The Hangman's 2-Meter Collinear
- Make your tower do double duty
- Drop this array from the top and get 6-dB gain

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- Kerchunk takes a dive with the addition of this audio delay

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- Go from east to west in less than a second with this 2-meter array
- And put your rotator out to pasture

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The Frugal Floppy Bazooka
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- All you need is a spare telephone

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The Bunesti Caper
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The Program That Knows It All
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DESIGN

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• High Dynamic Range • Excellent Sensitivity/Selectivity • Digital Readout •
• 160-10 Meters Plus WARC Bands and MARS Coverage**

Front panel switching allows independent MODE and optional crystal filter selection.

A passive double balanced mixer is employed in the receiver front end. This stage is preceded by a low noise high dynamic range bipolar rf amplifier to provide good, strong signal performance and weak signal sensitivity. Accurate digital readout of operating carrier frequency is displayed to 100 Hz.

A rugged, solid-state PA provides continuous duty in SSB and CW modes. A cooling fan (FA7) is available for more demanding duty cycles, such as SSTV or RTTY. The PA also features very low harmonic and spurious output. VOX GAIN, VOX DELAY, VOX disable, QSK, selectable AGC time constants, RIT and noise blanker selection are front panel controlled for ease of operation.

The TR5 is designed with modular construction techniques for easy accessibility and service.

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Power Input (Nominal): 150 Watts, PEP or CW.
Load Impedance: 50 ohms.
Spurious and harmonic output: Greater than 40 dB down.
Intermodulation Distortion: Greater than 30 dB below PEP.
Carrier Suppression: Greater than 50 dB.
Undesired Sideband Suppression: Greater than 60 dB at 1 kHz.
Duty Cycle: Ssb, CW: 100%.
Lock Key (w/o FA7 Fan): 30%, 5 minutes maximum transmit.
Lock Key (w/FA7 Fan): 100%.
Microphone input: High Impedance.
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Selectivity: 2.3 kHz minimum at -6 dB, 4.1 kHz maximum at -60 dB (1.8:1 shape factor).
Ultimate Selectivity: Greater than -95 dB.
AGC: Less than 5 dB output variation for 100 dB input signal change, referenced to agc threshold.
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1-F Rejection: 50 dB, minimum.
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Audio Output: 2 watts, minimum @ less than 10% THD (4 ohm load).
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Model 1545 RV75 Synthesized Remote VFO

Model 1531 MS7 Speaker
Model 1507 CW75 Keyer
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SHOULD DXCC BE PROHIBITED?

The blatant arrogance of the PY6SB DXpedition shook the amateur bands, bringing on wild attacks of jamming in retaliation. Frankly, after trying to use the twenty-meter band for an hour, I didn’t blame the jammers much. Not since Don Miller have I heard such a total disregard for the hobby.

This was, in my estimation, amateur radio at its worst. Those refugees from CB set up on one of the most rare spots in the world and then, transmitting outside of the American phone band, asked US hams to call them anywhere from 14,200 to 14,300. This went on, totally killing the band for any other use as thousands of stations called steadily, hour after hour. There was no possible way to make a normal contact anywhere in that entire band while this was going on.

This is totally unnecessary, as anyone with even a small amount of DXing experience knows. It is a shameless flaunting of the power of one group to bring the whole band to a halt. It isn’t even a fast way of making contacts. There is not even a remote excuse for such a display.

I’ve operated from some fairly remote spots and have faced as big pileups as anyone. I got started in seriously working DX in late 1945, the day our first DX band opened after the war. When I moved to New Hampshire, I started all over again, working 100 countries in the first week on twenty phone, 200 in the first month, and 300 in the first year. So I know the receiving end of the stick.

In 1956, I went on my first serious DXpedition... KC4AF, Navassa Island. Since then, I’ve operated from a bunch of places... come to mind S54, ZS6, 3D6, 7PB, OD5, YK1, YA1, YU, SN1, HL6, VR2, 5W1, KS6, FO8, HH, JY, OH6, KH2, KW6, and a bunch of non-rare countries. I’ve tried every way known to ham to get the most contacts per hour on the air from these rare places, so I have a good idea of what works and what does not work. Hmmm, I forgot to mention VP5, J6, and a revisit to Navassa in 1972.

The results of all this? Well, unless your signal is particularly weak, the fastest operation is when you operate on a fixed channel, thus containing the band mayhem to one single pileup. I’ve found that out by making regular announcements to this effect: “I will be listening for about ten seconds on this channel for the last letter of your call. Please do not all jump in immediately, but wait so your calls will be spaced a bit. I will make a note of the last letter of your call and call you with it after writing down as many as I can hear. Do not... I repeat... do not call more than a couple of times. If I hear anyone pushing and shoveling on channel I will work you, but there will be no QSL. Neither of us wants that.”

The result is a relatively orderly sorting out of the problem, which is to get the call letters of those on channel as quickly as possible. The rest of the contact is a matter of a couple of seconds. The long, hard part is getting the calls through.

By asking for the last letter, I am able to quickly get things down to two or three, at most, responding when I break. It makes everyone shut up and listen. I can then confirm the call, exchange signals, and be on to the next. With this system, I can double or triple the throughput of any system which calls for tuning a band of frequencies, looking for calls in the open.

The calling stations, perceiving that I am able to cope with the chaos and that they will have a fair chance of getting through, respond very positively and line up, doing as I ask. Megawatts of power are saved.

The entire band, except for about 6 kHz which I am using, is open for everyone... and at least twice as many operators are made happy with a new one. And think of the agonizing frustration saved for the thousands of ops, calling hour after hour, hoping to get through.

Another solution to the whole problem would be, of course, to get the League to cancel their Honor Roll and DXCC certificates so we wouldn’t have this enormous pressure to make a radio contact with some stupid island somewhere. That would spoil a lot of fun for thousands of us DXers, but it would at least stop such carnage as the Peter and Paul jokers dumped on us.

This whole DX thing, while it may be fun for amateurs in most of the ordinary countries, is a royal pain in the... ear for the ham who lives in a rare spot.
"Comm-packed."

**BIG performance... small size... smaller price!!!**

**TR-2500**

The TR-2500 is a compact 2 meter FM handheld transceiver featuring an LCD readout, 10 channel memory, lithium battery memory back-up, memory scan, programmable automatic band scan, Hi/Lo power switch and built-in sub-tone encoder.

**TR-2500 FEATURES:**

- Extremely compact size and light weight
- LCD digital frequency readout
  - Shows frequencies and memory channels. Four "Arrow" indicators.
- Ten channel memory
  - Nine memories for simplex or ±600 kHz offset. "M0" memory for non-standard split frequency repeaters.
- Lithium battery memory back-up
  - (Estimated 5 year life.) Maintain memory when Ni-Cd pack is fully discharged or removed.
- Hi/LOW power selection
  - 2.5 watts or 300 mw.
- Memory scan
  - Scans only channels in which frequency data is stored.
- Programmable automatic band scan
  - Upper and lower frequency limits and scan steps of 5-kHz and larger.
- UP/DOWN manual scan
- Built-in tuneable sub-tone encoder
  - Tuneable (variable resistor) to desired CTCSS tone.
- Built-in 16-key autopatch encoder
- "SLIDE-LOC" battery pack
- Repeater reverse switch
- Keyboard frequency selection
- Extended frequency coverage
  - Covers 143.900 to 148.995 MHz in 5-kHz steps.
- Optional power source
  - Using optional MS-1 mobile or ST-2 AC charger/power supply, radio may be operated while charging. (Automatic drop-in connections.)

**Actual size**

- High impact plastic case
- Battery status indicator
- Two lock switches
  - Prevent accidental frequency change and accidental transmission.
- Standard accessories include:
  - Flexible antenna with BNC connector
  - 400 mAH Ni-Cd battery pack
  - AC charger
- Optional accessories:
  - ST-2 Base station power supply/charger (approx. 1 hr.)
  - MS-1 13.8 VDC mobile stand/charger/power supply

**TR-3500**

70 CM FM Handheld

- 440-449.995 MHz in 5-kHz steps
- TX OFFSET switch keyboard programmable ±2.5 kHz to ±9.995 MHz
- 1.5 W/300 mW HI/LOW power switch
- Auto. squelch position on squelch control
- Tone switch for TU-35B optional
- Programmable CTCSS encoder
- Other features include 10 memories, lithium battery memory back-up, programmable automatic band scan, memory scan, UP/DOWN manual scan, repeater reverse, 16-key autopatch, keyboard frequency selection, slide-lock battery.

- VB-2530 2-M 25 W RF power amp., cables, mg. brkt. (TR-2500 only)
- TU-1 Programmable CTCSS encoder (TR-2500 only)
- TU-35B Programmable CTCSS encoder (mounts inside TR-2500 only)
- PB-25 Extra 400 mAH Ni-Cd battery
- PB-25H Heavy-duty 490 mAH Ni-Cd battery
- DC-25 13.8 VDC adapter.
- BT-1 Battery case for manganese/alkaline AA cells
- SMC-25 Speaker-microphone
- LH-2 Deluxe leather case
- BH-2A Belt hook
- RA-3 m 3/8A telescoping antenna (for TR-2500)
- WS-1 Wrist strap
- EP-1 Earphone

More information on the TR-2500 and TR-3500 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

Specifications and prices are subject to change without notice or obligation.
You wouldn't believe how soon the thrill of working stations for ten-second contacts palls. You might not find it as difficult to believe what a nuisance being expected to fill out and mail thousands of QSL cards is. Imagine, if you will, the excitement with which a ham in Tonga receives his 780th QSL from a WB2 station. It just goes into the nearest leftover washing machine carton.

Even with a QSL manager to take on the brunt of the card chore, the responsibility for keeping the log, getting a copy to the manager, and forever making instant contacts, with growing resentment whenever you stop to try to make friends with anyone forcing you to shut down... it's driven most hams in rare spots off the air.

With so many things of value which people can accomplish in this world, I am saddened when I see some ham who has gotten swept up in the DX Honor Roll excitement. What a frivolous waste of life it is to devote it to trying to make this silly list... and stay there... often at almost any expense.

Continued on page 172

Well... I Can Dream, Can't I? by Bandel Linn K4PP

"Are you the handsome one who advertised for 'Ham Help'?”
THE RTTY ANSWER

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If you write RTTY computer programs, call us. We are looking for new ideas in software.
The Hangman's 2-Meter Collinear

Make your tower do double duty. Drop this array from the top and get 6-dB gain.

Here is a 2-meter FM base-station antenna that's inexpensive, easy to build, and has about 6 dB omnidirectional gain. It can be mounted on the side of a tower or put on a mast of its own. No special tuning equipment is required. All you need is an SWR meter.

Design

The antenna described here is a 6-element vertical collinear array. It consists of six half-wave radiators placed end-to-end and fed in phase. The resulting directional pattern is theoretically a circle in the horizontal plane, with a gain of about 6 dB over a dipole. Results of testing at W1GV/4 indicate substantial improvement, both for transmitting and receiving, over a 5/8-wave antenna with ground plane at 25 feet.

Fig. 1 shows the configuration of the collinear antenna. Each element is 38 inches long. The end-to-end spacing between elements is negligible, about 1 inch. Allowing for a foot or two at the top and bottom, the entire antenna requires a vertical space of about 22 feet. Of course, the higher the system is placed, the better the performance will be.

Proper phasing is obtained by quarter-wave stubs between the elements. For all practical purposes, these stubs do not radiate, provided they are cut to the correct length. At 146.5 MHz, 18 inches with 2-inch spacing gives a resonant, ultra-low-loss matching section. Fig. 2 illustrates the construction details for each stub.

The antenna can, as previously mentioned, be mounted on the side of a tower or alongside a TV mast; it can even be hung from a tree branch! If the antenna is mounted on the side of a tower, the directional pattern will be modified slightly. The gain will be reduced in the direction of the tower and increased in the direction away from the tower. Therefore, you should position the antenna to provide the most gain in whatever direction you desire the best coverage (Fig. 3).

If the antenna is suspended next to a TV mast or hung from a tree limb, the pattern will be omnidirectional.

Construction

To put this antenna on a tower, you will need the following hardware, in addition to the usual tools and soldering apparatus:

- 6 42-inch lengths No. 12 solid uninsulated copper wire

Fig. 1. Configuration of the 6-element, 2-meter wire collinear antenna. The overall height is 22 feet. The array is fed at the physical center.

Fig. 2. Construction details for the tuning stubs. A spacing of 2 inches provides minimum loss while allowing essentially no radiation. When the stub is pulled tight, the wires will stay in place because of their stiffness.
*10 20-inch lengths No. 14 solid uninsulated copper wire
*1 20-foot (approx.) roll No. 12 solid wire
*5 2-inch lengths 1/4-inch o.d. copper tubing
*5 porcelain insulators (non-egg type)
*7 small egg insulators
*2 3-foot, 2-inch o.d. wooden dowel rods
*2 screw-in-type TV stand-off insulators
*1 15- to 20-pound weight
*1 roll of electrical tape
*1 strong set of legs

First, screw the TV standoffs into one end of each dowel. Then, attach the rods sideways to the tower braces, 22 feet apart. (If the tower braces do not exactly line up to 22 feet, use the next brace that will allow a spacing greater than 22 feet.) Of course, the higher the overall position, the better! The dowels should extend 26 inches out from the tower. Use No. 12 wire to secure the dowels to the tower braces.

To assemble the antenna, attach the seven egg insulators at the ends of the six antenna elements, making a long chain. Wrap and solder each wire end to the egg insulators. To minimize inter-element capacitance, it’s best to loop the wires through the egg insulators as shown in Fig. 2, in such a way that if the insulator should break, the wires will come apart. The elements should each measure exactly 38 inches from loop tip to loop tip. Attach an 18-inch length of No. 12 wire to one end of the array and a 48-inch length to the other end.

To construct the phasing stubs, solder two 20-inch lengths of No. 14 wire to each element end (see Fig. 1). Wrap 1 inch of wire around each element end. Space the wires 2 inches apart. Put a 2-inch piece of copper tubing through one end of a standard porcelain or glass insulator and twist a short piece of stiff wire around the tubing if necessary to keep it from slipping up and down in the hole. Wrap 1 inch of the free ends of the stub wires around the ends of the tubing and solder them in place. When you are done, you should be able to pull the stub tight and have both wires evenly spaced, straight, and 18 inches long (Fig. 2). You will have to construct five of these stubs, in locations shown by Fig. 1.

Now you’re ready to hang this contraption. Grab the top end—the one with the 18-inch piece of wire attached—climb the tower (don’t forget your safety belt!), and affix the wire to the TV standoff insulator at the end of the upper dowel. Then, climb back down to the lower dowel and run the 48-inch end wire through the standoff insulator there. Rotate the plastic inside the standoff so the wire can’t pop out, and crimp the insulator ring to keep it in place. Cut the lower wire so that roughly 8 inches remains below the standoff. Then attach the weight to the end of the wire (Fig. 4). This weight keeps the array taut as the wires expand and contract with changes in temperature. An alternative arrangement to the weight is to use an elastic band in place of the lower section of wire; however, the array may have a tendency to “oscillate” in the wind if this scheme is used.

To position the stubs, you’ll need five pieces of wire about two feet long. Run one end through the insulator at the end of the stub, twist the wire onto the insulator, and pull the stub reasonably tight. Twist the other end of the wire around the tower support nearest the array (Fig. 2).

The Feedpoint
You can rest a bit now. As you’re sipping a cool drink, admire the new appendage to your antenna farm. But don’t get carried away; you still don’t have it hooked up. And the final tuning procedure may require three or four more excursions up the tower.

Fig. 5 shows the matching section for the 6-element wire collinear. The transmission line is connected to the center stub. A good starting point

---

Fig. 5. Feedpoint diagram. The array should be fed at the center stub. A good starting point is 3 inches from the shorted end; however, some adjustment will probably be necessary to get a perfect match. Here, the center conductor of the transmission line is connected to the top part of the antenna and the shield to the bottom part. However, they could just as well be reversed.

Fig. 4. Arrangement for keeping the array taut. The distance between the weight and the TV standoff should be great enough to allow for contraction with cold weather, but small enough to prevent excessive swinging of the weight.

Fig. 3. Radiation patterns for a vertical array in free space (a) and near an obstruction such as a tower (b). The viewing position is directly overhead. The obstruction tends to reduce the gain in some directions while increasing it in others.
is 3 inches from the shorted end, as shown. However, you’d better not solder the wires there right away. The size of your tower will have some effect on the exact final position. Larger towers will lower the impedence for any given tap point, as compared to smaller towers.

The feedpoint should be moved slightly toward or away from the shorted end of the stub until the SWR is minimum at 146.5 MHz. It should be possible to get a nearly perfect match (at W1GV/4, a 1.3 SWR was obtained). Always keep the coax shield and center-conductor taps at the same distance from the end of the stub, don’t try to get fancy by putting them in different places.

The final tap position will be about 15 percent of the way from the shorted end of the stub to the antenna end. When the ideal position has been found, solder the wires in place and wrap the connections with electrical tape. Or, better, use silicone rubber cement. Tape the feedline cable to the inside of the tower to minimize possible induced currents on the coax from antenna coupling.

Closing Remarks

This antenna is a pleasure to use and requires essentially no maintenance. Since it is made from materials usually available at flea markets, the cost can be very low. I had much of the necessary hardware already in my junk box.

A gain of 6 dB over a dipole represents a quadrupling of the effective radiated power. But you get this gain on receive, too! With my Azden PCS-3000 at 25 Watts, I’m running 100 Watts effective radiated power, neglecting line losses. My installation, being attached to a TV mast with the bottom almost at ground level, is essentially omnidirectional. It is generally possible, in this pancake-flat South Florida area, to communicate with mobile stations via simplex out to 50 or 60 miles. Before, with the 5/8-wave antenna at 25 feet, the reliable range was only 30 to 40 miles. Of course, repeater operation is a breeze. I’m full-Q into all of the local repeaters.

There isn’t any reason why more elements cannot be added to this array, except for height limitations and certain engineering requirements. An 8-element array would require about 28 feet of vertical space and would produce about 7.5 dB gain over a dipole; a 10-element array would give around 8.5 dB gain.

As the number of elements is further increased, tuning of the stubs and elements becomes more and more critical, and special equipment will be required to ensure correct phasing for optimum performance. (Even with a 1-inch error on each element, the total discrepancy would be 5 inches at the top and bottom of a 10-element array; this is 23 degrees at 146.5 MHz! Such an imprecision would surely degrade the performance of the antenna.) Furthermore, as the number of elements increases, the bandwidth of the array gets narrower because the error adds up for each element off resonance. There is a point of diminishing returns.

A 6-element array can provide good communication without the headaches of painstaking adjustment and narrow bandwidth, and so it represents a good compromise. This antenna is ideal for the 2-meter FM operator who wants omnidirectional operation, but is presently using only a ground plane.
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- Preset memory (Option): 24 presets
- Frequency stability: ±0.0035% (Option)
- Image rejection ratio: 70dB or more
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- Input impedance: 50 to 75 ohms, unbalanced
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- Preset memory (Option): 24 presets
- Frequency stability: ±0.0035% (Option)
- Image rejection ratio: 70dB or more
- IF rejection ratio: 70dB or more
- Input impedance: 50 to 75 ohms, unbalanced
- AF outputs: 1W or more (4 ohms)
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Deep-Six Squelch Tails

Kerchunks take a dive with the addition of this audio delay.

Squelch tails are ugly. Few things are more annoying to repeater users than a long squelch tail every time someone drops his carrier. At WR3AFM, a Baltimore Amateur Radio Club (BARC) multiple-receive-site repeater, this problem is compounded by a second squelch tail, that of the link receiver. The resulting overall squelch tail is approximately 110 milliseconds in duration. However, thanks to the circuit described below, it is no longer audible.

A squelch tail is the noise heard at a receiver's audio output after the transmitting station has dropped its carrier but before the receiver's squelch circuit can mute the audio output. This is what you hear whenever the repeater carrier drops off the air, for example. The duration of the squelch tail is a function of your particular receiver.

Another source of squelch tails is a repeater receiver. Consider first a conventional single-site machine. Whenever the transmitting station drops its carrier, the repeater receiver's output follows with a burst of squelch noise. Since the repeater transmitter is still on the air at this point, this squelch tail is heard by all stations monitoring the machine.

Next, consider a split-site repeater (or a multiple-site repeater like WR3AFM) as shown in Fig. 1. In this type of setup, the repeater receiver (or each satellite receiver in a multiple-site scheme) is coupled to the repeater transmitter via a link, often on 450 MHz. The repeater receiver operates as before, appending a squelch tail to each transmission. The receiver output is sent by the link transmitter to the repeater transmit site, where it is received by the link receiver. When the link transmitter carrier drops, shortly after the repeater receiver squelch tail ends, the link receiver will append a squelch tail of its own to the audio output. Since the link receiver feeds the repeater transmitter (or voter, in the multiple-site case, which, in turn, feeds the transmitter), this (link) squelch tail also is heard by all monitoring stations.

In order to eliminate the squelch tail nuisance, a delay line was inserted into the audio-signal path. To see how this will allow the squelch tail to be silenced,
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refer to Fig. 2. Note that although the figure specifically illustrates the multiple-site (or split-site) system, by ignoring the link (second) squelch tail it is valid also for a single-site system.

Fig. 2(a) shows the audio output of a satellite receiver and its associated squelch tail. This signal is sent via a link transmitter to a link receiver, and from there to the voter, with the added link receiver squelch tail. The audio output of the voter, shown in Fig. 2(b), contains the satellite receiver squelch tail and the link receiver squelch tail. The carrier-operated switch (COS) depicted in Fig. 2(c), with logic high equivalent to on and logic low equivalent to off, changes state after both squelch tails are completed. Since the COS is usually employed to gate (switch on or off) the repeater transmitter audio (or the transmitter itself), both squelch tails are transmitted by the repeater.

Fig. 2(d) shows the voter audio output delayed in time. It can be seen that the squelch tails in Fig. 2(d) occur after the COS goes low. Using the COS signal to gate the audio in Fig. 2(d) gives Fig. 2(e). This audio contains no squelch tail at all.

The length of the satellite-receiver squelch tail is somewhat dependent on the received signal. Since the link transmitters and receivers are fixed, the link squelch tail is always the same length. To take this variability into consideration, the length of the delay was chosen to be longer than the worst squelch tail usually encountered. This ensures absolutely no transmitted squelch tail, but also chops off a small amount of audio in some cases. At worst, however, if the carrier is dropped immediately following a word, one syllable might be lost. This turns out to be insignificant in practice. Of the almost 500 members of BARC, only one seems ever to have problems with lost syllables, and then only on one-word transmissions! Overall performance has been great, and the total parts cost of approximately $70 puts the project within reach of almost everyone.

General Theory

A block diagram of the overall system is shown in Fig. 3. Starting with the delay itself, the various blocks will be examined.

The heart of the circuit is a Reticon R5101 Charge-Coupled Device (CCD) which performs the delay. The CCD acts as an analog shift register. It stores time samples of the analog input signal as packets of charge. The amount of charge in each packet is proportional to the amplitude of the analog input at the time of sampling. The packets of charge are shifted through 2000 stages before they reach the output of the CCD. Thus, the chip has 2000 samples of the input stored at any given time, each separated in time by T seconds, where T is the time between samples. The CCD uses two clock cycles per shift, and hence the overall delay time (Td) is given by Td = 2000 x (2/Fc), where Fc is the clock frequency supplied by the oscillator block and is equal to 2/T.

Instead of using a CCD, other schemes could be used to achieve the desired delay. These include tape loops and digital sampling, which are discussed briefly below.

The tape-loop scheme involves continuously recording and simultaneously playing back the received audio on a tape recorder. Since there is a physical gap between the record head and the playback head, a time-delay is introduced (Td = G/V, where G = gap length in inches and V = tape speed in inches per second). A Td of up to one second is typical at slow tape speeds with this approach. This scheme is the simplest to implement, but was not used because of the problems of reliability of such factors as the tape transport mechanism, tape breakage, and dirt on the tape heads.

The digital-sampling scheme is similar to the CCD technique except that the audio signal is first digitized by an analog-to-digital converter, then stored in a digital shift register, and finally converted back to analog form by a digital-to-analog converter. This approach has the advantage of being able to achieve any desired delay by adding more shift registers. To get a reasonable signal-to-noise ratio and still preserve the dynamic range of speech, we would need either many bits (12 or more) in the digital words or we would have
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Fig. 6. Measured overall response. Conditions: 1) Delay = 150 ms (Fc/4 = 26.67 kHz), 2) two-pole adjustable low-pass filter set for 0 dB at 3 kHz.

As in any time-domain sampling system, the input must be a band-limited process. In a low-pass application, such as with speech, any input components whose frequency is greater than one-half the effective sampling rate, called the Nyquist Frequency (Fc/4), must be removed prior to sampling to prevent a form of distortion called "aliasing." If not removed by filtering, these components will appear at the output as lower frequency (alias) signals (see Fig. 4).  Once aliasing occurs, it cannot be removed by filtering, since the aliased components are indistinguishable from the original components. The necessary filtering is performed here by a 3-section, 9-pole low-pass filter.

Since the CCD is a discrete time system (that is, its output changes only at specific times, resembling a staircase), the output also contains high-frequency terms which must be removed by filtering (see Fig. 5). This filtering is again performed by a 3-section, 9-pole low-pass filter.

Since the frequency response of the CCD is somewhat dependent on the clock frequency selected, a tunable low-pass filter is provided. By tweaking this filter, the overall response may be optimized for a particular clock rate. The response for the board at WR3AFM is given in Fig. 6. The tunable filter was set so that the response at 3 kHz was equal to that at 100 Hz (0 dB). Notice the excellent flatness over the speech bandwidth (–0 dB, +1.6 dB).

Fig. 7. Delay input and delay output filtering. Note: IC1 and IC2 are TL074Cs. IC1 – 100 series; IC2 – 200 series.

Fig. 8. Final filter. IC3 is a TL074C.

Fig. 9. 2000-sample delay. IC4 is a Reticon R5101.

to less than 1 volt peak to prevent overloading the device, and the output buffer is set to achieve unity overall gain (0 dB) at 100 Hz. Thus, the whole board is transparent to the rest of the repeater.

The switching stage allows the delay to be bypassed (if desired) and permits the audio to be gated with the COS signal. This eliminates the need for any external audio switching.

**Circuit Design**

**Filters**

The circuit was designed in a fairly straightforward manner. Quad bi-FET op amps were chosen because their high input impedance makes designing with them simple. Specifically, the TL074 is a low-noise version of the popular TL084, which could be substituted, as could many other audio op amps.

Since the frequency response of the CCD starts to roll off at about 1.5 kHz when set for a 150-millisecond delay, some form of equalization was required to extend the usable bandwidth of the system. High-frequency pre-emphasis (that is, boosting the high-frequency components ahead of the CCD, as opposed to post-emphasis) has the advantage that the input signal is kept large with respect to the noise at all times. However, since the CCD overloads at about 1-volt peak input, any boost in the spectrum ahead of the CCD must be accompanied by an overall cut in the input level (relative to that permissible with no pre-em-
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phasis). Post-emphasis completely avoids this problem, but it also boosts any noise added by the CCD circuitry. As a compromise, equal amounts of pre- and post-emphasis were employed.

The low-pass filters were designed to provide the needed boosting as well as to attenuate the high-frequency components. In order to achieve a 150-millisecond delay, \( F_c = 26.67 \) kHz from the equation, above. Thus, the Nyquist Frequency (\( F_c/4 \) here) is 6.67 kHz. The low-pass filters must attenuate at and above this frequency. The 9-pole filters shown in Fig. 7 have a peak (boost) of approximately 6 dB before rolling off at \(-54 \) dB/octave. The overall response is shown in Fig. 6.

The final output filter, a buffer and 2-pole low-pass filter combination, is shown in Fig. 8.

**Construction Notes**

The board was built using point-to-point techniques. The actual layout, shown in Fig. 12, was carefully planned to ensure neat wiring and no ground loops. Any popular construction technique should work. Whatever method is used, however, the ground leads should be heavy enough to keep op-amp noise reasonable.

All op-amp Vcc inputs were bypassed to ground with a .1-uf disc capacitor right at the chip, on the underside of the board. Polystyrene capacitors were used in the filters to achieve close tolerance and good temperature stability. Sockets were used for all chips, with the one for the CCD being a must.

The input and output audio, switching, and power-supply connections can conveniently be made using ribbon cable and a 14-pin DIP socket. A suggested pin configuration is shown in Fig. 13. Unused lines should be grounded at the board end only, to reduce noise and prevent ground loops. The ground lead from the DIP socket should be connected to the ground bus on the board at the spot that results in the smallest amount of noise on the audio-output line. In the layout shown in Fig. 12, the best spot was found to be near the inverter chip.

Finally, as shown in Fig. 14, a 10-uf filter capacitor was placed from Vcc to ground and from Vcc2 to ground. Tantalum capacitors were used because of their small size and low leakage, but any type capacitor will do.

**Parts**

The CCD is available for $50 from Reticon Corporation, 910 Benicia Avenue, Sunnyvale CA 94086, and their distributors (write to them for info) For most other parts, a good supply house is Digi-Key Corporation, PO Box 677, Thief River Falls MN 56701.

**Adjustment**

To set the clock frequency, adjust R21 while observing pin 15, IC5, on a scope or frequency counter. The desired frequency may be found from the equation, above. For a 150-millisecond delay, \( F_c = 26.67 \) kHz.

R101 is adjusted to prevent overloading the CCD. Since the maximum pre-emphasis is 6 dB, the maximum signal at pin 8, IC1, must not exceed .5 volts peak for any input signal. However, to achieve the best signal-to-noise ratio, it is desirable to keep the signal as large as possible. Therefore, apply a sine wave at the maximum level to be encountered in operation (such as the level that gives 5-KHz deviation on the repeater) to the input (I/O pin 2) and adjust R101 until the level at pin 8, IC1, is .5 volts peak.

To adjust the bias and symmetry of the CCD, apply an audio-frequency sine wave to the input (I/O pin 2). Adjust the amplitude of the sine wave until distortion is just evident at pin 14, IC2. Next, set R33 and R44...
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to minimize the distortion, and then increase the input until the distortion is again visible. Continue this process until no further reduction in distortion is observed.

Adjust R301 so that the overall gain (I/O pin 2 to I/O pin 6) is unity (0 dB) at 100 Hz and 3 kHz. This gives a desirable response for a voice channel.

Finally, adjust R201 so that the overall gain (I/O pin 2 to I/O pin 6) is unity (0 dB) at 100 Hz (or 3 kHz)

**Echoes, Etc.**

Since the unit introduces delay in the audio path, a rather interesting echo effect can be observed. Referring to Fig. 15, notice that due to the delay some audio output continues from the repeater after the transmitting station's carrier drops. The length of this audio is equal to the length of the combined squelch tails. Depending on the speed of the station's T-R switching, the operator will hear the end of his transmission coming back.

The only drawback of the device also is visible in Fig. 15. The final portion of audio is chopped by the circuit. The amount of audio lost is equal to the difference between the length of the delay and the length of the combined squelch tails. Since the usual squelch tail lasts for 110 milliseconds (at WR3AFM), if a short squelch tail was acceptable, the delay could be shortened to 110 milliseconds. In practice, almost everyone holds their PTT for a short amount of time after they stop speaking, so this is really a moot point.

The delay also causes a strange phenomenon if an operator is monitoring the repeater on a secondary receiver. It is virtually impossible to talk while listening to your own voice delayed by 150 milliseconds. This effect has encouraged the more fun-loving walkie talkie owners to engage in the friendly game of sneaking up behind an unsuspecting repeater user while he is transmitting and then turning up the volume on the walkie. This fun alone justifies the work involved in building the delay line.

---

**Fig. 15. Echo. (a) Transmitted audio plus squelch tails. (b) Delayed audio. (c) Repeater output.**

**References**

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Go from east to west in less than a second with this 2-meter array. And put your rotator out to pasture.

"Five-nine here in Northern New Jersey, OM 73 and thanks for the point. Anyone else calling?" Bzzz, whoosh... "three" sputter, bzzz, whrrr. "Oh, gosh... the W3 calling, you're in the noise here, but you're off the back of the beam,

I'll start turning in your direction." Click, click, click... 30 seconds later... click, click, click. "OK, now: the W3 who was calling, are you still there? Try again now."

What a waste of time to be constantly turning beams during a VHF contest. Especially on FM, where a good operator in the metropolitan area can run 60 or more contacts per hour on 146.52 MHz or other popular simplex channel, if only he doesn't have to spend half his time turning a beam. But in a densely-populated area (and there are many such regions in the US) one simply cannot use an omnidirectional

The four A147-4 beams installed on the tower.

The relay box mounted on the tower. Note the well-taped PL-259s.
gain array, due to high QRM levels. What to do? Thought you'd never ask.

How about four vertical yagis, aimed at compass points or areas of known activity, side-mounted on your tower or mast, with remote switching from a single feedline? Too expensive? Not really. Cumber-some? Not as much as a rotator. Tricky? Not at all. Simple, in fact, and requiring little time or homebrewing expertise. And the benefits are attractive, not only to the VHF contesteer, but to any active FMer; of course, the principle described lends itself to a variety of other interesting applications, such as diversity reception experiments or phasing of HF steerable arrays.

Personally, I used four Cushcraft A147-4 short-boom 4-element 146-MHz yagis, for their ease of matching to an unknown line impedance, light weight, and low cost. If all the control box parts listed in the parts list are purchased new at list prices per the 1980 Allied Electronic catalog and added to the 73 advertisers' prices for the coax and antennas listed, the total cost of this entire project is $159.88. The only additional expense would be the feedline (hardline sells for 49¢ per foot from several 73 advertisers), the hardline connectors (brand new for $8.00 each from Phelps-Dodge, or available for much less at flea markets), and the 4-conductor control cable (the Belden cable listed sells for $12.00 per 100' list price).

Sound like a lot of dough? I agree; that's why I bought most of the stuff (except for the antennas) at local surplus stores, which brought the cost of this project down to less than sixty bucks (minus antennas). The Cushcraft antennas specified sell for $21.00 each, but could be replaced with home-brew antennas—either yagis or quagis—for a fraction of that.

The A147-4s were selected here because they are small and light, they are end-mount types ideal for direct tower mounting, and they develop slightly over 6 dB gain, which is a tad more than my omnidirectional Phelps-Dodge Stationmaster. The Stationmaster, a well-respected, 20-foot-long fiberglass monster, sells for about $240.00; my 4-beam system works as well, and offers the advantage of selectable directivity for QRM reduction... and it costs far less.

See Fig. 1 for the circuit of the relay box and Fig. 2 for the control box. Real Novice stuff. Mount K1, K2, and K3 in a line on one flat, removable panel of the Bud AU-1029 cabinet. Mount the four output SO239 connectors in a line parallel to and about an inch away from the relays. Mount the SO239 "common" or "input" connector an inch from K1, on the opposite side of the relay from the four output connectors. Mount the Cinch Jones P304RP connector in whatever space is left on the same panel. Now all components and all wiring are on just one flat aluminum panel. The rest of the utility cabinet is only a weatherproof box for the relays.

Use the flattened braid from RG-58/U for the connections from each UHF receptacle to each corresponding relay terminal, per the schematic in Fig. 1. Keep these braid jumpers as short as possible—mine are about one inch long each. If this box is intended for use at 146 MHz, this is important. Use short lengths of RG-58/U to make the K1-to-K2 and K2-to-K3 jumpers (see Fig 1), keeping all exposed leads short. Solder the RG-58/U braid to ground lugs installed near each relay for this purpose.

The three relay coils must operate independently but they can have a common ground: thus, the wiring shown and the four-pin connectors.

After all the wiring in both the relay and control boxes is completed and double-checked, make up a short 4-conductor cable with the appropriate Cinch Jones connector at each end, and bench-test the two

---

**Fig. 1. Relay box.**

Here you can see the company the four A147-4s have: 4 el on 20, 15, and 10 meters; 19 el on 70 cm; 16 el on 2 meters. Guys are broken up with ceramic insulators.

**Fig. 2. Control box.**
units together. The dc output from the bridge rectifier should measure slightly over 17 volts with the rotary switch in position 1 (no load). This will drop to less than 17 volts with the switch in position 2, and then to about 16 volts in positions 3 and 4. The 12-volt relays specified seem to handle the slight overvoltage (and resultant overcurrent) just fine—their coils do not get hot even after hours of applied voltage. The maximum power dissipated in each relay coil is about 1.8 Watts.

Before the final installation of the relay box, drill two holes through one side of the box for a suitable U-bolt to clamp the box to your tower leg or mast. Then assemble the box on the tower or mast and caulk all corners and joints with the specified silicone caulking compound. I also wrapped the corners with Scotch 33 vinyl electrical tape.

The relay box provides a nice low vsrw through about 50 MHz, but at 146 MHz it does not. Using my Bird model 43 wattmeter, a range 25C slug, a Dielectric Communications model 4050 50-Ohm, 50-Watt microwave dummy load, and a 146-MHz, 25-Watt transmitter, I measured the vsrw looking into the box (with each output terminated in the 50-Ohm load) and found it to be less than 1.5:1 in position 1, but over 2:1 in the other three positions.

However, there was no actual loss through the relays, just an impedance mismatch. What do we do? Simple, tune the antennas to match the box!

Here's what to do to make it all work well at 146 MHz:

- Connect each antenna, once mounted in its permanent position, to its respective port on the box, using the 64" RG-8/U foam cables and PL259 connectors. The 64" is a nice length because it reaches, and also because it is one wavelength (in foam cable) at 146 MHz, thus making the box think the antenna is coupled directly to it.
- Connect the control box to the relay box with a length of 4-conductor cable. Locate the control box on your roof or tower for this temporary arrangement.
- Connect a 10-to-25-Watt two-meter exciter through 50-Ohm cable (any length) to a 50-Ohm coupler (I used a Bird 43) which is connected directly (like with a double-male UHF adapter) to the "common" port of the relay box.
- Apply power to the rig and the control box. With the control box switch in position 1, transmit and measure vsrw. If it's low, great. If not, adjust the gamma match on antenna 1 to bring reflected power to a minimum.
- Perform the same gamma-match adjustments on antennas 2 through 4, switching to each in turn by using the control box. It should be possible to bring the vsrw of each antenna down to reasonable proportions with the gamma match provided on each A147-4.

Now the system is adjusted. Remove the wattmeter, etc. Locate the control box in the shack, run the feedline and control cables down into the shack, and you're on the air.

Voila! A really high-class antenna system in just an afternoon's work. My whole installation (pictures!) took about four hours, including wrestling with the hardline. The two boxes took just one evening to assemble. It was worth it. As you can see in the picture, I do own a Stationmaster for 146-MHz FM work, and although it is an excellent antenna, it is 20" long, weighs over 25 lbs., catches a lot of wind (and ice), and cost over $200.00.

The four beams are more versatile, occupy less space, work at least as well, and were far less expensive.

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Class C amplifiers for the two-meter band are a “dime a dozen,” with commercial models, kits, and schematics available from a good number of suppliers. Linear amplifiers are another story. Their design and construction is all black magic, and manufacturers are the only wizards in on the mystery. With a little sleuthing, I found that Motorola would sponsor my initiation into this exclusive cult, allowing me to build an amplifier to boost the output of my 2-meter OSCAR station from 2.5 Watts to 20 Watts.

In order to linearize a solid-state rf power amplifier, you must solve two problems. First, you must bias the transistor into the linear region while supplying a substantial amount of varying base current. Secondly, you must tame any spurious oscillations generated by the high-gain transistor used.

First, the biasing problem will be faced. A small-signal transistor amplifier is usually biased with a voltage-dividing network such as that shown in Fig. 1(a). The current flowing through the network resistors is set to be about ten times the current needed by the base. With our amplifier needing from 10 mA to 100 mA of base current at any time, this circuit would not be practical. As well, the bias voltage must be held at a constant stiff value for all values of base current, which is not possible with a resistive voltage-divider network.

An alternate solution to this biasing problem, which satisfies the need for a constant bias voltage while supplying varying currents, is the solid-state voltage regulator. Either the shunt regulator of Fig. 1(b), where the total bias supply current is greater than the maximum base current and the surplus current is shunted to ground by the reference diode, or the series pass regulator of Fig. 1(c) can be used. The series regulator reduces the current which must flow through the reference diode by $V_{base}/hfe$, and the total bias current used becomes virtually the base current needed at each instant. The bias voltage is set by the forward voltage drop of the diode reference which is approximately 0.6 volts. The series regulator bias is set by two forward-biased diodes in series, the second diode voltage drop compensating for the base-emitter junction drop of the series pass transistor so that the bias supply voltage output will equal only one PN junction voltage drop.

Now for a very important point! As a transistor warms, its base will draw more current, which increases collector current, which warms the transistor more, and this will continue until the component self-destructs. To offset this, the base bias voltage must be reduced as the transistor warms. By mounting $D_{ref}$ as

![MRF 2-meter linear amplifier.](image)
close to the rf transistor as possible to provide thermal contact, the diode junction voltage will decrease as the diode warms, neutralizing the base-emitter junction change of the rf transistor and thus keeping the base current under control. Remember! Attach the reference diode so that it will be warmed by the rf power transistor. Either physically attach it to the transistor body or to the heat sink as close to the transistor as possible. Do not expect the reference diode to thermally track if the thermal path is broken by air.

Low-frequency oscillations also are a problem. My amplifier first oscillated in the HF band because at these frequencies the transistor has very high gain. By-passing the collector current fed did not tame these troublesome responses, so I took the brute-force method and fed back the collector signals to the base through a feedback network. The rf choke is a virtual short for the oscillations but an open circuit for the desired VHF circuit. The capacitor is a virtual short for the undesired oscillation but an open circuit for the collector supply. This network was placed between the collector and base with very short leads and the unwanted oscillations were completely suppressed.

The amplifier which I built (Fig. 2) is a modified version of the class C amplifier described by W4MNW in the November, 1977, issue of 73 Magazine. I lifted RFC1 from ground, added bypass capacitors to the lifted end so the rf input would continue to see a ground, then connected the base bias supply to RFC1. The low-frequency feedback network was added to stabilize the amplifier and the linear amplifier was a reality. It would appear to be quite possible to linearize many of the class C amplifiers now in FM and CW use in the same way.

The testing of this amplifier was done with a regulated and current-limited power supply. This saved the transistor from destruction before I had tamed the low-frequency oscillations. The transistor is rated for a collector current of four Amperes, but I set the supply to limit current to a maximum of one Ampere until I was satisfied that the amplifier would not hurt itself.

Low-frequency oscillations manifest themselves by a sudden jump in collector current and corresponding drop in supply voltage. The first time this happened I thought I had destroyed the transistor, but the power supply protection had saved it. I was able to continue my study of the problem and a wideband oscilloscope revealed a pulse-type response on the collector output. This was suppressed by the feedback network shown in the schematic.

I made an interesting observation about amplifier efficiency while tuning the amplifier. There is a particular collector current needed to give a particular output power—not so collector voltage. Thus 0.5 Watts input will become 4 Watts output at 2 Amperes collector current whether the collector voltage is 5 or 12 volts. Under the same conditions, the dc input power changes from 10 Watts to 24 Watts. For maximum efficiency, it seems that the amplifier should be operated at the maximum linear power output possible for the applied collector voltage, or if it is desired to operate the amplifier at reduced power, the collector voltage should be re-
The amplifier was built in a 5 1/4" x 3 3/4 x 2 1/2" minibox on double-sided epoxy glass PC board. The circuit lands were etched, but islands of PC board epoxied to the ground plane would serve as well. Be very certain that the capacitors that make up C5 are soldered with short leads as close to the transistor body as possible. Connect the ground plane on both sides of the board with eyelets or wires running through the board and solder on each side. A heat sink is necessary. My heat sink has 35 square inches of radiating area and it seems to be just satisfactory. A larger one is recommended.

The mounting of the MRF238 is very critical (see Fig. 4). Careless technique will result in a destroyed transistor if stress is placed on the leads. Mount the transistor seating plane with very good thermal contact to the heat sink. The thickness of the case metal and the PC board must not be greater than 1/2 inch. If it is, the transistor leads will be forced up, putting a strain on the transistor cap. On heating, the bonding material will fail and you will be out buying a new expensive transistor. If the PC board and case thickness together is much less than 1/2 inch, you may want to mill out the heat sink as in Fig. 4(b) so the transistor leads will not be bent down when soldered to the PC board. Do not solder the leads before tightening the stud mounting nut. Do not hold the transistor leads while tightening the nut. Do hold the transistor securely by the wrench flat on the end of the stud while tightening the nut. Only after the mounting nut has been tightened carefully may you solder the leads to the board.

The MRF238 Motorola transistor is available from Ramsey Electronics and Semiconductor Surplus, both 73 advertisers.

References
AN555—Mounting stripe-opposed emitter (SOE) transistors.
AN791—A simplified approach to VHF power amplifier design.

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The Frugal Floppy Bazooka

This 2-meter antenna coils up into a small package, but it shoots a straight signal.

Another 2-meter antenna for your handheld? You bet! When you combine low cost, portability, and reasonable gain as this antenna does, it is well worth covering the subject again. The design of this gain vertical was inspired by the excellent article by W11S in the May, 1981, issue of 73 Magazine. One of the current-distribution charts reminded me of the "bazooka" coax-to-dipole decoupling scheme which uses a grounded sleeve in place of radials, and the "floppy bazooka" was born.

Construction

My prototype antenna was assembled from RG-58A/U (with the stranded center conductor), which is (a) very flexible and (b) what I had on hand. I started with about 20 feet of the cable and terminated one end with a BNC male to match the connector on my HT. The next step is to remove approximately 34 inches of the outer cover and braid from the loose end of the coax, leaving about ¼ inch of braid exposed and the center conductor intact.

Why 34 inches if a quarter wave at 146 MHz is about 19 inches? Because I had to compress the braid slightly, increasing its diameter and decreasing its length, to slide it over the feedline. After doing so, I carefully soldered the ¼ inch of exposed braid on the feedline to the braid sleeve, taking care to not melt the center conductor dielectric. I provided as much coverage as possible with the braid splice.

I covered the splice with heat-shrink tubing, although electrician's tape will do fine. Pull the braid down snug on the feedline and now measure the 19½ inches you expected, from the splice just covered to the lower end of the sleeve. I found this dimension to be very noncritical, but the shortening with compression varied from sample to sample of coax, which is why I started with 34 inches! After cutting the sleeve to length, I secured the end to the feedline in the same way I covered the splice.

Testing

The first test I made was with an ohmmeter: checking at the BNC end for a potential short. Don't trust the ability to receive a full-quieting signal as proof of proper wiring—I live less than a mile from a local repeater, which breaks the squelch on my HT fine without any antenna plugged in at all!

After avoiding the "smoke test," it was time to prune that 34-inch center conductor to resonance. My first cut was to 20½ inches, and out came the swr bridge. One quarter of an inch at a time, I marched up the band—on low power and avoiding repeater inputs, of course. I found that the antenna would give better than a 2:1 swr over about a 1.5-MHz range,
with 19¾ inches hitting 146 MHz on the nose.

I wasn’t thrilled with that bandwidth, so I opted for a simple modification: a “thicker” radiator. I started with a 20-inch piece of RG-174/U, with the center conductor and braid shorted together where they are spliced to the center conductor of the RG-58A/U and shrink tubing again covering the evidence. After the same pruning procedure, this came much closer to my expectations, covering the entire 144-148-MHz band with a worst-case swr of 1.8.1.

Use

I attached some 1/8-inch nylon cord to the top of the center conductor with two small wire ties, and the installation problem of a non-self-supporting antenna was solved. The antenna can now be suspended almost anywhere. Bear in mind that it has a very low angle of radiation and must be kept quite vertical to take advantage of its gain characteristics. I chose the 17-foot length of feedline as a reasonable trade-off between losses and the ability to put the antenna in better (higher) places. The antenna and nylon “mount” bundle neatly into a tiny package hardly larger than my HT, making it an ideal traveler’s antenna.

My comparison of the floppy bazooka’s performance to other antennas was not rigorous, but very satisfying. It significantly outperformed my 1/4-wave ground plane in fixed-station use and incredibly outperformed the rubber duck.

The floppy bazooka is cheap, easy to build, and works very well. It also lends itself well to modification and experimentation. Try it!

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Taking It Higher

Raising a repeater’s antenna is the way to wider coverage, right? Wrong.

When it comes to repeaters, higher is better! Right?

Not necessarily. It depends on what you want to accomplish.

Sooner or later, every repeater organization in the country gets the urge to move the repeater antenna up to twice as high as it already is, to improve coverage. Most of the time, it does improve. Every once in a while, though, some unexpected glitches result.

The Tallahassee Amateur Radio Society went through the process of moving from a downtown site with an antenna elevation of about 350 feet to a new commercial tower near the edge of town with an elevation of 800 feet above mean sea level (MSL). Sure enough, coverage was considerably extended. But sure enough, there were several surprising developments. What happened, and why, makes an interesting case study.

We knew from experience that the downtown site gave us an effective coverage range of about thirty miles in all directions over fairly mild terrain. South of the city, the coastal plain stretches away to the Gulf of Mexico, flat as a pizza, with an elevation of about 50 feet above MSL. But right in the middle of the city the terrain rises abruptly at the limestone scarp which, a few million years ago, was the coastline when sea levels were higher than now. These hills rise to elevations of 150 to 230 feet, with an average elevation of perhaps 175 to 200 feet above MSL on any bearing in the northern semicircle centered on Tallahassee.

What would happen when we moved from 350 feet to 800 feet? Would we be able to work 75 miles? 100 miles, as some members predicted?

The visual line-of-sight distance from an antenna to the horizon is expressed by the formula \( R = \sqrt{2H} \), where \( R \) is the range (or radius) in miles and \( H \) is the height in feet of the antenna above average terrain. It is the basis, in commercial antenna engineering, for computer calculations of the antenna’s performance, cranking in corrections for such things as absorption of radio energy by foliage and buildings, shadowing by hills, and the fact that radio signals can nearly always be heard beyond the visual horizon.

Without benefit of a computer, I modified the formula based on empirical observations of repeater performance in actual operation. The formula is intended to be an approximation, not a precise prediction. I cranked in a number of assumptions about ham radio which do not apply to commercial and public safety services.

For example, most amateurs are willing to settle for less than 100% reliability over a given path. And most of us are willing to accept a noisy signal if it is still readable. The modified formula turned out to be:

\[ R = \sqrt{2.5H} \]

Applied to our downtown antenna site, it predicted a contour which agreed well with our experience with the repeater. Here it must be said that a number of other assumptions also must be made. For example, we assume that most mobiles will use about 15 Watts output to a quarter-wave whip, that they will be in motion, that they will have little or no ignition interference, that they have receivers with a sensitivity of half a microvolt or less for 20 dB of quieting, and that the ambient acoustical noise in the mobile will be fairly high.

The critical parameter was defined as the point at which “practical communication” through the repeater becomes possible between a mobile at the fringe of the coverage and a mobile or fixed station located within the full-quieting contour of the repeater. In effect, this boils down to: “Can I use the repeater to get useful information on..."
road directions or weather conditions?

Once the repeater was installed in the new location, I began collecting data by the simple expedient of working mobiles as they passed through the area and noting their positions when effective practical communication became impossible. Each such observation was noted on a large scale map (half an inch per mile) as a big red dot. Eventually, each of the roads into town became plastered with dots which sometimes covered several miles of road. These “smeared” observation points resulted from the variations between observations. One mobile might be using 25 Watts to a 5/8-wave whip. The next might be running only 10 Watts to a quarter wave. Another might suffer severe ignition noise on reception or his receiver might be “hot” or slightly “deaf.” Propagation conditions might exert some influence from day to day. The final point on the road was chosen at about the middle of the “smear.”

The results of the tests were plotted on a map, with the observation points on the highways being connected by a smoothed line. Circles, also centered on the repeater site, showed the 40- and 50-mile radii. The formula predicted an effective working range of 44 miles, disregarding terrain effects.

The interesting distortions of the working contour are almost entirely the result of terrain. A peculiar flattening in the northwest quadrant results from a ridge of hills along the eastern bank of the Apalachicola River. Mobile signals almost “wink out” when they drop over the crest of the hill into the river flood plain. The southern semicircle bulges outward because the terrain in that sector is substantially lower than Tallahassee and is dead flat coastal plain. The Gulf coast itself cuts off the bottom of what would be a rough circle. No observations were taken from boats in the Gulf. I suspect that the contour would bulge outward in that sector because of the high conductivity of the salt-water ground.

One unexpected side effect is that the repeater signal in the city of Tallahassee is not strong enough to quiet fully most mobile receivers. A possible reason is that the antenna is designed to provide some gain and it does this by taking energy away from the upper and lower hemispheres of the radiation pattern and concentrating it around the “equator.” The antenna is so high that most of the city lies in the deprived cone directly below it. The favored lobe of radiation widens gradually as it goes away from the tower, and at 10 miles or so the signal at ground level is quite strong.

Another unexpected problem arose in early work at the new site. We tried to use the top antenna at 800 feet for receiving and a side-mounted antenna at 485 feet for transmitting. Reflections and other effects resulting from the tower, guy cables, and other factors produced a radiation pattern which was pulled in strongly to the west and had a powerful lobe to the northeast with an effective range of nearly one hundred miles in the favored direction. We solved the problem by using the top omni antenna for both transmit and receive.

The repeater is on 146.31/91 MHz, and in this area we have very little, if any, co-channel interference unless there’s a strong band opening. For a few days, we experimented with a 146.16/76 machine on that tower. The results illustrate one of the problems which go along with great height. Mobiles trying to bring up the Valdosta, Georgia, repeater on 16/76 eighty miles away also brought up the Tallahassee repeater. And because of the strong northeast lobe, our signal was nearly as strong in Valdosta as the Valdosta signal was!

In urban areas, it is entirely possible to cover so large a ham population that the traffic load on a repeater becomes unacceptably high unless access is restricted in some way. When contemplating a repeater on a tower at 2,000 or 3,000 feet above average terrain, it may be desirable to choose a site considerably distant from any expected concentration of ham stations. Otherwise, the area deprived of signal by the antenna gain effect may become a real problem. The effect is greater on UHF than on VHF.

The Stone Mountain repeater near Atlanta, for example, covers Atlanta and most of the surrounding country like a blanket, but it is located about twenty miles east of the city itself. Repeaters located in the Great Smoky Mountains of Kentucky, Tennessee, and northern Georgia cover enormous ranges in their favored directions (where
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Other Hy-Gain vertical multiband antennas are available though not shown here. The 12AVQS (20, 15, 10 meter) is similar to 16AVT above but with VSWR of 1.5:1 or less on all bands. The 18VS (80-10 meter) comes with a base loading coil and may be installed on a short mast driven into the ground. All include stainless steel hardware.

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73 Magazine • December, 1982 43
Dial-A-Frequency

Let your fingers do the walking with this remote control.
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Have you ever had a need to remote control a multi-channel radio over a distance but didn't want to run a multi-conductor cable? I have a Heathkit® HW-202 two-meter radio that is located in my shop which is in a barn about 150 feet from the house. I wanted to be able to use the radio in both the barn and the house without moving it. One solution to this problem is described here.

The system I developed allows me to dial up any one of four channels in my two-meter radio. This is done using a standard dial telephone with a minor modification for push-to-talk operation. The telephone is connected to a controller via a single pair of wires that can be several hundred feet long. Several phones may be connected to the line, although only one may be used at a time. Of course, the telephone may be moved about by using jacks.

I'll review a little of telephone basics, go into the development of the system, talk about construction details and adjustments, and offer some afterthoughts that you may want to include in your version. Successful duplication of the ideas presented depends on how resourceful you are, as some of the relays and transformers may be difficult to find.

Basic Terminology

We all use the telephone every day. It seems to be a simple enough device, and on close inspection, it is. Fig. 1 shows the basic circuit from the telephone to the central office. The two wires that connect these two locations are a twisted, balanced pair with a typical characteristic impedance of 600 Ohms. Longitudinal balance describes how closely each conductor matches the other along the
This becomes increasingly important because the longer the circuit, the poorer the balance, the worse the frequency response. Thus, it is preferable to split the winding on one side of the circuit, as shown in Fig. 1. Note that dc current flows from the central office battery through the carbon microphone—but only when the switch is “off hook.”

At the central end of the circuit, note the one-to-one ratio transformer with a split winding on one side. This transformer allows the insertion of dc current and the picking off of the control signals while maintaining the circuit balance to ground. At the same time, voice and tone signaling (if applicable) are coupled through to the other side of the transformer. The capacitor shunting the power supply and relay coil on the line side of the transformer bypasses audio frequencies.

The circuit shown in Fig. 1 is the basis of my two-meter dial-up remote controller. I won’t go further into the operation of the central office, but if anyone is interested in further study in this area, Basic Telephone Switching Systems by David Talley (Hayden Book Company, New York, NY) makes excellent reading.

**Development of the Dial-Up Remote**

There are three control functions that must be provided in the two-meter dial-up system: the off-hook condition, dial pulses, and push-to-talk function. These three functions are provided by relays K1, K2, and K3, respectively, in Fig. 2. The telephone set itself must be modified to provide push-to-talk operation. More about this later.

---

**Fig. 1. Basic telephone circuit.** Note that dc current flows from the central office battery through the carbon microphone—but only when the switch is “off hook.”

**Fig. 2. Schematic diagram of the dial-up two-meter remote controller.**
When the telephone receiver is lifted off hook, the dc circuit is completed from the 35-volt source to K2 and to the series combination of the 12-volt zener diode and K3. Contacts on K2 apply 35 volts to K1 and charge C1 through R1. R1 is necessary to prevent contact arcing on K2. Now that K1 is picked up, the 48-volt source is removed from the reset coil on the stepping relay and applied to contacts on K2 which are connected to the stepping coil. A separate 48-volt source was necessary because of the particular stepping relay that I had available.

What happens now if the dc loop to the telephone set is broken for a fraction of a second by dialing a "1"? Relay K2 drops out for a brief period and picks up again when the dc loop is again completed. This removes the 35-volt source from K1 briefly, but the charge on C1 holds K1 closed through the diode. The 48-volt supply is therefore maintained to the contacts on K2 which close for the brief time that K2 drops out. This applies a single pulse of 48 volts to the stepping coil, advancing the switches one step to position two.

If you were to hang up at this time, relay K2 would immediately drop out. Relay K1 would remain energized for about one-half second because of the charge on C1. When K1 finally drops out, the 48-volt supply is applied to the reset coil. Because the switches are not in position one, the reset contacts on the stepping relay are closed. The reset coil will therefore reset the switches to position one, at which point the reset contacts on the stepping relay again would be open.

If we now lift the receiver and dial, for example, a three, the switches will advance to position four and stay there until we hang up again. Note that the stepping and reset coils never have voltage applied for any length of time. They usually are rated for intermittent duty only. Note also that dialing 12 or 21 has the same effect as dialing a three.

Relay K3 must be selected carefully. It must have a drop-out voltage not much less than its pick-up voltage. The unit I used has a 12-volt coil and is a plug-in type from an old IBM key punch machine. Most 12-volt relays will pick up at about 10 volts but many will not drop out once picked up until the voltage is less than three or four volts. The variable resistor in the power supply (Fig. 5) is adjusted for proper push-to-talk operation. You may want to experiment with electronic circuits to sense the push-to-talk voltage change and which would, in turn, drive the push-to-talk relay. Another alternative would be to run a separate pair of wires for the push-to-talk button.

The push-to-talk relay, K3, grounds the push-to-talk line to the radio and switches the 600-Ohm audio from the split-winding transformer, T1, between the radio microphone input and speaker output. Impedance matching is required on both of these circuits. I used some small, 120-to-12-volt (10:1 ratio) filament
transformers from my junk box.

The stepping relay that I used has three switch sections. It is a C. P. Clare model A321033 that was salvaged from an electrical circuit recloser. One section is used to connect the telephone circuit to the radio. This allows me to dial up other devices on other positions of the stepping relay, such as a weather receiver. The second section turns on the power to the two-meter transceiver. The third section changes channels in the radio. Stepping relays are available from time to time from surplus outlets such as Fair Radio Sales, 1016 East Eureka Street, PO Box 1105, Lima OH 45802.

Fig. 4 shows the channel-change circuit. Two miniature relays are used to select the appropriate crystals in the Heath HW-202. The resistors in series with the relays are necessary because the relays I had available have 3-volt coils. Note that when the stepping relay is in position three, neither relay is energized. When in position four, K6 is picked up, when in position five, K5 is picked up, and when in position six, both relays are picked up.

In each case, a different pair of crystal switching diodes is grounded. I disconnected the radio switch grounds from the chassis ground and reconnected them to be grounded when neither relay is energized, position three. This allows me to select with the radio switches which channel will be selected when dialing a two. It also allows the radio channel switches to function normally when not connected to the controller or when the controller is switched off. The other three positions are connected to the crystals of the most commonly used channels.

The power supply, Fig. 5, is straightforward. A small amount of 6.3-volt ac power is required for the channel-changing circuit. The 36-volt secondary on the transformer gives about 48 to 50 volts dc for the stepping relay. It must be capable of supplying the intermittent current requirements of the stepping relay, about 1 Ampere in my case.

Dropping resistors are used to supply a lower voltage for operation of K1, K2, and K3. This voltage should be relatively hum free as it is also used to bias the carbon microphone. The dropping resistor is made variable to allow setting the push-to-talk operating point. Positive grounds are used as this is telephone system convention but it certainly isn't necessary. If negative grounds are desired, it is only necessary to reverse the polarity of C1, the diodes associated with K1 and K3, and, of course, the power supply capaci-

![Photo C. Modified telephone set. Note the push-to-talk button in the handset and the resistor-capacitor combination mounted on the added terminal strip.](image)

![Fig. 5. Power supply schematic diagram.](image)
tors and diodes. Power supply requirements for other versions will probably be different depending on what relays the junk box and local surplus outlet may yield. Switch S1 turns on the power to the radio when switching the controller off so that the radio can be used in a normal fashion.

Construction

As can be seen by the photos, I mounted all components on a piece of wood. While this method of construction is simple and effective, it is not terribly attractive. I plan to reconstruct the unit in a 3”×10”×17” chassis mounted on a 3½”×19” relay rack panel. Layout is not critical.

Modification of the telephone consists of removing the bells to make room for a terminal strip on which to mount the added resistor and capacitor. See Photo C. The handset must be changed to a push-to-talk type (available from Graybar Supply, 345 Harrison Avenue, Boston MA 02118, and from Fair Radio Sales, previously mentioned). The resistor-capacitor-switch combination can be inserted anywhere in the dc current loop.

The channel-change relay circuit board (Photo D) was etched using a Radio Shack etch resist pen and etchant. The board is simple enough that no fancy techniques are required. Foil layout will vary depending on your radio and the relays you can find. The ungrounded side of the channel-change circuit clips to the wire poking through the plastic filler where the burst encoder would go. This can be seen in Photo A.

Cables between the controller and the radio should be only a few feet long because of the high-impedance microphone circuit. Run a separate return lead for the channel-change circuit. Otherwise, the return current will flow on the microphone cable sheath resulting in transmitted hum.

The 12-volt dc leads should be fairly heavy to carry the 2.5 Amperes or so required on transmit. The push-to-talk lead goes into the microphone connector of the microphone cable. Make the speaker connection to the remote speaker outlet and throw the speaker switch on the radio.

The connection between the telephone and the controller is a single pair of telephone wires, typically number 19. I use about 150 feet of ordinary telephone wire, but distances up to one-half mile or possibly more should work. The limiting factor will probably be getting the push-to-talk relay to operate properly due to additional resistance of the phone line.

Adjustments and Operation

The first adjustment is to set the variable resistor in the 35-volt portion of the power supply. Start by setting it for maximum resistance. Then with the push-to-talk button on the telephone pressed, decrease the resistance until K3 picks up. Note the position of the resistor shaft. Releasing the button should cause the relay to drop out. If it doesn’t, the push-to-talk relay you’ve selected must be replaced with a different type with a higher drop-out voltage. Assuming your relay did drop out, continue decreasing the resistance while pressing and releasing the button. Note the point where the relay will no longer drop out. Set the variable resistor midway between this point and the point where the relay first picked up.

Setting the transmit level can be done several ways. The ideal way would be to use a deviation meter. Barringer, connect a VTVM set for ac to the microphone connector terminals at the radio. Note the level range for normal speech while using the radio’s microphone. Now disconnect the microphone and connect the controller. Adjust the transmit level on the controller for a similar range while speaking normally into the telephone microphone. A third possibility would be to use on-the-air reports.

Once you’ve gotten everything working, operation is very simple. Lift the telephone receiver and dial a two for the channel selected on the radio switches, a three, a four, or a five for the specific channels you’ve chosen. You’ll need to set the volume for a comfortable level in the telephone receiver. By switching the power supply to the off position, reconnecting the microphone, and switching back to the internal speaker, the radio is restored to normal operation including the channel selector switches.
Afterthoughts

If you don’t mind running extra conductors between the controller and the radio, it would be simpler to run separate conductors for each channel rather than to use the relay switching scheme. The 6.3-volt winding wouldn’t be required on the power transformer and there would be no concern about transmitting hum from the channel-change circuit. Also, more channels could be dialed.

Some stepping relays available from surplus outlets have more than 20 positions. All positions could be used by dialing digits that add up to the desired position minus one. For instance, to step to position 19 you would dial “99”, “80”, or “08”.

The output of a dial-tone generator could be connected to position one of section one of the stepping relay.

You might leave power connected to the radio at all times and have a tone-dial decoder on the audio output ring a bell. Fellow hams can then reach you by using their tone-dial pads without having to monitor the channel. Position one of section three of the stepping relay would select the appropriate channel.

Conclusions

I’ve described a system that will dial up channels remotely in a two-meter FM radio using a standard dial telephone. With it you can place as many remotes as you want at considerable distance from the radio on a single pair of wires. It has been in everyday operation. I’ve also offered some ideas for expansion to include other services. With this system as a basis, use your imagination and you can develop a great system to suit your own needs.

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<thead>
<tr>
<th>FEATURE</th>
<th>SANTEC ST-144</th>
<th>YAESU FT-208</th>
<th>KENWOOD TR-2500</th>
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<td>6 Digits, Mem. #</td>
<td>4 Digits, Mem. #</td>
<td>4 Digits</td>
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</tbody>
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I have been a fan of Peter Stark’s K2OAW IDer ever since the original design first graced these pages back in 1973. The simplicity of programming the thing, the low parts count requirement, and the lack of those hated KerNaugh maps made this, for me, the ideal IDer circuit. In the years since its first appearance, I have built maybe half a dozen of these circuits for my various repeaters and those of a few of my friends. With the advent of the FCC’s decision to drop “R” calls for repeaters, regular

---

Fig. 1. K2OAW ID circuit update as it appeared in 73 in June, 1979.
amateur call signs, followed by "RPT" or "R", have generally necessitated more character space than the old K20AW circuit could provide. So, a couple of years ago, Peter obliged the troops with an update of that original design which doubled, from 32 to 64 characters, the amount of information available for use in the IDer.

However, though a lot of us need more than 32 characters for our ID, we don’t always need all 64 of ‘em, particularly those of us who believe that a repeater ID should say its legal piece and shut up. So, for those who wish to keep the ID process from continuing long after the CW is gone and to save a lot of diodes for the blank line, I hereby propose the “K20AW IDer Update.” As you will see, the improvements cover a lot more than what I’ve talked about so far.

Fig. 1 is the K20AW ID circuit update as it appeared in the June, 1979, 73. Peter added just 3 ICs, a 7473 (IC4B), and two 74154s (IC5b and IC6b) to accomplish the doubling of capacity. I changed the “ID hold” half of the original 7473 IC4B to a 74C76 (C? Yeah. Read on.), now called Z11A, and added one more IC, Z8, a 74CO2 quad NOR gate. A 4001 would work just as well. To top things off, IC1A and IC1B, which comprised the clock oscillator in the original K20AW circuit and its update, were scrubbed in favor of one half of an NE556 timer chip, running in the astable mode, with the other half being used for the ID audio oscillator. More on this later.

Fig. 2 shows how the two IC changes were implemented in the circuit. At the point in the ID where a stop bit is desired, two diodes are run to the appropriate pin on the 74C154 matrix, with one diode further connected to the dot line and the other attached to the blank line. The inputs of one gate of the 74C02 (Z8B) are connected to the dot and blank lines. This gate actually functions as a nega logic AND gate. When this aforementioned stop pin pulls both lines low together, the output of Z8B goes high.

This output is sent to two places, the “zero set” pins of Z3, which heretofore were grounded, and an inverter made from Z8A. Bringing the zero set pins on Z3 high sets all of its BCD outputs low. Grounding them allows the IC to operate normally.

The output of inverter Z8A feeds the “set” input on one half of the 74C76, Z11. A momentary low on this pin drives the Q output (also known as the ID hold line) low, halting the ID process in its tracks.

Z7A, half of the NE556, replaced IC1A and IC1B in the old circuit because the 556 is a much more reliable circuit, in my experience. The other half of the 556 is used in the astable mode as the ID tone generator.

IC1A and IC1B are not wasted, however. IC1B, now Z1B, is used to replace Q1, a 2N706 from the original ID circuit. It is connected as an inverter between the start line and the clear input of the 74C76. IC1A, now Z1A, is also used as an inverter, the input...
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References

One caveat: The 74C ICs used here are pin-for-pin replacements for their TTL counterparts except for the 74C93. If you're planning to retrofit an existing circuit and convert your 7493 to CMOS, you will have to rewire that part of the circuit.

With these modifications, I feel that the K2OAW IDer is the ultimate ID circuit. If you have one in use now and update to the circuit described here, I think you'll agree that the best has been made better.

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The Bunesti Caper

The two British agents needed a power amp—fast. Could the American ham build one?

December 7, 1941, was a day of glory and achievement for the Japanese Empire because of the unbelievably effective attack upon military installations in Hawaii. In England, the long hoped-for involvement of America in the war now seemed assured. The "Day of Infamy," however, also brought a special sort of gloom and silence to one small segment of the American population—the amateur radio operators.

In the midwest that night, most of the ham bands were full of stations relaying the FCC announcement that all radio amateur activity was to cease immediately. It seemed that almost every ham in the country was trying to make as many contacts as possible that last night. I kept my 20-Watt AM rig (push-pull 45s modulated by 47s) going on 160 meters until well past midnight, but finally closed down when I got too sleepy to continue.

The next morning, I turned on my Howard 435A receiver and heard a couple of guys yakking away just as though the Pearl Harbor attack had never occurred. Naturally, I cranked up the rig and told them of the FCC notice. They claimed that my call was the first they had heard about it and that they thought their receivers

Photo A. The crew of Destiny Deb prior to its final combat mission to Ploesti, Rumania. (The little guy on the left in the front row is W9PJF.)
made that all personnel
the Army Air Corps
showed that I had
day I was on a troop
pm. I don’t think that
were receiving
who knew Morse code
with as a ham. The
classes were pretty
much of a bore and I
did not advance my
rate, but I did manage
to pass 35 wpm. We
were not allowed to
printers, however, so I
felt that printing at
wasn’t too bad.

The practical part of
the course was a snap, and I
became reasonably proficient at
the operation and maintenance
of such items as the BC-221
frequency meter, BC-375
transmitter, BC-342 and BC-348
receivers, ARC-5-series HF
transmitters and receivers, BC-
610 transmitter, SCR-522
VHF transceiver, and miscellaneous
aircraft electronic gear such as
beacon receivers, the radio
compass, interphone systems, etc. I
was happy to be expanding my
knowledge of electronics
and was actually a bit
ty to pass the ham exam
had finally paid off, since I
avoided many miserable
hours of close-order drill.

The Air Corps radio
operator/mechanic school had a
curriculum that covered basic
theory, Morse code, and
radio repair. It included an
almost frightening amount of
material in a very short
time, but I was having a
ball. The films, lectures,
and demonstrations
expanded and solidified my
knowledge of the theories
I had struggled with as a
ham. The code classes were
pretty much of a bore and I
did not advance my speed
very rapidly, but I did man-
age to pass 35 wpm. We
were not allowed to use
typewriters, however, so I
felt that printing at 35 wpm
wasn’t too bad.

The practical part of
the course was a snap, and I
became reasonably proficient at
the operation and maintenance
of such items as the BC-221
frequency meter, BC-375
code, BC-342 and BC-348
timers and receivers, BC-
610 transmitter, SCR-522
VHF transceiver, and miscellaneous
aircraft electronic gear such as
beacon receivers, the radio
compas, interphone systems, etc. I
was happy to be expanding my
knowledge of electronics
and was actually a bit sor-
ty when I completed the
course.

I declined an invitation
to stay at Sioux Falls as an
instructor and requested an
assignment as a flight radio
operator. Within a couple
days I was on another
train, now enroute to King-
man, Arizona, this time to
qualify as an aerial gunner.
I spent some time on the
train sewing on my new corporal
stripes.

Gunnery school did not
have the same fascination
for me that I had felt at
radio school. While all of
the radio operators at gun-
ner school had to partici-
pate in weekly code prac-
tice sessions in order to
maintain proficiency, I
learned a lot more than I
thought possible (or neces-
sary) about the 50- and
30-caliber air-cooled machine
guns, the 20 mm cannon,
hydraulically- and
electrically-operated gun
turrets, and how to lead or
lag moving targets in flight.
We spent a few hours in the
air shooting at airborne
targets, but I enjoyed the
skew shooting part of the
course most of all. We
learned the basics of lead-
ing or lagging moving tar-
gets by shooting at clay pi-
gons from the back of a
moving truck! On days off,
we were encouraged to
shoot regular skew—the
guns and ammo courtesy of
Uncle Sam. After the mov-
ing truck training, the
normal skew seemed easy and
I was soon 25 for 25 most of
the time.

I was not sorry to
finish the gunnery course al-
though it had qualified me
for the first “flight pay” of
my life. I left Kingman as a
brand new “Buck” Ser-
geant, and headed for a
combat crew assignment at
Tucson, Arizona.

It would take a whole

Photo B. Back in Italy just before returning to the USA, W9P1F points to the souvenir Ruma-
nian Air Force pilot wings worn by “Charlie” Kourvelas, the tail gunner.
book to express my memories and feelings about our ten-man crew formed at Tucson. That crew became my family away from home, and a closeness developed between us that I have not experienced with any other group. Ten semi-trained civilians (four second lieutenants and six buck sergeants) became a reasonably competent crew for a B-24 Liberator, a heavy bomber. We soon were enroute overseas via Natal, Brazil, Dakar, West Africa, Marrakesh, and eventually to an austere base in southern Italy where our 450th Bomb Group joined the newly formed 15th Air Force.

I will always believe that aerial combat was at least as frightening as combat on the ground. Most of the time, our activities were conducted far inside enemy territory with the obvious risk of capture or death a long way from home base. We bombed a number of tough targets. We got shot at and were hit by fire from antiaircraft guns and fighter aircraft. We saw friends disappear in the cloud of an exploding aircraft, and we held back unmanly tears as corpsmen removed bodies from riddled airplanes. Our crew completed 34 missions with many close calls but with no physical wounds. Our flight engineer and I had been promoted to tech sergeant, and the other enlisted men now were staff sergeants. We were flying our third B-24, however: a nearly new one called Destiny Deb. Our first two aircraft had been totaled in crashes.

Our 35th mission was to bomb a target that was probably as well guarded as any in Europe. It was the oilfield/refinery complex at Ploesti, Rumania, which was a major source of petroleum products for the Nazi war effort. It was to be our second trip to Ploesti, and memories of the fighters and the intense antiaircraft fire were still fresh in our minds.

That mission turned out to be our last, as Destiny Deb was rocked by an enormous explosion just after we dropped our bomb load and while we were making a night descending turn to take up the return compass heading for Italy. An 88 mm shell had exploded between number two engine and the main fuselage, tearing a large hole in the fuselage and rupturing some fuel lines. Only God knows why we were not immediately surrounded by flames. The number two engine quit immediately, and number three on the other side began to smoke. We fell well behind the squadron and obviously would soon be alone, an easy prey for any Luftwaffe fighters that saw our plight.

The Fates were again kind to us that day, however, and while the number one engine soon failed and power had to be reduced on number three, the old gal flew long enough for us to get well away from the target area. We realized that we would not see Italy very soon as reluctantly we parachuted out over open country near the small town of Buneesti, and soon we were uninvited and unwanted guests of the Rumanian government.

The life and times of a POW in that era cannot be described very well in a few sentences, but a great deal of my time was spent in planning what I might build as my postwar ham station. I was still constrained by my depression views, however, and my most grandiose design turned out to be a T-55 modulated by a pair of TZ-40s. For anten-
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power amplifier for use with their small suitcase-sized radio station. Their transmitter provided only about 20 Watts of power, and they had been unable to contact their station in Egypt.

I must admit that I was a little confused by a situation wherein an agent of a nation at war with Rumania was to be assisted by an American prisoner of war in establishing radio contact with an Allied radio station in Egypt. The Rumanian colonel told me that the rapidly approaching Russian forces had created serious political problems and that the British communications arrangements had been approved by “high government officials.”

I said that I could build a suitable amplifier if I had the necessary parts, and one of the civilians replied that parts were available. After trading my flying suit for a pair of pants and a shirt, in order to appear less military, I gathered up my small collection of personal belongings and left the prison camp by car in the company of the civilians and two other radio operators, Charlie P. Brewer from Beaumont, Texas, and Ray Jones, RAF, from Sutton, Surrey, England.

We were taken to a large building which must have been part of a university physics department. I was escorted to a room that was full of electronic equipment and told to select whatever I needed. I found many American-made parts and some power supplies that appeared to be operational. I selected some triode transmitting tubes (they were either the HK-54 Gammatrons by Heintz and Kaufman or the 35TGs by Eimac—my memories have been somewhat dimmed by the passage of some 37 years), a 2500-volt power supply, a 300-volt power supply, tube sockets, varie-
able capacitors, wire, solder, a variable transformer (Vario), and an assortment of rf chokes, resistors, insulators, and fixed capacitors.

There was no heavy solid wire available, and I could find no meters or test equipment. I explained my need for wire or tubing to make coils, and one of the civilians said that he would bring some later. The parts that I selected were placed on a bench, and the civilian said they would be delivered to the transmitter location that afternoon.

We left the building and were driven to the Banca Nationale A Rumania (The National Bank of Rumania). In one of the basement rooms we were introduced to the two British agents. One was a British captain and the other a Rumanian national who also was a lieutenant in the British army. They showed me their small transmitter/receiver, and I was happy to see that they had several extra coil sets available which I could use in the amplifier circuit.

When the parts from the school were delivered, I assembled a simple power amplifier on a piece of pine board. Electrically, it was a pair of power triodes in parallel (see Fig. 1). The 2500-volt supply provided the plate voltage, and the 300-volt supply, Variac controlled, provided the bias. I used two of the spare coils from the “spy” radio for the amplifier-plate coil and checked for approximate tuning by coupling the output from the small transmitter to the antenna link on the plate coil. Resonance was easily established by tuning for maximum rf voltage in the tank coil.

Next, I capacity-coupled the grids of the power amplifier to the plate of the 6L6 output tube in the small transmitter. I hooked a flashbulb to the output link and carefully readjusted the amplifier plate, tuning for maximum output. Then the neutralizing capacitor was adjusted for minimum output, and the amplifier was ready for the first trial run. The flashbulb was replaced by a 300-Watt bulb, the bias voltage was set for maximum (—300 V) and the 2500-volt supply was turned on.

Surprisingly, nothing blew and no smoke appeared. By decreasing the bias voltage slowly and observing the intensity of the blue glow of the mercury-vapor rectifiers (866s) in the high-voltage supply, I could tell when the amplifier tubes began to draw plate current. I set the bias to a point where a definite plate current was evident and then keyed the small transmitter now being used as a driver for the amplifier. I was rewarded with a brilliantly glowing 300-Watt bulb and a large increase in the mercury-vapor glow.

The amplifier was indeed working and obviously was producing more radio energy than I had ever achieved with any of my ham gear. The only missing element now was an antenna, and the roof of the bank building was an awfully long way from the basement.

It was during this time period that a group of Rumanian leaders formed a provisional government, declared themselves the legal spokesmen, and agreed to cease combat activities against all Allied forces. I was introduced to Dr. Maniu who headed the provisional government and whose temporary abode was also in the basement of the bank. I understood that he had a long history of public service and was well thought of by the Rumanian people.

A man from the telephone company provided us with a large reel of twisted-pair telephone cable, a small reel of bare copper wire, and a great many glass insulators. Charlie, Ray, and I put a half-wave antenna with a quarter-wave matching stub on the roof and used the phone cable as a transmission line to the transmitter (see Fig. 2). The elevator shaft provided the shortest path for routing the cable between the roof and the basement.

During the installation of the antenna, the local German military authorities reacted immediately and harshly to the new government. Several Rumanian civilian facilities were bombed, and, for a few minutes one day while we were on the roof, we watched ME-109s dive-bomb nearby buildings. Luckily, the bank was not selected as a target.

I was concerned about the suitability of the phone cable as a radio-frequency transmission line because of the poor insulation and extreme length of the cable. [No one else there had ever heard about EO-1 cable] As it turned out, the phone cable was very lossy and the
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The Tube Returns

Bored with cranking out the contacts on your expensive transceiver? Been looking for a simple construction project to put some of the thrill back into ham radio? Maybe you'd just like to build something for the fun of seeing what you can make with that collection of old parts wasting away in the basement? If the answer is yes then this is for you.

Believe it or not, here is a surprisingly effective one-tube shortwave receiver you can build in a weekend. The cost is 0 to 15 dollars, depending on your resourcefulness. No slouch on performance, it will pull in just about every signal on the 80-meter ham band that an expensive commercial receiver will hear. As described here, it tunes from 3.5 to 7.5 MHz but the frequency range is determined by plug-in coils and can be extended easily in either direction.

Old-timers have already recognized this project as a regenerative receiver. This type of detector has its roots in the misty past of radio lore and its reputation for high sensitivity is well earned. Early amateurs found that putting an adjustable amount of positive feedback around a detector had several benefits: An astounding amount of gain was available, the selectivity of the associated tuned circuit was vastly increased, and with proper adjustment either AM or CW signals could be copied easily. If a dual triode is chosen for the tube, then one section can be the regenerative detector and the other an audio amplifier. The resulting receiver is easy to construct, sensitive, and inexpensive. It was a very popular design in the 1920s and 30s.

There are, of course, several drawbacks. To receive code signals the feedback is adjusted so the detector is just barely oscillating, and with that setting a long antenna blowing around in the wind can cause frequency instability on the higher bands. Since the detector is oscillating, a steady carrier can be broadcast via the antenna. A few microwatts isn't going very far but the ham next door might hear it. Furthermore, any receiver with a single tuned circuit will tune rather broadly. While that isn't too much of a problem when all of the signals in the band are of similar strength, a really strong station on a nearby frequency (within 30 kHz or so) can cause problems.

All of these problems were eventually solved with the development of the superheterodyne receiver, but the regenerative detector continued to be used, if to a lesser extent, because of its simplicity and sensitivity. Until the mid 1950s there was always a one-tube regen featured as a good beginner's receiver in the ARRL Handbook. Even in the 60s there were designs for simple superhet receivers using regenerative detectors and controlled amounts of i-f regeneration to sharpen selectivity.

So much for history; let's turn to the project at hand. This circuit is a distillation from several described in the literature of the 50s. I tried not to use components that would be difficult to locate today and I'll point out a lot of circuit alternatives to take care of the most likely junk-box shortages.

The receiver uses a plug-in coil—wound on the glass bulb of an extra octal tube—and covers 3.5 to 7.5 MHz. With that coil, the 80-meter band is covered with plenty of bandspread and the 40-meter band tunes pretty rapidly. You can wind other coils easily to cover 40 and 20 meters with plenty of bandspread.

The 80-meter tuning range is a good place to start since that band is not too crowded and the shortcomings of this simple receiver will be more pronounced on the higher frequency bands. The construction is genuine breadboard; very simple and easily adapted.
to whatever parts you collect. The performance is remarkable. With a 30- to 50-foot ended wire you will be able to copy just about everything on 80 meters, SSB included, without much problem. In fact, the 80-meter performance compares quite favorably with that of a 5- or 6-tube "all-wave" receiver. The regenerative detector won't tune as conveniently as the superhet, but with a little practice the results are the same.

The Circuit

The circuit diagram for my receiver is shown in Fig. 1. You can copy it exactly or use it as the starting point for your own version. Before getting into possible variations let's take a close look at Fig. 1.

The antenna is linked to the detector coil through three or four turns of wire. This is the swinging coil visible in the photograph. There are two tuning knobs. One 365-pF section of the tuning capacitor from an old tube-type broadcast radio does the main tuning while a smaller, 140-pF variable, tapped down on the coil, is the slower tuning bandspread capacitor. A three-to-fourturn feedback winding on the bottom end of the plug-in coil allows the detector to oscillate when the regeneration control is set high enough.

The plate lead from the detector triode is filtered clean of rf after running through that feedback winding and the audio is capacitively coupled into the grid of the audio-amplifier triode. An inductor (the primary of an audio-output transformer) keeps the audio from getting back to the power supply and a 25k pot sets the regeneration level by adjusting the detector's plate voltage.

The audio amplifier is pretty straightforward, except perhaps that the headphones are connected directly into the plate lead. This is simple and works well but please note that the B+ runs through the headphones and you should be mindful of the shock hazard. The headphone jack is wired so that the voltage doesn't appear on the external part of the jack (which is normally grounded) until the phones are plugged in and, of course, the jack is insulated completely from the front panel.

The power supply is correspondingly simple. Two small filament transformers feed each other back to back to provide both the 6.3 volts for the filament and a transformer-isolated 115 volts for the B+ supply.

Construction

The physical design is straight out of the 50s. A 7 1/2- by 8-inch board is the base for the receiver, and most of the parts are mounted on terminal strips screwed to this board. The two tube sockets are mounted on 1-inch stand-offs. The front panel is a piece of 1/16-inch aluminum to which are mounted the various controls. Most of the rf wiring is hung on the tuning capacitors, so it is important that the front panel be mechanically rigid and electrically shielding. These two conditions ensure a minimum of problems due to microphonics (audio noise in the headphones due to mechanical disturbance of the electrical parts) or hand effect (frequency shifts caused by circuit capacitance variations due to motion of the operator's hands near the receiver).

The antenna is coupled into the tuned circuit by means of a swinging link coil. As can be seen in the photograph, this link is mounted near the middle of a 5-inch length of 1/4-inch-

Behind the dials: A simple circuit and classic breadboard construction.
diameter plastic rod. The rod need not be plastic—any insulating material will do, even wood. The rod is supported at the front panel by a bushing (which was salvaged from an old volume control in keeping with the spirit of the project) and at the other end by a wooden pillar having a 1/4-inch hole through it in the appropriate spot.

The link was formed by winding stiff wire around a wooden dowel slightly larger in diameter than the 6SN7 coil form. The wire is kept under as much tension as possible while winding. The time-honored method is to clamp one end of the length of wire in a vise and, with the wooden form held in both hands, lean back to put tension on the wire as you wind your way toward the vise.

The coil will spring out some when it is taken off the form and probably several turns at the start will be distorted. Save three or four good turns with an inch and a half or so of lead on them. When the rod and 6SN7 coil form are both mounted, you can measure where the antenna link will have to go on the shaft in order to swing over the coil. Drill a pair of wire-diameter-sized holes at the appropriate spots and mount the link through them.

The rest of the receiver layout is pretty well defined in the photographs. I used heavy wire for all of the rf wiring so that vibration-induced microphonic effects would be at a minimum. Your layout doesn’t have to match mine exactly as you surely won’t have a matching collection of parts.

The construction style of the power supply is also historically motivated. The supply is built as a separate unit to minimize 60-cycle pickup in the receiver. I used a 1-foot-long section of wooden 2 by 3 with a slot jigsawed down the middle to contain the wiring. One concession was made to modern electronic design in the form of a silicon rectifier mounted on a terminal strip hidden under the “chassis.” In earlier years, there would have been a 5Y3 or type-80 rectifier tube in the supply.

Alternate Parts and Circuits

Half the fun of building the one-tube receiver is coming up with a suitable collection of parts. The circuits are so noncritical that the builder can substitute with wild abandon and still have excellent results. This is especially true of the power-supply circuit.

The receiver needs 6.3 volts ac at 6 Amps and 90 to 200 volts dc at 8 to 20 mA. If you’re lucky, you will have a single small transformer providing these voltages and probably 5 volts as well (for a rectifier filament) that you won’t need. I didn’t have any suitable small power transformers, but I did have a collection of filament transformers. Two were wired back to back as indicated in Fig. 1.

Of course, it is all right to use a single large transformer if that’s what’s available. If the voltage is too high (250 volts or more), a 10 or 15k, 1-Watt resistor can always be used in place of the filter inductor. A really large transformer, like that from an old TV set, should probably be mounted on a metal chassis for safety’s sake—an inverted cake pan will serve if the junk box lacks a chassis.

The rectifier I used is a small silicon unit rated at 1 Amp and 400 peak inverse volts. A full-wave bridge rectifier would be worse since the 120-cycle ripple is easier to filter than the output of a single diode. The more filter capacitance the better. Don’t be afraid to experiment with smaller amounts than I used, but be prepared to add more if hum is a problem. Be sure the capacitors are rated to work at voltages higher than they will see in the circuit. The filter inductor would ideally be a small 5- to 20-Henry unit rated at 20 mA or more. Small inductors, like small power transformers, are not too plentiful these days, so I used the primary of a salvaged TV set audio-output transformer instead.

An entire alternate receiver schematic is shown in Fig. 3. I haven’t built a receiver using this schematic, but it is included here to illustrate a number of circuit variations. You can mix and match circuit features from Figs. 1 and 3 to make maximum use of the parts you have on hand. Note first how the antenna is capacitively coupled to the tuned circuit. If you have a small variable capacitor and a big knob, you may find this version easier to build than the swinging link. Both sides of the capacitor must be insulated from the panel and the large knob is desirable since placing your hand near the control shaft may influence the antenna coupling. This circuit arrangement was used in the 1952 ARRL Handbook receiver with a homemade capacitor constructed much along the lines of my swinging link—though plates were used instead of coils, of course.

If you have another small capacitor with a suitable shaft, you can use it as a bandspread capacitor. The smallest variable I had was 140 pf, so when I wound my coil I put a tap a few turns up from the ground end and connected that larger capacitor across only part of the coil. A 10- or 15-pf variable can go across the entire coil as shown in Fig. 3, and if you only have several 365-pf units, you can use a tap on the coil even closer to ground than mine. Don’t overlook old FM radios as a

![The power supply: built on a hollowed-out length of 2 x 3.](image)

![Fig. 2. Coil data for 3.5-7.5-MHz coil.](chart)
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source of small-value variable tuning capacitors. UHF TV tuners are another possibility and they often have a built-in vernier dial as well.

The 100-pF coupling capacitor can be any value from 50 to 250 pF and the grid-leak resistor can range from 1 to 10 megohms. Even the tube itself can be changed; a 12AU7 or 6CG7 will work as well as the 6SN7, though the base wiring and filament needs will be different. Naturally a real plug-in coil form will work as well as the spare 6SN7 I used, and any flat-sided glass octal tube will do the job as well as a 6SN7. Be careful not to use both filament pins of a tube for coil connections unless the filament is burnt out. I used #24 solid insulated wire for winding the coils. The coil ends are brought down over the outside of the tube base and soldered to the ends of the pins. A dab of cement holds the wires in place on the glass.

One big change in the circuit of Fig. 2 is that the regeneration control has been replaced by a 365-pF variable capacitor. There is a good reason for this circuit change: lower adjustment noise. The trouble with the 25k pot used in Fig. 1 is that it has dc flowing through it. Carbon pots, unlike wire-wound ones, develop contact noise when used this way and eventually sound scratchy when rotated. I used the carbon pot because wire-wound ones are hard to find, but the variable-capacitor approach is a better solution to the problem and you may want to try it.

A 1- or 2.5-mH rf choke is used in the plate circuit and an audio-interstage transformer provides coupling to the audio amplifier. The audio-input transformer used for this purpose in Fig. 1 could also be replaced with any power-supply-type choke rated at more than 10 mA and 2 H or so inductance. Also shown in Fig. 2 is an audio transformer or supply choke used as a dc feed path for the audio amplifier. This permits ac coupling to the headphones and gets them out of the dc side of the circuit. If your main interest is in CW work, you may want to add some audio selectivity by placing a capacitor across the transformer winding as shown. The resulting tuned circuit can be set to the desired audio frequency by adjusting the capacitor value on a cut-and-try basis. The actual value will depend on the inductance of the transformer you have. Try starting with 0.01 or 0.05 uf and listen for an audio peak as you tune across a CW signal. Use a larger or smaller value capacitor to lower or raise the peak frequency as necessary.

**Operation**

Getting the most out of this little receiver is going to require some practice because the controls interact more than they do on a modern superhet. Peaking the preselector control on a transceiver may change the speaker volume a little, but you don't expect it to alter the if bandwidth or receiver tuning! Basic operation of the receiver is as follows. The main tuning is set to the approximate frequency of interest and the bandwidth control to the middle of its range. The antenna-coupling link is positioned over the top of the coil and the regeneration control advanced. A "pipelip-hiss" noise in the headphones announces that the detector has started to oscillate. The control is positioned just after the oscillation starts and the receiver is tuned to a signal with the two tuning capacitors.

You will find that the sensitivity and selectivity are greatest with the regeneration set so the detector is close to the oscillation threshold. CW and SSB signals are coupled with the detector oscillating, while for AM reception the regeneration is backed down just below the threshold. Often it is easiest to find a signal with the regeneration turned a bit to one side of the critical setting. Increasing the antenna coupling brings up the headphones volume but also reduces the amount of regeneration present and changes the received frequency slightly. The regeneration setting needed to maintain oscillation will vary some with frequency as well. All of this sounds more difficult than it really is. After a little experimentation, you'll find yourself pulling in an amazing number of signals.

**Troubleshooting and Calibration**

One side benefit of this design is that there is so little to go wrong. If the receiver is built according to the schematic and with good parts, it will most likely work when turned on. If it doesn't, and a series of circuit and voltage checks indicate that everything is OK, then the problem is probably with the regeneration coil. Try reversing the connection of the link winding. If the receiver cannot be made to oscillate on the lower end of the tuning range, then slide the feedback winding closer to the main coil. The coil dimensions recommended in Fig. 2 will surely get you off to a good start but you may wish to experiment with different geometries.

Once the receiver is pulling in signals, you will want to calibrate the dials. This is easy to do with the help of another receiver since the oscillating regenerative detector generates a weak carrier on the frequency to which it is tuned. Set the calibrated receiver to a given frequency, turn up the regeneration control on the little set, then sweep its bandset knob until you hear its carrier in the other receiver. At that setting the two receivers are listening to the same frequency. I glued a paper scale behind my tuning knobs and marked the bandset-dial

![Fig. 3. Alternate schematic showing some possible circuit variations.](image-url)
position at every half megahertz. The bandspread dial was marked for the 80-
meter Novice band and the whole 40-meter band. Of course, the bandspread cal-
ibration is only accurate when the bandset knob is set properly.

Other Coils

Changing the tuning range means winding other plug-in coils. Simply use more
turns to go down in frequency and fewer to go up. On the higher bands, space out the turns so the whole coil is 1/2 to 3/4 of an inch long. The number of regeneration turns should also increase or decrease one or two, in step with the main coil change. If your main tuning capacitor has two sections, you can place jumpers across otherwise unused coil pins and wire the socket to use both capac-
itor sections on low bands and only one on the higher frequencies.

A Word of Warning

This little receiver is really a lot of fun to operate. It is cheap to build and can be thrown together in a weekend. If there are a few spare octal tubes on hand, the fre-
quency range can easily be extended in either direction. One word of caution is necessary though. The time will come when you tune across 80 meters with this set and realize that you can hear just about every signal on the band. In fact, you could actually use this little gem to make some real con-
tacts (and enjoy shaking up the ham on the other end with a description of your receiver)! After you do that several times you'll naturally start to think about one-
tube QRP transmitters. So when nosing around the local flea market for 6SN7s
take an eye out for a slightly larger power transformer, a 6AG7, some 80-meter crystals, and maybe a few old B&W plug-in coils.

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I remember when I upgraded and was operating on new and unfamiliar bands, I was constantly referring to a chart to see where the band limits were and if I was still in the phone or CW portion of the band. Before using this program, I still had to resort to that chart when I would occasionally operate on a seldom used band. Now the computer will verify the legality of my operating frequency and visually display where I am operating within that band.

Last but not least, the program provides a visual reminder to satisfy the station identification requirement and will give a flashing reminder when it is time to identify.

Written for the Radio Shack Level II TRS-80 with 16K memory, the program requires about 9K to run. Since there are no unique statements, it should readily adapt to other BASICs. The overall program is actually composed of seven different subprograms. By compartmentalizing it in this manner, the user may choose all or portions of the program to fit his particular needs or memory capability.

Program action is simple to follow. Just respond to the computer's requests and you cannot go astray. The program should be loaded and ready to use when the operator sits down for a hamming session. He will have all these capabilities at his fingertips.

Program Introduction: Statement lines 1 through 52 graphically introduce the program and ask the user to input his choice of subprograms. I have made extensive use of the INKEY$ function throughout the program. This allows faster responses and saves wasted effort by not having to use the ENTER key to input data. Safeguards have been incorporated to prevent the program from crashing if a wrong key is inadvertently hit.

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Contest Logger: This routine is the answer to the contestant's prayers. It resides from lines 300 to 338. It will ask for the callsign of the station, check memory, and, if not already logged, will tell the operator that it is a new contact and to call it. If contact is made, the call can be saved in memory for recall later. If the station was previously logged, the user will be informed so that a different station can be checked. Searching action is completed in seconds—a lot easier than trying to find a callsign in a stack of dupe sheets! Statement line 11 is initialized for 100 contacts. This can be adjusted if desired.

Q-Signals: How many times have you heard a Q-Signal used and tried to remember its meaning? Statement lines 500 through 603 provide instant recall. The user enters his own catalog of Q-Signals into DATA statements beginning on line 600. I have already inserted 23 signals. These can be altered to suit individual needs. The only program modification required is changing the DATA statements and lines 525 through 547 to support the changes made. Be sure the last DATA element is "END".

Third-Party Agreements: This program will display the list of countries with which the United States has third-party agreements. Statement lines 700 to 732 support this function. The list includes call letter prefixes. If the country is not listed, do not make that phone patch!

Station Identification: The operator can initiate this program when the QSO
and may have to be adjusted to allow for differences in machines. Line 914 controls this timing.

Frequency Check: The largest and most complex subprogram, it resides from lines 1100 to 2007. Don't let that scare you, though. If you answer all prompts and data requests when required, the computer will provide the proper response. The program is designed to give the operator the security of knowing his operation is within the band limits established for his license. This verification is supported as the program is run and then reinforced by graphically displaying the operating frequency.

The frequency program can be customized for specific requirements. For example, if you always intend to remain a General, eliminate lines 1102 through 1121 and change lines 1100 and 1122 to read:

1100CLS
1122LET C=71

This eliminates answering the class of license question each time the program is run. If your operation is confined to one band, make variable B at line 1146 the applicable value. Also, if you never use CW, make M=80 at line 1160 to establish phone-only operation (also delete lines 1156 and 1157).

As previously stated, this is a highly versatile and useful program, either piece-meal or in its entirety. I believe it contains some routines which every ham will find helpful. I hope it will take some of the paperwork out of your operation and give you more time to rag-chew!
Berserk Direction-Finding

Zero in on transmitters in seconds with this TRS-80 program. It will tell you how to get there, too.

In any radio direction finding operation, whether it be tracking a jammer or a distress signal, the time factor is important. The Radio Amateur RDF Assistant minimizes the time involved in tracking a transmitter. The program allows the operator to determine the general location of the transmitter instantly by entering the headings to the transmitter from two stations whose locations are known. The advantages of this method over the standard map, protractor, and straightedge approach are speed and accuracy. The high speed of the operation allows for comparison of headings from different stations and for quick, repeated calculations if the transmitter is moving.

Other features of the program include the giving of directions to the transmitter for field units and providing a listing of the DF committee members and repeater users, with their calls, phone numbers, and distances and directions to the transmitter, allowing the RDF net control to coordinate the efforts of the stations in reaching the transmitter site. The data for this listing is stored on tape, so the user may have different tapes for different repeaters or bands.

Instructions

After you have CLOAD-ed the program and entered RUN, the computer will ask you if you want the data tape loaded before continuing with the program. You would normally do this when stations will not be giving you bearings immediately, such as right after a jammer or ELT has appeared on frequency. If you need to determine the transmitter's location immediately and have the appropriate information, enter N and the program will continue. You may load the tape later if needed by selecting that option from the menu.

Next, the computer will ask you for the coordinates of station A. Type in the horizontal coordinate, a comma, and the vertical coordinate of the first station that you will be taking a bearing from. (This information can be found by preparing an RDF Map and a Station Data Sheet described later.) Press ENTER and the computer will then ask you the bearing that that station has on the transmitter. Type in this and press ENTER. Repeat the procedure for station B, using a second station. It should be noted that you should not enter two stations that have the same bearings or whose bearings have a difference of 180°. This will result in a divide-by-zero error. This situation is rare and even if the computer were not used the results would be meaningless. The user should simply select another station to replace one of these.

Once this has been done, the transmitter's location is printed along with directions and distances from stations A and B to the transmitter. To see the list of options available, press ENTER.

The first option is DF-Fix Calculations, which was just described. You would select this option if you want to enter a new set of headings to the transmitter. This is the only option that affects the transmitter's location. The other options only use this data to provide related information.

The second option provides directions to the transmitter for a field unit. The computer will ask you for the coordinates of the
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field unit. Enter these coordinates. The coordinates can be found by finding the field unit on the RDF Map and finding its corresponding coordinates. The computer will then display the transmitter's location and the distance and directions to the transmitter from the field unit. This information is presented in two forms to allow for different types of field units. If the field unit is a car restricted to streets, the north/south and east/west directions are more appropriate. On the other hand, if the field unit is on foot or in open country, distance and bearing information is more relevant.

The third option is the DF-Net Listing. To use this option, you must have loaded the data tape in or inserted new data (option 5.2) during the current run of the program. The computer will first ask you for a maximum report range. The computer will list only those stations which are within the number of miles you entered to the transmitter. The computer will then ask if you want only DF committee members (those with asterisks at the front of their calls) to be listed. Enter either Y or N. The computer will then list the stations on the screen. It will only show eleven stations at one time, so merely press ENTER to see the next set of eleven. After the computer has listed all of the stations that have met the given requirements, it will tell how many stations were within the given range. You must press ENTER to see the list of options.

The fourth option is to load the data tape. The computer will guide you through the process of loading the tape. The menu will be displayed after the tape has been loaded.

The fifth option allows you to modify the data tape of the DF-Net stations (callsign, phone number, and location). How to determine the station's location will be discussed later. This option has five options of its own. The first merely lists the data. This allows you to check the data and see what, if anything, needs to be changed. The number displayed on the extreme left is a record number. This is the record number you will use in options 2 and 3. Before using options 2 and 3, it is a good idea to check the listing to make sure that you select the right number. To insert a new record, first determine after which record you would like the new record inserted. If it is the first record to be inserted, insert it after 0.

The third option is the delete option. If you have a station which is no longer active or needs to be deleted for some other reason, find it on the listing (option 1) and note its record number. Then select option 3. Enter this number in response to the computer's question about which record number should be deleted. If you choose to de-
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lete a record number that does not exist, the computer will print RECORD NOT FOUND and ask you for the record number to be deleted again. If a record has some incorrect information on it, you must insert the complete correct record and then delete the incorrect one.

The fourth option will write a new data tape with all of the new changes or duplicate the old data tape if it has been loaded in and no changes have been made. To use this option, place the tape you want to put the data on in the recorder. Press the Play and Record buttons on the recorder and then press ENTER on the computer. After the data tape has been written, the computer will return to the main program and display the menu.

The fifth option simply returns you to the main program and displays the menu. You would select this in case you did not want to write a new tape or did not want to write immediately after making the changes.

RDF Map

In order to use this program, you must prepare a map with a coordinate system on it. First obtain a map of the coverage area. This map should have an appropriate scale for RDF use, that is, it should not be so small that one inch equals twenty miles. After the map has been obtained, you should determine what length on the map corresponds to a distance of one mile; for example, 0.5 inch = 1 mile. Then, starting in the left-hand corner, you should make a mark every mile along the bottom edge of the map (see Fig. 1). Do the same along the top edge, starting in the upper left-hand corner. Repeat this procedure for the sides, starting in the lower left- and right-hand corners. Next, label them, starting with 0 and going from left to right and bottom to top. The markings on the side of your map should be similar to those in Fig. 1 (different scales and more numbers of course).

After you have prepared the map, you are ready to prepare the DF-Net station data sheet (see Fig. 2). Fill in the call and phone number columns with appropriate information. The first coordinate is the number on the top or bottom of the map which corresponds to the horizontal position of the station. The second coordinate is the number on the sides of the map which corresponds to the vertical position of the station. This sheet is sufficient for using options 1 and 2 of the program.

As has been stated before, in order to use the DF-Net Listing option, you must have previously inserted stations onto the data tape using option 5.2. The option will guide you through the procedure, but a few things should be mentioned before you use the option. First, answer all of the questions the computer asks about the station. Do not leave any answer blank. If a radio direction finding station does not have a call, (e.g., a future ham or SWL), type his name (if it is six or less letters) or his initials in response to the question about the station’s callsign. If a station does not have a phone or his number is not known, type in NO PHONE or N/A in response to that question. If you would like a station to be included in a selective printout in the DF-Net Listing, put an asterisk in front of the station’s callsign. The asterisk can be used to denote a station who is part of the DF committee or to denote those who have special RDF equipment in their cars, etc.

As well as using the program to find stations, it can be used to calibrate the members’ antenna-heading indicators. To use the program for this purpose, RUN the program and load the data tape. Next, you need to insert the coordinates of the station that everyone will be aiming at. To do this, enter station A’s coordinates as follows: first coordinate of station being aimed at, 0. For the bearing, enter 0. Enter B’s coordinates as follows: 0, the second coordinate of the station being aimed at. For the bearing, enter 90. Press ENTER to get to the menu, and select the DF-Net Listing option. Answer the questions as you normally would. The number in the bearing column of the listing is the direction that each station’s heading indicator should show. This information should be relayed to each station so that he can either correct his indicator or make a note of the error and correct for it when he is tracking a station. A good station to calibrate on would be the repeater.

Fig. 1. RDF map.

Fig. 2. DF-Net station data sheet.
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You also may want to include the repeater in your DF-Net Listing so you can estimate the station's transmitter power by comparing the distance to the repeater with the signal strength into the repeater.

Technical Data

The program is divided into six subprograms (DF-fix calculations, field-unit calculations, DF-Net Listing, loading the data tape, modifying the data tape, and the menu) and one major subroutine.

Statements 5 through 12 merely initialize the program. String space (5000 bytes) is set aside and the arrays are DIMentioned to a value of 100. Statements 15 through 21 give the user the option to load the data tape before he actually starts to use the program.

The DF-fix routine (lines 39 through 113) determines the location of the transmitter from the information entered by the user. This location (G,H) is used in all of the other routines for determining the transmitter's relationship to the positions of the other stations.

Statements 40 through 60 prompt the user to input the tracking station locations and beam headings. Statement 75 converts these headings from compass bearings (0° = North, increasing in a clockwise direction) to polar bearings used by the computer. Statement 90 converts these headings from degrees to radians and takes the tangent. Statement 100 solves the simultaneous equations representing the lines from the tracking stations at the given bearings. Statement 105 rounds the results of the calculations (G,H—transmitter's coordinates) to the nearest tenth. Statement 110 passes station A's coordinates to the variables used in the calculations subroutine. The results are then printed out.

Subroutine 1900 is called to print the directions, since it is used many times. This is again done for station B in line 113. The last half of line 113 is a dummy input used to pause the program and allow the user to continue when he is ready. This is done frequently throughout the program.

The field-unit routine prompts the user to input the field-unit's coordinates, calls the calculations subroutine, and displays the results. It then jumps to the menu. This routine is straightforward in that all it does is format the input and output of the calculations subroutine.

The DF-Net Listing first checks the data flag (DF) to see if data has been loaded in (line 181). The computer then prompts the user to input different parameters for the listing (lines 185 and 190). RN is the record number and specifies which element of the array is to be read. The computer compares the record number with the total number of records (TR). When RN exceeds TR, the listing routine then summarizes the results of the listing. If the user selects the selective printout, the program then checks to see if the first character of the callsign string (DS) is an asterisk (line 215). R is the "stations within range" counter and V is a line counter for limiting the number of stations printed on the screen at one time so that the results do not go flying off the screen before they can be read.

The data tape input routine is also straightforward. DF = 1 sets the data flag. One record, D$5,E$5,X,Y, is input off the tape and stored in an array, with the subscript being incremented after each record. The computer checks D5 for the end of file indicator, END. TR is found by taking the total number of records read (RN) and decreasing it by one to remove the end-of-file indicator from the count.

The modify data tape routine has five options. The first option merely prints out the contents of the arrays. The second option (263 through 276) inserts a new record into the file. First, the user types the information in, then the computer moves all of the records after where the new one is to be inserted up one record number. The new record then is put in the hole left by the records moved.

The delete routine merely moves all of the records above the record to be deleted down one. This destroys that record by writing over it. The program checks to make sure the user does not try to delete records that do not exist.

The fourth option (283 through 289) just outputs the arrays to the tape recorder, using a similar approach to the way they are read in. The fifth option is merely a jump to the menu.

The menu is straightforward, using an ON/GOTO statement to branch. Line 326 takes care of inputs that are not covered in line 325.

The calculations subroutine calculates the distance to the transmitter (lines 2001 and 2005), bearings to the transmitter, and directions to the transmitter (lines 2006-2220). The subroutine is made up of different branches used to correct the ambiguity of the ATN function.

It is hoped that this program and the presence of a good RDF committee will reduce the amount of jamming and be a valuable tool in locating emergency locator transmitters quickly.

---

**Variable List**

- A—First coordinate of station A's location
- B—Second coordinate of station A's location
- C—Bearing to transmitter from station A
- D—First coordinate of station B's location
- E—Second coordinate of station B's location
- F—Bearing to transmitter from station B
- G—First coordinate of transmitter's location
- H—Second coordinate of transmitter's location
- L—Maximum report range
- M—DIMension of arrays
- P—Dummy variable for pausing program
- Q—Menu selection
- R—Number of stations within given radius of transmitter
- S—Horizontal distance between a station and transmitter
- T—Vertical distance between a station and transmitter
- U—Distance from transmitter
- V—Line counter in listing
- X—First coordinate of station's location when using calculation subroutine
- Y—Second coordinate of station's location when using calculation subroutine
- Z—Bearing to transmitter
- DR—Record number to be deleted
- DF—Data flag
- FR—Former record number
- NN—New number of record after being renumbered
- NR—New record number (inserted record number)
- Q1—Option selection under option 5
- RN—Record number
- TR—Total number of station records in arrays
- AS—"EAST" or "WEST"
- BS—"NORTH" or "SOUTH"
- GS—"Y" or "N" to load data tape at beginning of program
- HS—"Y" or "N" to "DF-COMMITTEE MEMBERS ONLY?"
- DS—Station's call
- ES—Station's telephone number
Food for thought.

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

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

### Group A

<table>
<thead>
<tr>
<th>Frequency</th>
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<tr>
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<td>91.5 ZZ</td>
<td>118.8 2B</td>
<td>156.7 5A</td>
</tr>
<tr>
<td>71.9 XA</td>
<td>94.8 2A</td>
<td>123.0 3Z</td>
<td>162.2 5B</td>
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<td>74.4 WA</td>
<td>97.4 2B</td>
<td>127.3 3A</td>
<td>167.9 6Z</td>
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<td>77.0 XB</td>
<td>100.0 1Z</td>
<td>131.8 3B</td>
<td>173.8 6A</td>
</tr>
<tr>
<td>79.7 SP</td>
<td>103.5 1A</td>
<td>136.5 4Z</td>
<td>179.9 6B</td>
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<td>82.5 YZ</td>
<td>107.2 1B</td>
<td>141.3 4A</td>
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<td>85.4 YA</td>
<td>110.9 22</td>
<td>146.2 4B</td>
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<td>88.5 YB</td>
<td>114.8 2A</td>
<td>151.4 5Z</td>
<td>203.5 8A</td>
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</tbody>
</table>

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

### Group B

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<td>1750</td>
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<tr>
<td>2805</td>
<td></td>
<td></td>
<td>2000</td>
</tr>
</tbody>
</table>

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

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A man's home may be his castle, but have you tried to install a 6-element, 20-meter beam on a parapet lately? Most homes built or renovated today are not conducive to installing an amateur radio station.

The problem of what to do with the radio equipment confronted me when my wife and I opted to have a new home built in a semi-rural area. In our old home on a suburban lot, it had been make-do in a third bedroom with the attendant problems of running antenna feedlines, supplying adequate electrical power, and establishing decent grounds for the equipment.

My solutions will not necessarily be your solutions, but variations of these ideas may help you in solving your installation problems. Funds were a consideration—the overall objective was, after all, to build the house! But when it was all done, I wound up with a fair amount of operating room, all the electrical power I needed, and a TVI-free environment for less than two percent of the total cost of the house and property.

Review the Plans

Once you have selected the location (no zoning restrictions on towers, right?) and a builder, look over the plans carefully to determine options for the radio room.

In our case, the locale dictated no basement because of the water table. We chose an L-shaped ranch on a slab of concrete. The options were to put the equipment into a bedroom or in the back of the garage. Neither option was desirable.

The solution was relatively simple. The garage was on one end of the house on the long side of the L. We had the builder expand the long side of the L by adding a 6-foot-wide room between the living area and the garage and adding one wall and door. See Fig. 1.

The additional room provided space for the amateur radio equipment, enabled my wife to get the washer-dryer out of an interior closet in the living area, and gave us a mudroom in which to leave boots, raincoats, and other items that should not be trailed across carpeting.

In solving your installation problem, factors to consider would be (1) accessibility to the back yard (or the side yard) for antennas, with a minimum feedline run, (2) keeping the station away from the sleeping areas of the house so that...
late night and early morning DXing sessions don't disturb the rest of the family, (3) keeping the family TV antenna, TV, and audio equipment apart from the radio equipment, and (4) the location of overhead power lines coming into the house.

If you opt to expand the house or add an addition to solve the location problem of your equipment, you can hold costs down by doing it in such a way that no new corners are created, needing additional forms for concrete and framing. For example, it would have been more costly for us to tack a room on to the back of the garage, extending that by 10 feet or so. Additional costs would have been incurred for laying forms around two additional corners, a redesign of the roof and supporting rafters in that part of the house, and a reconfiguration of the heating and cooling systems; considerably more concrete, lumber, and siding would have been needed.

**Antenna Feedthroughs**

Because space for antennas was available in the back yard, I agreed not to punch holes in the sides or roof of the new house and to see that everything was put in the back and out of sight.

Before the slab was poured, I had the builder lay down 4-inch PVC pipe extending from beyond the foundation of the house to the rear of the proposed station operating area. A 90° elbow and a short section of pipe at the desk end put that end above the floor level. The poured concrete anchored the 10-foot sections; a board temporarily capped the end outside the house.

Later, I purchased additional sections of PVC pipe and extended the run further into the backyard, bringing it above ground beyond the normal traffic patterns and behind some ground cover. Two 90° elbows are needed so that rain and snow do not enter the pipe. See Fig. 2.

In retrospect, I probably should have put two runs of PVC pipe into the shack area. While one handles a number of RG-8 and RG-8X and control cables, hardline takes up a lot of room in a hurry.

Factors to consider in planning your own installation include (1) keeping runs of PVC pipe as straight as possible to minimize difficulties in routing cable, (2) leaving a "pull" rope in the pipe so that cable can be fed through from either end at any time (and don't forget to anchor it so that it's not accidentally pulled into the pipe beyond your reach), and (3) consideration of how many antennas and types of feedlines will be installed in the coming years.

Variations on the theme of using PVC pipe to route cable might include using PVC pipe inside the house to route cable to an exterior wall. Place the pipe inside the walls before the sheetrock is hung. Depending upon the design of the house, you may choose to route the pipe and cable to the attic from an interior first- or second-floor room chosen as the "shack," or route it to the basement or the garage before entering the underground run to the antenna tower.

Another variation, for those setting up the operating station in a basement or family room below ground level, would be to bring the PVC through the exterior wall to a point flush with the inside wall. Make up an appropriate bulkhead with connectors and label the lines. In times of electrical storms, shorting plugs can be put on each of the antenna feedthroughs and grounded through the ground attached to the bulkhead plate.

**Grounds**

At the same time that the PVC pipe was laid for the antenna cable runs and before the floor was poured, I installed 10-foot, ¾-inch ground rods at the rear of the area where the operating desk was to be placed. I left them about 8 inches above the finished floor.

That simple move has paid off handsomely in the reduction of in-house TVI and RFI on the operating desk compared with what I had been used to in the previous house. Ground leads are a maximum of 3 feet now.

In your installation, consider the shortest run possible. If you are setting up in an interior room, drop the ground leads through the walls directly to the basement. Use ground rods as long as possible: those 4-foot lengths just won't do the job. Run heavy wire. #4 would be fine. As the heavier wire is a bit difficult to work with, consider tying the heavy ground lead to a heavy-gauge metal plate that has been drilled and tapped with 3/8- or 1/2-inch bolts and place that behind the operating desk. The individual ground leads from the several pieces of equipment can be terminated with spade lugs and bolted to the plate.

**Electrical**

Before the wall between the added utility room/ham shack and the garage was closed, I had an electrician wire a separate electrical panel for the radio equipment. At the main electrical panel in the garage, a 70-Amp circuit breaker was installed. A three-wire line was run into the shack wall; another panel was installed with a 70-Amp main circuit breaker, and separate circuit breakers were installed to provide 220 and 110 V ac to a number of outlets.

Perhaps this was overkill, but the family members have instructions on how to turn off either main breaker in case of an emergency. Everything goes down when

---

**Photo B.** The PVC pipe comes up under the operating desk. One of the two ground rods is visible on the right.

---

**Fig. 1.** Before (top) and after (bottom) adjustments to original house plan.
that switch is thrown. (That panel is low enough for even my youngster to reach.)

Plan your needs carefully. I had eight 110 V ac outlets installed, and still I ran out. Also consider height and placement of the outlets. Don't install outlets at tabletop height if the surface of the operating area runs wall-to-wall; put them above or below the tabletop.

Odds and Ends

Some other planning-ahead activities to consider as the house is framed and before the sheetrock is hung are all based around pre-wiring the house for a variety of items.

Don't forget to get the telephone installer at work before the sheetrock goes on. The job is a lot easier and cleaner. Run a telephone line into the shack, and consider having the house wired for two (or more) telephone lines. If you change your mind at the time the installer returns to fish out the lines to telephone jacks, there is no problem reverting to one line. There is no charge for pre-wiring the framed house.

Want to install a burglar alarm system? A wired perimeter system tends to be the cheapest, and it's easy to do yourself. Supplies can be acquired from a number of wholesale and retail outlets. Pick the system best for you; it may be easiest to install before the walls are closed. Don't forget about electrical power to the system (most systems also have a battery backup).

Also consider pre-wiring for your stereo system. It's a lot easier to run speaker leads in the walls and over ceilings than under rugs or behind wall moldings. Use some larger-size electrical zip cord, such as #12 or #14, rather than the light stuff.

Plan ahead for the day when you upgrade to a larger, more powerful amplifier and have speakers in other areas of the house. You can always leave the wires in the walls until you actually have speakers in hand.

An intercom system is also very easy to put in before the walls are closed. Plan ahead. (It's your choice to put one in the shack so that you can be called to do chores in the middle of a contest!)

Be sure to install 75-Ohm coaxial cable for the household TV and FM antenna system before closing the walls. Consider the placement of the antennas with respect to the ham equipment when routing the cable. I opted to install an antenna to take care of both the TV and the FM stereo receiver under the roof of the house, rather than outside, and hung it in the end of the house away from the shack. Plan ahead if you want multiple outlets for multiple TV sets, and don't forget an electrical source for a distribution amplifier if your plans require one. Using shielded cable and picking the right spot for your TV/FM antenna(s) will go a long way to eliminating in-house TVI.

I also took advantage of the open walls to install a coaxial cable which was later hooked up to an attic-mounted scanner antenna and a scanner in the family room; my wife and I eavesdrop on one or two police and fire frequencies, some remote broadcast stuff, and one or two 2-meter frequencies.

In Closing

The building of a new home or of a major addition to an existing home is a massive undertaking. Attention has to be given to everything, and the smallest detail has to be reviewed on a continuing basis. If you tell the builder before he begins that you want to install certain wires and pipes for the amateur radio station, there shouldn't be any problems. In my case, the builder gave me a schedule of construction and permission to come in to install the ground rods and the pre-wiring described above; he placed the PVC pipe for me, and the electrician came after I took title to the house.

Keep receipts on everything you purchase and install. That's all part of your tax records for calculating the adjusted cost of the house and the improvements, depending upon the dates involved.

Some of the ideas described above are not necessarily new or original, but they are intended as food for thought. Your needs are different from mine, but if I have reminded you to think about a particular installation problem before you begin a project, then I have been successful. Good luck in your building.
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<tr>
<th>IMPORTANT KEYER AND/OR TRAINER FEATURES</th>
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travel through glass having a dielectric constant of 5, the distance it would move during the time period of one wavelength would be much shorter. In fact, one wavelength would be only 44.72% of the equivalent length in space. When converted to a decimal figure, 4472, this dielectric correction is the “velocity factor” (VF) of the glass. It is equal to the reciprocal of the square root of the dielectric constant or $VF = \frac{1}{\sqrt{5}} = 1/2.236 = .4472$. This formula describes the mathematical relationship between “dielectric constant” and “velocity factor.”

So, what can we do with dielectric constants or velocity factors? Actually, I can think of very few occasions when changing the dielectric in a capacitor would be necessary, desirable, or feasible. It would be fairly easy, though, to make a low-capacity variable capacitor by using two pieces of aluminum and to insert a variable amount of a plastic dielectric via a shaft and a dial system.

The velocity factor, though, is a much used and occasionally misused factor.

All of the coaxial and parallel-wire feedlines using solid dielectrics are characterized by higher losses than found in equivalent air-insulated lines and by having velocity factors of less than 1. These velocity factors mean that radio waves are propagated along these lines at velocities less than in free space. When the electrical length of the feedline to be used is critical, the velocity factor must be considered in calculating the physical length. If you wanted an electrical length of 1/2λ and the velocity factor was 80, then the desired formula for the physical length in feet would be: $1/2\lambda = (492 \times 80)\text{frequency (MHz)}$.

The velocity factors for some common coaxial feedlines range from .80 for polyethylene foam dielectrics to .66 for solid polyethylene. Some 300-Ohm parallel-conductor feedlines using a solid dielectric of polyethylene have a velocity factor of about .82. Why should that be? Fig. 1(a) shows a cross-sectional view of a piece of 300-Ohm line. The oval represents the solid dielectric and the dots represent the conductors. The arrowed lines represent an instantaneous electric field that might exist at a given moment in time. The fact that a portion of this field exists outside the solid dielectric is the reason that the 300-Ohm line velocity factor of about .82 lies between the .66 factor of solid polyethylene and the value of 1.0 for air. This also explains the sensitivity of oval 300-Ohm line to external influences such as rain, snow, and ice, or to the proximity of metallic objects.

Fig. 1(b) shows the cross section of a 100%-shielded coaxial cable. In this case, the electric field is wholly contained within the shield, and surrounding influences are minimal. That's why coaxial cable can be taped to your tower, run along gutters, or even buried with little observable effect upon its performance.

The velocity factor is used to determine the physical length of the line whenever a particular electrical length of feedline is required, and when in the feedline's use an electric field will exist between the feedline conductors as a result of current flow along the conductors. Fig. 2 shows some of the typical cases wherein the velocity factor would be used in calculating the physical length of the required feedline. In Fig. 2(a), a feedline 1/2λ long is used so that the impedance at the center of the antenna will be repeated at the ground end for easy impedance measurements.

The desired physical length of a 1/2λ line would be the free-space length times the velocity factor, or $1/2\lambda \text{ (ft.)} = (492 \times \text{VF})\text{frequency (MHz)}$. In this case, the line could be made any whole number multiple of the correct length if a single 1/2λ wasn't long enough.

Fig. 2(b) shows a 4:1 coaxial balun connected to a folded dipole radiator. The length of the 1/2λ U-shaped piece of coax is calculated with VF. Fig. 2(c) shows broadside radiating elements, each fed through a gamma match. Any equal lengths of cable could be used for pieces X and Y to satisfy the phasing requirements of the broadside array. The 3/4λ sections, however, also serve as impedance transformers between the radiators and the feedline junction. The physical length of the 3/4λ lines should be computed with the VF.

Fig. 2(d) shows a 1/4λ section of coaxial cable used as an rf choke. The shorted end of the 1/4λ section is transformed into a very high impedance at its connection point to the coaxial feedline. It has no effect upon the feedline as far as the operating frequency is concerned, but it keeps both sides of the coax at ground potential for dc or lightning protection. In addition, the 1/4λ section will act as a dead short across the coaxial cable at the second harmonic!

Fig. 2(e) shows 1/4λ ver-
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tional antennas spaced 1/2λ apart and fed 180° out of phase through a 1/2λ line to achieve a figure-eight radiation pattern. Fig. 2(f) shows similar antennas spaced 1/4λ apart and fed 90° out of phase to produce a unidirectional pattern. The velocity factor would apply to these phasing lines. Please note that Figs. 2(e) and (f) are just basic representations of an antenna system and not a practical arrangement.

How could you make a 1/2λ of coax (free space 1/2λ x VF) stretch between two verticals spaced a 1/2λ (free-space value) apart? It would be impossible unless you used an air-dielectric coax and then, of course, its proper length would be equal to the antenna spacing.

The proper phasing with solid-dielectric coax can be achieved as shown in Fig. 2(g). Dimension X is any convenient length of coax. The 1/2λ portion is computed with the VF. While this feedline system provides the proper phasing, it doesn’t provide the necessary impedance matching. The same scheme could be used to provide the correct phasing for Fig. 2(f), but then the lines would be X and X + 1/4λ.

Fig. 3 shows some cases where the velocity factor is not used in determining the physical length of solid-dielectric cables. In Fig. 3(a), a 1/4λ of coaxial cable is paired with a portion of the feedline to act as a decoupling stub or balun. Its length is approximately equal to the free-space length of a 1/4λ. The VF of the coax does not apply because no electric field exists between the inner conductor and the shield of the 1/4λ of coax. In fact, the inner conductor could be cut off flush with the dielectric, or even removed, as it has no function in this application other than to provide increased physical rigidity. In Fig. 3(b), line segments X and Y could be of any equal lengths and still provide the correct phasing for the broadside array. VF does not apply because a particular electrical length of feedline is not required.

The effects of velocity factor/dielectric constant in places other than feedlines can sometimes be important to the correct functioning of antennas or resonant circuits. For example, a coaxial version of a “J” antenna is shown in Fig. 4. The lower 1/4λ could be an air-insulated high-Q resonant section which matches the high end impedance of the 1/2λ radiator to the coaxial feedline.

This is a good, simple antenna for VHF. If it were to be built, though, you might be tempted to fill the lower 1/4λ section with plastic potting compound for improved physical rigidity or to minimize the effects of weather. Any dielectric added, however, would change the electrical length of the section, thereby detuning the system. A better approach would be to use the velocity factor of the plastic filler beforehand to determine the correct length of a plasticized 1/4λ section.

Why have I persisted in using the free-space formulas times the velocity factor to compute specific physical lengths? What’s wrong with the old, tried and true formula, 468/frequency (MHz), to find the length of a 1/2λ? The reason is that antenna design is influenced by something called “end effect.” This necessitates just about a 5% reduction of the free-space lengths when calculating the physical length of wire antennas. This phenomenon does not occur in transmission lines, so for these applications we just have to adjust the free-space figures with the velocity factor.

There is no doubt that coaxial cable is the most-used amateur feedline today. Its ease of use more than compensates for its small losses. If you need a critical electrical length, however, don’t forget to use the velocity factor established by the cable manufacturer.
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HAL COMMUNICATIONS

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The DS3100ASR Terminal and ST6000 Demodulator are the choice of professional RTTY operators the world over. Some of the advanced features offered by this equipment are:

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Here’s a simple, one-evening project that has proved to be very worthwhile. The end result is an instant portable soldering iron that is heavy enough for most soldering jobs short of antenna and chassis work. Since the tip can be changed from high to low power, the battery life may be extended when only light duty work is involved.

A 6-1/2” × 2” × 1-5/8” box neatly holds the parts, which consist of two size D nicads, two barrier strips, an on/off switch, a pilot lamp, a replacement soldering gun tip, and a diode to facilitate recharging the batteries. The pilot lamp is a #222 (2.25 V, 0.25 A).

Do use the lamp, as it is a very practical visual voltmeter and will give an indication as to when the battery needs a recharge. The tip still will get hot even if one of the cells is run down, and that can lead to deep discharge of the cell. Besides that, the lamp helps you to see where the solder is supposed to go inside of those dark and mysterious projects. (With 3.5-Ah cells and the tip removed, the thing makes an excellent 14-hour emergency flashlight.)

Without a doubt, there are better ways than the one shown to secure the tip, but this method is adequate and allows the business end of the instrument to get into tight places. If you wish to duplicate this mess, use a convenient length of #12 wire. The two-inch length shown has a voltage drop of about 10 millivolts per leg.

The heavy-duty tip, Wahl #7546, draws 8.5 A at 2.5 volts. The regular tip draws 6.5 A. With that kind of current, it is no surprise to find less than 2.5 V at the tip. The measured voltage is close to 2.1. The batteries fell to 2.25 volts.

With that kind of current, the on/off switch must be a heavy-duty type. The least expensive on/off switch that I could get happened to be a push-on/push-off type. Since the iron stands by itself, this allows both hands to be used for bringing the work to the iron—which is often the most convenient way to do it. With the lamp glowing and the point smoking, you are not likely to go off and leave the thing turned on.

A quick word concerning the batteries is now in order. With 1.2-Ah size D cells, expect about 8 minutes operating time. Allowing 10 seconds to reach operating temperature and another 10 seconds to make the connection, that would figure out to be about 25 connections (that’s the high-power tip). With 3.5-Ah batteries, the arithmetic says to expect about 73 connections. The lighter tip should give about 23% more operating time.

The batteries may be recharged by means of a suitable current source connected to the second barrier strip. The battery manufacturers normally state on the battery how much current should be used and for how long. The diode is included to ensure that the current is not fed in backwards.

Since this is a cordless iron, there is no cord to use for storing solder. (You do keep a chunk of solder on your regular iron handle or cord, don’t you?) The way the solder is stored here ensures an adequate supply and is almost self-feeding.

All of the parts for this project, except the batteries, were purchased new! (Don’t faint!) The heavy-duty 3-4 Ah nicads are quite expensive if purchased from the regular wholesale outlets, so try to get them from one of the surplus sources.

The unit has proved itself after many hours of reliable operation.
TS-930S

Superior dynamic range, auto. antenna tuner, QSK, dual NB, 2 VFO's, general coverage receiver.

The TS-930S is a superlative, high performance, all solid state, HF transceiver keyed to the exacting requirements of the DX and contest operator. It covers all Amateur bands from 160 through 10 meters, and incorporates a 150 kHz to 30 MHz general coverage receiver having an excellent dynamic range. Among its other important features are, SSB slope tuning, CW VBT, IF notch filter, CW pitch control, dual digital VFO's, CW full break-in, automatic antenna tuner, and a higher voltage operated solid state final amplifier. It is available with or without the AT-930 automatic antenna tuner built-in.

**TS-930S FEATURES:**

- **160-10 Meters, with 150 kHz-30 MHz general coverage receiver.** Covers all Amateur frequencies from 160-10 meters, including new WARC bands on SSB, CW, FSK, and AM. Features 150 kHz-30 MHz general coverage receiver. Separate Amateur band access keys allow speedy band selection. UP/DOWN bandswitch in 1-MHz steps. A new, innovative, quadruple "UP" conversion, digital PLL synthesized circuit provides superior frequency accuracy and stability, plus greatly enhanced selectivity.

- **Excellent receiver dynamic range:** Receiver two-tone dynamic range, 100 dB typical (20 meters, 50-kHz spacing, 500 Hz CW bandwidth, at sensitivity of 0.25 μV, S/N 10 dB), provides the ultimate in rejection of AM distortion.

- **All solid state, 28 volt operational amplifier.** The final amplifier operates on 28 VDC for lowest distortion. Power input rated at 250 W on SSB, CW, and FSK, and at 80 W on AM. Final amplifier protection circuits with cooling fan. SWR-Power meter built-in.

- **CW full break-in:** CW full break-in circuit uses CMOS logic IC plus reed relay for smooth, quiet operation. Switchable to semi-break-in.

- **Automatic antenna tuner, built-in.** Covers Amateur bands 80-10 meters, including the new WARC bands. Tuning range automatically pre-selected with band selection to minimize tuning time. "AUTO-THRU" switch on front panel.

- **Dual digital VFO's.** 10-Hz step dual digital VFO's include band information. Each VFO tunes continuously from band to band. A large, heavy, flywheel type knob is used for improved tuning ease. T.F. Set switch allows fast transmit frequency setting for split frequency operations. A-B switch for equalizing one VFO frequency to the other. VFO "Lock" switch provided. RIT control for ±9.9 kHz.

- **Eight memory channels.** Stores both frequency and band information. VFO-MEMO switch allows use of each memory as an independent VFO (the original memory frequency can be recalled at will, giving a fixed frequency). Internal Battery memory back-up, estimated 1 year life. (Batteries not Kenwood supplied.)

- **Dual mode noise blanker ("pulse" or "woodpecker").** NB-1, with threshold control, for pulse-type noise. NB-2 for longer duration "woodpecker" type noise.

- **SSB IF slope tuning.** Allows independent adjustment of the low and/or high frequency slope of the IF passband, for best interference rejection. HIGH/LOW cut control rotation not affected by selecting USB or LSB modes.

- **CW VBT and pitch controls.** CW Variable Bandwidth Tuning control tunes out interfering signals. CW pitch controls shifts IF passband and simultaneously changes the pitch of the beat frequency. A "Narrow/Width" filter selector switch is provided.

- **IF notch filter.** 100 kHz IF notch circuit gives deep, sharp notch, better than -40 dB.

- **Audio filter built-in.** Tuneable, peak-type audio filter for CW.

- **AC power supply built-in.** 120, 220, or 240 VAC. switch selected (operates on AC only).

- **Fluorescent tube digital display.** Six digit readout to 100 Hz (10 Hz modifiable), plus digitalized sub-scale with 20-kHz steps. Separate two digit indication of RIT frequency shift. In CW mode, display indicates the actual carrier frequency of received as well as transmitted signals.

- **RF speech processor.** RF clipper type processor provides higher average "talk-power", improved intelligibility.

- **One year limited warranty on parts and labor.**

- **Other features:** SSB monitor circuit. 3 step RF attenuator. VOX, and 100-kHz marker.

- **Optional accessories:**
  - AT-930 automatic antenna tuner.
  - SP-930 external speaker with selectable audio filters.
  - YK-88C-1 (500 Hz) CW plug-in filter for 455-kHz IF.
  - YK-88A-1 (500 Hz) CW plug-in filter for 8.83-MHz IF.

More information on the TS-930S is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.
The TS-830S has every conceivable operating feature built-in for 160-10 meters (including the three new bands). It combines a high dynamic range with variable bandwidth tuning (VBT), IF shift, and an IF notch filter, as well as very sharp filters in the 455-kHz second IF.

**TS-830S FEATURES:**
- LSB, USB, and CW on 160-10 meters, including the new 10, 18, and 24 MHz bands.
- Receives WWV on 10 MHz.
- Variable bandwidth tuning (VBT) for increased talk power.
- Notch filter high-Q active circuit in 455-kHz second IF.
- IF shift (passband tuning).
- Noise-blanker threshold level control.

**Optional accessories:**
- SP-230 external speaker.
- VFO-230 external digital VFO with five memories, digital display.
- VFO-240 external analog VFO.
- AT-230 antenna tuner.
- YK-88C (500 Hz) or YK-455CN (250 Hz) CW filter for 455 kHz IF.
- YK-88C (500 Hz) or YK-88CN (270 Hz) CW filter for 8.83 MHz IF.
- KB-1 deluxe heavy-weight knob.

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The TS-530S covers 160-10 meters using the latest, most advanced circuit technology, yet at an affordable price.

**TS-530S FEATURES:**
- LSB, USB, and CW on 160-10 meters, all amateur frequencies, including new 10, 18, and 24 MHz bands.
- Receives WWV on 10 MHz.
- IF shift tunes out interfering signals.

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The TS-660 “QUAD BANDER” covers 6, 10, 12, 15 meters.

**Optional accessories:**
- PS-20 power supply
- VOX-4 speech processor/VOX
- SP-120 External speaker
- MB-100 Mobile mount
- YK-88C, YK-88CN CW filters
- YK-88A AM filter.
R-600

"Now hear this"...digital display, easy tuning

The R-600 is an affordably priced, high performance general coverage communications receiver covering 150 kHz to 30 MHz in 30 bands. Use of PLL synthesized circuitry provides maximum ease of operation.

R-600 FEATURES:
- 150 kHz to 30 MHz continuous coverage, AM, SSB, or CW.
- 30 bands, each 1 MHz wide, for easier tuning.
- Five digit frequency display, with 1 kHz resolution.
- 6 kHz IF filter for AM (wide), and 2.7 kHz filter for SSB, CW, and AM (narrow).
- Up-conversion PLL circuit, for improved sensitivity, selectivity, and stability.
- Communications type noise blanker eliminates "pulse-type" noise.
- RF Attenuator allows 20 dB attenuation of strong signals.
- Tone control. Front mounted speaker.
- "S" meter, with 1 to 5 SINO "S" scale, plus standard scale.
- Coaxial and wire antenna terminals.
- 100, 120, 220, and 240 VAC, 50/60 Hz. Selector switch on rear panel.
- Optional 13.8 VDC operation, using DCK-1 cable kit.
- Other features include carrying handle, headphone jack, and record jack.

Optional accessories for R-600 and R-1000:
- DCK-1 DC Cable kit.
- SP-100 External Speaker.
- HS-6, HS-5, HS-4 Headphones.
- HC-10 Digital World Clock.

TS-130SE

"Small talk"...IF shift, Processor, N/W switch, affordable.

A compact, all solid-state HF SSB/CW transceiver for mobile or fixed base station, covering 3.5 to 29.7 MHz.

TS-130SE FEATURES:
- 80-10 meters including the new 10, 18, and 24 MHz bands. Receives WWV on 10 MHz.
- TS-130SE runs 200 W PEP/160 W DC input on 80-15 meters, 160 W PEP/140 W DC on 12 and 10 meters. TS-130V version at 25 W PEP/20 W DC, all bands, also available.
- Digital display, built-in.
- IF shift circuit.
- Speech Processor, built in.
- Narrow/wide filter selection on CW and SSB with optional filters.
- Automatic SSB mode selection (LSB on 40 meters and below, USB on 30 meters and up). SSB reverse switch provided.
- RF attenuator, built-in.
- Effective noise blanker.
- Final amplifier protection circuit assures maximum reliability. Output power is reduced if abnormal operating conditions occur. For very severe operations, optional cooling fan, FA-4, is available.
- Dimensions: 3-3/4 H x 9-1/2 W x 11-9/16 D (inches). Weight: 12.3 lbs.
- Other features: VOX, CW semi-break-in with sidetone, one fixed channel, and 25 kHz marker.

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R-1000

High performance, easy tuning, digital display

The R-1000 high performance communications receiver covers 200 kHz to 30 MHz in 30 bands. An up-conversion PLL synthesized circuit provides improved sensitivity, selectivity, and stability.

R-1000 FEATURES:
- Covers 200 kHz to 30 MHz.
- 30 bands, each 1 MHz wide.
- Five-digit frequency display with 1-kHz resolution and analog dial with precise gear dial mechanism.
- Built-in 12-hour quartz digital clock/timer.
- RF step attenuator.
- Three IF filters for optimum AM, SSB, CW.
- Effective noise blanker. Tone control.
- Built-in 4-inch speaker. Dimmer switch.
- Wire and coax antenna terminals.
- Voltage selector for 100, 120, 220, and 240 VAC. Operates on 13.8 VDC with optional DCK-1 kit.

Optional accessories:
- PS-30 matching power supply (TS-130SE).
- KPS-21 power supply (TS-130SE).
- PS-20 power supply (TS-130V).
- SP-120 external speaker.
- VFO-120 remote VFO.
- FA-4 fan unit (TS-130SE).
- YK-88C (500 Hz) and YK-88CN (270 Hz) CW filters.
- YK-88SN (8 kHz) narrow SSB filter.
- AT-130 antenna tuner.
- MB-100 mobile mounting bracket.
**TR-2500**

**Size, smaller price!**

The TR-2500 is a compact 2 meter FM handheld transceiver with every conceivable operating feature.

**TR-2500 Features:**
- Weighs 540 g, (1.2 lbs), 66 (2.5/8) W x 168 (6.5/6) H x 40 (1.5/8) D, mm (inches).
- LCD digital frequency readout.
- Ten memories includes "MO" for non-standard split repeaters.
- Lithium battery memory back-up, built-in, (est. 5 year life).
- Memory scan.
- Programmable automatic band scan, and upper/lower scan limits, 5-kHz steps or larger.
- Repeater: reverse operation.
- 2.5 W or 300 mW RF output.
- Built-in tunable (with variable resistor) sub-tone encoder.
- Built-in, 6-key autopatch encoder.
- Slide-lock battery pack.
- Keyboard frequency selection.
- Covers 143.900 to 148.995 MHz.

**TR-7950/7930**

**Big LCD, Big 45 W, Big 21 memories, Compact.**

Outstanding features providing maximum ease of operation include a large, easy-to-read LCD display, 21 multi-function memories, a choice of 45 watts (TR-7950) or 25 watts (TR-7930), and the use of microprocessor technology throughout.

**TR-7950/TR-7930 Features:**
- New, large, easy-to-read LCD digital display. Easy to read in direct sunlight or dark (back-lit).
- Displays TX/RX frequencies, memory channel, repeater offset, sub-tone number, scan, and memory scan lock-out.
- Lithium battery memory back-up. (Est. 5 yr. life.)
- 45 watts or 25 watts output. HI/LOW power switch for reduction to 5 watts.
- Automatic offset. Pre-programmed for simplex or ±600 kHz offset, in accordance with the 2 meter band plan. "OS" key for manual change in offset.
- Programmable priority alert. May be programmed in any memory.
- Programmable memory scan lock-out. Skips selected memory channels during scan.
- Programmable band scan width.
- Center stop circuit for band scan, with indicator.
- Scan resume selectable. Selectable automatic time resume scan, or carrier operated resume scan.
- Scan start/stop from up/down microphone.

**Optional accessories:**
- Programmable three sub-tone channels with optional TU-79 unit (encoder).  
- Built-in 16-key autopatch encoder, with monitor (Audible tones).  
- Front panel keyboard control.  
- Covers 142.000-148.995 MHz in 5-kHz steps.  
- Repeater reverse switch. (Locking)  
- "Beep" amplified through speaker.  
- Compact lightweight design.

**Optional accessories:**
- TU-79 three frequency tone unit.  
- KPS12 fixed-station power supply for TR-7900.  
- KPS7A fixed-station power supply for TR-7930.  
- SP-40 compact mobile speaker.
The TR-9130 is a powerful, yet compact, 25 watt FM/USB/LSB/CW transceiver. Available with a 16-key autopatch UP/DOWN microphone (MC-46), or a basic UP/DOWN microphone.

**TR-9130 FEATURES:**
- 25 Watts RF output on all modes, (FM/SSB/CW, FM/USB/LSB/CW all mode).
- Six memories, 16 for simplex or ±600 kHz offset, using OFFSET switch. Memory 6 for non-standard offset. All six memories may be simplex, any mode.
- Memory scan.
- Internal battery memory back-up, using 9 V NiCd battery, (not KENWOOD supplied). Memories are retained approx. 24 hours, adequate for the typical move from base to mobile. External back-up terminal on the rear.
- Automatic band scan.
- Dual digital VFO's.
- Transmit frequency tuning for OSCAR operations.
- Squelch circuit for FM/SSB/CW.
- Repeater reverse switch.
- Tone switch.
- CW semi break-in; sidetone.
- Compact size and lightweight.
- Covers 143.9 to 148.9995 MHz.
- High performance noise blanker.

**TR-7730**
Dyna-"mite"... miniaturized, 5 memories, memory/ band scan.

The TR-7730 is an incredibly compact, reasonably priced, 25 watt, 2 meter FM mobile transceiver, with five memories, memory scan, automatic band scan, plus other convenient operating features. It is available with a 16-key autopatch UP/DOWN microphone, (MC-46), or with a basic UP/DOWN microphone.

**TR-7730 FEATURES:**
- Dimensions: 5-3/4 W x 2 H x 7-3/4 D, inches. Weighs 3.3 lbs.
- Extended frequency coverage, 143.900-148.995 MHz, in 5 or 10-kHz steps.
- 25 watts RF output power, with HI/LOW power switch.
- Five memories, Simplex or repeater operation, with transmit offset switch. The 5th memory stores receive and transmit frequencies independently, for non-standard splits. Memory back-up terminal on rear panel.
- Memory scan, plus automatic band scan. Locks on busy channel, resumes when signals disappear, or when scan switch is pressed. Scan HOLD or PTT switch on microphone cancels scan.
- UP/DOWN manual scan on microphone, either version.
- Four digit LED frequency display.
- S/RF bar meter, LED indicators for BUSY, ON-AIR, REPEATER operation.
- Tone switch for internal tone encoder (not Kenwood supplied).
- Offset switch ±600 kHz, or simplex. Fifth memory for non-standard offset.

**Optional Accessories:**
- MC-46 16-key autopatch UP/DOWN microphone.
- SP-40 Compact mobile speaker.
- KPS-7A Fixed station power supply.
- KPS-7A AC power supply.
- KPS-7A Fixed station power supply.
- BO-9A system base with memory back-up supply.
- SP-120 external speaker.
- TK-1 AC adapter for memory back-up.

**TR-8400**
Synthesized 70-cm FM mobile rig

- Covers 430-440 MHz, in steps of 100 kHz, 1 kHz, 5 kHz, 25 kHz or 1 MHz.
- CW-FM Hi-10 W, Low-1 W. SSB 10 W.
- Automatic band/memory scan. Search of selected 10-kHz segments on SSB/CW.
- 5 memory channels.
- HI/LOW power switch. 25 or 5 watts on FM or CW.
- RF gain control. RIT circuit.

**Optional Accessories:**
- PS-20 AC power supply (TR-8400 only).
- BO-9A system base with memory back-up supply.

**TRIO-KENWOOD COMMUNICATIONS**
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**SM-220 FEATURES:**
- Monitors transmitted SSB and CW waveforms from 1.8 to 150 MHz.
- Monitors signal waveforms in receiver's IF stage.
- Functions as high-sensitivity, wide-frequency-range (up to 10 MHz) oscilloscope.
- Tests linearity of linear amplifiers (provides trapezoid pattern).
- Allows observation of RTTY tuning points (cross pattern).
- Built-in two-tone (1000 Hz and 1575 Hz) generator.
- Expandable to pan-display capability for observing the number and amplitude of stations within a switchable ±20 kHz/±100 kHz bandwidth.

**Optional accessories:**
- BS-5 pan-display module for TS-520 Series.

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**ACCESSORIES**

A wide selection of optional accessories is offered for optimum operating flexibility. In addition to the optional items listed with each piece of equipment described in this catalog, the following accessories are also available:

- **PC-1A Phone Patch**
  - PC-1A Phone Patch with hybrid circuit and VU meter for null and audio gain measurements.

- **BM-9A System Base** (for TR-9130, TR-9500: TR-9000).
  - With memory backup supply, speaker sound port, ST-BY switch, power switch, headphone jack.

- **DM-81 Dip Meter**
  - The DM-81 dip meter is highly accurate and features, in addition to the traditional inductive-coupling technique, capacitive coupling for measuring metal-enclosed coils and toroidal coils.
  - DM-81 FEATURES:
    - Measuring 700 kHz/250 MHz in seven bands.

- **HC-10 Digital Quartz Clock**
  - The HC-10 digital world quartz clock with 24-hour display shows local time and the time in 10 preprogrammed plus two programmable time zones.

- **Microphones:**
  - MC-60A Deluxe desk microphone with UP/DOWN switch, pre-amplifier, 50 kΩ/500Ω, 8-pin adapter cords (4-pn).
  - MC-60A4 Deluxe desk microphone, 50 kΩ/500Ω, 4-pin UP/DOWN switch, pre-amp. (not included). PG-4C available.
  - MC-50 Desk microphone, 50 kΩ/500Ω, 4-pin.
  - MC-46 16-key autopatch UP/DOWN microphone, 6-pin.
  - MC-425 Hand microphone with UP/DOWN switch, 500Ω, 8-pin.
  - MC-305 Hand microphone, 500Ω, noise-cancelling, 4-pin.
  - MC-355 Hand microphone, 50 kΩ, noise-cancelling, 4-pin.

- **Microphone Plug Adapters:**
  - MJ-48 (4-pin microphone to 8-pin transceiver).
  - MJ-84 (8-pin microphone to 4-pin transceiver).
  - MJ-86 (8-pin microphone to 6-pin transceiver).

- **Headphones:**
  - HS-5 Deluxe headphones.
  - HS-6 Lightweight headphones.
  - HS-4 Standard headphones.

- **General Purpose AC Power Supplies:**
  - KPS-7A 13.8 VDC, 7A intermittent.
  - KPS-12 13.8 VDC, 12A intermittent.
  - KPS-21 13.8 VDC, 21A intermittent.

- **Other Accessories:**
  - SP-40 Compact external speaker.
  - RD-20 Dummy load, 50Ω, DC 500 MHz, 50 W intermittent, 20 W continuous.
  - PG-3A DC line noise filter for mobile.

- **Service Manuals:**
  - Available for most transceivers, receivers, and major accessories.

**NOTE:** Prices and specifications of all Trio-Kenwood products are subject to change without prior notice or obligation.
Cutting Current to Size

Measuring large ac currents can be difficult unless you know a trick or two. W7CRY explains how.

Have you ever tried to measure large ac currents and found your trusty VOM somewhat short? Welcome to the club. I was stuck with the problem of finding the current used by an electric hot water heater but no way of measuring it. I also found my wallet short after letting my fingers walk through several instrument catalogs. Several hours of thrashing around the workbench yielded a simple and, best of all, inexpensive way of measuring large ac currents using an ordinary 88-mH choke, a trick or two, and Ohm's law.

Theory

Perhaps a little transformer theory should be covered before Ohm's law and the tricks are applied. By definition, a transformer is exactly what its name implies: It transforms one voltage (or current) to a different level. The major differences between a voltage transformer and current transformer are the turns ratio and power-transfer characteristics. Depending on design, the voltage transformer has a low turns ratio, i.e., approximately 19 to 1 (118/6.3) for a filament transformer. The current transformer, on the other hand, has a turns ratio from around 300 to greater than 10,000 to 1, depending on the burden (load) on the secondary.

The current transformer always has the burden specified along with the current ratio. For example, a typical 50-Amp to 5-Amp current transformer will require a burden of .25 Ohms. If the secondary burden were to open or be removed, the transformer would be destroyed because the voltage developed across the resulting open circuit would cause arcing within the windings.

An additional consideration is that the current transformer should not introduce significant changes in the circuit being measured.

Hybrid Current Transformer Design

Fig. 1 shows the basic technique in utilizing the 88-mH choke as a current transformer. The term hybrid is used because in using the choke, a "halfway in-between" turns ratio will result. The approximate number of turns is determined by measuring the resistance of the coil, finding

The almost-completed ac current transformer. The transformer is mounted on a piece of styrofoam which is glued to the box. Contact or rubber cement can be used for both the foam and transformer. The signal wires (not shown) can be routed out through any of the knockouts.

Fig. 1. Basic hybrid current transformer.
More Transceiver

Contest or rare DX—the world is waiting to hear from a new breed of HF operators who'll have the power of a microcomputer at their instant command. The Heath SS-9000 signals a new era in Amateur Radio, full of exciting promise. Challenge. And opportunity...

MORE WORLD HORIZONS
In the SS-9000, we met a major design goal: provide the highest-tech, most versatile transceiver possible. Our objective? Nothing less than setting the pace for transceiver performance in the next decade. And transforming the state-of-the-art in amateur telecommunications potential.

As a microprocessor-based, fully-synthesized nine band Transceiver, your SS-9000 leads the new revolution in computer-enhanced hamshacks—with an array of applications yet to be discovered. At your command under direct or RS-232 control, it could break all known records for station performance.

MORE MICRO CONTROL
Harness the SS-9000 to a video terminal, ASCII teletype or home computer. Commands are available to select, display and change all 27 operating and memory frequencies, assign and toggle T/R/Tr status on the dual readout, and freely manipulate the three stored frequencies on each band, with full diagnostic error-prompting.

There's more for the Ham at Heath

Keyboard command also allows you to set and switch the band, mode, passband shift, baud and scan rates, plus switch to one of five antennas automatically.

MORE POWER AS A PAIR
The FS-9000 AC Power Supply has an in-cabinet speaker and two digital 12 or 24-hour clocks. Both units benefit from thermal and over-current protection with high VSWR cutback. Test-prove the assembled System 9000. Get a hands-on tryout at your nearby Heathkit Electronic Center.*

MORE DETAILS IN CATALOG
FREE! For complete details and specs, get a copy of the latest Heathkit catalog.
Write: Heath Company, Dept. 311-964, Benton Harbor, MI 49022.

Units of Ventechnology Electronics Corporation in the U.S., a subsidiary of Zenith Radio Corp.
the wire size, and, from a wire table, finding the resistance per foot. By taking the average diameter of the donut and average cross section, a rough turns count can be calculated.

For those not willing to take the time to play with the math, a quick test can be found in the calibration section. If the ratio is found to be in excess of about 300, the choke is a good candidate.

Apparently, there are several so-called surplus 84-mH-type chokes. I found some with and some without center tap. I have also found some with two separate windings. These can be used if the windings are connected in series adding. Even though the choke defined here was intended for the audio frequencies, it works well at 60 Hz if the power levels are kept low.

Construction
The only construction required is covering the existing windings with tape. Once the value of $R$ is determined, it can be soldered to the windings and taped to the body of the coil or mounted as shown in Fig. 3. The signal wires are attached across the resistor and routed where necessary. Wire length is not critical, but wires should be routed away from high-noise areas.

Calibration
Fig. 2 shows the test setup used to calibrate the current transformer. It is not necessary to use the 120-volt, 60-Hz line to do the calibration. As shown, a low-voltage, high-current voltage transformer with an adjustable input is the quickest and safest.

For calibration purposes, $R$ can be a quality pot. The 100-Ohm resistor is used to prevent shorting the transformer, but is part of the burden. The source and load will depend on what is available. Use the following steps to calibrate the transformer:

1) Make sure that there are ten complete turns of #18 insulated wire wound as shown in Fig. 2.
2) Adjust the load for 10.0 Ohms.
3) Adjust the voltage to the load for 10.0 V ac.
4) Adjust $R$ (1k pot) for an even value of voltage—preferably 0.1 V ac. Remove power.

(If 0.1 volt was not obtainable, replace $R$ with a 2k pot. If the measured voltage was higher than 0.1 V ac, set the value to any even value above 0.1 V, e.g., 0.3 V ac.)

(The current ratio is calculated as follows: $I = E/R$, where $E$ was set to 10.0 V ac and $R$ was set to 10.0 Ohms. Therefore, $I = 10 \, V / 10 \, \Omega = 1$ Amp.

(Then 1 Amp through 10 turns equals 10 Amp/turns which is also equal to 10 Amps with 1 turn through the transformer. With one turn in the primary and the measured value across $R$ of 0.1 V ac, the ratio becomes 10 to 0.1. By Ohm’s law, $E$ is equal to 1 times $R$, and if $R$ is held constant, then $E$ must be proportional to $I$.

(What this boils down to is that the current through the transformer will generate a proportional voltage across $R$ as long as $R$ stays constant. If the ratio has been set correctly, adjusting the load to 1.0 Ohms and again adjusting the voltage across the load to 10.0 V ac, a value of 1 V ac should be measured across $R$.)

5) Determine the wattage for $R$ by measuring the value of $R$ and calculating as follows: $P \, \text{Watts} = E^2/R$. Generally, a ½-Watt resistor will be more than sufficient. Replace the pot and 100-Ohm resistor with a fixed value equal to the combination of the two in series.

Application
Obviously, this combination can be used with any current range. It is limited only by the size of wire capable of being wound (1 turn) through the donut. Note that at least one turn is necessary to excite the transformer core. Passing the wire through the hole is not sufficient. Practically speaking, a #5 (solid enamelled) wire is about the maximum-size wire which can be formed into one turn around the donut. This limits the upper current range to around 50 Amps.

The number of turns wound on the current transformer will depend on the current range to be measured and wire size. As an example, suppose a motor rated at 15 Amps (running) is to be monitored. We know from our calibration that 10 Amps gave us 0.1 V ac across $R$. Therefore, one turn of #12 wire through the donut should give us 0.15 V ac across $R$. The #12 was chosen because it is the smallest size generally used for motors in this range.

Another example is the case where only 1 Amp is to be measured. In this case, the wire size (assumed to be #14) is too large to pass a large number of turns through the donut. If you can assume also that nothing larger than approximately 5 Amps will be
The ultimate team...the new "Drake Twins"

The TR7A and R7A offer performance and versatility for those who demand the ultimate!

TR7A Transceiver

- CONTINUOUS FREQUENCY COVERAGE — 1.5 to 30 MHz full receive coverage. The optional AUX7 provides 0 to 1.5 MHz receive plus transmit coverage of 1.8 to 30 MHz, for future Amateur bands, MARS, Embassy, Government or Commercial frequencies (proper authorization required).
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- Both 2.3 kHz ssb and 500 Hz cw crystal filters, and 9 kHz a-m selectivity are standard, plus provisions for two additional filters. These 8-pole crystal filters in conjunction with careful mechanical/electrical design result in realizable ultimate rejection in excess of 100 dB.
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R7A Receiver

- CONTINUOUS NO COMPROMISE 0 to 30 MHz frequency coverage.
- Full passband tuning (PBT).
- Standard ultimate selectivity choices include the supplied 2.3 kHz ssb and 500 Hz cw crystal filters, and 9 kHz a-m selectivity. Capability for three accessory crystal filters plus the two supplied. Including 300 Hz, 1.8 kHz, 4 kHz, and 6 kHz. The 4 kHz filter, when used with the R7A’s Synchro-Phase a-m detector, provides a-m reception with greater frequency response within a narrower bandwidth than conventional a-m detection, and sideband selection to minimize interference potential.
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passed through the donut, then ten turns of #18 (solid enameled) will generate 0.1 V ac across R. In most cases, the number of turns will be determined by the measurement requirements.

**Installation**

According to most electrical codes, any splices of power lines must be located in a box. An outlet or junction box will work equally well. The transformer should not touch the metal box, and make sure that only the circuit being measured is in the box. It is best to use the low side (white wire) because the voltage between the low side and ground will not exceed the voltage rating of the enameled wire.

When measuring a 220-V ac line it will be necessary to use either of the two hot (red or blue) lines. In this case, the donut should have at least one layer of electrical (plastic) tape between the two sets of windings. Fig. 3 shows one method of mounting the donut and resistor R. Any method which meets your local code requirements will work.

**Use**

Now that you have a current transformer, how can it be used? The answer to that depends on why it was built. The easiest use of the current transformer is with an ac voltmeter. In my case, it is being used in a computer-controlled power system. Since a computer does not know ac from dc (or much else), the ac signal across R must be signal conditioned. There are many ways to signal-condition, but the method I chose was determined by the analog-to-digital converter (ADC) used with my computer. It has ±15 V dc available, so that the use of operational amplifiers seemed to be the best solution.

Fig. 4 is an example of how the ac signal is conditioned from ac to dc for the ADC. It is beyond the scope of this article to dissect the operation of Fig. 4 except to note that U2 and U3 form an absolute value (precision-rectifier) circuit. U1 is an inverting amplifier and U4 is used as a unity-gain buffer. U1 and U4 are in one LM747 and U2 and U3 are in another. Any general-purpose operational amplifier will work. (More information on this particular absolute-value circuit may be found in the November 8, 1979, issue of *Electronic Design*, page 94.)

A simple amplifier and diode arrangement also will work if accuracy and response time are unimportant. Fig. 5 is the method used in this case.

**Summary**

No matter what the requirement, a simple arrangement such as described here will provide a reasonably accurate measurement of ac line current. Sources of 88-mH chokes are found in the back of most electronic magazines and cost around $3.00.

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## EDUCATION

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73 Magazine • December, 1982 115
Construct This All-American Audio Signal Generator

The perfect project for starting a test bench or rounding one out.

It is still possible for the average builder to design and make equipment that is competitive in cost and effectiveness with that which is store-bought. Many simple, standard design concepts can be applied to modern technology.

The Circuit

This FET audio signal generator is an easy project derived from the audio oscillator circuit presented in “Working with FETs—part 1,” in 73 in November, 1979. There are some simple additions to the finished circuit which make it far more useful than just the basic circuit (see Fig. 1).

I could have used a switch and a selection of fixed values, but it would have cost more and built in a fixed limit. The easy way out was to put the frequency-determining capacitor outboard so that it can be changed quickly. You can use a substitution box or your junk-box selection with ease, but most of the time you can just leave the fixed value in place. I have rarely needed more than the one tone for testing.

Potentiometer R2 gives you an adjustable output level. This is very handy for testing or troubleshooting. Resistors R3 and R4 form an output attenuator network that gives you a low-level adjustable output. This is useful when working with high-gain circuits. Using an attenuator network gives you a cleaner low-level signal than trying to use a high-level signal at the lowest setting.

A 9-volt transistor radio battery or a power supply can be plugged in at J3. This way you can change quickly between battery and fixed supply, or use your battery or supply with other equipment. It’s handy. The low power drain, about 2.2 mA, makes this a really practical project for battery and portable operation.

There are only a few parts values that are at all critical. The design center was for 10% tolerance and in most cases it is much wider. Except in one important case, the voltage rating is anything reasonable over 20 WV dc.

L1 is an 88-mH unpotted toroid. It is a common surplus item, but you may have to look around. They are often used for filters in RTTY equipment.

C1 in combination with L1

Top view of FET audio signal generator.
is what actually sets the audio tone. My substitution box gave usable tones from 0.22 μF up, but the highest tones were out of the comfortable audio range. I think that 0.1 μF to 0.22 μF would be a good starting point. Get out the junk box and play around.

R1 limits the voltage swing of the output waveform at the gate of Q1. If it were not there, under some conditions the signal might be large enough to damage the transistor. The value is not critical; 3.3k or more will do, but have something there for protection.

Q1 is a Motorola HEP-801, a commonly available audio FET. It has four pins, the fourth being a connection to the outer case. When I made the prototype circuit, the matrix board automatically connected the case to the source pin. It worked well that way so I left it in the finished circuit.

Drain bypass capacitor C5 is not critical. Anything from 20 to 100 μF at 20 volts or more should do. The circuit worked well without it, but it might be needed to keep any noise from getting in from your supply. Keep in mind that to further decouple the circuit you can also add a 2.2k or so resistor in series with the drain line if you have a stubborn noise problem. The greater the capacitance of output coupling capacitor C2, the better the low frequency response. I used a 0.1-μF 50-V dc disc ceramic that was on hand.

Output level control R2 is a 50k linear-taper potentiometer. A linear taper is used because it is a voltage divider application, not a true volume control. Mine has an ac switch (SW1) right on the back, but you can use a separate switch.

R3 (470k) and R4 (47k) form the attenuator network. The textbook values would be different, but since I aimed for a wide 10% tolerance, it worked out well. The measured output is very close to a 10:1 ratio. My resistors happen to be 5% values as they were available in the store. Output coupling capacitors C3 and C4 have the only critical ratings. Both are 0.01 μF at 1000 volts disc ceramics.

The voltage rating is critical. They block any dc voltage in the test circuit (such as a tube-type amplifier) from getting back into the generator and frying all the little parts. Use at least 500-volt capacitors, preferably higher. You should not be using equipment like this in really high-voltage circuits. It's unhealthy. But a good safety margin will keep you going when you work with most tube-type equipment.

These two capacitors also will determine the frequency response of your generator and it's hard to find high capacitance at high working voltage. This means that your lowest audio tones will have less output voltage than mid or high tones.

I should stress that the low-frequency loss comes from the coupling capacitors in the circuit, not the oscillator, which will provide far flatter output across the audio spectrum.

Construction

Construction is easy. There are only a few mechanical problems to watch for. The photos show the parts layout and there are a few tricks to make it easier.

I used cardboard at the top and bottom of toroid L1 and a short length of insulation over the screw where it went through the toroid to prevent any shorting.

There is one potential trouble area. Clean the enamel off the magnet wire ends of the toroid very carefully. I mean really get in there with a sharp penknife and scrape it off. I was sloppy the first time. It looked good but it didn't work. It took me a while to find the problem. Check for a good clean contact with your ohmmeter. It doesn't matter which end is grounded when you install it, but when you make the center-tap, look for the two ends that are closest together.

Use a good quality transistor socket. The cheap one I tried at first fell apart. I soldered the leads to the socket first and then wired it to the terminal strip. I was going to tack it down with silicone sealer, but the wire was stiff enough that it didn't wander.

RCA jacks were used throughout. They are not the last word in connectors, but they are cheap and easy to get.

There are many styles of enclosure available; it just has to all fit. I did not try

![Fig. 1.](image-url)
Testing

When you have it put together, check for wiring errors and shorts. Put your milliammeter in the power lead and check the current as you turn it on. Don’t forget to put some capacitance value at 1B1 (C1) so there will be a complete LC circuit.

Use your scope or high-impedance headphones to check for a tone. If it works, use your scope or VTVM to measure the output voltage at both output jacks as it may vary between units. Don’t try to use a VOM on the low-level output. It will load it down to almost nothing. Check for proper operation of the level control and the on-off switch. If you get past all that, you are in business.

The first time I tried mine it didn’t work and I designed it! Here are the most likely troubles to look for:

1) Transistor inserted incorrectly in the socket, or you have the wrong pin configuration to the circuit.
2) Weak or dead battery. Check yours under load with meter.
3) Wiring error. Recheck schematic.
4) Coil doesn’t make connection with rest of circuit. Unsold and clean again. Ohmmeter might help here.

The signal should be at the gate of the FET. Lifting one lead of C2 will isolate the output circuit. If there is still no signal at the gate, then the trouble is in the oscillator circuit itself.

Performance

I checked the performance of mine with my usual assortment of ancient and out-of-tolerance test gear and got the following:

The output voltage varies only slightly over the supply-voltage range of 9 to 20 volts. This is a fringe benefit of R1. It holds the output voltage constant over a wide range of supply voltages.

The output drops off slightly with a supply voltage between 9 and 5 volts. At the design center of 9 to 12 volts, the drain current is about 2.2 mA.

The output voltage at the HI output jack (I1) is 15 volts peak-to-peak on the scope. At the LO jack (J2), it is 1.5 volts p-p. Pretty good for a rough and ready attenuator network.

The calculated rms voltage by formula was not what one meter showed. The VOM indicated 4.2 volts rms. The LO range was loaded down too much by the meter. The output across the “output” jack was about +15 dBm—enough for many purposes.

The minimum signal voltage available is about 0.01 volt p-p on the scope. The voltage is still controllable below this level, but you are at the extreme end of the range and there is a higher level of hum vs. signal. Some noise will get in from any test setup, but at very low levels, noise and crud are a higher percentage of your actual test signal.

Your performance measurements will probably vary from mine because of differences in the unit and test equipment used. The absolute values are not as significant as knowing the relative values as measured by your own equipment. This gives you a way to check the performance against a recorded value.

Always keep records on the operating characteristics of equipment you make when you complete it. Then you will have figures to use for comparison when you need them. It won’t be guesswork or vague memory.

Odds and Ends

There are a few little odds and ends to really finish the project properly.

Make a full-size schematic diagram of the circuit showing all parts and values, voltage and current, and the actual output at both jacks (use scope if available). A clear drawing of the parts layout will help if you ever have to work on yours. You may not remember it that well in time. You might even make a copy of this article for your service package.
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- Pure power in antenna
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- Small lightweight and weatherproof
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- For full legal power and more
- Helps eliminate TVI
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**HI-Q ANTENNA CENTER INSULATOR**

- **$12.95**

**HI-Q ANTENNA END INSULATORS**

- **$6.95** with SO 239 connector

**DIPOLES**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>BANDS</th>
<th>LENGTH</th>
<th>PRICE WITH HI-Q BALUN</th>
<th>WITH HI-Q BALUN CENTER</th>
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<tr>
<td>D-60</td>
<td>80,75</td>
<td>130</td>
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<tr>
<td>D-40</td>
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<td>66</td>
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<td>D-10</td>
<td>10</td>
<td>16</td>
<td>$7.95</td>
<td>$9.95</td>
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Shortened dipoles:
- **SD-80** 80,75 66 35.95 37.95
- **SD-40** 40 45 32.95 36.95

**Dipole antennas**—only same as included in SO models
- **S-80** 80,75 $11.95 pr
- **S-40** 40 $10.95 pr

All antennas are complete with a HI-Q Balun or HI-Q Antenna Center insulator. No. 14 antenna wire, ceramic insulators, 100 nylon antenna support rope (SO models only) $5 rated for full legal power. Antennas may be used as an inverted V and may also be used by MARs or SWLs.

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- Complete documentation supplied.

**4511 RTTY Interface**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>BANDS</th>
<th>PRICE</th>
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<tr>
<td>50</td>
<td>45</td>
<td>$169.95</td>
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</table>

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**4511 RTTY Interface**

<table>
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<th>MODEL</th>
<th>TYPE</th>
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<tr>
<td>PD-801</td>
<td>80,20,20,10</td>
<td>$19.95</td>
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<tr>
<td>PD-401</td>
<td>40,20,10,10</td>
<td>$19.95</td>
</tr>
</tbody>
</table>

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**HI-Q BALUN**

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**HI-Q ANTENNA CENTER INSULATOR**

- **$6.95** with SO 239 connector

**DIPOLES**

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This is one of the simpler pieces of test gear to use, but there are a few cautions I would like to stress.

If you have been used to working with transistor equipment, you may not be street-wise to the dangers of working in higher voltage tube circuits. This unit will help troubleshoot tube receivers and audio amplifiers, but make sure you observe all safety precautions for working with high voltage. Tube voltage levels are lethal.

Working with transistor equipment is a lot safer for you, but the oscillator has a husky output that easily can blow many transistor stages. Observe all safety precautions for working with transistor circuits, too.

As a general rule, set the controls of the unit under test as they would be for normal operation. Start with the lowest level signal you have and use the least signal that will do the job. You can damage a transistor stage with too much signal or even a static charge. It would be hard to damage a tube stage with this unit, but too much signal can cause distortion. You could be trying to fix a problem that you are causing while testing.

This unit will do a lot for you, but to use it safely and effectively you have to know what you are doing and why.

A good book or two on troubleshooting and repair will give you lots of ways to get the most out of your test equipment. Make sure your library covers both tube and solid-state gear.

A little hands-on experience working with this unit also will tell you a lot about its capabilities.
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-- See List of Advertisers on page 130 --
Maximum Modulation for CB Conversions

Many CB rigs lack the gain for full modulation. This preamp will help.

If you have recently converted a CB for 10-meter operation or if your present ham rig has insufficient mike gain, you may be interested in building this simple microphone preamplifier. The majority of CB rigs in the lower to middle price ranges do not provide adequate mike gain for optimum modulation. Typical modulation levels obtained are from 30 to 60 percent. The addition of a preamplified mike can significantly increase the "talk power" of these rigs; just ask any CBer.

You probably won't have enough room to install the potentiometer (R4) inside the CB, but it can be replaced with two fixed resistors once the proper mike gain adjustment level is established.

To provide similar circuit-operating parameters when installing inside a CB, substitute a 33k-Ohm resistor for R3 and connect it to a +12-volt power point in the CB. Also connect the common ground point of the preamplifier circuit to CB ground. Unsolder the existing microphone lead from the printed circuit board and connect it to the input of the FET circuit. Use a short piece of shielded wire to connect the output of the FET circuit to the printed circuit board and ground the shield to minimize hum pickup.

Adjustment is simply a matter of setting the potentiometer for optimum modulation level. This can be accomplished through the use of a modulation meter connected to the antenna feedline connector of the CB or during an actual QSO. Don't forget that the FCC limits the maximum permissible modulation level at 100 percent, so make sure that the gain setting used does not cause audio distortion or splatter.

When you have established the optimum level setting, the potentiometer can be replaced by two fixed resistors connected as a series voltage divider. To determine the proper resistor values, measure the resistance between the center lug of the potentiometer and each outside lug. Obtain two resistors having the same approximate values, connect them in series, and substitute these in place of the potentiometer. Connect the mike lead to the junction between the two resistors. Check that the resistors are installed in the circuit so that they have the same relationship as the measured resistance values on the potentiometer.

The circuit can be constructed in a separate minicabinet by using mating microphone connectors to match those used by your CB or it can be mounted inside the CB. When mounting within the CB, the additional mike connectors, switch, cabinet, and 9-volt battery are not required.

Fig. 1. Mike preamp circuit.

<table>
<thead>
<tr>
<th>Parts List</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1—9-volt transistor radio battery</td>
</tr>
<tr>
<td>S1—SPST switch</td>
</tr>
<tr>
<td>Q1—FET, Radio Shack 276-2028</td>
</tr>
<tr>
<td>C1—001μF capacitor</td>
</tr>
<tr>
<td>C2—0.1μF mylar capacitor</td>
</tr>
<tr>
<td>C3—100μF, 10-V-dc capacitor</td>
</tr>
<tr>
<td>R1—2-megohm, 1/2-Watt resistor</td>
</tr>
<tr>
<td>R2—3300-Ohm, 1/2-Watt resistor</td>
</tr>
<tr>
<td>R3—10k-Ohm, 1/2-Watt resistor</td>
</tr>
<tr>
<td>R4—50k-Ohm or 100k audio-taper potentiometer</td>
</tr>
<tr>
<td>J1, J2—Phone jacks to match equipment</td>
</tr>
</tbody>
</table>
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**PRICE**
**PERFORMANCE**

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- *5-50 WPM
- *Speed, Volume, Tone, Tune and Weight controls
- *Stiletone and speaker
- Semi-auto switch for bug or straight key
- Deluxe quarter-inch jacks for keying and output
- *Keys skip block or solid state rigs

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- Digs out CW signal, decodes it with Phased Lock Loop Toner Decoder then reproduces it with full operator control over Gain, Freq, Tone, Delay.
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73 Magazine • December, 1982 125
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THE TEN METER FM HANDBOOK—by Bob Neil KRIE. This handbook has been published and ten meter enthusiasts learn more about the many methods of conversions and tricks that are used to make existing units work better. Join the great "tinkers" of the world on ten FM and enjoy the fantastic amount of fun in communicating with amateur stations worldwide on ten meter FM. BK1190 $4.95.4

THE PRACTICAL HANDBOOK OF AMATEUR RADIO FM TESTING—by Bill Patterson W4TIP (author of 73 Magazines monthly column "Looking West!"). This book is the ultimate VHF/FM FM, compiled from material submitted by over a hundred individuals, clubs, organizations and equipment manufacturers. A "must have" for your ham shack shelf. BK1185 $12.95.

TOOLS & TECHNIQUES FOR ELECTRONICS—by A. A. Wicks. This is an easy-to-understand book written for the beginning kit builder as well as the experienced hobbyist. It has numerous pictures and descriptions of the safe and correct ways to use basic and specialized tools for electronic projects, as well as specialized metalworking tools and the chemical aids which are used in repair shops. BK7348 $4.95.

BEHIND THE Dial—This book explains, in detail, what's going on on all the frequencies, from shortwave up to microwave. It gives the reader a good idea of what he can find and where to find it, including some of the secret stations such as the C.I.A., and the F.B.I. Everything is covered short of microwave monitoring. Anyone interested in purchasing a shortwave receiver should have a copy of this book. BK7370 $4.95.

THE NEW WEATHER SATELLITE HANDBOOK—by Dr. Ralph E. Faggart WBQDJG. Here is the completely updated and revised edition containing all the information on the most sophisticated and effective space craft now in orbit. This book serves both the experienced amateur satellite enthusiast and the newcomer. It is an introduction to satellite watching, providing all the information required to construct a complete and highly effective ground station. Solid hardware designs and all the instructions necessary to operate the equipment are included. For experimenters who are operating stations, the book's detailed procedures necessary to modify equipment for the new series of spacecraft. Amateur weather satellites actually represents a unique blend of interests encompassing electronic equipment, space technology, telecommunications, and coincidentally the hobbyist's great love for all things meteorological.

THE CHALLENGE OF 160—The growth of amateur radio today is encouraging the use of 160 meters. All the information necessary to get started on this unique band, the all important antenna and ground systems are described in detail. Also, how to get on, top-band operating tips, top-band transmitters, propagation, weather receiving equipment, and more are covered in full. The introduction contains interesting photos. Stew Perry's (King of 160) shack reference is useful to new and experienced top-band operators. BK7309 $4.95.

INTERFERENCE HANDBOOK—by William R. Nelson, WAREAG. This timely handbook covers every type of RFI problem and gives you the solutions based on practical experience. Covers interference to TV, radio, hi-fi, telephone. radio amateur, commercial and CB equipment. Power line interference is covered in depth — how to locate it, cure it, work with the public, safely precautions, how to train RFI Investigators. Written by an RFI expert, any ham will find this profusely illustrated book is packed with practical easy-to-understand information. BK1230 $8.95.

OWNER REPAIR OF RADIO EQUIPMENT—by Frank Glass K6RKG. Here's a book that will teach you an approach to troubleshooting without a shack full of test equipment. Written in a narrative, non-mathematical style. It will encourage you to successfully fix your rig yourself even when you don't want to fix, you can learn a lot about how things work and how to add to your library and personal experience. BK7310 $7.95.

OWN AND OPERATE TV EQUIPMENT—by John H. Nelson. When surplus touted the worldwide communications networks of the 1940's, John Henry Nelson looked to the planets as a path to the future. That was a theory of propagation forecasting based upon interplanetary alignment that made the author the most reliable forecaster in America today. The book provides an enlighted book at communications past, present, and future, as well as teaching the art of propagation forecasting. BK7302 $6.95.

WORLD PRESS SERVICE FREQUENCIES—by Ralph E. Taggart WB8DOT. Here is the completely updated and revised edition containing all the important news services as AP, UPI, Reuters, TASS, VOA and London Press. Also included is an Introduction to RTTY with information on equipment, antennas, abbreviations—everything you need to get started in RTTY. BK1202 $7.95.

SSB ... THE MISUNDERSTOOD MODE—by James B. Wilson. Single Sideband Transmission—thousands of others use it every day, yet it remains one of the least understood facets of amateur radio. J. B. Wilson presents several methods of sideband generation, amply illustrated with charts and schematics, which will enable the ambitious reader to construct his own single sideband generator. A must for the technically serious ham. BK7365 $5.50.

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In exchange for these technical gems, 73 offers you the choice of a book from the Radio Bookshop, to be sent upon publication. Submit your idea (and book choice) to: Circuits, Editorial Offices, 73 Magazine, Peterborough NH 03458. Submissions not selected for publication will be returned if an SASE is enclosed.

THE KEYLESS KEYER: This circuit can be used to key a transmitter with just a touch. In Fig. 1, Q1 and Q2 are any NPN transistors. C1 can be any disc capacitor. Make sure the leads are long enough so that you can touch them. When the leads are shorted by your finger, the small signal from your body makes the relay drop from 5 volts to less than one volt. The relay toggles. The SPDT leads of the relay can be used to key a transmitter. No dangerous voltages pass through the capacitor. Diode D1 suppresses any high inductive kickback and thus protects the transistors. Use either two 9-volt batteries in series or build the power supply shown. The LED and 2.2-kilohm resistor serve to indicate when the supply is on and to bleed off any dangerous voltages from the 2000 µF capacitor.—Alan Weinberg

FREQUENCY ADJUSTMENT FOR THE YAESU FT-101: You can use an ordinary frequency counter to tell if your FT-101 is slightly off frequency. Pin 6 on the rig’s accessory plug is connected to the VFO output, while pin 8 is ground. Connect a frequency counter to these two pins and check to see if the radio has the same frequency on transmit and receive. The counter will display the VFO frequency — between 87 and 92 MHz — not the frequency shown on the main dial. You can correct for any difference between the transmit and receive frequency by adjusting the control marked zero, located under the top cover.—Doc Hall W6ZJQ, Elyria OH.

ALC MODIFICATION FOR THE HEATH SB-220: The ALC level in the Heath SB-220 is virtually unusable with the Collins 32S-3. This modification will provide an adjustable, stable ALC voltage for the SB-220. Install the ALC control in the front-panel position normally occupied by the Relative Power Sensitivity control. The RPS control is then installed on the left rear chassis apron about 4½ inches inboard from the left side. By adding a small capacitor across the R25, the response is made more uniform with respect to frequency. After modification, set the RPS to a reading of 270-280 measured on the grid milliammeter.—E. A. Wingfield W5FD, Little Rock AR.

OPERATE-StANDBY SWITCH: This circuit is ideal for a linear amplifier, such as the SB-220, which does not have a standby switch. The circuit requires only three components and a miniature box in which to house them. When S1 is in the OP mode, the 39-kilohm resistor and LED are shorted. Thus, when K1 is energized, the linear is on the air. In the STBY mode, the LED cathode is grounded and energizes. Selection of the resistor is critical: If too low a value, the relay will close in the STBY mode. The exciter can be tuned for maximum power with the antenna connected through the linear’s bypass relay. S1 is then switched to OP and the linear can be loaded into the antenna.—F. T. Marcellino W3BYM, Rockville MD.
I would like to obtain schematics or manuals for the following:

- E. F. Johnson “Ultroncom” 30-50 MHz FM transmitter
- Tempo One 80-10 meter transceiver (the black version)
- Unimetrics “Dura-Scan” 30-50 MHz scan
- Lafayette “Micro” P-50 30-50 MHz tunable FM receiver
- J. C. Penney model 6237A citizens band transceiver
- Krls model XL-70 citizens band transceiver
- International Crystal “Executive” model 1500 citizens band transceiver
- Heath HP-20 power supply

If copies are sent, please specify if they are to be returned or are for me to keep.

Gary B. Trustle WBRSPV
424 Franklin Ave.
Waverly OH 45690

I am looking for:

- Someone who has modified a Heath HD-1410 keyer for use with a Hallicrafters HT-37 transmitter.
- Firms who sell Motorola MV1404 tuning diodes: MAN-1, MAN-64, and MAN-6680.
- Someone who has modified a Heath 1500 citizens band transceiver.

Paul Kemp WBCJIB
1025 E. Loula
Olata KS 66061

I would like to find manuals or schematics for the following:

- AMPX-1 model CC323 TV camera
- ALL model R1263/GRC receiver
- ALL model IP60/GRG spectrum analyzer
- Tektronix model 1401A spectrum analyzer
- Dumont model 1062 oscilloscope
- model DM-1024A-160-A04 video display

Fred Wolf NSARO
1920 Ridgelawn Dr.
Gautier MS 39552

I am looking for the instruction manual, service manual, and any modifications for the Tennelec Memoryscan MS-2. I also need the service manual and paperwork for the Motorola LOG38B transceiver. I will pay for postage and copying costs.

Mark Klukis N2DML
2623 E. 11th St.
Brooklyn NY 11235

I need an Eico or similar VFO for a local Novice study group.

G. Samokovs NZBR
1420 M. Vernon Dr.
Holiday FL 33590

Wanted: drive belts for an Aiwa TP708B reel-to-reel tape recorder, as well as schematics and info on how to build a good communications receiver.

Derek H. Rout
3137 Champion St.
Christchurch, New Zealand

Wanted: an external vfo for the Sears 412.3570600 2 meter FM rig or a schematic of it. I will pay postage for the schematic.

SSG Gary E. Kohlta DA2XF
USAFA-A Box 1415
APO NY 09648

I am looking for a Hunter Bandit linear amplifier.

Ray Warner W7JKTJU
2200 Jamaica Cove
Riviera AZ 86442

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk in frequencies, and the name of whom to contact for further information. Announcements must be received at 73 Magazine by the first of the month, two months prior to the month in which they take place. Mail to Editorial Offices, 73 Magazine, Pine Street, Peterborough NH 03458.

FAIRBARTON MN
DEC 4
The annual Handi-Ham Winter Hamfest will be held on Saturday, December 4, 1982, at the Eagles Club, Fairbault MN. Registration will start at 9:00 am, followed by a Handi-Ham equipment auction, dinner at noon, and a program. Talk-in on 1607. For more information, contact Don Franz W8FST, 1114 Frank Avenue, Albert Lea MN 56007.

HAZEL PARK MI
DEC 5
The 17th annual Hazel Park Amateur Radio Club Swap and Shop will be held Sunday, Dec. 5, at Hazel Park High School. Hazel Park MI Hazel Park High School is located on Hughes Street at 99 Mile Rd. 1 mile east of I-75. Tickets are $1.50 in advance or $2.00 at the door. Tables are $1.00 per foot. Doors open at 8:00 am. Plenty of food and parking will be available. Talk-in on 512.529.39; 96.013; 93.33; 78.18; 69.09; 145.43; and 145.29. For more information, contact Wayne W9KU, 1809 Riverside Drive, South Bend IN 46616, or phone (219)233-5307.

RICHMOND VA
JAN 2
The Richmond Amateur Telecommunications Society will hold Richmond Frost Fest 83, the annual winter ham radio and computer show, on Sunday, January 16, 1983, at the state fairgrounds, Richmond VA. General admission is $4.00. All flea market and commercial exhibit spaces will be indoors in a 30,000 square-foot exhibit hib building.

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The RTTY Loop is a monthly column published in 73 Magazine that focuses on the topic of RTTY, a telegraphy mode used by amateur radio operators. The column covers various aspects of RTTY, including equipment reviews, operational tips, and information about special RTTY events and contests. The column is written by Marci L. Leavey, M.D., WA3AJR, and is used to educate and inform readers about the use of RTTY in amateur radio communications.
I'm always amazed at the average ham's grasp of geography. As if it weren't enough that most of us are already experts on electronic theory, radio propagation, and telegraphy, we can also claim a knowledge of virtually every square inch of this tired old planet's surface. Who else but a ham is intimately acquainted with such places as East and West Kiribati, Ba by Nuevo, Bouvet, and Chagos? When Great Britain and Argentina began fighting over a forsaken bit of territory known as the Falkland Islands, most of the world ran for an atlas. For hams, VP8-land was an old friend.

This month, Fun! tackles the field of ham geography. Think you know it all? Read on.

**ELEMENT 1—CROSSWORD PUZZLE**

(Illustration 1)

<table>
<thead>
<tr>
<th>Across</th>
<th>Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) G-land (2 words)</td>
<td>1) DL-land</td>
</tr>
<tr>
<td>2) From</td>
<td>2) Southern state (abbr.)</td>
</tr>
<tr>
<td>3) Eastern European land</td>
<td>3) African country (abbr.)</td>
</tr>
<tr>
<td>4) Western state (abbr.)</td>
<td>4) Far East country (abbr.)</td>
</tr>
<tr>
<td>5) New England state (abbr.)</td>
<td>5) A ham radio commercial (abbr.)</td>
</tr>
<tr>
<td>6) Austria prefix</td>
<td>6) Belonging to a group of northern states (2 words)</td>
</tr>
<tr>
<td>7) Arab country</td>
<td>7) Face or type of cup</td>
</tr>
<tr>
<td>8) Xmas in France</td>
<td>8) EP-land</td>
</tr>
<tr>
<td>9) Type of power measurement (abbr.)</td>
<td>9) Eπ-land</td>
</tr>
<tr>
<td>10) China (abbr.)</td>
<td>10) US York and Orleans</td>
</tr>
<tr>
<td>11) 49th state (abbr.)</td>
<td>11) Lauderdale</td>
</tr>
<tr>
<td>12) This column</td>
<td>12) New Guinea</td>
</tr>
<tr>
<td>13) Vermont flow product</td>
<td>13)Prefix</td>
</tr>
<tr>
<td>14) Diamond state (abbr.)</td>
<td>14) Down district number</td>
</tr>
<tr>
<td>15) Green Mountain State (abbr.)</td>
<td>15) Eiland</td>
</tr>
<tr>
<td>16) Soviet prefix</td>
<td>16) India prefix</td>
</tr>
<tr>
<td>17) Midwest state (2 words)</td>
<td>17) Chad prefix</td>
</tr>
<tr>
<td>18) Midwest state (2 words)</td>
<td>18) Australia prefix</td>
</tr>
</tbody>
</table>

**ELEMENT 2—MATCHING**

Sure, you know all sorts of rare countries by prefix. But do you know their capital cities? Master this subject, and surprise your friend in Paraguay by asking him how things are doing in downtown Asuncion.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Malta</td>
<td>A) Bogota</td>
</tr>
<tr>
<td>2) Bulgaria</td>
<td>B) Reyjavik</td>
</tr>
<tr>
<td>3) Romania</td>
<td>C) Manila</td>
</tr>
<tr>
<td>4) Nepal</td>
<td>D) Tripoli</td>
</tr>
<tr>
<td>5) Maldives</td>
<td>E) Nicolas</td>
</tr>
<tr>
<td>6) Bhutan</td>
<td>F) Rangoon</td>
</tr>
<tr>
<td>7) Burma</td>
<td>G) Caracas</td>
</tr>
<tr>
<td>8) Philippines</td>
<td>H) Katmandu</td>
</tr>
</tbody>
</table>

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**Maggione Electronic Laboratory**

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Phone 215-436-6051
1) In 1977, the president of the Comoros (D6) had every dog in his capital city of Moroni killed.

2) North Yemen (4W) used to be known as Aden.

3) The movie The King and I is banned in Thailand (HS).

4) In Tanzania (SH), wearing a wig is punishable by flogging.

5) When visiting Nepal (9N), one can stop in government-approved hashish stores.

6) Timbuktu is located in Mali (TJ).

7) Half of the population of Kenya (5Z) is less than 16 years old.

8) Paraguay (2P) is the only country with two faces on its flag.

9) In South Africa (ZS), only whites may hold ham tickets.

10) Dueling is legal in Uruguay (CX).

**ELEMENT 4—MAZE**

(illustration 2)

You know, ham radio is a lot like a maze. Thousands of frequencies, dozens of modes, hundreds of antenna types—it can all get very confusing. Here's a much simpler maze. All it requires is a pencil and some time. No money or physical effort is needed. Thanks go to my Radio Shack TRS-80 Model II for creating it.

**THE ANSWERS**

Element 1: See Illustration 1A.

- 1—True
- 2—False
- 3—True
- 4—False
- 5—True
- 6—False
- 7—True
- 8—True
- 9—False
- 10—True

Element 2: One point for each correct answer.

- 1-60 points—Know where your area repeater is located
- 61-80 points—Armchair traveler
- 81-100 points—Man of the World

**GREAT BRITAIN**

**ROMANIA**

**ANGOLA**

**YEMEN**

**I**

**P**

**W**

**A**

**D**

**E**

**S**

**R**

**U**

**V**

**T**

**N**

**A**

**O**

**L**

**E**

**S**

**H**

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**U**

**W**

**F**

**N**

**C**

**Y**

**E**

**O**

**R**

**T**

**H**

**A**

**D**

**K**

**A**

Illustration 1A.

**LETTERS**

**TALK FAST**

While reading your response to W6EO T’s letter in the September issue, it dawned on me just why the “already-known techniques” for high-speed communication are not used in the ham bands. You say we can communicate at 8,500 words per minute using these techniques. That would be great for traffic handlers (of which W6EO T is one) and maybe contestants if one could figure out how to program the system to be fast enough. One could conceivably work two or three thousand stations per minute!

However, you often expand on how nice good old rag chewing is. I can’t understand how you propose to rag chew at 8500 wpm! Some simple testing of my talking speed netted only 235 wpm. I sure can’t talk coherently or even think at 1000 wpm, much less 8500 wpm!

Therefore, to communicate at 8500 wpm, I would have to preprogram some device at my own speed (say 200-400 wpm), contact another station, and punch the proper button to transmit my message at 8500 wpm. I could make no doubt say anything on my mind at the time in less than thirty seconds, if I had 4000 words to say.

The other station's reply would then be transmitted to me at 8500 wpm, but I would have several minutes to wait before he programmed reply comments into his “super QRP box.” And, of course, he would have several minutes to wait for my next round of comments.

The fact that actual transmission time is
very small and more stations can use the available spectrum is a nice idea but needs some human engineering, namely, a QRG to QRG receive converter that would convert the high-speed transmission to normal talking speed with a voice synthesizer, either synced to the other station's voice tones or to a pleasing blonde (for OMs) or tall, dark, and handsome friend for YLs.

The transmit converter would take a few dozen words spoken into the microphone and blip transmit them at 8500 wpm, take a few dozen more and blip, and so on.

The receive converter takes the 8500 wpm transmission and begins "talking" to the receive operator at 20 or so wpm (inaudible of course). And there you have a high-speed system compatible with us relatively slow humans.

---

**LETTER ACCELERATION**

For some time I have been practicing CW just for the fun of it, as in the HK zone, code is required only for the first-class license. When getting on the air I find many Novices eager to make the HK contact. They go at my speed when they are calling CO, but surprise, surprise, once they get to their own call signs, they can read my code by several words per minute, so even if I know that they would immediately answer when they hear the HK coming back to their CO call, I find myself hesitating before I could write something about this in my magazine.

I usually try to answer CO calls because when I call CO with whatever my friends call me, I find out many stations, in my case only, if I sign the HK only once.

I intend to keep you posted on my adventures in CW land.

---

**TOPFSSHUTTER?**

My grandmother would say you are a Topfshutter—a pot stinger. Isn't that just what an editor is supposed to do? Make people think! You are, but I don't think you should allow your writers to use the same freedom.

73's view from Olympia must be a head one. However, the view is occasionally obscured, but I can still see the dog too much looking down the nose at mortal hams.

A case in point is John Edwards' column in his column in the July issue, page 123. Commenting on his question, "Do you own a computer?" he stated, "I can't see how a technically-inclined person can be without one." That is oddball mutilf "ive from a have to have the haves and is anything but constructive.

Wayne, please tell the lesser gods at 73 that it isn't 'eacly necessary to have a microcomputer or the latest fluxmeter from Japan In order to have fun (and fulfill our responsibilities under Part 97). Yes, 73 should tell us what it is handling and what the code speed is up to. But, too often, you promote the idea that the ham should be measured by his equipment when the equipment should be measured by the ham.

Robert F. Seon W6D8KL

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**WHAT'S THE FUSS?**

You all wanted more experienced hams in ham radio? Here I am! I'm 15 years old and just received my Tech ticket. I skipped the Novice test and was really surprised at how simple the FCC exam was. I finished my first year of electronics in High School, which provided all the theory I needed to know, but I had to learn Morse code on my own. I don't own what the big fuss is over learning Morse code. Anyone who can write can type. Even with the end of the school year approaching and final exams just around the corner, I was able to find time to study code. Everywhere I went I carried a set of phonetic flash cards with me. When I would finish an assignment in class, I would pull out my cards and study a group of letters. I even found time to study during my Spanish final exam. Nobody can use the excuse "I just don't have the time to study code."

It took me two months before I was ready for the FCC code test. After I took the code test I couldn't wait to study Morse Code. Within two days I was up to 13 wpm. It kind of made me wish I had held-out one more week to take the General code test. I do plan to upgrade to General or Advanced sometime in the near future.

I remember reading a letter in which someone said that the high price of gear prices kids out of the hobby, I say that 100% untrue. I agree that prices these days are a little steep, but you do not have to have a ham radio to be a ham. My shack consists of a DX-302 receiver and several dipole antennas. My school has a transmitter/receiver combination but we do not have a ham radio club, so I cannot use the equipment. I do plan on starting a club at school but that will take some time. In the meantime, I am asking any ham in the Spring Valley area to give me a call. My call is 455-1490: I'm dying to get on the air! I would like to thank the hams who work 3999 kHz at night. I never miss a night listening to this frequency. The more I listened to these fellows, the more I wanted to get my license. Unfortunately, I can't tell them this because I cannot work 75-meter phone, well, this just gives me more incentive to update to Advanced.

Jim Jones N4MOC

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**STILL BUILDING**

Having been involved in ham radio for half a century, I look back at what ham radio was and what it is today.

In the "Good Old Days," the talk during a QSO was largely technical, dealing with home-made projects. Traffic was handled. In an era when telephones were considered a luxury, Parts for your favorite projects were always available at "downtown" distributors. A less affluent society made hams more ingenious in their needs.

Today's QSOs are far different. Each new contact allows the ham to list his Japanese-made appliances as if owning a $2000 layout reflected on his technical ability. But let a transistor or IC go bad, and the appliance is quickly returned to a "re-pair" depot.

The iron is also that, even for those few hams who can handle difficult repairs, manuals for said appliances lack sufficient Information or cost fairly large amounts of money.

It is indeed fortunate for current hams that 72 Magazine is alive and kicking today! For myself, now 65 and retired, the many construction articles have given me many enjoyable hours. At the same time new comers (age 12-18) likewise were able to discover the "joys of building" via 73. Perhaps many readers may disagree with my view. I bet however I get a few remember building a Bearcat receiver or a 47-46-45 push-pull transmitter will agree, the golden years of hammering are past.

Gerard Samkolsky N4ZB

Holiday FL

Oh, gludio. Gerald. I started in 1938 and I believe that I could have hammed it at 8500 wpm, take a tall, dark and handsome buck (for YLs) tone or to a pleasing blonde (for OMs) or talking speed with a voicesynthesizer, vert the high-speed transmission to normal very small and more stations can use the available spectrum is a nice idea but needs some human engineering, namely, a QRG to QRG receive converter that would convert the high-speed transmission to normal talking speed with a voice synthesizer, either synced to the other station's voice tones or to a pleasing blonde (for OMs) or tall, dark, and handsome friend for YLs.

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**DESTINED**

After a few years of operating K1OGR at the summit of Mount Washington, and then this recent summer of traveling about the countryside, I have the following observations to report.

Some of my better friends used to be DXers. When I was originally a reply to one that I received after criticizing a fellow's operating habits. I would like to give this opinion wider coverage, as it is meant for the entire amateur community.

I apologize only for the way sometimes coming across: tack is one of the things I am still getting used to. Really. Bill, those of us that are not trying to impose "custom" on any one's operating habits. Some of it is rather complex—some, kind of stupid I suppose; I know I have very much to learn about it. So far I have not had to call CO, rather than some jerk's admonishment: 'That's not the way we do it on this repeater.' No logical connection, just: 'That's not the way...'

Here, at least you get some logic, advice, and conversation as well.

---

JIM Jones N4MOC

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BURKE VA

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73 Magazine • December 1982 • 137
Ammosco PL-25 $19.95

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<th>Description</th>
<th>Price</th>
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<tr>
<td>PL-25K</td>
<td>Push on adapter shell</td>
<td>$15.95</td>
</tr>
<tr>
<td>RG 29/A</td>
<td>Double Male Connector</td>
<td>$8.95</td>
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<td>PL-25E</td>
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</tr>
<tr>
<td>RG 59/A</td>
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**THE $1.98 LICENSE**

I just finished reading the code vs. no code gangfire letters in The October issue. Frankly, I felt like throwing up. Such lack of imagination; such lack of perception. What we need is negotiation. You know what negotiation is: that's where they have agreed to give all or part of it away in return for a return of a hostage, or not getting their heads busted, etc.

In the spirit of negotiation, let me suggest that no one has tried to unite all the factions of this argument by proposing an amateur radio license program with something for everyone. Let me then address it from that standpoint.

First, we need to set a goal; hell, anyone familiar with success can tell you that you must establish a goal. The goal must be reasonable—one you can expect to be fulfilled within a certain time. Amateur radio's goal then should be to find the method by which everyone will be licensed within 3 years. Change that: everyone who wants to be a ham, we don't want anyone bitching about how we forced him or her to become a ham. Let us at least be able to say, "where would we be without them?" We have literally millions of amateurs and radio frequencies which are relatively unused. No one said everybody had to be on 20 meters. The reason for not proposing to include any other frequencies was other galaxies don't work. First, it is unrealistic, and the goal must be kept reasonable to be feasible. Second, although the life form known as "slime" must be integrated into the amateur radio if we are to meet our goal (a belief in the "inferior goodness of man" being implicit), we do not know whether or not we would want to share our frequencies with other life forms. Between slime and upstart man, we should be able to bring enough hams into amateur radio to make it worthwhile for manufacturers and others with pecuniary interests, thereby assuring the future of our bands.

If this is established that our goal should be to make available an amateur radio operator's license to anyone and everyone who desires one within 3 years, let's work on a want to accomplish our goal.

First, the US should lead the way and show the rest of the world how it's done. Wayne Green has stated many times that the FCC has stifled the growth of amateur radio here. Anyone familiar with the dooms that followed the incentive licensing system imposed back in the 60s should require no further proof. Anyone, though, who needs more proof as to whether or not the FCC should administrate the amateur radio service, is reminded of the Citizens Band Class D service and the management failure.

Clearly, we do not need the FCC. As a result, the FCC should be abolished as a public service and the management of amateur radio highest bidder in the free enterprise market, to be operated as a concession.

People are basically good; everyone will help himself or herself. Remember that if they won't, we can just legalize the offense. Or, perhaps the trouble is not with the code at all, but with the theory, or the rules. We can be flexible here as well. If a person can copy 20 WPM, but can neither read nor write correctly, but his lips, he should not be denied access to an amateur radio license so he may participate in our fraternal brotherhood, in lieu of a theoretical "inability" at a time when we should be permitted to demonstrate some other skill, or possess money. Such substitute skills should be course of study, written license, in the same way that one learns to drive a car or to play the piano.

Now the big question about who should replace the FCC in administering amateur radio. If the job were turned over to the ARRL, new Ham Radio, 73 Magazine, and perhaps CO is there still a CO? I would our federal government, it's astounding to our reaching our goal. It is by no means the management of amateur radio to the highest bidder in the free enterprise market, to be operated as a concession.

The best way seems to be a proposal to the US government; this way we can go through the proper channels. The FCC, or whatever replaces it, must establish the Ham Radio License Commission and issue licenses to those who meet the requirements. The FCC will then be responsible for licensing and enforcement.

As an example: Code is a requirement for the MF bands. As time passes, if we see that people want to use code, then the FCC could require this skill for license renewal. It is also possible that the FCC could require some other skill in lieu of sending and receiving code by hand. Perhaps he is a skilled typist, or can understand code as he could learn to copy code. If so, he should be allowed to appear for testing with his computer keyboard and digital code reader under his arm. Provided he successfully operates his machinery and has ample reading skills, he should pass

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Thank you, you've been most helpful. Now, does anyone else have any more gazpuzz to throw on this here fire? Wayne
AM BROADCAST RECEIVER: Here is a neat project for a first-time builder. The gimmick is the coil L1. By using an alligator clip at the various taps on the coil, stations are shifted to the lower frequencies on the capacitor. This enables you to separate the stations more easily. D1 is a 1N34A—don’t use a cheap diode. C1 and C2 are both 365-pF variable capacitors. A good earth ground is required (the finger-stop on a dial telephone is ideal).—Jim Burtoft N3BQH, Washington PA.

IC-25A BATTERY BACKUP: Here is a simple but effective battery backup for retaining memory when the rig is temporarily removed from the power supply. In tests, the battery retained the memory over eight hours.—Francis J. Piraino WA3KKM, Pocono Summit PA.

SIMPLE AND/OR LATCH: This circuit can be used to trip a repeater relay in a timer circuit. For example, if A is high and B is pulsed by a timer, the output will latch high until the input signal ceases. The high output can be used to disable the transmitter. This eliminates the necessity of having a timer which remains high until well after the desired count is reached. A brief pulse is all that is required. The resistor is needed to hold the B input low since the diodes isolate the input. An OR gate could be used in place of the diodes, but the diodes work well. The gate is a CMOS 4081 or a 4011 NOR gate coupled to an inverter at the output.—John Ackermann AG9V, Green Bay WI.

SOLDERING IRON MODIFICATION: To have a better rechargeable soldering iron, remove the diode from the charging unit and install it on the soldering iron. Because the nicads in the iron will now be isolated from the charging pins, it will be impossible to short out. By placing an LED with a current-limiting resistor into the iron, you will get a visual indication every time the battery is charging. Installing the circuit shown here will enable you to charge your battery from either ac or dc. By installing a power diode in the headlamp circuit, the lamp is protected against accidentally burning out when the battery is at full charge.—Richard J. Molby WB7NEG/DA1DB, APO NY.

THE PVC PRINCIPLE VHF ANTENNA: Take one 6’ and one 9’ piece of 12-gauge copper wire and pull each piece until both are slightly longer. This serves to stiffen the copper. Wind the 6’ piece 13 turns on a 1/2-inch form. Leave 1/2 inch unwound to make a connection. Remove the coil form and cut the “one piece” radiator as shown. Solder one end of a short length of 28-gauge copper wire to the center terminal of an SO-239 and the other to an alligator clip. Attach the clip to the coil about 2 turns from the radiator. Cut the 9’ piece into four equal lengths (2’4”) and attach them to the SO-239 as shown. Hang the antenna so that you can trim it for vswr adjustment. Vswr is adjusted by 1) coil tap position, 2) spacing of coil turns, 3) radiator length, and 4) length/angle of radials. After vswr is optimum, solder the coil tap in place. The trimmed antenna can be slid into PVC pipe and epoxied into place. To make the J-stub, take three pieces of RG-8 coax, two 19-21 inches and one 38-40 inches. Carefully remove the outer insulation and braid. Lay the three pieces on a flat table and tape them together temporarily. Solder the coax to the antenna, and connect it to the radiator and the braid to the stub. The radiator/stub assembly can be slid into a PVC pipe. Unsolder the coax, thread it through the hole, and solder it back. The end can be capped and coax putty applied.—Jack Sammarco KC2FS, Union NJ.
NEW PRODUCTS

16-DIGIT DTMF DECODER

Palomar Engineers has announced a new low-cost 16-digit decoder, model P-411. The decoder features high-input impedance so it does not load the line, crystal control for long-term stability and operation over a wide temperature range, dual band-pass filters ahead of the detector, and digital logic that makes it almost entirely free of false outputs. The P-411 operates from +12 volts dc and has a 16-line output as well as BCD code and strobe on 5 lines. For further information, contact Palomar Engineers, 1924F W. Mission Road, Escondido CA 92025; (714) 747-3343.

PORTABLE EARTH STATION

The first completely portable, battery-powered Earth station for receiving satellite transmitted television has been introduced by Gillaspie and Associates, manufacturers of state-of-the-art satellite equipment. The system can be housed in a station wagon or recreational vehicle and used by campers to watch up to 105 channels of TV. The product also has more serious applications because of its ability to provide visual and audio information and data to remote, communications-poor areas.

The system can provide nine to ten hours of television before the batteries have to be recharged, so it could be used to communicate in civil defense emergencies or natural disasters and in areas susceptible to power outages. The system consists of an 8 or 10-foot metalized fabric dish antenna that collapses like an umbrella, and a battery-operated satellite receiver complete with a five-inch screen. It can be hooked up to a battery-powered television set if a larger picture is desired.

The portable unit, like the larger home systems, collects microwave beams sent from satellites circling 23,000 miles above. It electronically amplifies less than one Watt of power more than 10,000 times to produce clear, undistorted picture and sound.

Additional information may be obtained through Diane McNutt, Donald J. Sherman & Associates, 4300 Stevens Creek Boulevard, San Jose CA 95129; (408) 247-7200. Reader Service number 489.

LOW-COST WIND POWER

Thermax has announced a new wind generator design for small power systems. The TC25WG heilus rotor kit was developed as a low-cost battery charger for remote sites and applications, including power for camping, boats, radio operation, RVs, cottages, experimentation, and emergency power. The patented heilus design offers several advantages: It responds to winds from any direction and is self-starting. The TC25WG rotor operates at low rpm and avoids overspeed problems common in propeller designs. Virtually no maintenance is required, and the Lexan vanes resist sun, snow, sleet, and extreme temperatures. Assembly is easy with regular hand tools.

A free information package and further information are available from Thermax Corporation, One Mill Street, Burlington VT 05401. Reader Service number 481.

SUPER-RATT SOFTWARE

With the Super-Ratt radioteletype and CW program for the Apple II, you can have your own RTTY RBBB station on line quickly and easily, according to Universal Software Systems. Super-Ratt is the lowest-priced RTTY/CW program which also contains a full radio bulletin board system. The program will operate in ASCII as well as Baudot at any speed from 40 to 300 baud. CW speeds range from 5 to 100 wpm, with an automatic speed adjustment on receive.

The program may be run in either manual or RBBB modes. Extensive use of disk files permits storage of "canned" material for manual operation. In the RBBB mode, the system automatically saves nearly one hundred user messages to the disk. There are thirty-five different commands on the RBBB. They are all simple English words—and quite memorable.

Almost any modem terminal unit or converter, such as IRL, Flesher, Kantronics, HAL, or others can be used with Super-Ratt as well as such devices as the "RACCOM" card by APRV. The program is not protected against copying. The Basic portion may be listed and modified to suit your tastes. The registered owner's call is installed in the machine code by the factory.

A free one-year subscription to the user newsletter, The Ratt's Nest, is included in the purchase price of $59.95, which also covers shipping via UPS or first-class mail.

For a complete data sheet or other information, write or call Universal Software Systems, Inc., 9 Shields Lane, Ridgefield CT 06877, (203) 438-3117. Reader Service number 488.
The Synchronar 2110 solar watch.

SOLAR WATCH

Reali Time Corporation has just announced a new technological breakthrough in wristwatches, the Synchronar 2100, powered by the sun and programmed to the year 2100 with no resetting required, even for daylight saving time or leap year adjustments. Miniature silicon solar cells automatically gather and store energy from the sun, daylight, or even an ordinary light bulb, and this energy is used to drive a complex integrated circuit. The solar cells also measure the ambient light and adjust the brightness of the readout so that it may be viewed under any lighting conditions ranging from full sunlight to total darkness. Synchonr's system totally eliminates the problem of battery replacements, and even if left in a drawer for months, it will continue to operate.

Synchronar 2100 has dual time zones and is available in either standard or international time modes or a combination of both. It is guaranteed accurate to within plus or minus four seconds per year. An exclusive self-calibration system enables the wearer to adjust the watch to run faster or slower, should environmental extremes require recalibration.

A discrete alarm system, or "police" alert, is provided which, at a prescribed time, causes the display to flash on and off for a period of one minute. Synchronar 2100 features a patented, totally-sealed construction in which all electronic systems are encapsulated within a transparent Lexan module which can withstand shocks up to 25,000 G and water depths up to 750 feet.

Light enters the top surface of the transparent module and charges the solar cells, and the lighted display shines out through the edge above the band, providing a naturally positioned side view. Control switches are magnetically operated from outside the watch, meaning that the seal of the module is never broken.

For further information, contact Reali Time Corporation, 53 South Jefferson Road, Whippany NJ 07981. Reader Service number 485.

RADIO RACK

The Guild Radio Rack comes in finished solid ash. No assembly is required. Guild's rack comfortably holds Kenwood's TS305, VF0230/SP230 or TS20 series, or any similar rigs. Exact measurements are (overall) 16-7/8" W times 14-3/4" H times 14-1/2" D (top compartment) 7-1/2" W times 6" H, and (bottom compartment) 15-5/8" W times 7" H. It is also fully vented.

For more information, contact Guild Radio Rack, 225 West Grand St., Elizabeth, NJ 07202. (201)351-3002. Reader Service number 487.

TRIBAND BEAM

TET Antenna Systems has announced that their top-of-the-line MB35T triband beam is now available. This is a 5-element dual drive antenna for 20, 15, and 10 meters. With the dual drive concept, both the radiator and the reflector are driven with a phase difference that provides extra gain and improved front-to-back ratio.

The beam has only one pair of traps per element for simplicity and reliability. The trap capacitors are coaxial inside the elements to give low losses and weatherproof operation.

The MB35T has a 25' boom, weighs 50 lbs., and provides excellent gain for DX work.

For further information, contact TET Antenna Systems, 1924 E. Mission Rd., Fullerton, CA 92631. Reader Service number 480.

HAMTRONICS FM REPEATER

Hamtronics, Inc. has announced the availability of the REP-100 line of complete repeater packages, including all the hardware and controls.

The REP-100 is constructed on a 7-inch rack panel, with an uncluttered control arrangement. Electrical features include excellent sensitivity (0.15 uV at VHF and 0.2 uV on UHF), both 8-pole crystal filter and ceramic filter for ± 12 kHz at > 100 dB, a/c and heterodyne squelch to lock onto drifting or fading signals, a clean, easy-to-tune transmitter, and up to 20 Watts output. A proportional-controlled crystal oven option provides 2 gpm frequency stability down as low as - 30°F (- 22°C), if needed.

The REP-100 repeater is available for the 6m, 2m, 220 MHz, and 440-MHz bands and adjacent frequencies. It is available also in configurations for remote linking and crossbanding, including 10 meters. The 2m and 220 MHz models employ a 7-section helical resonator in the receiver front end. The UHF version uses 6 tuned lines in the receiver (That is important if you share a site with other transmitters.)

A complete catalog on the REP-100 repeater, and other information, is available from Hamtronics, Inc., 65 F. Moul Rd, Hilton NY 14468-9335. (716)392-9430. (For overseas mailing, please enclose $1.00 or 4 IRC's) Reader Service number 491.

SATELLITE TV ANTENNA KIT

Ghost Fighters, television antenna specialists, has announced the Space Cowboy P-600 series of parabolic antenna kits.

The Space Cowboy P-610 is a 10-foot hexagonal parabolic microwave antenna specifically designed to receive signals from all the domestic satellites, with over 60 channels of video and audio programming to choose from. It tracks the satellite orbit belt on a polar mount and changes from satellite to satellite in seconds. This kit is for the home video enthusiast who wants to save money and have the satisfaction of building.

The P-610 model, compared with most 10-foot fiberglass dishes, has a surface-intercept area 10% larger and a longer than-average focal length. Surface accuracy is proofed-on-site and fully tunable over the entire surface on a point-by-point basis (patent pending) for maximum gain and good picture quality. The surface is heavy duty galvanized steel screen. The P-610 is a true parabolic reflector with a...
tached feedhorn assembly and adjustable polar mount for easy selection of satellites. The kit comes complete with all materials pre-cut and ready for assembly. Some portions of the assembly will require two persons. Assembly and installation of the antenna can be accomplished by the average homeowner in a weekend or two. The polar mount is set on three concrete footings requiring 4 to 6 bags of pre-mix concrete.

Other models in the P-660 series include the P-613 and P-616 (13 and 16-foot antennas respectively.

For further information, contact Ghost Fighters, TV Antenna Specialists, Route 2, Box 136-B, Stevensville, MT 59745 (406) 642-3405. Reader Service number 479.

NEW MICRO SIDEBAND TRANSCIEVER

DenTron Radio Company has announced production of its new mini-sized, monoband transceiver. Titled the MLX Mini, it operates at 25-W PEP and 20-W CW with an LED frequency readout of ± 100 Hz accuracy. Available in models from 196-6 meters, the MLX Mini has selectivity of 2.1 Hz with sensitivity better than ± 35 nV for 10-dB signal-to-noise ratio. Receiver design is the single-conversion superheterodyne type with total power requirements of 12.14 V dc.


GLOBAL'S DIGITAL PULSER KIT

The DPK-1, a new digital pulser kit designed for use as a pulse injector in stimulusesponse testing of digital circuitry, has been introduced by Global Specialties Corporation.

This pulse generator is a portable test instrument featuring multi-logic family compatibility. It operates on both TTL and CMOS circuits. its pulse width is 15 seconds ± 30% for TTL and 5 V CMOS and 3 seconds ± 30% for 15-V CMOS.

One touch of the pulse button and the DPK-1 attempts to inject a positive pulse, then a negative pulse. One of these pulses is ignored, depending on the logic state the DPK-1 output is biased at (determined from node under test). Keep the pulse button depressed and after one second the DPK-1 delivers a continuous pulse train of positive and negative pulses at a rate of 150 pulses per second. In the same manner as the single-shot event, one of these pulses will be ignored, leaving a positive or negative-going pulse train at a 75-pulse per second rate.

An LED indicator flashes once to confirm single-pulse output and remains on for continuous pulse train confirmation.

Pulse voltage level is determined by the current requirements of the node under test. The DPK-1 output pulses are capable of sinking or sourcing up to 100 mA, which is sufficient drive to permit forcing most nodes to an opposite state without desoldering.

This digital-pulse generator offers short-circuit protection. High impedance output (minimum, 20-megohm) when not pulsing allows the DPK-1 to pulse into a short circuit continuously without damage.

The DPK-1 is circuit-powered at 5-18 V dc from Vcc of the circuit under test. A power cable, wired directly into the unit, terminates in two color-coded vinyl-jacketed alligator clips.

The DPK-1 digital pulser comes as a complete kit, including all parts, solder, wire, PCB, etc., and a comprehensive construction and operating manual. Kit construction and testing can usually be completed in one to three hours. Its dimensions are 5 1/8 x 1 0" x 0.7" and it weighs 3 oz.

For further information, contact Global Specialties Corporation, 70 Fulton Terrace, PO Box 1942, New Haven CT 06509. (203) 624-3103.

AIDS FOR THE BLIND AMATEUR

Although many textbooks have been translated into braille and onto recorded media, blind hams, technicians, and scientists are faced with the continual frustration of obtaining current and supplemental materials.

The Rehabilitation Engineering Center publishes a newsletter quarterly in braille, large print, and recorded form which will serve as a guide to the current technology as applied to the needs of the blind and persons with impaired vision. The newsletter, called Technical File, facilitates the pursuit of electronics interests among technically oriented, visually-impaired persons by serving as a reference source, a teaching tool, and a hands-on guide for construction projects and control modules that are already transcribed, catalog abstracts, data on integrated circuits, manufacturers applications notes, and construction details, to list just a few of the contents.

General interest is the primary purpose of the newsletter, but it also describes such processes as soldering, layout on circuit boards, and the use of power tools. The techsource is kept up-to-date by the subscriber.

For further information, contact Global Specialties Corporation, 70 Fulton Terrace, PO Box 1942, New Haven, CT 06509.

ICOM IC-45A SYNTHESIZED UHF MOBILE

Icom has announced availability of the IC-45A, providing FM mobile coverage of 440-450 MHz. Major features are its small size (2' x 5 1/2" x 7"), easy-to-read LEDs, 8 memories, priority channel, band and memory scan with automatic resume, memory backup provisions, 1-MHz upshift for quick GSY, and variable duty cycle. The touchtone TM microphone is included.

For more information, contact Icom America, Inc., 1212 116th Ave. NE, Bellevue, WA 98004. (206) 454-8555.

MOBILE ANTENNAS

Valor Enterprises, Inc. introduced a new series of mobile high-frequency antennas at the Chicago CES Show last June. These HF mobile antennas for the professional and amateur operator are approximately 8 feet in length, and are of a heavy duty, slim line construction designed for HF amateur bands on 75, 40, 20, 15, and 10 meters. Heavy-gauge copper wire wound on 1/2" fiberglass with nickel-chrome brass fittings, and 17-1 taper ground stainless-steel
whips ensure dependable mobile operation. The 4' stainless-steel whip is field-tuned for lowest vswr and double-locked with stainless-steel set screws. The antennas feature 38-24 ferrules to fit standard mobile mounts and are power-rated at 500 Watts PEP for top mobile performance.

For further details, contact Valor Enterprises, Inc., 185 W. Hamilton St., West Milton OH 45363. Reader Service number 484.

**RETI CON ACTIVE FILTER**

Applied Invention is the source for the recently introduced Reticon R-5620 programmable active filter—a complex MOS integrated circuit. The R-5620 uses switched-capacitor technology to synthesize a two-pole pair active filter that requires no external components and operates over the range of 0.05 to 25 kHz.

The five basic filter types: low-pass, high-pass, band-pass, band reject, and all-pass can all be implemented by the R-5620, and a programmable sine-wave oscillator is also possible.

Switched-capacitor filters (SCFs) are analog filters in which fixed resistors are replaced by time-div/datan-variable switched capacitors, resulting in very stable filters that can be tuned with a variable clock source.

The simple programmability of this new SCF makes it attractive for computer controlled synthesizers and other analog digital systems applications.

For additional information, contact Applied Invention RFQ #2, Route 21, Hillsdale NY 12529. Reader Service number 483.

**YAESU'S ACTIVE ANTENNA**

Yaesu Electronics Corporation recently announced the Introduction of the FRA-7700 active antenna for the FRG-7700 de luxe HF receiver.

The FRA-7700 utilizes a four-foot (1.2 meter) whip in conjunction with a low-distortion MOSFET preamplifier, providing short-wave reception for receiver owners unable to erect an outdoor antenna. The FRA-7700 includes front-panel gain control, tuned-circuit peaking, and a preamplifier on/off switch for maximum versatility.

For details on the FRA-7700, contact Yaesu Electronics Corp., PO Box 49, Paramount CA 90723. Reader Service number 486.

**RT-1100 MULTIMODE TERMINAL**

DGM Electronics has just introduced the RT-1100 receive terminal for Baudot, ASCII, and Morse. The RT-1100 converts the audio from your receiver, decodes it, and displays the words on a video monitor or TV set (using 11 modulation). The RT-1100 incorporates an active filter demodulator with scope tuning outputs. It will copy 170, 425- and 830-Hz shift RTTY signals at speeds of 66, 66, 75, and 100 wpm on Baudot and 110 baud on ASCII. The unit will copy 840 wpm Morse signals using automatic or manual speed tracking. The RT-1100 has a parallel ASCII printer output for hard copy. The video output provides 16 lines of 32 characters per line with 2 pages. The second page is stored in memory and can be recalled by using the page 1-2 switch on the front panel. The unit has a built-in 110-V ac power supply and is housed in an attractive 3" x 10" x 10" case with brushed, anodized front and rear panels. The cover is a gray wrinkle finish. The unit comes with a one-year warranty on parts and labor.

For more information, contact DGM Electronics, Inc., 787 Briar Lane, Bellfit WI 53511; (608) 362-0410. Reader Service number 477.

**MOBILE ANTENNA CONVERTER**

JL Industries has just announced their new X-Panda-Five mobile antenna adapter, which enables the owner of a Hustler, Hy-Gain, or similar mobile antenna to convert his antenna to a five-banders by adding resonators.

The X-Panda-Five consists of a precision-machined aluminum hub fitted with five rustproof 3/8" by 24" studs machined from high-tensile-strength carbon steel. The hub is attached to the antenna mast, and each of the five resonators screws onto the hub. One resonator is mounted vertically and four are mounted horizontally.

When the adapter is installed on your antenna, you can use either regular or super-size resonators and change bands without leaving the driver's seat. This assumes, of course, that you pre-tune each resonator to your favorite operating frequency in that band. No antenna tuner is required.

The X-Panda-Five also makes a good antenna for apartment houses and condominiums when fitted with the appropriate resonators and ground planes. It can be used to make a multiband antenna system for vans, campers, motor homes, and travel trailers.

For more information, contact JL Industries, PO Box 30413, Fort Lauderdale FL 33302. Reader Service number 490.

**ANTENNA COUPLER**

Wayne Research & Development has announced the availability of a new antenna coupler that replaces the center insulator of a balanced antenna system. The Wayne B-T-L antenna coupler contains an air balun, a tapped inductor, and a variable capacitor. The coupler is housed in an ABS plastic box with a removable lid for inspection and servicing. The strain insulator is made of Delrin plastic.

With the aid of graphs in the Instruction booklet (supplied) and an 1/2 meter, the user can design a matching network to match the low impedance of his wire beam or the high impedance of his loop antennas. Using the network as a T or an L, the Wayne B-T-L antenna coupler will match impedances over a frequency range from 10 kHz to 30 MHz.

The insertion loss is not more than -0.006 dB from 1.8 to 25 MHz, and minimal from 25 to 30 MHz. The introductory price is $49.95. For further information, contact Wayne L Jamison W5FJS, Wayne Research & Development, PO Box 75144, Houston TX 77234. Reader Service number 478.

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**Picture Credits**

-DGM Electronics' RT-1100 receive terminal.
-The Wayne B-T-L antenna coupler.
-Yaesu's FRA-7700 active antenna.
-The X-Panda-Five mobile antenna adapter by J. L. Industries.
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MODEL UM-1114A: Low Resolution Multiplier & Frequency counter does not enable view frequencies in an uncounted order and make comparisons. 500 ppm counter for low frequency instruments. BNC Input/output

HIND HELP

I need the manual and/or schematic for a Knight T10 transmitter. I am willing to pay a reasonable amount for any information.
J. W. Roberson WSRDI
745 Willow St.
Huntsville TX 72053

I would appreciate information on using the interact computer in amateur radio applications.
George W. Moran W2DGZ
950 Enron Drive
York PA 17402

Anyone out there have a schematic for an Ameco six meter type CN VHF converter? Expenses will be reimbursed.
H. S. Robb AFW
Box 17
Bird Island MN 55310

G.W. Legel's (N6TO) article "Dissertation Upon Roast Pig" (October) offers an interesting and useful suggestion for transformer salvage, but ignores an extremely important personal caveat.
Old transformers were frequently filled with polychlorinated biphenyls (PCBs). This is a dangerous, toxic material that should be dealt with by trained professionals. Old, oil-cooled transformers must be presumed contaminated. Unless they bear a green certification sticker, they should not be handled by amateurs under any circumstances.
Tom Archer KOSMR
Huron OH

The $100 TVRO receiver is a real winner. I'm going to build one, except for one small detail. The August issue of '73 (on page 64) has the layout of the downconverter used in Rex's "Cheap Trick." The only problem is that in Fig. 4 the scale is 10mm per division. The printed version is 128mm long when it should be 100mm. I'm sure that was done for clarity, but it is hard to interpolate 128mm to 100mm. I'm also sure that you know the dimensions at the frequency are critical.
What I'm asking is if you have an actual size drawing from Steve Gibson, could you print it in the next issue at 1:1? Please?
David Lawson W1A1MC5
Dallas TX

Here you go—Ed.

Fig. 1 in "The Vertical Deuce," on page 61 of the September issue, was drawn incorrectly. As drawn, closing the relay would put a short across the center conductor and braid of the feedline instead. The braid should be connected directly to ground and the center conductor should be hooked up to the coil at the opposite end from the antenna.
Avery Jenkins WBA7LG
73 Staff

CORRECTIONS

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The HF 10/160 solid-state Pll transceiver. The voice at the other end of the telephone line belonged to Bruce Sterrinck, president of National Communications Group, Inc. Impression of that nice little NCG 15-meter monoband rig which was reported in July, 1981, now isn't unusual for Bruce to call and chat, but I sensed that he had something special up his sleeve this time. After the usual chit-chat, he dropped the other shoe: "Jim, I've just got a new rig from Japan, how'd you like it?"

Indeed, all controls fall more or less conveniently to hand, and that if you have used any of the modern solid-state rigs from Japan, you will find everything where you expect it. It is impressed with the nice manual tuning feel and the utter simplicity of using the rig.

Physical Description

The transceiver is manufactured by Matsushita Electronic Industries Company Ltd., a parent company of Panasonic among others. It measures approximately 13 inches wide by 5 1/2 inches high by 16 inches deep (if you count the massive rear panel heat sink) and weighs 32 pounds — but wait a minute: that includes both ac and dc supplies — built-in! No need for an external supply, whether you are mobile or fixed. The usual tilt ball on the base gives a comfortable angle for viewing the front panel is provided, and there is the side carrying handle intended to make the rig conveniently portable. The case is dull black and has a vagueness military, i.e., functional, look. Perhaps the first thing you notice is the centrally-located spinner dial on the front panel, just below the large readout frequency display and control knobs. There no great leap into the unknown here: C for CW, U for upper sideband, and LC for lower sideband. The VOX sensitivity, VOX delay, and anti-VOX controls are on the left-hand side of the front panel, and the VOX sensitivity control knob has a concentric switch for the 100-kHz frequency marker provided in addition to the synthesized readout, because this permits the on-board phase-locked-loop circuitry to be zeroed against WWV, for example.

The new bands are provided for as well, and the rig covers all amateur frequencies with generous overlap on the ends for MARS or other use. The 5-Meter dial is in the upper-left-hand corner, and indicates relative power output or ALC (your choice) in the transmit mode and S-meter reading in the receive mode. As a matter of fact, I think you would be particularly pleased with the 5-meter, as it doesn't seem to be particularly leaky or particularly generous. Somehow, I have the feeling that it is about right — and consistent — from band to band.

The power-control switch is a toggle in the upper-left-hand corner, below the meter is a row of switches that control receiver functions such as noise blanker, meter scale, fast-scan, and tuning range. The tuning device is an optical chopper which permits simple dial lock to a desired frequency quite simply by disengaging the manual dial. There is a tuning-rate switch that permits you to tune each band in 50 Hz, 100 Hz, or 1 kHz increments. Right next to that manual selector is an auto-tuning switch that permits tuning of the up or down modes, and changes frequency at the rate selected by the adjacent rate switch. I never thought I would need — or want — such a device, but it's handy and I use it a lot.

Below the switches just mentioned are the microphone connector (standard Jap- anese 0.4 pin) and the phone jack (standard 1/4-inch diameter) right next to it. Then comes the key jack, which uses the smaller-diameter plug of the size used to plug in speakers and the like (I believe it is 18-gauge). Fortunately, another rig I tested recently had this size key jack, so I was ready, but on the front panel? Why there of all places? The answer is simple — convenience. I realized that as I recalled the times I have fumbled around the back of a rig you can't even try to plug in the key jack. The HF 10/160 has a built-in keyer placed on the bottom plate of the rig, and an key for an external speaker should you wish to use one. I found the audio quality to be quite good, even with the small enclosed speaker — and that certainly is the way to go for portability. The keyer is normally used in my shack, however, so I used that for the evaluation.

Next to the key jack is the mode-selector switch — permitting wide or narrow CW and upper or lower sidebands — you have to choose which. On the dial escutcheon you will find two small pushbuttons that activate the dial lock (left button) and the TX/RX switch. On the upper-right-hand side of the panel you will find the Delta F switch and the RX offset switch (RT).

The Delta F control corresponds to the receive incrementing tuning control (RT) on the other rigs. By pushing the switch, a red LED comes on to show that the circuit is active. Now, by varying the Delta F knob, you can move the receive frequency higher or lower than the dial setting frequency by about 1 kHz.

The TX/RX control permits further adjustment of the transmit or receive frequencies separately. When the switch is depressed, a red LED is illuminated to show that the circuit is active. How's that sound? If you choose you can have a transmit frequency where it is but wish to change the receive frequency. Push in the TX/RX switch to lock the transmitter frequency on the existing dial setting. Now, the receive frequency can be adjusted by the main tuning dial. The purpose of the effect of a dual vfo, and permits you to set the transmit frequency, for example, between DX on a split frequency, and then use the receive and main dial to tune the DX station. If you wish to listen to your frequency to your own frequency, simply flip the switch — for example, by tuning over to 14 MHz on a split frequency, and then use the receive and main dial to tune the DX station. If you wish to listen to your frequency to your own frequency, simply flip the switch — for example, by tuning over to 14 MHz on a split frequency, and then use the receive and main dial to tune the DX station.

Bandy-Selection push buttons are next, and require a separate discussion — since I will come back to them later. You should know, however, that you can store up to four different frequencies and scan between any pair of them at a variable rate, using "autoecho." If you really want to get fancy about all this, you can use all these features in combination, for example, Delta F, and memory select. I am sure that an accomplished dial twister and button pusher could really play a symphony on this rig after a few evenings of practice. Versatility is the name of the game with the HF 10/160 from NCG, and it's unlikely you will run out of permutations and combinations to try.

The main control knobs of the transceiver lie below the switches, and include in the top row: transmit frequency variation (Delta F), tuning (± 1 kHz) and the audio gain controls on concentric shafts for the receiver, and in the bottom row: the make-and-break carrier-control knob, the audio compressor/speech processor control, and finally the bandswitching 1.8-29.7 MHz.

Band Coverage

The HF 10/160 covers 1.8-20 MHz in the 160-meter band, 3.5-4.0 MHz in the 80-meter band, 7.0-7.3 MHz in the 40-meter band, 10.0-10.5 MHz in the 30-meter band (providing some general reception, too), 14.0-14.35 MHz in the 20-meter band, 18.066-18.166 MHz in the 17-meter band, 21-21.5 MHz in the 15-meter band, 24.89-24.99 MHz in the 10-meter band, and 29.0-29.7 MHz in the 10-meter band.

Stability is given as less than ±0.2 Hz within one hour and less than ±0.3 Hz after one hour. A comment about the extraordinary frequency stability was received from a ham on 40 meters who had been listening to me for half an hour. He mentioned that his frequency as measured on his frequency meter had changed once during the entire time he had been monitoring! This means that both voltage and temperature stability must be excellent, as the comment, by the way, was unsolicited. 

Transmitter Description

The final-stage input is 200 Watts on 160, 120, and 80 Watts on 10 meters. Balance-type modulation is used, and carrier suppression is more than 40 dB. Sideband suppression is more than 50 dB, and spurrious radiation is at a level below — 40 dB. Microphone impedance is about anything you want, and a range of 500 to 5000 Ohms is acceptable. The output connector for the is the usual 50-Ohm UHF type SO-239.

**Some Features Compared**

<table>
<thead>
<tr>
<th>Feature</th>
<th>NCG 10/160</th>
<th>TS-430</th>
<th>FT-101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuning Power Supply</td>
<td>PLL-synthesized</td>
<td>Vfo (capacitor)</td>
<td>Vfo (capacitor)</td>
</tr>
<tr>
<td>Weight</td>
<td>32 pounds</td>
<td>Ac</td>
<td>Ac (dc optional)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>13 inches x 5 1/2 inches x 16 inches</td>
<td>32 ounces</td>
<td>32 ounces</td>
</tr>
<tr>
<td>Frequency Memory</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Autoscans</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dual vfo</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Tune rate</td>
<td>3-step</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Paper tuning</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>I-f tune</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Notch filter</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>CW</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TX/RX control</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dilt-fine tune</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>All solid state</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
was somewhat bothered by the lack of a narrow CW filter, but I found that I could operate in all but the worst of crowded conditions by using the IF shift control to bring the 3-kHz window into a better location with respect to the carrier. This gave the impression of an improved selectivity by removing part of the background through which external noise would otherwise be audible. All CW operation very satisfactory, and was delighted to be able to work about anything I could hear. Although I did not find the shielded filter box and volume controls to be internal, I must confess that I did not search for them either. Once the English-language manual arrives, it will be a snap to get the rig onto my own 10-kW output level and tune it in. Single-sideband operation is where this rig really shines. I am not much of a phone operator because I have been a bit overconcerned about the modulation and signal levels that I would be able to produce. I needn't have worried; each report was outstanding.

The evening of single-sideband operation went something like this: "W1XU, this is W... You are five by nine here. By the way, what rig are you running?" The audio is outstanding, as usual with the Gaig control positioned at 10 o'clock.

"W..." This is W1XU right back. Thanks, OW, for the fine report. The rig is a new one and I think it is pretty good for 23. I must say I didn't tell you the make and model just yet, but I can tell you it is nominally a 100-Watt output rig, made offshore.

"W1XU, this is W..." What kind of rig did you say you were running? The audio is superb. Are you running a processor?

"But thanks for the report. I appreciate it. Can't tell you what the rig is, you'll read about it in 73 one of these months."

(Breaker) "W1XU, this is W..." I just want to tell you that this rig is so fine, I'll read about it in 73 one of these months.

"(Later that evening) W1XU, this is WA..." Audio certainly doesn't sound any better to me. I have been listening to you for half an hour, and your frequency is rock steady. You haven't varied by one cycle since I started listening. I also wanted to tell you that your rig is super, whatever it is.

"And I am sure you don't have any audio processing? It's crystal-clear and has magnificent punch."

Rather than bore you with further reports of the same or similar content, I'll just mention that every report has been outstanding. I have been very careful about avoiding requests for audio quality reports, and each one was unsolicited. In spite of the fact that I consider myself a dyed-in-the-wool CW operator, this rig has gone a long way to turn me back to SSB. Maybe it will help to underline this for you when I admit that my voice is one of those mid-range voices that could be described as soft-spoken. It does not "talk up" a rig like many that you hear. In fact, I suppose it's a Mike amplifier to help out, but with this rig it surely isn't necessary and probably is not desirable. Of course, being solid-state, no tune-up is necessary, and full output is delivered into an matched antenna. I did not notice any SWR shutdown protection at SWR values up to about 1.5 to 1. Inadvertently, I once attempted to operate with the antenna totally out of ground. Unfortunately, the finals shut down, and—fortunately—no damage was done. This was immediately obvious by the power output meter, which didn't flicker. Not having any SWR values in the 3:1 range, I can't be sure at what point shutdown began, but I would guess that 3:1 would result in a power output of about 50 Watts or less in other words, a progressive protective shutdown. The memory function had me a bit perplexed, but I got brave enough to finally give it a whirl. I dithered in two frequencies about 50 kHz apart, and committed them to memory: 14.007 on dial, punch the Write button, followed by button 1. 14.007 is now in memory 1 and also displayed on the screen. (Punch the vio button and you will get a dial in another frequency.) This time, I dialled up 14.012, depressed Write button and follow by vio 14.012 was now in the memory 2 location. Next, I made a mistake of about 0.2 kHz in memory 2 and 4... which I did, according to the previously described method. Now, by merely selecting any of the four memory buttons a continuously running spectrum was memory in memory. Nothing special, you'll agree—and about like any transceiver with memory.

Now, what about the autowatch function? Well, I pushed it—and what a result! The receiver goes into a scanning mode and scans between the two frequencies in memories 3 and 4! It scans very slowly—I would guess no faster than about 10 kHz per second. When it reaches the second frequency it returns to the lower one and begins scanning again. Although I don't have any particular need for that feature at this time, I can visualize applications of this feature when it might be very worthwhile to have. For example: Suppose you are looking for a friend on a particular frequency, and you can't get through. Just set the rig in this autescan mode above and below the intended frequency and punch autowatch! When your friend comes on, you'll hear him because the scan rate is slow enough to permit identification before it moves on next.

Frankly, I have not used audio compressors except on some DX contacts, where the reports have indicated an improved readability—perhaps because of the higher average power output. There were no adverse comments as to what had been on local contacts.

So far, I've not been able to find the time to install the rig in the car, but may do so in the near future to give a hamfester weekend. It's a long trip—about 400 miles each way—so that should provide ample opportunity to give the rig a real go during a hamfest weekend. I have no reason to think that it will perform other than spectacually.

Is this rig for you? Well, of course, it depends upon what you are looking for. Certainly it has many nice features, including some that aren't available in the run-of-the- mill modern transceiver, and it is rugged and functional. The price is right, as well, and does not seem as high as it is actually in the price range of similar transceivers. I felt the dial was very satisfactory, and the knobs, switch, and panel layout are as one would expect. The only picky-picky complaint I have (and this wouldn't bother any one else, I'm sure) is that the small knobs have knobs that decorated small solid-state stimulate metal and it looks like plastic, not metal. If I were the manufacturer, I'd forget trying to dress it up with this chassis. Leave them all black, and they'll be that much better for it.

You may find there is enough information available on the metering modes, all you get is a true output, 5-meter, and ALC information. Upon further consideration, what more do you really need?

With this article is a handy compass chart for you, between the HF IC-10A and two other contemporary rigs in the same price range. It is long over due, and—furthermore—will tell you if your new rig is really right for you. If you use a remote mic, or a swiveling microphone, or a AM receiver, or a SWR meter, then you may be interested. If you're not like me, you think I will be... very much so! For more information, contact NCQ

Using the Rig

This report is necessarily a preliminary and general one because the manual I have is In Japanese. The English versions should be available (along with the rig) by the time you read this. In spite of this, I would say that because it is an English language manual, I found that I paid more careful attention to the drawings and photos than usual. These are abundantly clear, and it was possible to almost immediately set up the rig incorrectly if you had any experience at all in putting in a "transceiver-from-the-box.

Carefully unpacking the rig from the usual sturdy cardboard box, I found the foam padded shelters of the container, I found a separate bag containing the microphone and still another small box with the ac and dc power cords inside. Selecting the ac cord, I plugged it into the polarized multi-pin socket on the back. My ground wire was put on the terminal, underneath the wash and wrench nut. The microphone plugged into the usual 4-pin front-panel connector.

One obtains a first impression of any rig as a whole from its cocoon, and this one was no exception. Its general appearance, weight, and feel lend the impression that it is functional and business-like in a no-frills, bulk and finish save any micky-moly look.

Being a CW man at heart, I tried to make that mode first, so I plugged my electronic keyer into the rig, switched the operate switch to VOX, and set the sensitivity control and delay control for comfortable semi-automatic break-in. Keying the rig produced a fine side-tone—to pleasant the ear—and my power-output meter showed a power output of approximately 70 Watts on 40 meters. A quick twist of the Mic Gain/CW Gain control brought the output to 100 Watts. The stations I worked on 80, 40, 20, and 5 meters all reported line keying and good solid signals with a nice CW note.

The only small objection I had was from an operator who claimed that on the initial (when the relay came on) there was a slight frequency warp which disappeared on the second relay hold. (This will be corrected in subsequent production rigs.) However, if you choose to set the VOX delay to a long duration, there will be only one note. This has to be the first character. This would be true, also, in the manual mode, and thereafter you should hear no complaints. Not having heard this myself, I can only report what that one operator told me. Significant, perhaps, no one else mentioned it.

The station, I mention is 1275 North Grove Street, Anaheim CA 92806. Reader Service number 492.

Jim Gray W1XU

73 Staff
priority switch allows you to sample any one of the memory channels every five seconds, regardless of whether the scanner is on or another frequency is being listened to. The S-Meter/RF-Output Indicator is of the currently-popular LED bar type.

The transmitter in the IC-290 has a high output of 10 Watts. By pulling out on the squelch knob, you are in low power which comes through from the factory set at 1 Watt and is internally adjustable. Transmit audio reports that I received were all favorable. The repeater offsets are controlled by two front panel switches. To the left of the main tuning knob is a three-position offset switch, selecting all offset, down, or simplex. The offset frequency is selected by placing the mode switch in the Offset/Placing and dialing the main tuning knob to the desired frequency. Then you return the mode switch to the FM position and your offset is set until you change it. Internal transmitter controls in clude everything you should need from de-viation-adjust in FM to CW sidetone-adjust.

Icom has provided an excellent operating manual. It includes inside photographs with all internal adjustments very well labeled. In fact, the manual is so good that Jeff DeTraY W8BTH used it to describe to me over the phone where the deviation pot was located. The manual with all its descriptive pictures was at his house and the reg was on his bench. He found the pot and described to me exactly where it was in just a matter of seconds. There is no need for an extra-cost service manual just to make adjustments.

With the IC-290 AE, Icom has once again demonstrated its ability to pack many features into an extraordinarily small package. And yet they've done it without sacrificing operator convenience. As the sum total cycle declines and all-mode rigs proliferate, we can expect to see more and more SSB and CW activity on 2 meters. Radios like the IC-290 will bring a lot of new blood to the low frequency bands. SSB-3927, 7250, 14295, 21370, and 28125.

On the other hand, SSB-3927, 7250, 14295, 21370, and 28125.

LET S FOR JUST A MOMENT PECK INTO THE CONTENTS AND SEE WHAT'S THERE THAT MAY INTEREST YOU AND HAVE APPLICATION TO YOUR PARTICULAR SITUATION. (I'M CONVINCED THAT LESS HAS SOMETHING FOR EVERYTHING TASTE AND PERSUASION.) THE BOOK IS DIVIDED INTO TWO BASIC PARTS. PART I IS TITLED "HOW ANTENNAS WORK," AND COVERS IN TEN CHAPTERS THE FOLLOWING SUBJECTS: TAKING A NEW LOOK AT HF ANTENNAS; WAVES AND FIELDS; GAUSSES AND TOSSES; FEEDING THE ANTENNA; CLOSE-SPACE BEAMS; ARRAYS, LONG WIRE, AND GROUND REFLECTIONS; MULTIBAND ANTENNAS; BAND-WIDTH; ANTENNA DESIGN FOR RECEPTION; AND THE ANTENNA AND ITS ENVIRONMENT.

PART II COVERS "THEORY INTO PRACTICE," AND INCLUDES THESE CHAPTERS: SINGLE-ELEMENT ANTENNAS: HORIZONTAL BEAMS; VERTICAL BEAMS; LARGE ARRAYS, EISEN-STEIN BEAMS; MOBILE AND PORTABLE ANTENNAS; WHAT KIND OF ANTENNA?, MAKING THE ANTENNA WORK, AND ANTENNA CONSTRUCTION AND ERECTION.

IF YOU CAN SEE, THERE'S ENOUGH MATERIAL THERE TO KEEP YOUR WINTER'S INTEREST, ONE WAY OR ANOTHER, AND SOMETIMES BETTER THAN—WHATEVER YOU MAY HAVE TRIED BEFORE.

LES MOXON'S ARTICLES, SKETCHES, AND IDEAS HAVE APPEARED IN THE RIGSB PUBLICATIONS, IN QST, AND IN COLLECTIONS AND MANUSCRIPTS EVERYWHERE. NOW, AT LAST, WE HAVE THE MAN ALL BY HIMSELF IN A BOOK THAT IS BOUND TO BECOME A MUST FOR THE BOOKSHELF. N. A. Moxon G6XN scarcely needs an introduction to all two generations of antenna enthusiasts. His fascinating descriptions of antennas of all kinds, ranging from beams to verticals and from wire antennas to space-saving and "Hidden" antennas, have inspired thousands of radio amateurs in this country and abroad to try their hand at just one more antenna. More often than not, the GNX antenna will exactly fit the requirements and will perform at least as well—and sometimes better than—whatever you may have tried before.

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NEWSLETTER OF THE MONTH

This month's winning newsletter is the Printed Circuit, published by the Lubbock Amateur Radio Club in Lubbock, Texas. As well as its unique masthead, the Printed Circuit offers a variety of features not found in most newsletters. For example, one issue features a full-page profile of a local old timer, which was followed by a column on personal computers. Not leaving out other areas of interest, the editor of the Printed Circuit included a story on amateur participation in a recent disaster drill and devoted another full page to DX news and propagation predictions.

And that's not all—there is also a regular technical column, public service announcements, repeater update, puzzles, and a monthly activity calendar.

One sure way of divining the success of a publication is by the activity of its letters section, and the Printed Circuit is not lacking in that area, either. Many newsletter editors must dream of getting the number of letters received by the Printed Circuit.

To top it all off, the Printed Circuit publishes a Q & A session with "The Old Ham." The Old Ham addresses timely and pertinent subjects, such as what to do in a Toronado warning and how to tell a Toronado from a Chevy. Hats off to Becky Swann WDK5BO and the staff for putting out a newsletter with more stuffed into it than a five-flavor banana split.

73 encourages clubs to send in their club newsletters. Just address them to 73, Pine Street, Peterborough NH 03458. Keep us up to date with what is happening in your area, and maybe even win the Newsletter of the Month contest.

THE PRINTED CIRCUIT

FREQUENCIES:
Phone—1820, 3770, 3900, 7070, 7230, 14150, 14300, 21200, 21400, 28500, 50.1, and 146.52.
CW—1810, 3525, 7025, 14025, 21025, 28025, 50.1, and 144.1.

Suggest phone on the even hours (GMT), CW on the odd hours (GMT). Since this is a Canadian-sponsored contest, remember to stay within the legal frequencies for your country!

AWARDS:
A plaque will be awarded to the highest score single operator, allband entry. Certificates will be awarded to the highest score in each category in each province, territory, US call area, and DX country.

ENTRIES:
A valid entry must contain log sheets, dupe sheets, a cover sheet showing claimed QSO points, a list of multipliers, and a calculation of final claimed score. Cover sheets and multiplier check lists are available. Entries should be mailed within one month of the contest, with your comments. To CARF, PO Box 2172, Stn. D, Ottawa, Ontario K1P5H4, Canada.

Results will be published in TCA. The Canadian amateur magazine. Non-subscribers may include an SASE for a copy of the results.

2ND ANNUAL 40-METER WORLD SSB CHAMPIONSHIP

Starts: 0000Z January 8
Ends: 2400Z January 8

SPONSOR: 73, Peterborough, New Hampshire 03458.

MISCELLANEOUS RULES:
Work as many stations as possible on 40 meters phone during the specified times of allowable operation. The same station may be worked once. Crossmode contacts will not count. Single-operator stations may operate a total of 16 hours. All the multi-operator stations may operate the entire 24-hour period. Off periods must be noted in your log(s) and on your summary sheet. Off periods are no less than 30 minutes each.

OPERATOR CLASSES:
(A) Single operator, single transmitter, phone only. (B) Multi-operator, single transmitter, phone only. EXCHANGE:
Station(s) within the continental US and Canada transmit an RS report and state, province, or territory. All other stations, including Alaska and Hawaii, transmit RS report and DX country.

POINTS:
1 QSO point is earned for each station worked in the continental 48 US states and Canada or within your own country. All other contacts are two points each. List points for each contact on your logsheet.

MULTIPLIERS:
1 multiplier point is earned for each US state (40 maximum) each Canadian province or territory (13 maximum), or DX country worked.

FINAL SCORE:
Total QSO points times total multiplier points equals claimed score.

CONTEST ENTRIES:
Each entry must include a contest log, a contest summary, and multiplier checklist. We recommend that contestants send for a copy of the contest forms. Send an SASE to the contest address listed below.

CONTEST DEADLINE:
Each entry must be postmarked no later than February 12, 1983.

DISQUALIFICATIONS:
Omission of any required entry form, operating in excess of legal power, manipulating of contest scores or times to achieve a score advantage, or failure to omit duplicate contacts which would reduce the overall score more than 2% are all grounds for immediate disqualification.

AWARDS:
Contest awards will be issued in each operating class in each of the continental 48 US states, Canadian provinces and territories, and each DX country represented. A minimum of 5 hours and 50 QSOs must be worked to be eligible for contest awards.

CONTEST ADDRESS:
To obtain copy forms or to submit an entry, forward an SASE to: 40-Meter Contest, Billy E. Maddox, 468 Century Vista Drive, Arnold MD 21012.

2ND ANNUAL 160-METER WORLD SSB CHAMPIONSHIP

Starts: 0000Z January 15
Ends: 2400Z January 16

SPONSOR: 73, Peterborough, New Hampshire 03456.

OBJECT:
To work as many stations as possible on 160-meter phone in a maximum of 30 hours allowable contest time. Multi-operator stations may work the entire 48-hour contest period. Stations may be worked only once.

ENTRY CATEGORIES:
(1) Single operator, single transmitter, phone only. (2) Multi-operator, single transmitter, phone only.

EXCHANGE:
Stations within the continental US and Canada transmit an RS report and state, province, or territory. All other stations, transmit RS report and DX country.

POINTS:
All valid two-way contacts score five (5) QSO points each.

MULTIPLIERS:
1 multiplier point is earned for each US state (48 maximum), each Canadian province or territory (13 maximum), or DX country worked.

FINAL SCORE:
Total QSO points times total multiplier points equals claimed score.

CONTEST ENTRIES:
Each entry must include a contest log, a contest summary, and multiplier checklist. We recommend that contestants send for a copy of the contest forms. Send an SASE to the contest address listed below.

CONTEST DEADLINE:
Each entry must be postmarked no later than February 12, 1983.

DISQUALIFICATIONS:
Omission of any required entry form, operating in excess of legal power, manipulating of contest scores or times to achieve a score advantage, or failure to omit duplicate contacts which would reduce the overall score more than 2% are all grounds for immediate disqualification.

AWARDS:
Contest awards will be issued in each operating class in each of the continental 48 US states, Canadian provinces and territories, and each DX country represented. A minimum of 5 hours and 50 QSOs must be worked to be eligible for contest awards.

CONTEST ADDRESS:
To obtain entry forms or to submit an entry, forward an SASE to: 40-Meter Contest, Billy E. Maddox, 468 Century Vista Drive, Arnold MD 21012.

1982 25 MAGAZINE WORLDWIDE DX SSTV CONTEST

1st DX FMY7CD 1022 pts.
1st US KE1Y 91.2
2nd VE4AOG 453
3rd VE6WVP 410
4th VE3JW 368
5th WD5JPX 331

63 entries total were received

Next SSTV contest is the WAS SSTV in January.
DX WINDOW:

Stations are expected to observe the DX window from 1.825-1.830 MHz as mutually agreed by top band operators. Stations in the US and Canada are asked not to transmit in this 5 kHz segment of the band. During the contest all stations are requested to utilize those frequencies from 1.806-1.825 and 1.830-1.900 MHz.

DISQUALIFICATIONS:

Operator omits a required entry form, operates in excess of legal power authorized for his/her given area, manipulates operating times to achieve a score advantage, or fails to omit duplicate contacts which reduce the overall score more than 2%.

AWARDS:

Contest awards will be issued in each entry category in each of the continental US states, each Canadian province and territory, and each DX country represented. A minimum of 5 hours and 25 QSOs must be worked to qualify.

CONTEST ADDRESS:

To obtain entry forms or to submit a contest entry forward an SASE to 150 Meter Contest, Billy E. Maddox, 468 Century Vista Drive, Arnold MO 21012.

2ND ANNUAL RTTY WORLD CHAMPIONSHIP CONTEST

Starts: 0000Z February 26
Ends: 2400Z February 26

SPONSORS:

73 and The RTTY Journal

DISQUALIFICATIONS:

The same station may be worked once on each band. Crossmode contacts do not count. Single-operator stations may work 18 hours maximum, while the multi-operator stations may operate the entire 24-hour period. Off periods are no less than 30 minutes each and must be noted in your log.

OPERATOR CLASSES:

(A) Single operator, single transmitter, phone only. (B) Multi-operator, single transmitter, phone only.

ENTRY CATEGORIES:

(A) Single band (B) Allband, 10-80 meters.

EXCHANGE:

Stations within the continental 46 US states and Canada must transmit an RST report and state, province, or territory. All other stations, including Alaska and Hawaii, transmit RST report and consecutive contact number.

QSO POINTS:

1 QSO point is earned for each valid contact.

MULTIPLIER POINTS:

1 multiplier point is awarded for each of the 48 continental US states, Canadian provinces or territories, and DX countries worked on each band.

FINAL SCORE:

Total QSO points times total multiplier points equals claimed score.

CONTEST ENTRIES:

Entries must include a separate log for each band, a dupesheet, a summary sheet, a multiplier checklist, and a list of equipment used. Contestants are asked to send an SASE to the contest address for official forms.

ENTRY DEADLINE:

All entries must be postmarked no later than March 26, 1963.

DISQUALIFICATIONS:

Omission of any required entry form, operating in excess of legal power, manipulating of contest scores or times to achieve a score advantage, or failure to omit duplicate contacts which would reduce the overall score more than 2% are all grounds for immediate disqualification.

AWARDS:

Contest awards will be issued in each entry category and operator class. In each of the US call districts and Canadian provinces and territories, as well as in each DX country represented. Other awards may be issued at the discretion of the awards committee. A minimum of 5 hours and 25 QSOs must be worked to be eligible for awards.

CONTEST ADDRESS:

Send an SASE to RTTY World Championship Contest, c/o The RTTY Journal, PO Box RV, Cardiff CA 92007.

WORLD COMMUNICATION YEAR

Next month's World Communication Year amateur radio activity will be using the 75 ITU zones for scoring multipliers. Be sure you use the correct ITU zones and not the ARRL zones for this contest. Copies of a world map and prefix list showing the ITU zones can be obtained from the contest sponsors, the Potomac Valley Radio Club, by sending an SASE or an IRC to: PVRC, PO Box 337, Cromsville MD 21732. Complete rules will appear here in my January column.
CIRCUITS

Do you have a technique, modification, or easy-to-duplicate circuit that your fellow readers might be interested in? If so, send us a concise description of it (under two pages, double-spaced) and include a clear diagram or schematic if needed.

In exchange for these technical gems, 73 offers you the choice of a book from the Radio Bookshop, to be sent upon publication. Submit your idea (and book choice) to: Circuits, Editorial Offices, 73 Magazine, Peterborough NH 03458. Submissions not selected for publication will be returned if an SASE is enclosed.

OVERTIME PROTECTION FOR NICADS: Nicad batteries are prone to damage if the batteries are charged for more than 12 to 16 hours. Unfortunately, most timers don't have a timer. To protect your batteries from possible overcharge and venting, you can add an onboard timer and thus protect your batteries. 24-hour appliance timers are available for less than $10. The timers have sliding “on” and “off” tabs which trip a switch when the dial rotates. There is also a rotary-type override switch on the back or side of the unit. To use this timer for your nicad charger, first disassemble the timer. Remove the tab from the “on” switch. To use the modified timer, set the dial to zero and set the “off” switch to a time 16 hours later. This would be 4:00 am. Plug in the charger to the timer, and turn the timer on with the manual override switch. If you have to interrupt the charging cycle and move the unit into another location, your unit will have a “memory” and the charging cycle will resume at the same time when you reconnect the unit.—John F. Sorensen, WB2EOG, Oradell NJ.

HALLICRAFTERS HA-5 GRID-BLOCK KEYING CONVERSION: The Hallcrafters HA-5 vfo is cathode-keyed. This conversion will enable the rig to be grid-block-keyed with a minimum of surgery to the unit. Begin by disconnecting cathode resistors R12 and R21 from the orange lead of the “Call-Off” switch, grounding them to chassis. Open R22 at the TA1 keying terminal strip. Disconnect R5, R7, and R10 from chassis, and connect their junction to the orange lead of the “Call-Off” switch. To reconnect to cathode keying, disconnect the ungrounded ends of R5, R7, R10, and R22, leaving them bent out, while installing new R5, R7, and R10 resistors whose long leads will more readily reach to the orange “Call-Off” switch lead. The grid-block transmitter lead (negative) then connects to the terminal marked “+”, and the transmitter ground connects to the terminal marked “ground” on the vfo keying terminal strip.—Tuckerman S. Jalet A1AC, Stamford CT.

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Montana State Award. Issued in five classes: Class D = 15 to 20 counties, class C = 20 to 30 counties, class B = 30 to 40 counties, class A = 40 to 55; GCR, SWL, $50.00 endorsement. $10.00 to: Scott Douglas KB7SB, PO Box 46032, Los Angeles CA 90046.

Other Awards

TEN-METER FM AWARDS

Sponsored by the North Whidbey Island Repeater Association (NWIRA), all contacts must be made on or after January 1, 1981. Crossmode contacts do not count. Contacts must be two-way ten-meter FM. Special endorsements include All-Mobile, All-Simplex, Single-Frequency accomplishments, and contacts made within a single day, week, month, or year. Do not send QSL cards; forward your list of contacts showing the date, time, and frequency of each QSO and provide a brief station description. Send with the fee of US $4.00 for each award to the attention of: Ten-Meter FM Awards Program, 2665 North Busby Road, Oak Harbor WA 98277.

Worked All Districts
To qualify, applicants must work one ten-meter FM station in each of the ten US call districts.

Worked All States
Applicants must work a minimum of 50 US states on ten-meter FM.

Centurion
This award requires the applicant to work a minimum of 100 stations on ten-meter FM.

DX Decade
Applicants must work a minimum of ten DX stations outside the fifty US states and Canada on ten-meter FM.

North American
To qualify, applicants must work all ten US call districts, a minimum of six Canadian provinces and territories, and at least four DX countries within the North American continent (other than the US and Canada) on ten-meter FM.

THE IOWA AWARD

An award will be issued to any amateur who has worked 19 Iowa counties. Cost will be $1.00. Each additional 20 counties will earn a new award. GSOs not required. Send usual log information and statement by two other amateurs or one club officer to the Mississippi Valley Radio Club, 3518 Columbia, Davenport IA 52804.

THE PLANET EARTH AWARD

The South West Ohio Repeater Club (SWORC) takes great pleasure in presenting the Planet Earth Award. To qualify, applicants must submit proof of GSOs with 10 different stations on the planet Earth. There are no restrictions, but GPQ operations will be noted. Send your log of contacts along with the award fee of $4.00 or 12 IRCs with an SASE to the Awards Chairman, South West Ohio Repeater Club, PO Box 18045, Cincinnati OH 45218.
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classes: Class C = 10, class A = 20, class A all 26 double calls (AA to ZZ). AAA counts in lieu of AA, BBB for BB, etc. Contacts after January 1, 1961. No charge, GCR. Log data to: MK3XX, AP 584, Bogota, Colombia.

CHK Award: by LCRA. Work HK stations. HK stations work 100 other HK stations, stations in Americas work 50. Others work 25. HKS send QSLs, others send certify list authenticated by club official. QSLs must have been sent and received. To: LCRA, AP 584, Bogota, Colombia.

ZH Award: by LCRA. Confirmed contacts with HK zones. HKS send QSLs from all 10 zones. Americas work 6, rest of the world work 8. All except HKS send list certified by club official. To: LCRA, AP 584, Bogota, Colombia. (No charges given for any of the LCRA awards.)

HK7 Award: by RC Santander, PO Box 222, Bucaresorta, Colombia. Work 7 HK stations, either all CW or all phone, after January 1, 1982.

10 HK1 Award: by RC Del Atlantico, Apartado Nacional 184, Barranquilla, Colombia. Work 10 HK1 stations post World War II. GRC—certified by club officer. (No costs given.)

HKS5 Award: by LCRA. Work HKS stations after January 1, 1957. American countries work 12, Colombian stations work 20, rest of the world work 8. GCR list to: Box 6149, Gali, Colombia.

US Navy Award

ARGONNE ARC
The Argonne Amator Radio Club plans to operate the club's memorial station, W9QVE, to commemorate the 40th anniversary of the first controlled nuclear chain reaction experiment conducted at the Amorone Site field on the University of Chicago campus. Two stations will operate from 1500 GMT December 4 through 2400 GMT December 5.

Frequencies: phone and CW—20 kHz up from lower edges of the General portions of the 80-10 MHz bands. Novice—40 kHz up, 2m—146.18/144.59, 146.52, and 147.42; RTTY—14,090 and 146.70. Send a business-type SASE or $1 to an 8” x 11” unfolded cert. to AARC, PO Box 275, Argonne IL 60439.

BETHELHEM WXP EPHIDIPON
The Triplet States Radio Amateur Club will operate daily from Bethlehem, West Virginia, December 9 through December 12, from 1400 to 2300 UTC. Operating frequencies for WD8DJL8 will be 7,275, 14,325, 21,425, and 28.550 kHz on SSB, and 7 110, 14,075, 21,110, and 28,110 MHz on CW. A special holiday certificate will be sent to all those contacted who send an SASE to TSRA, 26 Maple Lane, Bethlehem, Wheeling WV 26003.

CHRISTMAS VILLAGE
The KIBC GIL Radio Club will operate a special event station honoring the 25th anniversary of the Christmas Village located in Torrington, Connecticut. The club will operate from the Christmas Village from December 11 through December 19, on 10, 15, 20, 40, and 80 meters. Certificates of this event will be issued for contacts made. For further information, contact Jim W9YHA or Nettie WB1YVC.

SANTA CLAUS
The Pike County Amateur Radio Club of Winnsboro, Indiana, will operate a special events station from Santa Claus, Indiana, from December 18 through December 1700Z December 19, 1982. The call sign will be W9CRX. Operating frequencies will be plus or minus QRM 21,395, 14,305, 7,265, 3,925 kHz, 7,133 kHz, 14,053 RTTY, and 146.52 FM. Certificate for QSL and SASE to: Santa Claus, PO Box 111, Indiana IN 47545.

CHESTER GREENWOOD DAY
The Sandy River ARC will operate K1AGQ on Saturday, December 18, 1500Z, to Sunday, December 19th, 2100Z, in celebration of Chester Greenwood Day. We will also operate mobile from the Chester Greenwood Day Parade and related activities on Tuesday, December 21st, 1400Z to 2100Z. Frequencies: 5 to 10 kHz from bottom of General band edges and 3940 kHz. Certificate for your QSL card and two first-class stamps (no envelopes please) to K1AGQ, 5 Franklin Ave., Farmington ME 04938.

HONG KONG ACTIVITY
The Hong Kong Amateur Radio Transmitting Society (HARTS) is pleased to announce that once again there will be a V56 activity day between 001G Saturday, April 2, 1983, and 2355G Sunday, April 3, 1983. As in previous years, many V56 stations will be active on all bands. 1983 is World Communications Year (WCVY), and during 1983 the special call sign V56VWC will be in use by the HARTS club station. Special QSL cards will be issued for OSOs with V56VWC QSLs for WCVY station should be sent to the Hong Kong QSL Bureau Manager, PO Box 541, Hong Kong.

WORKED ALL NORTH POLE
The Borealis ARC will present, upon receipt of the request with the callsigns and dates worked of a minimum of three BARC members and $2.00, a Worked All North Pole certificate. Operating time will be from approximately 0400-0900Z, 30 kHz up from the lower edge of the Novice and General bands, plus or minus QRM. The club member whose call appears on the largest number of certificate requests during the month of December will win a prize. Certificate requests should be sent to: Borealis ARC, c/o Wendall Keller, SR Box 8034, Fairbanks AK 99701.

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THE TEN-METER BAND

Many DXers abandon the 10-meter band as a contest spot. But 10 meters provides DX rare opportunities to work the bottom of the sunspot cycle. Not as much, to be sure, when 10 is wide open to three continents at once, but, still, there is plenty of action. Because 10 meters lies at the dividing line between HF and VHF, it displays some of the propagation features of each part of the spectrum. By learning to recognize the different modes of propagation and practicing the operating patterns unique to each propagation mode, the DXer can quickly improve his success on 10 meters. The second weekend of the month of December provides a fine opportunity to practice this skill, in the ARRL 10-Meter Contest.

Let’s look at the various ways DX signals get through the ionosphere, and how the DXer should modify his operating techniques to take full advantage of each propagation mode.

HF Spectrum

Most DX contacts are made via the F2 ionization layer of the ionosphere. The F2 layer is ionized by radiation from the sun and tends to be strongest near the middle of the day. Thus, 10 meters will open up to the west in the morning. As the Earth turns, the band opens farther south, and then it swings around to the west in the late afternoon. The DXer can recognize F2 propagation because it is so widespread, with signals from a large part of the world coming in all at once. This propagation mode is quite steady, building rather slowly and fading gradually. Normal DXing techniques will be successful. Aim your beam at the station and make your call.

Ten meters is not always “open” via F2 propagation. So some DXer will get lucky with quicky contacts across the band with the beam aimed east, hear nothing, and drop to 15 meters. However, even when the ionization is not strong enough to provide east-west propagation, it often is strong enough for north-south contacts. The equatorial region receives more solar radiation than latitudes further north and often gets enough radiation to open the 10-meter band. Instead of the normal sequence of the band opening up in the east and swinging around to the west, around midday or a little later the band opens up just to the south.

WA1KID used to take advantage of this phenomenon during contests with a 4-element 10-meter beam fixed south. He could switch quickly to that antenna to watch for the trans-equatorial openings and for the CEs, LUs, and other South American stations. He knew only to work DX via trans-equatorial propagation is to know when and where to look; if your beam is aimed east, for example, you might never hear the South Americans.

This same ionization over the equatorial regions provides one of the more interesting propagation phenomena. There is backscatter. Strong signals aimed south can reflect off the ionization layer over the equator and bounce down to earth, and some small portion of the signal then bounces back along the same path. Not much of a signal gets through, to be sure, since most of the energy is lost or absorbed in the multiple bounces, but directional signals will be scattered enough by the ground at the other end of the hop to send some energy back north.

This means that it is possible to work other stations north of the equator by point-to-point DX with almost due south backscatter. The reason is the ionization layer is ionized south, but the signal fades as you swing your beam up to the northeast, you are probably receiving back or side-scatter signals. You can recognize these signals because they are weak and peak to the south, no matter in what direction the station is located. If you hear a scatter signal, resist the temptation to swing your beam according to the “head-beaming” chart; the signal will disappear. (If it gets louder, you’re not hearing a scatter signal! Instead, swing your beam across the south, listening for the loudest direction, and check out the ionospheric ionization layer, and, therefore, the most scatter. Note that both stations must be beam north. If the DX station hears your signal and swings his beam up to the west to work you, the contact is lost.

Explaining this under the weak signal strengths of scatter contacts can be frustrating. I remember spending quite a bit of time once trying to convince a station that we could make contact only if both of us pointed our beams south and not at each other! Whenever this W4 heard my call, if I was in New England, he would swing his beam north and lose it.

Side scatter is very similar to back scatter. The radio waves reflect off the side of the ionization region, not the underside. Again, you swing your 10-meter beam back and forth for the loudest signal without regard to the direction of the other station. If you can convince the DX station to do the same thing, you may have a satisfying DX contact.

VHF Spectrum

Since the 10-meter band is near the VHF region it exhibits some of the exciting propagation modes of VHF bands, including meteor scatter and E-skips. These short-range propagation modes don’t often provide much DX, but it helps to learn how to recognize and operate under each mode.

Meteor scatter is radio propagation off the ionized trails left after a meteor rips through our upper atmosphere. Since the Ten-Meter Contest coincides with a major meteor shower, you might well hear such signals then. Meteor-scatter signals last only a few seconds because the ionization region quickly dissipates. Your contact must be very short, giving your call three times probably will use up the entire opening. Listen for randomly occurring, quite loud signals which appear and disappear very quickly. If you start a contact on one meteor burst, you may well be able to complete the contact on another burst a minute or two later if you stay on the same frequency and beam heading. Don’t expect to exchange much more than a signal report, however. Meteor-scatter QSOs are extremely short.

E-skip allows the 10-meter band quite a pan. The E-layer ionization layer is much lower than the F layer, and the maximum communication distance on a single hop is about 1200 miles, compared to twice that with F2 propagation. But multiple-hop E-skips can provide some DX contacts, thus making life into a “devils game.” Because the ionization regions in the E layer are much smaller than those in the F layer, the E-skip propagation is much more restricted in area. You might hear only one or two states or countries at a time, for example. E-skip signals can be very loud as well as very directional, but often you can work stations across the fringes. You can find a QSO with the wrong time or date.

Mode. If your QSL has this box labeled “2X,” just write in the mode. If the box is labeled “2X CW” or “2X SSB.” RST. Honest signal reports in DX are as rare as Albanian integers. I always prefer honest reports, but usually get 59 even if the other station can barely hear me.

QSL. Always ask for the QSL if you want it. I get thousands of cards which I may assume are requests for my card, but no where does the station specifically request my card. Many DXers may have no simple way to assume these cards are answers to cards I sent, and I don’t answer them. And if you need a card for a particular reason, say so: “Need 3 more cards for my DXCC, please QSL.”

Another thing to remember: If you work a DX station during a contest with consecutive numbers as part of the exchange, write the other station’s QSO number on the card: “your number 1024.” Don’t put your own number on the card, as the DX station could cancel out your contest points, and you will locate your contact quickly in a long log. Speaking of contests, be sure to mention that the contact was made during a contest, if it was, many stations keep separate logs for contest and non-contest operations because of the special logs that contests require. So include “GW WW SSB contest” as appropriate.

Always send a card for each QSO. Although it is tempting to put all your contest QSOs with a single DX station on one card, it often works better if you make the DX station mighl QSL one band at a time or, in case of major DP decisions, have separate managers for each band. Sulfane, and send separate cards.

Finally, write legibly and accurately. Numerous QSLs have the Information so badly written that it is almost impossible to read. Or the information is mis-copied from the log. These QSLs end up in the “do to morrow” file or the circular one. And I still have cards from five years ago in my “do tomorrow” box.

And now a special treat for the loyal readers of this DX column. Send me your QSL card by the end of the year and I’ll put them all in a hat and draw out three cards. The lucky winners will receive: a 1983 DX Calibook, a one-year subscription to The DX Bulletin, the most prestigious of the DX bulletins, or a one-year subscription to the W5GO QSL List. A list of more than 5000 QSL managers which is updated every two weeks (more about this prize next month!)

So send in your cards to the address at the head of this column, right away. No cost, no obligation. Just mail me your QSL card and I’ll notify the lucky winners immediately. I’ll send you a photo of your shack, and I’ll use the best shots. Thanks for being such devoted readers of this column.

HAM HELP

Do you need help in getting your Atari computer? Or any OS or ASCII? Drop me a line, and I’ll be more than happy to get you started.

Bob Holst K7ZJKDKH PO Box 4425 AFB 88 Yigo, Guam 96912

I would appreciate a copy of a schematic for an RCA V1A 504-Ames square wave audio generator to be used in a small radio to pay postage and the cost of copying.

A. W. Beits WASC0 PO Box 50 Tunica LA 70782

Chod Harris VP2ML Box 4881 Santa Rosa CA 95402
SATELLITES

Ariane Takes a Dive

The amateur radio space program suffered another setback on September 10. On that date, a European Space Agency (ESA) Ariane rocket fell into the Atlantic Ocean instead of achieving orbit as planned. It was the second failure in five launches for Ariane, the vehicle which was scheduled to carry the Phase IIIB amateur satellite aloft in early 1983.

This time, the Ariane carried no amateur bids, but two multi-million-dollar communications satellites on board were lost. Apparently, the rocket dove into the ocean when a third-stage fuel pump failed. If the problem turns out to be specific to the unit that failed and not a design flaw, the Phase III launch schedule may be only slightly affected and the amateur satellite could still be launched sometime this year. Amateur satellite enthusiasts can only wait patiently for ESA to work out bugs.

Incidentally, the Ariane failure is a serious blow to ESA, which is in head-to-head competition with NASA and the Space Shuttle in the satellite launching business. With Ariane's success rate running only 60%, some ESA customers are getting edgy and may take another look at what the Shuttle has to offer.

MARECS: 0 for 2

One of the satellites lost in the ill-fated September launch was MARECS B, the second Maritime European Communications Satellite. What makes the loss particularly devastating is that it is the first in the series. MARECS A, failed in orbit without ever becoming operational. The bottom line: $250,000,000 spent without a single positive result for MARECS backers. Space flight remains an expensive business.

Thanks to AMSAT Satellite Report — Jeff DeTray WB8BTH, 73 Staff.

 Amateur Satellite Reference Orbits

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SS12
from page 8

But this pursuit is a totally selfish one. There are no benefits to the hobby to society. The work is not inched ahead one whit by these chaps. The League has let loose a monster on the world of amateur radio with their Honor Roll.

My own solution to this problem was to work hard and have fun as I worked toward 300 countries. Once I got to that level, I stopped counting. Today, when I hear a new one, I'll take a few minutes to get him in the log... preferring to talk with him if at all possible. If things are too frantic, I have better uses of my time. ...a lot better. I haven't the slightest idea of how many countries I've worked and I don't intend to try to count 'em up. Perhaps, if the League would let newcomers to DXing get credit for countries worked up to 300... with no further listings after that, we might be able to put a stop to this thing.

Remember that working DX and getting up on the Honor Roll requires mainly that one be able to spend enormous amounts of time at it. This is not time spent in learning anything or in developing a skill of use to the world. Once you have a decent station, you can make a contact anywhere in the world, so it's just a question of sticking around, being there at the right time, and then bludgeoning your way through.

One of the supposed purposes of amateur radio is to help develop world friendships. Show me a hint that DX piles up and the badgering of ops in rare countries for instant contacts and a QSL generates anything but a disdain. Much of this is aimed at Americans, who are by far the worst in this regard, though at times I find the Germans pushing us hard for bad manners awards. Oddly enough, those hundreds of thousands of no-code Japanese hams are about the best mannered operators in the whole world... and they have almost one million licensed amateurs today!

Those no-code hams, trained by their local ham clubs, often make us look like the CBers. They put most Americans to shame when it comes to real operating skills. And I don't think we can excuse our behavior on the air by explaining that learning the code made us crazy. I know that a lot of hams use the Morse Code as an excuse for being such terrible operators, but I don't believe that something so simple could explain what happens when a PY0 comes on the air.

And I don't think we can shrug our shoulders and put the whole thing down to basic cultural differences. The Japanese may bow when they meet, but they knock you around in the subways and in stores just as hard as you get bumped in America. No, the difference is, I believe, in basic ham training... in their club-trained hams. That's where they get across the concept of pride in being a ham and the responsibility of being a good operator.

Or, as old and good friend Bob Sullivan used to say, "I may not be wrong, but I'm not far from it."

---

**SMALL HAMFEST CATASTROPHE**

Some years ago, a disgruntled ham almost got the New England Annual Convention closed down. The problem hinged around the breaking of federal laws having to do with the advertising of lotteries through the mail. You can't, yet most hamfests and conventions continue to do this, ignoring the federal laws they are breaking.

Please note that it is presently against the law for any hamfest or convention to send a brochure through the mail which promises prize drawings if there is a charge for attendance... and there always is. Further, it is illegal for any magazine or other publication which uses the mails to mention that prizes will be given where there is a charge for attendance.

If you want to give prizes, fine... but it is illegal for you to mention that in anything which is going to be sent through the mails. You cannot send flyers or posters with this information on them through the mail. Got it?

No one has ever determined just how much prizes build up attendance at hamfests. As far as I know, every hamfest gives prizes, so no one could yet have tested the concept. With the veil of secrecy on prizes being lowered by the post office (we have heard from them in no uncertain terms), it may get a whole lot more difficult to get cooperation from manufacturers in the way of donated equipment.

Before the "incentive licensing" debacle of '63, it was much easier to get prizes. The ham industry was growing rapidly, meeting the needs for the then-new sideband equipment, so they were happy to donate nice prizes for our hamfests. Today, with only a handful of American firms left, most of the hamfest prizes have had to be bought, so the munificence has not been awesome. If hamfest committee members decide to spend less on prizes, this would leave them...
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anything of the slightest interest at the dinner table trying to get these chap's hands and able to third in production. Jean is by through some of the adventures of these chap's have and able to make it sound so incredibly dull to hear about. I once fell asleep at the dinner table trying to get anything of even the slightest interest out of two very well-known DXpetitioners.

There are plenty of interesting people around our hobby. Why not get one of our well-known ham publishers to tell about how he got his ham ticket in the '60s without knowing kiddly squat about either the theory or the code? I'll bet we'd love to hear about his trip to northern Maine to get a "Conditional" license and his later trials with the FCC when they found out.

Then there is Jean Shepard K2ORS, with two successful PBS films to his credit and a third in production. Jean is by far the best humorist we have in the hobby and our hamfests should grab him when they can. I understand his latest film, "The Great American Fourth of July... and Other Disasters," is up for an award. If you do get him to speak, be sure to tape it and send me a copy. Shep isn't inexpensive to get, but he will pull 'em in... and be worth every dollar you spend.

No one really interesting is going to be cheap to get. That's the law of supply and demand. And, as Shep found out long ago, few people really appreciate anything they get for nothing.

My own experience has been that when I speak for free I often find a lack of support by the hamfest committee which results in two or three dozen in attendance. If I cost $1,000 plus all travel expenses (first class), you bet they will be doing everything they can to get people to listen to me. Then I find myself facing two to three thousand in the audience instead of dozens. Between my already-made show commitments and trying to run my steadily-growing publishing firm while keeping up with two fast-growing industries, I'm not fishing for more work. If I do have extra time, it goes for writing, consulting, and even a touch of hamming. Most hamfests are on weekends, which is prime writing time.

In addition to getting interesting speakers for hamfests, with the no-longer-useful prize money, committee might look into putting on some really good demonstrations of new ham communications modes. I suspect that many amateurs would love to see some good slow-scan demonstrations. They'd also like to see fast-scan television. Then there is a growing interest in packet communications. But, for heaven's sake, watch out for some of the super turkey "experts" who flaunt their doctor titles. Several of these birds are crashing bores. Hamfest committees might, if they don't have personal recommendations on the "experts," ask for an audio tape preview and judge it as they might a radio audition.

If you have some hamfest committee members who are enthusiastic about the Morse code, why not try to inspire hams to accept code as a fun activity instead of merely something the government forces them to learn... and run code-copying contests, with certificates for the winners to display in their shack. You can help bring some pride to knowing the code, something sadly lacking today. How can one have pride in something which is mandated by the government? Some of the prize money can go for awards for code skills. There's no lottery aspect to that.

You might get some of your more fanatic DXers to bring in their rare cards for a display... and for a talk on how to get the darned things. That is an art in itself. A big board for attendees to pin up their cards, with a QSL contest (also not a lottery, obviously), won't hurt.

I realize that bribery and greed are time-honored movers of people, but let's try to cope with the post office laws and find alternate ways of getting hams to come to hamfests.

THE GREAT AMERICAN HAM CLUB... DISASTER

When I see the Japanese ham magazine each month, with a whole section devoted to club activities... often with 70 or more pages of news about the clubs and pictures of their activities... I think of how little our clubs are doing... and reporting. I don't think we could generate that much news in a year, much less every month.

Even the best of our ham clubs seem to have their ups and downs. One thing that might help would be an updated series of articles on how to run a ham club. I did run such a series nearly twenty years ago and it was very well received. It's about time for an updated series, eh?

Running a ham club is show business, which many of us seem to forget. Many club presidents gather weak people around them to help make the club go. They do little to organize exciting meetings and often let business intrude on the fun... only to find that in a few months they have little left of the club.

I'd like to see some articles on how to make ham clubs successful. Believe that the real strength of amateur radio lies in the strength of the clubs, not in a small group of professionals who are, for the most part, working for their own benefit first and ours second. How about some pictures of club groups and reports on club activities?

With amateur radio being a keystone, to my way of thinking, as far as providing our country with emergency communications, we're talking about club organization, not just individuals. Clubs can help get amateur radio set up so that it will be able to keep going after any kind of disaster. This means cooperative efforts to have both personal and mobile portable equipment, emergency repeaters, automated relaying, low-band interlinks, and—above all—experience. The duty is there, we already have the technology, and the work will be both fun and of help to tie us together, strengthening our clubs and our own value to our communities and country.

Then there is the responsibility of clubs to help amateur radio grow. This means devising schemes to interest teenagers in the hobby through talks at high schools, demonstrations at shopping malls, service for local groups, and participation in things like the March of Dimes. It means making sure that club activities are properly exploited with the local media. When there is a Field Day exercise, the local newspapers and television stations should get the word and be offered cooperation on the story.

Just getting the interest of teenagers isn't enough. Clubs should try to work with school officials to see that there is a radio club in the school which meets at least weekly. Schools have a serious problem about this which clubs can help solve. Any school activity has to have an adult advisor on hand. Since few schools have the budget to pay a teacher for this after-school work, the result has been a serious cutting down of after-school clubs. By providing the needed adult advisor, the local ham club could encourage the development of the school radio club.

Then there is the growing need for license classes to be put on by clubs. One of the really sad results of the Bash chart-book approach to getting a ham ticket has been the lack of ham club members with even the small technical background it takes to teach the rudiments of theory required for the Novice exam. In some clubs, it is a case of those with scant information trying to teach newcomers, spreading confusion.

All of these problems have been solved by many clubs, so I'd like to see some letters and articles on these subjects for possible publication.

174 73 Magazine • December, 1982
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- **DS58-04C** 400vdc 80Amps: $15.00 10/$120.00
- **IN3269** 600vdc 160Amps: $20.00 10/$175.00
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NIPPEON ELECTRIC COMPANY TUNNEL DIODES

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COAXIAL RELAY SWITCHES SPOT

Electronic Specialty Co./Raven Electronics
Part # 25N2B
Part # SU-01
26Vdc Type N Connector, DC to 1 GHz.

Amphenol
Part # 316-10102-8
115Vac Type BNC DC to 3 GHz.
$29.99

FXR
Part # 300-11182
120Vac Type BNC DC to 4 GHz.
FSN 5985-343-1225
$39.99

FXR
Part # 300-11173
120Vac Type BNC Same
FSN 5985-543-1850
$39.99

BNC To Banana Plug Coax Cable RG-58 36 inch or BNC to N Coax Cable RG-58 36 inch.
$7.99 or 2 For $13.99 or 10 For $50.00

$8.99 or 2 For $15.99 or 10 For $60.00

SOLID STATE RELAYS

P&B Model ECT1DB72
5vdc turn on
120vac contact at 7amps or 20amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.
PRICE EACH $5.00

Digisig, Inc. Model ECS-215
5vdc turn on
240vac contact 14amps or 40amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.
PRICE EACH $7.50

Grigsby/Barton Model GB7400
5vdc turn on
240vac contact at 15amps or 40amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.
PRICE EACH $7.50

NOTE: *** Items may be substituted with other brands or equivalent model numbers. ***

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The Recall Phone Telephone employs the latest state of art communications technology. It is a combination telephone and automatic dialer that uses premium-quality, solid-state circuitry to assure high-reliability performance in personal or business applications. $49.99

TOUCH TONE PAD

This pad contains all the electronics to produce standard touch-tone tones. New with data.

$9.99 or 10/$89.99

INTEGRATED CIRCUIT.

<table>
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<tr>
<th>Part</th>
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<td>MC1358P</td>
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FERRANTI ELECTRONICS FM RADIO RECEIVER MODEL ZN414 INTEGRATED CIRCUIT.

Features:
- 1.2 to 1.6 volt operating range. Less than 0.5ma current consumption. 150KHz to 30Hz Frequency range. Easy to assemble, no alignment necessary. Effective and variable AGC action. Will drive an earphone direct. Excellent audio quality. Typical power gain of 72db. T0-18 package. With data. $2.99 or 10 for $24.99

N1 CAD RECHARGEABLE BATTERIES

AA Battery Pack of 6 These are Factory New. $5.00

SUB C Pack of 10 2.5Amp/Hr. $10.00

Gates Rechargeable Battery Packs

<table>
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ARON ALPHA RAPID BONDING GLUE

Super Glue #CE-486 high strength rapid bonding adhesive. Alpha Cyanoacrylate. Set-Time 20 to 40 sec., 0.7fl.oz. (20gm.) $2.00

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Perfect for those unscrambler projects. New with data.

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AA Battery Pack of 6 These are Factory New. $5.00

SUB C Pack of 10 2.5Amp/Hr. $10.00

Gates Rechargeable Battery Packs

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Holiday greetings!

MHZ electronics

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73 Magazine • December, 1982 161
## SOCKETS AND CHIMNEYS

**EIMAC TUBE SOCKETS AND CHIMNEYS**

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<tr>
<th>SK110</th>
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**JOHNSON TUBE SOCKETS AND CHIMNEYS**

| 124-111/SK606 | Chimney For 4CX250B,BC,FG,R,4CX350A,F,FJ | $10.00 |
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| 124-0113-00   | Capacitor Ring                          | 15.00 |
| 124-116/SK630  | Socket For 4CX250B,BC,FG,R,4CX350A,F,FJ | 55.00 |

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**PRICES:** 1 to 10 - .94c, 10 to 100 - .60c * IS A SPECIAL PRICE: 10 for $7.50

**TUBE CAPS (Plate)**

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| HRL 3, 6, 7 | 13.00 |
| HRS 8 | 14.00 |
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$110.00

**Frequencies:** 3.6 to 4.2GHz, Power output, Min. 10dBm typical, 8dBm Guaranteed. Spurious output suppression Harmonic (nf), min. 20dB typical, In-Band Non-Harmonic, min. 60dB typical, Residual FM, pk to pk, Max. 5kHz, pushing factor, Max. 8kHz/V, Pulling figure (1.0 f/50f), Max. 4Hz, Tuning voltage range +1 to +5volts, Tuning current, Max. -0.1mA, modulation sensitivity range, Max. 120 to 30MHz/V, Input capacitance, Max. 100pF, Oscillator Bias +15 +0.05 volts @ 55mA, Max.

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**MHz electronics**

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NOTICE ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
TUBES MAY EITHER BE NEW OR SURPLUS CONDITION !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
### “TVRO BOARD LIST”

#### 70 MHz IF BOARD: This circuit provides about 43dB gain with 50 ohm input and output impedance. It is designed to drive the Demodulator. The on-board bypass filter can be tuned to bandwidths between 20 and 35 MHz with a passband ripple of less than 4 db. Hybrid IC’s are used for the gain stages.

#### SINGLE AUDIO BOARD: This circuit recovers the audio signals from the 6.8 MHz frequency. The Miller 9051 coils are tuned to pass the 6.8 MHz subcarrier and the 9052 coil tunes for recovery of the audio.

#### DUAL AUDIO BOARD: Duplicate of the single audio but also covers the 6.2 range.

#### DC CONTROL BOARD: No description.

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<thead>
<tr>
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<table>
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#### DEMODULATOR BOARD: This circuit takes the 70 MHz center frequency satellite TV signal in the 10 to 200 millivolts range, detects them using a phase lock loop, de-emphasizes and filters the result to produce standard NTSC video. Other outputs include the audio subcarrier, a DC voltage proportional to the strength of the 70 MHz signal, and AFC voltage centered at about 2 volts DC.

#### TVRO BOARD DESCRIPTION AND PARTS LIST

- **DUAL CONVERSION BOARD:** This board provides conversion from the 3.7-4.2 band first to 900 MHz, where gain and bandwidth filtering are provided and second, to 70 MHz. The board contains both local oscillators, one fixed and the other variable, and the second mixer. Construction is greatly simplified by the use of Hybrid IC amplifiers for the gain stages.

- **DEMULORATOR BOARD:** This circuit takes the 70 MHz center frequency satellite TV signal in the 10 to 200 millivolts range, detects them using a phase lock loop, de-emphasizes and filters the result to produce standard NTSC video. Other outputs include the audio subcarrier, a DC voltage proportional to the strength of the 70 MHz signal, and AFC voltage centered at about 2 volts DC.

---

**TV BOARD LIST**

**PRICE SUBJECT TO CHANGE WITHOUT NOTICE**

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Toll Free Number

**800-528-0180**

(For orders only)
“CHIPS”

FAIRCHILD VHF AND UHF PRESCALER CHIPS

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<td>11C05DC</td>
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GENERAL ELECTRIC CO. GUNN DIODE MODEL Y-2167
Freq. Gap (GHz) 12 to 18, Operation (Min.) 100mw, Duty (%) CW, Typ. Bias (Vdc) 8.0, Type Oper. (Max) 550, Max. Thres. (Max) 1000, Max. Bias (Vdc) 10.0, $39.99

VARIAN GALLIUM ARSENIDE GUNN DIODES MODEL VSX-920155
Freq. Coverage 6 to 14 GHz, Output (Min.) 100mw, Bias Voltage (Max) 14vdc, Bias current (Max) Operating 550 Typ. 750 Max., Threshold 850 Typ. 1000 Max. $39.99

VAR-L Co. Inc. MODEL SS-43 AM MODULATOR
Freq. Range 60 to 150MC, Insertion Loss 13dB Nominal, Signal Port Imp. 50ohms Nominal, Signal Port RF Power, +10Dbm Max., Modulation Port Bw DC to 1KHz, Modulation Port Bias 1ma. Nominal. $24.99

AVANTEK CASCADABLE MODULAR AMPLIFIERS

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HEWLETT PACKARD MIXERS MODELS

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FREQUENCY SOURCES, INC MODEL MS-74X MICROWAVE SIGNAL SOURCE
MS 74X: Mechanically Tunable Frequency Range (MHz) 10630 to 11230 (10.63 to 11.23GHz) Minimum Output Power (mW) 10, Overall Multiplier Ratio 108, Internal Crystal Oscillator Frequency Range (MHz) 98.4 to 104.0, Maximum Input Current (mA) 400. The signal source are designed for applications where high stability and low noise are of prime concern. These sources utilize fundamental transistor oscillators with high Q coaxial cavities, followed by broadband stable step recovery diode multipliers. This design allows simple screw mechanical adjustment of frequency over standard communications bands. Broadband sampling circuits are used to phase lock the oscillator to a high stability reference which may be either an internal self-contained crystal oscillator, external primary standard or VHF synthesizer. This unique technique allows for optimization of both FM noise and long term stability. List Price $1158.00 (THESE ARE NEW)

Price—$289.

DATA SHEETS: When we have data sheets in stock on devices we do supply them with the order.

HEWLETT PACKARD 1N5712 MICROWAVE DIODE
This diode will replace the MBD101, 1N5711, 5082 2600, 5082 2650 ect. This will work like a pump in all these Down Converter projects.

MOTOROLA MMH-11725 LOW DISTORTION WIDEBAND AMPLIFIER MODULE
Freq. Range: 40 to 300 MHz, Power Gain at 50MHz 16.66 to 17.4max, Gain Flatness ± 0.1 Typ. ± 0.2 Max. Dm., DC Supply Voltage — 28-6vdc. RF Voltage Input + 70dBm
PRICE $99.29

GENERAL ELECTRIC AA NICADS
Model #11B050HD11-G1
Pack of 6 for $5.00 or 60 Cells, 10 Packs for $45.00
These may be broken down to individual cells.

ORDERING INSTRUCTIONS:
DEFECTIVE MATERIAL: All claims for defective material must be made within sixty (60) days after receipt of parcel. All claims must include the defective material (for testing purposes), our invoice number, and the date of purchase. All returns must be packed properly and it will void all warranties.
DELIVERY: Orders are normally shipped within 48 hours after receipt of customer's order. If a part has to be backordered the customer is notified. Our normal shipping method is via First Class Mail or UPS depending on size and weight of the package. On test equipment it is by only APO shipping point.
FOREIGN ORDERS: All foreign orders must be prepaid with cashier's check or money order made out in U.S. Funds. We are sorry but C.O.D. is not available to foreign countries and Letters of Credit are not an acceptable form of payment either. Further information is available on request.
HOURS: Monday thru Saturday: 8:30 a.m. to 5:30 p.m.
INSURANCE: Please include 25¢ for each additional $100.00 over $100.00. Uninsured Parcel only.
ORDER FORMS: New order forms are included with each order for your convenience. Additional forms are available on request.
PORTAGE: Minimum shipping and handling in the U.S., Canada, and Mexico is $2.50 for all other countries it is $5.00. On foreign orders include 10% shipping and handling. PREPAID ORDERS: Order must be accompanied by a check.
RETAIL PRICE: All orders must be subject to change without notice.
RESTOCK CHARGE: If parts are returned to MH Electronics due to customer error, customer will be held responsible for all restocking fees, will be charged a 15% restocking fee, with the remainder in credit only. All returns must have applied:
SALES TAX: Arizona must add 5% sales tax, unless a signed Arizona resale tax card is currently on file with the state. All orders placed by persons outside of Arizona, but delivered to persons in Arizona are subject to the 5% sales tax.
SHIPPING OR DAMAGE: All claims for shortages or damages must be made within 5 days after receipt of parcel. Claims must include our invoice number and the date of purchase. Customers who do not notify us within this time period will be held responsible for the entire price as we will consider the order complete.

TERMS: DOMESTIC: Prepaid, C.O.D. or Credit Card
FOREIGN: Prepaid only, U.S. Funds—money order or cashier's check only.
C.O.D.: Acceptable by telephone or mail. Payment from customer will be by cash, money order or cashier's check. We are sorry but we cannot accept personal checks for C.O.D.'s.
CONFIRMING ORDERS: We would prefer that confirming orders not be sent after a telephone order has been placed. If company policy necessitates a confirming order, please mark "CONFIRMING" boldly on the order. If problems or duplicate shipments occur due to an order which is not properly marked, customers will be held responsible for any charges incurred. Bill a 15% restock charge on returned parts.
CREDIT CARDS: WE ACCEPT VISA AND AMERICAN EXPRESS.
DATA SHEETS: When we have data sheets in stock on devices we do supply them with the order.
SLEEP ELECTRONICS

GIVES TOP TRADE on your used ATLAS, COLLINS, DRAKE, ICOM, KENWOOD, TEN-TEC amateur gear... plus we accept your used solid state TEKTRONIX and HEWLETT-PACKARD test equipment, used AVIONIC equipment, and military surplus avionic and ground electronic equipment.

WE OFFER new factory-boxed latest models of: COLLINS, CUBIC/SWAN, DENTRON, DRAKE, ETO, HENRY, ICOM, TEN-TEC, plus all major antenna and accessory lines.

Tell us what you want and what you have to trade. We'll do the rest.

Write or phone Bill Slep (704) 524-7519

Slep Electronics Company
P. O. BOX 100, HWY 441, DEPT. 73
OTTO, NORTH CAROLINA 28763

---

THE PRESIDENT SAYS: “HOGWASH!!”

After taking one look at the TRIPUT POWER SUPPLY our engineer declared that the units were worth several hundred dollars each. He pointed out the engineering, high quality construction and state-of-the-art integrated design in support of his position. The President of BEC more pragmatically pointed out the already full warehouse and the two trailer truck loads of power supplies waiting in the parking lot, and set the price to move them QUICKLY! We have a large quantity, but the supply won’t last long. The only thing we ask is please read the ordering rules.

QUALITY DOUBLE SIDED GLASS BOARD

REGULATOR ASSEMBLY
(part of unit)

COMPLETE UNIT
(Plus Freight)

ORDERS SHIPPED WITHIN CONTINENTAL U.S. ONLY!

ORDERING RULES

1. Mail check or MO for $62.50 + $5.00 for shipping or phone (214) 278-3553 to charge VISA/MC or COD order. (UPS COD only, add $2.50 COD fee)
2. Texas residents include 5% sales tax.
3. Orders for this unit will be shipped within 48 HOURS or we pay the freight!
   (weekends or holidays excluded)
4. ONE TIME OFFER! LIMIT TWO (2) SUPPLIES PER CUSTOMER.

HAM HELP

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

Does anyone have information on RTTY software for a TRS-80 Model I? 
Gary Hansen KABUM Route 1 Box 103 Deerwood MN 56444

I am looking for hams with RTTY equipment who would like to help deaf students attending school in Washington DC communicate with their families back home.

Jeffrey A. Meyer NS4HA 26366 Greythorne Trail Farmington Hills MI 48018

I am looking for a used LCR bridge such as the Leader LCR 740.

Jim Buckwalter WA4FGM 3212 Millcreek Visalia CA 93291

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R E G U L A T O R  A S S M B L Y

• 62.50

+12V @ 7A; +5V @ 10A; -12V @ 5A
• UNIT IS COMPLETELY ASSEMBLED!
• Fused primary and DC sections
• HUGELY SHIELDED TRANSFORMER
• 2% Load & Line Regulation
• Low Ripple (<100mv)
• Short Circuit Protection
• Overvoltage Protection on all three outputs
• 25A Bridge Rectifier
• Over 60,000 mfd of filters
• High Efficiency Switching Regulator reduces heatsink area
• Schematics and service guide included
• Thermal Shutdown
• Statis LED’s (3)

I need a service manual and schematic diagram for a Hy-Gain Galaxy GT-550A SSB transceiver. I will pay reasonable copying costs or copy and return.

Jose Sanabrais
Av. Hidalgo No. 99
Queretaro, Gto.
76000 Mexico

I would like to buy the following WW II surplus receivers. In at least good used condition (they need not include power supply, dynamotor, etc.): ARB, RB8 (6.5 to 4.0 MHz), and SC-546 (broadcast band ARC-5 receiver).

Meyer Gottesman W6GIV
3377 Solaro Avenue, #312
Napa CA 94558

I am blind and bedridden and searching for someone to donate a Kenwood 600 receiver or any other shortwave receiver.

Richard Jastrow
Long Beach General Hospital
2597 Redondo Ave.
Long Beach CA 90806

My club’s 5-page Novice-class study guide is offered in exchange for your club’s Novice- and/or General class handouts. Ours is a brief description of the items listed in the current FCC syllabus and has a 95% pass rate in our classes.

Jim Koski KJ6W
1714 Austin Avenue
Los Altos CA 94022

---

13.6V @ 20A MODIFICATION

By changing a few parts on the board the Triput Power Supply will do 11-14W (adjustable) at up to 20A. Perfect for that 2 meter linear! We send step by step instructions and necessary parts. Modification per instructions will not void the 30 day warranty.

12V @ 7A; 5V @ 10A; -12V @ 5A
• UNIT IS COMPLETELY ASSEMBLED!
• Fused primary and DC sections
• HUGELY SHIELDED TRANSFORMER
• 2% Load & Line Regulation
• Low Ripple (<100mv)
• Short Circuit Protection
• Overvoltage Protection on all three outputs
• 25A Bridge Rectifier
• Over 60,000 mfd of filters
• High Efficiency Switching Regulator reduces heatsink area
• Schematics and service guide included
• Thermal Shutdown
• Statis LED’s (3)
The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

Here's a handy, general purpose counter that provides most counter functions at an unbeatable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can be used. Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in the field" frequency checks and repairs.

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The 50 MHz ADC is programmable for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter into any way changes the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double duty!

The DM-700 offers professional quality performance at a hobbyist price. Features include: 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, 0.5 inch LED readout with automatic decimal placement; automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges; making it virtually foolproof! The DM-700 looks great, is a handsome, jet black, rugged ABS case with convenient retractable tilt base that makes it an ideal addition to any shop.

Telescopic whip antenna - BNC plug.
High impedance probe, light loading...
Low pass probe, for audio measurements...
Direct probe, general purpose usage...
Tilt ball, for CT-70, CT-50, MINI-100...
Color burn calibration unit, calibrates counter against color TV signal...

For measuring extremely weak signals from 10 to 1000...
For plug transformer included...
Flat 25 dB gain...
BNC Connectors...
Great for sniffing RF with pick-up loop...
### NEW LOW-NOISE PREAMPS

New low-noise microwave transistors make preamps in the 0.9 to 1.0 dB noise figure range possible without the fragility and power supply problems of gas-let's. Units furnished wired and tuned to ham band. Can be easily tuned to nearby freq.

**Models LNA1, L30, and P432 shown**

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<tr>
<td>LNA 220</td>
<td>180-250</td>
<td>1.0 dB</td>
<td>17 dB</td>
<td>$39.95</td>
</tr>
<tr>
<td>LNA 432</td>
<td>380-470</td>
<td>1.0 dB</td>
<td>18 dB</td>
<td>$44.95</td>
</tr>
</tbody>
</table>

**Tunable**

**ECONOMY PREAMPS**

Our traditional preamps, proven in years of service. Over 20,000 in use throughout the world. Tuneable over narrow range. Specify exact freq. band needed. Gain 16-20 dB. NF = 2 dB or less. VHF units available 27 to 300 MHz. UHF units available 300 to 650 MHz.

- P30K, VHF Kit less case $14.95
- P30C, VHF Kit with case $20.95
- P30W, VHF Wired/Tested $29.95
- P432K, UHF Kit less case $19.95
- P432C, UHF Kit with case $24.95
- P432W, UHF Wired/Tested $33.95

P432 also available in broadband version to cover 20-650 MHz without tuning. Same price as P432; add "B" to model #.

### HELICAL RESONATOR PREAMPS

Our lab has developed a new line of low-noise receiver preamps with helical resonator filters built in. The combination of a low noise amplifier similar to the LNA series and the sharp selectivity of a 3 to 4 section helical resonator provides increased sensitivity while reducing intermod and cross-band interference in critical applications. See selectivity curves at right. Noise figure = 1 to 1.2 dB. Gain = 12 to 15 dB.

<table>
<thead>
<tr>
<th>Model</th>
<th>Tuning Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRA-144</td>
<td>143-150 MHz</td>
<td>$49.95</td>
</tr>
<tr>
<td>HRA-220</td>
<td>213-233 MHz</td>
<td>$49.95</td>
</tr>
<tr>
<td>HRA-432</td>
<td>420-450 MHz</td>
<td>$59.95</td>
</tr>
</tbody>
</table>

### RECEIVING CONVERTERS

- **VHF MODELS**
  - Kit $44.95
  - Less Case $39.95
  - Wired $59.95

### TRANSMIT CONVERTERS

- **For SSB, CW, ATV, FM, etc.** Why pay big bucks for a multi mode rig for each band? Can be linked with receive converters for transceive. 2 watts output.

### ECONOMY PREAMPS

- **For VHF, Model XV2**
  - Kit $79.95
  - Wired $119.95

- **For UHF, Model XV4**
  - Kit $99.95
  - Wired $149.95

### ECONOMY PREAMPS

- **For limited time, buy a transmit converter above with 40-45W PA ($129.95) and get $39.95 cabinet FREE**

### HELICAL RESONATOR PREAMPS

- **FM-5 PC Board Kit = ONLY $159.95**
  - complete with controls, heatsink, etc.
  - 10 Watts, 5 Channels, for 6M, 2M, or 220

### HELICAL RESONATOR PREAMPS

- **Cabinet Kit, complete with speaker, knobs, connectors, hardware. Only $59.95**

### ECONOMY PREAMPS

- **SAVE A BUNDLE ON VHF FM TRANSCIEVERS!**
  - FM-5 PC Board Kit = ONLY $159.95
  - complete with controls, heatsink, etc.
  - 10 Watts, 5 Channels, for 6M, 2M, or 220

### HELICAL RESONATOR PREAMPS

- **LOOK AT THESE ATTRACTIVE CURVES!**

### ECONOMY PREAMPS

- **REPEAT OF A SELLOUT!**
  - While supply lasts, get $59.95 cabinet kit free when you buy an FM-5 Transceiver kit.
  - Where else can you get a complete transceiver for only $159.95?

### ECONOMY PREAMPS

- **FREE OFFER**
  - For limited time, buy a transmit converter above with 40-45W PA ($129.95) and get $39.95 cabinet FREE

### ECONOMY PREAMPS

- **LOOK AT THESE ATTRACTIVE CURVES!**

### ECONOMY PREAMPS

- **HRA-432, HRF-432**
  - Typical Selectivity Curves of Receivers and Helical Resonators.

### ECONOMY PREAMPS

- **• Call or Write for FREE CATALOG**
  - (Send $1.00 or 4 IRC's for overseas mailing)
  - **• Order by phone or mail • Add $2 S & H per order**
  - (Electronic answering service evenings & weekends)
  - Use VISA, MASTER CARD, Check, or UPS COD.

---

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Hamtronics® is a registered trademark
For years, Hamtronics® Modules have been used by individual hams and manufacturers to make repeaters. Now, in the Hamtronics tradition of top quality and superb value, we are proud to offer a complete repeater package.

**JUST LOOK AT THESE PRICES!**

<table>
<thead>
<tr>
<th>Band</th>
<th>Kit</th>
<th>Wired/Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>6M, 2M, 220</td>
<td>$595</td>
<td>$745</td>
</tr>
<tr>
<td>440</td>
<td>$645</td>
<td>$795</td>
</tr>
</tbody>
</table>

Both kit and wired units are complete with all parts, modules, hardware, and crystals.

**CALL OR WRITE FOR COMPLETE DETAILS.**

Also available for remote site linking/crossband & 10M.

**FEATURES:**

- **SENSITIVITY SECOND TO NONE;** Typically 0.15 uV on VHF, 0.2 uV on UHF.
- **SELECTIVITY THAT CAN'T BE BEAT!** Both 8 POLE CRYSTAL FILTER & CERAMIC FILTER FOR GREATER THAN 100 dB AT ± 12KHZ. HELICAL RESONATOR FRONT ENDS. SEE R144, R220, AND R451 SPECS IN RECEIVER AD BELOW.
- **OTHER GREAT RECEIVER FEATURES:** FLUTTER-PROOF SQUELCH, AFC TO COMPENSATE FOR OFF-FREQ TRANSMITTERS, SEPARATE LOCAL SPEAKER AMPLIFIER & CONTROL.
- **CLEAN, EASY-TUNE TRANSMITTER; UP TO 20 WATTS OUT.**

**HIGH QUALITY MODULES FOR REPEATERS, LINKS, TELEMETRY, ETC.**

**INTRODUCING — NEW 1983 RECEIVERS**

- **R144/R220 FM RCVRs** for 2M or 220 MHz. 0.15uV sens., 8 pole xtal filter & ceramic filter in r, helical resonator front end for exceptional selectivity. AFC incl., xtal oven avail. Kit only $119.95
- **R451 FM RCVR** Same but for uhf. Tuned line front end, 0.2 uV sens. Kit only $119.95.
- **R76 FM RCVR** for 10M, 6M, 2M, 220, or commercial bands. As above, but w/o AFC or hel. res. Kits only $109.95. Also avail w/4 pole filter, only $94.95/kit.
- **R110 VHF AM RECEIVER** kit for VHF aircraft band or ham bands. Only $84.95.
- **R110 UHF AM RECEIVER** for UHF uses. including special 296 MHz model to hear SPACE SHUTTLE. Kit $94.95.

**COR KITS** With audio mixer and speaker amplifier. Only $29.95.

**CWD KITS** 158 bits, field programmable, clean audio. Only $59.95.

**HELICAL RESONATOR FILTERS** available separately on pcb w/connectors.
- HRF-144 for 143-150 MHz $34.95
- HRF-220 for 213-233 MHz $34.95
- HRF-432 for 420-450 MHz $44.95

(See selectivity curves at left.)

**TRANSMITTERS AND ACCESSORIES**

- **T51 VHF FM EXCITER** for 10M, 6M, 2M, 220 MHz or adjacent bands. 2 Watts continuous. Kits only $54.95.
- **T451 UHF FM EXCITER** 2 to 3 Watts on 450 ham band or adjacent. Kits only $54.95.
- **VHF & UHF LINEAR AMPLIFIERS.** Use on either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Kits from $69.95.

**A16 RF TIGHT BOX** Deep drawn alum. case with tight cover and no seams. 7 x 8 x 2 inches. Only $18.00.
HOLIDAY GIFT VALUES FROM SPECTRONICS!

"easy-talk!" VOX PORTABLE TRANSCEIVER

FREE WRNO T-SHIRT
with purchase of ICF-4800
Above From WRNO —
World's 1st commercial (3
Million Watts) SW Radio sta-
tion. Offer good thru
December 31st, 1982
SPECIFY SIZE (S, M, L, and XL)

Model PT-2 $79.95
Model PT-2E (240V) $84.95

Model PLF-2 $52.95
Model PLF-2E (240V) $57.95
Model PT-2 $75.95
Model PT-2E (240V) $84.95

SPECIAL PURCHASE FOR BIG
HOLIDAY SAVINGS!

SONY ICF-2001
INSTANT-ACCESS DIGITAL
SHORTWAVE SCANNER

List $349.95
Reg. $299.95
Now Only
$259.95

One Year Factory Warranty + AM/FM/7-BAND

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Big B Cat Radio Supply, 327 E. Hoover Ave., Ann Arbor MI. 883-5000. P.S. SATURDAY 8:30 TO 17:30. WS VGF R.

In the mountains of the world, you can communicate with anyone. Whether you just want to chat, or whether you want to make a QSO (a contact), you can do it. And you can do it all in a few minutes. Here are some tips on how to make your contacts successful.

1. Know your equipment. Make sure everything is working properly.


3. Know your contacts. Are they new or old? Do they live nearby or far away? This information can help you plan your contacts.

4. Be patient. Don't get discouraged if your first contact doesn't go as planned. Keep trying, and you will eventually succeed.

5. Have fun! Contacting others is a great way to meet new people and see new places.

DEALERS
Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the Feb. issue must be in our hands by Dec. 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Nancy Cimpa.
World Class Performance and Features

The FT-ONE is the culmination of an all-out design project by Yaesu's top engineering team. Working without the usual cost constraints, Yaesu's design group is proud to unveil the instrument they "always wanted to design," a revolutionary blend of computer and RF technology.

GENERAL COVERAGE, ALL SOLID STATE
The FT-ONE is a full-coverage all-mode transceiver, equipped for reception on any frequency between 150 kHz and 29.99 MHz, with transmit coverage on all nine present and proposed amateur bands. In countries where permitted, the FT-ONE may be programmed to transmit throughout the 1.8-29.99 MHz range.

KEYBOARD FREQUENCY ENTRY
Fully digitally synthesized, the FT-ONE uses a front panel keyboard for initial frequency entry. Frequency change is then accomplished via the main tuning dial or the pushbutton scanner, with tuning in either 10 Hz or 100 Hz steps possible. Truly the contester's dream, the FT-ONE permits extremely fine tuning and instantaneous band change with equal facility.

DUAL VFO SYSTEM
Ten digital VFO's with memory are provided, in conjunction with an A-B selection scheme that allows instant recall of any transmit, receive, or transceive frequency desired. For split-frequency operation, such as on 7 MHz SSB, the operator may select TX on VFO-A and RX on VFO-B, automatically storing the calling and listening frequencies for each pile-up. For net operations, a non-volatile memory board is available as an option, to eliminate the possibility of dumping memory.

FULL CW BREAK-IN
Recent advances in solid-state technology have finally made full CW break-in reliable enough to be incorporated into a Yaesu product. Now you can select traditional semi-break-in (for use with amplifiers not equipped for full break-in) or full high-speed break-in. When using amplifiers so equipped, the keyer output lead may be interrupted via a rear panel jack and routed to the break-in sequencing input on your amplifier.

SWITCHING REGULATOR POWER SUPPLY
Extremely compact and light in weight, the switching regulator power supply reduces substantially the space required to produce the operating voltages used in the FT-ONE. Highly efficient and uniquely stable, the switching regulator supply provides superb reliability in a field of design long neglected by amateur manufacturers.

ELITE CLASS PERFORMANCE FEATURES
In addition to the full break-in and superb receiver filters, Yaesu's design team packed the FT-ONE with subtle virtues that others might have overlooked. Rear panel jacks allow the use of both an external receiver and an independent receive antenna, such as a 160 meter Beverage. While scanning, automatic halting on a received signal may be programmed, perfect for watching a band for openings. If you're a DX-peditioner, an optional Curtis 6044 keyer board is available, so you won't need an external keyer that only wastes suitcase space. And if your amplifier fan is louder than it should be, there's even a microphone squelch (AMGC) to reduce background noise pickup between words and sentences!

ONE YEAR FACTORY WARRANTY
Because of the level of attention to design detail, parts selection, and factory quality control, your FT-ONE is backed by a one-year factory warranty for the original purchaser at retail. Prompt and meticulous attention to your warranty needs will be provided by our Ohio And California Service Centers. In addition, all units sold in the United States will be inspected and tested after clearing Customs, and will include a Service Manual in the purchase price.

GAIN/INTERCEPT OPTIMIZED RECEIVER FRONT END
Utilizing up-conversion with a first IF of 73 MHz, the FT-ONE RF amplifier stage uses push-pull power transistors configured to produce a typical output intercept of +40 dBm. The first mixer utilizes a diode ring module followed by a low-noise post amp, for optimum noise figure consistent with modern day intercept requirements. The result is a receiver with a typical two-tone dynamic range well in excess of 95 dB (14 MHz, CW bandwidth). Additional gain tailoring is provided via PIN diode attenuator controlled from the front panel.

FILTERS READY FOR COMPETITION
Three filter bandwidths are available for CW operation (two for FSK1), using optional 600 Hz or 300 Hz crystal filters. Filter insertion losses are equalized for constant IF gain. Both IF Shift and Variable Bandwidth are provided, and two CW filters may be cascaded, for competition-grade selectivity. For SSB work, the Variable Bandwidth feature eliminates the need for costly 1.5 kHz or 1.8 kHz filters, as any intermediate bandwidth may easily be programmed using the standard, cascaded SSB filters. To top it all off, a high-performance audio peak and notch filter is standard equipment.

EXPANDED OPERATING DISPLAYS
Digital displays for the VFO Frequency, memory channel, and RIT offset are provided for quick frequency identification. The large front panel meter provides easy viewing of transceiver operating parameters, including final transistor collector current, input DC voltage, FM discriminator center tuning, speech processor compression level, and forward/reflected relative power.

NOT AVAILABLE AS OPTIONS
It's hard to believe that other manufacturers still insist on making such essential items as a noise blanker or speech processor extra-cost options. We find that these are less expensive to incorporate and more reliable in operation when installed on our assembly line. No AC power supply is available as an option for the FT-ONE, either; it's equipped for operation from 100/110/117/200/220/234 volts AC or 13.5 volts DC. And it goes without saying that there will not be an external VFO offered for the FT-ONE — we're confident that ten VFO's are quite enough!

Experience the FT-ONE in your Authorized Yaesu Dealer's showroom today. This may be the last Amateur transceiver you will ever own.

Warranty policy available upon request. SASE, please. Specifications subject to change without notice or obligation.
FT-ONE

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The radio.

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Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 • (513) 874-3100
Watts to see...

Big LCD, Big 45 W, Big 21 memories, compact.

TR-7950/7930

Outstanding features providing maximum ease of operation include a large, easy-to-read (direct sunlight or dark) LCD display, 21 multi-function memories, automatic offset, programmable priority channel, memory and band scans, built-in lithium battery memory back-up, built-in 16-key autopatch encoder, and a choice of a hefty 45 watts output (TR-7950), or 25 watts output (TR-7930).

**TR-7950/TR-7930 FEATURES:**

- **NEW, large, easy-to-read LCD digital display**
  Easy to read in direct sunlight or dark (back-lighted). Displays transmit/receive frequencies, memory channel, repeater offset, +/−, sub-tone numbers [-0, 1, 2, 3], tone, scan, and memory scan lock-out.
  Includes LED 5/RF bar meter, and LED indicators for REVERSE, CENTER TUNING, PRIORITY, and ON AIR.

- **21 NEW, multi-function memory channels**
  Stores frequency, repeater offset, and optional sub-tone channels. Memories 1 through 15 for simplex or ± 600 kHz offset. Memory pairs 16/17, and 18/19 are paired for non-standard repeater offset. Memories "A" and "B" set upper and lower scan limits, or for simplex or ± 600 kHz offset. In MEMORY mode, a circle of light appears around the memory selector knob. When the memory selector knob is rotated in either direction to channel 1, an audible "beep" will sound.

- **Choice of 45 or 25 watts output**
  The TR-7950 provides a hefty 45 watts output, while the TR-7930 features a more modest 25 watts. A HI/LOW power switch allows power reduction to approx. 5 watts.

- **Long-life lithium battery memory back-up**
  Built-in lithium battery has an estimated 5 year life.

- **Automatic offset**
  The microprocessor is pre-programmed for simplex or ± 600 kHz offset, in accordance with the 2 meter band plan. "OS" key allows manual change in offset.

- **Programmable priority alert**
  The PRIORITY channel may be programmed in any of the 21 memories. With ALERT switch "ON", a dual "beep" sounds when a signal is present on the PRIORITY channel. An OPER switch allows an easy move to the PRIORITY channel.

- **Programmable memory scan lock-out**
  "LO" key for programming scan to skip selected memory channels, without erasing the memory.

- **Programmable band-scanned width**
  The lower limit may be programmed into memory "A" and the upper limit into memory "B".

- **Center stop during band-scan, with indicator**
  Stops in center of channel during band-scan, with center tuning indicator.

- **Scan resume selectable**
  Scan stops on busy channel. Selectable automatic time resume-scan (approx. 5 sec., adjustable), or carrier operated resume-scan. A scan delay of approx. 1.5 seconds built-in.

- **Scan control using up/down microphone**
  Momentarily pressing UP or DOWN button on microphone stops the scan (approx. 0.5 sec.) and selects the next channel. Holding the button for about 2 seconds starts UP or DOWN automatic scan action. Scan start also possible using "SC" key on keyboard. Scan may be cancelled by momentarily pressing the PTT switch, or by pressing both UP/DOWN buttons simultaneously.

- **Programmable sub-tone channels**
  Optional TU-79 3 frequency sub-tone channel provides keyboard selectable sub-tone channels, which may be stored in memory.

- **Built-in 16-key autopatch, with monitor**
  The keyboard functions as a 16-key autopatch encoder during transmit. DTMF tones appear in the speaker output when a key is pressed during transmit.

- **Front panel keyboard control**
  Used for selecting frequency, offset, program memory, controlling scan, and autopatch encode. Keyboard lighting is provided.

- **Extended frequency coverage**
  Covers 142.000-148.995 MHz, in 5-kHz steps.

- **Repeater reverse switch**
  Locking type switch, with indicator.

- **"Beeper" amplified through speaker**

- **Compact, lightweight design**

- **Easy-to-install adjustable-angle mobile mounting bracket**

Optional accessories:

- **TU-79 three frequency tone unit.**
- **KFS-12 fixed-station power supply for TR-7950.**
- **KFS-7A fixed-station power supply for TR-7930.**
- **SI-40 compact mobile speaker.**

More information on the TR-7950 and TR-7930 is available from all authorized dealers of Tri-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

KENWOOD

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