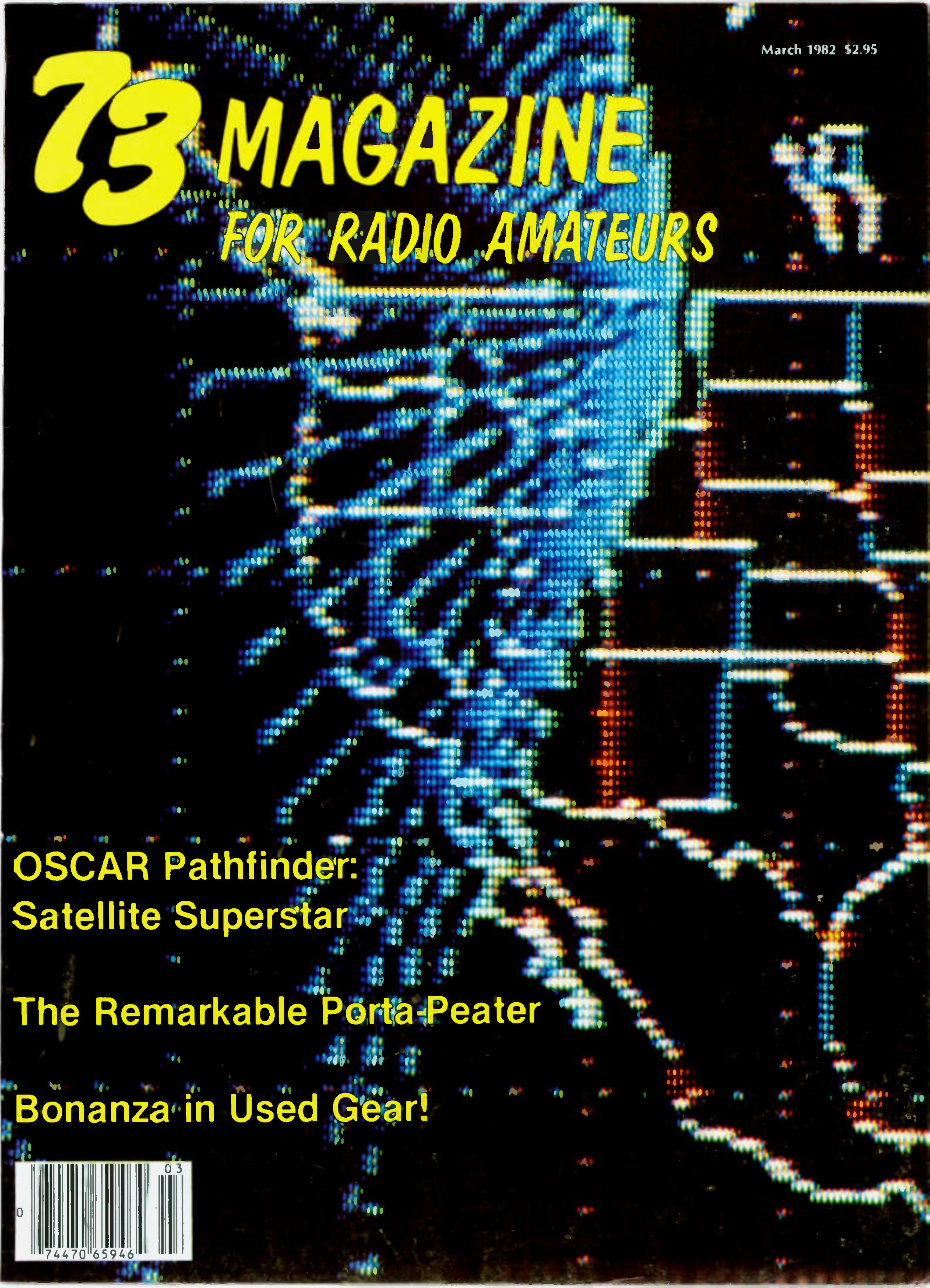
March 1982 $2.95

73 MAGAZINE
FOR RADIO AMATEURS



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Editorial Offices:

Pine Street
Peterborough NH 03458
Phone: 603-924-3873, 924-3874

Advertising Offices:

Elm Street
Peterborough NH 03458
Phone: 603-924-7138

Circulation Offices:

Elm Street
Peterborough NH 03458
Phone: 603-924-7296

Subscription Rates

In the United States and Possessions:
One Year (12 issues) $25.00
Two Years (24 issues) $38.00
Three Years (36 issues) $53.00

Elsewhere:

Canada—$27.00/1 year only, U.S. funds. Foreign surface mail—$35.00/1 year only, U.S. funds. Foreign air mail—$62.00/1 year only, U.S. funds.

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Subscription problem or question:

Write to *73 Magazine*, Subscription Department, PO Box 931, Farmingdale NY 11737. Please include an address label.

73 Magazine (ISSN 0098-9010) is published monthly by 73, Inc., 80 Pine Street, Peterborough NH 03458. Second class postage paid at Peterborough NH 03458 and at additional mailing offices.

Microfilm Edition—University Microfilm, Ann Arbor MI 48106.

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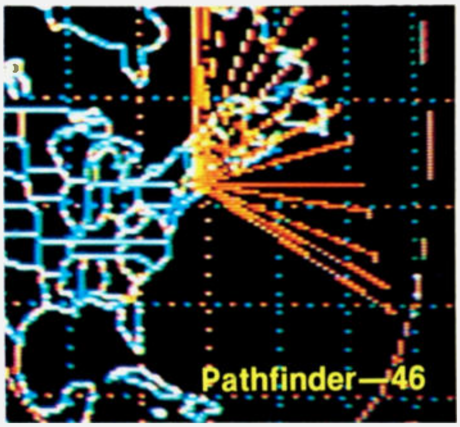
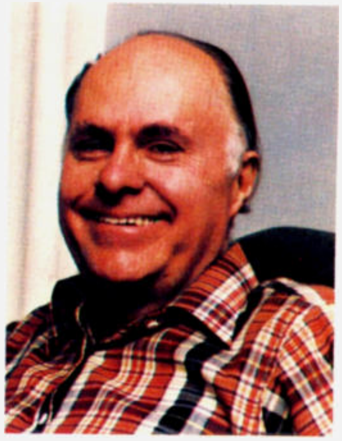
73 MAGAZINE



Cover: Harold Nelson's photo depicts WB6NQK's OSCAR Pathfinder program (page 46) being used to track Russian satellite RS-6 (page 120).

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green



MORSE AND THE DEMISED PLAIN LANGUAGE RULES

The FCC would probably have been able to get amateurs to buy the proffered plain language rewrite of the ham regulations but for one major miscalculation. Sure, there were some aspects of the rewrite which were in need of repairs, but the one disastrous flaw was so enormous in the eyes of amateurs that it sank the whole project. This was the deletion of 97.1, the Basis and Purpose of amateur radio.

All amateurs, whether walking around with an HT on the hip monitoring the local repeater or adding to the mess on 20 meters with fruitless calls in the pileups, are proud of the fundamental reasons for the existence of our hobby...or service, as the government likes to call it. When the FCC tampered with those magic words, they brought us out of our corner fighting.

Well, let's take a look at the words...and the concepts involved. Let's think about them in terms of our own personal contribution to amateur radio and see how we measure up. Let's also mull over the place of Morse code in this realm.

97.1(a) bids us to provide a noncommercial communications service, particularly with respect to emergencies. Fine. Some of us do that on occasion. Others make a career out of it. Well, we don't need a half-million active message handlers either during or between emergencies. We do need enough traffic-handling training so that whatever amateurs happen to be selected for an emergency situation by chance know what to do efficiently.

There is a tendency to think of traffic handling in terms of the CW nets which pass around endless streams of make-work messages, racking up traffic-handling scores for listing in *QST*. If we are going to be more honest about this, we have to admit grudgingly that when the chips are down, the emergency communications for most situations are handled on phone via two meters and repeaters... something few amateurs have had any real emergency experience with. One of the results of this is a pathetically slow traffic flow, with high percentages of the time wasted in callsign exchanges, the endless repeating of words spelled out letter by letter, and the jamming of transmissions by operators unfamiliar with emergency traffic handling.

If you stop to think about it, we are years beyond the time when we should have established a nationwide automated traffic net on high-speed ASCII which would route and pass along messages without any operator being needed. The resistance, right from the beginning, of the traffic organizations to the use of RTTY has kept this part of our "service" about 30 years behind technology. A group of us developed and were using automated message-handling techniques in the late 1940s, only to find a fierce resistance from the national relay organization to any changes from CW.

For emergency purposes, where two meters is the optimum band for local communications, we need hand and mobile phone rigs, not Morse code. With all due respect, there are times when it is advantageous to have a working system which even a CBer can step in and use if needed. Trying to stick to code for such communications is featherbedding.

If we are ever going to set up any serious emergency traffic-handling system in this country...or the world (why think small?)...it is going to have to be up-to-date. This means that we are going to have to think in terms of digital electronics and microcomputers, with automatic message pickup and relaying and with error-correcting codes which will ensure 100% copy at all times.

Indeed, if we start working on the elements of such a system now, I believe that within five years amateur radio can have an emergency communications system of which we can be proud. Such a system, if it is to work when really needed, must be in everyday use. Only in this way can we encourage the investment in equipment and technology which is required ...an investment by amateurs, not the government.

You know, if the worst should happen, our country could well be up the creek if we don't have a comprehensive system. I'm talking about automatic polling of stations in a net by the net control, with all messages typed in on a pocket-sized computer. I'm talking about relaying via repeaters, via satellites (ham and commercial), and via low-band links over any desired distances.

One of the last things we need in an emergency is to have to depend on the handful of hams who are good sharp Morse code operators. You know as well as I that at least 90% of the hams today are not capable of copying code at a reasonable speed under emergency conditions. Who are we trying to fool?

So much for 97.1(a)...though I will be writing more about our responsibility to catch up with technology for traffic handling and emergency nets. Let's look at 97.1(b) now...which has to do with the amateur contributing to the advancement of the state of the radio art. Well, we've a good history of that, if you look back far enough. In recent times we have little of which to be proud. Admittedly a good part of the responsibility for this lies with the FCC's restrictive regulations and inflexibility. But that isn't the whole story by any means.

Let me ask this...where does Morse code fit in any picture of the advancement of the radio art? Other than harking back to the beginnings of radio communications...before radiotelephone was invented... code plays little part in modern communications. Advancing technology has to do these days with digital techniques, with satellites, with microwaves, with high-speed communications, and many other possible new modes of communications. Revering our roots is one thing,

CALL FOR ARTICLES

Are you a RTTY, SSTV, or fast-scan TV enthusiast? Share your knowledge and enthusiasm with the rest of us by writing an article about your favorite mode. We are planning several special issues for later this year, so get cracking. Send your submissions to: Editor, *73 Magazine*, Pine Street, Peterborough NH 03458.

$$ HOME-BREW CONTEST $$

You can win a cash prize and receive fame and fortune by being a published author, all for telling us about your latest home-brew project. See the rules on page 6 of the February, 1982, issue of *73* for the rest of the story.

TR-2500

BIG performance, small size, smaller price!

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.

CONVENIENT TOP CONTROLS

TR-2500 FEATURES:

- Extremely compact size and light weight 66 (2-5/8) W x 168 (6-5/8) H x 40 (1-5/8) D, mm (inches), 540 g, (1.2 lbs) with Ni-Cd pack.
- LCD digital frequency readout, with memory channel and function indication.
- Ten channel memory, includes "M0" memory for non-standard split frequencies.
- Lithium battery memory back-up, built-in, (estimated 5 year life) saves memory when Ni-Cd pack discharged.
- Memory scan, stops on busy channels, skips channels in which no data is stored.
- UP/DOWN manual scan in 5 KHz steps.
- Repeater reverse operation.
- 2.5 W or 300 mW RF output. (HI/LOW power switch.)
- Programmable automatic band scan allows upper and lower frequency limits and scan steps of 5 KHz and larger (5, 10, 15, 20, 30 KHz . . . etc) to be programmed.
- Built-in tuneable (with variable resistor) sub-tone encoder.
- Built-in 16 key autopatch encoder.
- Slide-lock battery pack.
- Keyboard frequency selection across full range.
- Extended frequency coverage; 143.900 to 148.995 MHz in 5 KHz steps.
- Optional power source, MS-1 mobile or ST-2 AC charger/power supply allows operation while charging. (Automatic drop-in connections.)
- High impact plastic case.
- Battery status indicator.
- Two lock switches for keyboard and transmit.

STANDARD ACCESSORIES:

- Flexible rubberized antenna with BNC connector.
- 400 mAH heavy-duty Ni-Cd battery pack.
- AC charger.

OPTIONAL ACCESSORIES:

- ST-2 Base station power supply and quick charger (approx. 1 hr.).
- MS-1 13.8 VDC mobile stand/charger/power supply.
- TU-1 Programmable "DIP switch" (CTCSS) encoder.
- SMC-25 Speaker microphone.
- LH-2 Deluxe top grain cowhide leather case.
- PB-25 Extra Ni-Cd battery pack, 400 mAH, heavy-duty
- BT-1 Battery case for AA manganese or alkaline cells (not Ni-Cd).
- VB-2530 RF power amplifier.
- BH-2 Belt hook.
- WS-1 Wrist strap.
- EP-1 Earphone.

TR-7850

40 W, 15 memories/offset recall, scan, priority, autopatch (DTMF)

Kenwood's remarkable TR-7850 2-meter FM mobile transceiver provides all the features you could desire, including a powerful 40 watts output. A 25 watt version, the TR-7800 is also available.

TR-7850 FEATURES:

- 40 watts output, with selectable high or low power operation.
- 15 multifunction memory channels, easily selectable with a rotary control, M1-M13 . . . memorize frequency and offset (±600 KHz or simplex). M14 . . . memorize transmit and receive frequencies independently for non-standard offset. M0 . . . priority channel, with simplex ±600 KHz or non-standard offset operation.
- Internal battery back-up for memories. Requires four AA Ni-Cd batteries, (not supplied).
- Extended frequency coverage, 143.900-148.995 MHz in 5 or 10 KHz steps.
- Priority alert. Beep alerts operator when signal appears on priority channel.
- Built-in autopatch encoder (DTMF). All 12 plus four additional DTMF signaling tones. (With simultaneous push of REV switch.)
- Autoscan of memories and entire band. Scan resumes automatically.
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- Compact size.
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- Repeater reverse switch.
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- LED S/RF bar meter.
- Tone switch.

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but making a fetish of it is something else.

If we are going to live up to 97.1(b), it is about time that we shelved the code concept and encouraged amateurs to start building, experimenting, and pioneering new ideas. It is time we got behind the magazines pushing this concept. It is time we got these ideas into our clubs and discussed them.

I would love to print technical breakthrough articles as I did in past years. I still remember the Bill Ashby article on the Flying Nose Lock . . . the Costas articles on double sideband, years ahead of his time only because amateurs failed to take the bait and run with it . . . the parametric amplifier by Sam Harris, an invention which changed the long-range radar picture worldwide.

97.1(c) is a "rule" which is directed at the Commission, not at amateurs. Pity, for this is one of the most broken rules in our regulations. This one asks the FCC to encourage and improve the amateur service through rules which provide for the advancing of skills in both communications and the technical phases of the art. We've never had it so bad. If we had had any real national organization, it would have taken the FCC to court and sued in the name of the United States for several billion dollars . . . which is what has been lost due to the restrictive way the Commission has handled the amateur service . . . and totally ignored this rule.

Indeed, our country has lost many billions just as a result of the inept handling of the "incentive licensing" proposals of 1963. How much business has our country lost to Japan in television, radio, and other electronics equipment in the last few years? We are about one million engineers and technicians behind, today, as a result of that proposal—as I've beefed before.

Let's move on to 97.1(d) in our search for some ray of hope for a need for code. This one has to do with our providing a reservoir of trained operators, techni-

Continued on page 118

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

"We recognize your service to the community as a ham! Therefore, your bill is cut in half!"

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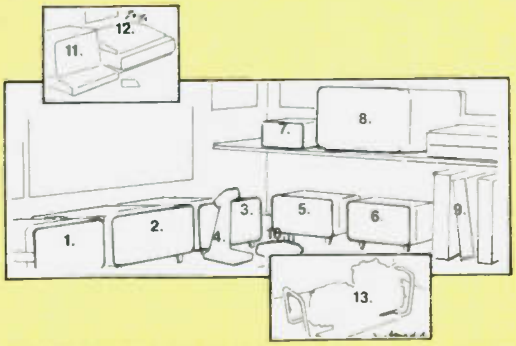

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The Porta-Peater—the Instant Communicator

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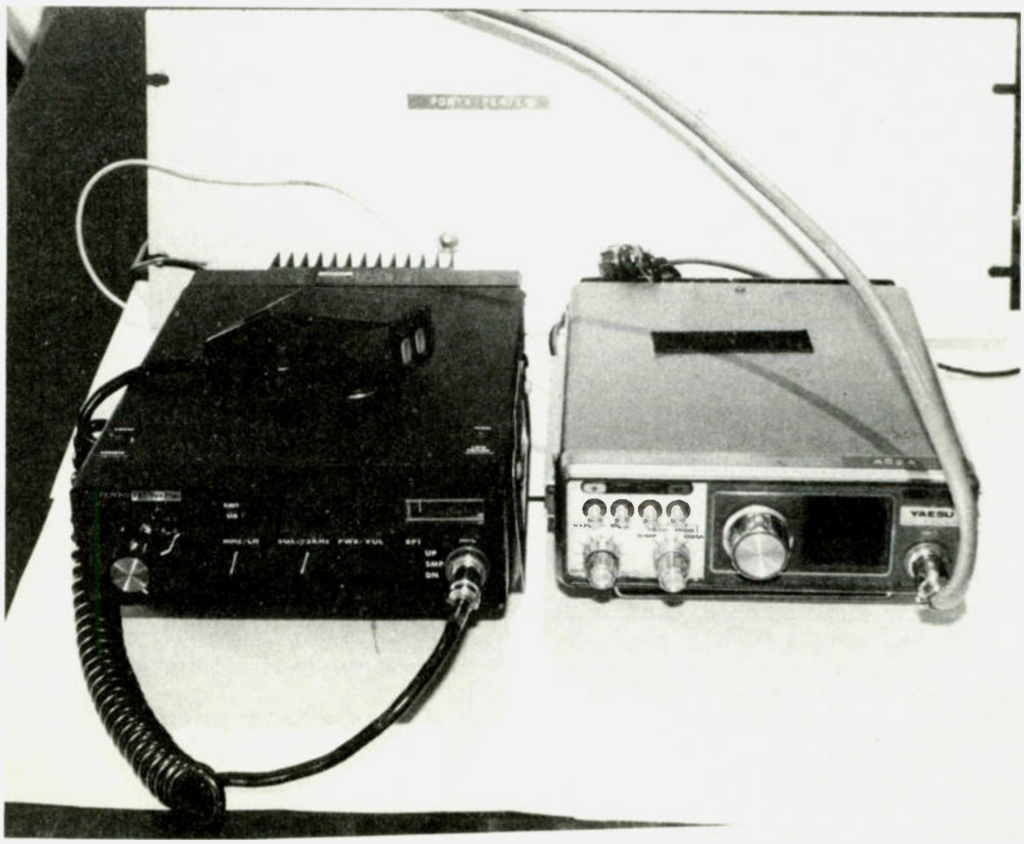

Photo A. Field Porta-Peater hookup with FT-227 and Tempo VHF-1. This Porta-Peater is housed in a minibox on a 19″ rack panel (original prototype).

Emergency situations always seem to happen where there is limited repeater coverage available or limited HT range, or when no one's HT has a crystal frequency which matches anyone else's (sound familiar?). The Porta-Peater™ solves these problems and provides capability and versatility beyond any commercially-available repeater package—and for a lot less money.

The system is an audio-driven command and control module which takes any two rigs and converts them into a QRP, frequency-agile, VOX-driven repeater with CW IDer, hang, and cycle timers. All this with absolutely NO modifications to any of the radios. All connections are made via the available audio input and output jacks on the radios. You can run any mode, any band, cross band, etc. Do whatever your heart desires! You are limited only by your imagination and the FCC for Porta-Peater applications.

A complete Porta-Peater should run you less than $100 for all new parts including an enclosure (but no printed circuit board).

Photo A shows a Porta-Peater field repeater in action. Notice the simple installation. This one is set up on two meters.

Birth of Porta-Peater

The idea for Porta-Peater came from AC2A's desire to be able to erect an instant repeater at hamfests on a frequency fitting most of the HTs in use that day. Since one could never be sure who would be along on the day of a hamfest, there was no way of knowing whose rigs would be available to build into a temporary repeater. This meant no modifications could be made to anybody's unit. Also, we were too cheap to want to invest $600 in a fixed-frequency repeater for what basically was just playing around.

Photo B shows the first Porta-Peater. It was a simple control system with IDer capability but limited timer ability. It was set up at a local Philadelphia hamfest using a Tempo VHF One-Plus, a Yaesu FT-227R, and two separate Larsen 5/8-wavelength antennas about fifty feet apart (one on the ground, the other about 10 feet up). Both rigs were set to low-power output. Fantastic! Everybody liked it and used it. We switched frequencies, splits. You could do whatever you wanted, with limitations depending on what rigs you used, not the repeater control.

Passersby suggested using split band/mode, etc., and its application to emergency usage. This thing was really *more* than just a toy. It had the makings of being the basis for an instant emergency repeater system, with super possibilities. With the Porta-Peater, you could put a repeater on the air as fast as you could hook up two audio cables and two antennas.

Porta-Peater I was a hand-wired, non-reproducible model with diode matrix IDer. Definitely not the stuff articles are made of. It was ugly, but it did work and work well. Porta-Peater II had a nice PCB layout with a new PROM CW IDer. It looked good, worked lousy. Six months (part-time, with spurts of midnight-oil genius) were spent creating Porta-Peater III which looks good, works well, and is capable of being reproduced by other hams. Photos C and D show a boxed unit, and Photo E shows a rack-mount version.

Theory of Operation

The basic concept behind the Porta-Peater was the creation of a repeater by taking any two readily-available amateur radios. One rig acts strictly as a receiver and the other as a transmitter. Fig. 1 is a schematic representation. One rig (any band/mode) receives an incoming signal; it is taken off the external speaker jack and fed into the Porta-Peater. Here it is amplified, and the audio is used to trigger the other rig's transmitter (any band/mode) line via the Porta-Peater VOX. Incoming audio also starts the time-out timer. A separate internal timer controls the CW IDer cycle. Porta-Peater is an interface link between the audio output jack of one rig and the microphone jack of the other rig.

If you use two 2-meter rigs, a duplexer is not necessary since separate TX and RX antennas work quite well with about 40 or so feet between them at QRP levels. The quality of the particular rigs in use (front end specs) determines individual antenna-spacing requirements. Also, since the emergency usage of the Porta-Peater is based on the fact that you don't know in advance what bands on which you may be setting up a repeater (6, 2, 1-1/4, 3/4, etc.), a carload of duplexers in one's back seat generally is not appreciated by the family. Also, it ain't cheap!

The Porta-Peater would be extremely effective in hooking up a VHF link into a low-band rig command center via a repeater, with easy crossband communications. Since the system is VOX driven, you could create multiple-rig and repeater systems in any configuration needed. Just keep a supply of audio jumper cables handy.

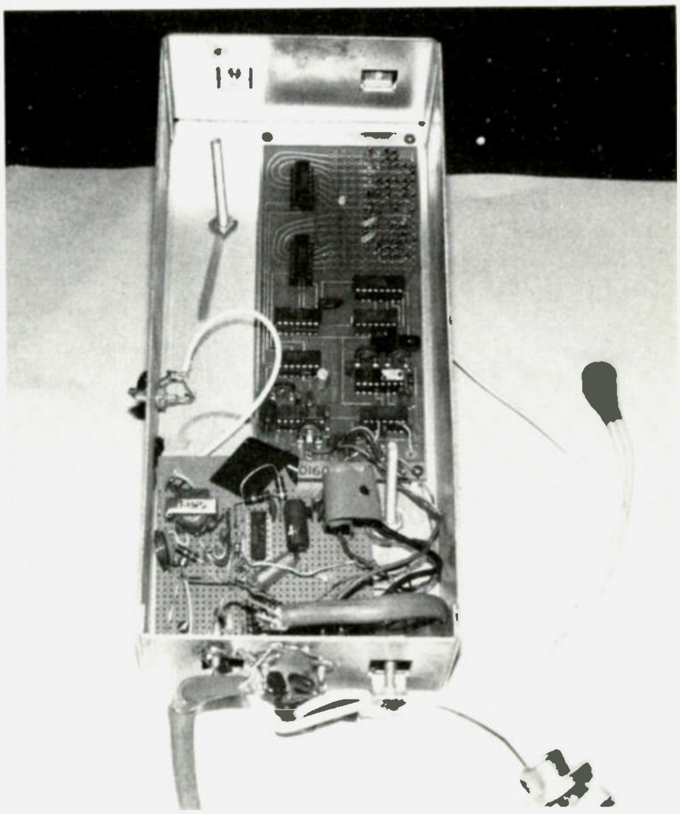

Photo B. Inside view of first unit from Photo A. CW IDer takes up most of box. Control system is in front.

Circuit Description

The Porta-Peater circuit is composed of six basic functions: a local mike amp, VOX amplifier, VOX trigger, reset timer, ID timer, and a selectable four-message PROM CW IDer. All circuit symbols are on Figs. 2 and 3. Audio from a receiver source is fed into an input transformer (T1), which provides a voltage transformation of 5-to-1 to drive the LM 3900 amp (section U1A), and the audio input of the transmitter. The LM3900 is a quad Norton current-mode amplifier. U1A and U1B form the VOX system. The VOX also can be triggered by closing the local PTT contact, which removes U1A pin 3 current bias and turns the VOX on. R2 and C1 form the hang-timer components for VOX hold-in.

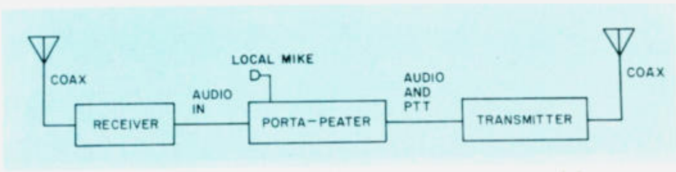

Fig. 1. System layout shows how simply a portable system can be constructed.

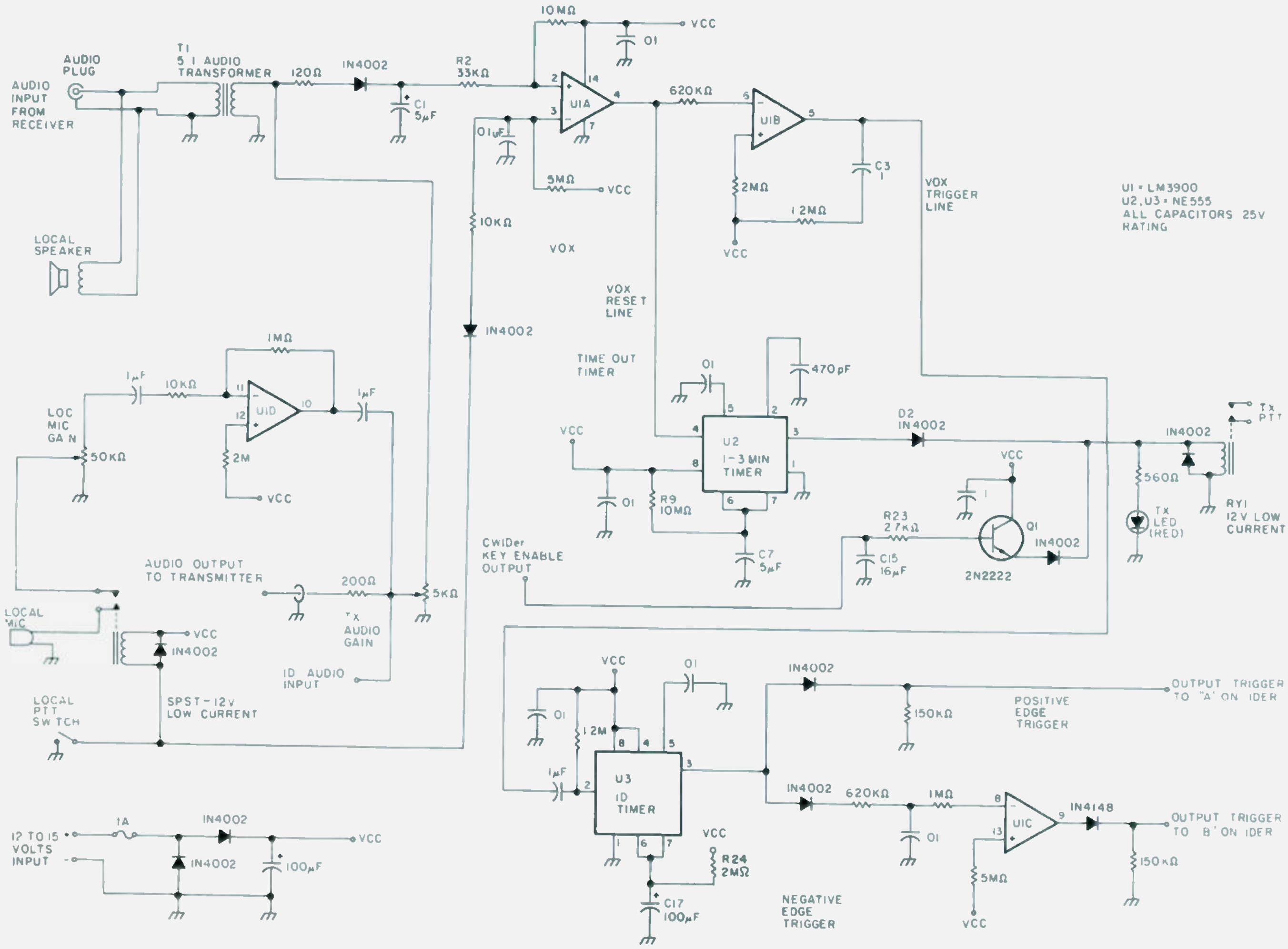

Fig. 2. Schematic of command and control logic for the Porta-Peater.

U1A output is normally low, which defeats the 555 timer, U2. The presence of an audio signal at U1A pin 2 shifts pin 4 to Vcc and enables the timer. U1B inverts the audio signal and provides a negative pulse through C3 and triggers U2 on, which is the 1-minute (adjustable via R9 and C7) time-out timer, and drives PTT relay RY1 on. Time-out timer U2 resets every time the VOX reset line goes low. D2 serves to isolate U2 from spikes due to RY1 operation.

Q1 is a relay driver driven by the CW ID source. The emitter follower is held reasonably high between ID pulses by R23 and C15. The 5-minute ID timer (adjustable via R24 and C17) is keyed by the VOX but is not reset by the VOX. When the 5-minute timer runs out, if

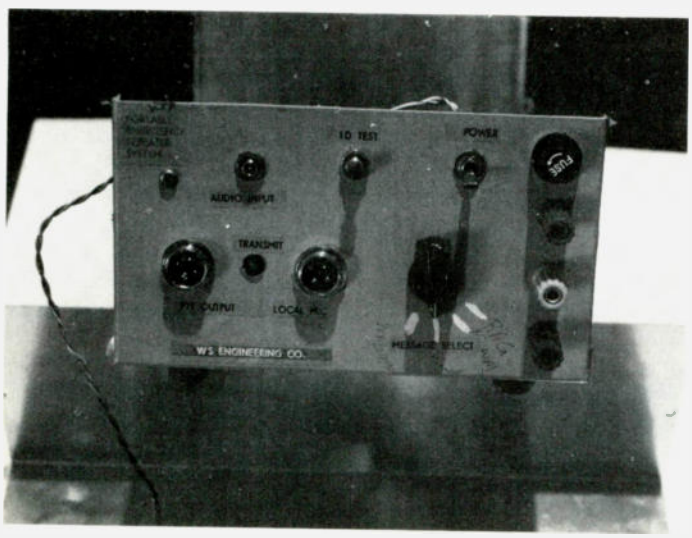

Photo C. Front view of the third version unit with four selectable IDs.

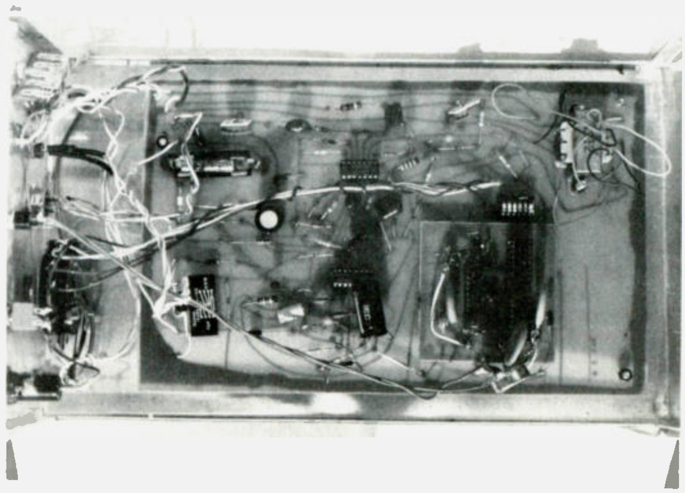

Photo D. Inside view of the same unit shown in Photo C.

the Porta-Peater is not in use, U1C inverts the falling pin 3 pulse and provides a positive trigger output to turn on the CW IDer, which in turn drives Q1 and turns on the transmitter for the final ID as required by the FCC.

The CW IDer is based on an 82S126 PROM, which is a 4-by-256 device. In the PROM, 1 bit is a dit and space, 3 bits a dash and letter space, and 7 bits a word space. The message is played back from memory by being sequentially addressed by the 4020 binary counter driven by one half of the 4011 in an oscillator mode. The particular 256-bit message grouping is selected by switching pins 12, 11, 10, or 9 of the 82S126. The output is combined with the clock signal in the remaining NAND of 4011 and available as a tone at the 10k pot. The output is adjusted to provide drive as needed.

Burning the messages into the PROM is not particularly easy unless you are equipped to do it properly. If you don't have a PROM programmer, it is best to buy a chip and have the supplier burn the memory. Any IDer will work with the Porta-Peater (i.e., diode matrix, or other PROM/ROM types) as long as an audio output signal and an external trigger input line are available. The original model used a VHF Engineering kit. Alternatively,

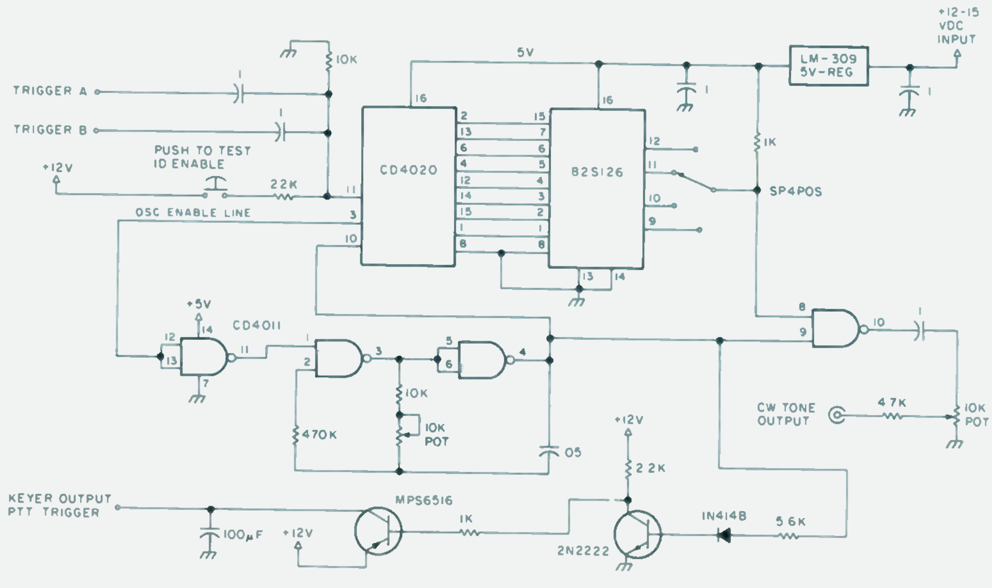

Fig. 3. Schematic of CW IDer. Any IDer can be used with the basic system shown in Fig. 2.

you can build the system without any IDer at all and use voice ID.

The circuit as designed uses an isolated single-pole relay for switching. Depending on your radio, you may have to use an SPDT relay for electronics-switched radios to move 12 volts from the RX to TX enable lines. For relay-switched rigs, simply use the SPST to complete the relay circuit in your radio.

Construction

The latest version of the Porta-Peater is mounted on two printed circuit boards, a mother and a daughter board. The mother board is shown in Photo F. Most of our units used a hand-wired panel instead of a daughter board. The mother board contains all of the command, control, and ID functions. All signal I/O, ground, and power buses are brought out to a standard 0.156-inch, 22-pin edge card connector. The daughter board interfaces to the mother board via the connector, or you can hand-wire the two boards together.

The daughter board has the TX LED, audio input jack, PTT output jack, local mike jack, ID-message-select switch, and ID-test switch mounted on it. This approach makes for a design that can be put in various enclosures easily without rewiring. Photo F shows how jumper wires were used instead of a daughter board.

The selection of enclosure is a matter of personal choice. The only requirement is that it be reasonably rf tight. The last thing you need is rf floating around inside an audio-frequency-control system.

Cable Assembly

Two interface cables are required to use the system. One is a shielded audio line and the other is a four-conductor microphone push-to-talk line. Since normally you will use the Porta-Peater physically close to the two rigs forming the repeater pair, a short convenient length is all that is needed. Two-foot lengths are a good starting point.

Most newer transceivers use subminiature jacks for external speakers. The jack

Photo E. Rack-mount version of the Porta-Peater.

Symptom	Possible Cause	Fix
1. Erratic time out	1. Leaky tantalum	1. C7
2. Erratic ID timer	2. Leaky tantalum	2. C17
3. Erratic VOX or distorted audio	3. LM3900—low gain at Vcc	3. LM3900, or remove protective input diode to raise Vcc by 0.8 V
4. No ID	4a. No clock	4a. 4011
	4b. No count	4b. 4020
	4c. No data	4c. 82S126
	4d. No audio	4d. 4011
	4e. No trigger	4e. 2N2222, MPS6516
5. Erratic ID	5. Poor voltage Regulation	5. LM309K

Fig. 4. A troubleshooting chart of symptoms, causes, and possible fixes.

Reader Service for facing page ✓70→

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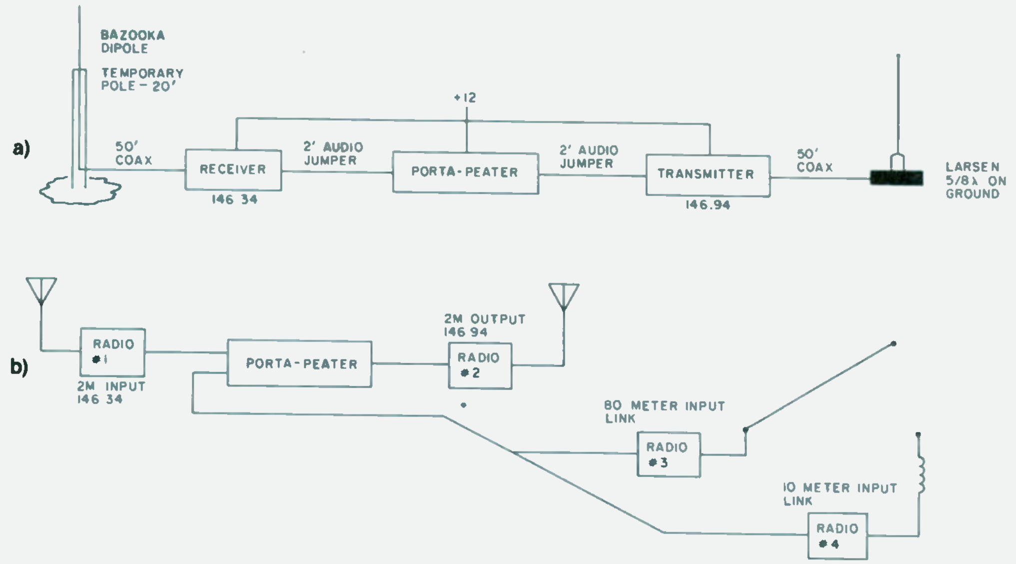

Fig. 5. Layout (a) shows a typical 2m hookup, and (b) a 3-band input command center. All inputs show up on 146.94 out. Mode has no effect on the system (i.e., CW, SSB, FM).

on the audio input of the Porta-Peater is also subminiature. Therefore, make up or buy a shielded jumper with subminiature connectors at both ends. In order to cover more possibilities, you might want to purchase several connector converters to change the subminiatures to PL-55 or whatever you have. Remember, the cable must be shielded.

The Porta-Peater uses a standard 4-pin, screw-on microphone plug. Again, most new rigs use this type, also. It is important that you make up this cable with the proper pin assignments. If you know in advance with which rigs you most likely will be using the Porta-Peater, you can make up a couple of dedicated jumpers. Alternatively, a small minibox can be made with a terminal block inside and the proper jumper assignments made for the rig to be used. Fig. 6 shows a possible design. This approach permits fast and easy field changes. Again, use only shielded cable.

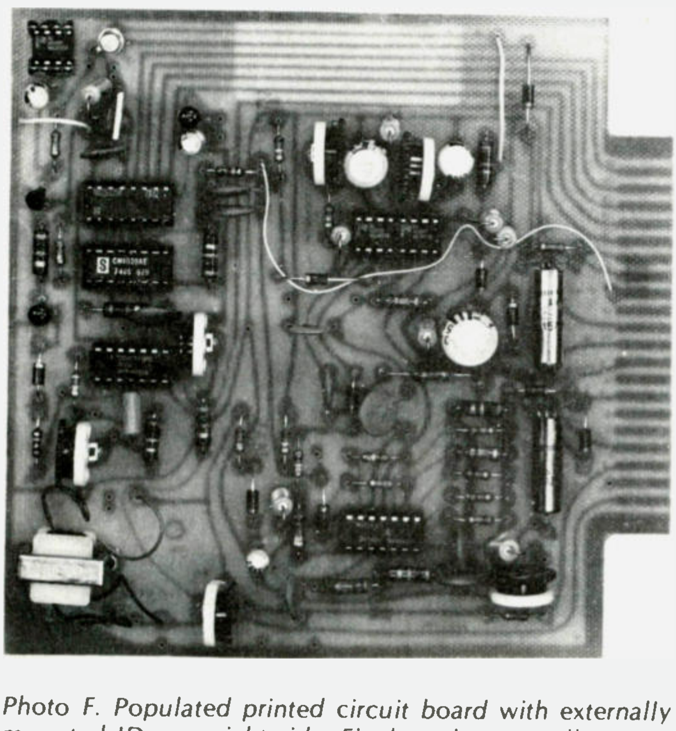

Photo F. Populated printed circuit board with externally mounted IDer on right side. Final version was all on one board.

Circuit Assembly

Figs. 2 and 3 show the entire circuit for Porta-Peater III. PCB construction is recommended but not required. (A commercially-manufactured PCB is available for purchase; write WA2BHB or AC2A for information.) Any type of perfboard assembly is fine. Layout is not critical except for isolating the inputs and outputs of the high-gain LM3900. Parts substitutions can be made except for the low-leakage tantalum capacitors. These must be used where specified because otherwise the circuit performance will be degraded or it will not work at all.

Alignment and Adjustment

The adjustments of the audio gains on the Porta-Peater are set to the particular rigs it is connected to. Simply hook up two rigs as per the schematic in Figs. 1, 2, and 3. Apply power and adjust for best audio. Select your ID message, push to test, and you are finished. If things don't seem all peaches and cream, perform troubleshooting procedures.

Troubleshooting

If your unit does not function, use the fail/cure list in Fig. 4 and you should be able to home in on the problem in a few minutes. (This list assumes that you have previously looked for broken connections and bad solder joints and taken corrective action.) Before taking apart your unit, be sure you have checked and tried the full range of adjustments on all the pots for gain, output, and oscillation on the Porta-Peater.

Field Hookup

In a field installation, all that is needed is two rigs and a 12-volt source to set up a Porta-Peater repeater. Remember, you can configure any setup you wish by proper interconnection of the audio output and microphone PTT lines to the rigs in use. The Porta-Peater gives you the capability to set up a reasonably sophisticated communications network based simply on whatever random collection of amateur rigs happens to be available in any emergency situation. Fig. 5 shows some configuration possibilities.

For a typical 2-meter QRP repeater setup, follow these instructions:

1) Select the rig to act as a receiver.

2) Set the desired input frequency on this unit.

3) Run a jumper from the external-speaker jack of the receiver rig to the audio-input jack of the Porta-Peater.

4) Connect the PTT-microphone-output jack of the Porta-Peater to the microphone-input jack of the rig selected as the transmitter. Make sure all ground audio and switching lines are wired correctly; otherwise the system will not work or could damage the

units. Set up the transmitter frequency.

5) Apply +12 volts to all units.

6) Set the receiver squelch to the desired trigger level.

7) Adjust the receiver volume control (when receiving a signal) to a level which doesn't overdrive the Porta-Peater and distort the transmitter signal (a quick on-the-air check is best; monitor with an HT).

8) Turn the volume on the transmitter rig to low or off (volume, not power).

9) Locate antennas for minimum interference and overload. (See Antenna Setup Hints.)

10) Operate and enjoy!

Antenna Setup Hints

If you want frequency agility and you are not using a duplexer, all of your isolation comes from antenna separation. Our standard setup uses two 50-foot lengths of RG-8 coax and a pair of 10-foot poles. One pole is aluminum, the other is bamboo. The two poles are lashed together, with the bamboo on top. A vertical dipole is made from the RG-8 by turning down the braid 19 inches leaving the insulated center conductor as is. This forms a bazooka dipole for one antenna; the Larsen 5/8 wavelength is used for the other. A 1/4 wavelength can be used, but in either case, ground-level mounting is employed.

In our field trials, it did not seem to matter which antenna was used for receiving or transmitting. You probably will want to try the different combinations for yourself in case there is some incremental improvement for a particular location. Under any circumstances, the two antennas should be separated as far as possible or until desensitization ceases. I often bring up the Porta-Peater before laying out the antennas, then, while the rig is madly squealing, walk the ground-level antenna away until the squealing stops.

In severe space-limitation situations, we sometimes put an attenuator in the receiver transmission line and eliminate desensitization by lessening receiver sensitivity. It is very easy to get radio coverage of a hamfest (i.e., several acres) when a 10- to 20-dB pad is ahead of the receiver.

Operating Notes

One of the things discovered in using the Porta-Peater with various 2m rigs was how really poor many amateur and commercial transceivers are in terms of their rf tightness. Several instances occurred where we thought the Porta-Peater was not performing right and was causing problems but found out that it was a manufactured rig which was at fault. Microphones with unshielded cables, no 12-volt lead rf bypassing, and plastic cabinets or face plates all contributed to problems. In a high-density rf environment (like the Dayton Hamvention), a rig which is not truly rf tight will give a lousy performance.

Therefore, if the Porta-Peater exhibits problems which could be contributed to rf leakage, check the rigs you are using first. A tight enclosure, with shielded and bypassed leads, will make a world of difference.

Pocket Porta-Peater?

The development and construction of this unit was really a challenge for us. Generally, it was fun (although WA2BHB seems to have less hair now than at the beginning of this project!). However, since the Porta-Peater was designed, Icom has, of course, come out with its new IC-2A synthesized HT. So, if we had a miniaturized Porta-Peater and two IC-2As, we literally could have a pocket-sized repeater that was no less frequency agile!

Well, the Pocket Porta-Peater is in development. It uses a lower current drain IDer, advanced IC VOX system, is smaller in size, but it does cost more (unfortunately, some smaller parts cost more than their bigger brethren). However, if you don't need to carry a repeater in your pocket, the present version represents the best bet.

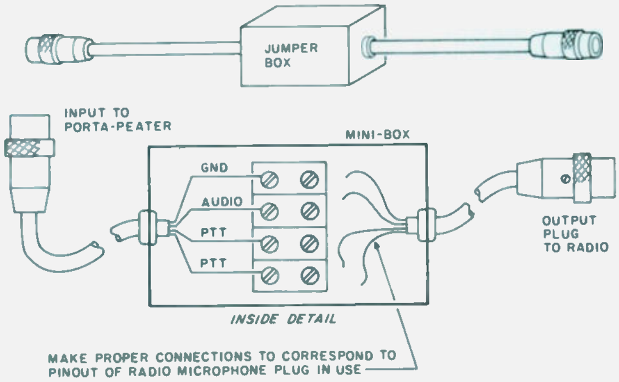

Fig. 6. A jumper box will solve the problem of a fistful of audio cables. Use shielded box and cables only.

Follow-Up

I will gladly answer any questions on the Porta-Peater, but you must include an SASE if you expect a response. Please remember, I'm a ham, not an electronics engineer, so the quality of answers must be gauged accordingly. 73s, and I hope you have as much fun with your Porta-Peater as we have had with ours. ■

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Amateur Television's Stripper

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(Ed. Note: For further information about this article, readers should consult the "Corrections" section of this issue.)

Of the many different ways in which radio amateurs participate in our wonderful hobby, amateur television is probably one of the least understood by the general ham population and virtually unheard of by the general public. I am not referring to slow-scan TV, but to old-fashioned, regular fast-scan television.

Since I was actively involved in TV broadcasting about twenty years ago, in the days of black and white, I knew of the limitations involved. We used to pump out 16 kW of visual rf and about 10 kW aural and were happy to be informed that some viewers 40 miles away could still actually see us, which was not always the case. You can see that I was always very skeptical of the concept of amateur television. What was the point of proving that we could squirt a live picture a few blocks away? Big deal, right?

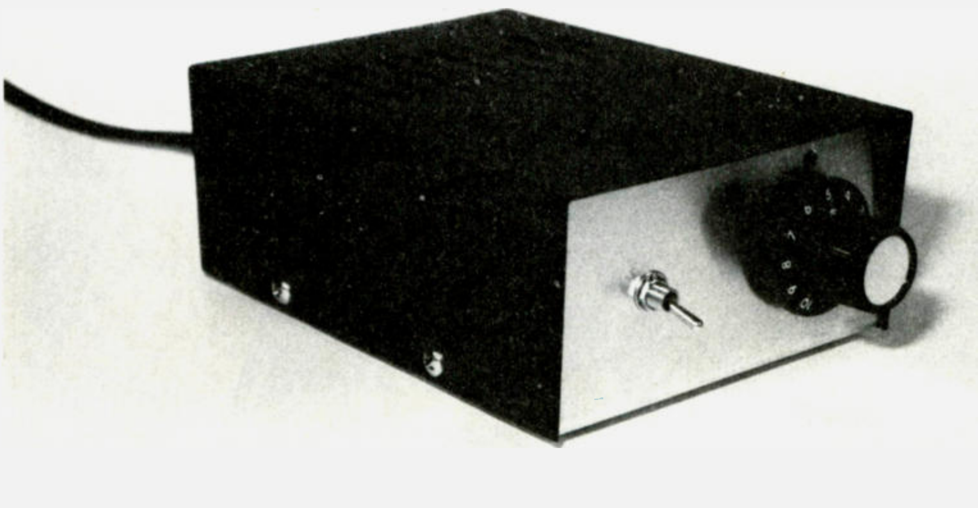

Photo A. The completed ATV converter.

Now I am here to tell you that I, and anyone thinking along the same lines, could not be farther from the truth. About five years ago, one of our local club members found out that I was trying to build my own TV camera and talked me into experimenting with some simple ATV equipment. After puttering around for a few weeks and optimizing a 6-element yagi, commercial TV converter, and a ½-Watt, 6J6-type free-running modulated oscillator, we actually managed to work over a path of thirteen miles. We were so enthusiastic that we wrote articles to several club bulletin editors to mark this great local breakthrough. There was no turning back now. I proceeded to push ATV from then on by demonstrating at ham

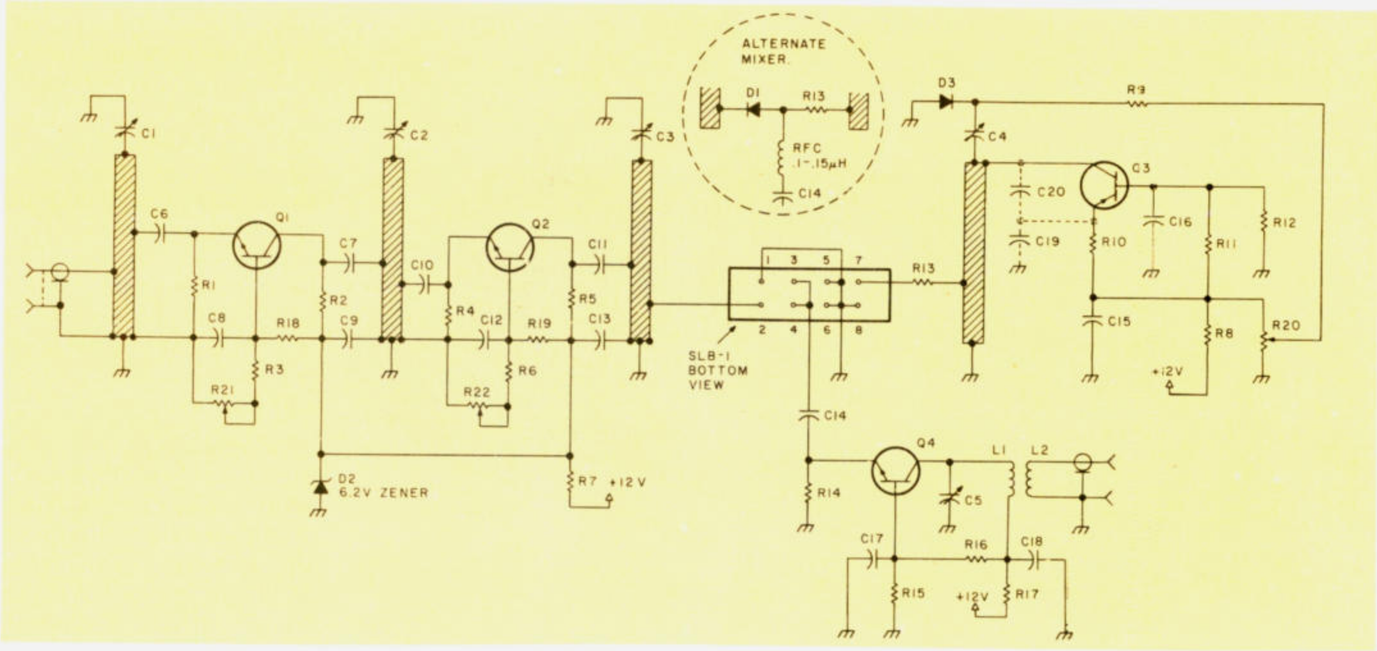

Fig. 1. ATV converter schematic.

clubs, hamfests, shopping malls, etc., and lecturing others on the pros and cons of ATV.

I have learned a great deal since that early beginning and, so, would like to pass on some helpful information to other hams who might want to follow in my footsteps.

First of all, ATV is not for everybody. I have seen many people come and go over the years. If you are not really that much interested in the workings of radio, from a scientific point of view, then forget it. Even if you buy all your equipment ready-made and get involved with your local ATV gang, you would soon lose interest because all they ever talk about and show you are ATV parts, circuits, theory, etc., until it comes out of your ears.

There are times when no one will be on, and that's usually when you want to demonstrate to your friends that you own channel 13½ and can do the same as your local station, only better. Other times, you may want to tune up your new preamp and find no one on; it can be frustrating. But there are times when another ATVer calls you on the land-line (or on 2 meters) and tells you that the band (70 cm) is wide open because the UHF TV stations are coming in like gangbusters. You will then drop whatever you are doing and get on the air right away, only to find out that all hell has broken loose on ATV—everybody and his brother seem to be coming in on a night like that.

You find yourself looking at a lot of co-channel interference, sometimes three stations at once. You turn your beam like crazy trying to separate them, while everybody is asking you via 2 meters to switch your transmitter on as well. You go bananas trying to videotape and play back, make pictures with your Polaroid, and keep track with your log sheets while simultaneously panning cameras, showing logos, etc. These openings occur more frequently than one might expect, depending a lot on your geographical location.

Around the Great Lakes region, we have a lot of thermal inversions. During the warmer weather from early spring to late fall, I can work W3POS in Erie PA at least a few times a week, and we are 85 miles apart.

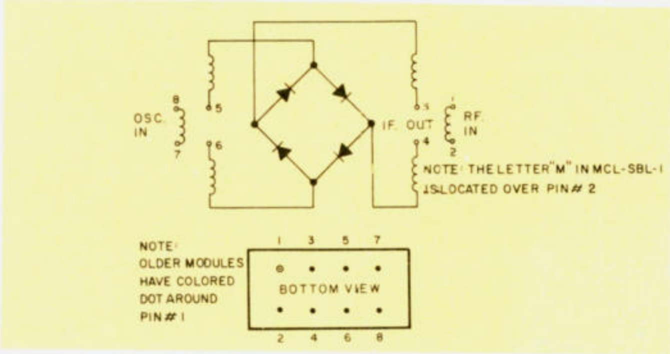

Fig. 2. Double-balanced mixer hookup details.

Last year, I worked W9ZIH in Chicago IL, which is 420 miles away from me. I also have seen K9KLM and N9AB who are up to 440 miles away from me. (See December, 1979, *73 Magazine* Letters, p. 226, or November, 1979, *A5 Magazine* for more details.)

With my present setup, I can work stations within a 50-mile radius quite comfortably. I put out 50 Watts of rf on 439.25 MHz, with sound on the video carrier, into a compact skeleton-slot antenna. (See March, 1969, *CQ Magazine* for more details.) I usually can see a 10-Watt station quite well, providing he uses a good antenna system and is not located at the bottom of a pit.

In an attempt to see how low we could go, VE3QF in Toronto, Ontario, reduced his power to 50 mW into a set of four 27-element yagis and his picture frame would still lock in at my TV set. The picture quality was P½ (P5 being absolutely snow free) and we were 50

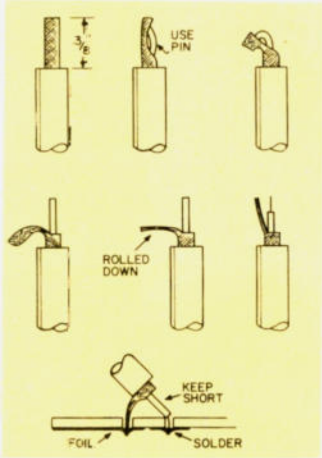

Fig. 3. RG-174 coax preparation and installation.

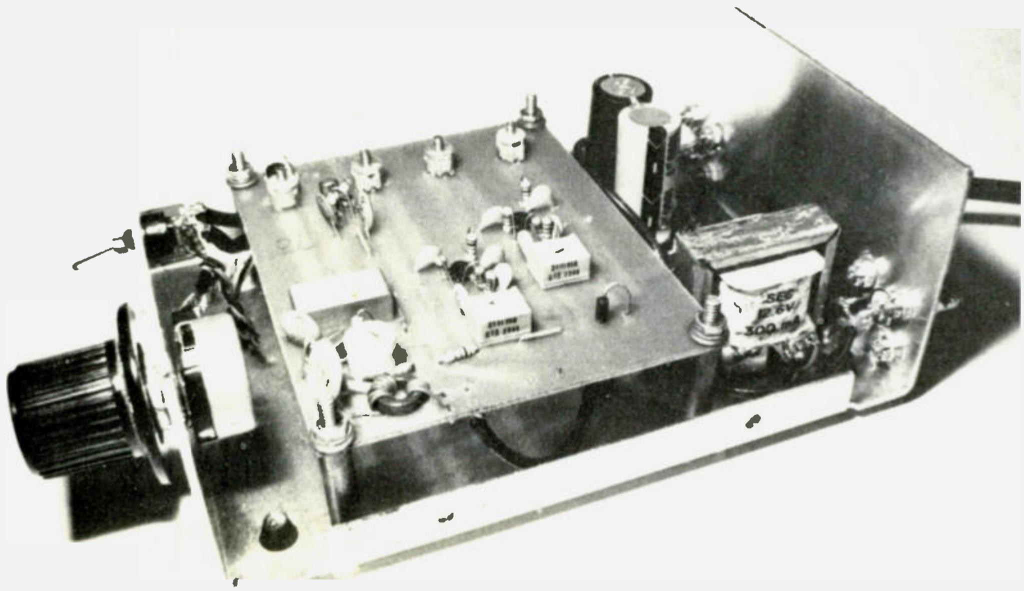

Photo B. Inside view of the converter showing PCB mounted on standoffs.

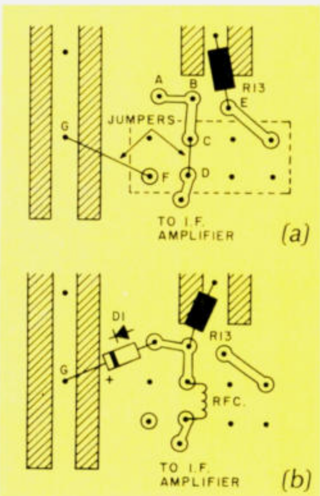

Fig. 4. Mixer installation details. (a) Double-balanced mixer. (b) UHF diode mixer.

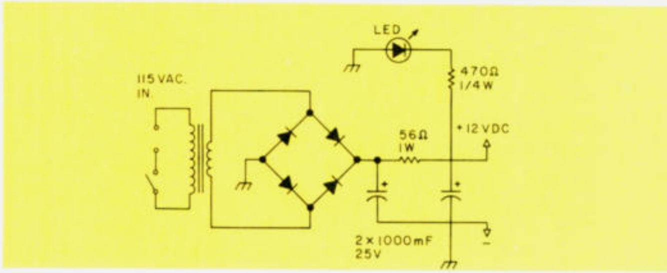

Fig. 6. 12-volt power supply.

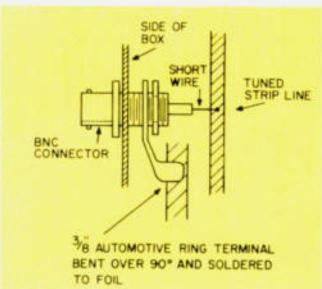

Fig. 5. BNC connector mounting.

miles apart. So, you see, with the converters, preamps, and antennas we use nowadays, ATV is really worthwhile. After all, a picture is worth *more* than a thousand words.

You, too, can do it, for it doesn't have to cost you an arm and a leg. If you are a newcomer to this TV game, make sure that there is local interest; find at least one other ATV fanatic. You will need at least one other person that you can count on for testing, adjusting, and fiddling with your video and audio equipment—it takes two to tango. Just two stations can keep busy for days, pruning and tuning. And when you drop that sharply-tuned converter, everything is out of whack again and you are set for another night of fiddling. When you've got a whole group on, you can take turns hamming it up making "Pink Rose Tea" commercials, putting on wigs or crazy caps with badges, and showing all your empty 807s.

As with any other mode of communication, the first thing to do is to be able to receive well enough. No point in playing around with old-fashioned UHF television converters, unless you are prepared to hang two or three preamps in cascade between it and the antenna. You can waste a lot of time this way and finally give up in disgust. If you can get ahold of a varactor UH tuner from a late-model TV set, you might be better off, although you still need additional amplification. Some of them will tune right down to 439.25 MHz and lower.

Unfortunately, the output frequency will only correspond with your TV set's video i-f frequency, which means you have to modify. Besides that, you do not take advantage of your TV UHF tuner's gain and selectivity. You also could build an ATV converter from various kits that are advertised in some ham publications, but my experience tells me that you will still need more amplification and selectivity.

Among the best preamps that I have built over the years were the ones that used tuned lines. The problem with them is that they are a bit tricky to make. You've got to be a combination of plumber and sheet-metal worker and you'll still end up with an amateuristic-looking contraption.

A couple of years ago (during a quiet ATV night), an idea came to me. Why couldn't I use stripline techniques instead of gas pipes and sheet copper? After all, they use it on rf power amplifiers for VHF and UHF. I decided to take one of my pet construction articles (see 1971 ARRL *Radio Amateur's Handbook*, page 417), of a 432-MHz preamp, and convert the tuned-line dimensions to stripline. I ended up with a printed circuit board that was a two-dimensional copy of the original three-dimensional preamp.

After I completed the new preamp, it took me a while to get things stabilized, but I got it working—surprisingly well, I might say. As a matter of fact, the results were so impressive that I supplied a number of ATVers in the area with similar preamps. I've made a few more since then, each time changing the dimensions a little bit; the objective was to make it smaller and simpler. Eventually it evolved into a complete converter.

The converter (Fig. 1) which will be described in

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- REMOTABLE HEAD: The control head may be located as much as 15 feet away from the main unit using the optional connecting cable. COMPARE!
- PL TONE OSCILLATOR BUILT IN: Frequency is adjustable to access PL repeaters.
- MICROPHONE VOLUME/FREQ. CONTROL: Both functions may be adjusted from either the microphone or front panel.
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- 25 WATTS OUTPUT: Also 5 watts low power to conserve batteries in portable use.
- GREEN FREQUENCY DISPLAY: Frequency numerals are green LEDs for superior visibility.
- RECEIVER OFFSET: A channel lock switch allows monitoring of the repeater input frequency. COMPARE!
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this article is actually the seventh in the series, each one being an improved version of the former one. This one consists of two stages of rf amplification, one varactor-tuned oscillator, and one i-f amplifier. Also incorporated is a double-balanced mixer (more about this later!).

If you are not in the market for a complete converter, you might be interested in just copying the rf sections. Or, you might like to use the i-f (channel) amplifier separately between your own converter and boob tube for another 6 dB of gain. You also could use the oscillator as a self-contained unit to be used as an independent UHF signal source.

I will now describe each section individually so that you can take out whatever section you might be interested in. Later on in this article we will put it all together and make a complete, tunable, high-gain ATV converter.

The Rf Section

As I said earlier in this article, you can find the theory on this two-stage preamp in the 1971 and older *Handbooks*. Although we now use stripline, it seems to work basically the same way. In some earlier attempts, I used feed-through capacitors and even used separators between stages, as well as carefully-selected bias resistors. Even though I had the thing working, I didn't want to press my luck at that stage and try anything more radically different than what I had already done with the tuned-line (tubing)-to-stripline conversion. In more advanced models, we got rid of the feedthroughs (too expensive) and separators and even tried a whole range of replacement transistors. We finally settled on what we've got now; it seems to be the best, cheapest, and easiest way to go.

The rf amplifiers could be used as a one- or two-stage preamp. Both PCB layouts are provided so that you can take your pick. The one-stage job was carefully evaluated by Ralph W2RPO, using professional equipment. The test results indicated a 15.3-dB gain at 440 MHz, with a bandwidth of roughly 20 MHz between 3-dB points. Noise figure was not measured but is assumed to be close to the 1.7-dB mark, as the manufacturer of the MRF901 states. Even with the best modern TV UHF converters, a one-stage preamp like this one should make quite an improvement, at least another P unit, as we ATVers call it —maybe even two P units.

The two-stage preamp

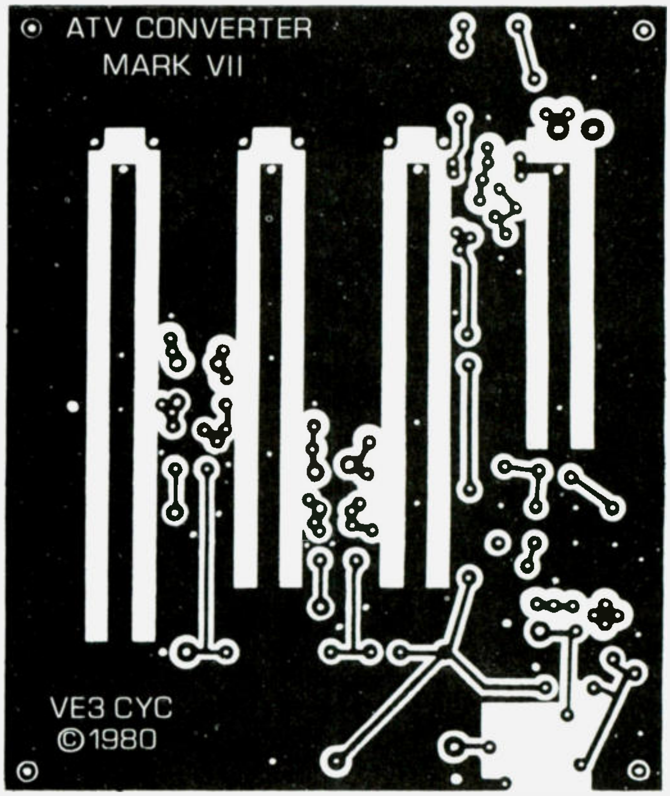

Fig. 7. ATV converter PCB layout.

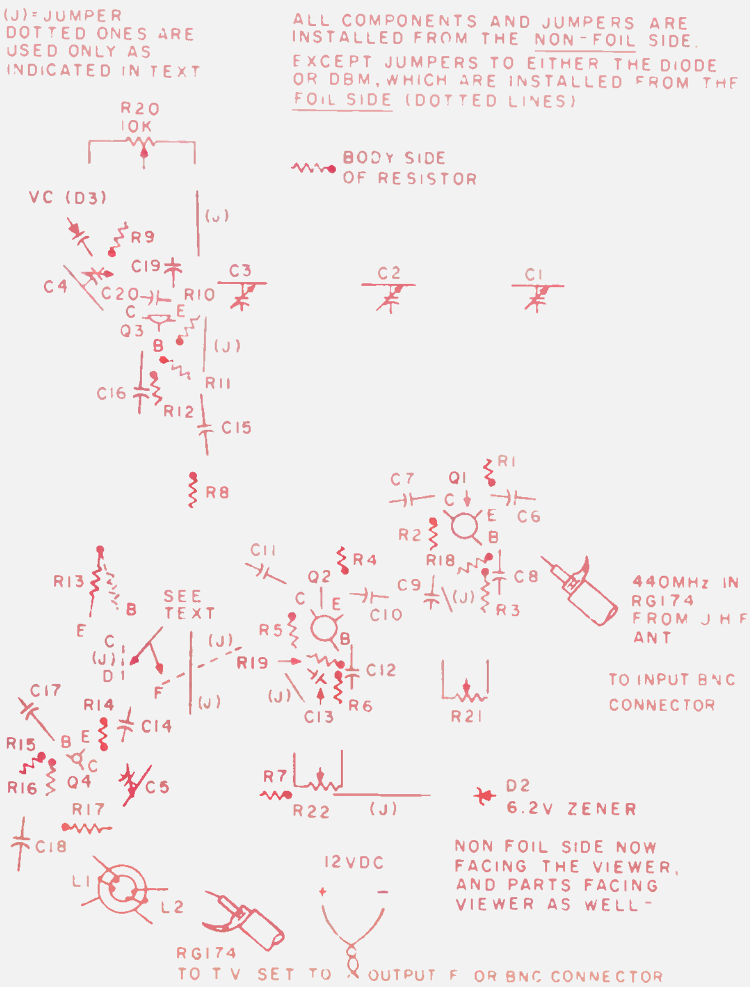

Fig. 8. ATV converter component location.

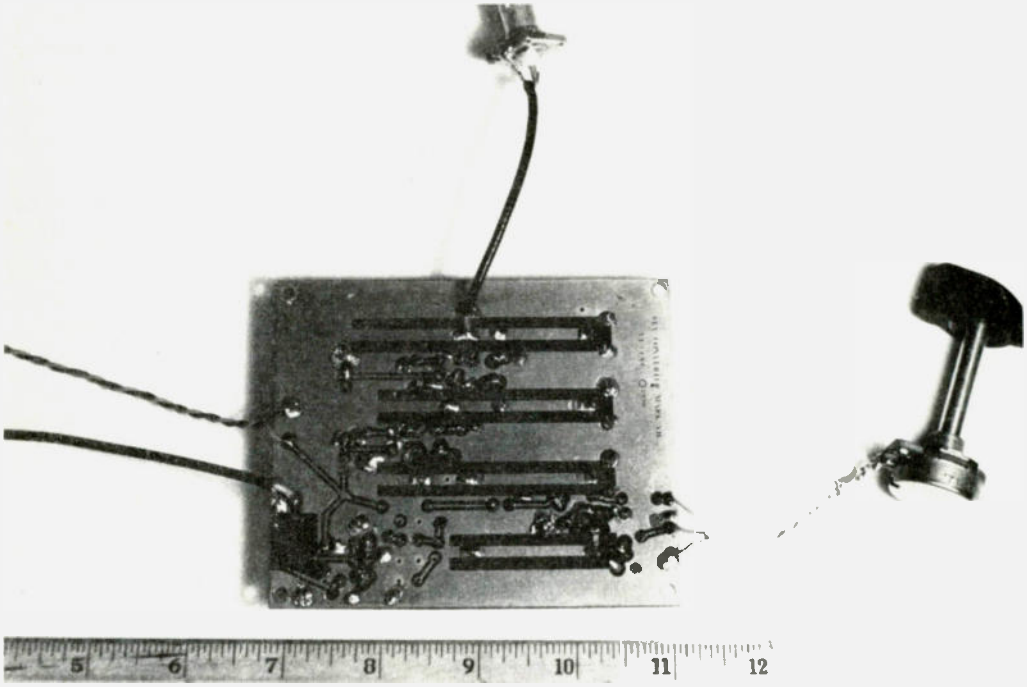

Photo C. Foil side view of converter with input, output, power, and frequency control connections.

will give about 40 to 50% more gain over the one-stage preamp. Therefore, you will have to decide whether it is worth the effort—it will make a day vs. night difference on those old tube-type converters like they used to have years ago—I can vouch for that.

I have dropped the 12 V down to about 6.2 V, which improves stability and keeps the noise figure down. You might try a higher voltage for more gain if you wish by changing the zener and dropping resistor values, but it will be trickier to tune up, especially when you live in intermod alley.

The Oscillator

It is not easy to make an oscillator work well with direct output in the 70-cm band. I had tried several schemes until I found this one. It originally had been developed by Tom O'Hara W6ORG, and it's used extensively in Tom's own products (PC Electronics). I have received Tom's permission to use his oscillator in this article.

Besides the change to stripline, I also changed a few values of parts, mainly to be more adaptable to other transistors (he uses the MPSH81) but also to keep the whole thing from radiating too much and getting into my scanner, etc. The two silver-mica capacitors, C19 and C20, are not always necessary with some transistors; the Sylvania ECG106 does a good job without them. These capacitors will lower the tuned frequency, and as a rule, the higher the value, the easier the oscillator starts and the less it drifts (try to keep the ratio about 1:3). If you've ever worked with regenerative UHF receivers, you might recognize the principles of this oscillator.

To preset the oscillator, it is best to set the 10k frequency control at mid range, clip a lead from a frequency counter to the output end of the 47-Ohm resistor (R13) and ground, and tune trimmer C4 to read 372 MHz for a 439.25-MHz video frequency in your area, providing your TV channel input would be channel 4. If you choose channel 3, your oscillator should be set at 378 MHz, and for channel 5 it should be 362 MHz, etc.

The carrier frequencies of channels 2, 3, 4, 5, and 6 are 55.25, 61.25, 67.25, 77.25, and 83.25 MHz, respectively. The sum of your chosen channel frequency and the oscillator frequency should be 439.25 MHz in this case, and correspondingly different for other ATV frequencies. If you don't have a frequency counter, you could use your TV set tuned to channel 59 or 60 and look for the second harmonic. The 1k resistor (R8) might have to be lowered if the oscillator fails to start.

I have tried several types of low-power PNP silicon UHF transistors, and most of them oscillate readily in this circuit. However, some have a tendency to drift more than others. The drift is not objectionable though, as it has to drift at least a few MHz to affect the video, which is seldom the case.

The I-f Amplifier

The main reason for the amplifier was to overcome the conversion losses in the double-balanced or the diode mixers, which is about 6 to 7 dB. The T37-2 toroid seems to be a better match than a T37-10 or T37-12 which I also have tried. The tuning is smoother and the tendency to oscillate has disappeared. The wire size is not critical; I have used #24 to #30 wire with equal results.

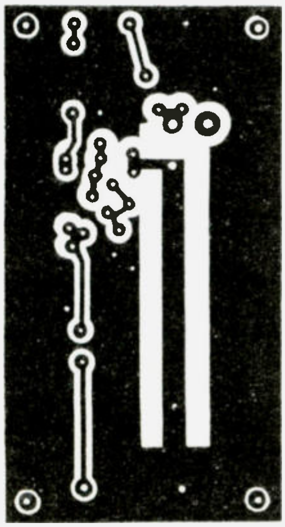

Fig. 9. UHF oscillator board PCB layout.

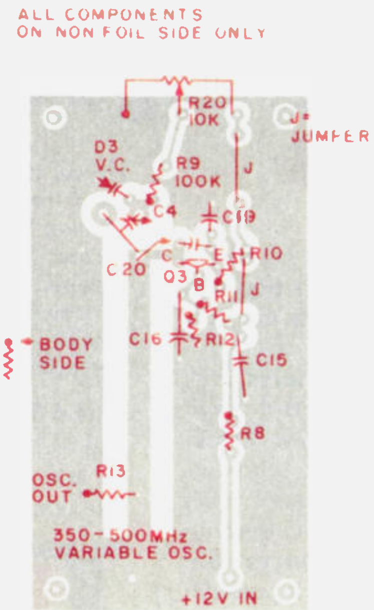

Fig. 10. UHF oscillator board component location.

This amplifier can be tuned up by hooking it to your TV set's unbalanced input (75-Ohm). On some older sets, you might have to go past the balun directly to the VHF tuner input. Apply power, clip a piece of wire to C14, and tune for the best picture on the channel of your choice or the next one, if the channel is blank. That completes the tuning.

The Mixer

When I started writing this article, the only mixer worth considering, in my opinion, was a double-balanced mixer (see *The Radio Amateur's Handbook* for details). The one I selected was the MCL-SBL-1 (see Fig. 2) for no other reason than availability. There is no question about it. They do a fine job in this circuit. But in small quantities they are rather expensive.

So, just for you cheapskates out there like myself, I included a makeshift mixer, which consists of two parts: a home-wound rf choke and a small-signal diode. How cheap can you get?

Despite its simplicity, this cheap mixer works very well. The conversion losses seem at least equal to if not less than the double-balanced mixer, but it is slightly more prone to intermod (at least when you live within a mile of FM and TV stations as I do). Nevertheless, it is a good substitute until you can get a double-balanced mixer—or you could use it permanently.

Construction and Tune-Up

The printed circuit boards are made of single-sided G10, 1 oz. copper-clad laminate. After you have obtained your board, either through your own efforts or otherwise, it is best to make sure that all parts have the proper hole sizes (i.e., #62—resistors and capacitors; #60—MRF901 transistors; #56—trimmer capacitors; 1/16″—coax braiding, etc.).

Place all trimmer capacitors and trimmer resistors in their respective positions. Some of these parts might not line up right away; you might have to bend the pins to fit them. These parts must be flush with the board before soldering.

Next, I would suggest that you install all the jumper wires. (Refer to the component location figures for positioning of all parts and jumpers.) Install all capacitors, chipping off excess material around the leads as may be required to place them flush with the board. Then install the resistors, leaving the 12-V side of R7 and R8 detached. Make sure that these are flush as well, as shown in the photos. Always install them with their bodies

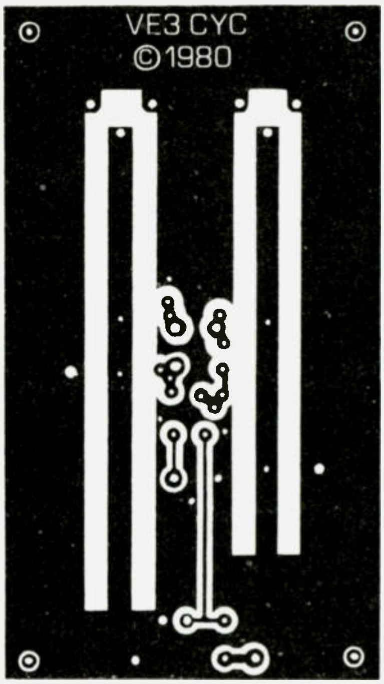

Fig. 11. One-stage preamp board PCB layout.

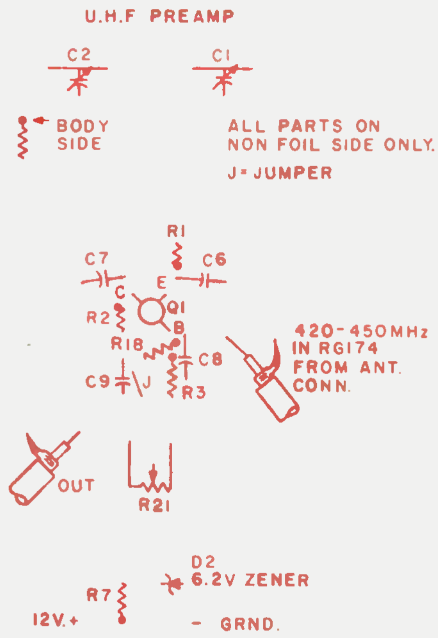

Fig. 12. One-stage preamp board component location.

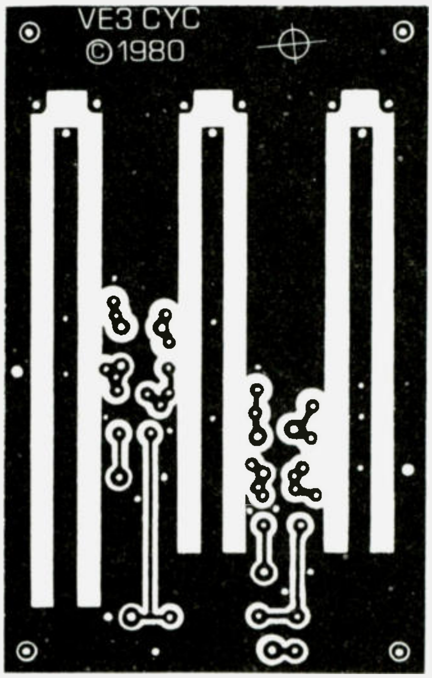

Fig. 13. Two-stage preamp board PCB layout.

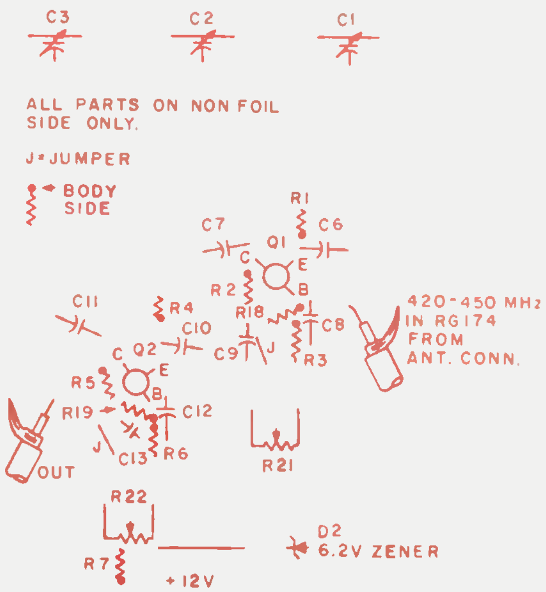

Fig. 14. Two-stage preamp board component location.

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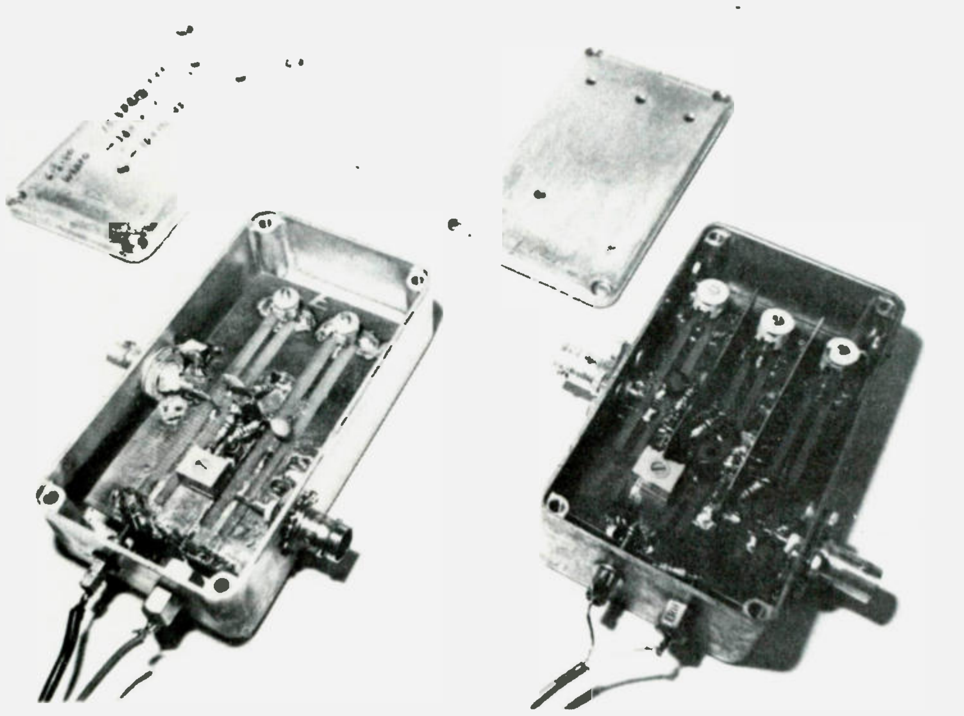

Photo D. Completed preamps in metal enclosures.

toward the rf side and leads toward the ground side.

Now install the transistors and diodes. Observe proper pin connections on the transistors and polarity on the diodes. Use a small soldering iron on this job and don't apply too much heat, as the copper foil may come loose. Never use a soldering gun on this kind of work—it might kill your transistors.

Install the remaining parts (toroid coil, rf choke, double-balanced mixer), then the power leads, three wires to the tuning potentiometer, R20, and the input and output cables from the board to the connectors. Make sure that the inner leads of each RG-174 cable to the board are as short as physically possible. A neat way would be to fish the inner lead with a pointed object through the side of the braided shield. About 3/8" from the end, roll the braided material to a smaller size between your finger tips, and solder in the ground hole as indicated in Fig. 3.

Normally, I would have included a couple of 1N914s back-to-back across the input for protection, but I skipped the idea, since it would just give you a false sense of security. Besides losing a little gain, I found it to be very ineffective when it comes to rf overload protection.

I have blown away a small fortune on replacement transistors in the process, despite the presence of the diodes. They even blew without any battery power hooked up every time I switched my 100-W linear on.

After throwing away my home-brew antenna relay (made from a conventional relay) and replacing it with a proper coaxial relay, my problems were solved. At this frequency, you only need a few pFs of stray capacitance between the relay parts to pass enough energy to knock that front-end transistor from here to the moon and further while the diodes just sit there laughin' at you. It doesn't seem to bother them.

Depending on whether you go for the double-balanced mixer (DBM) or the diode mixer, you will have to make some minor changes accordingly. Referring to Fig. 4(a), if you use the DBM, you will have to join C and D, hook R13 to E, and join G to F with a jumper wire as shown. Referring to Fig. 4(b), when using the diode mixer, join G and A with the mixer diode, D1, keeping the positive (banded) side on G, and hook R13 to B—that's all. *Make sure* to install the DBM from the component side of the board, and solder all 8 pins to the appropriate traces and ground connections. Note: To prevent C14 from accidentally shorting against the DBM, it might help to keep some clearance between the mixer module and the circuit board (about 1/16" will do).

I have used several types of diodes (silicon and germanium) and most of them seem to work quite well. A 1N82 UHF diode I tried seems to be a good choice. Hot-carrier diodes were disappointing in this circuit. You might try different ones yourself as most small-signal diodes work well in the GHz range.

In regard to the independent preamp boards (one or two stage), they should be installed in a metal box of some kind. I have used die-cast aluminum boxes for this purpose. The boards should be mounted away from the walls of the box as near to the center as possible by using spacers. If the box is small enough, you could possibly solder it right onto the BNC connectors as I did (see Fig. 5 and Photo D). Use a 0.001-μF feedthrough capacitor to feed 12 V in.

Preamp or Converter Alignment Procedure

While I explained the alignment of the oscillator and i-f amplifier earlier in this article, I will now proceed with explaining how to align the preamps and also the complete converter assembly:

1) Connect output to TV set, tune in your favorite i-f channel, and clip a length of wire to C14. Apply 12 V (Fig. 6, for example) to supply line and tune C5 for maximum on TV set.

2) Set R21, R22, C1, C2, and C3 to mid-range.

3) Tune TV to a low UHF channel that has a program on. Connect UHF TV antenna input to C10, R4, or Q2's input by spot-soldering a wire onto one of these spots. Connect a UHF antenna to antenna input on preamp or converter board. Hook a 12-V supply to R7 and ground.

4) Peak up C1, C2, and slowly turn R21 counterclockwise until a point of maximum gain is reached. If R21 is turned too far, the stage will break into oscillation; it should be kept just below this point.

5) Disconnect wire as installed in step 3, hook UHF TV's antenna to output of 2nd rf amplifier (connecting point to either D1 or SBL1, whichever is applicable), and peak up in the following order: C3, C1, C2, R22, and R21.

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6) Repeat step 5 a few times until everything tunes smoothly. Be careful to keep R21 and R22 below the oscillating points. By now, you should notice quite an increase in gain on the UHF channel.

7) Tune oscillator as described under "The Oscillator" by applying 12 V to R8.

8) Solder R7 and R8 to 12-V line.

9) Peak up complete converter once more, step-by-step, to a distant ATV signal source.

10) After you close up your box or whatever metal housing you decide to use, you will have to touch up the adjustment a little to allow for detuning caused by the metal shield. If your box is the kind with slots in it, you could reach some trimmers with a narrow tuning tool, and after turning the shield half a turn, do the same with the remaining trimmers. In other cases you might accomplish this feat by using a temporary cover made from a tin can with some holes punched in it.

By now you should be able to pick up ATV stations 40 to 50 miles away, and hand out P4 picture reports, while others wonder how you do it; they only get a P2 picture or nothing at all. If you've got money to burn, you might want to use a $20 transistor in the front end with a 0.9-dB noise figure, but I wonder if you'll notice much difference.

Some Afterthoughts

If you run out of range on the 5k trimpots (R21 and R22), you could extend them by using higher values for R3 and R6. This might be necessary with some oddball transistors but if you stick with the types I mentioned, you should have no problems. If R3 and R6 prove to be too high, you can lower their values, but don't go below 220 Ohms. You won't have enough isolation between the trimpots and the rf-carrying parts of the transistor bases.

If you are interested in a wider range of coverage such as 427-444 MHz, it would be better to stagger-tune the stages a bit—439 MHz on the first rf stage and 434 MHz on the second stage for instance; this also will improve stability.

If you pick up signals that shouldn't be there while your box is closed, you might have to resort to a bandpass filter; there are some good designs in the *Handbook*, etc. I am working on one now that uses stripline techniques similar to the ones in this article. If successful, you might see it some day.

In regard to the varactor diode tuning arrangement, some suitable diodes can be found in surplus varactor TV tuners. Varactor diodes do not change capacitance in a linear response to a varying voltage, so don't expect your tuning arc to be linear with the oscillator frequency. The arrangement used here seems adequate, but you could alter the value of the tuning potentiometer, R20, and add series resistance to make the dial more linear. This, of course, will change with the kind of diode used. For instance, when R20 is 3k instead of 10k and you put a 6.8k resistor in series with the pot's ground leg and ground, your dial will cover about 6 MHz over its total arc (see Fig. 3).

You could make up a second board just for the oscillator to be used as signal sources. By carefully tuning, I managed to go as high as 500 MHz and as low as 350 MHz. When tuned to 439.25 MHz, it acts as a fairly stable low-power signal source ideal for tuning up UHF preamps.

My future plans include the development of a similar setup as described in this article, but for higher frequencies such as 900 and 1296 MHz. I am also presently working on a UHF TV exciter, intermediate amplifier, and linear amplifier, all solid state and stripline, of course!

I must thank the many Canadian and American ATVers who switched on their TV transmitters endlessly for long periods of time (which is hard on the tubes and transistors with small heat sinks and no blowers) just for me to tune up and try a newly-made preamp. And for their encouragement for me to write this article. Special thanks in this regard go to: VE3EJV, VE3CJP, VE3EYR, W3POS, W2RPO, and W2PBU.■

Parts List for Converter and Preamp Boards:

C1-4—.6-to-5.5-pF film trimmers (Phillips 010EA 5E) note #1
C5—22-pF film trimmer (Phillips 010EA 20E)
C6-14—0.001-μF ceramic disc capacitors, 1/4" lead spacing
C15-18—0.01-μF ceramic disc capacitors, 5/16" lead spacing
C19—5-pF silver mica (NPO) 3/16" lead spacing or axial leads, see note #2
C20—1.5-pF silver mica (NPO) 3/16" lead spacing or axial leads, see note #2
R1-8—1.k-Ohm, 1/4 W
R9—100k, 1/4 W
R10—470 Ohm, 1/4 W
R11—27k, 1/4 W
R12—10k, 1/4 W
R13—47 Ohm, 1/4 W
R14—330 Ohm, 1/4 W
R15,16—2.2k, 1/4 W
R17—100 Ohm 1/4 W
R18,19—4.7k, 1/4 W
R20—10k volume control (linear) Radio Shack #271-1715 or equivalent
R21,22—5k trimpots, Jim Pak #850P5K (Radio Shack #271-335, 10k, as a possible substitute only; requires one additional hole in board)
D1**—1N82 or equivalent high-speed, low-power UHF diode, or better
D2—6.2-V 1 W zener diode (1N4735), Radio Shack #276-561
D3—Varicap diode ±15 pF at 4 V (MV2205, MV2105, CGE-95, or equivalent
Q1,2—MRF901 transistors or equivalent NPN silicon UHF types
Q3—MPSH81, ECG106 or equivalent PNP silicon UHF types
Q4—2N2222
Rfc—approximately 0.1 to 0.15 μH (Cambion #2960-21-03-00) or wind your own: 10 turns #28 close-wound on 1/8" form or 1/2 W 100k resistor
Mixer*—Double-balanced mixer MCL-SBL-1 (made by Mini Circuits Lab, 2625 E. 14th. St., Brooklyn NY 11235; see '78 *Handbook*, page 306 for equivalents)
L1—5 turns of small gauge hook-up wire or #24 enamel wire on Amidon toroid T37-2
L2—3 turns same as L1
Miscellaneous parts: RG-174 coax cable, two BNC connectors, SPST mini toggle switch, LED, knob, hardware to mount board, and cabinet
*Only needed when not using diode mixer
**Only needed when not using double-balanced mixer (SBL-1)
Note #1: Transcap #24PX005 from Mouser Electronics could be used instead although you have to re-drill some holes. Similarly, Transcap #24PX020 could be substituted for C5.
Note #2: Plastic-film-type capacitors or even ceramics (NPO types) could be used as substitutes for the more costly silver mica types. Lower values such as 1 pF and 3 pF have also been used successfully.
All circuit boards, parts, built-up boards, and complete units are available from Spectrum Electronics. For price list and ordering information, write to PO Box 4166 Station D, Hamilton, Ontario, Canada L8V 4L5.

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Polishing Kenwood's R-1000

—a gem in the rough

This is not intended to be a product-report type of article. There are a few improvements that can be made to the R-1000 with a little effort and some are mentioned in the advertising literature. I will say that I think the R-1000 is an outstanding receiver that has excellent stability, sensitivity, and ease of operation. Following are some comments on the suggested changes.

The R-1000 comes supplied with three i-f filters: 12 kHz, 6 kHz, and 2.7 kHz. The advertising literature mentions that the filters can be switched to use the 6 kHz for AM WIDE and the 2.7-kHz filter for AM NARROW. This is not difficult, as the filters are diode-switched and there are no critical circuits involved. Actually, all filters can be used, as will be shown.

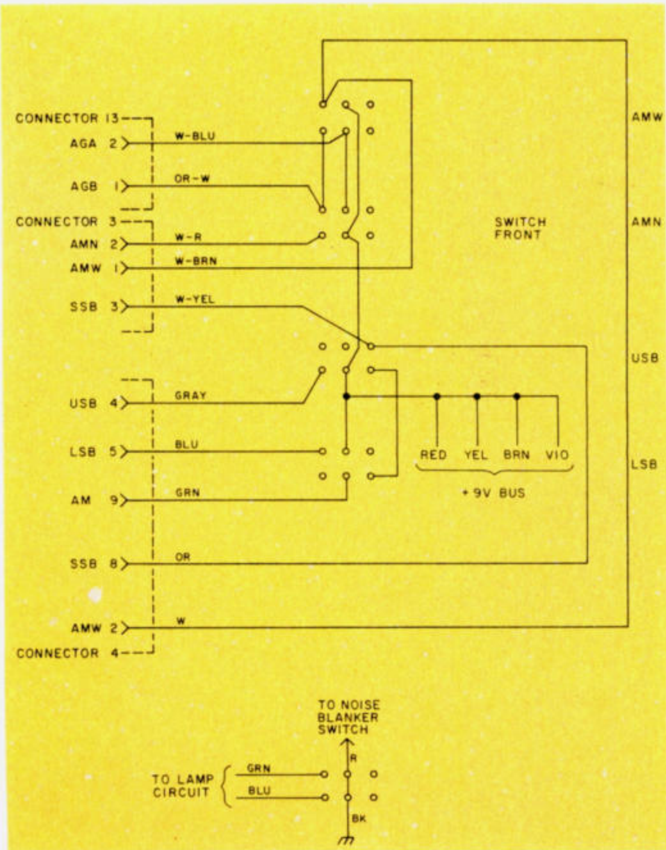

Fig. 1. Original mode switching for the R-1000. Switch at bottom is BRIGHT/DIM display control.

Kenwood goofed on the agc time-constant switching. In fact, both the schematic supplied with the receiver as well as the one in the service manual fail to show the agc switching as it is actually wired. The problem is that the fast agc is used in the SSB mode and the slow agc is used in the AM mode, just the reverse of the way it should be. Further thinking resulted in wanting the agc switched separately from the mode. It is sometimes desirable to switch to fast agc when using an SSB receiver for RTTY.

When using the R-1000 below 2 MHz, I encountered a lot of broadcast signals where they didn't belong. This is due to the fact that a single bandpass filter is used ahead of the rf amplifier for the 200-kHz-to-1-MHz range, and a second one is used for the 1-to-2-MHz range. This allows both harmonics as well as intermod products to be present. Also, while the 1000-Ohm input is probably better for the random-type wire antenna most likely to be used when tuning this range, it is probably still quite far from what the antenna impedance really is. Now for what to do about these items:

Fig. 1 shows the actual wiring of the switches as traced in my receiver. In the AM mode, 9 volts is switched to the appropriate i-f filter switching diode to activate the appropriate filter. In the SSB mode, the 2.7-kHz filter is turned on via SSB gate diodes, D51,52. The AM detector is selected by the normally-closed contacts on the SSB switches. When either AM switch is depressed, AGA and AGB are connected together, resulting in the longer time constant.

Fig. 2 shows some additional circuitry found in the service manual that did not appear in the schematic supplied with the receiver. In the AMW mode, Q47 is turned on, which grounds the negative end of C158. This extends the low-frequency response for hi-fi quality. (It is possible that the earlier R-1000s did not have this circuit, explaining why it was not in the manual. If this is the case, the pin numbers shown for connector 4 may not be as shown in my drawings, but the wire colors are probably the same.)

Some comment on the display is due at this point. I feel that the bright display is too bright. Also, the display and lamps are bound to last longer if operated in the dim mode, especially if you leave the time displayed when not using the receiver. Thus, I decided to use the BRIGHT-DIM switch to switch the agc time constant.

Removing the lamp wires from the switch and taping them up leaves the display in the dim mode. (By the way, you will have to remove the front panel to make the wiring changes. This is done by removing both the top and bottom sections of the receiver case. Then remove the knobs. The bandswitch and tone knobs have hex screws; the others pull off. Remove the two screws holding the analog frequency dial knob. Then the panel screws can be removed. The mode switch is held on the front panel with two screws.)

Fig. 3 shows the change in the switch wiring I made in my R-1000. Rewiring the switches as shown not only allows use of the 2.7-kHz filter on AM, but also allows use of all three filters in both modes. This is possible due to the mechanical construction of the 4-section mode switch. It is possible to release all the buttons by pressing one in only as far as necessary to release one that is latched. It is also possible to have more than one depressed at a time. With all switches released, the receiver is in AM with the 2.7-kHz filter selected. (The 2.7-kHz filter is now switched directly with 9 volts instead of via the SSB gate diodes.) AMW and AMN are the same as before. When either USB or LSB is depressed, both AM switches are released, resulting in the 2.7-kHz filter being selected. If you desire wider bandwidth in SSB, press either LSB or USB and at the same time press AMN for 6 kHz or AMW for 12 kHz. Pressing another button will release both latched switches.

The AGA and AGB leads are wired to the normally-open contacts of the dimmer switch. Now, fast agc occurs with the switch released and slow when the switch is depressed. The strap across the common terminals is left alone. The red and black wires that go to the center switch terminals are removed and soldered together so the red lead going to the noise blanker switch is still grounded.

It occurred to me that with the 12-kHz filter in the receiver, an FM detector could be added for those who want to listen to the FM activity on the high end of 10 meters. A simple 565 PLL circuit can be added to provide this; however, it would be necessary to add a switch somewhere and also dig into the main circuit board itself to switch the audio.

For those wanting a little better selectivity for RTTY, it is possible to obtain a 1.5-kHz filter from Murata. It will be necessary to remove the main receiver board to change filters (probably best to change the 12-kHz one).

Low-frequency performance of the R-1000 can be improved with an outboard tuner. The tuner can be used with a whip, wire, or coaxially-fed antenna. It will perform impedance transformation from 50 Ohms to 1000 Ohms. A whip or short wire (most any ham antenna used as a single wire looks short at these frequencies) looks like a capacitive load. This type

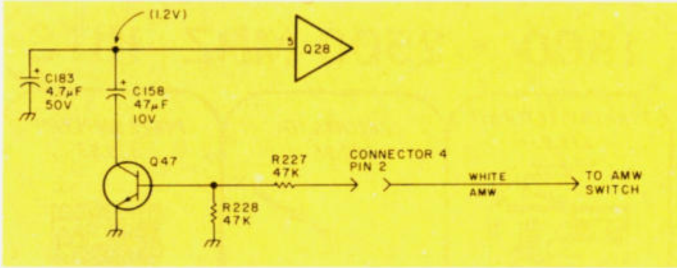

Fig. 2. Additional circuit on Q28 shown in service manual. This extends low-frequency response on AM wide.

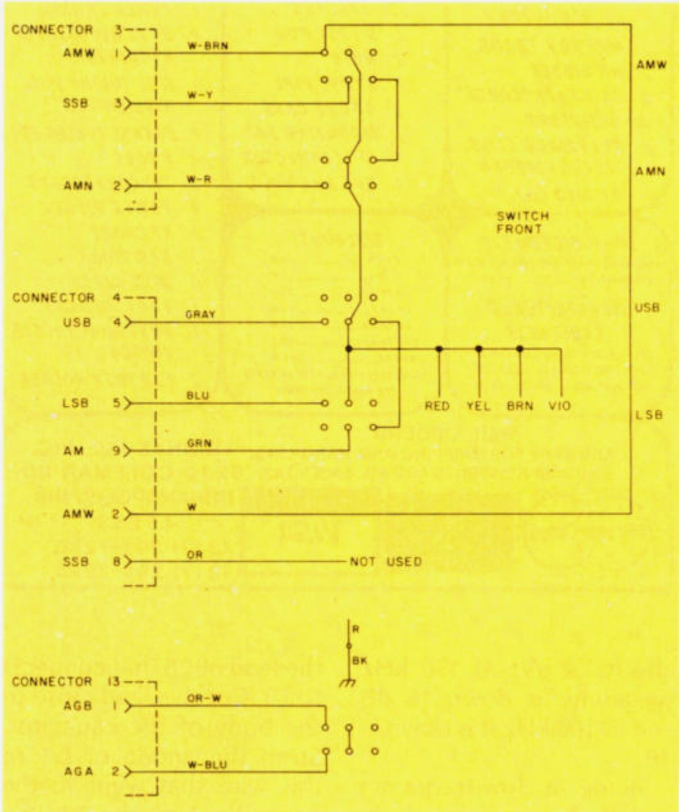

Fig. 3. Modified mode switching to provide fast and slow agc.

of antenna is best connected right to the "high" end of the tuned circuit. Fig. 4 shows a suggested tuner.

While my tuner includes several coils for three frequency ranges, I only show one here. You may wish to use ferrite rods or slug-tuned coils, but the link-winding turns should remain about the same. If your antenna has a high capacity to ground, the high frequency end will not extend as far as you may wish. This may be cured by adding about 100 to 200 pF in series with the wire antenna input on the higher frequency range. Some values are shown in Table 1.

Going down in frequency, the sensitivity rapidly drops off below 200 kHz. (The specs say 200 kHz is the bottom end of the useful range.) Above this frequency the sensitivity runs

Frequency Range	L1	L2 (turns)	Tap (turns)
1-2 MHz	40 µH	20	5
0.5-1 MHz	150 µH	20	5
200-500 kHz	1 mH	30	6
80-200 kHz	6 mH	40	8

Table 1. Approximate values for R-1000 antenna tuner.

about 1.2 μV. At 150 kHz, sensitivity is down 16 dB, and at 100 kHz it is down 37 dB.

Being a low-frequency addict, I wondered if the low-frequency range could be extended. I felt that the filter consisting of L1, L2, L3, C7, and C8 was the limiting area. Connecting the signal generator to the junction of L4 and C9 confirmed this. It looked worthwhile to bypass the filter components, and this can be done without removing the circuit board if you are careful.

Cut the anode lead of D1 close to the board. Then cut the lead of C8 that connects to L3. Cut this lead close to the body of the capacitor. Strap the anode of D1 to this wire that went to the capacitor. Now the sensitivity is 2 μV at 150 kHz and 3 μV at 100 kHz. At 50 kHz, the sensitivity is 20 μV, where it originally was 18000 μV! This modification does not seem to increase the broadcast interference noticeably. In either case, an external tuner is needed if you are near any broadcast stations.

Kenwood sells a kit for operating the R-1000 on 12 volts dc. Why this is not included in the receiver is anybody's guess, but this feature can be easily added. There is no reason that a connector is needed on the power supply board. A pair of wires for the +12 and ground connections can just be soldered directly to the board. The power supply board is easily removed by unsoldering the wires from the power transformer. There is a blank plate on the rear panel of the receiver where the dc power connector is intended to go. A connector of your choice can be installed here. I recommend fusing the dc input with a 1-Amp, slow-blow fuse.

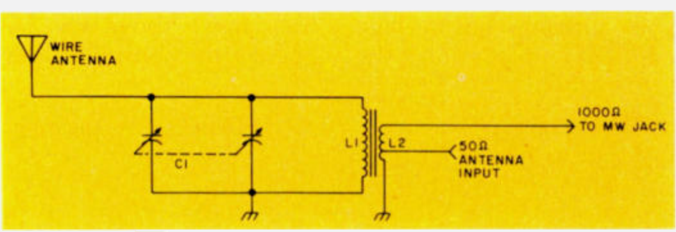

Fig. 4. Antenna tuner for the R-1000 (2 MHz and lower). C1 is a dual broadcast variable, about 730 pF.

The receiver cannot be powered by nicad batteries for very long as the current is typically around 700 mA. It draws 25 mA with the receiver off. Having the display on DIM reduces the drain by about 20 mA. Looking at the voltage readings on the drawing reveals that the audio output stage draws about 140 mA. It is evident that this stage (Q28) is inefficient because the heat sink runs quite warm.

I don't believe that there is a better device that is pin-for-pin compatible, but it still may be worth investigating replacing Q28 with something else. Also, if extended battery operation is anticipated, it might be smart to switch the displays with a momentary pushbutton switch. I estimate the displays draw 60 to 100 mA.

I did a quick check on the audio-frequency response (in the SSB mode) to see how bad it might be for RTTY. It is desirable, of course, to have a flat response at the mark and space frequencies. I originally thought that the bfo frequencies could be changed to favor RTTY operation so I did adjust the trimmers to move the bfo frequencies further from 455 kHz. They wound up at a maximum of 1700 Hz above and below 455 kHz. With the bfo readjusted like this, the response, relative to 2125 Hz, is −0.5 dB at 2295 Hz, −1 dB at 1550 Hz, and −1.5 dB at 2975 Hz. I consider this pretty good. The high-frequency response is better at the speaker output than at the record output, which was a surprise.

I hope I have not painted a dim picture of the R-1000. I think a lot of thought was put into the design. An engineer who designs equipment for the military told me that the basic rf design (synthesizer and upconverter front end with a high-frequency i-f) is the way most of the new precision communication receivers are designed. It is a fine choice for hams and SWLs alike. ■

Author's Note

Between the time I originally submitted this article and when I received the proof copy, more experiments were done on the R-1000 receiver. There have been a lot of complaints about the agc time constant being too long. I agree and therefore changed mine so the time constant compares with that of the 820 transceiver. To decrease the "fast" agc time constant, remove capacitor C217. To decrease the "slow" agc time constant, either replace C138 with a 1.5-uF capacitor or install a 2-uF capacitor in series with the AGA or AGB lead at the switch. Note that the present C138 is polarized, so if you use a polarized capacitor, connect it correctly.

To improve the high frequency response in the SSB mode for better RTTY characteristics, change C159 from .047 uF to .015 uF. This will not noticeably change anything by ear, but will produce mark and space tones of equal amplitude.

R-1000 receivers with serial numbers 009001 or higher have a jumper plug which will permit use of the 2.7- or 6-kHz filters in the AM mode. If you want to be able to use any of the three filters in either SSB or AM mode, my previous switch wiring modifications still apply.

Thanks to Ken WB9FRV for suggestions and help with the additional changes.

Reader Service for facing page ✓15→

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Peaking and Tweaking Surplus CB Boards

—the untold story

The closing of Hy-Gain's electronic assembly operations in early 1978 created a stock of readily-available surplus parts for the amateur who was willing to convert a CB printed-circuit-board assembly to 10-meter operation. These were PLL-type boards which require only two or three crystals for frequency generation. Several articles have appeared during the ensuing time describing the methods to use in converting to 10 meters. The most common method is simple crystal replacement, although some authors have opted for vco retuning.

The purpose of this article is to supplement this information with details which will describe the various boards used, and to provide correct alignment procedures.

There were five different models of board assemblies using PLL circuitry which may have made their way into the surplus market. Four of these were manufactured in Japan and have these identifying part numbers: PTBMO27AOX, PTBMO36AOX, PTBM-O38COX, and PTBM-O51AOX etched into the foil of the board. The fifth, manufactured by Hy-Gain itself, has the number 750096 etched in the foil and the Hy-Gain name silk-screened on the component side. This board, while very similar to the circuit used in the Japanese boards, was destined for use in the manual-switched radios and the remote-controlled model 2716 microprocessor radio; it contains mostly US transistors and ICs.

The Japanese-manufactured boards were used in model series 680, 2680, and 2700, along with some of the base stations. Table 1 gives component types, symbolism, and oscillator frequencies for boards which were used in these series.

For those who have converted factory-assembled transceivers, there may be an X or an A following the model number on the serial plate. These were identifications used to indicate various levels of FCC type acceptance, and don't have any bearing on amateur work. There may be various component differences which were required to meet tightened FCC emission requirements, but for the most part they have no effect upon the ultimate function of the unit.

Table 2 gives the same information for the remaining models of the 2700 series, and Table 3 covers the 750096 Hy-Gain-designed board.

Alignment instructions for each series will be listed separately due to changes in component identification and function. There is, however, little variation from one board to another. As in all alignment procedures, there is interaction between successive sections, so go back and forth for maximum performance. The most critical alignment in the transmitter section concerns the three final coils. Follow directions carefully, and a power output holding within ±0.5 W can be obtained over the 40-channel spread permitted by the PLL.

There can be significant differences, from one board to another, in maximum power output—which is a function of the final amplifier transistor. Ranges will be between 3.5 W and 7.0 W. Component designations are silk-screened on the component side of the board.

Since several methods of conversion have been used, the alignment instructions are written for the original frequencies. If you have converted the board already, the relationship between the original frequencies and the converted frequencies will be obvious. *Note:* Most of the components in the vco circuit have been covered with hot-melt wax to prevent movement. This should not be disturbed as component placement is critical to maintaining performance of the circuit.

Transmitter Alignment PTBMO27AOX

This board uses a three-crystal scheme. Q105 is a 9.51-MHz oscillator, Q109 is the 5.9453-MHz offset oscillator, and Q117 is a 6.4005-MHz reference oscillator.

Step 1—Oscillator Frequency Check

Q105 collector should show 9.5 MHz. Change values of C118 (nominal 47 pF) and C119 (nominal 10 pF) to correct frequency. Q109 collector should show 5.9435 MHz. Change value of C130 (82 pF) to correct frequency. Q117 should indicate 6.4005 MHz, and

C178 (39 pF) can be changed if necessary.

Step 2—Vco Alignment

Place the channel-selector switch in position 1. Using a high-impedance VOM connected between TP8 (R114) and ground, adjust T101 for 1.5 volts. Change channel switch to position 40 and the voltage should read 4.0 volts.

Step 3—Pre-Adjustment

Using a wattmeter or swr meter showing relative power output and a dummy load, turn L110 clockwise until it reaches bottom (don't over do it!). Turn L106 clockwise until power output is about 2 Watts.

Step 4—Rf Alignment

Set the channel-selector switch to position 1. Tune (in order) L103, L104, T102, and T103 for maximum rf power output. Turn L106 further clockwise if necessary to keep power at about 2 W. Change the channel-selector switch to position 40—power output should be within 0.25 W of position 1. Repeat the above procedure until this condition is met. This tuning sequence is shaping the bandpass of the rf circuit, which is capable of almost flat response across the channels if properly tuned.

Step 5—Final Circuit Adjustment

This is the most critical step in obtaining maximum power output and in maintaining the flat power response across the channels. With the channel switch in position 1, adjust L109 for maximum output, and then L110 for maximum. Repeat the adjustments. Switch to position 40 and verify that power output remains within 0.5 W. If not, L109 often has two positions for resonance, and normally the lower position is correct. Find the second position and repeat the adjustments of both coils. If this has no effect, turn L110 clockwise one-half turn and repeak the final circuit by readjustment of L109. Repeat as necessary.

Lastly, adjust L106 for maximum output. Repeak L109, and then L110 slightly, as required. Check channel 40 for power output within the 0.5-W specification.

Component and Designation	Function
Q101	vco
MPS3704	
Q102	PLL mixer
2SC710D	
2SC829	
2SC839	
Q103	Buffer
2SC710	
2SC829	
2SC839	
Q104	Buffer
2SC710D	
2SC829	
2SC839	
Q105	Oscillator*
2SC710D	
2SC829	
2SC839	
Q106	AVR (Automatic Voltage Regulator)
2SC1318Q	
Q107	Xmit switch
2SA719Q	
Q108	Buffer
2SC1359B	
2SC1047	
Q109	Offset oscillator*
2SC710D	
Q110	Xmit mixer
2SC710D	
MPS3704	
Q111	Pre-driver
2SC1215	
2SC1687	
2SC1688	
Q112	Driver
2SC1760-3	
2SC1957	
Q113	Rf power amp
2SC1306	
2SC1678	
2SC1816	
Q114	Rf amp
2SC784	
2SC1047B	
2SC1359	
Q115	1st mixer
2SC710B	
2SC1359B	
Q116	2nd mixer
2SC710	
2SC829C	
2SC839	
Q117	Ref oscillator*
2SC710D	
Q118	1st i-f
2SC710	
2SC829C	
2SC839	
Q119	2nd i-f
2SC710	
2SC829C	
2SC839	
Q120	Squelch switch
2SC327Y	
2SC828	
2SC945	
Q121	Range boost
2SC372	
2SC828PQ	
2SC945	
Q122	Xmit audio alc
2SC372	
2SC828PQ	
2SC945	
Q125 (36AOX only)	Noise blanker gate
2SC900U	
Q126 (36AOX only)	Noise blanker amp
2SC900U	
IC101	PLL custom chip
IC102	Audio amp
TA7205P	
BA521	

*** Values:**

	27AOX	36AOX, 38COX
Q105	9.51 MHz	11.8066 MHz
Q109	5.945 MHz	10.695 MHz
Q117	6.4 MHz	10.24 MHz
IC101	01A	01A

Table 1. Components and functions for the 27AOX, 36AOX, and 38COX.

Step 6—Modulation Adjustment

Using a scope or other modulation indicator connected to the antenna terminal (dummy load still attached), adjust RV102 for correct modulation. If a calibrated, modulated signal generator is available, put 20 mV at about 1 kHz into the mike input and adjust for slightly under 100% modulation.

Step 7—Rf/S-Meter Adjustment

The board was fabricated for use with an rf/S-meter. A suitable meter can be connected between point 6B and ground. Adjust RV104 (20k pot) to calibrate meter to the power output indicated on the wattmeter.

Receiver Alignment

This board has circuitry for anl functions which can be made operational by connecting point 39 on the PCB to ground. Do this prior to receiver alignment.

Step 1—Vco Alignment

The vco circuitry is common to both transmit and receive functions of the transceiver, and was covered in the oscillator-frequency check in the transmitter-alignment section.

Step 2—Circuit Alignment

Use the rf/S-meter previously installed, an audio VOM connected to the speaker terminals, or a scope to monitor alignment. Set a frequency generator, or a *very* attenuated transmitter, to a mid-frequency (27.205 MHz if still unconverted) and very low output to avoid agc action. Adjust, in order, L115, T104, T105, L112, T106, T107, T108, and T109 for maximum output. The frequency generator should have low-level modulation if using audio output as the indicator. Since adjustments interact, repeat several times to obtain maximum sensitivity. If using a calibrated generator, check sensitivity at each band edge. Sensitivity should be less than 1 uV.

Step 3—Squelch Circuit Adjustment

Turn to maximum the external pot being used for squelch control and adjust RV101 so that an S9 signal just breaks the squelch. If you are using a calibrated generator, input a 50-uV signal at the antenna terminal and adjust for squelch break.

Step 4—S-Meter Adjustment

Using the same signal level as step 3, adjust meter-calibration pot RV103 for S9 indication.

This completes the alignment for the PTBMO-27AOX board.

Transmitter Alignment

PTBMO36AOX and PTBMO38COX

Step 1—Oscillator-Frequency Check

These boards use a three-crystal frequency scheme. Q105 is an 11.8066-MHz oscillator, and C118 (39 pF) and C119 (12 pF) may be changed to adjust frequency. Offset oscillator Q109 operates at 10.695 MHz, and C127 (56 pF) is used for frequency adjustment. Q117 is the 10.24-MHz reference oscillator, and C178 (56 pF) is used to adjust frequency.

Step 2—Vco Adjustment

Connect a VOM to TP8 (R114) and adjust T101 for 1.5 V with the channel-selector switch in position 1. Switch to position 40, and the voltage should be 4.5 V.

Step 3—Pre-Adjustment

Using a wattmeter or swr meter showing relative power output and a dummy load, turn L110 clockwise until it reaches bottom. Turn L106 clockwise until power output is about 2 W.

Step 4—Rf Alignment

Set the channel-selector switch to position 1. Tune (in order T111, L103, L104, T102, and T103, for maximum output. Turn L106 further clockwise if necessary to keep power at about 2 Watts. Change the channel switch to position 40—the power output should be within 0.25 W of position 1. Repeat the above procedure until this condition is met. This process is shaping the bandpass of the rf circuit, and it is capable of almost flat response across the channels.

Step 5—Final Circuit Adjustment

Use the same procedure as in Step 5 for the 27AOX board.

Step 6—Modulation Adjustment

Use the same procedure as in Step 6 for the 27AOX board.

Step 7—Rf/S-Meter Adjustment

Use the same connection and adjustment procedures as on the 27AOX board.

Receiver Alignment

The boards were designed with an anl function which can be made operational by connecting point 29 on the PCB to ground; this should be done prior to receiver alignment.

Step 1—Vco Alignment

The vco circuit is common to both transmit and receive functions of the transceiver, and was covered in the oscillator-frequency check in the transmitter-alignment section.

Step 2—Circuit Alignment

Use the rf/S-meter, an audio VOM connected to the speaker terminals, or a scope to monitor alignment. Set a frequency generator, or a *very* attenuated transceiver, to a mid-frequency and very low output to avoid agc action. Adjust, in order, T104, T105, L112, T106, T108, and T109 for maximum output. The frequency generator should have low-level modulation if using audio output as the indicator. Since adjustments interact, repeat several times to obtain maximum sensitivity, decreasing the generator output if necessary. If a generator is used, check the sensitivity at both band ends, which should be less than 1 uV.

Step 3—Squelch Adjustment

Use the same procedure as with the 27AOX board.

Step 4—S-Meter Adjustment

Using the same signal level as in step 3, adjust meter-calibration pot RV103 for S9 indication.

This completes alignment of the 36AOX and 38AOX boards.

Transmitter Alignment

PTBMO51AOX

Step 1—Oscillator-Frequency Check

This board uses a two-crystal frequency scheme in conjunction with the particular PLL circuitry used in the design. Q1 is a 10.2-MHz reference oscillator for the PLL and injects a signal into the second receiver mixer, Q10. This signal is fed into PLL IC1 where it is divided by 1024. A 10.695-MHz signal is generated and mixed with the above in IC3.

Q1 should show a frequency of 10.24 MHz. Adjust TC1 (adjacent to X1) for correct frequency. The mixer oscillator (10.24 MHz) as measured at pin 1 of IC3 can be adjusted by changing the value of C25 (4 pF).

Step 2—Vco Adjustment

Connect a VOM to TP8 and adjust L1 to obtain 1.5 V with the channel switch in position 1. Switch to position 40, and the voltage should be 3.6 V.

Step 3—Pre-Adjustment

Using a wattmeter or swr meter showing relative power and a dummy load, turn L12 clockwise until it reaches bottom. Turn L7 clockwise until power output is about 2 W.

Step 4—Rf Alignment

Set the channel-selector switch to position 1. Tune (in order) T1, L2, T2, L5, T3, and T4 for maximum power output. Turn L7 further clockwise if necessary to keep power at or about 2 W. Change the switch to position 40, and power output should remain constant within about 0.25 W. Repeat the above procedures until this condition is met. This procedure is shaping the bandpass of the rf circuit, and it is capable of almost flat response across the band.

Step 5—Final Circuit Adjustment

This is the most critical adjustment to obtain maximum power output and maintain the flat power response across the band. With the selector switch in position 20, adjust L11 for maximum power output and then L12 for a higher maximum. Repeat the adjustments. Switch successively to channel 1 and 40 to verify that power output remains within 0.5 W of that obtained in position 20. If it does not, return to position 20, turn L12 a quarter turn clockwise, readjust L11 for maximum output and recheck position 1 and 40. Last, adjust L7 for maximum output. Repeak L11

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and L12 slightly for maximum output. Recheck channels 1 and 40.

Step 6—Modulation Adjustment

Using a scope connected to the antenna terminal (dummy load still attached) or other modulation indicator, adjust RV2 for just under 100% modulation. If a calibrated, modulated signal generator is available, put 20 mV at about 1 kHz into the mic input and adjust for the correct modulation level.

Step 7—Rf/S-Meter

The board was fabricated for use with an rf/S-meter. A suitable meter can be connected between point 68 and ground. Adjust RV2 (near L12) to calibrate the meter to the power level indicated on the wattmeter.

Receiver Alignment

This board has circuitry for an anl and noise-blanker function. The anl can be made operational by connecting points 31 and 41 on the PCB. When these points are not connected, the noise-blanker circuit is operational. A switch can be installed for easy function selection, and the anl should be engaged prior to alignment.

Step 1—Circuit Alignment

Use the rf/S-meter, an audio VOM connected to the speaker terminals, or a scope to monitor alignment. Set a frequency generator or a very attenuated transmitter to a mid-frequency and very low output to avoid agc action. Adjust, in order, T5, T6, L14, T7, T8, and T10 for maximum output. The frequency generator should have low-level modulation if using audio output as the indicator. Since adjustments interact, repeat several times to obtain maximum sensitivity and, if using a calibrated generator, check the sensitivity at each band edge. Sensitivity should be less than 1 uV.

Component and Designation	Function	Component and Designation	Function
Q1	10.24-MHz oscillator	Q10	2nd mixer
2SC710		2SC710	
Q2	Buffer	2SC829	
2SC710		2SC839	
Q3	Rf pre-driver	Q11	1st i-f
2SC1687		2SC710	
Q4	Rf driver	2SC829	
2SC1750		Q12	2nd i-f
2SC1846		2SC710	
2SC2036		2SC829	
Q5	Rf power amp	Q13	Audio switch
2SC1306		2SC372	
2SC1678		2SC828	
2SC1974		2SC945	
2SC2075		Q14	ALC
Q6	AVR (Automatic Voltage Regulator)	2SA564	
2SC1318		2SA719	
Q7	Xmit switch	2SA720	
2SA719		Q15	ALC
2SA720		2SC900	
Q8	Rf amp	2SC945	
2SC710		Q22	Dc switch
2SC460		2SC900	
2SC1047		IC1	Custom PLL 02
Q9	1st mixer	IC2	Vco/mixer/buffer
2SC710		TA7310P	
2SC1359		IC3	Xmit osc/mixer
		TA7310P	
		IC4	Audio amp
		BA521	

Table 2. Components and functions for the 51AOX.

Step 2—Squelch Circuit Adjustment

Turn the external pot being used for squelch control to maximum and adjust RV1 (adjacent to T8) so that an S9 signal just breaks the squelch. If a calibrated generator is being used, input a 50-uV signal at the antenna terminal and adjust for squelch break.

Step 3—S-Meter Adjustment

Using the same signal level as Step 2, adjust meter-calibration pot RV3 (adjacent to T10) for S9 indication.

This completes alignment of the 51AOX board.

This board was made to use an LED channel display. A special channel-selector switch with an extra section of contacts protruding from the top side was mounted to the board. Another PCB assembly (PTSWO23AOX) was connected to the top of the switch and contained the LED drivers. The LEDs were mounted on board assembly PTLDO15AOX and interconnected to the driver board with flat ribbon cable. Each board connected to the identical lettered holes on the other board. Driver board PTSWO23AOX hole 1 is connected to main PCB ground and hole 2 to terminal 9 on the main PCB.

Hy-Gain produced two radios that had all of the functional controls in the microphone, the main chassis assemblies of which could be mounted in the trunk or under the car seat. This not only facilitated ease of operation but, by removing the microphone, prevented theft.

Model 2679

The transceiver used conventional PLL circuitry contained on the 36AOX board which was connected to an auxiliary control board mounted above it on the metal chassis. The control board has 750070 etched on the foil side, and 878928 silk-screened on the component side. The rear of the chassis contains a large 16-contact connector which was used to interconnect with the microphone through a specially-made cord.

The microphone was black with two seven-segment red LEDs used for channel indicators and red (transmit) and green (receive) diodes located one on either side of a silver-handled toggle switch. There are commercially-available service manuals which will illustrate the interconnection of the two PCBs and the microphone.

Since the transceiver uses the same main PCB for transmit and receiver functions, the radio can be converted in the same manner as a switch-selected channel unit. One word of caution—the mike cord was prone to failure. Buy two.

Model 2716

This radio was known as the Hy-Gain 16 and was a

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state-of-the-art advancement over the remote-controlled 2679. It was completely designed by Hy-Gain and was the first remote-microprocessor-controlled radio manufactured. The main PCB used could be operated with a conventional 40-channel switch or interconnected with a logic-control board to accept serial data from the microprocessor located in the microphone.

The transceiver featured 40-channel operation, two frequency memories, an emergency switch to override all functions and go to channel 9, PA function, a switchable noise blanker, and a clock.

The heart of the system was a National Semiconductor microprocessor which was bonded to the microphone PCB. National Semi manufactured this board. It has been advertised for sale for use of the clock only. Identification on the lower left corner of the foil side is MA6008-c. The trimmer cap, IC, and crystal and associated components on the foil side are the clock. Look at the crystal frequency carefully if you have one of the boards—it's a TV crystal adjusted by the cap to give nearly correct time. Much less expensive than using a special crystal running at exactly 3600 kHz.

All functions were activated by depressing the appropriate keys, with the channels slewing up or down, and the squelch and volume controlled by 16-step control circuits.

In addition to the microphone board, the interface board (750097 on foil side and 879499 on component side) and the main PCB (750096 on foil side and 879709 on component side) were interconnected to form the functional unit.

Since the main PCB can be made operational with a conventional channel-selector switch as used on other models, the following alignment procedure is provided. Should you be able to locate all of the components necessary to construct a complete unit, consult commercially-available service manuals for connections.

Transmitter Alignment

879709

This board uses a three-crystal frequency scheme. Q105 is an 11.8066-MHz oscillator which is tripled to function with the vco. Offset oscillator Q109 runs at 10.695 MHz, and PLL reference oscillator Q117 is at 10.24 MHz.

Step 1—Vco Adjustment

Connect a high-impedance VOM to TP8 (R114) and adjust T101 for 1.5 V indicated when set to channel one. Collector of Q108 should give a frequency reading of 37.66 MHz at this time.

Step 2—Pre-adjustment

Using a wattmeter or swr meter showing relative power output and a dummy load, turn L110 maximum clockwise and L106 clockwise until power output is approximately 2 Watts.

Step 3—Rf Alignment

Place in operation on channel 1 and adjust T111, L103, L104, T102, and T103, in order, for maximum power output. Reduce output by turning L106 clockwise if necessary to remain at no more than 2 W. Repeat several times if necessary to obtain maximum power output. Switch to position 40 and verify that power output is within 0.25 W of the position 1 reading.

Step 4—Final Circuit Alignment

Follow the instructions in Step 5 for board 27AOX.

Step 5—Modulation Adjustment

Using a scope or other modulation indicator connected to the antenna terminal, adjust RV102 for correct modulation. If a calibrated, modulated signal generator is available, connect to point 22 on the main PCB and set for 20 mV at about 1 kHz, and adjust for just under 100% modulation.

Step 6—Rf/S-Meter

An rf/S-meter can be used with this board by connecting between point 6B and ground on the main PCB. Adjust RV104 to calibrate the meter to the power indicated on the wattmeter.

This completes the transmitter alignment.

Receiver Alignment

Step 1—Vco Alignment

The vco circuitry is common to both transmitter and receiver and was covered in the oscillator-frequency check during transmitter alignment.

Step 2—Circuit Alignment

Connect an audio VOM to the speaker terminals or a high-impedance VOM to point 6B (or use the rf/S-meter installed previously) and ground. Using a frequency generator or a *very* attenuated transmitter set for a mid-channel, adjust, in order, T104, T105, L112, T106, T107, T108, and T109 for maximum audio output.

Component and Designation	Function		
Q101 MPS3704	vco	Q113 MRF472	Rf power amp
Q102 MPS6514	PLL mixer	Q114 MPS6514	Rf amp
Q103 MPS6513	Buffer	Q115 MPS6514	1st rec mixer
Q104 MPS6513	Buffer	Q116 MPS6513	2nd rec mixer
Q105 MPS6513	11.806-MHz oscillator	Q117 MPS6513	Ref oscillator, 10.24 MHz
Q106 MPS3704	AVR (Automatic Voltage Regulator)	Q118 MPS6514	1st i-f
Q107 MPS3702	Xmit switch	Q119 MPS5172	2nd i-f
Q108 MPS6513	Buffer	Q120 MPS5172	Squelch
Q109 MPS6513	10.695-MHz offset oscillator	Q121 MPS6514	Range boost
Q110 MPS6513	Xmit mixer	Q122 MPS6513	Xmt audio ALC
Q111 MPS6513	Pre-driver	Q125 2N5088	Noise-blanker gate
Q112 MPS-U02	Driver	Q126 2N5088	Noise-blanker amp
		IC101 MM48141	PLL
		IC102 TA7205P	Audio amp

Table 3. Components and functions for the 750096.

Repeat the adjustments as necessary.

Step 3—Squelch Adjustment

The squelch-adjustment circuitry was located on the control interface board. To make the squelch circuit functional, connect the wiper pin of a 10k pot to PCB point 7 and a 20k resistor in series between one of the pot TR pins and point 11 on the PCB. Last, connect a 10k pot (which will be the squelch control) between point 7 and ground.

Turn the 10k pot completely clockwise and adjust the 20k pot (squelch calibrate) so that an S9 signal just breaks squelch. If a calibrated signal generator is available, input 50 uV at the antenna terminal and adjust for squelch break.

This completes alignment of the receiver portion of the board.

Should any of the boards fail to align properly, start troubleshooting from the front end of the receiver or transmitter sections to locate the trouble. Since these boards were in various stages of manufacture when operations ceased, they should be inspected carefully for damaged components or solder bridges.

In some models, the detector is a 1N4148 diode (usually found after the 2nd i-f amp Q119) and it is subject to infant mortality due to solder heat during assembly. If it is replaced, leave it standing up in the air on long leads and heat sink between the board and diode body.

That is the list of boards which many hams have converted. They are very well designed items, and if in proper condition and alignment should give very good service for a number of years. ■

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OSCAR Pathfinder

— a colorful way to track the satellites

After purchasing my shiny New Apple II Plus last year, I went searching through my stacks of old *73 Magazines* for some good programs to run on it. To my amazement, there was an annoying lack of articles on this machine. (Hey, Apple owners . . . what gives?) There were a lot of programs for other machines, but I didn't feel like going through the hassle of translating them. Besides, I wanted to use the graphics capability of the Apple, and the programs I found were not suitable for graphics. So I decided that a good way to get familiar with the machine and to offer something to other Apple hams would be to write my own program. Since I have always had a lingering interest in the OSCAR satellites, an OSCAR satellite tracking program became my objective.

The features I wanted my program to have were:

1) A graphics routine to display in real time the position of the satellite being tracked on a scale map of the US along with a simultaneous display of azimuth and elevation figures for an antenna array.

2) A routine to display a list of the azimuth and elevation figures for the orbit.

3) The equatorial crossing data for each of the orbits on the day selected.

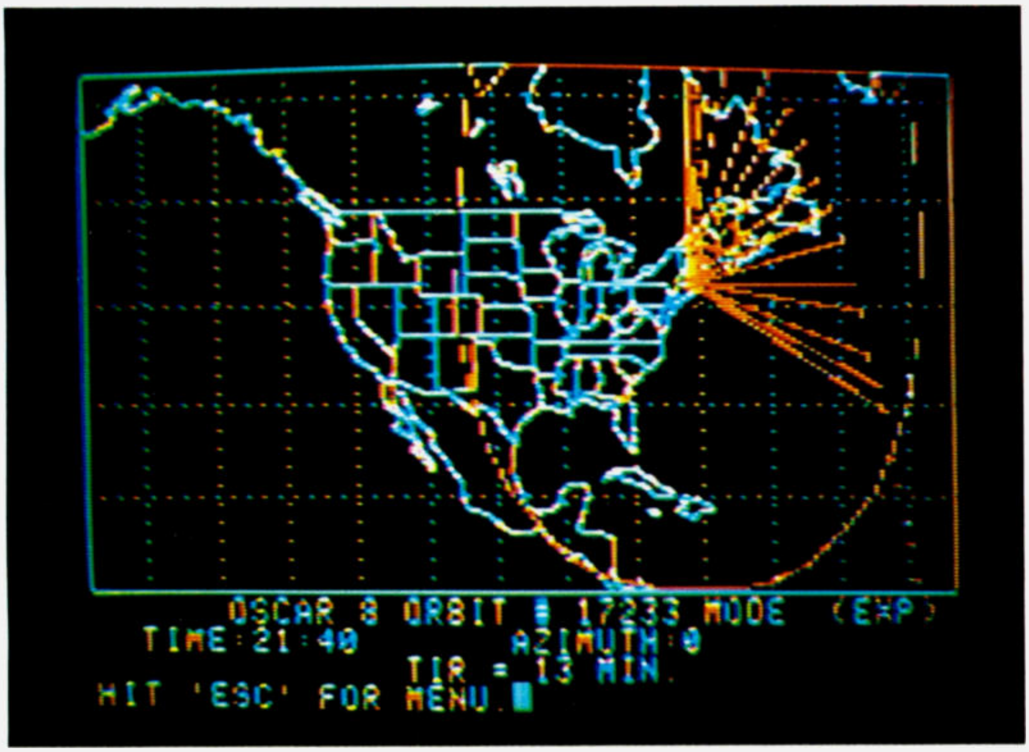
4) A routine to display a list of the latitude and longitude of the satellite for each minute of the orbit.

Besides computing orbital data for OSCAR satellites, I wanted the capability to compute orbital data for any circular orbit satellite. Building on the basic ideas and research of the authors I have mentioned in the references, I came up with OSCAR Pathfinder.

Although the basics of the program came straightforwardly, there were two major obstacles I had to overcome before it would operate in the Apple. The first and most difficult to solve stemmed from the way the Apple memory is organized (see Fig. 1). As you can see, Hi-Res screen buffer 1 is located from 8192 to 16383. Hi-Res screen buffer 2 is located piggyback to that from 16384 to 24525. Basic programs start loading into memory at location 2048, filling up memory from there the way water fills a glass. LOMEM floats up through memory with the loading program like a cork floats up with the water. When the program is fully loaded, LOMEM is at the end of the program. Now, if the program is longer than 6K bytes, the end of the program extends up into and possibly beyond the screen buffers.

In the case of OSCAR Pathfinder, which is approximately 13K-bytes long, 7K of the program overlaps Hi-Res screen buffer 1. When the command HGR is encountered in the program, the buffer is cleared and *POOF!*—the last 7K of OSCAR Pathfinder goes off to the bit bucket.

Since the Hi-Res screens cannot be moved to another location in memory (at least as far as I know), the program must therefore be made to occupy another non-conflicting portion of



memory. With 48K of memory available, there is lots of room to use between the end of Hi-Res screen buffer 1 and DOS.

Ahah, but to get the program up there — that was the problem! Since LOMEM and HIMEM affect only the limits of variable and array space, it wouldn't help to move them around. After a lot of PEEKing, POKEing, hair pulling, and studying of the Apple manuals, I discovered the fact that the Apple uses software pointers to indicate the beginning and ending of BASIC programs in memory, along with other various pointers, all located in page Zero. Locations 103 and 104 ($67,$68) make up the pointer to the program's beginning address.

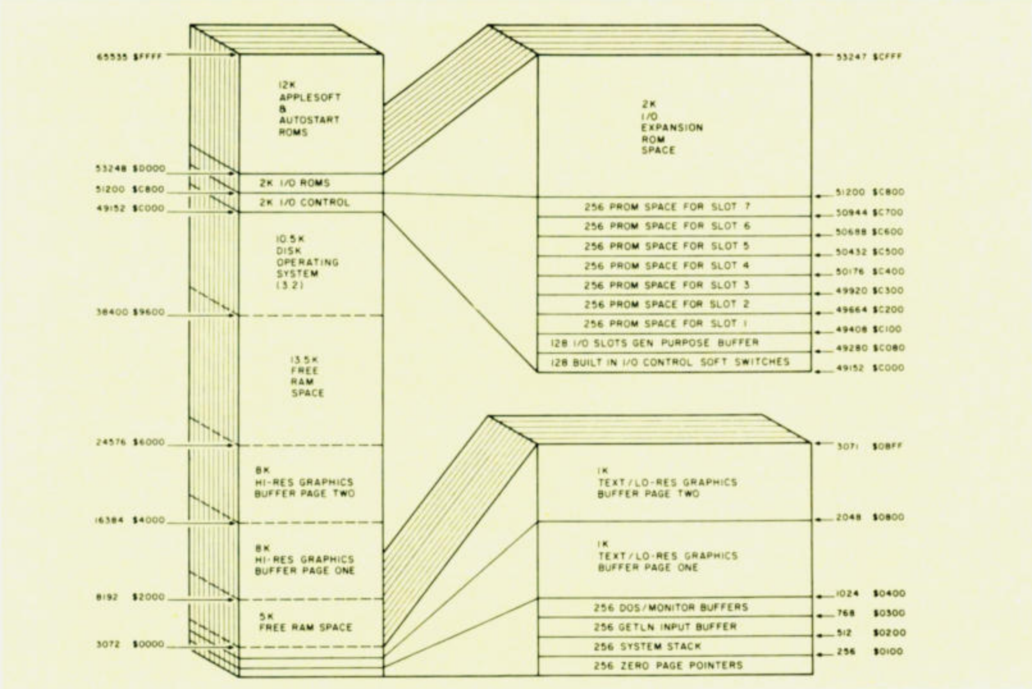


Fig. 1. 48K Apple II Plus memory organization.

After a little experimenting, I discovered that by changing the contents of this pointer I could control the location at which the BASIC programs start loading. *Success!* Now by typing the command "POKE 104,64:POKE 103,0:POKE 16384,0", I set the address of the beginning of a BASIC program to 16384, immediately following Hi-Res screen buffer 1. Since Hi-Res screen 2 is not used at all in OSCAR Pathfinder, I didn't have to worry about it causing any problems. OSCAR Pathfinder could then be loaded into memory and would reside from 16384 on up, with plenty of room left available for variables and arrays between the end of the program (LOMEM) and DOS (HIMEM).

This memory shuffling is accomplished by the small program, OSCAR STARTER, which appears in Listing 1. OSCAR STARTER will then cause the main program (Listing 2) to load from the disk and run.

The second major problem encountered was how to get an accurate scale map into the screen buffer for the program to plot on. I had two options that I knew of. One was to obtain one of those fancy sophisticated graphics digitizer tablets—which costs lots of bucks. The other was to do it by software—which costs lots of hours. Since I had lots more hours to burn than bucks, I chose the latter method. I decided that by using *lots* of HPLOT instructions, I could draw the necessary map.

The map I chose to put into memory was a Mercator projection because the latitude and longitude lines were straight, easing the math requirements to plot coordinates. In order to obtain the X, Y coordinates for the HPLOT commands, I traced the map on some graph paper which had a sufficient number of vertical and horizontal lines to provide reasonable resolution for the map. Then by numbering the vertical lines from 0 to 279 and the horizontal lines from 0 to 159, I was able to come up with the X,Y coordinates of all the major features of the map. (Believe me, that's a lot of dots!)

The resulting program is given in Listing 3. Since its length extends into Hi-Res screen buffer 1, either the same relocation method used to run OSCAR Pathfinder may be used or one could split the program in half and draw the map in two steps. Running the program results in a map of the US, Mexico, and Canada with latitude and longitude lines for every 10 degrees. To save this map for later use by OSCAR Pathfinder, first enter and run the program in Listing 3. Then use the BSAVE command to save the map on disk as a binary file. Use the file name "MAP 1." OSCAR Pathfinder will load the map as needed.

Operation

As you might already have deduced, OSCAR Pathfinder was originated on a 48K Apple II Plus machine with a single disk drive. When run, OSCAR Pathfinder first sets up variables, arrays, and formulas. Then it asks you for the data necessary for computation. The program computes the data for the orbit you select and then offers a choice of display modes.

The first information to be entered is the position of the station in longitude and latitude, in the range of −180 to 180 degrees and −90 to 90 degrees, with east longitude and south latitude entered as negative numbers. The data is checked to be sure it is in the proper range. Next, OSCAR Pathfinder asks the user for the date of the orbit to be computed. This is entered in six digits, two each for day, month, and year. The program checks the entry for proper range. Then the day of the week for the date entered is requested, to be used later in determining the mode of operation for the satellite.

OSCAR Pathfinder then requests the name of the satellite and, if it is not an OSCAR satellite, it then requests the orbital parameters for that satellite. The program asks for the northbound equatorial

```
5  HOME
10  POKE 104,64: POKE 103,1: POKE 16384,0
20  VTAB 10: PRINT "OSCAR PATHFINDER IN 48K APPLESOFT"
30  VTAB 12: PRINT  TAB( 10)"USING DOS 3.2.1"
40  PRINT  CHR$ (4);"RUN OSCAR PATHFINDER"
```

Listing 1.

Listing 2.

```
10  REM  *********************
20  REM  *                   *
30  REM  * OSCAR PATHFINDER  *
40  REM  *        BY         *
50  REM  *    T.C.JOHNSON    *
60  REM  *     --WB6NQK--    *
70  REM  *    NOV   1980     *
80  REM  *                   *
90  REM  *********************
210  POKE 33,40: POKE 34,0: HOME : TEXT : PRINT  CHR$ (4);"NOMONC,I,O"
300  VTAB 10: HTAB 12: PRINT "OSCAR PATHFINDER"
303  VTAB 11: HTAB 12: PRINT "----------------"
305  VTAB 12: HTAB 19: PRINT "BY"
310  VTAB 14: HTAB 15: PRINT "T.C.JOHNSON"
315  VTAB 16: HTAB 16: PRINT "-WB6NQK-"
320  VTAB 18: HTAB 16: PRINT "NOV 1980"
400  GOTO 540
500  REM  ERROR
510  HOME : FLASH : VTAB 12: HTAB 5: PRINT "ERROR # ": PEEK (222);" IN LINE "; P
EEK (218) +  PEEK (219) * 256: NORMAL
520  VTAB 20: HTAB 5: PRINT "HIT ANY KEY TO CONTINUE.": GET G$: PRINT G$;
530  POKE 216,0: CLEAR
540  ONERR  GOTO 500
1000  REM  DEFINE CONSTANTS
1010  DIM L%(52),MC%(1,53),RC%(1.35)
1020 L%(0) = 158:L%(1) = 156:L%(2) = 153:L%(3) = 151:L%(4) = 149:L%(5) = 146
1030 L%(6) = 144:L%(7) = 142:L%(8) = 140:L%(9) = 137:L%(10) = 135:L%(11) = 133:L
%(12) = 130:L%(13) = 128:L%(14) = 125:L%(15) = 123:L%(16) = 120:L%(17) = 118:L%(
18) = 115:L%(19) = 113:L%(19) = 110:L%(20) = 108
1040 L%(21) = 105:L%(22) = 103:L%(23) = 100:L%(24) = 97:L%(25) = 95:L%(26) = 92:
L%(27) = 89:L%(28) = 86:L%(29) = 83:L%(30) = 81:L%(31) = 78:L%(32) = 75:L%(33) =
 72:L%(34) = 69:L%(35) = 66
1050 L%(36) = 62:L%(37) = 59:L%(38) = 56:L%(39) = 52:L%(40) = 49:L%(41) = 45:L%(
42) = 42:L%(43) = 38:L%(44) = 35:L%(46) = 27:L%(47) = 22:L%(48) = 18:L%(49) = 14
:L%(50) = 10:L%(51) = 5:L%(52) = 0
1070 D$ =  CHR$ (4)
1080 D1$ = "SU":D2$ = "MO":D3$ = "TU":D4$ = "WE":D5$ = "TH":D6$ = "FR":D7$ = "SA
"
1090 R1 = 1.5708:R2 = 3.14159:R3 = 4.7124:R4 = 6.2832:R5 = 57.296:R6 = .01745:R9
 = 111.12:R7 = 3957:R8 = 1440
1100 M1$ = "B":M2$ = "A":M3$ = " (ORP)":M4$ = " (EXP)":M5$ = "J"
1110  DEF  FN ASN(X) =  ATN (X /  SQR ( - X * X + 1))
1120  DEF  FN ACS(X) =  -  ATN (X /  SQR ( - X * X + 1)) + 1.57079
1130  DEF  FN AN(X) =  -  ATN (X) + 1.5708
1140  DEF  FN DP(X) =  INT (X * 10 + .5) / 10
1150  DEF  FN MOD(A) =  INT ((A / 2 -  INT (A / 2)) * 8 + .05) *  SGN (A / 2)
2000  REM  OSCAR PATHFINDER MAIN ROUTINE
2020  POKE 33,40: POKE 34,0: HOME : TEXT : PRINT D$;"NOMONC,I,O"
2040  VTAB 1: HTAB 11: INVERSE : PRINT "OSCAR PATHFINDER": NORMAL
2050  POKE 34,1: HOME
2060  HOME
2070  VTAB 10: PRINT  TAB( 12)"STATION LOCATION": VTAB 11: PRINT  TAB( 12)"-----
-----------"
2080  VTAB 13: HTAB 5: INPUT "LONGITUDE (+ DEG W,- DEG E): ";A$: IF A$ = "" THEN
 2080
2090 SD(2) =  VAL (A$): IF SD(2) > 180 OR SD(2) <  - 180 THEN  VTAB 13: PRINT  S
PC( 40): GOTO 2080
2100  VTAB 15: HTAB 5: INPUT "LATITUDE (+DEG N,-DEG S): ";A$: IF A$ = "" THEN 21
00
2110 SD(1) =  VAL (A$): IF SD(1) > 90 OR SD(1) <  - 90 THEN  VTAB 15: PRINT  SPC
( 40): GOTO 2100
2120 SD(1) = SD(1) * R6:SD(2) = SD(2) * R6
2200  REM  GET SAT DATA
2210  HOME
2220  VTAB 12: PRINT  TAB( 2)"WHAT IS THE DATE OF THE ORBIT DESIRED?"
2230  VTAB 14: PRINT  TAB( 10)"DATE:(MMDDYY)          ]"
2240  VTAB 14: HTAB 24: INPUT DT$
2250  IF DT$ = "" THEN 2230
2260 DT =  VAL ( MID$ (DT$,3,2)): IF DT < 0 OR DT > 31 THEN 2230
2270 AX =  VAL ( LEFT$ (DT$,2)): IF AX > 12 OR AX < 0 THEN 2230
2280 DT$ =  LEFT$ (DT$,2) + "/" +  MID$ (DT$,3,2) + "/" +  RIGHT$ (DT$,2)
2290  POKE 34,1: HOME
2300  VTAB 12: HTAB 5: INPUT "WHAT DAY OF THE WEEK IS THAT?";A$
2310 DA$ =  LEFT$ (A$,2): IF DA$ <  > D1$ AND DA$ <  > D2$ AND DA$ <  > D3$ AND
DA$ <  > D4$ AND DA$ <  > D5$ AND DA$ <  > D6$ AND DA$ <  > D7$ THEN  HOME :: VT
AB 10: PRINT  TAB( 4)"DAY NOT RECOGNIZED": FOR I = 1 TO 3000: NEXT : GOTO 2290
2320  HOME : VTAB 8: HTAB 7: PRINT "NAME OF SATELLITE DESIRED:": VTAB 9: HTAB 7:
 PRINT "-------------------------": VTAB 13: HTAB 12: PRINT "1]  OSCAR 7": VTAB 1
5: HTAB 12: PRINT "2]  OSCAR 8": VTAB 17: HTAB 12: PRINT "3]  OTHER"
2330  VTAB 19: HTAB 12: PRINT "4]  QUIT": VTAB 8: HTAB 34: INPUT "";G$
2340  IF  VAL (G$) < 1 OR  VAL (G$) > 4 THEN 2320
2350  IF G$ = "1" THEN OS% = 7:OS$ = "OSCAR 7":ALT = 910:PER = 114.945:INC = 101
.7: GOTO 2390
2360  IF G$ = "2" THEN OS% = 8:OS$ = "OSCAR 8":ALT = 542:PER = 102.79:INC = 99.9
: GOTO 2390
2370  IF G$ = "4" THEN  END
2380  GOSUB 13000
2390 B =  INT (R8 / PER + .5): REM            ORBITS PER DAY
2400 C = (PER / R8) * 360 * R6: REM                PRECESSION(RAD)
2410 E =  FN ACS(R7 / (R7 + ALT)): REM    SAT HORIZON (RAD)
2420  DIM AF(2,B),SSP(5, INT (PER + .5))
2430  GOSUB 8000: GOSUB 6000: GOSUB 5000
2440  GOSUB 6500
2450  VTAB 23: PRINT  TAB( 5)"WHICH ORBIT?(SELECT BY REF #):"
2460  VTAB 23: HTAB 35: INPUT A$
2470  IF A$ = "" THEN 2450
2480 AG =  VAL (A$): IF AG > B OR AG < 0 THEN 2460
2490  POKE 34,1: HOME
2500  VTAB 5: PRINT  TAB( 5)"NOW COMPUTING ORBITAL DATA FOR ": VTAB 7: PRINT  TA
B( 5)OS$;" ORBIT # ";AF(0,AG);" ON ";DT$
2510  VTAB 10: PRINT  TAB( 12)"PLEASE STAND BY..."
2520  VTAB 14: FOR I = 1 TO 40: PRINT "-";: NEXT
2530  VTAB 18: HTAB 5: PRINT "ORBITAL DATA COMPUTED FOR      ": VTAB 20: HTAB 5:
PRINT "OUT OF "; INT (PER + .5);" MINUTES OF THE ORBIT."
2540  GOSUB 7000
2550  POKE 34,1: TEXT : HOME : VTAB 5: PRINT  TAB( 5)"ORBITAL DATA NOW COMPUTED"
2560  POKE 34,5
2570  TEXT : HOME : VTAB 5: PRINT  TAB( 5)"THESE DISPLAY MODES ARE AVAILABLE:"
2580  VTAB 8: HTAB 5: PRINT "1] REAL TIME GRAPHICS": PRINT  TAB( 5)"2] HIGH SPEE
D GRAPHICS": PRINT  TAB( 5)"3] ANTENNA AZ/EL DATA": PRINT  TAB( 5)"4] SUBSATELLI
TE POINT DATA": PRINT  TAB( 5)"5] ORBITS FOR CURRENT DAY"
2585  VTAB 13: HTAB 5: PRINT "6] COMPUTE DATA FOR ANOTHER ORBIT": PRINT  TAB( 5)
"7] RESTART PROGRAM": PRINT  TAB( 5)"8] QUIT"
2590  VTAB 18: PRINT "  ANY CHOICE MAY BE ABORTED AT ANY      TIME BY HITTING TH
E 'ESC' KEY. HITTING  ANY KEY WHEN A ROUTINE IS COMPLETED WILLACCESS THE MENU."
2600  VTAB 24: PRINT  TAB( 20)"YOUR CHOICE?";: GET G$: PRINT G$
2610 G =  VAL (G$): IF G < 1 OR G > 8 THEN 2560
2620  ON G GOTO 4000,3000,3400,3600,2650,2440,2630,2640
2630  CLEAR : GOTO 1000
2640  END
2650  GOSUB 6500: GOTO 2600
3000  REM   HIGH SPEED GRAPHICS
3010  HGR : HOME : HCOLOR= 3
3015  PRINT  CHR$ (4)"BLOAD MAP 1"
3020  POKE 34,1: HOME
3030  IF FB% = 1 THEN 3070
3035  POKE  - 16303,0
3040  VTAB 10: HTAB 5: FLASH : PRINT "THE SATELLITE DOES NOT PASS": VTAB 11: HTA
B 5: PRINT "WITHIN THE BOUNDS OF THE MAP.": NORMAL : VTAB 12: PRINT  TAB( 5)"TO
DISPLAY THE MAP ALONE TYPE 'M'"
3050  GET G$: IF G$ = "M" THEN  HOME : POKE  - 16304,0:: VTAB 24: PRINT  TAB( 13
)"NEXT CHOICE?";: GET G$: PRINT G$
3060  GOTO 2560
3070  HOME : POKE  - 16304,0
3080  GOSUB 9000: GOSUB 9500: GOSUB 10000
3090  VTAB 21: PRINT  TAB( 7)OS$;" ORBIT # ";AF(0,AG);" MODE ";MO$
3100  IF TR = 0 THEN  HTAB 5: PRINT OS$;: FLASH : PRINT " NOT IN RANGE ";: NORMA
L : PRINT "THIS ORBIT": GOTO 3320
3110  GOSUB 10500
3120  VTAB 22: PRINT "HIT SPACE BAR WHEN READY TO START"
3130  VTAB 24: PRINT "HIT 'ESC' FOR MENU.";
3140  VTAB 24: HTAB 20: GET G$: PRINT G$;: IF G$ =  CHR$ (27) THEN 2550
3150  IF G$ <  >  CHR$ (32) THEN 3140
3160  VTAB 22: HTAB 1: CALL  - 868: VTAB 22: HTAB 3: PRINT "TIME:": VTAB 22: HTA
B 20: PRINT "AZIMUTH:"
3200  FOR I = AS(2) TO LS(2)
3210  HPLOT XS,YS TO MC%(0,I),MC%(1,I)
3220 T = SSP(0,I): GOSUB 12500:T$ =  LEFT$ (T$,5):AZ =  FN DP(SSP(4,I) * R5): VT
AB 22: HTAB 8: PRINT "       ": VTAB 22: HTAB 28: PRINT "       ": VTAB 22: HTAB 8
: PRINT T$: VTAB 22: HTAB 28: PRINT AZ
3280  FOR J = 1 TO 2:KB =  PEEK ( - 16384): POKE  - 16368,0: IF KB = 155 THEN 25
60
3290  NEXT
3300  PRINT  CHR$ (7); CHR$ (7);
3310  NEXT
3315  VTAB 23: HTAB 15: PRINT "TIR = ";TR;" MIN."
3320  VTAB 24: HTAB 20: GET G$: GOTO 2550
3400  REM   DISPLAY AZ/EL
3410  POKE 34,2: HOME : TEXT
3420  VTAB 3: PRINT  TAB( 5)OS$:" ORBIT # ";AF(0,AG);" ON ";DT$
3430  IF TR = 0 THEN  VTAB 12: HTAB 8: FLASH : PRINT "SATELLITE NOT IN RANGE.":
NORMAL : VTAB 14: PRINT  TAB( 8)"NO ANTENNA DATA AVAILABLE.": GOTO 3540
3440  VTAB 4: PRINT  TAB( 8)"ANTENNA DIRECTION DATA:"
3450  VTAB 5: PRINT "TIME(ZULU)      AZIMUTH           ELEVATION"
3460  VTAB 6: FOR I = 1 TO 40: PRINT "-";: NEXT
3470  POKE 34,6
3480 L = 6
3490  FOR I = AS(2) TO LS(2)
3500 L = L + 1: IF L >  = 22 THEN 3550
3510 T = SSP(0,I): GOSUB 12500:AZ =  FN DP(SSP(4,I) * R5):EL =  FN DP(SSP(5,I) *
 R5)
3520  VTAB L: PRINT T$; TAB( 16);AZ; TAB( 32);EL
3530  NEXT
3540  VTAB 24: HTAB 20: GET G$: GOTO 2610
3550  VTAB 23: PRINT  TAB( 10)"HIT ANY KEY TO CONT.";: GET G$: PRINT G$: IF G$ =
  CHR$ (27) THEN 2610
3560  HOME :L = 7: GOTO 3510
3600  REM   DISPLAY SSP'S
3610  POKE 34,2: TEXT : HOME : VTAB 3: PRINT  TAB( 5)OS$;" ORBIT # ";AF(0,AG);"
ON ";DT$
3620 T = AF(1,AG): GOSUB 12500:L1 =  FN DP(AF(2,AG) * R5)
3630  VTAB 4: PRINT "TIME OF EQX:";T$;" EQX(LON W)";L1
3640  VTAB 5: PRINT "THE SUBSAT. POINTS FOR THIS ORBIT ARE:"
3650  VTAB 6: PRINT "   TIME            TIME       LAT       LON"
3660  VTAB 7: PRINT "(AFTER EQX)       (UTC)      (+N)      (+W) "
3670  VTAB 8: FOR T = 1 TO 40: PRINT "-";: NEXT
3680  POKE 34,8:L = 8
3690  FOR I = 1 TO  INT (PER + .5)
3700 L = L + 1: IF L < 22 THEN 3730
3710  VTAB 23: HTAB 10: PRINT "HIT ANY KEY TO CONT.";: GET G$: PRINT G$: IF G$ =
  CHR$ (27) THEN 2560
3720 L = 10: HOME
3730 T = SSP(0,I): GOSUB 12500:L1 =  FN DP(SSP(1,I) * R5):L2 =  FN DP(SSP(2,I) *
 R5)
3740  VTAB L: PRINT I;: HTAB 16: PRINT T$;: HTAB 26: PRINT L1;: HTAB 35: PRINT L
2
3750  NEXT
3760  VTAB 24: HTAB 20: GET G$: POKE 34,2: HOME : GOTO 2610
3770  GOTO 2610
3990  END
4000  REM   REAL TIME GRAPHICS
4010  HGR : HOME : HCOLOR= 3
4015  PRINT  CHR$ (4)"BLOAD MAP 1"
4020  POKE 34,1: HOME
4030  IF FB% = 1 THEN 4070
4035  POKE  - 16303,0
4040  VTAB 10: HTAB 5: FLASH : PRINT "THE SATELLITE DOES NOT PASS": VTAB 11: HTA
B 5: PRINT "WITHIN THE BOUNDS OF THE MAP.": NORMAL : VTAB 12: PRINT  TAB( 5)"TO
DISPLAY THE MAP ALONE TYPE 'M'"
4050  GET G$: IF G$ = "M" THEN  HOME : POKE  - 16304,0: VTAB 24: PRINT  TAB( 13)
"NEXT CHOICE?";: GET G$: PRINT G$
4060  GOTO 2560
4070  HOME : POKE  - 16304,0
4080  GOSUB 9000: GOSUB 9500: GOSUB 10000
4090  VTAB 21: PRINT  TAB( 7)OS$;" ORBIT # ";AF(0,AG);" MODE ";MO$
4100  IF TR = 0 THEN  HTAB 5: PRINT OS$;: FLASH : PRINT " NOT IN RANGE ";: NORMA
L : PRINT "THIS ORBIT": GOTO 4140
4110  GOSUB 10500
4120 T = AS(1): GOSUB 12500: VTAB 22: PRINT "HIT SPACE BAR WHEN TIME= ";T$;" (AO
S)"
4130  VTAB 23: PRINT "HIT 'ESC' FOR MENU."
4140  VTAB 24: HTAB 20: GET G$: IF G$ =  CHR$ (27) THEN 2550
4150  IF G$ <  >  CHR$ (32) THEN 4140
4160  VTAB 22: HTAB 1: PRINT  SPC( 40): VTAB 22: PRINT "TIME(UTC)      AZIMUTH
      ELEVATION": POKE 34,22
```

crossing (EQX) data for the reference orbit for the date selected earlier. This data is entered as (1) orbit number, (2) EQX time of day in the format HHMMSS, and (3) the EQX longitude with the west longitude being positive.

The program then computes the equatorial crossing data for each of the orbits for that date. The desired orbit number is selected from the list presented by entering the reference number associated with it. The program then begins its major number-crunching routines, generating latitudes, longitudes, bearings, and ranges for subsatellite points (SSP) in one minute intervals for the orbit, and computing elevation to the satellite for each minute the satellite is within range (above the horizon).

The computing time for SSP data is approximately 1.4 seconds for each minute of the orbit. For example, if the orbit is 100 minutes long, it would take about 2

```
4170  FOR I = AS(2) TO LS(2):T = SSP(0,I): GOSUB 12500:T$ =  LEFT$ (T$,5):AZ =
FN DP(SSP(4,I) * R5):EL =  FN DP(SSP(5,I) * R5): HOME : VTAB 23: PRINT T$; TAB(
16);AZ; TAB( 32);EL
4180 TC = LS(2) - I: VTAB 24: HTAB 12: PRINT "TIME TO LOS: ";TC;
4190  IF TC = 0 THEN 4310
4200  HPLOT XS,YS TO MC%(0,I),MC%(1,I)
4280  FOR J = 1 TO 2309:KB =  PEEK ( - 16384): POKE  - 16368,0: IF KB = 155 THEN
 2560
4290  NEXT
4300  PRINT  CHR$ (7); CHR$ (7)
4310  NEXT
4320  VTAB 24: HTAB 20: GET G$: GOTO 2550
5000  REM   FIND OSCAR MODES
5010  IF  LEFT$ (OS$,5) <  > "OSCAR" THEN MO$ = "N/A": RETURN
5020  IF OS% = 8 THEN 5080
5030  IF  FN MOD(AC) = 0 THEN MO$ = M1$
5040  IF  FN MOD(AC) = 1 THEN MO$ = M2$
5050  IF DA$ = D$(2) THEN MO$ = MO$ + M3$
5060  IF DA$ = D$(4) THEN MO$ = M4$
5070  RETURN
5080  IF DA$ = D2$ OR DA$ = D5$ THEN MO$ = M2$
5090  IF DA$ = D1$ OR DA$ = D7$ THEN MO$ = M5$
5100  IF DA$ = D3$ OR DA$ = D6$ THEN MO$ = M2$ + " & " + M5$
5110  IF DA$ = D4$ THEN MO$ = M4$
5120  RETURN
6000  REM  COMPUTE ALL ORBITS FOR DAY
6010 F = 1
6020  FOR I = 0 TO 8
6030  FOR J = 0 TO 2
6040  ON J + 1 GOTO 6050,6070,6100
6050 AF(J,I) = AE(J) + F * I
6060  NEXT
6070 AF(J,I) = AE(J) + PER * I
6080  IF AF(J,I) > R8 THEN AF(J,I) = AF(J,I) - R8
6090  NEXT
6100 AF(J,I) = AE(J) + C * I
6110  IF AF(J,I) > R4 THEN AF(J,I) = AF(J,I) - R4
6120  IF AF(J,I) > R2 THEN AF(J,I) = AF(J,I) - R4
6130  IF AF(J,I) <  - R2 THEN AF(J,I) = AF(J,I) + R4
6140  NEXT
6150  NEXT
6160  RETURN
6500  REM  LIST ORBITS FOR DAY
6510  HOME
6520  VTAB 3: PRINT  TAB( 6)OS$;" ORBITS FOR ";DT$
6530  VTAB 4: PRINT "REF #   ORBIT#    TIME EQX    EQX(DEG W)"
6540  VTAB 5: FOR I = 1 TO 40: PRINT "-";: NEXT
6550  POKE 34,5:L = 5
6560  FOR I = 0 TO 8
6570 L = L + 1: IF L > 22 THEN 6630
6580 T = AF(1,I): GOSUB 12500
6590 LD =  FN DP(AF(2,I) * R5)
6600  VTAB L: PRINT I; TAB( 9);;AF(0,I); TAB( 19);T$; TAB( 31);LD
6610  NEXT
6620  RETURN
6630  VTAB 23: HTAB 10: PRINT "HIT ANY KEY TO CONT. LISTING.";: GET B$: PRINT G$
;: HOME :L = 5: GOTO 6570
7000  REM   COMPUTE SUBSATELLITE DATA
7010 I1 = INC * R6:T = AF(1,AG):EQX = AF(2,AG):A% = 0:L% = 0:FB% = 0
7020  FOR I = 1 TO  INT (PER + .5)
7030 SSP(0,I) = T + I: IF SSP(0,I) > R8 THEN SSP(0,I) = SSP(0,I) - R8
7040 SSP(1,I) =  FN ASN( SIN (I1) *  SIN (R4 * I / PER))
7050 BA =  COS (R4 * I / PER) /  COS (SSP(1,I))
7060  IF BA = 1 OR BA =  - 1 THEN SSP(2,I) = (.25 * 1 * R6) + EQX: GOTO 7080
7070 SSP(2,I) =  FN ACS(BA) + (.25 * I * R6) + EQX
7080  IF SSP(2,I) > R4 OR SSP(2,I) > R2 THEN SSP(2,I) = SSP(2,I) - R4
7090  IF SSP(2,I) <  - R2 THEN SSP(2,I) = SSP(2,I) + R4
7100 H = ALT + R7:N = SD(2) - SSP(2,I): IF N <  - R2 THEN N = N + R4
7110  IF N > R2 THEN N = N - R4
7120 SSP(3,I) =  FN ACS( SIN (SD(1)) *  SIN (SSP(1,I)) +  COS (SD(1)) *  COS (SS
P(1,I)) *  COS (N))
7130  IF SSP(3,I) < 0 THEN SSP(3,I) = SSP(3,I) + R2
7140 TA =  SIN (SSP(1,I)) - ( SIN (SD(1)) *  COS (SSP(3,I))):TB =  COS (SD(1)) *
  SIN (SSP(3,I)):TC = TA / TB
7150  IF TC <  - 1 THEN TC =  - .999999999
7160  IF TC > 1 THEN TC = .999999999
7170 SSP(4,I) =  FN ACS(TC): IF  SGN (N) =  - 1 THEN SSP(4,I) = R4 - SSP(4,I)
7180  IF SSP(3,I) <  = D AND A% = 0 THEN AS(1) = SSP(0,I):AS(2) = 1:A% = 1
7190  IF SSP(3,I) > D AND L% = 0 AND A% <  > 0 THEN LS(1) = SSP(0,I):LS(2) = I:L
% = 1
7200  IF SSP(3,I) <  = D THEN SSP(5,I) = R1 -  ATN ((H *  SIN (SSP(3,I))) / (H *
  COS (SSP(3,I)) - R7))
7210  IF I = 1 THEN 7270
7220  IF SSP(1,I) >  = .15705 AND SSP(1,I - 1) < .15705 AND  SGN (SSP(2,I)) = 1
THEN YA = I
7230  IF SSP(1,I) <  = 1.0645 AND SSP(1,I - 1) > 1.0645 AND  SGN (SSP(2,I)) = 1
THEN YA = I
7240  IF SSP(1,I) > 1.0645 AND SSP(1,I - 1) <  = 1.0645 AND  SGN (SSP(2,I)) = 1
THEN YB = I - 1
7250  IF SSP(1,I) < .15705 AND SSP(1,I - 1) >  = .15705 AND  SGN (SSP(2,I)) = 1
THEN YB = I - 1
7260  VTAB 18: HTAB 31: PRINT I
7270  NEXT
7280 TR = LS(1) - AS(1)
7290  IF SSP(2,YA) < 2.7571 AND SSP(2,YB) > .586 THEN FB% = 1
7300  RETURN
8000  REM   INPUT REF ORBIT DATA
8010  HOME : VTAB 5: HTAB 5: PRINT OS$;" REFERENCE ORBIT DATA ": VTAB 7: HTAB 14
: PRINT "FOR ";DT$
8020  VTAB 10: HTAB 5: PRINT "ENTER ORBIT NO.(XXXXX):              ": VTAB 10: HTAB
28: INPUT "";A$: IF  LEN (A$) > 5 THEN 8020
8025  IF A$ = "" THEN 8020
8030 AE(0) =  VAL (A$)
8040  VTAB 12: HTAB 5: PRINT "ENTER EQX TIME(UTC)    :HHMMSS ": VTAB 12: HTAB 28:
 INPUT "";A$: IF  LEN (A$) <  > 6 THEN 8040
8045  IF A$ = "" THEN 8040
8050  IF  VAL ( RIGHT$ (A$,2)) > 59 OR  VAL ( RIGHT$ (A$,2)) < 0 THEN 8040
8060  IF  VAL ( MID$ (A$,3,2)) > 59 OR  VAL ( MID$ (A$,3,2)) < 0 THEN 8040
8070  IF  VAL ( LEFT$ (A$,2)) < 0 OR  VAL ( LEFT$ (A$,2)) > 23 AND  VAL ( MID$ (
A$,3,2)) > 59 THEN 8040
8080 T$ = A$: GOSUB 12000:AE(1) = T
8090  VTAB 14: HTAB 5: PRINT "ENTER EQX LONGITUDE    :        ": VTAB 14: HTAB 28:
INPUT "";A$: IF A$ = "" THEN 8090
8100  IF  LEN (A$) > 5 THEN 8090
8110  IF  VAL (A$) > 180 OR  VAL (A$) <  - 180 THEN 8090
8120 AE(2) =  VAL (A$) * R6
8130  RETURN
9000  REM   COMPUTE RANGE CIRCLE
9010 DD = D + D * .2
9020  FOR I = 0 TO 350 STEP 10
9030 K = I * R6
9040 RC =  COS (K) * DD + SD(1)
9050 RD =  SIN (K) * DD + SD(2)
9060 A =  INT (RC * R5 + .5):O = RD * R5
9070  IF A < 9 THEN A = 9
9080  IF A > 61 THEN A = 61
9090  GOSUB 11000
9100 RC%(1,I / 10) =  INT (X + .5):RC%(0,I / 10) = Y
9110  IF RC%(1,I / 10) > 279 THEN RC%(1,I / 10) = 279
9120  IF RC%(1,I / 10) < 0 THEN RC%(1,I / 10) = 0
9130  IF RC%(0,I / 10) > 159 THEN RC%(0,I / 10) = 159
9140  IF RC%(0,I / 10) < 0 THEN RC%(0,I / 10) = 0
9150  NEXT
9160  RETURN
9500  REM  PLOT RANGE CIRCLE
9510  HPLOT RC%(1,0),RC%(0,0)
9520  FOR I = 1 TO 35
9530  HPLOT  TO RC%(1,I),RC%(0,I)
9540  NEXT
9550  HPLOT  TO RC%(1,0),RC%(0,0)
9560  RETURN
10000  REM   PLOT PATH
10010  IF  NOT FB% THEN  RETURN
10020  FOR I = YA TO YB
10030 O = SSP(2,I) * R5:A =  INT (SSP(1,I) * R5 + .5): IF A < 9 OR A > 61 THEN 1
0120
10040  GOSUB 11000
10050  IF X < 0 OR X > 279 THEN 10120
10060  IF X = 0 AND Y = 0 THEN  HPLOT X,Y TO X + 1,Y TO X,Y + 1: GOTO 10120
10070  IF X = 279 AND Y = 0 THEN  HPLOT X,Y TO X - 1,Y TO X,Y + 1: GOTO 10120
10080  IF X = 279 THEN  HPLOT X,Y - 1 TO X,Y + 1 TO X - 1,Y: GOTO 10120
10090  IF X = 0 THEN  HPLOT X,Y - 1 TO X,Y + 1 TO X + 1,Y: GOTO 10120
10100  IF Y = 0 THEN  HPLOT X - 1,Y TO X + 1,Y TO X,Y + 1: GOTO 10120
10110  HPLOT X - 1,Y TO X + 1,Y TO X,Y - 1 TO X,Y + 1
10120  NEXT
10130  RETURN
10500  REM   COMPUTE BEARING LINES
10510 A = SD(1) * R5:O = SD(2) * R5: GOSUB 11000:XS = X:YS = Y
10520 DB(1) = ( ATN ((279 - 5) / YS)) * R5
10530 DB(2) = 180 - (( ATN ((279 - XS) / (159 - YS))) * R5)
10540 DB(3) = 180 + (( ATN (XS / (159 - YS))) * R5)
10550 DB(4) = 360 - (( ATN (XS / YS)) * R5)
10600  REM   COMPUTE XY POINTS FOR BEARING LINES
10610  FOR I = AS(2) TO LS(2)
10620 A =  INT (SSP(1,I) * R5 + .5): IF A < 9 OR A > 61 THEN 10670
10630 O = SSP(2,I) * R5: GOSUB 11000:XP = X
10640  IF XP > 279 OR XP < 0 THEN 10670
10650 MC%(0,I) = XP:MC%(1,I) = Y
10660  NEXT
10665  RETURN
10670 BNG = SSP(4,I) * R5
10680  IF BNG > DB(4) OR BNG <  = DB(1) THEN MC%(1,I) = 0: GOTO 10720
10690  IF BNG > DB(1) AND BNG <  = DB(2) THEN MC%(0,I) = 279: GOTO 10750
10700  IF BNG > DB(2) AND BNG <  = DB(3) THEN MC%(1,I) = 159: GOTO 10780
10710  IF BNG > DB(3) AND BNG <  = DB(4) THEN MC%(0,I) = 0: GOTO 10810
10720  IF BNG > DB(1) THEN 10740
10730 MC%(0,I) = YS *  TAN (SSP(4,I)) + XS: GOTO 10660
10740 MC%(0,I) = XS - (YS * ( TAN (R4 - SSP(4,I)))): GOTO 10660
10750  IF BNG <  = 90 THEN 10770
10760 MC%(1,I) = YS + ((279 - XS) * ( TAN (SSP(4,I) - R1))): GOTO 10660
10770 MC%(1,I) = YS - ((279 - XS) * ( TAN (R1 - SSP(4,I)))): GOTO 10660
10780  IF BNG > 180 THEN 10800
10790 MC%(0,I) = XS + ((159 - YS) * ( TAN (R2 - SSP(4,I)))): GOTO 10660
10800 MC%(0,I) = XS - ((159 - YS) * ( TAN (SSP(4,I) - R2))): GOTO 10660
10810  IF BNG > 270 THEN 10830
10820 MC%(1,I) = YS + (XS * ( TAN (SSP(4,I) - R3))): GOTO 10660
10830 MC%(1,I) = YS - (XS * ( TAN (R3 - SSP(4,I)))): GOTO 10660
11000  REM    CONVERT LON-LAT TO X,Y
11010 X = 220 - ((O - 60) * 2.2353)
11020 Y = L%(A - 9)
11050  RETURN
11500  REM   CONVERT RADIANS TO DEGREES
11520 L1 = L1 * R5
11530 L2 = L2 * R5
11540  RETURN
12000  REM   TIME CONVERSION
12010  REM   (HHMMSS TO XXXX.XX MIN)
12020 T1 =  VAL ( LEFT$ (T$,2)) * 60
12030 T2 =  VAL ( MID$ (T$,3,2))
12040 T3 =  VAL ( RIGHT$ (T$,2)) / 60
12050 T = T1 + T2 + T3
12060 T =  INT (T * 100 + .5) / 100
12070  RETURN
12500  REM   TIME CONVERSION
12510  REM  (XXXX.XX TO HHMMSS)
12520 T1 =  INT (T / 60)
12530 T2 =  INT ((T / 60 -  INT (T / 60)) * 60)
12540 T3 =  INT ((((T / 60 -  INT (T / 60)) * 60) -  INT ((T / 60 -  INT (T / 60
)) * 60)) * 60 + .5)
12550 T1$ =  STR$ (T1):T2$ =  STR$ (T2):T3$ =  STR$ (T3)
12560  IF T1 = 0 THEN T1$ = "00"
12570  IF  LEN (T1$) = 1 THEN T1$ = "0" + T1$
12580  IF T2 = 0 THEN T2$ = "00"
12590  IF  LEN (T2$) = 1 THEN T2$ = "0" + T2$
12600  IF T3 = 0 THEN T3$ = "00"
12610  IF  LEN (T3$) = 1 THEN T3$ = "0" + T3$
12620 T$ = T1$ + ":" + T2$ + ":" + T3$
12630  RETURN
13000  REM  INPUT ALTERNATE SATELLITE DATA
13010  HOME : VTAB 10: PRINT "NAME OF SATELLITE:        ]       ": VTAB 10: HTAB
 19: INPUT "";A$:A$ =  LEFT$ (A$,7):OS$ = A$
13020  IF  LEN (A$) > 7 THEN OS$ = A$ +  RIGHT$ ("       ",7 -  LEN (A$))
13030  VTAB 12: INPUT "SAT. ALT.(STATUTE MILES):";A$: IF A$ = "" THEN 13030
13040 ALT =  VAL (A$)
13050  VTAB 14: INPUT "SATELLITE INCLINATION IN DEG.:";A$: IF A$ = "" THEN 13050
13060 INC =  VAL (A$)
13065  VTAB 20: HTAB 5: INPUT "IS ALL DATA CORRECT?";A$: IF  LEFT$ (A$,1) = "N"
THEN 13010
13070 PER = (R4 *  SQR (((ALT + R7) ^ 3) / 95600)) / 60
13080 OS% = 0: RETURN
```

minutes and 20 seconds to compute all the satellite data. (Try doing it in that time on your calculator!)

Display Menu

Finally, with all data computed, the program goes into the display mode, starting out with the display menu offering the choice of (1) real-time graphics, (2) high speed graphics, (3) azimuth-elevation list, (4) SSP data list, (5) orbits for the day, (6) compute data for another one of the orbits of the day, (7) start the program over, and (8) quit. If, while any of the display routines is running it becomes necessary to access the display menu again, pressing the ESC key will accomplish this. This allows one to jump around the display modes without having to wait for each one to finish.

If the real-time graphics choice is selected, the computer loads the map from the disk into the Hi-Res screen buffer 1. Then, if the satellite path is within the

Listing 3.

```
10  REM ********************
20  REM *                  *
30  REM * US MAP GENERATOR *
40  REM *                  *
50  REM *  BY T.C.JOHNSON  *
60  REM *                  *
70  REM *     WB6NOK       *
80  REM *                  *
90  REM *    NOV 1980      *
95  REM *                  *
97  REM ********************
100  HOME : HGR : HCOLOR= 3: HPLOT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0.0
110  HPLOT 75,55 TO 75,56 TO 76,57 TO 76,58 TO 77,59 TO 77,66 TO 76,67 TO 76,72
TO 75,73 TO 75,74 TO 76,75 TO 76,80 TO 77,81 TO 77,83 TO 80,88 TO 80,89 TO 82,93
 TO 84,94 TO 84,96 TO 91,99 TO 93,102 TO 98,102 TO 105,105 TO 112,105 TO 112,104
120  HPLOT  TO 123,111 TO 124,110 TO 124,109 TO 127,109 TO 135,119 TO 136,119 TO
 136,115 TO 137,114 TO 137,113 TO 143,109 TO 149,109 TO 149,110 TO 152,110 TO 15
3,111 TO 154,111 TO 154,110 TO 153,109 TO 154,108 TO 155,108 TO 156,107
130  HPLOT  TO 160,107 TO 163,109 TO 165,109 TO 166,108 TO 167,108 TO 168,109 TO
 168,110 TO 169,111 TO 169,112 TO 168,113 TO 168,115 TO 171,118 TO 171,119 TO 17
3,121 TO 174,121 TO 175,120 TO 174,119 TO 174,118 TO 175,117 TO 174,116
140  HPLOT  TO 174,112 TO 174,110 TO 172,104 TO 173,103 TO 173,102 TO 177,100 TO
 177,99 TO 178,98 TO 180,98 TO 184,94 TO 184,89 TO 183,88 TO 185,87 TO 186,86 TO
 186,83 TO 187,83 TO 188,82 TO 188,80 TO 189,80 TO 190,79
150  HPLOT  TO 192,79 TO 192,78 TO 197,76 TO 197,75 TO 196,74 TO 196,72 TO 199,6
9 TO 204,67 TO 204,66 TO 203,65 TO 203,61 TO 202,60 TO 202,59 TO 199,59 TO 195,6
5 TO 186,66 TO 183,70 TO 181,72 TO 177,72 TO 177,73
160  HPLOT  TO 176,74 TO 168,77 TO 168,74 TO 169,73 TO 169,70 TO 168,69 TO 167,7
0 TO 166,70 TO 168,68 TO 168,67 TO 167,66 TO 167,65 TO 166,65 TO 165,64 TO 164,6
4 TO 164,65 TO 163,66 TO 162,66 TO 162,67 TO 160,69
170  HPLOT  TO 160,70 TO 161,71 TO 161,75 TO 159,76 TO 158,76 TO 158,72 TO 157,7
1 TO 158,70 TO 159,67 TO 159,65 TO 160,64 TO 162,63 TO 165,63 TO 165,61 TO 159,6
1 TO 158,60 TO 157,60 TO 157,59 TO 158,58
180  HPLOT  TO 156,59 TO 153,60 TO 152,61 TO 151,61 TO 150,59 TO 162,56 TO 160,5
6 TO 157,55 TO 156,54 TO 155,54 TO 154,55 TO 153,55 TO 152,53 TO 80,53 TO 80,57
TO 81,56 TO 77,56 TO 76,55
190  HPLOT 93,102 TO 93,107 TO 94,108 TO 94,109 TO 95,110 TO 96,110 TO 97,111 TO
 98,111 TO 98,113 TO 97,114 TO 96,114 TO 96,115 TO 98,116 TO 99,116 TO 100,117 T
O 101,117 TO 103,119 TO 103,120 TO 102,121 TO 103,122
200  HPLOT  TO 104,122 TO 105,123 TO 105,124 TO 106,124 TO 107,125 TO 107,126 TO
 108,126 TO 109,125 TO 109,124 TO 105,120 TO 105,119 TO 103,117 TO 103,116 TO 10
2,116 TO 102,113 TO 101,112 TO 100,112 TO 100,111 TO 99,111 TO 99,110
210  HPLOT  TO 98,109 TO 97,109 TO 97,102
220  HPLOT  TO 97,105 TO 99,105 TO 100,106 TO 103,112 TO 107,116 TO 109,117 TO 1
09,118 TO 108,119 TO 109,120 TO 110,120 TO 118,130 TO 118,134 TO 119,135 TO 119,
136 TO 120,137 TO 123,137 TO 124,138 TO 126,138 TO 129,141 TO 130,141
230  HPLOT  TO 131,142 TO 132,142 TO 133,143 TO 140,143 TO 141,142 TO 143,142 TO
 147,146 TO 148,146 TO 150,148 TO 152,148 TO 153,149 TO 157,149: HPLOT 167,149 T
O 167,144 TO 165,144 TO 164,143 TO 157,143 TO 156,142 TO 155,142 TO 155,141
240  HPLOT  TO 157,139 TO 157,137 TO 158,137 TO 158,134 TO 159,133 TO 159,130 TO
 153,130 TO 150,133 TO 150,135 TO 148,137 TO 144,137 TO 144,138 TO 143,138 TO 14
3,137 TO 140,136 TO 138,136 TO 138,133 TO 135,127 TO 135,119
250  HPLOT 167,126 TO 175,126 TO 177,128 TO 179,128 TO 181,130 TO 186,132 TO 187
,132 TO 187,133 TO 180,133 TO 180,132 TO 178,130 TO 170,128 TO 170,127 TO 164,12
9 TO 164,128 TO 167,126: HPLOT 190,133 TO 191,133 TO 192,134 TO 196,134
260  HPLOT  TO 196,135 TO 198,135 TO 199,136 TO 200,136 TO 200,137 TO 195,137 TO
 195,138 TO 194,139 TO 193,139 TO 192,138 TO 190,138 TO 189,137 TO 187,137 TO 18

8,136 TO 191,136 TO 191,135 TO 190,134 TO 189,134
270  HPLOT 178,137 TO 182,137 TO 182,138 TO 179,138
280  HPLOT 153,56 TO 154,56 TO 156,54 TO 159,54 TO 159,53 TO 160,53 TO 162,55 TO
 162,56 TO 164,56 TO 164,57 TO 165,58 TO 165,62 TO 168,62 TO 169,63 TO 171,63 TO
 172,64 TO 173,64 TO 174,65 TO 174,68 TO 173,68
290  HPLOT  TO 171,66 TO 171,70 TO 170,71 TO 170,72: HPLOT 169,75 TO 170,74 TO 1
76,74: HPLOT 177,71 TO 178,70 TO 183,70: HPLOT 189,65 TO 189,64 TO 194,60 TO 195
,60 TO 204,49 TO 208,49 TO 209,50 TO 213,50 TO 214,49 TO 220,50
300  HPLOT 202,54 TO 204,54 TO 205,53 TO 208,53 TO 209,52 TO 210,53 TO 210,55 TO
 209,56 TO 209,61 TO 210,60 TO 211,60 TO 212,61 TO 215,61 TO 215,64 TO 215,63 TO
 211,63 TO 211,62 TO 210,62
310  HPLOT 216,64 TO 217,64 TO 217,62 TO 218,61 TO 219,60 TO 219,63 TO 218,64 TO
 218,65 TO 217,66 TO 215,66 TO 213,68 TO 211,68 TO 210,69 TO 209,69 TO 209,71 TO
 206,71 TO 206,68 TO 207,68 TO 209,67 TO 209,64 TO 207,66 TO 205,66
320  HPLOT 210,51 TO 212,51 TO 213,52 TO 215,52: HPLOT 213,53 TO 216,53
330  HPLOT 78,55 TO 77,55 TO 77,54 TO 75,54 TO 72,51 TO 71,51 TO 71,50 TO 69,50
TO 69,49 TO 68,48 TO 67,48 TO 67,47 TO 73,47 TO 73,49 TO 74,50 TO 75,51 TO 77,51
 TO 77,52 TO 80,55
340  HPLOT 79,52 TO 78,51 TO 76,51 TO 76,50 TO 75,49 TO 75,48 TO 74,47 TO 71,47
TO 71,45 TO 68,45 TO 68,42 TO 63,37 TO 64,37 TO 64,36 TO 61,33 TO 61,30 TO 59,30
 TO 59,31 TO 57,31 TO 56,30
350  HPLOT  TO 56,29 TO 55,28 TO 55,27 TO 54,26 TO 55,25 TO 55,21 TO 54,22 TO 52
,22 TO 52,15 TO 52,18 TO 50,16 TO 48,18 TO 45,15 TO 45,13 TO 42,13 TO 42,12 TO 4
1,11 TO 40,11 TO 39,12 TO 38,12
360  HPLOT  TO 37,10 TO 33,10 TO 33,11 TO 31,11 TO 30,10
370  HPLOT 76,75 TO 105,75: HPLOT 85,75 TO 85,85 TO 97,95 TO 97,100 TO 96,101: H
PLOT 98,75 TO 98,92 TO 97,92 TO 97,94: HPLOT 91,75 TO 91,65 TO 92,65 TO 92,63 TO
 91,62 TO 91,53: HPLOT 78,62 TO 79,63 TO 84,63 TO 85,62 TO 91,62
380  HPLOT 93,54 TO 93,55 TO 94,56 TO 94,58 TO 95,58 TO 95,59 TO 96,60 TO 97,60
TO 97,64 TO 99,64 TO 99,66 TO 100,66 TO 100,68 TO 101,67 TO 105,67 TO 105,78 TO
125,78 TO 125,89 TO 123,89 TO 123,104 TO 116,104
390  HPLOT 110 78 TO 110,105: HPLOT 99,89 TO 142,89 TO 142,91 TO 184,91: HPLOT 1
05,66 TO 120,66: HPLOT 120,53 TO 120,78: HPLOT 120,62 TO 137,62: HPLOT 120,72 TO
 133,72 TO 134,73 TO 138,73: HPLOT 125,81 TO 140,81
400  HPLOT 123,91 TO 129,91 TO 129,94 TO 130,95 TO 130,96 TO 131,97 TO 134,97 TO
 135,98 TO 143,98: HPLOT 138,71 TO 149,71: HPLOT 140,79 TO 150,79
410  HPLOT 137,53 TO 137,64 TO 136,64 TO 138,65 TO 138,75 TO 139,76 TO 139,79 TO
 140,80 TO 140,82 TO 142,84 TO 142,98 TO 143,99 TO 143,103 TO 144,103 TO 144,109
: HPLOT 145,106
415  HPLOT 143,100 TO 150,100
420  HPLOT 149,60 TO 148,60 TO 148,62 TO 147,62 TO 147,63 TO 146,64 TO 146,65 TO
 147,66 TO 147,67 TO 148,68 TO 149,68 TO 149,71 TO 151,73 TO 151,77 TO 150,78 TO
 150,82 TO 153,87 TO 154,88
430  HPLOT  TO 154,91 TO 152,93 TO 152,95 TO 150,98 TO 150,102 TO 149,103 TO 149
,105 TO 153,105 TO 153,107 TO 154,108
440  HPLOT 152,74 TO 158,74 TO 158,85 TO 157,86 TO 157,87 TO 156,88 TO 156,89 TO
 155,89: HPLOT 160,75 TO 168,75 TO 164,75 TO 164,83 TO 163,84 TO 163,85 TO 161,8
7 TO 158,87
450  HPLOT 152,95 TO 173,95 TO 174,96 TO 176,96 TO 178,98: HPLOT 157,95 TO 157,9
8 TO 156,99 TO 156,107 TO 158,107 TO 158,105 TO 163,105 TO 163,106 TO 169,106 TO
 169,107 TO 170,107 TO 171,106
460  HPLOT 162,95 TO 162,97 TO 163,97 TO 163,100 TO 164,101 TO 164,102 TO 163,10
3 TO 163,105: HPLOT 170,92 TO 168,94 TO 168,96 TO 169,97 TO 169,99 TO 170,99 TO
173,102
470  HPLOT 175,75 TO 186,75 TO 186,81 TO 174,81 TO 174,76: HPLOT 165,84 TO 166,8
4 TO 167,85 TO 168,85 TO 170,83 TO 171,83 TO 173,81 TO 175,81 TO 175,83 TO 176,8
3 TO 177,82 TO 178,83 TO 179,83 TO 183,87
480  HPLOT 167,90 TO 168,89 TO 169,89 TO 169,87 TO 168,86 TO 170,88 TO 174,88 TO
 174,87 TO 175,87 TO 175,86 TO 178,83: HPLOT 190,66 TO 190,73 TO 189,74 TO 189,7
8 TO 188,78 TO 187,77

490  HPLOT 193,66 TO 191,72 TO 194,72 TO 194,66: HPLOT 190,75 TO 194,75 TO 194,7
7 TO 193,76: HPLOT 184,82 TO 184,84 TO 183,85 TO 183,87
500  HPLOT 142,10 TO 142,14 TO 143,15 TO 145,15 TO 146,16 TO 146,20 TO 147,20 TO
 147,23 TO 148,23 TO 149,22 TO 153,22 TO 153,23 TO 155,23 TO 158,27 TO 160,27 TO
 164,30 TO 170,30 TO 170,39
510  HPLOT  TO 171,40 TO 172,40 TO 172,41 TO 173,42 TO 173,43 TO 174,44 TO 176,4
4 TO 176,43 TO 177,43 TO 177,38 TO 176,37 TO 176,33 TO 175,32 TO 176,31 TO 178,3
1 TO 181,29 TO 183,26 TO 182,21
520  HPLOT  TO 181,20 TO 181,19 TO 178,17 TO 180,10: HPLOT 199,10 TO 199,15 TO 2
01,15 TO 201,16 TO 204,17 TO 206,16 TO 209,10 TO 210,10 TO 213,15 TO 213,17 TO 2
15,19 TO 216,20 TO 216,25 TO 215,26 TO 215,27
530  HPLOT  TO 217,27 TO 218,28 TO 218,29 TO 219,30
560  HPLOT 106,14 TO 106,16 TO 107,16 TO 108,15 TO 109,15 TO 109,14 TO 110,14 TO
 111,13 TO 113,13 TO 111,13 TO 109,12 TO 108,13 TO 107,13 TO 107,14
570  HPLOT 125,19 TO 125,24 TO 124,25 TO 123,24 TO 127,20 TO 126,19
580  HPLOT 128,38 TO 128,39 TO 129,39 TO 130,40 TO 130,42 TO 133,45 TO 133,47 TO
 134,48 TO 135,47 TO 134,47 TO 134,46 TO 134,43 TO 132,43 TO 132,42 TO 131,42 TO
 131,39 TO 129,37
590  HPLOT 133,36 TO 135,36 TO 137,36 TO 137,41 TO 137,42 TO 139,44 TO 139,45 TO
 138,48 TO 138,44 TO 136,41 TO 135,41 TO 133,41 TO 133,39 TO 134,38 TO 133,37 TO
 132,37
600  HPLOT 180,9 TO 180,6 TO 178,6 TO 178,5 TO 179,5 TO 180,4 TO 180,0 TO 191,0
TO 193,2 TO 194,2 TO 194,4 TO 195,5 TO 198,5 TO 198,6 TO 197,7 TO 197,8 TO 198,8
 TO 198,10
610  HPLOT 220,30 TO 222,30 TO 222,31 TO 224,31 TO 225,32 TO 224,33 TO 222,33 TO
 221,34 TO 221,35 TO 220,35 TO 220,36 TO 221,36 TO 222,35 TO 223,35 TO 224,34 TO
 226,34 TO 226,35 TO 227,36 TO 229,36
620  HPLOT  TO 229,41 TO 228,42 TO 228,43 TO 227,44 TO 223,44 TO 222,45 TO 222,4
7 TO 221,47 TO 220,48 TO 220,49
630  HPLOT 221,57 TO 231,57 TO 231,58 TO 230,58 TO 229,59 TO 231,59 TO 233,57 TO
 233,59 TO 234,60 TO 235,59 TO 235,56 TO 234,57 TO 234,55 TO 233,55 TO 235,53 TO
 235,54 TO 233,52 TO 234,51 TO 234,50
640  HPLOT  TO 230,50 TO 230,49 TO 228,49 TO 228,47 TO 229,46 TO 229,45 TO 228,4
5 TO 226,47 TO 226,48 TO 225,49 TO 225,50 TO 224,51 TO 223,51 TO 223,52 TO 222,5
3 TO 223,54 TO 221,55 TO 221,57
650  HPLOT 242,0 TO 244,2 TO 244,3 TO 245,3 TO 245,4 TO 246,5 TO 246,6 TO 247,5
TO 249,5 TO 250,6 TO 253,6 TO 252,7 TO 253,7 TO 253,9 TO 254,9 TO 254,10 TO 251,
10 TO 252,9
660  HPLOT  TO 252,7 TO 253,6 TO 253,2 TO 254,2 TO 255,0
670  HPLOT 29,9 TO 28,9 TO 27,8 TO 27,7 TO 25,7 TO 25,6 TO 24,5 TO 23,5 TO 21,7
TO 23,9 TO 21,9 TO 21,10 TO 19,10 TO 18,12 TO 16,12 TO 16,13 TO 13,13 TO 14,12 T
O 13,11
680  HPLOT  TO 14,10 TO 14,8 TO 16,6 TO 17,6 TO 18,5 TO 17,4 TO 15,6 TO 15,5 TO
13,7 TO 13,8 TO 12,9 TO 12,10 TO 11,10 TO 11,12 TO 9,12 TO 8,13 TO 8,14 TO 10,14
 TO 10,15
690  HPLOT  TO 9,16 TO 9,18 TO 5,20 TO 5,21 TO 0,23
700  HPLOT 158,150 TO 158,151 TO 159,152 TO 160,152 TO 160,153 TO 161,153 TO 162
,154 TO 162,155 TO 163,155 TO 164,156 TO 164,157 TO 165,157 TO 166,158 TO 166,15
9 TO 175,159 TO 176,158 TO 177,159 TO 180,159
710  HPLOT  TO 180,158 TO 179,158 TO 178,157 TO 177,157 TO 176,156 TO 174,158 TO
 173,158 TO 172,159 TO 171,158 TO 170,158 TO 168,156 TO 168,155 TO 166,153 TO 16
7,152 TO 167,150
720  HPLOT 143,9 TO 143,6 TO 144,5 TO 144,4 TO 147,1 TO 146,0
1000  FOR I = 18.8293539 TO 270 STEP 22.35294
1005  FOR J = 0 TO 159 STEP 5
1010  HPLOT I,J
1015  NEXT
1020  NEXT
1030 Y(2) = 49:Y(3) = 81:Y(4) = 108:Y(5) = 133:Y(1) = 10
1040  FOR I = 1 TO 5
1045  FOR J = 0 TO 279 STEP 5
1050  HPLOT J,Y(I)
1055  NEXT
1060  NEXT
```

bounds of the map, it draws the satellite path and range circle and displays the satellite name, orbit number, and mode of operation. The computer then requests the operator to press the space bar when the actual time of day matches that displayed on the screen (which is the time of Acquisition Of Signal—AOS). When that is done, the computer begins its real-time display procedure, during which it displays the current satellite position along the path, with a bearing line from the station to the current SSP, the time of day, the time remaining until Loss Of Signal (LOS), and current antenna azimuth and elevation figures. The computer updates all this information every minute until LOS.

If the high-speed graphics routine is selected, the computer performs basically the same operations as the real-time routine except that the speed of the updating is increased.

If the choice is made to display antenna direction data, then the Apple displays the azimuth, elevation, and associated time of day for each minute the satellite is in range.

The choice to display SSP data displays the time after EQX, time of day, and longitude and latitude of each SSP for each minute of the orbit.

The choice to display all orbits will display the same list of data for all the orbits for the day selected.

If you choose to compute another orbit, the program retains all satellite parameters and displays the orbit list, allowing the operator to select another one of the orbits for that day.

Choosing to restart clears all variables and starts the program over from the beginning.

Finally, a choice to quit will do just that, stopping the program immediately.

Program Structure

This program is constructed of fifteen separate software modules, each with a specific job as indicated below.

1000 Initiates all variables, arrays, constants, and functions.

2000-4000 Main routine.

5000 Determines the mode of operation for OSCAR 7 or 8. (OSCAR 7 is now out of operation, of course.)

1) Subpoint latitude

$LAT = \arcsin[\sin(inc) * \sin(360T/PER)]$

T = time after EQX

PER = period time

2) Subpoint longitude (Earth rotation is .25T)

$$LON = \arccos\left[\left(\frac{\cos(360T/PER)}{\cos(LAT)}\right) + (.25T) + L_{EQX}\right]$$

L_{EQX} = longitude at EQX

3) Distance from station to subpoint

$DIST = \arccos[(\sin(A)\sin(B) + \cos(A)\cos(B))\cos(L)]$

A = LAT of first point (station) (+ 90° to − 90°)

B = LAT of second point (SSP) (+ 90° to − 90°)

L = LON of first point − LON of second point

DIST units is in great circle arc degrees radians

4) Bearing from station to subpoint

$$BNG = \arccos\left[\frac{\sin(B) - \sin(A)\cos(DIST)}{\cos(A)\sin(DIST)}\right]$$

If L in formula 3 was negative then the bearing = 360° − BNG

5) Elevation to satellite

$$ELEV = 90 - \arctan\left[\frac{H \times \sin(DIST)}{H \times \cos(DIST) - 3957)}\right]$$

H = Earth radius + satellite altitude

6) Distance to satellite

$$RNG = \left[\frac{H \times \cos(DIST) - 3957}{\cos(90 - ELEV)}\right]$$

RNG is in statute miles

7) AOS/LOS range (horizon of satellite)

$$D = \arccos\left(\frac{R}{H}\right)$$

R = Earth radius (3957 miles); D is in great circle degrees

8) $$PER\ time = \left(2\pi \times \sqrt{\left(\frac{(H)^3}{9.56 \times 10^4}\right)}\right) /60$$

PER is in minutes

9) $$\text{Precession of Earth per orbit} = (PER \times .25)° \left(\frac{360°}{1440min}\right) = .25$$

10) Orbits per day = 1440/PER

Fig. 2. Formulas.

SD(1) = station latitude
SD(2) = station longitude
RC%(1,36) range circle plotting points; RC%(0,X) = Y coordinate;
RC%(1,X) = X coordinate
AE(0) = orbit#; AE(1) = time of EQX; AE(2) = EQX longitude
AF(2,B) data for orbits for the day requested
AF(0,X) = orbit#; AF(1,X) = time of EQX; AF(2,X) = EQX longitude
B = no. of orbits per day
SSP(5,PER) = subsatellite point data for orbit
SSP(0,X) = time of day; SSP(1,X) = LAT; SSP(2,X) = longtitude;
SSP(3,X) = distance
SSP(4,X) = azimuth; SSP(5,X) = elevation
PER = satellite orbital period in minutes
X—denotes each minute of orbit
Latitude & longitude are in radians
Distance is in great circle radians
Azimuth and elevation is in radians
L%(53) map latitude to Y coordinate-conversion constants
MC%(1,53) = satellite path plotting points
MC%(0,X) = X coordinates
MC%(1,X) = Y coordinates
D1$ to D7$ = days of week D1$ = "SU"; D2$ = "MO"; etc.
M1$ to M5$ = OSCAR operating modes
AS(1) = time of acquisition of signal (UTC); AS(2) = time after EQX(min)
for AOS
LS(1) = time of loss of signal (UTC); LS(2) = time after EQX(min)
for LOS
TR = time in range (LS(2) − AS(2))
AG = selected orbit
R1 = 1.5708; R2 = 3.14159; R3 = 4.7124; R4 = 6.2832; R5 = 57.296;
R6 = .01745; R7 = 3957; R8 = 1440; R9 = 111.12
MO$ = OSCAR mode of operation—made up of M1$ to M5$
DA$ = day of week
DT$ = date of orbit (MM/DD/YY)
OS% = satellite selected
OS$ = satellite name
ALT = satellite altitude in statute miles
INC = satellite orbit inclination (in radians)
C = satellite precession degrees per orbit (in radians)
D = satellite horizon (in great circle radians)
D$ = control (D for DOS)

Fig. 3. Variables, arrays, and constants used in OSCAR Pathfinder.

6000 Lists the orbits and EQX data for all orbits of the day.

7000 Computes SSP data. This is the main math routine. It computes the time of day for each point, stored in array SSP(0,I); latitude, stored in SSP (1,I); longitude, stored in SSP (2,I); distance from station to subsatellite point, stored in SSP(3,I); and true bearing from station to subsatellite point, stored in SSP(4,I) for each minute of the orbit. It checks to see if the satellite is in range and, if it is, it computes the elevation, stored in SSP(5,I), and sets up pointers to AOS and LOS time. "I" in the arrays corresponds to the time in minutes after EQX. The subroutine also checks to see if the satellite path will take it within the bounds of the map and, if it does, it sets up pointers to when it enters and leaves the map bounds (YA and YB). Finally, it computes the time in minutes that the satellite is in range.

8000 Used to input reference orbit data: orbit number, time of day of EQX, and EQX longitude.

9000 Computes X,Y coordinates for the range circle to be displayed on the map.

9500 Draws the range circle on the map.

10000 Draws the satellite path on the map.

10500 Computes X,Y coordinates for drawing bearing lines from station location to each SSP. Stored in MC%(0,I) and MC%(1,I).

11000 Converts longitude and latitude figures to X and Y coordinates.

12000 Converts time in the form of hours, minutes, and seconds to the form of minutes after midnight.

12500 Converts time in the form of minutes after midnight to hours, minutes, and seconds.

13000 Accepts data needed to compute orbit data for satellites other than OSCAR. Satellite altitude, inclination, and name must be entered.

The formulas used in these routines are detailed in Fig. 2. The major arrays and variables being used are detailed in Fig. 3.

Have Fun!

I hope you can make some use of this program as I have. I have been using it regularly to predict OSCAR positions and I've also used some of the techniques in other programs.

If you really want to get OSCAR Pathfinder running with the least amount of effort, you can send me $15 and I'll ship you a disk with everything on it ready for turnkey operation. If you have any questions that I haven't answered here, send me an SASE and I'll see if I can help you out. Have fun! ■

References

1. "Track OSCAR With Your SR-52," Art Burke W6IX, *73 Magazine*, November, 1977.
2. "Track OSCAR 8," Kazimierz J. Deskur K2ZRO, *73 Magazine*, November, 1977.
3. "Tracker—The Ultimate OSCAR Finder," Bruce Nazarian WD8DRK, *73 Magazine*, January, 1981.
4. "Orbits and Revolutions," *NASA Facts*, NASA.

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Which TVRO Antenna Is Best?

—Satellite Central, part IV

In the past few months, I've received dozens of letters from hams wanting to know which antenna is best. Since it's easy to get stung, you must know what to ask for and, in many cases, to demand!

The $100 Receiver!

December's mail was heavy, mostly due to my mention of the $100 receiver design by Rex Roads. Well, Rex is busy cleaning up the drawings and we have a complete construction article planned for late spring. In the meantime, start looking for a site for your $100 dish. We've got one of those coming, too.

Let's cover the kinds of antennas you'll likely find in TVRO service and then move on to selection tactics in my next article. All things considered, you need about 40 dB antenna gain at 4 GHz for domestic birds, with more gain necessary as you move off the prime coverage footprints.

The situation is aggravated by the need to shield the antenna from noise on all sides except the main lobe. Down in the dc bands, antenna side-lobe response is usually something you ignore unless you want maximum efficiency or enjoy climbing the tower to prune beam elements! You must pay attention to this problem in TVRO work because the signals you want are well below the terrestrial noise floor in the vicinity of the antenna. Typical signal levels are 30 dB *below* the surrounding noise. It's like trying to hear a normal conversation in a room full of people shouting at you! More gain won't help.

The solution is to build a dish reflector large enough to produce a very narrow beamwidth. Then use some plumbing in the form of a feedhorn to channel the signal to a shielded monopole antenna probe. Several antenna designs can be used. All of them work, but you must study them carefully.

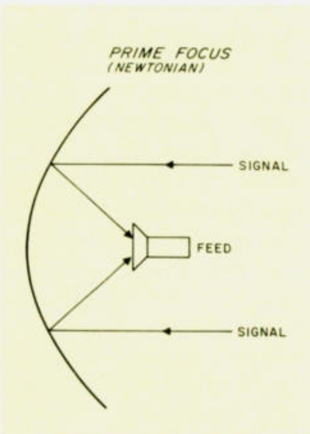

Fig. 1. The prime-focus design uses a parabolic reflector to concentrate the signal from the satellite into a small area known as the focus point. The accuracy of the dish surface to a true parabolic curve governs the size of the focus point and placement of the feedhorn.

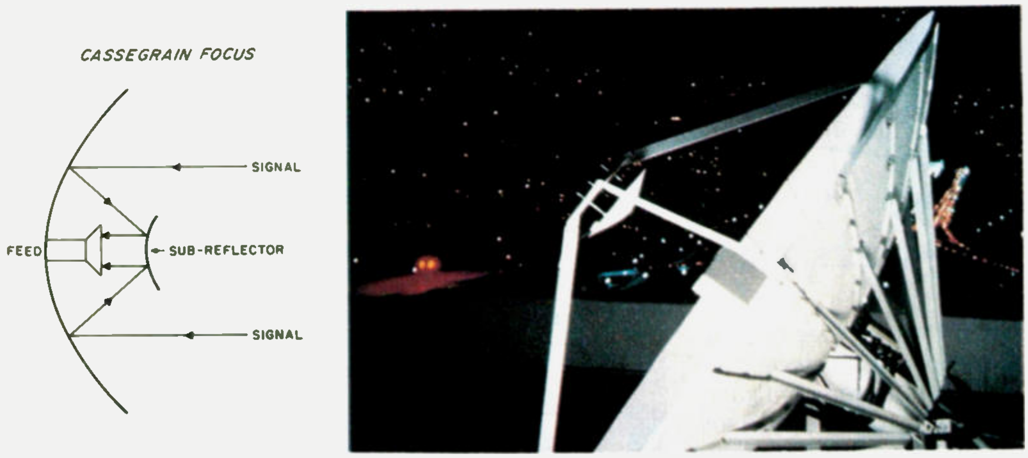

Fig. 2. The Cassegrain or twin-reflector design offers increased efficiency, but there are limits. As a rule, Cassegrains must be larger than ten feet before you can derive any benefit because the subreflector blocks a significant portion of the signal from ever reaching the dish.

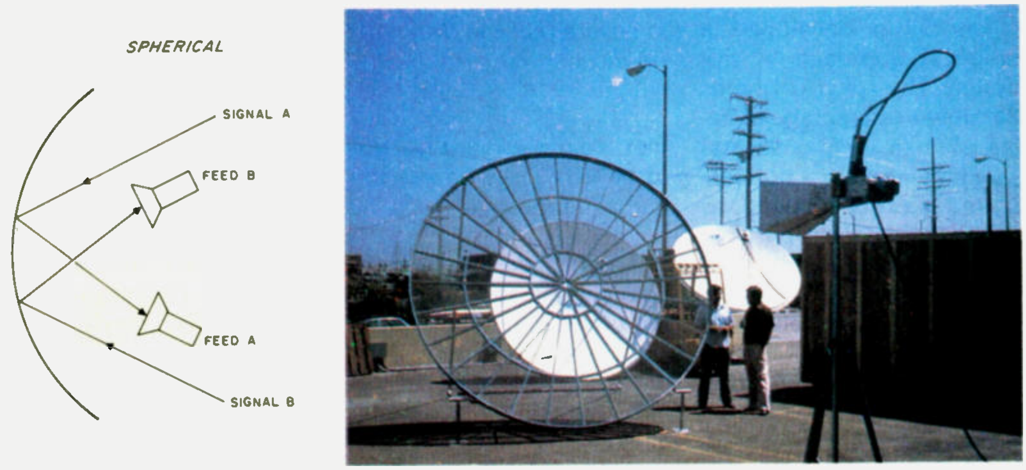

Fig. 3. Carve out a piece from a very large metal ball and you have the spherical antenna. It is possible to receive several satellites at once using separate feeds or you can simply mount the feed and LNA on a tripod and move it from satellite to satellite.

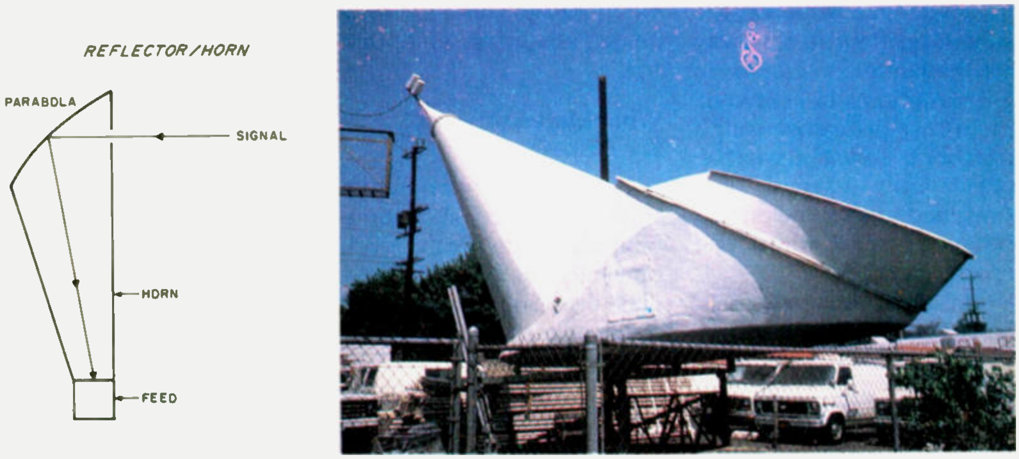

Fig. 4. The horn/reflector antenna is just a segment of a parabola fed by a very long horn. It has been in use for many years by A.T. & T. and other terrestrial microwave users. This design is considered by many as the ideal solution to high gain and low side-lobe response.

A Tempting Menu of Dishes

The prime-focus design seen in Fig. 1 is by far the most popular TVRO antenna today. The surface is formed into a parabolic curve so that the reflected signal travels the same distance to the focus point where it enters the feedhorn opening. The distance from the reflector to the focus point is referred to as the focal length. The formula for a parabola is available out of many trig or calculator instruction books. It is easy to apply the formula to a wood or masonite template and to build a working dish from wood and window-screen material in a few evenings. Prime-focus dishes are simple to build, and they may have very good side-lobe properties if you are careful with construction and feed selection.

Next, we have the Cassegrain, or two-reflector, dish seen in Fig. 2. Most commercial satellite stations use this design because overall efficiency can be improved by additional contouring of the hyperbolic subreflector and, in some cases, modifying the curve of the main reflector. Cassegrains can have very good directivity and may, with very special design, achieve low side-lobe response as well as greater gain than equivalent-sized prime-focus models. This slight advantage is due in part to the longer focal length and reduced area presented to the feed.

Building a Cassegrain may be harder because you now have two reflectors that must be in perfect alignment before the signal can reach the feed. That is, the focus point of the main reflector (parabolic) must coincide with the back focus point of the subreflector (hyperbolic). As a rule, Cassegrain subreflector sizes are between 10 and 20 percent of the diameter of the main reflector, but the main reflector must be larger than ten feet before you can derive any benefit. So the subreflector presents a real problem since it blocks a significant portion of the signal from ever reaching the dish! This phenomenon is known as aperture blockage and is the one factor that keeps the Cassegrain from becoming popular in dish sizes below 4 meters.

Perhaps the most interesting style in use today is the spherical antenna. The late

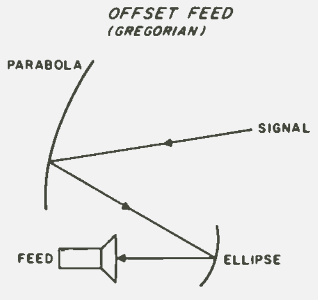

Fig. 5. The offset feed dish is similar to the Cassegrain in the two-reflector configuration, though single-reflector versions are also used. Side-lobe response is greatly improved because of a lack of aperture blockage.

Fig. 6. Nearly ideal reflector surfaces are possible when flame-spraying is applied to fiberglass dishes. Care must be used in the coating as well as curing time for the resin to ensure that the dish will follow the proper curve within 1/8 inch.

Oliver Swan developed a practical approach to this design. The spherical holds the unique advantage of being able to receive several satellites at once—but separate feeds are required, as shown in Fig. 3. It is possible to place a spherical so that it can see almost a 40-degree arc of the Clarke belt. Then you simply move the feed in an arc to move from satellite to satellite.

The spherical looks almost like a flat plate or a very long focal length parabola. Mere inches keep either statement from being true. Despite the hassle of poor side-lobe response, the spherical offers an easy way for the home constructor to get his antenna built at minimum cost. Instead of using a parabolic curved template, one simply uses a wire stretched from some distant radius point to adjust and check accuracy.

Ma Bell, on the other hand, has a lot of experience with 4-GHz signals. Her horn/reflector, or Hogg horn (named after one of the inventors), is shown in Fig. 4. This design embodies high gain and excellent side-lobe response. It's just about the only style that will work in a metropolitan area where interference is rampant. Unfortunately, the Hogg is a beast to mount! A typical 4.5-meter-aperture unit may have an overall length of 34 feet. Your backyard has got to be very large or else the barbecue must go!

Another design used in commercial applications is the offset parabolic seen in Fig. 5. The feedhorn does not get in the way of the signals, thus improving the gain and reducing side lobes. The modified torus is finding use in cable TV and military installations where several signals may be needed with about equal efficiency. Each design has its own unique advantage and price tag!

What Materials Work For Dishes?

Just about any reflective surface will work, but some obvious concern can develop when you look at a fiberglass dish. Some designs use mesh or sheet-metal reflectors imbedded in the fiberglass. Others may use a metal film applied by a technique known as flame-spraying—as seen in Fig. 6. Flame-spray may improve the accuracy of the dish geometry, but there is no easy way to know how well the coating was applied. It's easy to get sloppy. I've tested dishes where large sections had no reflective properties at all!

On the other hand, a dish constructed of mesh screen may not follow a parabolic or spherical curve over the entire surface. This is especially true of window-screen designs. The mesh bends easily and must be applied in flat sections. Despite the claims of many manufacturers, a flat section cannot possibly work as well as one which follows a parabolic or spherical curve. Why, then, do some mesh dishes work? The secret is simply in the number of sections used. More sections come closer to the overall desired curve. Interestingly enough, gain loss is not the big problem with window-screen designs. Using fewer sections affects the side-lobe response of the dish more than it does the gain!

How big can the holes in the mesh be? Good question. Logically, they must be big enough to appear as a reflective surface to the wavefronts. If we go back to the books, we can think of the holes as waveguides beyond cutoff and simply make them progressively smaller until microwaves don't slip through. The bottom line is about 1/8-inch-diameter holes. Anything larger does not reflect nearly as well.

Solid spun-metal dishes are by far the best. Their accuracy and reflective properties outweigh their unwieldiness. The only catch is that large spun dishes are nearly impossible to find. The surplus market top-ends at the ten-foot mark.

The next best bet in materials is metal petals. They reflect just as well as anything else, but you must use care during assembly or they may not accurately follow the dish curve. Bending, twisting, and sweating are normal occurrences when you try to put one of these types together!

What About Feedhorns?

Fig. 7 shows some typical feedhorns. Their primary purpose is to efficiently couple most of the signal bouncing off the reflector into the LNA. But therein lies the problem and perhaps the first place you may want to try to improve basic TVRO-antenna design. You see, the feedhorn, like the dish, has its own sensitivity pattern, too. Like any antenna, they are most sensitive on axis, tapering off at the sides. The key to feed efficiency is in the taper. Remember, we want to receive a signal that is well below the terrestrial noise floor. And the feed overshoot seen in Fig. 8 would indeed intercept the noise we want to reject.

So what do you do if all feeds overshoot? The trick is in finding a happy medium of gain and efficiency versus noise intrusion. Let's assume for the moment that the feed is designed to taper off sensitivity so that the edges of the main dish reflector just intercept the 10-dB points on the feed pattern. Visualize the situation where the feed is most sensitive to signals bouncing off the center of the reflector, but less sensitive to signals at the edges. This problem has kept feed designers working in the wild quest for the ideal curve seen in Fig.

Fig. 7. Feeds may take on various shapes, but their sole purpose is to properly illuminate the dish. I had a chance to test several of the feedhorns sold today. My spectrum analyzer showed a drastic difference in gain and efficiency on my particular dish, so feed matching to the dish is important.

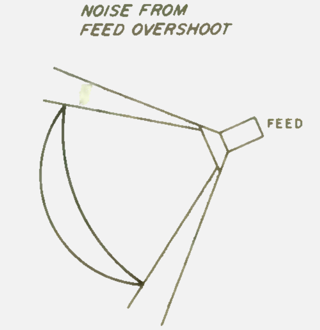

Fig. 8. Better efficiency achieved by a broader feed beam will only cause overshoot and increase intercepted terrestrial noise. The best compromise is about a 10-dB drop at the edge of the dish. A metal shroud around the rim of the dish can block some noise seen by the feed.

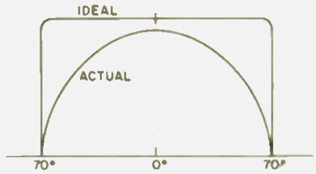

Fig. 9. Typical feed-pattern sensitivity just covers the dish at the 10-dB points. This means that the dish is less efficient at the edges. Nearly 100 percent antenna efficiency would be possible if you could achieve the ideal curve and still eliminate feed-phase taper, aperture blockage, and reflector-surface errors.

9—one that tapers off like a steep ledge rather than a rolling hill.

Perhaps the most interesting outcome from recent feed design advances has been the radical departure from the classic flared waveguide approach. Look at any dish and you will realize that because the dish is circular, the wavefront reflected into the feed will be also! So "circular-to-waveguide" transitions in feed are becoming the rule rather than the exception.

This deviation from the classic rectangular feed can boost overall antenna efficiency to nearly 60 percent. Is that all? Higher efficiency is possible and, in fact, within reach if you can make better use of the surface near the edge of the dish. The two-reflector, or modified Cassegrain, design is a step in that direction. But the problems of proper amplitude illumination and equal phase paths over an unobstructed reflector aperture are still there. For the moment, it appears that matching a feed to a dish is like fitting a round peg in a square hole. A hammer won't help! ■

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If you liked our low-noise amplifier article in the February, 1982, issue of *73* ("Job's Own LNA"), you will love our no-alignment downconverter.

This downconverter can be built by an average technician and the parts are readily available. The local oscillator (LO) and the mixer are commercial units manufactured by Magnum Microwave Corporation of Sunnyvale, California. The design features a dc block for feeding power to your LNA, and it can be built for less than $225. With this downconverter, an LNA, and a good antenna, you can receive noise-free pictures from the satellites.

The converter takes the 3.7-to-4.2-GHz signal from the LNA and converts it to a 70-MHz i-f signal. The design features single conversion for simplicity and ease of duplication. The local oscillator is voltage-tuned, and there is no alignment required. You put the parts on the board, mount it in the box, power it up, and watch the birds! How simple can you get?

Circuit Description

Refer to the schematic, Fig. 1, and to the PC-board layout and parts placement overlay for the following discussion. The complete downconverter is constructed on a 2" by 4" teflon PC board, 1/32" thick. Impedance matching is achieved by using microstrip transmission lines. To supply dc power for the LNA, a dc block is incorporated on the board. This lets the coax from the LNA supply the LNA's required operating power. The dc feed is accomplished very simply by supplying the +18 to +22 volts that powers the downconverter to the rf input through an rf choke. The dc side of the choke is bypassed for rf with a 1000-pF chip capacitor.

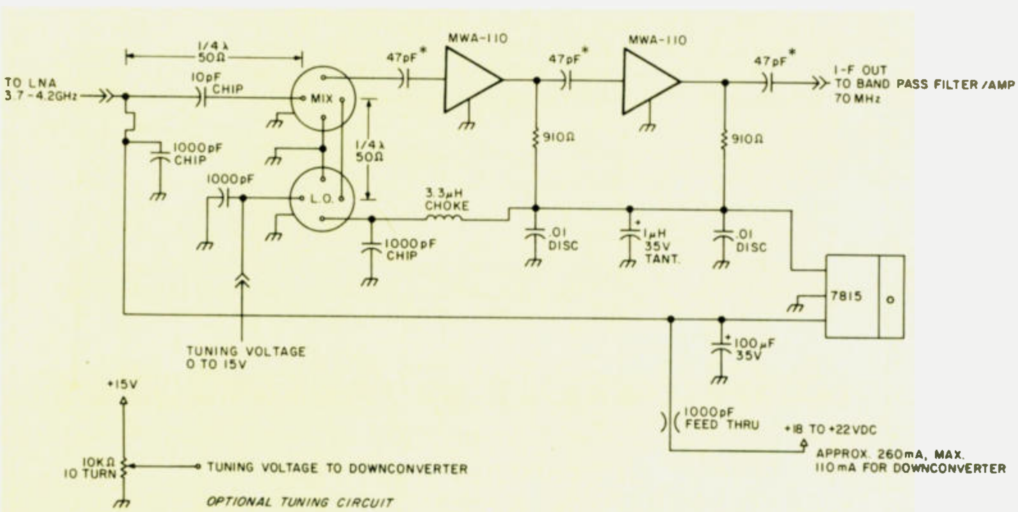

*Fig. 1. Satellite downconverter schematic. * = chip or disc ceramic.*

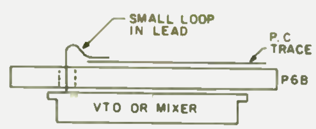

Fig. 2. Mixer and vto lead bending and soldering instructions.

The 4-GHz input is ac-coupled through a 10-pF chip cacpacitor to a ¼-wave, 50-Ohm transmission line going to the rf port of the mixer. Local oscillator injection to the mixer is also via a ¼-wave, 50-Ohm transmission line for impedance matching. The i-f port of the mixer is ac-coupled to the first MWA-110 for approximately 14 dB of i-f gain, and then to the second MWA-110 for an additional 14 dB of i-f gain. The output of the downconverter feeds the 70-MHz bandpass filter in our home-brew receiver.

Construction

The first step in constructing the downconverter is to drill the 2″ by 4″ minibox using the drilling guide shown in Fig. 3. The bare PC board can also be used as a drilling template. Use ½″ standoffs to mount the board in the box. We used a type-N connector for the rf connection from the LNA. You also can use an SMA connector in place of the type-N with equally good results. BNC or type-F connectors are adequate for the LO tuning voltage and 70-MHz i-f out.

Next, install the two MWA-110 i-f amplifier ICs on the printed-circuit board. Be sure that they are flat against the ground-plane side of the PC board. Solder the tabs on the 110s to the ground plane, cut the leads to 1/8″, bend them flat against the PC board, and solder. Now install the mixer and local-oscillator modules. Be sure that the ground pins are in the correct holes on the PC board, or you will wind up with some expensive but useless trinkets.

Caution: Do not cut the pins on the modules. Bend the pins in a small loop over to the PC board and solder. (See Fig. 2.) Solder the pins to the PC-board trace using as little solder as possible. Install and solder the six feedthrough jumpers, using pieces of cut-off resistor leads, and solder on both sides of the board. Now install the rest of the components, except for the 3.3-uH choke.

After construction is complete, check for solder bridges. Temporarily connect the +18 to +22 volts to the dc input of the voltage regulator. Measure the output voltage to see that the voltage regulator is working. The output should be +15 volts. Measure the voltage drop across the 910-Ohm resistors; it should be 2 to 3 volts. If it's not within the range, then you probably have a bad MWA-110 (we have found several). If the voltage drop measures OK, remove power and discharge the electrolytic capacitors. Now install the 3.3-uH choke. This completes the PC-board assembly. The next step is to install it in the minibox.

Depending upon the type of rf connector used, N or SMA, it may be necessary to solder extension leads to the PC-board pads to reach the connectors. Be sure that when the extension leads go through the PC board they do not short out to the ground-plane side. Solder the four leads (three from the connectors and one from the 1000-pF feedthrough capacitor) to the appropriate points on the PC board as shown by the parts overlay.

PC BOARDS

Etched and drilled teflon printed circuit boards for the downconverter are available for $27.00, plus $1.50 for handling and postage, from Mart-comm, Inc., PO Box 74, Mobile AL 36601.

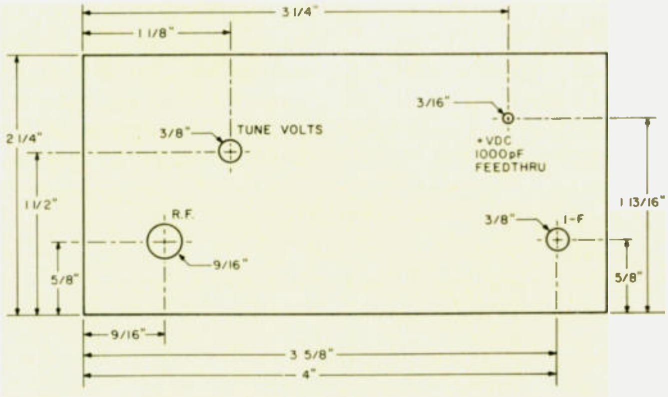

Fig. 3. Drilling template for 2″ by 4″ minibox.

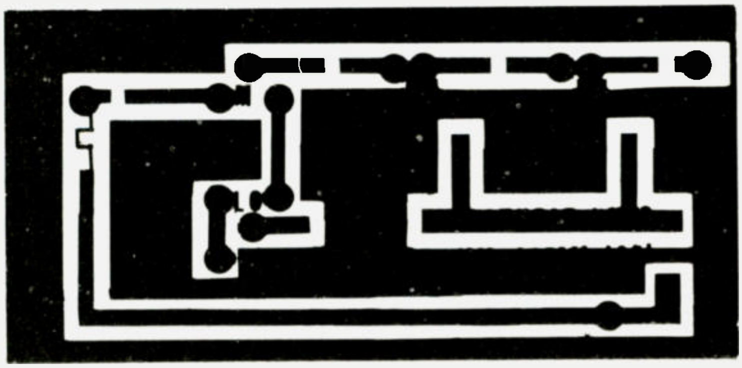

Fig. 4(a). Foil side view of board.

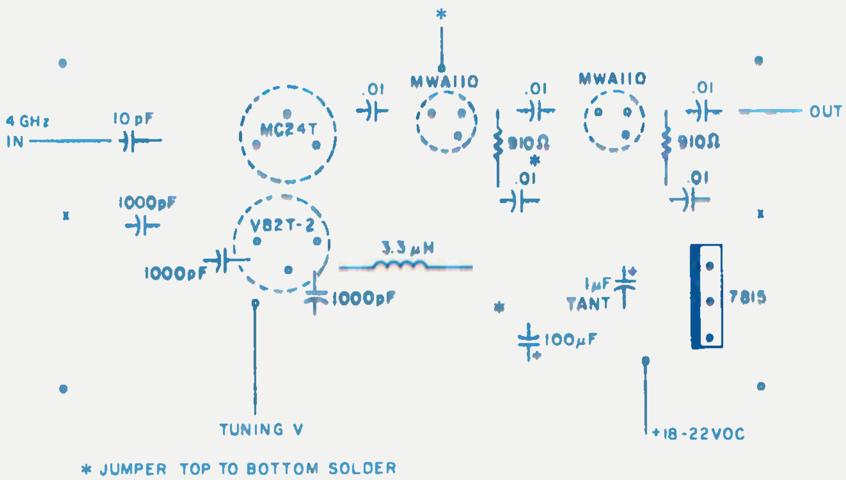

Fig. 4(b). Parts placement, foil side view.

Checkout

If your antenna and LNA have been completed, you will be able to check your system through the i-f output of the downconverter. With your LNA and downconverter connected to your antenna, apply power. Connect the output of the downconverter to the antenna terminals of a *conventional* color-TV receiver, with the TV tuned to any unused low channel between 2 and 5. If possible, connect a voltmeter to the agc line on the TV set tuner. The agc voltage can give a very useful indication of proper aiming and adjustment of your satellite TV antenna.

With the optional tuning circuit (Fig. 1) connected to the tuning voltage input of the downconverter, transponder 1 tuning voltage will be about 4 volts. To tune transponder 24, you will need about 12 volts. You should be able to tune in most transponders over the 4-to-12-volt range. Also, you should get an indication of video on the color-TV set when a transponder is tuned in. The video will be of very poor quality since the satellite signal is frequency modulated while the conventional terrestrial TV signal is amplitude modulated. You should still be able to recognize the pictures, however. Sync will be very critical and you probably won't be able to sync on all transponders.

That's it! The rest of your TVRO receiver is cheap and simple, as we will show you in future articles. ■

Parts List

Quantity	Description
1	MC24T mixer module (Magnum Microwave)
1	V82T-2 local oscillator module (Magnum Microwave)
1	10-pF chip capacitor
2	1000-pF chip capacitors
3	50-pF disc ceramic capacitors
2	.01 disc ceramic capacitors
1	1-uF, 35-V tantalum capacitor
1	100-uF, 35-V electrolytic capacitor
1	1000-pF feedthrough capacitor (mounted on minibox)
2	910-Ohm, ½-Watt resistors
1	10k-Ohm, 10-turn pot (optional tuning circuit)
1	3.3-uH choke
2	MWA-110 ICs
1	7815 voltage regulator
1	2" by 4" minibox
	Rf connectors, hardware, etc.

The Magnum Microwave MC24T mixer module, the V82T-2 local oscillator module, the MWA-110s, chip capacitors, and the rf connectors are available from Cliff Jones at Alaska Microwave, 4335 East Fifth Street, Anchorage AK 99504, (907)-338-0340, a regular *73 Magazine* advertiser.

Acknowledgments

We would like to thank the staff at Magnum Microwave for running tests on our prototype downconverter. The measured down-conversion gain was 21 dB with 4-GHz input. At −20-dBm and −40-dBm input, the second harmonic of the 70-MHz i-f was −25 dBc and −50 dBc, respectively. Magnum also confirmed our discovery that the MWA-110 will oscillate if not properly grounded. The above specs were furnished to us by Magnum Microwave and are quoted with their permission.

SOCIAL EVENTS

PHILADELPHIA PA
MAR 7

The Penn Wireless Association, Inc., will hold its Tradefest '82 on Sunday, March 7, 1982, at the National Guard Armory, Southampton Road and Roosevelt Boulevard (Rte 1), 2 miles south of exit 28 on the Pennsylvania Turnpike, Philadelphia PA. General admission is $3.00 and a 6'×8' seller's space is $5.00 (bring table) with an additional $3.00 for a power connection (limited number). There will be prizes, displays, refreshments, rest areas, and surprises. Talk-in on 146.115/.715 and .52. For additional information, contact Mark J. Pierson KB3NE, PO Box 734, Langhorne PA 19047.

EAST HARTFORD CT
MAR 11

The Hartford County Amateur Radio Association will hold its annual auction of used equipment on March 11, 1982, at 7:30 pm at the Veterans Memorial, Sunset Ridge Road, East Hartford CT. Refreshments will be served.

MERRIMACK NH
MAR 13

The Interstate Repeater Society, Inc., will hold its annual hamfest and flea market on Saturday, March 13, 1982, from 9:00 am until 4:00 pm at the Merrimack Hilton Hotel, Merrimack NH. Admission is $1.00 and tables are $10.00. Features will include commercial vendors, prizes during the day, and a dinner dance with live music and entertainment. Talk-in on 146.25/.85 and 146.52. For further information, contact Ken Soares N1BAD at PO Box 94, Nashua NH 03061 or on .25/.85.

MIDLAND TX
MAR 13-14

The Midland Amateur Radio Club will hold its annual swapfest on Saturday, March 13, 1982, from 8:00 am until 6:00 pm, and on Sunday, March 14, from 8:00 am until 3:00 pm, at the Midland County Exhibit Building east of Midland TX on the north side of Highway 80. Registration is $5.00 in advance or $6.00 at the door. An additional $3.00 will be charged for each table. There will be door prizes. Talk-in on 146.16/146.76 and 146.01/146.61. For more information, write the Midland Amateur Radio Club, Box 4401, Midland TX 79704.

LAFAYETTE LA
MAR 13-14

The Acadiana Amateur Radio Association will sponsor the

Continued on page 104

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TVRO Q & A

—advice from WB0POP

Ken Rae WB0POP
737 South Clarkson
Denver CO 80906

I want to build a TVRO. What is the first step?

Most people get started by acquiring an antenna. You can buy a commercial antenna or you can build your own dish. If you buy, plan on spending $1000 or more. Building your own is cheaper, but it can take considerable time and energy. Plans are available from several sources, but don't expect to get a world of information from a $10 brochure. It takes a lot of research and study since there is no one source for all the information you need.

How can I get a picture for the lowest possible cost?

If you are not concerned about the quality of the picture, then all you'll need is an antenna, a low-noise amplifier (LNA), a mixer, and a conventional television receiver. With just these components you'll be able to say that "I received satellite TV." Since the TV receiver acts as a slope detector, the video will not be clear or stable, but this low-cost approach will get you started.

What about kits?

Kits are available for each part of an Earth terminal, but the best way to describe this part of the industry is "buyer beware." Try to find someone who has successfully completed the kit before you take the plunge.

What size dish do I need?

The size of antenna depends on the quality of the LNA, the strength of the satellite "footprint" in your location, and the desired signal-to-noise ratio. You can get watchable video from an eight-foot dish, but the 10-foot dish seems to be the industry standard for home TVROs.

Why are 10-foot antennas so popular?

A 10-foot dish is usually the minimum size that is practical for receiving good quality pictures in most locations in the US. You can use a smaller antenna, but the need for a better quality LNA may boost the overall cost higher than what you would spend for a 10-foot system.

What is the smallest dish I could use?

If you are willing to settle for audio only, a four-foot diameter antenna supposedly works. A six-foot antenna might give you a faint video image if everything else is perfect.

How much should a 10-foot dish weigh?

At one extreme there is an umbrella-type antenna that weighs only 22 pounds. On the other end of the scale there are heavy-duty antennas that weigh half a ton or more. The average weight of a fiberglass or spun-aluminum dish is in the neighborhood of 200 pounds.

Should I get a spherical or parabolic antenna?

The parabolic is my choice because it's versatile. You can sweep the antenna across the sky, making it easy to change to a new satellite. The spherical is a good antenna from a construction viewpoint. Unfortunately, changing satellites involves moving the feedhorn, which is usually six to eight feet above the ground.

Someone told me that I should build a spherical dish because it exhibits more gain than a parabolic antenna. Is this true?

The gain of spherical antennas is indeed greater because the dish has a flatter surface. However, the flat curvature means that the spherical will pick up more unwanted noise. The parabolic has slightly less gain but more noise immunity. You must consider both noise and gain characteristics when choosing an antenna.

How can I tell if a dish is a parabolic or spherical?

A parabolic dish will tend to look flatter as your eye moves toward the edge. The spherical antenna has a constant curve, rounded all the way to the rim.

I found a surplus dish. How can I tell if it is too deep or too flat?

You want to check the focal-distance-to-diameter ratio, F/D. You can find the focal point by using the equation $D \times D/(16 \times H)$, where D is the diameter and H is the depth. The F/D should be between 0.35 and 0.55 with 0.4 being about best. Ratios out of this range will not have the optimum noise versus gain characteristics.

I have found a dish but it has some dents and holes. Will that affect the performance?

A 10-foot dish has approximately 78 square feet of reflective surface area, so a few imperfections won't cause a problem. You probably can afford to lose as much as 5% of the surface area.

How smooth does the surface of the dish have to be?

The accuracy of the antenna should be plus or minus a sixteenth of an inch of the parabolic curve if you expect a reasonable level of gain.

I am trying to choose between buying a 10-foot dish made for TVRO work and a surplus 16-foot antenna. The price is about the same; wouldn't the 16-footer be a better deal?

It depends upon their quality. Often a surplus dish that was not designed for use with 4-GHz signals will be inferior to a smaller, better constructed antenna. Check the surface accuracy of both antennas. Anything more than an average inaccuracy of an eighth of an inch means that gain will be adversely affected. If the big dish meets the requirements for 4-GHz operation, then by all means grab it.

How important is the structural strength of a antenna?

A dish that can stand on its own rim and still hold the parabolic shape within an eighth of an inch is not likely to be harmed by weather. Anything weaker is questionable.

The area I live in has a lot of wind. What can I do to avoid losing my antenna?

To avoid having an airborne dish, I fastened a cable around the rim and attached it to a deadman anchor.

Screen antennas seem easy to build. How large can the holes in the mesh be?

A quarter-inch hole is about the largest gap you can have without an appreciable amount of the signal feeding through. An eighth of an inch is a good choice. Window screen can be used, but it does have a lot of wind resistance.

Is it necessary to solder every joint in a screen reflector?

If the sections of mesh or screen overlap each other by at least one wavelength (approximately three inches), the seams will not cause a dead spot. If there is not enough overlap, there should be some sort of electrical bonding.

What do trees and shrubs do to the satellite TV signal?

Foliage acts as a sponge that absorbs microwave signals, and it generates noise that will be picked up by the antenna. Trees and shrubs have a destructive effect and should be avoided when you choose a site for the antenna.

What effect do rain and snow have?

Precipitation doesn't seem to have much effect on a 4-GHz signal—perhaps half of a dB at most. If the moisture gets inside of the electronics, there can be significant attenuation. Powdered snow can pile up in a dish without causing a problem. But if the snow melts and refreezes, the surface of the dish can be distorted, causing the signal strength to drop. You should keep your antenna clear of ice and snow.

My neighbors complain about the appearance of my TVRO antenna. Can I cover the dish without adversely affecting the signal?

A thin covering of plastic or fiberglass can be used without too much signal attenuation. Avoid a covering made from wood or other material that contains moisture.

Will my dish work inside a barn or garage?

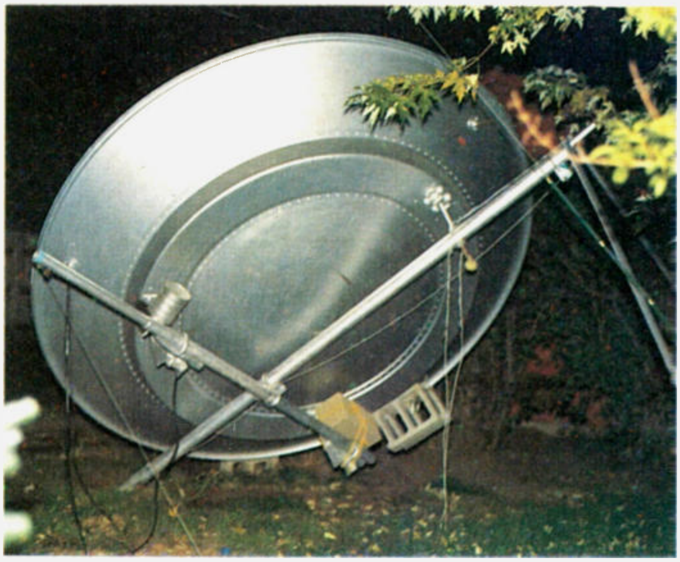
Yes, you can keep the antenna inside. Of course, the building will attenuate the signal. The exact amount of the loss depends on the type of building; it can be anywhere from two to six dB of attenuation.

I bought a used metal dish and want to paint it. Any suggestions?

Aluminum antennas can be painted with a good grade of latex house paint intended for house siding. Be sure to use a light color. Painting the dish black will result in the antenna absorbing heat, stressing the dish and changing the shape. The texture of the surface should be dull and flat, not shiny, since we want the light to be diffused instead of reflected towards the LNA. Follow the same guidelines for painting a wooden or fiberglass antenna.

How far above ground should I mount my dish?

The rule of thumb for dish installation suggests that the lowest edge of the dish should be located two or three feet above the ground. Setting the antenna directly on the earth will increase the amount of noise that enters the system. ■



I used readily-available materials to build this simple, yet effective, mount for my satellite TV antenna.

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Miss K. Rama
Post Box 725
Madras-600 006
India

Indian Hams Rejoice

—import restrictions lifted

Indian hams have achieved a breakthrough in their efforts to solve their problems of lack of equipment. The manufacture of communications equipment in India is the monopoly of the public sector (government-owned industries), which is itself lagging so much in production that it is unable to fully meet even the needs of the governmental users.

For several years, the Federation of Amateur Radio Societies of India had been making representations to the government, requesting relaxation of import controls without much success. The improvement in the foreign exchange position enabled the government to make concessions to certain users—among them scientists and professionals—who were allowed to import equipment valued at up to 10,000 rupees (about $1200 US) for their personal use. M.V. Chauhan VU2MV, Hon. General Secretary of the Federation, saw an analogy between the scientists and the hams. He convinced the Electronics Commission that the extension of similar privileges to amateurs was the only solution to the equipment problem.

Disaster can sometimes have a beneficial fallout. The communications link set up at Morvi by our hams (led by Saad Ali VU2ST, president of the Federation, Jimmy Mistry VU2IJ, and Vasant Bhat VU2RX) after a bursting dam had killed an estimated 30,000 in the span of a few hours cleared any lurking doubts in the mind of the government about the utility of ham radio to the nation.

Relentless representations to the various ministries by the Hon. General Secretary Chauhan and President Saad Ali finally resulted in the inclusion of radio amateurs in the category of scientists, and they were allowed the privilege of importing, under Open General License, test equipment worth up to 10,000 rupees in a year. There were more representations, and the momentous decision was announced which permitted the import of "amateur radio communications equipment, including kits, accessories (including antenna rotator motors, feedlines, standing wave ratio bridge), instruments, spares, and components" up to 10,000 rupees in a year, without the need for a formal license.

The Federation of Amateur Radio Societies of India is today a tower of strength to the Amateur Radio Service in India. Its QSL bureau handles the bulk of incoming and outgoing cards. *Radio,* the monthly journal of the Federation, edited by M.V. Chauhan VU2MV, is read by virtually every ham and SWL. The ARRL *Handbook* and other books have been imported and sold at a low price. A guide to amateur radio in India by Saad Ali has been published. The Federation's efforts have led to a breakthrough in making equipment available to Indian hams.

The Federation is not resting on its laurels. M.V. Chauhan is continuing his efforts to have the manufacture of ham equipment thrown open to private industry, so that equipment can be made available to the less affluent ham for prices expressed in hundreds of rupees rather than in thousands, which is the case with imported equipment. He believes another breakthrough is on the way, which will help amateur radio in India to become the hobby of the common man and not a monopoly of the affluent. ■

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Harry A. Schools KA3B/DA2AL
PSC Box 2713
APO New York 09109

Licensing for Americans Overseas

—classes help, but our government doesn't

In an earlier issue of *73 Magazine*, Wayne Green mentioned that he would like to hear what the amateur radio community was doing to get more people into the classrooms and on the air. At first, I thought of sending a letter to *73 Magazine* describing our current situation here in West Germany involving military personnel in regard to licensing classes. After pondering the idea for a few days, I decided that an article would be more appropriate.

The not-yet-licensed American civilian or military person abroad will, in many cases, encounter some problems that are unique, to say the least. But being a ham in the military has many advantages, such as the opportunity to operate from various countries of the world with reciprocal licensing. Unfortunately, getting that US license once an individual has been sent to a far corner of the world is sometimes difficult. But for those who are interested in obtaining their ticket, there is hope. Thanks to a crop of dedicated and hardworking hams scattered throughout worldwide military installations, amateur radio licensing classes are a reality.

Before I tell you about amateur radio classes and the people who teach them, let's take a look at why these individuals who aren't licensed desire their ticket. Actually, their reasons are no different than anyone else's. Basically speaking, they have a genuine interest in amateur radio. However, there are some underlying reasons which motivate these prospective hams.

First of all, it is a fact that a large number of newly licensed hams in the United States were once active on 11 meters. West Germany, like other countries in Western Europe, has a personal communications band on 27 MHz. Quite a few Americans come to Germany with their CB gear only to discover, to their dismay, that it's just as bad or even worse than back home. There are fewer channels, lower allowable output powers, monthly licensing fees, and severe overcrowding on the airwaves. Also, there is a language barrier because many 11-meter operators speak little or no English. It is a very disheartening situation, to say the least. Therefore, they have three options available. One, pack up the radio in its box and place it in the closet; two, stick it out on the band; or three, get an amateur license and talk to the world. I don't have to tell you that many choose option number three.

Secondly, many military members are met with the misfortune of having to serve at remote installations in places that you and I never thought existed. However, someone has to do it. In this case, amateur radio is a tremendous boost for one's morale.

And finally, there are those individuals who want the license only to talk with the family back home. I have run across several people whose parents were licensed but never did force the radio or electronics on them when they were growing up. Now they have the motivation and time they need to get that ticket. Besides saving on phone bills, writing letters, and waiting in line at the local MARS station, getting the license would please the heck out of Mom and Dad.

Although the reasons I have stated for military personnel and their families wanting an amateur license are generalizations, they are real. They are the sparks that ignite the fire . . . motivation is the key.

Once an individual has decided that he would like to pursue amateur radio as a hobby, his next step is to locate a licensed ham in the area for more information. Most larger military installations have active amateur radio clubs, but this is not always the case. Therefore, a check with the local MARS station is a good idea. If there isn't someone working there who is licensed, they will usually refer you to someone who is. What happens next? Well, if the military installa-

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tion itself and the surrounding community is saturated with a large number of Americans, chances are that some sort of licensing program exists. For the smaller installations, it's a somewhat different situation. There may be only one or two active hams, but in the spirit of amateur radio, they will undoubtedly be helpful and outgoing. One interesting point I should bring up here is that the *Stars & Stripes* bookstores overseas are usually stocked with the ARRL license manuals, *Radio Amateur's Handbooks*, and the latest copies of *73 Magazine*. Therefore, individualized study, reinforced with the tutoring and supervision of an Elmer, will usually reap good results. Individual study of a subject which is diversified and foreign to most people, such as amateur radio, is a major undertaking that requires considerable motivation and determination when no other help is available.

The military life-style can be more demanding than its civilian counterpart, and because of this, not every ham has the time for the individualized tutoring of an aspiring student. It's a sad fact of life. However, there are some hams who care enough to make time and are doing a great job of getting the newcomers started. What follows is one of many such success stories that are taking place in West Germany where an overwhelming number of American military and civilian personnel and their families live and work.

A Ham Who Cares

Hahn Air Base is located about 50 miles west of Wiesbaden. I arrived there on orders from Uncle Sam back in March of 1979. Before I even processed into my squadron, I dropped by the MARS station in hopes of locating another ham. The military operator on duty there directed me to Steve Hutchins, who was acting as a contact point for the hams. Steve was one of those individuals like myself who first started out with CB radio. He was first licensed in 1977 as a Novice, WD6BKA. Shortly thereafter, Steve upgraded to General and received the reciprocal call, DA2HS. During that first meeting we had together, he gave me the full rundown. There were 10 hams stationed at the base, but no formal club to speak of. One of those hams, Floyd Bixler WD8DUP/DA1VF, was teaching an amateur code and theory class every Sunday for several of the personnel stationed here. Floyd had to cancel his classes due to other commitments, but only after everyone had successfully passed the Novice examinations.

At this point, Steve took over the reins and put the word out through various channels that an amateur radio code and theory class would be starting. Steve was well qualified to teach due to his excellent working knowledge of electronics, something he never learned in school, but on his own in his spare time. Assisting Steve in the classroom was Bob Haggart, who was very knowledgeable in the radio and TV repair field and at that time was a Novice with the call KA3CSE. Steve also enlisted my help to teach propagation and regulations and substitute for him when it was impossible for him to be at class. Steve carefully planned the learning sessions so that the conclusion of the three-month class would occur just when the FCC was due to arrive.

The FCC travels to West Germany twice a year in order for American military and civilians to test for their amateur and commercial radio licenses. Steve's plan was to get everyone a Novice ticket at the end of the first month; then he could teach them the additional theory needed to pass the Technician exam.

A Novice license is of little or no value in some countries under current reciprocal agreements, but since Germany recognizes the interim permit issued by the FCC as being a valid license, when a Novice ham with a callsign upgrades, he is immediately eligible to apply for a reciprocal German license without waiting 6 to 8 weeks for a callsign and license from the FCC. But the pressure is really on to pass the exams, because if an individual fails this attempt at the examination, it is six long months before there is another chance to test. This is one of those unique problems that the American citizen abroad encounters. Many students of amateur radio lose their interest and bail out because of this unfortunate situation. More on this later.

Steve's first class had its share of students who dropped out for various reasons. Those who hung in there and worked hard upgraded to Technician or General. This is the only reward that a teacher can receive, and the majority of his students rewarded Steve generously.

An interesting point to bring up here is that the student of amateur radio in Germany has it a little bit rougher than the student back home. The reason is that everyone's aim is to achieve at least the Technician-class license because it gives more operating freedom under the German reciprocal agreement. Therefore, not only does the student have to be familiar with the US regulations for the test, but also with the German regulations if a reciprocal license is desired. When it comes to frequency allocations and authorized emissions, things can get very confusing, even for the old-timer.

Steve has no magic formula for teaching or recruiting people into amateur radio. Patience and determination are the virtues that produce results. Steve is not a one-man show or Super Elmer. He regularly invites other hams in the area to help him teach classes. Their experience in the areas of ham radio in which they specialize is a great asset in helping the students learn and hold their interest.

Along with teaching code and theory, Steve has been putting much time and effort into the Air Force MARS program, which provides valuable training for new licensees. How he finds time to enjoy his rag-chewing, DXing, building, and troubleshooting is beyond me. Besides all of this, during 1980 he still managed to obtain his amateur Extra license (KN6G), his Second Class Radiotelephone license, and another stripe to wear on his sleeve. What more is there to say?

What Determines Success

You are probably asking yourselves, what's the big deal about four people getting their Novice tickets? Actually, I am trying to make a point. The dictionary defines success as "a degree or measure of succeeding; a favorable termination of a venture." For some strange reason, many amateur radio classes never materialize because someone determines that not enough people are interested. Baloney! The success of a class or study group is not dependent on its size but on the basis that something constructive has been accomplished. An amateur radio class does not have to be congested with so many bodies that a "Standing Room Only" sign is hanging

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at the door. This is utter nonsense! Many are denied entry into our great hobby due to such primitive thinking. As I suggested before, individual study should be avoided where possible. Classroom study with supplemental home study is the way it should be done. If every radio club across America started some sort of training program, no matter how big or how small, we would be in a lot better shape.

All radio clubs across the country should get into gear as quickly as possible and drum up constructive and educational amateur radio classes. Look where it has taken the Japanese! It certainly hasn't hurt them. Here in West Germany, hams serving with the Air Force are doing their part. Classes are regularly held at Ramstein, Sembach, Hahn, Zweibrucken, Rhein Main, and in the Spangdahlem and Bitburg areas. I am not familiar with what the amateurs in the Army in West Germany are doing regarding amateur radio classes in their communities, but judging from their numbers, they must also be active with classes. Perhaps someone would like to write a follow-up and let us know what they are doing also.

FCC Policies: Hurting the Growth of Amateur Radio

As I mentioned earlier, the FCC travels twice a year to Germany, once in the spring and once in the fall. This certainly is not often enough! Now there is talk of no visits by FCC examiners due to the cost of travel, etc. They have got to be kidding! The US government gives millions of dollars away to countries who have stabbed us in the back and continue to do so, yet they can't seem to allot a few thousand dollars a year for examiners to test Americans abroad. The U.S. military and civilians who are serving overseas defending our great country deserve some consideration. Perhaps the FCC could institute some type of system similar to the Conditional licensing program that existed some years back. Or else they should consider traveling overseas more often. Amateur radio operators perform a public service with emergency communications and enhance international goodwill. If these policies remain in effect an extended period of time, the growth of amateur radio will resemble a centipede with sore feet. . . yes, that slow!

It would be much more comforting to know that the FCC was working with us and not against us. But, like other government agencies, the FCC is a strange animal with its own behavioral patterns. Until we find out what their last minute decision-making will bring forth, we are gritting our teeth and rolling with the punches.

This article was prepared in order to illustrate the present situation concerning Americans abroad. Amateur radio is sought as a hobby and/or morale booster by many because of those unique motivation factors. Secondly, licensing classes are reality, thanks to those who care enough to give of their time. And, to repeat what was written earlier, the success of a class or study group is not dependent on its size but on the basis that something constructive is to be accomplished. Think about it. And finally, current FCC policies are hurting the growth of amateur radio with no reversing trend in sight. . that's the bottom line. ■

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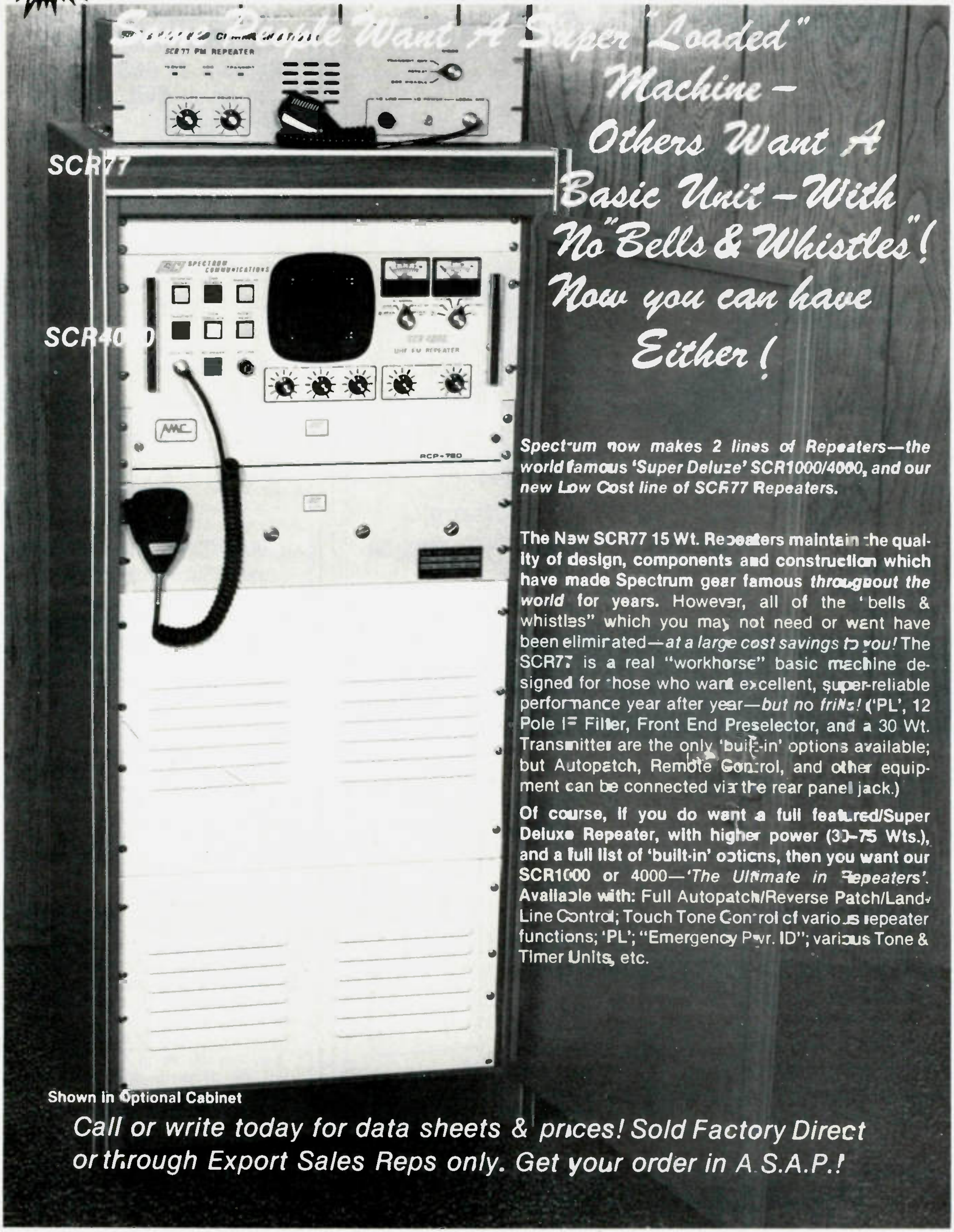

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The Masher

—son of The Amazing Audio Elixir

When I first read the article on which this article is based, "The Amazing Audio Elixir," *73*, September, 1979, I really didn't read it at all. It looked a little hokey. Words like "amazing" and "cure-all" turn me off, especially when they're used to describe an audio limiter, processor, compressor, etc. I flipped on through the magazine to find something more interesting and useful. It wasn't until several months later, when a friend asked me to help him check out a compressor he had just built, that I gave any serious attention to N6WA's article and circuit.

My friend, John W8SSM, had built The Amazing Audio Elixir and he was anxious to receive some on-the-air reports. John was using the Elixir with his Kenwood T-599D and Heath SB-221. We were on 40 meters and the band was in good shape. I would be able to give him an accurate and, I expected, negative report. It had long been my belief that unless you wanted to spend a tidy sum for a store-bought rf speech processor like the Vomax, all that an external audio limiter, processor, compressor, etc., would do would be to junk-up an otherwise clean and intelligible signal. Got the picture?

John started the tests: "Compressor on: 1, 2, 3, 4, 5 . . . Compressor off: 1, 2, 3, 4, 5 . . ." And on and on. I couldn't believe what I was hearing! The blooming thing actually *improved* his signal! It reduced the peak-to-average ratio of his audio, and it seemed to give his audio more brilliance; that is, it attenuated many of the lows, which only consume power without adding to intelligibility, and it enhanced the mid-range and highs. It did this *without causing undue distortion and without raising background noises noticeably.* John turned on The Amazing Audio Elixir, and he turned me on to it. I liked what I heard, and I decided that I should have one.

It should be noted that the circuit diagram appearing in the original *73* article contained one error. It showed the gate of Q1 and capacitor C4 connected to the junction between R1 and R2. This should not be, and the corrected diagram is shown in Fig. 1. This is the circuit that John used and that worked so well as is.

But few things are so good that they can't be improved upon. After all, the original Elixir was described as a multi-purpose device—for tape recorders, computers, phone patches, repeaters, etc. N6WA mentioned only in passing that it might be used as a transmitter speech processor/compressor.

So, I set out to optimize the Elixir for use as a

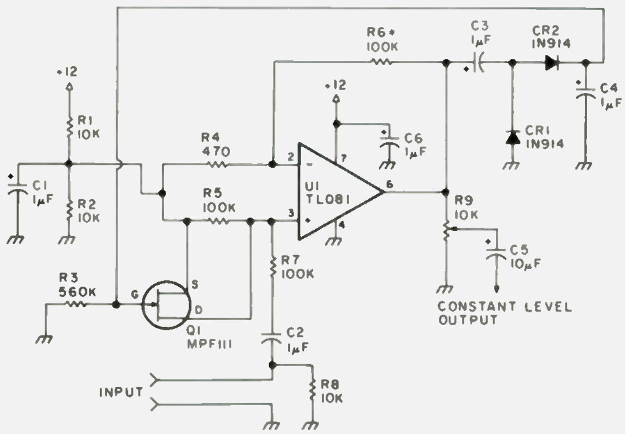

Fig. 1. Original circuit of the Amazing Audio Elixir (with correction).

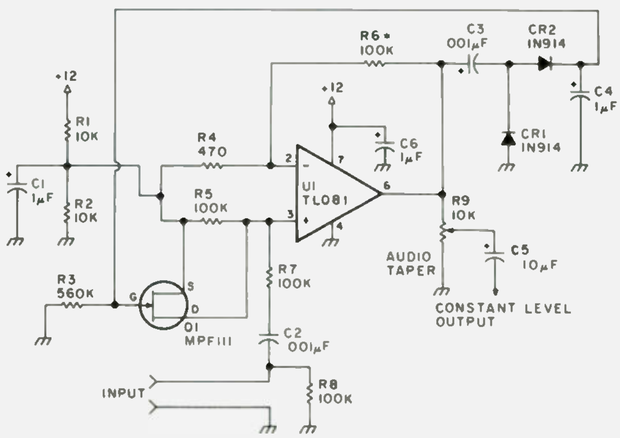

Fig. 2. The Masher circuit, fine-tuned for speech processing tasks.

transmitter speech processor/compressor. By the way, John found it clumsy to refer to the gadget by its given name, The Amazing Audio Elixir, or by its generic name, a transmitter processor/compressor, so he tagged it The Masher. It does "mash" the audio peaks down closer to the average modulation level —a descriptive name, I think, and a whole lot less clumsy to use.

Fortunately, N6WA makes available a neat 2" × 2" printed circuit board for $3.50 ppd. I ordered one, and when it came I was pleased to find that an accompanying data sheet gave significant technical information and specifications, which I found useful in my subsequent modifications. For example, the original circuit provides an af range of 100 Hz to 25 kHz to the 2-dB points. Ham transmitters don't need that extremely low frequency response. The data also showed that the input impedance was 10k Ohms. My microphones are high impedance. These considerations prompted the modifications to change the Elixir into the Masher. The modified circuit is shown in Fig. 2.

Experiments and on-the-air tests indicate that changing R8 from 10k to at least 47k not only raises the input impedance, but also allows a high-impedance microphone to retain its original characteristics. Values from 47k to as high as 1 meg were used without noticeable difference. I settled on 100k.

C2 and C3 were changed from their original values to 0.001 μF, providing a low-frequency roll-off at about 400 Hz. R3 was changed to 470k (Radio Shack does not stock 560k) with no effect on performance. And, finally, I used a regular 1/2-Watt audio-taper potentiometer for R9 and mounted it on the front panel of a small minibox. The multi-turn, board-mounted trimpot originally specified made adjustment of the output level much too difficult.

Construction is simplicity itself, whether you use N6WA's PCB (that makes it really simple) or perfboard. The hardest part for me was drilling the holes in the minibox for the switch, potentiometer, microphone, and power connectors—and that was easy. I should caution you, however, to be careful in your selection of cable to be used between the microphone and the Masher and between the Masher and your transmitter, especially if you use a high-impedance microphone. Use a shielded cable, but *do not* use the type that has the audio *and* PTT wires inside the shield. Only the audio wire should be inside the shield, as the PTT wire may carry hum and rf to the sensitive audio stages. I recommend Belden No. 8734 (straight) and Belden No. 8497 (coiled) for this purpose.

Testing and adjusting the Masher should present no great problem, especially if you have a cooperative friend with a good ear for audio. With the Masher switched out of the circuit, adjust your transmitter microphone gain as usual, for an alc indication of one-half to two-thirds of the alc range while close-talking the microphone at one to two inches. Set the Masher output level control at minimum, switch the Masher in, and while continuing to talk in a normal voice slowly increase the Masher output level until the alc meter *just begins to flicker*. In most cases, further adjustment will not be necessary. By no means should you try to kick up the alc meter as high with the Masher as you do without it. If you do, your friend out there, listening with the good ear, will probably tell you that your audio doesn't sound very good and that the background noise is too high.

A final word. I didn't have any particular problem finding suitable parts or substitutions for the MPF111 or the TL081—lucky, I guess. But you may save yourself a lot of time by ordering them from N6WA (C. W. Electronics, Box 8306, Van Nuys CA 91409). The PCB is $3.50, the MPF111 and TL081 are $2.00, and a complete kit of parts is $14.95.

That's all there is to it. Try it and you'll be amazed. ■

Parts List

Designation	Description	Qty.
U1	TL081 BIFET op amp	1
Q1	MPF111 FET	1
CR1, CR2	1N914 signal diode	2
R4	470-Ohm, ¼-Watt, 5% resistor	1
R1, R2	10k, ¼-Watt, 5% resistor	3
R5, R6*, R7, R8	100k, ¼-Watt, 5% resistor	3
R3	560k, ¼-Watt, 5% resistor	1
R9	10k pot, audio taper	1
C2, C3	.001-uF capacitor	1
C1, C4, C6	1-uF electrolytic capacitor	4
C5	10-uF electrolytic capacitor	1
	PCB	1

*R6 is a feedback resistor that determines the gain level for the operational amplifier chip. If the mike has a particularly low output level, it may be necessary to increase the gain by making R6 as large as 150k Ohms.

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Innovation or Consternation?

—recent patents dealing with radio

Keith Greiner AK0Q
421 N. Pleasant Hill Blvd.
Des Moines IA 50317

There is an old saying which says that in the life of every person there is one good book. So it is with inventions and amateur radio operators. There is at least one good patentable idea in every good ham operator. What about that little change you made to your antenna, or that FET you stuck in your FT-101?

It is entirely possible that if you wanted to spend the time and money you could discover that your idea is patentable as a new and unique device. As such, it could put your name on the list of over four million pa-

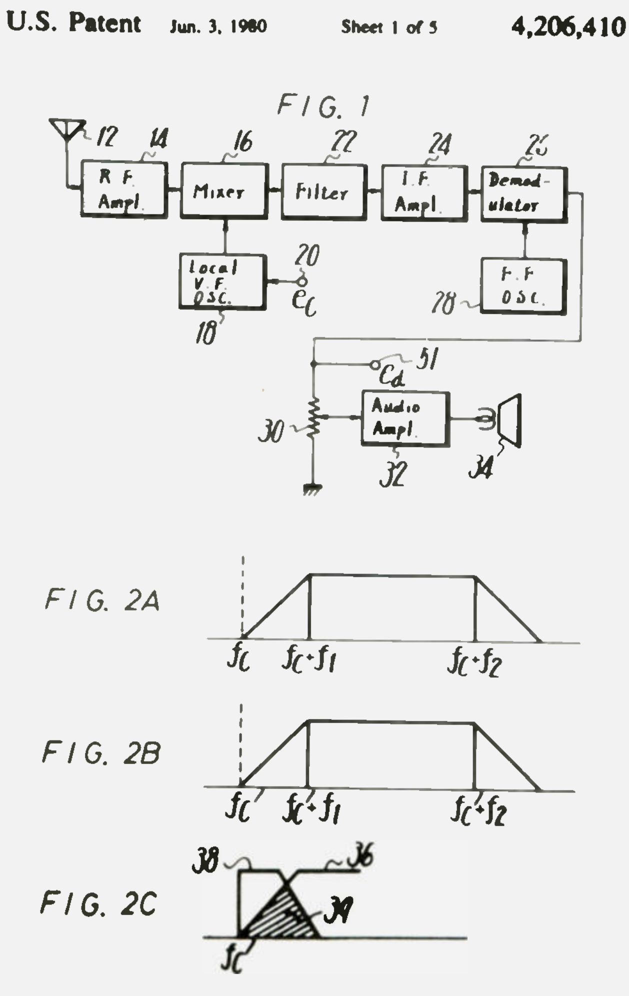
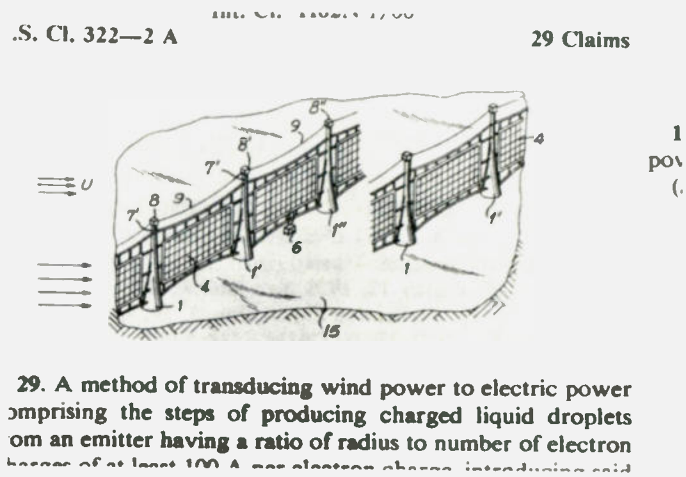


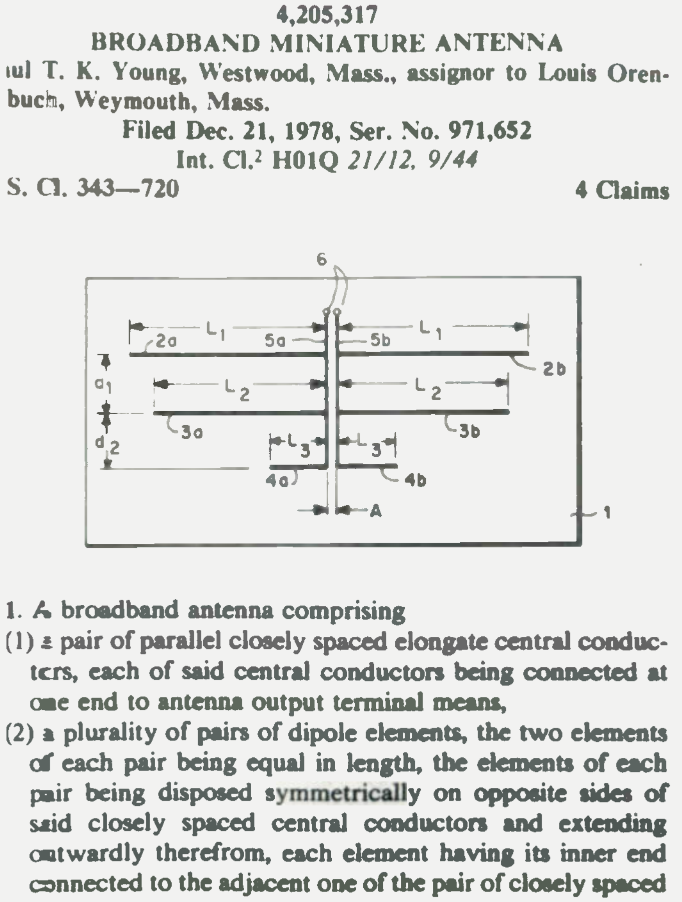
Fig. 1. Automatic frequency control system.


.S. Cl. 322—2 A

29 Claims

29. A method of transducing wind power to electric power ɔmprising the steps of producing charged liquid droplets om an emitter having a ratio of radius to number of electron

Photo A. Wind to water to Watts?


4,205,317
BROADBAND MINIATURE ANTENNA
ul T. K. Young, Westwood, Mass., assignor to Louis Orenbuch, Weymouth, Mass.
Filed Dec. 21, 1978, Ser. No. 971,652
Int. Cl.^{2} H01Q *21/12, 9/44*
S. Cl. 343—720 4 Claims

1. A broadband antenna comprising
(1) a pair of parallel closely spaced elongate central conductors, each of said central conductors being connected at one end to antenna output terminal means,
(2) a plurality of pairs of dipole elements, the two elements of each pair being equal in length, the elements of each pair being disposed symmetrically on opposite sides of said closely spaced central conductors and extending outwardly therefrom, each element having its inner end connected to the adjacent one of the pair of closely spaced

Photo B. Broadband miniature antenna.

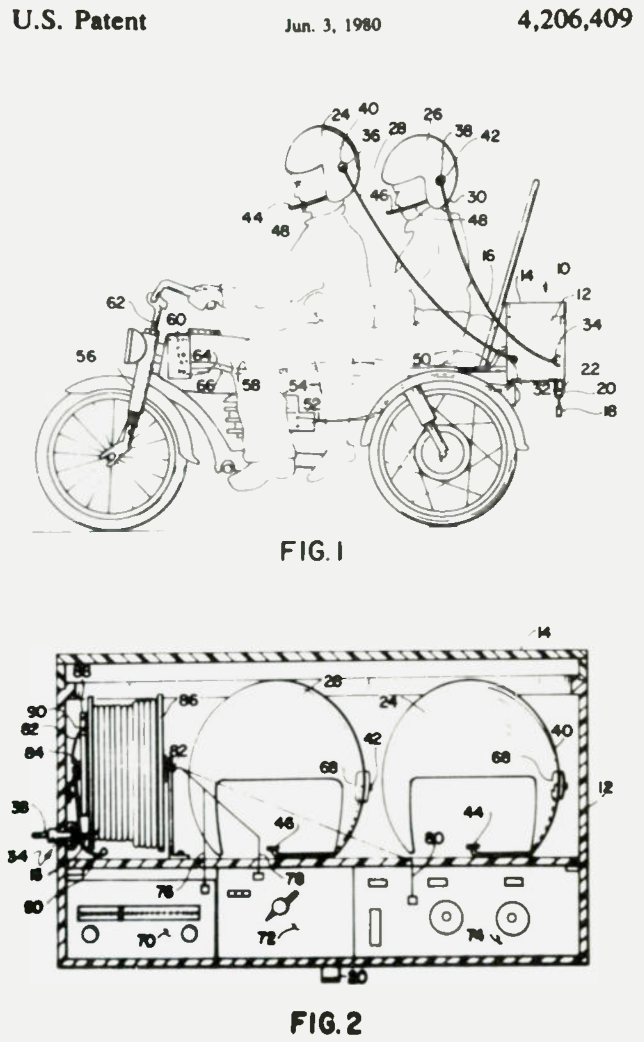


Fig. 2. Helmet-to-helmet communications.

tents by creative people from all over the world. The list is a giant conglomeration of creativity with ideas from the truly unique to the absolutely absurd . . . from the extremely useful million-dollar money-makers to some which are obviously million-dollar boondoggles.

But for people who are constantly wondering "what makes it tick," finding out how others made it tick can be a fascinating pastime. A perfect source for details of these new ideas is the illustrated weekly publication of the US Patent Office, the *Patent Office Gazette*. The publication is usually about an inch thick and contains hundreds of interesting ideas patented during the previous week.

A subscription to the *Gazette* is not inexpensive; it runs about $300 per year. But for purists, I can imagine that curling up with a copy of the *Gazette* at night could be just as interesting as a Nancy Drew mystery is to a junior high school girl.

Unfortunately, the Patent Office doesn't publish information about inventors or their hobbies, so it is impossible to determine how many of them are amateur radio operators. However, it is easy to surmise that many of the ideas might be the direct result of a night of DX-chasing on twenty meters.

Patents are also a way to see the direction that our technology is taking. In fact, there is a section of the Patent Office called the Office of Technology Assessment and Forecast. Some of the basic changes are obvious. For example, it wasn't very long ago that parts used in patents included tubes, mechanical relays, and switches. Now they include many block diagrams showing the flow of logic and processing used in the invention.

Following are some summaries of inventions which have been patented recently.

4,206,410
Automatic Frequency Control System for Single-Sideband Signal Receiver

This invention (Fig. 1) was patented by two Japanese men, Hideo Ito Sagamihara and Haruo Hiki. It could be perfect for locking your receiver to the transmitter of your friend on the other end. With it, you would never need to touch the dial for perfect reception once you've established contact.

The invention works in quite a simple manner. The received single-sideband signal is passed through a low-frequency audio filter. The low-frequency signal has been modulated at the transmitter with a signal which your receiver uses to keep your receiver on exactly the same frequency as the transmitter.

How ingenious! Why didn't I think of that?

To imagine the most absurd possibilities, if your friend's transmitter were a bit unstable, the two of you could go floating along together all across the 80-meter band. On the other hand, given good engineering practice, this device

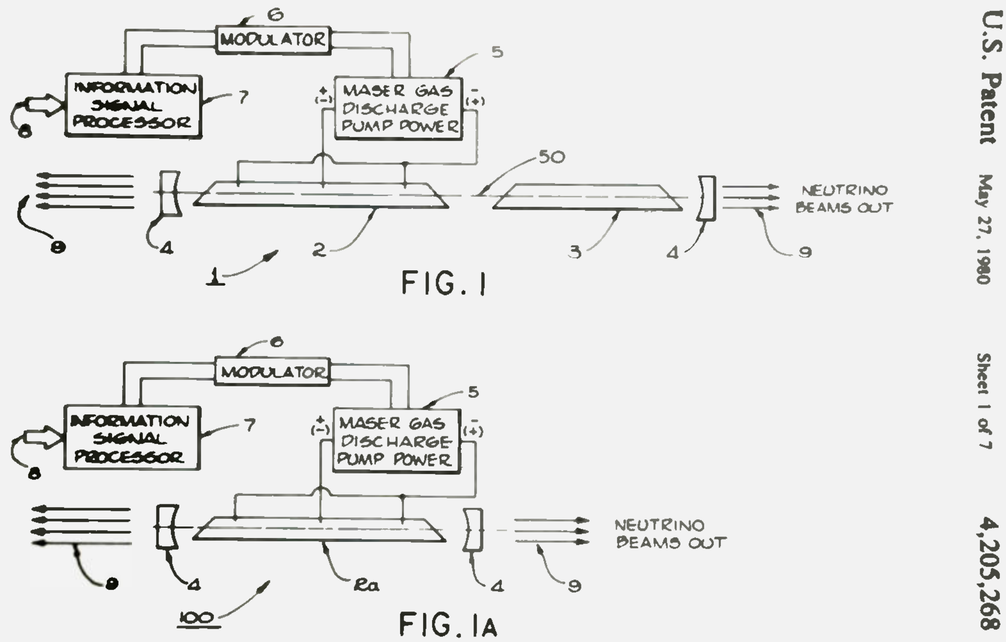


Fig. 3. Intelligence-modulated neutrinos.

United States Patent [19] Watanabe

[11] **4,205,269**
[45] **May 27, 1980**

[54] REMOTE CONTROL VARIABLE ATTENUATION DEVICE FOR AN ANTENNA AMPLIFIER
[75] Inventor: Masakatsu Watanabe, Akatsukahonmachi, Japan
[73] Assignee: Hochiki Corporation, Tokyo, Japan
[21] Appl. No.: 913,269
[22] Filed: Jun. 7, 1978
[30] Foreign Application Priority Data
Jun. 9, 1977 [JP] Japan 52-75100
[51] Int. Cl. H04N 7/16
[52] U.S. Cl. 455/4; 358/86
[58] Field of Search 325/62, 309, 394, 308, 340/310 R, 310 A, 358/86, 184, 194
[56] References Cited
U.S. PATENT DOCUMENTS

2,679,001	5/1954	Tomsick	358/184
3,064,195	11/1962	Frown	325/308
3,909,560	9/1975	Martin et al	325/308

OTHER PUBLICATIONS

D. Lieberman, "Wideband Distribution Equipment for Cable Television (CATV)", Sylvania Bulletion, Jul. 1971, pp. 1-3

Primary Examiner—James W. Moffitt
Assistant Examiner—Randall P. Myers
Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn and Macpeak

[57] ABSTRACT

A variable attenuation device is provided for an antenna amplifier by providing high attenuation and low attenuation signal flowpaths connected to the amplifier input by respective pin diodes. The biasing of the diodes and, thus, the attenuation factor provided, is controlled in proportion to the output of a rectifying circuit which, in turn, provides a DC output proportional to the magnitude of a given polarity of the AC signal supplied to the amplifier from inside the subscriber's home.

7 Claims, 6 Drawing Figures

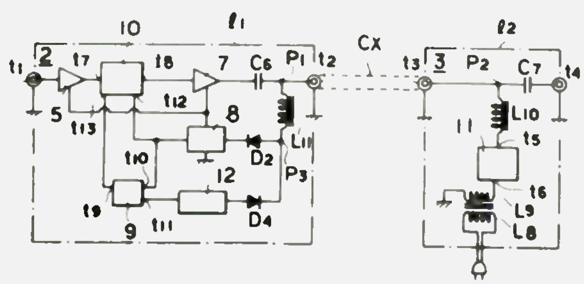


Fig. 4. A device for an antenna amplifier.

could appear in a future generation of improved transceivers and be heralded as a useful innovation for the industry.

Look for this invention to appear first in some piece of Sony equipment. The two inventors have assigned their patent to that company.

4,206,409
Motor Vehicle Communication Apparatus

This novel device by Samuel A. McKinney of Pickering, Canada, could be just the thing you need for mobiling from your Honda. See Fig. 2.

It is made up of two or more helmets, containing microphones and earphones. The helmets are connected to a receiver, an amplifier, and a control box. Now, when you're seeing the world on your cycle, you can listen to some nice music, talk on the repeaters, and even hold a decent conversation with your friend on the back.

I can imagine using the helmet and microphone combination in my car so that my wife and I can communicate while the children yell to their hearts' content in the back seat.

4,206,396
Charged Aerosol Generator With Uni-Electrode Source

Could this be the answer to portable power at your campsight? (See Photo A.) Would it help you chalk up extra points on Field Day? Alvin Marks of Whiteside, New York, may think so.

Marks says that you can change wind power into electric power by producing charged liquid droplets, putting the droplets into a windstream, and discharging them through a load and a grounded electrode.

No doubt, bright ideas like this may one day solve our energy problems. For this one, I surmise that you'll need to charge batteries or find a place with a steady wind. Now, with my ingenuity I'd probably just hook it up to a big fan.

4,205,268
Neutrino Communication Arrangement

Could we some day have ham radio communications on the Neutrino Bands? Neutrinos are neutrally charged particles found in atoms which have a mass of nearly nothing.

Josef W. Erkens, of Pacific Palisades, California, theorizes that by producing a stream of neutrinos, then modulating that stream with intelligence, you can transmit that intelligence to wherever the neutrinos go. Erkens also has patented the idea of a receiver for this system. (See Fig. 3.)

4,205,269
Remote-Control Variable-Attenuation Device for An Antenna Amplifier

This little device could be perfect for that preamp on your antenna (Fig. 4). In essence, the inventor, Masakatsu Watanabe, sends an ac signal from the control box to the preamp along the transmission line. Two diode circuits at the control box allow him to change the amplitude of one-half cycle of the ac. By comparing the difference in amplitude of the two ac half-cycles, the preamp circuit can determine how much to attenuate the output signal from the preamp. The current from one of the half-cycle signals is also used to power the preamp at the antenna.

I see this as an excellent innovation in the field, and one which may soon appear on many antenna circuits. The patent, number 4,205,269, has been assigned by the inventor to

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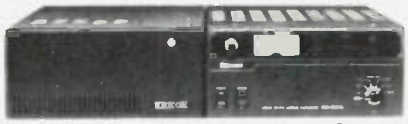

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*BC-30 required to charge BP-2 & BP-5

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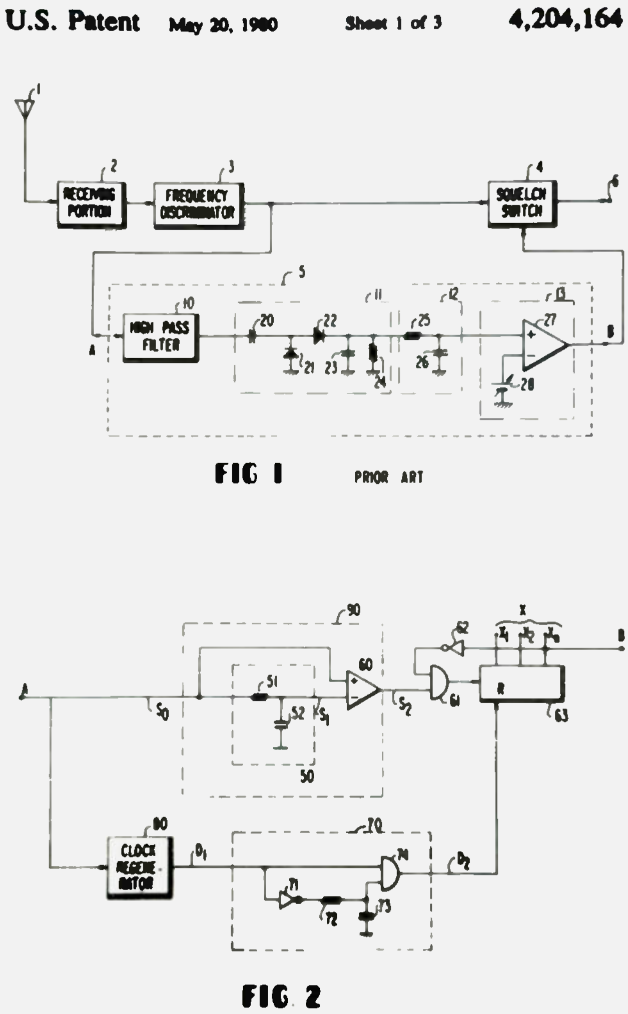


Fig. 5. Taking a noise pulse.

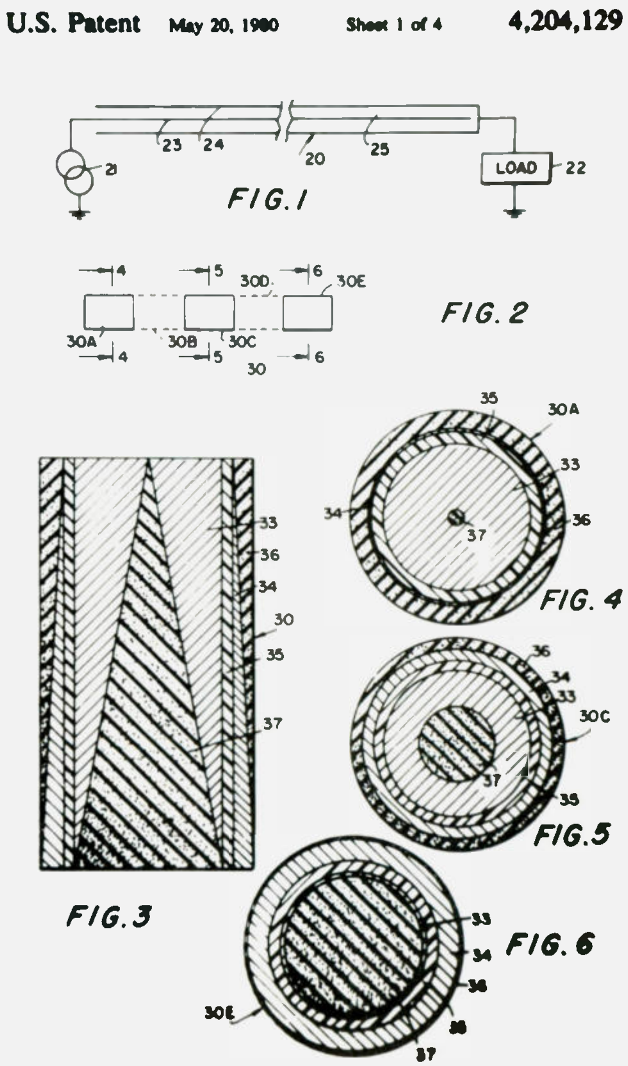


Fig. 6. Capacitance-compensated cable.

the Hochiki Corporation of Tokyo.

4,205,317
Broadband Miniature Antenna

This interesting antenna, shown in Photo B, is made of three dipoles which are spaced apart from each other by somewhere between a half- and a quarter-wavelength of the highest frequency to be used.

The longest dipole pair is approximately one eighth of the wavelength of the lowest frequency to be used, while the shortest dipole is roughly a third of a quarter wavelength of the highest frequency to be used. The middle length dipole is, according to the inventor, Paul Young, of Westwood, Massachusetts, "some intermediate frequency in the broadband."

4,204,164
Noise-Detector Circuit

Having trouble detecting noise lately? Here is a circuit by a Japanese inventor which is designed to do the trick for you—see Fig. 5.

The circuit, which has been assigned to the Nippon Electric Company, is described as consisting of a first circuit for slightly delaying a received signal which contains noise. The output of the first circuit is then fed into a second circuit which converts the delayed signal into a number of pulses. The rate of pulses per minute is directly dependent on the level of the noise being detected. By counting the number of pulses, you know the noise level.

Although it sounds simple enough, I am sure that the actual details, which may be found in the original patent documents, are anything but simple.

4,204,213
Flexible Dipole Antenna

I can just imagine this dipole antenna made of a bright yellow ribbon-like material, and wrapped around an old oak tree or perhaps a small house. It may be just the thing you'll need to toss into a trunk while preparing for your next trip. (See Photo C.)

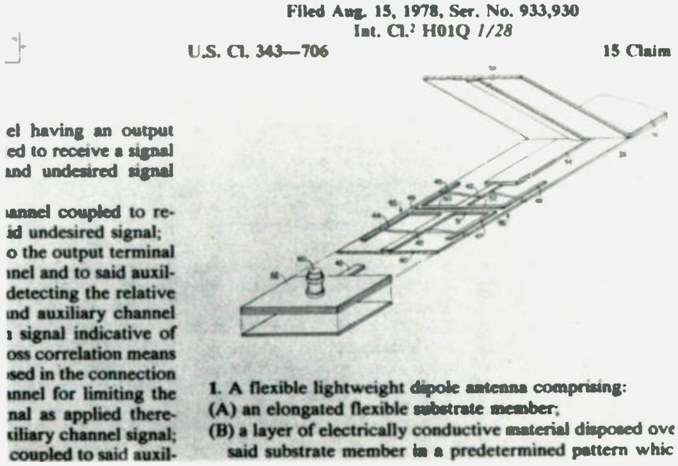


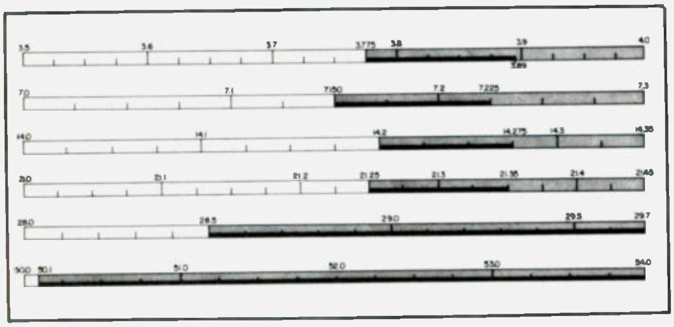
Photo C. Can you Mobius-twist it?

Generals Get HF SSTV

The FCC has amended its rules to allow general class amateurs to operate SSTV on any frequency where they are authorized voice transmission. The action by the Commission occurred on 24 November, and while no effective date was given, it is expected to become effective in January or February of 1982.

FCC Opens General Class Phone Bands to SSTV

The FCC last month approved a proposal (Docket #80-252) to allow the transmission of television (SSTV) on all amateur radio frequencies above 3.775 MHz where voice transmissions are currently allowed. This resulted in opening up the general class portions of all phone bands to SSTV without impairing the special bands set aside for Advanced and Extra Class licenses. The frequencies now available for SSTV are shown in the accompanying band allocation chart.



With this new ruling there are no longer any restrictions on using SSTV on the same bands you've been working phone. By adding a Robot Model 400 Scan Converter to your station for just $795 you can transmit and receive visual data without having to change frequencies. Not

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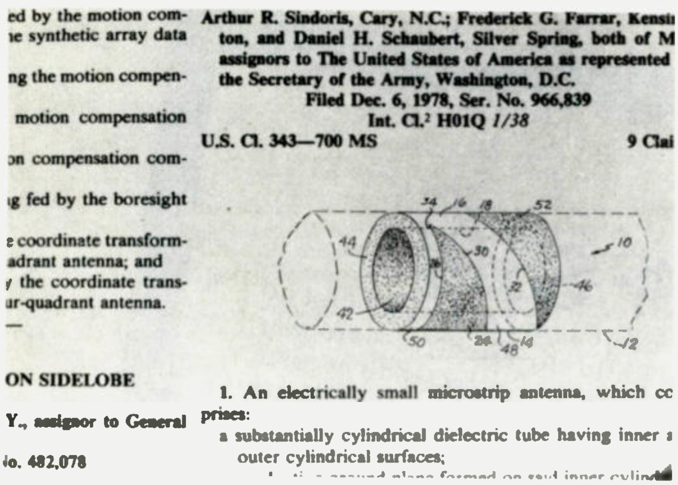
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Filed Dec. 6, 1978, Ser. No. 966,839
Int. Cl.[2] H01Q 1/38
U.S. Cl. 343—700 MS 9 Clai

1. An electrically small microstrip antenna, which co
prises:
a substantially cylindrical dielectric tube having inner a
outer cylindrical surfaces;

Photo D. Conformal spiral antenna.

The *Gazette* describes this antenna as a flexible substrate (the ribbon) with a conductive material attached to it in a predetermined pattern. The pattern isn't described in detail, but we can assume it is most likely used for matching, length adjustment, and Q adjustments. To make things more complex, this layer is covered with another layer of flexible insulating material which has a conductive material attached to it. To top off the sandwich, another layer of flexible, insulating material is then attached, to make three layers of insulation separated by two layers of conductive material.

The patent has been assigned to the Westinghouse Electric Company.

4,204,212
Conformal Spiral Antenna

There is no mention in the *Gazette* description of this antenna of what type of equipment it is intended to be used with. So, at this point, we can assume it is as useful as some designer wishes to make it. The US Army, in its wisdom, must think this is a useful invention, for they have been assigned the patent rights by the three inventors.

The unique design is made of a cylindrical dielectric tube. (See Photo D.) On the inner surface of the tube there is a conducting material which is described by the inventors as "a conductive ground plane." A spiral strip of conductive material is placed on the outside of the cylinder. All you need to do is connect the two conductive surfaces to your feedline, and you have a "conformal spiral antenna."

4,204,129
Capacitance-Compensated Cable

Perhaps the best explanation of this design for cable is that it turns the cable into a series-capacitor between the frequency generator and the load. The generator is connected to the center conductor of the cable and the load circuit is connected to the shielding of the cable. The two circuits are completed through ground. (See Fig. 6.)

In order to compensate for and control the capacitance, the surface area of the center conductor is designed to become smaller as it approaches the load, while conversely the surface area of the shield is designed to become smaller as it approaches the generator (or vice versa). ■

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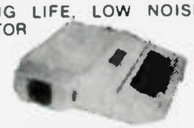

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All these questions and more go through your mind when it's time to get a rig. If you're lucky enough to have a ham friend who has the time to help you choose and to go to hamfests to help you look over the rigs, you'll not be totally lost. But your friend can only advise you, not choose for you. You can't hold your friend responsible when it turns out your purchase doesn't do what you wanted it to do. He didn't know what you wanted any more than you did! You must face the ultimate responsibility of making *your* choice and spending *your* money.

Whether or not you have a friend to help you, I think you will find this article helpful in deciding what you need, what you can afford, and how to go about getting it. It will guide you in organizing your thoughts and doing some conscientious planning *before* you take that important first step!

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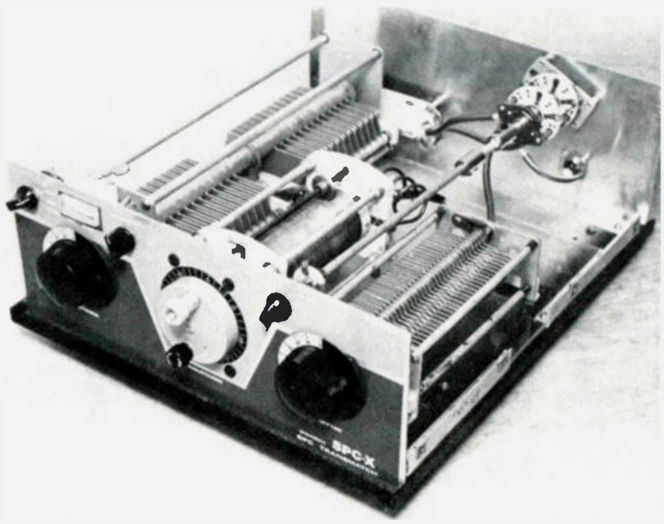
Empty your pockets and your piggy bank and count it. Uh huh, just as you thought, only $15.42 there. Well, where can you get more? How about selling something? Maybe you've outgrown your high school fixation about being in a

Would you give $3 for this junked home-brewed amplifier? I did. Along with plug-in coils, switches, insulated standoffs, and other goodies was the 12-inch long dual-section air-variable capacitor used in my home-built SPC transmatch. A real parts bonanza for just $3.



My home-built SPC transmatch uses the dual-section air-variable capacitor mentioned under the photo of the "junk." The single-section air-variable, the roller inductor with turns counter, and both vernier drives were salvaged from a junked military surplus transmitter purchased for $12 at a hamfest. The transmatch cabinet was designed to blend with my Drake equipment.

rock 'n' roll band. You never could play the electric guitar anyway, and it's collecting dust under the bed. Well, take it to the next hamfest and sell it for $50, or $100, or whatever you can get for it. How about that old dilapidated shortwave set your next-door neighbor gave you when you first got interested in radio? Maybe you can get $10 for it. If you have any hobbies like painting, woodworking, or arts and crafts stuff, you could try selling some of it. If you've ever been to a hamfest, you'll know that a ham is liable to buy anything. Hams have other hobbies and interests, too. Old model trains, guns, cameras, and many other items can get you a dollar or two if you're willing to part with them. So think hard! You can think of something to sell.

Am I Safe Buying Used Equipment?

Now that you've figured out where the money is coming from and how much you have to spend, you can begin deciding what you want to spend it for. You can purchase a used rig for around half its original price and get years of good service from it. If you buy good, clean used gear at a good or "steal" price, you can always sell it in a year or two for as much as you paid for it. In other words, as long as you take good care of it, your investment will not depreciate and you can get your money back to spend on a nicer rig when your finances allow such a move. That is the reason why good used equipment can be your best bargain.

El primo rule when buying used equipment is *buyer beware!* You can get taken by a shrewd seller more often than you can find a steal unless you exercise reasonable caution when buying. This is especially true when buying used transmitters, receivers, and transceivers. There can be aggravating minor problems that don't show up until you've had the rig on the air for a while. Usually the seller will admit to any obvious major problem with the rig being sold. Some will tell you every little detail, and some will swear it's in perfect shape when it's really a piece of junk. You and only you can be the final judge. If you can't tell by the look of the rig, then try to judge the look on his face.

Of course, no one selling used equipment can give you an ironclad one-year warranty on what he is selling. But if it hasn't given any major problems or had a recurring problem while he used it, you can assume you should have no major problems. If you can buy a rig from another ham you know and trust, you can probably get a better rig at a better price. In any event, when seriously considering buying *any* rig, ask to operate it, or test it out in some fashion before buying. This is an excellent way to see if you like the controls and features on the rig, as well as checking it for any defects.

In spite of a real need for such testing, it isn't always possible at a hamfest. In fact, it has been my experience that this is almost never possible at a hamfest. Hamfest organizers often claim they will have a testing area set up, but usually there is not even an electrical outlet set aside for such purposes. The minimum requirements would include a table, a dummy load for keying up, and some sort of wire hanging up for minimum reception. So if you want to buy at a hamfest and check out the rig first, at least ask, but don't be surprised if all you get is a run-around from the organizing club.

A matching transmitter-receiver combination is known as "twins." Shown here are my Drake twins, vintage 1967. In 1967, this set, with matching speaker and ac power supply, had a combined suggested retail price of over $950, including tax. They were purchased at a hamfest in 1978, complete and in excellent condition, for slightly over half the original price. The wattmeter atop the transmitter was home-built. Its cabinet was designed to blend with the Drake equipment.

What Is Better for Me, A Transceiver or Separates?

Now comes the question of whether to buy a transceiver or a separate transmitter and receiver combination. (By the way, a matching transmitter/receiver combination is known as twins. They usually look very much alike and are made so that they operate together without complicated external switching hookups.) Here are some points to consider when deciding on a transceiver or separates:

1) Transceivers are generally less expensive than a comparable set of matched twins.

2) Transceivers are generally easier to operate, due to the absence of controls duplicated in a set of twins (2 vfos, 2 band-selector switches, 2 tuning or peaking controls, etc.).

3) Transceivers can be more costly to have repaired due to the complexity of the combined transmit/receive functions crammed into one case.

4) Transceivers usually take up less space than comparable twins.

5) Twins are more versatile. Having a vfo on each unit gives you split-frequency operation without the purchase of an outboard vfo necessary for split-frequency operation with a transceiver. If one unit breaks down (the transmitter, for example), you still have the other unit to use (you can still receive and keep up your code practice) until repairs can be made.

6) Twins often have more good features as standard equipment than do transceivers.

7) Separate transmitter and receiver units that are *not* matched (odd couples) can be hooked up, and in many cases may be less expensive than either twins or a transceiver.

Most Novices have no need for split-frequency operation available with twins or transceivers with an outboard vfo. Let your pocketbook be your guide on that point. Split frequency has its applications when working some DX, can be a help in contests and service nets, or it can be *confusing* if you don't pay attention to what you're doing.

How Much Is a Rig Going to Cost?

Now you should have

This is a popular model of transceiver, the Heathkit HW-101, purchased by one of my Novice students at a recent hamfest. A little bargaining got this gem, including ac power supply and CW filter, for only $175.

Don't let minor damage like chipped paint and superficial scratches (circled area) deter you from a good buy on an otherwise clean, operable rig.

three things taken care of: (1) where the money is going to come from; (2) how much money you have to spend, and (3) whether you are looking for a transceiver or separates. Now you have to decide which brands or models are within your financial means. This can be a specific unit to decide on, or it can be a list of several good possibilities in the range of your budget.

I strongly suggest checking the ham magazines for advertisements by dealers who list their used equipment and prices. These listings will give you a good idea of the market value of used units with the dealer's markup tacked on. Most dealers charge more than you'd have to pay for the same unit at a hamfest, but usually they have gone over the rig and checked it out before putting it on sale.

Many dealers will give some sort of warranty on used gear, too. If you like the idea of having the extra peace of mind that this might offer and you can afford the extra bucks, you might consider calling them. In any case, the information on current prices of used gear is an excellent help in judging the real value of a rig.

Compare the dealer's used prices with the prices in the classified ads of ham magazines. That also will help you develop some idea of fair prices for the rigs you are considering. (A word of caution is appropriate here if you are considering buying a rig from the classified ads. You're not only buying a rig from someone halfway across the country, but you're buying it sight unseen. At least at a hamfest you have the chance to look over the rig before you buy it. Prices in these classified ads can be a bit inflated, too. The seller must recoup his cost of advertising, and those ham ads do cost money.)

Another big help for me was a set of manuals called *Ham Equipment Buyer's Guide*, published by A.L. Brand WA9MBJ. They may be ordered from Barbara Brand Wixon, 189 Kenilworth, Glen Ellyn IL 60137. These manuals show pictures of commercial ham gear and military and government-surplus gear of interest to the amateur market. With each picture there is a description of the unit. Most have the date of manufacture or the date the unit came on the market, and its original retail price. These manuals cover gear from about 1945 to the present.

This was especially helpful to me in keeping all the Heathkit® rigs organized in my mind. There seemed to be so many that looked alike, I could never keep straight whether I was looking at a 6-meter rig or an HF rig. It was equally difficult for me to separate the transmitters from the receivers from the transceivers! It is a small investment when you consider that you may be preparing to spend $200 to $500 or even more on some equipment. Armed with this information, you now have something to choose from, and some idea of the cost.

Which Rig to Buy—When I Don't Know What to Look For?

Now comes the hard part. Different rigs have different features. What is standard on one rig may be an add-on option for another rig. The more goodies, such as RIT, audio filters, LED readouts, and speech processors, that the rig comes with, the more it is going to cost. If you've not operated any ham gear before, you may well have *no idea* what features you want in a rig or which features are worth the extra cost. So how do you know where to start choosing?

The following is a list of features you should consider and some explanations of what the feature is or does. Following each item are one or more letters. The T means that the feature is usually found on a transmitter, the R that it is found on a receiver, and the X stands for transceivers. Read over the list and ask each question appropriate to each rig you consider buying.

1) How many bands or portions of bands does the rig cover? Does it include a WWV receive function? If not, see item 5. (T,R,X)

2) Is it vfo controlled or single fixed-frequency crystal controlled? (T,R,X)

3) What is its rated input or output wattage? (T,X)

4) What modes does it have (AM, SSB, CW, RTTY, FM, etc.)? (T,R,X)

5) Is its band coverage easily expandable? Some rigs have accessory crystal sockets which give you extra band coverage in 400- to 600-kHz sections with the simple addition of one plug-in crystal. This is an important feature if you want to be ready for the new amateur bands recently allocated for our future use. (T,R,X)

6) For CW operation, does the rig have full break-in or semi-break-in? This

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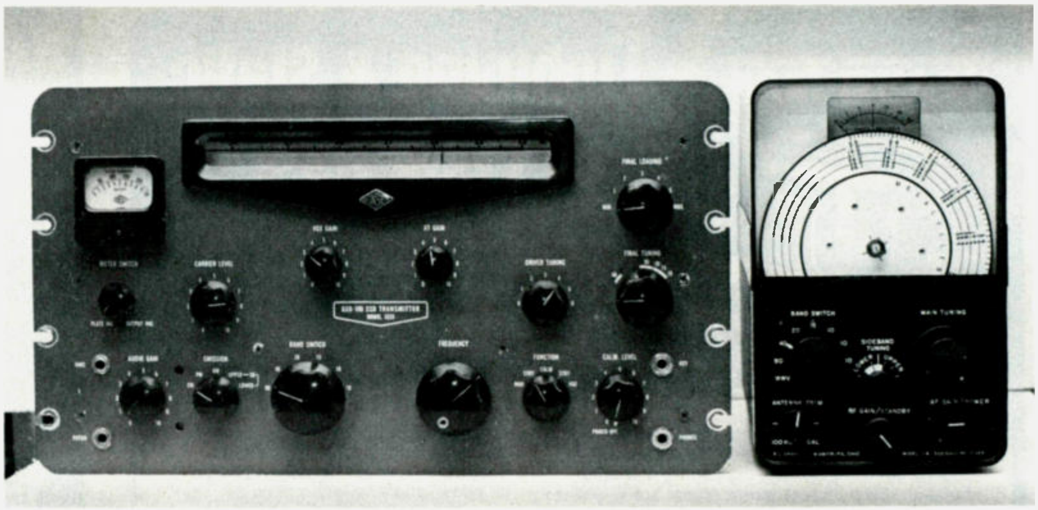


At the left is a Gonset GSB-100 transmitter, vintage 1958, which sold for over $450 new. At the right is a Drake 1-A receiver, vintage 1959, which went for $300 new. These could be used as an "odd couple" to set up a Novice station. The Gonset is a rack-mount unit and should have some kind of cabinet on it for rf shielding and shock protection. It measures 10" × 18" × 20" and weighs 120 pounds! Be sure your operating table can handle it! (The decorative face plate is missing from the 1-A dial in this photo.)

means you can hear your receiver audio between every dit and dah with full break-in, or only during longer pauses between words or sentences with semi-break-in. (T,R,X)

7) For phone operation, does the rig have PTT (Push To Talk), or VOX (Voice Operated Xmit—short for transmit), or both? (T,X)

8) Does the unit come with an outboard vfo, or at least have an accessory jack for an outboard vfo? (X)

9) Is the frequency readout digital (LEDs) or analog (dial markings)? (T,R,X)

10) What is the bandwidth of the audio filters it comes with? For AM phone you need about 4.5-kHz to 5-kHz bandwidth, SSB phone requires about 1.5 kHz to 2.5 kHz, and CW, anywhere from 50 Hz to 500 Hz. There are two types of audio filters: active and passive. The active type amplifies the chosen audio-frequency band louder than the background, making it easier to hear over other audio. The passive type cuts down the background sounds and passes the chosen audio band. Active filters are less expensive but tend to sound harsher than passive filters. (R,X)

11) If it doesn't have the filter bandwidth you want as standard equipment, can it be purchased and plugged in inside the rig or must it be added externally? What would be the cost of the manufacturer's recommended plug-in type? (For example, new plug-in crystal filters can cost $40 and more!) (R,X)

12) Does it have a notch filter? This is sort of the opposite of an audio filter. A notch filter cuts out a particular thin band of audio. It is particularly helpful for filtering out a carrier signal in your audio. (R,X)

13) Does it have a noise blanker? (R,X)

14) Does it have RIT (Receiver Incremental Tuning—sometimes called a clarifier)? This feature allows you to shift your receive frequency 1 or 2 kHz without moving your transmitting frequency. This is a real help on a transceiver without an outboard vfo. (X)

15) Does it have a crystal calibrator (usually 25-kHz or 100-kHz increments)? A crystal calibrator is a built-in crystal oscillator which allows you to calibrate your vfo dial without having to use external test equipment. (T,R,X)

16) Does the rig come with its power supply built in, included as an accessory, or not included at all? (T,X)

17) Is the speaker built in, in a matching cabinet, or not included at all? (R,X)

18) Have there been any user-installed modifications? If so, what are they, and are they indicated on your schematic? (T,R,X)

19) Are the original operator manuals and schematics included? (T,R,X)

20) What is the appearance of the rig? Is it scratched, dented, rusty, cracked, knobs missing or mismatched, poorly repainted, etc.? (T,R,X)

21) Is the physical size and weight of the rig suitable for your available operating space and situation? (T,R,X)

22) What is the reputation within the ham community for the particular rig or rigs you are considering? (Examples: a reputation for frequency drift, poor audio quality, hard-to-find tubes, poor selectivity, hard-to-reach controls and adjustments, etc.) (T,R,X)

Boy, that sure sounds like a lot to think about, doesn't it? Well, it *is* a lot to think about. That's exactly the reason you should think about all these things *ahead of time*. You will find that before long you will automatically check for many of these items from memory, without having to refer to this list for them. Don't be afraid to take this article along as reference, though; you can't commit every one of these questions to memory. Mark those options you are considering. Star the ones you *must* have and mark the ones you would like but would pass over unless the price was right.

What Features Do I Really Need?

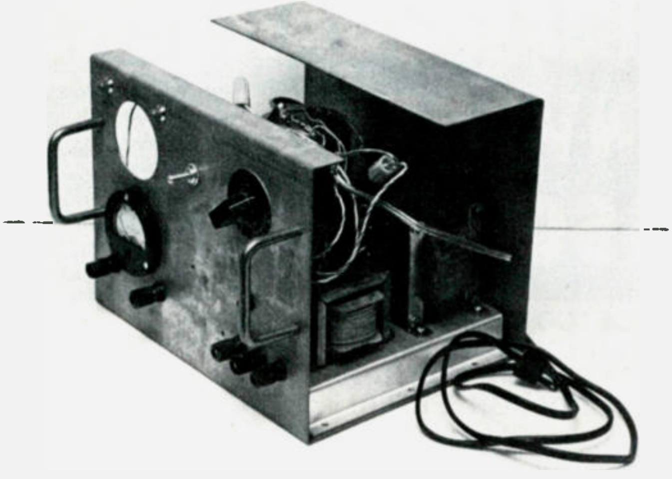
If you are still undecided about some of the features and options, the following list of comments and my own recommendations for Novices might help you decide. The numbering on this list corresponds to that of the previous list.

1) If you can afford an all-band rig, good! You will be happier with it in the long run. I recommend some type of WWV coverage. (Refer to item 5.)

2) Crystal control is pretty much a thing of the past. By the time you collect enough crystals to make a crystal rig of any value, you could have purchased a good vfo for the same money. If you can at all afford it, go for vfo control.

3) Wattage choice is a matter of preference (though the cost can be a minor factor). Many all-transistor rigs are 20-Watt input or less. Tube-type rigs generally run from 40- to 300-Watt input. The 50-to-100-Watt range is a good starting point for Novices.

4) As a Novice, you certainly need CW. SSB is a good option so that you won't *have* to buy again when you upgrade your license. AM, FM, and RTTY are of no particular value to



A home-brewed power supply like this one often can be purchased at a hamfest for less than the individual parts could cost used! Even if it doesn't work, you could use the good parts and cabinet and build your own. Refer to amateur publications like this magazine for construction projects on power supplies and many other useful items that are relatively easy to build.

you as a Novice.

5) If you can afford a rig with easily-expandable band coverage, get it. It will pay for itself in a couple of years when you upgrade, or when the new bands become available to amateurs. It is also an easy way to add WWV reception if the rig doesn't already have it. However, expandable band coverage is not a must for the Novice.

6) Full break-in or semi-break-in: The choice is a matter of personal preference. Full break-in normally is available only on the newer transistorized, digitalized rigs. Personally, I find full break-in annoying, but you should listen to a sample of it to decide for yourself. Semi-break-in is quite sufficient for the Novice.

7) VOX is nice when you upgrade, but is not a necessity for the Novice.

8) An outboard vfo on a transceiver is nice, but not a necessity for Novice use. RIT will serve you as well. However, if RIT isn't available on your rig you might consider an outboard vfo as a second choice if the price is right.

9) Digital readouts are pretty but definitely not a necessity for Novice use. Digital readouts cost more and give more trouble than an analog display. If you want pretty lights, get a good frequency counter. It will be of much more use to you now and later on.

10,11) The QRM on 40 and 80 meters can get awfully hairy in the Novice bands. A good audio filter can be a QSO saver and a nerve saver, too. The tighter the filter, the better. 500 Hz or tighter is good (almost a necessity) since you probably need all the help you can get copying CW on the air. Don't worry if the rig you pick out doesn't have a tight CW filter, though. You can build a good add-on active or passive filter from any of several projects covered in the ham magazines and other publications.

12) A notch filter is not a necessity, though it can be especially helpful on 40 meters where there are a lot of shortwave carriers.

13) If your choice of rig has a noise blanker, fine. But the cost of an add-on noise blanker could prove prohibitive to your budget. You don't really have to have one.

14) I recommend RIT if you get a transceiver. There are articles showing how to add RIT to many rigs. If the one you want doesn't happen to have RIT, check the annual indexes of the ham magazines (December issues) and other publications to see if there is an RIT modification for the rig you're considering.

15) If your choice of rig has a crystal calibrator, so much the better. You should have one. But if it doesn't, you can probably add one. Refer to the many amateur publications for details.

16) You *must* have the proper power supply for your rig. When buying a used rig, deduct from the going price if the power supply isn't included. You have to get one from somewhere, and they tend to cost more and are harder to come by when purchased individually. This is especially true of supplies for tube-type rigs. A 12-to-13-volt dc supply isn't as critical or as hard to find, though must still meet manufacturer's specifications for the supply for your rig.

17) You can buy a good speaker for a dollar and put it in some kind of enclosure if you have to. But deduct from the asking price if the receiver you want doesn't have a built-in speaker or a matching speaker cabinet.

18) User-installed modifications can be nice, but if they are poorly or improperly installed they may do more harm than good. Check workmanship carefully and see that it is marked in the schematic or manual with the unit.

19) You need the manuals and schematics. If they don't come with the rig, knock \$3 to \$5 off the price. You're going to have to order them and pay for them elsewhere.

20) If the rig looks bad, it's probably been taken poor care of. Beware. Also, you should learn to recognize the difference between fair wear on older equipment and downright mistreatment and abuse. Don't knock too much off the price for fair wear, but watch out for excessive wear or abuse.

21) Certainly don't get a rig that's too big and heavy for your flimsy operating table! However, if you have the room, some of those old, large rigs have a lot of good spark left in them, and they're cheaper, too!

22) Put your ear to the ground and listen. Reputations may or may not be fair. Often there is a simple modification that can cure the reputed problem with a certain rig. Ask around and see what you can find out. Write the manufacturer. He may be able to tell you what needs to be done to correct the problem.

What About Home-Brewed Equipment?

By now you should be well along in deciding what you want in a rig. However, there are still more things to consider before buying. Besides commercially-manufactured gear, you may come across home-brewed equipment for sale at hamfests. You should be especially cautious of home-brewed transmitters and receivers. You have no way of knowing the spectral purity of the transmitters or the sensitivity of the receivers. Often they don't even have a schematic so that you could troubleshoot any problems. Workmanship may be shoddy, though you can find beautifully-built home-brews on occasion.

It's a different story with home-brewed equipment such as antenna tuners, power supplies, and other simple-to-build items. Many times you can find a home-brewed antenna tuner for

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sale for less than the individual parts and cabinet are worth. You may find a home-brewed power supply for less than the transformer and capacitors in it are worth! These can be excellent buys, even if only for parts. But other items such as frequency counters, electronic keyers, and other complicated equipment can be a real headache if home-brewed.

(While on the topic of electronic keyers, I wholeheartedly discourage Novices from using electronic keyers. A good military surplus straight key can be purchased for as little as $3. That's hard to beat on a tight budget. Electronic keyers are difficult to operate properly and sound absolutely horrid when poorly operated. The money spent on one can be much better spent on a dummy load, coaxial switches, antenna and tuner parts, etc.)

Another item found at hamfests is ye olde 23-channel (or 40-channel) CB mobile rig. For $10 to $60 you can get an AM or SSB CB for conversion to 10 meters. That's a cheap way to get on the air if you don't mind being limited to a single band. If you're not afraid to try a CB-to-10-meter conversion, then you might even consider trying to home-brew your own CW transmitter. Especially if you are willing to try QRP work, your chances of home-brewing a good CW transmitter are good. If you can get help from another ham who is an experienced builder, you will find that help very valuable with such a project. And a home-brewed direct-conversion receiver isn't so bad either. So keep these options in mind if your budget is limited.

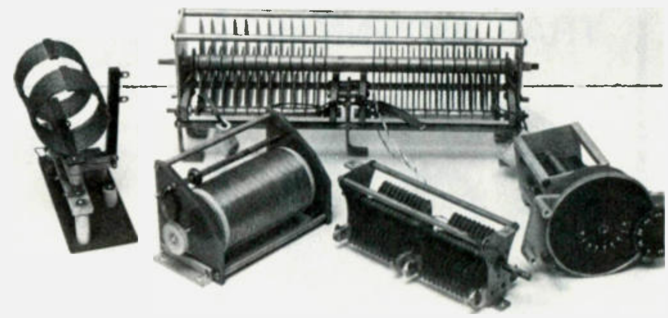
Anything you can home-brew for your station helps take the strain off your finances, and it gets you off on the right foot. Part of what being a ham is all about is being as self-sufficient as possible and not being afraid to try things yourself. Most everyone can build an antenna tuner, an swr meter or wattmeter, and other small items which can run into a lot of money if purchased commercially. I encourage Novices to home-brew as much of their station as their time, tools, workspace, courage, and talent will allow. If you've never tried it, you're missing part of the total experience.

I Think I'm Ready to Buy Now . . .

Don't forget that you have an option not to buy but to *swap*. You may be able to work out a good deal by swapping your old guitar for something you want. Or you could swap it for something you don't especially want which is worth more than your guitar and probably easier to sell. Then you could either swap that for something you *do* want, or you could sell it and use the money to get what you want.

When swapping or buying, a good rule to follow is: *Don't pay the asking price.* Even if the asking price is a fair price (according to your careful research and pre-planning), offer less! If your offer is accepted, fine. If not, you can probably agree on a price that's acceptable to both of you. But if you don't offer less, you'll never know if you could have gotten it for less.

Two dollars saved here and three dollars saved there will buy that five dollar item later. If you can't agree on a price that's acceptable to you, walk away. You may get called back, on your terms, before you've taken two steps! In any event, decide what your top dollar will be and don't pay more than that for it, even if it hurts. There are other fish in the sea. If you look on the next row of tables, you may find just what you want for less than you expected to pay.



When searching for goodies such as coils, roller inductors, and capacitors for your antenna tuner and other projects, don't pass up goodies like these because they are hidden inside something else. You very often will find the best bargains by rummaging around in and under *what looks like junk! Be curious when shopping at a hamfest! The large capacitor in this photo is over 14 inches long!*

Of course, there are exceptions to this rule. Once you've gained some experience, you can spot a real steal when you see it. In such cases, it's often better to pay the price. If you wait until later, the guy behind you will have already paid the price and gotten the bargain. So if you're *sure* it's a steal, buy it whether you need it or not. You can put it on your table and sell it for nearer the usual asking price and make a little money on it, giving you just that much more cash on hand to get what you really need. With a little experience, you can become a real horse trader and still turn an honest dollar. A real steal at $3 can be bought and resold at an honest fair market price of $10, and you'll undersell the crook at the other table trying to get $20 for the same thing!

Ready to Go . . . Did I Forget Anything?

If you can remember the guidelines I've covered here, you will feel much more confident about your ability to judge used gear and its real worth. You'll not only be able to spot a good buy, like an old-timer, you'll be able to spot the rip-offs and junk, too. You'll know the right things to look for and to ask about before laying out your hard-earned money.

Plan ahead and know what you want and how much you'll pay for it. And when you find what you're looking for, stick to your top dollar and don't pay a penny more! Never go off half-cocked. If you have planned and prepared well, the time you've put in before the hamfest will save you money and anguish when trying to decide what to do. Don't buy the first thing you see unless you *know* it is a real bargain. Take your reference along for double-checking when your memory becomes foggy.

Check out the condition of transmitters and such carefully. Outward appearance is a hint, but testing is the *only* way to spot problems. If possible, have an experienced friend help you. Just having someone assisting in spotting what you're after can be more help than you realize. If your friend knows about used equipment, he can help advise you on its con-

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The old and the new together: an Icom IC-730 transceiver sits atop an "odd couple." Left is a Hallicrafters HT-37 transmitter, vintage 1960, which listed for $450 new. At the right is a Hammarlund HQ-145-X receiver, vintage 1961, which listed for $285 new. Combined, they weigh 122 pounds! By comparison, the IC-730 will do everything the older pair will do, and comes in a package less than 4 × 10 × 11 inches! The 1981 vintage Icom lists for $829. The older pair can be purchased now for about half their original price.

dition. He may be more experienced at spotting little things that you may overlook.

Even without the help of a friend, if you have prepared well you won't be totally at the mercy of the other guy's honesty or dishonesty. If you talk and look as if you know what you're doing, there's less chance the seller will try to take you for a ride at your expense. The only thing better than the *knowledge* you should now have is real *experience*. But that, too, will come in time.

I haven't forgotten my first attempt at purchasing a receiver and transmitter. If you follow these guidelines and suggestions, you can avoid the mistakes I made. I learned the hard way, but you don't have to. So go get 'em, tiger. And good luck! ■

Acknowledgement

My thanks to N4BGU and KA4YBJ for their assistance in assembling equipment for photos. Also a special thank you to KZ4J for his photo of "The old and the new together."

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624 PHONE PATCH WITH VU METER	59.95	55.50
321 SATELLITE CONVERTER W/PREAMP	49.95	43.50
312 POLICE/FIRE/WEATHERBAND CONVERTER	59.95	55.50
308 SHORTWAVE CONVERTER 8 BAND TO AM RADIO	79.95	74.50
262 50 OHM LOAD 1KW AIR COOLED	49.95	46.50
260 AS ABOVE 300 WATTS	26.95	26.50
250 OIL FILLED 2KW DUMMY LOAD	29.95	29.50
812 SWR/WATT METER 14-170 MHZ	29.95	29.50
814 HF WATTMETER 2KW READS SWR DIRECTLY	49.95	46.50
102 24 HOUR DIGITAL CLOCK	32.95	32.50
200BX CRYSTAL CALIBRATOR	29.95	29.50
CPO-555 CODE PRATICE OSCILLATOR	19.95	19.50
202 RF NOISE BRIDGE	54.95	51.50
40T 40 MTR QRP TRANSMITTER	29.95	29.50
40V COMPANION VFO FOR 40T	29.95	29.50
1104 8 SOCKET RFI FILTERED POWER STRIP	59.95	55.50
1103 12 SOCKETS ONE FILTER FOR ALL	44.95	41.50

MFJ FILTERS

	REGULAR	SALE
752B DUAL TUNABLE SSB/CW ACTIVE FILTER	89.95	83.50
721 SUPER CW/SSB FILTER 2 WATT AMP	59.95	55.50
720 DELUXE SUPER CW FILTER	39.95	37.50

MFJ KEYERS

	REGULAR	SALE
406 DELUXE KEYER DOT AND DASH MEMORY	69.95	65.50
410 CURTIS KEYER PLUS CODE GENERATOR	129.95	121.50
481 GRANDMASTER MEMORY KEYER 2 50 CH MSGS	89.95	83.50
484 AS ABOVE UP TO 12 MSGS UP TO 100 CH MSGS	139.95	130.50
496 SUPER KEYBOARD 1K/256 CH BUFFER & MEM	339.95	279.50
53 AFSK PLUG IN MODULE FOR 496		39.50
54 LOOP KEYING PLUG IN MODULE		29.50
61 CLOCK MODULE FOR 496		29.50
494 CW BAUDOT ASCII KEYBD/50 CH BUFFER MEMORY	279.95	237.50

MFJ ANTENNA TUNERS

	REGULAR	SALE
989 3KW/ROLLER INDUCTOR/300W LOAD/MTR/BALUN	319.95	263.50
949B 300W TUNER/SWR WATTMTR/LOAD/ANT SW/BALUN	139.95	126.50
941C 300W TUNER/SWR WATTMTR/ANT SW/BALUN	89.95	86.50
944 300W TUNER/ANTENNA SWITCH		79.50
901 VERSA TUNER/COAX/RDM WIRES/BALANCE LINES		54.50

BENJAMIN MICHAEL

	REGULAR	SALE
1730P 24 HOUR DUAL CLOCKS LCD WALNUT CASE	69.95	67.50
1730 LCD 24 HOUR CLOCK	34.95	32.50

NYE VIKING

	REGULAR	SALE
MASTER KEY CW KEY W/ HEAVY BASE NAVY KNOB AND CABLE		24.50
310-003 STANDARD CW KEY W/ SWITCH		12.50
312-003 BRASS PLATED CW KEY W/ SWITCH		13.50
320-003 NICKEL PLATED HEAVY DUTY CW KEY W/SW		14.50
321-003 CHROME PLATED HEAVY DUTY KEY W/SW		22.50
322-003 BRASS VERSION OF 320-003		15.50
404-002 CODE PRATRICE SET W/KEY		23.50
SSK-1 DUAL PADDLE SQUEEZE KEY WITH BASE		29.50
SSK 1CP CHROME-PLATED SSK-1		38.50
SWR-001 AUTOMATIC SWR WATT METER		99.50
046-003 PHONE PATCH WITH SPEAKER		67.50

NYE VIKING TUNERS

	REGULAR	SALE
MB II -01 3KW BALUN SWR/WATT METER ROTOR INDUCTER	335.00	292.50
MB II -02 AS ABOVE WITHOUT BALUN	305.00	267.50
MB II -03 BALUN KIT		32.50

PALADIN

	REGULAR	SALE
1751 TESTER 6 440VAC DC LEDS PROBE STYLE		19.50
1758 AS ABOVE PLUS CONTINUITY AND AUDIBLE		34.50
1752 CONTINUITY/VOLTAGE TESTER		18.50
1208 COAX STRIPPER RG58 RG59 RG8 ETC		14.50
1115 COMPACT SELF ADJ WIRE STRIPPERS 16 30AWG		32.50
1820 ROUND CABLE SLITTER UP TO 4/0 CABLE		19.50
1700 DESOLDERING TOOL PLUNGER STYLE DELUXE		16.50
1701 AS ABOVE WITH MINIATURE TIP		16.50
2712 REPLACEMENT TIPS FOR 1700		2.50
2714 REPLACEMENT TIP FOR 1701		2.50

FREE
WITH PURCHASE OF 3-TBA ANTENNA

ALLIANCE HD-73
HEAVY DUTY ROTOR $159.95 Value

3-TBA Tri-Band Beam
10 - 15 - 20 METER
Fixed Station Antenna

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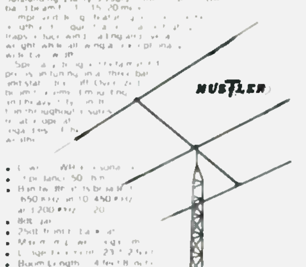

$319.95

TUFTS ELECTRONICS

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MOR GAIN

HALF-SIZE FULL PERFORMANCE
Multi-Band HF Communications Antennas

MOR GAIN HD Dipoles
- One half the length of conventional half wave dipoles
- Multi band Multi frequency
- Maximum efficiency no traps loading coils or stubs
- Fully assembled and pre tuned no measuring no cutting
- All weather rated 1 KW AM 2.5 KW CW or PEP SSB
- Proven performance more than 10,000 have been delivered
- Permit use of the full capabilities of today's 5 band xcvrs
- One feedline for operation on all bands
- Lowest cost highest performance antenna on the market today
- Highest performance for the Novice as well as the Extra Class Op

MOR GAIN

	REGULAR	SALE
40 20 HD A 40 20 MTR DIPOLE 36 FT W/SO239	90.00	81.50
80 40 HD A 80 40 + 15 MTR DIPOLE 69 FT W/SO-239	109.50	99.50
80 40 HD A NT AS ABOVE TUNED FOR NOVICE	109.50	99.50
75 40 HD A 75/40 MTR DIPOLE 66 FT W SO 239	104.75	94.50
75 40 HD A SP AS ABOVE TUNED TO 3900	104.75	94.50
75 20 HD/A 75/40 20 MTR DIPOLE 66FT W/SO 239	121.00	109.50
75 20 HD A SP AS ABOVE TUNED TO 3900	121.00	109.50
75 10 HD A 75 40/20 15/10 MTR DIPOLE 66FT SO 239	141.00	127.50
75 1 HD A SP AS ABOVE TUNED TO 3900	141.00	127.50
80 10 HD A 80/40/20/15/1 MTR DIPOLE 69 FT SO239	147.00	132.50
8 1 HD A NT AS ABOVE TUNED FOR NOVICE	147.00	132.50

RECORD-A-CALL

	REGULAR	SALE
AUTO 60A AUTOMATIC PHONE ANSWERING	149.95	136.50
VOX 70A AS ABOVE WITH VOX UNLIMITED MSG CAPACITY	199.95	179.50
REMOTE 80A ALL ABOVE PLUS REMOTE PLAYBACK FOR MSGS	299.95	257.50
REMOTE 90A ALL ALBOVE PLUS REMOTE OUTGOING MSG CHG	369.95	311.50
OE12L ENDLESS LOOP OUTGOING TAPE 12 TO 120 SEC		8.50
IC30P LEADERLESS INCOMING MSG TAPE 30 MIN		3.50
IC60P AS ABOVE 60 MIN		5.50
RK 1 EXTRA REMOTE KEY FOR 80A SPECIFY FREQ		29.50

ROBOT RESEARCH

	REGULAR	SALE
400 SLOW SCAN TV CONVERTER	795.00	699.50
800 CW/RTTY KEYBOARD SPLIT SCREEN MEMORY ETC	895.00	799.50
SANYO VM 4209 9 INCH B&W MONITOR	245.00	199.50
VC 1600X B&W TELEVISION CAMERA	295.00	249.50

ROHN TOWER

	REGULAR	SALE
25G 10 FT TOWER SECTION		45.50
25AG-3 TOP SECTION W/SUPPORT TUBE 2 1 4 OD	83.50	62.50
25AG 4 TOP SECTION W/BEARING PLATE TOP	83.50	62.50
SB-25G SHORT BASE TO MOUNT IN CONCRETE	23.95	20.50
SBH-25G HINGED SHORT BASE FOR CONCRETE	49.50	40.50
BPC 25G CONCRETE BASE PLATE	44.50	36.50
BPH-25G HINGED CONCRETE BASE PLATE	83.50	68.50
3 8X12"PP PIER PIN NEEDED WITH CONCRETE BASES		4.50
1/2X12"BB BASE BOLT FOR HINGED BASE PLATE		4.50
FR-25G FLAT ROOF MOUNT	47.00	39.50
PR-25G PEAK ROOF MOUNT	39.00	33.50
RP 25G ROTOR POST		7.50
AS-25G ACCESSORY SHELF (ROTOR PLATE)		13.50
GA-25G GUY BRACKET WITH TORQUE ARMS	27.50	24.50
GB 25G GUY ASSEMBLY	17.00	15.50
HBU UNIVERSAL HOUSE BRACKET 6 TO 30	23.95	20.50
TB 50 BUSHING FOR 25AG-3		5.50
TB-3 THRUST BEARING	67.00	55.50
WP 25G WORK PLATFORM	34.00	29.50
EF-2545 ERECTION FIXTURE	193.00	165.50
506 GUY LINE INSULATOR		5.50
M200 10 FT STEEL MAST 2 INCH OD	27.95	24.50
M200H 10 FT STEEL MAST HEAVY WALL 2 IN OD	49.50	41.50
1 4 TH THIMBLES FOR GUY WIRE		0.50
3/16 CCM 3 16 CABLE CLAMPS FOR GUY CABLE		0.50
3/8 TB EXE TURNBUCKLE EYE AND EYE		10.50
3 8 TB EXJ TURNBUCKLE EYE AND JAW		14.50
3/16 EHS GUY WIRE 3/16 STEEL PER 100 FT		19.50
25G 50FT 50 FT TOWER PACKAGE WITH HOUSE BRACKET	410.25	299.50
25G 50FT G 50 FT TOWER PACKAGE GUYED	660.05	499.50
TRT 36 3 FT STEEL TRIPOD		13.50
TRT-60 5 FOOT TRIPOD STEEL		17.50
TRT 112 10 FOOT TRIPOD STEEL		39.50
SAB 25G 2 SIDE ARM BRACKET	39.95	33.50
UHF 25G SIDE ARM EXT FOR SMALL ANT (2 NEEDED)		9.50
BAC-253 5 FT CONCRETE GUY ANCHORS AND EQUALIZERS	22.95	19.50
6 TOWERS ANY COMB OF 6 TWR PKGS SAVE 20%	0	0.50
H30 30 FT TELESCOPING STEEL MAST	37.95	39.50
GR304 3/8 4 FOOT GROUND ROD		4.50
GR306 3/8 6 FOOT GROUND ROD		6.50

SHURE MICROPHONES

	REGULAR	SALE
444D DUAL IMPEADENCE DESK MIC W CALL LETTERS	62.00	59.50
526T DYNAMIC AMPLIFIED DESK MIC	87.00	79.50
414C CONTROLLED MAGNETIC HAND MIC COIL CORD	46.00	42.50

SONY SHORTWAVE

	REGULAR	SALE
ICF 2001 GEN COVG RCVR/DIGITAL TUN/LCD SCAN/MEM	349.95	299.50
ICF-6800W 31 BAND/DIGITAL DISPLAY/GEN COVG RCVR	699.95	599.50
ICF 7600 7 BAND COMPACT SW/AM/FM HIGH QUALITY RCVR	159.95	159.50
ICF-5M HIGH QUALITY AM BROADCAST RECEIVER W/FM	89.95	72.50

SONY WALKMANS

	REGULAR	SALE
WM 1 PORT STEREO CASSETTE W/LIGHT WGT HEADSET	99.95	97.50
WM 2 ULTRA SMALL AS ABOVE PLUS 60 HR PLAYBACK	179.95	157.50
TCS-310 PORT STEREO LGT WGT HDSET RECORD & PLAY	179.95	157.50
M 1000 MICRO CASETTE STEREO RECORD & PLAY/HDSET	199.95	174.50
SRF 40W FM WALKMAN STEREO LGHT WGT HEADSET	89.95	86.50

TELEX HEADSETS

	REGULAR	SALE
PRO COMM 300 LIGHT WEIGHT BOOM MIC HEADSET HI LO IMP		89.95
PRO-COMM 200 DUAL MUFF BOOM MIC HEADSET HI/LO IMP	99.95	91.50
FS 1 FOOT SWITCH FOR PROCOMM HEADSETS		28.50
HS 1 HANDSWITCH FOR PROCOMM HEADSETS		15.50
PC 100 8-200 OHMS HEADSET		16.50
SHL 610 2000 OHM HEADSET		12.50
C 1210 DUAL MUFF HEADSET 3 20 OHMS		29.50
C-1320 DUAL MUFF HEADSET 3 20 OHMS	41.95	38.50
CS 7 DUAL MUFF 600 OHM HEADSET	49.95	45.50

XCELITE TOOLS

	REGULAR	SALE
99CG EXTRA THIN LONG NEEDLE NOSE CUSHION GRIP		11.50
87CG VERY FINE NEEDLE NOSE CUSHION GRIP		9.50
78CG MIDGET SEMI FLUSH CUTTER CUSHION GRIP		11.50
90CG SEMI FLUSH CUTTING DIAGONAL CUSHION GRIP		8.50
99SM 23PC KIT CUTTERS PLIERS SCREW NUTDRIVERS		33.50
99SMX AS ABOVE WITH STRIPPERS AND SOLDER IRON		46.50
SPT 11 SCREWDRIVER SET 2 PHILLIPS 4 SLOTTED		14.50
TK1 11 11 PC KIT PLIERS CUTTERS DRIVERS CASE		41.50
75C COMBINATION SLIP JOINT PLIERS 5		4.50
104CG WIRE CUTTER STRIPPER ALL SIZES DELUXE		6.50
15C LEATHER TOOL HOLSTER		17.50
TC 200ST BRIEFCASE TOOL KIT 1 TOOLS 1 DRIVERS	20 5	155.50
TC 150ST AS ABV 14 TOOL 14 DRIVERS SOLDER IDPT	332.1	241.50
TC 100ST AS ABV 51 HANDTOOLS 11 DRIVERS & MUM	408.17	287.50

OUR RETAIL STORE PRICES MAY BE SLIGHTLY HIGHER ON SOME ITEMS

TEN-TEC INC

	REGULAR	SALE
ARGONAUT QRP XCVR SSB/ CW 80-10 METERS	469.00	399.50
ARGOSY SSB/CW 80-10 METERS	549.00	479.50
OMNI DIGITAL 160-10 METERS XCVR	1289.00	1079.50
DELTA SSB/CW 160-10 XCVR	869.00	749.50
227 ANTENNA TUNER		79.50
228 ANT TUNER/ SWR BRIDGE		95.50
225 SUPPLY 110/230VAC FOR ARGOSY	139.95	125.50
280 DELUXE SUPPLY 110/230VAC FOR XCVRS	199.00	186.50
HERCULES 1 KW LINEAR SLD STATE&SUPPLY	1575.00	1279.50
234 SPEECH PROCESSOR	139.95	130.50
214 ELECTRET MIC FOR 234		39.50
215P MIC FOR XCVRS		29.50
243 REMOTE VFO FOR OMNI	189.95	177.50
283 REMOTE VFO FOR DELT	189.95	184.50
209 300 WATT DUMMY LOAD		36.50
648 ULTRAMATIC DUAL PADDLE KEYER		85.50
670 SINGLE PADDLE KEYER		39.50
208A NOTCH CW FILTER FOR ARGONAUT		59.50
OMNI/HERCULES SPECIAL PACKAGE	3628.00	2599.50
229 2 KW ANTENNA TUNER W/SWR BRIDGE MEAN	299.00	235.50

TRAC ELECTRONICS

	REGULAR	SALE
TE-122 CMOS ELECTRONIC KEYER	45.95	43.50
TE 133 CMOS ELECTRONIC KEYER	55.95	52.50
TE 144 DELUXE CMOS ELECTRONIC KEYER	65.95	63.50
TE-301 MESSAGE MEMORY KEYER	75.95	71.50
TE-284 DELUXE MESSAGE MEMORY KEYER	89.95	83.50
TE-292 CHAMPION MESSAGE MEMORY KEYER	125.95	119.50
TE-424 TRAC ONE CW PROCESSOR	89.95	83.50
TE-464 CW PROCESSOR AND CMOS KEYER DELUXE	119.95	109.50

TRIONYX IND

	REGULAR	SALE
TR-1000 10HZ TO 600MHZ .05 PPM 7 DIGIT COUNTER	159.95	149.50

VAN GORDEN ENG

	REGULAR	SALE
D-80 80 METER DIPOLE 130 FT		28.50
D-40 40/15 METER DIPOLE 66 FT		25.50
D-20 20 METER DIPOLE 33 FT		24.50
D-15 15 METER DIPOLE 22 FT		23.50
D-10 10 METER DIPOLE 16 FT		22.50
SD-80 80 METER TRAP DIPOLE 90 FT		31.50
SD-40 40 METER TRAP DIPOLE 45 FT		29.50
PD-8010 80 THRU 10 METER FOLDED DIPOLE 130 FT		39.50
PD-4010 40 THRU 10 METERS FOLDED DIPOLE 66 FT		33.50
PD-8040 80/40/15 METER FOLDED DIPOLE 130 FT		35.50
PD-4020 40/20/15 METERS FOLDED DIPOLE 66 FT		29.50
HI-Q BALUN HI-Q BALUN		10.50

VIBROPLEX

	REGULAR	SALE
IAMBIC DELUXE CHROME PLATED IAMBIC DUAL PADDLE	68.95	65.50
IAMBIC STND IAMBIC STANDARD DUAL PADDLE	56.95	50.50
VIBRO-KEYER DELUXE CHROME PLATED PADDLE	68.95	65.50
VIBRO-KEYER STANDARD SINGLE PADDLE	56.00	50.50
PRESENTATION SUPER DELUXE	99.95	89.50
ORIGINAL DELUXE KEY	69.95	64.50
ORIGINAL STANDARD KEY	56.95	52.50
LIGHTING BUG DELUXE	69.95	64.50
LIGHTING BUG STANDARD KEY	56.95	52.50
CHAMPION AUTOMATIC KEY	63.95	57.50

VO COMM PRODUCTS

	REGULAR	SALE
5/8 WHIP COLLAPSIBLE 19" WHIP FOR 2 METER WALKIES		24.50
2M MINI-DUK 2 METER MINI-DUK ANTENNA BNC		14.50
2 MTR MINI-DUK 2 METER MINI-DUK ANTENNA 5/16 THREADED		12.50
2C025 2 MTR POWER BOOSTER 2 TO 25 WATTS	84.95	79.50
2C050 2 MTR POWER BOOSTER 2 TO 50 WATTS	124.95	113.50

UNADILLA/REYCO

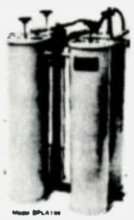
	REGULAR	SALE
W2AU BALUN 1 1 2KW 3-40 MHZ BALUN		17.50
W2AU BALUN 4-1 AS ABOVE FOR FOLDED DIPOLES		17.50
W2AU/W2VS ANT 5 BAND ANTENNA KIT 110 FEET LENGTH		54.50

WELLER

	REGULAR	SALE
EC-1000 SOLDER STA/TEMPL VARI 10 DEG STEPS	115.00	84.50
EC-2000 AS ABOVE WITH LED TEMP READOUT	145.00	115.50
8200 ALL PURPOSE SOLDER GUN 140/100 WATTS	19.07	16.50
D-550 ALL PURPOSE SOLDER GUN 260/200 WATTS	25.95	22.50
WC-100 CORDLESS RECHARGEABLE IRON FINE PT TIP	32.10	27.50
TCP12 12 VOLT SOLDER IRON W/BATT CLIPS	38.13	32.50
SP23 25 WATT SOLDER IRON PENCIL TIP	7.83	6.50
SP40 40 WATT SOLDER IRON PENCIL TIP	10.00	8.50
SP120 HEAVY DUTY SOLDER IRON 120 WATTS	18.15	15.50
WP-25 PROFESSIONAL SOLDER IRON 700 DEG 25 WATT	14.38	13.50
WP-40 PROFESSIONAL SOLDER IRON 700 DEG 40 WATT	17.67	15.50
WP12 PENCIL THIN SLDER IRON 700 DEG 12 WATT	16.44	14.50
W60 CONT OUTPUT IRON TIPS FOR 600/700/800 DD	37.47	35.50
WTCPN TEMP CONTROLLED STA TIPS 600-800 DEGS	76.26	60.50
MP-137 MINIATURE CONTROLLED STATION 600-800 DEG	79.55	63.50
8200 KIT INCLDS GUN/TIPS/SOLDER BRUSH/TOOL/SLDR	22.24	19.50

BANDPASS-REJECT DUPLEXER
DPLA-144 FOR 144-174 MHz

Also available for 54, 220, 450 MHz.



WACOM

These Band Pass Band Reject Circuit duplexers include the use of an exclusive circuit developed for WACOM, which provides superior suppression of spurious sideband noise between and adjacent to the duplex frequencies. When used with a high Q filter, the Band Pass Band Reject Circuit provides frequency response curves with bandpass cavity characteristics at the frequency to be passed and band-reject cavity characteristics at the frequency to be attenuated.

WACOM DUPLEXERS

	REGULAR	SALE
WP 639 2 METERS 350 WATTS 6 5 CAVATIES 8000 ISOL	529.00	499.50
WP-652 AS ABOVE FOR 220MHZ BOTH INCLUDE CABLES	529.00	499.50

YAESU ELECTRONICS

	REGULAR	SALE
FT-902DM 160-10 METER XCVR W/MEMORY AND METER	1335.00	1299.50
FV-901DM SYNN VFO	415.00	368.50
FC-902 ANTENNA TUNER	199.00	186.50
SP-901P SPEAKER PHONE PATCH		76.50
SP-901 REMOTE SPEAKER		35.50
FTV-901R TRANSVERTER 6/2MTR MODULE	389.00	343.50
6MTR MODULE MODULE FOR FTV-901R		110.50
70CM MODULE MODULE FOR FTV-901R	258.00	231.50
YO-901P MONITOR SCOPE W/PANADAPTER	515.00	454.50
YR-901 CW RTTY READER (VIDEO MONITOR EXTRA)	730.00	643.50
YK-901 ASCII KEYBOARD	175.00	163.50
FT-107M 160/10 MTR/SLD ST/DIGITAL/MEMORY/AC DC	1149.00	999.50
FP-107E EXTERNAL AC SUPPLY FOR 107	145.00	135.50
FP-107 INTERNAL AC SUPPLY FOR FT-107	139.00	131.50
FC-107 ANTENNA TUNER	150.00	140.50
FV-107 EXTERNAL VFO	150.00	140.50
SP-107P SPEAKER PHONE PATCH		65.50
SP-107 EXTERNAL SPEAKER		29.50
FTV-107R TRANSVERTER W/2 MTR MODULE	284.00	250.50
FT-101ZD 160-10 MTR XCVR DIGITAL AFF WARC	925.00	839.50
FV-101Z EXTERNAL VFO	175.00	162.50
DC-101ZD DC CONVERTER		60.50
AM-101Z AM UNIT FOR FT101ZD		27.50
FM-101Z FM UNIT FOR FT101ZD		56.50
FT-707 80-10 MTR COMPACT XCVR FOR MOBILE/BASE	810.00	739.50
FV-707DM MEMORY/SCAN VFO	279.00	265.50
FP-707 AC POWER SUPPLY	162.00	152.50
FC-707 ANTENNA TUNER		139.50
MMB-2 MOBILE BRACKET		20.50
XF8.9HC 600 HZ FILTER FOR HF RIGS		45.50
XF8.9HCN 350 HZ CW FILTER FOR HF RIGS		50.50
XF8.9B AM FILTER FOR HF RIGS		45.50
YH-77 LIGHTWEIGHT HEADSET FOR HF LRIGS		15.50
QTR-24D QUARTZ WORLD CLOCK		49.50
YS-200 200W SWR/WATTMETER 8000 TO 150MHZ		79.50
YS-2000 2000W SWR/WATTMETER 8000 TO 60MHZ		98.50
YP-150Z DUMMY LOAD WATTMETER	135.95	128.50
YC-1000L LOGGING DATA PROCESSOR	1800.00	1371.50
FA-9 COOLING FAN		22.50
FRG-7700 DIGITAL SYNN VLF TO 30MHZ RCVR	549.00	499.50
MU 7700 MEMORY UNIT	149.95	140.50
FRT-7700 ANTENNA TUNER		59.50
FF-5 VLF LOW PASS FILTER		20.50
DC-7700 DC ADAPTER KIT		6.50
FRV-7700 118-150 MHZ CONVERTER	149.00	140.50
YE-7A HAND MIC FT101ZD		17.50
YD-148 DESK MIC HI/LO FOR FT101ZD		32.50
YM-34 DESK MIC HI/LO FOR 107/707		31.50
YM-35 SCAN MIC 107/707		20.50
YM-36 HAND MIC 107/707		20.50
YM-37 HAND MIC 107/707		10.50
YM-38 DESK SCAN MIC 107/707		39.50
FT-ONE ALL BAND XCVR CPU GEN CVG RCVR KEYER ETC	2995.00	2400.50
XF8.9KC 600HZ 8 POLE FILTER FOR FT-ONE		49.50
XF8.9KCN 300 HZ 8 POLE FILTER FOR FT ONE		49.50
XF8.9KA 6 KHZ 8 POLE AM FILTER FOR FT-ONE		49.50
XF10.7KC 800 HZ 6 POLE 3RD IF FILTER FOR FT-ONE		44.50
RAM UNIT MEMORY BACK-UP BOARD FOR FT-ONE		19.50
FT-ONE CURTIS 8044 KEYER UNIT FOR FT-ONE		69.20
DC-CABLE DC CABLE FOR FT-ONE		14.50
FV-101DM SYNN SCANNING MEMORY VFO FOR FT-101ZD	359.00	316.50

YAESU VHF/UHF

	REGULAR	SALE
FT-208R 2 MTR SYNN WALKIE LCD MEMORIES TTP SCAN	359.95	308.50
FNB-2 BATT PACK		29.50
YM-24A SPEAKER MIC		39.50
NC-7 BASE CHARGER		59.50
NC-8 RAPID BASE CHARGER	99.95	82.50
PA-3 MOBILE ADAPTER CHARGER		39.50
LCC-8 LEATHER CASE		35.50
FT-290R ALL MODE 2 WATT 2MTR PORT/MOBILE XCVR	399.00	359.50
NC-11B WALL CHARGER		9.50
LCC-90 CARRY CASE		38.50
NICD NICAD C CELLS		5.50
FT-720RVH 25W 2MTR FM MOBILE SCAN MEMORY	429.00	349.50
720-RU 70CM 10W RF DECK ONLY	252.00	227.50
S-72 SWITCH BOX FOR MULTIPLE RF DECKS		88.50
MMB-3 RF DECK MOBILE MOUNT		8.50
E-72S SHORT CABLE		35.50
E-72L LONG CABLE		40.50
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✓See List of Advertisers on page 130

SOCIAL EVENTS

from page 61

22nd annual ARRL-approved Lafayette Amateur Radio Hamfest on Saturday and Sunday, March 13-14, 1982, at the Evangeline Downs Racetrack Club House facility, located directly off Highway 167, five miles north of Lafayette LA.

WINCHESTER IN
MAR 14

The Randolph Amateur Radio Association will hold its 3rd annual hamfest on Sunday, March 14, 1982, from 8:00 am to 5:00 pm at the National Guard Armory, Winchester IN. Tickets are $2.00 in advance and $3.00 at the door. Table space is $2.50 and table space with table is $5.00. Setup times are 6:00 pm to 8:00 pm on Saturday and 6:00 am to 8:00 am on Sunday. For reservations or additional information, contact RARA, PO Box 203, Winchester IN, or phone W9VJX at (317)-584-9361.

MARSHALL MI
MAR 20

The Southern Michigan ARS and the Calhoun County Repeater Association will hold the 21st annual Michigan Crossroads Hamfest on Saturday, March 20, 1982, at the Marshall High School, Marshall MI. Doors will open at 7:00 am for exhibitors and 8:00 am for buyers and lookers. Free parking, carry-in help, and full food service will be available at the school. Table space is $.50 per foot and will be reserved until 9:00 am. Talk-in on .07/.67 and .52. For more information, write SMARS, PO Box 934, Battle Creek MI 49016, or call Earl Goodrich at (616)-781-3554.

GRAYSLAKE IL
MAR 20

The Civil Air Patrol will hold its second annual spring hamfest on Saturday, March 20, 1982, at Lake County Fairgrounds, US 45 and 120, Grayslake IL. Donations are $2.00 and tables are $3.00. For more information and reservations, send an SASE to Captain Ed Rehm W9NXR, 637 Emerald Street, Mundelein IL 60060.

FORT WALTON BEACH FL
MAR 20-21

The Playground Amateur Radio Club will hold its 12th annual swapfest on Saturday, March 20, 1982, from 8:00 am to 4:00 pm and Sunday, March 21, 1982, from 8:00 am to 3:00 pm at the Okaloosa County Fairgrounds, Fort Walton Beach FL.

IRVINGTON NJ
MAR 21

The Irvington RAC Hamfest will be held on Sunday, March 21, 1982, from 9:00 am to 4:00 pm at the P.A.L. Building, 285 Union Avenue, Irvington NJ. Take the Garden State Parkway to exit 143 north 143B south. Admission is $1.00 and tables are $3.00. Refreshments will be available. Talk-in on .34/.94 and .52. For additional information, call Ed WA2MYZ at (201)-687-3240 or write IRAC, P.A.L. Building, 285 Union Avenue, Irvington NJ 07111.

JEFFERSON WI
MAR 21

The Tri-County Amateur Radio Club will hold its annual hamfest on March 21, 1982, from 8:00 am to 3:00 pm at the Jefferson County Fairgrounds, Jefferson WI. Tickets are $2.50 in advance and $3.00 at the door. Tables are $2.50 in advance and available at the door for $3.50. Parking is free and there will be plenty of food, beer, and prizes. The grand prize will be awarded at 2:30 pm. Talk-in on 146.52 and 146.22/.82. For more information, advance tickets, and tables, send an SASE to Horace Hilker K9LJM, PO Box 204, 261 E. High Street, Milton WI 53563.

COLUMBUS GA
MAR 27-28

The Columbus Amateur Radio Club will hold its annual hamfest on March 27-28, 1982, at the Columbus Municipal Auditorium, Victory Drive (US 280) at the south end of 4th Avenue (Highway 27), Columbus GA, from 9:00 am to 5:00 pm on Saturday and from 9:00 am to 3:30 pm on Sunday. Features will include a flea market, free overnight parking at hamfest site for self-contained campers, free coffee and hot chocolate, inside exhibits, and many prizes (including a main prize of a Radio Shack TRS-80 Mod III). Ticket donations are 6 for $5.00 or 13 for $10.00. To reserve inside table space at $3.00 per table per day, contact Jeannie Hunting K4RHU, 2701 Peabody Avenue, Columbus GA 31904, or call (404)-322-7001. Talk-in on .01/.61 N4BJZ/R. For additional information, write CARC, PO Box 6336, Columbus GA 31905.

ST. LOUIS MO
MAR 27-28

The Gateway Amateur Radio Assn. will hold ARCH '82, an official ARRL convention, March 27-28, 1982, at the Chase Park-Plaza Hotel, St. Louis MO. Advance tickets are $3.00. Features for the amateur radio operators and computer hobbyists will include a flea market, workshops, forums, major national exhibitors and dealers, prizes, ladies' activities, and a Saturday evening banquet. Special hotel accommodations will be available. For additional information, contact Gateway Amateur Radio Assn., PO Box 8432, St. Louis MO 63132, or phone (314)-361-4965.

MADISON OH
MAR 28

The Lake County Amateur Radio Association will hold its fourth annual Lake County Hamfest on Sunday, March 28, 1982, at Madison High School, Madison OH. Admission is $2.50 in advance (send an SASE before March 14, 1982) and $3.50 at the door. A table and display space is $5.00 for a 6-foot table and $6.50 for an 8-foot table. A table donation with a reservation will hold a space until 10:00 am. There will be plenty of free parking, commercial exhibits for ham and computerist, an inside flea market, door prize drawings hourly, and a main prize drawing at 3:05 pm. Hours will be from 8:00 am to 4:00 pm and vendors may set up at 6:00 am. Overnight accommodations are available within a 15-minute drive. Talk-in on 147.81/.21. Check-in on 146.52/.52. For further information or reservations, send an SASE to Lake County Hamfest Committee, 1326 East 349th Street, Eastlake OH 44094, or call (216)-953-9784.

GRAYSLAKE IL
MAR 28

The Libertyville and Mundelein Amateur Radio Society (LAMARS) will hold its annual hamfest on March 28, 1982, at the Lake County Fairgrounds, located at the intersection of Rtes. 120 and 45, Grayslake IL. Tickets are $2.00 in advance or $2.50 at the gate. Doors open at 8:00 am. Hot food and drink will be available, as well as 9-foot tables at $5.00 per table. Prizes,

CORRECTIONS

Readers who build the VE3CYC ATV project beginning on page 20 of this issue should include the following changes to make the converter more stable and less sensitive to antenna and feedline changes:

1) Install the MRF901 transistors from the foil side of the board.

2) Referring to Fig. 8 in the article, add a 68-Ohm resistor directly across the 440-MHz input cable on the circuit board. Solder one end of the resistor to the stripline near the center conductor of the coax. The other end of the resistor should be soldered directly to the circuit board ground foil.

Jeff DeTray WB8BTH
***73 Magazine* Staff**

The schematics in "TVRO Signal Source" (page 46, January, 1982), are missing a resistor between the +12-V terminal and the collector of the oscillator transistor. This part should be added to Figs. 1 and 2.

Tim Daniel N8RK
***73 Magazine* Staff**

Paul Grupp KA1LR's review of the AEA MBA Code Reader in the January, 1982, issue of *73* mentioned that a cure is available to reduce noise emitted by the unit's microprocessor. AEA informs us that this cure is very simple: Just put a bypass capacitor at the power-line input.

Tim Daniel N8RK
***73 Magazine* Staff**

✓*See List of Advertisers on page 130*

including a synthesized HT, will be awarded to licensed amateurs. Talk-in on 146.94 and 147.63/.03 (Waukegan repeater). For reservations or tickets, write WA9HRN, Chairman, LAMARS, PO Box 751, Libertyville IL 60048 and include an SASE.

SEWARD PA
MAR 28

The Conemaugh Valley Amateur Radio Club will hold its fifth annual hamfest on March 28, 1982, from 8:00 am until 4:00 pm at the Sandy Bottom Sportsman's Club, Seward PA, approximately ten miles northwest of Johnstown on Rte. 56. There will be plenty of food and refreshments available, as well as many good prizes. Talk-in on 146.34/.94.

BALTIMORE MD
MAR 28

The Baltimore Amateur Radio Club, Inc., will hold the 1982 Greater Baltimore Hamboree and Computerfest on Sunday, March 28, 1982, beginning at 8:00 am at the Maryland State Fairgrounds Exhibition Complex located at exit 17 of I-83, three miles north of I-695 (near Baltimore) in Timonium MD. Admission is $3.00. Amateur radio, personal computer, and small business computer dealers will be featured at the dealers' display area. There also will be an indoor flea market, an outdoor hard-surface tailgate area, food service, free parking, hourly door prizes, and cash grand prizes. Talk-in on .34/.94 and .07/.67. For more information and table reservations, contact GBH&C, PO Box 95, Timonium MD 21093, or call (301)-561-1282. For a recorded announcement, dial (301)-HAM-TALK.

TRENTON NJ
MAR 28

The Delaware Valley Radio Association will hold its annual flea market on Sunday, March 28, 1982, from 8:00 am to 4:00 pm at the New Jersey National Guard 112th Field Artillery Armory, Eggerts Crossing Road, Lawrence Township NJ. Advance registration is $2.50; $3.00 at the door. There will be indoor and outdoor flea market areas, door prizes, raffles, refreshments, and FCC examinations. Sellers are asked to bring their own tables. Talk-in on 146.07/.67 and 146.52. For further information, write DVRA, PO Box 7024, West Trenton NJ 08628.

FRAMINGHAM MA
APR 4

The Framingham Amateur Radio Association will hold its 6th annual spring flea market on Sunday, April 4, 1982, at the Framingham Police Station drill shed, Framingham MA. Admission is $2.00. Sellers' tables are $8.00 before March 27, and $10.00 after that date. Doors will open at 10:00 am but sellers may begin setting up at 8:30 am. Radio equipment, computer gear, food, and bargains will be available. Talk-in on .75/.15 and .52. For more information, contact Ron Egalka K1YHM, 3 Driscoll Drive, Framingham MA 01701, or phone (617)-877-4520.

GRAND JUNCTION CO
APR 17

The Grand Mesa Repeater Society will hold the third annual Western Slope Swapfest on Saturday, April 17, 1982, from 10:00 am to 4:00 pm at the Plumbers and Steamfitters Union Hall, 2384 Highways 6 and 50, Grand Junction CO. Admission is free and swap tables are $5.00. Features will include an auction, door prizes, and refreshments. Talk-in on .22/.82. For further information, send an SASE to Dale Ellis KD0M, 588 Starlight Street, Grand Junction CO 81501, or call (303)-434-5981.

RALEIGH NC
APR 18

The Raleigh Amateur Radio Society will hold its 10th annual hamfest on Sunday, April 18, 1982, from 8:00 am to 4:00 pm at the Crabtree Valley Shopping Center parking area, Raleigh NC. Admission is $4.00; there will be a table charge for exhibitors and flea market displays. First prize is a choice of a Kenwood TS-830S transceiver or an Icom IC-251A multi-mode 2m transceiver with a Mirage B108 80-Watt amplifier. A hospitality room and party will be held the preceding evening from 7:00 pm to 10:00 pm. Talk-in on 146.04/146.64 and 146.28/146.88 both days. For more information, please contact Ken Boggs KB4RV, 8704 Cliff Top Ct., Raleigh NC 27612, or phone (919)-782-8646.

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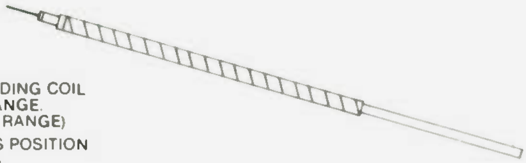

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HAL 567-12: single line in, 12 lines out, complete with 2-sided plated-through G-10 board and all components. Uses seven 567's and three 7402's **$39.95**

HAL 567-16: single line in, 16 lines out, complete with 2-sided plated-through G-10 board and all components; includes 22-pin edge connector. Uses eight 567's and four 7402's. (See construction article in April 1981 Radio & Electronics for complete writeup.) **$69.95**

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HAL ECD-12: 3 × 4 twelve-character encoder utilizing the ICM 7206 Intersil chip. Kit comes complete with both LED and audio-coupled outputs (speaker included). With aluminum anodized case **$29.95**

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✓See List of Advertisers on page 130

NEW PRODUCTS

Kenwood's Quad Bander all-mode transceiver.

DX PREFIX LIST DX-1

The DX Prefix List is a custom-printed list of 367 separate places, including all of the current ARRL DX countries. Each location is calculated by pinpointing two locations. The DX Prefix List has 10 unique columns of information. First the list is arranged alphabetically and numerically by prefix. The next column contains the name of the country. The third column describes each CQ continent, while the fourth column lists the CQ zone. The ITU zone is listed in the fifth column. Columns six and seven give the short and long path distances in statute miles. The eighth and ninth columns provide bearings for short and long path. The rest of each line has a checklist to tally contacts, SSB or CW, and receipt of a QSL.

The DX Prefix List is priced at $6.95 (plus $1.50 shipping). Each listing is custom-printed for your station's location. For more information, contact *DX Prefix List, Jon Presley WD0EAO, Route 3, Box 117, Lebanon MO 65536.* Reader Service number 477.

QUAD BANDER ALL-MODE TRANSCEIVER

Trio-Kenwood Communications has announced a unique new radio, the TS-660 "Quad Bander," an all-mode transceiver designed for operation on 6, 10, 12, and 15 meters. The unit features built-in dual vfo's, a five-channel memory, and memory scan. Modes of operation are FM, SSB (USB), CW, and AM.

The TS-660's rf output power is 10 Watts on SSB, CW, and FM, and four Watts on AM. The radio operates from a 13.8 volts dc power supply. Kenwood's list price is $699.95. Additional information may be obtained by contacting *Trio-Kenwood Communications, PO Box 7065, Compton CA 90224.*

COAXIAL ANTENNA

Power Gain Systems has announced a coaxial antenna that offers a new approach to the construction of the well-known double-bazooka dipole design. The antenna has the broadband, low swr characteristics of the bazooka and features injection-molded plastic construction for weatherproofing, strength, and durability.

The antenna comes with an SO-239 fitting and is ready to accept any length of 50-Ohm feedline without the necessity of a balun or tuner. Available for 80 through 10 meters, the Power Gain Systems coaxial dipole costs between $34.95 and $39.95. For more information, contact *Power Gain Systems, 1007 Cypress St., West Monroe LA 71291; (315)-325-4754.* Reader Service number 476.

10-kHz-TO-30-MHz TUNER

The new Signa/Match from Grove Enterprises is a state-of-the-art frequency-selective tuner designed to optimize impedance matching between 10 kHz and 30 MHz. It will reduce, and in many cases remove, receiver intermodulation, images, and front-end overload. Background noise is reduced. VLF signals you never dreamed were there come roaring in loud and clear.

Front-panel switches allow instant selection between two antennas and between two receivers (or two antenna inputs to one receiver). Matched rotary switches permit the listener to peak signal strength of the frequency of interest, while a main tuning dial provides sharp resolution of the final signal. Priced at $99.95, Signa/Match comes complete with instruction manual and all interconnecting cables. For further information, contact *Grove Enterprises, Dept. C, Brasstown NC 28902; (704)-837-2216.* Reader Service number 478.

3.3-METER DISH

The Director III satellite receiving antenna from International Satellite Video Corporation utilizes space-age materials and technology for a unique lightweight design. The 3.3-meter dish has a high-efficiency Cassegrain (dual reflector) feed system which places receive electronics at the rear. The unusual perforated aluminum reflector surface with approximately 80% open area is almost impervious to wind.

The Director III is supplied with a correcting polar mount so that satellite selection requires only one adjustment. The complete system may be shipped by UPS. Installation time is approximately 2-3 hours. Options include programmable remote sat-

Grove Enterprises' Signa/Match.

The Director III 3.3-meter dish.

ellite aiming and electronic polarity selection. The Director III is available from *International Satellite Video Corp., Box 5685, Orange CA 92667; (714)-998-6080.* Reader Service number 481.

HF SWR/WATTMETER

MFJ Enterprises is introducing its new MFJ-816 low-cost HF swr/wattmeter for the 1.8- to 30-MHz range. Features include toroidal pickup for uniform sensitivity over the entire HF frequency range, dual ranges (30 and 300 Watts), and a two-color meter scale.

The MFJ-816 HF swr/wattmeter is priced at $29.95 (plus shipping and handling). For more information, contact *MFJ Enterprises, PO Box 494, Mississippi State MS 39762; (800)-647-1800.* Reader Service number 479.

SATELLITE TV RECEIVER

Telecom Industries' new TIC 1240 satellite television receiver now provides improved AFC and scan tune (for fast and easy satellite locating) as standard features. Improved threshold combined with better video resolution provides picture quality found in receivers twice the price.

The dual-conversion downconverter (204A) mounts directly at the LNA output while providing +15 volts through the N connector as well as externally. Improved environmental characteristics include hermetically-sealed connectors and temperature compensation for a virtually drift-free picture. The TIC 1240, with a retail price of $995, is available from *Telecom Industries Corp. 27 Bonaventura Drive, San Jose CA 95134; (408)-262-3100.* Reader Service number 482.

5/8-WAVE HT ANTENNA

The Tuned Antenna Company has announced a two-meter 5/8-wave antenna, the Super Stick II, for use on hand-held radios. The Super Stick II, when fully extended, offers 6 to 9 dB of signal output over traditional rubber duck antennas. All connections are soldered and copper-plated for years of troublefree service. The Super Stick II has been designed to operate when collapsed, giving performance equal to or better than a rubber duck antenna.

Super Stick II is available with BNC, 5/16-32, F, TNC, or PL-259 connectors, at a suggested retail price of $19.95. For more information, see your local ham dealer or contact the *Tuned Antenna Company, 9520 Chesapeake Dr. #606, San Diego CA 92123.* Reader Service number 480.

The Tuned Antenna Company's 5/8-wave HT antenna.

LETTERS

TO BE A DXER

I enjoyed very much the interview with the Colvins of Yasme fame in the October, 1981, issue of *73*. Many DXers I know would give their right 3-500Z to go on a DXpedition like those the Colvins are famous for. To be a DXer one must incorporate feelings about being on the other end of the microphone. Some day I'll be there, but for now, CQ DX.

Michael Weber WB8RDN
Cincinnati OH

EARTH PEOPLE

I was recently rummaging through *Sailing*, a new book of whimsical nautical definitions by Henry Beard and Roy McKie. Therein I encountered the following unlikely commentary: "Citizens Band Radio—Part of a government study of terrestrial radio emissions to determine if intelligent life exists on Earth. None has so far been detected." 10-4!

Robert Rice WB7VIP
Oak Harbor WA

SING ALONG

Kit K5KL and *73 Magazine* are to be congratulated for the fine story, "Update your CW Music Keyboard," in the December issue. It is hoped that this article will motivate others to write about their experiences and improvements.

CW music keyboards ("This Station Plays Beautiful CW," *73 Magazine*, February, 1979) are playing from Auckland (Fred ZL1ALP/MM) to Vienna (Hans OE1WH) with many in between. My mail indicates that others also could write interesting stories and additions and improvements for the CW music keyboards. Topics mentioned to me include: hard copy, expanded memory, speed indicator, replacing the 4078, use of the 3351 and a single-voltage power supply, solving propagation-delay problems, Crom was wrong to badmouth wirewrap, and many others.

If anyone still has a problem, be advised that I still answer all letters. Please include an SASE.

Russell C. W. Crom AG9N
Mt. Prospect IL

WATCH IT!

In the article, "Ham Shack Design for Beginners," a very dangerous situation could develop if a reader followed the author's advice. I am referring to questions two and three that deal with fusing both the hot and the neutral.

In the National Electrical Code, 1981 edition, Article 240, Section 20, it states: A fuse or an overcurrent trip unit of a circuit breaker shall be connected in series with each ungrounded conductor.

Section 22 of Article 240 goes on to say: No overcurrent device shall be connected in series with any conductor that is intentionally grounded.

Besides being against the Code, the article's suggestion could pose a serious hazard. If the neutral fuse should open, the equipment, though not operational, would still be energized and a possible hazard.

Although I do not agree with the author's suggestion that the neutral be fused for lightning protection, it can be done according to the Code by using a special breaker that disconnects the neutral simultaneously. This is commonly used in service-station wiring.

Gary Strong KB0UI
Auburn KS

MAJORITY OF ONE

I am firmly opposed to any type of no-code license on any band. You have constantly criticized the League for forcing incentive licensing upon us despite the majority of active amateurs being firmly against the whole concept. Now you have somehow arrived at the idea that we need a no-code license and openly admit you will push for it despite the wishes of the majority of amateur radio operators. I find this contradictory, to say the least.

You also state that amateur radio needs leaders. Well, that is true, but we need leaders who are responsive to the wishes of the majority of all operators, not to the wishes of "thousands" of would-be amateurs who want to be licensed at their own terms. We also do not need any self-appointed leaders who decide single-handedly what is good or bad for amateur radio.

A true leader should always work with the majority to develop new ideas and accomplish needed improvements. This is a democracy, and that's the way it works.

Charles E. Daum WA4YZF
Lutz FL

Charles, aren't you a little confused between what is a leader and what is a follower? You seem to be looking for a leader who won't lead, but who will do what the majority wants . . . if anyone really knows what that is. When the ARRL proposed the plan to get 85% of the hams off phone, they claimed that only 20% of the members were opposed, so perhaps they were representing the majority. Since we have no elections in the ham field for leaders, all you are ever going to get are self-appointed ones. Now, if you want leaders without any ideas and with no interest in improving amateur radio . . . which is what you seem to be plugging for . . . by golly why not back all of those you see around? I opposed the ARRL plan to return to the prewar band system because I felt it would create severe problems . . . and I pointed them out. I did not oppose it as a representative of amateur radio or a leader presuming to represent the majority. In the present case, where I feel that we have had exhaustive proof that the code requirement does not keep out the severely psychotic and where there is a good reason to believe that a license based upon technical competence would clean things up, I am going to push for that, majority or no. I expect to find a wide variety of the confused, the apathetic, the psychotic, and reactionary hams fighting any changes. I also expect to find the more intelligent hams looking at the situation, weighing the evidence . . . and deciding that my ideas are worth a try. It would be difficult to have any new system fail worse than the one we have now. Charles, I have never been responsive to the majority and I'm not going to start now. When I perceived that FM and repeaters would be fantastic for amateurs I went ahead and published hundreds upon hundreds of articles . . . I published book after book . . . and held FM symposiums . . . plus a monthly repeater newsletter. The majority of hams hated it and raised hell over this. I stuck to my guns and today FM is the most popular aspect of amateur radio by far. Now the majority sees it my way . . . and perhaps now I am a leader in their eyes. Well, when I was one against the crowd, was I a leader then? You don't want a leader, you want a wishy-washy namby-pamby puppet and I wish you a lot of luck in finding one. Come to think of it . . . you won't have much trouble, for just such a sterling man seems to be in the offing. If you really want to be in the large group following a puppet, your opportunity is at hand . . . but leave me out of that.—Wayne.

HOOEY

In an effort to sell magazines and memberships, the ARRL drafted almost every CBer onto the ham bands. And now you want to drop the code requirements and draft everyone else, probably to sell magazines also. If the Aircraft Owner's and Pilot's Association took the same position, we would have the air space completely full of aircraft.

Mister Green, you need to understand that amateur radio is a hobby, not a business. And a *no-skills* license is not the answer to poor circulation. There are many hams that have dropped *73* (like myself) because of your "license everyone" position. In the future, I intend to plug you on the air and at meetings as the man who "sells magazines at the expense of amateur radio." Regrettably, your publication is a very good one. But it is not worth the damage you are doing to amateur radio.

"Butch" Rogers K3RYI
Wichita KS

Butch, you are full of guano. Oh, I've heard that brand of baloney before . . . about the crass commercial interests trying to get anyone and everyone into hamming in order to make dirty money. Well, it's hooey. ARRL did not draft CBers into amateur radio. If you would put what is left of your brain into gear you would recognize that anyone with any kind of an interest in radio communications . . . which is what I think we're looking for in hams . . . has to be a fruitcake not to try out CB for starters. If there had been anything like that when I got into ham radio, you can bet I would have been using it. So putting down someone for starting off with CB is ridiculous . . . a redneck reaction. No one that I've seen is trying to draft people for amateur radio with less abilities than now . . . indeed, it would be difficult to have a lower entry requirement than at present, considering some of the turkeys we have been getting into amateur radio of late . . . in case you've turned on a radio. I . . . and 73 Magazine *. . . are proposing a much tougher type of license exam than at present . . . one which might keep some of the pigs out of the ham fraternity. I think we've seen more than enough proof that a code exam keeps out little and that some other means of separation of the sheep from the goats is needed. I believe that a technical exam, given by a ham club, one which follows a series of technical classes given by the club, will be a better system and will result in fewer obscene-mouthed nerds getting licenses. It is you who are doing the really serious damage to amateur radio . . . not those of us who are trying to clean it up by setting better standards for licensing.—Wayne.*

NOT DUMB

I fully agree with you in reference to your editorial in December's *73 Magazine*. I would very much like to have a ham license but I have trouble with the code portion of the test. I do not consider myself a dumb person, but I seem to have a mental block concerning code. I have used your tape and others, but it seems that when I learn the sounds, I cannot get words out of them. Anyway, keep up the good work on *73 Magazine*, knowing that I for one will not drop my sub until your mag goes to all computers. I use computers in my work, but still do not own my own personal one. As I live 90 miles from Denver, I do not get even one television station and so subscribe to about 70 magazines at this time. I must say that the most-read and looked-at magazines are the ones put out by you. Keep up the good work.

You can also be sure of my support concerning a non-code license. Basically, I would like a license to be able to use ham radio in emergency situations. To be honest, the way the bands sound I do not have any interest in DX. It seems that most stations are interested only in a signal report and a QSL card. At least as far as US stations are concerned. In case you were wondering, I have a business license and so do use radio in the course of my everyday work—which is running a ranching business. Well, anyway, keep up the good work with your magazines.

David L. Andrews
Granby CO

David, a contact is whatever you make it. Whether you are talking on two meters, on 75 meters, or working DX, the type of contact is up to you. Oh, if you call in on a DX pileup or on a list operation, you know you are in for a QSL-type of contact. But if you are really interested in meeting people and talking with them, they are there, and they are as anxious to talk with you as you with them . . . if you give them the chance. I've had hour-long rag chews with even the rarest

✓See List of Advertisers on page 130

of DX, finding things of mutual interest to discuss. I've found that most hams in rare spots are pathetically eager to talk. They are always running up against hams who want their QSL for a country, a prefix, etc., and it gets to be an expensive bore in a short while, driving many of them off the air. The more you can get into rag chews with these chaps, the more they will enjoy amateur radio . . . so you are performing a public service at the same time that you are enjoying yourself. You know, not every ham in the world lives and dies over the ARRL Honor Roll, or even over a DXCC certificate. Some are in it for the fun of talking . . . so give them a chance. You'll rarely hear me fighting the pileups. I tend to look for longer contacts, talking about how it is to live where they are, what there is to see, the skin diving, the photography, things like that.—Wayne.

WHERE'S ELMER?

As an aspiring Novice, I naturally subscribe to the better publications such as *73*. I read and re-read each issue, with the hope that I can somehow begin to make sense of some of the articles and projects. I have been a kit builder for years (Heath), and just recently I decided to venture again into the world of amateur radio.

While I have received much information from *73*, I think that many of the construction articles go right over the heads of the less sophisticated in electronics construction. Many of the equipment designs would be fantastic for the Novice just getting started, but the schematics scare them away. If the projects were presented with circuit board layouts with parts placement and wire directions, that would be a real boon to the Novice, both educationally and in the pocketbook.

There is one other problem that I would like to discuss with you briefly. As an "outsider" looking to get in, I have noticed a few idiosyncrasies of the amateur operator that perhaps have escaped the eye of those "inside."

I use the words "outsider" and "insider" because this is the way I have been made to feel by some of the amateurs I have come in contact with. They have made me feel as though my questions were stupid. They seem to lack the time to answer questions, and can't be bothered with a person who can't read schematics but only Heathkit™ diagrams. It would seem that unless you are a 25-wpm Extra with a 2-kW station with super quads, membership in clubs is discouraged.

Your editorial in the December, 1981, issue of *73* was of particular interest to me. You bemoan the loss of potential amateurs, the loss of new technical manpower, etc. You also stated that the youth of our nation should be made aware of the future in electronics and the fun of ham radio, through local clubs. This reminded me of when I was 16 and my imagination was first sparked by the lure of amateur radio. I was met with the same indifference as I am experiencing now, 20 years later. I had forgotten my bad experience and was just reminded of it recently when I again attempted to join the fraternity—or should I say clique.

I don't mean to sound negative, but it is easy to see why most potential Novices are turned away from amateur radio. The amateurs should be looking more to themselves rather than rattle sabers at the FCC. License requirements are tough, but not insurmountable. But if left to the clubs, I dare say even fewer would be licensed, at least through my experience, anyway. For the last 7 months I have been searching for that elusive "Elmer" I've heard about, who is always ready, willing, and able to lend a hand. Instead, I've received indifference, ambiguous information concerning membership in most clubs, infrequent or non-existent schedules for meetings, and what seems like a total lack of interest in helping a newcomer.

No longer a child, I refuse to give up this time. I'll make it on my own, through your excellent tapes and books. Maybe someday I can offer myself as an Elmer and perhaps revive what appears to be a lost tradition.

William J. Naughton, Jr.
Philadelphia PA

SURVIVAL

I have just finished reading Marvin Solomon WB8VNP's letter, "Survival," which appeared in the December, 1981, issue of *73*. I agree with his concern for the caliber and amount of scholastic training our children are receiving, but I think it goes further back than high school, all the way to our grade schools. Committed teachers are rewarded by moving them up into administration and replacing them with less competent educators who are interested only in the financial gains and not the education of our children. I'm not saying they are all like this, but the percentage of teachers who would rather promote a child with whom they had trouble instead of assuming the responsibilities of their jobs, namely to teach them the basics, is way too high!

I have a business where I'm in constant contact with children from grade school to college (I'm a barber) and it's amazing how many cannot even fill out a check properly, let alone do the basic fundamentals of math.

I have had a running battle with the school system here for almost twenty years, with four children in different levels of schooling. Sometimes I'm not sure whether I'm winning, but I urge every parent to be aware of the quality of schooling his children are receiving and if there is the smallest doubt that they are getting an adequate education, fight. Don't let them tell you what to do—you tell them. Otherwise the gap will get even wider.

Barry Vierra WB6GZK
Fair Oaks CA

You're right, Barry. Education has changed a good deal in the last 50 years. In the third grade I was taking courses in art appreciation, complete with the fundamentals of composition. This was invaluable to me when I got into photography . . . and later, when I went to work as a television cameraman, I was the only one in the crew who had had this sort of training. They taught us how to read music in the third grade, too . . . later valuable to me when I started singing in church and then in choruses. As far as I know, those subjects are long forgotten in most schools. Then there was a class in recognizing classical music, another one I'll bet they've stopped. That was in Brooklyn, New York, of all places . . . in the public schools. The art and music classes were in New Jersey. Later, in high school, the art classes were even better. My mother got so enthused by them when she went to the same high school that she went into art for a career. There is much to be done about education. If we can't get the schools to improve we still may be able to pull it together with video/computerized teaching systems which will be along in a few years.—Wayne.

CRIMINAL BAND?

After reading the letter by A. E. M. Spence VE7DKY, I felt compelled to voice my disagreement. First of all, I did not appreciate the insinuation that most of the lids on the air were from the 4th and 5th call areas. Since being licensed in 1976, I have heard very few hams from the 5th call area that would fall into the lid category. As for the New Mexico hams, I believe them to be of the highest caliber in the country.

The other statement that bothered me was the one on wanting the rest of the "Criminal Band" fraternity on the air. First of all, the proper name is "Citizens Band." Second, I as well as probably most of the amateurs don't want the average CB operator in the ranks, but there are a lot of CBers who would be an asset to the Amateur Radio Service. After all, they are humans just like everyone else, and everybody must start somewhere.

I got my start because of CB, and I don't consider myself a lid. I have an Advanced class license for which I *worked* very hard, and am into VHF, HF, and into the extra modes of RTTY and OSCAR. I am very active in building, and work with integrated circuits. I am also into computers.

Now, if it were not for CB, I probably would never have entered the world of amateur radio and electronics. Now, of course, I have a very marginal use for the Citizens Band radio service, but let us place credit where credit is due.

I do think that Mr. Spence should do a re-evaluation of the entire basis of his opinions.

Stan Gantz WB5TGL
Silver City NM

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RTTY LOOP

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

One of the most enjoyable and at the same time most rewarding aspects of writing this column is answering questions posed by readers. Because of the volume of mail received and my rather tight schedule, I am not always able to answer each one individually. Letters containing requests for a specific circuit or part are often unanswerable when received, and normally are held until such time as the requested information becomes available.

On the other hand, questions of general interest, such as those relating to RTTY principles or techniques, frequently wind up here in the pages of *73*. Not everyone is an expert, or even well versed, in everything. Questions from novice RTTY users as well as meaty tidbits from old pros provide an interesting and varied fare for the readership. Hungry? Let's see what's on today's menu.

Emil Guerrero, a "prospective ham" living in Portchester, New York, wants to add RTTY to his SWL (shortwave listening) shack. Emil notes that he is "no speed reader" and is interested in using a code converter to allow display of ASCII data on a Murray (Baudot) machine. Specifically, he asks about the feasibility of using a Murray printer running at 60 wpm (45.45 baud) to copy an ASCII transmission being sent at 150 or 300 baud.

Converting the eight-level ASCII to five-level Murray is no problem, Emil, and several hardware and software schemes have been covered in this column and within the pages of *73* over the past few years. The problem comes in when you try to build the reservoir.

"Reservoir," you ask? Well, it breaks down like this. ASCII transmission coming in at 300 baud, the most commonly used speed, represents about 30 characters every second. In, let's say, the first minute, that represents about 1800 characters. On the receiving end, that teleprinter is able to handle five-level input at 45.45 baud, which represents about six characters per second, or about 360 characters per minute. Not counting slop-over, this represents about 1440 characters per minute that must be stored. In a ten-minute broadcast, you would have to provide a reservoir, such as with a computer-style read/write memory, of some 14,400 characters. That's roughly 14 kilobytes! Now you need some means of stuffing data into that memory, pulling it out, keeping track of where you are, and doing a code conversion (ASCII to Murray, remember?) all at the same time. You need a computer.

Now, it can be done, and certainly individual characters can be converted from one code to another without all this hassle. But in order to receive automatic transmission, that is, transmission at machine speed, a buffer and some machine "smarts" are needed. Hopefully, some of the articles published in the past will help.

Emil is not alone, by the way. A similar letter was received from Larry LeMone K7IHI, out in Provo, Utah, who is also interested in such a conversion scheme.

Along the same line, but with an interesting variation, comes a letter from Curt Heuberger K1CH in Seekonk, Massachusetts. Curt is interested in using an IBM Selectric® typewriter for a RTTY I/O device. I see no reason why such a code conversion could not be implemented using a Murray-to-correspondence scheme similar to those which implement ASCII on the Selectric. I am using such a scheme here with an unpublished program that turns an I/O Selectric into a "smart" printer. It would be simple to take a scheme like that and change the code tables to convert to Murray rather than ASCII. Curt mentions that he has the "fixin's" for a small Z-80 computer sitting on the shelf. Either that or a small single-board computer like the "Kilobaud Klassroom Komputer" described here a few months back would be ideal to implement a RTTY Selectric system.

Emil, along with Richard Flink WB2SOU, out in Hillsdale, New Jersey, wonders about where to find stations broadcasting weather or press information. I again refer to Tom Harrington's book, *World Press Service Frequencies*, available from the *73* Radio Bookshop for $5.95 (order book number BK1202). This book, along with its periodic updates, comprises one of the most complete listings I have seen and includes a wide spectrum of international RTTY stations. It is, by the way, only one of the good books to be found on a tour through the Bookshop.

Merging computers and RTTY continues to be a popular topic. George Gadbois W3FEY is confused as to why, with several of the schemes I have described to input RTTY into a 6800 computer, I have resorted to a software UART rather than configuring the serial port into the five data bits needed for Murray code.

Well, George, this all relates to the type of chip used for input into this series of computer. Rather than a general-purpose UART, the 6800 series of computers—that is, most computers based on the Motorola M6800 CPU—commonly use a Motorola 6850 ACIA (Asynchronous Communications Interface Adapter) chip. The ACIA is more "powerful" than a UART in that it allows more control to be passed in and out of the computer and interfaces with the bus and serial communications line very well, but lacks the ability to be configured in other than a seven- or eight-bit format.

It is this failing, as it were, that forces us into using an alternate scheme, other than the serial ACIA, that is, to input five-level Murray into a 6800 computer. There are two ways to go. Either use a UART, which means building an interface board and software, or use a parallel port, which involves only new software. For a frugal fellow like me, the "software UART" is the logical choice.

Once selected, the software approach suddenly offers all kinds of other advantages. Speed changing or code changing is trivial to accomplish. Auxiliary lines are available to key the transmitter, turn on lights, or brew the coffee. All kinds of nice things fall into place, and you even save a few bucks: Neat!

It is for this reason that another scheme, posed by Paul Pennington of Martinez, Georgia, will fall through. Paul is using an SWTPC 6800 computer with a video board display and a modem connected to the computer's former input board, an ACI-based interface. Paul feels that feeding receiver audio into the modem and then through into the ACIA for input would be a viable way to implement RTTY on a shoestring.

There are a few problems with this idea, no matter how attractive it seems. First of all, the common modem receive frequencies in originate mode, the "normal" state of affairs, are mark = 2225 Hz and space = 2025 Hz. Contrast this to the RTTY "standard" of mark = 2125 Hz and space = 2975 Hz used on VHF links. Not only is the degree of shift different (200 Hz vs. 850 Hz), but the direction is wrong also. Now, if you were on HF and used the wrong sideband to tune in a 170-Hz shift signal, you might get the modem filters to recognize the signal, but then another problem arises.

The usual mode of transmission on amateur circuits is still five-level Murray, and here you are with that ACIA board just as tied as ever to seven- or eight-bit codes. Sorry! I am afraid that you would either be limited to receiving ASCII or would have to replace the ACIA with a UART in order to input the Murray code unmolested. As a kluge you could try to interface the modem to the one-bit parallel port software UART we have been talking about, but I can't recommend that.

The other problem is in using that modem itself. The extra bucks that a RTTY demodulator costs buy quite a bit in selectivity, function, and features when compared to a landline-style modem. You might look into a small demodulator, such as the iRL FSK-500 highlighted here a few months back, to complete a RTTY station at minimal expense.

Boy, this has been a depressing column, so far! All I have done is tell this fellow or that one that this scheme or that will not work. How about something encouraging?

Nicholas Oland W3DSE of Reading, Pennsylvania, is looking for a way to convert a surplus ASCII video terminal to Murray. Nick states that he is

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not looking for buffers or other bells and whistles, but just for a straight ASCII/Murray scheme for manual operation.

Well, as long as the display terminal is able to operate faster than the input, as it would be with a 300-baud terminal receiving 45.45-baud code, the reservoir problem detailed above would not be a factor. Similarly, I presume few of us can type at machine speed for any length of time, and if you can, you could not go any faster on an old Model 15, so let's accept that constraint also. Fig. 1 is a block diagram of what you need, a simple hardware ASCII-to-Murray duplex converter. Several such schemes have been published in *73 Magazine* in the past.

Nick also relates difficulty in finding specialized chips, UARTs, and the like needed for building projects such as this. I have found that most of the firms who advertise right here in *73* do a fine job of providing just about any imaginable part. When I have needed a particular chip or part that is not listed in their ads or catalogs, a phone call or letter to selected firms will usually turn up one able to supply the item from stock. Not all stocked items are able to be listed, you know.

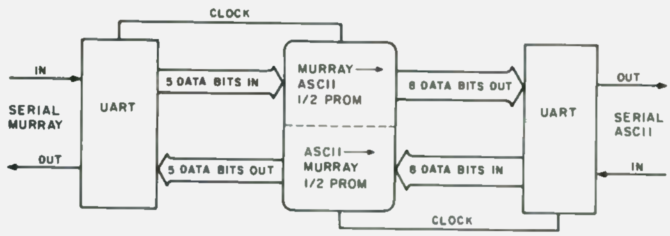


Fig. 1. ASCII/Murray conversion block diagram.

Above all, know the firm with which you deal, either through a friend's recommendation or with the endorsement of the publisher of the ad. Don't send cash through the mails, and keep a copy of your order should problems develop later.

Next month is April, and every year at this time I get the urge to write something, shall we say, unique. Want to find out? Don't miss next month's RTTY Loop!

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 8

cians, and electronics experts. Well, the recent emphasis on skipping theory in the getting of a ham ticket, with the use of the ARRL Q&A and Bass cheat books instead of an understanding...using only an ability to copy code as the filter...has reduced our ranks to a mere handful of technicians and electronics experts. By using the code as the only serious test...if you can call five words per minute serious...and throwing out any real need for technical knowledge, we have thrown out most of our value to the country...and to ourselves.

Yes, a few of you reading this have taken the trouble to use the *73* license study course and you have a good understanding of the fundamentals of electronics. You are in the minority, sad to say. And how many clubs take a half hour or so at the beginning of their meetings to run through some aspect of radio or electronics theory? Maybe a dozen out of several thousand.

Reservoir of operators? Sure, but for what? Not for any military need today. The military rarely uses code today. They use phone for local communications and automatic encrypted systems for longer ranges. Fortv years ago, it took a few months to train a ham to be of value to the armed forces. During WWII, 80% of the hams went into the services and helped out... mostly as technicians, not as Morse operators. That was before RTTY was really invented. Once that was an accomplished fact, the use of Morse virtually disappeared. Today, with computers so small you can carry them in your shirt pocket, no one needs a hand key or an old Teletype™ clunker. Computers can be used to write messages and then they can be plugged into a communications system and the message can be transferred almost instantly, anywhere.

Indeed, I've recently written about a system which I suggest that amateurs start developing, using currently-available technology and equipment, which would allow us to communicate at 8,500 words per minute. With some encoding, that can be upped to 26,000 words per minute.

Some reservoir we are at present! It could take a couple of years to train hams to cope with today's military technology.

Okay, on to 97.1(e), the last of the reasons for amateur radio to exist as a service. International goodwill. Boy, can we stand to do some work on *that* one. I suppose there are a few ops in foreign countries who feel goodwill when dumped on by a pileup... damned few. And how many of the DX ops really enjoy our 5,000-Watt Honor Roll (the irony of *that*)—ops wiping out every new and rare country which comes on the bands? Is it going to be claimed that an exchange on CW of signal reports and a handle are really generating goodwill? Don't make me laugh so hard that I break open my 40-year-old appendix scar.

Look here, don't get mad at me for simply stating the facts of life. If you don't like the facts, do something to change them ...don't beef at me for having the gall to state the obvious.

Now, you are not going to have any problem finding a whole raft of hams who swear by the Morse code...which I admit is extremely useful when you want to blink your eyes in code (would it be faster in ASCII?). But how many of you are going to try to tell me that you honestly believe that the code requirement has kept out the dingbats? Brother, we are up to here in psycho cases, so don't tell me about keeping out the undesirables. When I see four-year-old kids passing the code test and getting a ham ticket, I have trouble not being terminally sarcastic when I hear claims about it keeping our bloodline pure. If you are lucky enough to be in an area where two meters is sane, please get Bill Pasternak to send you some tapes of two meters in Los Angeles. You'll never be the same. A zoo.

And I'm getting a little sick of hearing that I am for opening the floodgates to the loonies. Those gates have been open for years. I'm for making amateur radio a technical hobby...with required courses in theory given by clubs...and damned good exams given by the same clubs. Maybe we can stem the tide of CB outcasts.

By golly, *that* felt good. Well, now back to being mild-mannered, lovable old Wayne Green.

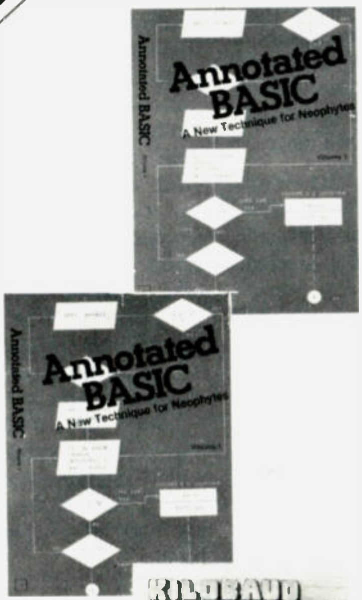
CODE COURSES THE PITS

A recent call from Larry Horne, who runs a school in New York which teaches code in a matter of a few days, preparing people for their ham tickets, brought out that tests of the many code cassette courses on the market had shown most of them to be disasters. One of the very worst, oddly enough, was one of the best selling, put out by a national ham organization. And, yes, the organization knows that the course is bad and is losing us hams by the tens of thousands, but apparently it feels that it is too much trouble to change it... and, after all, it is selling well. Dealers, interested in making a buck any way they can, allow this travesty to be sold. Pity, when there *are* some very good code courses available.

Larry is running some tests for the Coast Guard to show them how fast some of the modern systems are...systems such as the *73* Code Course. The Coast Guard, which I understand has been quite hostile to amateur radio in the past, has been putting their trainees through a five-month, forty-hour-a-week course in which about 20% get to a speed of 18 wpm. Then, after a year on the job, another 20% qualify for 18 wpm.

Wayne Green Books

NEW ARRIVALS



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60% wash out. So much for the old code-teaching system.

Would you believe that it is possible to start rank beginners out at 20 wpm? In fact, tests are being made at 35 wpm for starters...yes, from the very start. And the tests are very promising. It seems it is no more difficult to get the feeling of the pattern of a character at 35 wpm than it is at 5 wpm. Better; instead of setting up a look-up table in one side of the brain and transferring the sound pattern from the other half of the brain for comparison, everything is done in the same side of the brain. This avoids the old plateau syndrome...a disaster which has washed out hundreds of thousands of prospective hams.

Tentative tests seem to indicate that women, in particular, benefit from this avoidance of the left to right to left brain-shuffle problem. Perhaps it is the more intense competitive dedication of men that finally overcomes this mess rather than anything inherent. At any rate, setting up a learning system which uses one side of the brain only cuts the learning time to shreds, avoids much of the agony and sweat, and almost guarantees 100% success for anyone trying. It's almost fun...but not quite.

I'd like to see how far this concept can be carried. I don't see any reason why code can't be taught using this system and starting out at 50 wpm...and possibly even up to 100 wpm. Once you stop having to send the signals back and forth through the slow brain circuits and set up an operation which is largely done in the super-fast subconscious part of the brain, we're not sure what speed can be attained.

So, if you are asked about code-learning systems by newcomers, their fate is in your hands. You can recommend the best sellers...and doom them, for the most part...if not to failure, at least to agony. Or you can give them a real boost by recommending one of the only two (as far as I know) courses on the market which train the brain for automatic character recognition. That's the *73* Blitz Code Course.

IT'S UP TO US!

Don KA7DTP sent me a copy of an article from *Science* which said that the government has now terminated all efforts at listening for alien radio messages. The $2M a year program was shot down by Senator Proxmire, saying that, "It's hard enough to find intelligent life here in Washington."

NASA scientists were building a multichannel spectrum analyzer to detect non-random signals from space. That's down the tubes now and, according to a scientist from Stanford University, "The important contacts with extraterrestrial life will be left to radio hams." That's hardly a mandate, but if any readers are interested in pursuing the project, I can assure you that *73 Magazine* is most interested in providing the needed communications via articles and news.

What a pity that Sam Harris W1FZJ/KP4, who was a scientist on the big dish at Arecibo, isn't around to help get this started. Sam was one of the real ham inventors and pioneers...which is how he got the job at the research laboratory in the first place. It was Sam who built the first working parametric amplifier. He built it at home for use on six meters, and when I published the article on it most readers thought it was a humor piece. Who ever heard of feeding an oscillator into an amplifier?

As a piece of further bad news for VHF old-timers, Sam's wife, Helen W1HOY, a true pioneer on six meters, passed away a few weeks ago. She was living in Puerto Rico in Arecibo. Both Sam and Helen will be missed by all of their friends...and by future hams who will not benefit from the many inventions that Sam might have produced if he had lived.

Getting back to listening for signals from space...I'm interested in some articles on this and perhaps an organization of ham pioneers to systematically scan space for coherent signals. With the recent progress in digital circuits, we should be able to come up with some relatively inexpensive circuits for detecting non-random signals. The next step is to choose the best frequencies...get all of the help from the satellite TV technology we can for dishes, low-noise front ends, downconverters...and start listening.

NASA and Senator Proxmire...I say that amateurs accept the challenge. Now, let's hear it from those readers who want to be involved with this project.

OSCAR ORBITS

The tables of orbital information for OSCARs 8 and 9 were prepared with the assistance of Project OSCAR, Inc., PO Box 1136, Los Altos CA 94022. Due to the low orbit of OSCAR 9, its orbit is changing rapidly, making accurate long-range orbital predictions very difficult. Therefore, the OSCAR 9 information in these tables may be in error by several minutes and several degrees of longitude.

THE RUSSIAN SATELLITES

The last days of 1981 were exciting ones for amateur satellite fans. On December 17, the Soviet Union simultaneously launched six new Radio Sport (RS) amateur radio satellites, designated RS-3 through RS-8. The new birds were placed into orbit by a single launch vehicle and each takes about two hours to orbit the Earth. Although they are in similar orbits, the RS satellites are by no means identical, and some of them have quite unique capabilities. Below is a brief description of the various features. Tables 1 and 2 summarize some important information for each satellite.

Beacons

Each satellite has one or more 10-meter beacon frequencies, as

OSCAR 8 ORBITAL INFORMATION FOR MARCH

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
20319	1	0106:11	85.3
20333	2	0110:42	86.4
20347	3	0115:13	87.6
20361	4	0119:44	88.8
20375	5	0124:15	89.9
20389	6	0128:46	91.1
20403	7	0133:17	92.2
20417	8	0137:48	93.4
20431	9	0142:19	94.6
20444	10	0003:39	69.9
20458	11	0008:10	71.1
20472	12	0012:41	72.2
20486	13	0017:12	73.4
20500	14	0021:43	74.6
20514	15	0026:15	75.7
20528	16	0030:46	76.9
20542	17	0035:17	78.0
20556	18	0039:48	79.2
20570	19	0044:19	80.4
20584	20	0048:50	81.5
20598	21	0053:21	82.7
20612	22	0057:52	83.8
20626	23	0102:23	85.0
20640	24	0106:54	86.2
20654	25	0111:25	87.3
20668	26	0115:56	88.5
20682	27	0120:27	89.6
20696	28	0124:58	90.8
20710	29	0129:29	92.0
20724	30	0134:00	93.1
20738	31	0138:31	94.3

OSCAR 9 ORBITAL INFORMATION FOR MARCH

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
2199	1	0009:45	132.1
2215	2	0132:56	152.7
2230	3	0120:54	149.5
2245	4	0108:50	146.4
2260	5	0056:45	143.2
2275	6	0044:39	140.0
2290	7	0032:32	136.8
2305	8	0020:23	133.6
2320	9	0008:13	130.4
2336	10	0131:13	151.0
2351	11	0119:01	147.8
2366	12	0106:47	144.6
2381	13	0054:32	141.3
2396	14	0042:16	138.1
2411	15	0029:58	134.8
2426	16	0017:40	131.6
2441	17	0005:20	128.3
2457	18	0128:09	148.8
2472	19	0115:46	145.5
2487	20	0103:23	142.3
2502	21	0050:58	139.0
2517	22	0038:31	135.7
2532	23	0026:04	132.3
2547	24	0013:35	129.0
2562	25	0001:05	125.7
2578	26	0123:43	146.1
2593	27	0111:11	142.8
2608	28	0058:37	139.4
2623	29	0046:02	136.1
2638	30	0033:25	132.7
2653	31	0020:48	129.3

OSCAR 8 ORBITAL INFORMATION FOR APRIL

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
20752	1	0143:02	95.4
20765	2	0004:23	70.8
20779	3	0008:54	72.0
20793	4	0013:25	73.1
20807	5	0017:56	74.3
20821	6	0022:27	75.4
20835	7	0026:58	76.6
20849	8	0031:29	77.8
20863	9	0036:00	78.9
20877	10	0040:31	80.1
20891	11	0045:02	81.2
20905	12	0049:33	82.4
20919	13	0054:04	83.6
20933	14	0058:35	84.7
20947	15	0103:06	85.9
20961	16	0107:37	87.0
20975	17	0112:08	88.2
20989	18	0116:39	89.4
21003	19	0121:10	90.5
21017	20	0125:41	91.7
21031	21	0130:12	92.8
21045	22	0134:44	94.0
21059	23	0139:15	95.2
21072	24	0000:35	70.5
21086	25	0005:06	71.7
21100	26	0009:37	72.8
21114	27	0014:08	74.0
21128	28	0018:39	75.2
21142	29	0023:10	76.3
21156	30	0027:41	77.5

OSCAR 9 ORBITAL INFORMATION FOR APRIL

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
2668	1	0008:09	126.0
2684	2	0130:38	146.4
2699	3	0117:56	143.0
2714	4	0105:14	139.6
2729	5	0052:30	136.1
2744	6	0039:45	132.7
2759	7	0026:58	129.3
2774	8	0014:10	125.9
2789	9	0001:21	122.4
2805	10	0123:40	142.7
2820	11	0110:48	139.3
2835	12	0057:55	135.8
2850	13	0045:01	132.3
2865	14	0032:06	128.9
2880	15	0019:09	125.4
2895	16	0006:12	121.9
2911	17	0128:21	142.1
2926	18	0115:20	138.6
2941	19	0102:19	135.1
2956	20	0049:16	131.6
2971	21	0036:11	128.0
2986	22	0023:06	124.5
3001	23	0009:59	121.0
3017	24	0131:59	141.2
3032	25	0118:50	137.6
3047	26	0105:39	134.0
3062	27	0052:27	130.4
3077	28	0039:14	126.9
3092	29	0026:00	123.3
3107	30	0012:45	119.7

Satellite Name	Beacon Frequency	Robot Uplink	Robot Downlink
RS-3	29.320	—	—
RS-4	29.360	—	—
RS-5	29.450	145.830	29.330
RS-6	29.450	—	—
RS-7	29.500	145.840	29.340
RS-8	29 500	—	—

BEACON AND ROBOT FREQUENCIES (MHz)

Table 1.

shown in the Table 1. When you hear one of the RS satellites, the frequency of the beacon can be a guide as to which bird it is. The beacon frequencies of RS-5 and RS-7 change when the satellite is in the "robot" mode. See below.

The beacons transmit telemetry information in a coded format. The information is sent in Morse Code at 20-30 words per minute. Each telemetry frame consists of the satellite identifier plus seven pieces of data. A typical telemetry frame might consist of "RS5 K00 D00 O76 G00 U00 S15 W17." As this is being written, the only channel thus far interpreted is the K channel, which indicates the output power of the transponder. When the value for K is 00, as in the example above, this means that the satellite's transponder is presently turned off. A K value other than 00 indicates that the transponder is in operation.

Transponders

At press time, RS-5, 6, 7, and 8 were known to contain transponders for two-way communication. These operate in Mode A, which means you transmit to the satellites on 2 meters between 145.910 and 146.000 (the uplink), and listen for returning signals on 10 meters just below the beacon frequency (the downlink). Table 2 summarizes the transponder uplink and downlink frequencies.

Since a popular class of Soviet amateur license allows only low-power operation on VHF, these latest birds have very sensitive receivers. Therefore, it is recommended that you use no more than 10 Watts effective radiated power (erp) when attempting to communicate through the RS satellites.

Robots

The most unusual feature of the new RS satellites is the "robot," an automatic CW QSO device present on RS-5 and RS-7. When operating, the robot calls CQ on one of the beacon frequencies and then listens for amateurs to respond on a specific 2-meter frequency. If you make the proper response, the robot then sends a short confirmation message containing your callsign, assigning a number to your contact, and thanking you for the QSO.

If I am trying to work the RS-5 robot, for instance, the response expected by the robot is "RS5 DE WB8BTH AR" or "RS5 DE WB8BTH AR K" (it's not yet clear if the final "K" is necessary). Of course, you

COMMUNICATION PASSBANDS (MHz)

Satellite Name	Uplink Passband	Downlink Passband
RS-5	145.910-145.950	29.410-29.450
RS-6	145.910-145.950	29.410-29.450
RS-7	145.960-146.000	29.460-29.500
RS-8	145.960-146.000	29.460-29.500

Table 2.

must substitute your own callsign as well as send the proper satellite identifier. If the robot has copied your complete response correctly, it will confirm the contact by sending "WB8BTH DE RS5 QSO NR XXX OP ROBOT TU FR QSO 73 SK." The XXX is a serial number assigned by the robot to your QSO. Sometimes the robot will "listen" to several callers and then send several confirmation messages in succession.

The uplink frequencies for robot operation are given in Table 1. The best success has been achieved when transmitting slightly (perhaps 4 kHz) below the frequencies in the table. Sometimes the beacon and robot frequencies are interchanged, so be sure to tune around.

Experiments

According to the Soviets, RS-3 and RS-4 are intended for experimental use, explaining why no transponder or robot activity was heard on these satellites during their early life. By the time you read this, these two satellites may have produced some surprises.

Orbital Parameters

The first rough estimates for the orbital periods of the new satellites range from 118.52 minutes for RS-3 to 119.77 minutes for RS-8. The corresponding per orbit longitude increments vary from 29.76 to 30.07 degrees. When the six satellites were first launched, they were quite close together. However, since they are in slightly different orbits, they quickly began to drift away from one another.

Summary

The new RS satellites are very easy to hear. In the mid- to late evening, and again in the late morning hours, the six satellites have been solid copy, even on inexpensive shortwave receivers. A dipole or other simple 10-meter antenna will be perfectly adequate for good reception.

At this writing, the new satellites were only two weeks old, and their orbital parameters were not known with sufficient accuracy to permit the preparation of reference orbit tables, such as those published for OSCARs 8 and 9. More up-to-date information on the RS satellites can be found in ARRL bulletins and on the various AMSAT nets. Thanks to WB1EYI and W9KDR at the ARRL for their assistance in providing information used in this article. —WB8BTH.

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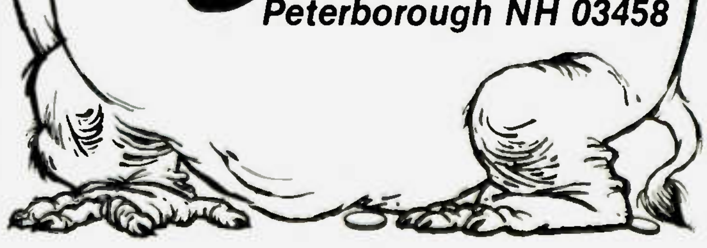

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I would like to correspond with someone who has used a Cushcraft R-3 half-wave vertical antenna.

Marvin Rosen N3BQA
20 W. Madison St.
Baltimore MD 21201
(301)-685-6308

I am looking for a vfo to accompany my Hallicrafters SR-42 receiver.

Ben Kronnick WB6REN
2539 Thayer Court
Riverside CA 92507

I am in need of a copy of the owner's manual and schematic for a Robyn MT701 CB transceiver tester.

S.E. Hess W7CW
6540 Chico Way N.W.
Bremerton WA 98310

I would like to hear from old members of the 136th Radio Intelligence Corps, especially those operating at Section Eight: Nadzab, Hollandia, Leyte, and Tokyo.

Donald E. Head K8NCZ
8190 Wright Road
Broadview Heights OH 44$47

I am in need of an assembly manual for a Knightkit dc oscilloscope, model KG-635. I will copy and return your original.

R. Weinberger KB6TI
14130 Alta Vista
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I am looking for a used communications service monitor, preferably a Cushman or IFR.

Tommy S. Evans NE4J
401 East Vance St.
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I am in need of a schematic and instruction manual for a Gonset G-151 FM Communicator.

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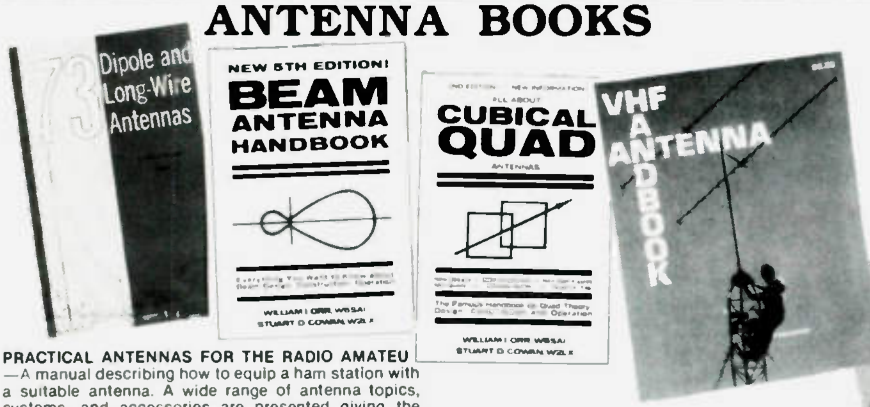

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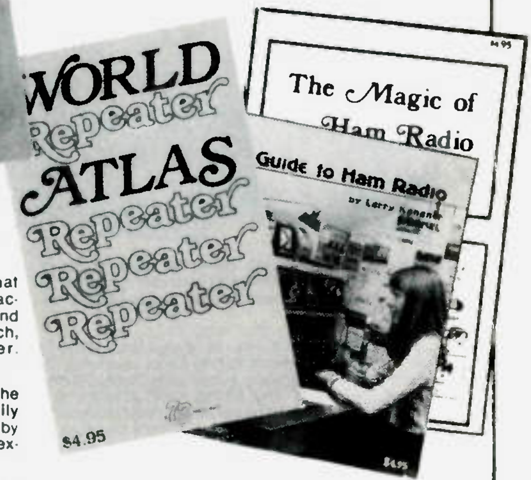

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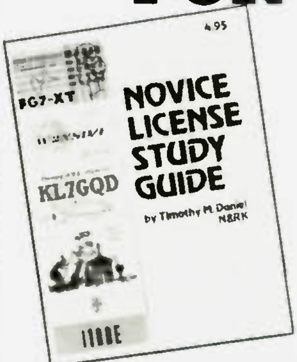

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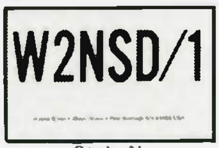

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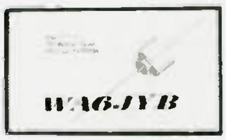

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A What is your education?
1 High School
2 Some College
3 College Graduate
4 Post Graduate

B What is your yearly income?
1 Less than $10 000
2 $10 000-$15 000
3 $15,000 $20,000
4 $20 000-$25 000
5 $25 000-$30 000
6 More than $30 000

C How much have you spent on amateur radio in the last 12 months?
1 Less than $100
2 $100 $500
3 $501 $2 000
4 $More than $2 000

D What brand(s) of antenna(s) do you own?
1 AEA
2 Antenna Specialists
3 Avanti
4 B & W
5 Bassette
6 Bilal
7 Butternut
8 Cushcraft
9 Daiwa
10 F9FT Tonna
11 Gem
12 Gotham
13 Heath
14 Hustler
15 Hy Gain
16 Kirk
17 KLM
18 Kreco
19 Larsen
20 Lunar
21 Mor Gain
22 Mosley
23 Skylane
24 Stewart
25 Telrex
26 TET
27 Van Gordon
28 Western Electronics
29 Wilson
30 Other

E What brands of HF and VHF equipment do you own?
1 Azden
2 Clegg
3 Collins
4 Drake
5 Heath
6 Hy Gain
7 Icom
8 KDK
9 Kenwood
10 KLM
11 Melco
12 NCG
13 Santee
14 Swan Cubic
15 Tempo
16 Ten Tec
17 Wilson
18 Yaesu
19 Other

F Are you now on RTTY?
1 Yes
2 No

G If not, are you interested in getting RTTY?
1 Yes
2 No

H Would you favor a no-code license if ham clubs were placed in charge of licensing?
1 Yes
2 No

I Would you like to see articles on satellite TV in *73*?
1 Yes
2 No

J Which of these magazines do you read regularly?
1 *73*
2 *Ham Radio*
3 *QST*
4 *World Radio*
5 *Popular Electronics*
6 *Radio Electronics*
7 *CQ*

K How many people read your copy of *73*?
1 1
2 2
3 3
4 4
5 5
6 6 or more

Reader Service: Return this card to receive full information on the products advertised in this issue. Refer to the ad. You will find numbers near the logo of each advertiser. Each represents the advertiser's individual Reader Service Number. Circle the corresponding numbers on the card on this page, include your name, address & zip, and drop in a mailbox. In 4-6 weeks you'll hear from the advertiser directly.

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1	6	11	16	21	126	131	136	141	146	251	256	261	266	271	376	381	386	391	396
2	7	12	17	22	127	132	137	142	147	252	257	262	267	272	377	382	387	392	397
3	8	13	18	23	128	133	138	143	148	253	258	263	268	273	378	383	388	393	398
4	9	14	19	24	129	134	139	144	149	254	259	264	269	274	379	384	389	394	399
5	10	15	20	25	130	135	140	145	150	255	260	265	270	275	380	395	390	395	400
26	31	36	41	46	151	156	161	166	171	276	281	286	291	296	401	406	411	416	421
27	32	37	42	47	152	157	162	167	172	277	282	287	292	297	402	407	412	417	422
28	33	38	43	48	153	158	163	168	173	278	283	288	293	298	403	408	413	418	423
29	34	39	44	49	154	159	164	169	174	279	284	289	294	299	404	409	414	419	424
30	35	40	45	50	155	160	165	170	175	280	285	290	295	300	405	410	415	420	425
51	56	61	66	71	176	181	186	191	196	301	306	311	316	321	426	431	436	441	446
52	57	62	67	72	177	182	187	192	197	302	307	312	317	322	427	432	437	442	447
53	58	63	68	73	178	183	188	193	198	303	308	313	318	323	428	433	438	443	448
54	59	64	69	74	179	184	189	194	199	304	309	314	319	324	429	434	439	444	449
55	60	65	70	75	180	185	190	195	200	305	310	315	320	325	430	435	440	445	450
76	81	86	91	96	201	206	211	216	221	326	331	336	341	346	451	456	461	466	471
77	82	87	92	97	202	207	212	217	222	327	332	337	342	347	452	457	462	467	472
78	83	88	93	98	203	208	213	218	223	328	333	338	343	348	453	458	463	468	473
79	84	89	94	99	204	209	214	219	224	329	334	339	344	349	454	459	464	469	474
80	85	90	95	100	205	210	215	220	225	330	335	340	345	350	455	460	465	470	475
101	106	111	116	121	226	231	236	241	246	351	356	361	366	371	476	481	486	491	496
102	107	112	117	122	227	232	237	242	247	352	357	362	367	372	477	482	487	492	497
103	108	113	118	123	228	233	238	243	248	353	358	363	368	373	478	483	488	493	498
104	109	114	119	124	229	234	239	244	249	354	359	364	369	374	479	484	489	494	499
105	110	115	120	125	230	235	240	245	250	355	360	365	370	375	480	485	490	495	500

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3-82

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DX

AMATEUR RADIO IN PARADISE

Cook Islands certainly has a lot to offer the traveling ham. There are only twenty-five amateurs, and its Prime Minister, Tom Davis ZK1AN, is very active on the air. It is an excellent location for working all types of DX, and when you are operating from there, you are rare DX yourself.

If the Cook Islanders are not already famous for their friendly, hospitable ways, it is only because the world has seen so little of them. Long isolated from major travel routes and today's world of bustling cities and crowded beaches, the islands which make up the self-governed area of Cook Islands are possibly the last unspoiled discoveries in the South Pacific.

The fifteen islands that comprise Cook Islands lie scattered over 751,000 square miles of the Pacific to the northeast of New Zealand. There are two distinct groups, the Northern and the Southern.

In the north lie the islands of Penrhyn, Nassau, Pukapuka, Manihiki, Rakahanga, and Suwarrow. All except Nassau are coral atolls. Amateur radio activity there is sparse, often only from visiting hams sent for research or for United Nations work. At the moment, there are no permanently active hams in the Northern Cooks. I was recently on Manihiki Atoll for two weeks and made seventy HF contacts. Unfortunately, however, Murphy struck in the form of two large lizards which shorted out the rectifier board and the power transformer in my Kenwood 530S transceiver, limiting the number of radio contacts that I could have. (I will be making another trip shortly and hope this time to have a spare rig available.)

The Southern Group consists of two atolls, Palmerston and Manuae, and seven islands. These are Mangaia, Aitutaki, Atiu, Mauke, Mitiaro, Takutea, and the largest island and capital, Rarotonga, the most developed of all of them, although it is only twenty-five square miles in area.

Rarotonga is a fertile island with the breathtaking scenic beauty of white sand beaches and a sparkling clear lagoon. It has spectacular rugged mountain peaks together with a warm tropical climate perpetually tempered by the soft, cool, southeast trade winds. The highlands are mainly covered with tropical evergreen forests while the lowlands and valleys are used for planting.

The author and a Cook Islands friend.

Cook Islands, with a population of eighteen thousand, is virtually bereft of natural resources and is dependent for its livelihood mainly on overseas trade. It imports over fifty percent of its food, all of its raw materials, plant machinery, and oil, the main source of energy in the islands. The main exports are bananas, copra, and canned orange and pineapple juices. It is completely self-governing, with an elected Prime Minister and legislature.

All electricity in the islands is produced from oil imported from Fiji, and, like most other developing countries, Cook Islands is simply reeling under the burden of vastly higher energy costs and increasing food prices.

Amateur radio equipment for use in Cook Islands has a twenty percent customs duty levied upon it. In the case of an amateur bringing his own equipment for his own personal use, no duty is paid as long as the equipment leaves the country with the foreign ham. Local ac voltage is 240 volts, 50 Hz. The license fee is NZ$6.00 per annum and is issued upon presentation of a copy (or the original) of your home station license. A very quick way of obtaining a ZK license is to forward full particulars to Miss Jane Amoa, PO Box 243, Rarotonga, Cook Islands, South Pacific.

Miss Amoa also runs an excellent service for the visiting amateur. This service provides a beach house complete with all the latest radio gear including antennas for all bands, a housemaid, and car or bike rental, all for a very reasonable cost. In addition, portable generators with multi-voltages, transceivers, and antennas all can be hired by the more adventurous ham who wants to stage his own DXpedition to the outer or Northern Group of islands.

There are no television transmissions in Cook Islands, but there is an FM broadcast station on 103 MHz. Radio Cook Islands broadcasts on shortwave—11760 kHz, and ZK4 and 1ZC on medium wave—630 kHz.

Stuart Kingan ZK1AA handles all of the interisland telephone patching, using modified amateur equipment. Transmissions are on 4038.00 MHz USB from 1800 hours GMT for the Southern Group. Northern Group transmissions are on 12214.00 MHz USB from 2000 hours GMT. His callsign for this network is ZKA2. He is also in charge of the PEACESAT network, transmitting as ZK1XA Rarotonga on satellite frequency 149.220 MHz and receiving on 135.600 MHz from 0200 hours GMT. He uses very modest circularly-polarized antennas with 150 Watts output, which give excellent results. The network is in use daily.

Shortage of equipment and trained personnel to teach local youngsters about amateur radio and electronics is the main reason why so few new licenses are being issued.

If you ever have the chance to visit Cook Islands, I strongly suggest you take out a license and operate, as conditions are excellent to all parts of the world. The local people are friendly and very helpful.

Kia Orana!

James Goodger ZK1DG
PO Box 64
Rarotonga, Cook Islands
South Pacific

CONTESTS

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

QCWA QSO PARTY—PHONE

Starts: 0001 GMT, March 13
Ends: 2400 GMT, March 14

This is the second weekend of the 25th annual QCWA QSO party. Contacts with the same station on more than one band can be scored only once. Contacts made with "captive" stations, such as those operating in local nets, are not valid.

EXCHANGE:

QSO number, operator's name, and QCWA chapter identification (official number or name). Members not affiliated with a chapter should use "AL".

FREQUENCIES:

Any authorized amateur frequency is permissible. The following suggested frequencies have been selected to minimize interference to others: 3900-3930, 7230-7260, 14280-14310, 21350-21380, and 28600-28630. The above frequencies are selected as a starting place. When pileups occur, don't be afraid to go to either side of these frequencies.

SCORING:

Each contact made with another QCWA member will count as a single point. This year's contest has two multipliers. The first is the same as in years past: Each chapter is a multiplier of one. The second is that DX stations are a multiplier of two. DX stations are defined as Europe, Africa, South America, Asia, and Oceania—the same as for WAC of ARRL. Contacts within your own country count only as a chapter multiplier. Final score is then the total QSO points times the sum of the number of chapters and DX stations worked.

AWARDS:

Plaques for the top phone and top CW scorers. Certificates will be given for the 2nd through 5th runners-up in both the phone and CW parties. Standings and scores will be published in the *QCWA News* (summer, 1982, issue).

ENTRIES:

Logs should include the following information: time (GMT), call, QSO numbers, name, chapter number or name, and state or country. It is the responsibility of each contestant to provide a legible log (no carbon copies) and to list all claimed contacts. The total contacts for each page will be recorded at the bottom of each page. The total contacts for the party should be recorded at the top right of the first page of the log. Log sheets will not be returned. Make sure you have correct postage when you mail your logs. Send logs not later than March 31st to: Pine Tree Chapter #134, Glenn Baxter K1MAN, Long Pond Lodge, Belgrade Lakes ME 04918. Separate logs and scores must be submitted for both the CW and phone parties. Work as many QCWA members as possible and apply for any of the special QCWA certificates which you may have qualified for: Worked 50 States, Worked 60 Chapters, Worked 100 Members, and/or Worked 500 Members.

RSGB COMMONWEALTH CONTEST

Starts: 1200 GMT, March 13
Ends: 0900 GMT, March 14

This contest is open only to members of the RSGB resident in the UK, and radio amateurs licensed to operate within the British Commonwealth or British Mandated Territories.

The general rules for RSGB HF contests, published in the January, 1982, issue of *Radio Communication*, will apply. This contest is a single-operator, single-transmitter event. Evidence of simultaneous operation on more than one frequency may result in disqualification.

Also, all contacts must be on CW only. Contacts may be made with any station using a British Commonwealth callsign, except those within the entrant's own call area. UK stations may not work each other for points.

EXCHANGE:

RS(T) plus serial number starting at 001.

FREQUENCIES:

CALENDAR

Mar 6-7	**ARRL DX Contest—Phone**
Mar 13-14	**QCWA QSO Party—Phone**
Mar 13-14	**RSGB Commonwealth Contest**
Mar 20-21	**YL ISSB QSO Party—CW**
Mar 20-22	**BARTG Spring RTTY Contest**
Mar 27-28	**Spring VHF/UHF QSO Party**
Apr 3-4	**CW & RTTY World Championships**
Apr 17-18	**ARCI QRP Spring QSO Party**
Apr 24-25	**YL ISSB QSO Party—Phone**
Jun 12-13	**ARRL VHF QSO Party**
Jun 26-27	**ARRL Field Day**
Jul 10-11	**IARU Radiosport**
Jul 17-18	**International QRP Contest**
Aug 7-8	**ARRL UHF Contest**
Aug 14-15	**European DX Contest—CW**
Sep 11-12	**ARRL VHF QSO Party**
Sep 11-12	**European DX Contest—Phone**
Oct 16-17	**ARCI QRP CW QSO Party**
Nov 6-7	**ARRL Sweepstakes—CW**
Nov 13-14	**European DX Contest—RTTY**
Nov 20-21	**ARRL Sweepstakes—Phone**
Dec 4-5	**ARRL 160-Meter Contest**
Dec 11-12	**ARRL 10-Meter Contest**

RESULTS

RESULTS OF WASHINGTON STATE QSO PARTY FOR 1981
sponsored by
Boeing Employees' Amateur Radio Society (BEARS)

Alabama			
*K4ZGB	91	29	5,829
Alaska			
*NL7D	38	15	1,140
Arizona			
*W7ZMD	152	38	15,352
Arkansas			
*KE5B	122	31	9,517
California			
*N6PE	190	42	19,740
Colorado			
*N0CKC	25	13	975
Connecticut			
*W1TEE	76	29	6,061
Florida			
*WA4FNA	43	17	2,196
Georgia			
*KA4BYS	67	24	3,264
Idaho			
*KA7LBA	8	7	112
Illinois			
*WB9TBU	101	27	6,804
Indiana			
*KI9U	212	46	23,368
Iowa			
*WA0VBW	29	16	1,024
Kansas			
*WD0CCW	46	21	1,932
Kentucky			
*N4FCE	21	13	546
Maine			
*K2QE/1	75	28	5,376
Maryland			
*N3AC	21	11	506
Massachusetts			
*W1AQE	50	26	3,900
Michigan			
*W8WVU	53	24	3,816
Minnesota			
*WB0LNO	44	18	1,584
Missouri			
*K0TBB	41	19	2,242
Montana			
*N7ATT	9	7	126
Nebraska			
*W0JJL	25	12	660
New Jersey			
*W2CC	5	5	50
New York			
*WB2NDE	107	33	7,062
North Carolina			
*KB4GZ	13	8	208
North Dakota			
*N0CZO	9	5	90
Ohio			
*N8FU	71	25	3,975
Oklahoma			
*N5AFV	39	15	1,170
Oregon			
*WA7RQS	56	18	2,070
Pennsylvania			
*AD8J/3	49	19	2,147
South Dakota			
*WA0BZD	16	10	320
Tennessee			
*WA4CMS	45	20	2,180
Texas			
*W5OVU	82	26	4,264
Utah			
*W7LN	27	10	800
Vermont			
*N1BRT	10	6	120
Virginia			
*K4OD	60	22	3,344
West Virginia			
*KD8K	48	19	2,090
Wisconsin			
*K9GDF	107	34	9,350
CANADA			
British Columbia			
*VE7AVN	39	21	1,638
Manitoba			
*VE4RF	51	22	3,058
Ontario			
*VE3KK	70	27	5,670
BRAZIL			
*PY1NEZ	20	8	320
ENGLAND			
*G4HBI	6	4	48
JAPAN			
*JA7KE	45	20	2,240
SWEDEN			
*SM3DXC	24	16	1,136
WASHINGTON			
Benton			
*K7RF	90	32	5,760
Chelan			
*K7GAH	57	22	3,762
Clallam			
*WA7YMC	162	38	15,656
Columbia			
*W7GHT/M	21	17	1,071
Cowlitz			
*KJ7N	511	53	70,331
Douglas			
*W7GHT/M	40	21	2,520
Ferry			
*W7GHT/M	9	5	135
Franklin			
*W7GHT/M	13	9	351
Garfield			
*W7GHT/M	13	10	390
Grant			
*W7WMO	418	53	54,696
Island			
*W7GHT/M	46	21	2,898
King			
*KB7G	1,590	103	346,595
Kitsap			
*W7IIT	49	25	3,650
Kittitas			
*WA7STA	202	37	14,985
Klickitat			
#*VE7ZZ/W7	1,043	109	252,771
Lewis			
*WA7YFJ	8	5	80
Lincoln			
*W7GHT/M	42	21	2,646
Mason			
*W7DFO	122	37	10,323
Okanogan			
*KD7H	233	43	30,057
Pend Oreille			
*W7GHT/M	25	15	1,125
Pierce			
*W7BUN	900	73	131,473
Skagit			
*W7GHT/M	31	20	1,860
Skamania			
#*VE7ZZ/W7	1,043	109	252,771
Snohomish			
*KB7NU	527	51	54,060
Spokane			
*KB7UL	637	60	76,440
Stevens			
*W7GHT/M	35	18	1,890
Thurston			
*WA7RDJ	86	32	6,144
Walla Walla			
*W7GHT/M	31	17	1,581
Whatcom			
*WB7CLU	1,484	103	305,704
Yakima			
*N7AEN	264	67	37,252

*Winner of QSO Party Certificate Award
#Operated from Skamania/Klickitat county line
Numbers after call letters are: QSOs, multiplier, and total score.

Use all bands, 80 through 10 meters. In accordance with IARU recommendations, contestants are requested to operate within the lower 30 kHz of each band except when contacting Novice stations.

SCORING:

Each completed contact counts 5 points per QSO. In addition, a bonus of 20 points may be claimed for the first, second, and third contacts with each Commonwealth call area. All British Isles prefixes (G, GB, GD, GI, GJ, GM, GU, and GW) count as one call area.

AWARDS:

To the winner, the BERU Senior Rose Bowl; to the runner-up, the BERU Junior Rose Bowl; and to the leading UK station, the Colonel Thomas Rose Bowl. Certificates of merit will be awarded to the first through third placings in home and overseas multi-band or single-band entries, as well as to the leading station in each overseas call area.

ENTRIES:

Separate logs are required for each band. Each band log should be separately totalled and should include, at the end, a check list of call areas worked on the band. Logs must include GMT time, callsign of station worked, exchanges, and points claimed. Separate band totals should be added together and total claimed score entered on the cover sheet. It is important that logs are carefully checked for duplicate contacts. Unmarked duplicate contacts for which points have been claimed will be heavily penalized and logs containing in excess of five will be disqualified.

Entries may be single- or multi-band. Single-band entries should show contacts on one band only; details of contacts made on other bands should be enclosed separately for checking purposes. Multi-band entries will not be eligible for single-band awards. Each entry will consist of the separate band logs together with a cover sheet, summary, and declaration that the rules and spirit of the contest were observed. Entries should be addressed to: D. J. Andrews G3MXJ, 18 Downsview Crescent, Uckfield, East Sussex TN22 1UB, England. All entries must be received no later than May 17th.

VIRGINIA STATE QSO PARTY

Starts: 1800Z, March 13
Ends: 0200Z, March 15

Sponsored by the Sterling Park Amateur Radio Club. This year there are three categories of participation: 1) fixed or portable single transmitter, 2) fixed or portable multi-transmitter, and 3) mobile.

EXCHANGE:

QSO number and QTH (county for VA stations; state, province, or country for others).

FREQUENCIES:

Phone—3930, 7230, 21375, 28575; CW—60 kHz from low end, plus Novice bands.

SCORING:

Count one point per QSO. A station may be worked once on each band/mode. In addition, Virginia mobiles may also work the same station from each county visited. Virginia stations multiply QSO points times total of states, provinces, countries, and VA counties worked to get final score. All others multiply QSO points times numbers of VA counties worked to get final score. Virginia counties are determined by the USA-CA counties list.

AWARDS:

A plaque will be awarded to the highest Virginia score. Certificates go to the highest score in each state, province, country, and VA county.

ENTRIES

Mail logs and summary sheets no later than April 15, 1982, to A. Ray Massie K3RZR, Rt. 1 Box 115E, Dunnsville VA 22454. For a copy of the results, please include an SASE.

YL ISSB QSO PARTY—CW

Starts: 0001 GMT, March 20
Ends: 2359 GMT, March 21

Two six-hour rest periods are required. Operating categories include: single operator, DX/WK teams, and YL/OM teams. All bands will be used and the same station may be contacted on different bands for contact points but not as country multipliers. Two meters may be used, but contacts must be direct and not through repeaters.

EXCHANGE:

Name, RST, SSBer number, country, state, and partner's call. If no partner, leave blank. If non-member, send "no number."

SCORING:

Score eight points for each member contacted on any continent. Non-member contacts count *one* point. Only member station contacts count for multipliers. Multipliers are each state, country, and province, as well as each team contacted (only once for each team). When DX/WK partners contact each other, it counts as a double multiplier. Final score is sum of QSO points times the total multiplier.

ENTRIES:

Logs must show date/time (GMT), RST, SSBer number, partner's call, mode of operation, band, and period of rest time. Summary sheets show number of states, Canadian provinces, countries, YL/OM teams, DX/WK teams, and partner contacts. Send logs, summary sheets, and completed YL ISSB QSO Party applications to Minnie Connolly

WISCONSIN ASSOCIATION OF REPEATERS NEWSLETTER

NEWSLETTER OF THE MONTH

Some clubs have broad membership with diverse interests, while others focus much more closely on a single aspect of amateur radio. Similarly, a newsletter should contain information relating to the club's specialty. A general-interest club shouldn't fill its newsletter with DX info, while a DX-club newsletter would lose readership rapidly if it concentrated on 75-meter rag chewing.

This month's winner, the Wisconsin Association of Repeaters newsletter, sticks to its specialty and covers it well. WAR is the frequency coordinating body for repeaters in Wisconsin and, frequency coordination being the touchy matter it is, keeping the members (who are primarily repeater owners) informed is very important. The December issue is four letter-size pages long and includes an editorial regarding newsletter policies and an explanation of the new size of the newsletter (it used to be printed in half-page size). WAR's chairman writes concerning the new regulatory mood in Washington and the frequency coordinator describes in a "bedtime story" a recent problem concerning coordination in the state and uses it to point out the repeater owner's responsibility in the coordination process. The bulletin finishes off with minutes of the last (quarterly) meeting—particularly important for a club which draws its membership from across a large state.

The newsletter is printed by offset on colored paper with attractive graphics. Perhaps its nicest feature is the inclusion of an up-to-date listing of all coordinated repeaters in the state, arranged by geographical region. One portion of the list is a map of Wisconsin showing the regional breakdowns, so it is easy to determine in which region a repeater belongs. The list is printed on both sides of a separate letter-size sheet, so the newsletter needn't be defaced to save the list.

A newsletter editor needs to keep in mind the audience he is trying to reach; if he gives his specialized audience the specialized information that they joined together to learn, they will be happy both with the newsletter and with the club.

KA0ALX, Star Rt. #1, Crocker MO 65452. Anyone needing blank forms or further information should send an SASE to the same address.

BARTG SPRING RTTY CONTEST

Starts: 0200 GMT, March 20
Ends: 0200 GMT, March 22

The total contest period is 48 hours, but not more than 30 hours of operation is permitted. Time spent as listening counts as operating time. The 18 hours of non-operating time can be taken at any time during the contest, but off periods may not be less than 3 hours at a time. Times on the air must be summarized on the summary sheet.

There are separate categories for single-operator, multi-operator, and shortwave listener stations. Use all amateur bands from 80 through 10 meters. Stations may not be contacted more than once any one band.

EXCHANGE:

The message exchange consists of:

1) Time in GMT; this must consist of a full four-figure group and the use of the expression "same" or "same as yours" will not be acceptable.

2) RST and message number; the message must consist of a three-figure group starting with 001 for the first contact made.

SCORING:

All 2-way RTTY contacts with other stations within one's own country earn two points; contacts outside your country earn ten points. All stations can claim a bonus of 200 points for each country worked, including their own. Note that any one country may be counted again if worked on a different band, but the continents are counted once only. The ARRL country list is used and, in addition, each W/K, VE/VO, and VK call area will be counted as a separate country. Final score is (sum of QSO points times the total number of countries worked) added to (the number of countries times 200 bonus points each times the number of continents). Note: Proof of contact will be required in cases where the station worked does not appear in any other contest log received or the station worked does not submit a check log.

AWARDS:

Certificates will be awarded to the leading stations in each of the three classes, the top station in each continent, and to the top station in each W/K, VE/VO, and VK area.

If a contestant manages to contact 25 or more different countries on 2-way RTTY during the contest, a claim may be made for the Quarter Century Award (QCA) issued by BARTG and for which a fee of $3.00 (USA) or 15 IRCs is required. Make your claim at the same time you send your log. Holders of existing QCA awards should indicate and list any new countries to be added to their existing records. Make your claims at the same time that you send in your log. However, due to the high volume of work, it will not be possible to prepare and dispatch any new awards or update any existing awards until the final results of the contest have been evaluated and published.

Additionally, if any contestant manages to make contacts on 2-way RTTY with each of the six continents and the BARTG Contest Manager has received either a contest or check log from each of the six stations concerned, a claim may be made for the WAC Award issued by the American *RTTY Journal*. The necessary information will be sent to the *Journal*, which will issue the WAC Award free of charge.

ENTRIES:

Use a separate sheet for each band and indicate all times on the air. Logs should contain: date/time in GMT, callsign of station worked, RST and message number sent, time RST and number received, and points claimed. Logs received from shortwave listeners *must* contain the callsign of the station heard and the report sent by that station to the station he is working. Incomplete loggings are not eligible for scoring. The summary sheet should show the full scoring, the time *on* the air, and, in the case of multi-operator stations, the names and callsigns of all operators involved with the operation of the station. All logs must be received by May 31st in order to qualify. Summary and log sheets are available from the Contest Manager at the address shown below. The judges' decision will be final and no correspondence can be entered into with respect to incorrect or late entries. All logs submitted will remain the property of the British Amateur Radio Teleprinter Group. Send entries to: Ted Double G8CDW, 89 Linden Gardens, Enfield, Middlesex EN1 4DX, England.

SPRING VHF QSO PARTY

Starts: 1600 local time, March 27
Ends: 2400 local time, March 28

Sponsored by the Ramapo Mountain ARC. The contest rules are considerably different from the last two contests.

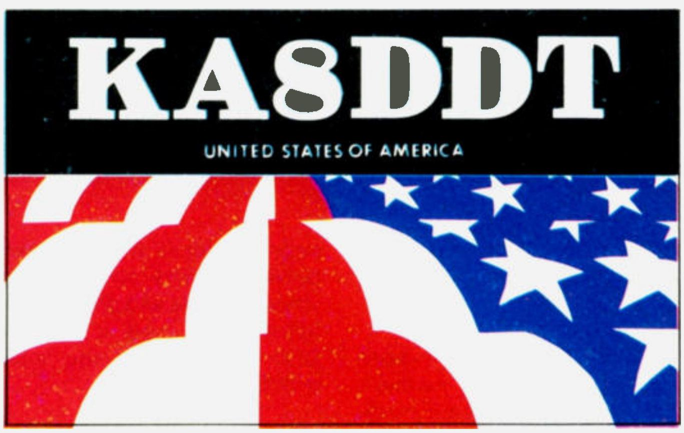
Classes of entry include single- and multi-transmitter. A station of the single-transmitter class may operate using several different transmitters but may not emit more than one signal at any given time. A station of the multi-transmitter class may operate simultaneously with a single emission on several different bands. The number of operators, loggers, etc., does not affect the class of the station entry.

A section is defined as a geographical area one degree in longitude by one degree in latitude, identified by a 4- or 5-digit number indicating the next lowest degree of longitude and latitude. Example: RMARC club station WA2SNA, located in Oakland NJ at 74° 15' west and 41° 3' north, would use a section designator of 7441.

Each QSO has a point of value based on the distance between stations as determined by the larger of the differences between the section designators' latitude or longitude plus 1, with a maximum of 10 QSO points. Example: WA2SNA in 7441 works W3XX in 7638. The difference between 74 and 76 is 2. The difference between 41 and 38 is 3. Three is the larger difference, so adding 1 to it would result in 4 QSO points.

The section multiplier is the total number of different sections worked per band. The following band multipliers are used to determine the final score per band: 50 MHz = ×1, 144 MHz = ×2, 220 MHz = ×4, 432 MHz = ×8, 1296 MHz = ×16, and 2304+ MHz = ×32. The score per band is equal to the total of QSO point values per band times the section multiplier times the band multiplier. The total score is the total of individual band scores. Each two-way QSO must include an exchange of station callsign, section designator, and class of entry (single- or multi-transmitter).

Prepare a separate log sheet for each band. Heading information must include your station callsign, section designator, and class of entry. Each individual QSO entry must include date/time (GMT), callsign, section designator, and entry class of the station worked, and the QSO point value. Per band summary information must include the total of QSO point values



QSL OF THE MONTH: KA8DDT

Does the design on David Ashenfelter KA8DDT's card look familiar? It's based on graphics used by ABC News during the 1980 presidential election.

If you would like to enter our contest, put your QSL card *in an envelope* and mail it, along with your choice of a book from *73*'s Radio Bookshop, to *73 Magazine*, Pine Street, Peterborough NH 03458, Attention: QSL of the Month. Entries which do not use an envelope (the Postal Service does *occasionally* damage cards) and do not specify a book will not be considered.

and the total of different sections worked.

Prepare one entry sheet, indicating for each band: band, QSO point total, number of sections, band multiplier, and band score. Also include the total of all band scores. This sheet must also include your station callsign, your section designator, ARRL section and division, and mailing address, and must be signed by the licensee or trustee of the call used.

An SASE to the RMARC will obtain log and entry forms. All who submit the required data will receive a copy of their newsletter with results. Award certificates will be issued to the highest scoring stations on each band as well as on a total basis in each ARRL section, division, and overall. Mail forms no later than May 1st to: Ramapo Mountain ARC, PO Box 364, Oakland NJ 07436.

CW & RTTY WORLD CHAMPIONSHIPS

CW Event: 0000 to 2400 GMT, April 3
Phone Event: 0000 to 2400 GMT, April 4

Sponsored jointly by *73 Magazine* and the *RTTY Journal*. Use all bands, 10 through 80 meters, on the specified mode. Cross-mode contacts do not count. The same station may be worked *once* per mode.

Operator classes are: a) single operator, single transmitter, non-computerized; b) single operator, single transmitter, computerized; c) multi-operator, single transmitter, non-computerized; and d) multi-operator, single transmitter, computerized. Single operator stations may work 18 hours maximum per mode, while multi-operator stations may operate the entire 24-hour period. Off times are no less than 30 minutes each and must be noted in logs. To be eligible for the computerized class, your station must be interfaced with a microprocessor-controlled RTTY and/or CW operating system such as the TRS-80, Heath/Zenith, Apple, PET, OSI, Hal, etc. Utilizing a memory keyer for CW does not constitute a computerized station.

Entry categories are: a) CW only, b) RTTY only, and c) CW and RTTY both.

EXCHANGE:

Stations within the 48 contiguous United States and Canada must send RST and state, province, or territory. All others will send RST and a consecutive contact number. If your station is computerized, add the letter "C" to the end of your exchange.

SCORING:

Count 1 QSO point for each valid contact. An additional *bonus* point is earned if the station worked is computerized and sent a "C" at the end of his exchange. Count 1 multiplier point for each of the 48 contiguous United States and each Canadian province/territory and DX country (outside the contiguous US and Canada). The total claimed score is the total QSO points times the total multiplier points.

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 50 QSOs must be worked on a mode to be eligible for awards.

ENTRIES:

Entries must include a *separate* log for each event entered, a dupe sheet, a summary sheet, a multiplier check list, and a list of equipment used for each mode of operation. Contestants are asked to send an SASE to the contest address for official forms!

Omission of the required entry forms, operating in excess of legal power, manipulating 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.

Entries must be postmarked *no later than* May 10th and sent to: CW and RTTY Championships, c/o The *RTTY Journal*, PO Box RY, Cardiff CA 92007.

AWARDS

Bill Gosney KE7C
Micro-80, Inc.
2665 North Busby Road
Oak Harbor WA 98277

TEN-METER FM AWARDS

- Sponsored by the North Whidbey Island Repeater Association (NWIRA).
- All contacts, to be valid, must have been made on/after January 1, 1981.
- Crossmode contacts do not count. Contacts must be 2-way ten-meter FM.
- Special endorsements can be made for all-mobile, all-simplex, and single-frequency accomplishments and contacts made within a single day, week, month, or year.
- Note: Members of the NWIRA monitor 29.600 MHz, as well as the area repeater on 29.640 MHz (an 1800-Hz tone or whistle is required to access).
- *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, along with the fee of $4.00 for each award, to Ten-Meter FM Awards Program, 2665 North Busby Road, Oak Harbor WA 98277.

Worked All Districts Award

To qualify, applicants must work one ten-meter FM station in each of the ten US call districts.

Worked All States Award

Applicants must work a *minimum* of fifty US states on ten-meter FM.

Centurion Award

This award requires the applicant to work a *minimum* of 100 stations on ten-meter FM.

DX Decade Award

Applicants must work a *minimum* of ten DX stations outside the fifty US states and Canada on ten-meter FM.

North American Award

To qualify, applicants must work all ten US call districts, a *minimum* of six Canadian provinces and/or territories, and at least four DX countries within the North American continent (other than the US and Canada) on ten-meter FM.

OPERATING ACHIEVEMENT AWARDS FROM *A5 MAGAZINE*

Fast-Scan ATV Award

"Getting the amateur television station operating is an award in itself!" This award certificate recognizes the "first" amateur television two-way contact. Endorsements for DX mileage and color ATV are available. Contacts via ATV repeaters are allowed. Award inscriptions are made around the border of the A5 block. Black/white, 8" × 10".

Master Scanner A5 SSTV Award

This award certificate recognizes the serious SSTVer. Entry level is 100 two-way SSTV contacts. Endorsements for 500, 1000, 1500, 2000, etc., are available. Special endorsement for color SSTV available with verified print copy. A must for every SSTVer! Gold, 8" × 10".

Specialized Communications Achievement Award

This award recognizes accomplishments in ATV, MSTV, NBTV, SSTV, fax, RTTY, EME, microwaves, and satellites. Entry levels are contacts over 100 miles on ATV. Special-event ATV projects, 25 DX country contacts on SSTV, reception of HF MSTV or fax signals via amateurs, microwave DX, 10 DX foreign countries via EME, 10 two-way contacts on an amateur satellite, and 25 DX countries on RTTY are required, with special endorsements available for additional contacts. Certificates are numbered as received. Gold, 8" × 10", suitable for framing.

Worked All States SSTV

Work all 50 states (including Hawaii and Alaska) with exchange of callsign and signal report in video. A special WAS map is available to color in the states as you get them. This is an ongoing award not limited to the annual contest. Special endorsements available for multiband WAS.

Worked All States RTTY

Work all 50 states (including Hawaii and Alaska) with log copy verification. This is an ongoing award not limited to the annual contest. Special endorsements available for multiband WAS.

"Good Image" Award

Awarded at the Dayton Hamvention each year, the Good Image Award is presented to the individual or group of individuals who contributed to the advancement of the A5 code of communication by technical achievement or public awareness. Top-of-the-line award!

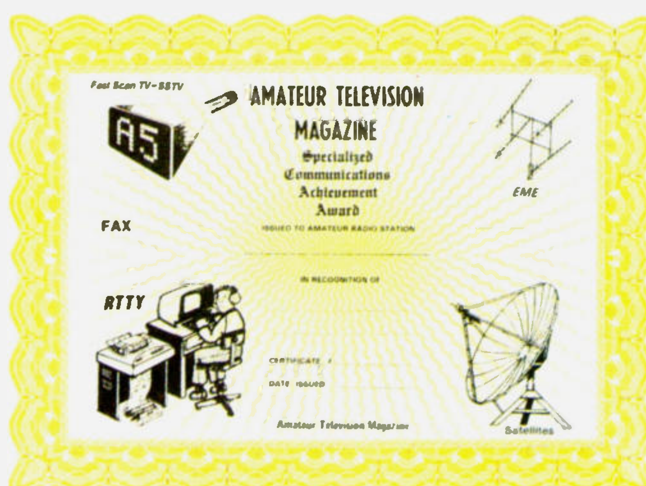
All *A5 Magazine* awards require subscription label information date codes. Enclose $1.00 for the cost of the award certificate and 50¢ postage for return mailing (envelope is provided). Allow 2-3 weeks for verification and mailing. Send all requests to Awards Manager, *A5 Magazine*, PO Box H, Lowden IA 52255-0408. Winners of awards will be published on a regular basis in *A5 Magazine*.

CENTRAL STATES VHF SOCIETY OPERATING AWARDS

At the 1981 Central States VHF Conference in Sioux Falls, South Dakota, in August, the Central States VHF Society formally announced its new operating awards program with three colorful awards for VHF/UHF/SHF bands.

Each award was designed to stimulate activity on the bands above 144 MHz. The differences in the awards as well as the variety of endorsements available provide challenging but achievable goals regardless of the station's geographic location or capabilities.

The awards are open to all amateurs—not just CSVHF Society members. To receive rules and application sheets, send a legal-size SASE (with two stamps) to Bob Taylor WB5LBT,



10715 Waverland, Baton Rouge LA 70815.

General Rules—All Awards

● The awards described below are available to all amateurs worldwide who submit details of the required contacts (on the separate award Application Detail Sheet) and have the accuracy of the application certified by a local member in good standing of the CSVHF Society. In addition to the basic awards, certain optional endorsements are available as described below and on the Application Cover Sheet.

● For all awards, direct two-way communication must be established on amateur radio bands of 144 MHz and above. Minimum contact requirements are the exchange of callsigns, signal reports (or other mutually understood information), and receipt of acknowledgement that both stations have received this information. All contacts for each award must be on the same band.

● Contacts must be made from the same location or from other location(s) licensed to the applicant, no two of which are more than 50 miles apart.

● Contacts for the VUCC and WHG awards may be made over any period of years, with no starting date, but *numbered* certificates will only be issued to those who have made all the required contacts after August 1, 1981. 1K Coverage Award contacts must be made during any two consecutive months after August 1, 1981.

● Contacts made through "repeater" devices or any other power relay method do not count toward any of the awards. In addition, no crossband contacts are permitted.

● False statements on the Application Cover Sheet or on the Detail Sheet(s) shall result in immediate disqualification for any of the awards.

● Remember, you do not have to be a member of the CSVHF Society to apply for an award. However, if you wish to join, send the $5.00 membership dues to: Ted Mathewson W4FJ, CSVHF Society Secretary, 1525 Sunset Lane, Richmond VA 23221. Please do not send dues with awards applications.

VUCC

The VUCC (VHF/UHF Century Club) award simply requires contacts with 100 different amateur stations. Optional endorsements for working additional stations in increments of 25 (e.g., 125, 150, 175, etc.) or for making all the contacts during a single calendar year (Jan. 1 through Dec. 31) are available *only* if all the contacts were made on the same mode of propagation (sporadic E skip, EME, meteor scatter, or aurora).

1KCA

The 1K Coverage Award requires contacts of sufficient number and distance such that the sum of the QSO points for all the contacts during *each* of any two consecutive calendar months is equal to or greater than 1000. The QSO points for any given contact are the band points multiplied by the distance points. The band points are determined as follows: 144 = 2, 220 = 5, 432 = 4, 1295 = 5, 2300 = 10, 3300 = 15, 5650 = 25, and 10 GHz and up = 50. The distance points are simply the number of 1° × 1° "grids" (see definition under WHG Award) you are away from the other station's 1° × 1° grid. For example, if the station is in the next grid over from yours, the distance points for the contact are 1; if it is two grids over, the distance points are 2, etc. Contacts in your own grid have a distance point value of 1. For stations which are not in a grid directly north, south, east, or west of yours (i.e., off at an angle), the distance points have to be calculated. In such cases, the distance points are equal to the square root of the sum of the latitude difference squared and the longitude distance squared, where the differences in latitude and longitude are measured in numbers of whole 1° × 1° grids. The resulting distance points are to be rounded off to the nearest tenth. Only one contact with a given station per GMT day counts toward this award, and EME contacts do not count. There are no additional endorsements available for this award.

WHG

The WHG (Worked Hundred Grids) award requires contacts with stations in 100 different 1° × 1° geographic "grids." The 1° × 1° grids are defined as the area bounded by integral values of latitude and longitude. For example, a station whose longitude is 112° 32' 15" west and latitude is 37° 25' 16" north would be in the grid 112W37N. All stations are urged to include their latitude and longitude and/or equivalent recognized QTH locator code on their station cards to assist others in determining their grid. If you have to determine the other station's grid yourself, it can be easily done by looking up the town location in any good road atlas and the locating the position on a larger map which shows the 1° lines of latitude and longitude. Two such maps are:

1. "Map 2-A," which comes in two halves (54" × 80" assembled) and is available for $3.00 postpaid from: Branch of Distribution, U.S. Geological Survey, Federal Center, Denver CO 80225. Shown are counties, county seats, capitals, and cities larger than 500,000.

2. Rand McNally's "Contemporary United States," which measures 36" × 54" and is available through bookstores for $2.95. The map does not show counties but does include major highways, a number of cities and towns, and 3° more latitude in Canada than the USGS map.

Optional endorsements are available for working additional 1° × 1° grids in increments of 25 (e.g., 125, 150, 175, etc.) or for working all the different grids in a single calendar year.

FUN!

John Edwards KI2U
78-56 86th Street
Glendale NY 11385

HOW HAMS VIEW THEMSELVES II

Here we go again. One year and two postal increases later, it's time once more for the famous Fun! poll.

For those who missed last year's event, the Fun! poll is not a scientific survey. What it represents, though, are the gut feelings of amateurs as they answer questions ranging from their personal lifestyles to how they view emerging trends in our hobby. Last year we discovered, for instance, that 12 percent of our respondents used a "cheat book" to upgrade, 54 percent felt that ham radio interfered with their personal relationships, and 61 percent would give up the hobby for a million dollars.

This time around we're keeping many of the old questions and adding some new ones. I hope that you'll take the time to fill out the response sheet and mail it to *the address at the top of this column*.

Last year, some club officers wrote in to say that they made the poll a meeting activity. Photocopy ballots were passed out and members were encouraged to voice their opinions on the various topics. I think that's a great idea. Anything that can get hams thinking and talking can't be all bad. Just be sure to mail in those ballots

ELEMENT 1—BACKGROUND

1) Sex:

A) Male
B) Female

2) Age:
- A) 15 or below
- B) 16-21
- C) 22-39
- D) 40-59
- E) 60 and above

3) License class:
- A) Novice
- B) Technician
- C) General
- D) Advanced
- E) Extra

4) Number of years licensed:
- A) 1 year or less
- B) 1-5 years
- C) 6-10 years
- D) 11-20 years
- E) 21 years and up

5) Do you have a new (post-March '78) call?
- A) Yes
- B) No

6) How many hours a week do you devote to amateur radio?
- A) 0-1 hour
- B) 2-5 hours
- C) 6-10 hours
- D) 11-20 hours
- E) 21 hours or more

7) Which HF band do you most use?
- A) 80-75 meters
- B) 40 meters
- C) 20 meters
- D) 15 and/or 10 meters
- E) Don't operate HF

8) Which VHF-UHF band do you most use?
- A) 6 meters
- B) 2 meters
- C) 220 MHz
- D) 420 MHz and/or up
- E) Don't operate VHF-UHF

9) Which mode do you most use?
- A) SSB
- B) CW
- C) FM
- D) RTTY
- E) Other

10) How much money have you spent on amateur radio within the past year? (Include QSL expenses, magazine subscriptions, club dues, and other incidental expenditures.)
- A) 0-$250
- B) $251-$500
- C) $501-$1,000
- D) $1,001-$2,500
- E) $2,501 and up

ELEMENT 2—SOCIAL CHARACTISTICS

11) Has amateur radio influenced your career choice?
- A) Greatly
- B) Somewhat
- C) Not at all

12) Do you answer QSLs with no return postage?
- A) Yes
- B) No

13) Politically, how would you define yourself?
- A) Conservative
- B) Middle-of-road
- C) Liberal

14) Do you think amateur radio will exist 20 years from now?
- A) Yes
- B) No

15) Have you ever had a fight with a family member over amateur radio?
- A) Yes
- B) No

16) Do you have any relatives who are hams?
- A) Yes
- B) No

17) Are most of your friends (more than half) hams?
- A) Yes
- B) No

18) Did you ever use a "cheat book" (not counting the ARRL License Manual) to upgrade your license?
- A) Yes
- B) No

19) If someone offered you five million dollars, tax free, on the condition you give up amateur radio forever, would you?
- A) Yes
- B) No

20) Do you belong to a local ham radio club?
- A) Yes
- B) No

21) Have you ever attended a ham flea market?
- A) Yes
- B) No

22) Have you ever attended the Dayton Hamvention?
- A) Yes
- B) No

23) Would you pay five dollars to join the ARRL if they offered no magazine, QSL services, awards, or technical and instructional help?
- A) Yes
- B) No

24) Would you like to see another national organization compete with the ARRL?
- A) Yes
- B) No

ELEMENT 3—OPERATING HABITS

25) Would you favor a licensing system that had only two classes: Novice and General or Communicator and General?
- A) Yes
- B) No

26) Would you like to see the FCC turn over amateur testing responsibility to clubs?
- A) Yes
- B) No

27) Do you think religious and politically-oriented nets have a place in ham radio?
- A) Yes
- B) No

28) Should contests be outlawed?
- A) Yes
- B) No

29) Do you think the FCC should assign exclusive frequencies and times to nets?
- A) Yes
- B) No

30) Do you think the FCC should assign exclusive frequencies to repeaters?
- A) Yes
- B) No

31) Should there be a no-code, VHF and above, "digital-class" license? This license would require a heavy theory test and carry no phone or CW privileges (except perhaps for ID purposes).
- A) Yes
- B) No

32) Should there be a no-code, 220 MHz, "communicator-class" license? This license would require a moderately difficult theory test and carry only F3 privileges at a maximum of 50 Watts.
- A) Yes
- B) No

33) Do you own a microcomputer?
A) Yes
B) No

34) What sort of CW sending device do you most often use?
A) Straight key
B) Keyer
C) Bug
D) Keyboard
E) Never operate CW

35) If required, coulc you solidly copy CW at the speed at which you were licensed?
A) Yes
B) No

36) Have you ever purposely operated in an amateur subband you weren't licensed to use?
A) Yes
B) No

37) Do you think the FCC affects amateur radio in a positive manner?
A) Yes
B) No

38) Do you ever speak to foreign, non-English-speaking hams in their own language?
A) Always
B) Sometimes
C) I attempt it
D) Rarely
E) Never

39) Do you feel yourself competent to replace the finals in a tube-type rig?
A) Yes
B) No

40) Do you feel yourself competent to replace the finals in a transistor-type rig?
A) Yes
B) No

41) Have you ever built an electronic project from a kit?
A) Yes
B) No

42) Have you ever "home-brewed" an electronic project from a book or magazine?
A) Yes
B) No

43) Have you ever designed your own electronic project?
A) Yes
B) No

44) What do you think of contesting?
A) Great
B) Good
C) Okay
D) Don't like it
E) Despise it

45) What do you think of DXing?
A) Great
B) Good
C) Okay
D) Don't like it
E) Despise it

46) What do you think of repeaters?
A) Great
B) Good
C) Okay
D) Don't like them
E) Despise them

47) What do you think of traffic handling?
A) Great
B) Good
C) Okay
D) Don't like it
E) Despise it

48) Do you plan to use Phase III OSCAR within a year of its launch?
A) Yes
B) No

49) Do you plan to use the new 10.1 MHz band within one year of its opening?
A) Yes
B) No

50) Do you believe amateurs should have the right to build, use, and sell equipment intended for the reception of subscription television?
A) Yes
B) No

RESPONSE FORM

Instructions: Read each question and mark your response by circling the appropriate letter next to the number of the question.

Element 1:

1)	A	B			
2)	A	B	C	D	E
3)	A	B	C	D	E
4)	A	B	C	D	E
5)	A	B			
6)	A	B	C	D	E
7)	A	B	C	D	E
8)	A	B	C	D	E
9)	A	B	C	D	E
10)	A	B	C	D	E

Element 2:

11)	A	B	C
12)	A	B	
13)	A	B	C
14)	A	B	
15)	A	B	
16)	A	B	
17)	A	B	
18)	A	B	
19)	A	B	
20)	A	B	
21)	A	B	
22)	A	B	
23)	A	B	
24)	A	B	

Element 3:

25)	A	B			
26)	A	B			
27)	A	B			
28)	A	B			
29)	A	B			
30)	A	B			
31)	A	B			
32)	A	B			
33)	A	B			
34)	A	B	C	D	E
35)	A	B			
36)	A	B			
37)	A	B			
38)	A	B	C	D	E
39)	A	B			
40)	A	B			
41)	A	B			
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44)	A	B	C	D	E
45)	A	B	C	D	E
46)	A	B	C	D	E
47)	A	B	C	D	E
48)	A	B			
49)	A	B			
50)	A	B			

Comments:

Send to: John Edwards KI2U, 78-56 86th Street, Glendale NY 11385.

REVIEW

THE YAESU FT-680R TRANSCEIVER

The Yaesu FT-680R is a compact, six-meter, multi-mode transceiver designed for both mobile and fixed station use. It is part of a rather complete line of nearly identical VHF/UHF transceivers which includes the FT-480R two-meter and the FT-780R 430-MHz multi-mode rigs.

The FT-680R is fully synthesized, with a four-bit NMOS microprocessor-controlled operating frequency, scanning, priority channel selection, and the various memory functions. Frequency coverage is from 50 to 53.99999 MHz, in steps of 10 Hz, 100 Hz, and 1 kHz in SSB (CW and AM modes) and 1-kHz, 20-kHz, and 100-kHz steps in the FM mode. These steps correspond to one click on the main tuning knob, or one press of the up or down buttons on the microphone.

Of the sixteen controls on the front panel, eleven are associated with frequency selection. The other five are volume and squelch controls, high/low power switch, and a noise-blanker on/off switch. The microphone jack is an eight-pin affair identical to that found on many Icom rigs and provides for microphone-mounted up/down scanning switches, a "Call" button for tone-burst operation, and a microphone lock switch, in addition to the obligatory PTT, signal, and ground lines.

Underneath the front panel on the right-hand side are three switches: SAT, which allows the operating frequency to be changed while transmitting, a repeater offset selector, and a busy/clear scanning selector. A miniature connector is located near the back of the bottom panel, allowing tone burst on six meters. The unit's speaker is also on the bottom panel.

The rear panel is mostly heat sink, but squeezed into the corners are jacks for antenna, power, and CW key. The entire unit measures approximately 2½" high, 7¼" wide, and 9½" deep. A hefty mobile bracket is included, as is a wire bail for home use. The bail is necessary because the speaker housing prohibits the rig from sitting flat on a table without it.

Other Features

Upon first unpacking the FT-680R, I decided that the front panel was the most confusing I had ever encountered. This is no small distinction, considering the needlessly complex panels on some of the competition! However, my opinion was modified considerably after reading the instruction manual. In retrospect, the 680 offers a thoughtful layout. What need work are some of the labels over the switches. For example, use of the switch marked DIL is not exactly obvious. A glance at the manual explains everything. The switch ". . . transfers frequency control from the memory channels to the main tuning knob." That makes perfect sense, but please don't ask me what it has to do with DIL! Once you understand some of the confusing labels, the front panel is a lot friendlier.

There are four memories available as well as a priority channel. These function in the generally accepted manner. An interesting and extremely useful twist is the clever programming of the up/down switches on the microphone. At first, they appear to operate just like the mike switches on countless other rigs, but if you hold down one of the switches for more than half a second, the automatic scanner is activated. Even if you release the switch, the unit will continue to scan up or down the band. To stop, simply press either the up or down buttons or the PTT switch. Surprisingly, pushing the PTT switch during scanning will not result in a transmission. The next time you press it though, it will behave normally and you'll be on the air. Nice touch!

The controls on the underside of the transceiver are inconvenient and their labels impossible to read without turning the rig over. Yaesu's engineers correctly assumed that most users would rarely need access to these controls, but they failed to consider how easy it is for an operator unknowingly to change the position of the switches while moving the rig. Hopefully, Yaesu will not mount switches here on future rigs.

Particularly useful to the six-meter DXer is the inclusion of semi-break-in operation on the CW mode. Also included is an 800-Hz sidetone. Missing is an amplifier-keying jack. With 4CX250 amplifiers so easy to home-brew for this band, such a jack is sorely missed. Fortunately, adding one should prove to be easy for anyone on familiar terms with a soldering iron.

The Yaesu FT-680R six-meter transceiver. (Photo by KA1LR)

On the Air

The FT-680R spent several weeks accumulating dust on the shelf after its arrival because I couldn't find the time to install a proper six-meter yagi. One Friday evening as my wife and I settled in to view our favorite program on Channel 2, we found it had been pre-empted. The Boston station we had planned to watch faded in and out of the hash, and then for a few minutes a Florida news broadcast captured the set completely! Without so much as a word, Alyson went to the ham shack, got the FT-680R, and dropped it at my feet. We found a spare 12-volt supply and then hooked up the rig to a Radio Shack TV antenna on the roof. The swr was about 3:1, but the rig put out almost full power and didn't make any funny noises, so I started tuning up the band. Among other things, we heard a Georgia station calling CQ, and I gave him a quick call. Wonder of wonders, he came back with a 59 report! Over the weekend, I worked 21 states in the south and midwest, using 10 Watts PEP and a TV antenna fed with 75-Ohm coax. Bob Cooper in the Turks and Caicos came in 59 + 20 Saturday morning, but I apparently couldn't be heard over the pileup of kilowatts and stacked arrays. I did manage to make several contacts elsewhere using the low-power position (one Watt PEP), but signal strength reports at this power level were not uplifting.

When the band finally went dead and I reconnected the TV, it occurred to me that I had forgotten about the lossy 300-Ohm to 75-Ohm transformer installed at the antenna. Close examination revealed it to be undamaged, but I've always wondered how much power I lost in the darn thing!

All things considered, the 680's performance is outstanding. Receiver sensitivity is more than adequate for all but the most demanding weak-signal work. After a couple of hours with most multi-mode rigs, one usually begins thumbing the catalogs in search of a suitable preamp, but no one who used the 680 ever felt the urge. Receiver audio quality was very good—better than that found on other Yaesu transceivers. Transmit audio reports were excellent, and I'm just as glad the 680 doesn't include a speech processor! The Monadnock region of New Hampshire is not exactly bursting with FM six-meter activity, so about all I can say about the FM section is that it works.

The instruction manual is very complete. Several other well-known manufacturers would do well to offer the sincerest form of flattery—imitation. As well as the usual specifications and operating instructions, the FT-680R owner is furnished with alignment and service instructions, a parts list, a theory of operation section, and three poster-sized schematics. An amateur radio operator deserves nothing less.

A rather complete line of optional accessories is offered for the 680. For those of us too lazy to build our own, there is the FP-80 dc power supply. The AD-1 antenna coupler permits a single mobile antenna (the RSL-50) to be used with both six- and two-meter rigs at the same time. One less hole in the old crate. Home-station operators will appreciate the choice of stand microphones, including one with scanning push-buttons in the base. Finally, for owners of the 680 and one of its twins, there is the SC-1 station console which makes the rigs into a single compact package and includes a power supply, digital clock, 16-button DTMF pad, and some convenient switching.

Conclusion

Six meters remains one of our interesting amateur bands. Propagation is often unpredictable and wild, rewarding the alert operator with dizzying tours of the country. On occasion, it is rather tame, behaving like a mischievous 10 meters, offering long, solid rag-chews before sweeping your friend off the S-meter. As solar activity provides fewer opportunities to sample the thrills of six-meter DX, the FM position on the mode switch will offer a bastion of tranquility and camaraderie, free from the crowding and circus-like atmosphere that prevails on other, more populous FM bands. Six meters offers some of the very best of the HF and VHF worlds, and the FT-680R provides an excellent means to sample the action. In features, price, and performance, it stands with the best. Yaesu has a winner!

For information, contact *Yaesu Electronics Corp., 6851 Walthall Way, Paramount CA 90723,* Reader Service number 483.

Paul Grupp KA1LR/4
Casselberry FL

THE CURTIS K5 KEYER

The Curtis keyer IC has been used in countless keyer models offered by a wide range of manufacturers, and with good reason. The chip offers almost every feature a radio operator could require in a non-memory keyer, and very few additional components are needed to produce a complete unit. But while everyone was building keyers around the chip, almost all neglected its most obvious use. Since the component count is so small, why not produce a tiny keyer that could go anywhere, anytime? Well, that's exactly what Curtis did!

The K5 keyer measures only 1-1/2" square by 3-1/16" deep. A tiny glass-epoxy circuit board is securely screwed to a U-shaped piece of .062" heavy aluminum. This assembly slides into a rectangular case, also made of .062" aluminum, and is held in place by friction fit.

On the rear panel are a phono jack for transmitter keying, a submini phone jack for power, and a submini phone jack for sidetone output. Four eight-inch-long lugged wires exit through a plastic grommet. These are for connection to keyer paddle and straight key.

Correctly, the Curtis engineers judged that the only control that most users would need immediate access to is the combination speed control and on/off switch. This is mounted on the otherwise bare front panel. By mounting seldom-used controls inside the box, enough space was saved to allow room for a standard 9-volt transistor battery.

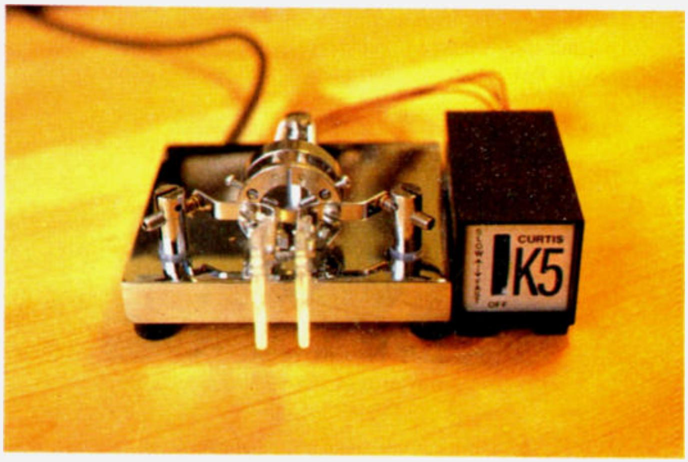
The internal controls are all miniature trimpots. Sidetone frequency is set to 1000 Hz and volume to a nominal level. The sidetone output is really only designed to drive headphones (there is no internal speaker), but the instruction manual points out that a 500-Ohm to 8-Ohm miniature transformer will bring up the volume to a usable speaker level.

There is also an internal control for weighting, factory-set to 3:1. Curtis discourages the use of nonstandard weighting, but provides complete instructions on the use of the control for hams with special requirements as well as for those diehards who insist on making a perfectly good keyer perform something like a grossly maladjusted Vibroplex bug. If you can't resist playing with the weighting, rest assured that it is easily reset to 3:1 by turning the control fully counterclockwise.

A particularly useful control is the maximum-speed trimmer. The keyer is factory-set for a top speed of 50 wpm, but this can be raised or lowered appreciably by adjusting the maximum-speed trimmer to taste. For example, I never send faster than 25 wpm. By setting the trimmer for this slower top speed, I enjoy a much wider range of adjustment with the front-panel speed control.

In the Real World

Curtis's years of experience producing keyers are evident in the design of the K5. It's no use



The Curtis K5 keyer with Bencher paddles. (Photo by KA1LR) having a portable keyer if it places an unseemly demand on available power. The K5 draws less than 50-uA quiescent current and about 20 mA while keying with an average sidetone level. Turning the sidetone off completely reduces drain somewhat.

The K5 is designed to operate at 9 V dc, but can be operated at up to 20 V dc as long as the battery is removed before the higher voltage is applied. For lower voltages, the relay's current limiting resistor can be shorted out, which will permit operation with as low as 3 V dc input. The voltage range recommended for most reliable operation is 5 to 15 V dc.

Because of the K5's sealed-contact tungsten relay, keying incompatibility problems are a thing of the past. The touchiest solid-state keying circuit (like the one in my Icom IC-701) is keyed without complaint. No more changing polarity when switching rigs, either! The maximum contact rating of 500 V, 1 A at 15 VA should handle your swishing clobber from the fifties with ease. And if you are worried about getting along with a noisy relay, relax—this one makes less noise than the contacts on my Bencher paddle!

Importantly, the circuitry is well-protected against the harsh electrical environment amateur radio equipment often faces. A diode in the power-input line protects the keyer from reverse polarity. Both sides of the output relay are protected against inductive-kickback spikes. Anything and everything that could suffer from rf pickup is bypassed and/or equipped with a ferrite bead. The paddle inputs include debouncing circuitry, and two pairs of germanium diodes protect them from accidental application of voltage.

One potentially confusing feature of the K5 is its availability in two different models. The K5 offers iambic keying that handles like earlier Curtis keyers. The K5B offers iambic keying with characteristics similar to the Accukeyer, AEA, Heath, Nye, and Ten-Tec units. Make sure you order the model that provides the characteristics that you are familiar with. If this is to be your first keyer, the K5B would be your best choice since you won't have to relearn anything when you use a keyer from a different manufacturer. If you ever wish to try an alternate method of "paddling," you can simply unplug the chip and replace it with the other version.

It is hard to imagine a better keyer for the ham who doesn't require a unit with memory capabilities. It should be especially popular with hams who use portable multi-mode VHF and UHF gear. No more sending CW with the mike button to make a few contacts during a meteor shower!

Whenever you use it though, you'll find that the K5 produces code that is indistinguishable from its more expensive and bulkier competitors. And as a ham who frequently tests new transceivers, I find the relay-driven transmitter keying particularly useful. I own several excellent keyers from a variety of manufacturers, but because the K5 never needs rewiring to make it compatible with a new transceiver, it's always the first keyer connected to a new addition to the shack.

For more information, contact: *Curtis Electro Devices, Box 4090 Mountain View CA 94040.* Reader Service number 484.

Paul Grupp KA1LR/4
Casselberry FL

HAM HELP

I am in need of a schematic and manual for a Hammarlund FM50a business-band radio, 1960s vintage. I would like to convert this to 50 MHz.

Leonard W. Martin WD5DNQ
PO Box 18665
Baton Rouge LA 70893
(504)-342-6933

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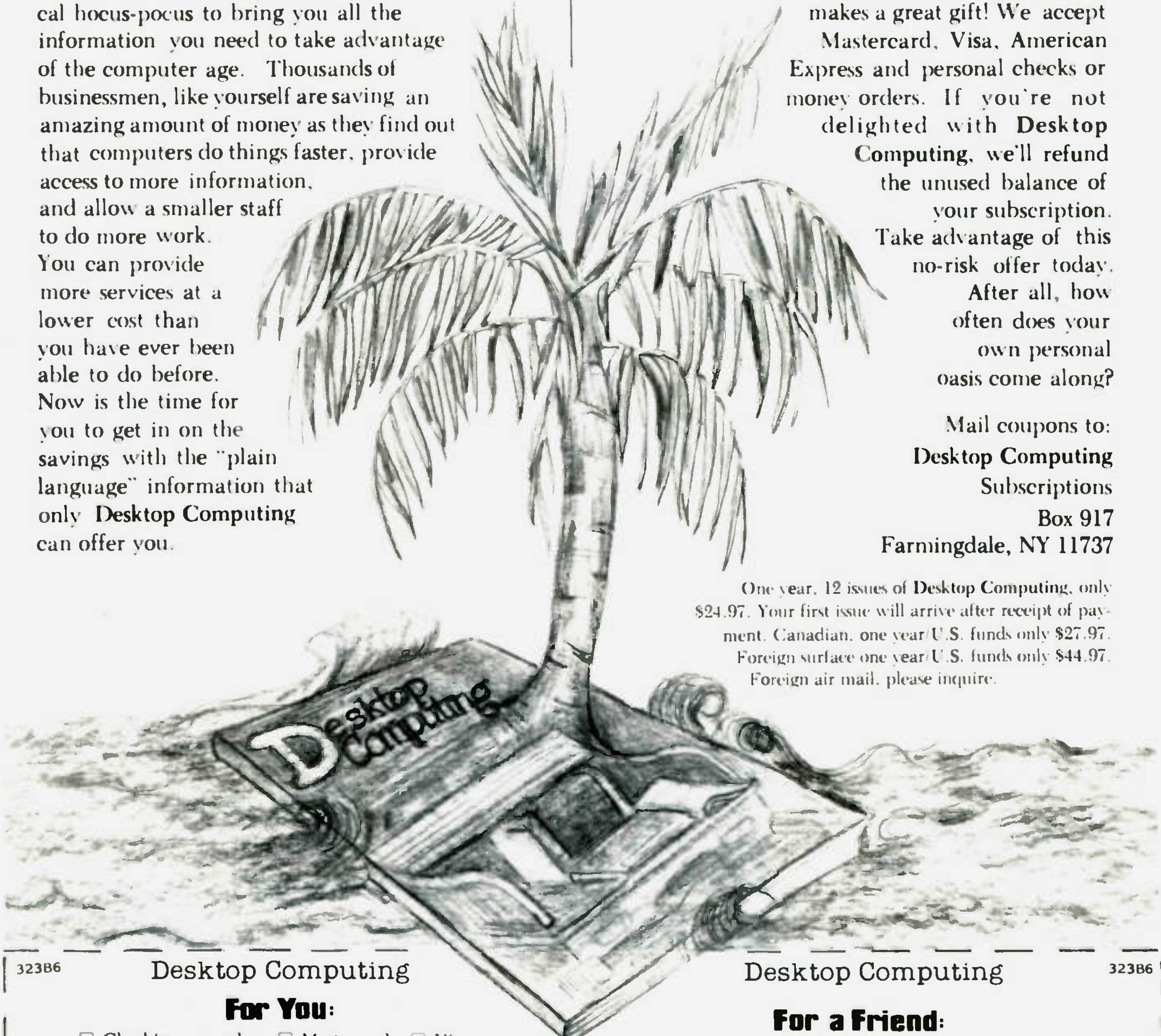

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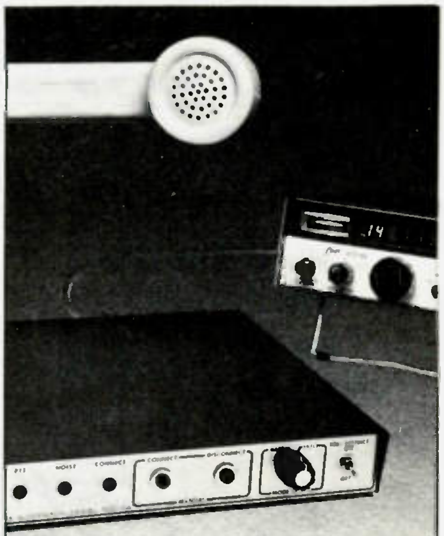

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The Ultimate Synthesized Scanner!
List price $599.95/CE price **$399.00/$50.00 rebate**
Your final cost is a low $349.00
7-Band, 50 Channel • Alpha-Numeric • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC
Bands: 30-50, 118-136 AM, 144-174, 421-512 MHz.
The new *Bearcat* 350 introduces an incredible breakthrough in synthesized scanning: Alpha-Numeric Display. Push a button—and the Vacuum Fluorescent Display switches from "numeric" to word descriptions of what's being monitored. 50 channels in 5 banks. Plus, Auto & Manual Search, Search Direction, Limit & Count, Direct Channel Access, Selective Scan Delay, Dual Scan Speeds, Automatic Lockout, Automatic Squelch, Non-Volatile Memory. Order your *Bearcat* 350 today!

Bearcat® 300
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Your final cost is a low $299.00
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Bands: 32-50, 118-136 AM, 144-174, 421-512 MHz.
The *Bearcat* 300 is the most advanced automatic scanning radio that has ever been offered to the public. The *Bearcat* 300 uses a bright green fluorescent digital display, so it's ideal for mobile applications. The *Bearcat* 300 now has these added features: Service Search, Display Intensity Control, Hold Search and Resume Search keys, Separate Band keys to permit lock-in/lock-out of any band for more efficient service search.

NEW! Bearcat® 350

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The *Bearcat* 250 performs any scanning function you could possibly want With push button ease you can program up to 50 channels for automatic monitoring. Push another button and search for new frequencies. There are no crystals to limit what you want to hear. A special search feature of the *Bearcat* 250 actually stores 64 frequencies and recalls them, one at a time, at your convenience.

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List price $449.95/CE price **$289.00/$25.00 rebate**
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Frequency range 32-50, 118-136 AM, 144-174, 420-512 MHz
The *Bearcat* 20/20 automatic scanning radio replaces the *Bearcat* 220 and monitors 40 frequencies from 7 bands, including aircraft. A two-position switch, located on the front panel, allows monitoring of 20 channels at a time.

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List price $349.95/CE price **$229.00/$15.00 rebate**
Your final cost is a low $214.00
6-Band, 18 Channel • Crystalless • AC/DC
Frequency range: 32-50, 144-174, 421-512 MHz.
The *Bearcat* 210XL scanning radio is the second generation scanner that replaces the popular *Bearcat* 210 and 211. It has almost twice the scanning capacity of the *Bearcat* 210 with 18 channels plus dual scanning speeds and a bright green fluorescent display. Automatic search finds new frequencies. Features scan delay, single antenna, patented track tuning and more!

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NEW! Bearcat® 100
The first no-crystal programmable handheld scanner.
Allow 30-120 days for delivery after receipt of order due to the high demand for this product.
List price $449.95/CE price **$299.00**
8-Band, 16 Channel • Liquid Crystal Display Search • Limit • Hold • Lockout • AC/DC
Frequency range 30-50, 138-174, 406-512 MHz
The world's first no-crystal handheld scanner has compressed into a 3" x 7" x 1¼" case more scanning power than is found in many base or mobile scanners. The *Bearcat* 100 has a full 16 channels with frequency coverage that includes all public service bands (Low, High, UHF and "T" bands), the 2-Meter and 70 cm. Amateur bands, *plus* Military and Federal Government frequencies It has chrome-plated keys for functions that are user controlled, such as lockout, manual and automatic scan. Even search is provided, both manual and automatic. Wow...what a scanner!

The *Bearcat* 100 produces audio power output of 300 milliwatts, is track-tuned and has selectivity of better than 50 dB down and sensitivity of 0.6 microvolts on VHF and 1.0 microvolts on UHF. Power consumption is kept extremely low by using a liquid crystal display and exclusive low power integrated circuits.

Included in our low **CE** price is a sturdy carrying case, earphone, battery charger/AC adapter, six AA ni-cad batteries and flexible antenna. For earliest delivery from **CE**, reserve your *Bearcat* 100 today.

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List price $189 95/CE price **$124.00/$10.00 rebate**
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Frequency range: 33-47, 152-164, 450-508 MHz.
The incredible, *Bearcat* Four-Six Thin Scan™ is like having an information center in your pocket. This four band, 6 channel crystal controlled scanner has patented Track Tuning on UHF Scan Delay and Channel Lockout. Measures 2¾ x 6¼ x 1. Includes rubber ducky antenna. Order crystal certificate for each channel. Made in Japan.

Fanon Slimline 6-HLU
List price $169.95/CE price **$109.00**
Low cost 6-channel, 3-band scanner!
The *Fanon* Slimline 6-HLU gives you six channels of crystal controlled excitement. Unique Automatic Peak Tuning Circuit adjusts the receiver front end for maximum sensitivity across the entire UHF band. Individual channel lockout switches Frequency range 30-50, 146-175 and 450-512 MHz. Size 2¾ x6¼ x 1." Includes rubber ducky antenna. If you *don't* need the UHF band, get the **Fanon model 6-HL** for $99 00 each, and save money. Same high performance and features as the model HLU without the UHF band. Order crystal certificates for each channel Made in Japan.

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SSB Noise Fiqure		fR 3.7 to 4.2GHz
	4.9dB Typ. 6dB Max.	fI 30 to 1125MHz fL fR
	5.5dB Typ. 6.5dB Max.	fI 880MHz fL fR
Isolation		
fL at R	30dB Min. 40dB Typ.	fL 2.8 to 5.35GHz
fL at I	25dB Min. 30dB Typ.	fL 4.5 to 5.35GHz
	20dB Min. 30dB Typ.	fL 3.6 to 4.5GHz
	15dB Min. 25dB Typ.	fL 2.8 to 3.6GHz
Conversion Compression	1dB Max.	fR Level +2dBm
Flatness	.2dB Peak to Peak Over any 40MHz Segment of fR=3.7 to 4.2GHz	
Third Order Input Intercept	+11dBm	fR1=4GHz fR2=4.01GHz Both at -5dBm fL=4.5GHz @ +13dBm
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7445N	69
7447N	69
7448N	69
7474N	35
7475N	49
7485N	65
7489N	1 70
7490N	35
7495N	55
74100N	1 00
74107N	30
74123N	55
74125N	45
74145N	60
74150N	1 20
74151N	65
74154N	1 25
74157N	55
74161N	70
74162N	85
74163N	85
74174N	89
74175N	85
74190N	1 15
74192N	79
74193N	79
74221N	1 25
74298N	85
74365N	65
74366N	65
74367N	65

74LS00 TTL	
74LS00N	25
74LS02N	25
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74LS22N	25
74LS28N	35
74LS30N	25
74LS33N	55
74LS38N	35
74LS74N	45
74LS75N	50
74LS90N	60
74LS93N	65
74LS95N	85
74LS107N	40
74LS112N	45
74LS113N	45
74LS132N	75
74LS136N	40
74LS151N	75
74LS155N	79
74LS157N	75
74LS162N	95
74LS163N	95
74LS174N	95
74LS190N	1 00
74LS221N	1 19
74LS258N	69
74LS367N	69

LINEAR	
CA3045	90
CA3046	1 10
CA3081	1 80
CA3082	1 90
CA3089	3 40
LM301AN/AH	34
LM305H	87
LM307N	35
LM308N	98
LM309K	1 25
LM311H/N	64

LM317T	65
LM317K	3 75
LM318	1 49
LM320K-5	1 35
LM320K-12	1 35
LM320K-15	1 35
LM320T-5	95
LM320T-8	95
LM320T-12	95
LM320T-15	95
LM323K-5	4 95
LM324N	99
LM339N	99
LM340K-5	1 35
LM340K-8	1 35
LM340K-12	1 35
LM340K-15	1 35
LM340K-24	1 35
LM340T-5	85
LM340T-8	85
LM340T-12	85
LM340T-15	85
LM340T-18	85
LM340T-24	85
LM350	5 50
LM377	2 29
LM380N	1 00
LM381	1 60
LM382	1 60
LM709H	59
LM723H/N	49
LM733N	85
LM741CH	35
LM741N	35
LM747H/N	75
LM748N	50
LM1303N	1 75
LM1304	1 10
LM1305	1 27
LM1307	1 10
LM1310	2 75
LM1458	55
LM1812	8 25
LM1889	2 49
LM[illegible]111	1 75
LM2902	2 25
LM3900N	59
LM3905	1 25
LM3909N	95
MC1458V	55
NE550N	1 30
NE555V	39
NE556A	85
NE5[illegible]A	1 00
NE566V	1 50
NE567V	1 00
NE570B	4 75
78L05	60
78L08	60
78M05	85
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75492CN	55
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CD4014	95
CD4015	95
CD4016	45
CD4017	1 05
CD4018	94
CD4019	45
CD4020	95
CD4021	95
CD4022	1 10
CD4023	28
CD4024	75
CD4025	23
CD4026	1 65
CD4027	65
CD4028	80
CD4029	95
CD4030	45
CD4035	85
CD4040	95
CD4042	75
CD4043	85
CD4044	85
CD4046	95
CD4049	45
CD4050	55
CD4051	95
CD4060	1 42
CD4066	71
CD4068	39
CD4069	35
CD4070	35
CD4071	30
CD4072	30
CD4073	35
CD4075	30
CD4076	95
CD4078	30
CD4081	30
CD4082	30
CD4116	47
CD4490	5 50
CD4507	99
CD4508	1 95
CD4510	95
CD4511	94
CD4515	2 25
CD4516	1 10
CD4518	1 25
CD4520	1 02
CD4527	1 51
CD4528	1 25
CD4553	3 50
CD4566	2 45
CD4583	2 35
CD4585	95
CD40192	3 00
74C00	35
74C04	35
74C10	35
74C14	75
74C20	35
74C30	35
74C48	1 95
74C74	85
74C76	80
74C90	1 25
74C93	1 25
74C154	3 25
74C160	1 69
74C175	1 19
74C192	1 65
74C221	1 90
74C905	6 00
74C906	75
74C914	1 95
74C922	5 00
74C923	5 50
74C925	6 75
74C926	6 95
74C927	6 95

INTERFACE	
8095	65
8096	65
8097	65
8098	65
8T09	1 25
8T10	1 75
8T13	1 40
8T20	4 95
8T23	1 75
8T24	1 75
8T25	3 20
8T26	1 69
8T28	1 95
8T97	99
8T98	1 65

MOS MEMORY RAM	
2101-1	1 95
2102-1	85
2102AL-4	1 45
2102AN-2L	1 65
2104A-4	4 95
2107B-4	3 75
2111-1	2 99
2112-2	2 99
2114	2 24
2114L 300ns	2 50
2114L 450ns	2 37
4116 200ns	2 50
8 4116 200ns	15 40
MM5280	3 00
MM5320	9 95
MM5330	5 94
P5101L	8 95
4200A	11 50
9368	3 50
410D	10 00
416	2 50

CLOCKS	
MM5311	4 95
MM5312	3 90
MM5314	3 90
MM5369	1 95
MM5841	14 45
MM5865	7 95
CT7010	8 95
CT7015	8 95
MM5375AA/N	3 90
MM5375AG/N	4 90
7205	16 50
7207	7 50
7208	15 95
7209	4 95

MICROPROCESSOR	
6502	6 95
6502A	9 50
6504	6 95
6522	8 75
6530	9 50
6532	14 95
6551	11 85
6800	5 70
6802	11 95
6820	4 95
6850	3 50
8080A	3 95
8085A	8 50
Z80A	6 00
Z80B	18 95
Z80 PIO	6 50
Z80A PIO	5 95
Z80 CTC	5 95
Z80A CTC	8 65
Z80 DART	15 25
Z80A DART	18 75
Z80 DMA	17 50
Z80A DMA	27 50
Z80 SIO 0	23 95
Z80A SIO 0	28 95
Z80 SIO 1	15 00
Z80A SIO 1	23 90
Z80 SIO 2	23 95
Z80A SIO 2	28 95
Z80B CTC	17 95
Z80B PIO	17 95
8212	2 25
8214	3 90
8216	2 25
8224	2 50
8228	4 95
8251	5 50
8253	8 95
8255	5 25
8257	9 00
8259	9 95
1802CE plas	13 95
1802E plas	17 95
1861P	5 95

UART FIFO	
AY5 1013	5 50
AY5 1014	7 50
3341	6 95

PROM	
1702A	4 50
2532	19 75
2708	3 95
2716TI	8 50
2716 5 Volt	5 75
8 2716 5 Volt	39 00
2732	16 50
2758	7 49
8741A	39 95
8748	55 00
8748-8	55 00
8755A	49 95
N82S23	2 95
N82S123	3 95
N82S126	5 75
N82S129	4 75
N82S131	4 95
N82S136	8 75
N82S137	8 75
8223	3 50

CONNECTORS	
30 pin edge	2 50
44 pin edge	2 75
86 pin edge	4 00
100 pin edge	3 95
100 pin edge w/w	4 95

IC SOCKETS
Solder Tin Low Profile

PIN	1UP	PIN	1UP
8	13	22	30
14	14	24	30
16	16	28	40
18	20	36	58
20	29	40	49

WIRE WRAP LEVEL 3

PIN		PIN	
14	55	24	93
16	57	28	1 00
18	67	40	1 59

2 level 14 pin w/w 20

CRYSTALS	
1 MHz	4 50
2 MHz	4 50
4 MHz	4 25
5 MHz	4 25
10 MHz	4 25
18 MHz	3 90
20 MHz	3 90
32 MHz	3 90
32768 Hz	4 00
1 8432 MHz	4 50
3 5795 MHz	1 20
2 0100 MHz	1 95
2 097152 MHz	4 50
2 4576 MHz	4 50
3 2768 MHz	4 50
5 0688 MHz	4 50
5 185 MHz	4 50
5 7143 MHz	4 50
6 5536 MHz	4 50
14 31818 MHz	4 25
18 432 MHz	4 50
22 1184 MHz	4 50

KEYBOARD ENCODERS	
AY5 2376	11 95
AY5 3600	17 95
74C922	5 49
74C923	5 50
HD0165 5	7 95

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DA15S	3 10
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12 6V CT 2 amps	5 95	12V 500 ma	4 50
12 6V CT 4 amp	8 60	12V 1 amp	5 95
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MAN72/74	CA/CA	300	75
DL704	CC	300	1 25
DL707/DL707R	CA	300	1 00
DL727/728	CA/CC	500	1 90
DL747/750	CA/CC	600	1 49
FND359	CC	357	70
FND500/507	CC/CA	500	99
FND503/510	CC/CA	500	90
FND800/807	CC/CA	800	2 20
10 digit display			1 25
7520 Clairex photocells			39
TIL311 Hex			9 50
MAN3640	CC	30	99
MAN4610	CA	40	99
MAN4640	CC	40	1 20
MAN4710	CA	40	95
MAN4740	CC	40	1 20
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MAN6710	CA	60	99
MAN6740	CC	60	99

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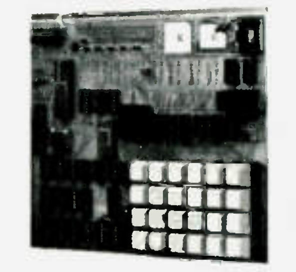
Model 950	$1010 00

4116 200ns Dynamic RAM 8/$15.40



RCA Cosmac 1802 Super Elf Computer $106.95

The Super Elf is a small single board computer that does many **big** things. It's an excellent computer for training and for learning programming with its machine language and yet it's easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest address and data bus** displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Moews Video Graphics **$3.50**, Games and Music **$3.00**, Chip 8 Interpreter **$5.50**, Starship 4K cassette **$14.95.**

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic by Ron Cenker** including floating point capability with scientific notation (number range $\pm .17E^{38}$), 32 bit integer ± 2 billion, multi dim arrays, string arrays, string manipulation, cassette I/O, save and load, basic, data and machine language programs, and over 75 statements, functions and operations.

New improved faster version including **renumber** and essentially **unlimited variables**.

Also, an exclusive user expandable command library.

Serial and Parallel I/O routines included.

Super Basic on Cassette $55.00.

Free 14 page brochure of complete Super Elf system.

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed**. EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports with full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two S-100 slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at **$18.95** for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

ELECTRONIC SYSTEMS KITS

Apple Peripheral Kits

SERIAL I/O INTERFACE 0 to 30,000 baud, D.T.R., Input & output from monitor or basic, or use Apple as intelligent terminal, Bd only (P/N 2) **$14.95**, Kit (P/N 2A) **$51.25**, Assembled (P/N 2C) **$62.95**.

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PARALLEL TRIAC OUTPUT BOARD 8 triacs, each can switch 110V, 6A loads, Bd only (P/N 210) **$19.20**, Kit (P/N 210A) **$119.55**.

OPTO-ISOLATED INPUT BOARD 8 inputs, can be driven from TTL logic, Bd only (P/N 120) **$15.65**, Kit (P/N 120A) **$69.95**.

Interface Kits

SERIAL/PARALLEL INTERFACE Bidirectional, Baud rates from 110 to 19.2K, sw selectable polarity of input and output strobe, 5 to 8 data bits, 1 or 2 stop bits, parity odd or even or none, all characters contain a start bit, +5 & −12V required. Bd only (P/N 101) **$11.95**, Kit (P/N 101A) **$42.89**.

RS-232/TTL INTERFACE Bidirectional, requires ±12V, Kit (P/N 232A) **$9.95**.

RS-232/20mA INTERFACE Bidirectional, 2 passive opto-isolated circuits, Kit (P/N 7901A) **$14.95**.

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Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$9.95**

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16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00.** Tiny Basic **$30.00.**

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Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$35.95.** Kit with chassis and all hardware **$51.95.** Add $5.00 shipping. Kit of hardware **$16.00.** Woodgrain case **$10.00.** $1.50 shipping.

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Text to speech synthesizer with unlimited vocabulary, built-in text to speech algorithm, 70 to 100 bits per second speech synthesizer, RS232C Interface **$369.00.**

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Expandable to 64K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$25.00.**

S-100 4-slot expansion	**$ 9.95**
Super Monitor VI.I Source Listing	**$15.00**

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6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display. ROM monitor, fully expandable **$419.00.** 4K version **$449.00.** 4K Assembler **$35.00.** 8K Basic Interpreter **$65.00.**

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Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80, etc. **Dealers: Send for excellent pricing/margin program.**

TERMS: $5.00 min. order U.S. Funds. Calif. residents add 6% tax. $10.00 min. VISA and MasterCard accepted. $1.00 insurance optional. Shipping: Add 5%; orders under $25.00—10%.

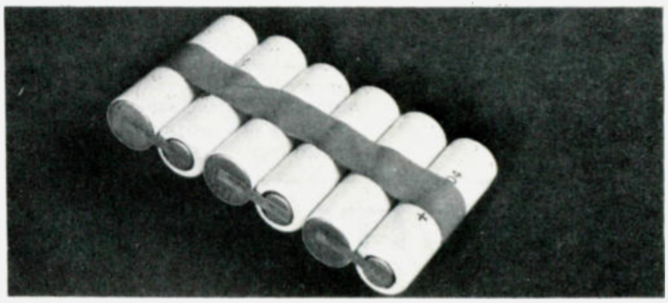
FREE: Send for your copy of our NEW QUEST CATALOG. Include 88¢ stamp.

SEMICONDUCTORS SURPLUS

64

MINIMUM ORDER $10.00

THE CORDLESS EXTENSION TELEPHONE "ESCORT"
Good for up to 300 ft. away from the base unit.
(Call for quantity prices of 10 and up.)



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MRF227	3.45
MRF238	12.65
MRF240	15.50
MRF245	34.00
MRF247	34.00
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MRF314	20.70
MRF406	13.80
MRF412	25.30
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MRF422A	41.40
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MRF428	46.00
MRF428A	46.00
MRF426	15.50
MRF426A	15.50
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BFR91	1.65
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MMCM2484	15.25
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544-4001-002, similar to type MHW 401-2.
1.5 Watts output.
440-512 MHz.
15 dB gain min. $29.99 each

Motorola rf transistors.
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43 pgs. $1.99 each

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PL-258 UHF female to UHF female	1.69
M-359 UHF 90°	2.50
UG363 UHF double female Panel mount	2.99
UHF M PL-259 to RCA	.90
F71-1115 4 pin plug	.75
F71-1116 4 pin jack	.75
F71-1120 6 pin plug	.85
F71-1121 6 pin jack	.85
Din plug & jack 5 pin male & female	.49
BNC UG260 BNC male for RG 59U	1.25
BNC UG88U BNC male for RG 58U	
UG 273 BNC female to PL-259	2.50
UG 274 BNC T 2 female to 1 BNC male	3.75
UG 21 Type N male	3.60
UG 23 Type N female	3.75
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SO-239	.69
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2N2949	3.60
2N2947	15.00
2N2950	4.60
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40282 2N3927	17.25
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Frequency range: 144-148 MHz.
Output power: 25W.
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Ferrite Beads 1/8" long		12/1.00
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Plug Ins

Model#	Description	Make	Quantity	Price
1783A	Time Mark Generator	Hewlett Packard	1	$ 69.99 each
1A1	Dual Trace	Tektronix	4	$ 350.00 each
1A2	Dual Trace	Tektronix	1	$ 250.00 each
2A63	Differential Amp.	Tektronix	1	$ 100.00 each
1A4	Four Channel Amp.	Tektronix	4	$ 450.00 each
1S1	Sampling Unit	Tektronix	1	$ 250.00 each
3A72	Dual Trace Amp.	Tektronix	1	$ 250.00 each
53/54C	Dual Trace Calibrated Preamp	Tektronix	5	$ 79.99 each
3A75	Amplifier	Tektronix	1	$ 100.00 each
N	Sampling Unit	Tektronix	1	$ 100.00 each
1754A	Four Channel Amp.	Hewlett Packard	3	$ 90.00 each
1750B	Dual Trace Vertical Amp.	Hewlett Packard	1	$ 70.00 each
3T77	Sampling Sweep	Tektronix	1	$ 250.00 each
3T4	Programmable Sampling Sweep	Tektronix	1	$ 200.00 each
10A1	Differential Amp.	Tektronix	2	$ 100.00 each
3S76	Sampling Dual Trace	Tektronix	1	$ 250.00 each

Equipment

Model#	Description	Make	Quantity	Price
CDC5	Decade Capacitance	Cornell/Dubilier	4	$ 19.00 each
CDC3	Decade Capacitance	Cornell/Dubilier	2	$ 19.00 each
204B	Dialamatic Volt Meter	Wavetek	1	$ 100.00 each
201	Dialamatic Volt Meter	Wavetek	1	$ 100.00 each
10411A	Horizontal Gain Calibrator	Hewlett Packard	1	$ 39.95 each
422	Oscilloscope	Tektronix	1	$ 900.00 each
PS163	Oscilloscope	Sencore	1	$ 409.95 each
175A	Oscilloscope Includes: plug ins; 1781B Delay Generator 1754A 4 Channel Amp.	Hewlett Packard	2	$ 400.00 each
71D	Capacitance/Inductance includes: 94A Digital Display 15A Bias Supply	Boonton Elect.	1	$ 200.00 each
2200	Filter	Krhon-Hite	1	
8100	Automatic Counter	Dana	1	$ 300.00 each
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3200B	VHF Oscillator	Hewlett Packard	1	$ 750.00 each
431C	Power Meter	Hewlett Packard	1	$ 250.00 each
431B	Power Meter	Hewlett Packard	1	$ 150.00 each
TF1041C	Vacuum Tube Volt Meter	Marconi Instrument	1	$ 79.99 each
6328A/401B	Power Meter	Spectra Physics	1	$ 49.99 each
71A	Capacitance/Inductance Meter	Boonton Elect.	1	$ 300.00 each
3121	Selective Volt Meter	Rycon	1	$ 99.99 each
353A	Patch Panel	Hewlett Packard	1	$ 100.00 each
DC1108A	Precision Volt Meter	Calibration Standards	1	$ 69.99 each
691B	Sweep Oscillator	Hewlett Packard	1	$ 200.00 each
ME11/U	RF Watt Meter With Case	Bird Elect.	1	$ 100.00 each
1133A	Frequency Converter	General Radio	1	$ 199.00 each
M68 U Cana	Microcomputer Analyzer	Motorola	1	$2000.00 each
74C58	Capacitance Bridge	Boonton Elect.	1	$ 300.00 each
190A	Constant Amplitude Signal Generator	Tektronix	1	$ 100.00 each
TF1066B	F.M. Signal Generator	Marconi Instruments	1	$1000.00 each
300	Potentiometric Volt Meter	Electro Scientific	1	$ 250.00 each
530	Semiconductor Tester	B&K Precision	1	$ 350.00 each
75D	Direct Capacitance Bridge	Boonton Elect.	1	$1000.00 each
180A	Time Mark Generator	Tektronix	1	$ 49.00 each
1521B	Graphic Level Recorder	General Radio	1	$ 500.00 each
6M901	Monochrome TV Monitor	Setchell/Carlson	1	$ 155.00 each
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101	Automatic plug in Bread Board	A.P. Products	1	$ 50.00 each
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MA71508	Microwave Circulator 1.71-1.85 GHZ 20 db ins 3/10 loss 1.15-1 SWR	Microwave Assoc.		$ 50.00 each
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KENWOOD

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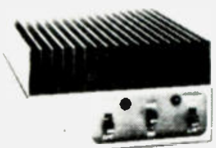
R-600

MIRAGE B-108 Two Meter Amplifier



Features: 10W in — 80W out, Built-in Receive Preamp, Adjustable Delay for SSB, Automatic Internal or External Relay Switching, Frequency Range 144 to 148 MHz. Works for SSB, CW or FM Modes, Receive Preamp Provides 10db Gain Min., 5 year Warranty (1 Year on Power Trans.).

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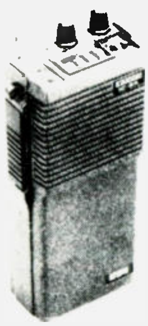

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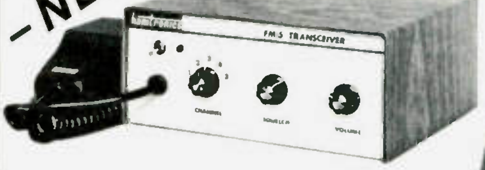

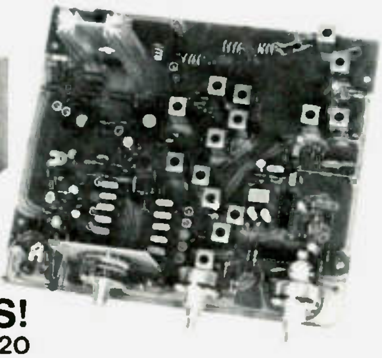

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complete with controls, heatsink, etc.

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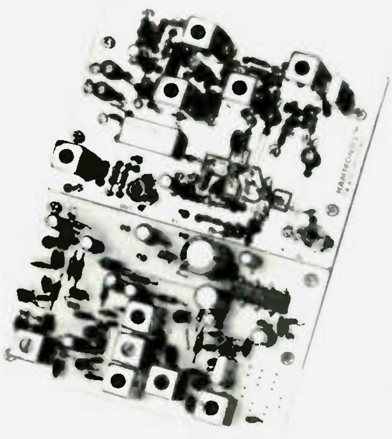

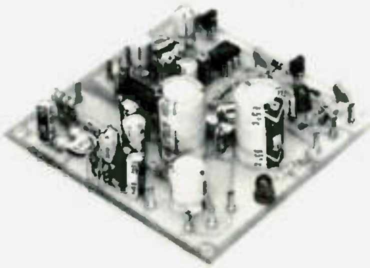

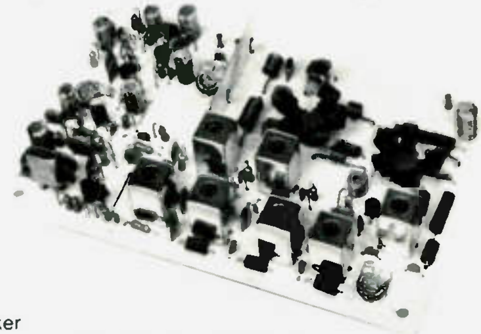

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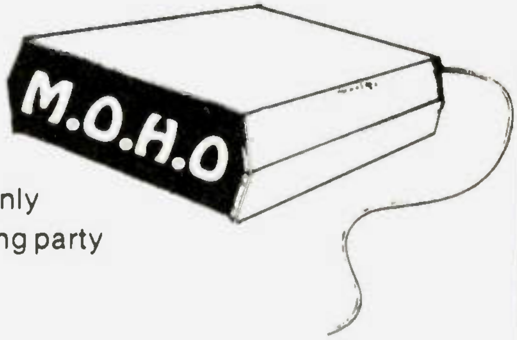

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- Dual Emitter leads
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- Very low noise - High gain 1.5 DB @500 MHZ
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12 AMP Darlington NPN
VCEO - 80 VDC
IC - 12 ADC
HFE-3500 (Typ.) @ 5.0ADC
TO-3 Case

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- Maximum efficiency — no traps, loading coils, or stubs
- Fully assembled and pre-tuned — no measuring, no cutting
- All weather rated — 1 KW AM, 2.5 KW CW or PEP SSB
- Proven performance — more than 10,000 have been delivered
- Permit use of the full capabilities of today's 5-band xcvrs.
- One feedline for operation on all bands.

80-40HD/A 80/40 Mtr bands (69).... 99.00
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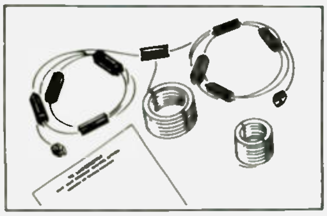
80-10HD/A 80/40/20/15/10 Mtr (69). . 132.00



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- COMPLETELY WEATHERPROOF!
- COMPLETE, NO ASSEMBLY NEEDED!
- 60, 49, 41, 31, 25, 19, 16, 13 & 11M BANDS!

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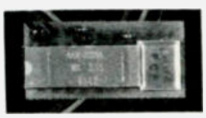

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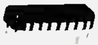

7400

SN7400N	.20
SN7401N	.20
SN7402N	.25
SN7403N	.25
SN7404N	.25
SN7405N	.29
SN7406N	.35
SN7407N	.35
SN7408N	.29
SN7409N	.29
SN7410N	.25
SN7411N	.29
SN7412N	.35
SN7413N	.40
SN7414N	.69
SN7416N	.29
SN7417N	.29
SN7420N	.25
SN7421N	.29
SN7422N	.45
SN7423N	.29
SN7425N	.29
SN7426N	.29
SN7427N	.25
SN7428N	.49
SN7430N	.25
SN7432N	.29
SN7437N	.25
SN7438N	.40
SN7439N	.25
SN7440N	.20
SN7441N	.89
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SN7444N	1.10
SN7445N	.89
SN7446N	.79
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SN7448N	.79
SN7450N	.20
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SN7453N	.20
SN7454N	.20
SN7459A	.25
SN7460N	.20
SN7470N	.29
SN7472N	.29
SN7473N	.35
SN7474N	.35
SN7475N	.49
SN7476N	.35
SN7479N	5.00
SN7480N	.50
SN7482N	.99
SN7483N	.69
SN7485N	.89
SN7486N	.35
SN7489N	1.75
SN7490N	.49
SN7491N	.59
SN7492N	.45
SN7493N	.45
SN7494N	.69
SN7495N	.69
SN7496N	.69
SN7497N	3.00
SN74100N	1.49
SN74104N	.89
SN74105N	.89
SN74107N	.35
SN74109N	.39
SN74116N	1.95
SN74121N	.39
SN74122N	.55
SN74123N	.59
SN74125N	.49
SN74126N	.49
SN74132N	.75
SN74136N	.75
SN74141N	.99
SN74142N	3.25
SN74143N	3.49
SN74144N	3.49
SN74145N	.79
SN74147N	1.95
SN74148N	1.29
SN74150N	1.25
SN74151N	.69
SN74152N	.69
SN74153N	.79
SN74154N	1.25
SN74155N	.79
SN74156N	.79
SN74157N	.69
SN74160N	.89
SN74161N	.89
SN74162N	.89
SN74163N	.89
SN74164N	.89
SN74165N	.89
SN74166N	1.25
SN74167N	2.79
SN74170N	1.95
SN74172N	4.95
SN74173N	1.39
SN74174N	.99
SN74175N	.89
SN74176N	.79
SN74177N	.79
SN74179N	1.49
SN74180N	.79
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SN74182N	.79
SN74184N	2.49
SN74185N	2.49
SN74190N	1.25
SN74191N	1.25
SN74192N	.89
SN74193N	.89
SN74194N	.89
SN74195N	.69
SN74196N	.89
SN74197N	.89
SN74198N	1.49
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SN74251N	.99
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SN74279N	.79
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SN74284N	3.95
SN74285N	3.95
SN74365N	.69
SN74366N	.69
SN74367N	.69
SN74368N	.69
SN74390N	1.49
SN74393N	1.49

74LS

74LS00	.29
74LS01	.29
74LS02	.29
74LS03	.29
74LS04	.35
74LS05	.35
74LS08	.35
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74LS33	.59
74LS37	.45
74LS38	.39
74LS40	.35
74LS42	.89
74LS47	.89
74LS48	1.15
74LS49	1.15
74LS51	.35
74LS54	.35
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74LS73	.45
74LS74	.45
74LS75	.59
74LS76	.45
74LS78	.49
74LS83	.89
74LS85	1.25
74LS86	.49
74LS90	.69
74LS92	.75
74LS93	.75
74LS95	.99
74LS96	1.15
74LS107	.45
74LS109	.45
74LS112	.45
74LS113	.49
74LS114	.49
74LS122	.89
74LS123	1.25
74LS125	.59
74LS126	.59
74LS132	.99
74LS133	.89
74LS136	.49
74LS138	.89
74LS139	.89
74LS151	.89
74LS153	.89
74LS154	1.75
74LS155	.89
74LS156	.89
74LS157	.89
74LS158	.89
74LS160	1.15
74LS161	1.15
74LS162	1.15
74LS163	1.15
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74LS165	1.15
74LS168	1.19
74LS169	1.19
74LS170	1.95
74LS173	.99
74LS174	.99
74LS175	.99
74LS181	2.95
74LS190	1.25
74LS191	1.25
74LS192	1.15
74LS193	1.15
74LS194	1.15
74LS195	1.15
74LS197	1.19
74LS221	1.19
74LS240	1.49
74LS241	1.49
74LS242	1.49
74LS243	1.49
74LS244	1.49
74LS245	2.95
74LS247	1.19
74LS248	1.19
74LS249	1.19
74LS251	.99
74LS253	.99
74LS257	.89
74LS258	.69
74LS260	.69
74LS266	.69
74LS273	1.95
74LS279	.89
74LS283	.89
74LS290	.99
74LS293	.99
74LS298	1.25
74LS352	1.29
74LS353	1.29
74LS365	.69
74LS366	.69
74LS367	.69
74LS368	.69
74LS373	1.95
74LS374	1.95
74LS375	.89
74LS386	.69
74LS393	2.49
74LS399	2.49
74LS670	2.49
81LS95	1.95
81LS97	1.95

74S

74S00	.45
74S02	.45
74S03	.45
74S04	.55
74S05	.55
74S08	.50
74S09	.50
74S10	.45
74S11	.45
74S15	.45
74S20	.45
74S22	.45
74S30	.45
74S32	.55
74S38	1.25
74S40	.50
74S51	.45
74S64	.50
74S65	.50
74S74	.75
74S86	.79
74S112	.79
74S113	.79
74S114	.79
74S124	3.95
74S133	.55
74S134	.69
74S135	1.19
74S136	1.75
74S138	1.35
74S139	1.35
74S140	.79
74S151	1.35
74S153	1.35
74S157	1.35
74S158	1.35
74S160	2.95
74S174	1.59
74S175	1.59
74S188	2.95
74S194	1.95
74S195	1.95
74S196	1.95
74S240	2.95
74S241	2.95
74S242	3.25
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74S244	3.25
74S251	1.45
74S253	1.45
74S257	1.35
74S258	1.35
74S260	.79
74S280	2.95
74S287	3.25
74S288	2.75
74S373	3.49
74S374	3.49
74S387	2.95
74S471	10.95
74S472	10.95
74S473	10.95
74S474	12.95
74S475	12.95
74S570	5.95
74S571	5.95
74S572	9.95
74S573	9.95
74S940	3.15
74S941	3.15

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CA3013H	2.15
CA3023H	3.25
CA3035H	2.49
CA3039H	1.35
CA3046N	1.30
CA3059N	3.25
CA3060N	3.25
CA3080H	1.25
CA3081N	2.00
CA3082N	2.00
CA3083N	1.60
CA3086N	.85
CA3089N	3.75
CA3096N	3.95
CA3130H	1.39
CA3140H	1.25
CA3160H	1.25
CA3401N	.59
CA3600N	3.50

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CD4001	.39
CD4002	.39
CD4006	1.19
CD4007	.25
CD4009	.49
CD4010	.49
CD4011	.39
CD4012	.25
CD4013	.49
CD4014	1.39
CD4015	1.19
CD4016	.59
CD4017	1.19
CD4018	.99
CD4019	.49
CD4020	1.19
CD4021	1.39
CD4022	1.19
CD4023	.29
CD4024	.79
CD4025	.23
CD4026	2.95
CD4027	.69
CD4028	.89
CD4029	1.49
CD4030	.49
CD4034	3.49
CD4035	.99
CD4040	1.49
CD4041	1.49
CD4042	.99
CD4043	.89
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CD4046	1.79
CD4047	2.50
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CD4051	1.19
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CD4056	2.95
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CD4060	1.49
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CD4068	.39
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CD4070	.55
CD4071	.49
CD4072	.49
CD4073	.39
CD4075	.39
CD4076	1.39
CD4078	.55
CD4081	.39
CD4082	.39
CD4093	.99
CD 4098	2.49
CD4506	.75
CD4507	.99
CD4508	3.95
CD4510	1.39
CD4511	1.29
CD4512	1.49
CD4514	3.95
CD4515	2.95
CD4516	1.49
CD4518	1.79
CD4519	.89
CD4520	1.29
CD4526	1.79
CD4528	1.79
CD4529	1.95
CD4543	2.79
CD4562	11.95
CD4566	2.79
CD4583	2.49
CD4584	.75
CD4723	1.95
CD4724	1.95
MC14409	17.95
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MULTI DIGIT REFLECTOR ARRAYS FOR CLOCKS

Part Number (Color)	[illegible]	Polarity	Description	Overall Size	Light Output	Forward Voltage	[illegible]	Price	2 FOR SALE
[illegible]	[illegible]	C.C.	[illegible] Colon and Auxiliary Indicators	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/2.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/2.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/7.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/2.[illegible]

MULTI DIGIT REFLECTOR ARRAYS

Part Number	[illegible]	Polarity	Description	Overall Size	[illegible]	[illegible]	[illegible]	Price	2 FOR SALE
[illegible]	[illegible]	C.C.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.79	2/.[illegible]
[illegible]	[illegible]	C.A.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/1.19
[illegible]	[illegible]	C.C.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/1.[illegible]
[illegible]	[illegible]	C.A.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/3.49

NATIONAL Stick Display Sale

LIMITED QUANTITY!

SALE!

LED NUMERIC ARRAYS

PART NO	DIGIT SIZE (RED)	FORMAT	DRIVE Comm Cathode Comm Anode	OVERALL SIZE	PRICE	SALE
[illegible]	[illegible] Bubble Stick	[illegible]	C.C. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/.99
[illegible]	[illegible] Bubble Stick	[illegible]	C.C. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/.[illegible]
[illegible]	[illegible] Bubble Stick	[illegible]	C.C. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/.[illegible]
[illegible]	[illegible] Bubble Stick	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	2/.79
[illegible]	[illegible] Bubble Stick	[illegible]	C.C. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/.[illegible]
[illegible]	[illegible] Bubble Stick	[illegible]	C.C. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/1.19

MULTI DIGIT LED NUMERIC DISPLAYS

PART NO	DIGIT SIZE (RED)	FORMAT	DRIVE	OVERALL SIZE	PRICE	SALE
[illegible]	[illegible]	[illegible]	C.C. 2 Digit Direct	[illegible]	[illegible]	2/.79
[illegible]	[illegible]	[illegible]	C.A. 2 Digit Direct	[illegible]	[illegible]	2/.99
[illegible]	[illegible]	[illegible]	C.A. 2 Digit Direct	[illegible]	[illegible]	2/1.49
[illegible]	[illegible]	[illegible]	C.A. 2 Digit Direct	[illegible]	[illegible]	2/1.49
[illegible]	[illegible]	[illegible]	C.C. 2 Digit Multiplexed	[illegible]	[illegible]	2/1.79
[illegible]	[illegible]	[illegible]	C.C. 2 Digit Direct	[illegible]	[illegible]	2/1.79
[illegible]	[illegible]	[illegible]	C.C. 2 Digit Multiplexed	[illegible]	[illegible]	2/1.95
[illegible]	[illegible]	[illegible]	C.C. [illegible]	[illegible]	[illegible]	2/.89
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	2/.89
[illegible]	[illegible]	[illegible]	C.A. 3½ Digit Multiplexed	[illegible]	[illegible]	2/1.49
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Colon PM Indicator	[illegible]	[illegible]	2/1.19
[illegible]	[illegible]	[illegible]	C.C. [illegible] Digit AM PM [illegible]	[illegible]	[illegible]	2/3.95
[illegible]	[illegible]	[illegible]	C.A. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/3.95
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	2/4.95
[illegible]	[illegible]	[illegible]	C.A. 4 Digit Multiplexed	[illegible]	[illegible]	2/4.95
[illegible]	[illegible]	[illegible]	C.A. 3½ Digit Multiplexed	[illegible]	[illegible]	2/5.95
[illegible]	[illegible]	[illegible]	C.C. 4 Digit AM PM Colon Ind.	[illegible]	[illegible]	2/3.95
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	2/5.95
[illegible]	[illegible]	[illegible]	C.A. 4 Digit Multiplexed	[illegible]	[illegible]	2/5.95
[illegible]	[illegible]	[illegible]	C.C. 3½ Digit Multiplexed	[illegible]	[illegible]	2/3.49
[illegible]	[illegible]	[illegible]	C.A. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/3.49
[illegible]	[illegible]	[illegible]	C.C. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/4.95

*Standard [illegible]

COMPUTER GRADE CAPACITORS

MFD	WVDC	PRICE	MFD	WVDC	PRICE	MFD	WVDC	PRICE
250	150	1.95	10,000	15	2.95	24,000	20	2.95
500	200	2.49	10,000	10	3.95	27,000	10	2.95
1,250	3	.99	11,000	10	4.95	32,500	25	4.95
1,500	25	1.95	11,000	50	5.49	40,000	25	5.95
1,500	50	2.95	11,000	60	6.95	43,000	10	5.95
2,000	10	2.95	13,000	15	2.95	50,000	20	7.95
2,250	100	3.95	14,000	13	2.95	52,000	20	5.95
2,300	33	2.95	14,000	35	3.95	56,000	15	5.95
2,500	15	2.95	18,000	10	3.95	56,000	20	5.95
3,000	25	1.95	20,000	20	2.95	68,000	10	7.95
3,000	40	3.95	20,000	50	3.95	73,000	5	7.95
4,000	50	3.95	21,000	15	3.95	80,000	15	9.95
5,000	25	4.49	23,000	7	1.95	90,000	10	8.95
6,100	40	2.49	23,000	10	2.95	100,000	10	8.95
6,000	50	4.95	23,000	20	3.95	200,000	3	12.95

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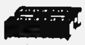
LOW PROFILE (TIN) SOCKETS



	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
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ASST. 1	5 ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50 pcs.	$1.95
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ASST. 5	5 ea.	22K 27K 33K 39K 47K 56K 68K 82K 100K 120K	50 pcs.	$1.95
ASST. 6	5 ea.	150K 180K 220K 270K 330K 390K 470K 560K 680K 820K	50 pcs.	$1.95
ASST. 7	5 ea.	1M 1.2M 1.5M 1.8M 2.2M 2.7M 3.3M 3.9M 4.7M 5.6M	50 pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

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7106EV/Kit*	IC, Circuit Board, Display		34.95
7107CPL	3½ Digit A/D (LED Drive)		15.95
7107EV/Kit*	IC, Circuit Board, Display		29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.		18.95
7117CPL	3½ Digit A/D LED Dis. HLD.		17.95
7201IDR	Low Battery Volt Indicator		2.25
7205IPG	CMOS LED Stopwatch/Timer		12.95
7205EV/Kit*	Stopwatch Chip, XTL		19.95
7206CJPE	Tone Generator		5.15
7206CEV/Kit*	Tone Generator Chip, XTL		12.95
7207AIPD	Oscillator Controller		6.50
7207AEV/Kit*	Freq. Counter Chip, XTL		13.95
7208IPI	Seven Decade Counter		17.95
7209IPA	Clock Generator		3.95
7215IPG	4 Func. CMOS Stopwatch CKT		13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL		19.95
7216AIJI	8-Digit Univ. Counter C.A.		32.00
7216CIJI	8-Digit Freq. Counter C.A.		26.95
7216DIPI	8-Digit Freq. Counter C.C.		21.95
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7218CIJI	8-Digit Univ. LED Drive		10.95
7224IPL	LCD 4½ Digit Up Counter DRI		11.25
7226AIJL	8-Digit Univ. Counter		31.95
7226AEV/Kit*	5 Function Counter Chip, XTL		74.95
7240IJE	CMOS Bin Prog. Timer/Counter		4.95
7242IJA	CMOS Divide-by-256 RC Timer		2.05
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7555IPA	CMOS 555 Timer (8 pin)		1.45
7556IPD	CMOS 556 Timer (14 pin)		2.20
7611BCPA	CMOS Op Amp Comparator	5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr.	5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp.	5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp.	10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp.	10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp.	10MV	7.50
7660CPA	Voltage Converter		2.95
8038CCPD	Waveform Generator		4.95
8048CCPE	Monolithic Logarithmic Amp		21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode		2.50
8211CPA	Volt Ref/Indicator		2.95
8212CPA	Volt Ref/Indicator		2.95

74C

74C00	.39
74C02	.39
74C04	.39
74C08	.39
74C10	.39
74C14	.75
74C20	.39
74C30	.39
74C42	1.39
74C48	1.95
74C73	.79
74C74	.79
74C85	1.95
74C86	.99
74C89	6.95
74C90	1.29
74C93	1.29
74C95	1.59
74C107	1.89
74C151	2.95
74C154	3.95
74C157	2.25
74C160	1.69
74C161	1.69
74C162	1.49
74C163	1.69
74C164	1.59
74C173	1.39
74C174	1.39
74C175	1.19
74C192	1.69
74C193	1.69
74C195	1.59
74C221	1.95
74C240	2.25
74C244	2.25
74C373	2.49
74C374	2.59
74C901	.69
74C903	.69
74C911	10.95
74C912	10.95
74C915	1.69
74C917	10.95
74C922	5.49
74C923	5.75
74C925	7.50
74C926	7.50
80C95	.79
80C97	.79

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TL072CP	1.39
TL074CN	2.49
LH0082CD	35.80
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LM301CN	.35
LM302H	1.95
LM304H	1.95
LM305H	.99
LM307CN	.45
LM308CN	1.00
LM309H	1.95
LM309K	1.25
LM310CN	1.75
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LM317MP	1.15
LM317T	1.75
LM317K	3.95
LM318CN	1.95
LM319N	1.95
LM320K-5	1.35
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1.25
LM320T-12	1.25
LM320T-15	1.25
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LM324N	.99
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LM334Z	1.30
LM335Z	1.40
LM336Z	1.75
LM337T	1.95
LM337MP	1.15
LM338K	6.95
LM339N	.99
LM340K-5	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340T-5	1.25
LM340T-12	1.25
LM340T-15	1.25
LM341P-5	.75
LM341P-12	.75
LM341P-15	.75
LM342P-5	.69
LM342P-12	.69
LM342P-15	.69
LM348N	1.25
LM350K	5.75
LF351N	.60
LF353N	1.00
LF355N	1.10
LF356N	1.10
LM358N	1.00
LM359N	1.79
LM370N	4.49
LM373N	3.25
LM377N	2.95
LM380N	1.25
LM381N	1.95
LM382N	1.79
LM384N	1.95
LM386N-3	1.29
LM387N	1.45
LM389N	1.35
LM392N	.69
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NE564N	3.95
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LM733N	1.00
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LM741CN	.35
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LM1877N-9	3.25
LM1889N	3.20
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LM2002T	1.49
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LM2878P	2.25
LM2896P-1	2.25
LM3189N	2.95
LM3900N	.69
LM3905CN	1.25
LM3909N	1.15
LM3914N	3.95
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75450N	.89
75451CN	.39
75492	.89

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22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

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Value	1-9	10-99	100+	Value	1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

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.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
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1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	7A	14	21	21A
ARGENTINA	14A	14	14	7	7	7	14	21	21A	21A	21A	21
AUSTRALIA	21A	14	14	7B	7B	7B	7B	14	14	14	21A	21A
CANAL ZONE	14A	14	7	7	7	7	7A	14	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7	7A	14	21A	21A	21A	14A	14
HAWAII	21A	14	7	7	7	7	7	7	14	21	21A	21A
INDIA	7A	7	7B	7B	7B	7	14	21	14A	14	14	7A
JAPAN	14A	14	7B	7B	7B	7B	7	7B	7B	14B	14	21A
MEXICO	21	7A	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	14A	7A	7B	7B	7B	7B	7B	7	14B	14	14	21A
PUERTO RICO	14	7A	7	7	7	7	14	14	21A	21A	21	21
SOUTH AFRICA	14A	14	14B	7B	7B	14	21A	21A	21A	21A	21A	21
U.S.S.R.	7B	7	7	7	7	7B	14	21A	21A	14A	14	7B
WEST COAST	21A	14A	14	7	7	7	7	14	21A	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	14	14	21	21A
ARGENTINA	21	14	14	7	7	7	14	14	21	21A	21A	21A
AUSTRALIA	21A	21	14	7B	7B	7B	7B	14B	14	14	21A	21A
CANAL ZONE	21	14	7	7	7	7	7A	14	21	21A	21A	21A
ENGLAND	7A	7	7	7	7	7	7B	14	14	21	21A	21A
HAWAII	21A	14A	14A	7	7	7	7	7	14	21	21A	21A
INDIA	14	14A	7B	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	21A	21	14B	7B	7B	7B	7	7	7	14B	14	21A
MEXICO	21	14	7	7	7	7	7	14	14	21A	21A	21
PHILIPPINES	21	14	7A	7B	7B	7B	7B	7	14B	14	14	21A
PUERTO RICO	14A	14	7A	7	7	7	14	14	21	21A	21A	21
SOUTH AFRICA	14A	14	14B	7B	7B	7B	14	21	21A	21A	21A	21
U.S.S.R.	7B	7	7	7	7	7B	7B	14	21A	14	14	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14A	14	7	7	7	7	7	7A	14	14A	21A
ARGENTINA	21	14	14	7A	7	7	7B	14	21	21A	21A	21A
AUSTRALIA	21A	21	14A	14	14	7	7B	7B	14	14	21A	21A
CANAL ZONE	21	14	7A	7	7	7	7	14	21	21A	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	7B	14A	21A	14	14
HAWAII	21A	21	14	14	7	7	7	7	14	21	21A	21A
INDIA	14	21A	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	21A	21A	21	14B	7B	7B	7	7	7	14	14	21A
MEXICO	21	14	7A	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21A	21	14A	7A	7B	7B	7B	7	14B	14	14	21A
PUERTO RICO	21A	14	7A	7	7	7	7	14	21	21A	21A	21A
SOUTH AFRICA	14A	14	14B	7B	7B	7B	7B	14	21A	21A	21A	21
U.S.S.R.	7B	7B	7	7	7	7B	7B	14B	21	14	7B	7B
EAST COAST	21A	14A	14	7	7	7	7	14	21A	21A	21A	21A

First letter = day waves Second = night waves
A = Next higher frequency may also be useful
B = Difficult circuit this period F = Fair G = Good
P = Poor * = Chance of solar flares; # = of aurora

MARCH

SUN	MON	TUE	WED	THU	FRI	SAT
	1 G/G	2 G/G	3 G/G	4 G/G	5 G/G	6 G/G
7 G/G	8 F/F	9 G/F	10 G/F	11 G/G	12 G/G	13 G/F
14 G/F	15 G/F	16 G/F	17 G/G	18 G/G*	19 F/P*	20 F/P*
21 F/F	22 G/F	23 G/F	24 F/P*	25 G/F	26 G/G	27 G/G
28 G/G	29 G/G	30 G/G	31 G/G			

By Popular Demand . . .

Yaesu's All-New VHF/UHF Transceivers!

Yaesu is proud to introduce a new generation of computerized VHF and UHF equipment. With the features you have asked for and the quality you demand, these revolutionary transceivers are your passport to the newest frontiers in Amateur Radio!

COMPLETE OSCAR STATION!

- **FT-480R - 143.5 to 148.5 MHz SSB/CW/FM**
- **FT-780R - 430-440 MHz SSB/CW/FM**
- **SC-1 Station Console w/Digital Clock**

A complete microprocessor-based communication system with convenient switching of scanning and microphone controls, AC power supply, and 16 button tone pad.

FT-290R 2M MULTIMODE PORTABLE!

- **Battery Powered (NiCd C-Cells Optional)**
- **LCD Display with Night Light**
- **USB/LSB/CW/FM with 2.5W RF Output**

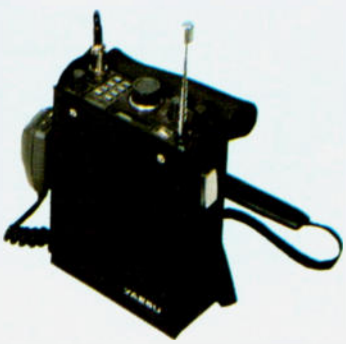
An entirely new concept in VHF operating! LCD display with full microprocessor control, 10 memories, two VFO's and multimode flexibility, all from a battery powered package. Telescoping antenna built in. Optional FL-2010 PA and FP-80A AC Supply.

FT-208R

2 METER FM HAND-HELD!

- **LCD Display with Lithium Backup Cell**
- **Selectable 5 kHz/10 kHz Scanning**
- **10 Memories with Auto/Resume Scan**
- **16 Button Tone Encoder**

Yaesu's latest thoroughbred for 2 FM is the FT-208R Hand-Held. Four digit LCD display, 10 memories, limited band scan, and priority channel make this the most versatile hand-held ever made available to the amateur fraternity.



FT-690R

6 M MULTIMODE PORTABLE!

- **USB/CW/AM/FM Battery Portable**
- **LCD Frequency Display with Night Light**
- **10 Memories with Lithium Backup Cell**

Catch those exciting DX openings with the new FT-690R 6 meter portable. Repeater shift (1 MHz), two scanning steps per mode, and dual VFO's for top flexibility.

FT-708R

70 CM FM HAND-HELD!

- **LCD Display with Lithium Backup Cell**
- **Selectable 25 kHz/50 kHz Scanning Steps**
- **440-450 MHz with 10 Memories**
- **Memory/Band Scan and Limited Band Scan**
- **Resume Scan**
- **16 Button Tone Encoder**

Yaesu leads the way with its pioneering micro-processor controlled 440 MHz hand-held. Priced competitively against much simpler units, the FT-708R system includes a full line of accessories, including CTCSS, NiCd chargers, and remote speaker/microphone options.

Sporting unmatched engineering and manufacturing know-how, Yaesu's technical staff is committed to pushing the state of the art. Yaesu products are backed by a nationwide dealer network and two factory service centers for your long-term service needs. So when it's time to upgrade your station equipment, join the thousands of hams that are tired of compromise – join them by investing in Yaesu!

✓83

Some accessories pictured above are extra-cost options. See your Yaesu dealer.

Price And Specifications Subject To Change Without Notice Or Obligation

YAESU

The radio.

YAESU ELECTRONICS CORP. 6851 Walthall Way, Paramount, CA 90723 • (213) 633-4007
Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 • (513) 874-3100

Watt's new...on 2 meters?

All mode (FM/SSB/CW) 25 watts, plus...!!!

TR-9130

The TR-9130 is a powerful, yet compact, 25 watt FM/USB/LSB/CW transceiver providing increased versatility of operation on the two meter band. It features six memories, memory scan, memory back-up capability, automatic band scan, all-mode squelch, CW semi break-in, and incorporates microprocessor technology. It is available with a 16-key autopatch UP/DOWN microphone (MC-46), or a basic UP/DOWN microphone.

TR-9130 FEATURES:

- **25 Watts RF output**
  All modes, (FM/SSB/CW), utilize a new high power linear module, for more reliable FM operation and increased DX on SSB or CW.
- **FM/USB/LSB/CW all mode operation**
  For added convenience in all modes of operation, the mode switch, in combination with the digital step (DS) switch, determines the size (100 Hz, 1 kHz, 5 kHz, 10 kHz) of the tuning step, and the number of digits displayed.
- **Six memories**
  On FM, memories 1 through 5 for simplex or ±600 kHz offset, with the OFFSET switch. Memory 6 for non-standard offset. All six memories may be operated simplex, any mode.
- **Memory scan**
  Scans memories in which data is stored. Stops on busy channels.
- **Internal battery memory back-up**
  With 9 volt Ni-Cd battery installed, (not KENWOOD supplied), memories will be retained approximately 24 hours, adequate for the typical move from base to mobile. A terminal is provided on the rear panel for connecting an external back-up supply.
- **Automatic band scan**
  Scans within whole 1 MHz segments (ie., 144.0-144.999 MHz), for improved scanning efficiency.
- **Dual digital VFO's**
  Incorporates two built-in digital VFO's, selected through use of the A/B switch, and individually tuned.
- **Transmit frequency tuning for OSCAR operations**
  On SSB or CW, the tuning knob or UP/DOWN buttons on the microphone may be used to adjust the transmit frequency during transmission.
- **16-key autopatch UP/DOWN microphone version**
  The TR-9130 is available with the MC-46 16-key autopatch UP/DOWN microphone, or with the basic UP/DOWN microphone. Manual UP/DOWN scan of entire band possible using either microphone.
- **Squelch circuit on all modes (FM/SSB/CW)**
  The squelch circuit is effective on SSB, CW, and FM.
- **Repeater reverse switch**
  For checking signals on the repeater input, on FM.
- **Tone switch**
  For activating a tone device, (not KENWOOD supplied).
- **CW semi break-in circuit with sidetone**
  Built-in, for convenience in CW operations.
- **Digital display with green LED's**
- **High performance receive-transmit design**
  The use of a low-noise dual-gate MOSFET plus two monolithic crystal filters in the receiver front-end results in excellent two signal characteristics. Care in transmitter design assures clean signals in all modes.
- **Compact size and light weight**
  170 (6-11/16) W x 68 (2-11/16) H x 241 (9-1/2) D mm (inch), 2.4 kg (5.3 lbs.) weight.
- **Extended frequency range**
  Covers 143.9 to 148.9999 MHz, which includes certain MARS and CAP frequencies.
- **Transmit offset switch**
- **High performance noise blanker**
  Suppresses pulse-type noise on SSB and CW.
- **RF gain control**
  For all modes of operation.
- **RIT (Receiver Incremental Tuning) circuit**
  Useful during SSB/CW operations.
- **Amplified AGC**
  Enhances SSB and CW operation. The AGC time constant is automatically optimized for each mode of operation.
- **HI/LOW power switch**
  Selects 25 or 5 watts RF output on FM or CW.
- **Accessory terminal**
  A four pin accessory terminal is provided for use with a linear amplifier or other accessory.
- **Quick release mounting bracket** (Supplied)

More information on the TR-9130 is available from all authorized dealers of Trio-Kenwood Communications
1111 West Walnut Street, Compton, California 90220.

KENWOOD
...pacesetter in amateur radio

Accessories:

- KPS-7 Fixed station power supply.
- TK-1 AC adapter for memory back-up.

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