NM

Get into "220" Mobile the Easy Way with Midland

Midland has a pair of proven performers, crystal controlled or P.L.L. synthesized . . . both designed to be easy on the pocketbook

To start with, here's Midland's Model 13-509. It's a compact, rugged mobile with capacity for 12 crystal-controlled channels. The "509" transmits with 10-watt or 1-watt output. Its receiver has a dual gate MOS FET front end with hi-Q resonator and ceramic filters. There are SWR and polarity protection circuits, internal DC filtering and electronic switching. With its jack for optional tone burst and discriminator meter, the "509" has even been the basis for many repeaters.

Midland's choice alternative in "220" is P.L.L. synthesized Model 13-513. Here's advanced design with modular construction and digital frequency readout. It's programmed for 500 frequencies between 220 and 225 MHz, with a 5 KHz shift up giving 500 more . . . and 4 offsets are available for repeater use. The receiver has a multiple FET front end with monolithic crystal and ceramic filters. The transmitter switches for 20-watt, 10-watt or 2-watt output. With automatic SWR and polarity protection, internal DC filtering, electronic switching and a jack for tone burst and discriminator meter, the "513" is a very desirable "220" mobile . . . or base.

Pair either of Midland's "220" mobiles with Midland's trunk/roof mount or magnet mount antennas (Models 18-950 and 18-951) for top-notch performance on the band.

MIDLAND INTERNATIONAL

For more about Midland "220" Mobile, write: Midland Amateur, P.O. Box 1903, Kansas City, Missouri 64141

Who Says Verticals Don't Work?

—the four-band phased-vertical bomber

William C. Purdy W2LFJ
3421 Pleasant Valley Rd.
Syracuse NY 13215

Numerous on-the-air and mail inquiries have prompted me to write this article describing my vertical phased-array antenna system. I make no claims to originality, since the design is standard and encompasses antenna theory which has been around for a very long time.

Some of the array virtues are herewith enumerated:

1. relatively inexpensive to build;
2. respectable forward gain;
3. low-angle radiation;
4. good front-to-back ratio (end fire);
5. inobtrusive;
6. wind- and iceproof;
7. instantaneous change of directivity with no mechanical rotation;
8. cardioid pattern end fire; figure-eight pattern broadside (see Fig. 4);
9. always grounded for lightning protection.

There have been many articles of recent vintage which have expounded on the subject of vertical arrays, and, while they are all excellent reading, the arrays are either expanded to the point where they are expensive to build, or they require more ground space than is generally available to the average ham.

One article* touches

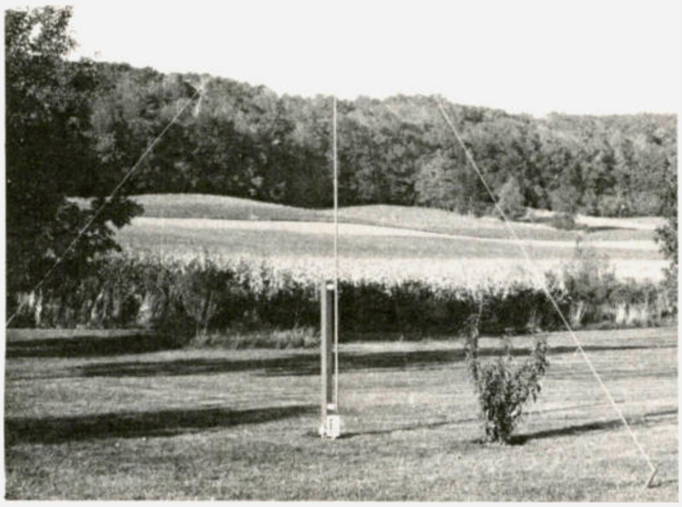
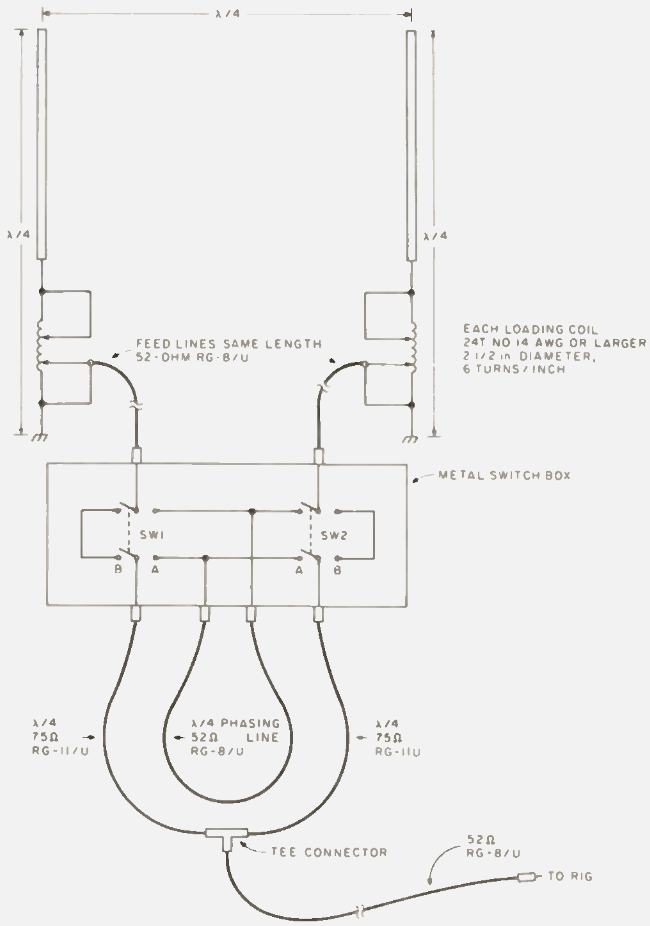


Photo A.



SW1 POSITION	SW2 POSITION	RESULTING DIRECTIVITY
A	B	CARDIOID END-FIRE LEFT
B	A	CARDIOID END FIRE RIGHT
B	B	BI-DIRECTIONAL BROADSIDE

Fig. 1.

*QST, "Broadband, Steerable Phased Array," Richard C. Fenwick K5RR and R. R. Shell, April, 1977, p. 18.

closely on the array to be described. However, it uses two two-element arrays and three ferrite hybrid power dividers and matching transformers. My antenna uses one two-element array, and matching and power dividing are done with coax and a T-connector. The general layout is shown in Fig. 1.

The design of this array was based on peak performance on 40 meters with capability for operating on 15, 20, and 80 meters, as well. The vertical height selected was 30 feet, which precluded 10 meters for low-angle radiation. A loading coil was included at the base to facilitate resonance and matching on all operable bands.

The two verticals are fabricated from hard-drawn copper tubing beginning with 1 inch for the bottom section, 3/4 inch for the middle section, and 1/2 inch for the top. The top is finished with a 1/2-inch copper end cap. Standard reducers are used between sections, and all sections are sweated with solder and a propane torch. The verticals could be made from aluminum tubing or steel TV masting, but copper and solder were preferred for integrity and permanence of the joints, and the cost is not prohibitive. The easy (but more expensive) way out is to use DenTron EX-1 verticals or even trap verticals.

Referring to Photo A, each vertical is strapped to two large standoff insulators which are mounted to an 8-foot 4 x 4 sunk 2 feet into the ground. The bottom of the 4 x 4 is treated with creosote and stabilized with some rocks and half a bag of concrete mix. Some redwood stain makes the 4 x 4 above ground look pretty. The verticals are guyed at the second reducer with three nylon lines spaced 120 degrees on a circle.

The loading coil for each vertical is mounted on standoffs at the base, as shown in Photo B, and is much oversized, but, for 50¢ on the surplus market, who would argue? The coils can be fabricated from B & W coil stock for powers to about 500 Watts. For a kW, the wire size should be #12 AWG or larger.

The 52-Ohm coax to each vertical is terminated in a 2-3/4 x 1-5/8 x 2-1/8-inch minibox, and the center conductor is led to the loading coil through a feedthrough insulator and a short piece of 1/4-inch flat copper braid terminated in an alligator clip. Eventually, I plan to enclose each loading coil in a weatherproof box. While 3 feet of snow didn't seem to bother operation last winter, weatherproofing can't hurt!

Each antenna is fed with a length of 52-Ohm coax long enough to reach the point where the phase switching will be done. My phasing is done in the basement of my home by relays which are controlled from switches upstairs in the den, so the cables are each 100 feet long.

Fig. 2. Bird's-eye view.

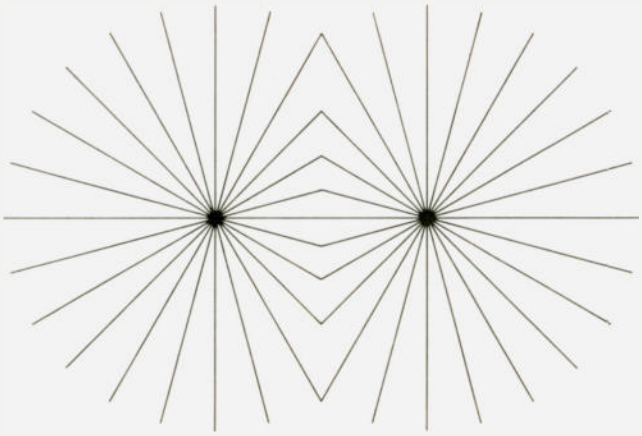


Fig. 3. Radial pattern.

It is important that these 52-Ohm cables are the same length, since no phase shift is desired at this point in the system. The cables are buried underground about 6 inches without protection. Be extremely careful not to puncture the jackets. A safer way would be to thread each cable through a plastic garden hose before burial.

The 52-Ohm cable coming from the T-connector can be any convenient length to reach the operating position. Note in Fig. 1 that the phasing could be done with manual switching at the operating position, if you don't

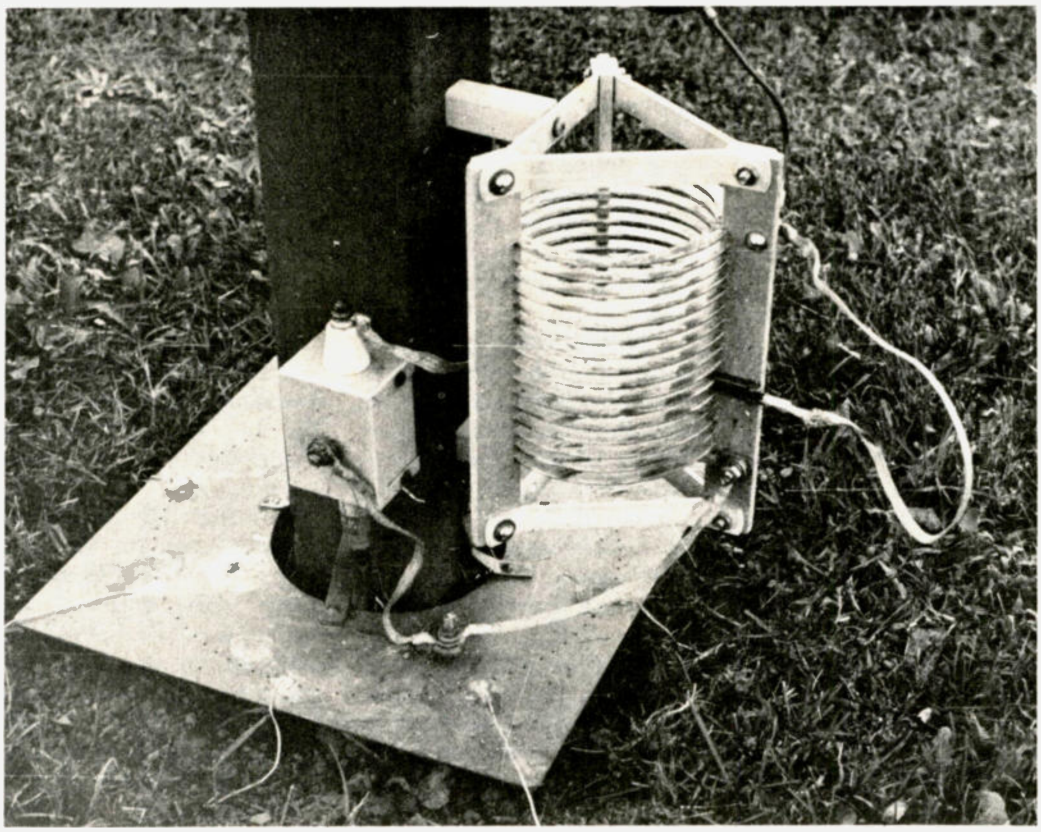


Photo B.

with no phasing in either leg are omnidirectional and figure-eight broadside, respectively. In all cases, when shifting bands, the λ/4 matching lines must be changed also.

Tune-up of the array is fairly simple. Resonate each loading coil to the approximate operating frequency with a dip meter by adjusting the coil tap. Then hook an swr meter in series with the coax feeding one of the verticals and tap up the coil a few turns from the ground end with the coax clip lead. Apply some power at the operating frequency through the swr meter and then adjust both coil taps for lowest swr. The adjustments are interrelated, so some juggling is necessary. Repeat for the other vertical.

After each vertical is tuned up, feed the entire array and recheck the swr. If there has been a change, make the adjustments that are necessary to bring the swr in line.

The performance of the phased array is spectacular and is well worth the effort necessary to install it properly. Photo C shows the completed array as installed in my yard. I work anything I can hear on 40 meters, mostly barefoot. Reports are always excellent, including "loudest on the band" or "only W2 heard on the west coast tonight." S9 reports are common in South Africa, New Zealand, Australia, Europe, and all points south. If the QTH were not shielded on the north by a high ridge (which generally precludes Japan, the USSR, India, the Philippines, etc.), I would have three verticals in an equilateral triangle configuration and, driving them two at a time, have a cardioid pattern in six different directions, instantly switchable. Even so, the broadside bidirectional mode (see Fig. 2) performs excellently to the south, and I have no trouble working Central and South America and Antarctica with head-swelling signal reports. ■

Photo C.

mind running two coaxial cables and having a phasing line and two matching lines coiled up in the shack for each band.

The λ/4 phasing and matching lines are calculated from the equation:

$$\lambda/4 \text{ (ft.)} = \frac{246 \text{ (VF)}}{f \text{ (MHz)}}$$

where VF is the velocity factor of the coax line and is 0.81 for foam dielectric and 0.66 for standard dielectric. For a frequency of 7.15 MHz and foam dielectric, the calculation is as follows:

$$\lambda/4 = \frac{246 \text{ (0.81)}}{7.15 \text{ MHz}} = 27.87 \text{ ft.}$$

The λ/4 lines can be cut to the formula, or, for greater accuracy, the lines can be made slightly too long and then resonated with a dipper to the desired frequency. This is done by terminating one end in a male connector and plugging this into a female connector with a one-turn loop. Loosely couple the dipper to the loop and lop off small lengths of the cable's bitter end until resonance occurs. Then terminate the bitter end in another male connector and the job is completed.

The λ/4 75-Ohm lines and the T-connector comprise a way of matching two antennas to one feedline. Since the T places the two lines in parallel, it is desirable that the output of each line exhibit an impedance of 104 Ohms. The input of each line is 52 Ohms, so you must determine what characteristic impedance is needed in a λ/4 section to realize 52 Ohms at one end and 104 Ohms at the other. Calculate as follows:

$$Z_o = \sqrt{Z_1Z_2} = \sqrt{52 \cdot 104} = \sqrt{5408}$$
$$Z_o = 73.5 \text{ Ohms.}$$

The above equation is nothing more than the geometric mean of the input and output impedances, and the calculation shows that RG-11/U with a characteristic impedance of 75 Ohms is a first-class candidate for the job.

The theoretical gain of the antenna with the cardioid end-fire pattern is about 4 dB and the front-to-back ratio is about 18 dB. The front-to-back ratio proved to be extremely useful on 40 meters when working to the west, by attenuating the European broadcast interference about 3 S-units.

A high-resistance ground can soak up all the power gain, so a good ground system is a must. I use an 8-foot ground rod and 32 λ/4 radials under each vertical soldered to a one-foot square copper plate, as shown in Photo B. Each plate is drilled to accommodate 90 radials, which is about optimum for a good ground. I install radials as the spirit moves me by soldering a λ/4 copper wire into a plate hole and then burying the wire in a slit in the turf made with a lawn-edging tool. This gets the radials out of reach of the lawn mower and doesn't hurt the lawn one bit. Fig. 3 shows the general radial pattern. Where two radials cross, they are soldered together and cut short at the joint. When Photo B was taken, only 8 radials had been installed and the performance was quite acceptable with 180 Watts input.

The horizontal radiation patterns for this array can be found in the *Radio Engineers' Handbook* for various spacings in wavelengths versus phase shift. From these patterns, one can readily determine the necessary phase shift required for operating the array on 20 and 80 meters. (The array can be used as is on 15 meters.) To elaborate on this briefly, I selected a 3λ/8 phasing length for 80 meters to give an end-fire cardioid pattern and a λ/2 phasing length for 20 meters to give a figure-eight pattern end fire. The patterns for 80 and 20 meters

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Low-Cost Keyboard — II

— software for the April keyboard

This program details the software for a low-cost keyboard ("Now Anyone Can Afford A Keyboard," *73,* April, 1978) that results in a powerful and versatile system. The routines are written comparably to TTY I/O routines that fetch or output one letter at a time with data passed through the accumulator. A graphics section has been added which allows the user to construct graphics characters on screen by individually turning on any or all of the six PolyMorphic graphics blocks.

00-1F	ASCII machine codes (vectors to machine code table)
20-2F	ASCII punctuation
30-3F	ASCII numbers and punctuation
40-5F	ASCII upper case letters and punctuation
60-7F	ASCII lower case letters and punctuation
80-9F	Greek and math symbols
A0-BF	Undefined
C0-FF	Graphics characters

Table 1. Code assignments.

The machine codes (00-1F) have been expanded with the addition of TABULATION, SHIFT LOCK, CLEAR (home cursor), and ESCAPE. Altogether, 9 of the possible 32 codes have been defined. The program is written with all the starting addresses of the routines in a table so that you can easily add routines of your own.

If you have built the hardware shown in the article, then you will be able to use this software with a few changes. You will have to wire in four new switches (TAB, CLEAR, SHIFT LOCK, and GRAPHICS) in order to take advantage of all the features of the complete system.

Description

The software consists of two main subroutines. CHARIN (300A) will scan the keyboard for a single keystroke. Once found, the code will be modified according to the SHIFT and CONTROL keys and the result returned in the accumulator. CHAROT (30C5) will take the code that is in the accumulator and either display it or perform the necessary machine function.

The software is designed to work with a PolyMorphic

Key	IC1	IC2	Code	Shift	Control	Shift and Control
@	0	3	40 @	60 \	00 NUL	80 α
A	1	3	41 A	61 a	01 SOH*	81 β
B	2	3	42 B	62 b	02 STX*	82 γ
C	3	3	43 C	63 c	03 ETX*	83 δ
D	4	3	44 D	64 d	04 EOT*	84 ε
E	5	3	45 E	65 e	05 ENG*	85 ζ
F	6	3	46 F	66 f	06 ACK*	86 η
G	7	3	47 G	67 g	07 BEL*	87 θ
H	8	3	48 H	68 h	08 BS	88 ι
I	9	3	49 I	69 i	09 HT	89 κ
J	A	3	4A J	6A j	0A LF	8A λ
K	B	3	4B K	6B k	0B VT*	8B μ
L	C	3	4C L	6C l	0C FF*	8C ν
M	D	3	4D M	6D m	0D CR	8D ξ
N	E	3	4E N	6E n	0E SO*	8E ◊
O	F	3	4F O	6F o	0F SI*	8F π
P	0	2	50 P	70 p	10 DLE*	90 ρ
Q	1	2	51 Q	71 q	11 DC1*	91 σ
R	2	2	52 R	72 r	12 DC2*	92 τ
S	3	2	53 S	73 s	13 DC3*	93 υ
T	4	2	54 T	74 t	14 DC4*	94 φ
U	5	2	55 U	75 u	15 NAK*	95 χ
V	6	2	56 V	76 v	16 SYN*	96 ψ
W	7	2	57 W	77 w	17 ETB*	97 ω
X	8	2	58 X	78 x	18 CAN	98 ∩
Y	9	2	59 Y	79 y	19 EM*	99 √
Z	A	2	5A Z	7A z	1A SUB	9A →
[{	B	2	5B [	7B {	1B ESC	9B ←
\ ¦	C	2	5C ¥	7C ¦	1C FS*	9C ↑
] }	D	2	5D]	7D }	1D GS*	9D ÷
↑ ~	E	2	5E ⚓	7E ~	1E RS	9E ≤
DEL	F	2	5F _	7F ■	1F VS*	9F ≈
0	0	4	30 0	20		
1 !	1	4	31 1	21 !		
2 "	2	4	32 2	22 "		
3 #	3	4	33 3	23 #		
4 $	4	4	34 4	24 $		
5 %	5	4	35 5	25 %		
6 &	6	4	36 6	26 &		
7 '	7	4	37 7	27 '		
8 (	8	4	38 8	28 (		
9)	9	4	39 9	29)		
: *	A	4	3A :	2A *		
; +	B	4	3B ;	2B +		
, <	C	5	2C ,	3C <		
- =	D	5	2D -	3D =		
. >	E	5	2E .	3E >		
/ ?	F	5	2F /	3F ?		

*Table 2(a). ASCII codes and symbols. *Undefined — default to NUL.*

video display board. This is a 64 x 16 display which occupies 1024 bytes of memory (7C00-7FFF).

Both routines use a pointer in memory to keep track of the position of the cursor on the screen. VIDLIN (00ED) contains the low-order byte of the cursor address, while VIDLIN&1(00EE) contains the high-order byte. This pointer should be set to 7C00 when the system is loaded. The routines will take care of updating it.

Operation

Both routines use the accumulator to pass data back and forth to the calling routine. An 8-bit accumulator can have up to 256 possible codes, but only 224 are used by these routines. Table 1 shows how the codes are assigned to the different characters. A complete breakdown of all the codes and their displayed symbols is given in Tables 2(a), 2(b), and 2(c). The symbols are dependent on the type of character generator that your video board uses, but they will generally be the same as those shown.

If a machine code (00-1F) is given to the CHAROT routine, it will vector to a machine language routine that will perform the needed function. Routines are provided for NUL, BACKSPACE, TABULATION, LINEFEED, CARRIAGE RETURN, CLEAR, SHIFT LOCK, ESCAPE, and SCROLL. All other machine codes are set to vector to NUL if they are called. If you want to define any additional machine codes (or redefine any of the current ones), all that you have to do is write a machine language routine to perform the needed function and place its starting address in the machine code vector table (see Table 3).

PolyMorphic video graphics characters can be created on the screen. With graphics, the entire character block is divided into six large squares. When the GRAPHICS key is pressed, all six squares will light up at the cursor position. Then pressing any of the keys from 1 through 6 will turn off the corresponding square. Any or all of the squares may be turned off. If a mistake is made, then pressing any other key on the keyboard will relight the entire block. Releasing the GRAPHICS key will move the cursor to the next position.

The REPEAT key can be used by itself to move the cursor to the right without changing any of the displayed video. When used with any other key, it will continuously input that key over and over.

Several machine language routines are used to perform various functions. BACKSPACE will move the cursor to the left one position. It can be used with or without the REPEAT key.

When a CARRIAGE RETURN is pressed, it will cause the video from the cursor to the right margin to be blanked out. The cursor will be reset to the start of the next line. If that is off the screen, then the display will be scrolled and the cursor set to the bottom line.

A LINEFEED will move the cursor down one line from its current position but not move it horizontally. If it goes off the bottom of the screen, it will wrap around to the top line.

Pressing the SHIFT-LOCK key will set the shift-lock memory bit to 1. This has the same effect as holding down the SHIFT key as you type. It can be reset by depressing the SHIFT key by itself.

The ESCAPE key causes the program to jump to the address that is stored at 17FC. You will normally load the address of your monitor program in there. The return address of the routine that called the CHAROT routine is pulled from the stack so that repeated use of the ESCAPE function will not fill up the stack.

The CLEAR key causes the cursor to home to the top left corner. It will also set the first 64 bytes of page zero memory to 00. This is for routines that need to handle an entire line at one time. For more on this, see Appendix 1.

A SCROLL function is called whenever the screen has been filled. The routines automatically scroll the screen when the last position has been filled. If you want to manually scroll it, you can do it with an "up arrow" and CONTROL .

A TABULATION function

Fig. 1. Graphics block.

Key	IC1	IC2	Code	Results
SPACE	0	5	20	Places a blank on the screen.
BACKSPACE	8	7	08	Backspaces cursor one position to the left.
TAB	9	7	09	Moves cursor to the next position with a tab set on. TAB with SHIFT will set a tab; TAB with CONTROL will clear a tab.
LINEFEED	A	7	0A	Moves cursor down one line, wraps around to top of screen.
CAR RET	D	7	0D	Blanks line from cursor to right margin. Resets cursor to start of next line. Scrolls if on the last line.
CLEAR	8	6	18	Clears the line register and homes the cursor.
SHIFT LOCK	A	6	1A	Sets shift-lock mode to on.
ESCAPE	B	6	1B	Transfers control to (17FC).

Table 2(b). Machine codes and results.

Code	Pressed
C0	None
C1	1
C2	2
C3	1, 2
C4	3
C5	1, 3
C6	2, 3
C7	1, 2, 3
C8	4
C9	1, 4
CA	2, 4
CB	1, 2, 4
CC	3, 4
CD	1, 3, 4
CE	2, 3, 4
CF	1, 2, 3, 4
D0	5
D1	1, 5
D2	2, 5
D3	1, 2, 5
D4	3, 5
D5	1, 3, 5
D6	2, 3, 5
D7	1, 2, 3, 5
D8	4, 5
D9	1, 4, 5
DA	2, 4, 5
DB	1, 2, 4, 5
DC	3, 4, 5
DD	1, 3, 4, 5
DE	2, 3, 4, 5
DF	1, 2, 3, 4, 5
E0	6
E1	1, 6
E2	2, 6
E3	1, 2, 6
E4	3, 6
E5	1, 3, 6
E6	2, 3, 6
E7	1, 2, 3, 6
E8	4, 6
E9	1, 4, 6
EA	2, 4, 6
EB	1, 2, 4, 6
EC	3, 4, 6
ED	1, 3, 4, 6
EE	2, 3, 4, 6
EF	1, 2, 3, 4, 6
F0	5, 6
F1	1, 5, 6
F2	2, 5, 6
F3	1, 2, 5, 6
F4	3, 5, 6
F5	1, 3, 5, 6
F6	2, 3, 5, 6
F7	1, 2, 3, 5, 6
F8	4, 5, 6
F9	1, 4, 5, 6
FA	2, 4, 5, 6
FB	1, 2, 4, 5, 6
FC	3, 4, 5, 6
FD	1, 3, 4, 5, 6
FE	2, 3, 4, 5, 6
FF	1, 2, 3, 4, 5, 6

Table 2(c). Graphics characters and codes.

Address	Data	Machine Code	Called by
0300	01 31	00 NUL*	
0302	01 31	01 SOH	
0304	01 31	02 STX	
0306	01 31	03 ETX	
0308	01 31	04 EOT	
030A	01 31	05 ENG	
030C	01 31	06 ACK	
030E	01 31	07 BEL	
0310	02 31	08 BS	BACKSPACE
0312	7B 31	09 HT	TAB
0314	22 31	0A LF	LINEFEED
0316	01 31	0B VT	
0318	01 31	0C FF	
031A	16 31	0D CR	CARRIAGE RETURN
031C	01 31	0E SO	
031E	01 31	0F SI	
0320	01 31	10 DLE	
0322	01 31	11 DC1	
0324	01 31	12 DC2	
0326	01 31	13 DC3	
0328	01 31	14 DC4	
032A	01 31	15 NAK	
032C	01 31	16 SYN	
032E	01 31	17 ETB	
0330	42 31	18 CAN	CLEAR
0332	01 31	19 EM	
0334	34 31	1A SUB	SHIFT LOCK
0336	3D 31	1B ESC	ESCAPE
0338	01 31	1C FS	
033A	01 31	1D GS	
033C	54 31	1E RS	↑ & CONTROL
033E	01 31	1F VS	

*Table 3. Machine code vector table. *All undefined codes default to NUL.*

has been programmed into this software. Each of the 64 characters on a line has a unique tab bit that can be set or cleared. When the TAB key has been pressed, the cursor will move to the right and will not stop until it reaches a position with the tab bit set or the right margin. To set the tab, you must position the cursor to the desired column and press TAB and SHIFT. To clear a tab, use TAB and CONTROL. Don't tab the column on the left margin because that tab bit is also used as a shift-lock bit.

Memory Requirements

The software itself can be placed in either ROM or RAM and only requires 512 bytes. The video display board should be comparable to a PolyMorphic board in order to use all of the features of the software. It should reside in memory at 7C00-7FFF.

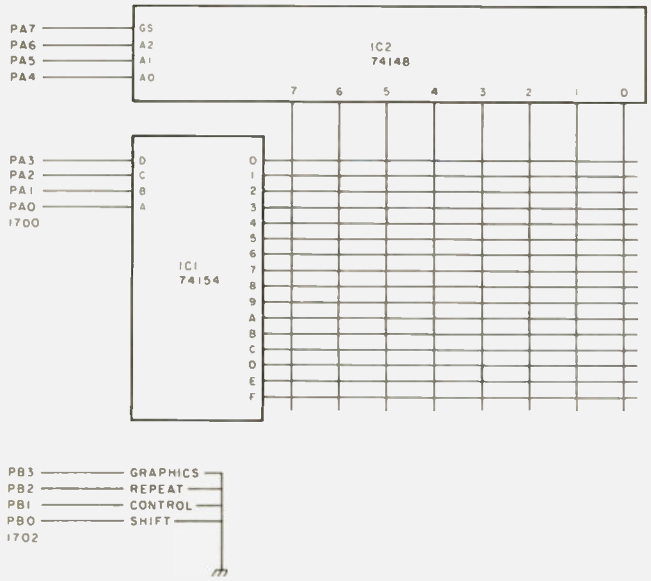

Fig. 2. Hardware requirements for the keyboard port.

The software uses 7 bytes of page zero memory. Five bytes, from 0080 through 0084, are only used while the routines are executing and may be used by other programs as required. Only 2 bytes of memory must be uniquely assigned to the video I/O system. These are 00ED and 00EE. They contain the address of the cursor position. During system power up, you must set these to 00, 7C. The program will update and change them as required.

The first 64 bytes of page 03 contain the machine code vector table. This should be RAM in order to allow you to modify and expand the machine codes.

Eight bytes, from 0340 through 0347, contain the tabulation table. The 64 single bits in this table contain the tab status for the 64-character line. A 1 is a set tab, and a 0 is a cleared tab. The tab bit for the left margin row also serves as a shift-lock memory.

CHARIN Routine: Theory of Operation

When the CHARIN routine is called, it will initialize the Y-index and the data direction register for the keyboard port. The character that is currently on the screen where the cursor is to go is read and stored in memory. A cursor (FF) is then displayed on the screen.

The program then starts its main scanning loop at LOP101. Y is set to sixteen, and the program increments the keyboard port sixteen times. Each time, bit #7 is tested to see if a key is pressed. If one is, then the program will branch to PROCES.

If no key is pressed, the port with the SHIFT, CONTROL, REPEAT, and GRAPHICS keys is tested.

When a SHIFT key is pressed by itself, the program will clear the shift-lock bit to 0. It does this by ANDing the shift-lock memory byte with 7F and storing it back into memory.

At location CON101, the program will test the REPEAT key. When it is pressed, the program will branch up to SKIP. The cursor is turned off, and the video pointer is moved to the next position. The cursor is then turned back on again. The use of the DELAY subroutine at 3007 and 3019 will assure that the cursor will move slowly enough across the screen.

If the REPEAT key was not pressed, the program would have tested the GRAPHICS key and branched back to the main scanning loop if it was not pressed.

When the GRAPHICS key is pressed, the program will store a 00 on the screen, which lights up the entire character block. The program then goes into a loop that tests both the GRAPHICS key and scans the keyboard for a pressed key. If the GRAPHICS key is released, the character that is currently on the screen will be sent to the calling program. If any keyboard key is pressed, it will be tested to make sure that it is between 1 and 6. If any illegal key is pressed, the program branches back to the start of the graphics section and starts over.

When a key from 1 through 6 is pressed, the key is masked with an 07 to clear the five highest bits. The result is then placed in Y. The accumulator is cleared, and a single 1 in the carry flag is shifted into the accumulator Y number of times. This positions a single 1 bit in the accumulator, according to the number of the key that was pressed. The result is combined with the character already on the screen and then is displayed. This process is repeated until the GRAPHICS key is released.

When the main scanning loop has detected that a

ASCII key has been pressed, it will branch to PROCES (3074). Here it jumps directly to a short delay subroutine. This gives around 700 microseconds delay and resets Y to 00. The delay, along with the nature of the scan routine, will ensure that, when the code is read from the port, it will not be during a switch bounce.

The cursor is turned off, and the normal code is read from the keyboard port and saved in memory. The program then goes into a wait loop. The program will exit the loop only when: (1) the ASCII key is released, (2) the REPEAT key is pressed, and (3) another key on the same matrix row as the original key, but with a higher priority connection to IC2, is pressed. That third condition ensures that, when you press a second key without releasing the first one, both of them will be correctly read.

Once the program is out of the wait loop, it will test the code that it has received. If the code is a machine code or a SPACE, then the program will terminate and give that code to the calling routine.

For all other codes, the CONTROL key is then tested. If pressed, it will AND the code with 3F. That strips away the two high-order bits.

The SHIFT key and shift-lock bit are then tested. If neither is on, then the program will terminate and pass the code to the calling routine.

If the code is to be shifted, it is tested to determine what needs to be done. Codes that are greater than or equal to 40 need only to be ORed with 20 to perform the shift. These are all the letter keys. Codes that are less than 20 can only be made by Greek and math symbols, so they must be ORed with 80. Any other code must be between 20 and 40, and these require that their fifth bit is inverted. This is done with an

Program A. Main listings.

```
0000                    LR          Line register 64 bytes
0080                    TEMP        Temp storage 4 bytes
0084                    CURSOR      Cursor storage
00ED                    VIDLIN      Cursor address
0300                    MACTAB      Vector table 64 bytes
0340                    TABTAB      Tab table 8 bytes
1700                    PORTS       Keyboard ports

3000  A5  84            SKIP     LDA CURSOR          Repeat section
3002  91  ED                     STA (VIDLIN),Y      Cursor off
3004  20  E7  30                 JSR NEXCHA
3007  20  04  31                 JSR DELAY
300A  A0  00            CHARIN   LDY#00              Start of routine
300C  A9  0F                     LDA#0F
300E  8D  01  17                 STA PORTS&1         DDR
3011  B1  ED                     LDA (VIDLIN),Y
3013  85  84                     STA CURSOR
3015  A9  FF                     LDA#FF
3017  91  ED                     STA (VIDLIN),Y      Cursor on
3019  20  04  31                 JSR DELAY
301C  A0  10            LOPI01   LDY#10              Main loop
301E  EE  00  17        SCAN     INC PORTS
3021  2C  00  17                 BIT PORTS           Test for key
3024  10  4E                     BPL PROCES          Key pressed
3026  88                         DEY
3027  D0  F5                     BNE SCAN            Test 16 times
3029  AD  02  17                 LDA PORTS&2         Test other port
302C  4A                         LSR A
302D  B0  0A                     BCS CONI01          SHIFT not pressed
302F  48                         PHA
3030  A9  7F                     LDA#7F
3032  2D  40  03                 AND TABTAB
3035  8D  40  03                 STA TABTAB          Clear shift lock
3038  68                         PLA
3039  4A                CONI01   LSR A
303A  4A                         LSR A
303B  90  C3                     BCC SKIP            Repeat key pressed
303D  4A                         LSR A
303E  B0  DC                     BCS LOPI01          GRAPHICS not pressed
3040  A9  00            GRAPH    LDA#00
3042  91  ED                     STA (VIDLIN),Y      Turn on block
3044  EE  00  17        LOPI02   INC PORTS           Search for key
3047  AD  02  17                 LDA PORTS&2
304A  29  08                     AND#08              Mask off GRAPHICS
304C  D0  21                     BNE CONI02          GRAPHICS released
304E  AD  00  17                 LDA PORTS
3051  30  F1                     BMI LOPI02          ASCII not pressed
3053  C9  31                     CMP#31
3055  90  E9                     BCC GRAPH           Key less than 1
3057  C9  37                     CMP#37
3059  B0  E5                     BCS GRAPH           Key gtr than 6
305B  29  07                     AND#07
305D  A8                         TAY
305E  A9  00                     LDA#00
3060  38                         SEC
3061  2A                LOPI03   ROL A               Shift bit y times
3062  88                         DEY
3063  D0  FC                     BNE LOPI03
3065  11  ED                     ORA (VIDLIN),Y      Combine with screen
3067  91  ED                     STA (VIDLIN),Y      Display
3069  20  04  31                 JSR DELAY
306C  38                         SEC
306D  B0  D5                     BCS LOPI02          Relative jump
306F  A9  C0            CONI02   LDA#C0              Convert to graphics
3071  11  ED                     ORA (VIDLIN),Y      code and return
3073  60                         RTS
3074  20  12  31        PROCES   JSR DEL             Keybounce delay
3077  A5  84                     LDA CURSOR
3079  91  ED                     STA (VIDLIN),Y      Cursor off
307B  AD  00  17                 LDA PORTS           Fetch ASCII code
307E  85  80                     STA TEMP
3080  AD  02  17        LOPI04   LDA PORTS&2
3083  29  04                     AND#04
3085  F0  09                     BEQ CONI03          REPEAT pressed
3087  AD  00  17                 LDA PORTS
308A  30  04                     BMI CONI03          ASCII released
308C  C5  80                     CMP TEMP
308E  F0  F0                     BEQ LOPI04          Same key pressed
3090  A5  80            CONI03   LDA TEMP            Fetch normal code
3092  C9  21                     CMP#21
```

```
3094  90  19                BCC CONI05           Machine code
3096  AD  02  17            LDA PORTS&2
3099  29  03                AND#03
309B  C9  02                CMP#02
309D  B0  08                BCS CONI04           CONTROL not pressed
309F  48                    PHA
30A0  A9  3F                LDA#3F
30A2  25  80                AND TEMP
30A4  85  80                STA TEMP
30A6  68                    PLA
30A7  4A          CONI04    LSR A
30A8  90  08                BCC SHIFT            SHIFT pressed
30AA  2C  40  03            BIT TABTAB
30AD  30  03                BMI SHIFT            Shift lock set
30AF  A5  80      CONI05    LDA TEMP             Fetch code
30B1  60                    RTS
30B2  A5  80      SHIFT     LDA TEMP
30B4  C9  40                CMP#40
30B6  90  03                BCC LO               Code less than 40
30B8  09  20                ORA#20
30BA  60                    RTS
30BB  C9  20      LO        CMP#20
30BD  B0  03                BCS MED              Code from 20 to 3F
30BF  09  80                ORA#80               Greek and math
30C1  60                    RTS
30C2  49  10      MED       EOR#10               Invert 5th bit
30C4  60                    RTS
30C5  A0  00      CHAROT    LDY#00               Single char output
30C7  48                    PHA
30C8  C9  20                CMP#20
30CA  B0  10                BCS CONI06           Not a machine code
30CC  0A                    ASL A
30CD  85  81                STA TEMP&1
30CF  A9  6C                LDA#6C
30D1  85  80                STA TEMP
30D3  A9  03                LDA#03
30D5  85  82                STA TEMP&2
30D7  20  80  00            JSR TEMP             Indirect jump to table
30DA  68                    PLA                  Restore code
30DB  60                    RTS
30DC  C9  C0      CONI06    CMP#C0
30DE  B0  02                BCS CONI07           Graphics
30E0  29  7F                AND#7F               Clear high bit
30E2  49  80      CONI07    EOR#80               Invert high bit
30E4  91  ED                STA (VIDLIN),Y       Display
30E6  68                    PLA
30E7  48          NEXCHA    PHA                  Increment VIDLIN
30E8  E6  ED                INC VIDLIN
30EA  D0  0F                BNE OUTI01
30EC  E6  EE                INC VIDLIN&1
30EE  10  0B                BPL OUTI01           Result on screen
30F0  20  54  31            JSR SCROLL
30F3  A9  C0                LDA#C0
30F5  85  ED                STA VIDLIN
30F7  A9  7F                LDA#7F
30F9  85  EE                STA VIDLIN&1
30FB  A9  3F      OUTI01    LDA#3F
30FD  25  ED                AND VIDLIN
30FF  AA                    TAX
3100  68                    PLA
3101  60                    RTS
3102  C6  ED      BACSPC    DEC VIDLIN           Backspace routine
3104  48          DELAY     PHA                  Delay routine
3105  A9  55                LDA#55
3107  85  81                STA TEMP&1
3109  20  12  31  LOPI05    JSR DEL
310C  C6  81                DEC TEMP&1
310E  D0  F9                BNE LOPI05
3110  68                    PLA
3111  60                    RTS
3112  C8          DEL       INY
3113  D0  FD                BNE DEL
3115  60                    RTS
3116  A9  3F      CART      LDA#3F               Car ret routine
3118  91  ED                STA (VIDLIN),Y       Display a blank
311A  20  E7  30            JSR NEXCHA
311D  25  ED                AND VIDLIN
311F  D0  F5                BNE CART             Line not finished
3121  60                    RTS
3122  18          LINFD     CLC                  Linefeed routine
3123  A5  ED                LDA VIDLIN
```

EOR#10.

The CHARIN routine has now finished, and the accumulator can contain any one of the 224 possible codes that can be produced at the keyboard.

CHAROT Routine: Theory of Operation

Now that you have received a code from the keyboard, you want to display it on the screen. The CHAROT routine does this. The routine first tests the code to see if it is less than 20. If it is, the code must be a machine code.

When a machine code is found, it is doubled with an ASL A command and stored in memory. The memory byte before it is filled with a 6C, which is the op code for an indirect jump. The byte after it is filled with 03, which is the page number of the machine code table. Then, by jumping to the address with the 6C op code, the program makes an indirect jump into the machine code table. Whatever address is stored in that position of the table takes control of the processor.

If the code was not a machine code, it is tested again at CONI06. A non-graphics character will be masked with 7F to clear the high-order bit. The high-order bit for all characters is inverted to conform with the PolyMorphic video board. The character is displayed by storing it in the video memory.

The pointer at VIDLIN is incremented to the next position. If the resulting address is 8000, the screen is scrolled, and the pointer is reset to 7FC0. The value of the X-index is set from 00 to 3F, depending on the new cursor position. For more on this, see Appendix 1.

Machine Codes: Theory of Operation

The nine machine codes in the software were designed to make using the system easier and to simulate the action of a normal TTY machine. A vector table containing the starting addresses of all the routines was chosen to allow for flexibility and expansion. The routines work as follows:

NUL: The simplest routine is merely a jump to an RTS statement. It, in effect, does nothing. All undefined codes in the machine table default to a NUL.

BACKSPACE: This routine decrements the value in the low-order byte of the cursor address (00ED). It then delays for a moment in order to slow down the cursor movement when used with the REPEAT key. Because the high-order byte of the address is never changed, it will not backspace across the left margin when the cursor is on lines 1, 5, 9, and 13.

CARRIAGE RETURN: This routine takes a PolyMorphic blank (3F) and stores it on the screen at the cursor. It then increments the cursor to the next position and ANDs the low-order byte of the new cursor position with 3F. If the result is not 00, then the cursor is not yet to a new line. The program repeats until the cursor is at the start of the next line. Scrolling occurs when the cursor is incremented into address 8000.

LINEFEED: This routine works by adding 40 to the cursor address. If the result is greater than 7FFF, the high-order byte is set to 7C. The decimal flag in the 6500 must be cleared in order to use this routine.

SHIFT LOCK: This routine merely sets the highest bit at address 0340 and does not affect any others. This bit would normally be the tab status bit for the left-hand margin of the screen. Since there is no need to tab to a margin (a CARRIAGE RETURN does the same thing), it is used as a shift-lock indicator.

ESCAPE: This routine pulls the normal return address of the program off the stack and jumps to the address stored at 17FC and

```
3125  69  40              ADC#40
3127  85  ED              STA VIDLIN
3129  A9  00              LDA#00
312B  65  EE              ADC VIDLIN&1
312D  10  02              BPL OUTI02          Result on screen
312F  A9  7C              LDA#7C
3131  85  EE      OUTI02  STA VIDLIN&1
3133  60                  RTS
3134  AD  40  03  SHIFTL  LDA TABTAB          Shift lock routine
3137  09  80              ORA#80
3139  8D  40  03          STA TABTAB
313C  60                  RTS
313D  68          ESCAPE  PLA                 Escape routine
313E  68                  PLA
313F  6C  FC  17          JMP (17FC)
3142  A9  7C      CLEAR   LDA#7C              Clear line register
3144  85  EE              STA VIDLIN&1        and home cursor
3146  A9  00              LDA#00
3148  85  ED              STA VIDLIN
314A  A0  3F              LDY#3F
314C  99  00  00  LOPI06  STA LR,Y
314F  88                  DEY
3150  10  FA              BPL LOPI06
3152  C8                  INY
3153  60                  RTS
3154  84  80      SCROLL  STY TEMP            Scroll routine
3156  A9  40              LDA#40
3158  85  82              STA TEMP&2
315A  A9  7C              LDA#7C
315C  85  81              STA TEMP&1
315E  85  83              STA TEMP&3
3160  B1  82      LOPI07  LDA (TEMP&2),y
3162  91  80              STA (TEMP),Y
3164  E6  80              INC TEMP
3166  D0  02              BNE CONI08
3168  E6  81              INC TEMP&1
316A  E6  82      CONI08  INC TEMP&2
316C  D0  F2              BNE LOPI07
316E  E6  83              INC TEMP&3
3170  10  EE              BPL LOPI07          Still on screen
3172  A9  3F              LDA#3F
3174  91  80      LOPI08  STA(TEMP),Y         Blank out last line
3176  E6  80              INC TEMP
3178  D0  FA              BNE LOPI08
317A  60                  RTS
317B  AD  02  17  TAB     LDA PORTS&2         Tab routine
317E  29  03              AND#03
3180  C9  03              CMP#03              Test for S or C
3182  D0  12              BNE SHCT            Shift or control
3184  20  E7  30  TABIT   JSR NEXCHA
3187  20  A2  31          JSR SETUP
318A  B0  12              BCS UNSET           Tab found
318C  20  9E  31          JSR UNSET
318F  A9  3F              LDA#3F
3191  C5  80              CMP TEMP
3193  D0  EF              BNE TABIT           Not end of line
3195  60                  RTS
3196  20  A2  31  SHCT    JSR SETUP
3199  AD  02  17          LDA PORTS&2
319C  4A                  LSR A
319D  4A                  LSR A
319E  A4  81      UNSET   LDY TEMP&1
31A0  10  10              BPL LOPI09          Unconditional jump
31A2  A9  3F      SETUP   LDA#3F
31A4  25  ED              AND VIDLIN
31A6  85  80              STA TEMP
31A8  86  82              STX TEMP&2
31AA  A8                  TAY
31AB  A9  3F              LDA#3F
31AD  38                  SEC
31AE  E5  80              SBC TEMP
31B0  85  81              STA TEMP&1
31B2  A2  07      LOPI09  LDX#07
31B4  3E  40  03  LOPI10  ROL TABTAB,X        Shift tabtab Y times
31B7  CA                  DEX
31B8  10  FA              BPL LOPI10
31BA  88                  DEY
31BB  10  F5              BPL LOPI09
31BD  A6  82              LDX TEMP&2
31BF  C8                  INY
31C0  60                  RTS
```

17FD. This should be set to the starting address of your system monitor and acts as an easy way to stop the program when it asks for data. Since this system is not an interrupt driven system, it is handy to also connect a RESET line to a spare keyswitch to handle any continuous loops in your program.

CLEAR: This routine sets the VIDLIN pointer to 7C00 (upper left corner) and sets the first 64 bytes in page zero to 00. Appendix 1 gives more details concerning the use of the page zero memory.

SCROLL: The SCROLL routine acts to move all the data on the screen up one line. It does this by setting up two pointers in page zero memory. The first pointer points to 7C00, and the second one points to 7C40. The 64-byte difference is the length of one line. Data is read from the second pointer and stored at the first. Both are then incremented by one. When the second pointer has reached 8000, the lower 15 lines have been moved to the upper 15 lines. A PolyMorphic blank (3F) is then used to fill up the bottom line.

TABULATION: This routine actually does three separate things. It sets a tab when TAB is pressed along with a SHIFT key. It clears a tab when TAB is pressed along with the CONTROL key. When TAB is pressed by itself, it moves the cursor to the right and stops it at the first column with a set tab. If none are set, it will stop at the right margin.

The program maintains a table for the tab status at 0340. The 64 columns require 8 bytes of RAM. These 8 memory bytes and carry flag are turned into a 65 x 1 recirculating shift register by the SETUP routine in the TAB program. When SETUP is called, it figures out which one of the 64 columns it is looking for by ANDing 3F with the cursor position. It then uses two loops and a ROL instruction to shift all 64 bits of memory and the carry flag until the tab bit it needs has been shifted into the carry flag. While in the flag, it can easily be set, cleared, or tested. The SETUP routine also computes the number of times that it will have to continue to shift the memory in order to restore it to its original position. The routine UNSET takes this number and uses it to restore the table.

When the TAB routine is entered, it first tests the SHIFT and CONTROL keys to see if they are pressed. If they are, it shifts the table until the tab bit for the current position is in the carry flag. It then sets or clears the flag, depending on the key pressed, and restores the table. The only bit affected is the tab bit for the current position.

If neither the SHIFT nor CONTROL key is pressed, the cursor is moved one position. The cursor is incremented by subroutine NEXCHA, and the table is then shifted until the tab bit for that column is in the carry flag. A set carry flag will cause the program to branch to the UNSET routine, where the table is restored. The routine is terminated with the cursor left on a set tab position.

If the carry flag was not set, the program would still use the UNSET routine to restore the table. But then it would test the column, and, if it was not at the right margin, it would go back and start again. Eventually, it would find either a set tab or the margin. ■

APPENDIX 1
Using the Routines

The single character I/O used in these routines is generally compatible with standard TTY I/O routines. One incompatibility is that the CHARIN routine will not (except for graphics) echo the inputted character to the screen. If you merely set the starting address for CHARIN and CHAROT in your system I/O vectors, you may find that you cannot see anything that you type. If that is the case, use this patch in your program:

```
2000  20 0A  30  INPUT    JSR CHARIN
2003  4C C5  30  OUTPUT   JMP CHAROT
```

Now, when you jump to subroutine INPUT, it will input a character and also display it. CHAROT restores the accumulator when finished, so the data is preserved.

Sometimes it is desirable to input an entire line rather than just one character. This way you can edit and correct any mistakes, and the calling program only sees the final result. One way to do this is by using the first 64 bytes of page zero RAM as a line register. This program will accept up to one line of characters and store them in the line register. It returns to the calling program when you type a CARRIAGE RETURN.

```
START    LDX#00
LOOP     JSR CHARIN
         STA 00,X
         JSR CHAROT
         CMP#0D
         BNE LOOP
         RTS
```

A simple program that will display an entire line at one time is:

```
START    LDX #00
LOOP     LDA 00,X
         JSR CHAROT
         CMP#0D
         BNE LOOP
         RTS
```

Both of these programs work fine with displayed characters. Since the CHAROT routine sets the X-index to a number that corresponds to the cursor position, it can be used to index through the line register. One weakness that these programs share is that nondisplayed characters (LINEFEED, CLEAR, etc.) will not alter the X-index. This means that machine codes cannot be used with these routines. If you want to use them, you must alter the routines to set the X-index to its proper value after each machine code.

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Computerized Loop Antenna Design

—in BASIC

Almost any time you see an article on small loop antennas, the author points out that such antennas are probably the least explored by amateurs.

Then he points out why that's so, and, indeed, you say, the little darlings can well stay unexplored. Their frighteningly low radiation resistance is almost instantaneous discouragement.

But (dare I risk nonconformity among authors), although loop antennas are probably the least explored by amateurs, they have much to offer. So much, in fact, that it is almost astounding that the dipole is not given less attention.

I, for one, am tired of seeing the radiation patterns of dipoles and having it pointed out to me even before I put one up that the damn thing is going to shoot most of my rf straight up unless I have two giant redwood trees and a chair lift.

The loop is small — at least as compared with its operating wavelength. It is directional — at least it can be rotated without having to move two giant redwoods a few hundred feet. It has a narrow bandwidth — and if you think that is a disadvantge, you haven't listened to atmospheric noise in the summer on 80 meters. But it is tunable and could be remotely tuned with a motor, so bandwidth is not really a problem once the system is operational.

Consider the alternatives: a dipole which intrudes upon Eastern Airlines' flight schedules or a vertical which requires a copper backyard for optimum results. If I had enough copper to make a really good ground system for a vertical, I wouldn't use it for an antenna (as much as I love amateur radio). I'd melt the stuff and retire. Maybe put down a few radials of solid gold, which probably is cheaper.

Small loop antennas can be the answer for the amateur with space and tower limitations who does not have a biological noise filter twixt his anvil bone and his stirrup bone.

A magnetic loop antenna, which does to the magnetic component of the rf wavefront what dipoles do to the electrical component, can almost be put in a cave and will still work.

Ideally, it turns out, it should not be mounted in a cave, so you don't have to have one of those either. Its lowest radiation angle —and, hence, its most effective position for DX—is about five-sixteenths wavelength above ground. At 80 meters, that is only slightly more than a quarter wave or slightly more than 33 feet. That's not bad, when a dipole would have to be part of a thundercloud to give the same yield, and then in only two directions.

Mounted vertically, as it should be to maximize radiation resistance, the loop can be rotated to null out noise and QRM — kind of like a beam on 80.

As you will probably have noticed if you are older than 12, there is no such thing as a free lunch. What price this miraculous antenna? Well, there is that radiation resistance thing...

Radiation resistance does not exist, but it is measurable, and, if you want to be heard more than a block away, it is very, very important.

In physics, accounting is strict, much stricter than a bank's ledger. If power goes into something and less power comes out, there has to be a reason. The credit and debit sides of the energy balance sheets must match.

When you pump power into an antenna, the energy sets up standing fields near the system. There is less power in those fields and in the conductor itself than was pumped in there. So where did it go? It went to that rare DX station's receiving antenna, that's where.

Well, says the physicist accountant, if the system "lost" that power to the "ether" — which doesn't exist either — there must be a reason. There the comparison between dollar and electrical accountants ends. The electrical accountant may have to make his balance sheets match more accurately, but he engages in some practices which would land him in a federal pen if he tried them with bucks.

He invents things which don't exist but at least explain where the power

```
10 Rem Program designs small loop antennas and show effects
20 Rem of altering various parameters
30 Rem by William Slattery
40 Rem October, 1977
50 For x = 1 to 6: #"": next x
60 # "loop antenna designer"
70 For x = 1 to 5: #"": next x
80 # "this program aids in the design"
90 # "of loop antennas small compared"
100 # "to their operating frequencies"
110 #
120 # "enter data as requested."
130 #
140 For x = 1 to 5000: next x
150 For x = 1 to 20: #"": next x
160 Input "Enter frequency", F
170 #
180 #
190 Input "Enter loop diameter", D
200 Let K = D: Let Z = F
210 #
220 Gosub 1180
230 # "the radiation resistance of a"
240 # "loop antenna"; D; "feet in diameter"
250 # "is"; R; "at"; F; "MHz"
260 #
270 # "loop antenna efficiency depends"
280 #"on the diameter and composition"
290 #"of the conductor."
300 #
310 Input "Enter conductor diameter (inches)", D(1)
315 Let P = D (1)
320 #
330 #"Is the conductor copper or aluminum?"
340 #"Enter A or C"
350 Input A$
360 If A$ = "C" then B$ = "copper"
370 If A$ = "A" then B$ = "aluminum"
380 Gosub 1200
390 Gosub 1250
400 #
410 # "Do you wish to alter a parameter"
420 # "And observe the effects? (Enter Y or N)"
430 Input D$
440 If D$ = "Y" then 490
450 If D$ = "N" then #"Do you wish a new design?"
460 If D$ = "N" then Input C$
470 If C$ = "Y" then 160
480 End
490 # "Do you wish to alter —"
500 #"1. Frequency."
510 #"2. Loop diameter."
520 #"3. Conductor diameter."
530 Input "Enter appropriate number", C
540 If C = 1 then 590
550 If C = 2 then 870
560 If C = 3 then 1030
570 #"Enter your choice"
580 GOTO 490
590 Let F = 1.8
600 Gosub 1180
610 Gosub 1200
620 Gosub 1250
630 Let F = 3.8
640 Gosub 1180
650 Gosub 1200
660 Gosub 1250
670 Let F = 7.2
680 Gosub 1180
690 Gosub 1200
700 Gosub 1250
710 Let F = 14.25
720 Gosub 1180
730 Gosub 1120
740 Gosub 1250
750 Let F = 21.2
760 Gosub 1180
770 Gosub 1200
780 Gosub 1250
790 Let F = 28.9
800 Gosub 1180
810 Gosub 1200
820 Gosub 1250
830 # "The formulae used in these cal-"
840 # "culations are of insufficient"
850 # "validity for frequencies above 10 meters."
860 GOTO 410
870 For x = 1 to 3 : #"": next x
880 Let F = Z: Let D(1)=P
890 Let D = 3
900 # "Frequency in memory is"; F; "MHz"
910 # "Conductor is"; B$; D(1); "inches"
920 # "in diameter"
930 For x = 1 to 3000: next x
940 #
950 # Diam.            Eff."
960 for x = 1 to 8
970 Gosub 1180
980 Gosub 1200
990 # D, E
1000 Let D = D + 1
1010 Next x
1020 GOTO 410
1030 For x = 1 to 3; #""; next x
1040 # "Frequency in memory is", Z
1050 #
1060 # "Loop is"; B$ "and is"; d; "feet"
1070 #"in diameter": #
1080 For x = 1 to 3000: next x
1090 #
1100 # "Diam.            Eff."
1110 Let D(1) = .5
1120 For x = 1 to 10
1130 Gosub 1180
1135 Gosub 1200
1140 # D(1)
1150 Let D(1) = D(1) + .5
1160 Next x
1170 GOTO 410
1180 Let R = 31200*((3.14*(D/2)↑2)/(984/F)↑2)↑2
1190 RETURN
1200 Let R(1) = SQRT(F)/(1000*D(1))
1210 If A$ = "A" then 1390
1220 R(2) = R(1)*(3.14*D)
1230 E = R/(R+R(2))*100
1240 RETURN
1250 For x = 1 to 3: #"": next x
1260 # "The loss resistance of"
1270 # "a loop antenna"; D; "feet"
1280 # "in diameter snf made of"
1290 # "D(1); "inch"; B$; "tubing"
1300 # "is"; R(2); "Ohms at"; F; "MHz"
1310 #
1320 # "Its radiation is"; R; "Ohms"
1330 #
1340 #
1350 # "Its efficiency is"; E; "per cent"
1360 #
1370 For x = 1 to 5000: next x
1380 RETURN
1390 Let R(1) = R(1)*1.28
1400 GOTO 1220
```

Fig. 1. Loop antenna designer.

LOOP ANTENNA DESIGNER

THIS PROGRAM AIDS IN THE DESIGN OF LOOP ANTENNAS
SMALL COMPARED TO THEIR OPERATING FREQUENCIES
ENTER DATA AS REQUESTED
ENTER FREQUENCY 3.8
ENTER LOOP DIAMETER 14
The radiation resistance of a loop antenna 14 feet in diameter is .16427068 at 3.8 MHz
Loop antenna efficiency depends on the diameter and composition of the conductor
ENTER CONDUCTOR DIAMETER(INCHES)
3
Is the conductor copper or aluminum? ENTER A OR C
C
The loss resistance of a loop antenna 14 feet in diameter and made of 3-inch copper tubing is .02857825 Ohms at 3.8 MHz
Its radiation resistance is .16427068 Ohms
Its efficiency is 85.181017 per cent
Do you wish to alter a parameter and observe the effects?
(ENTER Y OR N)
Y
Do you wish to alter—
1. frequency
2. loop diameter
3. conductor diameter
ENTER APPROPRIATE NUMBER
1
The loss resistance of a loop antenna 14 feet in diameter and made of 3-inch copper tubing is 1.9668901E-02 at 1.8 MHz
Its radiation resistance is 8.2701934E-03 Ohms
Its efficiency is 29.600793 percent
(NOTE: Program repeats above paragraph substituting frequencies of 3.8, 7.2, 14.2, 21.2, and 28.9 MHz in the calculations)
The formulae used in calculations are of insuffcent validity for frequencies above 10 meters
Do you wish to alter a parameter and observe the effects?
(ENTER Y OR N)
Y
Do you wish to alter—
1. frequency
2. loop diameter
3. conductor diameter
ENTER APPROPRIATE NUMBER
2
Frequency in memory is 3.8 MHz
Loop is copper and is 3 inches in diameter

DIAMETER	EFFICIENCY
3	5.351593
4	11.82175
5	20.751192
6	31.151973
7	41.810146
8	51.749839
9	60.42897
10	67.68762

Do you wish to alter a parameter and observe the effects?
(ENTER Y OR N)
Y
Do you wish to alter—
1. frequency
2. loop diameter
3. conductor diameter
ENTER APPROPRIATE NUMBER
3
Frequency in memory is 3.8 MHz
Loop is copper and is 14 feet in diameter

DIAMETER	EFFICIENCY
.5	24
1	38
1.5	48
2	55
2.5	61
3	65
3.5	68
4	71
4.5	74
5	76

Do you wish to alter a parameter and observe the effects?
(ENTER Y OR N)
N
Do you wish a new design?
Y
ENTER FREQUENCY 14.35
ENTER LOOP DIAMETER 6
The radiation resistance of a loop antenna 6 feet in diameter is 1.1270057 at 14.35 MHz
Loop antenna efficiency depends on the diameter and composition of the conductor.
ENTER CONDUCTOR DIAMETER(INCHES)
1
Is the conductor copper or aluminum? ENTER A OR C
A
The loss resistance of a loop antenna 6 feet in diameter and made of 1-inch aluminum tubing is 9.1395378E-02 Ohms at 14.35 MHz
Its radiation resistance is 1.1270057 Ohms
Its efficiency is 92.498743 per cent
Do you wish to alter a parameter and observe the effects?
(ENTER Y OR N)
N
Do you wish a new design?
N
ready

Fig. 2. Loop antenna designer — sample run.

went. Radiation resistance is what he invents.

As you've probably guessed, the more power lost to the ether, the quicker you'll win your WAC.

Small loops have very little radiation resistance, but they do have, like anything else, true loss resistance. That ohmic resistance eats up power and turns it into heat. And, unless Pitcairn Island now has antennas sensitive into the infrared, heat is wasted energy.

But, what really matters is the ratio of radiation resistance to loss resistance. It determines the efficiency of an antenna. If losses are kept low, compared to radiation resistance (no matter how low it is), efficiency is high.

Practical loops may be as efficient as 80 per cent or more.

If that doesn't impress you, run out to your mobile, call and chat with someone across the country, and remember that your base-loaded whip has an efficiency somewhere in the single digits.

Keeping loss resistance low is accomplished two ways. One is by reducing the resistance of joints. Obviously, the answer here is to reduce the number of joints and weld or carefully solder what joints there must be.

Another is by increasing the size of the conductor. Rf flows on surfaces. Increase surface areas, and you decrease resistance.

There has to be an optimum in here somewhere. There is, but it depends on your QTH and pocketbook. Sewer pipe made out of copper is a great conductor at 3 MHz, but you'll begin to wonder why they keep gold in Fort Knox.

A 50-foot diameter loop is terrifically efficient, but your house can jump rope through it.

Hence, the following program.

Let me say that, in real life, I am not an electronics engineer. I'm just a newspaper reporter, but that at least means I can read, and that's what it takes to learn enough about antenna design and programming to come up with this masterpiece.

To be truthful, the only book larger than the one about what I don't know about antenna design is the one about what I don't know about programming.

You can get a few more articles on small loops before building one. And you can probably get an education in inefficient program design by reading my loop antenna designer. You can also improve it.

One addition might be a section to relate radiation resistance to height above ground. Another could compute the angle of the strongest radiation lobe for a given height. The formulas are not difficult and not difficult to obtain.

You probably could simply streamline this program to run better. It is written in Digital Group Maxi-BASIC and runs on my Z-80 system in much less than the 18K memory I've got. I'd guess the BASIC takes up about 13K and the program about 2.5K.

I'm sure the program could be modified to fit any other BASIC, but then again I'm making that statement from the "expert" position of a person who doesn't know a damn thing about any other BASIC.

The antenna, I think, has promise. I have always found the most exciting part of amateur radio to be experimenting with systems which push a meager amount of rf further. It's my kink. ■

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Hey! Wait For Me!

—slowing computers to reading speed

Trying to read game directions on a TV monitor at 1200 baud can be a real rat race!

Ever since I made the 1200 baud rate conversion on my SWTPC 6800, all I hear are complaints from the game players who frequent my computer keyboard. (The conversion was based on a *Kilobaud* article by Jim Huffman, "Speed Up Your 6800," No. 5, May, 1977.)

I think the faster speed actually scares some people away from the keyboard (more than usual). If the player attempts to read the game directions at the 1200 baud rate, he sometimes runs away even before the game begins. The alternative, of course, is to return to the original 300 baud rate supplied by the control board. This makes for very slow drawing of game maps and grids.

If the player is given plenty of time to read the directions before he starts the game, he might stay relaxed enough to enjoy it, so I use a subroutine to develop this needed delay. The routine can be used every few sentences, especially if the directions are rather lengthy. The subroutine, in BASIC, is shown in Fig. 1. The delay routine is found between lines 900 and 920. Be sure your variable character (N in my example) is not used for anything else in the main program. Fig. 2 shows the approximate time delays encountered with my SWTPC 6800 8K BASIC. Now your guests can relax while reading those game directions! ■

```
XXX Last line of directions in your game program
XXX GOSUB 900
XXX Your game program continues . . .

900 FOR N = 1 TO 200
910 NEXT N
920 RETURN
```

Fig. 1. Subroutine delay.

Line #900	Approximate time delay for my SWTPC 6800 8K BASIC
N = 1 TO 125	2 seconds
N = 1 TO 200	3 seconds
N = 1 TO 300	4 seconds
N = 1 TO 1000	15 seconds
N = 1 TO 5000	70 seconds

Fig. 2. Time delay values.

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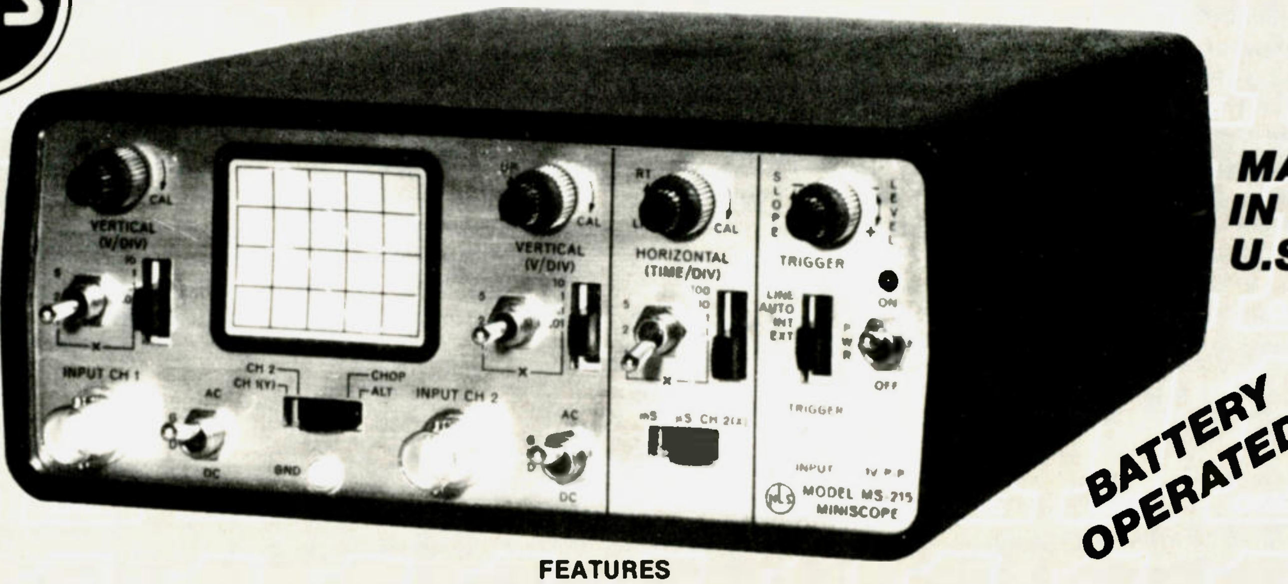

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From the originator of the Digital Voltmeter, Non-Linear Systems comes the MS-215 Miniscope. It is a fine electronic instrument with a graat daal of measuring capability and excellent accuracy. Its design is modern, utilizing the latest in low-powered integrated circuits, and it is packaged into the smallast practical size. The instrument fits into many briefcases and tool boxes with room to spare.

Operating characteristics have been chosen so that tha MS-215 will make all of the measuraments needed in servicing most electronic equipment. It is field-portable so its use is not restricted to the bench.

SPECIFICATIONS:

Vertical
Mode: CH1, CH2, CH1 & CH2 (Chopped) & CH1 & CH2 (Alt.)
The Following Specifications apply to each channel

Y Axis
Verticle Input: 10mV/div to 50V in 12 Calibrated ranges, as follows:
x1-10mV/div to 10V/div in four ranges, each continuously variable.
x2-20mV/div to 20mV/div in four ranges, each continuously variable.
x5-50mV/div to 50mV/div in four ranges, each continuously vairiable.
Accuracy is 3%
Input Impedence: 1M ohm shunted by 50 pF.
Bandwidth: DC/DC to 15 Mhz ±6 db (DC to 8 Mhz ±3 db). AC, same as DC down to 3Hz.
Rise Time: Approximately 23 nS @ 1 division deflection.
Input Voltage: 250 maximum (DC and Peak AC).

Horizontal
Mode: Internal Time Base or External Horizontal, switch selectable. In the XY mode, vertical input is through CH1 and horizontal input is through CH2
Bandwidth: DC to 200 KHz (±3 db).
Coupling: AC, DC or ground, switch selectable. Low frequency point on AC is 3 Hz.
Input Impedence: 1Meg ohm shunted by 50 pF.
Deflection Factor: 10mV/div to 50V/div in 12 calibrated ranges. The ranges can be calibrated with the CH2 gain control
Input Voltage: 250V maximum (DC and Peak AC)
Time Base: **0.1uS/div to 0.5 Sec/div in 21' calibrated ranges, as follows:**
x1, uS-0.1uS/div to 100 uS/div. x2, uS-0.2uS/div to 200 uS/div.
x5, uS-0.5uS/div to 500 uS/div. x1, mS-0.1mS/div to 100 mS/div
x2, mS-0.2mS/div to 200 mS/div. x5, mS-0.5mS/div to 500 mS/div.
all in four ranges, each continuously variable. (Range increments ar .1, 1, 10, 100.) With vernier in full clockwise position, calibrated time measurements are possible. Accuracy is 3%.

Triggering
Internal: Sweep triggered from internal trigger source (In the dual trace modes, the internal trigger source is CH1).
Automatic: Trigger source is internal calibrater frequency. To be used if there is no other trigger source available to synchronize the sweep.
Line: Trigger is derived from line frequency when using the battery charger.
External: Controls function as for internal triggering (1 Megohm input impedence).
Slope: Selects sync to positive- or negative- going waveform.
Coupling: AC
Sensitivity: Less than 1 div for internal trigger and less than 1 volt for external trigger.
Level: Trigger Level control permits continuous adjustment of trigger point in all modes except Auto.
Internal Calibrater: A square-wave signal of 1 volt p-p ±5% is provided. Frequency is approximately 1KHz.

Display
Graticule: 4x5 div, each division is 0.25 inch. Viewing area 1.1"Hx1.35"W
CRT: Bluish-white phospher, medium peristence. CRT uses low power filament for low battery drain. Instant on!

Power
On-Board Batteries: Three sealed, rechargeable lead acid "D" Cells
Operating Time: Typically 4 hours.
Charging Time Scope Operating: Will run indefinitely but not reach full charge.
Non-operating: Sixteen hours.
External Power: Battery charger 115 vac (220 vac on request). 50-400Hz, less than 15 watts.
Dimensions: 3.1"Hx6.4"Wx8.0"D.
Weight: Three pounds.

Environment
Operating Temperature: 0° to 40°C
Shock and Vibration: Designed to with stand normal shock and vibration encountered in commercial shipping and handling.

Accessories
Furnished: Tilt stand, battery charger, 2 input cables, and 3 miniature banana plugs.
Optional: Leather carrying case and probes
Warranty: One year parts and labor. Made in the U.S.A.

MS-215 with Rechargeable Batteries and Charger
$395.00

Leather Carrying Case

The leather case has 2 separate compartments. One to hold the scope, the other to hold the charger, probe, shoulder strap, etc. The case can be worn on the belt, or over the neck.

The snaps used on the case are "one way", thus accidental striking of the case against an object will not undo the snaps or let it be pulled off your belt.

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Probe uses spring hook tip for sure connection. Compensation network is located at the connector rather than at the probe, so as to keep size and weight to a minimum.

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Morrow's Marvelous Monitor

—reviewing the Morrow front panel

One of the finest, though unheralded, microprocessor boards on the market today is the George Morrow CPU/front panel board, known as the "Sigma 100." It is being sold directly from Morrow's Micro-Stuff or through dealers around the country. Although it is being advertised innocently enough as a replacement front panel for the Altair or Imsai computers, it does far more than any other CPU system currently being offered. The Morrow board also comprises the brains of the Equinox 100 computer system from Parasitic Engineering.

I first discovered the early version of the board in late 1976, when my friend Jay Bell (computer freak of magnitude 9.9) called my attention to a miniscule ad George Morrow was running which offered a computer board at a ridiculous price. I hustled off a check, figuring at the time that, if computers turned out like my ham radio hobby, I would soon have a roomful of blinking LEDs (which I now have).

My previous experience in computers was a frustrating FORTRAN course, watching Jay's toggle-switch acrobatics on an Altair, and articles in magazines that I didn't understand. I just plowed ahead and decided to learn as I went. There's a first lesson for beginners here — go ahead, even if you aren't sure that you know what you're doing. This isn't ham radio where you need a license or can mess up an FAA airplane circuit if you misadjust a transmitter.

I received my Morrow CPU board in a week. This is a fully-debugged working production model. There's no waiting months until the company gets into production and works out glitches. This is an important point because you see a lot of neat things advertised which aren't being shipped.

The Morrow board itself is a nicely laid out double-sided job. Assembly is straightforward. Stick sockets in, solder, and it works.

Then comes the problem: What do you do with a computer when you don't know anything about computers? First of all, you need a power supply, case, and mother board with sockets to give the CPU board a home. You can get the works from Parasitic Engineering in their Equinox 100. In addition to what I would best describe as a "moose power supply" (it powers 18 card slots — your money will run out before this power supply will), the Equinox has a specially designed mother board, also from George Morrow.

Next, you need some memory. There's another lesson here for beginners — pick a CPU that is compatible with your friends', or pick friends who have CPUs and mother boards like yours. That way, you can borrow a board or two of memory when you want to run some biggie program that hogs up memory. You can also swap

boards for debugging — at your own risk, of course!

After the memory is in and the power on, you begin tinkering with the keys on the front panel to see what happens. George doesn't swamp you with information, but you do get basic instructions and a little program which makes the seven-segment LEDs count. It helps familiarize you with the operation. The board's operation is so simple that, in about an hour, I had figured out basically what was happening inside the computer. The normal reaction is, "Why aren't all computers designed like this?"

The control of the Morrow panel is set up in a perfectly rational way, so, if you can operate a pocket calculator, you can work a Morrow computer. You don't have to know anything about status lights, memory protect, machine cycles, or nitty-gritty computer design to get going. There's no binary conversion, no flashing lights. The only switch on the board is a "reset" switch, which sort of sends everything back to home when you mess up the program. There are twelve keys for control functions and ten LED seven-segment readouts to tell you what's going on.

How Does It Work?

Basically, the Morrow front panel/CPU works like this: There is a combination hardware-software (called "firmware") which controls operation of the CPU and does all the work supervising the computer operation. In the normal "run" mode, the CPU will go full speed just like anybody else's 8080 CPU. But now comes the neat part. You can execute the program just one step at a time (called "single stepping") or let the front panel step through it at any rate you want (called "slow stepping"). I will discuss this in detail later. You can also put a "halt" instruction in the program, and the front panel program will stop your program so that you can see what happened so far. Then you can continue from that point, at any speed from single step to full run. Normally, when an 8080 CPU reads a "halt" instruction, it stops dead in its tracks, and you have to reset the whole works to get going again. Morrow's "halt" just pauses the program and leaves all the registers, memory, etc., alone, so you can continue from that point on. Now the "halt" instruction is a truly useful programming aid. Programs can be run in sections to help isolate the bugs more easily.

In addition to the regular speed of operation, the Morrow CPU panel has four "modes" of operation at stepping speeds. The firmware program lets your program execute just one step, and then it takes over and displays to you what you want to see. You can select the program counter where you look at the memory location and data, any register or pair, any port location, or watch one memory location. You select whether it will execute just one step at a time or automatically step through your program.

Pressing the "M" key will run the CPU normally, and the front panel will be in control for halts but will not display any data. The CPU simply runs too fast for any practical monitoring of data in this manner. Pressing "S" will stop the program, and the front panel program will be completely in command. Pressing "S" while the front panel program is in operation will single step your program.

Pressing the "0" and then "M" keys is the normal mode which examines each memory location as the program is stepped. The six LED digits on the left tell you what memory location you are seeing — the first location is 000,000 (octal), then 000, 001, etc., on up to 377,377, the last location in memory. The right three digits tell you what is in the memory location displayed. In Fig. 1(a), you see that, at location 000,100, there is a 303, which would be executed as a jump instruction. Since this instruction requires two more bytes following for the address, you can press "E" and the next memory location will be displayed (in the example, 000,101 would be displayed) along with the data in that location. Pressing "E" again will display the next location (000,102) and so on. To examine any memory location, enter the location and press "E". To deposit new data at any memory location, first examine the location (enter the location and press "E"), then enter the data (which might be an instruction or a data byte), and press "D". If you press "D" again, the same data will be deposited in the next memory location also. It is not necessary to examine each location before depositing data. Each time you deposit data, the memory location will advance to the next location. Thus a long program can be entered in a reasonable amount of time.

The next mode is the register mode. To enter, press the "1" and then "M" keys. Two digits on the left indicate which of the 8080 registers is displayed. The three or six (depending on whether it is a 16-bit pair or an 8-bit register) digits on the right indicate what is in the

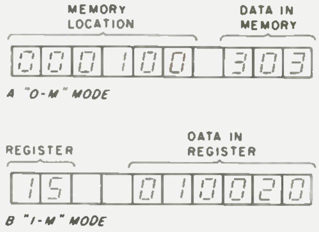
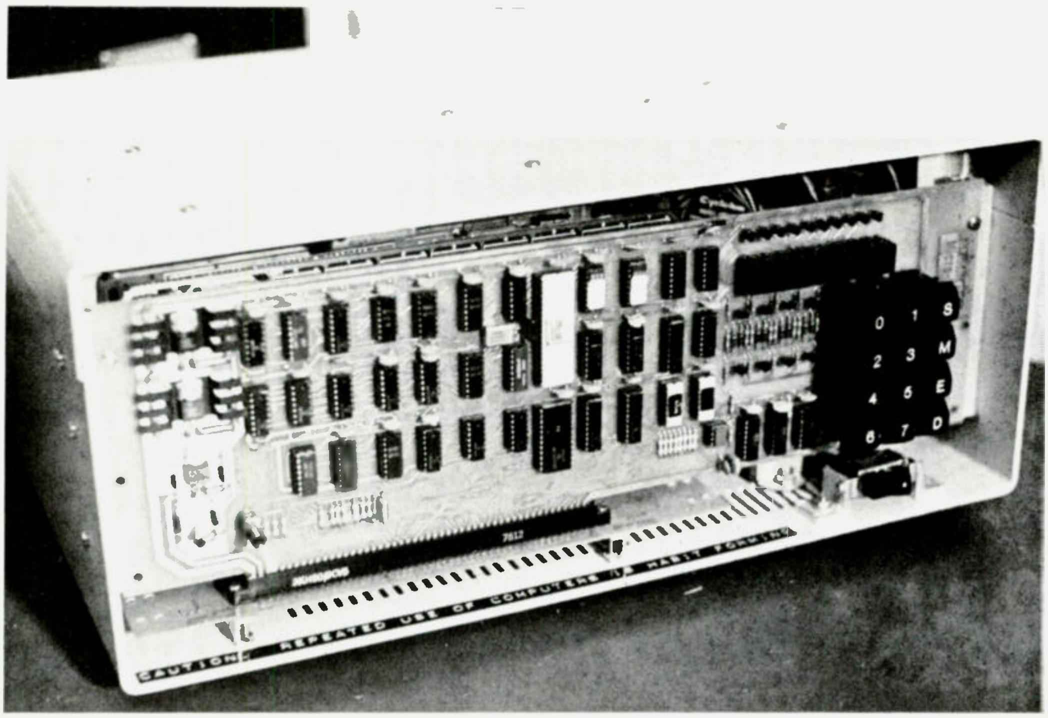


Fig. 1.



register. In Fig. 1(b), you are looking at register 15, the program counter. The next location that will be executed is 010,020. You can examine a register and deposit data just like the memory locations. As you single or slow step through a program, you can watch a selected register or pair change. This is an extremely valuable tool in debugging programs. In most computers, it takes an elaborate "trace" program to perform this function.

Since the accumulator (register A) is a standard register, you can watch the accumulator in the register mode. If you are building an interface to the outside world (such as a keyboard), this function can be useful in determining whether a problem lies in the interface circuit or in your computer program. If you aren't getting data into the accumulator, the interface circuit isn't working. If data is getting into the accumulator register, your program is at fault.

In another mode, the "2-M" mode, input ports may be examined and data may be outputted. During any part of your program, while the program is halted and the front panel is in control, data may be sent to any port, just as if you had written a section of computer program which moves data to an output port. For example, if you have just built a device connected to the computer's output port which turns on relays and you want to test the relay interface circuits, you would enter the port mode and then examine the port your relays are connected to. By depositing data into that port, you could see if the relays are turned on or not. Again, you can isolate any problems to the computer program, the device interface circuit, or the device itself. As another example, say you've built an analog-to-digital converter board which takes analog values (voltages) and converts them to a digital number. By examining the A/D input port, you can determine if the board is working. By slow stepping a program which inputs the ports, you can watch the values change.

The final mode is the "3-M" mode, which watches a particular memory location. The display looks the same as the "0-M" mode, where the left six digits represent the memory location and the right three represent the data. As the program is stepped through, the memory location will not change in the "3-M" mode, but, if different data is put into the memory location, it will be displayed.

Miscellaneous

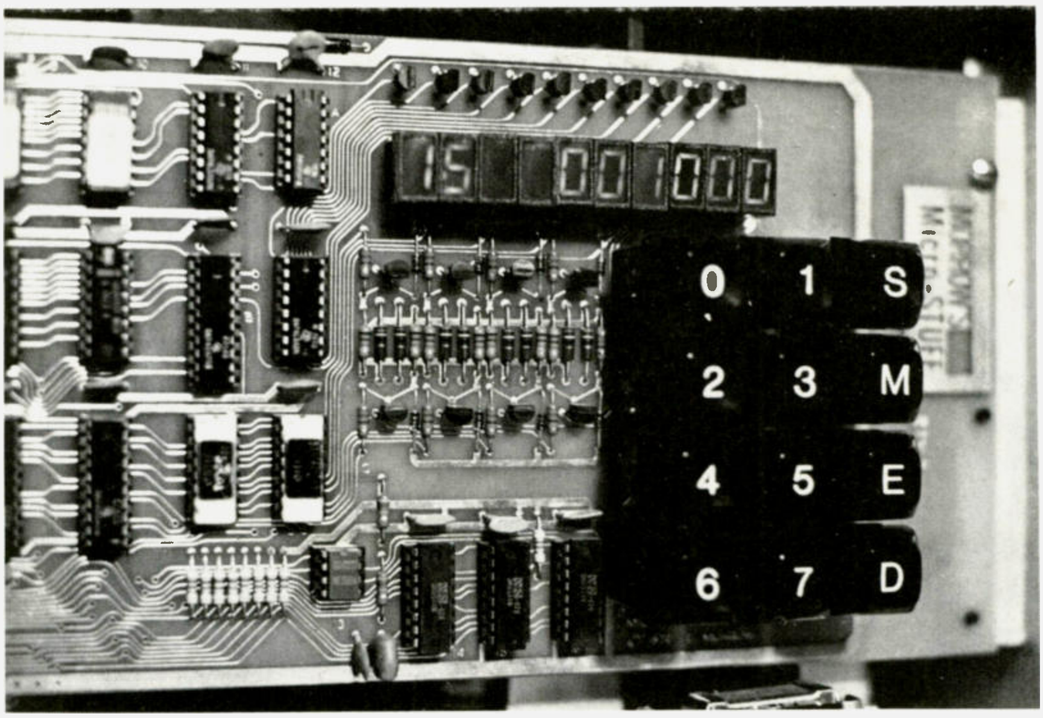
By now, you may have noticed that the Morrow front panel/CPU bears a resemblance to the "trainers" which use similar LED schemes and to the new Heath 8080 computer machine. It should be noted that the Morrow board is the only one with a selectable slow-step rate and with the "controlled halt" which does not require a CPU reset and lose all of the program information. The stepping rate of the slow step is determined by entering a value and then pressing "S". Entering "1" and then "S" runs the program very fast – it's good for clearing memory areas quickly – and entering "100" and then "S" will execute your program at about one step per second.

An additional plus for the Morrow board is the S-100 bus. There's complete compatibility with the dozens and dozens of other computer boards on the market. The system is totally upward compatible, meaning that, as you begin to squander more and more money on computers, you can use all that you have purchased so far. You might think that 18 slots in the Equinox computer are a lot, but just wait . . .

It doesn't take long to realize that there's more to a computer than just getting the CPU board and power supply. You need memory and interface boards if you want to communicate with the machine via a keyboard and look at the results on a TV screen. That translates into money. Fortunately, the Morrow board allows you to use all ten LED readouts and eleven of the keys as input/output ports. When the firmware program is not using them, i.e., when the "M" key is pressed and the CPU is going full blast, you can display any segments of the readouts and input information from the keys. The "S" key is not usable, however, since pressing it anytime stops your programming. You cannot use the readouts or keys during any slow-step mode, since they are dedicated to the firmware program at this time. Still, the keys and readouts do provide at least something. You can devise a frequency counter and use the readouts for frequency display, write a clock program which keeps time (none of this $9.95 stuff), or put input data into the readouts to give you a visual indicator that data is being received.

The LED displays are simply memory locations beginning at 377,000. The eight data lines drive each segment of an LED. By depositing a 117 octal, the segments forming a "3" will turn on. With help from Morrow's instructions, you can easily make the readouts count. Remember that, when the front panel program takes over, all the information in the LEDs is lost, so the information needs to be stored at another location.

The keypad is I/O ports 376 and 377. As a key is pressed, a latch is set so that you can input any data combinations from the keys. It's a



little bit cumbersome but still better than toggle switches.

In Conclusion

Now that you've looked at some of the features of the Morrow CPU board, I will briefly describe several applications for which this computer is ideally suited. The first, and most obvious, is the educational value of seeing what is going on inside a computer as the program is running. Students can easily enter machine language programs (in octal) and then run and debug the programs. As the student becomes more and more proficient, additional boards — memory, analog/digital, interface, etc. — can be plugged in to make the system more sophisticated. I have found that, within the educational realm, the Morrow board is uniquely suited for students to learn computer control applications, beginning with simple programs for simple control applications and progressing into more and more complicated programs. Since data can be read from the LED displays and program parameters changed through the front panel keys, external displays such as CRTs need not be used. This is particularly nice if the computer is going to be used in a laboratory situation, such as machine control, where heat or vibration might cause a TV screen some problems.

George Morrow, in his design of this CPU/front panel board, has pretty well covered all bases — a simple-to-operate board for beginners, a sophisticated supervisory-control firmware program for programming and debugging, and complete compatibility with the currently popular S-100 bus structure. Parasitic Engineering, with the rugged power supply and cabinet to house the Morrow board, provides the complementary components for the base for any degree of sophistication. ■

Enjoy All Bands With A Remote Tuner

—motorized marvel

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Anchorage AK 99502

This article describes an "L" network tuner for matching the nominal 50-Ohm impedance of the modern transmitter to a random-length longwire antenna, primarily for 80 and 40, but also useful for all the bands. The unusual feature of this tuner is that it is mounted up on the tower and is fed with coax and a control cable. The advantage of this system is that high-impedance rf is kept where it belongs — up in the air and out of the shack! Open wire feeders seem to be a thing of the past, and bringing one end of a longwire into the shack to one of the modern day matchbox-type couplers is one way to skin the cat, but not without bringing the radiating element — one end of the antenna — into areas conducive to TVI, RFI, etc. The coupler I will describe has been in use since 1972 (first in Kansas as WØOC and then for two winters here in Alaska). It has survived below-zero weather, intense rain, and very high winds.

A remote control panel at the operating position permits separate adjustments of the rotary inductor and the large transmitting capacitor. My control also allows me to read the relative position of the L and the C so that a chart may be drawn with arbitrary meter settings (0-100) for each band in increments (25 kHz) for presetting the tuner. The control works in conjunction with an external directional wattmeter. Simply adjust the L and C for minimum reflected power and retune in the forward position for each setting. Having once made the chart, it is unnecessary to use the wattmeter each time. So you could borrow a wattmeter to calibrate your tuner once and then use the chart. There is some minimal seasonal change in the setting, but this is not important. One may adjust for a zero reflected power setting for any frequency with an antenna of any reasonable length, horizontal, vertical, or a combination. I'd guess anything much over 50 feet would do. My present antenna is about 300 feet long and works fine. The one in Kansas was almost 500 feet long.

Naturally, a good ground is required; the better the ground, the better the tuner works. I buried a few long ground rods in the base of the tower before the concrete was poured. Since the unit bolts to the tower, a good ground will be had if your tower is well grounded. You might consider cutting some radials into your lawn with a flat-bladed ice chopper. The slits will self-seal in a short time.

Circuit Description

The inductor is a Johnson 229-203 28 uH rotary inductor of some 30 turns. The capacitor is a Johnson 154-10, 347 pF, 3 kV unit. Both of these items are available from Whitehouse, as are couplers (Millen 39002), miscellaneous porcelain standoffs, panel bushings, and feedthrough insulators. Motors, microswitches, relays, and the components for the control panel are best obtained from Allied Electronics. I had most of the "stuff" in my junk box. Some of it, like the Bodine gear head motors and 4PDT pushbuttons, is either no longer available or is now outrageously expensive. But a turn through the Whitehouse and Allied catalogs shows that just about everything can still be obtained new and at a total price of about $150 plus the cost of a waterproof metal box to house the unit. Using the L and C described, you can safely run 2 kW PEP.

The L and C occupy a compartment within the enclosure. Nothing else is in this compartment, to minimize coupling rf into the control circuitry, where it would certainly find its way back into the shack. A second compartment houses the motors, relays, limit switches, and tracking pots. Finally, there is a panel with a barrier strip for the control cable and a bulkhead connector for the RG-8/U. The enclosure has two flat strips of metal, each drilled for 2 U-bolts to hold everything on the tower at

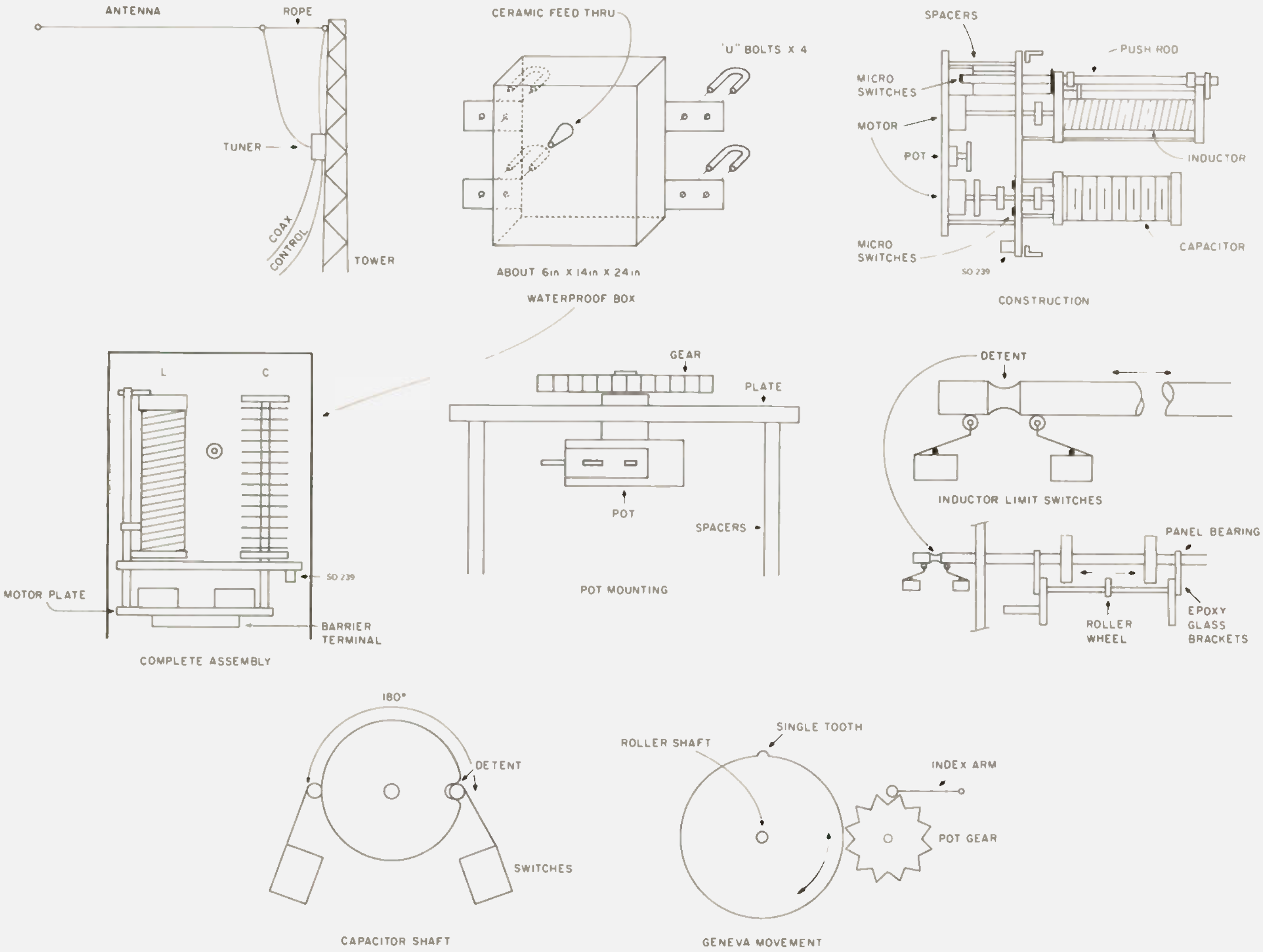

Fig. 1.

whatever level you wish. Mine is about 45 feet up, which gives the antenna an inverted "L" shape from the top of the tower down to the feed-through, which extends out of the rf compartment. Incidentally, I use the double-pulley method to support the longwire. I have a pulley at the top of the tower and a continuous loop of 3/8" plastic line through this and the base of the tower. This line in turn raises a second pulley to the top, where a second line goes out to the antenna wire. In this manner, if the antenna wire breaks, I simply lower the whole mess and start over without climbing the tower.

Each motor is a reversible 120 V ac motor (Hurst, about $20 each). One with an output of 30 rpm is ideal for the inductor, and one with a 4 rpm output is ideal for the capacitor. Limit switches (small microswitches with rollers on arms) sense the end of the roller (each way) or the max./min. of the capacitor's rotation. Thus, when the inductor reaches near maximum inductance, the motor is automatically disconnected, and the operator must reverse the control signal to effect movement in the opposite direction. The remote console readout is accomplished by a 1 mil meter, a dc supply, and 5k wirewound pots which track each motor. Obviously, a simple gear or pulley and belt system may be used for the capacitor and its pot which only turn ½ revolution (min. to max. capacity). You could even use different diameter gears (I did) so that the ½ revolution of the capacitor turns the pot 3/4 turn to give a nice movement to the 1 mil meter in the control unit. The belt drive is second best, for belts slip and harden in very cold weather. Of course, not everyone has gears from old Command sets or bombsights, but they are still available through Boston Gear. All shafting is ¼ inch.

To get back to the 30-turn roller inductor, how do you track the pot for this? Simple — use a Geneva movement, a gear with one tooth on the motor shaft which meshes with a normal gear on the pot. With each turn of the roller, the pot moves one tooth's equivalent rotation. At the control panel you see the meter move, pause, move, etc. Since there is nothing to keep this pot from "free wheeling" when the single tooth is not engaged, simply add an index tension arm of slight springiness, with a roller or vee bent into it, to fall in place each time the pot moves one tooth either way. It works.

Next, how do you know when the roller is at either of its limits? To keep the control circuitry out of the rf compartment, use a ¼" push-rod, made of laminated fiber, held in place with ¼" panel bushings at each end of the coil with two epoxy glass blocks positioned along the rod with setscrews. As the roller contact wheel gets to its limit, it moves the rod in and out through a panel bearing. Outside the rf compartment, mount the roller limit switches perpendicular to the panel on a bracket, and spring load the rod centered between switches. Now when the pushrod moves either way at limit, the respective switch sees a dent in the rod and actuates. Drill the mounting holes for the switches a bit

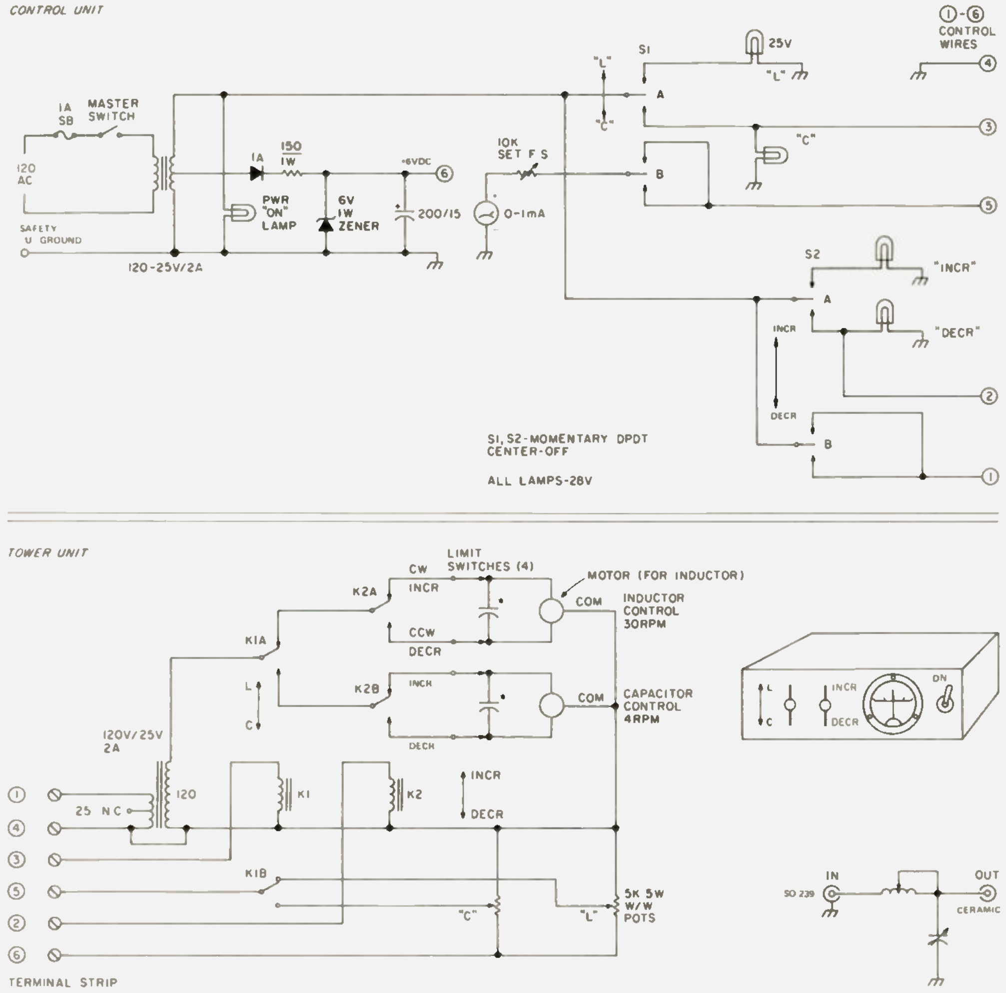

*Fig. 2. K1 = L or C; K2 = Incr. or Decr. *Motor-reversing capacitors (furnished with motors).*

large and you can correctly set the limit switches the first time. Remember to use a strong fiber rod — Plexiglas™ may snap after a while. The limit switches for the capacitor are easier to activate. A simple wheel around the capacitor shaft with one detent actuates the switches at each limit.

Note in the schematic that two 25-volt, 2-Amp transformers are used back to back. The reason for this is simply to keep the control voltage down to the 25 V and eliminate the hazard of having the 120 V on the tower. The low voltage is also used to control two relays in the tower unit. These relays, in turn, reduce the number of wires in the cable and permit a single transformer (step-up) to be used in the remote unit. Half of the low voltage is used in a half-wave dc supply (zener regulated to 6 V) which operates the meter circuit. Two momentary lever switches (center off) and as many pilot lights as you fancy complete the control unit. One lever switch is labeled "L" and "C", the other "INC" and "DEC." Operating just the first switch gives you either meter reading, while using both switches changes the particular element setting. There is a master on-off switch which you can eliminate if you can find lever switches or push-buttons with enough sections so that one section on each can be dedicated to this master switch function. There is a single pot in the meter circuit which adjusts the meter swing to full scale. Note that one section of the L/C relay selects the proper remote pot.

Construction

The rotary coil and capacitor are mounted on ceramic standoffs on a 1/8" aluminum plate about 6" x 14". Panel bushings (¼) and insulated couplings (Millen) are used. An SO-239 is mounted at one end of the panel. All internal rf connections are made with 3/8" wide copper strips, including the lead to the output feedthrough. The inside portion of this insulator is assembled and pulled through the outside wall of the watertight box with a fishwire at final assembly. The outer cone of the insulator and its hardware are then installed.

To the first plate is affixed a second plate of 1/8" aluminum, the same width but only 11" long, to permit access to the SO-239. This second plate is affixed with bolts and spacers cut from 3/8" copper tubing about 3" long. To this second plate are mounted the motors, pots, relays, etc. The limit switches for the capacitor are placed on the outside of the first plate. As described before, the pushrod and microswitches for the inductor are mounted on a bracket. The barrier strip for the control cable goes on the outside of the second plate. Scraps of angle bracket are affixed to both plates, with holes for self-tapping screws. Now everything is slid into the watertight box, held in with self-tapping screws which have some RTV or other goop smeared over their heads, and the unit is ready to install. It ends up with the L and C pointing up and the barrier strip on the bottom, recessed some 4" up into the box. The bottom of the box facing the ground is open. My box is made of 18-gauge galvanized sheet metal, fastened with screws and sweat-soldered with a torch and acid core solder. It was then neutralized with baking soda and water, dried, and primed with spray zinc chromate. It's been up a few years and, probably, I should climb up with a tube of RTV and a can of primer . . . next year.

Construction of the control unit is left up to you. You would probably use a small cabinet and panel to match your rig and a meter, switches, lamps, etc., to suit your taste.

That's it. I think a guy can scrounge quite a bit from friendly junk box owners. Radio Shack has some of the goodies you'll need for the control. Quite a few World War II rigs used rotary inductors, and there are a million TX caps floating around, but I'd recommend going the Whitehouse route (and Allied), if you can afford it.

There's no reason why a guy couldn't hide this up in the attic, get onto a metal vent pipe for a ground, and simply hang up as much wire as he could. This tuner would get him on the air with a respectable signal. ■

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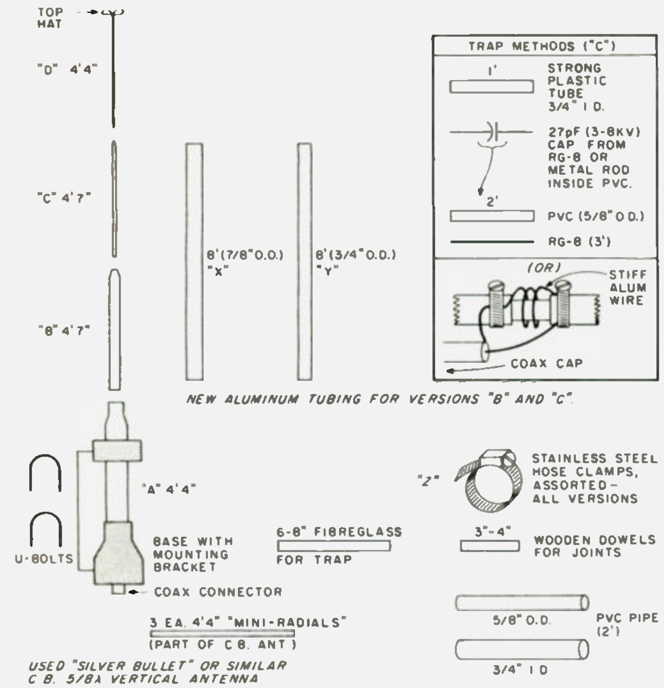

Fig. 1. As can be seen, a minimum of extra hardware (only a few hose clamps in two cases) is required, and yet a number of quite useful commercial-quality antennas can be constructed. The hose clamps must be stainless steel. Also, avoid over-tightening unless wooden dowels are inserted into the smaller tube of a joint. The original joints are not as good as they could be, which is why you need the clamps and dowels.

Karl Schulte WA2KBZ/JY9KS
223 Firestone Drive
Hoffman Estates IL 60195

Have you ever wanted a cheap but effective commercial-quality antenna? Do you live in an area without any handy trees to hold up a wire? Perhaps you're a converted CBer and are wondering what to do with that "good buddy" antenna up on the roof. Even the lucky op with forty acres and rhombics for each compass direction may find this set of antennas both useful and interesting.

In order to convert a CB antenna, you first have to find one. I have seen various suitable types for sale through local classified ads and from disgruntled CBers. I purchased my antenna from the local Montgomery Ward for only $16.00, as it had one small (and useless) piece missing. It was either a Hy-Gain "Silver Bullet" or a very similar ½ λ model. Almost any of the many models and makes in use are suitable for these modifications or adaptations of them.

Four variations are shown in the sketches in Figs. 1 through 7, together with several suggestions for possible mounting and grounding methods for the average home lot. Two of the antennas, variants A and B (Figs. 2 and 3), need no additional parts except for the recommended stainless steel hose clamps. These are required in order to provide stronger joints than those used in the original. The other two versions require only two standard sections of aluminum tubing from your local hardware store, plus a couple of short pieces of coax, PVC tubing, and some wire.

Here are instructions for each type, variants A through D, with a summary of the features of each, together with sketches and construction notes. There are two methods shown for constructing the trap for the 10-40 meter antenna. Although I have not tried it, the one using a dowel on the inside, PVC pipe outside, and the coaxial capacitor is not the

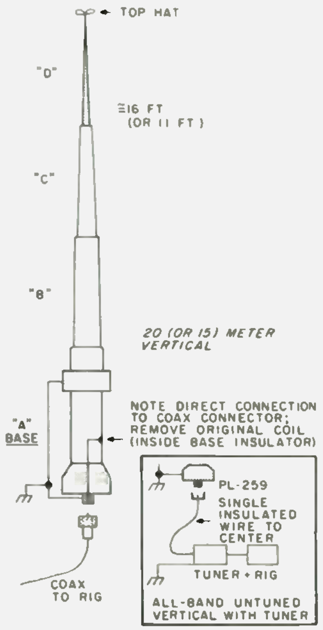

Fig. 2. Variant A — 20 meter (or 15m) ¼ λ vertical.

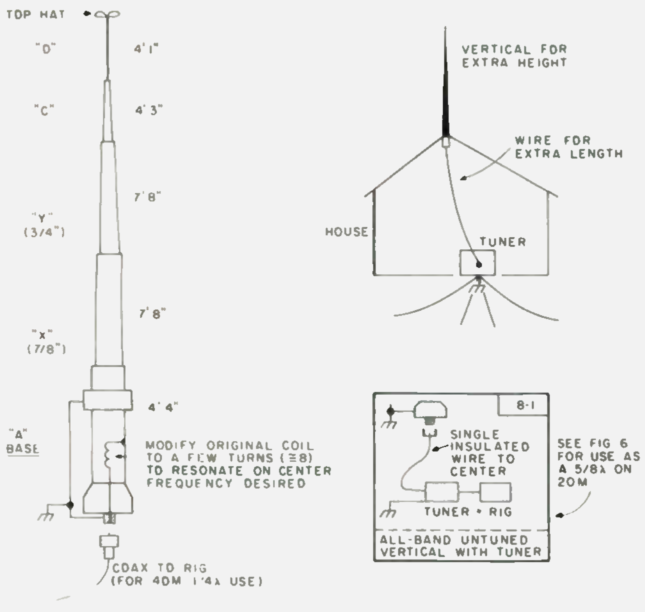

Fig. 3. Variant B — 40 meter (or tuned) vertical.

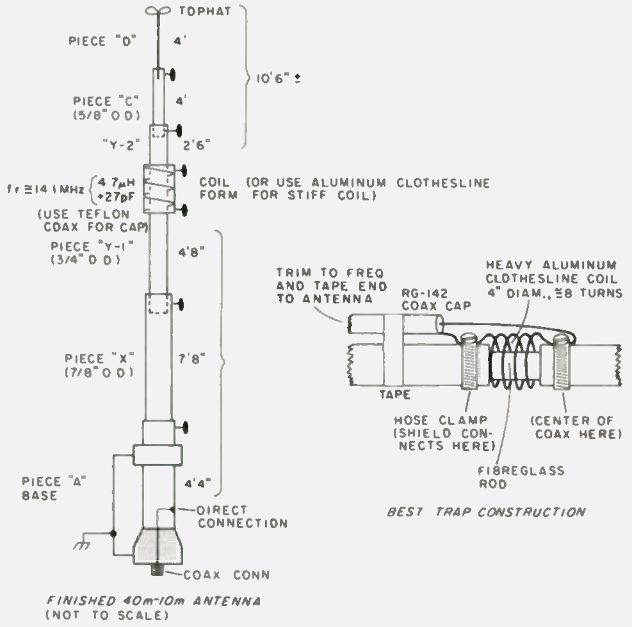

Fig. 4. Variant C — 10 to 40 meter trap vertical.

stronger of the two. I just happened to have a heavy fiberglass rod the right size to construct a trap by the other method. Each model has been tried and works quite well.

So pick the one that you like best, and remember that these ideas can apply to a complete homemade model, too, although without as easy a base mount. Finally, don't forget the ground rod and radials for good performance.

Variant A

This is a 20 meter (or 15 meter) quarter-wave vertical antenna. (See Fig. 2.) By sliding the tubing together and clamping it, you can shorten the antenna to 11 feet or to 16 feet (±). Replace the base coil inside the insulator with a direct connection. Modify the tubing to utilize the slot-and-clamp method for greater strength. No extra materials are required except clamps. The original radials are not used, but heavy wire (#12-14) quarter-wave ± 5% insulated radials are a must, together with a good ground at the base. The support pipe, if used, can be 8' or more to provide a fair ground, but it should be supplemented with several small rods wired together. See the ground and radial suggestions in Fig. 6.

Variant B

This is a 40 meter (or tuned) vertical antenna. (See Fig. 3.) The useful height is 28' with the top hat capacitive loading; only a few turns of #12 insulated wire in the base insulator (where the original coil was) will resonate at 7.1 MHz. The entire band will be covered. Use a good ground plus radial wires for best efficiency. This will also work on a portion of the 15m band as a three-quarter wave vertical. Note that if you only want to use a vertical radiator with a tuner, make a connection with a single insulated wire to the center of a PL-259. Using a

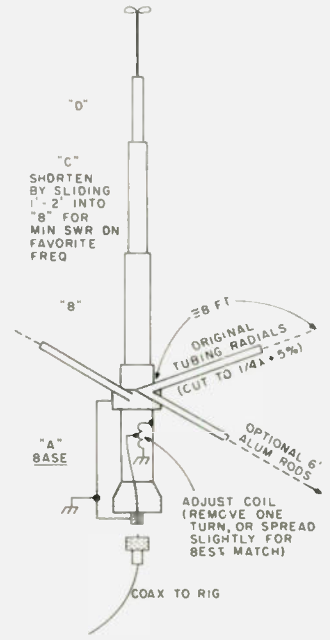

Fig. 5. Variant D — 10 meter ½ λ vertical.

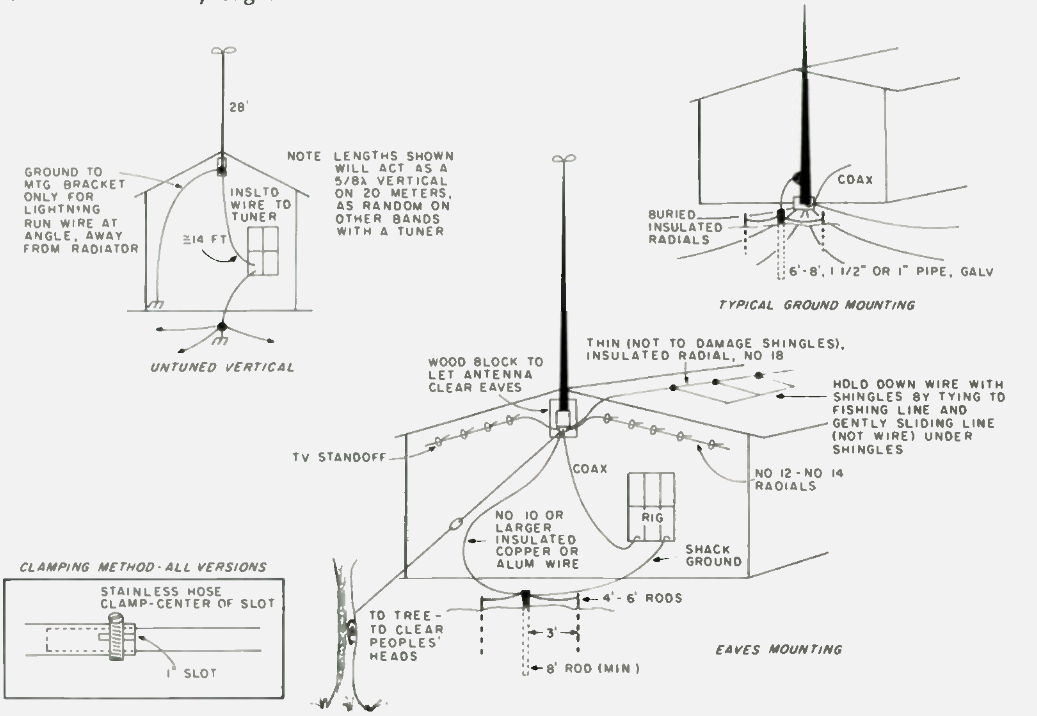

Fig. 6. Installation suggestions.

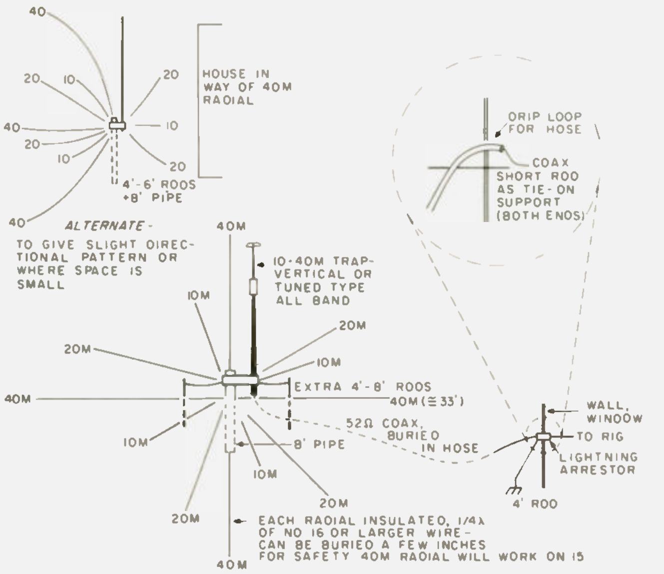

Fig. 7. Variant C — suggested radial pattern. This will provide efficient operation on each band. A small amount of directivity at low angles will be obtained by the pattern in the upper-left corner.

roof (or eaves) mounting, run wire (through a feedthrough insulator) to the tuner (with a ground system). The extra length will be more efficient on 80 or 160m, and the vertical will allow some extra height over the usual suburban long wire.

Variant C

This is a 10 to 40 meter trap vertical antenna. (See Fig. 4.) Use the original base and the top two sections (C and D). Add the two new 8' tubes (X and Y). Cut off Y at 2' 9" from one end. The trap will be inserted between the two parts of Y. For instructions for making the trap, see Fig. 4. The original radials may be used, if you wish, but they will have little effect on bands below 10 meters. Even on 10, they are not long enough. See variant D for an idea for lengthening them for 10m.

This antenna will work on all bands from 10 through 40 meters but with a little less bandwidth than the other version. Since the trap requires only a small inductance, the bandwidth reduction is not large. My model works over 350 kHz on 40, all of 20, all the CW end of 15, and 1 MHz of 10 with an swr between 1.3 and 2. Only enough "L" is needed to resonate the coil at 14.0 MHz. The values shown are what my unit needed. Fine tune the lengths. Note that 40, 20, and 10 meter operation is easiest, but a little extra fudging with L/C will bring in 15m, too. Use a grip-dip meter with a small loop of wire at the base of the antenna to guide in adjustments.

Variant D

This is a 10 meter half-wave vertical antenna. (See Fig. 5.) By slightly shortening the original 11 meter antenna and tweaking the base matching coil, this version results. The original tubing radials are retained. Most of 10 meters will be covered, with 2 to 3 dB gain. This is the easiest conversion of all.

A helpful suggestion: The radials, as supplied, are not quarter wave and serve mainly to decouple the coax shield. By inserting and adjusting aluminum rods, true quarter-wave radials can be had. This will improve the efficiency and lower the radiation angle. A ground rod is still desirable for safety and to reduce loss. ■

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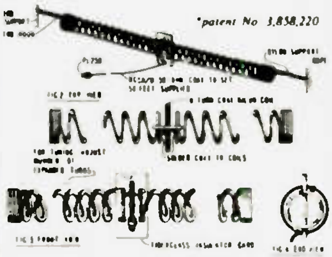

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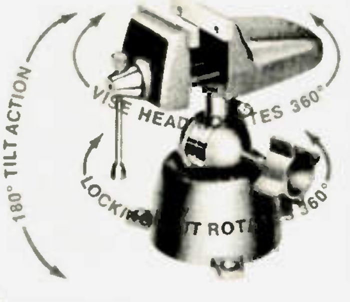

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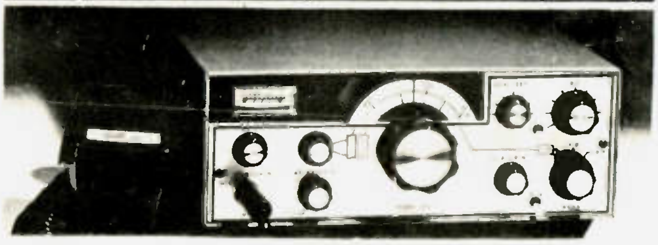

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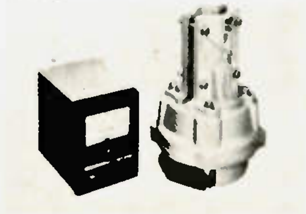

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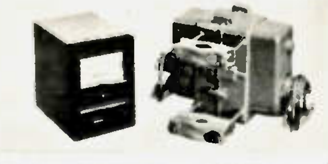

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- New L.E.D. Control Box
- Safe 26 Volt Operation

Designed for the newest of the king-size communications antennas, the TAIL TWISTER™ is the ultimate in antenna rotational devices. The TAIL TWISTER™ starts with a deluxe control box featuring snap action controls for brake and directional controls; L.E.D. indicators signal rotation and brake operation, while the illuminated meter provides direction readout. This new control box couples to the newest bell rotor. Using the time tested bell rotor principle, the TAIL TWISTER™ is a brand new design with thickwall castings and six bolt assembly. A brand new motor with prebrake action brings the antenna system to an easy stop, while the massive square front brake wedge locks the assembly in place. A new stainless steel spur gear system provides final drive into a new steel ring gear for total reliability. Triple race, 138 ball bearing assembly carries dead weight and maintains horizontal stability.

An optional heavy duty lower mast adaptor is available for lighter loads with mast mounting. Price: $259.00

The HAM III sets new levels of performance. Snap action switched wedge brake and rotational controls brings pinpoint accuracy to large directional arrays popular in communications. A new motor provides pre-brake action to assist in slowing down rotational mass, and the new thicker wedge brake offers far stronger lock-in phase action. To take full advantage of this new design, the HAM III is designed for in-tower mounting. A new optional heavy duty lower mast adaptor is available when the HAM III is to be mast mounted with smaller arrays. A stainless steel spur gear system multiplies the torque into the dual race 98 ball bearing support assembly assuring years of trouble free performance. Price: $139.00.

TELEX PROFESSIONAL HEADPHONES & HEADSETS

BOOM MIC HEADSETS

For the ultimate in communications convenience and efficiency select a boom mic headset. Long time favorites of professional communications, boom mic headsets allow more personal mobility while always keeping the mic properly positioned for fast precise voice transmission. Boom microphones are completely adjustable to allow perfect positioning. And boom mic headsets leave both hands free to perform other tasks.

All models are supplied with "close talking" microphones to limit ambient noise pick up and provide superior intelligibility. Each model has a convenient inline push to talk switch which can be wired for either push to talk relay control or mic circuit interrupt for voice operated transmitters. The switch may be used as a momentary push button or it can be locked in the down position. All models have tough, flexible, 8 foot cords which are stripped and tinned unterminated. Communication grey with black trim.

MODEL	C 610	SWL 610	C 1210	C 1320	CM 610	CM 1210	CM 1320	CM 1320S
Headphone Sensitivity Ref .0002 Dynes/cm² @ 1mW input 1kHz	103dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	105dB SPL ±5dB
Headphone Impedance	3.2 20 ohms	2000 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms
Microphone Frequency Response					50 8000 Hz	50 8000 Hz	50 8000 Hz	50 8000 Hz
Microphone Impedance					High	High	High	High
Microphone Sensitivity Below 1 volt microbar at 1kHz					51dB ±5dB	51dB ±5dB	51dB ±5dB	51dB ±5dB
Price	$9.95	$11.65	$28.30	$37.90	$42.80	$56.90	$68.30	$54.50

Model C610 (SWL 610)

Model C 1320

Model CM 610

Model C 1210

Model CM 1210

Model CM 1320

Model CM 1320S

The NEW KENWOOD TS-820S transceiver

TS-820S now has factory installed digital readout ● 160 thru 10 meter coverage ● 200 watts PEP ● Integral IF shift ● Noise blanker ● VOX & PLL circuitry ● DRS dial ● IF out, RTTY, XVTR capabilities ● Phone patch IN and OUT terminals ● RF speech processor. $1098.00.

the indispensable BIRD 43 THRULINE WATTMETER

Power Range	Frequency Bands (MHz) 2-30	25-60	100-250	200-500	400-1000
5 watts	—	5A	5C	5D	5E
10 watts	—	10A	10C	10D	10E
25 watts	—	25A	25C	25D	25E
50 watts	50H	50A	50C	50D	50E
100 watts	100H	100A	100C	100D	100E
250 watts	250H	250A	250C	250D	250E
500 watts	500H	500A	500C	500D	500E
1000 watts	1000H	1000A	1000C	1000D	1000E
2500 watts	2500H				
5000 watts	5000H				

MODEL 43	$120
Elements (Table 1) 2-30 MHz	42
Elements (Table 1) 25-1000 MHz	36
Carrying case for Model 43 & 6 elements	26
Carrying case for 12 elements	16

READ RF WATTS DIRECTLY! (Specify Type N or SO239 connectors) 0.45 — 2300 MHz, 1-10,000 Watts ±5%, low insertion VSWR — 1.05. Unequalled economy and flexibility. Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

Now you can receive the weak signals with the Ameco PT-2 pre-amplifier!

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one. Price: $69.95.

- Improves sensitivity and signal-to-noise ratio.
- Boosts signals up to 26 db.
- For AM or SSB.
- Bypasses itself automatically when the transceiver is transmitting.
- FET amplifier gives superior cross modulation protection.
- Simple to install.
- Advanced solid-state circuitry.
- Improves immunity to transceiver front-end overload by use of its built-in attenuator.
- Provides master power control for station equipment.

AMECO

ALL BAND PREAMPLIFIERS

AMECO

- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp. Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

Model PCLP Uses nuvistor $44.00

KENWOOD PRICE LIST

Model	Description	Price
HF EQUIPMENT 820 PACESETTER SERIES		
TS-820S	TS-820 Deluxe Transceiver with Digital Display (DG-1) installed. 160-10 meters, IF shift	1,098.00
TS-820	Deluxe HF Transceiver 160-10 meters, RF speech processor, IF shift, RF negative feedback	919.00
DG-1	Digital Frequency Display for TS-820	179.00
VFO-820	Deluxe Remote VFO for 820 Series. Includes its own RIT circuit; frequency reads out on transceiver's digital display	149.00
SP-820	Deluxe External Speaker. Includes audio filters for added versatility on receive; 2 audio inputs	49.00
CW-820	500 Hz CW Filter for TS-820	49.00
520 SERIES		
TS-520S	160-10 HF Transceiver. Digital Display (option) speech processor, RF attenuator, super noise blanker	739.00
DG-5	Digital Display for TS-520S. Doubles as a frequency counter, too! Adaptable to TS-520 and 599 series	189.00
VFO-520S	Remote VFO for TS-520S. Built in RIT circuit provides super operating flexibility	135.00
SP-520	Matching External Speaker for TS-520S. 8 Ohms. Frequency response 100-5000 Hz	30.00
CW-520	500 Hz CW Filter for TS-520	49.00
599D Series		
R-599D	160-10 Solod State Amateur Receiver. 2 and 6 meters (optional). SSB, CW, AM, FM Transceives/splits with T-599D	549.00
T-599D	80-10 Meter Amateur Transmitter. Solid State (except driver andfinals). Semi break-in, sidetone, built in power supply	549.00
S-599	External Speaker for 599 Series. 8 Ohms. Frequency response: 100-5000 Hz	25.00
CC-29A	2 Meter Converter for R-599D	35.00
CC-69A	6 Meter Converter for R-599D	35.00
FM-599A	FM Filter for R-599D	45.00
HF MISCELLANEOUS		
R-300	All Band Communications Receiver. 170 kHz to 30 MHz — 6 bands, AC/DC/Batteries; built in speaker	249.00
AT-200	Antenna Tuner. Includes an tenna coupler, SWR meter, power meter, antenna switch, 200W	149.00
TL-922	Deluxe 160-10 Linear Amplifier. 2 KW PEP 2 x 3-500Z tubes, rugged built in power supply	TBA
DK-520	Digital Adaptor Kit (TS-520)	
DS-1A	DC-DC Converter for TS-820/TS-520S Series	65.00
VHF/UHF EQUIPMENT		
TS-600	6 Meter All Mode Transceiver. SSB, CW, FM, AM, 10 watts. Built in AC/DC power supplies	699.00
TS-700S	2 Meter All Mode Transceiver. SSB, CW, FM, AM, semi break-in, CW sidetone. Digital readout, receiver pre-amp	729.00
VFO-700S	External VFO for TS-700S. Frequency displays on TS-700S. Special "frequency check" feature	129.00
SP-70	8 Ohms External Speaker Matches TS-600 and TS-700S. Excellent frequency response	30.00
TR-2200A	2 Meter Portable Transceiver. FM, 12 channels (6 supplied); NI-CAD batteries, charger are included	229.00
TR-7400A	2 Meter Synthesized Transceiver. 25 Watts, 800 channels, 4 MHz, continuous tone-coded squelch (option)	399.00
TR-7500	2 Meter FM Transceiver; digital readout, one knob channel selector system, 10 watts output	299.00
TR-8300	70 CM FM Transceiver. 23 channels (3 supplied). 10 watts, broadband design	299.00
TV-502S	2 Meter Transverter, 8 watts; SSB and CW easily hooks up to 520/820 Series	TBA
TV-506	6 Meter Transverter, 10 watts; SSB and CW, easily hooks up to 520/820 Series	249.00
OTHER ACCESSORIES		
HS-4	KENWOOD Headphone set (8 Ohms)	16.00
MB-1A	Mobile bracket for TR-2200 A	13.00
MC-50	Dynamic Microphone for all KENWOOD stations (Hi/Lo Z)	39.50
PS-5	AC Power Supply; 12 VDC @ 3.5 Amps, matches TR-8300; built-in digital clock with timer	79.00
PS-6	AC Power Supply; 12 VDC @ 3.5 Amps; matches TR-7500; 8 Ohm speaker included	79.00
PS-8	AC Power Supply; 12 VDC @ 8 Amps; matches TR-7400A; well regulated; current limiting	129.00
VOX-3	VOX Unit for TS-700A and TS-600	25.00

ICOM

MODEL			
IC-22S	299.00	IC-245	499.00
IC-30A	399.00	IC-245/SSB	599.00
IC-202	259.00	IC-502	249.00
IC-20L	98.00	IC-50L	98.00
IC-211	749.00	IC-701 AC	1,499.00
IC-215	229.00	IC-701 DC	PRICE
IC-215/BC-20	249.00	IC-3PS	99.00
		IC-3PE	99.00

MIC-500M	Mobile Mic (specify model)	$18.00
SM-2	Electret Base Mic (for 4 pin mic conn)	34.50
IC-MM	Mobile Mount (specify model)	13.95
IC-DCC (22S)	DC Power cord (245,22S,211) w/fuse	3.00
IC-DCC (std)	Power cord (specify model AC or DC)	2.00
IC-PC	Power connector (specify model)	.50
RRD	Reverse dial (22A, 30A, 22S)	2.00
9PP	9 Pin Plug	2.00
BC-20	900 mAh Batteries & Charger for 202, 215, 502	49.95
24PP	24 Pin Plug	3.00
24PP set	24 Pin Set w/Bracket (22S)	6.00

IC-211
4 MEG, Multi-mode
2 Meter Transceiver

ALL MODE

• 144-145 MHz operation on SSB and CW as well as 146-147 MHz operation on FM is possible with the IC-211. Try 144 MHz DX or just local rag chew with friends. Work the Amsat Oscar six or seven using the IC-211 for either the receiver or transmitter.

TUNING SYSTEM

• A large weighted flywheel knob mounted with low friction ball bearings is used to drive an optical chopper to provide pulses to the ICOM LSI synthesizer. A breaking mechanism, which operates inertially, changes to provide a smooth feel at slow speeds similar to the old PTO type units.

FULL FUNCTIONS BUILT IN

pulse type noise blanker
VOX with adjusting VOX gain, antivox
semi-break-in C. W. Operation
Built in SWR bridge
CW monitor
automatic power control
AC or DC operation

• The synthesizer designed by ICOM and implemented in the proprietary LSI chip operates in 100 Hz steps from 144 to 146 MHz and in 5 KHz steps from 146 to 148 MHz for FM operation.

• The IC-211 contains both the 117VAC and the 13.6VDC power supplies.

IC-502
6Meter SSB & CW Portable

• Get in on the fun of working 6 meters with this great portable radio. Operate QRP on 6 SSB or CW with this self contained transceiver, including antenna and battery pack. (Nicads and charger are now available.) Grab it and take it with you wherever you go . . . hill top, lakeside or car. The aluminum diecast frame provides a rugged radio for travel. Three watts PEP and the stable VFO make for fun and FB QSO's. There is even an RIT for the receiver, as well as a true I.F. noise blanker that really works on six meters!

• The VFO used in the IC-502 covers the first 800 KHz of the 6 meter band where most of the activity is. The excellent stability of the VFO and the smooth tuning dial make operating the IC-502 even in cold mountain top climates a pleasure worth the effort of getting there. The three watt PEP signal really gets through when the band is open and provides sufficient drive for an AB1 type linear amplifier.

IC-245
146 MHz FM 10 W Transceiver

• The ICOM developed LSI synthesizer with 4 digit LED readout in the IC-245 offers the most for mobile. In FM, the synthesizer command frequency is displayed in 5 KHz steps from 146 to 148 MHz, and with the sideband adapter the step rate drops to 100 Hz, from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programable on any separation. The IC-245 even comes equipped with a multiple pin Molex connector for remote control.

• Optional equipment for the IC-245 includes a single sideband adapter which attaches as an integral part of the transceiver. With this easy to make conversion, your IC-245 operates in both FM and SSB/CW modes.

IC-215
2 Meter FM portable

• An extremely rugged, high quality, radio with 15 channel capacity.

• The 'C' size cells may be replaced with rechargeable cells of the same size and very simple modification made to provide FULL CHARGE from either the auto electrical system or the IC-3PS power supply while the IC-215 is in operation. This feature is possible due to the BC-20 battery pack and charger.

IC-22S
146 MHz FM 10 W Transceiver

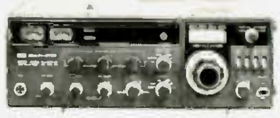
• The frequency synthesizer can be preset to any 15 KHz channel between 146 and 148 MHz by the diode matrix board. This frequency may be offset by 600 KHz higher than the program frequency. To provide a low cost unit without sacrificing quality, we have eliminated the readout and switching in favor of a customer programmed diode matrix using eight diodes to represent the frequency. A digital adder then provides the offset for the unit by adding 600 KHz to the frequency set by the diode matrix. Once the channel is set by the matrix, the channel number is set in the window to operate the unit.

IC-202
2 Meter SSB Portable

• A full 3 watts PEP from this compact transceiver is plenty of punch when the band is open. Three watts PEP will also dim most home-brew amps to full output or our optional amplifier to 10 watts.

• This unit also includes a true I.F. noise blanker that really gets the job done on reducing pulse type interference.

• The band switch selects 144.0, 144.2 or two other 200 KHz bands as selected by the user. Your ICOM distributor stocks 145.0-145.2 MHz and 145.8-146.0 MHz for the technician calling frequency and the satellite band.



A brilliant new 2 meter transceiver with every in-demand operating feature and convenience

KLM MULTI 2700 — $756.00

★ Synthesizer and VFO.
★ All modes: NBFM, WBFM, AM, SSB w/USB/LSB and CW.
- Frequency synthesizer (PLL) 3 Knob, 600 channels, 10 kHz steps.
- VXO, plus or minus 7 kHz.

★ LED readout on synthesizer.
- Standard 600 kHz splits plus . . .
- Two "oddball" splits.

★ OSCAR transceive 2 to 10 meter operation
- OSCAR receiver built-in.
- Connectors on rear for separate 2 meter and 10 meter antennas.
- Built-in VFO (continuous coverage, 144-148 MHz in 1.3 MHz segments. 1 kHz readout).
- 8 pole SSB filter plus two FM filters.
- 100 kHz crystal calibrator.
- Voice operated relay (VOX) or p-t-t.

★ Audio speech compression.
- Noise blanker.
- RIT, plus or minus 5 kHz.
- Power out/"S" meter.
- FM center deviation meter.
- 10W minimum output power. NO TUNING!
- Hi-Lo power provision.
- Built-in AC/OC power supply.
- Oouble conversion receiver. 16.9 MHz and 455 kHz I-Fs.
- Receiver sensitivity:
  FM: 0.5μV for 28 dB S/N.
  SSB/CW: 0.25μV for 14 dB S/N.
  AM: 2μV for 10 dB S/N.
- Size: Inches: 5H, 14.88W, 12O. MM: 128H, 378W, 305O.
- Weight: 28 lbs. (13 KG).

Larsen Külrod® Antennas

- Handle full 200 watts ● low-low V.S.W.R.
- Deliver 3 dB gain and more!
- Pick the one that best fits your needs:

MAGNETIC MOUNT
stays put even at 100 mph!

MM-JM-150 for 144 MHz use	Only $38.50 complete
MM-JM-220 for 220 MHz use	
MM-JM-440 for 440 MHz use	

TRUNK LID MOUNT
No holes and low silhouette too!

TLM-JM-150 for 144 MHz use	Only $38.50 complete
TLM-JM-220 for 220 MHz use	
TLM-JM-440 for 440 MHz use	

And 1/4 wave antenna for trunk and magnetic mount — $18.50

ROOF or FENDER MOUNT
Goes on quick and easy in 3/8" or 3/4" with fewest parts.

JM-150-K for 144 MHz use	Only $31.50 complete
JM-220-K for 220 MHz use	
JM-440-K for 440 MHz use	

And 1/4 wave antenna for roof and fender mounts $11.50

Above antennas all complete with mounting hardware, coax, connector plug, allen wrench and complete instructions.

MOR-GAIN

FULLY AIR TESTED — THOUSANDS ALREADY IN USE

#16 40% Copper Weld wire annealed to it handles like soft Copper wire — Rated for better than full legal power AM/CW or SSB-Coaxial or Balanced 50 to 75 ohm feedline — VSWR under 1.5 to 1 at most heights — Stainless Steel hardware — Drop Proof Insulators — Terrific Performance — No coils or traps to break down or change under weather conditions — Completely Assembled ready to put up — Guaranteed 1 year — ONE DESIGN DOES IT ALL.

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/ 73	36/10 9
40-10 HD	40/20/15/10	59.50	36/1 01	36/10.9
80-40 HD	80/40 + 15	57 50	41/1 15	69/21 0
75-40 HD	75/40	55 00	40/1 12	66/20 1
75-40 HD (SP)	75/40	57.50	40/1 12	66/20 1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66 50	44/1 23	66/20.1
75 10 HD	75/40/20/15/10	74 50	48/1 34	66/20 1
75-10 HD (SP)	75/40/20/15/10	74 50	48/1.34	66/20.1
80-10 HD	80/40/20/15/10	76 50	50/1 40	69/21 0

NO TRAPS — NO COILS — NO STUBS — NO CAPACITORS

MOR-GAIN HD DIPOLES . . . ● One half the length of conventional half-wave dipoles. ● Multi-band, Multi-frequency. ● Maximum efficiency — no traps, loading coils, or stubs. ● Fully assembled and pre-tuned — no measuring, no cutting. ● All weather rated — 1 KW AM, 2.5 KW CW or PEP SSB. ● Proven performance — more than 15,000 have been delivered. ● Permit use of the full capabilities of today's 5-band xcvrs. ● One feedline for operation on all bands. ● Lowest cost/benefit antenna on the market today. ● Fast QSY — no feedline switching. ● Highest performance for the Novice as well as the Extra-Class Op.

EXCLUSIVE 66 FOOT, 75 THRU 10 METER DIPOLES

■ All models above are furnished with crimp/solder lugs.
■ All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
■ 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3650 kHz. See VSWR curves for other resonance data.

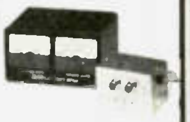
NEW
Jr. Monitor Antenna Tuner

- Continuous tuning 1.8—30 MHz
- Forward reading relative output power meter
- 300 watt power capability
- Built-in encapsulated balun
- Mobile mounting bracket
- Ceramic Rotary Switch 12-position
- Capacitor spacing 1000 volts
- Tapped toroid inductor
- Antenna inputs:
  a. Coax unbalanced SO239
  b. Random wire
  c. Balanced feedline 75—660 Ohm
- 5¼" w. x 2¾" h. x 6" d.
- All metal black wrinkle finish cabinet
- Weight: 2½ pounds

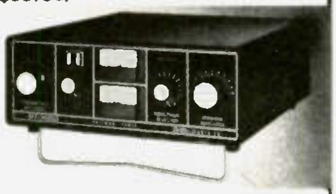
DenTron

AMPLIFIERS
MLA-2500 Amplifier (with Built-in Power Supply) $899.50
MLA-1200 Amplifier 399.50
AC-1200 / AC Power Supply for MLA-1200 . . . . 159.50
DC-1200 / DC Power Supply for MLA-1200 . . . . 199.50
TUNERS
MT-3000A Tuner 349.50
MT-2000A Tuner 199.50
160-10AT Super Tuner . . 129.50
Jr. Monitor Tuner 79.50
ANTENNAS
160M Mobile Antenna "Mobile Top Bander" (160 meters) . 59.50
Center Feed All Band Doublet Antenna 24.50
ACCESSORIES
Big Dummy with coolant . . 29.50
W-2 Wattmeter 99.50
160 XV Transverter "Top Bander" 249.50

Read forward and reflected watts at the same time



READ FORWARD AND REFLECTED WATTS AT THE SAME TIME. Tired of constant switching and guesswork? Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter. $99.50.



The MT-3000A
SPECIFICATIONS:

- Power handling capability in excess of 3 KW PEP
- Front Panel Antenna Switch with 5 Antenna Inputs plus Tuner bypass position
- Built-in 50 Ohm — 250 Watt dummy load
- Dual Wattmeters
- Compact: 5½" x 14" x 14", 18 pounds
- Continuous Tuning 160-10 meters
- 3 Core Heavy-Duty Balun

160 XV MARS Dual Band 279.50
100 ft. 2kw 300 Transmission Line 19.50
100 ft. 470 Ohm Ladder Line 12.00
1 Kilowatt Balun 4:1 Chassis Mt. 27.50
3 Kilowatt Balun 4:1 Chassis Mt. 29.50

THE MLA-2500 SPECIFICATIONS

- 160 thru 10 meters
- 2000+ watts PEP input on SSB
- 1000 watts DC input on CW, RTTY, or SSTV Continuous Duty
- Variable forced air cooling system
- Self-contained continuous duty power supply
- Two EIMAC 8875 external-anode ceramic/metal triodes operating in grounded grid.
- Covers MARS frequencies without modifications
- Harmonic Suppression better than 50 dB
- Built-in ALC
- Built in RF Wattmeter
- 117V or 234 V AC 50-60 Hz
- Third order distortion down at least 30 dB
- Frequency Range: by plug: 1.8 MHz (1.8-2.5) 3.5 MHz (3.4-4.6) 7 MHz (6.0-9.0) 14 MHz (11.0-16.0) 21 MHz (16.0-22.0) 28 MHz (28.0-30.0)
- 40 watts drive for 1 KW DC input
- Rack mounting kit available (standard 19" rack)
- Size: 5¼" H x 14" W x 14" D
- Weight: 47 lbs.

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.

Meet the SuperTuner

MEET THE SUPER TUNER 160-10 AT. The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?
1 KW MODEL $129.50; 3 KW MODEL $229.50.

Model 331A transistor dip meter — Portable RF single generator, signal monitor, or absorption wavemeter. Lightweight (1 pound, 6 ounces with all coils), battery-powered unit is ideal for field use in testing transceivers, tuning antennas, etc. Can also be used to measure capacity, inductance, circuit Q, and other factors. Indispensable for experimenters, it is easily the most versatile instrument in the shop. Continuous coverage from 2 MHz to 230 MHz in seven ranges.

Frequency Coverage	2 MHz to 230 MHz in 7 overlapping ranges by plug in coil assemblies 2 MHz–4 MHz, 4 MHz–8MHz, 8 MHz–16 MHz, 16 MHz–32 MHz, 32 MHz–64 MHz, 50 MHz–110 MHz, 110 MHz–230 MHz
Accuracy	3%
Modulation	1000 Hz, 25% to 40%
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	7" x 2¾" x 2½"
Shipping Weight	1 lb., 6 oz.
Price	$120.00

Model 372 CLIPREAMP. Get maximum legal modulation without danger of splatter.

Input Impedance	100,000 ohms
Input Levels	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9 volt transistor battery, Burgess 2U6 or equivalent
Size	2¾" x 3" x 4½"
Shipping Weight	7 oz.
Connectors	Terminal strip
Price	$27.50

B&W

Model 333 dummy load wattmeter — Favorite Lightweight Portable—250 WATT RATING — Air Cooled. Ideal field service unit for mobile 2-way radio — CB, marine, business band. Best for QRP amateur use, CB, with zero to 5 watts full scale low power range.

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	250 watts intermittent
Wattmeter Ranges	0-5, 0-50, 0-125, 0-250
Connector	SO 239
Size	4" x 7" x 8"
Shipping Weight	2 lbs.
Price	$98.50

High Power — 1000 WATT RATING — Oil Cooled — model 334A dummy load wattmeter. Our most popular combination unit. Handles full amateur power. Meter ranges individually calibrated. Can be panel mounted.

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1000 watts CW intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0-10, 0-100, 0-300, 0-1000
Input Connector	SO 239 (hermetically sealed)
Size	4½" x 9" x 10½"
Shipping Weight	12 lbs.
Price	$174.00

Model 374 dummy load wattmeter — Top of the Line — 1500 WATT RATING — Oil Cooled. Our highest power combination unit. Rated to 1500 watts input (intermittent). Meter ranges are individually calibrated for highest accuracy.

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts DC intermittent. Warning light* signals maximum heat limit
Wattmeter Ranges	0-15, 0-50, 0-300, 0-1500
Input Connector	SO 239 (hermetically sealed)
Size	4½" x 9" x 10½"
Shipping Weight	12 lbs.
Price	$215.00

Wide range attenuator — Model 371-1. Seven rocker switches provide attenuation from 1 dB to 61 dB in 1-dB steps. Switches are marked in dB, 1-2-3-5-10-20-20. Sum of actuated switches (IN position) gives attenuation. With all switches in OUT position, there is NO insertion loss. Attenuator installs in coaxial line using UHF connectors.

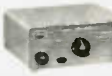
Power Capacity	½ watt
VSWR	1.3:1 maximum, DC to 225 MHz
Impedance	50 ohms
Accuracy	1 dB/dB, DC to 60 MHz
	0.1 dB/dB ±0.5 dB, DC to 160 MHz
	0.1 dB/dB ±1.0 dB, DC to 225 MHz
Size	8½" x 2½" x 2½"
Shipping Weight	1½ lbs.
Price	$49.50

Coaxial antenna changeover relay. Model 377.

Power Rating	1000 watts CW (2000 watts SSB)
VSWR	Less than 1.15:1, DC to 150 MHz
Power Requirements	0.015 Ampere, 45 to 130 volts AC
Connectors	UHF Type SO 239
Dimensions	3½" x 1½"
Shipping Weight:	1 lb.
Price.	$17.95

Model 359. Increase your transmitter's effective speech power up to four times. This two stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters.

Input Impedance	100,000 ohms
Input Level	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2¾" x 3" x 4½"
Shipping Weight	6½ oz
Connectors	Terminal strip
Price	$37.50



Universal hybrid coupler II phone patch. Model 3002W and model 3001W. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in Compreamp speech preamplifier/limiter (in Model 3002W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The Compreamp also functions as a preamplifier/limiter with the station microphone, if desired.)

Model 300 2W with Compreamp $125.00
Model 300 1W without Compreamp $85.00

Inputs from	
Line	600 ohms
Receiver	4 ohms
Microphone	High impedance (50,000 ohms) crystal or dynamic
Tape Recorder	4 ohms
Outputs to	
Transmitter	50,000 ohms
Receiver Speaker	4 ohms
Tape Recorder	0.5 megohm
Size	6½" x 7½" x 3"
Shipping Weight	3½ lbs.
Power	9 volt battery, Burgess 2U6 or equivalent
Connectors	Phono

2-meter mobile AT-200 Antenna Matcher. Use your cars AM/FM antenna for your 2-meter mobile rig. Tunes from the front panel for max. output, min. VSWR (1.2:1 or less for most car antennas). $24.95

$69.95

Two-way-radio headset with superior fidelity Electret-Capacitor boom microphone and palm-held talk switch.

FOR BROADCAST-QUALITY TRANSMISSION AND RECEPTION FOR BOTH MOBILE UNITS AND BASE STATIONS.

- Boom-mounted electret-capacitor microphone delivers studio-quality, undistorted voice reproduction. Variable gain control lets you adjust for optimum modulation.
- Cushioned earcup lets you monitor in privacy – no speaker blare to disturb others. Blocks out environmental noises, too. Made of unbreakable ABS plastic.
- Headband self-adjusts for comfortable wear over long hours. Spring-flex hinge lets you slip headset on and off with just one hand. Reversible for right or left ear.
- Headset can be hung on standard microphone clip.
- Compact palm-held talk switch lets you keep *both* hands on the wheel for safer driving. Made of unbreakable ABS plastic.
- Built-in FET transistor amplifier adapts microphone output to any transceiver impedance.
- Compatible with most two-way radios including 40-channel CB units.
- Built-in Velcro pad for easy mounting of the talk switch.
- Made in U.S.A.

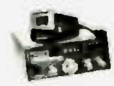
SPECIFICATIONS

Earphone impedance and type:	8 ohms, dynamic
Microphone type:	Electret capacitor
Microphone frequency response:	200-6000 Hz
Amplifier type:	FET transistor, variable gain
Amplifier battery power:	7-volt Mallory TR-175
Switching:	Relay or electronic

IDEAL FOR EVERY TWO-WAY RADIO COMMUNICATIONS NEED . . .

CB operators • Amateur radio operators • Police and fire vehicles • Ambulances and emergency vehicles • Taxis and truckers • Marine pleasure and work boats • Construction and demolition crews • Industrial communications • Security patrols • Airport tower and ground crews • Remote broadcast and TV-camera crews • Foresters and fire-watch units •

MIDLAND



13-513 220 MHz FM Transceiver – 12 vdc. Three position power selector for 20, 10 or 2 watts output. PLL synthesized. 1000 frequencies between 220.00 and 225.00 MHz in 10 KHz steps with a 5 KHz shift-up. 4 offsets, ± 1.6 MHz supplied, 2 optional. $499.95

13-500 2m FM Xcvr. 15W, 12 ch w/16/76, 34/94, 94/94, mic. & mt. $169.95

13-509 220 MHz FM Xcvr. 10W, 12 ch. w/223.50 MHz, mic. & mt. $159.95

The Bencher Ultimate Paddle . . . a dual lever, iambic keyer paddle that will increase your speed, accuracy & operating comfort.

- ADJUSTABLE CONTACT POINT SPACING – Precision screw adjustments on each set of contacts make exact settings easy. Contact posts are split and locked by set screws, eliminating the need for locknuts.
- WIDE RANGE OF TENSION ADJUSTMENT – Tension on finger knobs is maintained by a long expansion spring. Dual screw adjustments adjust spring tension to match your "fist."
- SELF ADJUSTING NEEDLE BEARINGS – Keying shafts pivot in nylon bearings that "float" on machined brass fittings. Spring tension prevents free play and slop; eliminates contact bounce and backlash.
- SOLID SILVER CONTACT POINTS – The contact points are solid silver for a lifetime of flawless keying.
- PRECISION-MACHINED COMPONENTS – Main frame, contact posts, spring post and bearing ring are all machined from solid brass . . . polished and chrome plated for durability and rich appearance. The Bencher Paddle looks as good as it works!
- HEAVY STEEL BASE; NON-SKID FEET – Finished in an attractive black wrinkle finish (chrome plating optional), the base measures 9.5cm x 10.2cm x 1.3cm thick. It weighs 1 kilogram, and with its non-skid rubber feet is as solid as a rock.

Model BY-1 Standard Black Base . . . $39.95. Model BY-2 Polished Chrome Base . . . $49.95.

BENCHER, INC.

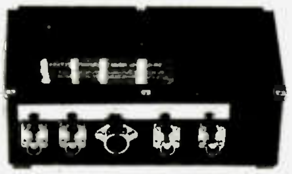
PP-1 PP-2

M series is for mounting to surfaces inaccessible from the rear (walls, mobiles, systems interface, panels, test equipment). K series is self-contained with a relay inside the encoder. When keys are pressed contact closer occurs with a 2 sec. delay (adjustable). Contacts are rated at 110 mA @ 28 volts switched, 500 mA carry. PP-2K contains delay exclusion for the fourth column. However, by jumping D-5, 4th column is restored. Unit is operable from 4.5-60 volts at temperatures from 0°-140° F. Output level will drive any transmitter or system. Adjustabe output level is controlled with an extremely stable multi-turn trimpot, w/access from the front of the encoder (not behind), saving time for level setting, which amounts to hours when involved w/a system.

PP-1 $55 (12 keys); PP-1m $55 (lettering optional add $1), PP-1K $66; PP-2 $58; PP-2m $58 (lettering optional add $1); PP-2K $69, PP-1A $68 (for standard comm hand-held).

Pipo Communications

MICROWAVE MODULES TEXAS RF



MICROWAVE MODULES
HIGH PERFORMANCE UNITS
FOR 144, 432 and 1296 MHz

144 MHZ MOSFET CONVERTER – MMC144/28
With dual protected gate Mosfet RF Amplifier and Mixer stages
Input frequency: 144-146 MHz
I.F. output frequency: 28-30 MHz
Typical gain: 30 dB
Guaranteed maximum noise figure: 2.5 dB
Typical image rejection: 65 dB
Crystal oscillator frequency: 116 MHz (zener controlled)
Maximum frequency error at 144 MHz: 3 KHz
Power requirements: 12 volts DC ±25% at 50 mA
Other I.F. output frequencies available:
12 14, 14-16, 18-20, 24-26 MHz

144 MHZ MOSFET CONVERTER – MMC 144/28 LO
Similar to the MMC144/28, this unit features an additional 116 MHz buffer amplifier to provide a local oscillator signal suitable for transverter use.

144 MHZ DOUBLE CONVERSION MOSFET CONVERTER – MMC144/2 – MMC144/4
This unit has been developed to meet the requirement for a converter suitable for use with receivers having better performance at lower frequencies.
Input frequency 144 146 MHz
I.F. output frequencies available: 2 4, 4 6 MHz
Oscillator frequency: 71 MHz (2-4 MHz IF), 70 MHz (4-6 MHz IF)
Maximum frequency error at 144 MHz: 3 KHz
Typical gain: 30 dB
Guaranteed maximum noise figure: 2.5 dB
Power requirements 12 volts DC ±25% at 30 mA

144 MHZ DUAL OUTPUT MOSFET PREAMPLIFIER – MMA144
This two-stage mosfet preamplifier has two separate isolated outputs, for leading two receivers, for example.
Input frequency 144 146 MHz
Typical gain: 18 dB
Guaranteed maximum noise figure: 2.5 dB
Bandwidth 5 MHz at -3 dB, 8 MHz at 10 dB
Power requirements. 12 volts DC ±25% at 25 mA

432 MHZ MOSFET CONVERTER – MMC432/144
Two RF Amplifiers and a Mosfet Mixer combine high sensitivity and low cross-modulation characteristics.
Input frequency: 432-434 MHz
I.F. output frequencies available 14-16, 18-20, 28-30, 144 146 MHz
Typical gain: 30 dB
Guaranteed maximum noise figure 3.8 dB
Crystal oscillator frequency: 101 MHz (28 30 MHz IF) (zener controlled): 96 MHz (144 146 MHz IF)
Maximum frequency error at 432 MHz 5 KHz
Power requirements: 12 volts DC ±25% at 45 mA

1296 MHZ CONVERTER – MMC 1296/28 – MMC1296/144
A hybrid ring mixer with a matched pair of hot-carrier diodes, driving a dual gate mosfet I.F. amplifier.
Input frequency: 1296 1298 MHz
I.F. output frequencies available. 28-30, 144 146 MHz
Typical gain 25 dB
Guaranteed maximum noise figure: 8.5 dB
Crystal oscillator frequency: 105.666 MHz (28-30 MHz IF) (zener controlled): 96 MHz (144 146 MHz IF)
Maximum frequency error at 1296 MHz: 20 kHz
Power requirements: 12 volts DC ±25% at 50 mA
Connectors: 50 ohm BNC

TRANSVERTERS:	
MMT 144/28	198.95
MMT 144/50	198.95
MMT 432/28S	259.95
MMT 432/50S	259.95
MMT 432/144S	298.95
RECEIVING CONVERTERS:	
MMC 144/28	55.95
MMC 144/28LO	60.95
MMC 432/28S	65.00
MMC 432/144	65.00
MMC 1296/28	71.95
MMC 1296/144	71.95
VARACTOR TIPLER:	
MMV 1296	81.50
ATTENUATORS:	
MAA 15	16.00

TEE/AX

Patent Pending   Model SW-5000

TEE/AX
Coax Toggle Switch – $39.95; Coax Relay Version – $55.95
• All brass construction • Teflon insulated • Captivated internal contacts • available in UHF, BNC, N, E, all series. • 52 Ohms • SPDT DPDT • Power 1 KW

TEE/AX, INC.

AMPHENOL BUNKER RAMO

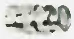
SERIES 31 – BNC CONNECTORS
Amphenol's BNC connectors are small, lightweight, weatherproof connectors with bayonet action for quick disconnect applifications.

Shells, coupling rings and male contacts are accurately machined from brass. Springs are made of beryllium copper. All parts in turn are ASTRO-plated® to give you connectors that can take constant handling, high temperatures and resist abrasion.

BNC BULKHEAD RECEPTACLE 31-221-385 UG-1094 Mates with any BNC plug. Receptacle can be mounted into panels up to 104" thick. $1.25

UG-1094

BNC (M) TO UHF (F) ADAPTER 309-2900-385 UG 255 Adapts any BNC jack to any UHF plug. $3.63

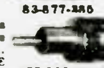


UG-255

DOUBLE MATE ADAPTER 83-877-385 Both coupling rings are free turning. Connects 2 female components. $2.72

83-877-385

JACK ADPATER $1.95 575-102-385 Adapts 83-1SP-385 to Motorola type auto antenna jack or pin jack.



575-102-385

PANEL RECEPTACLE 83-1R-385 SO239 Mounts with 4 fasteners in 21/32" diameter hole. $1.17

PANEL RECEPTACLE

SO239

BNC(F) TO UHF (M) ADAPTER 31-028-385 UG-273 Adapts any BNC plug to any UHF jack. $2.39

UG-273

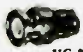
PUSH-ON 83-5SP-385 Features an unthreaded, springy shell to push fit on female connectors. $2.27

83-5SP-385

LIGHTNING ARRESTOR 575-105-385 Eliminates static build-up from antenna. Protects your valuable equipment against lightning damage. $4.80

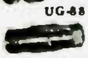
575-105-385

BNC PLUG 31-002-385 UG-88 Commonly used for communications antenna lead cables. For RG 55/U & RG 58/U cables. $1.59



UG-88

BNC STRAIGHT ADAPTER 31-219-385 UG-914 1 9/32" long, allows length of cables to be joined. Mates with BNC plugs. $2.12



UG-914

BNC PANEL RECEPTACLE 31-003-385 UG-290 Mounts with 4 fasteners in 29/64" diameter hole. $1.74

UG-290

83-878-385 SO239SH Mounts in single 21/32" diameter hole. Knurled lock nuts prevent turning. $1.59

SO239SH

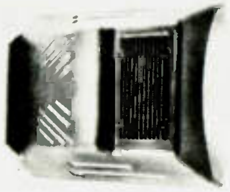
BNC ANGLE ADAPTER 31-009-385 UG-306 Adapts any BNC plug for right angle use. $4.23

UG-306

BNC TEE ADAPTER 31-008-385 UG-274 Adapts 2 BNC plugs to 31-003-385 or other female BNC type receptable. $4.56

UG-274

PL-259 . . . 90¢ UG-175 (Adapter for RG 58U) . . . 25¢



Model M-1S

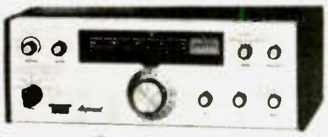
Nemarc Auto Console Model M-1

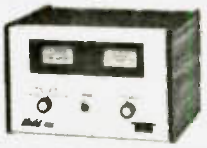
- Universal mount for CB and amateur radios, tape players, AM & FM tuners, & scanners.
- Sculptured design for "original equipment" look.
- Low profile for non-slip mounting: 13 1/2" x 10-1/2" x 5-5/8" high.
- Easy-to-install & remove for theft protection.
- Tough unbreakable copolymer with rich brown textured finish.
- Integral cup holder and coin tray.
- $14.95

Auto Console Model M-1S: Same features as above model PLUS:

- Specially designed 3" x 5" oval speaker for voice communication. Frequency response: 150 hz–7 Khz, voice coil: 9/16" diameter.
- $19.95

Nemarc





ARGONAUT, MODEL 509

Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

TRITON IV Digital Model 544

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes. For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age. But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air. The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as full CW break-in, preselectable ALC, off-set tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW waveform, built-in SWR bridge and on and on.

TEN-TEC

ACCESSORIES

206	Crystal Calibrator	$29.00
207	Ammeter for Models 251, 252G, 262G	14.00
208	CW Filter, for Model 509	29.00
212	Crystal, for Models 540, 544, 29.0-29.5 MHz	5.00
213	Crystal, for Models 540, 544, 29.5-30.0 MHz	5.00
215P	Microphone, Ceramic with plug	29.50
240	One-Sixty Converter, for Models 540, 544	97.00
241	Crystal Oscillator, for Models 540, 544	29.00
242	Remote VFO, for Models 540, 544	169.00
244	Digital Readout/Counter, for Model 540	197.00
245	CW Filter, for Models 540, 544	25.00
249	Noise Blanker, for Models 540, 544	29.00
271	Crystal, for Model 570, 21.0-21.5 MHz	5.00
272	Crystal, for Model 570, 28.0-28.5 MHz	5.00
273	Crystal, for Model 570, 28.5-29.0 MHz	5.00
276	Crystal Calibrator, for Model 570	29.00
1102	Snap-Up Legs, per pair	1.00
	POWER SUPPLIES	
210	117 VAC, 13 VDC, 1 A	30.00
210/E	Same as Model 210, but 115/230 VAC	35.00
251	117 VAC, 13 VDC, 9 A	85.00
251/E	Same as Model 251, but 115/230 VAC	92.00
252G	117 VAC, 13 VDC, 18 A	109.00
252G/E	Same as Model 252G, but 115/230 VAC	116.00
262G	Same as Model 252G, with VOX & speakers	139.00
262G/E	Same as Model 262G, but 115/230 VAC	146.00
	LINEARS AND TRANSCEIVERS	
405	Linear Amplifier. 100 W. 3.5-30 MHz	159.00
509	Argonaut Transceiver, SSB/CW, 5 W. 3.5-30 MHz	359.00
540	Triton IV, SSB/CW, 200 W. 3.5-30 MHz	699.00
544	Triton IV, Digital, SSB/CW, 200 W. 3.5-30 MHz	869.00
570	Century/21, CW, 70 W. 3.5-30 MHz	289.00
574	Century 21, Digital	399.00
	KEYERS	
670	Single Paddle, for Model 570 only	29.00
KR-1A	Paddle Assembly, Dual	35.00
KR-2A	Paddle Assembly, Single	17.00
KR-5A	Single Paddle Keyer, 6-14 VDC	39.50
KR-20A	Single Paddle Keyer, 117 VAC/6-14 VDC	69.50
KR-50	Ultramatic, Dual Paddle, 117 VAC/6-15 VDC	110.00

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC. 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. Price $69.50

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. Price $39.50

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. Price $35.00

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. Price $17.00

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weithting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortless. The jambie (squeeze) feature allows the insertion of dits and dahs with perfect timing.

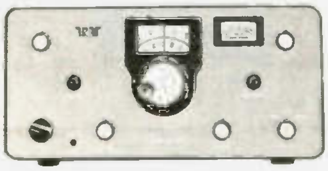
Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing. Price $110.00

SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms.
Power Source: 117VAC, 50-60 Hz, 6-14 VDC.
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA. 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¼"
Weight: 1¾ lbs.

KR50

THE SURPRISE OF THE CENTURY



Century 21, the exciting 70-watt, 5-band CW transceiver that surprised everyone with its super performance and low cost, has another surprise for you. A second model with digital readout (and a mod kit for those who would like to convert their dial model). Both Models 570 and 574 have the same unique circuitry that has won raves from everyone — both have the same fine features:

• Direct Frequency Readout (Model 574:5 red LED digits, 0.3" high, accurate to nearest 1 kHz. Model 570: marked in 5 kHz increments from 0-500 kHz, MHz markings for each band displayed, tuning rate typically 17 kHz per tuning knob turn. • Full Break-In • Full Band Coverage on 3, 5, 7, 14, 21 MHz Bands, 1 MHz on 28 MHz Band • 70 Watts Input • Total Solid-State • Receives SSB and CW • Receiver Sensitivity 1 μV • Instant Band Change, No Tune-up • Offset Receiver Tuning • 3-Position Selectivity • Adjustable Sidetone Level • Linear Crystal-Mixed VFO • Overload Protection • Built-In AC Power Supply • Black & Gray Styling • HWD: 6-1/8" x 12-1/2" x 12", 15-1/2 lbs. • Matching Accessories

FIRST WITH SSB HF DIGITAL TUNING, IS ONLY THE BEGINNING OF WHAT THE AMATEUR GETS FROM THE CIR ASTRO 200.

Standard Features:
Electronic Tuning / All Solid State / Digitally Synthesized / 200 Watts PEP Input / Full RF Filtering / Digital Readout / Noise Blanker / Squelch / Variable Speech Processing / Full Metering / WWV Receiver / VOX / LSB-USB-CW

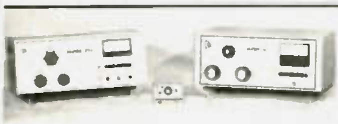
The heart of the ASTRO-200 is the frequency synthesizer. The latest in phase-lock-loop technology is incorporated to provide the built-in versatility of all electronic tuning, crystal frequency stability at each frequency of operation, and over 40,000 HF channels displayed in 100 Hz increments . . . ±50 Hz fine tuning for continuous ham band coverage.

Each circuit board is "baked-in" for over 100 hours prior to installation in the transceiver assembly.

Discover the ease and accuracy of electronic tuning. Calibrate all bands with WWV at the turn of a switch. Lowest frequency drift, with no VFO to calibrate. Only 2.8" high x 9.5" wide x 12.3" deep. Ideal for mobile use or with accessories, provides complete fixed station operation. Price $995.00.

Accessories AC Power supply $135.00. Speaker in cabinet $29.95. Station operating console with phone patch, 24 hr. digital clock, speaker, 10 min. timer $295.00. Desk microphone $38.00. Mobile mount $12.00. Mobile mic $15.00. 400 Hz narrow band CW filter $50.00.

CIR TRANSCEIVERS



WHEN QRM RAGES AND THE PILE-UPS DEEPEN, WOULDN'T YOU LIKE TO HAVE . . .

• ALL THE AOCK-CRUSHING POWER YOUR LICENSE ALLOWS — on all modes —
• INSTANT BANDCHANGE 'NO-TUNE-UP' all the way from 10 through 80 meters, with the exclusive ALPHA 374?
• COVERAGE ALL THE WAY DOWN TO 160 METERS with the smooth-tuning, extra-rugged ALPHA 76 powerhouse?
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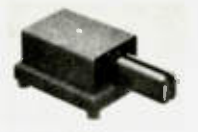

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• Antenna impedance	50 ohms nominal
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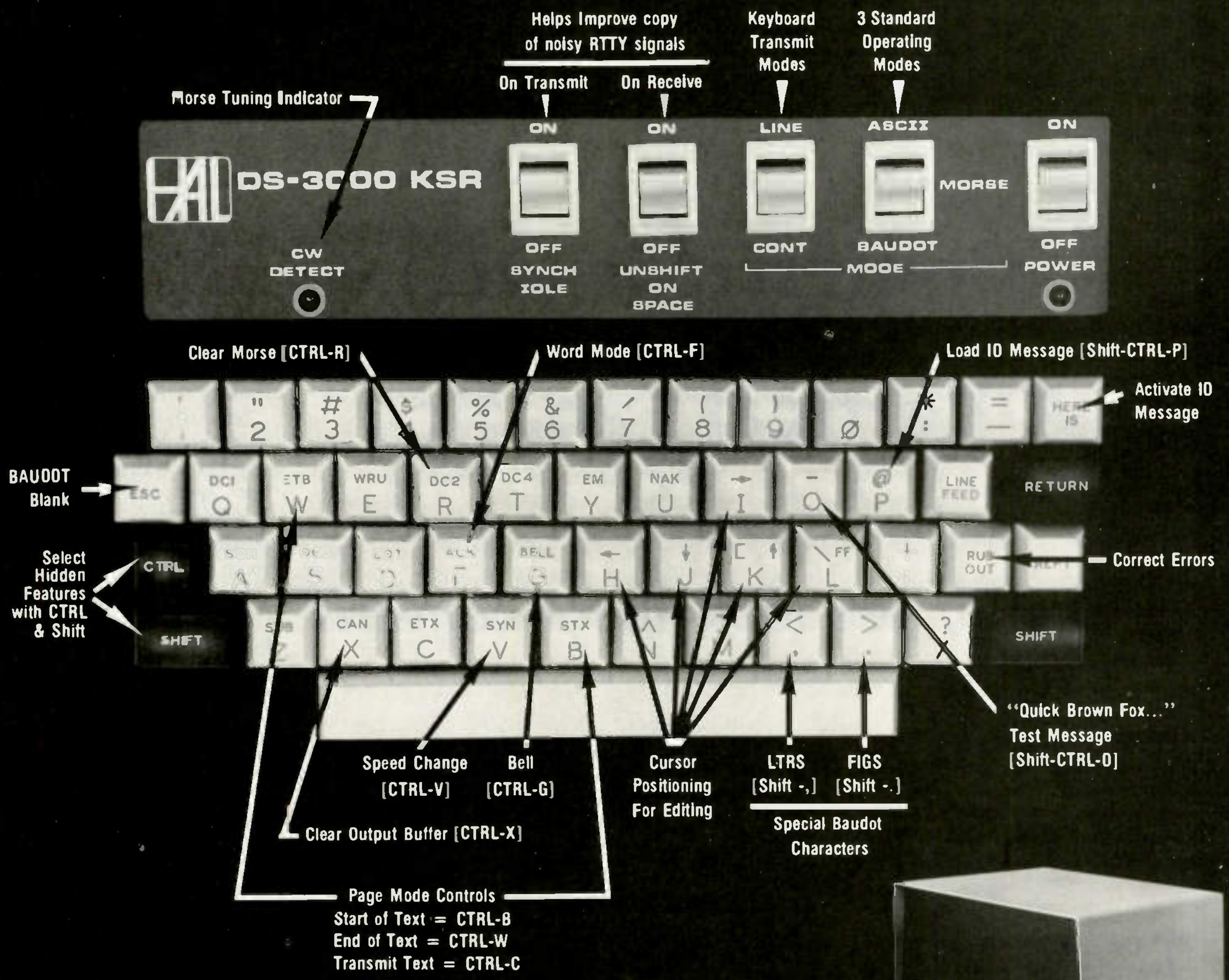

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Confessions Of A Vertical Fanatic

—careful, he's looking for converts

The vertical antenna should be well appreciated as a ham antenna, as it is truly a sleeper. This antenna is great for DX, is compact and simple, and it can give a good accounting of itself even under less-than-ideal conditions.

As a demonstration, the "Quick 'N Easy 15 or 20 Meter Vertical," as described in *73* in February, 1974, is a fine starting point. For 15 meters, an 11-foot aluminum rod (or for 20 meters, a 16-foot aluminum rod) is installed by setting it in a pop bottle. Even as few as one or two isolated radials cut to the same length as the upright will surprise you with their performance. I daily worked KH6HGJ and KH6HHD from the San Francisco area with only 100 Watts and a 5 by 9 report. This 20 meter rod was only two feet from the porch and the house, and the top was steadied with a broom stick.

All of this makes one wonder what I could have done if I had found a clear, open spot with a 360-degree ground system. This was not possible, but the makeshift setup worked. You can't beat success.

My next note on the vertical concerns the ground system. A little experimentation will show that the ground radials which perform the best on receiving and transmitting are those which are elevated and insulated at the ends. With these same radials lying on or beneath the ground, the swr is elevated, and the receiving signal is less in volume. Following this, one can check four rods driven into the earth at 90 degree angles, and here find

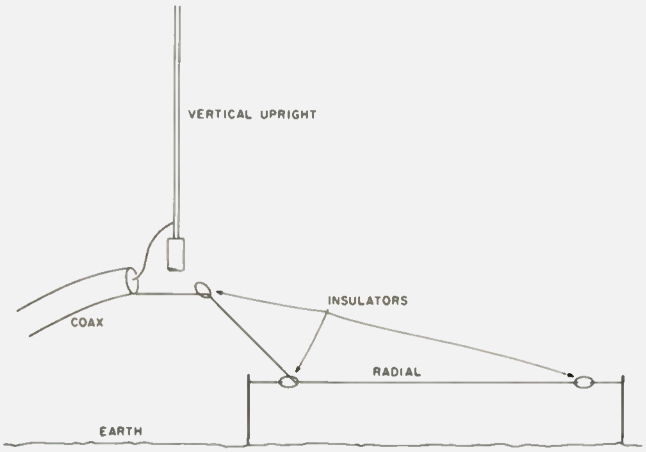

Fig. 1. Radial angle at vertical base to bring impedance to 50 Ohms.

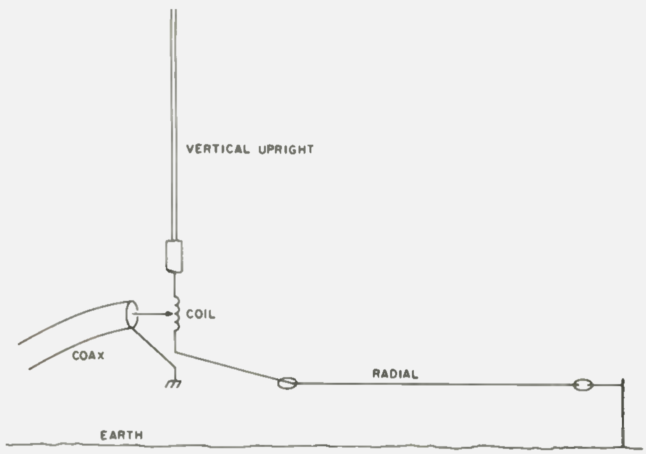

Fig. 2. Tap method used to bring impedance to 50 Ohms on a vertical antenna.

the least-desired function. Lastly, trying with no radials, as I have heard a few operators do, is nearly worthless. Were I pressured into such a situation, I would use the vertical as a long wire and use a ground with a long-wire tuner in the shack, which will do a good job.

Recently I learned from George Onsum W7IC about his technique of using wound coils in his 75-80 meter radials, and I've tried it. It works.

The vertical makes a grand showing as a mobile antenna for the auto, motor home, trailer, and particularly for marine work. Use of the vertical over salt water, using the water as ground, is a fine way to go. As a practical matter, the compact vertical is pretty close to the only antenna for such mobile and marine use.

Another note on the advantages of the vertical might be made about the fact that the resonant frequency and impedance adjustments on such an antenna may be handily made from the ground without climbing towers.

Some will say that the vertical is nondirectional and has less gain than a yagi. It is also true that a vertical will pick up a greater number of man-made noises from rotating machines, generators, motors, ignitions, and home appliances.

Despite these factors, the vertical which is in the clear, free of buildings, trees, scrubs, and nearby metal obstructions, will, with a good ground, do a grand job.

For instance, I visited a ham who had a vertical next to his house, completely hidden by an evergreen tree. He had neighbor problems. His ground was the house water pipe. He worked locally and at great distances, and the neighbor is now quiet.

Here in Hawaii, where seventy-five percent of the homes are on leased land, the ham antenna can be a problem. The lawyers have written in every restriction known to man. In one ritzy neighborhood where no type of antenna is allowed, I talked to a chap who tipped over a commercial vertical in his attic with which he worked the world.

Now, here's a note about impedance in the vertical. If the radial system is brought off at 90 degrees from the base, the impedance will read from 25 to 30 Ohms. To bring this to a 50-Ohm usable range, there are two easy methods to use. The first, as shown in Fig. 1, brings the radial off the upright at an angle and then straight out. The second technique, as shown in Fig. 2, uses the tap method. This is used by commercial manufacturers, and is my preference.

Another note on verticals is that the best technique for finding the resonant frequency and impedance is the grid-dip meter/antenna bridge setup. With good readings on these two instruments, the swrs will be low. In mobile situations, I use the swr meter for adjustments.

Verticals have been made with a large assortment of things. One can use water pipe, irrigation pipe, downspout stock, beer cans, copper tubing, coax, clothesline poles, ham towers, aluminum tubing, stainless steel tubing, and wire of every description. I recently was interested to read of a vertical made with an aluminum ladder.

One afternoon last year, the strongest 20 meter signal on the band was a retired chap who phased two commercial verticals using the aluminum skin of his trailer as ground. Here, in a final note on verticals, we open a whole new bag of worms.

What notes do you have? ■

Reference

1. Al Lee KH6HDM, "Quick 'N Easy 15 or 20 Meter Vertical," *73*, February, 1974, pages 37-39.

Jerrold Swank W8HXR
657 Willabar Drive
Washington Court House OH 43160

Novice Guide To Phased Antennas

—*part I*

An Indian once came into an automobile salesroom, the story goes, and asked about a car which drew his fancy.

"Where do you put the horse?" he asked. The salesman said that no horse was needed and proceeded to give him a very complete explanation of how the internal combustion engine works. The Indian listened closely and frequently nodded his head, so the salesman asked, "Now do you understand how the automobile works?" "Yes," replied the Indian, "but I still don't see where you put the horse."

Then there is the little girl who was given a book to review for her school homework. She wrote the following: "This book told me more about penguins than I cared to know."

This is the way I feel about most of the articles and books I have read on phased antennas. I just purchased a book on vertical antennas. It was a complete work on how to figure out the radiation angles and the various patterns and had page after page of higher mathematics. It even suggested that it would be better to use a computer.

Since I had no computer and only had a roll of wire and some tools, the book was a total loss.

Actually, phasing antennas is extremely simple, if you only want to put up a pair of phased antennas which will give the maximum results with a minimum of mathematics. If you don't care how phasing works, just ignore the drawings I have included. I felt that there would be a few who would like to know how it works without caring for anything more than a simple understanding. I have also included a page of patterns possible with phased antennas, but only to show that phasing is not only uncritical, but also that there is no point in knowing more than the most simple and easily understood patterns. The small difference is not worthwhile.

The main considerations are: How much space do you have, and which direction do you want the antennas to cover? There is the additional factor of: What, if any, do you want to reject in the way of noise or other signals?

I will also give some ground radial information for those who are using ground-mounted verticals. Even the poorest ground will not affect the phasing

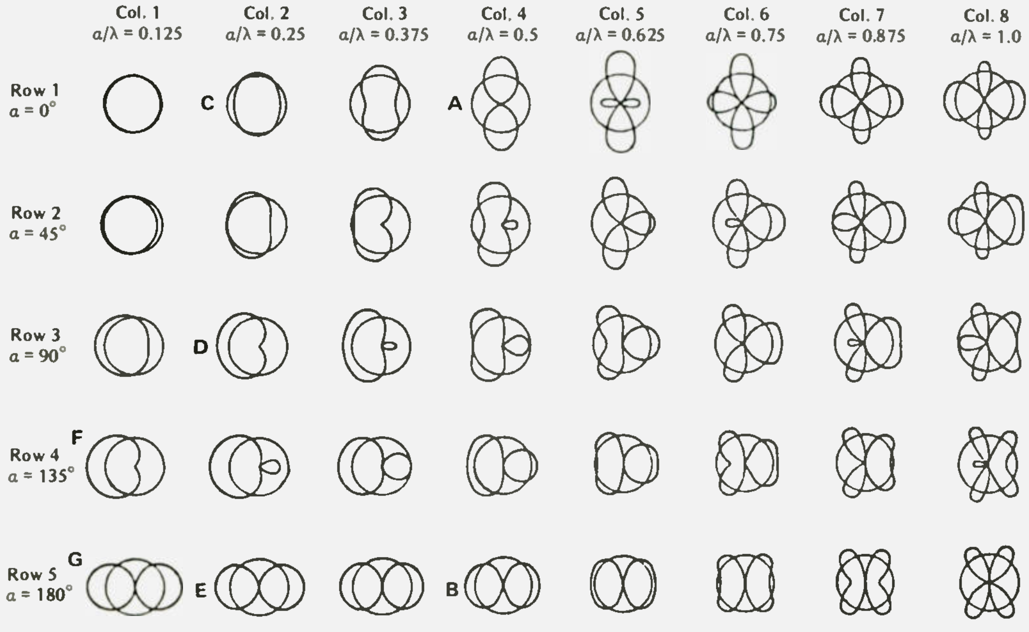

Fig. 1. Variations of patterns available with two towers.

appreciably.

I have never used radials for ground-mounted verticals, but only a pattern of five ground rods, as shown in Fig. 4. My ground is moist clay, so I know that, if it were sand, I would need more.

I am not a gain nut, and I feel that, if I get into Antarctica with a 20-over-nine signal, I won't spend much time worrying whether I get into Antarctica with 17 over 9 or 23 over nine. The main thing is that I get there.

The other consideration is: Can I cut out noise and interfering signals so I can copy them at all?

Several years ago, I wondered how a roof-mounted single ground plane would compare with the phased array. I put one up and tried it out. This was on 40 meters at night.

On the single ground plane, I received a screaming mass of signals from every direction. The signals from KC4USN, now KC4AAA, at the South Pole, were unreadable in this noisy situation. But, when I switched to the phased array on the ground, there was the South Pole coming through clear and strong, and the rest of the band had quieted down remarkably.

I was using a pair of verticals spaced 66 feet and fed with equal lengths of coax. The antennas were east and west, and the broadside pattern was that of the fourth pattern in the first row, marked A (see Fig. 1). I should have spaced the antennas 68 feet, the free space distance, but I forgot and used 66 feet. However, the difference was not noticeable. I have even used 54 feet, but the rejection was not quite as good, as it was more like pattern number 3, though a little better.

The width of the pattern between half power points is only 60°, and the rejection at the side is around 30 dB average.

At one time during my twelve years of handling Antarctic traffic, I worked at 7.290 MHz after Radio Moscow signed off, at 0700 GMT, and, at the same time, Johnston Island was handling phone patch traffic on the same frequency with California. If I switched my antennas east/west, they were S9. But, when I was north/south, I could not hear them, they could not hear me, and neither station could hear South Pole Station, as they were using beams. We worked like this through the entire season.

This half-wave arrangement is the easiest to set up and the easiest to match. If you will make the lines to the antennas equal, the pattern will be broadside at right angles to the line of the antennas and will be the pattern marked A. If you are using 14AVQ antennas, with a 50-Ohm impedance, the paralleled lines will be 25 Ohms. This will give an swr of 2:1. If you feel that this is too high, there is an easy way to fix that. In the line from each antenna, add a quarter wavelength of 72-Ohm coax, such as RG-59. This will raise the impedance of the line to 100 Ohms, and, when they are paralleled, the result will be 50 Ohms and the swr will be 1:1. If you use a tuner, there will be no point in adding the 75-Ohm line.

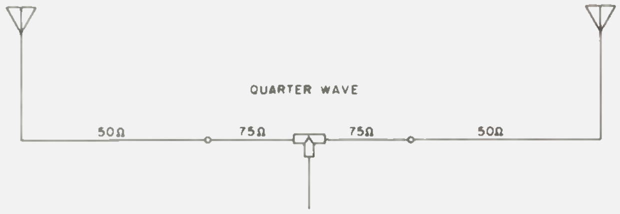

Fig. 2.

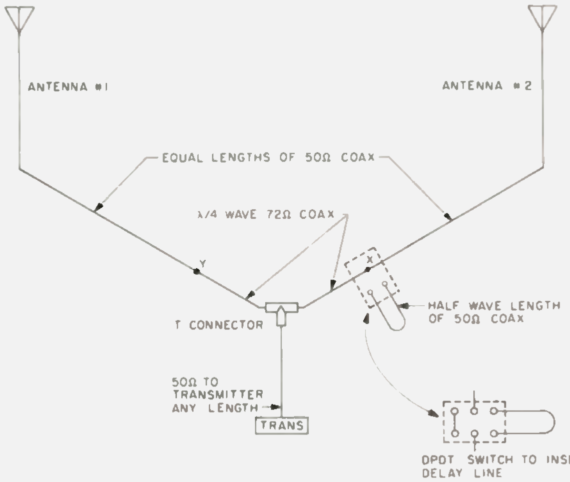

Fig. 3.

If you use an antenna such as the 4BTV (or a homemade one) which has no matching coil in the base, then the impedance will be about 36 Ohms, and adding the quarter-wave RG-59 will be of more value. This will raise the impedance in each line to 72 Ohms, and the swr then will be 1:1.44. However, again, if you use a tuner, you won't need the matching sections.

On 40 meters, the matching sections will be 22'6" at 7.200 MHz. This is (246/7.2) x .66, corrected for the velocity factor of polyethylene line.

Fig. 3 shows how the lines are connected. Inserting a half wavelength of 50-Ohm line at point X will delay the signal 180° and change the pattern to pattern B, the fourth pattern from the left in the bottom row. This will be end fire in the direction of the line of the two antennas.

One more point should be made here: If you use any pair of antennas which are not identical, the pat-

					Polyethelene (.66) coax			
Band	***Antenna**		**Spacing**		**45°**	**90°**	**135°**	**180°**
	λ/4	λ/8	λ/4	λ/2	1/8 λ	1/4 λ	3/8 λ	1/2 λ
80 meters								
3.9 MHz	60'	31'6"	63'	126'	20'10"	41'7"	62'7"	83'4"
40 meters								
7.2 MHz	32'6"	17'1"	34'2"	68'4"	11'3"	22'7"	33'11"	45'2"
20 meters								
14.2 MHz	16'6"	8'8"	17'4"	34'8"	5'8"	11'5"	17'2"	22'11"
15 meters								
21.3 MHz	11'	5'9"	11'6"	23'1"	3'10"	7'7"	11'5"	15'3"

*Table 1. Dimensions for phased antennas. *Quarter-wave verticals or half of a dipole.*

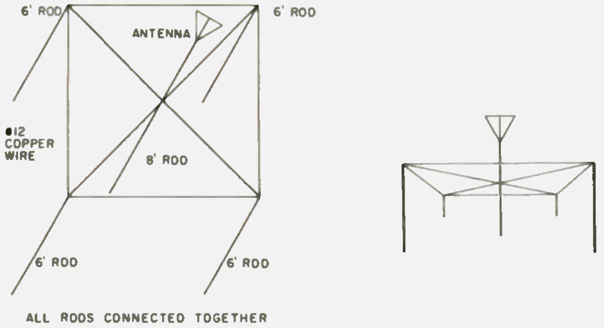

Fig. 4(a). All rods connected together. If ground rods are used instead of radials, install them as per Fig. 4(c).

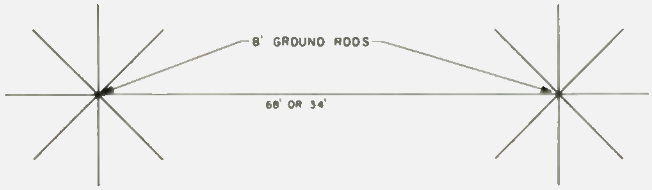

Fig. 4(b). Radial ground system (8 shown) illustrating interconnection of towers.

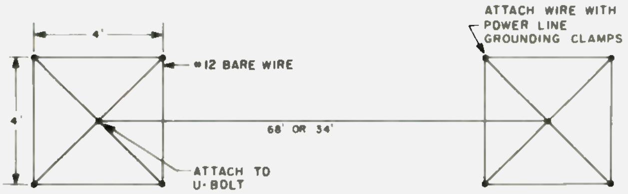

Fig. 4(c). Ground system utilizing four 6-foot ground rods (illustrating proper connection of rods).

terns may not be the same. For example, if you should use a 14AVQ with an older 14AVS or with a 4BTV, which does not have a coil in the base, or a home brew type, this will be 180° out of phase, and the pattern will be end fire when the lines are equal. The reason is that the coil in the base of the 14AVQ changes the phase of the antenna 180°. In this case, you will need to add a half-wave section at point X to get a broadside pattern.

This is no great problem with half-wave spacing. Quarter-wave spacing will cause problems. You can make everything simpler if both antennas are identical.

The closer the electrical lengths of the lines, the deeper the nulls at the sides of the pattern, but, in general, the lengths are not critical. If you use new coax, you will have no trouble if you simply measure with a tape measure. It is not necessary to use impedance measurements.

One thing worth knowing is that the best results are obtained when the swrs on the two antennas are the same. I have had occasion to adjust one antenna or the other to compensate for nearby trees or metal objects, such as a wire fence. Even this will not make serious differences, but it is so easy to correct that you might as well do it.

To sum up, use identical antennas and equal lengths of good coax, 50-Ohm, and you will have no trouble. If you only want to have the antennas fire in one fixed pattern, you can use the setup in Fig. 3, with a T-connector between the two antennas. When I first worked Antarctica for a few years running phone patch traffic, I used this system.

I had quite a bit of noise from the power line, a steady S6, and this pattern cut the noise to practically zero. Also, most of the other stations I worked were in Florida, New Orleans, or South America, so I just left the antennas like that for three or four years before I changed and brought the lines into the shack where I could switch delay lines into the coax to the antennas.

I might mention one other idea, in case you haven't already thought of it. If one antenna is closer to the shack than the other, which was the case with my setup, you can remove a half wavelength of line from the antenna feedline, since either line can be used to make the change from broadside to end fire.

I brought both 50-Ohm lines into the shack and coiled up the quarter-wave matching sections of RG-59 and hung them on a nail, as well as the half-wave delay line.

Since the power is divided into two antennas and each feedline carries only half the power, RG-58 is ample for a 2000-Watt PEP sideband rig. I used it for years and only changed to RG-8 because it stood up better when buried in the ground going to my antennas. I always used RG-58 or 59 in the shack.

Now let's take up the question of quarter-wave spacing, which takes up less space and, for some stations, is a better arrangement. The quarter-wave patterns are C and D in Fig. 1.

It is also possible that you might want to use the pattern E, which is the bottom pattern in the second row from the left.

Pattern C is the same condition as pattern A for the half-wave spacing. It is what you get when you feed with two equal lengths of line, has a noticeable gain, a fair null on the sides, and is much better than a single vertical. The most used pattern, however, is the one at D, which, for some stations, is the best of all patterns.

By inserting a quarter-wave delay line at point X, the cardioid pattern will fire in the direction of antenna #2. If you insert the same delay at point Y, the array will fire in the direction of antenna #1. The null on the backside of this pattern is very deep, about 40 dB, and is useful for taking out foreign broadcast stations, a nearby amateur, or a local noise source. The forward pattern is about 120° wide, and, by switching from one line to the other, you can cover most of the directions around you. If you are in the northwest corner of the states, you can fire southeast and cover the U.S. The same is true for the other corners of the country. The gain is a little better in this configuration, also. It is about 4.5 dB, while the gain of the half-wave lobes is about 3.8 dB. It also has a lower angle of radiation than the half-wave pattern.

If you insert a half wavelength of line in either antenna lead, you will get pattern E, which is a slightly better end-fire pattern than the pattern at D, as far as gain goes. But the nulls at the side are not as broad, and the signals at the side will not be weakened as much.

Another pattern which is very interesting is F, and, perhaps, so is G. This requires only an eighth-wave spacing, which is 17' at forty meters. In this case, the delay line is 3/8 wave, which is 33'11" at forty meters.

This arrangement has, however, one great drawback. The swr, because of the mutual impedance from the close spacing, can be quite high. In my case, it was about 5:1. When I first tried it, I didn't have a tuner, so I promptly took it down. Later I tried it again and found that a simple L-network would bring it down to 1:1. Since I only use ground rods instead of radials, I had no trouble, but, if you lay radials, you won't have room to run them in a circle. You can just run radials on one side of one antenna and the other side of the other.

If you want the pattern at G, you will have to add a half-wave delay line in one leg of the array to make it end fire.

Now that you have seen how simple phasing is, I hope you will try it out. Once you have tried it, you will never go back to a single vertical again. HyGain put out an engineering report on phased verticals a few years ago and said that they experienced a 12 to 15 dB improvement on receiving, and I believe them.

I will now add some general information on the subject. This won't add to any confusion, I hope, but will answer a few questions which will arise when you start to construct your antenna.

First is the matter of ground system. HyGain suggests the use of six 8-foot ground rods for their 18HT antenna as a substitute for radials, all about 6 inches apart around the base of the antenna. I use the method shown in Fig. 4, consisting of a single 8-foot rod at the antenna, no more than six inches away, and a square arrangement of 6-foot ground rods four feet apart, connected to each other and to the 8-foot rod, as shown. I have found this to be very satisfactory. I have so many trees in the way and my space is so limited that I simply cannot run radials.

Another way is to run insulated wire radials on the surface of the ground and pin them down by the use of bent wire Us from coat hangers. The grass will soon cover them, and you can mow the yard right over them. The ends of the radials will be hot and must be well insulated either by plastic tape or pieces of tubing slipped over them and closed.

If you use insulated wires, you won't need more than about 4 or 6 quarter-wave radials. When you use buried bare wire, you are using a different method. They are used to cut the ground resistance, and you need more.

Of course, the very best way, if you are surrounded by trees and power lines, is to mount the antennas on a pipe, preferably a quarter-wave long, and raise the antennas in the air. Then three sloping radials will do a fine job. They will serve to guy the pipe or mast and will make a sturdy installation.

Another consideration is: What bands will you be working? Half-wave spacing on forty meters is quarter-wave spacing on seventy-five meters, and quarter-wave spacing on forty meters is half-wave spacing on twenty meters.

Fig. 5 shows a simple way to reverse the pattern on any array with quarter-wave spacing, as well as to give a broadside pattern. The results of switching are very dramatic. Often if you ask a station to give you a signal report when you are firing in his direction, and then reverse it, he will not even be able to hear you at all.

One of the advantages of the half-wave spacing firing broadside is that storms approaching from the west do not cause heavy static until they are almost directly north or

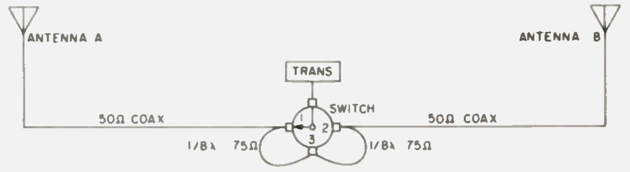

Fig. 5. Switching arrangement for quarter-wave spacing. At position 1, antenna A is fed directly and antenna B is fed through a quarter-wave delay line. At position 2, the direction is reversed. At position 3, both antennas are fed equally and a broadside pattern results. In position 1, there is a cardioid pattern toward antenna B and vice versa.

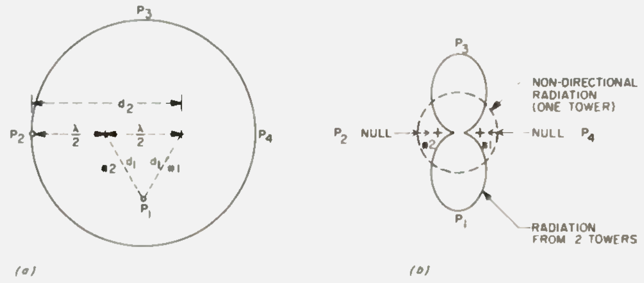

Fig. 6.

south of you. As they pass by, the static will fall off again as the storm goes to the east.

When I was running Antarctic traffic, this was a great help, as it was summer here when it was winter down there and the static here was often heavy. If this happens to you, it will sell you on phased antennas for good.

Phasing will also improve 2 meter and CB antennas, and these smaller antennas offer great opportunities for wire arrays.

The fundamentals of phasing are shown in Fig. 6. This is a half-wave spaced array and will show, for those interested, just what happens.

#1 and #2 are similar antennas, fed with equal currents, and are not affected by any surroundings which might cause phase shift or reflections.

Picture yourself at P1, which is a position equally distant from both antennas. Here you will get both signals from the two antennas arriving at the same time and, thus, with double the strength of one antenna. If you were at position P3, the same conditions would prevail.

Now put yourself at P2, and you will be twice as far from #1 as you were at P1. In addition, you are the same distance from #2 as you were at P1. We will assume that this distance is a half wave from antenna #2 and two half waves from antenna #1. The radiation at P2 from #1 will be out of phase with that from #2, and these waves will cancel.

Thus, at P1 or P3, you will get twice the radiation from a single antenna, and, at P2 or P4, you will get virtually no radiation from either, since it will cancel.

This will give you the pattern in Fig. 6(b). You will have about 3.8 dB gain to the north or south and a loss of 30 to 40 dB from the east or west. Signals or noise from the sides will be greatly weakened, and the signals from the north or south will be not only stronger, but also free of the interference from the sides. Add this to the very low angle radiation from vertical antennas, and you will see that towers and beams are not the only way to work DX. ■

The 21-Element Brown Bomber

—2m beam with sadistically strong signal

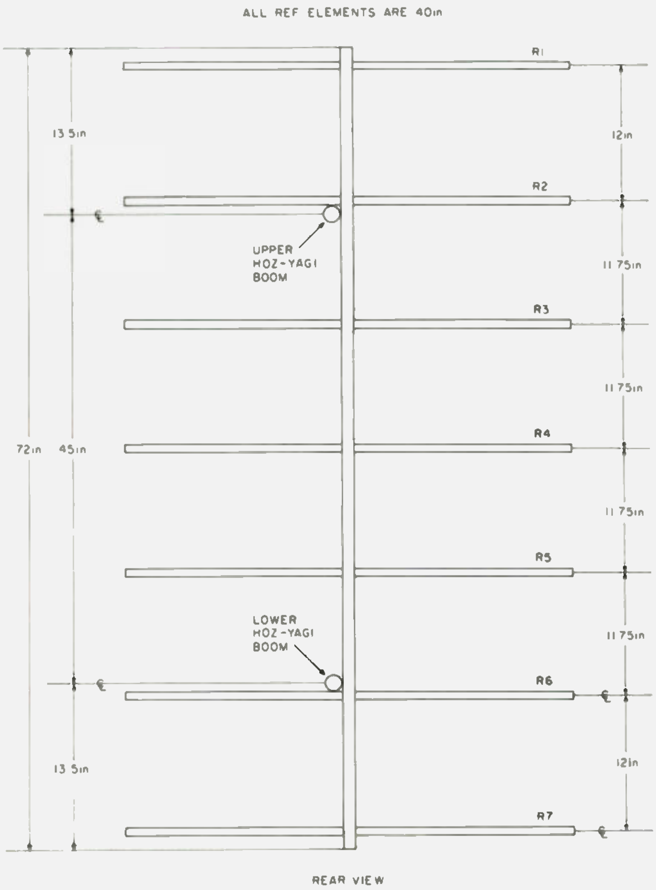

Fig. 1. Rear view. Reflector-to-reflector dimensions are approximate to help you visualize what the actual construction is. R1 and R7 go as close to the ends as mounting permits. R4 is centered at the 36" mark on the vertical mast. R2 and R6 are outside the horizontal booms and as close to them as mounting permits. R3 is centered between R2 and R4. R5 is centered between R4 and R6.

Dave Brown W9CGI
R5, Box 39
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This antenna really may be too much for the average 2 meter enthusiast. It is larger than the average 2m yagi, though not really huge in the 20m yagi sense. Basically, it is one yagi over another and at closer spacing than you may be used to. The antenna is best described as a British J-slot yagi with some very different modifications. In slot terms, it is an "8 over 8" slot, but there has been quite a modification in the reflector territory to enhance the front-to-back ratio.

In addition to a written description on how I built mine, I will give a complete parts list in commercially-available part numbers. This should make it easier for you to acquire parts if you are far from big cities and supply houses. The vast majority of the parts are Hy-Gain, because they came from four 64B, 4-element 6m beams I had on 6m SSB for a while. The part numbers given under the part number column in the parts list are Hy-Gain part numbers from their 64B yagi sheet.

Fig. 1 is a rear view of the antenna. There are seven reflector elements making up the reflector "screen." Curving the mast that these are mounted to into a somewhat circular form may enhance things, but the mechanics of that are much harder than the effort is worth. Therefore, on this model, the mast is straight up and down, vertical to the ground. The circles in the drawing are the yagi booms, which are 45" apart, center to center. The vertical boom shown at the rear (the front is the same, without the reflector elements), is 6-foot-long easy-to-find Reynolds aluminum tubing. Mine was number 4241, 1" o.d., .049" wall thickness. Measure and mark the 36" center of the mast. From this mark, measure up 22.5″ and down 22.5″, and mark these spots. The top and bottom reflectors go as close to the ends of the vertical mast as the mounting hardware will allow. The next set of reflectors working toward the center from the ends is placed so the reflector crosses the yagi booms. This works out to be about 12″ from the end reflectors on mine. The next set of reflectors is another 11-3/4″ toward the center. This gives approximately equal spacing between all seven of the reflectors, or at least as close as other hardware will allow. The last reflector, of course, goes at the center where you marked the 36″ mark.

At this point, I would like to cover how I assembled mine, as it can be unwieldy if you don't go about it right. The yagi booms will come to you as two each of booms 68¼″ and 75¾″ long. First, place the cap plugs on one end of each of these 4 items. Now, using the ends that do not have cap plugs, lay one end of a 68¼″ piece (rear) end to end with a 75¾″ piece (front). Use one each of items 3a and 3b (see parts list) to wrap around the end-to-end pieces. Before bolting, lay the ends in one half (3a), and mark the boom pieces with a lead pencil where the end of the clamp touches the boom with the boom's splice centered in the clamp. This is so that later, when the boom clamp is closed over the boom pieces, you can be sure the splice is centered in the clamp. Do this on the other boom pair, as well. Now, using the ¼″-20 x ¾″ long screws (2a) and one lock washer and nut per screw from 2b, and using the outermost 4 holes of the clamp, loosely assemble both clamps, forming two 12-foot-long booms with cap plugs on their extreme ends. When you are sure you have the splice centered in the clamps, go ahead and tighten the four screws on each clamp. You now should have two reasonably rigid 12-foot-long booms for later yagi assembly.

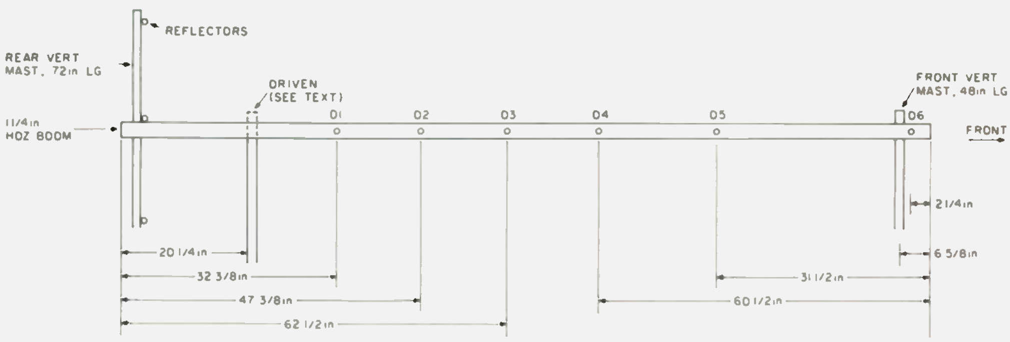
If you have a workbench edge that has no overhanging top (or can block it up flush), the next steps are easier. Assemble item 4, the U-bolts, into the clamps on the yagi booms with the U of the U-bolt on the same side as the V of the clamp. You should use all of the hardware of item 4 in the parts list to do this. Don't tighten the U-bolts down just yet. If you purchase the EMT conduit in standard 10-foot lengths, now is the time to saw off a 48″ to 50″ piece of it. This becomes the center vertical mast of the array and allows easier assembly and mounting, as you will later see. Mark the center of the 48″ to 50″ piece, and then make two marks 22.5″ in each direction from the center mark. These marks will then be 45″ apart, the distance that the yagi beams will be vertically separated. On a large flat surface (garage floor?), lay the two 12-foot booms about 45″ apart with the U of the U-bolts down. This leaves the eight nuts up so you can tighten them. Slip the EMT conduit through the 4 loops of the U-bolts, and center the 45″-apart marks over the centerlines of the booms. When you are sure the two booms are in line with one another (hold one end of each against the floor at the front or rear of the booms), tighten the U-bolts with a wrench. If you are in a windy area (who isn't?), you may want to drill a 5/16″ hole through each clamp (after you double-check boom alignment) and pass a 5/16″ bolt (not listed in the parts list) through these holes. The hole should be in the center of the clamp on each side and pass through the boom splice. Use 5/16″ flat and lock washers and nuts on these bolts (also, not listed). You now should have a rather large 12-foot "H" shape. With this "H" on its side (EMT tubing vertical), you can use a U-bolt (not listed) to bolt the "H" to the workbench, so the EMT is about 1 foot off the floor and the booms are parallel to the front edge of the workbench. (I hope you don't mind holes in the front edge of your workbench, because, if you hit the right spot to not later have elements hitting your workbench legs, you must have cheated and measured things first.)

Take the vertical mast you earlier marked off for the reflector support (rear vertical mast) and 2 of the U-bolts from item 22, and drill the booms so the U-bolts pass through them in a horizontal plane. Drill both upper and lower booms. Position the U-bolts so they are just ahead of the cap plugs. If you pass each of the U-bolts through the boom from your side, while keeping the vertical mast enclosed in the U-bolt loop, you have only to put a flat U-bolt plate (or flat washers) over the U-bolt ends, lock washers, and nuts and draw everything up just snug. If you put the EMT center mast at 1 foot off the floor, with the rear vertical mast just touching the floor, the 45″ marks on the reflector mast should almost line up in the center of the last U-bolts mentioned. Align them until they do and tighten the U-bolts. You now have a box 45″ high by 68¼″ wide, with the front ends of the horizontal booms still hanging loose out front.

Move to the front of the booms. Drill both of these the same as for the reflector vertical mast. Take the second Reynolds 6-foot long, 1″-diameter piece, and saw it down to 50″. Mark the center of this mast, and put two marks 22.5″ from the center (45″ apart). Place the U-bolts in from the same side, and,

ELEMENT LENGTH BOOM C/L TO TIP

FM-20	18in	17 875in	17 75in	17 625in	17 5in	17 5in
R	D1	D2	D3	D4	D5	D6
SSB-20 25	18 25in	18in	17 8in	17 7in	17 6in	17 6in



UPPER BEAM SIDE VIEW – LOWER HAS SAME DIMENSIONS

Fig. 2.

using same method, do as you did for the rear vertical mast. Line up the 22.5" marks with the centerline of the horizontal booms, and, again, draw the U-bolts down snug. When you're sure of the alignment, tighten the bolts down with a wrench. You should now have a large and quite rigid figure "8" lying on its side that you can begin mounting the actual antenna on. Up until now, you have been only working on the support frame.

The antenna and frame are all aluminum, except for the center EMT mast and the steel hardware, so the overall array is quite light. One man can easily lift the finished array, but I won't kid you—it is rather unwieldy, and I would find some help and use a pulley arrangement getting it up.

Assuming you are over a flat floor, begin the next phase by mounting all the directors on the lower boom. To do so, cut 12 of the 40" aluminum tubes (item 6) into two 20" pieces each. By all means, use a plumber's small tubing cutter as used on copper tubing. One with a ½" or so capacity will handle this job and is quite inexpensive. Place one each of these aluminum tubes into the tube reducer (item 5) with most of it hanging out the small end of the reducer. Slip one of the compression clamps (item 12) over each of the tube/tube reducer combinations. Slip a square nut (item 16d) between the compression clamp and the reducer, and line up the hole of the nut and the slot in the reducer. Run a screw into the nut through the hole in the compression clamp and pull it down just finger tight. Do this to 24 combinations. The 20" tubes should come just short of even with the fat end of the reducer. Do not tighten them more than finger tight at this time.

The next step is to assemble the elements onto the booms where they belong. Mark off the upper and lower booms, as in Fig. 2. Make the marks exactly along the top centerline of each boom, and you will save time later. Make the marks and the centerline imaginary Xs, and, where they occur, drill small starting holes for the self-tapping screws (item 16f). There are holes in the element clamps (item 1). At each of the starting holes

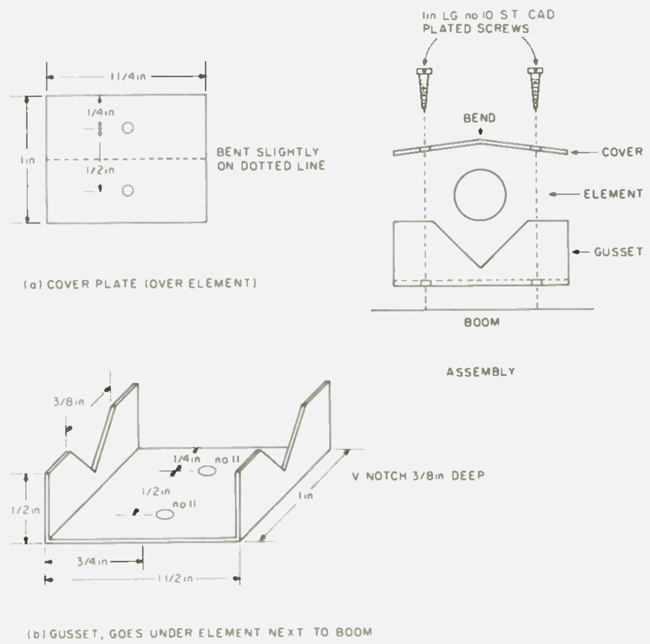


Fig. 3. Reflector mounting clamps.

in the booms, mount one of the element-to-boom brackets (item 1). Be careful to keep the brackets parallel to the floor. Once the 12 brackets are mounted, use the other remaining 12 to form the bottom side of the mountings by loosely starting a screw (2a) and lock washer and nut (2b) at opposite corners of opposite boom sides of the bracket. Tighten only enough to bring the plates (upper and lower) close, but not so they're touching. You should have 2 screws in each clamp, 2 brackets (item 1) per clamp (or director position), and 12 positions (6 upper, 6 lower) started. Now slip the fat end of one of the tube/tube reducer combinations into each opening of the 12 clamps (24 openings in all). Then, doing one position at a time, draw the upper and lower plates snug around the 2 reducers, making sure the reducers are pushed in flush with the boom. Also at this time, push the tubes in flush with the boom. With the bracket holding the reducer snug now, tighten the screws in the compression clamps with the screw oriented downward. This makes the tube and reducer into one rigid piece. The hole in the bracket allows some play on the #10 self-tapping screw holding the top bracket, so, before you tighten the rest of the bracket screws inserted at this time, be sure the overall element is parallel to the floor (horizontal). Once all the alignment has been checked and is assured correct, tighten all hardware—¼"-20, self-tapping, and compression clamp screws. When one director is done, move on to the next, doing the lower boom first, as it is closest to the floor and you can better judge the part parallel to the floor. Then do the upper boom, measuring either from the floor or from the completed boom. From the floor is a good bet, if you have a long ruler or stick, and then you can use the measurement from the upper boom element to the lower boom element as a cross check. If you have carefully cut the twelve 40" pieces (item 6) exactly in half and pushed them into the reducers until flush with the boom in all cases, you now have, fully mounted, 12 directors of 41¼", or 20-5/8" per side from the boom centerline. You can trim them later.

The time has now come to do something about that bald reflector mast. Use the home brew clamps and mounting system of Fig. 3 to mount the full length (40") of the seven remaining tubes. The reflectors are used at their full 40" length and require no further trimming like the directors. Mark a point 1" off center on all reflector elements. This point centers on the centerline of the mounting clamp and vertical upright mast. Let the long side be the one that goes to the long side of the mounting, or, in other words, the horizontal boom side. What this does is center the reflector over the horizontal boom and behind all the other elements. The fact that its point of ground is offset seems to cause no problems at all—i.e., no false lobes, etc. You have marked the reflector masts earlier for where they go, and the same small starting holes for the self-tapping screws are used here for the mounting holes. Use the mounting bracket for a template on the vertical mast. All of the reflectors mount on the front, or driven element side, of the rear vertical mast. The reflectors form a "screen" behind the quasi-yagis, so try to align the reflectors so they are 90 degrees to the boom and in one flat plane (vertical) to each other. Use Fig. 1 to get the idea. This is a rear view of the array, with the driven element and directors omitted to avoid confusion.

Let's get on to the live part of this whole aluminum farm—the driven element. When you find aluminum tubing, if it is soft enough to form into the rectangular form of the driven element of any J-slot antenna, it also deforms later (wind, birds, buzzards, whatever). If you find and use the larger 5/8″ or 3/4″—hard drawn—there are 90-degree plugs to form a square or rectangle out of straight tubing pieces. You can go that way if you like, but I have found a slick way for other projects that worked out well for this one, too. It is an aluminum U-channel. You can cut it neatly using a miter box and hacksaw for nice 90- or 45-degree angles. The driven element is 15″ across, side to side, inside to inside. The height is cut one of two ways. For the FM man, use the inside of both upper and lower booms, or a dimension of 43-3/4″ outside to outside on the vertical sides. A better match for the SSB man in the 145 MHz territory occurs if the vertical parts are cut a full 45″ on the outside dimension and the tops of both booms are used for mounting, instead of between them as on the FM version. You may want to adjust these figures according to your choice of operation, even using the boom outsides for mounting in the case of 144 MHz. The bandwidth is not all that critical, and my almost flat 1:1 SSB version is only up to 1.8:1 at 146.94 MHz FM. The driven element gussets or clamps slip into the U-channel (facing rearward) of the driven element, and are secured by a self-tapping screw at their tail end and the driven element mounting screw in the channel itself. The "L"-shaped reinforcing corners have four holes and just slip down into the channel. Try to buy it all at the same store so you can try fitting the parts right there. They are all standard parts except the mounting brackets and gussets, in order to keep the metal work to a minimum for the weekend builder. They make Ts like the Ls that you could use for the gussets, but I just have never found anything available ready-made to beat the mounting clamps for the reflectors as I have shown. The L slips into a mitered (45 degree cuts to mate) corner, and then holes are drilled to match the holes already in the L. Slip a square-head nut into the channel over the L-plate and run a screw in from the channel outside side. 4 screws later, you have a very rigid corner. 16 (total) and you have a very respectable and sturdy rectangular driven element. Don't forget to assemble it "around" the top boom in the SSB version. For FM, it just slips between the booms in assembled form. Be sure to use the gussets of some sort, or the driven element will pivot on its own vertical axis of the boom to driven element mounting screws. It may be easier to drill the holes where the delta match will mount with the driven not mounted. I did it after with no problem. The holes go from the outside to the inside of the vertical sides and into the vertical center of them. The holes pass through both walls of the U. The mounting bolts will later pass through the flattened ends of the delta feed, through both walls of the U, and a nut on the inside of the rectangle.

Cut the remaining 40″ tube into two 20″ pieces, just as you did the directors. Flatten one end of each for about 1″. I suggest a vise and slow pressure for this, as a hammer seems to harden and make the tubing I used brittle. About ½″ down the flattened end, a small bend is plated to start a curve that will bend inward toward the centerline of the array from the outer edges of the driven element. Final forming can be done when you draw the two parts of the delta towards each other and their common mounting plate. That plate for me was a leftover ground plane radial plate from an old CB antenna. Any plate you can mount the delta to, but keep it insulated from, with about 4″ between the tube ends, is fine. See the drawing for a better idea. The delta mounts with the wide ends screwed to the center of the vertical upright parts of the driven element and the narrowing V portion facing forward. The 4″-apart portion of the V is almost under one and above another D-1 director. ½″ PVC tubing makes a fair insulator if you use a 6″ piece. Run 2″ of delta into it and bolt it 1″ from the end you entered. Then clamp the other end of PVC in a ground plane clamp and bolt it, being careful not to get the bolt anywhere near the active delta tube. The clamp (item 11) is sawed in half and used to connect the coax to the delta feed. See the delta drawing to show the clamp positioning. Start with the dimension of 13½″ from the front edge of the driven element and delta tube to the back edge of the clamp. Adjust from there for minimum swr at your desired frequency. The RG-8 coax feeding the antenna is brought in to the clamps (item 11), with the braid to one screw and clamp, and the center to the other screw and clamp. Which is which is like asking, "do you like right-hand

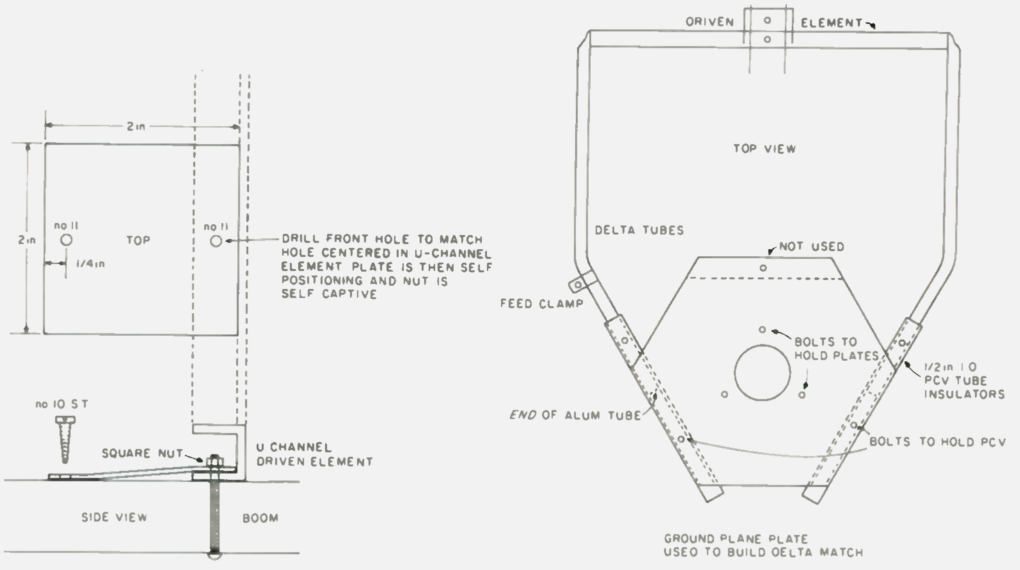


Fig. 4. Driven-element-to-boom gusset (anti-element twist).

horizontal polarization or left-hand polarization?" (In other words, it matters not.) The delta match lies on the same plane as the two horizontal booms and halfway between them. The feed cable is dressed away from the delta feedpoint in a 60-degree (not that critical) angle upward to the upper boom and is taped securely there and several places down the upper boom until the center vertical mast is reached, where it turns downward to the tower, shack, etc. The taping to the upper boom helps support the delta match weight and holds it positioned. Carefully make this feedline a multiple of half wavelengths. 1½ or 2 should do it. If you do this very carefully and take into account the velocity factor of the coax you use (50 Ohm of some kind), the end of the cable can have a male connector at that point, and a bridge put in here will show exactly what it would at the antenna feedpoint. A coaxial barrel can then join the coax to the down run when the meter is removed. Tape the connectors well for weather, and a coat of clear Krylon spray goes on everything here.

I believe this should get you going. Even if you use your own home brew methods, the beam and principles all still hold. All that remains is to trim the directors to the dimensions of Fig. 1. With a rigid element to work on and the cutter gadget, this really goes fast—almost too fast, so here is a trick to use to avoid errors. Item 10, the smaller cap plugs, can be added to all the reflectors, as they are already the right length (14 plugs). The remaining 24 plugs are added one at a time, as you complete each cutting. That way, if you are careful on your measurements, you cut each one only once. Aluminum is not cheap, and it's a good way to save a buck.

Send an SASE for help, as always. I put mine together in three evenings of about four hours each, working carefully and taking notes for this article. Besides the great gain, the front-to-back is truly amazing. I can null (0) an S-8 signal by going front to back. Rather than quote 3 dB beamwidths (14 degrees), let's say the usable beamwidth is about 25 degrees. ■

Parts List

	Quantity		Part #
1.	24	element-to-boom brackets	161422
2a.	109	¼"-20 x ¾" large stainless steel bolts or Hy-Gain hardware for assembly of items 1, 3, 11, and 18	505325 bolt
b.	109	¼" stainless steel nuts or Hy-Gain hardware for item 2a	556960 nut
c.	109	¼" stainless steel lock washers or Hy-Gain Hardware for item 2a	567110 washer
3a.	2	boom-to-mast body	385142
b.	2	boom-to-mast clamp	385144
4a.	4	U-bolts 5/16"	545146
b.	8	lock washers 5/16"	567075
c.	8	nuts 5/16" #18	551026
5.	24	tube/reducer 5/8" x 7½	190002
6.	20	beta tube, 7/16" x 40", 7 for reflector as is; 12 split into 20" lengths for elements before "pruning"; 1 split into 20" length for delta feed	175637
7.	2	boom (rear half) 1¼" x 68¼"	175648
8.	2	boom (front half) 1¼" x 75¾"	175649
9.	4	cap plugs 1¼" for items 7 and 8	455630
10.	38	cap plugs 7/16" for item 6	475639
11.	1	clamp—sawed in half for delta feed	165641
12.	24	compression clamps—for securing elements into tube/reducer (fitting part 6 into 5)	165123
13.	24	hardware for item 12—screw 10-24 x 5/16"; nut square 10-24	505671 555362
14.	2	4" pieces of 5/8" o.d. PVC tubing delta feed insulators	N/A
15.	2	6-foot pieces of aluminum channel 33/64" x 1/2" x 1/16" wall cut into 43-7/8" and 15" pieces	N/A
16.		cadmium-plated stove bolt hardware for assembly of item 15	
a.	4	3/16" x 1" screw	
b.	2	3/16" x 1½" screw	
c.	16	3/16" x ½" screw	
d.	18	square nut 3/16"	
e.	2	hex nuts 3/16"	
f.	38	self-tapping hex-head ¾"-10 screws	
g.	4	corner L-braces 1/8" x 3/8" x 2½" on a side to lay inside corners of channel forming driven element	
17.	2	driven-element gussets 2" x 2" of .060" or thicker (see Fig. 4).	
18.	2	ground plane-type radial brackets (delta feed bracket)	
19.	7	home brew reflector mounting brackets, .060" material or better (see Fig. 3)	
	7	cover plates (see Fig. 3)	
	14	self-tapping, hex-head, cad.-plated 1" x 10 screws—reflector mounting	
20.	2	front and rear vertical mast—Reynolds #4241, 6 ft. long 1" o.d. by .049" wall aluminum tube stock	
21.	1	48" to 50" section of 1½" EMT electrical conduit (center vertical mast and main support for mounting the array)	
22.	4	U-bolts and hardware for mounting front and rear vertical masts (item 20)	

The Towerless "Tower"

—new grounded-rotor design

Robert H. Walker K4FK
400 Tivoli Ave.
Coral Gables FL 33143

Roy D. Mazzagatti N4OG
18551 S.W. 204th St.
Miami FL 33157

Amateur radio is experiencing a tremendous resurgence of growth. Many newcomers, however, are missing much of the potential pleasure of the hobby because they are settling for relatively inferior dipoles or ground planes, even on bands for which directional antennas are commonly available. Today, a used triband beam and rotor can often be purchased for about the same price as a new multiband trap vertical. The problem then becomes one of supporting the beam, securely, at some height above the ground. This immediately conjures up visions of a tower, both an expense and a mechanical complexity with which many newcomers are unwilling or unable to cope.

Photos by James R. Allison WA4KIL

A telescoping TV mast is an alternate support structure which is summarily rejected by most hams. We, too, cringe at the thought of mounting both the beam and the heavy rotor on the weakest section of the mast and then relying on guy wires to keep the entire structure erect.

The following is a description of a simple and inexpensive method of making a telescoping TV mast into a reliable support for a beam or quad. This method has been employed at K4FK (formerly WA4FKJ) since 1971. During that period, there have been no failures or difficulties of any type. Photo A shows a 50-foot telescoping TV mast supporting a 4-element 20 meter yagi beam. The beam has a 26-foot boom and is up about 20 feet. Note that no guy wires are used. The secret is to mount the rotor at the bottom of the mast and to turn the entire structure.

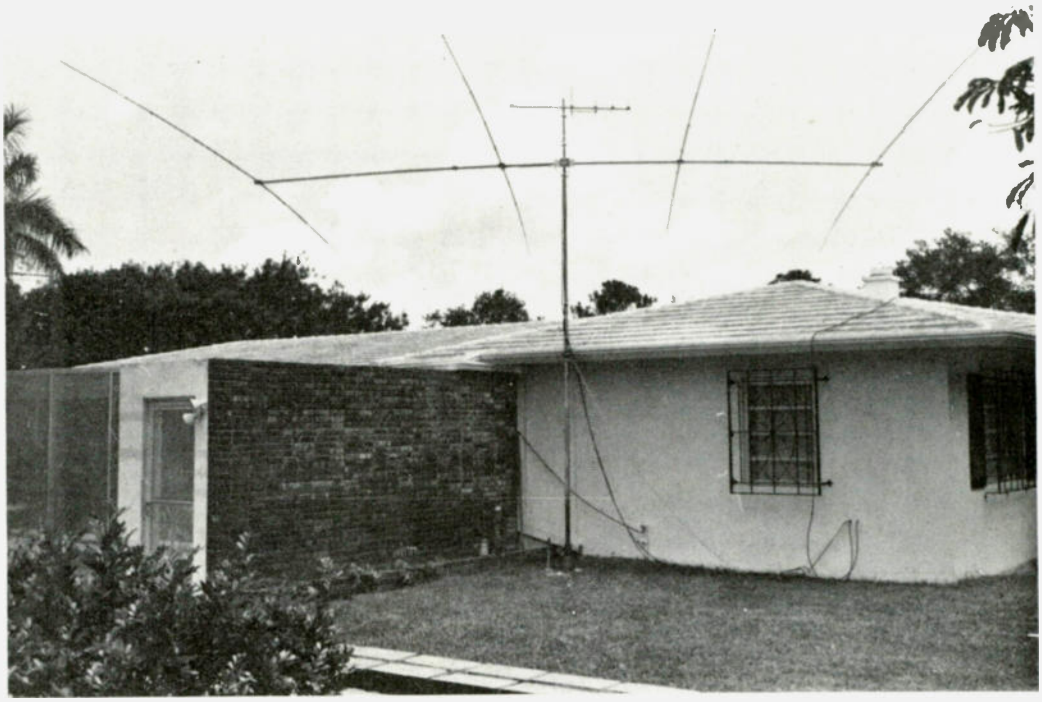


Photo A.

Photo B shows the rotor mounting. A CDE Ham-M was used simply because we already owned it. There is certainly no need to use as heavy a rotor if you already have a lighter one available. The rotor is bolted to a piece of 24" x 12" x 1/2" plywood. The size of the board is not critical, but it would be wise to avoid the use of one much smaller. It should be given several coats of paint for protection. At K4FK, the original 1971 vintage board is still in use and shows no signs of deterioration.

The rotor will need to be spaced about 1/2" above the board to keep it from sitting directly on the control cable. CDE's Tower Plate (part number 50559-10) is excellent for this purpose. Flat washers will suffice if such a plate is not available. Use bolts about 3/4" longer than necessary to pass through the board, spacers, and into the rotor. You will need to use flat washers as spacers on the bottom of the board. The bolt heads and washers will dig into the ground and eliminate the need for staking down the board. Since the rotor is essentially at ground level, it is a good idea to use a coating of silicone sealer over the terminal connection block to help prevent corrosion and accidental shorts.

In areas where snow and/or flooding occur, the rotor should be raised above ground level. Two possible ways of accomplishing this are: Mount the board on heavy brackets which are bolted to the wall of the building, or construct a set of cross-braced "legs" for the board. Just remember that your brackets or "legs" must be able to withstand the full torque of the mast and antenna system.

Photo C shows a heavy-duty bracket supporting the mast at the eave of the roof. Your individual installation will determine the best type of bracket for you. They are available in many different configurations and sizes from TV antenna suppliers. Make sure the one you choose will hold the mast clear of any roof overhang and will comfortably accommodate the outside diameter of your mast. The bracket should be tightened sufficiently to eliminate any free play between the mast and the bracket, but left loose enough for easy rotation. Since there is metal-to-metal contact at this point (unless you fit a bearing), lubrication will be necessary. Number 2 lithium grease has been found to withstand the rigors of the Florida climate and makes an excellent lubricant.

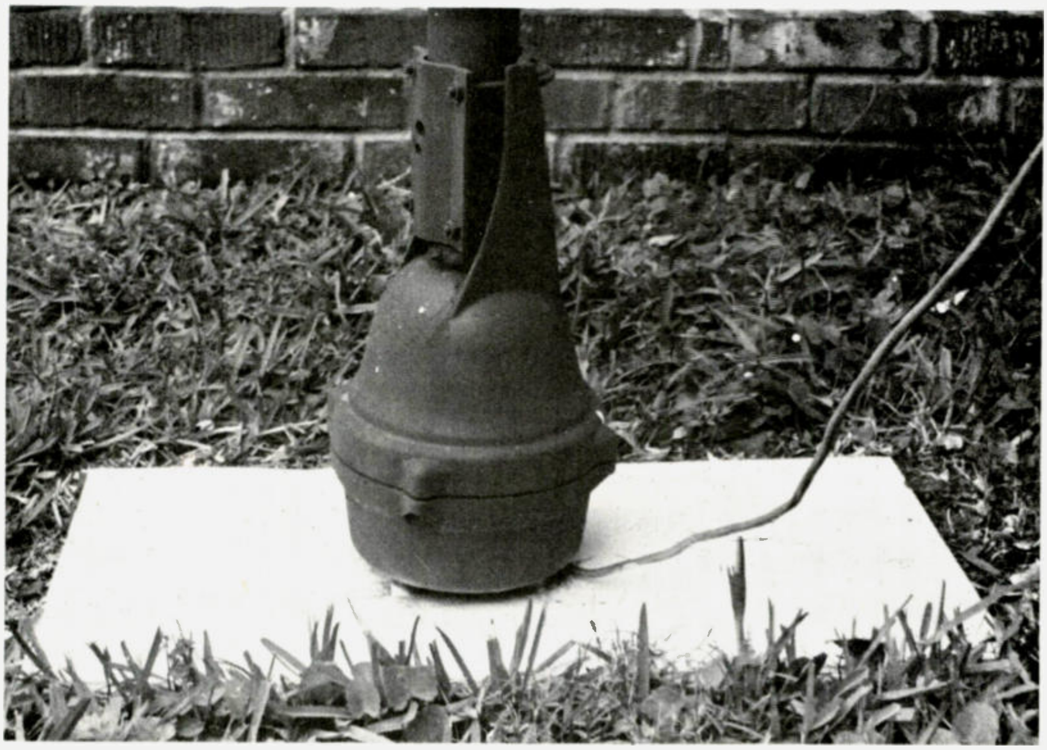


Photo B.

Your antenna can now be installed at roof level, making servicing and adjustment especially easy. In times of extreme weather, your antenna can be lowered to the ground in about 10 minutes. We fasten the beam to the next-to-the-smallest section of mast and then partially extend the heavier sections. If you favor the unguyed approach, a height of 18 to 25 feet is safely attainable, depending on the size of the antenna. If you're willing to employ guy wires on the mast's slip collars, then a height of 35 to 40 feet seems reasonable. As a bonus, you can suspend an 80/40 meter inverted vee from one of the slip collars beneath the beam.

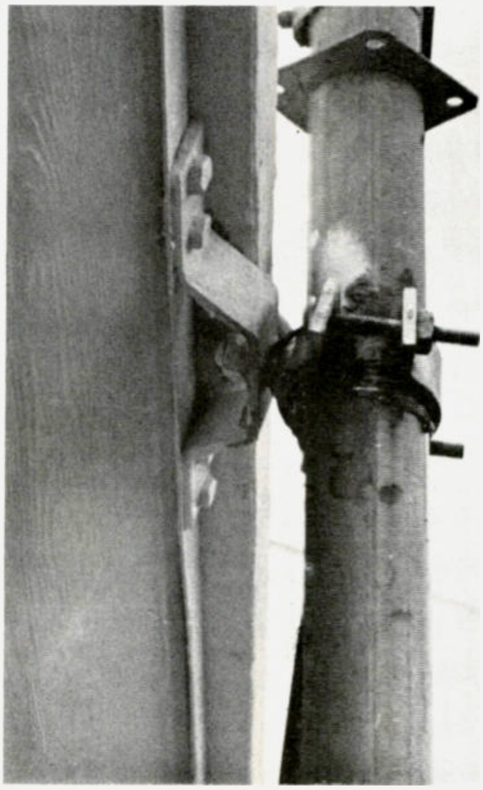
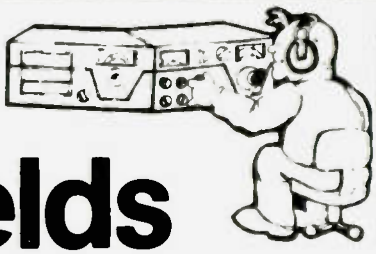


Photo C.

With a quad, this becomes somewhat more difficult to do.

No, you won't be a "big gun" in the pileups with this arrangement. Your antenna performance will, however, greatly exceed that of a conventional dipole or a ground plane with only a few radials. You have come closer to maximizing the value received for your antenna dollar. Additionally, you have a good start on the project, should the day arrive when you decide that a tower is an absolute necessity. ■

Call Toll Free for vacation hand-helds



1-800-633-3410

WILSON T-1407-MX 2m handi-talki

• Frequency range 134-174 MHz • 6 channel operation • Sensitivity 0.3 microvolts for 20 dB quieting • RF output 7 watts or 1 watt selectable • Power consumption: receive 15 ma squelched, transmit 1.3A (7W), 400 ma (1W)

349.95 Call for yours today

WILSON 2m Mark II hand-held

The small size hand-held features excellent adjacent channel selectivity & inter-mod image rejection • 6 channel operation • Individual trimmers on all TX RX xtals • Microswitch control of TX RX • Includes rubber flex antenna & 1 pair xtals 146.52 52 installed

261.90 Price with touch-tone pad.

WILSON 2m Mark IV hand-held

The Mark IV small size hand-held has the same great features as the Mark II. The 4 watt Mark IV is the ultimate hand-held for the amateur who demands quality, performance & value. • Built-in microswitch speaker-mic • 90 day warranty

301.90 Price with touch-tone pad.

REGENCY HRT-2 2m FM transceiver

Features • 5 channel operation • 2W HI output, 1W LOW output • Double conversion, super-hetrodyne receiver design with 2 ceramic filters • TX and RX sections employ band-pass circuitry. TX power & RX sensitivity are maintained across entire band (144-148 MHz).

179.00 list price. Call for quote.

HYGAIN 3806 2m hand-held transceiver

The 3806 is an entirely self-contained unit. Use over medium distance or with repeaters. • 144-148 MHz coverage • Current drain: 380 mA at 12VDC on TX, 100 mA at 12VDC on RX • Power source: 8 AA penlight or optional NiCad pack • 6 channels (146.52 simplex supplied). 1 watt output

189.95 list price. Call for quote.

WILSON 1405 SM 2m hand-held radio

6 channel operation • 0.3 micro volt sensitivity • 12 KHz ceramic filter • Individual trimmers on all TX RX crystals • 10.7 & 455 KHz IF • Switchable 5W or 1W output • Touchtone pad included • Recharger base available.

339.90 list price. Call for quote.

Remember, you can call TOLL FREE: **1-800-633-3410** in U.S.A. or call **1-800-292-8668** in Alabama for our low price quote. Store hours: 9:00 AM til 5:30 PM, Monday thru Friday.

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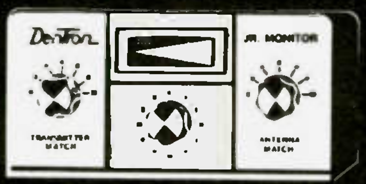
1-800-633-3410 vacation and accessories:



DENTRON Jr. Monitor antenna tuner

The Jr. Monitor antenna tuner/matching network has it all in one neat 5 [illegible]" x 2 [illegible]" x 6" cabinet • Continuous tuning, 1.8 to 30 MHz • Forward reading relative output power meter • 300 watt power capability • Built-in encapsulated balun, plus much, much more!

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YAESU FL-110 mobile amplifier

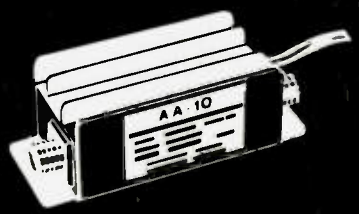
The FL-110 is a wide-band SSB CW amplifier. It is perfect for Yaesu's new FT-7 mobile transceiver. Has 200 watts PEP, solid-state construction, 13.8 volts DC operation. Don't wait, supply limited.

165.00 list price. Call for quote.

DENTRON all band HF doublet antenna

This all band doublet or inverted antenna covers 160 thru 10 meters. It has a total length of 130 ft. of 14 gauge stranded copper wire. Tuned & center fed thru 100 ft. of 460 ohm PVC covered transmission line. Assembly is complete.

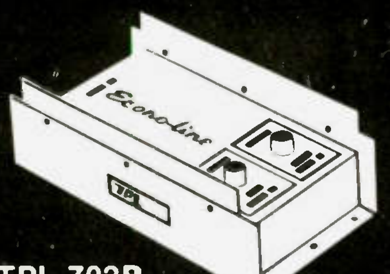
24.50 Call for yours today



DRAKE AA-10 power amplifier

AA-10 has no relays—auto TX/RX switching • Frequency coverage 144-148 MHz • RF output 10 watts min. at 13.8 VDC • RF input 1 watt nominal, 1.8 watt max. • Receive loss: Fraction of 1 dB • SO-239 connectors • Power requirements 13.8 VDC at 1.5 amps • 10 dB power increase

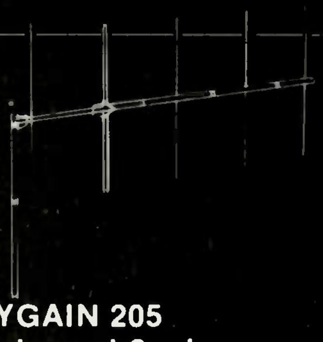
44.96 Call for yours today



TPL 702B 2m RF amplifier

702B is solid-state featuring magnetically coupled transistors and floating ground. Linear Bias for FM or SSB. Input: 1 watt to 5 watts. Output: 60 watts to 80 watts. Typical: 1 watt in/70 watts out. Frequency coverage: 143 to 149 MHz. 100 watts PEP typical.

169.95 list price. Call for quote.



HYGAIN 205 5-element 2m beam

The 205 has 5 elements, optimum spaced on a 75" boom, plus: • Gain (average), 11.3 dBi & 9.1 dBd • F/B ratio, 20 dB • Max. SWR, 2:1 • 4 MHz band width • Max. power, 500 watts PEP • Longest element, 39 [illegible]" • Net wt. 2.9 lbs. • Turning radius, 73".

16.95 Call for yours today.

YAESU FP-4 power supply

The FP-4 is designed for base station operation of the FT-7, FT-227R or similar transceivers. Provides a DC output of 13.8 volts at 4 amps. Also features overload & short-circuit protection threshold of 5 amps.

49.95 list price. Call for yours today.

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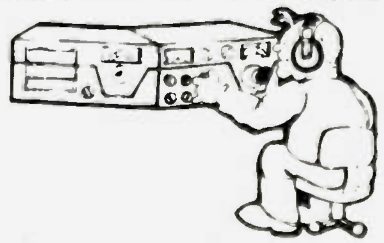

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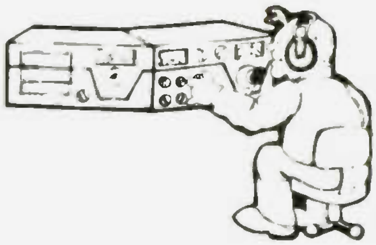
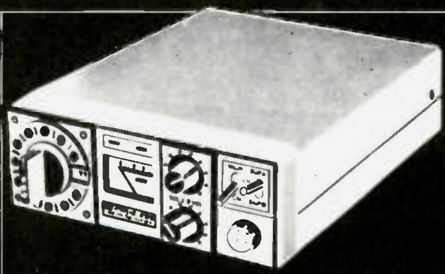


1-800-633-3410

KENWOOD TR-7400A
2m FM transceiver

Features: • CTCS provisions, encode and decode • 25 watt output RF • Solid-state final stage • LED readout • PLL gives 800 discrete channels • Repeater offset circuit • PLL unlock protection circuit • MOS FET.

399.00 list price. Call for quote.



ICOM IC-22S
FM transceiver

Features: • 22 channel radio • Frequency range: 146 to 148 MHz • Preset any 15 KHz channel in the frequency synthesizer by the diode matrix board • Excellent spurious attenuation • IDC type circuit controls modulation bandwidth • Output: 10W HI, 1W LOW.

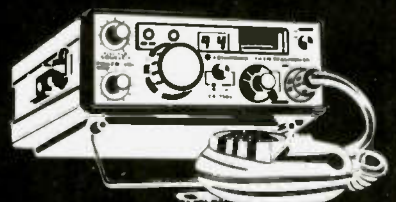
299.00 list price. Call for quote.

NEW PRODUCT

YAESU FT-7
HF transceiver

The NEW FT-7 features: • Frequency coverage: 10 thru 80 meters • Sensitivity: 0.5 micro volts for S/N 20 dB • Emissions: LSB, USB, CW • Input power: 20 watts DC • Completely solid-state, single knob tune-up • 100 KHz calibrator built-in • Semi-break-in with sidetone • Receiver offset tuning • Extremely compact for installation under dashboard.

499.00 list price. Call for quote.



KENWOOD TR-7500
2m transceiver

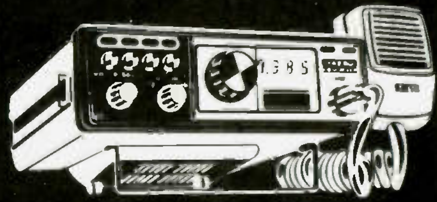
The TR-7500 has the features you need! • PLL synthesized • 100 channels (88 pre-programed, 12 extra diode programable • 1-know channel selection • 2 digit LED frequency display • Powered tone pad connection • 10 watts HI output, 1 watt LOW output.

299.00 list price. Call for quote.

ICOM IC-245
2m transceiver

• LSI synthesizer PLL • 4-digit LED readout • TX & RX frequencies are independently programable on any separation • Receiver front-end is a balance of low noise, high-gain MOS FET & 5 section filter • TX output: 10W PEP and more!

499.00 list price. Call for quote.



THE NEW YAESU
FT-227R "Memorizer"

Features: • One knob channel selection to select 800 channels • Memory circuit allows instant return to any frequency between 144-148 MHz • 4-digit LED readout • Selectable 10 watt/1 watt • PLL "unlock" protection circuit and busy channel indicator.

319.00 list price. Call for quote.

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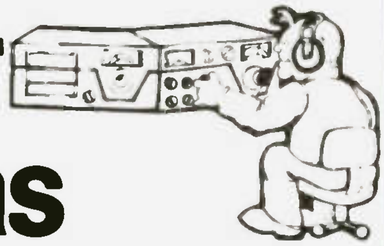
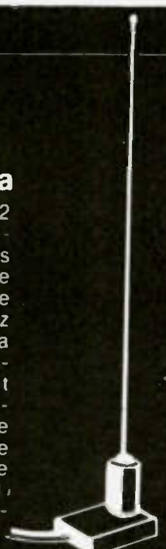


1-800-633-3410

LARSON LM-MM-150K 2m ⅝ mag mount antenna



The - wave length 2 meter antenna consists of a 49" stainless steel rod, quadruple plated, and coil for use between 144-174 MHz • A full 3dB gain over a wave length antenna. Magnet guaranteed permanent in ordinary use • Full capacitance coupling • Complete with 12' of RG-58 A/U coax & coax connector

38.45 Call for yours today

HUSTLER BBLT-144 ⅝ antenna

• 3.4 dB gain over wave antennas • 200 watts FM power rating • Whip & mount 52" high • 1.1:1 typical SWR at resonance • Sturdy stainless steel impact spring • 17-7 stainless radiator • Trunk lip mount, easy installation, no drilling

33.75 Call for yours today

NEW PRODUCT

B&W AT-200 2m antenna matcher

Use your automobile AM FM antenna for 2-meter mobile. Tunes 144-148 MHz • Front-panel tuning & loading adjustments • LED indicator to show when you have maximum output • VSWR Adjustable to 1.[illegible]:1 or less with most antennas • Power capacity 50 watts

24.95 Call for yours today

ANTLER A-280 2m mobile antenna

The A-280 is as close to the ideal antenna as you can get. Features:
• Precision tuned coil • 47" tapered 17-7 stainless steel whip • VSWR: less than 1.3 • Certified 3 dB gain • Magnetic mount has roof-top stability to withstand winds up to 100 MPH.

39.95 list price. Call for quote

HUSTLER RM resonators

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation. Power rating 400 watts SSB. Call for yours today.

RM-10 meter resonator	6.50
RM-15 meter resonator	6.95
RM-20 meter resonator	7.30
RM-40 meter resonator	13.20
RM-75 meter resonator	15.50
RM-80 meter resonator	15.95

ORDER TODAY

HUSTLER antenna accessories

MO-1 mast for deck or fender mount	22.00
MO-2 mast for bumper mount	22.00
RSS-2 resonator spring for either mount	5.65
BM-1 bumper mount fits any shape bumper	14.75
L-14-144 feed line 144" long with PL-259 connector & split lead	4.85

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The Two Hour, Two Meter Beam

—simple five-element loop yagi

William Thornburg WB9TNW
400 E. Jackson
Desoto IL 62924

The quad, or loop, antenna is a special antenna to me. Perhaps this is because of its antiquity. I remember old movies on TV where wireless operators used receiving "loops." And, on an often traveled highway near my home, an amateur had a tremendous triband quad array. I didn't recognize it for what it was until many years later, but I knew it had something to do with radio.

My need for a two-meter antenna became acute when I had to remove my old home brew wooden-masted ground plane from my tower to make room for a new steel mast, rotor, and triband beam system.

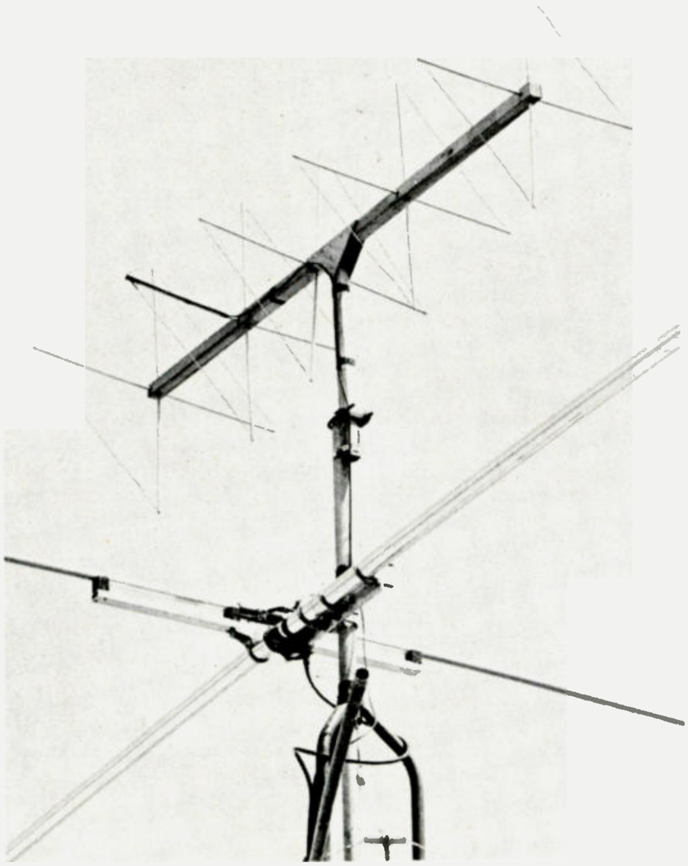
The excitement of an HF beam caused a virtual end to two meter activity. After a few weeks, I rigged up a mobile antenna on the top of a bookshelf and was able to trip the local repeater. However, my rig is a two-Watt affair, and I began to get complaints of a scratchy signal.

It only took a couple of days of rummaging through the *ARRL Antenna Book* and the *Radio Amateur's Handbook* to arrive at a plan: a quad for two.

I chose 146 MHz for a target frequency. The sizing of the passive elements is roughly a 3% series. For example, the reflector is about 3% larger than the driven element, the first director is about 3% smaller than the driven element, the second director is about 3% smaller than the first director, etc. For those desiring a different target frequency, start with a driven element which is (1005 x 12)/freq. in MHz inches around, and scale the passive elements according to the 3% rules.

A person who is experimentally minded might "adjust and test" in an attempt to optimize this antenna. Factors such as taper ratio, element spacing, wire size, and feed system all or partially affect forward gain, swr, feed impedance, bandwidth, and front-to-back. I was in a hurry and just slapped things together.

The construction of this antenna is simple, and the pictures tell it all. My old ground plane mast was an 8-foot two-by-two. I hacked it up into a 6-foot length for the boom and a



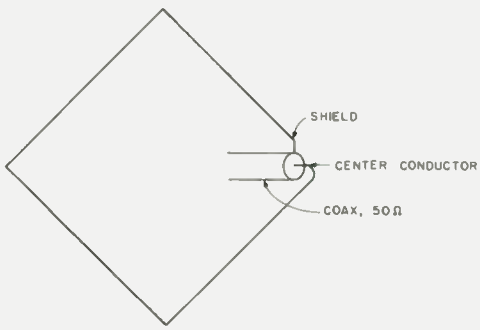


Fig. 1.

2-foot length for a shorty mast. The spreaders were made from 5/16″ wood dowel stock. Another good material would be fiberglass arrow shaft stock. You could even use balsa or spruce sticks. The critical dimensions are in Table 1.

Element	Length (inches)	Dowel length (inches)	Interelement spacing (inches)
Reflector	85	30	reflector to driven element—17
Driven element	83	29.3	driven element to first director—13
First director	80	28.3	first director to second director—16
Second director	77	27.2	second director to third director—21
Third director	74	26.2	

Table 1.

The elements were made from 18 AWG solid copper wire. Plastic insulated wire could be used. Magnet wire from old television power transformers would be perfect, and the price is right.

Each element requires two spreaders, so I used an offset of about 0.5 inches when I drilled my holes in the boom. A drill press is the ideal tool for this job.

I made my spreaders a shade longer because I notched the ends with a moto-tool to accommodate the wire. You could use tape or string for the same purpose. I used epoxy to glue the spreaders in the two-by-two boom, using straight pins to hold some of the loose ones.

When cutting the wire, allow an additional inch or two. When you solder the loops closed, snip the excess wire off.

My 2-foot mast was butt glued to the boom, and gusset plates of scrap ¼″ plywood were used. A few screws hold the wood together nicely while the glue hardens. The joint between the two-by-two mast and the pipe mast of my antenna installation was made using one U-bolt and one hose clamp, because that's all I could find at that moment.

I used the diamond configuration, and feed was applied at a side corner to achieve vertical polarization. No special matching was attempted. I just connected the ends of the coax in the loop. (See Fig. 1.) The passive elements are closed loops. The end of the coax could be potted with epoxy to keep water out. A touch of varnish would help preserve wood parts.

On the air, results were very satisfying. My friends report a 2 to 3 S-unit front-to-side and front-to-back ratio. In fact, with my two-Watt transmitter, I can hear stations that can't hear me.

According to the classical antenna theory, a 5-element yagi parasitic array has a forward gain of about 9.5 dB. This quad parasitic array seems to be behaving in a similar fashion. For the person who would like to bone up on quad theory, a suggested starting place is Hardy Landskov's article, "Evolution of a Quad Array," in the March, 1977, issue of *QST*. Also, my copy of the *ARRL Antenna Book* has always been a big help.

A special thanks goes to Mr. Lucius Smith for his photographic skill. ■

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NEW JBW 220 MHz REPEATER NOW AVAILABLE!

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PIPO TOUCHTONE PADS — COAX — ROTORS
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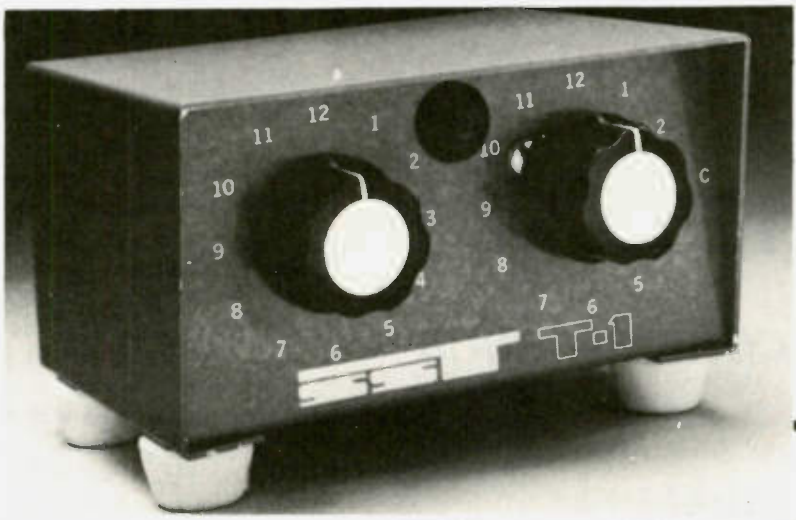
J9

SST T-1 RANDOM WIRE ANTENNA TUNER



All band operation (160-10 meters) with any random length of wire. 200 watt output power capability—will work with virtually any transceiver. Ideal for portable or home operation. Great for apartments and hotel rooms—simply run a wire inside, out a window, or anyplace available. Efficient toroid inductor for small size: 4-1/4" x 2-3/8" x 3", and negligible loss. Built-in neon tune-up indicator. SO-239 connector. Attractive bronze finished enclosure.

only $29.95

THE ORIGINAL Random Wire Antenna Tuner. . . in use by amateurs for 6 years.

SST T-2 ULTRA TUNER

Tunes out SWR on any coax fed antenna as well as random wires. Works great on all bands (80-10 meters) with any transceiver running up to 200 watts power output.

Increases usable bandwidth of any antenna. Tunes out SWR on mobile whips from inside your car.

Uses efficient toroid inductor and specially made capacitors for small size: 5-1/4" x 2-1/4" x 2-1/2". Rugged, yet compact. Negligible line loss. Attractive bronze finished enclosure. SO-239 coax connectors are used for transmitter input and coax fed antennas. Convenient binding posts are provided for random wire and ground connections.

only $39.95

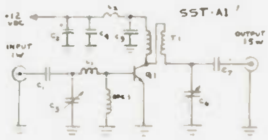
only $19.95

SST T-3
Mobile Impedance Transformer

Matches 52 ohm coax to the lower impedance of a mobile whip or vertical. 12-position switch with taps spread between 3 and 52 ohms. Broadband from 1-30 Mhz. Will work with virtually any transceiver—300 watt output power capability. SO-239 connectors. Toroid inductor for small size 2-3/4" x 2" x 2-1/4". Attractive bronze finish.

GUARANTEE

All SST products are guaranteed for 1 year. In addition, they may be returned within 10 days for a full refund (less shipping) if you are not satisfied for any reason. Please add $2 for shipping and handling. Calif. residents, please add sales tax. COD orders OK by phone.



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1 watt input gives you 15 watts output across the entire 2 meter band without re-tuning. This easy-to-build kit (approx. 1/2 hr. assembly) includes everything you need for a complete amplifier. All top quality components. Compatible with all 1-3 watt 2-meter transceivers. Short and open protected—not damaged by high SWR.

Kit includes:
- Etched and drilled G-10 epoxy solder plated board.
- Heat sink and mounting hardware. All components—including pre-wound coils.
- Top quality TRW RF power transistor.
- Complete assembly instruction with details on a carrier operated T/R switch.

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90260 · (213) 376-5887

S10

Now Try 1296 MHz

—simple discone antenna

John M. Franke WA4WDL
1006 Westmoreland Ave., Apt. 225
Norfolk VA 23508

Norman V. Cohen WB4LJM
7719 Sheryl Drive
Norfolk VA 23505

Ask most amateurs why they do not try the microwave bands, and you will receive four standard answers:

1. Nobody to talk to.
2. No commercial equipment available.
3. Communication is limited to line of sight.
4. Construction requires lathe and mill precision work.

The first reply is self-serving — if you get on the band, then there is another operator to talk to. The second reply is sadly true, with the exception of the Microwave Associates "Gunnplexer." The third reply reminds us of the response to two meter FM before repeaters came on the scene. The fourth is a myth — many of the pioneers in microwaves started with a soldering iron and tin snips. Good examples of what can be done with simple tools are the many fine construction articles by Bill Hoisington K1CLL.

This article shows how to construct simple and efficient broadband antennas for 1296 MHz and up. The construction is not difficult and can be done with simple hand tools. The antennas can be classified as inverted discones. You can find the theory of operation elsewhere; this will be concerned with the practical construction.

Fig. 1 shows a cross section of the inverted discone. The conic portion has a 60-degree apex angle. The cone's base and sides are all made three-eighths wave long at the lowest frequency of interest. Most texts specify this length to be one-quarter wave, but we have found that three-eighths wave gives a significantly lower vswr. The disc diameter is also three-eighths wave. The cone is made by cutting a semicircle

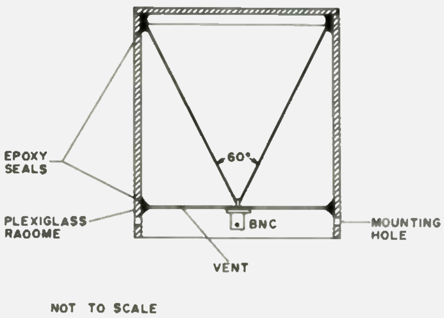

Fig. 1. Inverted discone antenna.

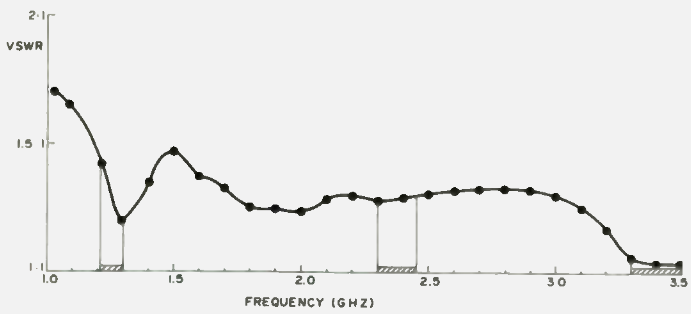

Fig. 2. Vswr of 100 mm inverted discone antenna.

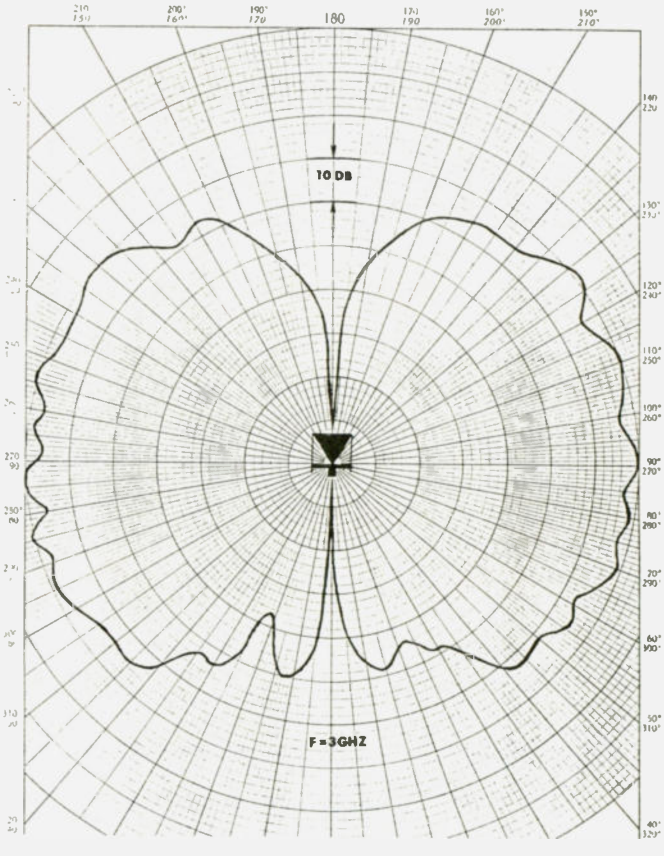

Fig. 3. Polar plot of 100 mm inverted discone.

from copper or brass sheeting with a radius equal to the desired length and rolling it into a cone. The edges are sweat soldered. The BNC connector is sweat soldered to the disc, and then the cone peak is soldered to the connector's center pin. The entire assembly is slid into a Plexiglas™ radome which serves to support the cone and weatherproof the antenna (see the photograph). If the radome is allowed to extend below the disc, it can serve as a convenient mounting ring. The antenna in the photograph has a base diameter of 4 inches (100 mm). The vswr from 1 GHz to 3.5 GHz is shown in Fig. 2. A typical radiation pattern is shown in Fig. 3. The antenna is vertically polarized. The horizontal radiation pattern is a circle. The useful bandwidth for an inverted discone is 5 to 1; a 1 GHz design is useful to 5 GHz. A smaller unit would be usable to still higher frequencies. ■

Joe Kasser G3ZCZ/W3
11532 Stewart Lane
Silver Spring MD 20904

The OSCAR Boppers

—turnstile antennas for 145 MHz and 432 MHz

This antenna is cheap and simple, is made out of aluminum angle and Plexiglas™, requires no special tools, and anyone can assemble it in less than 30 minutes.

The same basic design may be used for both 145 MHz and 432 MHz.

The dimensions of the elements and the matching sections are different for each band, of course, but the center section is the same.

Aluminum angle may be purchased in six-foot lengths. If one such length is cut into four equal pieces, it is the correct size for the two meter turnstile.

Joe Kasser with his two-dollar turnstiles.

The center piece, shown in Fig. 1, is a piece of Plexiglas ¼-inch thick and 1-inch square on a side. Four holes are drilled in each corner for mounting the elements and a center hole is drilled for mounting the whole thing to a mast. The holes can be measured and drilled ¼ inch away from the sides, or the elements can be placed into position and spot drilled using a drill press.

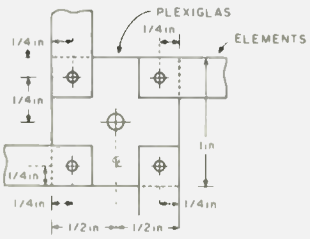

Fig. 1.

The elements are shown mounted to the center piece in Fig. 2. A no. 4 bolt passes through the center piece and element. A washer is placed on the bolt below the Plexiglas. A solder lug is placed on the bolt between the washer and the nut. The coax cable is soldered to the lug later.

The 70 cm antenna is made in the same way but with shorter elements. A reflector element can be placed beneath the driven element. The antenna can be fed in any manner that you wish, for circular or linear polarization. One technique is to mount the antenna facing north-south and feed each dipole in a linear polarization mode, switching antennas as necessary. A second technique is to use circular polarization, but that has to be changed when going from receive to transmit via OSCAR.

Results in Use

Both the 432 and 145 MHz versions have been used to access the AMSAT OSCAR 6 and 7 spacecrafts. The 432 MHz version was fed with 8 W of CW power, and 599 signal reports were received. The 145.9 MHz version was fed with 50 W of CW power, and signal reports of 569 were received.

For $2.00 and 30 minutes, you can't go wrong. ■

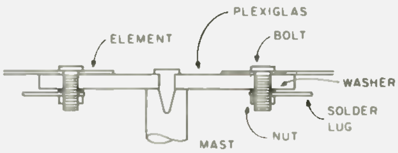

Fig. 2. Materials: Plexiglas block, 1" square, ½" thick; ¼" aluminum angle lengths; nuts, bolts, washers, and solder lugs.

Frequency	Element length	0.221 λ spacing	Reflector length
145.9 MHz	18"	not used	not used
432 MHz	5¼"	6 3/4"	6"

Table 1. Dimensions for the elements.

Synthesizer II

FOR 2 METERS

Kit – $169.95, Wired & tested – $239.95

The Synthesizer II is a two meter frequency synthesizer. Frequency is adjustable in 5 KHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 100 KHz to MHz. No additional components are necessary!

SPECIFICATIONS

- Frequency: 140.000 – 149.995 MHz
- Transmit offsets: Simplex, +600 KHz, – 600 KHz plus 3 additional field programmable offsets.
- Output: 3 volts to a 50 load
- Input voltage: 11 – 18VDC at .900 amps
- Size: 8" long x 5½" wide x 2¼" high
  20.32CM x 13.97CM x 5.715CM
- Complete kit including all electronics, crystal, thumb wheel switch, cabinet, etc.

FEATURES

- T^2L Logic
- Maximum offset versatility – easily programmed to any IF and transmitter offset between 100 KHz and 30MHz in even 100KHz increments (simple MARS modification available).
- Simple jumper wire change enables use on rigs with 6-8 or 12 MHz Transmit crystals.
- All frequencies locked to one master cyrstal oscillator
- 2 pole output filter on receive line.
- Virtually no measurable difference in spurious outputs between crystal or SYN II.
- Lockup time typically 150 milliseconds.
- Easily interfaced to most rigs.

Synthesizer 220

FOR 220 MHz

Kit – $169.95, Wired & tested – $239.95

Comparable with virtually all 220 transceivers; Clegg, Midland, Cobra, etc. . . .

The Synthesizer 220 is a 1¼ meter frequency synthesizer. Frequency is adjustable in 5 KHz steps from 220.00 MHz to 225.00 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 100 KHz to 10 MHz. No additional components are necessary!

SPECIFICATIONS

- Frequency: 220 – 225 MHz
- Transmit offsets: Simplex, +1.6 MHz, – 1.6 MHz plus 3 additional field programmable offsets.
- Output: 3 volts to a 50 load.
- Input voltage: 11 – 18 VDC at .900 amps.
- Size: 8" long x 5½" wide x 2¼" high
  20.32CM x 13.97CM x 5.715CM
- Complete kit including all electronics, crystal, thumb wheel switch, cabinet, etc.
- Shipping weight 2 lb. 4 oz.

FEATURES:

- T^2L Logic
- Maximum offset versatility – easily programmed to any IF and transmitter offset between 100 KHz and 30 MHz in even 100 KHz increments.
- Simple jumper wire change enables use on rigs with 18, 9, 6 MHz transmit crystals.
- All frequencies locked to one master crystal oscillator.
- 2 pole output filter on receive line.
- Virtually no measurable difference in spurious outputs between crystal or SYN 220.
- Lockup time typically 150 milliseconds.
- Easily interfaced to most rigs.
- Also available for 2 meters.

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Social Events

from page 26

Woodbridge Wireless, Inc. Attractions will include: QSL bureaus—learn how they work; FM clinic—sensitivity, deviation, and power checks; and CW proficiency awards—5 wpm and up. Indoor exhibit space is available for dealers. For information, contact Sam Lebowich, 9512 Sudley Manor Dr., Manassas VA 22110. Talk-in on 146.37/.97, 147.84/.24, and CB ch. 1.

MILTON PA
JUN 4

The 7th annual MARC (Milton Amateur Radio Club) hamfest will be held on June 4, rain or shine, at the Allenwood Firemen's Fairground located on US Rt. 15, 4 miles north of Interstate 80. The time is from 8 am to 5 pm. Advanced registration for sellers is $2.50; the gate is $3.00; XYLs and children free. There will be a flea market, an auction, contests, cash door prizes, a free portable and mobile FM clinic, and supervised children's activities. Indoor area available; food and beverages at reasonable prices. Talk-in on 37/97, 34/94, and 52 simplex. For further details, call or write Jerry Williamson WA3SXQ, 10 Old Farm Ln., Milton PA 17847, (717)-742-3027. Camping and motels nearby.

PORTLAND ME
JUN 10

The Portland Amateur Wireless Association will hold an amateur flea market on June 10, 1978, at the Red Coach Grill in Portland, Maine. Tables will cost $2.50 (shared tables are invited), and donations of $0.50 will be taken at the door. Donations will go toward door prizes which will be awarded during the day. The door will open at 9:30 am. The Red Coach is located at Exit 8 of the Maine Turnpike. Talk-in on .13/.73 or .52/.52 direct. For further information, write to P.A.W.A., PO Box 1605, Portland ME 04104.

WILLOW SPRINGS IL
JUN 11

The 21st annual ABC hamfest will be held on Sunday, June 11, 1978, at the Six Meter Club of Chicago, Inc. The location is southwest of Chicago at Santa Fe Park, 91st and Wolf Road, Willow Springs, Illinois. Advance registration is $1.50. It will be $2.00 at the gate. There will be a large swap row, color TV, and many other goodies. Picnic grounds and plenty of parking space will be available. Come see the displays in the pavilion and attend the AFMARS meeting. Talk-in on 146.94 FM or WR9ABC 37-97 (PL2A). Get advance tickets from Val Hellwig K9ZWV, 3420 South 60th Court, Cicero Il 60650.

NEWBERRY MI
JUN 11

The S.P.A.R.K. annual swap and shop will be held from 9:00 am to 4:00 pm at the Pentland Township Hall, on M-28, on Sunday, June 11, 1978. Plenty of tables and chairs will be available, plus a nonsmoking area. There will be demonstrations of hobby computers and how they work, an MARC discussion, a Q.C.W.A. area for get-together and visitation, a YL and XYL craft table and a white elephant sale. Bring your QSL card for display and judging for prize. A bake sale will be sponsored by S.P.A.R.K. YLs and XYLs. Ample parking facilities with attendants—easy unloading (feel free to ask a S.P.A.R.K. member to assist you). Food and beverages served throughout the day. Exhibitors may set up Saturday afternoon and evening. Security will be on duty in the building throughout Saturday night to eyeball. Donations will be $2.00 for registration and drawings. Tables will be $1.50 and $2.50. All activities are designed for family participation. For advance tickets, reservations, and information, contact Larry Baine W8GBR, Box 67, Newberry MI 49868, (906)-293-8651, R. J. Beach W8NBJ, 115 E. Avenue "A", Newberry MI 49868, (906)-293-8425, or Herb Miller W8SUN, RFD 1, McMillan MI 49853, (906)-586-9661.

GRANITE CITY IL
JUN 11

The annual hamfest of the Egyptian Radio Club W9AIU will be held at the club grounds on Sunday, June 11, 1978.

MONROE MI
JUN 11

The Monroe County Amateur Radio Club's annual swap and shop will be held on Sunday, June 11, at the Monroe County Community College, Monroe, Michigan, from 8 am till 4 pm on Raisinville Road off M50. Talk-in on 146.13/73. $1.00 donation at the gate. Free tables and trunk sales. Plenty of refreshments.

AKRON OH
JUN 11

The Goodyear Amateur Radio Club will hold its 11th annual hamfest and family picnic on Sunday, June 11, at Wingfoot Lake Park from 10:00 am to 6:00 pm. The park is southeast of Akron on County Road 87 near Rte. 43. There will be five main prizes, plus many others, ample parking, shelters, picnic facilities, kids' play areas, and refreshments. Sorry, no overnight parking. Flea market and display space is free to ticket holders. Family donation is $2.50 in advance, $3.00 at the gate. For details, write Don Rogers WA8SXJ, 161 S. Hawkins Ave., Akron OH 44313, or phone (216)-864-3665.

SALT LAKE CITY UT
JUN 17

The Utah Council of Amateur Radio Clubs will sponsor a statewide ARRL hamfest at the Talorsville Park in Salt Lake City on June 17. Activities will include an ARRL forum, MARS meetings, an ATV forum, a TTY forum, a radio control demonstration, a VHF-UHF weak signal forum, an OSCAR demonstration, a personal computer forum, and a search and rescue forum. Also on the program are contests, including CW, transmitter building, antenna efficiency, transmitter hunts, home brew and treasure hunts. Other activities planned are dealer displays, swap tables, movies, QSL board, ladies' and kids' activities, a hot-air balloon demo, a barbecue, door prizes, two meter crystal swap, and an equipment auction. Camping, trailering, and motel facilities are close by. Preregistration is $3.00 for adults and $1.00 for kids under 13. Inquiries and preregistration fees should be sent to the Utah Council of Amateur Radio Clubs, PO Box 18563, Salt Lake City, Utah 84118.

PORTAGE IN
JUN 18

The fifth annual "Dad's Day" hamfest, sponsored by the Lake County Amateur Radio Club, N.W., IN, will be held on June 18 from 8 am till 5 pm. There will be food, drink, door prizes, and fun. It will be held at the Izaak Walton League picnic grounds in Portage, Indiana, 30 minutes from Chicago. Take I-94 to Indiana 249, Portage exit, go north ½ mile, and turn right at the hamfest gate. Overnite camping—no hookups. Talk-in on 146.52 or 147.84/.24, W9LJ-WR9AMU. Tickets will be $2.00 at the gate or $1.50 in advance. Send check to: Tickets, PO Box 348, Griffith IN 46319.

BARNESVILLE PA
JUN 18

The Schuylkill Amateur Repeater Association will sponsor a hamfest on Sunday, June 18, 1978, rain or shine. Gates will open at 9:00 am. The hamfest will be held at Lakewood Park, Barnesville PA, along Route 54, 3 miles east of Exit 37 on Interstate 81. Talk-in on 147.78/18 and 146.52 simplex. Registration is $2.00; XYL and children are free. Amusement rides, picnic tables, and refreshments available on the park grounds. Large indoor and outdoor flea market area. For more information, write Carl H. Zimmerman

W3EEK, RD #2, Box 580, Tamaqua PA 18252.

FREDERICK MD
JUN 18

The first annual Frederick Amateur Radio Club of central Maryland hamfest will be held on Sunday, June 18, 1978, at the Frederick fairgrounds on East Patrick Street, Frederick MD. There will be prizes, exhibits, and demonstrations. Food and drink (country cooking) will be available. Grounds open at 6 am for commercial displays and at 8 am for general admission (YLs and children free). Main prize drawing at 2 pm. Inside and outside tables available, as well as tailgating. Talk-in on 146.52, 13/73.

ORCUTT CA
JUN 18

The Satellite Amateur Radio Club will hold its annual swap/funfest and Santa Maria barbeque on Sunday, June 18. Join us for the best steak and biggest hamfest in the west. Fantastic prizes! Swap tables available. Try the all-you-can-eat dinner for $6.00 for adults and $3.00 for children under 12. Contact Tom Geiger W2KVA/6 at (805)-925-0398, or write to Swapfest, PO Box 2531, Orcutt CA 93454.

JACKSONVILLE IL
JUN 18

"The little hamfest with a lot of prizes and good eyeball QSOs" will be held on June 18, 1978, at the Morgan County Fairgrounds. Talk-in on 146.40/147.00 W9TZL/9. Tickets in advance are $1.50 each or four for $5. For information, write to JAARC, Box 571, Jacksonville, Illinois 62651. You need not be present to win.

RAPID CITY SD
JUL 1-2

The annual South Dakota hamfest will be held on July 1 and 2, 1978, at Surbeck Center on the campus of the South Dakota School of Mines and Technology, Rapid City, South Dakota. There will be technical forums, an ARRL forum, a flea market, and industrial tours. The grand prize will be a Kenwood TS-520S; the preregistration prize will be a Kenwood TR-7500. Admission is $4.50 in advance (before June 1) or $5.00 at the door. Plan to include this on a vacation to the Black Hills for the July 4th weekend. We recommend early reservations for accommodations. For more information and/or assistance with reservations, write to Black Hills ARC, Box 1014, Rapid City SD 57709.

CUMMINGTON MA
JUL 8-9

The Northern Berkshire Amateur Radio Club's hamfest will be held on July 8th and 9th at the Cummington Fair Grounds, Cummington, Massachusetts. There will be free overnight camping, technical talks, demonstrations, and dealers. The flea market will cost $1. Admission will be $4 or, with spouse, $6. Advanced tickets are $3 and $5. For information write: Hildy Sheerin WA1ZNE, 89 Greylock Terrace, Pittsfield MA 01201.

INDIANAPOLIS IN
JUL 9

The Indianapolis hamfest will be held on Sunday, July 9, 1978. The gates will open from 6:00 am to 4:30 pm. The place is the Marion County Fairgrounds, S.E. corner, in Indianapolis, Indiana. There will be professional commercial exhibiting, a covered flea market, and an unlimited outside flea market. Overnight camping facilities with hookup are available. For information, write to Indianapolis Hamfest, PO Box 1002, Indianapolis IN 46206.

ESSEX MT
JUL 15-16

The International Glacier-Waterton Hamfest will be held on July 15-16, 1978, in the West Glacier Area, Montana. The location will be at the Three Forks Campground, 10 miles east of Essex MT on U.S. Highway 2. Registration begins at 9:00 am MST.

BOWLING GREEN OH
JUL 16

The Wood County, Ohio, 14th annual Ham-a-Rama will be held on Sunday, July 16, at the fairgrounds in Bowling Green (just off I-75). Gates open at 10:00 am. Admission and parking are free. Tables are available for $3.00 or 8-foot spaces for $2.00 (advance table or space rental to dealers only). Trunk-sale space and food will also be available. There will be a main prize drawing and lots of door prizes. K8TIH talk-in on 146.52 simplex. Tickets are $1.50 in advance, $2.00 at the door. Write to Wood County Amateur Radio Club, c/o Eric Willman, 14118 Bishop Road, Bowling Green, Ohio 43402.

MARSHALL MO
JUL 23

The Indian Foothills Amateur Radio Club, Inc., will hold its third annual hamfest on July 23, 1978, in an air-conditioned

Continued on page 175

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CN-144	39
TX-62	79
621 VFO	45

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Nuvertor 2+6 Conv.	$ 75
6100 SSB Xmitter	395
670 SSB Adaptor	39
Co Dax Keyer	95

Central Electronics

100V Transmitter	325
MM-2 Scope	69
20-A SSB Adaptor	79

Clegg

22'er FM	$129
66'er 6M Xcvr	115
99'er 6M Xcvr	59
Interceptor BRCUR	275
Ant Pre Amp	22
All Bander	69
HT-146	125
2 Vess	259
FM-27-B Xcvr	325

Collins

75 A4 Receiver	$395
75S3B Receiver	695
75S1 Receiver	349
KWM-2 Xcvr	595
32S1 Xmitter	349
PM-2 AC Supply	95
516 F2 AC Supply	139
312B5 Console	425
361D2 Mount	29

Drake

2A Receiver	$149
2B Receiver	189
2AQ SPKR QMULT	29
R4 Receiver	289
R4-B Receiver	349
R4-C Receiver	399
MS-4 Speaker	19
2NT Transmitter	125
2NT Transitter	99
TR-6	695
TR-22 2 Meter	140
T-4X Transmitter	339
TR-72 2 Meter FM	225
AC-4 AC Supply	95
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CC 1 Console	
CPS-1 Supply	
SC 2 Conv	
SC 6 Conv	
SC-1 Calibrator	
The above all assembled complete pkg.	Only $200

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10-0 2 M Ampl	$125
35-0 401N 110 Out	130
470 25 450 MC	120
P 1416 16 Amp Supply	95

Eico

720 Transmitter	$ 49
722 VFO	39
730 Modulator	39

Eimac

AF-67 Transmitter	$ 45
PMR-8 Receiver	79

Genave

GTX22M FM	$165
GTX-200 2M FM	149

Globe/Galaxy

VHF 6+2 Transm	$ 39
Chief Transmitter	39
Galaxy III Xcvr	159
Galaxy V Xcvr	189
Galaxy V Mk II	239
GT-550 Xcvr	279
GT-500A Xcvr	329
AC-400 Supply	79
FM-210 2M FM	95

Gonset

Com II 2M	$ 75
Com II 6M	69
Com IV 2M	129
GC-105 2M	115
G-28 Xcvr	149
G-50 Xcvr	149

Hallicrafters

S-108 Receiver	$ 99
SX-101 Receiver	159
HT-32 Transmitter	179
HT-32B Transmitter	269
SX-99 Receiver	79
SX-115 Receiver	349
HT-37 Transmitter	159
HT-40 Transmitter	49
SX-99 Receiver	99
SX-117 Receiver	189
SR-150 Xcvr	259
SR 160 Xcvr	159
SX-146 Receiver	175
HT-44 Transmitter	159
SX 111 Receiver	149
SX-122 Receiver	249
S-36 UHF Receiver	125

Hammarlund

HQ-110 A VHF Receiver	$189
HQ 110C Receiver	119
HQ-110AC Receiver	149
HQ-145X Receiver	169
HQ-170C Receiver	159
HQ-180 Receiver	379
HQ-215 Receiver	259
SP 600 Receiver	179
HX-50 Transmitter	169

Heathkit

SB-300 Receiver	$199
SB-301 Receiver	229
HR-10-B Receiver	69
SB-303 Receiver	269
SB-220 Linear Amp	449
SB-102 Trivcvr	379
DX-60B Transmitter	69
HW-32 Transmitter	85
HW-100 Transceiver	249
SB-100 Transceiver	299
SB-401 Transmitter	249
SB-101 Transceiver	349
SB-650 Digital Freq. Display	149
HW-30 Twoer	29
Also Sixer	29
H-10 Monitor	69
VHF-1 Seneca	79
HW-12 Transmitter	75
HP-23 AC Supply	49
HP-23B AC Supply	59
HW-202 2M FM Xcvr	159
SB-620 Spectrum Analyz	120
SB-102 Xcvr	369
SB-610 Scope	95
HA-20 6m Linear	125
SB-634 Console	175
SB-604 Spkr	29.50
SB-644 VFO	129.50
SB-230 Linear	359
SB-104 Transceiver	625

ICOM

IC-21 2M FM Xcvr	$299
IC-230 Demo	369
IC-22A 2M FM Xcvr	185
IC-30A 432 MCFM	269

Johnson

1 KW Matchbox/SWR	$195
Courier Linear	139
Ranger I Transmitter	85
Ranger II Transmitter	139
Valiant I Transmitter	129
Invader 2000 Xmitt	495

Kenwood

T-599 Transmitter	$289
R 599 Receiver	289
TS 520 Tranc	429
QR 666	259
QR-666 Receiver	239
TV 502 Transvertor	179

Knight

T-60 Transmitter	$ 39
r-100 Receiver	59
TR 108 Trancur 2M	79

Lafayette

HA-800 Receiver	$ 89
HP-350 Receiver	149
HE-45 Transceiver	49

Midland

509 H.T.	$149

Millen

92200 Transmatch	$149
90651-A Grid Dipper	95

National

NC-270 Receiver	$119
NC-300 Receiver	129
NCX-5 Transceiver	279
NCX-5MKII Transcvr	299
NC-303 Receiver	199
AC-500 AC Supply	69
NCX-500 Transceiver	199
NCX-3 Transceiver	169
NC-190 Receiver	149
NC-105 Receiver	69

Regency

HR-2B 2M FM	$169
HR-220 FM 220 MC	185
AR-2 2M Amplifier	85
HR-25 2M FM	225
HR-6 Meter FM	189

SBE

SB-34 Transceiver	$249
SB-33 Transceiver	189
SB-144 2M FM	175
SBZ-LP Linear	179

Standard

SRC 146 HT	$149
826 M Trnscvr	195
SRC-144	395
SRC-851T	250

Swan

700-CX Xcvr	$459
260 Cygnet	289
279 Cygnet	329
500 Xcvr	299
500 CX Xcvr	389
117 XC AC Supply	95
14X DC Module	39
MK II Linear	475
KK VI 6 Meter	550
250 C 6M Xcvr	349
FM 2X2M Xcvr	169
FM 1210A 2M	249
350 Transceiver	269
350C Xcvr	299
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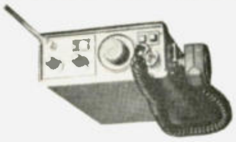

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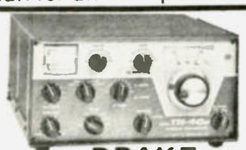

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Cushcraft Does It Again!

—their new tribander is a winner

David B. Perrin K1OPQ
RFD #1, Tyler Dist.
Contoocook NH 03229

Now that we (my family and my beam) have survived the winter, it is time to rebuild, replace, or at least discuss putting up a new antenna. For those on the low bands, this may mean a new beam. Whether you buy or build depends on many things—such as amount of time, availability of necessary antenna designing equipment, mechanical knowledge of assembling a beam, and hardware and machining equipment to make brackets and element and boom supports.

A year ago, I found myself in this position: My four-year-old three-element tribander, which had been up for two years at my QTH, had transformed itself into a rotatable dipole by winter's end. What was left of it could not handle more than 1 kW PEP. Thinking of alternatives, I quickly dispelled the possibility of separate beams—they would be too expensive, my 40-foot self-supporting tower wouldn't handle the mass, and I didn't want to create a landmark, just a good antenna for 20, 15, and 10 meters. Although I would like to try a quad, I still don't believe that a quad can last as well as a beam. (I suspect, though, that it will outperform a beam while it's up and working.)

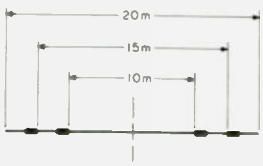


Fig. 1.

Since I've had three triband beams, which were up forty feet and supported in a variety of ways at three locations, since 1961, I knew what I wanted. The new beam would have to meet the following requirements:

1. reasonable price;
2. more rugged boom-to-mast and boom-to-element supports;
3. able to withstand the New Hampshire ice, wind, and snow;
4. uncomplicated design;
5. use of locally available hardware;
6. ability to adjust swr on each band separately;
7. single line feed;
8. competitive specifications with other triband beams;
9. 2 kW PEP power capability (may be needed someday);
10. good performance on all three bands;
11. ability to stay up and together;
12. good customer service when needed.

The decision not to design and build a triband beam was easy—I didn't have enough time. There are things other than antennas in life and, from what the XYL and IRS say, other than ham radio, too.

Cushcraft has designed a four-element triband beam with impressive specifications, complete with balun and a reasonable price. I compared and reviewed specifications and then visited the new Cushcraft plant in Manchester NH to check the various aspects of design and construction which concerned me. The beam looked good on paper. The construction was as rugged as more expensive antennas and it was simple—all standard parts and proven ideas. The decision was made.

My new Cushcraft ATB-34 (3 bands, 4 elements) arrived by UPS in early September. The delivery man must have been tired—he claimed it was over fifty pounds. However, the manufacturer had assured me that the total package was designed realizing weight and size limitations in shipping.

Taking a tip from building kits, when I opened the package, the first thing I did was check for all the parts, to the last bolt—no problem. Then I made the assembly area off limits to anyone without a ham license to avoid losing parts. The traps come not fully assembled, so you can get a look at this part of the design. With my other beams, the traps had been just bumps, keeping the design a total secret.

Assembly of this 18-foot boom antenna is no problem, but I do have a few comments. The instructions say that you don't need a tape measure to assemble it. I say you do—who can make an antenna without a tape measure? Make certain that you read, and understand, the instructions before you begin assembly. One shortcoming is that the various pieces for each of the elements are not color coded, packaged separately, or in any other way kept separated from other element pieces. It's confusing, so first check each trap (they are coded), measure all element pieces for each element, and check these lengths with the parts list. The parts list does tell you the length and diameter for each part of each element.

Once the pieces were sorted so that I knew which element I was assembling, everything went together fairly smoothly. When the elements were finally on the boom, I made certain that they were all in the same plane by eyeballing the elements from the end of the boom. I figured out the placement of the boom-to-mast support by attaching a rope near the center of the boom, lifting the antenna off the ground, and adjusting the rope to find the exact center of gravity. The boom-to-mast plate was centered at this point. Next, I carefully leveled the entire antenna and adjusted this plate to be perpendicular to the driven element by using a small level. Before getting the antenna to the top of the tower, check to see that the U-bolts and V-blocks for the mast will all line up and fit through their holes in the boom-to-mast plate. A few taps on the U-bolts with a soft-faced persuader (mallet) should do it.

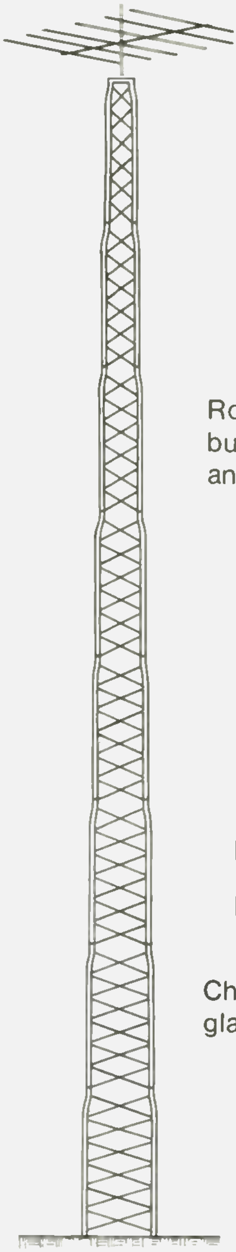
With the beam completely assembled, connect an swr bridge at the balun and connect the length of RG-8/U to your exciter. Lean the beam, with the boom vertical (or close to it), up against your tower or house. Have the reflector supported off the ground on a couple of wooden chairs. Now, go get a beer and call your friends. Load the rig on your favorite portion of 10 meters, and adjust the length on each side of the driven element, making it equal to the first set of traps, until the swr is as low as it will go. (See Fig. 1.)

Usually, the length will be close, but you can get the swr closer to 1:1 if you try. Then load up your rig on 15 meters and adjust the length of the driven element between the two traps. Make sure that the element sections on each side of the boom are adjusted evenly. Next, load up on 20 meters and adjust the length of the driven element beyond the second trap to the end of the element. Go back and check the swr on each band, and then check all mechanical and electrical connections. Now you are ready to install the beam in the air.

At 42 pounds, this beam is not light, nor is it small, so don't try walking it up your tower. I raised it using a homemade gin pole and tied it off so I could attach it to the mast and not have to support the weight of the antenna. It went up more easily than I expected, but that was because I forgot to invite Murphy. When raising any antenna, think safety—it's not worth the risk not to.

Once this beam was up, I realized in short order that it would outperform any of my previous beams. The directivity is considerably sharper. Even at 8000 miles or better, a swing of 20° will cancel DX. The front-to-back ratio, at around 25 dB, and front-to-side ratio are excellent . . . ah, to be able to swing the antenna and QSB the QRM without QSYing. The beam is at a modest height, but it outperforms my wire antenna at fifty feet by 30 dB on receive. This beam works very well, though I have no figures, since my reference antenna isn't isotropic and it wouldn't be fair.

At this point, I question whether a larger triband beam would be worthwhile. Perhaps I'll try one this summer, just for the fun of it, when I finish the 90-foot tower. ■



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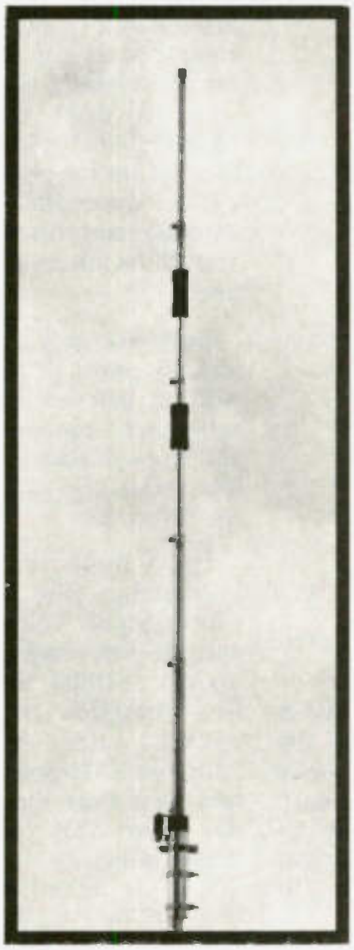
T18

NEW HF VERTICALS BY CUSHCRAFT

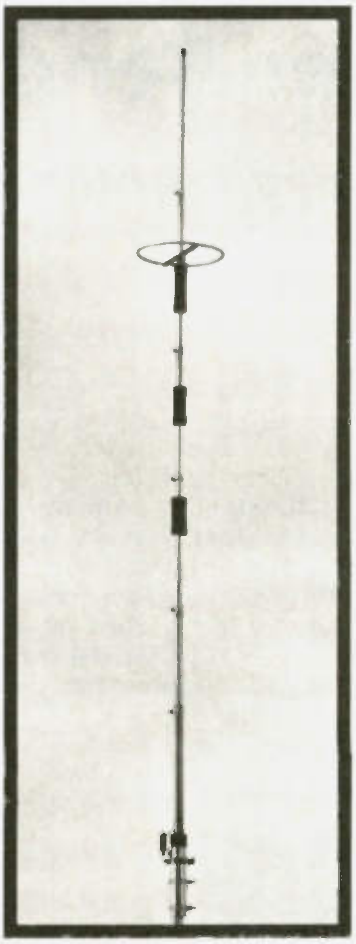
Cushcraft's new multiband vertical antenna systems have been optimized for wide operating bandwidth and provide the low angle of radiation which is essential for long haul DX communications on the high frequency amateur bands. The high Q traps which were designed especially for these verticals use large diameter enamelled copper wire and solid aluminum air dielectric capacitors; the trap forms are manufactured from filament wound fiberglass for minimum dielectric loss and high structural strength. High strength 6063-T832 aluminum tubing with 0.058" (1.5 mm) walls is used for the vertical radiator. The massive 2 inch (50 mm) OD double-walled base section and heavy-duty phenolic base insulator ensure long life and durability. For maximum performance with limited space, choose a Cushcraft multiband vertical; all models may be roof or ground mounted on a 1¼" - 1⅞" (32 - 48 mm) mast.

10-15-20 METERS



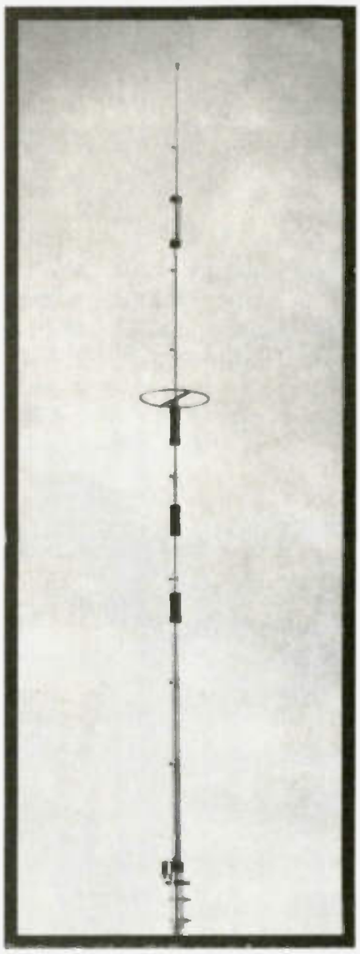
ATV-3 Cushcraft's ATV-3 multiband vertical provides low VSWR operation for both SSB and CW on 10, 15, and 20 meters. Matched to 50 ohms, built-in connector mates with standard PL-259. Stainless-steel hardware is used for all electrical connections. The ATV-3 is a compact 166 inches (4.2 meters) tall. Rated at 2000 watts PEP.

10-15-20-40 METERS

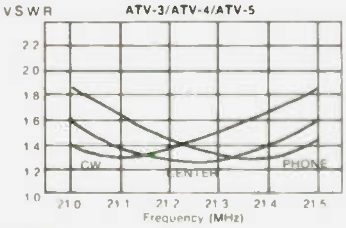


ATV-4 The Cushcraft ATV-4 four band vertical antenna has been optimized for wide operating bandwidth on 10, 15, 20, and 40 meters. SWR is less than 2:1 over the CW and SSB segments of 10, 15, and 20. The 2:1 SWR bandwidth on 40 meters is approximately 240 kHz, may be quickly and easily adjusted to favor any part of the band. Coaxial fitting takes 50 ohm transmission line with PL-259 connector. Overall height, 233 inches (5.9 meters). Rated at 2000 watts PEP.

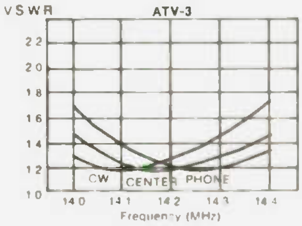
10-15-20-40-80 METERS



ATV-5 The ATV-5 trapped vertical antenna system has been engineered for five band operation on 80 through 10 meters. The high Q traps are carefully optimized for wide operating bandwidth. 2:1 SWR bandwidth with 50 ohm feedline is 1 MHz on 10 meters, more than 500 kHz on 15 and 20 meters, 160 kHz on 40 meters, and 75 kHz on 80 meters. Instructions are provided for adjusting resonance to your preferred part of the band, CW or SSB. Built-in coaxial connector takes PL-259. Nominal height, 293 inches (7.4 meters). Rated at 2000 watts PEP on **all** bands.

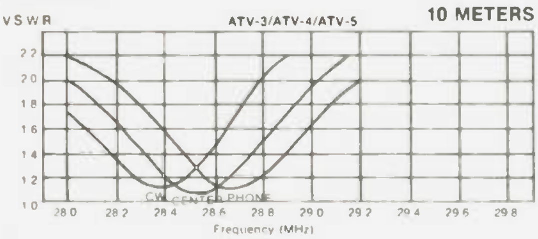


15 METERS



20 METERS

10 METERS



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The S-Meter Bender

—W7DND's magic antenna

"Unique" means one of a kind. Many things are loosely called unique, but I believe that this antenna is really one of a kind. It belongs to Tom Erdmann W7DND of Bremerton, Washington.

Although the antenna is usually pointed down the west coast, once in a while Tom turns it to the east. When he does, many an S-meter swings to the right toward the pin on 40 meters.

A great many hams have asked about the antenna, and, to some, Tom has sent photos. Most of them, however, don't really have a clear conception of what the array really is — only what it does to their S-meters. I have, therefore, asked Tom for photos and a clear description of the antenna, and this will give you all the information you need.

Basically, it is a pair of phased vertical antennas with a pair of parasitic reflectors, spaced about 65′ apart broadside, with the reflectors 20′ behind the driven pair.

Fig. 1 shows the circuit information. The antenna was originally voltage fed, and the box shown in the photos contains the tuner for protection from the weather. Lately, however, Tom has changed to current feed, thus eliminating the tuner. This circuit is shown in Fig. 2.

He has added six ele-

Tom Erdmann, with one 40 meter vertical mounted on the corner of the boom clearly shown.

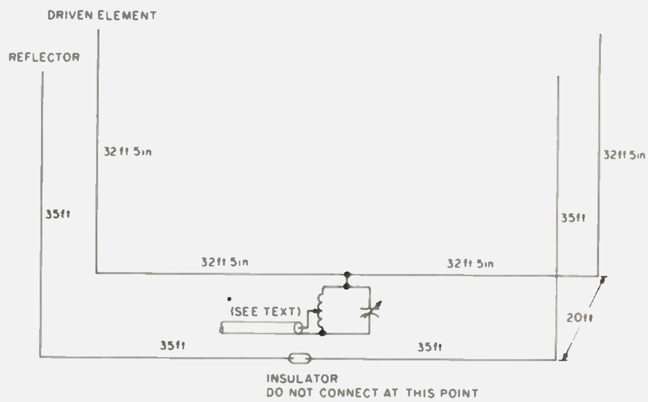


Fig. 1. 40 meter four-element vertical beam, voltage fed.

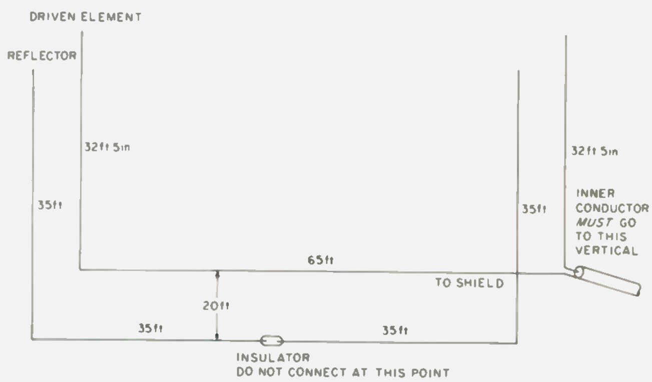


Fig. 2. 40 meter four-element vertical beam, current fed.

ments on 15 meters, and this array is shown in Fig. 3.

Tom is shown standing beside his creation, which will give you a feeling of its size.

The boom is made of 2 × 4s, was built in 1961, and has gone through winds up to 85 miles per hour. The array weighs about 900 pounds and is supported from the top of the 32′ telephone pole by ten nylon ropes. At the bottom, it rests on a bearing, which Tom keeps well greased.

It is rotated by hand and has a 12′ 2″ × 3″ wooden piece which serves both as a chock to prevent rotation in the wind and as a handle to raise up and rotate the array.

It is not likely that many hams will care to build such a heavy boom for an antenna, but the same principles used here can be applied to wire and masting arrays in a fixed position.

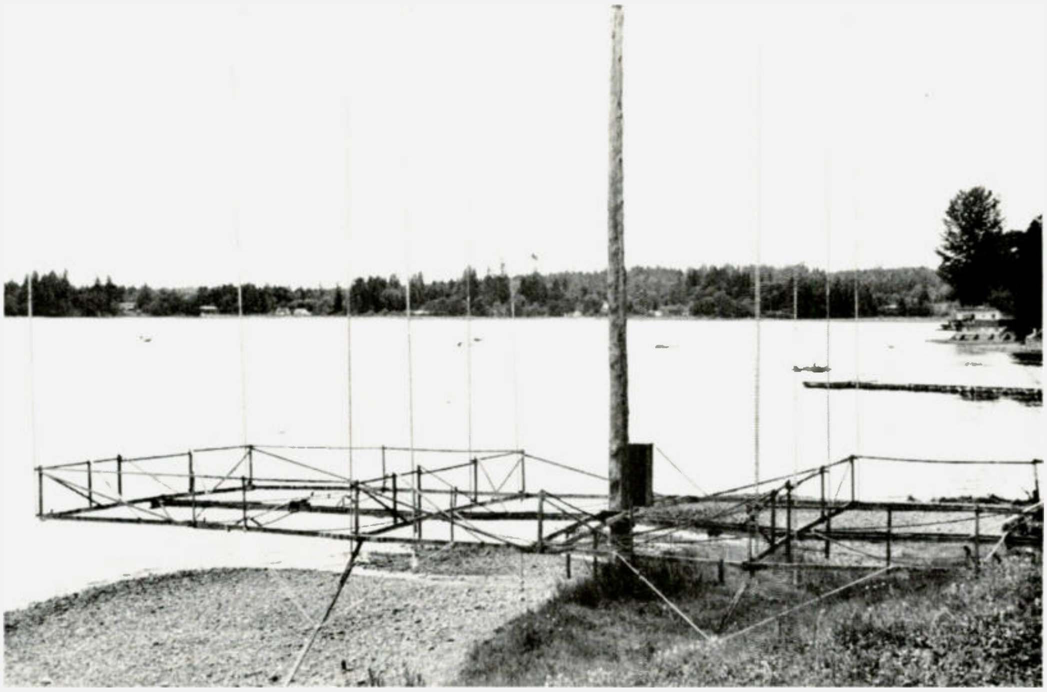
This will be good news for those who cannot find the space or energy for buried ground radials. Since the connecting wire is a half wave, it acts as a counterpoise for each antenna, completing the array.

You have probably noticed that the photographs show four elements in each of the 15 meter beams. This was the way the array was originally set up. However, the angle was too low, so Tom removed one of the directors. Thus, there are three elements in the text and the drawings.

His new array will be four vertical three-element beams on 15 meters.

He is planning to remove the four 40 meter antennas and replace them with two more three-element 15 meter arrays, making 12 elements on 15 meters, which is now his favorite band.

The 15 meter antennas are half-wave verticals voltage fed at the bottom.



The water in the background is Puget Sound. The beam is pointed south and the camera is facing south. The four 15 meter verticals shown have been changed to three (see text).

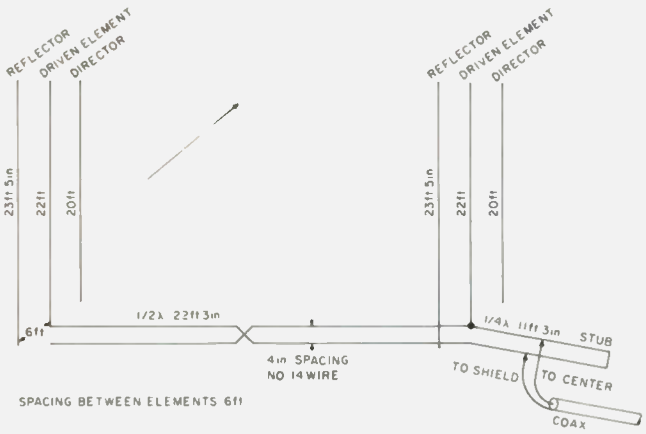
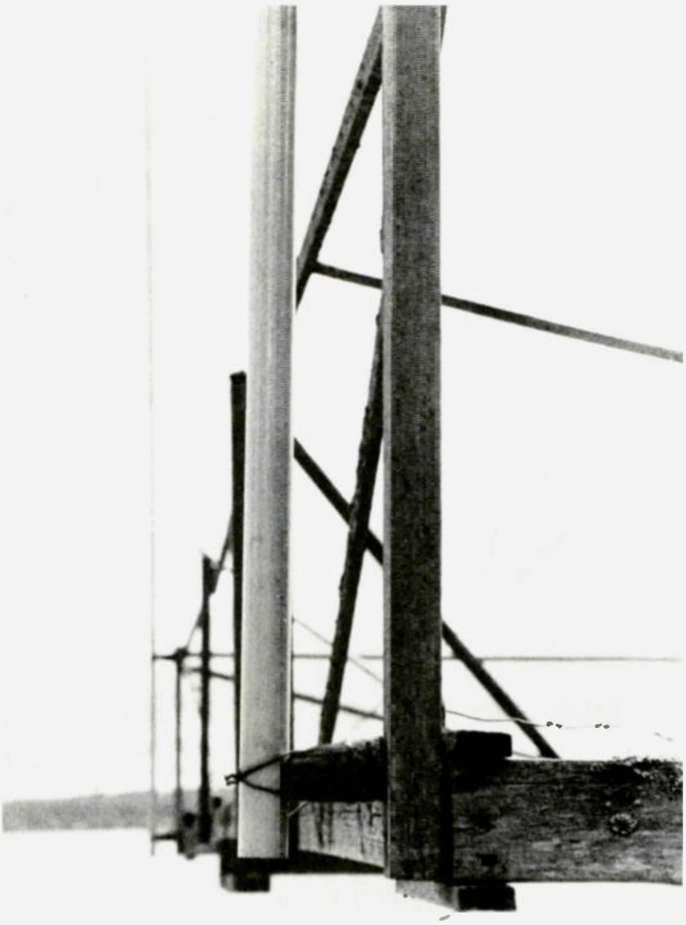
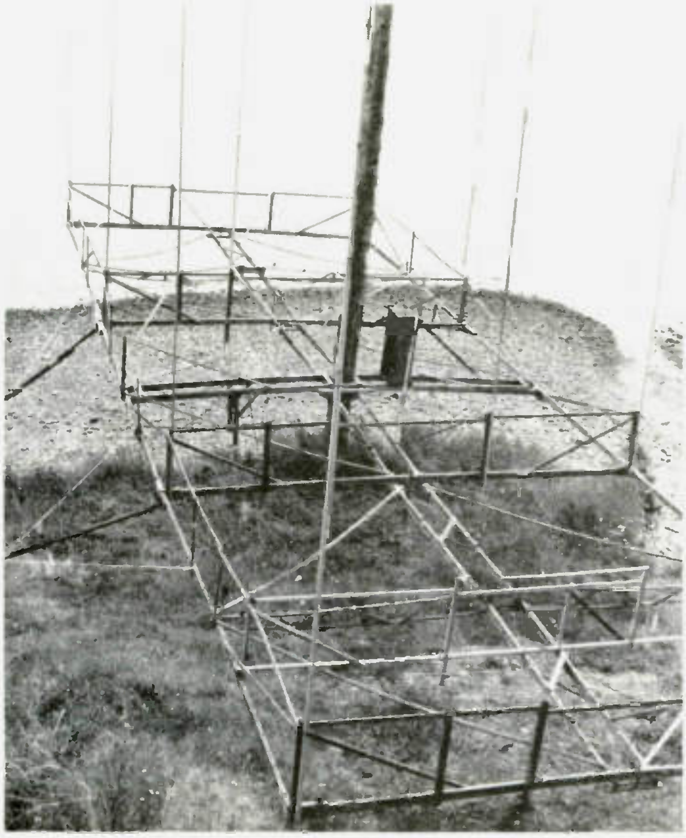


Fig. 3. 15 meter six-element vertical beam, half-wave end-fed elements.

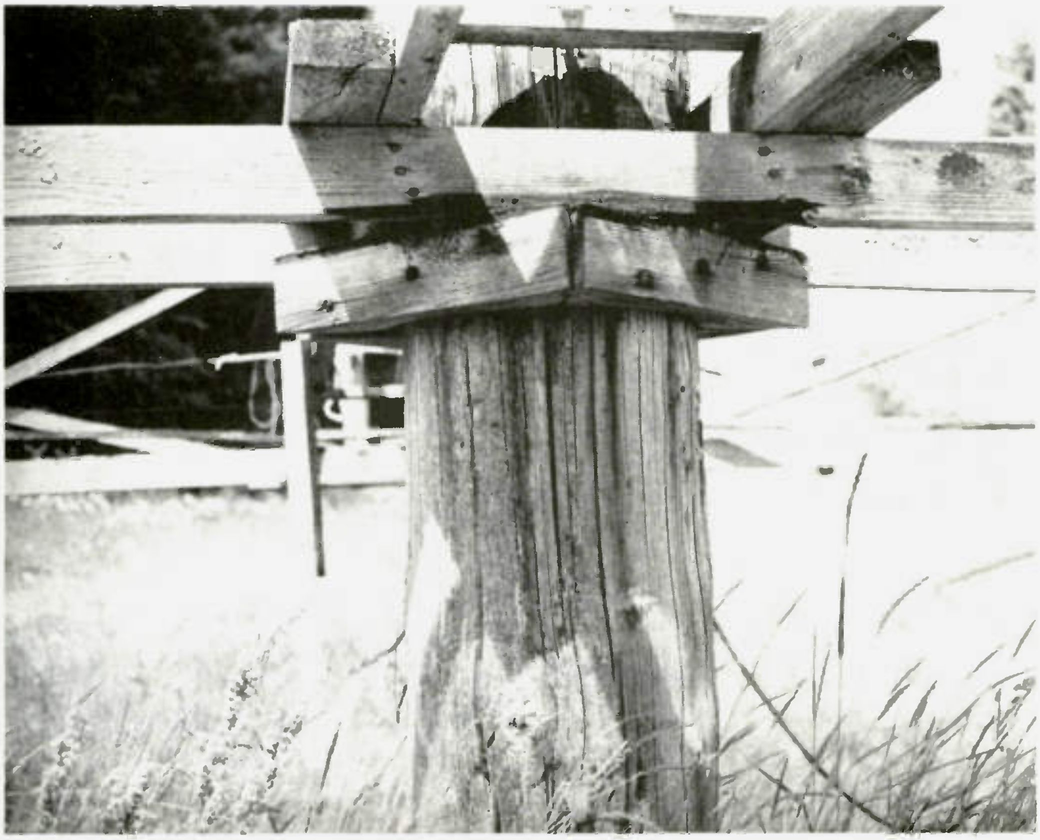


Close view of a forty meter vertical showing how they are mounted on standoff insulators.



This photo was taken from the roof of Tom's home. The camera is facing east, with the boom facing south. The box contains the tuning unit to protect it from the weather. The ten nylon lines supporting the boom are shown in this photo.

Close-up showing 12′ 2 × 3s, which prevent rotation by the wind and which are used to turn the boom by hand.



The bearing is kept well greased and supports the entire array with the aid of the ten nylon lines.

If you look closely in one of the under-the-boom shots, you can see the quarter-wave stub used to feed the 15 meter antennas.

The manner of support for the 40 meter aluminum verticals is shown in a close-up.

This array is about 3′ off the ground, and there is no ground connection, nor are there any ground radials. The horizontal wire between the two antennas is the counterpoise system.

Tom refers to the antenna as an "upside down bobtail," and there is a great similarity between this antenna and a full bobtail.

The gain is probably in the neighborhood of 8 dB. The angle is low and the beam width is narrow, making the antenna better for DX than a single vertical or even a yagi beam, unless the beam is at least a half wave high and three elements.

Of course, one of the chief advantages is elimination of the need for a tower.

You may notice that there is moss on some of the 2 × 4s after 16 years of use.

The coil used for the voltage-fed version in Fig. 1 has 17 turns spaced 3/16″ and is 3-1/4″ in diameter. Since there is high voltage across the coil, the capacitor spacing should be the same as in the capacitor in your tank circuit. The capacity is about .001 uF.

The horizontal wires in the reflector are not connected at the center.

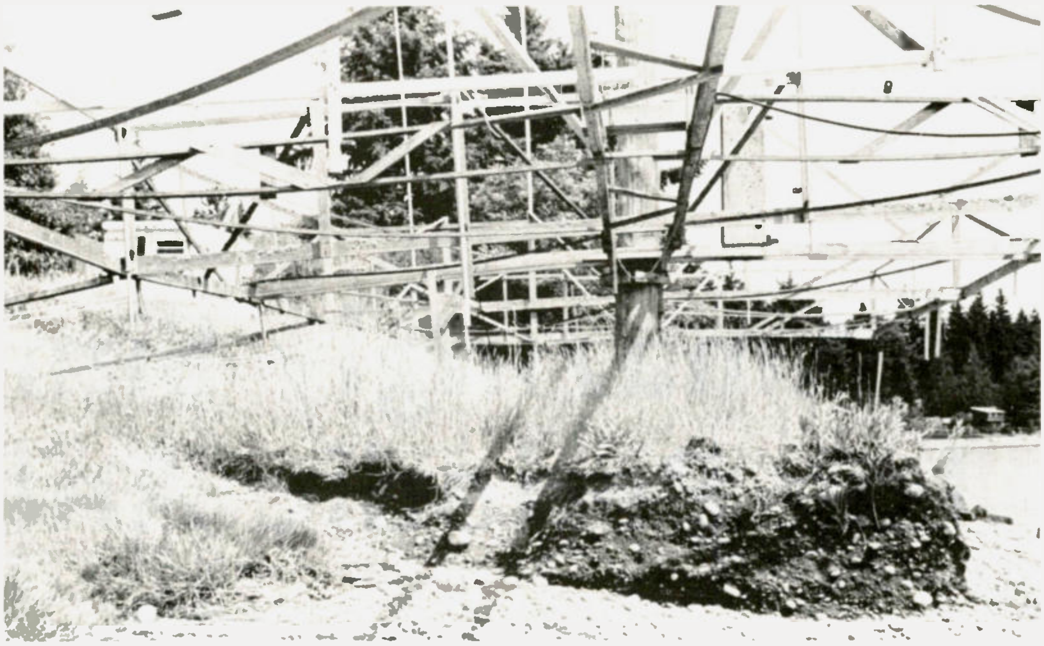
The lead from the coax is tapped for a 50-Ohm match, and the capacitor is tuned for maximum voltage at resonance at the feedpoint. Tune for maximum brilliance in a 1/4-Watt neon bulb. There is no ground at the antenna, since the shield of the coax furnishes a ground at the transmitter.

Tom's original antenna was made of 32′ bamboo poles with #14 wire attached as radiators, but it is now made of aluminum masting. This may give you some ideas. The supporting pole is 32′ high. The nylon ropes are fastened five to each side.

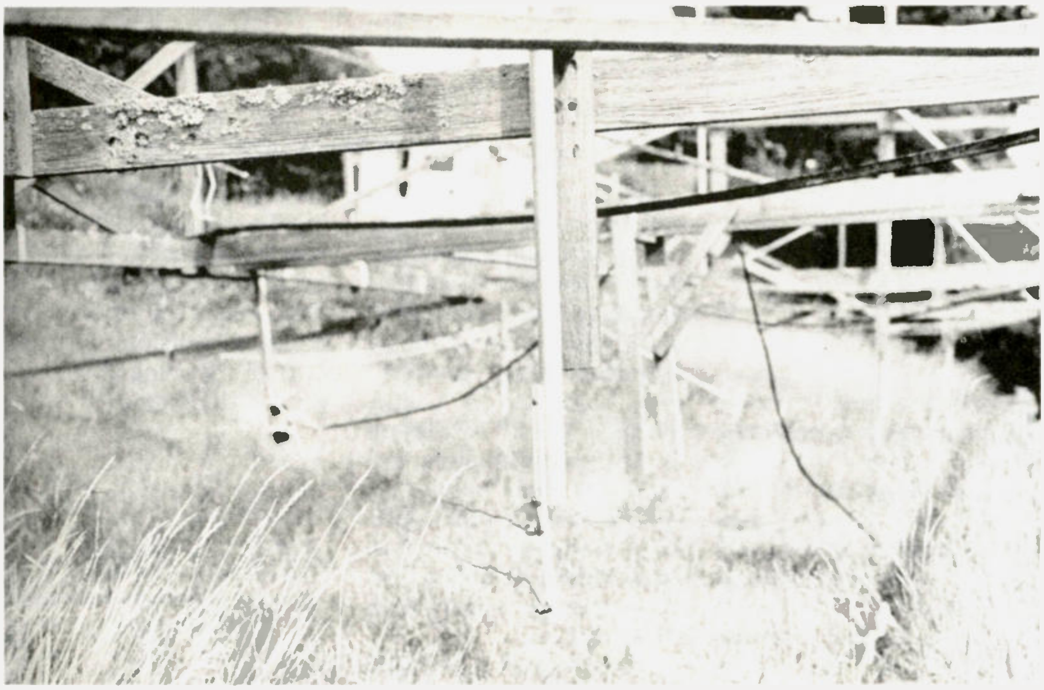
The most notable feature of this antenna is the complete lack of need for ground radials or counterpoise.

It would be rather easy to make a fixed array with pipe supports for the four antennas and stretch the horizontal wires between the supports three feet above the ground, so you could mow the yard under them.

The complete antenna would take an area of 65′ × 20′, which isn't too hard to get in a yard. If you live in a corner of the USA, the antenna could be slanted across the country for complete coverage with no rotation.



A view from under the boom, with the camera facing north.



Quarter-wave stub at the bottom of one of the 15 meter elements. Notice the moss on the 2 × 4 at the upper left.

Tom said that he noticed no difference in results between the voltage feed and the current feed.

All horizontal sections are #14 wire. They are out of phase and do nothing for the signal. The vertical sections are self-supporting aluminum and are in phase.

Tom sent me a tape which he received from Graham Knight, a listener in Aberdeen, Scotland. The signal was quite good on 40, even though the beam was headed at 90°, which is straight east, and Scotland is about 25° from Bremerton. It would have been much better if the beam had been headed toward Scotland.

They say a picture is worth ten thousand words, so I have used photos and diagrams for most of my explanation. I hope this will interest many hams who will see that there are ways to achieve results other than the most usual and most expensive ways.

An antenna is the cheapest way to get a good signal out, and it also works on receive, which is not true of a linear. So plan a little and save a lot.■

Amazingly Simple Log Periodic Antenna

—*an 8-lb. mini LP for 20m*

Photo by Dennis Lopez

Ted Robinson K1QAR
General Delivery
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Experimenting around with some mobile whips, I found that four pairs of them on a 10½ foot boom could give usable directivity using log periodic feed. This antenna weighed 8 lbs., about half as much as the smallest commercial 20 meter beam.

While the yagi is the most popular way to go, for an ultrasmall antenna, the LP seems better. It is broadbanded, covering all of 20, which is something a miniature yagi couldn't even begin to do. Unlike the yagi, the LP is tolerant of super close spacing, losing only 1-2 dB. Finally, the LP's all-driven configuration avoids the problem of insufficient coupling between the tiny mobile whip elements.

Construction is straightforward. Eight solid-core fiberglass fishing-pole blanks, 6' long, 3/8" at the base, and tapering to 1/8" at the tip, are obtained from a tackle supply house (these dimensions are not critical). Starting at the tip, wind #20 enameled wire, with adjacent turns touching, for about 18". For the next 18", the pitch gradually increases to 1/4" between turns. At this point, switch to #18 wire, soldering the connection. Pitch increases smoothly

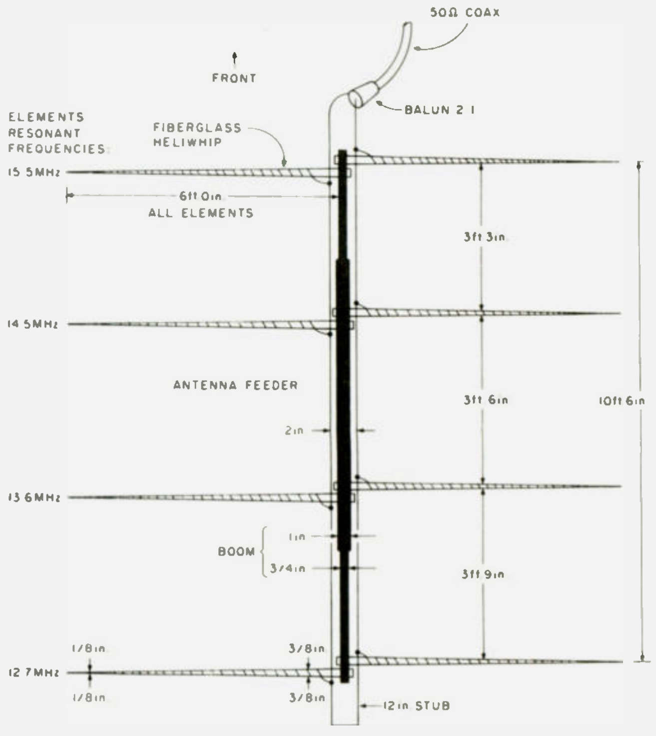

Fig. 1. 20 meter mini-log periodic beam.

from 1/4" to 3/4" as the winding is continued to the base. Using a grid-dip oscillator, add or subtract turns from the tip to resonate to the nearest of the following frequencies: 12.7, 13.6, 14.5, and 15.5 MHz. Making sure to always wind in the same direction and varying the amount of wire appropriately, fabricate all eight whips with two resonant to each frequency. The easiest way to wind is rotate the pole and feed wire onto it.

The boom is made from 6' of 5/8" aluminum with 3' of 1/2" aluminum tubing telescoped in either end. Pairs of holes the same size as the pole bases are drilled in the boom for element mounting, observing the following spacing: 45", 42", and 39". An antenna feeder supported on top of the boom, consisting of #16 wire spaced 2", completes the array.

Varying this spacing will vary the impedance of the antenna. Normally a 75-Ohm matching section into 50-Ohm line will give good results. Remember that adjacent elements get fed out of phase and that the lower frequency whips go with the wider spacings. Feed is to the high-frequency end, and a 12" stub is attached to the low-frequency end of the antenna feeder.

With such a small antenna, it was quite easy to get it up 65 feet on a mast made from scrap pipe, which was clamped to the side of the house next to a window for hand rotation. With this setup, measurements indicated an f/b of 5-8 dB, an f/s of 10 dB, and a low swr across the band. Gain was calculated to be 4-5 dB. Compared with other beams on the air, performance seemed to bear this out. A bonus was an apparent 20 dB f/b for power-line noise. ■

Social Events

from page 164

multipurpose building at the Saline County Fairgrounds in Marshall, Missouri. There will be flea markets for the OM and XYL (tables—$2.00 for first table; $1.00 for each additional table). Many prizes are to be awarded and there will be old and new equipment displays. Campgrounds (no connections for utilities) are available. The timetable is 8:00 am—registration; 8:00 am to 10:00 am—breakfast rolls and coffee; 11:30 am—lunch—all you can eat; 2:30 pm—drawing. Tickets are $2.00 in advance, $2.50 at the door. For information and tickets, write James H. Little WDØBPG, 405 East Rosehill, Marshall, Missouri 65340. Talk-in on 52, 28/88.

SALEM OH
JUL 23

The Kent State Salem Amateur Radio Club will hold a hamfest on July 23, 1978. The door prize will be a Ten-Tec #540 transceiver, courtesy of KenMar Industries; there will be many others for the whole family as well as a hot air balloon, a ramp for wheel chairs, and plenty of free parking. Wives and kids under 12 free. XYL drawing and recreation facilities available on beautiful campus. Open at 9 am; main drawing at 3 pm. Admission: $2.00; flea market: $1.00; tables: $5.00. Talk-in on 146.10-.70. For information, write W8JPG 147.27, Milhoan Electronics, 1128 West State Street, Salem OH 44460; (216)-337-9275.

INDIANAPOLIS IN
JUL 26

The IEEE Computer Society of Central Indiana and the Central Indiana section of IEEE will sponsor the third annual Indy Microcomputer Show on Wednesday, July 26, 1978, from 11:00 am to 9:00 pm at the Holiday Inn located at I-70 and Shadeland Avenue in Indianapolis. There will be exhibits, demonstrations, and technical seminars addressing the engineering, industrial, scientific, business, and personal applications of microcomputer systems.

OKLAHOMA CITY OK
JUL 28-30

Central Oklahoma Radio Amateurs will present Ham Holiday '78 on July 28, 29, and 30, in the Lincoln Plaza Forum, 4345 North Lincoln Boulevard, Oklahoma City. Preregistration closes July 14 with a fee of $3.00; $4.00 at the door. Non-commercial flea market tables are free in the ten-thousand-square-foot flea market area. Commercial exhibitors contact K5MB at (405)-787-9545 or 787-9292. Technical programs are scheduled throughout the hamfest. Many prizes will be given away, including a special preregistration prize. Mail preregistrations to Ham Holiday '78, PO Box 14604, Oklahoma City OK 73113.

FT TUTHILL AZ
JUL 28-30

The Amateur Radio Council of Arizona will present the annual Ft. Tuthill Hamfest on July 28, 29, and 30, 1978. Come on out in the cool pine country of Arizona, and join our western barbeque, prize drawings, and tech sessions. For further details or pre-registration forms, contact PO Box 11642, Phoenix AZ 85061.

KINGSFORD MI
JUL 29-30

The 30th annual U.P. hamfest, cosponsored by the Great Northern Repeater Association and the Mich-A-Con ARC of Iron Mountain-Kingsford, Michigan, will be held on Saturday, July 29, and Sunday, July 30, 1978, at the Dickinson County Armory on M-95 in Kingsford, Michigan. Registration will begin at 9:00 am on both days. Tickets are $2.50 in advance and $3.00 at the door. Saturday night banquet tickets are $6.50, and reservations should be received by July 1. Daily activities include: U.P. net meeting, U.P.R.A. meeting, YL net meeting, ARRL director's meeting, computers, DX and contests, slow scan, satellite, RTTY, moonbounce, FAX, 2m SSB, a swap and shop, and a special discussion on "Antennas—Legal Aspects" by George Goldstone W8AP, vice-director of the Great Lakes Division. Planned family activities will be held both days. Plenty of parking is available. Prizes galore! Talk-in on 146.25/.85 and 3922. For information, write UPHAMFEST 78, Box 2056, Kingsford, Michigan 49801.

HOUSTON TX
AUG 4-6

On August 4, 5, and 6, 1978, the Houston Echo Society will host the annual Texas VHF-FM Society Summer Convention in the Galleria Plaza Hotel, just off interstate loop 610 at Westheimer Rd. While primarily devoted to the VHF-FM spectrum, attractions will also include microprocessors/microcomputers, the annual Texas champion hidden transmitter hunt, OSCAR communications, and much more, covering all phases of amateur radio. There will be forums conducted by both the ARRL and the FCC. A banquet/dance is planned for Saturday night. The featured speaker will be William A. Tynan W3XO, editor of "The World Above 50 MHz" column in *QST*. Exhibitors will be displaying their wares all day Saturday and Sunday. Several excellent prizes will also be given away. The main prize will be the choice of an HF rig or an allmode VHF rig, with the second prize being the rig which is not given away as the main prize. There will also be a preregistration prize as well as hourly door prizes. More information can be obtained by writing to: FM Society Summer Convention, PO Box 717, Tomball, Texas 77375.

MACKS INN ID
AUG 4-6

The 46th Annual WIMU (Wyoming, Idaho, Montana, Utah) Hamfest will be held on August 4, 5, and 6, 1978, at Macks Inn, Idaho, 25 miles south of West Yellowstone, Montana. Talk-in on 146.34/94 and 3935. Advance registration is $6.00 for adults and $2.00 for children, before July 25th, 1978. Late/regular registration is $7.00 and $2.50. There will be a special prize drawing for preregistration. Please send preregistration to: WIMU Hamfest, 3645 Vaughn Street, Idaho Falls, Idaho 83401; phone (208)-522-9568.

PETOSKEY MI
AUG 5

The 3rd annual Straits Area Radio Club swap and shop will be held on Saturday, August 5, at the Emmet County Fairgrounds, Charlevoix Avenue, Petoskey, Michigan, from 9 am to 3 pm. Talk-in on 146.52. Food services, prizes. Tickets will be $1.50 at the door. Campsites nearby. For information, write to SARC in care of W8IZS, Box 416, Pellston MI 49769.

JACKSONVILLE FL
AUG 5-6

The Jacksonville Hamfest Association is happy to announce the 5th annual

Continued on page 213

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You've heard of the "bird cage antenna," the "vertical antenna," and the invisible "apartment dweller's antenna," but the antenna I am about to describe is just the thing you need if you live in an apartment or a rental house where the landlord will not let you put up an outside antenna. Also, if the sight of large antenna arrays automatically makes your neighbors' television sets start acting up and you are tired of those annoying phone calls every time you start operating, maybe what you need is a disguised antenna that is a super DX antenna that also puts out a respectable stateside signal.

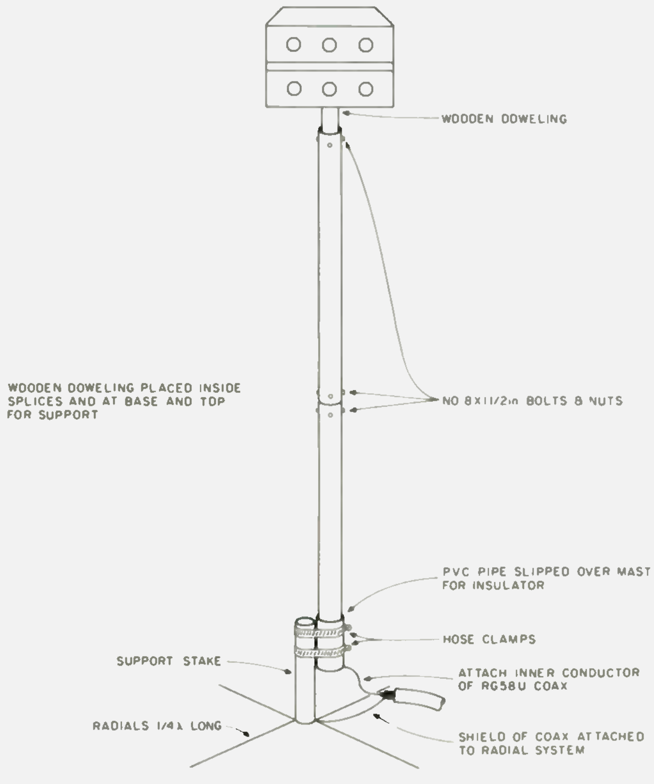

Fig. 1.

I am sure that you have heard the old saying that a vertical antenna radiates equally poorly in all directions, but you may be in for a surprise if you have never used one. The vertical is an amazing antenna and outperforms my dipole at forty feet on all occasions and with some very startling results. This is not the place to run down my log and list all the DX stations that I worked with this antenna, but I will say that my two-element 40 meter yagi is still in the box in the garage. I used this antenna in the 1976 sweepstakes and ran up a score of over 100,000 on forty meters to win my state. It seems to work great for short or long distances, and the point I am trying to make is, "Try it; you'll like it!"

My antenna was constructed for forty meters, but the antenna can be made for 20, 15, or 10 meters, also. Simply cut the length of the vertical radiator to a quarter wavelength for the center of the band you want to work and cut the radials this same length plus five percent.

The fact that a purple martin birdhouse appears at the top of the vertical is the main camouflage system. For all practical intents and purposes (as far as your neighbors are concerned), this is simply a birdhouse supported by a metal pole. Only you know that it is really an antenna for a ham rig.

Every one knows about purple martins. These are those wonderful little birds that spend spring and summer in the United States, raising their families of little purple martins. While they are here, their most beneficial contribution is the fact that each day they eat their weight in insects, and they are about the best mosquito eradicators known to mankind. There is no use ruining the ecology using pesticides when the purple martin will do the job much better and cheaper, while producing no unwanted side effects. After the purple martins have raised their families, they will return to central America during the fall and spend the winter there. Now the truly amazing fact is that, in the spring, the same birds will return to the same nesting place to raise another family, and the young that were born last year will return to the place of their birth to raise their families. In a couple of years, you will have a colony of purple martins that will keep your neighborhood insect free. About the only thing that purple martins require is a clear flyaway zone around the house they are nesting in. This works out very nicely because the same objects that annoy the purple martins will soak up rf like a sponge.

In the construction of the vertical antenna, the aluminum used was purchased at the local TV shop and is known as locking TV mast. It is a painted aluminum tubing and cost $2.95 for a ten-foot section. I bought forty feet, cut three feet off one section, and joined it with three other sections to make a 33-foot vertical. I put a wooden doweling rod about a foot long at each joint, the base, and the top. The doweling was fastened to the mast with #8 x 1½" bolts and nuts through the mast and doweling. Two bolts were used at the top and bottom of each joint. Solder lugs can be used under each bolt and braid strapping used to jumper each joint to provide excellent electrical connections.

The type of purple martin house that you use is, of course, optional. These houses are advertised in Sears and other national mail-order catalogs and, in most instances, can be obtained locally. They come in both metal and wooden models.

The birdhouse is best attached to the top of the vertical using a floor-type pipe flange and a piece of doweling material about 18 inches long. The wooden dowel, of course, will insulate the birdhouse for the antenna.

Now here is the secret of how the birdhouse antenna works like an antenna and not like an rf choke. You will have to put in a ground system of quarter wavelength radials. These should go from the base of the vertical and stretch out like the spokes of a wagon wheel. Now I know you have heard of all the guys who just stick a ground rod in the ground and their vertical antennas work just fine. Don't you believe it! The ground rod is simply for lightning protection. Forty meter rf energy will only penetrate the earth to a depth of a couple of inches, so you must use a ground system, but this should be no trouble. A minimum of two radials will work, but, like other things, the rule is: the more, the better. Realistically, a minimum of four radials should be used, and eight will work better. Equal currents flow in the vertical and the radials, so the radials are a must.

On the radials, I had good luck with a shovel making a slit in the ground, pushing the radial in the slit, and then walking over the ground to cover the radial up. Others have had good results with simply laying the radials on top of the grass and letting the grass grow up over the radials. When the grass is cut, it forms a mulch layer over the radials, and, in about a month, the radials are completely covered.

The quarter wavelength vertical radiator has an impedance of about 30 to 35 Ohms but will present a good match to 52-Ohm RG-58/U coax without any matching devices. My vertical exhibits an swr of 1.5 to 1 at resonance and less than 2.0 to 1 at the band edges. This swr across the entire band is negligible in terms of rf loss.

For 40 meters, the antenna may have to be guyed if you experience much strong wind in your area. These guys can be made of nylon string and tied to existing trees or buildings. However, for 20, 15, or 10 meters, the length is short enough that the antenna will be self-supporting in most winds. The antenna can be made of any material that can be obtained locally at a reasonable price, such as downspout, conduit, etc.

The installation is completed by burying the coax coming to the building and then using your imagination to get the coax into the ham shack in an unnoticeable way.

All connections should be soldered and then coated with RTV bathtub sealer. The antenna will surprise you on 40 meters, and, if you need an antenna that no one will recognize as an antenna, then this is the one for you. ■

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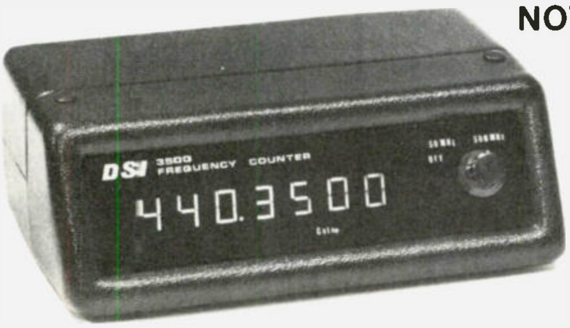

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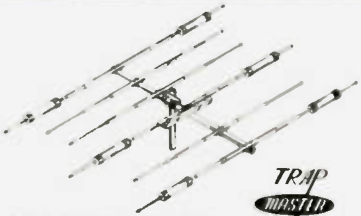

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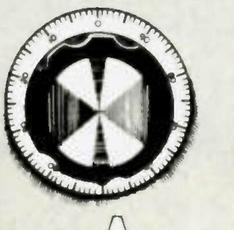

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NE556A 78
NE565A 1 00
NE566V 1 15
NE567V 1 20
78L05 60
78L08 60
78L05 70
78M05 85
75108 1 75
75491CN 50
75492CN 55
75494CN 89

A to D CONVERTER
8038B 4 50
8700CJ 13 95
8701CN 22 00
8750CJ 13 95
LD130 9 95
9400CJV/F 7 40
ICL7103 9 50

CMOS
CD34001 50
CD4000 16
CD4001 21
CD4002 21
CD4006 1 10
CD4007 21
CD4008 21
CD4009 39
CD4010 39
CD4011 21
CD4012 21
CD4013 36
CD4014 86
CD4015 86
CD4016 36
CD4017 94
CD4018 94
CD4019 21
CD4020 1 02
CD4021 1 02
CD4022 86
CD4023 21
CD4024 75
CD4025 21
CD4026 1 51
CD4027 36
CD4028 79
CD4029 1 02
CD4030 21
CD4035 1 02
CD4040 1 02
CD4042 71
CD4043 63
CD4044 63
CD4046 1 67
CD4049 36
CD4050 36
CD4051 1 13
CD4060 1 42
CD4066 71
CD4068 40
CD4069 40
CD4070 40
CD4071 21
CD4072 21
CD4073 21
CD4075 21
CD4076 1 75
CD4078 40
CD4081 21
CD4082 21
CD4116 47
CD4490 5 50
CD4507 1 00
CD4508 4 25
CD4510 1 02
CD4511 94
CD4515 2 52
CD4516 1 10
CD4518 1 02
CD4520 1 02
CD4527 1 51
CD4528 79
CD4553 5 75
CD4566 2 25
CD4583 4 50
CD4585 1 10
CD40192 3 00
74C00 28
74C04 33
74C10 28
74C14 2 10
74C20 28
74C30 28
74C48 1 95
74C74 75
74C76 1 40
74C90 1 15
74C93 1 40
74C154 3 00
74C160 1 44
74C175 2 00
74C192 2 40
74C221 2 75
74C905 3 00
74C906 1 50
74C914 1 95
74C922 7 50
74C923 7 50
74C925 10 50
74C926 10 50
74C927 10 50

INTERFACE
8095 65
8096 65
8097 65
8098 65
8T09 1 75
8T10 4 50
8T13 3 00
8T20 5 50
8T23 3 10
8T24 3 50
8T25 3 20
8T26 1 69
8T28 2 75
8T97 1 69
8T98 1 69

MOS/MEMORY RAM
2101-1 3 95
2102-1 1 28
2102AL-4 1 60
21F02 1 85
2104A-4 4 95
2107B 4 70
2111-1 4 95
2112-2 7 90
2114 13 45
MK4116 27 50
25138 8 75
21L02-1 1 49
MM5262 40
MM5280 3 00
MM5320 9 95
MM5330 5 94
PD411D-3 4 00
PD411D-4 5 00
P5101 13 95
4200A 12 95
82S25 2 90
91L02A 2 50
HD0165-5 6 95
MM57100 9 50
GIAY38500-1 13 95
MCM6571A 9 95
9368 4 50

CLOCKS
MM5309 3 00
MM5311 3 60
MM5312 4 80
MM5313 3 60
MM5314 3 90
MM5315 4 00
MM5316 5 00
MM5318 3 60
MM5369 2 10
MM5841 14 45
MM5865 7 95
CT7001 5 80
CT7002 8 95
CT7010 8 95
CT7015 7 25
MM5375AA/N 3 90
MM5375AB/N 4 90
7205 16 50
DS0026CN 3 75
DS0056CN 3 75
MM53104 2 50

IC SOCKETS
Solder Tin Low Profile

PIN	1UP	PIN	1UP
8	15	24	36
14	18	28	43
16	20	36	58
18	27	40	61
22	35		

3 level wire wrap gold
14 pin 35 16 pin 39
2 level 14 pin ww 25

MICROPROCESSOR
6800 19 50
8080A with data 11 50
Z80 29 95
8212 2 95
8214 8 00
8216 3 15
8224 2 95
8228 4 95
8251 11 50
8253 10 00
8255 10 75
CDP1802CD 19 95
CDP1802D 25 00
CDP1861 12 95
6820 8 95
6850 12 95
6502 24 50

UART/FIFO
AY5-1013 5 50
AY5-1014 7 50
3341 6 95

PROM
1702A 3 95
N82S23 2 95
N82S123 3 50
N82S126 3 75
N82S129 3 75
N82S131 3 75
N82S136 8 75
N82S137 8 75
2708 14 65
DM8577 2 90
8223 2 90
2716 33 95

CONNECTORS
44 pin edge 2 00
100 pin edge 4 50
100 pin edge WW 5 25

CRYSTALS
1 MHz 4 50
2 MHz 4 50
4 MHz 4 25
5 MHz 4 25
10 MHz 4 25
18 MHz 3 90
20 MHz 3 90
32 MHz 3 90
32768 Hz 4 00
1 8432 MHz 4 50
3 5795 MHz 1 20
2 0100 MHz 1 95
2 097152 MHz 4 50
2 4576 MHz 4 50
3 2768 MHz 4 50
5 0688 MHz 4 50
5 185 MHz 4 50
5 7143 MHz 4 50
6 5536 MHz 4 50
14 31818 MHz 4 25
18 432 MHz 4 50
22 1184 MHz 4 50

CLOCK MODULES Complete alarm clocks ready to hook up with transformer and switches. Very compact with .50" and .84" display
MA1002A C or E .50" 8.95
102P3 Transformer 2.25
MA1010A, C or E .84" 11.95
102P2 Transformer 2.25
Special transformer and six switches when purchased w/module 2.95
MA1003 car module .3" green fluor. display 17.50
Four MCS 6300 .63" 9.95

RESISTORS ¼ watt 5%
10 per type .03 1000 per type .012
25 per type .025 350 piece pack
100 per type .015 5 per type 6.75

KEYBOARDS
Hex keyboard $10.95 Fully encoded w/ PC board, parts and instructs $24.95
53 key ASCII keyboard kit 55.00
Fully assembled 65.00 Enclosure 14.95

LEDS
Red TO18 15
Green Orange Yellow TO18 20
Jumbo Red 20
Green Orange Yellow Jumbo 25
Clipite LED Mounting Clips 8/$1.25 (specify red, amber, green, yellow, clear)

CONTINENTAL SPECIALTIES in stock
Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $128.95

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Portable Multimeter $18.00

DIGITAL THERMOMETER $48.50
Batt. oper. General purpose or medical 32°-230°F Disposable probe cover [illegible] accuracy. Comp. assy. in compact case

COMPUTER BOARD KITS
8K RAM Board kit $134.95
4K EPROM Kit 114.95
I/O Board Kit 44.50
Extender Board w/connector 12.50
Video Interface board kit 125.00
16K EPROM board kit w/o PROMS 74.50
16K Static RAM board kit 395.00
North Star Floppy Disk Kit $885.00
Additional Drive Kit 415.00

SPECIAL PRODUCTS
MM5865 Stopwatch Timer 9.00
PC board 7.50
Switches Mom. Pushbutton .27
3 pcs. [illegible] .25
Encoder HD0165-5 6.95
3 Digit Universal Counter Board Kit Operates 5-18 Volt DC to 5 MHz typ. 125" LED display 18.50
Voice actuated switch [illegible]
Paratronics 100A Logic Analyzer Kit $199.00
Model 10 Trigger Expander Kit $239.00
Model 150 Bus Grabber Kit [illegible]

TRANSFORMERS
6V 300 ma 3.25
12 Volt 300 ma transformer 1.25
12.6V CT 600 ma 3.75
12V 250 ma wall plug 2.95
12V CT 250 ma wall plug 3.50
24V CT 400 ma 3.95
10V 1.2 amp wall plug 4.85
18V 6 amp 12.95

DISPLAY LEDS
MAN1 CA 270 2.90
MAN3 CC 125 [illegible]
MAN72/74 CA/CA 300 1.00
DL704 CC 300 [illegible]
DL707/DL707R CA 300 1.00
DL727/728 CA/CC 500 1.90
DL747/750 CA/CC 600 [illegible]
DL750 CC 600 [illegible]
FND359 CC 357 [illegible]
FND507 CC/CA 500 1.35
FND503/510 CC/CA 500 [illegible]
FND800/807 CC/CA 800 [illegible]
3 digit Bubble [illegible]
4 digit bubble [illegible]
DG8 Fluorescent 1.75
DG10 Fluorescent 1.75
5 digit 14 pin display 1.00
NSN69 9 digit display [illegible]
7520 Clairex photocells .39
TIL311 Hex 9.50
IC Test Clips
Red [illegible]
Black [illegible]
Keyer 8043 14.50
comp. w/spec. sock.

Sinclair 3½ Digit Multimeter
Batt./AC oper. 1mV and .1NA resolution. Resistance to 20 meg. 1% accuracy. Small, portable, completely assem. in case. 1 yr. guarantee. Best value ever! $59.95

Not a Cheap Clock Kit $14.95
Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instrucs. Green and orange displays also avail. Same kit w/.80" displays. $21.95

Digital Temperature Meter Kit
Indoor and outdoor. Switches back and forth. Beautiful. .50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure –100° to +200°F, air or liquid. Very accurate. Comp. inst. $39.95
Beautiful hardwood case w/bezel $11.75

NiCad Batt. Fixer/Charger Kit
Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts & instruc. $7.25

RCA Cosmac VIP Kit 275.00
Video computer with games and graphics.

'78 IC Update Master Manual
1978 IC Update Master Manual $30.00
Complete IC data selector 2175 pg. Master reference guide. Over 42,000 cross references. Free update service through 1978. Domestic postage $3.50. Foreign $6.00. Final 1977 Master closeout $15.00

New Cosmac Super "ELF"
RCA CMOS expandable to 64K microcomputer w/HEX keypad input and video output for graphics. Just turn on and start loading your program using the resident monitor on **ROM**. Pushbutton selection of all four CPU modes. LED indicators of current CPU mode and four CPU states. Single step op. for program debug. Built in pwr. supply. 256 Bytes of RAM, audio amp. & spkr. Detailed assy. man. w/PC board & all parts fully socketed. Comp. Kit $106.95. High address display option 8.95; Low address display option 9.95; Custom hardwood cab., drilled front panel 19.75. Nicad Battery Backup Kit w/all parts 4.95; Fully wired & tested in cabinet 151.70; 1802 software club. 10–12 pg. monthly publication 12.00 per yr.

4K Elf Expansion Board Kit with Cassette I/F $79.95
Available on board options: 1K super ROM monitor $19.95 Parallel I/O port $7.95 RS232 I/F $3.50 TTY 20 ma I/F $1.95 S-100 Memory I/F $4.50

Tiny Basic for ANY 1802 System
Kansas City Standard Cassette $10.00
On ROM Monitor $38.00
Super Elf owners take 30% off.

Original Cosmac "ELF" kit
All parts and instructs. $89.50
Board only 14.95

Video Modulator Kit $8.95
Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

60 Hz Crystal Time Base Kit $4.40 Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

Clock Calendar Kit $23.95
CT7015 direct drive chip displays date and time on .6" LEDS with AM-PM indicator. Alarm/doze feature includes buzzer. Complete with all parts, power supply and instructions, less case.

2.5 MHz Frequency Counter Kit Complete kit less case $37.50
30 MHz Frequency Counter Kit Complete kit less case $47.75
Prescaler Kit to 350 MHz $19.95

Stopwatch Kit $26.95
Full six digit battery operated. 2–5 volts. 3.2768 MHz crystal accuracy. Times to 59 min., 59 sec., 99 1/100 sec. Times std., split and Taylor. 7205 chip, all components minus case. Full instruc. Molded plastic case with bezel. $5.00

Auto Clock Kit $15.95
DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

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$25.00 Postpaid **$23.50** each lots of three
Includes: 5 - PL259, 5 - SO239, 5 - UG175, 5 - UG176, 2 - PL258, 1 - DM, 1 - M358, 2 - M359, 1 - UG255, 1 - UG273, 2 - PL259PO, 1 - 1021-20, 1 - Lightning Arrestor.
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Matching or brass callplate—add $2.00
Brass code key installed—add $5.00
(PA residents add 6% tax)
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Glenside PA 19038 S45

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 51

Royal Coach Inn . . . see you there.

HOW TO SELL AMATEUR RADIO

The secret to survival is to be needed . . . to be important. The small countries which make up the bulk of the votes at the International Telecommunications Union (ITU) do not, in the main, understand amateur radio. Those who do not confuse it with CB often think of it and put it down as mainly an American hobby.

Put yourself in the position of the king or president of a small country. Your shortwave broadcasting people are raising hell because they can't get a frequency which is in the clear to broadcast news and cultural programs. Businessmen are raising the devil because they find it impossible to get clear channels for communications between their offices and their trucks, warehouses, etc. Your phone service is lousy because there is a shortage of frequencies for that. With all these pressures, how much support is your government going to give to an American hobby group which wants to use these valuable frequencies for playing around? You got the picture?

Oh, we can talk all day about emergency communications, but a country with two hams is not going to get a lot of help in any emergency. That is irrelevant to them.

Sure, radio amateurs have invented and pioneered most of the communications techniques in everyday use. But these countries are not interested in more inventions—they want spectrum space and they want it right now and hang next year or ten years from now.

Radio frequencies can be rented and sold, so they are a nice source of income. When a single communications channel can earn over $1 million a year, why on Earth would a country want to just plain give that channel away to hams? That's nuts.

There are several reasons why these small countries should support not only the present ham bands, but help us to get more . . . and these are extremely important reasons for these countries. If we can get the leaders of these countries to understand the importance of amateur radio to them, we'll get our bands . . . and more.

So what are the benefits of amateur radio to emerging nations? First, there is their almost unbelievable need for local people trained in electronics and communications. Without amateur radio as a personal interest, it is very difficult to get people to take the time and effort it requires to learn electronics. Let's face it, there are a lot of easier ways of earning a living.

Without native people to help install, service, and operate the telephone, radio, and other communications systems, a country has to pay such incredible salaries to bring in Swiss and German technicians that they end up with very little communications. The whole world is going electronic—radio and computers, microwaves, satellites—without these modern systems, a country just can't grow and keep up with its neighbors.

Amateur radio clubs for the teenagers can spark the enthusiasm which will result first in hundreds and then thousands of hams, people interested personally in electronics and communications—the very best type of people for a growing country and an invaluable asset. A country should begin to see the first benefits from such a program within two years of its inception.

A Ham Trade Mission could encourage these emerging nations to set up a ham station in each of the youth centers, complete with a traveling teacher to instruct the prospective hams on a once-a-week basis. The investment for a country would be miniscule compared to the benefits. The Mission would cooperate to provide a set of rules and regulations which would be tailor-made for the country and which would encourage youngsters to get their ham licenses and progress. The Mission could also arrange for teaching materials for the prospective hams—in their native language.

The nice thing about it is that everyone involved would benefit. The countries would develop a low-cost supply of trained technicians and eventually engineers. The kids would have a fun hobby plus the opportunity to make their own way as far as they want in the world, an opportunity which is available to very few in these new countries. The ham manufacturers who participate would have the possibilities of greater sales of their equipment as these markets open. And amateur radio worldwide would benefit from having another country support it at the ITU, plus a lot more DX contacts.

One additional benefit for any small country is the unique ability of radio amateurs to promote their country. A Stanford study (distributed by the ARRL) showed that there are more people listening to radio amateurs on the shortwaves than to the shortwave broadcasting stations. Amateurs could have a significant effect on the tourist trade in a country, just by talking up the country and inviting anyone listening to come and visit. There is little correlation between government shortwave broadcasting and tourism, but hams do bring in their worldwide friends like a magnet.

Mounting a Ham Trade Mission is not going to be inexpensive. While it is true that in the long run such a Mission might benefit those who participate in it to some degree, so will all of the manufacturers benefit, for a developed ham market is anyone's game. There is good reason for every amateur manufacturer and dealer to support a Hambassador Trade Mission program. Without ham bands you have no business, and has anyone come up with any other plan for protecting bands?

Just between *73* and *QST*, I count about 230 different firms in the ham business who are advertising, and that's just for one month. If each of these firms put up $20 a week toward the Hambassador program, we would have $19,933 a month available for getting amateur radio going in the third world countries, and enough left over to do one whale of a job of lobbying in Washington and seeing to it that nothing like the linear amplifier disaster happens again.

If you think this is a good idea, you might drop a letter or QSL card to some of your favorite manufacturers and call your local ham dealer and see if you can get them to get behind such a plan. No firm that is in business can be hurt by $20 a week, and any firm that is too stingy to help get amateur radio over a very rough spot does not deserve your support.

The Amateur Radio Manufacturer's Association (ARMA) should, I think, include dealers in their group and solicit the funds to protect the future of amateur radio, whether it be to garner the votes of emerging nations at the ITU, to thwart the blundering of the FCC, or even to counter predatory attacks from the likes of a Cooper.

Since Jordan is one of the best examples of the value of amateur radio as a medium for the development of a technical body, I should think that a Mission would first go there and get familiar with the situation which was set up and how it worked. I would be surprised if King Hussein would not cooperate with such a group and perhaps put in a good word to help them meet at the highest levels in some other countries.

With that excellent background, the Mission would be on firm ground in talking with the leaders and telecommunications ministers of other countries. We might be able to find out from our State Department (and perhaps even from the CIA) what funds are available from the U.S. to back up a Mission . . . with such things as ham stations for youth clubs.

The effects of such a Mission could snowball. Even a few successes could be turned into triumph through public relations and promotion. Once a few countries have agreed that this is a good idea, it will be much easier to sell others on it, and such a movement could completely rewrite the present handwriting on the wall . . . which is exceedingly grim. The first few visits will be critical; from then on, less experienced teams could follow up and make sure that every voting country of the ITU is visited at a high level.

The important thing is to get started as quickly as possible . . . like this summer. If we wait much longer, many countries will have firmed up their WARC proposals. It is much easier to stay out of trouble than to try and get back out of it after you're in. Getting countries to change their minds, once set, is much more difficult than preventing the setting in the first place.

CONTESTS

from page 15

State. Object is for all stations outside the 7th W/VE call districts to QSO as many 7-land W/VE stations as possible in a maximum of 30 hours out of the total 36-hour contest period. The same station can be worked on each band.

EXCHANGE:

All W/VE stations (including KH6 and KL7) transmit RS(T) and state or province; foreign stations transmit RS(T) and serial QSO number.

SCORING:

On each band, 7-land stations get 1 multiplier for each of the 50 US states and 1 multiplier for each Canadian province. All others get 1 multiplier for each state or province worked in the 7th W/VE call districts (on each band). 7-land includes: Alaska, Arizona, British Columbia (Canada), Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.

Power multipliers are as follows: 500 Watts dc input or more = multiplier of 1.00; 300 to 499 Watts dc input = 1.25; 100 to 299 Watts dc input = 1.50; less than 100 Watts dc input = 2.00.

Final score is total valid QSOs times QSO points times total sum of all multipliers times the power multiplier for your station. QSO points are 1 point per QSO for 7-land stations including other 7-land QSOs; all others score 5 points per 7-land QSO.

ENTRIES & AWARDS:

Certificates of performance will be issued to the top scores in each state, province, and country for single class operation. Certificates issued to top multi-op station in each W/VE call district. All entries must include a self-prepared log sheet with separate sheets per band. Each log must show freq, mode, date/time GMT, station worked, exchange sent and received, and points. Each entry must include a completed summary sheet; for stations with over 100 QSOs, a dupe sheet for each band must be submitted. Dupe sheets are self-prepared! All entries must include a business size SASE; foreign stations may enclose 2 IRCs. Deadline for entry is Aug.1. Mail entries to: NAS Whidbey Island ARC, Bill Gosney WB7BFK, 4471 40th NE St., Oak Harbor WA 98277 USA.

Summary sheets and contest rules can be obtained from the above address. Please include an SASE!

THE PONY EXPRESS CERTIFICATE

This award is being reissued by the Missouri Valley Amateur Radio Club, Inc. The certificate will be available to any ham working the HF bands. This certificate is not affiliated with any other organization. To qualify, US amateurs must work 5 MVARC members, then send 5 QSLs confirming contacts plus two 13¢ stamps. DX amateurs must work 3 MVARC members, then send 3 QSLs plus 1 IRC. All QSLs should be sent directly to the certificate manager: WBØ, PO Box 141 Station E., St. Joseph MO 64505.

Member stations to work are: WBØLVW, WØNUT, KØERD, WBØWXD, WBØVRB, WDØBBH, WBØMGQ, WØYVJ, WBØZLM, WBØVRA, WBØHNO, WØGC, WBØWXE, WBØWKK, WDØGEJ, WØPWH, WAØCHE, WØQB, WBØHEF, KØCWQ, WBØVQY, WBØZLP, WØFXD, WDØGEK, WØHRL, KØUQH, WBØVRD, WBØOVZ, WBØPKJ, KØZMZ, WAØRTT, WØFXY, WBØEYJ, WBØZLO.

CANTERBURY AERO CLUB AWARD—JULY, 1978

Contact any station and use the last letter of the callsign to make up the words "Canterbury Aero Club." All stations must contact at least one ZL3 station with additional ZL3 stations used as bonuses to fill any gaps. Each station may be used only once for the award. Use all bands, all modes; also available to SWLs. No QSLs required; send certified list only to CAC Award, PO Box 1733, Christchurch, New Zealand. Cost is 50¢ for ZL, $1 overseas (award airmailed). Applications must be received before November 1. Award period is the entire month of July, 1978!

Note: Overseas stations can claim the Christchurch award also at no additional cost if they contact 5 ZL3 (Christchurch) stations; VK contact 10.

JEFFERSON DAVIS MONUMENT AWARD

The Pennyroyal Amateur Radio Society will be operating portable from the Jefferson Davis Memorial Park on June 3, 1978. This certificate will be issued to any amateur presenting written confirmation of contact with a PARS member during the QSO period, or any ten KY amateurs during the year. Awards may be obtained by sending $2.00 and your QSL cards to PARS, PO Box 1077, Hopkinsville KY 42240. Your QSL cards will be returned with the award. The QSO period begins at 1400 GMT June 3 and ends 0500 GMT June 4. Frequencies to be monitored are as follows: Novice—3.740, 21.240, 28.104; General—3.970, 7.270, 14.310, 28.610.

Ham Help

I am looking for a schematic and manual for a model H21-10 Motorola handie-talkie. I will gladly pay for a photocopy.

Robert D. Houlihan N9DH
497 E. Second St.
Galesburg IL 61401

I am interested in contacting a ham who shares my interests in radio and electronics and model railroading in order to set up a 40 meter sked.

Paul Braun WD9GCO
PO Box 32
Steeleville IL 62288

I need schematics 5030089, 5030494, 5030683, and for the ac P.S. for the ITT Mobile Tel. MT-600.

Dick Haskin W6KEC
149 Mauna Loa Dr.
Monrovia CA 91016

I would like to obtain the booklet "AN/ARC-2 Conversion," written by Roy Pafenberg. I recently saw this advertised in the June, 1963, *73*. I would also appreciate any info on any other articles written concerning the conversion of this radio. Any help would be greatly appreciated.

John P. Centers
514 S. Pine St.
Wapakoneta OH 45895

I would like to get schematic/service manuals for Hewlett-Packard model 150A scope and Hewlett-Packard model 400D ac VTVM. I am willing to pay a reasonable price for these manuals.

John A. Poplawski
PO Box 1708
Killeen TX 76541

Oscar Orbits

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive 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 first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR 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 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, 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.

Oscar 7 Orbital Information

Orbit	Date (June)	Time (GMT)	Longitude of Eq. Crossing W
16203 Bbn	1	0114:48	76.3
16215 Abn	2	0014:09	61.2
16228 Bbn	3	0108:26	74.7
16240 Bbn	4	0007:46	59.6
16253 Abn	5	0102:04	73.2
16265 Bbn	6	0001:24	58.0
16278 Bbn	7	0055:41	71.6
16291 Abn	8	0149:59	85.2
16303 Bbn	9	0049:19	70.1
16316 Bbn	10	0143:37	83.6
16328 Abn	11	0042:57	68.5
16341 Bbn	12	0137:14	82.1
16353 Bbn	13	0036:35	66.9
16366 Abn	14	0130:52	80.5
16378 Bbn	15	0030:13	65.4
16391 Bbn	16	0124:30	78.9
16403 Abn	17	0023:50	63.8
16416 Bbn	18	0118:08	77.4
16428 Bbn	19	0017:28	62.2
16441 Abn	20	0111:45	75.8
16453 Bbn	21	0011:06	60.7
16446 Bbn	22	0105:23	74.3
16478 Abn	23	0004:44	59.1
16491 B	24	0059:01	72.7
16504 Bfd	25	0153:18	86.3
16516 Abn	26	0052:39	71.1
16529 Bbn	27	0146:56	84.7
16541 Bbn	28	0046:17	69.6
16554 Abn	29	0140:34	83.2
16566 Bbn	30	0039:54	68.0

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New Products

from page 19

The top-of-the-line SST T-2 Ultra Tuner tunes out swr on any coaxfed or random wire antenna. It works great on all bands (80-10 meters) with any transceiver running up to 200 Watts output. Because of its small size (5¼" x 2¼" x 2½"), the Ultra Tuner is ideal for mobile and portable as well as home installations.

The T-2 Ultra Tuner is housed in an attractive bronze finished enclosure. SO-239 coax connectors are used for transmitter input and coaxfed antennas. Convenient binding posts are provided for random wire and ground connections.

The SST T-2 Ultra Tuner sells for $39.95.

The SST T-1 Random Wire Antenna Tuner is the original small tuner. It will load up a random wire on all bands (160-10 meters) with any transceiver running up to 200 Watts output. The T-1 is great for apartments and hotel rooms—simply run a wire inside, out a window, or anyplace available. The T-1 features a neon tune-up indicator, SO-239 connector, and a compact (4-1/4" x 2-3/8" x 3") bronze-finished enclosure. It sells for $29.95.

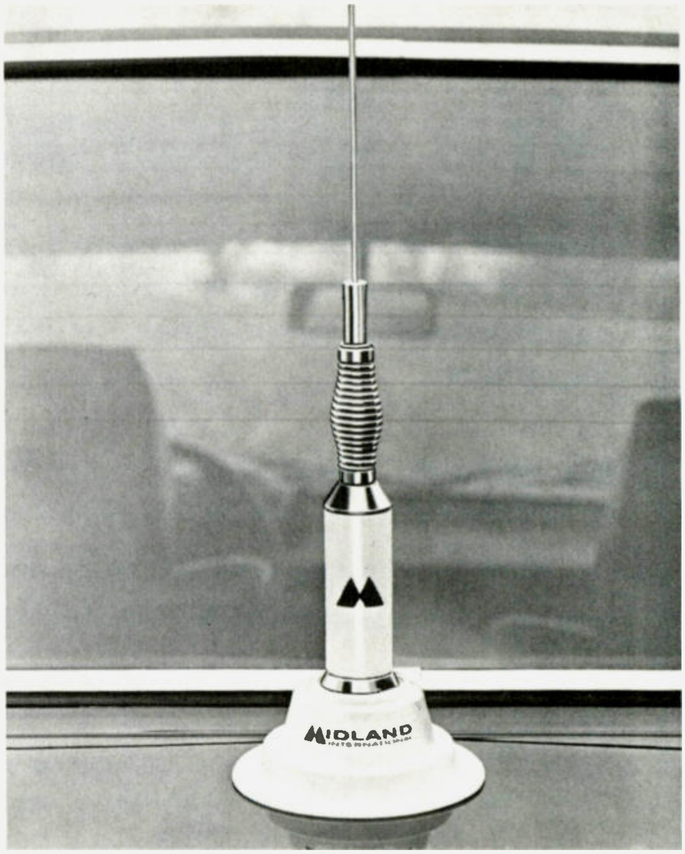
The SST T-3 Mobile Impedance Transformer matches 52 Ohm coax to the lower impedance of a mobile whip or vertical. It has a 12-position switch with taps spread between 3 and 50 Ohms. The T-3 uses an efficient toroid inductor for small size: 2¾" x 2" x 2¼". It sells for $19.95.

All SST products carry a 1 year unconditional guarantee and may be returned within 10 days for a full refund if you are not satisfied for any reason. To order, call (213)-376-5887, or mail to: *SST Electronics, PO Box 1, Lawndale, California 90260.*

MIDLAND INTRODUCES MOBILE AMATEUR ANTENNAS

Midland International Corporation's Communications Division has announced the introduction of four newly-designed mobile radio antennas for the amateur radio enthusiast. Specifically designed and factory tuned for operation with 1.5:1 or better vswr on the 2 meter (144 MHz-148 MHz) or 220 meter (220 MHz-225 MHz) amateur band, the antennas are base loaded, with precision wound and sealed loading coils.

Offered in either trunk/roof mount or magnet mount models, the 2 meter and 220 meter antennas feature a stainless steel whip and 17 feet of coaxial cable with connector and weather-resistant, plated hardware. The trunk/roof mount antennas (model 18-940, 950) clamp on the trunk lid lip or hatchback without drilling holes for mounting. The magnet mount antennas (models 18-941, 951) are prewired and feature heavy-duty, 5 oz. magnetic bases to hold the antenna securely at highway speeds. All four antennas are designed to give 3 dB gain in either the transmit or receive mode.



The portable Magnet mount model 18-941, 2 meter mobile antenna from Midland.

For further information on Midland's full line of 2 meter and 220 meter amateur radios and accessories, contact: *Pat O'Malley, National Marketing Manager for Amateur Radio, Communications Division, Midland International Corporation, PO Box 1903, Kansas City, Missouri 64141, (913)-384-4200.*

PALOMAR'S LOOP ANTENNA

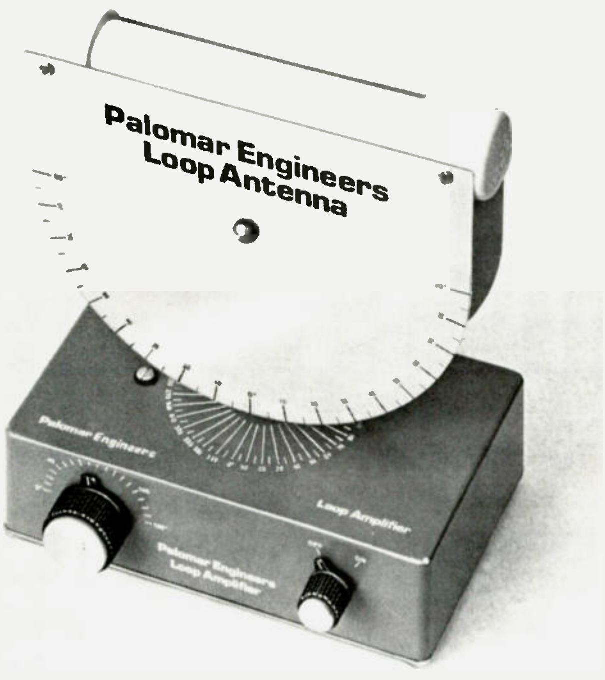
A new receiving antenna for the 80 and 160 meter amateur bands, the broadcast, and the VLF band has been introduced by Palomar Engineers.

The loop rotates 360° in azimuth and ±90° in elevation, with calibrated scales for both. The elevation or "tilt" of the loop is a new feature of the Palomar Engineers design and gives much deeper nulls than ordinary direction-finder loops.

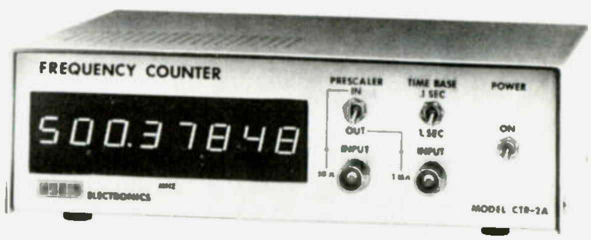
Loop nulls are very sharp on local and ground wave signals, but are broad or nonexistent on distant sky wave signals. This allows local interference to be eliminated while DX stations can still be heard from all directions.

The loop picks up much less noise than the usual transmitting antenna. This, along with its ability to null out specific interfering signals, improves reception considerably.

A loop amplifier serves as the mounting base for the



The loop antenna from Palomar.



Davis 500 MHz and 1 GHz frequency counter.

antenna. It contains a tuning capacitor to resonate the loop and an amplifier to boost the signal and preserve the high "Q" of the loop. The loop antenna plugs into the amplifier.

Plug-in loops are available for 160/80 meters (1600-5000 kHz), broadcast band (550-1600 kHz), and VLF (150-550 kHz).

The loop amplifier is $67.50 and the plug-in loops are $47.50 each. Add $2 shipping/handling.

A free descriptive brochure is available from *Palomar Engineers, PO Box 455, Escondido CA 92025.*

LOW-COST, PROFESSIONAL-QUALITY DAVIS 500 MHz AND 1 GHz FREQUENCY COUNTERS INTRODUCED

A versatile series of professional-quality, low-cost 500 MHz and 1 GHz frequency counters—designed for reliability and high accuracy in communications, engineering labs, and general electronics applications—has been introduced by Davis Electronics.

Covering the entire frequency spectrum to 1000 MHz, the Davis CTR-2A series of wide-range VHF-UHF frequency counters combines a 50 MHz (100 MHz in model CTR-2A-1000) counting range with built-in prescaler and preamplifier; a period measurement option is available to further extend usefulness of the CTR-2A series. Affordable 500 or 1000 MHz versions come either factory-assembled or in kit form (for even greater savings) and all CTR-2A models measure a compact 8.8" x 8" x 2.8", weighing only 2 lbs. 10 ozs.

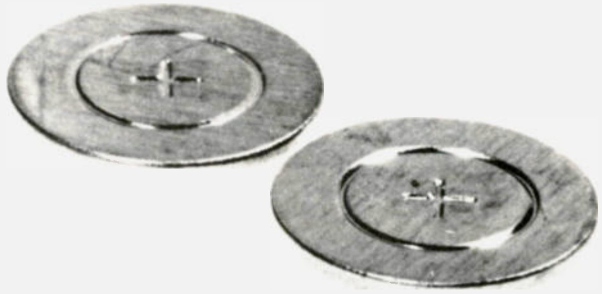
Superior features include 8-digit display, built-in VHF-UHF preamp and prescaler, high stability TCXO timebase, automatic input limiting, protected input, and automatic Dp placement. Selectable gate times are 0.1 and 1 sec. (10 sec. optional), with resolution to 1 Hz (or 0.1 Hz with 10 sec. option). Available low-cost options are oven crystal, 12 V dc operation, 10 sec. timebase, tilt handle, oversize digital display (.43" versus .3"), and period measurement.

Model CTR-2A-500 covers a frequency range from 10 Hz to 512 MHz, and the CTR-2A-1000's range is 10 Hz to 1000 MHz. Input impedance for both models is 1 megohm/20 pF (direct) and 50 Ohms (prescaled). CTR-2A-500 sensitivity (direct) is 10 mV @ 25 MHz, 30 mV @ 50 MHz, while the CTR-2A-1000 is 50 mV @ 100 MHz; sensitivity (prescaled) is 50 mV @ 500 MHz for model CTR-2A-500 and 50 mV @ 1000 MHz for the CTR-2A-1000. Maximum safe input is 120 Vrms to 10 MHz, 2.5 V @ 500 MHz, while accuracy is ± 1 count ± timebase accuracy. Timebase specifications include a crystal frequency of 10.000 MHz (standard TCXO or optional oven crystal) and setability of .2 ppm (TCXO) or .1 ppm (oven crystal).

The 500 MHz kit (CTR-2A-500K) with TCXO costs $249.95, while the 1000 MHz kit (CTR-2A-1000K) with TCXO is $399.95. Kits come complete with all parts, drilled and plated-through glass PC boards, cabinet, switches, and hardware, plus detailed assembly manual and calibrating instructions. Assembly time is about 8 hours; all parts are guaranteed 90 days and factory service is available, if needed, at $25.00 plus shipping.

Factory-assembled units cost $349.95 for 500 MHz (CTR-2A-500A) and $549.95 for 1000 MHz (CTR-2A-1000A). Factory units are calibrated to specifications and guaranteed for one year; the transformer is guaranteed for life. Shipping cost is $2.00 extra.

Options are (01) handle $10.00, (02) oven crystal $49.95, (03) .43" digits $10.00, (04) 12 V dc $15.00, (05) 10 sec. timebase $5.00, and (06) period measurement $15.00. For further information, contact: *Davis Electronics, 636 Sheridan Drive, Dept. 808, Tonawanda, New York 14150, (716)-874-5848.*



Panasonic's new long-life lithium batteries.

NEW SIZE LONG-LIFE LITHIUM BATTERY INTRODUCED BY PANASONIC

A new coin-size long-life lithium battery is now available from Panasonic Company. The new battery joins the previously announced coin lithium batteries by Panasonic for men's digital watches and calculators.

The new battery has the same profile as the other coin units (0.098" thick), but it offers a smaller diameter—0.785" versus 0.906". This reduction in size will enhance its acceptance in small digital watches and miniature calculators.

Nominal voltages of the new battery are at the 3-volt level and their capacities are in excess of 90 mAh. The cells are hermetically sealed and their shelf life is in excess of five years.

Prices of the new cells are compatible with the prices for silver oxide watch cells that the new units are expected to be replacing (one new lithium cell replaces two silver oxide units). OEM quantity prices are available on request. *Panasonic Company, One Panasonic Way, Secaucus NJ 07094.*

Ham Help

May I have your assistance, please. I am planning some redesign and modernization of my general coverage communications receiver. It appears that if high performance is to be achieved, commercial filter modules are practically necessary. Correct? Therefore, my question:

Can someone please supply the names and addresses of source candidates for obtaining one or two piece orders of such filters at less than maximum cost. Any hints for reducing the cost of these parts will be appreciated.

I had suspected that current receiver manufacturers would be a possibility; however, learning the specifications of the units and who uses what would be a miserable chore.

I have left the i-f frequency choice open until I see the prices of suitable units. My preliminary choice for passbandwidths are approximately 2.5 and 10 kHz.

A. Kubicz W8IGJ
Box 141
Golden CO 80401

I would like to ask for the benefit of whatever experience may be out there in the use of synthesizers and touchtone pads with walkie-talkies.

I would like to know, particularly, which brands of pads have particularly good, or particularly bad, ruggedness and reliability. My walkie-talkie is a Motorola HT-220 with Omni back. It's fully gasketed and essentially watertight. Are there any pads which can be mounted on it in such a way that HT and pad are both sealed tight?

I hear there's a synthesizer designed specifically to go into this unit, but I haven't been able to track it down. Who makes it, and how good is it? Has anyone successfully mounted a GLB synthesizer board inside without sacrificing the watertightness of the case or adding bulges, and what problems were encountered?

A related item: Has anyone come up with an antenna connector for the HT-220, other than the oversize kluge box Motorola makes strictly for tune-up purposes? I have a tentative solution, but a machine shop is required to build the screw-in adapter for the antenna hole.

John A. Carroll WB1AVV
25 Evergreen Ave.
Bedford MA 01730

Corrections

73 readers interested in obtaining the USCG *Loran-C User Handbook* should write to Loran-C Information Project, USCG (GWAN/73), Washington DC 20590 (phone (202)-426-0990). This will result in a quicker response than the address given in *73* for April, 1978, in the "Loran-C Receiver, part I" article. Also, the U.S. Naval Observatory now has a recorded daily message on time difference and phase value, obtained by dialing (202)-254-4662.

Ralph W. Burhans
Athens OH

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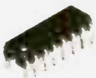
74L$08	21	74LS153	66
74LS10	21	74LS154	1 00
74LS14	85	74LS157	62
74LS20	23	74LS160	82
74LS21	23	74LS161	82
74LS22	23	74LS162	82
74LS30	23	74LS163	82
74LS32	30	74LS164	98
74LS37	31	74LS174	75
74LS38	31	74LS175	79
74LS42	60	74LS190	90
74LS47	75	74LS191	90
74LS48	72	74LS192	90
74LS73	35	74LS196	80
74LS74	35	74LS197	80
74LS75	53	74LS221	1 06
74LS76	37	74LS257	71
74LS86	36	74LS258	70
74LS90	52	74LS266	26
74LS92	52	74LS283	72
74LS93	52	74LS365	55
74LS109	36	74LS366	55
74LS112	36	74LS367	55
74LS113	36	74LS368	55
74LS114	36	74LS386	39
74LS125	46	81LS95	77
74LS126	46	81LS96	77
74LS132	75	81LS97	77
		81LS98	77



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4007	16	4035	98
4008	79	4040	99
4009	37	4049	34
4010	37	4050	34
4011	16	4051	89
4012	16	4052	1 15
4013	29	4053	89
4014	74	4066	59
4015	74	4071	19
4016	29	4081	23
4017	79	4082	23
4018	79	4507	39
4019	23	4510	1 05
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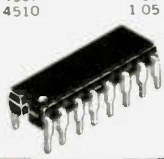
4022	89		
4023	16		
4024	67		



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7400	11	7482	50
7401	13	7483	62
7402	13	7485	75
7403	13	7486	26
7404	15	7489	1 75
7405	13	7490	40
7406	16	7491	51
7407	23	7492	[illegible]
7408	17	7493	40
7409	17	7494	[illegible]
7410	13	7495	60
7411	18	7496	60
7412	13	74107	28
7413	25	[illegible]	22
7414	61	74121	29
7416	24	74122	38
7417	22	74123	48
7420	13	74132	65
7423	25	74141	70
7425	25	7414[illegible]	65
7426	22	74150	88
7427	17	74151	61
7430	13	74153	61
7432	23	74154	95
7437	21	74157	55
7438	21	74161	55
7439	25	74163	55
7440	13	74164	85
7441	70	74165	90
7442	37	74170	1 69
7443	59	74173	1 10
7444	59	7417[illegible]	85
7445	65	74175	75
7446	62	74176	69
7447	59	7417[illegible]	70
7448	60	74180	65
7450	13	74181	1 75
7451	13	74190	95
7453	13	74191	95
7454	13	7419[illegible]	79
7460	14	7419[illegible]	80
7470	26	7419[illegible]	49
7472	21	[illegible]	86
7473	21	[illegible]	1 00
7474	[illegible]	7436[illegible]	62
7475	45	74366	62
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1N759A	12v	z	.25
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4019	.50
4020	.85
4021	1.00
4022	.85
4023	.25
4024	.75
4025	.30
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	.95
4044	.95
4046	1.75
4049	.45
4050	.45
4066	.95
4069	.40
4071	.35
4081	.70
4082	.45
MC14409	14.50
MC14419	4.85

— T T L —

7400	.15
7401	.15
7402	.20
7403	.20
7404	.15
7405	.25
7406	.35
7407	.55
7408	.25
7409	.15
7410	.10
7411	.25
7412	.30
7413	.35
7414	1.10
7416	.25
7417	.40
7420	.15
7426	.30
7427	.45
7430	.15
7432	.30
7437	.30
7438	.35
7440	.25
7441	1.15
7442	.45
7443	.65
7444	.45
7445	.65
7446	.95
7447	.95
7448	.65
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.40

7473	.25
7474	.30
7475	.35
7476	.40
7480	.55
7481	.75
7483	.95
7485	.75
7486	.25
7489	1.35
7490	.55
7491	.95
7492	.95
7493	.35
7494	.75
7495	.60
7496	.80
74100	1.15
74107	.35
74121	.35
74122	.55
74123	.55
74125	.45
74126	.35
74132	1.35
74141	.90
74150	.85
74151	.65
74153	.75
74154	.95
74156	.95
74157	.65
74161	.85
74163	.85
74164	.60
74165	1.50
74166	1.35
74175	.80

74176	1.25
74180	.75
74181	2.25
74182	.95
74190	1.75
74191	1.05
74192	.75
74193	.85
74194	1.25
74195	.95
74196	1.25
74197	1.25
74198	2.35
74221	1.00
74367	.85
75108A	.35
75110	.35
75491	.50
75492	.50
74H00	.15
74H01	.25
74H04	.20
74H05	.20
74H08	.35
74H10	.35
74H11	.35
74H15	.45
74H20	.30
74H21	.25
74H22	.40
74H30	.20
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.20

74H72	.45
74H101	.75
74H103	.75
74H106	.95
74L00	.25
74L02	.25
74L03	.30
74L04	.30
74L10	.30
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.85
74S00	.35
74S02	.35
74S03	.30
74S04	.30
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.35
74S40	.20
74S50	.20
74S51	.25
74S64	.20
74S74	.35
74S112	.60
74S114	.65

74S133	.40
74S140	.55
74S151	.30
74S153	.35
74S157	.75
74S158	.30
74S194	1.05
74S257 (8123)	1.05
74LS00	.25
74LS01	.35
74LS02	.35
74LS04	.30
74LS05	.45
74LS08	.25
74LS09	.35
74LS10	.35
74LS11	.35
74LS20	.25
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.35
74LS40	.45
74LS42	1.10
74LS51	.50
74LS74	.65
74LS86	.65
74LS90	.95
74LS93	.95
74LS107	.85
74LS123	1.00
74LS151	.95
74LS153	1.20
74LS157	.85
74LS164	1.90
74LS367	.75
74LS368	.75
74C04	.25
74C151	2.25

9000 SERIES

9301	.85	95H03	1.10
9309	.35	9601	.45
9322	.75	9602	.45

MICRO'S, RAMS, CPU'S, ETC.

74S188	3.00
1702A	4.50
MM5314	3.00
MM5316	3.50
2102-1	1.45
2102L-1	1.75
TR1602B	4.50
TMS 4044-45NL	14.50
8080AD	12.00
8T13	1.50
8T23	1.50
8T24	2.00
8T97	1.00
2107B-4, A	4.00
2708	11.50

LINEARS, REGULATORS, etc.

MCT2	.95
8038	3.95
LM201	.75
LM301	.45
LM308 (Mini)	.95
LM309H	.65
LM309K (340K-5)	.85
LM310	1.15
LM311D (Mini)	.75
LM318 (Mini)	.95
LM320K5 (7905)	1.65
LM320K12	1.65

LM320T5	1.65
LM320T12	1.65
LM320T15	1.65
LM324N	.95
LM339	.95
7805 (340T5)	.95
LM340T12	1.00
LM340T15	1.00
LM340T18	1.00
LM340T24	.95
LM340K12	1.65

LM340K15	1.25
LM340K18	1.25
LM340K24	.95
78L05	.75
78L12	.75
78L15	.75
78M05	.75
LM373	2.95
LM380 (8-14 PIN)	.95
LM709 (8,14 PIN)	.25
LM711	.45

LM723	.50
LM725N	2.50
LM739	1.50
LM741 (8-14)	.25
LM747	1.10
LM1307	1.25
LM1458	.95
LM3900	.50
LM75451	.65
NE555	.50
NE556	.95
NE565	.95
NE566	1.75
NE567	1.35

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\$100 - \$300	10%
\$301 - \$1000	15%
\$1000 - Up	20%

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ONE CENT IC SALE

P2

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THESE ONE-CENTERS ARE THE CENT-CIBLE WAY TO SHOP AND SAVE!

BUY ONE AT SALE PRICE, GET 2ND FOR ONLY 1¢ MORE.

TTL'S & OP AMPS!

Order By Cat. No. 6A1981 & Type No.

Type	Each	2 for	Type	Each	2 for	Type	Each	2 for
SN7400	$.19	$.20	SN7465	.19	.20	SN74145	1.25	1.26
SN7401	.19	.20	SN7470	.25	.26	SN74148	1.75	1.76
SN7403	.19	.20	SN7471	.25	.26	SN74150	.99	1.00
SN7404	.25	.26	SN7472	.25	.26	SN74151	.99	1.00
SN7405	.19	.20	SN7473	.55	.56	SN74153	.99	1.00
SN7406	.19	.20	SN7474	.29	.30	SN74154	1.75	1.76
SN7408	.21	.22	SN7475	.79	.80	SN74155	.79	.80
SN7410	.19	.20	SN7476	.59	.60	SN74156	.69	.70
SN7413	.39	.40	SN7478	.59	.60	SN74157	.99	1.00
SN7414	.65	.66	SN7480	.29	.30	SN74158	.99	1.00
SN7416	.29	.30	SN7482	.39	.40	SN74160	1.25	1.26
SN7420	.19	.20	SN7483	.99	1.00	SN74161	1.25	1.26
SN7423	.29	.30	SN7485	1.49	1.50	SN74163	1.19	1.20
SN7426	.25	.26	SN7486	.39	.40	SN74164	.99	1.00
SN7427	.25	.26	SN7488	1.95	1.96	SN74165	1.25	1.26
SN7430	.29	.30	SN7490	.69	.70	SN74166	1.25	1.26
SN7432	.25	.28	SN7491	.79	.80	SN74173	1.25	1.26
SN7437	.25	.26	SN7492	.45	.46	SN74174	1.49	1.50
SN7438	.29	.30	SN7493	.49	.50	SN74175	.99	1.00
SN7440	.19	.20	SN7494	.69	.70	SN74177	.79	.80
SN7442	.69	.70	SN7495	.69	.70	SN74179	1.49	1.50
SN7443	.69	.70	SN7496	.69	.70	SN74180	.49	.50
SN7444	.65	.66	SN7498	.69	.70	SN74182	.69	.70
SN7445	.99	1.00	SN74100	1.49	1.50	SN74190	1.49	1.50
SN7446	1.35	1.36	SN74107	.39	.40	SN74191	1.75	1.76
SN7447	1.25	1.26	SN74112	.25	.26	SN74192	.85	.86
SN7448	1.35	1.36	SN74113	.19	.20	SN74193	.85	.86
SN7450	.19	.20	SN74114	.25	.26	SN74194	1.25	1.26
SN7451	.19	.20	SN74121	.49	.50	SN74195	.49	.50
SN7453	.19	.20	SN74123	.69	.70	SN74197	.75	.76
SN7454	.19	.20	SN74125	.59	.60	SN74199	1.75	1.76
SN7455	.19	.20	SN74126	.39	.40	SN74200	5.50	5.51
SN7460	.19	.20	SN74132	1.25	1.26	SN74251	1.75	1.76
SN7462	.19	.20	SN74140	.99	1.00	SN74284	4.50	4.51
SN7464	.19	.20	SN74141	1.49	1.50	SN74285	4.25	4.26

POP-AMPS AT "CENT-CIBLE" PRICES

Case code: T=TO-220 Power Tab; V=Mini dip, K=TO-3; H=TO-5; N=DIP.

Type	Each	2 for	Type	Each	2 for	Type	Each	2 for
LM300H	$.49	$.50	LM370N-H	1.29	1.30	LM741V-H	.29	.30
LM301H-V	.45	.46	LM374H	1.79	1.80	LM1304	.79	.80
LM308V-H	.79	.80	LM376V	.29	.30	LM1310	.99	1.00
LM309K	1.29	1.30	LM377N	2.25	2.26	LM1312	1.99	2.00
LM311H-V	.79	.80	LM381N	1.69	1.70	LM1414V	.79	.80
LM318V	1.29	1.30	LM531H	1.49	1.50	LM1458V	.69	.70
LM320H-5, 12, 15	1.29	1.30	LM532H-N	.29	.30	LM1800N	.99	1.00
LM320K-15	1.29	1.30	LM555V	.75	.76	LM3028H	.65	.66
LM320T-6, 5	1.29	1.30	LM558V	.79	.80	LM3900N	.49	.50
LM322N	1.19	1.20	LM561N	1.00	1.01	LM3909V	1.75	1.76
LM324N	1.75	1.76	LM565N	.99	1.00	LM4195	1.95	1.96
LM339N	1.09	1.10	LM703H	.49	.50	LM4250	1.19	1.20
LM340K-5, 6, 8, 12, 15, 18,	1.29	1.30	LM704H	.29	.30	LM75451	.39	.40
LM340T-5, 6, 8, 12, 15, 18, 24	1.29	1.30	LM709N-H	.25	.26	LM75453	.39	.40
LM350N	.59	.60	LM710N	.39	.40	LM75491	.79	.80
			LM733N	.79	.80	LM75492	.79	.80
			LM739N	.89	.90	LM75494	.59	.60

YOU GET 120-DAY MONEY BACK GUARANTEE

HI-POWER STUD RECTIFIERS

Cat. No. 6A3567 - 150 amp / Cat. No. 6A87U685 - 250 amp

V.	Each	1¢ Sale	V.	Each	1¢ SALE
50	$ 2.95	2 for $ 2.96	50	$ 4.95	2 for $ 4.96
100	3.95	2 for 3.96	100	6.50	2 for 6.51
200	4.95	2 for 4.96	200	7.50	2 for 7.51
400	7.50	2 for 7.51	400	8.50	2 for 8.51
600	9.00	2 for 9.01	600	10.50	2 for 10.51
800	10.50	2 for 10.51	800	13.00	2 for 13.01
1000	12.50	2 for 12.51	1000	14.50	2 for 14.51

Order by Cat. No. & Voltage

10 AMP - POWER TABS!

SCRS! TRIACS! QUADRACS!

Order by Cat. No. and voltage! #6A1448 - TRIACS 7N1730 - SCR #6A 1590 - QUADRACS

PRV	Sale	2 for
50	$ .55	$ .56
100	.69	.70
200	.88	.89
400	1.19	1.20
600	1.59	1.60

25 AMP BRIDGE RECTIFIERS

Order by Cat. No. 6A2273 & voltage

V	Each	1¢ SALE
50	$1.95	2 for $1.96
100	1.49	2 for 1.50
200	1.69	2 for 1.70
400	1.99	2 for 2.00
600	2.25	2 for 2.26
800	2.50	2 for 2.51

25 AMP POWER STUD SCRS, TRIACS

Cat. No. 6A-14A147 (SCRs)
Cat. No. 6A-60B86A (Triacs)

V.	Each	1¢ SALE
50	$ .95	2 for $ .96
100	1.25	2 for 1.26
200	1.95	2 for 1.96
400	2.50	2 for 2.51
600	2.95	2 for 2.96

1N4000 Epoxy Rectifiers

• Miniature! • 1.5 Amp! Order by Cat. No. and Type No.

Cat. No.	Type No.	PIV	Price	1¢ MORE!
6A 2377	1N4001	50	10 for $.65	20 for .66
6A 2378	1N4002	100	10 for .75	20 for .76
6A 2379	1N4003	200	10 for .85	20 for .86
6A 2380	1N4004	400	10 for .99	20 for 1.00
6A 2381	1N4005	600	10 for 1.29	20 for 1.30
6A 2382	1N4006	800	10 for 1.39	20 for 1.40
6A 2383	1N4007	1000	10 for 1.49	20 for 1.50

1¢ SALE

1.5 AMP

BULLET RECTIFIERS!

Order by Cat. No. 6A60B84 and voltage

50V	10 for $.59	20 for $.60
100V	10 for .69	20 for .70
200V	10 for .79	20 for .80
400V	10 for .89	20 for .90
600V	10 for 1.09	20 for 1.10
800V	10 for 1.19	20 for 1.20

MICRO MINI

TOGGLE SWITCHES!

3 Amps. 125 VAC contacts, with chrome handles, complete with mounting hardware.

Cat. No	Type	Sale	2 for
6A3936	SPDT	$1.29	$1.30
6A5085	SPDT*	1.39	1.40
6A4037	DPDT	1.45	1.46
6A5087	4PDT*	1.95	1.96

* Center OFF

BUY 1 AT OUR SALE PRICE
GET 2 FOR 1¢ MORE

LYTIC KLINIC

Electrolytic capacitors

Order by Cat. No. 6A3269 and value

UF	V	Style	Sale	1¢ SALE
10	15	P.C.	10 for $1.00	20 for $1.01
50	15	P.C.	8 for 1.00	16 for 1.01
15	25	P.C.	8 for 1.00	16 for 1.01
50	25	P.C.	6 for 1.00	12 for 1.01
20	15	Axial	10 for 1.00	20 for 1.01
20	15	P.C.	10 for 1.00	20 for 1.01

6 AMP CARTWHEEL RECTIFIERS

Cat. 6A3584 — AXIAL LEADS

V.	Each	1¢ SALE
50	$ .36	2 for $ .37
100	.45	2 for .46
200	.61	2 for .62
400	.79	2 for .80
600	.90	2 for .91
800	1.19	2 for 1.20
1000	1.39	2 for 1.40

LEDS!

YOUR CHOICE 5 for $1.00
1¢ SALE 10 for $1.01

Order by Cat. No.
- #6A2135 JUMBO RED LEDS
- #6A2137 MICRO RED LEDS
- #6A2790 JUMBO RED CLEAR LEDS
- #6A2792 JUMBO TAPERED AMBER
- #6A2140 MICRO GREEN LEDS

ZENERS!

Order by Cat. No. 6A5210 & voltage & wattage!

1 Watt	Sale	1¢ SALE	5 WATTS	Sale	1¢ SALE
7.5V	5 for $1.	10 for $1.01	3.3V	3 for $1.	6 for $1.01
8.2V	5 for 1.	10 for 1.01	6. V	3 for 1.	6 for 1.01
9.1V	5 for 1.	10 for 1.01	6.2V	3 for 1.	6 for 1.01
11.V	5 for 1.	10 for 1.01	8.2V	3 for 1.	6 for 1.01
12.V	5 for 1.	10 for 1.01	9.1V	3 for 1.	6 for 1.01
15.V	5 for 1.	10 for 1.01	12. V	3 for 1.	6 for 1.01
			15. V	3 for 1.	6 for 1.01
			18. V	3 for 1.	6 for 1.01
			24. V	3 for 1.	6 for 1.01
			30. V	3 for 1.	6 for 1.01

THIS NEW LIST OF "ONE-CENTERS" HELPS FIGHT INFLATION!

Quan.	Description (Order by Cat. No. in parenthesis)	Sale	1¢SALE
1	WOODGRAIN CABINET, 3½ x 10 x ½" deep, sohrs, alarms. (#6A5201)	$1.49	2 for $1.50
2	LCO THERMAL INDICATORS, 88-108°F, 7x1", flexible (#6A5195)	1.00	4 for 1.01
1	JOYSTICK, four 100K pots, with knob (#6A3808A)	4.95	2 for 4.96
1	EECO THUMBWHEEL SWITCH, BCO, 0-7 (#6A2870A)	1.49	2 for 1.50
1	8-TRACK TAPE TRANSPORT, with preamp (#6A3010)	9.95	2 for 9.96
1	PLESSEY TV SIDEBAND FILTER, for chan. 3 or 4 (#6A3975)	1.95	2 for 1.96
5	TRANSITORS, 2N3904 equal, NPN, switching (#6A5209)	1.00	10 for 1.01
1	METER, 50uA, 1½" square, 0-20db (#6A3705)	1.19	2 for 1.20
1	SPST RELAY, norm. open 12-24 VDC, 1250 ohms, dip style (#6A5175)	1.00	2 for 1.01
1	VEEDER ROOT COUNTER, 000-999, resettable, panel mt. (#6A5081)	1.49	2 for 1.50
2	DUAL GATE MOSFET, sim. to 3N200, 3N187, for RF & Mixer (#6A5101)	1.00	4 for 1.01
1	8-TRACK TAPE HEAD, with plug' n' cord (#6A3468)	2.50	2 for 2.51
10	CALCULATOR KEYBOARDS, 20 keys and more (6A3524)	$2.00	20 for $2.01
15	SLIDE VOLUME CONTROLS, asstd values (6A3057)	2.00	30 for 2.01
10	CRYSTALS, may include CB, Ham & more (6A3250)	2.00	20 for 2.01
150	MOLEX IC SOCKETS, on a strip, cut to length (6A3144)	2.00	300 for 2.01
100	TERMINAL STRIPS, from 2 lugs up (8A3136)	2.00	200 for 2.01
30	NE-2NEON LAMPS, all 100% good (6A2613)	2.00	60 for 2.01
40-ft.	SHIELDED CABLE, 1 cond. mikes, phonos, (#6A3577)	2.00	80 ft. for 2.01
50	TRANSISTOR ELECTROS, asstd values, styles (6A2747)	2.00	100 for 2.01
3	SOUND TRIGGERS, sound triggers scr w/amp (6A3625)	2.00	6 for 2.01
15	6V TEST INDICATORS, leads, grain-o-wheat (6A3526)	2.00	30 for 2.01
100	CAPACITOR SPECIAL, discs, mylar, tytics, more (6A2738)	2.00	200 for 2.10
30	MINI TRIMPOTS, to 1 meg, 1 turn, ¼W (6A3345)	2.00	60 for 2.01
10	VOLTAGE REGULATORS, hobby LM320, 340, TO-3 (6A3330)	2.00	20 for 2.01
30	PANEL SWITCHES, slides, rotaries, mod, etc (6A3268)	2.00	60 for 2.01
200	RESISTOR SPECIAL, ⅛ to 1W, carbon, metal (6A3054)	2.00	400 for 2.01
200	HALF WATTERS, resistors, carbon, metal (6A3046)	2.00	400 for 2.01
100	NATIONAL IC BONANZA, linears, 7400s ROMS (6A2860)	2.00	200 for 2.01
40	HOBBY LEOS, asstd types, mostly useable (6A2859)	2.00	80 for 2.01
15	LM340T VOLTAGE REGULATORS, 5 to 24V, TO-220 (6A2635)	2.00	30 for 2.01
100	TWO WATTERS, resistors, carbon-metal marked (6A2735)	2.00	200 for 2.01
100	POLYSTYRENE CAPS, asstd values, voltage, hi-Q (6A2729)	2.00	200 for 2.01
50	THERMISTORS, resistors that change with temp (6A4089)	2.00	100 for 2.01
20	BRIDGES, untested, 2, 4, 6, 10, amp, full wave (6A4022)	2.00	40 for 2.01
25	LAMP'N'SOCKET SETS, micro, 1.5V, T2 (6A3957)	2.00	50 for 2.01
15	MIXED READOUTS, hobby, untested, .127, .3, .5, etc. (6A3619)	2.00	30 for 2.01
150	QUARTER WATTERS, resistors, metal film, marked (6A3413)	2.00	300 for 2.01
100	PLASTIC TRANSISTORS, untested, RO-92 (6A2604)	2.00	200 for 2.01
200	PREFORMED RESISTORS, ¼, ½, 1W, marked, asstd (6A2608)	2.00	400 for 2.01
200	PRECISION RESISTORS, ¼, ½, 1W, 1%, 2% marked (6A2428)	2.00	400 for 2.01
60	DIPPED MYLARS, shiny finish, asst values (6A2597)	2.00	120 for 2.01
30	VOLUME CONTROLS, audio, linear, asstd values (6A2421)	2.00	60 for 2.01
5	7.5 VOLT ZENER DIODES, 1 watt (6A5187)	1.00	10 for 1.01
5	9.1 VOLT ZENER DIODES, 1 watt (6A5188)	1.00	10 for 1.01
30-ft.	WIRE WRAP WIRE, 30 gage, for ICs, terminals (#6A3803)	1.00	60-ft for 1.01
5	TANTALUM ELECTRO CAPACITORS, 2.2uF, 25V (#6A5189)	1.00	10 for 1.01
1	ALARM CLOCK CHIP, MM5316, 4-digits (6A1759)	2.95	2 for 2.96
5	PANCAKE PHOTOCELLS, 600 to 15K ohms (6A2939)	1.00	10 for 1.01
1	100KHZ MARKER CRYSTALS, approx for marker gen. (6A3896)	1.95	2 for 1.96
1	MOTHERBOARD EDGE CONNECTOR, 106 pins, .125" (6A3987)	3.50	2 for 3.51
1	48-PIN EDGE CONNECTOR, .156" spacing (6A3963)	1.95	2 for 1.96
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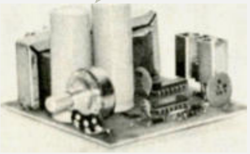

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LED volume unit meter rectifier section	9419-1	5.15
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FM tuner (E23) i.f. converter	9447-2	3.60
stereo decoder	9447-3	2.55
auto slide changer	9743	1.45
morse decoder	9759	16.25
signal injector	9765	1.10

5 BACK ISSUES OF ELEKTOR MAGAZINE containing a variety of electronic projects, with schematics, PC layouts, parts list. PC boards are available. Regular $1.50/copy
$4.00/5 issues
25 26 29 30 31

ELECTRONIC BUZZER

Miniature, Solid State
6V 15ma (4-9V oper.) $1.29 ea.
12V 15ma (8-20V oper.) $1.29 ea.

ELECTRONIC DOOR CHIME KIT

WITH TI TMS 1000 MICROPROCESSOR CHIP PROGRAMMED TO PLAY 24 DIFFERENT TUNES

$39.50 SHIPPING $1.00

TANTALUM CAPACITOR KIT

solid dipped, 12 values, 5 each
.1uf/35V 2.2/35 10/25 33/10
.33/35 4.7/16 15/20 47/25
1/35 6.8/16 22/16 56/6
capacitors only......$14.95
supplied in styrene utility box..................$19.95

CAPACITOR KIT - ceramic disc

50V, 24 values, 10 capacitors each

1pf	33pf	82pf	220pf	820pf	.022uf
5pf	47pf	100pf	270pf	.001uf	.030uf
10pf	56pf	150pf	470pf	.0047uf	.050uf
22pf	68pf	180pf	600pf	.01uf	.1uf

capacitors only...$11.95
Packeged in 15 drawer, 60 compartment cabinet....$19.95 plus $2.00 shipping

CERAMIC DISC CAPACITORS - 50V

1pf	22pf	56pf	120pf	270pf	820pf	.022uf
5pf	27pf	68pf	150pf	390pf	.001uf	.030uf
7pf	33pf	82pf	180pf	470pf	.0047uf	.050uf
10pf	47pf	100pf	220pf	600pf	.01uf	

0-10 per value..$.10ea 10-up per value $.05ea
10-up per value $.05ea

TANTALUM CAPACITORS - solid dipped

.1u/35V	$.20	6.8/6	$.25	15/50	$.40
.22/35	.20	6.8/16	.25	22/16	.40
.33/35	.20	6.8/50	.30	33/10	.50
1/35	.20	10/16	.30	47/6	.50
2.2/20	.25	10/25	.35	47/25	.55
2.2/35	.25	10/50	.35	56/6	.65
3.3/35	.25	15/10	.35	150/15	1.25
4.7/16	.25	15/20	.35		

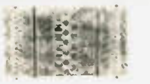
DIODES

Silicon SW diode assorted 400 mw	$.05ea
1N4148 (1N914) Silicon diode 400 mw	10
1N3064 Silicon SW diode 400 mw	10
1N4006 Silicon rect. diode 600V 400mw	10
Zener diode 400 mw - 2.4V, 3.6V, 5.1V, 6.5V, 6.8V, 10V, 12V, 14.5, 15V, 120V	.15
Germanium diode 400 mw	.08

TRANSISTORS

2N1132	PNP Gen Purp. Ampl TO-5	$.69
2N2218A	NPN Low Power Trans TO-5	.69
2N2222A	NPN Low Power Trans TO-18	.29
2N2223	NPN Low Power Trans. TO-5	.69
2N2369	NPN Low Power Trans TO-5	.29
2N2904	PNP Low Power Trans TO-5	.49
2N2905A	PNP Low Power Trans TO-5	.76
2N3227	NPN Low Power Trans TO-18	.69
2N3904	NPN Low Power Trans TO-92	.17
2N3906	PNP Low Power Trans TO-92	.17
SCA 13572	NPN Pwr Trans - 200V TO-5	1.75

UNIVERSAL BREADBOARD

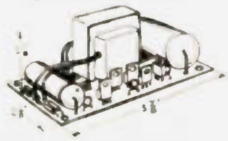


Silver placed copper circuits fits any IC and related components. 2 triple rows of 27 holes for DIP. 3-3/16"x5-1/16"
$1.00

I C BREADBOARD

Silver plated copper circuits holds 5 - 16 pin DIP IC's and interconnection holes. $1.00

REGULATED POWER SUPPLY



Plus & minus 5V, 12V and 15V. Uses 3 LM340T and 3 LM320T regulators, 115V/29V CT transformer plus PC board capacitors & diodes. All parts, schematic, instructions
PS-29..........$12.95 + $1.00 Shppng.

LINEAR ASSORTMENT

1 each of following - all functional
301M, 302H, 307M, 311N, 340T-5, 340T-6, 340T-15, 380-8, 385K, 723N, 739N, 741M, 748M, 75453M
$4.75

TRIMPOT - Single Turn

Mepco - Cermet 8014
.5w, + 100 PPM/°C + 20%
500 ohm, 2K, 10K, 25K, 50K, 100K, 500K, 1M. $.75 ea.
.69/10-

TRIMPOT - 25 turn

Bourns - Cermet 3299W
PC Mount, vert. adj.
2K, 10K, 20K $1.75 ea

CLOCK KIT - Mark I

6 digit clock kit with one PC board. Accommodates MM5314 clock chip and 6 FND 359 displays contains all components except transformer. Includes 3 switches. Board has terminals for remote displays. $10.95

with 12V/300 ma transformer
$13.95

PRECISION RESISTOR PACKAGE

Metal Film ± 1% 1/4 watt
Starter Kit - 2ea. 60 values
120 Resistors 10.5 ohm- 464K
$14.95
Supplied in 15 Drawer 60 Comp. Cabinet - $26.50 + $2.00 Sh.

PLASTIC CASES

VERO - dark and light gray nominal O.D.

2514F	2"x4"x1"	$4.34
2516G	2"x4"x1.6"	4.90
2518H	2.6"x 4.7"x1.6"	5.48
2520J	3.2"x6"x2"	6.24
2522K	4.3"x7.4"x2.4"	8.28
2755G	2.6"x4.7"x2.6"	6.74
2760D	4.3"x7.4"x2.4" (w/ handle/stand)	10.78
2525F	2.8"x5.4"x2.4" (ventilated)	5.40
HAMMOND - blue		
1591C	2.6"x4.8"x1.6"	2.65

KEYBOARD

20 Keys - 2 slide switches
3" x 3-3/4" $1.00/3

BEZELS - with red filters

140-2 cut-out 1.125" x 2.375" max .062" panel thickness $1.75
140-4 cut-out 1.160" x 4.375" max .125" panel thickness $2.75

Rohm QUALITY RELIABILITY

METAL FILM RESISTORS

± 1%, 1/4w, + 50 PPM/OC
Standard Decade Values 10.5 - 464K

Qty.	Ea.	Min 10/value	Min 100/value
1-99	$.20	$.15	
100-999	.20	.10	$9.00/100
1000-			8.00/100

Carbon Film Resistors ± 5% 1/4w, 1/2w

Qty.	Ea.	Min 10/value	Min 100/value
1-99	$.10	$.05	
100-999	.10	.04	$3.00/100
1000-			2.50/100

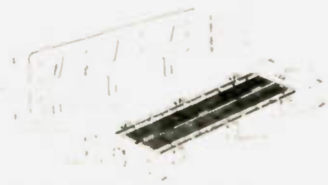
TTL

7400	11	7451	20	74155	75
7401	18	7453	20	74156	75
7402	14	7454	20	74157	85
7403	14	7460	20	74158	1 39
7404	16	7464	35	74160	1 23
7405	19	7465	35	74161	95
7406	29	7470	38	74162	1 39
7407	28	7472	35	74163	95
7408	22	7473	35	74164	95
7409	17	7474	31	74165	95
7410	16	7475	49	74166	1 19
7411	25	7476	34	74170	1 90
7413	43	7483	68	74173	1 49
7414	65	7485	88	74174	1 19
7415	25	7486	38	74175	95
7416	35	7489	2 25	74176	84
7417	35	7490	43	74177	84
7420	16	7491	75	74180	95
7423	37	7492	48	74181	2 30
7425	35	7493	48	74182	85
7426	22	7494	75	74185	2 20
7427	35	7495	75	74190	1 25
7430	20	7496	75	74191	1 15
7432	23	74100	1 15	74192	89
7437	25	74107	37	74193	85
7438	25	74121	37	74194	1 15
7439	50	74122	38	74195	74
7440	15	74123	45	74196	98
7441	85	74125	54	74197	95
7442	59	74126	58	74198	1 69
7443	65	74132	75	74199	1 69
7444	73	74141	85	745200	3 95
7445	65	74145	90	74279	79
7446	81	74150	98		
7447	59	74151	68		
7448	79	74153	60		
7450	17	74154	1 20		

LINEAR CIRCUITS

LM300H	$.71	LM372N	2 93	LM733H	79
LM301CN	29	LM376CN	59	LM739N	99
LM302H	65	LM380N	1 29	LM741CN(8)	32
LM304H	80	LM380 8CN	95	LM741CN(14)	32
LM307CN	26	LM381N	1 75	LM741CH	31
LM307H	30	LM382N	1 75	LM747H	79
LM308H	89	LM385K	45	LM747N	[illegible]
LM309H	1 05	NE531V	2 90	LM748CN	35
LM309K	99	NE540L	2 90	LM1310N	2 80
LM310CN	1 07	NE546A	1 09	LM1414N	1 59
LM311CN	89	NE550A	75	LM1456CN	1 29
LM311H	89	LM555CN	39	LM1458CN	59
LM311N	89	NE556A	85	LM1496N	89
LM319N	1 13	LM560N	2 95	LM1800N	2 48
LM320K		LM561N	2 95	ULN2208	89
5 5.2 12 15	1 29	LM565N	1 19	ULN2209	89
LM320T		LM565H	1 39	CA3046	1 19
5 12 15	1 19	LM566H	1 39	CA3081	1 49
LM322N	1 59	LM568CN	1 19	LM3900N	49
LM324N		LM567CN	1 29	LM7524	79
(LM2902N)	1 52	LM567H	1 49	LM7525	79
LM339N	1 58	LM703H	59	8038B	4 59
LM340K		LM703CN	39	75451CN	35
5 6 8 12		LM709N	25	75452CN	35
15 18 24	1 29	LM709H	29	75453CN	35
LM340T		LM710N	59	75454CN	35
5 6 8 12		LM711N	39	75491N	71
15 18 24		LM723H	55	75492N	85
(78 — — Equiv) 1 19		LM723N	52		

BIMBOARD - BREADBOARD KIT



Solderless breadboard section has 94 breadboard strips of 5 sockets each. 2 bus strips of 40 sockets each. Component bracket for switches lamps etc., accepts leads .01" to .035" diameter. $11.95 ea.

RESISTOR PACKAGE

Carbon Film ± 5% 1/4 w or 1/2 w
15 ea. of 12 values:
100, 220, 470, 1K, 1.5K, 3.3K
4.7K 6.8K, 10K, 33K, 100K, 1M.
$5.45

Carbon Film ± 5% 1/4w or 1/2w
Usage Evaluated Assortment
5 to 20 ea of 44 values.
$12.95
Supplied in 15 Drawer 60 Comp. Cabinet. $22.95 + $2.00 Sh.

IC SOCKETS

Low Profile Solder Tail				Wire Wrap	
8 pin	$.16	24 pin	$.36	8 pin	.45
14 pin	.19	28 pin	.44	14 pin	.49
16 pin	.21	40 pin	.61	16 pin	.55
18 pin	.28				

COMPLETE SATISFACTION GUARANTEED. SHIPMENT TO US AND CANADA PREPAID UNLESS INDICATED OTHERWISE. OTHER COUNTRIES ADD 10% - EXCESS REFUNDED. ORDERS SHIPPED IN 3 WORKING DAYS FROM RECEIPT. MINIMUM ORDER $10.00 CALIFORNIA RESIDENTS ADD SALES TAX. MINIMUM COD OR CHARGE ORDER $15.00

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TELEPHONE 408 659-3171

14

NEW

Frequency Counter

$89.95 kit

UTILIZES NEW MOS-LSI CIRCUITRY

You've requested it, and now it's here! The CT-50 frequency counter kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 V dc as it does on 110 V ac. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $89.95. Order yours today!

CT-50, 60 MHz counter kit . . . . $ 89.95
CT-50 WT, 60 MHz counter, wired and tested 159.95
CT-600, 600 MHz prescaler option for CT-50, add 29.95

SPECIFICATIONS

Sensitivity: less than 25 mv.
Frequency range: 5 Hz to 60 MHz, typically 65 MHz
Gatetime: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 10 ppm, .001 ppm with TV time base!
Input: BNC, 1 megohm direct, 50 Ohm with prescale option
Power: 110 V ac 5 Watts or 12 V dc @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case

Color burst adapter for .001 ppm accuracy
CB-1, kit $14.95

CLOCK KIT
6 digit 12/24 hour

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits, Polaroid lens filter, extruded aluminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, bronze, blue (specify).

Clock kit, DC-5 . . . . $22.95
Alarm clock, DC-8, 12 hr only 24.95
Mobile clock, DC-7 . . . . 25.95
Clock kit with 10 min ID timer, DC-10 . . . 25.95
Assembled and tested clocks available, add $10.00

CHEAP CLOCK KIT $8.95

DC-4 Features:
- 6 digit .4" LED
- 12 or 24 format

Does not include board or transformer

PC Board $2.95
Transformer $1.49

VIDEO TERMINAL KIT $149.95

A compact 5 x 10 inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5 volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard operated cursor and page control, parity error display and control, power on initialization, full 64 character ASCII display, block type see thru cursor. Keyboard computer control backspaces, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit . . . $149.95
TH3216 Assembled and Tested . . . 239.95
VD-1 Video to RF Modulator Kit . . . 6.95

CAR CLOCK KIT $27.95

12/24 Hour 12 Volt AC or DC
- High Accuracy (1 minute/month)
- 6 jumbo .4" LED readouts
- Easy, no polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super instructions

Complete Kit, DC-11 . . . $27.95

AUTO-DIMMER $2.50

Automatically adjusts display brightness according to ambient light level. For DC-11 Car Clock

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 meter Power Amp

The famous RE class C power amp now available mail order! Four Watts in for 30 Watts out, 2 in for 15 out, 1 in for 8 out, incredible value, complete with all parts, instructions and details on T-R relay. Case not included.
Complete Kit, PA-1 . . . . $22.95

CALENDAR ALARM CLOCK

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car!

FEATURES:
- 6 Digits, .5" High LED
- Calendar shows mo./day
- True 24 Hour Alarm
- Battery back up with built in on chip time base
- 12/24 Hour Format
- Snooze button
- 7001 chip does all!!

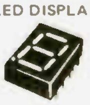
Complete Kit, less case, DC-9 . . . . $34.95

		LINEAR		REGULATOR		TRANSISTORS	
5314 Clock	$2.95	555	$ .50	78MG	$1.49	MRF-238 30W VHF	$11.95
74S00	.35	556	.75	309k	.89	NPN 2N3904 type	10/$1.00
74S112	.75	566	1.49	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.49	340K-12	.99	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.89	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.89	FET MPF-102 type	3/$2.00
7490A	.55	75491	.50	7815	.89	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.89	2N3055 NPN Power	.75

SPECIAL

DIODES: 1KV,2.5A . . . . 5/$1.00 100V,1A . . . . 10/$1.00 1N914A type . . . . 50/$2.00

LED DISPLAYS



FND 359 75
FND 510 . . . . . 1.25
DL 707 . . . . . 1.25
HP 7730 . . . . . 1.25
Red Polaroid Filter . . . 4.25" X 1.125" 59

741 OP-AMP SPECIAL
Factory prime mini dip with both Xerox and 741 part numbers
10 for $2.00

SOCKETS

14 PIN 5/$1.00
16 PIN 5/$1.00
24 PIN 2/$1.00
40 PIN 3/$2.00

FERRITE BEADS

with info and specs
15/$1.00
6 hole Balun Beads
5/$1.00

MINI-KITS

TONE DECODER KIT

A complete tone decoder on a single PC Board. Features: 400-5000 Hz adjustable frequency range, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.
Complete Kit, TD-1 . . . . $4.95

SUPER SLEUTH AMPLIFIER

A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.
Complete Kit, BN-9 . . . . $4.95

FM WIRELESS MIKE KIT

Transmit up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9 V. Type FM-2 has added super sensitive mike preamp.
FM-1 . . . . . . $2.95 FM-2 . . . . . . $4.95

COLOR ORGAN/MUSIC LIGHTS

See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.
Complete Kit, ML-1 . . . . $7.95

LED BLINKY KIT

A great attention getter which alternately flashes 2 Jumbo LEDs. Use for name badges, buttons, or warning type panel lights. Runs on 3 to 9 volts.
Complete Kit $2.95

POWER SUPPLY KIT

Complete triple regulated power supply provides variable ±15 volts at 200 mA and +5 volts at 1 Amp. 50 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8 V at 1 Amp and 18 to 30 VCT.
Complete Kit, PS-3LT $6.95

SIREN KIT

Produces upward and downward wail characteristic of police siren. 5 watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.
Complete Kit, SM-3 . . . . $2.95

DECADE COUNTER PARTS

Includes: 7490A, 7475, 7447, LED readout, current limit resistors, and instructions on an easy to build low cost frequency counter.
Kit of parts, DCU-1 . . . . $3.50

ramsey electronics

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(716) 271-6487

TELEPHONE ORDERS WELCOME

Satisfaction guaranteed or money refunded. COD, add $1.00. Orders under $10 add $.75. NY residents add 7% tax. Add 5% for postage, insurance, and handling. Minimum order $6.00.

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PHONE ORDERS ON MASTERCHARGE OR VISA CARDS

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DALLAS, TX. 75219
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B8

PS-14 HIGH CURRENT REGULATED POWER SUPPLY KIT

- Better than 200MV load and line regulation
- Foldback Current Limiting
- Short Circuit Protected
- Thermal Shutdown
- Adjustable Current Limiting
- Less than 1% ripple.
- 15 amps 11.5 to 14.5V
- All parts supplied including heavy duty transformer.
- Quality plated fiberglass PC board.

Less Case, meters & jacks

39.95

UPS SHIPPING PAID!

MK-03A CLOCK/TIMER KIT

Features 24 hour Zulu time and up to 24 hours of elapsed time on the same set of six digit LED readouts. Totally independent operation of both functions. Clock has presettable alarm with 10 minute snooze. Timer has reset, hold, and count functions. Full noise and overvoltage protection. 24 hour only. Readouts has dimmer feature or they can be turned off without disturbing the clock or timer. Timebase included (.01% accuracy). Because of the many options and mounting considerations the case and switches are not included. Switches are standard types. Will fit inside standard aircraft instrument case.

9–14VDC
150MA W/readouts on
40MA W/readouts off

28.95

OVERVOLTAGE PROTECTION KIT 6.95

Provides cheap insurance for your expensive equipment. Trip voltage is adjustable from 3 to 30 volts. Overvoltage instantly fires a 25A SCR and shorts the output to protect equipment. Should be used on units that are fused. Directly compatible with the PS-12 and PS-14. All electronics supplied. Drilled and plated PC board. (Order OVP-1)

POWER SUPPLY METERS

Quality 3½" meters for the P-S14. 0-15VDC & 0-25A. Matched set, individually packaged. NOT SURPLUS! 12.95/set

WARBLE ALARM KIT

A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 5–12VDC at up to 1 amp (using 12VDC•8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker. ORDER W8–02

2.50

New! ULTRASONIC SENDER RECEIVER KIT US-02

TOTAL SECURITY! Completely invisible ultrasonic (23KHZ) Sound beam works like a photoelectric beam but is uneffected by light, heat or noise. Seperate Transmitter and Receiver can be used from 6 inches to 25 feet! A solid object breaking the beam causes an output to go low that will sink up to 150 MA to Drive a Relay, TRIAC, etc. Complete electronics are provided. Works on 12VDC (unregulated) and draws less than 100 MA. Use it for burgler alarms, object counters, automatic door openers, automatic door bells, electronic rat trap(?) and more.

COMPLETE KIT LESS CASES 21.50

Optional entry delay and Alarm Timeout Circuit 3.95 will source or sink up to 200 MA DC.

MOBILE CLOCK CALENDAR KIT

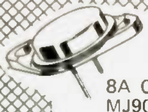
Seems like everybody sells digital clock kits, however we have the only low cost **DIGITAL CLOCK / CALENDAR** for Mobile operation. We provide quality plated' through hole boards and step by step instructions, parts overlays and schematics. This clock has many features and we supply all the parts but a small speaker. Fantastic for car, boat or Van.

- Intergral Timebase (.01% ACC)
- Large 4 DIGIT LED display with AM/PM indicators
- Flashing colon at 1HZ rate
- Special noise and overvoltage protection for mobile use
- Auxillary output will drive relay or TRIAC to control external equipment
- 5¼ Wx1¾x2½D
- Built in ignition blanking turns off readouts when not in use
- Presettable alarm with Snooze
- Special "SleepTimer"

23.50 NO CASE

12 VAC XFMR for 110 VAC 1.50
24 Hour Format add 2.00

All Parts Are Prime & Guaranteed!



PICK A PAIR!

8A Complimentary Darlington Power Transistors. MJ900 PNP, MJ1000 NPN. 90 Watts. Build high power audio amps.

Buy a Pair for $3.00!

MC1469R

500ma postive regulator. 3 to 30 volts. with complete specs and applications. $1.25 - house no.

Heatshrink Tubing

A very good asst. of 3/32", 1/8", 3/16" 1/4" & 7/16" 6" lengths 12 pcs. 75c

This item FREE with purchase of 15.00 or more

Multicolored 26 Conductor Ribbon Cable
No. 28 wire with a woven binder. Super Flexible!
10' roll – $2.95

Special!

Limited Qty! LM567 Tone Decoders while they last! 99c

220mfd @25V Axial Cap 7/$1.00

.500mfd @35V Axial Cap 5/$1.00

1100mfd @ 35 Axial Capacitor 4/$1.00 Sprague

#30 Silver Plated

Wirewrap wire with Kynar® jacket. 4 colors available, 100 ft. of each color.

$4.95 (400')

CA3011

100Khz to over 20Mhz. Good for IF's and low frequency Complete Specs!

50¢ each

MG-01 ELECTRONIC GRANDFATHER CLOCK

While we are talking about clocks check out the MINI GRANDFATHER CLOCK Reviewed in April 1978 RADIO ELECTRONICS. We have the *only* kit in the world with all the below listed features. The biggest problem is to describe how unique and fascinating this timepiece really is! The LED **"Swinging " Pendulum** and **Matching Tick-Tock Sound** are available only on our clock. In addition the electronic "bell" notes each hour (ie 3 times for 3 o'clock). Housed in the optional Solid Hardwood Case, the unit makes a beautiful addition to any room.

- ½"4 DIGIT LED READOUT
- Adjustable tone & duration on chime
- Simulated swinging LED Pendulum
- All CMOS Construction
- Quality plated boards
- All electronics switches
- and XFMR included

39.95 KIT 59.95 ASEMB

Optional Solid Hardwood Case for MG-01 Clock over 10 inches tall Includes Ruby front. Unassembled.
SOLID HARDWOOD 17.95 SOLID WALNUT 19.95

Miniature 7K Pot w/switch PC Mount or panel mount 1/8" shaft .49
Black plastic knob for above FREE

LIMITED QTY Computer Grade FILTER CAP Screw Terminals 2" X 5½" 9500 mfd@75V 2.95 or 4/9.95

SPECIAL SALE TIL 312 LED Common Anode 7 Segment Readout .3" Character Size Standard Pinout while they last .65 6/3.00

ZENER GRAB BAG. A very nice assortment of 10 different voltages between 2.7v and 30 VDC in 400 MW, ½W and 1W. All are prime units but most have Mfg's. numbers. We supply a cross reference sheet to standard numbers.
SPECIAL PRICE 10 pieces 1.00

MC1351P

MC1351P FM IF AMP. 14 pin IC. Complete FM sound subsytem, similar to LM2111 house no.

3/$1.00

General Purpose NPN

2N3569 Fairchild Vceo = 60V Hfe to 300. 800MW power, epoxy TO–5. Limited Qty!

6 for $1.00

MICRO TRIMMER CAPS
Tiny 4-40 pfd trimmer used originally in watches! 3/$1.00

FANTASTIC SOUND SYNTHESIZER 76477

Brand new from TI. Make any sound under the sun with this 28 pin gem! Single IC contains: Noise generator, super low frequency OSC, VCO, one shot, mixer envelope control and amp. Works from a single 5 to 9VDC source. With 8 page manual. $3.95 each

THE SMALL PRINT

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600 MHZ. FREQUENCY COUNTER
±0.1 PPM TCXO

OPTO-8000.1

This new instrument has taken a giant step in front of the multitude of counters now available. The Opto-8000.1 boasts a combination of features and specifications not found in units costing several times its price. Accuracy of ±0.1 PPM or better — *Guaranteed* — with a factory-adjusted, sealed TCXO (Temperature Compensated Xtal Oscillator). **Even kits require no adjustment for guaranteed accuracy!** Built-in, selectable-step attenuator, rugged and attractive, black anodized aluminum case (.090″ thick aluminum) with tilt bail. 50 Ohm and 1 Megohm inputs, both with amplifier circuits for super sensitivity and both diode/overload protected. Front panel includes "Lead Zero Blanking Control" and a gate period indicator LED. AC and DC power cords with plugs included.

SPECIFICATIONS:
Time Base—TCXO ±0.1 PPM GUARANTEED!
Frequency Range—10 Hz to 600 MHz
Resolution—1 Hz to 60 MHz; 10 Hz to 600 MHz
Decimal Point—Automatic
All IC's socketed (kits and factory-wired)
Display—8 digit LED
Gate Times—1 second and 1/10 second
Selectable Input Attenuation—X1, X10, X100
Input Connectors Type —BNC
Approximate Size—3″h x 7½″w x 6½″d
Approximate Weight—2½ pounds
Cabinet—black anodized aluminum (.090″ thickness)
Input Power—9-15 VDC, 115 VAC 50/60 Hz
or internal batteries

OPTO-8000.1 Factory Wired	**$299.95**
OPTO-8000.1K Kit	**$249.95**

ACCESSORIES:
Battery-Pack Option—Internal Ni-Cad Batteries and charging unit **$19.95**
Probes: P-100—DC Probe, may also be used with scope **$13.95**
P-101—LO-Pass Probe, very useful at audio frequencies **$16.95**
P-102—High Impedence Probe, ideal general purpose usage **$16.95**

VHF RF Pick-Up Antenna-Rubber Duck w/BNC #Duck-4H **$12.50**
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FC-50 — Opto-8000 Conversion Kits:
Owners of FC-50 counters with #PSL-650 Prescaler can use this kit to convert their units to the Opto-8000 style case, including most of the features.

FC-50 — Opto-8000	**Kit $59.95**
*FC-50 — Opto-8000F	**Factory Update $99.95**
FC-50 — Opto-8000.1 (w/TCXO)	**Kit $109.95**
*FC-50 — Opto-8000.1F	**Factory Update $149.95**

*Units returned for factory update must be completely assembled and operational

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5821 NE 14 Avenue
Ft. Lauderdale, FL 33334
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Electronic INSPIRATIONS

WE'D LIKE TO RELAY A SPECIAL TO YOU . . .

We've got some dandy little reed relays that are currently on special. These units are 12V, normally open SPSt types that usually go for $1.50. But through the cover date of this magazine, you can have **TWO FOR $1.50** . . . no kidding.

JUST IN TIME — NATIONAL'S 12V CLOCK! $16.50 or 3/$46

The MA1003 clock module is a complete unit . . . just put it in a package and you're on your way. A built-in time base, along with 12V DC operation, make this unit a natural for no-hassle car clock installations. Includes flourescent readouts (**not** LEDs) for easy visibility under adverse ambient lighting conditions.

HI-CURRENT VARIABLE AUTOTRANSFORMERS

We used to have a lot of these, but now we're down to a few and we want to move them out so we can have space for newer goodies. Normally $150 — but for this last chance, you can get one for $125. Quantities are limited.

VECTORBOARD

Everybody needs Vectorboard, if our continual need to re-order is any indication. The kind we carry is 8½" × 17", 1/16" thick, with pre-punched .1" grid holes on an epoxy glass base. Works well with the Slit-N-Wrap or Vector's other wiring wonder, the Wire Pencil, to give fast prototypes. **Our price: $6.39**

RF TRANSISTORS

#2NRF0 (3/$1.95) 3 GHz power transistors for oscillator/amplifier applications. Guaranteed 100 mW out @ 1.5 GHz. T0-18 package.

(All specs for the following taken at 25 degrees C at 2 GHz)

#2NRF1 ($4.95) 2 GHz power transistor. Pd max 3.5W, Pout minimum 1.0W, Pin 310 mW, efficiency 30%. Similar to RCA 2N5470.

#2NRF2 ($5.95) 2 GHz power transistor. Pd 8.7W, Pout 2.5W, Pin 300 mW, efficiency 33%. Similar to RCA TA8407.

#2NRF3 ($6.95) 2 GHz power transistor. Pd 21W. Pout 5.5W, Pin 1.25W, efficiency 33%. Similar to RCA 2N6269.

#2NRF4 ($7.95) 2 GHz power transistor. Pd 29W, Pout 7.5W, Pin 1.5W, efficiency 33%. Factory selected prime 2N6269.

VECTOR "Slit-N-Wrap" WRAPPING TOOL: $24.50

Ever notice that breadboarding goes a lot easier with a Slit-N-Wrap? If not, then you probably don't own one . . . which means you should carefully study the following paragraph.

The Slit-N-Wrap is a manual wire wrapping tool. It has a spool containing a special kind of wire which, when wrapped around wrap posts, has its insulation slit . . . which makes excellent contact with the post, both electrically and mechanically. This wire may be fed out **continuously** for daisy-chaining connections if desired. And, there's no cutting, no stripping, no need to have lots of different sized wire lengths hanging around. The price includes tool, wire, and instructions.

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7400	$0.18
7401	$0.20
7402	$0.20
7403	$0.20
7404	$0.21
7405	$0.22
7406	$0.33
7407	$0.36
7408	$0.23
7409	$0.23
7410	$0.18
7411	$0.22
7413	$0.45
7414	$1.05
7416	$0.30
7417	$0.33
7420	$0.18
7422	$0.23
7425	$0.30
7426	$0.25
7427	$0.29
7430	$0.26
7432	$0.30
7437	$0.36
7438	$0.36
7439	$0.45
7440	$0.19
7442	$0.55
7444	$0.45
7445	$0.63
7446	$0.85
7447	$0.80
7448	$0.83
7450	$0.18
7454	$0.18
7460	$0.18
7472	$0.29
7473	$0.36
7474	$0.36
7475	$0.65
7476	$0.36
7483	$0.89
7485	$0.99
7486	$0.36
7489	$1.75
7490	$0.60
7492	$0.63
7493	$0.55
7495	$0.90
7496	$0.90
74107	$0.36
74109	$0.53

74121	$0.45
74123	$0.65
74125/8093	$0.50
74126/8094	$0.53
74128	$0.65
74145	$0.63
74148	$1.25
74150	$1.07
74151	$0.71
74153	$0.71
74154	$1.23
74155	$0.71
74156	$0.90
74157	$0.71
74159	$2.20
74160	$0.89
74161	$0.89
74162	$0.89
74163	$0.89
74164	$1.34
74165	$1.34
74173	$1.34
74174	$1.52
74175	$1.34
74176	$0.89
74177	$0.88
74179	$0.75
74180	$0.98
74181	$2.23
74182	$0.80
74190	$1.00
74191	$1.00
74192	$1.34
74193	$1.34
74194	$1.34
74195	$0.71
74196	$0.98
74197	$0.98
74198	$0.96
74199	$1.96
74273	$1.89
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82S129	$4.38
74S288/8223	$2.50
74365	$0.69
74366	$0.69
74367	$0.69
74368	$0.69
74390	$1.50
74393	$1.50
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75325	$0.65
75492	$0.82

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G4

7400 TTL

SN7400N	16	SN7472N	29	SN74160N	89
SN7401N	18	SN7473N	35	SN74161N	89
SN7402N	18	SN7474N	35	SN74162N	1 95
SN7403N	18	SN7475N	49	SN74163N	89
SN7404N	18	SN7476N	35	SN74164N	89
SN7405N	20	SN7479N	5 00	SN74165N	89
SN7406N	29	SN7480N	50	SN74166N	1 25
SN7407N	29	SN7482N	99	SN74167N	1 95
SN7408N	20	SN7483N	59	SN74170N	1 59
SN7409N	20	SN7485N	79	SN74172N	6 00
SN7410N	18	SN7486N	35	SN74173N	1 25
SN7411N	25	SN7489N	1 75	SN74174N	89
SN7412N	25	SN7490N	45	SN74175N	79
SN7413N	40	SN7491N	59	SN74176N	79
SN7414N	70	SN7492N	43	SN74177N	79
SN7416N	25	SN7493N	43	SN74179N	1 95
SN7417N	25	SN7494N	65	SN74180N	79
SN7420N	20	SN7495N	65	SN74181N	1 95
SN7421N	29	SN7496N	65	SN74182N	79
SN7422N	39	SN7497N	3 00	SN74184N	1 95
SN7423N	25	SN74100N	89	SN74185N	1 95
SN7425N	29	SN74107N	35	SN74186N	9 95
SN7426N	29	SN74109N	59	SN74188N	3 95
SN7427N	25	SN74116N	1 95	SN74190N	1 25
SN7429N	39	SN74121N	35	SN74191N	1 25
SN7430N	20	SN74122N	39	SN74192N	79
SN7432N	25	SN74123N	49	SN74193N	79
SN7437N	25	SN74125N	49	SN74194N	89
SN7438N	25	SN74126N	49	SN74195N	69
SN7439N	25	SN74132N	75	SN74196N	89
SN7440N	20	SN74136N	75	SN74197N	[illegible]
SN7441N	89	SN74141N	79	SN74198N	1 49
SN7442N	49	SN74142N	2 95	SN74199N	1 49
SN7443N	75	SN74143N	2 95	SN74200N	5 59
SN7444N	75	SN74144N	2 95	SN74251N	1 79
SN7445N	75	SN74145N	79	SN74279N	79
SN7446N	69	SN74147N	1 95	SN74283N	2 25
SN7447N	59	SN74148N	1 29	SN74284N	3 95
SN7448N	79	SN74150N	89	SN74285N	3 95
SN7450N	20	SN74151N	59	SN74365N	69
SN7451N	20	SN74153N	59	SN74366N	69
SN7453N	20	SN74154N	99	SN74367N	69
SN7454N	20	SN74155N	79	SN74368N	69
SN7459A	25	SN74156N	79	SN74390N	1 95
SN7460N	20	SN74157N	65	SN74393N	1 95
SN7470N	29				

C/MOS

CD4000	23	CD4028	89	CD4070	55
CD4001	23	CD4029	1 19	CD4071	23
CD4002	23	CD4030	49	CD4072	49
CD4006	1 19	CD4035	99	CD4076	1 39
CD4007	25	CD4040	1 19	CD4081	23
CD4009	49	CD4041	1 25	CD4082	23
CD4010	49	CD4042	99	CD4093	99
CD4011	23	CD4043	89	CD4098	2 49
CD4012	25	CD4044	89	MC14409	14 95
CD4013	39	CD4046	1 79	MC14410	14 95
CD4014	1 39	CD4047	2 50	MC14411	14 95
CD4015	1 19	CD4048	1 35	MC14419	4 95
CD4016	49	CD4049	49	MC14433	19 95
CD4017	1 19	CD4050	49	MC14506	75
CD4018	99	CD4051	1 19	MC14507	99
CD4019	49	CD4053	1 19	MC14562	14 50
CD4020	1 19	CD4056	2 95	MC14583	3 50
CD4021	1 39	CD4059	9 95	CD4508	3 95
CD4022	1 19	CD4060	1 49	CD4510	1 39
CD4023	23	CD4066	79	CD4511	1 29
CD4024	79	[illegible]	69	CD4515	2 95
CD4025	23	[illegible]	45	CD4518	1 29
CD4026	2 25			CD4520	1 29
CD4027	69			CD4566	2 25

74C00

74C00	39	74C89	8 49	74C163	3 00
74C02	55	74C90	3 00	74C164	3 25
74C04	75	74C93	2 00	74C173	2 60
74C08	75	74C95	2 00	74C192	3 49
74C10	65	74C107	1 25	74C193	2 75
74C14	3 00	74C151	2 90	74C195	2 75
74C20	65	74C154	3 00	74C922	9 95
74C30	65	74C157	2 15	74C923	8 95
74C42	2 15	74C160	3 25	74C925	14 95
74C48	4 75	74C161	3 25	74C926	11 95
74C73	1 50			80C95	1 50
74C74	1 15			80C97	1 50

LINEAR

78MG	1 75	LM340T-8	1 25	LM733N	1 00
LM300H	80	LM340T-12	1 25	LM739N	1 19
LM301M	35	LM340T-15	1 25	LM741CH	35
LM301CN	35	LM340T-18	1 25	LM741CN	35
LM302H	75	LM340T-24	1 25	LM741-14N	39
LM304H	1 00	LM350N	1 00	LM747H	79
LM305H	60	LM351CN	65	LM747N	79
LM307CN/H	35	LM370N	1 15	LM748H	39
LM308H	1 00	LM373N	3 25	LM748N	39
LM308CN	1 00	LM377N	4 00	LM1303N	90
LM309H	1 10	LM380N	1 25	LM1304N	1 19
LM309K	1 25	LM380CN	99	LM1305N	1 40
LM310CN	1 15	LM381N	1 79	LM1307N	85
LM311H	90	LM382N	1 79	LM1310N	2 95
LM311N	90	NE501N	8 00	LM1351N	1 65
LM317K	6 50	NE510A	6 00	LM1414N	1 75
LM318CN	1 50	NE529A	4 95	LM1458CN/H	59
LM319N	1 30	NE531H	3 00	MC1488	1 95
LM320K-5	1 35	NE536T	6 00	MC1489	1 95
LM320K-5.2	1 35	NE540L	6 00	LM1496N	95
LM320K-6	1 35	NE550N	1 30	LM1556V	1 75
LM320K-8	1 35	NE555V	39	MC1741SCP	3 00
LM320K-12	1 35	NE556	99	LM2901N	2 95
LM320K-15	1 35	NE560B	5 00	LM3053	1 50
LM320K-18	1 35	NE561B	5 00	LM3065N	69
LM320K-24	1 35	NE562B	5 00	LM3900N(3401)	49
LM320T-5	1 25	NE565H	1 75	LM3905N	89
LM320T-5.2	1 25	NE565N	1 25	LM3909	1 25
LM320T-8	1 25	NE566CN	1 75	MC5558V	1 00
LM320T-12	1 25	NE567H	1 25	LM7525N	90
LM320T-15	1 25	NE567V	99	LM7534N	75
LM320T-18	1 25	NE570	10 50	8038B	4 95
LM320T-24	1 25	LM703CN/H	45	LM75450	49
LM323K-5	5 95	LM709H	29	75451CN	39
LM324N	1 80	LM709N	29	75452CN	39
LM339N	99	LM710N	79	75453CN	39
LM340K-5	1 35	LM711N	39	75454CN	39
LM340K-6	1 35	LM723H	55	75491CN	79
LM340K-8	1 35	LM723N	55	75492CN	89
LM340K-12	1 35			75494CN	89
LM340K-15	1 35			RC4151	5 95
LM340K-18	1 35			RC4194	5 95
LM340K-24	1 35			RC4195	4 49
LM340T-5	1 25				
LM340T-6	1 25				

74LS00 TTL

74LS00	23	74LS74	35	74LS155	69
74LS02	23	74LS75	49	74LS157	69
74LS03	23	74LS76	35	74LS160	89
74LS04	29	74LS83	75	74LS161	89
74LS05	29	74LS85	99	74LS163	89
74LS08	23	74LS86	35	74LS164	89
74LS10	23	74LS90	49	74LS175	79
74LS13	49	74LS92	59	74LS181	2 49
74LS14	99	74LS93	59	74LS190	89
74LS20	23	74LS95	79	74LS191	89
74LS26	29	74LS96	89	74LS192	89
74LS27	29	74LS107	35	74LS193	89
74LS28	29	74LS109	35	74LS194	89
74LS30	23	74LS112	35	74LS195	89
74LS32	29	74LS123	99	74LS253	79
74LS40	29	74LS132	79	74LS257	69
74LS42	69	74LS136	39	74LS260	55
74LS47	69	74LS138	69	74LS279	59
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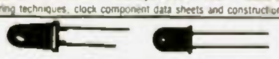
DISCRETE LEDS



.125" dia									.190" dia		
XC209	Red	5/$1							XC111	Red	5/$1
XC209	Green	4/$1							XC111	Green	4/$1
XC209	Orange	4/$1							XC111	Yellow	4/$1
XC209	Yellow	4/$1							XC111	Orange	4/$1
.200" dia			.185" dia.			.200" dia.					
						XC556	Red	5/$1	.085" dia		
XC22	Red	5/$1	XC526	Red	5/$1	XC556	Red	100/$8	MV50	Red	6/$1
XC22	Green	4/$1	XC526	Red	100/$8	XC556	Green	4/$1			
XC22	Yellow	4/$1	XC526	Green	4/$1	XC556	Yellow	4/$1	INFRA-RED LED		
XC22	Orange	4/$1	XC526	Yellow	4/$1	XC556	Orange	4/$1	¼ x ¼ x 1/16		
SSL 22	RT	4/$1	XC526	Clear	4/$1	XC556	Clear	7/$1	Flat		5/$1.00

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	270	2 95	MAN 6680	Common Cathode-orange	560	99
MAN 2	5 x 7 Dot Matrix-red	300	4 95	MAN 6710	Common Anode-red-D.D.	560	99
MAN 3	Common Cathode-red	125	25	MAN 6730	Common Anode-red ±1	560	99
MAN 4	Common Cathode-red	187	1 95	MAN 6740	Common Cathode-red-D.D.	560	99
MAN 52	Common Anode-green	300	1 25	MAN 6750	Common Cathode-red ±1	560	99
MAN 71	Common Anode-red	300	1 25	MAN 6760	Common Anode-red	560	99
MAN 72	Common Anode-red	300	99	MAN 6780	Common Cathode-red	560	99
MAN 74	Common Cathode-red	300	1 25	DL701	Common Anode-red ±1	300	99
MAN 81	Common Anode-yellow	300	99	DL702	Common Cathode-red	300	1 25
MAN 82	Common Anode-yellow	300	99	DL704	Common Cathode-red	300	99
MAN 84	Common Cathode-yellow	300	99	DL707	Common Anode-red	300	99
MAN 3620	Common Anode-orange	300	99	DL741	Common Anode-red	600	1 25
MAN 3630	Common Anode-orange ±1	300	99	DL746	Common Anode-red ±1	630	1 49
MAN 3640	Common Cathode-orange	300	99	DL747	Common Anode-red	600	1 49
MAN 4610	Common Anode-orange	300	99	DL749	Common Cathode-red ±1	630	1 49
MAN 4640	Common Cathode-orange	400	99	DL750	Common Cathode-red	600	1 49
MAN 4710	Common Anode-red ±1	400	99	DL338	Common Cathode-red	110	35
MAN 4730	Common Anode-red	400	99	FND70	Common Cathode	250	69
MAN 4740	Common Cathode-red	400	99	FND359	Common Anode	350	75
MAN 4810	Common Anode-yellow	400	99	FND503	Common Cathode (FND500)	500	99
MAN 6610	Common Anode-orange-D.D.	560	99	FND507	Common Anode (FND510)	500	99
MAN 6630	Common Anode-orange	560	99	5082-7300	4 x 7 Sgl. Digit-RHDP	600	19 95
MAN 6640	Common Cathode-orange-D.D.	560	99	5082-7302	4 x 7 Sgl. Digit-LHDP	600	19 95
MAN 6650	Common Cathode-orange ±1	560	99	5082-7304	Overrange character (±1)	600	15 00
MAN 6660	Common Anode-orange	560	99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	600	22 50

RCA LINEAR

CA3013	2.15	CA3082	2.00
CA2023	2.56	CA3083	1.60
CA3035	2.48	CA3086	.85
CA3039	1.35	CA3089	3.75
CA3046	1.30	CA3130	1.39
CA3059	3.25	CA3140	1.25
CA3060	3.25	CA3160	1.25
CA3080	.85	CA3401	.49
CA3081	2.00	CA3600	3.50

CALCULATOR CHIPS AND DRIVER

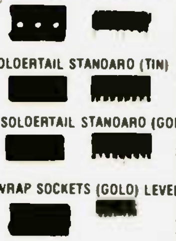
FCM3817	$5 00
MM5725	2 95
MM5736	1 95
MM5738	2 95
DM8864	2 00
DM8865	1 00
DM8887	75
DM8889	75
5030	7 95

CLOCK CHIPS

MM5309	$9 95
MM5311	4 95
MM5312	4 95
MM5314	4 95
MM5316	6 95
MM5318	9 95
MM5369	2 95
MM5841	9 95
7001	5 95

9374 - 7-segment LED driver common anode LEDs $ .99

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS



	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	$.17	16	15	22 pin LP	$.37	36	35
14 pin LP	20	19	18	24 pin LP	38	37	36
16 pin LP	22	21	20	28 pin LP	45	44	43
18 pin LP	29	28	27	36 pin LP	60	59	58
20 pin LP	34	32	30	40 pin LP	63	62	61

SOLDERTAIL STANDARD (TIN)

14 pin ST	$.27	25	24	28 pin ST	$.99	90	81
16 pin ST	30	27	25	36 pin ST	1 39	1 26	1 15
18 pin ST	35	32	30	40 pin ST	1 59	1 45	1 30
24 pin ST	49	45	42				

SOLDERTAIL STANDARD (GOLD)

8 pin SG	$.30	27	24	24 pin SG	$.70	63	57
14 pin SG	35	32	29	28 pin SG	1 10	1 00	90
16 pin SG	38	35	32	36 pin SG	1 75	1 40	1 26
18 pin SG	52	47	43	40 pin SG	1 75	1 59	1 45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

8 pin WW	$.40	38	35	22 pin WW	95	85	75
10 pin WW	45	41	37	24 pin WW	1 05	95	85
14 pin WW	39	38	37	28 pin WW	1 40	1 25	1 10
16 pin WW	43	42	41	36 pin WW	1 59	1 45	1 30
18 pin WW	75	68	62	40 pin WW	1 75	1 55	1 40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea	10 OHM, 27 OHM	12 OHM, 33 OHM	15 OHM, 39 OHM	18 OHM, 47 OHM	22 OHM, 56 OHM	1/4 WATT 5%	50 PCS.
ASST. 2	5 ea	68 OHM, 180 OHM	82 OHM, 220 OHM	100 OHM, 270 OHM	120 OHM, 330 OHM	150 OHM, 390 OHM	1/4 WATT 5%	50 PCS
ASST. 3	5 ea	470 OHM, 1.2K	560 OHM, 1.5K	680 OHM, 1.8K	820 OHM, 2.2K	1K, 2.7K	1/4 WATT 5%	50 PCS
ASST. 4	5 ea	3.3K, 8.2K	3.9K, 10K	4.7K, 12K	5.6K, 15K	6.8K, 18K	1/4 WATT 5%	50 PCS
ASST. 5	5 ea	22K, 56K	27K, 68K	33K, 82K	39K, 100K	47K, 120K	1/4 WATT 5%	50 PCS
ASST. 6	5 ea	150K, 390K	180K, 470K	220K, 560K	270K, 680K	330K, 820K	1/4 WATT 5%	50 PCS
ASST. 7	5 ea.	1M, 2.7M	1.2M, 3.3M	1.5M, 3.9M	1.8M, 4.7M	2.2M, 5.6M	1/4 WATT 5%	50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets — 25¢
1978A Catalog Available—Send 35¢ stamp

NEW NAME

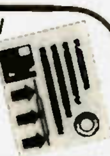
Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070
Advertised Prices Good Thru June

J1

WIRE-WRAP KIT — WK-2-W



WRAP • STRIP • UNWRAP
- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$12.95

WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP - $6.95

WIRE WRAP WIRE — 30 AWG
25 ft. min. $1.25   50 ft. $1.95   100 ft. $2.95   1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30
- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.95 ea.**
- Cuts wire to desired length
- Strips 1" of insulation   **Specify** — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red **$1.98/spool**

EXAR

XR-L555 $1.50
Micro-Power version of the popular 555 Timer and directly interchangeable. Dissipates 1/15th the power and operates down to 2.7 volts. Perfect for battery operation and CMOS circuits.

XR2242CP $1.50
Precision timing circuit for generating timing pulses in minutes, hours and days or up to 1 year by using two. Reduces cost of time delay circuits. Basic 555 Timer with built-in 8-bit Counter.

XR2206KA-$14.95   XR2206KB-$19.95

XR205	$8 40	XR1489	1 39	XR2556	$3 20
XR210	4 40	XR1800	3 20	XR2567	2 99
XR215	4 40	XR2206	4 40	XR3403	1 25
XR320	1 55	XR2207	3 85	XR4136	1 25
XR555	39	XR2208	5 20	XR4151	2 85
XR556	99	XR2209	1 75	XR4194	1 4[illegible]
XR567CP	99	XR2211	5 25	XR4202	3 60
XR567CT	1 25	XR2212	4 35	XR4212	2 05
XR1310P	1 30	XR2240	3.45	XR4558	75
XR1468CN	3 85	XR2264	4 25	XR4739	1 1[illegible]
XR1488	1 39			XR4741	1 4[illegible]

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3 3	400m	4/1 00	1N4005	600 PIV	1 AMP	10/1 00
1N751A	5 1	400m	4/1 00	1N4006	800 PIV	1 AMP	10/1 00
1N752	5 6	400m	4/1 00	1N4007	1000 PIV	1 AMP	10/1 00
1N753	6 2	400m	4/1 00	1N3600	50	200m	6/1 00
1N754	6 8	400m	4/1 00	1N4148	75	10m	15/1 00
1N959	8 2	400m	4/1 00	1N4154	35	10m	12/1 00
1N965B	15	400m	4/1 00	1N4305	75	25m	20/1 00
1N5232	5 6	500m	28	1N4734	5 6	1w	28
1N5234	6 2	500m	28	1N4735	6 2	1w	28
1N5235	6 8	500m	28	1N4736	6 8	1w	28
1N5236	7 5	500m	28	1N4738	8 2	1w	28
1N456	25	40m	6/1 00	1N4742	12	1w	28
1N458	150	7m	6/1 00	1N4744	15	1w	28
1N485A	180	10m	5/1 00	1N1183	50 PIV	35 AMP	1 60
1N4001	50 PIV	1 AMP	12/1 00	1N1184	100 PIV	35 AMP	1 70
1N4002	100 PIV	1 AMP	12/1 00	1N1185	150 PIV	35 AMP	1 70
1N4003	200 PIV	1 AMP	12/1 00	1N1186	200 PIV	35 AMP	1 80
1N4004	400 PIV	1 AMP	12/1 00	1N1188	400 PIV	35 AMP	3 00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR (2N1849)	$1 95
C38M	35A @ 600V	SCR	1 95
2N2328	1 6A @ 300V	SCR	50
MDA 980 1	12A @ 50V	FW BRIDGE REC	1 95
MDA 980 3	12A @ 200V	FW BRIDGE REC	1 95

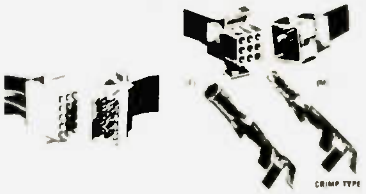
TRANSISTORS

C106B1	50			2N3904	4/1 00
MPSA05	30	2N3055	89	2N3905	4/1 00
MPSA06	5/1 00	MJE3055	1 00	2N3906	4/1 00
TIS97	6/1 00	2N3392	5/1 00	2N4013	3/1 00
TIS98	6/1 00	2N3398	5/1 00	2N4123	6/1 00
TIS133	5/1 00	PN3567	3/1 00	PN4249	4/1 00
TIS135	5/1 00	PN3568	4/1 00	PN4250	4/1 00
40409	1 75	PN3569	4/1 00	2N4400	4/1 00
40410	1 75	MPS3638A	5/1 00	2N4401	4/1 00
40673	1 75	MPS3702	5/1 00	2N4402	4/1 00
2N918	4/1 00	2N3704	5/1 00	2N4403	4/1 00
2N2219A	3/1 00	MPS3704	5/1 00	2N4409	5/1 00
2N2221A	4/1 00	2N3705	5/1 00	2N5086	4/1 00
2N2222A	5/1 00	MPS3705	5/1 00	2N5087	4/1 00
2N2369	5/1 00	2N3706	5/1 00	2N5088	4/1 00
2N2369A	4/1 00	MPS3706	5/1 00	2N5089	4/1 00
MPS2369	5/1 00	2N3707	5/1 00	2N5129	5/1 00
2N2484	4/1 00	2N3711	5/1 00	PN5134	5/1 00
2N2906	4/1 00	2N3724A	65	PN5138	5/1 00
2N2907	5/1 00	2N3725A	1 00	2N5139	5/1 00
2N2925	5/1 00	2N3772	2 25	2N5210	5/1 00
MJE2955	1 25	2N3823	1 00	2N5449	3/1 00
2N3053	2/1 00	2N3903	4/1 00	2N5951	3/1 00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	05	04	03	001µF	05	04	035
22 pf	05	04	03	0047µF	05	04	035
47 pf	05	04	03	01µF	05	04	035
100 pf	05	04	03	022µF	06	05	04
220 pf	05	04	03	047µF	06	05	04
470 pf	05	04	035	1µF	12	09	075
100 VOLT MYLAR FILM CAPACITORS							
001mf	12	10	07	022mf	13	11	08
0022	12	10	07	047mf	21	17	13
0047mf	12	10	07	1mf	27	23	17
01mf	12	10	07	22mf	33	27	22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
1/35V	28	23	17	1 5/35V	30	26	21
15/35V	28	23	17	2 2/25V	31	27	22
22/35V	28	23	17	3 3/25V	31	27	22
33/35V	28	23	17	4 7/25V	32	28	23
47/35V	28	23	17	6 8/25V	.36	31	25
68/35V	28	23	17	10/25V	40	35	29
1 0/35V	28	23	17	15/25V	63	50	40
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				Radial Lead			
47/50V	15	13	10	47/25V	15	13	10
1 0/50V	16	14	11	47/50V	16	14	.11
3 3/50V	14	12	09	1 0/16V	15	13	.10
4 7/25V	15	13	10	1 0/25V	18	14	11
10/25V	15	13	10	1 0/50V	16	14	11
10/50V	16	14	12	4 7/16V	15	13	10
22/25V	17	15	12	4 7/25V	15	13	10
22/50V	24	20	18	4 7/50V	16	14	11
47/25V	19	17	15	10/16V	14	12	09
47/50V	25	21	19	10/25V	15	13	10
100/25V	24	20	18	10/50V	16	14	12
100/50V	35	30	28	47/50V	24	21	19
220/25V	32	28	25	100/16V	19	15	14
220/50V	45	41	38	100/25V	24	20	18
470/25V	33	29	27	100/50V	35	30	28
1000/16V	55	50	45	220/16V	23	.17	.16
2200/16V	70	62	55	470/25V	31	28	26



NYLON CONNECTORS

Mfg by Molex

Complete Connectors Per Pkg.	Type No.	Class	Description	Price Ea. Pkg.
5	1625-1PRT	Min.(.062")	1 Circuit	$1.75
3	1625-2PRT	"	2 Circuit	1.90
3	1625-3PRT	"	3 Circuit	2.10
2	1625-4PRT	"	4 Circuit	2.10
2	1625-5PRT	"	5 Circuit	2.20
2	1625-6PRT	"	6 Circuit	2.35
1	1649-8PRT	"	8 Circuit	1.55
1	1625-9PRT	"	9 Circuit	1.75
1	1625-12PRT	"	12 Circuit	1.90
1	1625-15PRT	"	15 Circuit	2.30
1	1625-24PRT	"	24 Circuit	3.25
1	1772-36PRT	"	36 Circuit	4.55
5	1619PRT	Std.(.093")	1 Circuit	1.75
3	1545PRT	"	2 Circuit	1.90
3	1396PRT	"	3 Circuit	2.10
2	1490PRT	"	4 Circuit	2.10
2	1653PRT	"	5 Circuit	2.20
2	1261PRT	"	6 Circuit	2.35
1	1292PRT	"	9 Circuit	1.80
1	1360PRT	"	12 Circuit	1.90
1	1375PRT	"	15 Circuit	2.45

Prototype hand tools combine efficiency with economy. Ideal for prototype or limited production runs.

HT 1919 for .093" pin dia. terminals — $8.95 each

HT 1921 for .062" pin dia. terminals — $8.95 each

Econo-Extractor removes terminal from nylon connector housing with smoothness and ease.

HT 2054 for extracting .093" pin dia. terminals — $2.25 each

HT 2023 for extracting .062" pin dia. terminals — $2.25 each

Deluxe ejector tools, spring loaded for simple, efficient removal of terminal from nylon connector housing extracts either male or female terminals of same pin diameter.

HT 2038 for extracting .093" pin dia. terminals — $6.70 each

HT 1010 282 Replacement tip for HT 2038 — $2.50 each

HT 2285 for extracting .062" pin dia. terminals — $6.70 each

HT 1672 3 replacement tip for HT 2285 — $2.50 each

INTEGRATED CIRCUITS

555 Timer 8 pin mini-DIP	.49
741 Compensated OP-Amp 8 pin DIP	.37
LM 1889N RF Video Modulator	7.45
CA3130 Bipolar/Mos FET Op Amp	1.19
CA3140 MOS-FET Op Amp, Bi-polar out	.99
LM3909 Lo Voltage Led Pulser	1.50
LM3911 Temp Control CHIP	1.50
Signetics 2504TA 1024 bit S.R. memory (1404A)	$1.75
MCM 6571P Character Generator	9.95
MCM6571AP Character Generator	9.95
MCM6575P Character generator	$9.95
AF100-1CJ Active Filter, State Variable	7.50
LM2907N Tachometer F/V Converter	2.65
LM1812N Ultra-sonic Transceiver	9.15
LM1815 Adaptive Sense Amp for Tachometer	5.73
S2518B Hex 32 bit Shift Register	$2.95
TL170 TO-92 Hall effect switch w/spec sheets	1.25
MC14409P Telephone Rotary Pulser	10.98
MC14419P Touch Pad Converter for 14409	4.25
MC14411P Baud Rate Generator	11.98
MC14412VP CMOS Modem Chip	16.95
MM57109N Number Cruncher Micro	18.95
74C915 7 Segment to BCD Converter	2.99
74C922 16 Key Keyboard Encoder	6.35
74C923 20 key Keyboard Encoder	6.45
74C925 4 Decade Counter w/latches	12.00
74C926 4 Decade Counter w/carry	12.00
74C935-1 3½ Digit DVM CMOS Chip	16.98
9601 Retriggerable One shot	.50
MC4015P Hi Speed quad "D" low power TTL	$1.00

DATA AQUISITIONS SUBSYSTEM

ADC0817 is a 40 pin CMOS I.C. with an 8-bit analog-to-digital converter, a 16 channel multiplexer and micro processor compatible control logic. Converter features high impedance chopper stabilized comparator, voltage divider with analog switch tree and a sucessive approximation register. Latched Tri-State outputs for easy u-processor interface. Require only 15 mW of power from single 5V supply. Fast, 100uS conversion time.

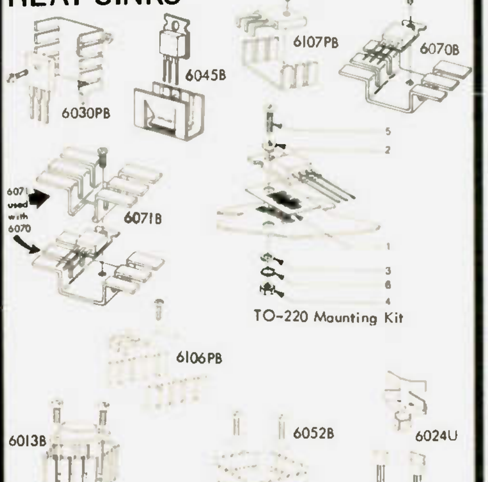
ADC0817......(40 pin DIP)................$29.88

Spec sheets..................................$1.00

Annie Sez,

If you've been studying to find a better source for your electronic parts, enroll in TRI-TEK. We're a degree better!

HEAT SINKS



TO-220 Mounting Kit

Economical 1 piece heat sinks for plastic power parts in TO-220 and Motorola cases 77, 90, 199, and TO-126. All are black anodized aluminum. "B" series is anodized after forming. "PB" series is anodized prior to forming.

THM	6030PB	Vertical	25¢, 5/$1.00, 10/$1.90
THM	6045B	Slip Over	30¢, 4/$1.00, 10/$2.00
THM	6070B	Extra Dissipation Horiz.	35¢, 3/$1.00, 10/$3.00
THM	6071B	Top Hat for 6070	35¢, 3/$1.00, 10/$3.00
THM	6106PB	Flat With Fingers	30¢, 4/$1.00, 10/$2.00
THM	6107PB	Smaller Size Flat	25¢, 5/$1.00, 10/$1.90
THM	6013B	TO-3 Diamond	69¢, 4/$2.50, 10/$5.00
THM	6024-U	Unfinished TO-92	10/$1.00, 100/$5.00
THM-6052B		TO-3 Square	60¢, 5/$2.50, 10/$4.25

TO-220 6 Piece Mounting Kit - Handy Package...25¢

P. C. BOARD TERMINAL STRIP

Molded body encloses postive screw activated clamp which will accomodate wire sizes 14-30 AWG. Contacts and pins are solder plated copper. Pins are on .200 inch (5.08mM) for standard P. C. mounting. 10Amp rating. Compare our prices before you buy.

4 pole	TS-2504	.99
8 pole	TS-2508	1.49
12 pole	TS-2512	2.19

S-100 BUS CONNECTORS (IMSAI TYPE)

Gold, Solder tail for Mother boards $4.50, 4/$17.00

Tin-Nickel, (NASGLO) Solder tail $3.75, 4/$14.00

Gold, wire-wrap............... $4.50, 4/$17.00

Tin-Nickel, (NASGLO) wire-wrap $3.75, 4/$14.00

HEX DARLINGTON ARRAY

MC1413P is a 16 pin DIP package with (6) 50V 500mA Darlington pairs.

MC1413P..................................$1.59

Specs/Apps...................................30¢

I.C. SOCKETS

La Profile Tin Solder Tail Dip Sockets

8 pin	10/$1.50	100/$14.00	1000/$120.00
14 pin	10/$1.70	100/$16.00	1000/$140.00
16 pin	10/$1.90	100/$18.00	1000/$160.00

VOLTAGE REGULATORS

7805-06-08-12-15-24 TO220	95¢	5/$4.50
7905-06-08-12-15-24 TO 220	95¢	5/$4.50
78L05A-12-15 4% 100 mA TO-92 Plastic		50¢
78H05KC 5V 5A TO-3		9.15
78H12KC 12V 5A TO-3		9.15
78H15KC 15V 5A TO-3		9.15
Lm317K 1.5A *Adjustable* TO-3		4.99
Lm317T 1.5A *Adjustable* TO-220		3.99
Lm317MP .5A *Adjustable* TO-202		13.95
TL430C Adjustable Zener-*Think About It*		1.50
TL497C Switching Reg. & Inductor		9.50
RCA CA 3085 100 mA *Adjustable*		.60

ADJUSTABLE NEGATIVE REGULATOR

LM337 is the compliment to the popular LM317 positive adjustable regulator. Capable of 1.5Amp from - 1.2V to - 37V.

LM337K.....(TO-3 Metal)................ $5.99

LM337T.....(TO-220 Plastic)............. $4.65

Specs and applications.......................60¢

DIODES AND BRIDGES

IN4003 200 V 1 amp		12/$1.00
IN4004 400 V 1 amp		10/$1.00
IN4148 Hi Speed Signal	15/$1.00	100/$5.00
D-600 115 V, 100 mA Hi Speed Signal		20/$1.00
D2131 200 V, 25A Stud		85¢
D2135 400 V, 25A Stud		1.00
D2138 600 V, 25A Stud		1.55
D3289R 200 V, 160A Stud Anode		5.85
D3909-4 50 V, 45A Fast Recovery		2.00
IN4732A-47A 1W 5% Zeners		4/$1.00
13 Assorted *Brand New* Zener Diodes		1.00
50V 3 amp Epoxy Bridge		79¢
200V 30 amp Bridge		2.00
600V 4 amp Epoxy Bridge		1.49
600V 3 amp Stud Bridge		.89
SI-2 200V, 1.5A Gold Leads		15/$1.00
D1A 0030 30V DIAC		10/$1.00
100V 2.5 WATT ZENER		
IN5051A Epoxy Zener with heavy silver leads		25¢

MISCELLANEOUS

RG-174 Miniature 50Ω coax	50'/4.25
WSU-30 Wire Wrap/unwrap tool	5.95
WSU-30M Modified Wrap/unwrap tool	6.95
BW-630 Battery Operated Wrap Tool — Free Wire with any Wrap Tool —	34.95
Miniature Square .05/100V Monolithic Cap	10/2.00
FND5002 .125" C.C. 7 Seg. Read-out	.49¢, 10/$3.95
2N4036 90V, 1A PNP Silicon TO-5	.50
2N6101 80V, 10A NON HI GAIN TO-220	.50
6.3 VCT, 1.2A Transformer F41X	2.49
12V, 1A Transformer with 6' Power Cord	2.88

Jumper Kits for .025 Square Posts.. All material for making jumpers for quick circuit changes and prototyping. Use for breadboarding, trouble shooting, field modifications. Fits standard IC socket wire/wrap posts. Excellent wiping action on gold plated box contacts. Kit contain 10 box contacts, heat shrinkable sleeving, and 5 feet of wire plus instruction sheet.

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DPDT on off 1.59
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Measures Logic 1, Logic 0, and pulsing circuit condition
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2N3926	7.0W	175 MHz	T060	6.30
2N4427	1.0W	175 MHz	T039	1.35
2N5589	3.0W	175 MHz	MT71	4.75
2N5590	10W	175 MHz	MT72	7.80
2N5591	25W	175 MHz	MT72	10.25
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2N6080	4.0W	175 MHz	MT72	5.40
2N6081	15W	175 MHz	MT72	8.45
2N6082	25W	175 MHz	MT72	10.95
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2N6094	4.0W	175 MHz	X106 PNP	6.60
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GE28	12W	50 MHz	X51	2.15
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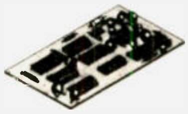

Board Measures 2-5/8" x 4-3/8"

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.032 diameter.
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12 Vdc SIRENS

Very Loud $8.95

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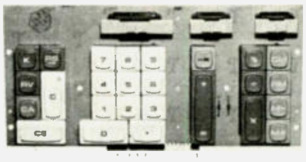

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110 Vac Amber, w/ built in resistor & wire leads—3 for $1.50

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$ 5.00 per hundred
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.1 Ohm—5 W
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@ 15¢ each

POWER MATCH CONVERTER

Pearce-Simpson
—Max Loads 30 Watts
converts:
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for positive or negative ground systems
3½" x 3½" x 2"
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#P-818OB—117 V in—
25.2 V ct at 1 Amp
$3.00 ea.,
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2¼" x 2¼" also 2¼" x 3"

10-0-10 dc Amps	$4.00 ea
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25-0-25 dc Volts	2 for
0-25 dc Volts	$7.00
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-Shunt Required-

New Dry Nickel-Cadmium Battery

2¼" x 2¾" x 8¾"
General Electric
12.0 Volts dc @ 4.0 Amp hrs.
$19.95 while they last.

MUFFIN FANS

3 Blades, 110 Vac, 4¾" sq.
Removed from equipment—
Excellent condition—$4.95

"New" Muffin Fans

3 Blades-110 Vac, 4¾" sq.
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110 AC to 12 VDC
550 mA 23 Watts
3½"w x 4"h x 6½"d
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Size 20 or 22—
various colors—
no color selection
solid
$6.00/1000'
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Equal to RG174
$4.95/100'
Low Loss
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Small enough to fit in your watch—
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Grey vinyl over wood—inside also lined w/ vinyl & foam padding. Flip-top w/ handle and keylock w/ key.
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52 x 52
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For TV games and hi fi with four, 100K pots
2¾" X 2¾" X 1"
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EQUIPMENT / COMPONENTS / WIRE & CABLE / ACCESSORIES

Social Events

from page 175

Jacksonville hamfest which will be held on August 5 and 6, at the Jacksonville Beach Municipal Auditorium. Activities will include the usual swap tables and exhibitors' displays. Featured programs include a DX presentation by the North Florida DX Assn. on that group's recent DXpedition to Haiti at the invitation of the Haitian government. Shortly after the trip, amateur radio was legalized in Haiti after being outlawed for many years. NFDXA also has two *CQ Magazine* world championships to their credit. A complete seminar on microprocessors will also be featured, along with a "pileup" contest, hidden transmitter hunt, QLF contest, and ARRL meeting. Advanced tickets are now available for $2.50 per person ($3 at the door), with swap tables available for $5 per day. The hamfest site is only one block from the Atlantic Ocean, and those attending can bring their families for a weekend of fun on the beach. Door prizes and hourly drawings will be conducted. All inquiries should be directed to N4UF, Hamfest Chairman, 911 Rio St. Johns Dr., Jacksonville FL 32211. Phone is 744-9501.

UPPER ST. CLAIR TOWNSHIP PA
AUG 6

The 41st annual hamfest of the South Hills Brass Pounders and Modulators will be held on August 6, 1978, from noon to dusk, at St. Clair Beach on Route 19 south, Upper St. Clair Township. There will be a swap and shop, picnic area, and swimming for the family. Mobile check-in on 29.0 MHz and 146.52 simplex. Information and preregistration for $1.50 ($2.00 at the door) are available from Bruce Banister, 5954 Leprechaun Dr., Bethel Park PA 15102. Vendors must register.

AMARILLO TX
AUG 11-13

The 1978 edition of the Golden Spread Amateur Radio Convention will be held at the Holiday Inn West Motor Hotel, 601 Amarillo Blvd. West, Amarillo, Texas, on Friday evening, Saturday, and Sunday, August 11, 12, and 13, 1978. It is sponsored by the Panhandle Amateur Radio Club of Amarillo. An area has been set aside for amateurs to display their trading and swapping gear. Two Hospitality Hours are slated: one for early arrivals the evening of Aug. 11 and the second for Saturday evening, Aug. 12. Six technical sessions will be held, featuring the very latest in communications expertise. Special activities for the ladies will be available so that there will be something for everyone. Preregistration will be $4.00 per person; registration at the door will be $6.00.

LEXINGTON KY
AUG 13

The Bluegrass Amateur Radio Club (Lexington, Kentucky) will hold its annual Central Kentucky Hamfest on August 13, 1978, at the Lexington National Guard Armory located adjacent to the Bluegrass Field on Airport Road, Lexington, Kentucky. The hamfest program will include grand prizes, hourly door prizes, manufacturers' exhibits, an indoor/outdoor flea market, guest speakers, and forums.

CEDARTOWN GA
AUG 13

The Cedar Valley Amateur Radio Club of Cedartown, Georgia, will sponsor the Cedar Valley Hamfest, which will be held on August 13, 1978, from 9 am to 4 pm, at the Polk County Fairgrounds located one mile east of Cedartown on US 278. Talk-in frequency will be (WR4AZU) 147.72/.12. Food, drinks and lots of prizes! For more information, please contact Jim T. Schliestett, Pres., W4IMQ, Cedar Valley ARC, PO Box 93, Cedartown GA 30125; telephone: (404)-748-5968.

WILLOW SPRINGS IL
AUG 13

The Hamfesters 44th annual picnic and hamfest will be held on Sunday, August 13, 1978, at Santa Fe Park, 91st and Wolf Road, Willow Springs, Illinois, a southwest suburb of Chicago. There will be exhibits for OMs and XYLs and the famous swappers' row. Tickets at the gate will be $2.00; in advance, $1.50. For hamfest information or advance tickets, send check or money order (SASE appreciated) to Bob Hayes, 18931 Cedar Ave., Country Club Hills, Illinois 60477.

ROCHESTER PA
AUG 19

The Beaver Valley Amateur Radio Association's first annual hamfest will be held on Saturday, August 19, from 9 am to 5 pm at Brady's Run Park located 5 miles north of Rochester PA on Route 51. Advance tickets are $3.00 or three for $8.00; at the gate, they'll be $4.00 or three for $10.00. Seller's fee is $1.00—bring your own table. There will be a flea market for new and used equipment. Camping spaces, swimming, boating and fishing are available at the park. Refreshments will be available. Prizes: (1st) Kenwood TS-520S, (2nd) Midland 13-500 2 meter FM transceiver, (3rd) DenTron Super Tuner. Talk-in on 25/85; check-in on 52/52. For more information, write Wayne R. Sphar WA3ZMS, Secretary BVARA, 1200 Atlantic Ave., Monaca PA 15061.

HAMDEN CT
AUG 20

The WELI Amateur Radio Club's second annual flea market and auction will be held on Sunday, August 20 (rain date August 27) from 10:00 am to 4:00 pm at Radio Towers Park, Benham St., Hamden, Connecticut. General admission will be $.50, and vendor spaces are $5.00 each. For further information, contact Mike WA1PXM at 934-1063 or Dave WA1ZWB at 467-3258 (area code 203).

HUNTSVILLE AL
AUG 20

The North Alabama hamfest will be held on Sunday, August 20, 1978, at The Mall in Huntsville AL. There will be prizes, a large flea market, an ARRL forum, MARS meetings, and ladies activities. A hamfest supper will be held on Saturday night. For more information, write to N.A.H.A., PO Box 423, Huntsville AL 35804.

WENTZVILLE MO
AUG 27

The Saint Charles Amateur Radio Club, Inc., will hold the SCARC Hamfest '78 on August 27 at the Wentzville Community Club. There will be prizes, food, and fun—flea market, CW contest, free bingo, food, beer, and more. Admission will be $1 per car. Talk-in on 34/94 and 07/67. For motel and camping information, prize lists, dealer reservations, and airport pickup, write to SCARC, PO Box 1429, St. Charles MO 63301.

MONTICELLO IN
AUG 27

The Tioga Amateur Radio Society, Monticello, Indiana, will sponsor a ham radio cruise day on Lake Freeman on Sunday, August 27, 1978. It will take place aboard the Madam Carroll boat—the largest inland boat in Indiana with a length of 135 feet and a beam of 36 feet. Fun for the entire family. There will be 4 rigs aboard. You can work amateur radio from a marine mobile—special certificates and QSL cards for this operation. Decks open at 1:00 pm for 2 cruises at 2:00 pm and 4:00 pm. Advance tickets are $2.00; at the dock, $2.50. Send an SASE to Byron Robbins WD9EXI Sec'y, 571 South Bluff St., Monticello, Indiana 47960, for advance tickets or further details.

BUTLER PA
SEP 10

The Butler County Hamfest, sponsored by the Butler County ARA, will be held on Sunday, September 10, from 11 am to 4 pm at the Butler County Farm Show Grounds, adjacent to Butler Roe Airport (with a paved runway for fly-ins). Check-ins on 147.90/.30 and .52 simplex. Contact John K3HJH or Cliff WB3CDA for more details.

FINDLAY OH
SEPT 10

The second largest hamfest in Ohio, the 36th annual Findlay hamfest, will be held on September 10, 1978, rain or shine, at Riverside Park from 5 am to 5 pm. Watch for directional signs. There will be free parking, free reserved indoor space (bring your own tables), a massive swap and shop, and lots of prizes. A 2 meter hunt will be held at 1 pm and the main prize drawing at 3 pm. Tickets are $1.50 in advance, $2 at the door. Talk-in and prize check-in on 146.52. For tickets, space reservation, and further information, send an SASE to Clark Foltz W8UN, 122 West Hobart Ave., Findlay, Ohio 45840.

TYSONS CORNER VA
SEPT 16-17

DXPO '78 will be held on September 16-17, 1978, at the Ramada Inn at Tysons Corner, Northern Virginia (intersection of routes 7, 123, and 495). It's one of the world's greatest DX events . . . if you attended DXPO '74 and DXPO '76, you know what we are talking about. You will receive an advance program, but mark your calendar now! If you have not attended one of our DXPOs, get your name on the mailing list for the advance program and details. Write to Richard Vincent K3AO, Route 1 Box 230, Bryantown, MD 20617.

SYRACUSE NY
OCT 7

October 7, 1978, from 9:00 am until 6:00 pm, will be the date and time for this year's annual Radio Amateurs of Greater Syracuse hamfest. The event will be held at the New York State Fairgrounds, located adjacent to Interstate route 690, 3 miles southeast of New York State Thruway, Exit 39, one mile northwest of Syracuse.

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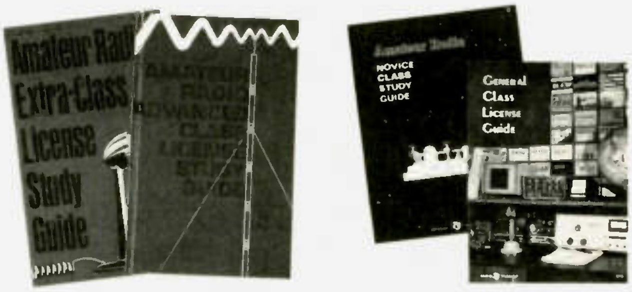

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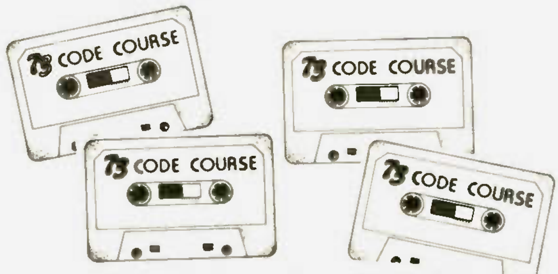

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13 + WPM—CT7313—Code groups again, at a brisk 13 per so you will be at ease when you sit down in front of the steely-eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test, you'll thank heavens you had this back-breaking tape.

"COURAGEOUS"
20 + WPM—CT7321—Code is what gets you when you go for the Extra Class license. It is so embarrasssing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape. No one who can copy these tapes can possibly fail the FCC test. Remove all fear of the code forever with these tapes.

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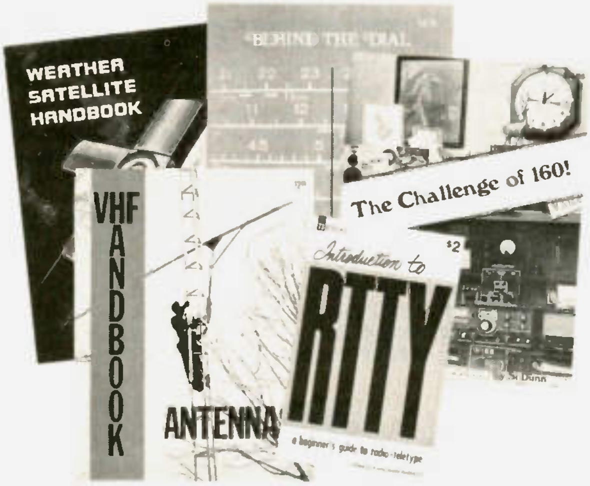

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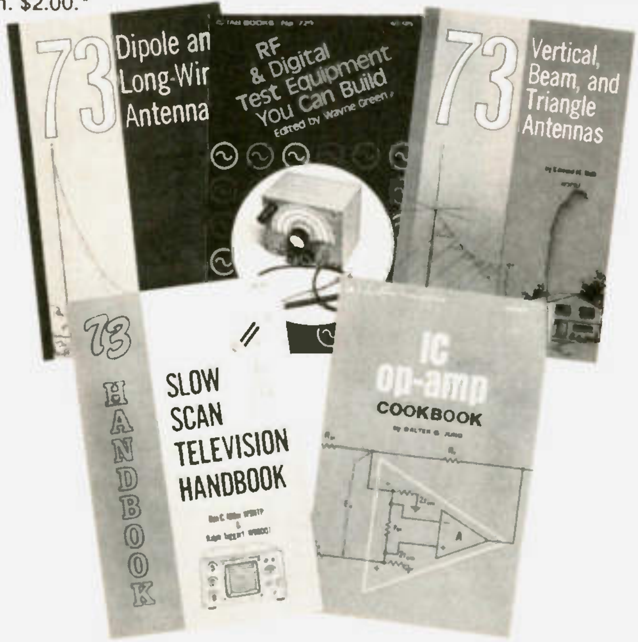

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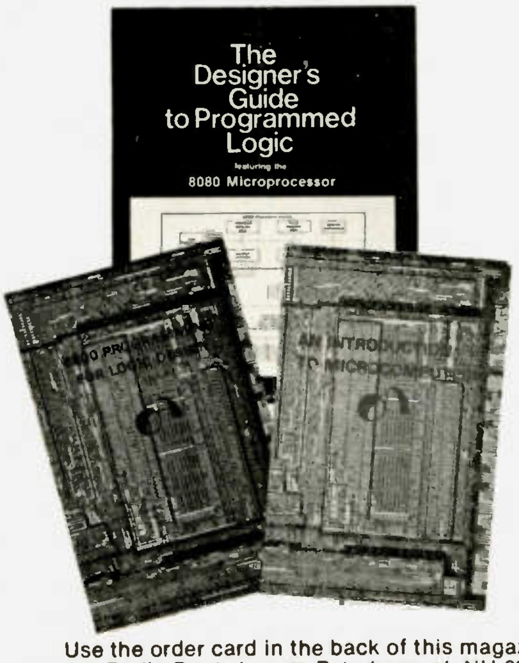

● **AN INTRODUCTION TO MICROCOMPUTERS**—BK1030 (Vol. I), BK1031 (Vol. II)—by Adam Osborne Associates, are references dealing with microcomputer architecture in general and specifically with details about most of the common chips. These books are not software-oriented, but are invaluable for the hobbyist who is into building his own interfaces and processor. Volume I is dedicated to general hardware theory related to micros, and Volume II discusses the practical details of each micro chip. (Detailed review in *Kilobaud* #2) Published by Osborne Associates, Vol. I—$7.50*; Vol. II—$12.50.*

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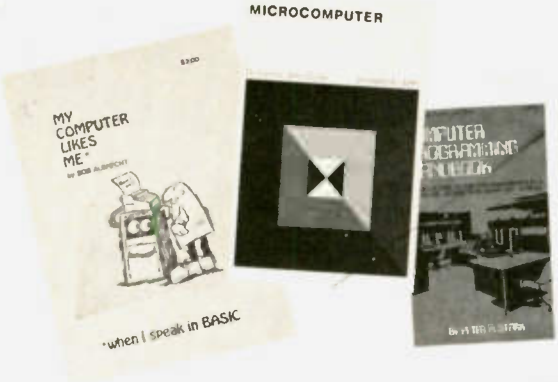

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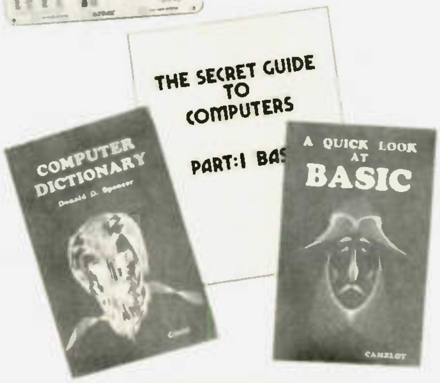

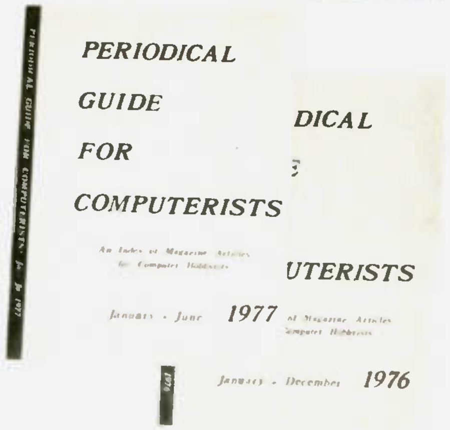

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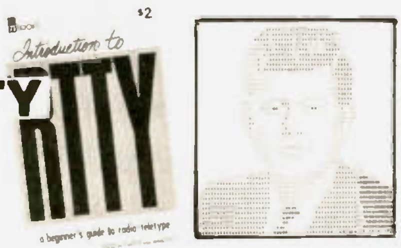

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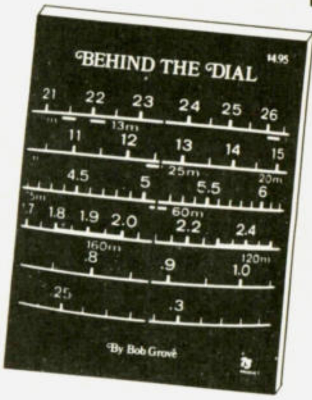

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A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Solar Flares

june

sun	mon	tue	wed	thu	fri	sat
				1 G	2 G	3 P
4 G	5 G	6 G	7 F	8 F/SF	9 G/SF	10 G/SF
11 F/SF	12 F/SF	13 F/SF	14 F/SF	15 F/SF	16 F/SF	17 F/SF
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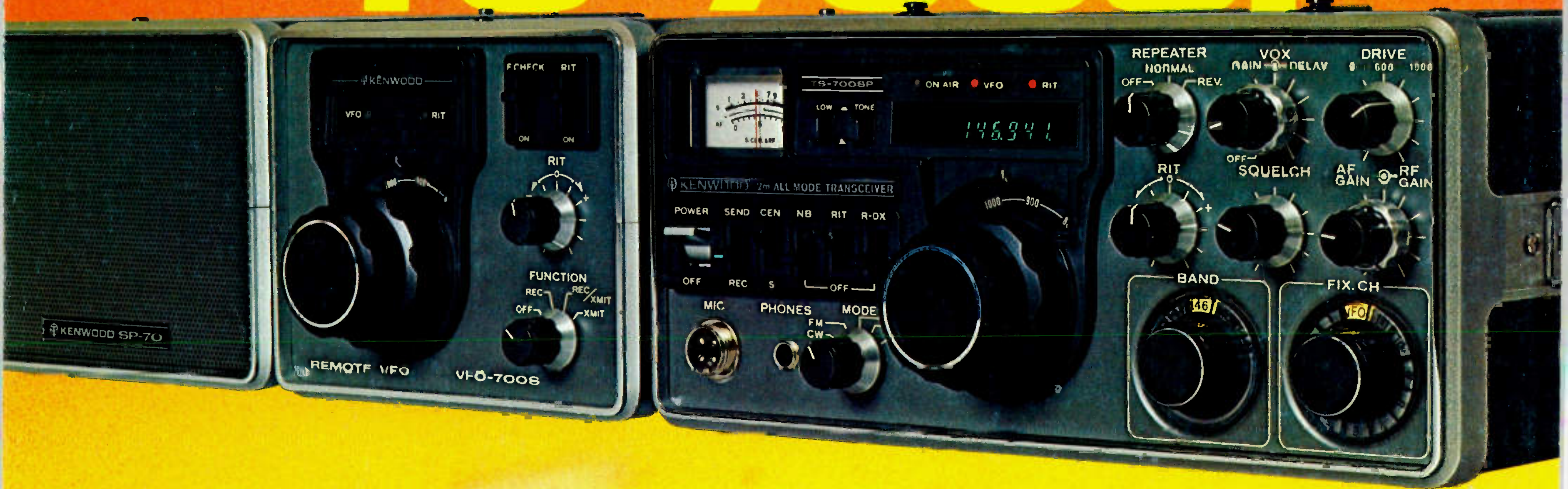

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