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73

Amateur Radio's Technical Journal

A Wayne Green Publication

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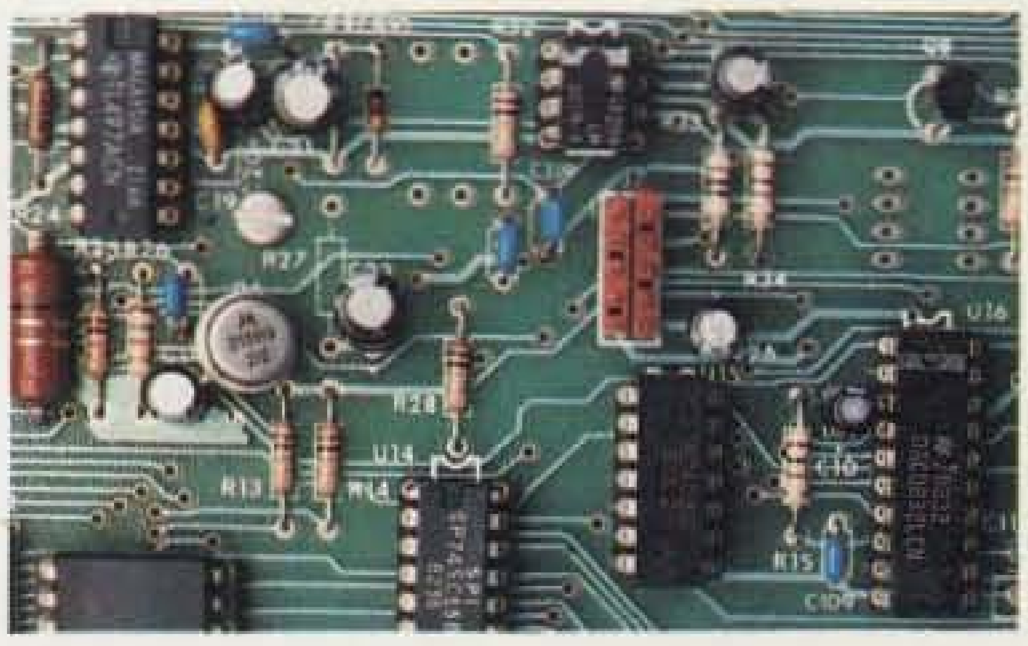

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INFO

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PRO-SEARCH
Reaching The World

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

IT'S SNOW FUN

Are you going to be wasting your time the second week of January chasing some fool DXpedition around twenty meters or are you going to be out with a bunch of us on the slopes of Aspen, HTing it and having a ball? That's the low season in Aspen, so the prices are still a bargain. . . and it's right after the Winter Consumer Electronics Show in Las Vegas, if you're in the electronics industry.

During the day, Chuck Martin WA1KPS (Tufts Electronics) will be leading the kamikaze group down the expert slopes, while I'll be struggling to keep up with the geriatric crowd and their walkers on the gentler slopes. It is a lot of fun to ski with fellow hams. . . keeping in touch with HTs. And it's even more fun to get together for dinner at some of the famous Aspen restaurants and talk over the ham industry, DXing, and so on.

If you can get away January 8-12, we'll be skiing out of The Limelight Hotel (again), so don't miss the Eighth Ham Industry Winter Symposium. . . obviously an historic event. We're expecting ham manufacturers there as well as dealers, so there should be some brisk discussions on discounts, service support, needed new products, technical advances, and so on.

THE VIEW FROM OVERSEAS

With such a heavy percentage of our DX contacts going not much further than an exchange of names, locations, and, possibly, in some rare cases, a recitation of the equipment being used, not only are we failing most of the time to live up to one of the fundamental rationales for amateur radio—the development of international friendship—but also we are wasting an impressive technology. When is the last time you got on the air and had a half-hour contact with someone in a relatively rare DX country?

Rather than lecture you and try to make you feel guilty for maintaining the most eternal tradition of amateur radio, meaningless contacts, I'd rather go about this in a positive fashion. I recognize that one of the problems when you meet someone new is to find a field of mutual interest about which to talk. Most of us are so used to our own areas that we tend to forget that though they are pedestrian to us, they might be of considerable interest to someone overseas.

Sure, the chap in a small town in Germany will go to a fair in his area just as you may in yours. But there the similarity ends. While the fair I go to may offer Italian hot-sausage sandwiches with fried onions and green peppers, fruit salad, green salad in a pita-bread pouch, fried dough, french-fried onion rings, french fries, do-it-yourself ice cream sundaes, and corn on the cob, my friend in Germany will be eating a wide variety of sausages, hot potato salad, grilled fish, pigs' knuckles, shashliks, and drinking new wine or a special seasonally-produced type of beer. At French fairs, the fare is again different, but no less delicious.

In order to work toward bringing amateurs together on a worldwide basis, I'd like to solicit regular reports on hamming overseas via a group of correspondents. If you are living in some area of the world which should be reported on in *73*. . . or if you know someone who might be interested in such, I'd like to hear from you.

What I have in mind is a regular. . . perhaps monthly for many areas. . . report on any news of interest to hams around the world. I think many of us would like to know about contests which are coming up which are organized in your area. We'd like to know about new certificates. We'd like to know about any outstanding ham conventions. We'd like to know about ham products which are made in your area. We'd like to know more about the growth of hamming, any special developments, important rule changes, how to get a visitor's license, and so on.

What areas? I'm open to suggestions. Perhaps we'd like to hear from the U.K., Germany, France, Benelux, Scandinavia, Southern Europe, the Mediterranean area, the Mideast, India, Japan, Southeast Asia, Australia-New Zealand, Oceania, South America, the Caribbean. . . and so on?

Regular correspondents will not only be paid for the reporting work, but also will get special press passes from the magazine, special QSL cards, business cards, and other such documents to help them with their reporting contacts.

This would be a good medium for bringing up area problems for world discussion. It would help us know more about coming and past DXpeditions. We might be able, with such a widespread correspondent system, to develop some sort of network of ham help to meet traveling hams and make them welcome. We would be better able to keep things like local net frequencies known, repeater channels publicized, and so forth.

I would love to have some correspondents from Iron Curtain countries, recognizing that they might prefer to be paid in magazine subscriptions and books rather than American cash, which can be a problem.

If you have any good friends in spots around the world who you think might be able to provide a continuing series of interesting reports, you might drop them a line with a copy of this editorial and suggest the idea. Or you could bring it up on the air. . . give you something of interest to talk to them about. The prestige of being published in an international magazine can help a person substantially, sometimes. I remember when I first ran into that. It was in 1956 and I was visiting St. Thomas and Dick Spenceley KV4AA. I was the editor of *CQ* at the time, which I didn't think of as being of much importance. Well, I stopped by a store downtown, happened to mention Dick, and was told how important he was, doing a DX column for an international magazine! Hmmm. It

NEW BAND APPROVED

The FCC has approved use of the 10-MHz band, but amateur operation is limited and the Commission did not release the new rule without a cautionary note.

According to the rule, most of the frequencies from 10.1 to 10.15 MHz are available to hams, except for a slice from 10.109 to 10.115 MHz. That section is still reserved for government use.

General-, Advanced-, and Extra-class licensees are allowed to transmit CW and RTTY (FSK and AFSK) with a final input power of up to 250 W. In its decision, the Commission cited the "limited size" of the band and the "temporary nature" of the ruling.

The FCC's action is valid until the Senate takes action on the WARC treaty, leaving present limitations open for change. Although 30 meters has been a possibility since the 1979 WARC convention, approval of the treaty was delayed.

Though the FCC previously denied an ARRL petition requesting use of the band, the amendment did not directly address the Commission's change of mind.

"Strong interest" in the amateur community was cited as a reason for the decision, but the Commission warned that since its action is subject to future Senate decisions about the treaty, the amendment "may be effective for only a brief period."

The FCC added that hams would be "ill-advised to invest heavily in equipment which can only be used in this band."—WB8JLG.

Scan the World.

NEW

SSB, CW, AM, FM, digital VFO's, 10 memories, memory and band scan, dual 24-hour clocks...

R-2000

The R-2000 is an all mode SSB, CW, AM, FM receiver that covers 150 kHz–30 MHz in 30 bands. New microprocessor controlled operating features and an UP conversion PLL circuit provide maximum flexibility and ease of operation to enhance the excitement of listening to stations around the world. Key features include digital VFO's, ten memories that store frequency, band, and mode information, memory scan, programmable band scan, fluorescent tube digital display, and dual 24-hour clock with timer.

R-2000 FEATURES:

- **Covers 150 kHz–30 MHz in 30 bands.** Uses innovative UP-conversion digitally controlled PLL circuit. UP/DOWN band switches (1-MHz step). VFO's continuously tuneable across 150 kHz–30 MHz.
- **All mode: USB, LSB, CW, AM, FM.** Provides expanded flexibility in receiving various signal types. Front panel mode selector keys, with LED indicators.
- **Digital VFO's for best stability.** 50-Hz step, switchable to 500-Hz or 5-kHz, using front panel pushbutton switches. F. LOCK switch provided.
- **Ten memories store frequency, band, and mode data.** Complete information on frequency, band, and mode is stored in memory, assuring maximum ease of operation. Each memory may be tuned as a VFO. Original memory frequency may be recalled. AUTO. M switch for automatic storage of current operating data, or, when off, selective storage of data using M. IN switch.
- **Lithium battery memory back-up. (Est. 5 yr. life.)**
- **Memory scan.** Scans all memories, or may be programmed to scan specific memories. HOLD switch interrupts scanning. Frequency, band, and mode are automatically selected in accordance with the memory channel being scanned. The scanning time is approximately 2 seconds per channel.
- **Programmable band scan.** Scans automatically within the programmed bandwidth. Memory channels 9 and 0 establish upper and lower scan limits. HOLD switch interrupts scanning. Frequency may be adjusted, using the tuning control, during scan HOLD.
- **Fluorescent tube digital display (100-Hz resolution).** Built-in 7 digit fluorescent tube digital display indicates frequency or time, plus memory channel number. DIM switch provided. The display may be switched to indicate CLOCK-2, FREQUENCY, CLOCK-1, and timer ON or OFF by the front panel FUNCTION switch.
- **Dual 24-hour quartz clocks, with timer.** Permits programming two different time zones. Timer for ON and OFF programming. Timer REMOTE output on rear panel (not for AC power).
- **Three built-in IF filters with NARROW/WIDE selector switch. (CW filter optional.)** 6 kHz wide or 2.7 kHz narrow on AM. 2.7 kHz automatic on SSB. 2.7 kHz wide on CW, or, with optional YG-455C filter installed, 500 Hz narrow. 15 kHz automatic on FM.
- **Squelch circuit, all mode, built-in, with BUSY indicator.**
- **Noise blanker built-in.** Eliminates pulse-type noise on SSB, CW, and AM.
- **Large front mounted speaker.**
- **Tone control.**
- **RF step attenuator. (0-10-20-30 dB.)** Four step attenuator, plus antenna fuse.
- **AGC switch. (Slow-Fast.)**
- **"S" meter, with SINPO "S" scale.**
- **High and low impedance antenna terminals.** A high impedance (500 ohm) terminal, and a low impedance (50 ohm) co-axial connector are provided.
- **100/120/220/240 VAC, or 13.8 VDC operation.** (Optional DCK-1 cable kit required for 13.8 VDC.)

Other features.
- RECORD output jack.
- Audible "beeper" (through speaker).
- Carrying handle.
- Headphone jack.
- External speaker jack.

Optional accessories:
- HS-4, HS-5, HS-6 headphones.
- DCK-1 DC cable kit.
- YG-455C 500-Hz CW filter.
- HC-10 World digital quartz clock.

More information on the R-2000 is available from all authorized dealers of Trio-Kenwood Communications 1111 West Walnut Street Compton, California 90220.

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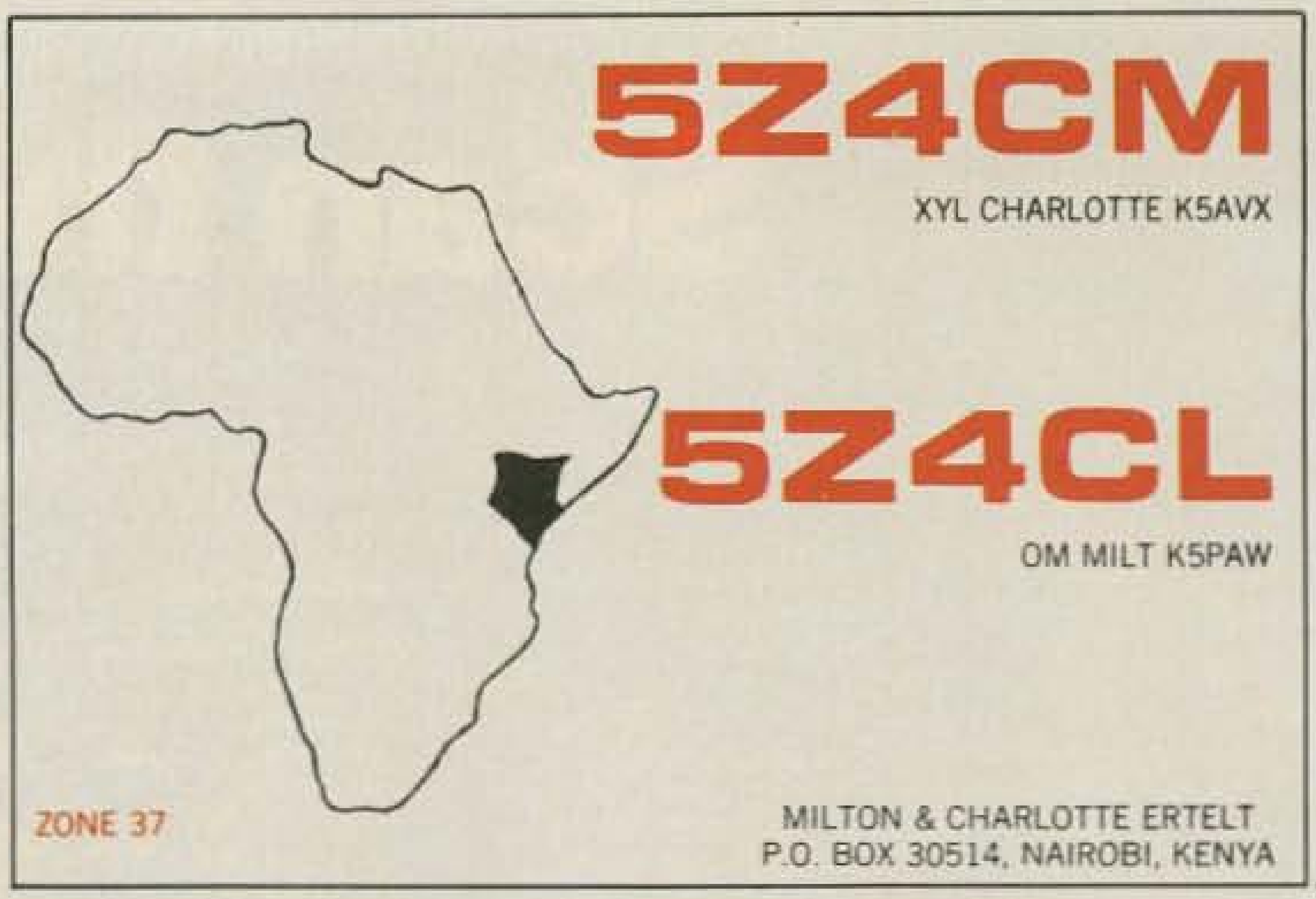
sure cut a lot of ice in St. Thomas. I was sorry to hear that Dick passed away recently... we'll all miss that incredible fist of his. Any serious CW operator could tell Dick instantly by the perfection of his fist.

Please give me a hand with this so that we can bring amateurs worldwide together a bit. The end result will be a lot more interesting things for us to talk about... perhaps bringing more DX operators onto our bands. Ops in rare countries sure get sick of endless demands for instant contacts and QSL cards. I get ham magazines from the U.K., South Africa, Malaysia, Australia, and so on, so I have a fair idea of what is going on... but 99.99% of you don't have that sort of input or the resources to pay for such a wide variety of magazines. Columns devoted to

Continued on page 118



QSL OF THE MONTH

This month's winning QSL comes from a Baptist mission in Kenya, the home of Milton (5Z4CL) and Charlotte (5Z4CM) Ertelt. The design is simple and informative, using only two colors to achieve a striking contrast.

Few cards are as succinct as this one, telling the reader at a glance where in the world the station is located. And from a distance, Charlotte and Milton's calls stand out clearly, leaving no doubt that this QSL is probably the pride of many a DXer's shack.

Entering *73*'s QSL contest is easy—send your QSL, in an envelope, to: Editorial Offices, *73*, Peterborough NH 03458. Specify a book from *73*'s Radio Bookshop; if your card is chosen, we'll be happy to send the book along to you. Entries which are not in an envelope or do not specify a book will not be considered.

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

"I don't do anything much! He calls CQ and answers all questions!"

HL-32V—This Little Beauty is the first of our compact, low profile amplifiers for use with handheld radios. For VHF operations, this unit produces 10W to 25W output with drive from your 0.5W to 3W handheld. Excellent for mobile use in your car.

Turn it on with the convenient front panel controls, including Power LED and Transmit LED, or slip the package under the seat out of sight and out of mind.

Low insertion loss on receive and selectable power level design provides low VSWR to the transceiver.

Use with any talkie from 0.5W to 3W for 10W to 25W output.

The HL-32V operates linear mode for SSB or FM (switch selected), and the best news of all: the price is only $89.95 suggested retail! At your favorite dealer now!

HL-20U New Product Preview—Another super compact from Tokyo Hy-Power Labs . . . This one is for UHF, and it's beautiful, with the controls on the brushed metal face panel to make operation as easy as touch-and-go.

The ultra compact HL-20U is a basic amplifier for all UHF handheld radios, and it can accept input levels from 200mW to 3W, to produce a big 20W output signal.

Your UHF handheld operations have never experienced anything like this surprising little amplifier from Tokyo Hy-Power Labs. Price and availability of the HL-20U will be announced soon.

TOKYO HY-POWER LABS, INC.

Long the quality leader among fine Japanese communications equipment manufacturers, TOKYO HY-POWER LABS now makes these outstanding units available to you through American dealers. Now you can get our advanced features and quality at your kind of prices.

Tokyo Hy-Power Labs' HC-150 tuner, with an accurate 200W 3-30 MHz power meter/VSWR bridge and sturdy, quality-built coax or wire line antenna coupler, provides smooth, precision matching from any barefoot transceiver to antenna between 10 and 200 ohms. For a most reasonable sum of $99.95.

If stompin' through the QRM at the edges of the band, where somehow the DX always seems to be, and where the VSWR usually heads for the sky, is your kind of thing; the HC-2000 is your kind of coupler. It can provide a matched antenna, while ready for both forward and reflected power at the same time on the accurate dual meter VSWR/wattmeter. At $349.95 suggested retail, the HC-2000 can handle the output resulting from the full legal limit input to your linear amplifier.

The next time you want to make a lumpy line flat or to make a long line perform as it should, use a quality built, quality performing Tokyo Hy-Power Labs antenna coupler.

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Action Machine for 20

Are home-brew rigs a lost art? Not yet! Here's an SSB transceiver you can build.

I designed and built mini'ceiver 20 to learn something about SSB transceiver design. Several times in the course of the project I became convinced that I was learning more about SSB transceiver design than I ever wanted to know! Anyway, mini'ceiver has worked out and it's quite a conversation piece on the air. You can run mini'ceiver from a lantern battery, which opens up a number of possibilities. I have made an effort to use readily-available parts and easy-to-tune circuits in mini'ceiver, so I feel you will have a good shot at making it work if you want to give it a try.

This article covers mini'ceiver's circuit operation once over lightly and then, in some detail, the circuit schematics. No math or theory here, just a shirt-sleeve discussion of the circuitry and how well it seems to work. If you are game at this point, I'll then give you some hints on how to build and tune up mini'ceiver, and I'll wind up with some ideas on accessories, possible design alternatives, and operation. If you've always wanted to build a good size project from scratch but never quite got around to it, this article is written for you. I'll try to give you an idea of what you've been missing.

Photo A. Mini'ceiver 20 is an SSB transceiver boiled down to the basics.

Mini'ceiver Circuit Operation

Let's first look at Fig. 1, mini'ceiver's block diagram. Mini'ceiver is a 20-meter single-conversion superheterodyne transceiver boiled down to the basics. A conventional 9-MHz i-f frequency is used.

In the receive mode, an incoming signal in the 14.25-14.30-MHz range is routed through the receiver antenna switch to a dual-gate MOSFET mixer where it is mixed with the vfo signal (vfo range is 5.250-5.300 MHz). The mixer's difference output, at 9 MHz, is routed through the receiver side of the T/R filter switch to the four-pole crystal filter, which provides the receiver's selectivity. The i-f output from the crystal filter is amplified by a single-stage IC amplifier which can provide a voltage gain of up to about 1000. The output from the i-f amplifier is mixed with the 8.9985-MHz bfo in the MOSFET product detector, recovering, typically, 5 mV of audio.

The audio output from the product detector is amplified by the low-level audio amplifier and then routed to the agc amplifier and the volume control. The agc amplifier further amplifies the audio to around five volts peak-to-peak and then detects this signal to develop the agc control voltage. Meanwhile, audio from the volume control is routed to the audio power amplifier and on to the speaker jack. While in the receive mode, the transmit circuitry is disabled by switching off the +T supply voltage.

In the transmit mode, the +T voltage is switched on as the +R voltage is switched off, enabling the transmitter circuitry as the receiver circuitry drops out. Low-level speech signals from the microphone are amplified to about 1.5 volts peak-to-peak by the speech amplifier and applied to the balanced-modulator audio input. Here the audio is mixed with the bfo signal in an IC double-balanced mod-

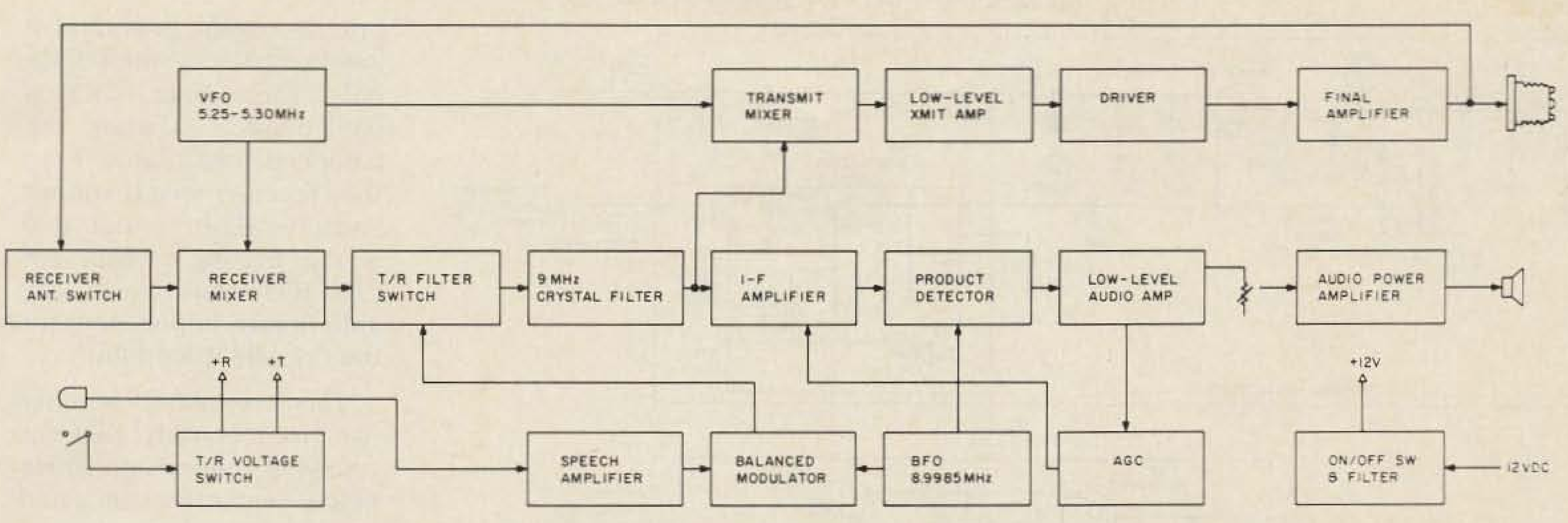

Fig. 1. Mini'ceiver 20 block diagram.

ulator. The double-sideband output from the modulator is routed through the transmit side or the T/R filter switch to the crystal filter. The crystal filter strips off the unwanted lower sideband and routes the 9-MHz SSB signal to the transmit mixer. At the transmit mixer, the 9-MHz SSB signal is mixed with the vfo signal and the sum output at 14 MHz is developed in the transmit mixer's tuned output circuit.

The 14-MHz SSB signal next is amplified by two MOSFET low-level transmit amplifiers to about 600 mV peak-to-peak. The driver stage boosts this signal to about 200 mW and the final amplifier to about 1.5 W. The output from the final is sent to the antenna. Since the receiver antenna switch is open in the transmit mode, the receiver mixer is protected from overload.

The +R and +T power-supply voltages are alternately switched on under the control of the microphone PTT switch. All in all, mini'ceiver is a simple and straightforward design.

T/R Voltage Switch

Almost every modern SSB transceiver design incorporates digital logic, and mini'ceiver is no exception. Refer to Fig. 2, the T/R voltage switch schematic. A 4093BE CMOS quad Schmitt NAND gate is the heart of this circuit. When the PTT switch is open, +12 V dc is applied to R1 and on through the gate interconnections to pull R3 low at pin 10. This turns on Q1 and supplies +R to most of the receiver circuitry. +R also turns on Q4, which helps pull down the +T voltage on a transmit-to-receive transition. Meanwhile, pin 11 is at +12 V dc and Q2, +T, and Q3 are off.

When the PTT switch is closed, the input side of R1 is grounded, which first allows pin 10 to go to 12 V dc, shutting off Q1 and Q4. About 30 milliseconds later pin 11 will go low, turning on Q2 and Q3, supplying +T to the transmit circuitry and clamping +R to ground. R2 and C3 account for the time that both +R and +T are off during a receive-to-transmit or transmit-to-receive transition. R1 and C2 simply form a glitch filter. Schmitt inputs were chosen for reliable logic switching with the slow rise times provided by R1-C2 and R2-C3.

The vfo, bfo, audio power amplifier, and the collectors of the transmitter driver and final amplifier are continuously supplied with +12 V dc from the input power jack. C1 provides dynamic filtering for operating from dry cell batteries, etc.

Vfo and Bfo

Fig. 3 provides the vfo and bfo schematics. We'll start with the latter. The bfo is a grounded-base crystal oscillator designed to work with a series-resonant 8.998500-MHz crystal. It is easily tuned ± 300 Hz, which allows you to tailor the "sound" of the rig somewhat. It will provide a 5-V peak-to-peak output when loaded by the product detector and balanced modulator. Note that it is enclosed in a minibox. This is a must. I first had the bfo circuit on the receiver main board. I also had about two volts of bfo in the i-f amplifier output, plus all the local AM radio stations, etc! Keep the bfo shielded from the i-f amplifier; that is sage advice.

The vfo consists of a buffered Hartley oscillator designed along recently-published guidelines.[1] I found the vfo to be quite stable. Tuning is very fast; you may want to use a reduction drive if you don't have a steady hand. R18 allows the vfo output to be adjusted to 5 V peak-to-peak. The vfo also is built in a minibox, primarily for its own protection. The box helps stabilize temperature and shield the vfo from other rf signals.

Receiver Rf Section

CR3, CR4, R24, R25, R26, C28, and C29 form the receiver antenna switch. In the

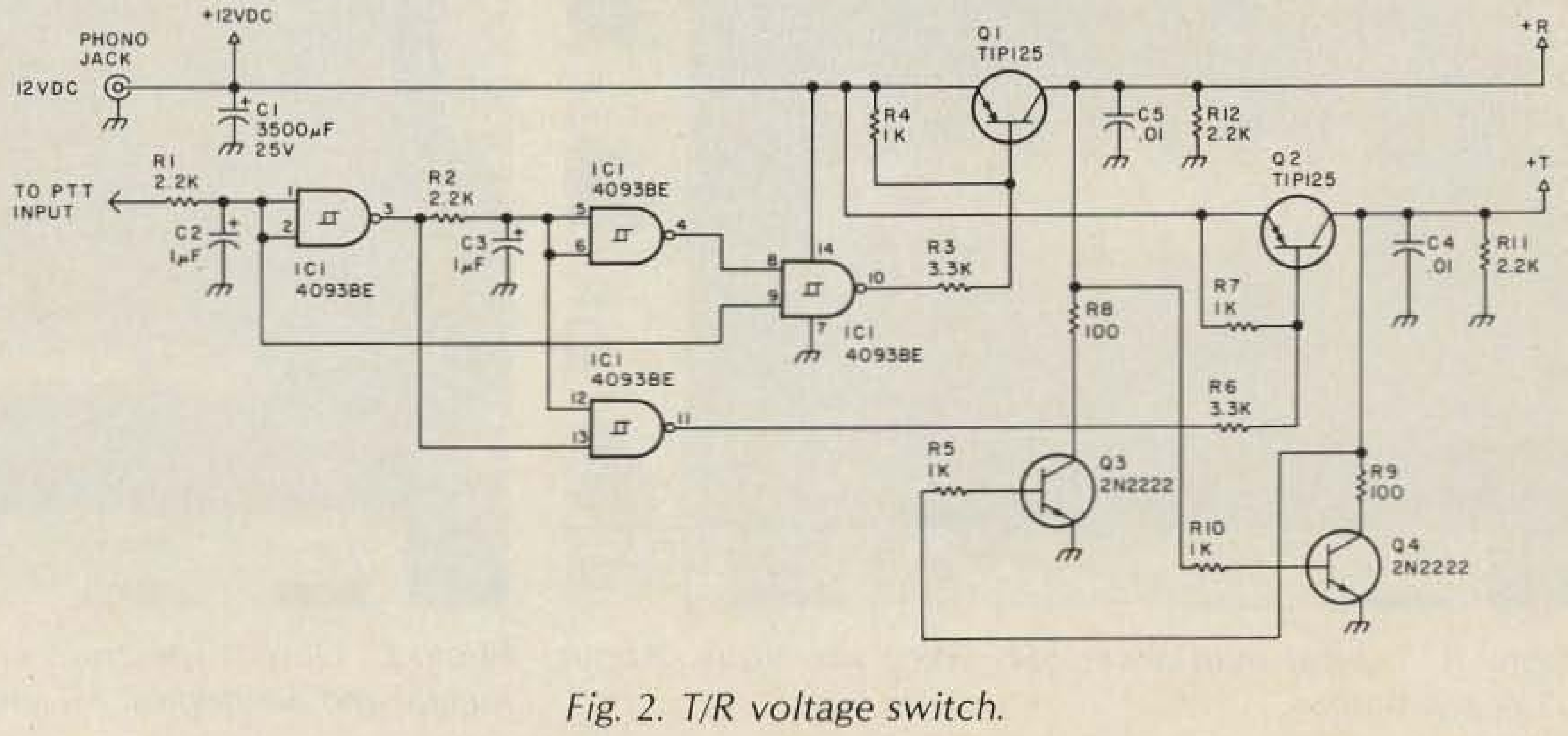

Fig. 2. T/R voltage switch.

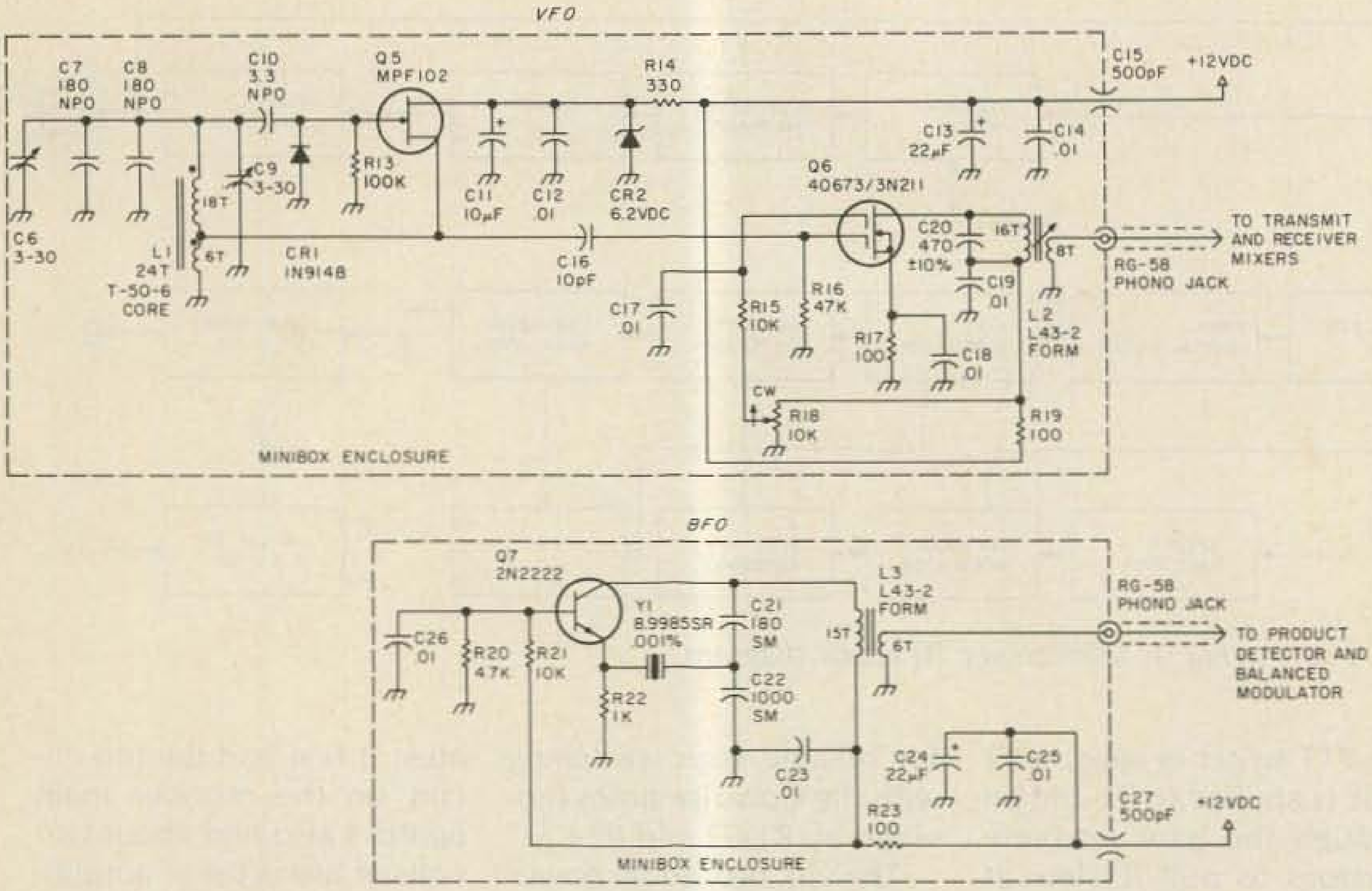

Fig. 3. Vfo and bfo schematics.

receive mode, R25 supplies current to CR3-R24 and CR4-R26 from +R. CR3 and CR4 are forward-biased with about 5 mA dc and appear to small rf signals from the antenna as 25-Ohm resistors. Receiver signals thus easily can pass through C28 and C29, which are dc blocking capacitors, and the two forward-biased diodes to the input transformer of the mixer.

When the bias to the diodes is removed in the transmit mode, the diode switch opens. Notice that when the rf output from the final amplifier is positive, CR3 is reverse-biased so little signal makes it to the mixer input transformer. When the rf output from the final is negative-going, CR3 is forward-biased so the rf signal appears at R25. However, CR4 is now reverse-biased, blocking the rf output from reaching the mixer input.

The use of this type of diode switch eliminates the need for a mechanical relay. Purists would probably add some rf chokes in series with the biasing resistors and might use PIN diodes; however, I'm not a purist —just cheap.

The receiver mixer employs the often-used 40673 (Q8) which is adequate for this application. We now come to the second diode switch in the mini'ceiver, which is used to switch signals to the crystal filter from either the receiver mixer or the double-balanced modulator. CR5 forms half the switch; CR8 (Fig. 6) forms the other half. When +R is on, CR5 is conducting about 6 mA dc, again providing a low-loss path to small rf signals. Meanwhile, CR8 is back-biased, isolating the balanced modulator from the receiver-mixer output and crystal-filter input. R30 is the biasing resistor for CR5. R31 establishes a suitable input impedance for the crystal-lattice filter.

The crystal-lattice filter uses four crystals, two cut for series-resonance 750 Hz below center frequency and two cut for series-resonance 750 Hz above center frequency. The overall 6-dB bandwidth appears to be about 2200 Hz. Unwanted sideband suppression is around 26 dB (5%) at 1000 Hz, which is OK for QRP.

While the filter can be built for under $30, you won't hurt my feelings if you use a commercial filter here. Remember to adjust R31 and R32 to suit the commercial filter's termination impedance if you decide to go this route.

I've always had good luck with the MC1350 i-f amplifier (IC2). It exhibits high but stable gain when properly terminated and smooth forward agc action, assuming you keep the bfo signal out of it. The value of R40 and the turns ratio of L6 were chosen for high stable gain. I

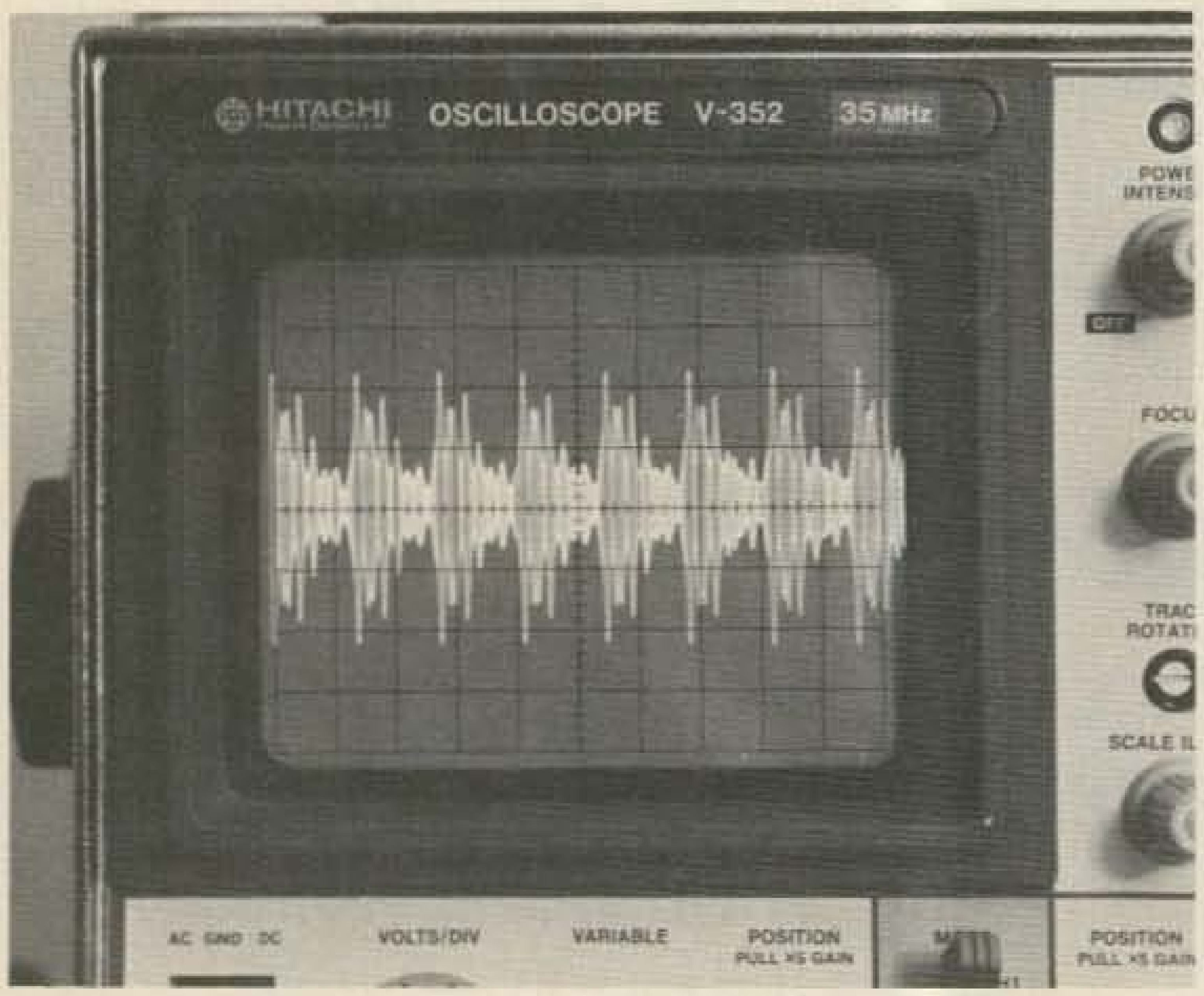

Photo B. Typical mini'ceiver SSB voice waveform. About 1.5-W p-p output.

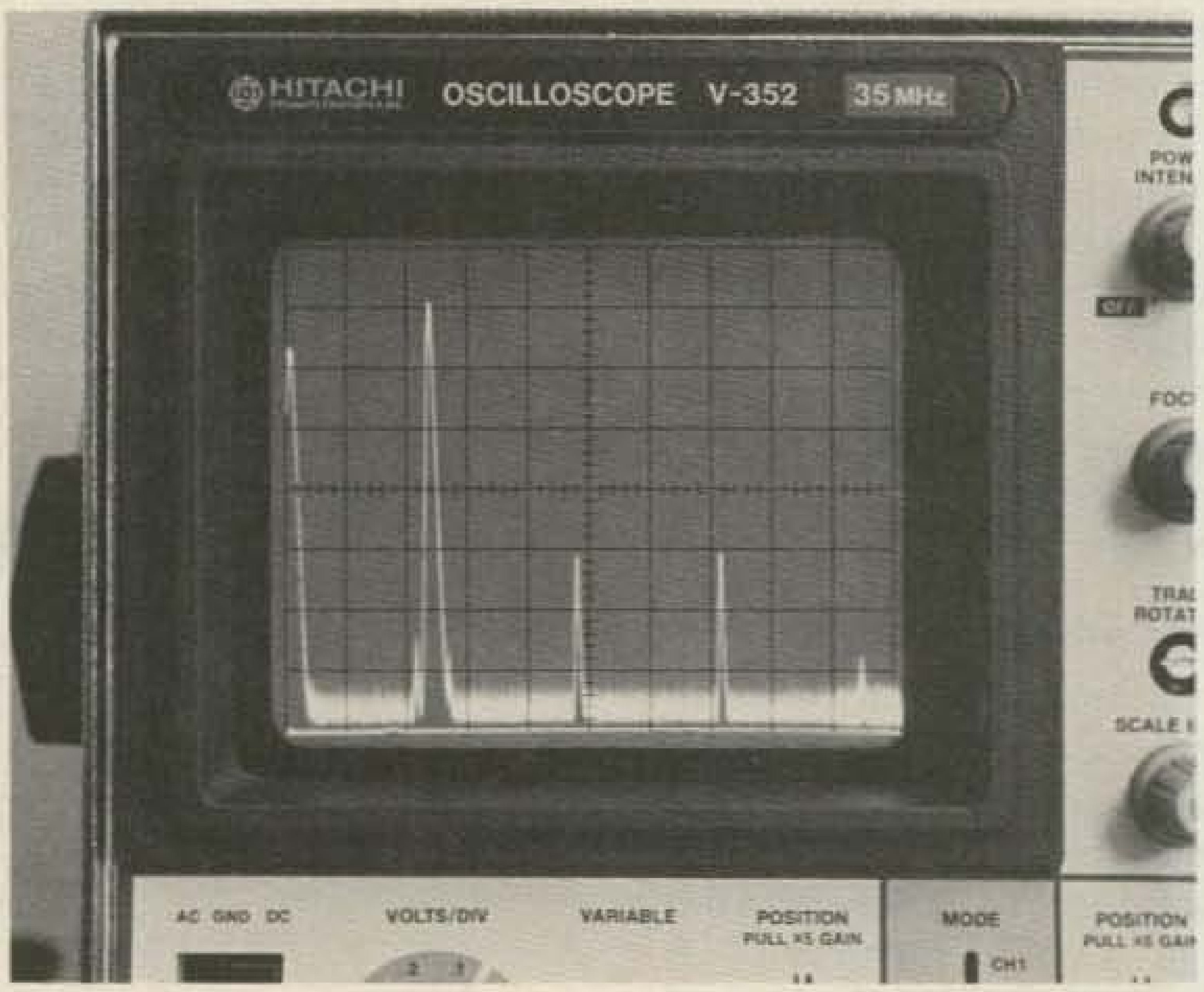

Photo C. Output spectrum consists primarily of the fundamental and harmonics. All spurs are more than 40 dB down.

REGAL RTTY

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don't suggest pushing the IC harder by raising the value of R40. You don't need the extra gain and accompanying headache.

The faithful 40673 MOSFET is again in service as a product detector at Q9. Notice the heavy audio bypassing and decoupling.

Receiver Af Section

Refer to Fig. 5. An LF353 dual op amp (IC3) is used as the receiver low-level audio amplifier. R47 allows the audio gain to be trimmed out to suit. C50 and C51 help roll off the high-frequency response of the audio section. The LM383 audio power amplifier, IC5, is somewhat of a power overkill, but it provides low-distortion audio at normal listening levels—much better than trying to push an underrated audio section too hard.

IC4 is another LF353, this time used as an agc amplifier and detector. I seem to get the best results with audio-derived agc when the base audio frequencies are rolled off—which explains the small value of C54. R57 controls the agc attack time and R58 controls the release time. Of course, changing C58 messes up both time constants. Agc characteristics are quite subjective, so feel free to experiment here. You might consider agc something of a luxury on a basic transceiver. On 20 meters, I don't.

Speech Amp, Balanced Modulator, and Transmit Mixer

Fig. 6 details the abovementioned circuitry. Again an LF353 is used as a two-stage audio amplifier (IC6). This time it is rigged to provide a high-impedance input to the microphone. Since high-impedance audio circuits make me nervous, I heavily decoupled the input from rf. A 1496N double-balanced mixer (IC7) is employed as the balanced modulator and works quite well. At least 40 dB of carrier suppression is easily obtained by adjusting R77. Notice the other end of the T/R filter switch (CR8) at the output of the balanced modulator.

After being routed through the crystal filter to do away with the lower sideband, our 9-MHz SSB signal is ready to be translated to 14 MHz. It was at this point that I started learning too much about SSB transceiver design. I won't bore you with all the mixer circuits that didn't work. Let me just say that I have seen just about every picket fence display on my spectrum analyzer that I could imagine (see "Poor Man's Spectrum Analyzer," *73*, August, 1982). The biggest problem was the 3rd harmonic of the vfo at 15 MHz. Now you can supposedly get this out with a carefully designed multipole bandpass filter, but it sort of compromises our simple-to-build theme. Fortunately, there is another way.

First, start with a 1496N double-balanced mixer. Next, don't drive the carrier port (pin 8) with more than 70 mV peak-to-peak of vfo signal. This leaves the mixer pretty much in "linear" operation so that not much 3rd harmonic of the vfo appears in the mixer output. (Refer to the spectrum photo, which tells the story.) Anyway, we now have a clean 14-MHz SSB signal, so on to the transmit amp chain.

Transmit Amplifier Chain

Referring to Fig. 7, we find the transmit amplifier chain uses both tuned and broadband stages. Q11 and Q12 are tuned low-level amplifier stages. There is more potential gain in these stages than needed, so the turns ratio at L9 is not for impedance matching, it's to "throw away" some extra gain without lowering Q. The turns ratio at L10 provides a suitable match between the drain of Q11 and the 30-Ohm or so input im-

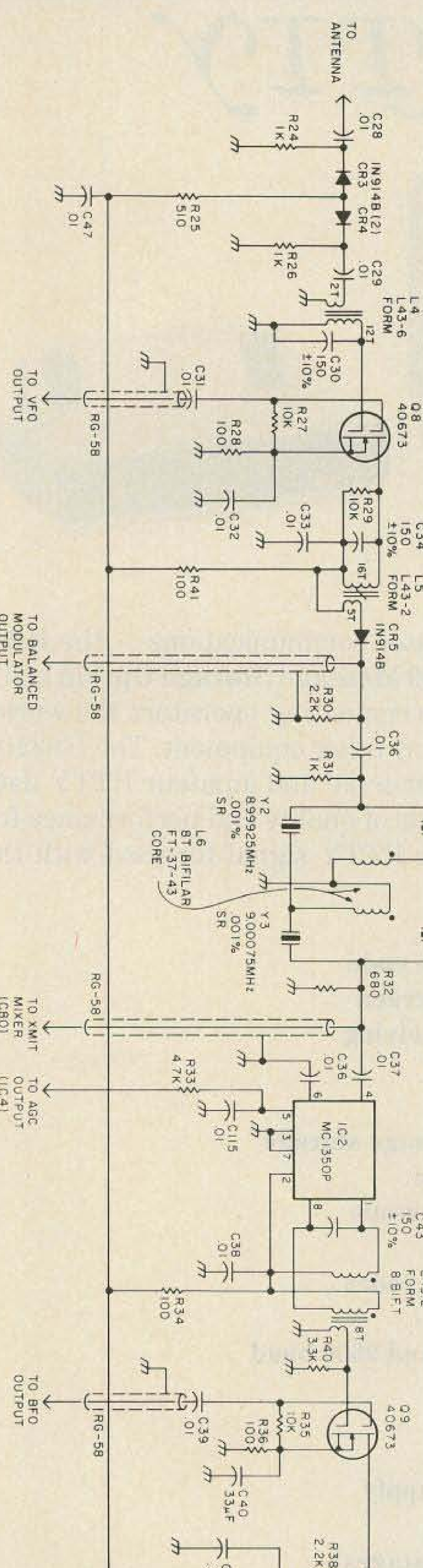
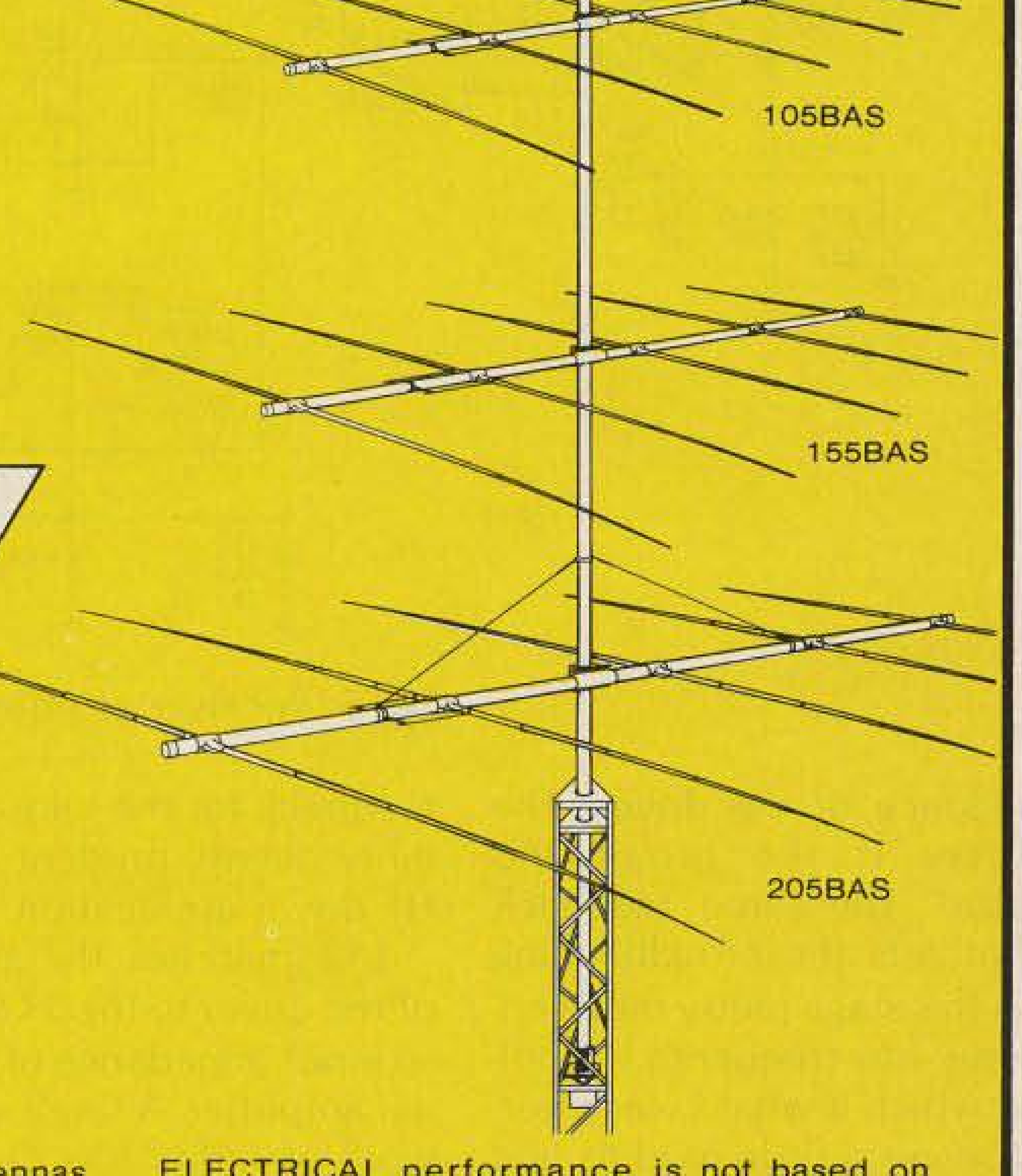
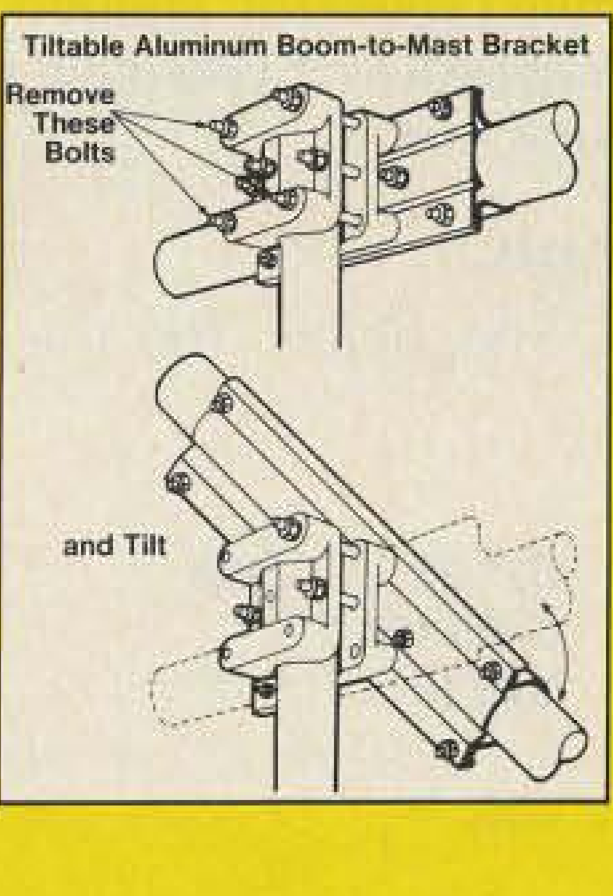
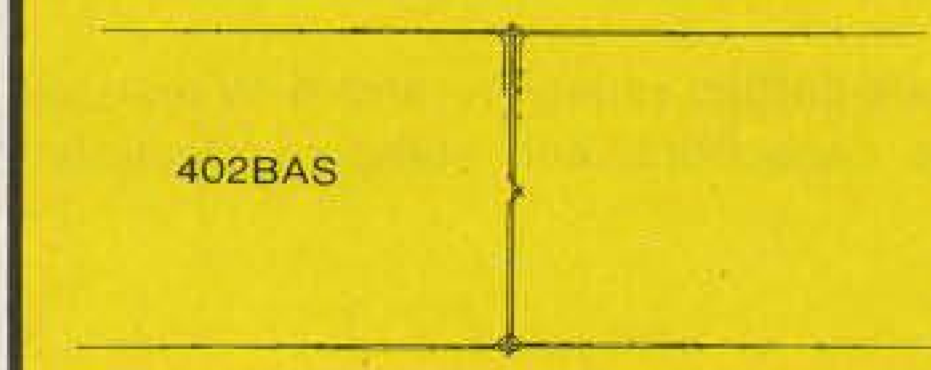
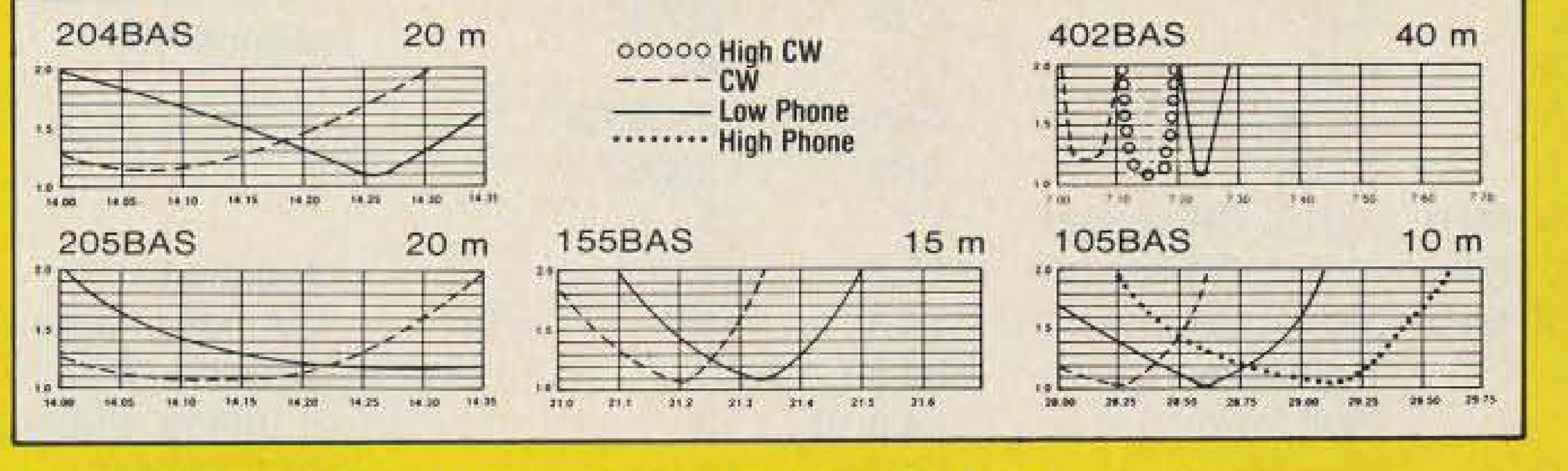


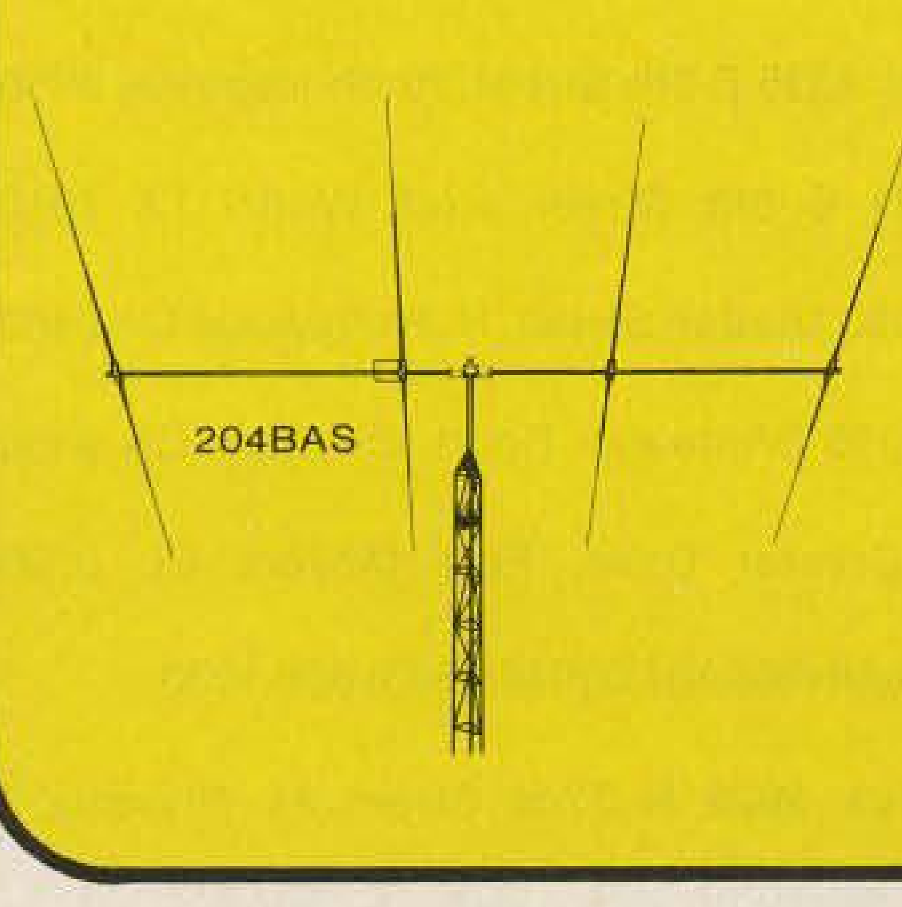
Fig. 4. Receiver rf schematic.











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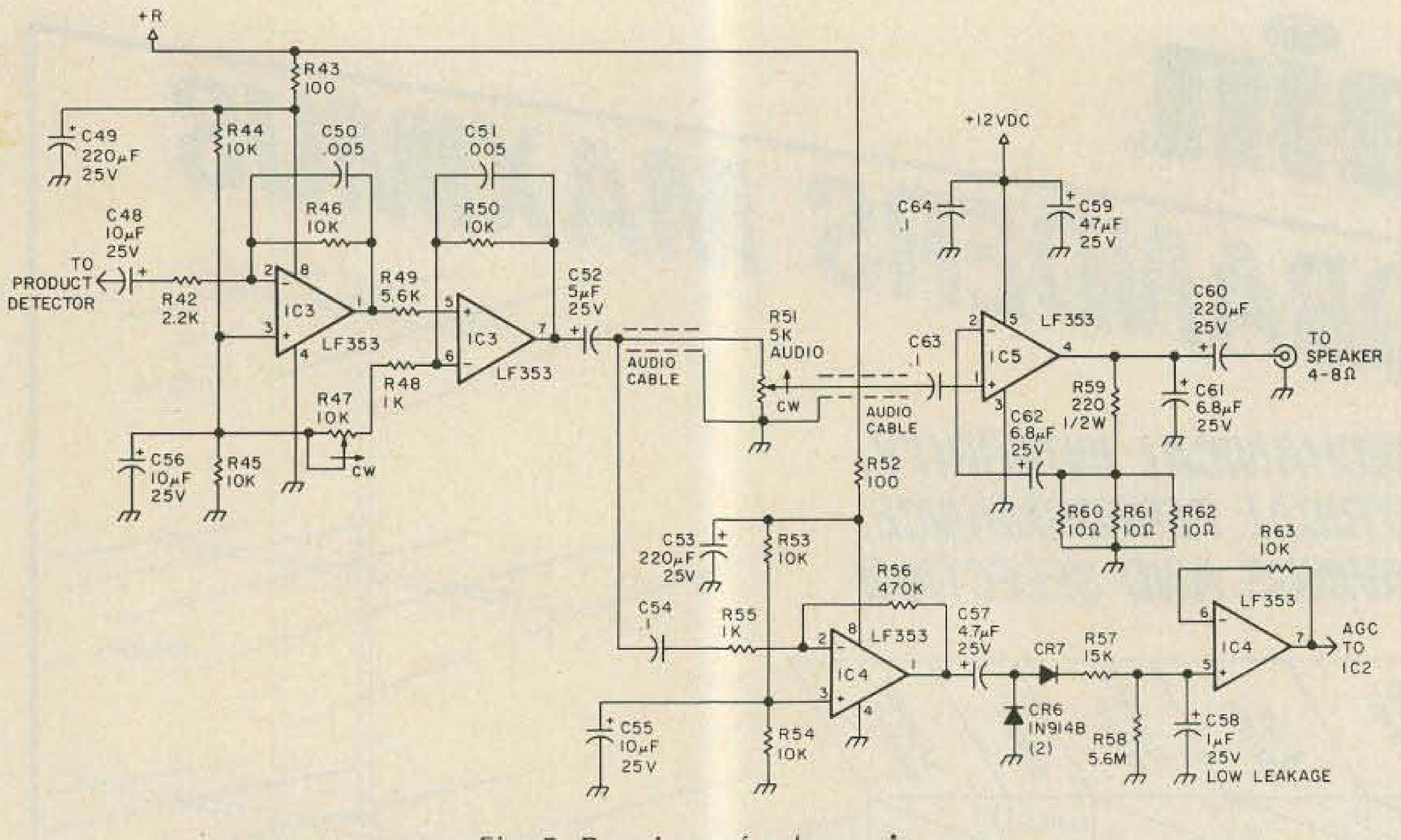


Fig. 5. Receiver af schematic.

pedance of the driver. The driver is the broadband stage. The same feedback that sets the broadbanding on this stage pretty much ensures low-frequency stability, which is what I was after. It seems a little hard to find a suitable driver for HF work, but the 2N3866, which often is used in cable TV systems, is very easy to find. Since it is a VHF transistor, feedback for the sake of stability seems prudent in an HF driver application.

L12 matches the output of the driver to the 5-Ohm or so input impedance of the final amplifier. A single pi network of rather low Q transforms the assumed 50-Ohm antenna impedance to around 35 Ohms, setting up the 1.5-W output with some room to spare. L16 and C108 form a series-resonant trap that takes care of the 2nd harmonic, which is the only offending spur. Notice that the bias to both the driver and the final amplifier are switched by +T. Despite some deliberate and undeliberate attempts, I've not managed to zing the final (probably because I have a spare). Harmonic suppression appears to be fairly insensitive to antenna impedance, which is characteristic of series trap suppression. R99 allows you to adjust the overall gain of the amplifier chain.

Mini'ceiver Construction

I feel that you will have a good chance of successfully building the mini'ceiver, or your customized version of it, if you are comfortable using a triggered oscilloscope in troubleshooting and have built several kits and scratch-built projects. Or, of course, if you can get help from a friend and/or someone in your club or repeater group with the above experience. I'm not trying to discourage anyone; I just want you to have a good chance for success if you embark on the project. Building and experimenting is great fun, and I want it to stay that way for you. I believe that you can build mini'ceiver for about $200, maybe less if you have a big junk box.

Parts

See below for the list-

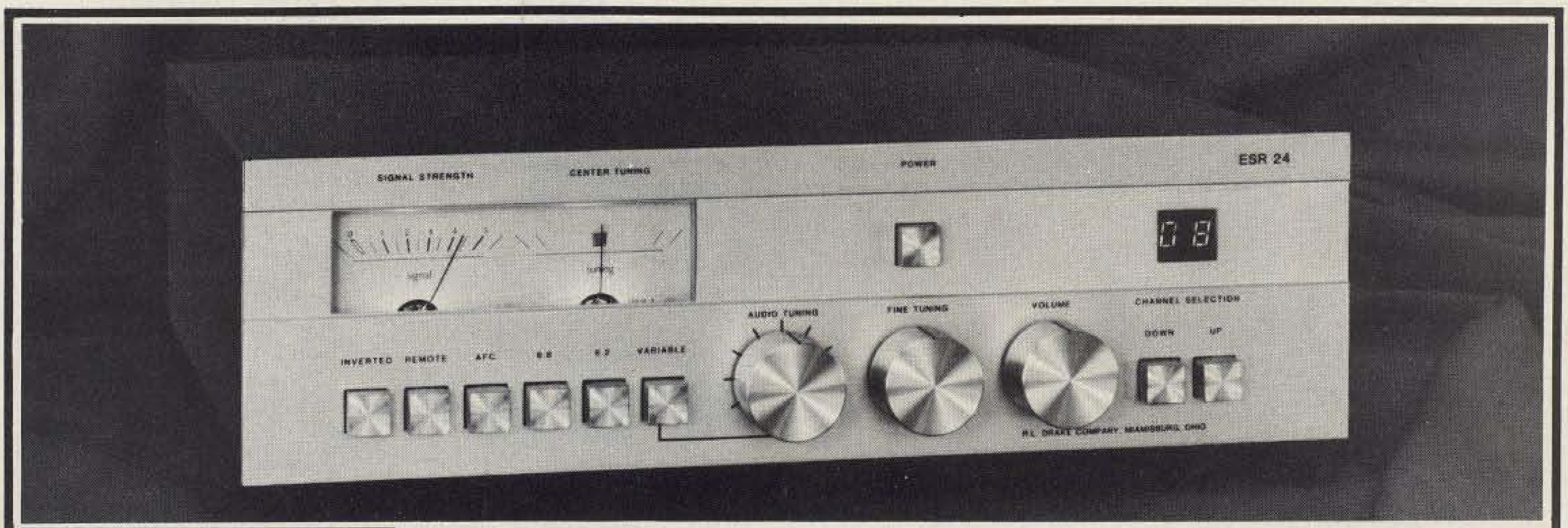
Parts List

Component		Ref#	Supplier#
4093BE	IC	IC1	4
1350P	IC	IC2	2,4,6,7,8
1496N	IC	IC7-8	4
LF353	IC	IC3-4,6	2,4,7
LM383	IC	IC5	2,4,7
TIP125	DBJT	Q1-2	2,4,7
2N2222	BJT	Q3-4,7	2,4,6,7,8
MPF102	JFET	Q5	2,4,6,8
40673	MOSFET	Q6,8-10	1,2,4,6,7,8
2N3866	BJT	Q12	2,7,8
MRF476	BJT	Q13	8
1N914B	Diode	CR1-8,10	2,4,6,7,8
1N4001	Diode	CR9	2,4,6,7,8
8.998500 MHz	.001% SR crystal	Y1	5
8.999250 MHz	.001% SR crystal	Y2,5	5
9.000750 MHz	.001% SR crystal	Y3-4	5
L43-2	Coil form	L2,5-7	3
L43-6	Coil form	L4,8-10	3
FT-37-43	Toroid	L6	3
FT-50-61	Toroid	L11	3
T-50-6	Toroid	L14-16	3
3-30 pF	Var. cap., ¼" shaft	C9	6
3-30 pF	Var. cap., PC mount	C6	6
80-300	Arco trimmer	C114	8
4-40	Arco trimmer	C108	8
5% NPO	Ceramic cap	C7-8,10	Local TV supply
10% TS	Ceramic cap	C20,30,34 43,76-77 88, 91	Local TV supply or use silver mica 5%
5% SM	Silver mica cap	C21,22 C105-107	2,4,8
500 pF	Feedthrough cap, threaded type	C15,17	1
1 uF	Low-leak cap	C58	7
CU-3000A	Bud minibox		2
CU-3011A	Bud minibox		2

Note: Other components are garden variety ¼- and ½-W resistors, +80, −10% 50-V ceramic capacitors, and standard electrolytic capacitors.

Suppliers:

1. Alaska Microwave Labs, 4335 E 5th Street, Anchorage AK 99504; (907)-338-0340.
2. Allied Electronics, 401 E 8th Street, Fort Worth TX 76102; (817)-336-5401.
3. Amidon Associates, 12033 Otsego Street, N. Hollywood CA 91607; (213)-760-4429.
4. Jameco Electronics, 1355 Shoreway Road, Belmont CA 94002; (415)-592-8097.
5. Jan Crystals, 2400 Crystal Drive, Fort Meyers FL 33906; (813)-936-2397.
6. RadioKit, Box 411S, Greenville NH 03048; (603)-878-1033.
7. Radio Shack.
8. Semiconductors Surplus, 2822 N 32nd Street #1, Phoenix AZ 85008; (602)-956-9423.



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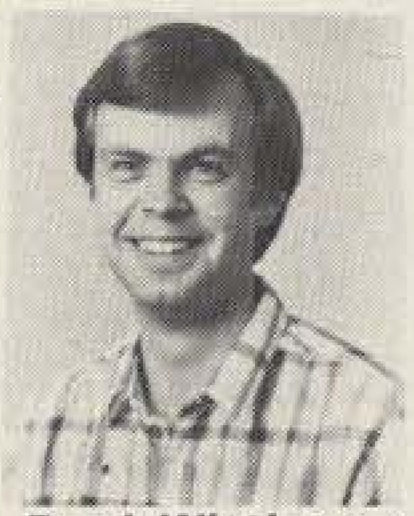

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Survival	100 mph steady load
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VSWR	1.25 or less
Gain	41 dB
F/D Ratio	.44
1/2 power beamwidth	1.5°

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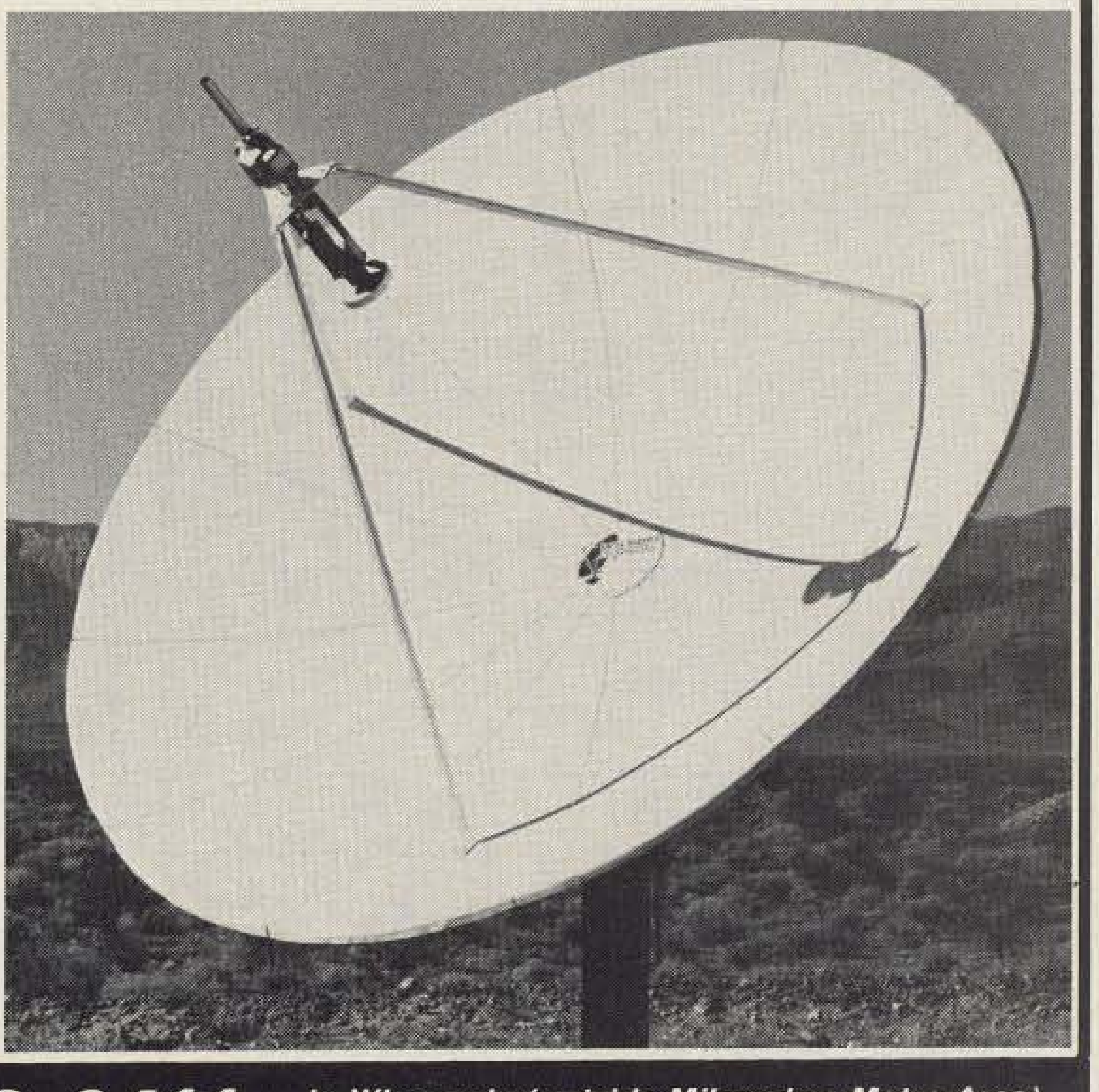

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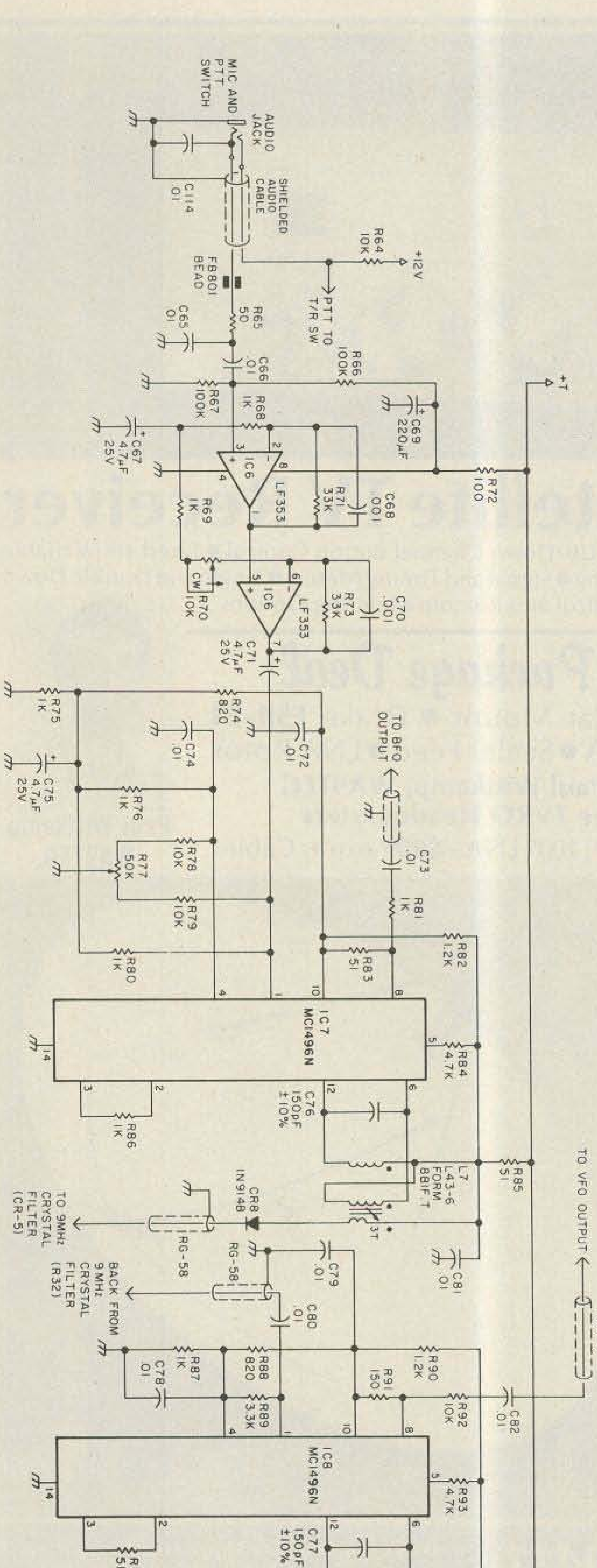

Fig. 6. Speech-amp, balanced-modulator, and transmit-mixer schematic.

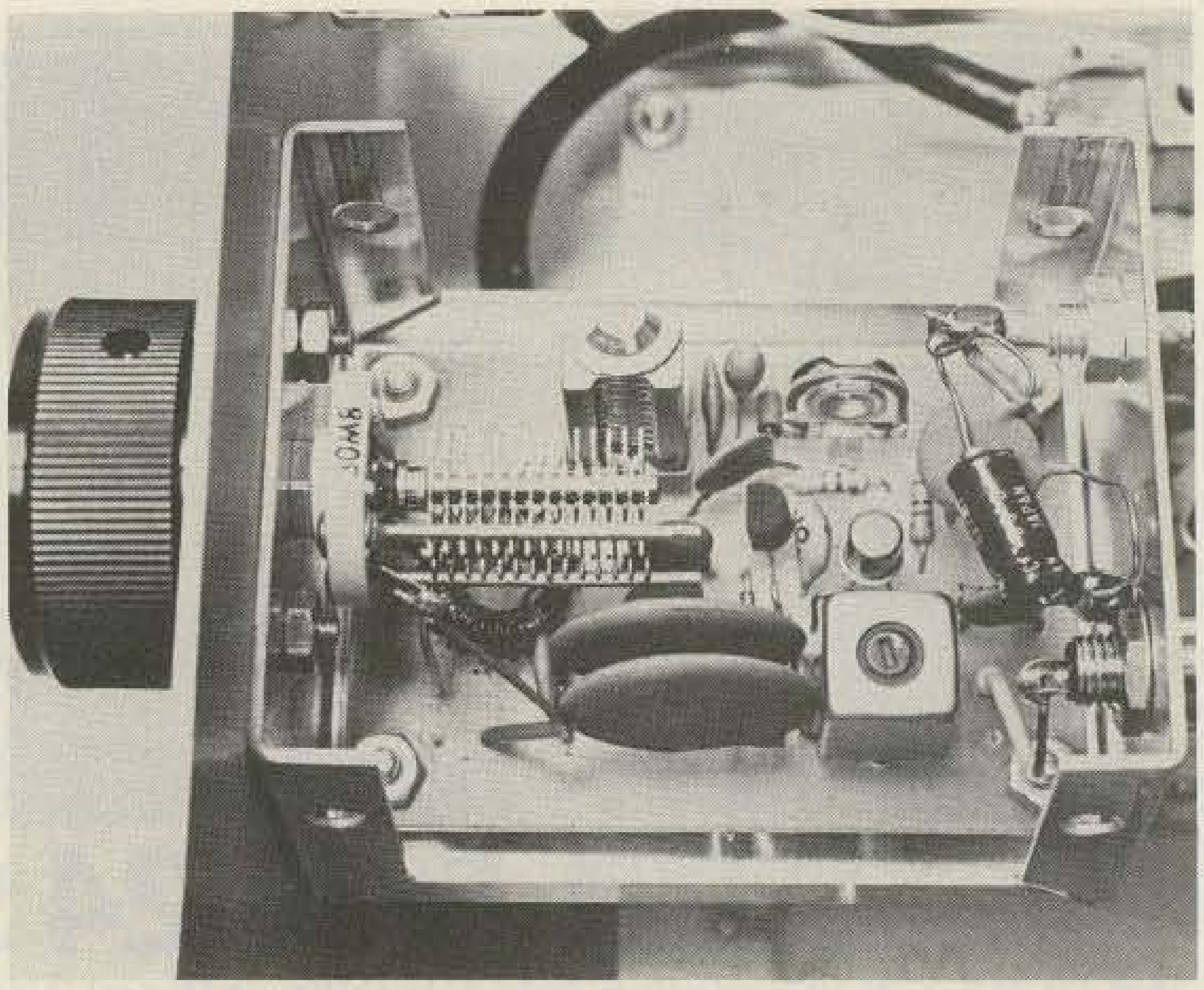

Photo D. Vfo construction detail.

ing of all major parts. As I promised, the parts are readily available. You might have a little trouble finding the NPO capacitors, but many radio-TV parts houses stock them. Keep in mind that one of your best sources for parts information is just a CQ or two away—just don't conduct your purchases directly on the air!

Chassis

I built my mini'ceiver in a 12" L × 7" W × 4" H Bud CU-3011A minibox, and used two 2¾" L × 2-1/8" W × 1-5/8" H Bud CU-3000A miniboxes within to house the vfo and bfo. As you can see in the construction photos, I put the power supply, receiver, speech amp, balanced modulator, and transmitter mixer on a main board and the transmit amp chain on a smaller piggyback board. This worked out successfully. However, I plan to use two cards of the same size mounted vertically, each facing out, in the next mini'ceiver. In this case, I would put most of the transmitter circuitry on one card. If you decide on this layout, keep the speech amplifier and final rf amp at opposite ends of the transmitter board!

Circuit Boards

The layout of high-gain rf and audio PC boards is something of an art form. For a one-shot project, it's hard to beat the use of single-sided (2-ounce copper) circuit board with the copper on the component side used as a ground plane. Notice that the transmit amplifier chain is built in this way. It's generally faster to duplicate a circuit using this approach than to go through the process of lifting circuit board art, exposing resist, etching, etc.

I've outlined the approach I like to use in an earlier article, but it's worth going through again. If nothing else, it makes component substitutions a snap. Get some drafting vellum with a light blue 1/10th-inch grid on it. After you have gathered all the parts for a circuit, you can begin developing the board layout. Start by mulling over the schematic and inspecting the components. Then lay out the components on the grid paper and think through their interconnection. Juggle the components around as needed for a neat arrangement that minimizes trace lengths and crossovers. If you think in terms of circuit strips, it makes things easier.

After you have the layout and interconnection for a section of the circuit visualized, pick up the components and sketch in their

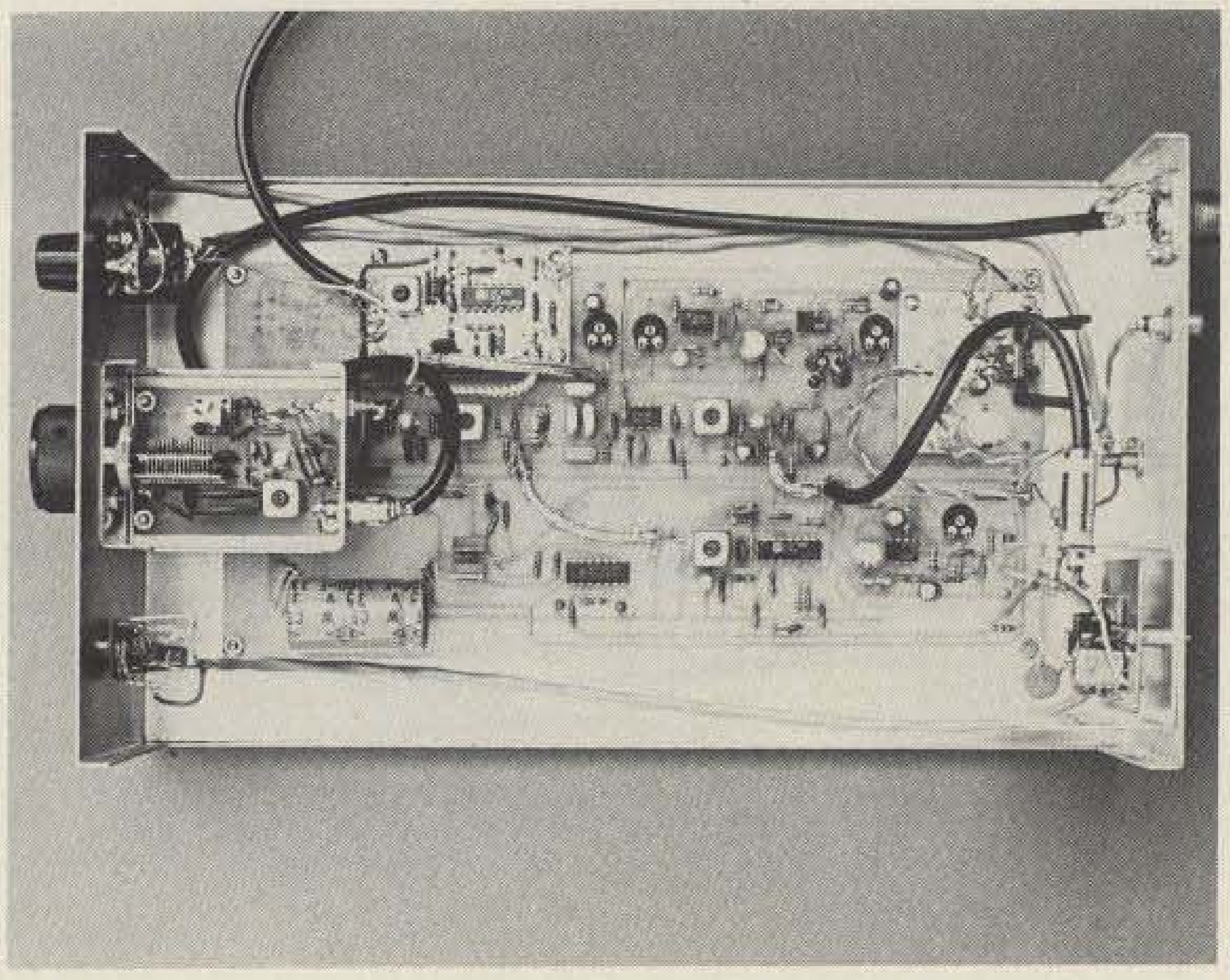

Photo E. View of the main board, which includes the receiver, speech amp, balanced modulator, and transmit mixer.

outlines on the vellum. Show the component interconnections underneath the circuit board with dotted lines. You will be surprised how fast this goes. Remember that all ground connections are on top. Be careful to keep input and output connections of high-gain rf and audio stages separated.

Once the layout is complete, you can tape it directly to your circuit board blank. Drill through the layout and the circuit board each place a component lead or wire goes through the board. I use about a #62 bit for most holes except IC leads, where I use a #68 bit. It's easy to enlarge holes later as needed for the bigger component leads.

After all the holes are drilled, lightly countersink them with a 3/32" bit—except those which are going to be direct ground connections. The countersinking keeps the leads from shorting out on the ground plane. After cleaning the board and perhaps tin-plating it, you can begin installing components. They are interconnected under the board by their leads and/or bus wire. Remember to keep connections as short as possible and watch input-output routing around high-gain stages.

Rf Coils and Transformers

Radio Shack currently markets a packet of magnet wire in three gauges: part number 278-1345. This type of wire can be stripped simply with hot solder, so it's ideal for rf coil and transformer applications. Use the 30-gauge wire for winding all the shielded transformers. Use the 22-gauge wire for winding all the toroids except L6 and L14, where the 26-gauge wire will be easier to use. I used a small 10-uH molded choke for L13. However, this should not be too critical. If you have trouble finding a molded choke, try 16 turns or so on an FT-50-61 ferrite core. It might be a good idea to put a 10-Ohm resistor in series with this choke to avoid any surprise resonances.

You will notice a number of bifilar windings are used. I use an electric drill to pretwist pairs of wires to about 6-8 turns per inch. Use an ohmmeter to figure out which wire is which after winding the bifilar coils. On the shielded coils, bring the bifilar pairs out together at each end of the bifilar winding and then separate and tin them under the circuit board. Don't try to solder directly to the coil-form posts on these transformers. You'll wind up a post short.

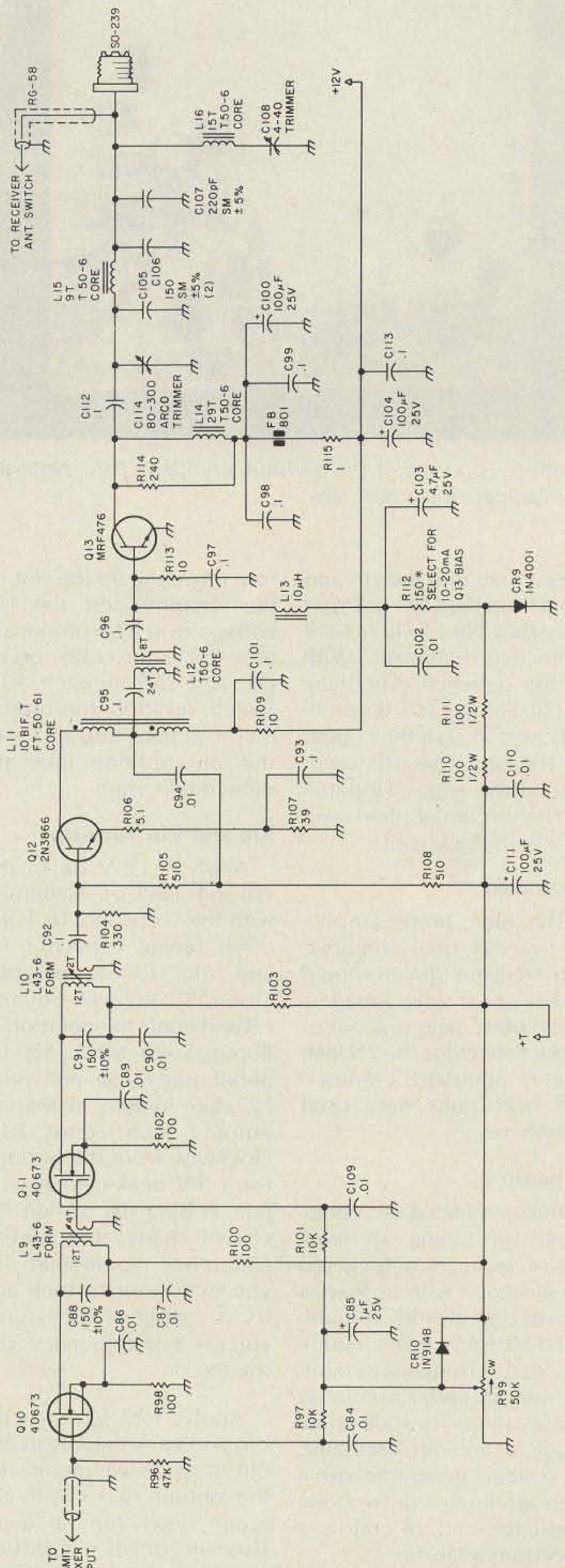

Fig. 7. Transmit-amplifier chain.

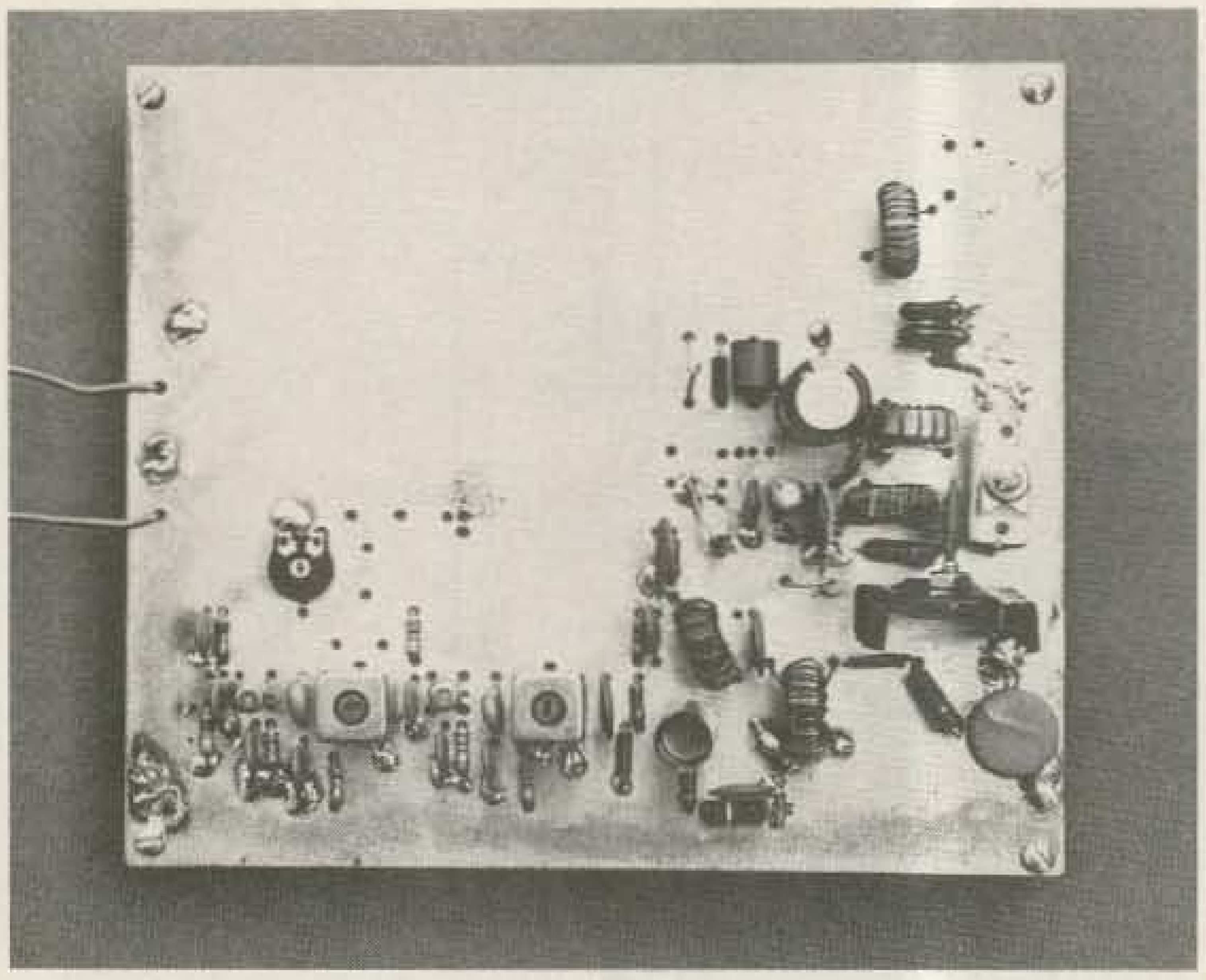

Photo F. Top view of the transmit amplifier chain. Note the "stovepipe" driver heat sink.

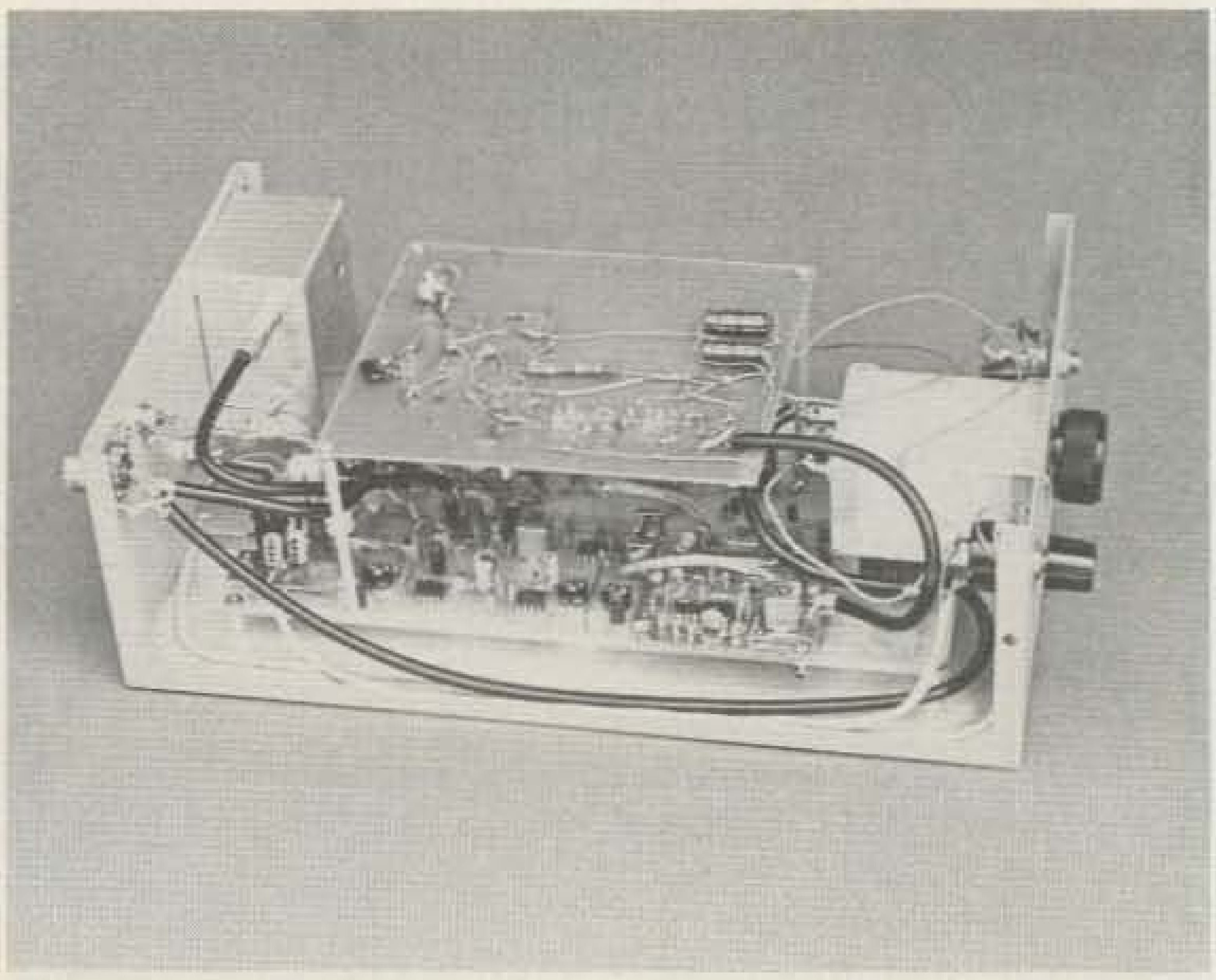

Photo G. Overall view of the mini'ceiver circuitry with the transmit amplifier card in place. The bfo is housed in the small minibox in the back.

You may find the vfo and bfo a little tight to construct since they have to fit in their respective miniboxes. With a little patience everything will fit. For the vfo, it's probably best to etch the copper off the circuit board except around the edges. Hopefully, the vfo detail photo will help with the layout.

Heat Sinks

The audio power amplifier, transmit final amplifier, and transmit driver should all have heat sinks. I made a "stovepipe" heat sink out of copper sheet for the 2N3866 driver. Standard commercial heat sinks were used elsewhere.

Tune-Up

Recommended test equipment for tuning up mini'ceiver includes a triggered oscilloscope with at least a 20-MHz bandwidth, a multiband HF transceiver, a dummy load, a frequency counter, and an audio oscillator. Luxury items for tune-up include a grid-dip oscillator, an rf signal generator with a step attenuator, a two-tone oscillator, and, of course, a spectrum analyzer.

Power Supply and T/R Voltages

You can run a mini'ceiver off a 12-V-dc, 1-A supply. Before powering up the rest of the circuitry, test the T/R voltage switch for proper action. Check the collectors of Q1 and Q2 in each PTT switch position for proper on/off action. You did wire the microphone jack up right, didn't you?

Bfo and Vfo Tune-Up

Apply +12 V dc to the vfo and check for oscillation with the scope at C16. Fully mesh tuning capacitor C9 and adjust C6 for operation around 5.250 MHz. Unmesh C9 and confirm operation at about 5.300 MHz. Set C9 about mid-range and peak L2 while looking at the vfo output. Then adjust R18, clockwise from the bottom, for a 5-V peak-to-peak output. Putting the top on the vfo will change its operating frequency somewhat, so you may want to tune and try a couple of times until you get it on frequency with the top on.

Apply +12 V dc to the bfo and back the slug nearly out of L3. While monitoring the output of L3 with the scope, slowly run the tuning slug in until oscillation starts. Peak the oscillator output. You should get about a 5-V peak-to-peak output. Check oscillation frequency with your counter and fine-tune the slug in L3 for operation at 8.998500 MHz. The bfo must be loaded with the product detector and balanced modulator for proper operation. It's a good idea to put a small hole in the top of the bfo minibox over L3 to allow for touch-up adjustment of the slug with the minibox top in place.

Receiver Tune-Up

Run the tuning slugs in on L4, L5, and L6 so that the tops of the slugs are just slightly above the top of the shield cans. Set the volume control and R47 at mid-range. You should now be able to hear 20-meter SSB signals on your antenna or on a 15' piece of wire stuck in the antenna jack.

Fire up your other HF rig into a dummy load at low output power and set its output frequency for about 14.275 MHz. Tune the mini'ceiver to find the signal. Once found, monitor pin 7 on IC4 (the agc output) and peak L4, L5, and L6 for maximum agc output. If you see the agc voltage peaking above 6 V dc during tuning, reduce your signal level a bit. You can now adjust R47 to suit. Back this pot down a bit if you run into high-volume audio distortion or instability when running off dry cells.

Transmitter Tune-Up

Hook mini'ceiver to a 50-Ohm dummy load. Short the PTT input on the mike jack to ground. Check the voltage across R115. It should be around 20 mV dc, which indicates a 20-mA quiescent bias on Q13. If it's much off this value, replace R112 with a larger or smaller resistor as needed to bring the bias in range. Incidentally, if you have trouble finding a 1-Ohm resistor for R115, you can use a 10-Ohm resistor (200 mV dc), but short the resistor out after setting up the bias.

Input a single audio tone of about 8 mV peak-to-peak into the audio side of the mike jack. Adjust R70 for a 1.5-V peak-to-peak audio signal at pin 1 of IC7. Hook the scope to the anode of CR8 and peak L7. You will see a waveform that looks like an AM signal with 20-40% modulation, about 400 mV peak-to-peak. Check pin 1 of IC8 for a fairly clean 150-200-mV CW signal. Look at the output of L8 and peak for a 14-MHz signal of about 150-200 mV. Move the scope to the output of L10 and peak L9, L10, and R99. Adjust R99 for a lower bias voltage to Q10 and Q11 if the output of L10 is more than 500 mV peak-to-peak. Check the output of Q12 at C59 for about a 5-V peak-to-peak signal.

Hook the scope to the output of the amplifier chain (SO-239 connecter) and peak C114. This is broad tuning, so watch carefully. You should have about 25 V peak-to-peak of rf output. Find the 2nd harmonic of mini'ceiver's output on 10 meters and tune C108 for a null. Tuning is quite sharp, so tune carefully. C108 can also be tuned to peak the 2nd harmomic; be sure you tune for *minimum* output on 10 meters. You can use a short piece of wire for a receive antenna on your 10-meter rig since it's in the same room with mini'ceiver.

Disconnect the jumper and audio oscillator from the microphone jack and plug in the mike. Readjust R70 a bit, if needed, for an SSB voice signal similar to the one in Photo B. Be careful not to push too hard; there is enough flat-topping out there already.

Operation

Now the moment of truth. The results you get with mini'ceiver depend heavily on your antenna system, but this is true of any station. I think you will be surprised. I've gotten clean audio reports (except when I tried a narrower crystal filter!) and moderate signal strength reports which is expected for QRP. The fact that mini'ceiver is home-brewed does generate QSO interest.

Mods and Alternative Circuitry

An S-/rf-output meter can be added easily if you like to watch meters jiggle. For the S-meter, monitor the agc voltage which will vary from about 4 to 7 V. Add a 2:1 resistive divider across the rf output (about 1k total load) and then detect the peak rf voltage at the divider output with a diode-capacitor rf detector. This should give you about 6 V peak to drive the meter. Use a toggle switch to switch modes on the meter.

There is enough room left to add an "afterburner" if you feel you need a little more power. I suggest using an MRF477, which should take you easily into the 25-W range. No more lantern battery operation, though. The receiver antenna switch should be moved to the collector side of the matching network in this case. I don't suggest this unless you have already done some rf amplifier design.

Mini'ceiver should be fairly easy to put on other HF bands by adding the appropriate crystal oscillator and another 1496 mixer to achieve a suitable vfo output range, along with adjusting L and C values as needed.

From Here

You can never really finish an electronic design (or a computer program for that matter) and mini'ceiver is no exception. There are many ways the design can be improved. If you have an idea, try it! Experimenting is fun. If you would like to ask me a question about mini'ceiver, please send an SASE. 73! ■

References and Readings

1. "Progressive Communications Receiver," Wes Hayward and John Lawson, *QST*, November, 1981.

2. *Solid State Design for the Radio Amateur*, Wes Hayward and Doug DeMaw, ARRL publication.

3. *Crystal Oscillator Design and Temperature Compensation*, Marvin Frerking, Van Nostrand Reinhold.

4. *Introduction to Radio Frequency Design*, Wes Hayward, Prentice-Hall. (Excellent if you can handle higher math.)

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An Alarming Procedure

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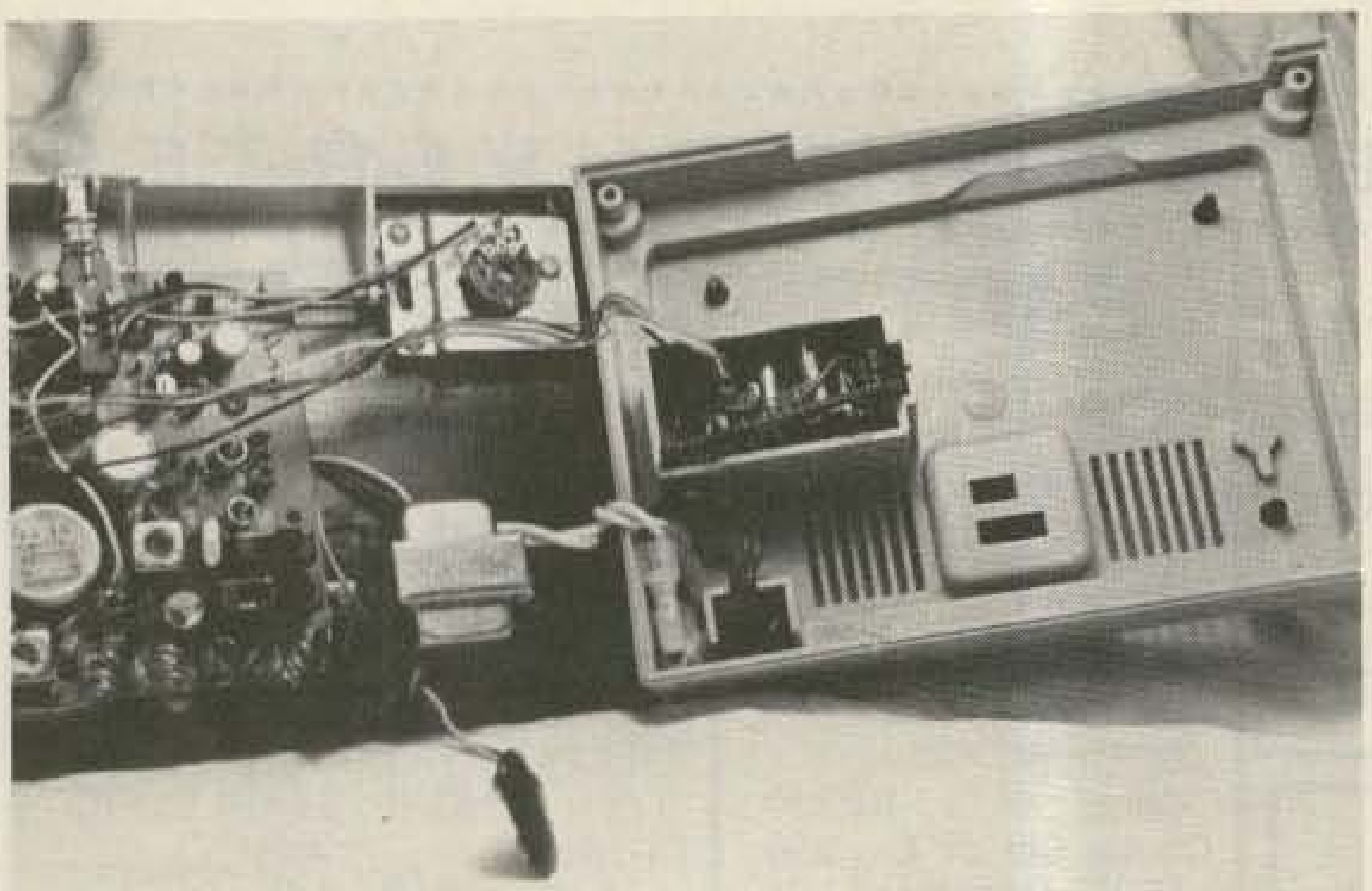

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Decoder board mounted in battery compartment.

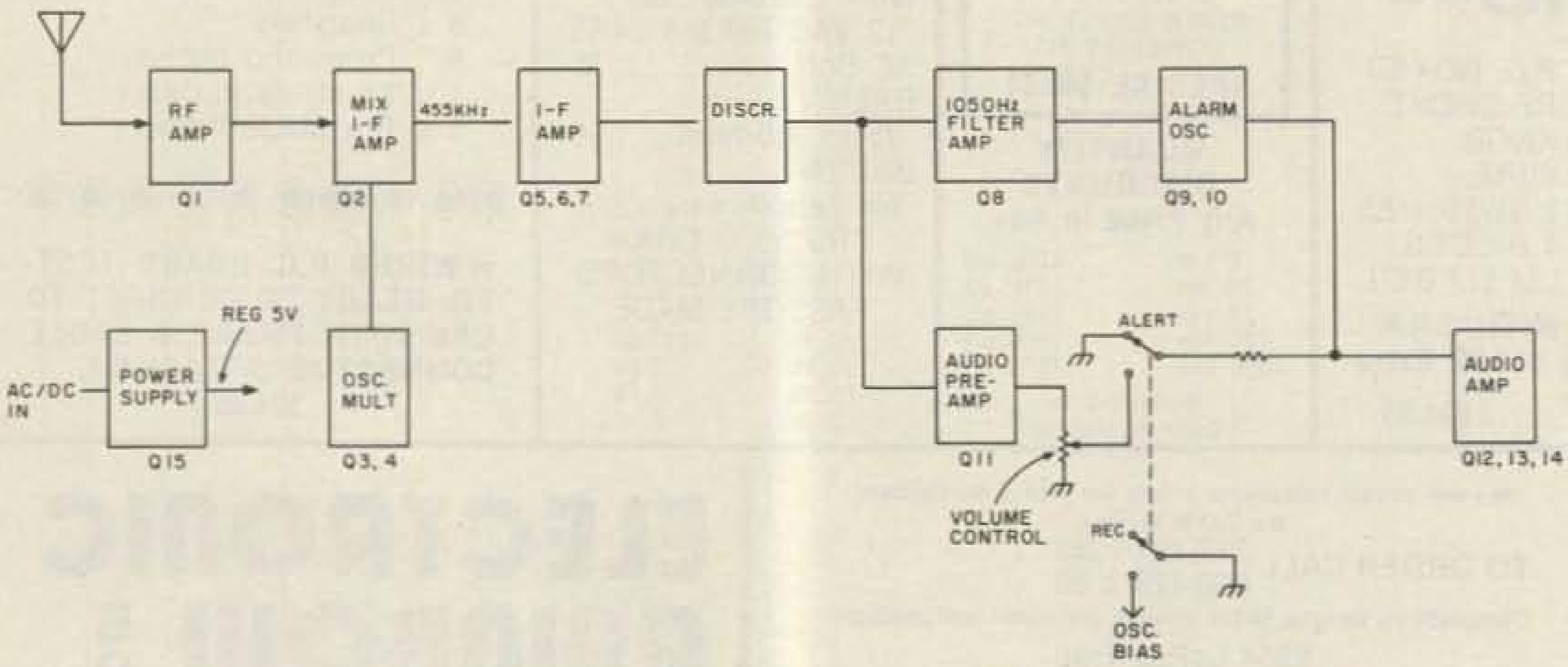

Fig. 1. Block diagram.

Two-meter repeaters provide reliable communication for relatively large areas surrounding the repeater site. There has long been a need for a reliable warning or alert system operating through a repeater for civil defense, RACES, emergency, and similar type requirements. In particular, if this need is required in the specific area within the locale of a repeater, then the approach described here-in will prove more than satisfactory.

On the assumption that a secure alert signal must be coded in some way, it becomes readily apparent that the receiver/decoder must be immune (i.e., secure) from false triggering. The problems associated with using a repeater manifest themselves through the types of signals transmitted. For example: engine whine, noise, voice characteristics, whistling, and other distortions contained in speech must not falsely trigger the alarm mechanism. The receiver, therefore, must be of sufficient sensitivity to operate within a given signal-strength area and contain a decoder. The repeater must be able to pass the coded signal with sufficient amplitude to activate the alarm mechanism.

Additional requirements are that any operator can initiate the alarm without the necessity of a special code generator and that existing 2-meter receivers not be pressed into service to monitor and decode the alarm signals. (A previously published article out of Canada described the use of a 2-meter transceiver with a "listening" decoder placed in front of the speaker to receive and decode the alarm signal. Not only does this tie up a piece of very expensive equipment—but also it implies that the user must listen to every QSO and not forget to turn up the audio volume.) Finally, and above all, the receiver and code generator must be inexpensive.

With the rudimentary specifications as set forth above, a search was conducted into readily available equipment that could be modified for the task. After some deliberation it was decided that a crystal-controlled FM weather radio of the type used by mariners for monitoring NOAA

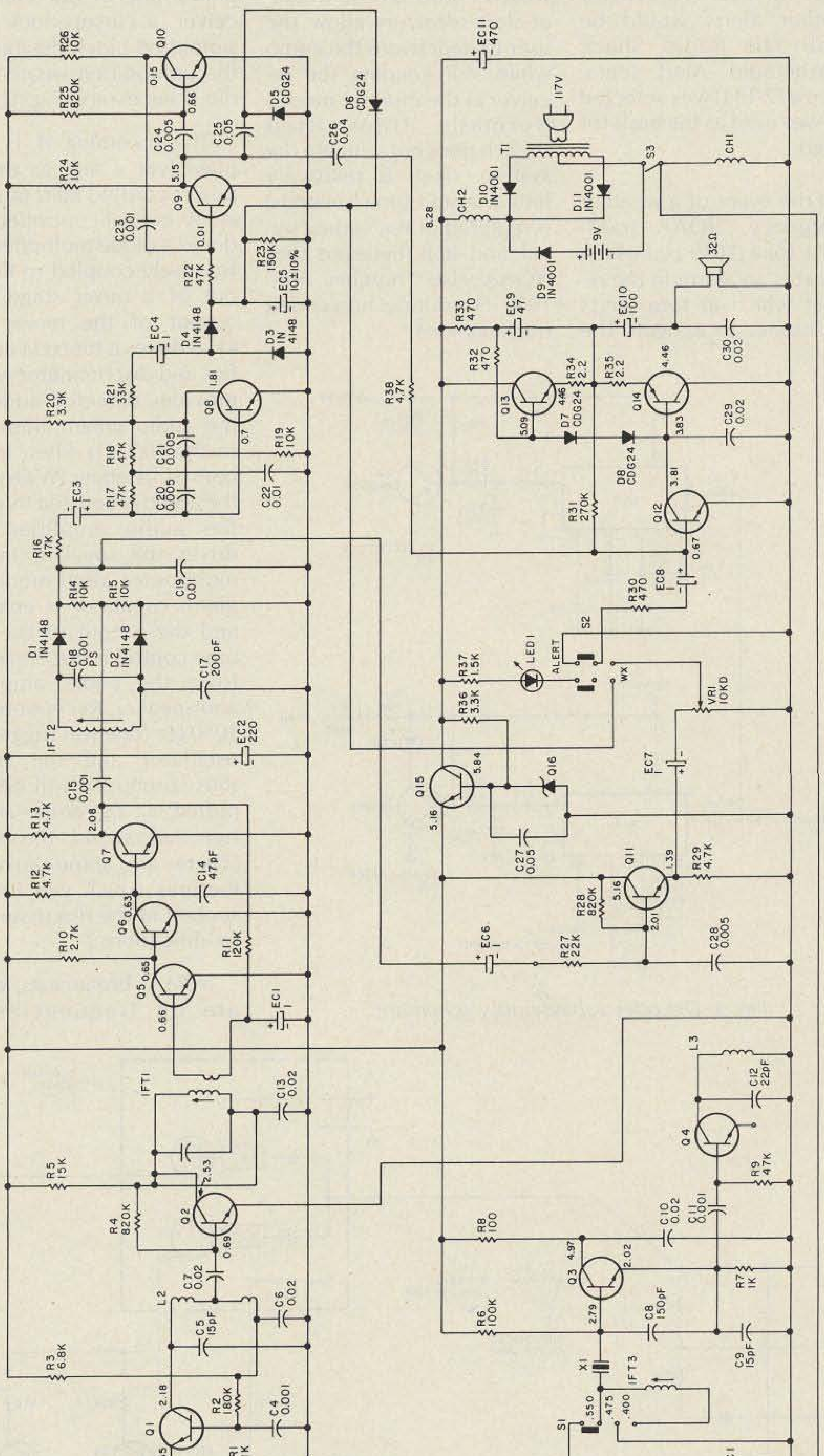

Fig. 2. Schematic diagram of unmodified Weatheradio.

weather broadcasts that also contains the built-in decoder for NOAA-broadcast weather alerts would be ideal. The Radio Shack Weatheradio Alert (catalogue #12-154) was selected and was used as the basis for design.

In the event of a weather emergency, NOAA transmits a tone (1050 Hz) which activates an alarm in the receiver which in turn alerts the listener to activate the audio portion of the receiver and listen to the detailed weather info. (Most weather-alert receivers allow the user to deactivate the audio while still keeping the receiver in the monitor mode.) Normally transmitted speech does not activate the system since a relatively long transmit time (seconds) is required of the coding signal and it is believed that NOAA also "notches out" 1050 Hz during non-coded transmissions.

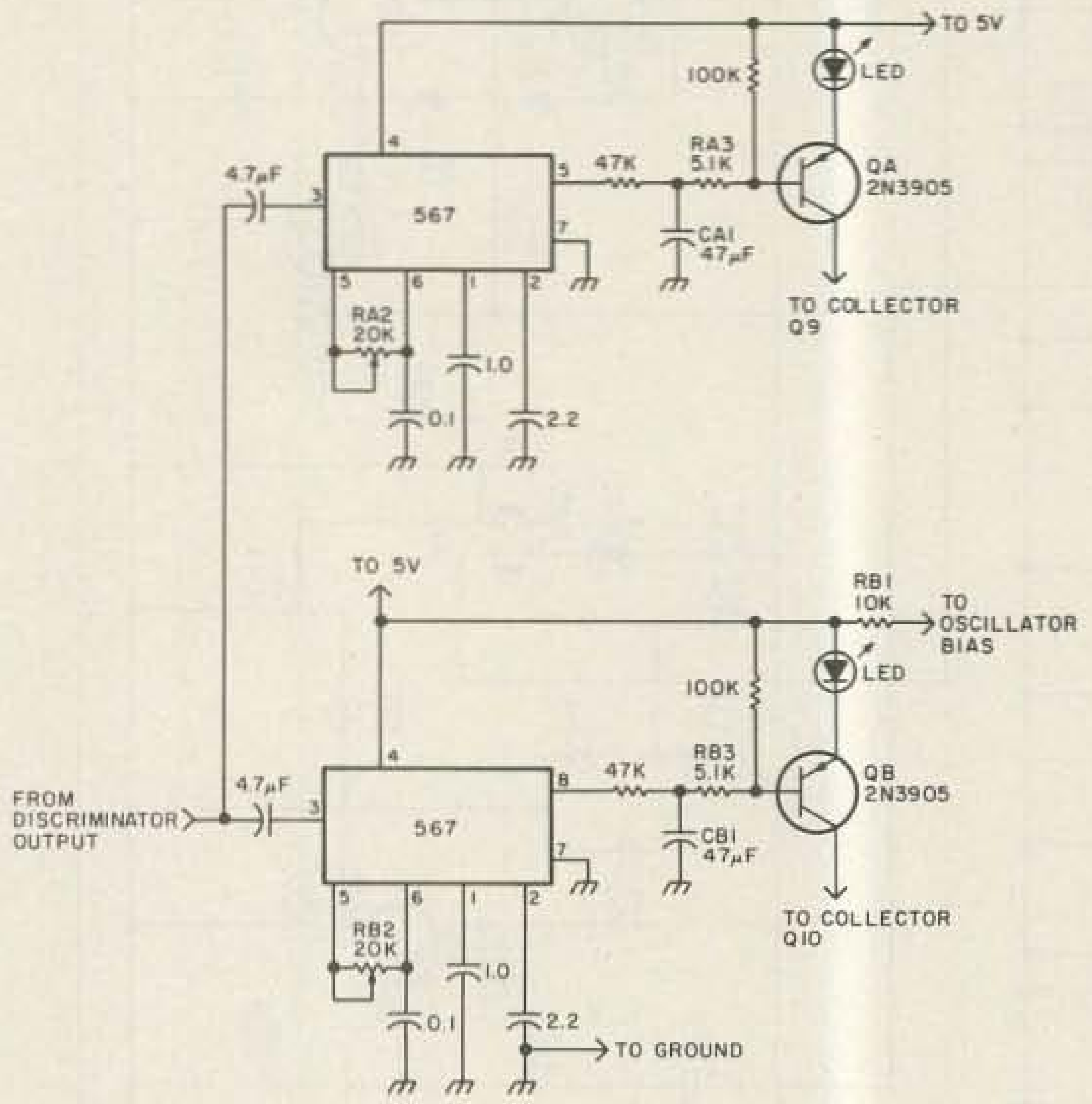

Fig. 3. Decoder subassembly schematic.

Before describing the modifications and design philosophy of our alert receiver, a cursory look at a simplified block diagram of the unmodified weather radio is necessary (Fig. 1).

The incoming rf is supplied (via a link to the ac power cord) to an rf amplifier. A crystal-controlled LO drives a diode multiplier and is loosely coupled to the input of a mixer stage. The output of the mixer (455 kHz) drives a tuned i-f amplifier and discriminator which provides detected audio to the audio preamplifier and to the 1050-Hz filter. In the normal listening (WX) mode the audio is boosted through the audio amplifier and drives the speaker. In the monitor (or alert) mode the alarm oscillator is enabled and the output of the volume control is disconnected from the audio amplifier and speaker. Reception of a 1050-Hz tone will trigger the oscillator and the signal thus produced will be amplified via the audio amplifier and sound the alert. (There are some auxiliary features which will be described in the discussion on modifications.)

NOAA broadcasts operate on frequencies of 162.400, 162.475, and 162.550. This is facilitated in the unmodified alarm receiver by operating the crystal padded with either a capacitor, an inductor, or nothing. A three-position switch on the rear of the unit is provided for this purpose. Since we will be operating on a fixed frequency, this is an unnecessary feature and must be disabled. (We set the switch in the "unpadded" position and epoxied it in place.)

The repeater frequency we are using is 146.865-MHz output. The rf stages must be retuned to this frequency as well as selecting a new crystal which will provide an i-f of 455 kHz when operating in conjunction with this frequency. A crystal frequency of 16.202 MHz is used to generate 455 kHz when operating with the "central" NOAA frequency of 162.475 MHz. Working backwards, 162.475 MHz −455 kHz = 162.02 MHz. It becomes obvious then that the multiplier is operating at a multiplication factor of 10. At the repeater operating frequency of 146.865, a crystal of (146.865 - 455 kHz)/10 = 14.641 MHz is required for the LO. (The crystal can be purchased from: Sentry Mfg. Co., Chickasha, Oklahoma: #SCM-18, HC-25/µ case with wire leads, 15-pF load.)

With this determined and the planned use of the 1050-Hz coding signal, we set off to modify the receiver. First we applied a signal at the NOAA frequency of 162.475 MHz FM modulated with 1050 Hz (3-kHz deviation) and measured the output of the discriminator at the point where the alarm would just trigger. We observed the output of the signal generator and used this output (in microvolts) as the target sensitivity at the repeater frequency. On the trial unit this was observed as approximately 1 uV. Next we replaced the crystal, ob-

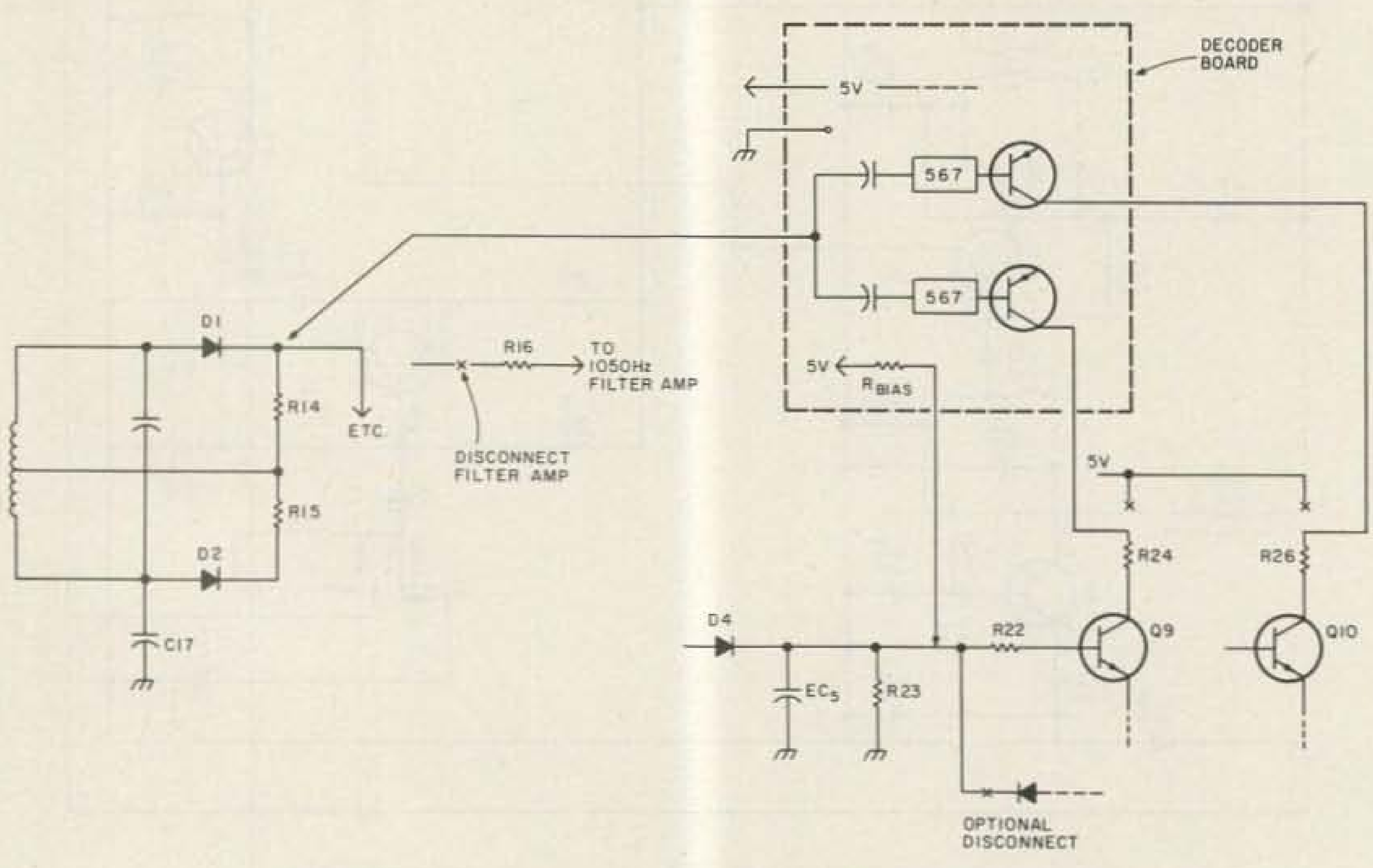

Fig. 4. Connecting the decoder board to the receiver.

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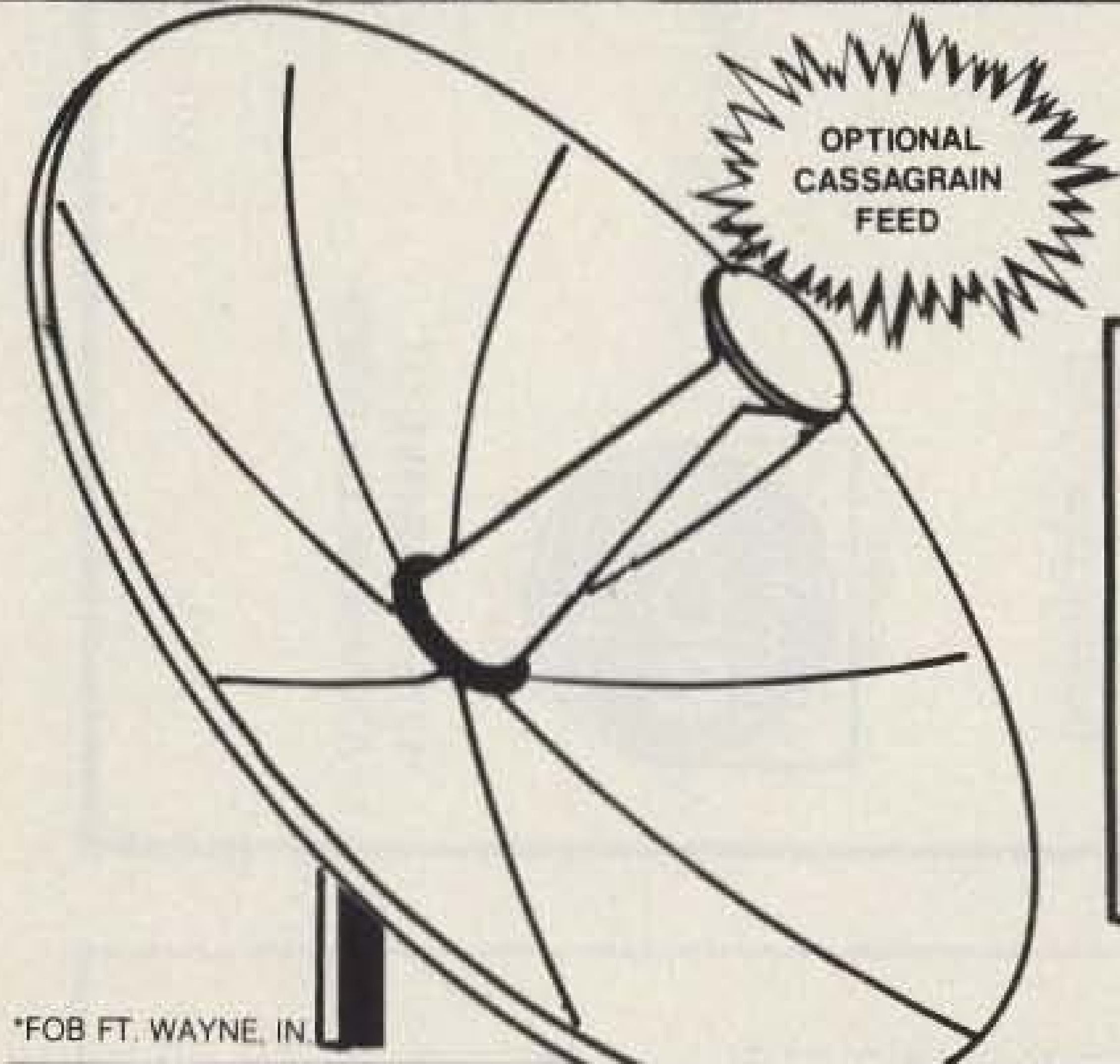

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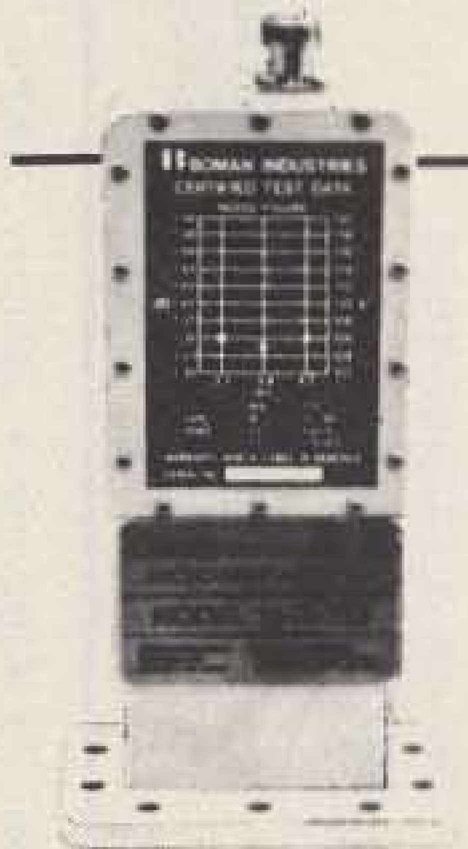

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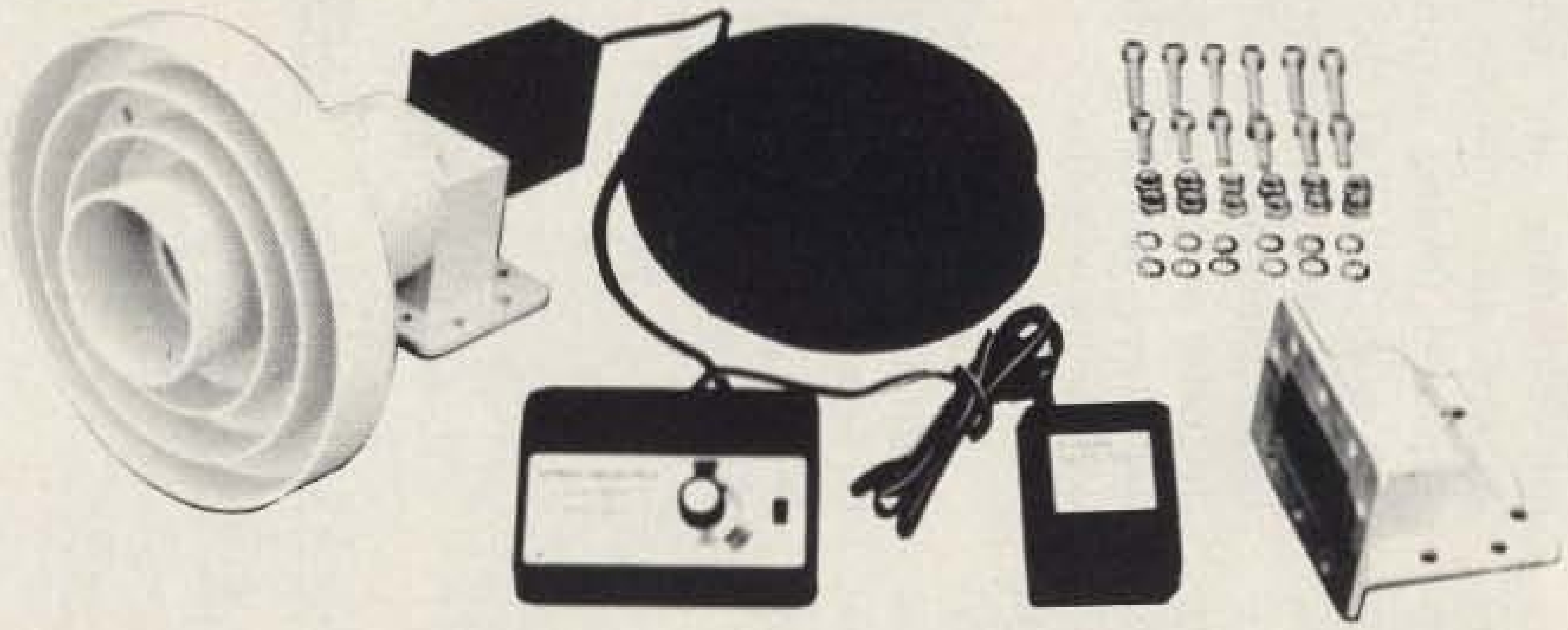

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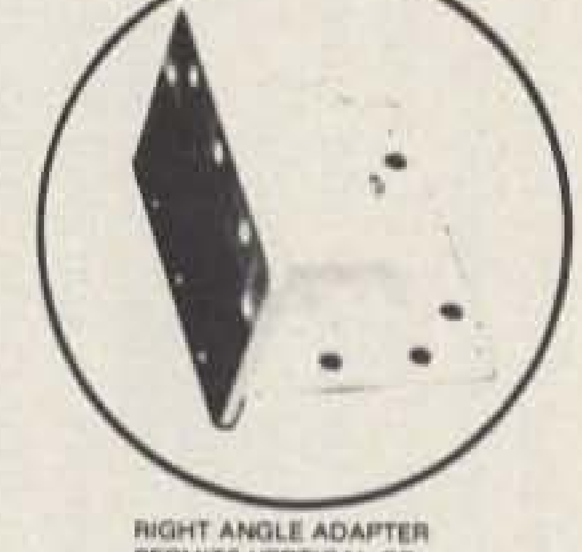

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Toll Free Inside Ca.: (800) 352-2553 Outside (800) 421-2533 served that the LO was operating, and proceeded to retune the rf and LO stages. Unable to lower the tuned frequency adequately by squeezing the inductor coils closer together, we added capacitors in parallel to the tank circuits to bring the tuning in range of the coils. All the while we monitored the output of the discriminator and tuned for maximum output of the 1050-Hz signal. With judicious twisting and squeezing of the coils we were able to match the sensitivity observed at the NOAA frequency.

A hastily designed 1050-Hz tone generator was implemented and the receiver was put to the test. It triggered obediently in response to the coded signal—as well as from alternator whine and anybody who spoke with the right quantity of 1050-Hz energy! We quickly deduced that any decoding scheme that was dependent on a single frequency was doomed to a similar fate. In order to minimize the cost of the decoding circuitry, we decided against any scheme which required timing sequences. We also felt that the more complicated the scheme, the larger (and more costly) the decoder would be, and we did have space limitations within the receiver.

The solution decided upon was to code and decode a single two-tone composite signal much like that used in the Bell Touch-Tone™ system. In fact, for purposes of simplicity and availability, we designed around an actual DTMF tone pair. The 1050-Hz filter/amplifier was of no further use; therefore, it was bypassed. A small printed-circuit board containing the two tone decoders and their associated drivers was designed to fit into the backup battery compartment. (The backup battery would be glued to the receiver case using double-sided masking tape.) A detailed description of the electrical design and receiver modifications follows.

To understand how our decoder design developed, it is first necessary to understand the operation of the unmodified decoder-alarm circuit. Transistors Q9 and Q10 are operated as a triggered astable multivibrator. R22 and R23 keep the pair in an untriggered state by keeping Q9 off in the ab-

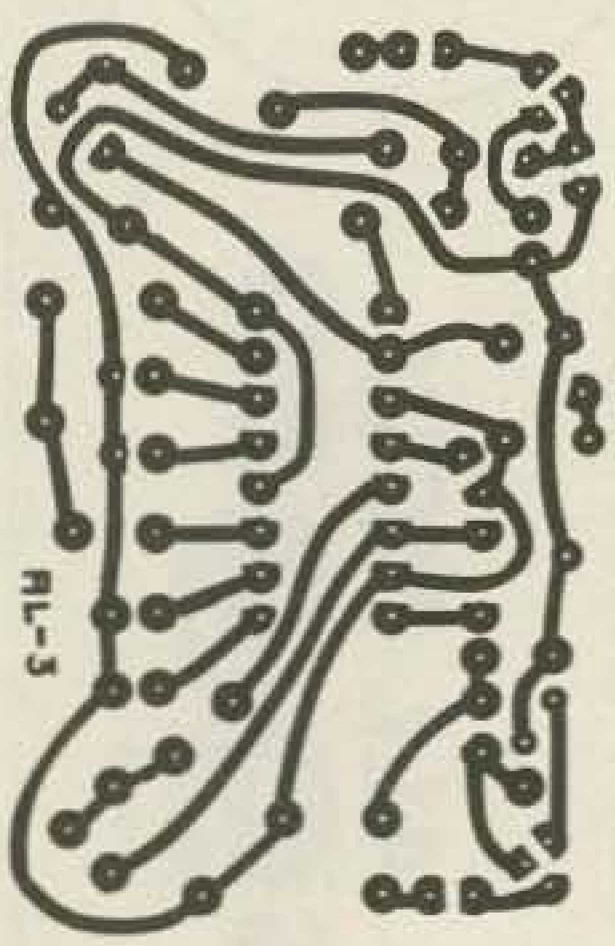

Fig. 5. PC board.

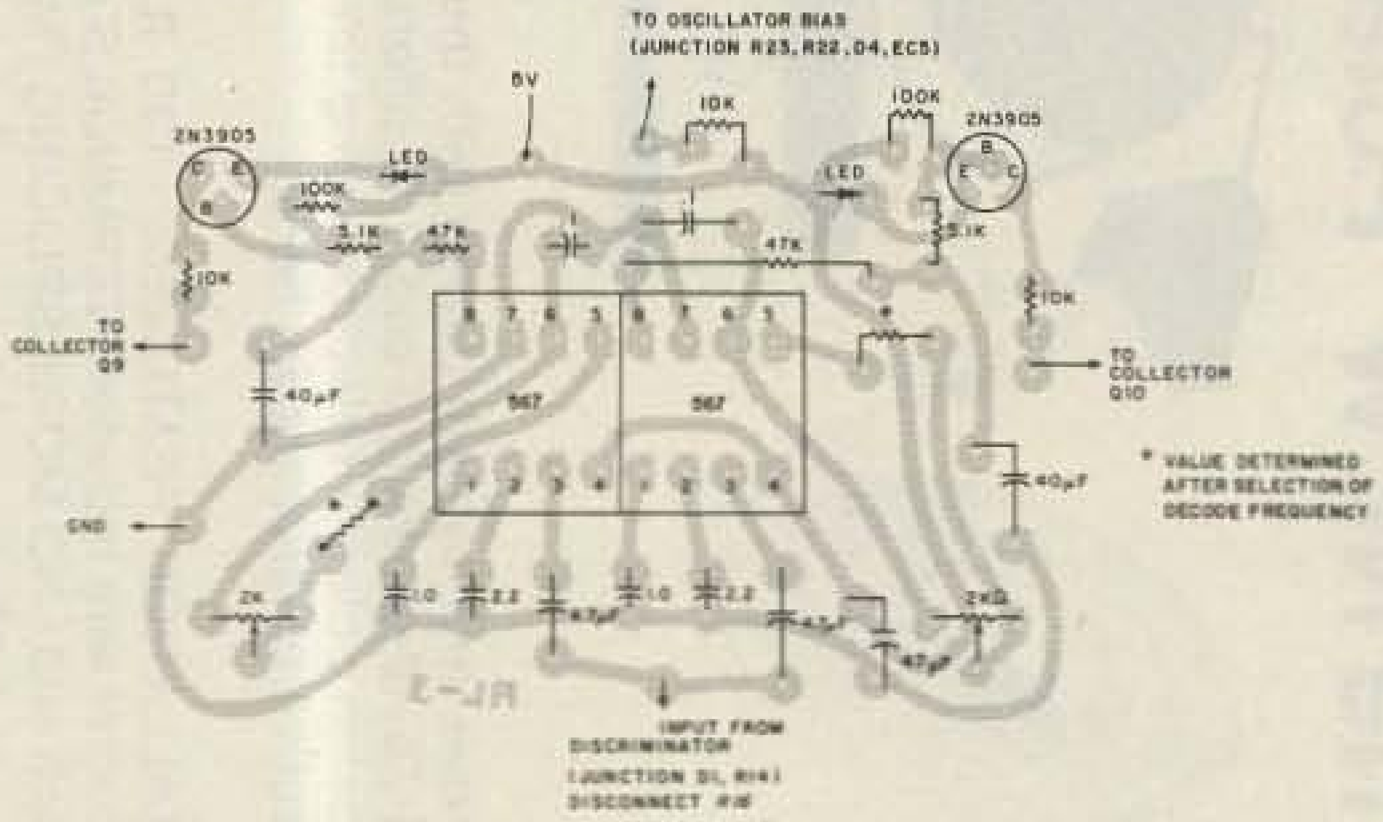

Fig. 6. Component layout. If resistors marked with asterisks are not used, they must be replaced by jumpers.

sence of any external bias current. When the coded 1050-Hz signal is received and passed through the 1050-Hz twin-T filter/amplifier (Q8), it is rectified and doubled via D3, D4, and EC4. The resulting dc is applied to the base of Q9 through R22 as a trigger current. The multivibrator then oscillates. Diode D6 rectifies the oscillator output and feeds it back to the input of Q9, thereby maintaining the alarm even after the initial trigger signal is removed. Depending on the desired mode of operation as an alert receiver, this may or may not be a desirable feature. This will be discussed later.

The two-tone-decoder design is a relatively straightforward adaptation of a standard NE567 design. Two decoders are connected in parallel and drive a pair of PNP trigger amps. In order to use as much of the existing receiver as possible, it was decided to disconnect the collectors of the multivibrator transistors from the supply rail and drive each of them from the tone decoders. In this way the oscillator cannot function unless both tones are present, thereby acting as an AND gate as well as an oscillator. The PNP trigger amps (Fig. 3) provide the necessary inversion of the 567 output as well as a convenient node to add some time delay to the decoding functions. (To prevent accidental triggering, a time delay was added to the decoding spec.)

Referring to Fig. 3, the output of either 567 (pin 8) goes low when the correct tone is presented to its input. This in turn provides bias current for the base of the PNP (QA or QB), but not until CA1, B1 is first discharged (providing the time delay). The LEDs in the emitters of the PNPs necessitate that the base drop an additional two diode drops (in addition to VBE) before the PNP can turn on again for time delay purposes. (They also add the additional feature of illuminating for test purposes.)

As mentioned above, when both PNPs are on, the multivibrator can oscillate. Note: Since the 1050-Hz filter/amp is disconnected, a permanently enabling bias voltage is applied to multivibrator transistor Q9 through RB1 on the decoder board. Potentiometers RA2 and RB2 permit tuning the tone decoders for the desired frequency. Refer to Fig. 4 for the modified schematic showing points of connection (and disconnection). Figs. 5 and 6 show the PC layout and an assembled board, respectively.

Some final comments are in order. We decided not to depend on rf coupled through the power line for our input. A banana jack was mounted on the case and connected to the rf input through a small capacitor. An inexpensive ¼-wave antenna was implemented using a piece of #10 electrical wire soldered into a banana plug.

Also, for the needs of the Sharon, Massachusetts, Civil Defense group for whom this receiver was designed, the latching diode (D6) was disconnected. Our philosophy is that in time of civil emergency the intent of generating an alarm is to alert *available* personnel. If within the vicinity of the receiver, they will respond by switching to the audio mode and following the broadcast instructions coming over the repeater. If they are not around or available, latching the alarm will not serve any useful purpose. This is obviously a policy decision based on individual need.

One of the obvious advantages of this system is that any DTMF tone pair can be used. Using # or * has the advantage that they are not normally used tones in a repeater with a phone patch. If, however, it is felt that using known (and easily generated) tones can cause false alarms, then any pair can be used simply by designing simple multivibrator oscillators driving speakers and holding them against the microphone of a transmitter. Only authorized personnel would be issued coders.

The first prototype was built using perfboard and placed in continuous operation in the spring of 1980. As of this writing it has never "falsed" yet and continues to respond when needed upon adequate application (several seconds) of the coded tone pair. The unit is self-tested merely by unplugging and replugging the ac power by virtue of the momentary-charging current to the two time-delay capacitors, CA1 and CB1, applied through the base-emitter junction of the PNP drivers. That, by the way, is why the capacitors are connected to ground and not the supply rail, and why resistors RA3 and RB3 are required (to prevent burnout of the junctions).

One final comment: A more secure three-tone system is possible with no further modification of the receiver. Merely reconnect the 1050-Hz filter/amp (disconnecting the bias resistor RB1) and now a simultaneous three-tone signal (of which 1050 Hz is one) is necessary to trigger the alarm. Of course a proper three-tone generator would have to be designed. Other options are available if the filter frequency is altered from 1050 Hz.

We believe this design achieved our initial objective of providing a relatively inexpensive alert receiver wth minimal modifications and additions to an existing receiver. At the same time it did not require an elaborate code-generating device. It also does not require modifications to or need the use of other 2-meter equipment. ■

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Trimming the Fat from ATV

Why use 3 MHz when 500 kHz will do? WB6FHD proposes a way.

My colleagues of the Southern California Amateur Television Club have been asking me to submit an extended article to *73 Magazine* since my brief presentation of this concept at our monthly club meeting, July, 1980, and its subsequent publication in our August newsletter. My purpose in publishing this article is to stimulate those of my radio amateur colleagues blest with true scientific creativity to develop this concept into a refined state-of-the-art system of global amateur radio television communication.

The development of a practical narrowband system of real television, in the true sense of the word, is of tremendous importance at this time, because every time we turn around, this or the other big commercial interest wants to lobby the FCC to give them portions of our amateur bands for their own private use, even though other amateurs in other countries still continue to use these same frequencies. My proposal not only will result in making it possible to transmit a picture almost similar in quality to a commercial televison station, but will do it in only one-twelfth of the usual channel bandwidth normally required. It will do this as low as six meters if we get together and petition the FCC with a proposal for experimental narrowband television privileges on the almost disused upper three-fourths of the band.

Another reason I want the experimentation to be on six meters is that occasionally there are some pretty good band openings into other countries.

I want to give thanks to Al Lipkin W3AEH, whose narrowband TV article in the 1964 ATV Experimenter Anthology (by *73 Magazine*) inspired me to carry his idea through the next few logical steps to the present engineering conceptualization of the entire system, all the way from camera to TV receiver. I sincerely hope that this article will start an avalanche of contributions by other engineers—as happened with SSTV exactly twenty years ago.

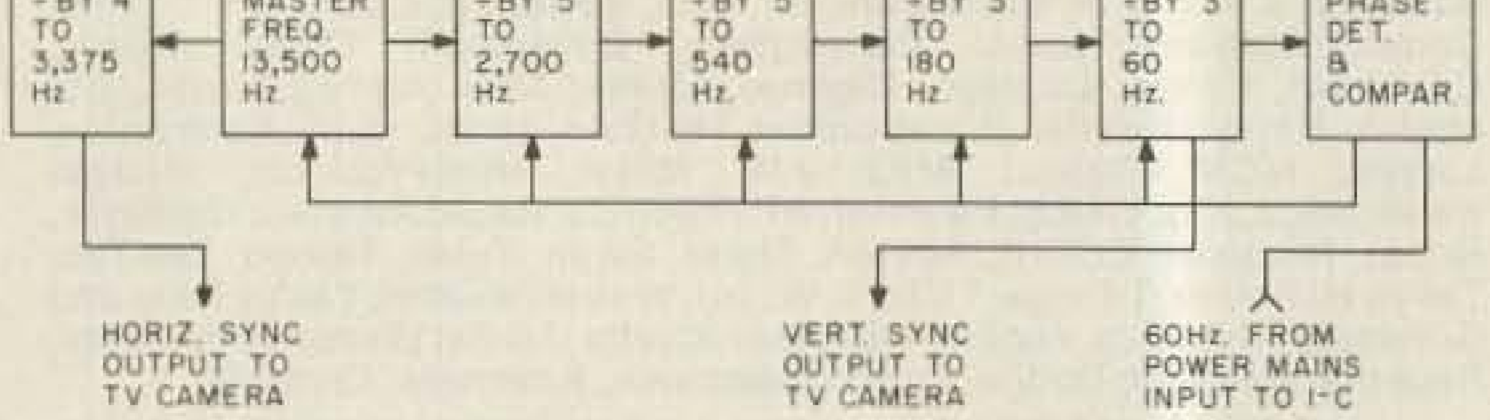

Fig. 1. The sync-generator countdown frequency-divider chain.

My profession is electronics-concepts design engineering, but I was caught in the aerospace layoffs of 1969 and have not been active in it since then. This means I am not up on the newest devices and technology, and accordingly will not submit any schematics.

The most interesting things about this proposal are that:

- The entire channel, video and sound combined, can be fitted into a bandwidth of only 500 kHz.
- The video and sound signals are generated independently, each crystal-controlled, both just above 10 MHz.
- Using simple SSB techniques (but no balanced modulator), the lower vestigial video sideband is completely filtered out, like an SSB signal, while retaining the carrier (for the present, but some day . . . ?).
- The signal is now heterodyned from just above 10 MHz upward in frequency to the region between 51 and 54 MHz, where the maximum video modulating frequency will be less than one percent of the final transmitting carrier frequency, as with good engineering practice.
- The scanning standards will be: 225 lines per frame, 4:1 interlace, 15 frames per second, 60 fields per second, 56.25 lines per field.

The horizontal deflection frequency will be 3,375 Hz, and the vertical deflection frequency will be 60 Hz. The synchronizing pulses for the TV camera are generated by solid-state frequency divider-comparators and a phase-locked loop. The master frequency for the countdown (frequency-dividing) sequence will be 13,500 Hz.

To obtain the horizontal sync pulses, some of the master-frequency oscillator output goes to a divide-by-four device, output, 3,375 Hz. To obtain the vertical sync pulses, some of the master-frequency oscillator output (13,500 Hz) goes to a series of divide-by devices (see Fig. 1) resulting in an output of 60 Hz. This sync generator will provide the camera's modified horizontal and vertical sweep oscillator/amplifiers with the complex sync necessary to scan a 225-line, 4:1 interlace raster on the camera's vidicon image tube.

If the usual practice of ATVers is to be the case, this system will work fine, as there will be no discernible flicker if the motion in the image is not excessively rapid. We ATVers who use vidicon TV cameras know better than to either pan the camera quickly or go suddenly from a bright to a dimly-illuminated scene, as we get smear in the image. The reduced horizontal scan rate will increase the vidicon's light sensitivity due to the photoelectric/photon-charge-storage principle, so an ordinary table lamp should suffice to light up the shack.

You might ask, why use only 225 lines in the image? Commercial television uses 525 lines; wouldn't the picture have less than half the sharpness, resolution, and detail of standard TV? Believe it or not, unless you have a huge screen and are almost sitting on the set, you probably won't even notice the difference. Have you seen how sharp the picture is on a 14" surveillance-camera monitor TV screen, or how crisp the detail is on your living room TV set when the kids are playing with the TV game? Those security systems and the TV games have one thing in common: The images are non-interlaced, and provide an image of only 262.5 lines on a security monitor or on any TV set.

I'm sure you're all wondering by now how a TV set can receive both a 525-line *and* 262.5-line image! Did you know that when your TV set is not receiving a signal, it is scanning only 262.5 lines on the screen? Whether or not you're receiving a signal, an interlaced signal or a non-interlaced signal, the TV set's scan oscillators don't change frequency. The 2:1 interlace system used in commercial television allows twice the number of scanning lines (and, therefore, vertical image detail) to be scanned by the TV camera than its scan-system oscillators, actually operating at no difference in frequency, would normally scan.

Whether the camera is scanning 262.5 lines or 525 lines, the maximum video frequency in the camera output is exactly the same. A 525-line non-interlaced picture would require a horizontal deflection frequency of twice that used for an interlaced system, and the maximum video frequency also would be twice that of an interlaced system. As for the difference between the 262.5-line picture which was discussed earlier and a 225-line picture, the difference amounts to only 37.5 lines—slightly noticeable, yes, but only if you had a 262.5-line picture being displayed on another TV set of the same screen size alongside.

In practice, a 14" screen is about the largest practical size for a 225-line TV system, and at a viewing distance of eight feet, no line structure can be resolved by the eye. The 4:1 interlace system outlined in this proposal consists of transmitting four coarse-scan fields, each consisting of 56.25 lines, in 1/15 of a second, to form a complete frame of 225 interlaced scanning lines.

The requirements for designing a 4:1 interlace system are as follows: The master frequency must end in a zero, and each divider stage downward in frequency must also end in a zero, all the way down to the mains-power frequency. The vertical scanning frequency must be the same as and lock to the mains-power frequency. The horizontal scanning frequency must be 1/4th of the master frequency, and end in the whole number five. The total number of lines comprising a frame, when divided by four, must end in the decimal .25 in the lines-per-field count.

Only a very limited number of different 4:1 interlace line-count systems which are mathematically possible are practical for a television system of this kind, and far fewer can be constructed to work, much less work reliably, if a relatively high frequency must be divided to a far lower frequency in just one device. This is because of these three big problems to be solved: stability, obtainability, and cost.

The following is for a 225-line-per-frame system with a 3×4 aspect ratio: The horizontal deflection frequency of 3,375 Hz is derived by multiplying the rate of frames per second (15) times the line count per frame (225). If the line-per-frame count is divided by four, we get the line-per-field count of 56.25, as four of these interleaved fields are scanned consecutively to form one complete frame. The usable lines and portions thereof for the image with any line-count or aspect-ratio scan system are approximately and on the average only 5/6ths of the total lines scanned, due to loss of lines during vertical retrace time, vertical and horizontal overscan on the camera image tube, and other scanning efficiency factors.

To calculate the maximum video frequency which will be produced by a television system, we first consider the aspect ratio (the ratio of height to width). In America, we use an aspect ratio of three units high to four units wide, or 3×4. Converting the 225-lines per frame to picture elements (pixels), we have 225 pixels vertically. As we have a 3×4 aspect ratio, 225 pixels is therefore only 3/4ths of what must be the horizontal pixel count; it follows that the horizontal pixel count is 300. The total number of pixels per frame, then, is 67,500, and multiplied times 15 frames per second is 1,012,500.

We must now divide this large number by 2, as at this point it must be understood that the maximum video frequency consists of alternate black and white squares on each scanning line, a black and white pair equaling one full cycle. When the video signal is closely examined, however, it is found that only the black (or only the white) squares count as the maximum measured video frequency. Therefore, 1,012,500 cycles divided by 2 is 506,250, and as we only have 5/6th efficiency, it follows that the maximum video frequency is 421,875 Hz.

For the sake of making things slightly easier, divide the product of total pixels times "rep-rate" by 2.4. (1.012,500 divided by 2.4 is 421,875.) Using the same system to calculate the maxium video frequency of a conventional commercial TV camera, 525 pixels × 700 pixels is 367, 500 pixels × 30 frames/second is 11,025,000 divided by 2.4 is 4,593,750 Hz.

In commercial practice, a filter limits the maximum video frequency to 4,000,000 Hz. As this 225-line system is incompatible with commercial television standards, it must be pointed out that commercial vacuum-tube TV camera and TV sets can be modified easily to a 225-line system, and what's more, I'll tell you just how to do it, too!

To begin with, the vertical deflection circuits in both TV cameras and TV sets aren't touched at all, as both systems are locked to 60 Hz. The TV camera conversion, first of all, must have the solid-state sync-generator board installed within, along with its power source. The horizontal-sweep circuitry will have to be modified from a frequency of 15,750 Hz to 3,375 Hz. If the vidicon won't fully scan horizontally, either more energy is required or the associated deflection coil hasn't enough inductance to give a good reactive load at this much lower deflection frequency.

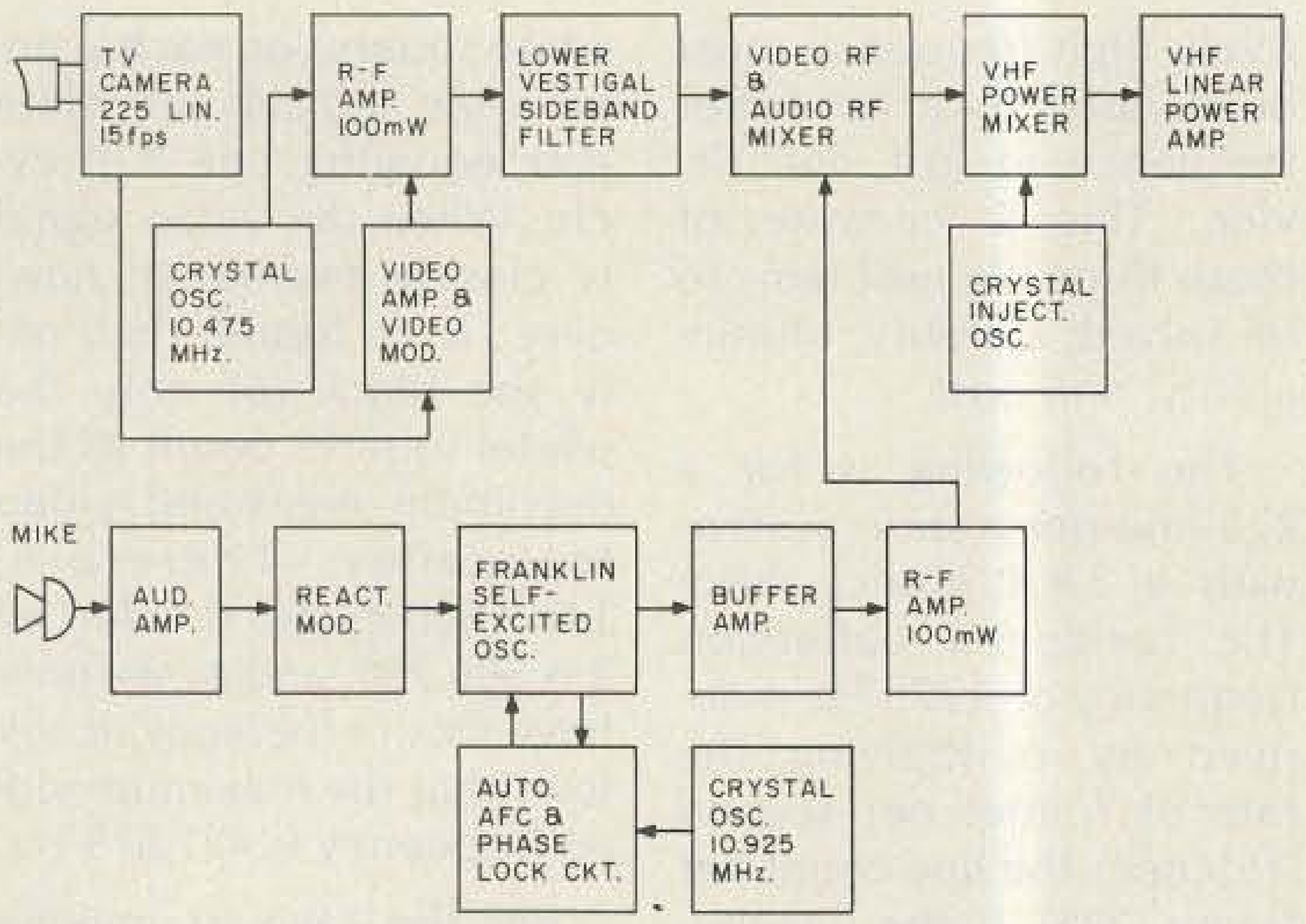

Fig. 2. The rf-generator video and audio-exciter chain.

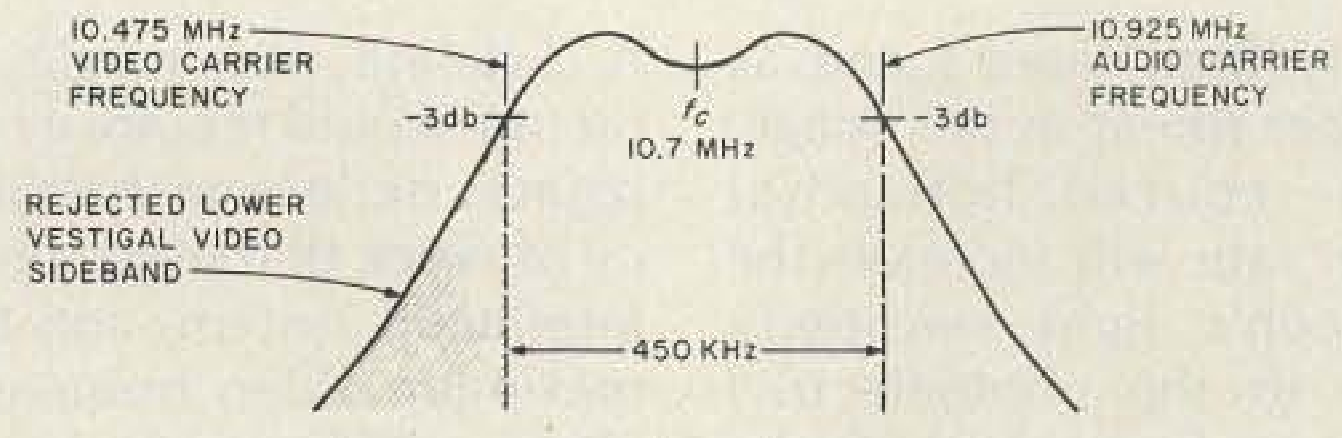

Fig. 3. The over-coupled, double-humped-response curve of the modified 10.7-MHz i-f transformer used in the output/filter circuit of the video-modulated rf amplifier.

Instead of the high-impedance horizontal-sweep tube, a silicon PNP transistor may have to be used, as its output impedance is low, and at 3,375 Hz it will be "looking into" a load which will be closer to a correct impedance match.

The receiver conversion will be fun. The horizontal-oscillator/amplifier circuit will continue to provide the picture tube with high voltage, but that's all. The afc circuit will be disconnected from both the horizontal oscillator and the horizontal-output transformer, and the horizontal deflection coils will be disconnected from the same transformer. A solid-state horizontal-oscillator/amplifier circuit will be built using the latest state-of-the-art phase-locked-loop technology to "lock the sync" even under adverse conditions of heavy QRM.

As with the TV camera, a silicon PNP transistor will likely be required to directly drive the horizontal-deflection coils. The metal case of the transistor will be grounded directly to the metal chassis of the TV set (and remember, the transistor's case is the collector) and the emitter will be connected to the sawtooth-scan side of the horizontal-deflection coils. The other end of the same coils will go to the plus side of the transistor's power supply. Since both the horizontal sweep frequency and the circuit impedances are now much lower than before, the diode damper normally required in the horizontal-output circuit should not be needed. Of course, the one in the high voltage power supply will naturally remain, as it is part of the "bootstrap" power supply associated with the high-voltage circuit to the picture tube.

An electron-beam squelching circuit will have to be added to put a dc voltage on the picture tube's electrode which blanks out the vertical retrace lines, because when no signal is being received to cause a fully 4:1 interlaced raster to appear on the screen, the free-running deflection circuits in the modified TV receiver will be scanning only 56.25 lines on the picture tube. This much-reduced scan of only one field will be intensely bright and will permanently damage the phosphorescent coating on the face of the picture tube with ugly brown horizontal streaks from which little or no useful light will come. Remember, 3,375-Hz horizontal-scan frequency divided by 60 Hz vertical-scan frequency equals 56.25 lines on the picture tube!

Now, on to the signal circuits. The TV set's tuner must have the swamping resistors removed to narrow down the band-pass to around 500 kHz. The channel 2 coils will be our concern here, as the signal coils will be centered between 51 and 54 MHz, say, 52.5 MHz. The oscillator will be modified to tune this range, but 23 MHz above. Why 23 MHz? Only the older TV sets had an i-f that low; all modern TV sets use 40-MHz i-f amplifiers! Well, first of all, the modern i-fs are twice as broad as we need, so they'll have to go—and be replaced with some Miller (or other) bifilar-wound 20-MHz i-f transformers, with best Q at around 23 MHz. All of the swamping resistors associated with the former i-f transformers are to be removed, of course. All of the i-fs will be tuned to the same frequency, not only for best gain, but with three i-f stages—optimum bandwidth, too. At the output of the last i-f stage, the bandpass should be around 500 kHz at −3 dB.

If it is desired to use an intercarrier sound-recovery system, it will operate on a frequency of 450 kHz, as this is the heterodyne difference frequency between the picture and sound carrier frequencies. 455 kHz i-f transformers will tune down here easily. The sound system is NBFM with plus and minus 5-kHz deviation. Another way to recover the sound is by using a low-band FM communications receiver made to tune below 30 MHz to the region between 22 and 24 MHz. The local oscillator should be converted from crystal control to self-excited, with the tuning control on the front panel. An afc circuit should be added to prevent drifting off center frequency.

Now we get to the *piece de resistance*, the rf generator. A block diagram is shown in Fig. 2. The video circuit will consist of a crystal-controlled oscillator driving a very low-powered amplifier with an output below 100 mW. This amplifier will be grid- or cathode-modulated by a video amplifier/modulator, supplied with composite negative-going video and sync by the modified TV camera. The output of the video-modulated amplifier will pass through a lower vestigial video-sideband filter composed of a large 10.7-MHz FM i-f transformer with overcoupled primary and secondary windings; this is in order to slightly broaden the bandpass and form the characteristic double-humped response curve.

Other components of the filter include a tunable 10.7-MHz series-T rejection trap, and a few crystals—in order to put a deep, wide notch just below the video-carrier frequency so that the lower vestigial video sideband will be completely filtered out. The video-carrier crystal oscillator will operate at a frequency of 10.475 MHz. The audio-carrier crystal oscillator will operate at a frequency of 10.925 MHz. These two frequencies are 450 kHz apart; both are sym-

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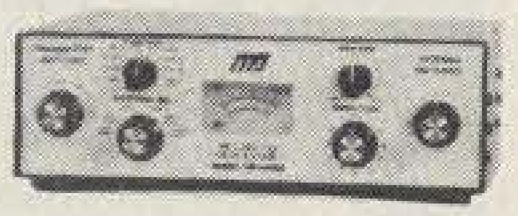

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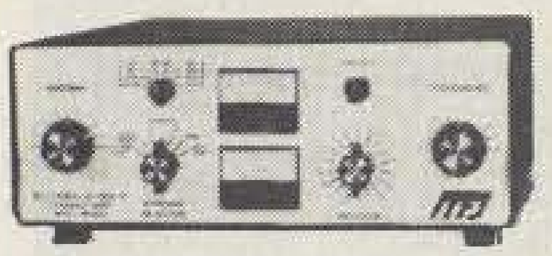

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metrically on opposite sides of the 10.7-MHz center frequency of the i-f transformer, and both, therefore, are the same number of dBs down on the transformer's response curve.

The FM audio signal's rf does not pass through the same i-f transformer used in the output/filter circuit of the video-modulated rf amplifier, but it will pass through a similar transformer in the output of the video rf/audio rf mixer. The 10.925-MHz FM audio generator will have one crystal oscillator and one afc phase-locked loop self-excited oscillator, both operating on the same frequency. The time constant of the afc/phase-lock circuit will allow for FM carrier deviation.

Now comes the rest of the answer to the question I'm sure all of you are asking by now, which is: Why does he keep harping on six meters? Doesn't he know that the FCC would never allow "that sort of thing," and hasn't he heard about the "national band-apportionment plan"? Well, I'll tell you, at the risk of sounding like some sort of rebel.

First of all, about FCC—how many of you can remember back when we could do anything we wanted to do on those ultra-shortwave bands? I do! As for this so-called national band-appointment plan, how many of you out there really agree wholeheartedly with how two meters and now 220 have been and are being chopped up into neat little slices for all of those open and closed machines?

Where are those "wide open spaces" we knew in the 40s and 50s where we had megacycles to burn? I know, I know—progress! OK, fine. Two things I know: A long time ago, I read somewhere that no one has a monopoly or right to any "personal" frequency in the "ham bands"—and I've got a box full of crystals for six and two meters and I guess a lot of them must fall across repeater-band edges and outputs!

'Nuff said? I think so, too, so let's get back to business. By now, at least a few of you must be wanting to say, Hey! How can a country with a different mains-power frequency than ours send us a picture with a 50-Hz vertical-deflection frequency and some cockamamie horizontal frequency and we receive it?

That's easy! All you have to do is remember that your TV set doesn't care what it gets—just design enough latitude into your horizontal and vertical hold controls and their phase-locked-loop circuits, and you can reach out and hold on to the "man in the moon"!

Next question: How about color? Thought you'd never ask!

Let's get black and white off the ground first (!) but, since you won't get any sleep unless I tell you, here goes. Yes, of course, the present American or European systems can be converted to work with my system. The TV receiver should have many adjustments (like a scope) so that any scan system, type, and polarity of sync or modulation can be received. Incidentally, I've got another, even narrower-band system of real TV which I can tell you about. It would fit into an FM channel. Of course, it wouldn't have nearly the definition or quality of what I'm offering you here. However, I'll give you one more hint. It would be like slow scan, but real TV. Cheerio! ■

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The Forgetful Autodialer Puzzle

Even Sherlock couldn't figure out how to make an autodialer that reprograms with no hardware changes. Elementary, says dear Batie.

Howard F. Batie W7BBX
12002 Cheviot Drive
Herndon VA 22070

Photo A.

Among some autodialer designs for 2-meter mobile autopatch use, a common limitation has been a lack of programming flexibility.[1,2,3] Although it is much easier to design and implement a diode-logic or PROM scheme for storing phone numbers, changing or adding a telephone number can be quite inconvenient for hard-wired systems or PROM-based designs. In this design, programming is done directly from the tone-encoder keyboard and allows programming of up to eight phone numbers. Numbers which are not programmed can be dialed directly from the keyboard in the normal manner.

The primary disadvantage of a RAM-based design is the requirement to continuously power the RAM to overcome its volatility. However, when you consider that an ample power source is available at both places in which an autodialer has a real application (your car and the shack), the disadvantage is more than offset by the ability to reprogram the memories very quickly and easily. Since the circuit described here has a total continuous current drain of only about 45 mA from a 12-15-volt source, it may be connected directly to the car battery without fear of running it down, since cars usually do not sit idle for weeks at a time. If complete disconnection is necessary, each phone number can be reprogrammed as quickly as the phone number can be manually dialed.

The RAM used was carefully selected after considering all available CMOS and bipolar memories; the logic support circuitry was then designed to meet the needs of the RAM. The most important constraints were that the RAM have bidirectional input/output lines and that these lines be tri-state. These requirements were necessary in order to significantly reduce the circuit complexity and cost while still permitting the keyboard to be used manually without affecting the stored phone numbers. Of secondary importance, it was desired that the RAM be organized 8 bits wide to allow direct interface with the seven data lines of a 3×4 keyboard matrix. The RAM selected was the Texas Instruments TMS 4036 since it met all of these requirements.

Description

Fig. 1 shows the complete autodialer schematic; connections to the transceiver are shown in Fig. 2. The autodialer memory holds up to eight numbers of up to seven digits each (* and # count as digits); therefore, the number actually stored may be either a standard 7-digit telephone number or an autopatch access code of from 1 to 7 digits in length. The total number of phone numbers in memory is a function of the RAM organization, in this case 64×8. With selection of a different RAM, more or fewer telephone numbers could be stored. For example, if the RAM organization were 128×8, sixteen phone numbers could be stored. Eight 8-bit words are required to completely store each 7-digit telephone number.

Inclusion of D2 and D3 drops the voltage supplied to the RAM from +5.0 volts down to about +3.5 volts. This decreases the current required by the entire autodialer from 65 mA to about 40–45 mA. Reliable data retention is maintained with this RAM as long as the Vcc pin remains above +2.8 volts dc.

In addition to direct programming from the encoder keyboard, other features of the autodialer include a speed control to vary the rate of readout, an onboard audio amplifier to allow you to hear the tones sent to the transceiver, a visual indication to aid in both programming and readout, and a minimum number of controls. The autodialer may also be used as a "standard" tone encoder to manually dial

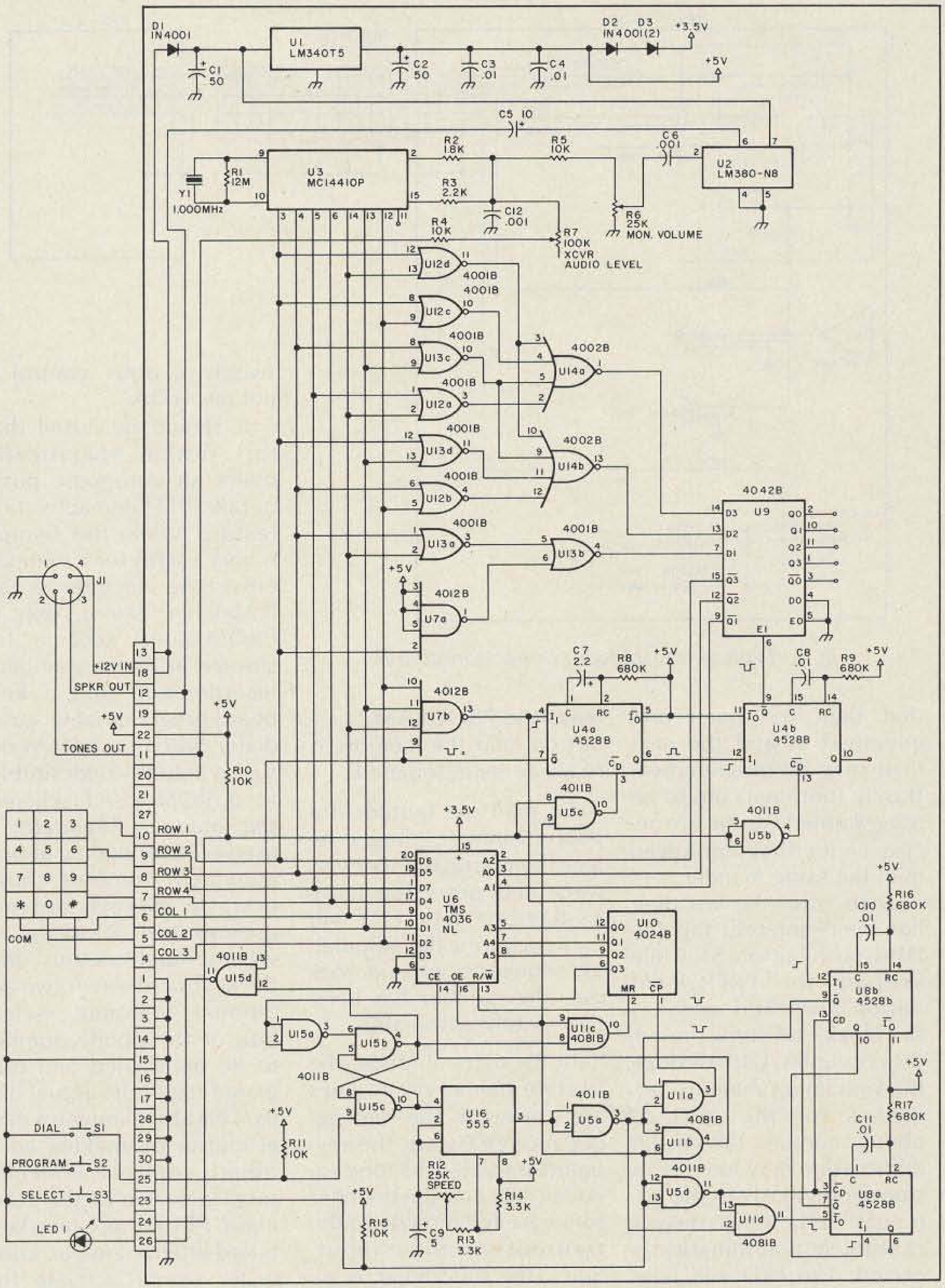

Fig. 1. Schematic diagram.

phone numbers or access codes which are not programmed directly into the memories.

Operation

Selection of one of the eight stored phone numbers is accomplished by depressing the appropriate keyboard digit (1–8) while holding down the SELECT pushbutton, S3. This action latches the logic state of three RAM address lines (A0, A1, and A2), and is used to select the desired phone number location for either autodial readout or programming. The selected phone number will then be available until a new one is selected; neither manual operation of the keyboard nor autodialing the stored phone number will alter the selection of the phone number.

To program the autodialer, the phone number digits are keyed in on the tone encoder keyboard with the PROGRAM push-button, S2, held down. This action routes the U8b output pulse produced by each keyboard digit depression to the clock input of the counter, U10. When each digit key is depressed, LED1 will light for about half a second; when it goes out,

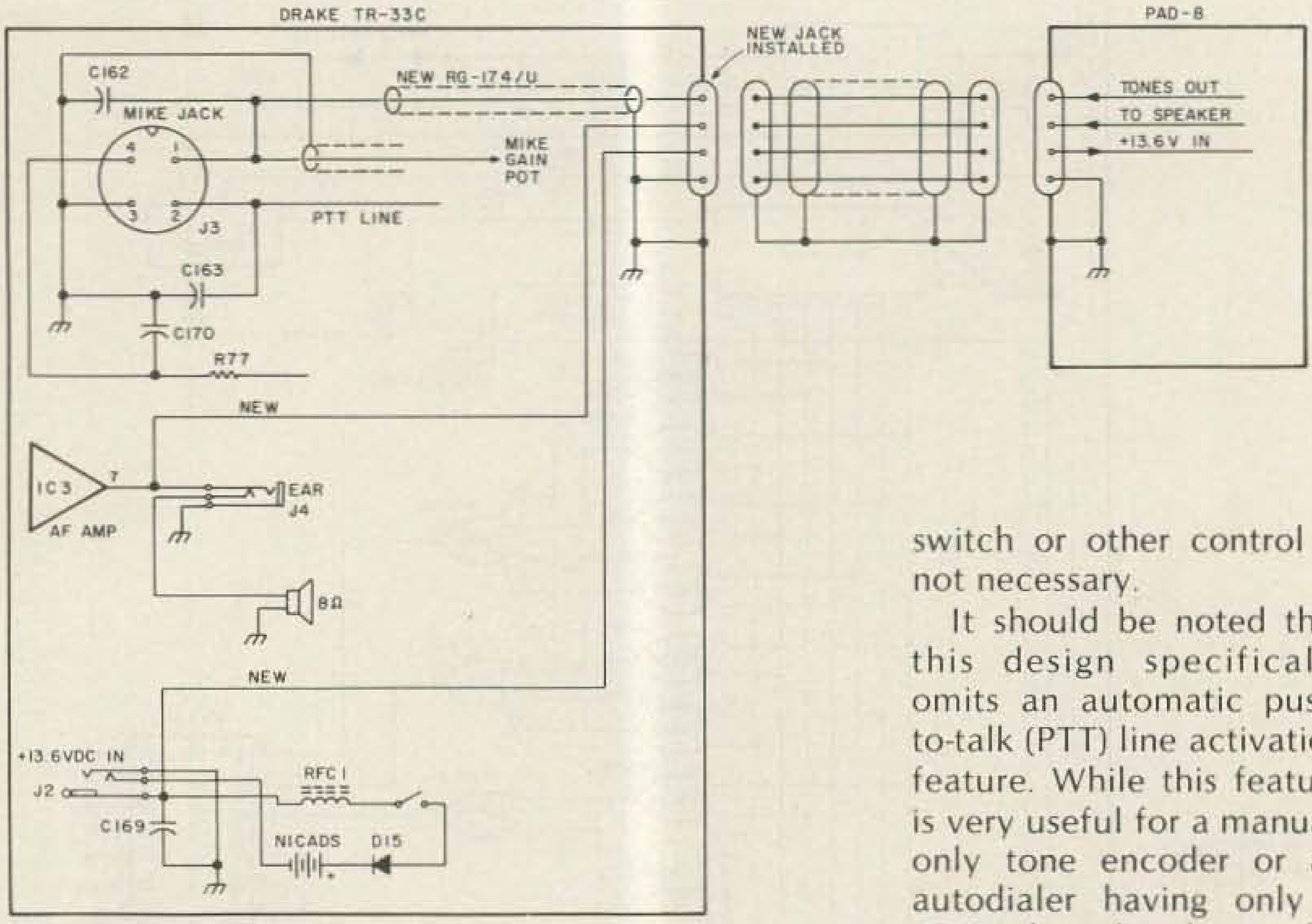

Fig. 2. Typical transceiver connection detail.

that digit has been programmed in and the next digit may be programmed. If only four digits are to be programmed (as in an access code), they are keyed in in the same manner.

Then, after the last digit has been entered, tap the DIAL push-button, S1, while keeping the PROGRAM button down. This activates the clock and steps the address counter, U10, through the remaining memory addresses for the selected phone number. Whatever information may have been stored previously in the latter part of the 8-digit memory segment is automatically erased. The LED will light up while the clock cycles through the unused digits; when it goes out (or when all the digits have been entered into the memory), release the PROGRAM push-button, and the memory is ready to be autodialed.

To read out (autodial) a phone number, simply select the phone number you want and press the DIAL push-button, S1. LED1 will light up during the autodialing sequence; when it goes out, the number has been completely autodialed.

In the manual mode, the tri-state memory data lines are always in the high-impedance OFF state; the keyboard activates the tone encoder, U3, and the encoder tones are fed directly to the transmitter mike input. Since the autodialer is always ready to dial a phone number manually (except when programming or during autodial readout), a separate manual/autodial switch or other control is not necessary.

It should be noted that this design specifically omits an automatic push-to-talk (PTT) line activation feature. While this feature is very useful for a manual-only tone encoder or an autodialer having only a PROM-based scheme for storage of phone numbers, incorporation into a keyboard-programmable autodialer based on a RAM design is actually undesirable. In a ROM-based scheme, the manual keyboard is used only for dialing unprogrammed numbers; however, in a keyboard-programmable RAM-based scheme such as this one, the keyboard serves two additional functions—selection of the phone number to be autodialed and programming of the actual digits. This also eliminates panel clutter by making additional controls unnecessary. Inclusion of the automatic PTT feature on a keyboard-programmable autodialer would activate the transmitter when selecting or programming a phone number. This is undesirable and was avoided, allowing off-the-air phone number selection, programming, and autodial readout monitoring. The microphone PTT switch is used in the normal manner to key the transceiver for both speaking and for autodialing.

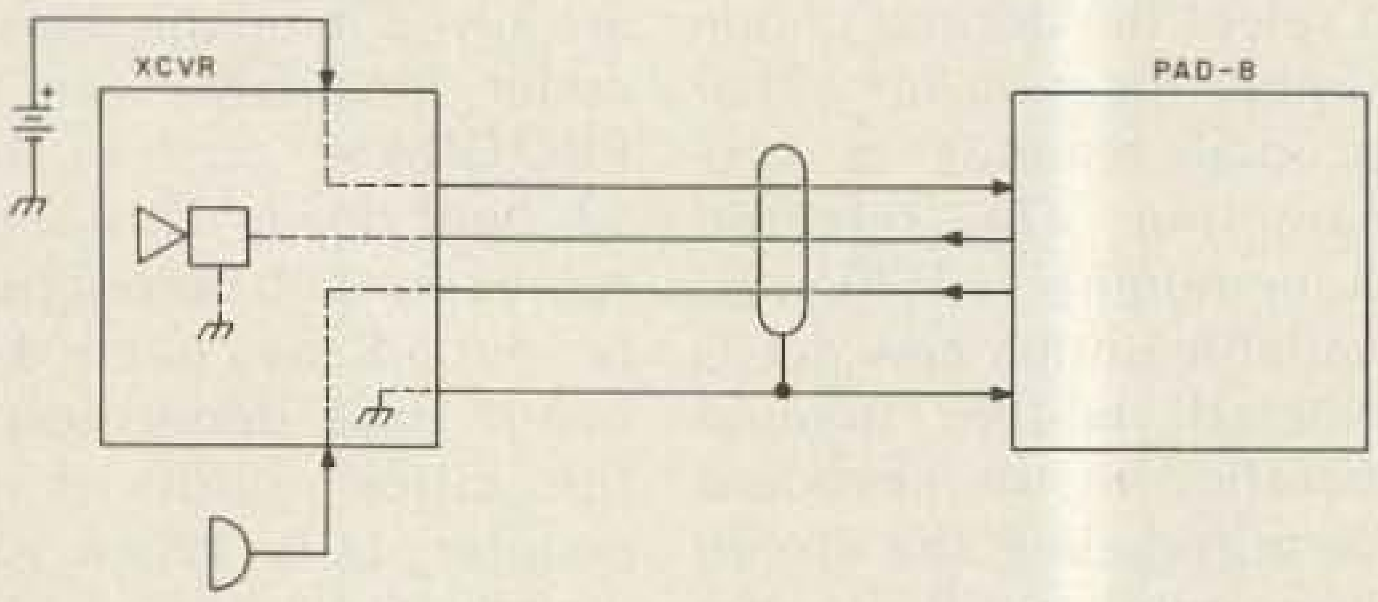

Fig. 3. Connection as shown for Fig. 2. Power is derived from transceiver and transceiver speaker is used for monitor.

Construction

A conscious effort was made to keep the overall size of the finished autodialer to the minimum necessary, so that installation in the car would not be hampered by a bulky cabinet. A large and expensive multideck rotary switch for phone number selection was eliminated from an earlier design, as was an internal monitor speaker. The final PC board design and layout now incorporates keyboard-selection of the phone numbers and still retains the onboard audio amplifier to permit monitoring the encoder tones in the speaker of your transceiver.

The requirement for bulky panel controls in an earlier project[4] has been eliminated by incorporating the panel control functions within the logic design. The result is a very compact unit which retains all the necessary features. A standard LMB enclosure (CR-531) was chosen, based on its small size and neat appearance, and the PC board was laid out to conform to it.

The PC board itself measures 2½" × 5¼" (6.35 cm × 13.34 cm), is of top-quality commercial-grade G-10/FR-4 material, is double-sided with plated-through holes, and contains all of the components required except the three panel push-buttons, the input/output jack, and the LED. Connection to all panel controls is eased by providing all required logic and power signals to a central location on the PC board; a ribbon cable can then be used to interconnect the PC board with the panel controls. All panel, signal, and panel-control lines are also available at the dual, 15-pin edge-connector fingers on the PC board (0.156"/3.96 mm spacing). By laying out the PC board in this fashion, maximum flexibility is afforded for selection of any convenient-sized cabinet or, if desired, the panel controls can be remoted entirely from the autodialer PC board through an edge connector.

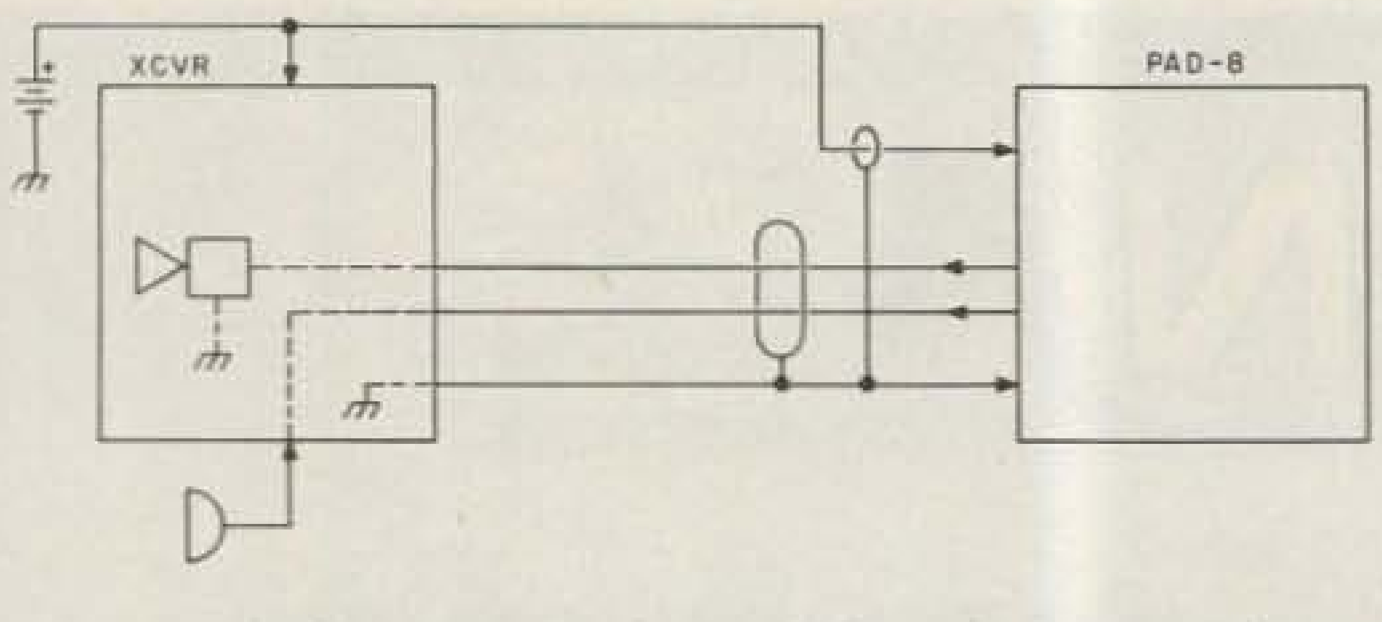

Fig. 4. Autodialer power is derived directly from car battery; transceiver speaker is used for monitor.

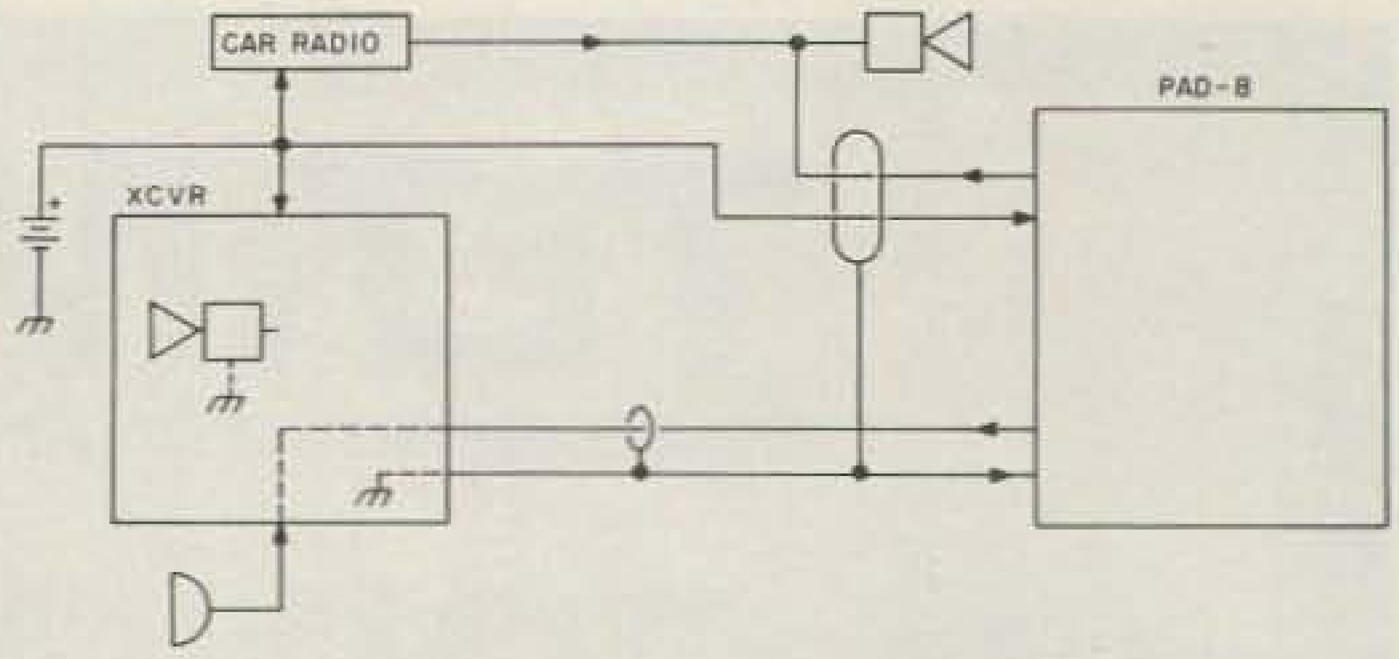

Fig. 5. Autodialer power is derived directly from car battery; car radio speaker is used for monitor.

Installation and Adjustment

Autodialer interconnections to your 2-meter transceiver include the +13.6-volt supply line, tone encoder output, and the audio amplifier output; these should be shielded between the autodialer and transceiver as shown in Fig. 2. The TONE jack on the rear of my Drake TR-33C was replaced with an audio DIN jack. Although a six-pin jack was used (for possible future access to other parts of the transceiver), only the three lines mentioned above plus ground are required by the autodialer.

The supply line can be run to a +13.6-volt source separate from the transceiver, if desired, permitting use of a standard 2-wire shielded mike case between the autodialer and transceiver. The autodialer tone-encoder output is extended through a short piece of RG-174/U to the transceiver microphone jack; the coax shield need not be grounded at the mike-jack end. The audio amplifier, U2, is connected directly to the transceiver speaker; normal transceiver audio is not affected and this arrangement eliminates the need for a separate speaker. The wire to the speaker inside the transceiver cabinet need not be shielded. The tone encoder output can be interfaced directly with either low-impedance microphone inputs (e.g., TR-33C) or with high-impedance inputs (e.g., the Heath HW-2036A).

Only three adjustments are necessary for proper operation of the autodialer. The speed is set by R12 to give a total autodial duration of about one second for all seven digits. The tone encoder output level into the transceiver microphone input is adjustable by R7. If a deviation meter is available, the tone-encoder output may be set to yield a deviation of about 4.5 kHz when any keyboard digit is held down.

Alternatively, the level may be adjusted by ear with the help of another operator on the repeater to a point which gives reliable autopatch access and dialing operation but which does not sound distorted (over deviated). The last adjustment is to set the audio-amplifier output level to give a comfortable and undistorted speaker volume under road conditions. R7 is the trimmer which does this. If the external audio monitor is not desired, R5, R6, C5, C6, and U2 can be eliminated altogether.

Final Notes

The addition of the autodialer described here has made a great improvement in the ease and enjoyment of using the local autopatch repeaters and has certainly decreased the risk of becoming a potential traffic statistic while trying to dial a phone number. Further, the ability to rapidly and conveniently program or reprogram phone numbers in the memories is greatly appreciated, especially when access codes are changed periodically. In addition, performance of the autodialer has been absolutely flawless throughout three very cold winters and hot summers, and I'm looking forward to many more years of enjoyable repeater autopatch use with this autodialer.

The printed-circuit board for this project and a 10-page illustrated step-by-step assembly manual are available from me for $10.00 postpaid in the US. I'll be happy to answer questions about the autodialer, but please include an SASE. ■

References

1. Crawford, John, "An Automatic Dialer for Deluxe Mobile," *73*, January, 1976.
2. Lloyd, Bob, "Mobile Autodialer," *73*, June, 1976.
3. McEwan, Don, "A No-Hands Telephone Dialer," *73*, January, 1977.
4. Batie, Howard, "A Programmable Contest Keyer," *Ham Radio*, April, 1976.

Parts List, PAD-8

C1—50-uF, 16-V tantalum
C2—50-uF, 16-V tantalum
C3—.01-uF, 16-V disc ceramic
C4—.01-uF, 16-V disc ceramic
C5—10-uF, 10-V tantalum
C6—.001-uF, 16-V disc ceramic
C7—2.2-uF, 10-V tantalum
C8—.01-uF, 16-V disc ceramic
C9—4.7-uF, 10-V tantalum
C10—.01-uF, 16-V disc ceramic
C11—.01-uF, 16-V disc ceramic
C12—.001-uF, 16-V disc ceramic

D1-D3—1N4001 Si rectifier

J1—MAS-4/MAB-4 (two)

LED—MV5023 or equivalent

Y1—1.000 MHz crystal

LMB CR-531 cabinet

Digitran KL-0054 keyboard

IC Sockets:
8 pin—2
14 pin—8
16 pin—4
20 pin—1

#4 Hardware:
¾" bolts—4
¼" bolts—4
Nuts—16
Lockwashers—16

8" 12-conductor ribbon cable

S1-S3—SPST mom. push-button (normally open)

U1—LM340T5, uA7805, etc. (TO-220 case)
U2—LM380 (8-pin) Do not substitute
U3—MC14410P Do not substitute
U4—MC14528B, CD4528B, etc.
U5—MC14011B, CD4011B, etc.
U6—TMS 4036NL Do not substitute
U7—MC14012B, CD4012B, etc.
U8—MC14528B, CD4528B, etc.
U9—MC14042B, CD4042B, etc.
U10—MC14024B, CD4024B, etc.
U11—MC14081B, CD4081B, etc.
U12—MC14001B, CD4001B, etc.
U13—MC14001B, CD4001B, etc.
U14—MC14002B, CD4002B, etc.
U15—MC14011B, CD4011B, etc.
U16—NE555V, LM555, etc.

R1—12 meg, ¼ W
R2—1.8k, ¼ W
R3—2.2k, ¼ W
R4, R5—10k, ¼ W
R6—25k PC trimmer
R7—100k PC trimmer
R8, R9—680k, ¼ W
R10, R11—10k, ¼ W
R12—25k PC trimmer
R13, R14—3.3k, ¼ W
R15—10k, ¼ W
R16, R17—680k, ¼ W

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My Own Silver Mine

For W1FLP, reclaiming silver from photographic fixer is cheap, easy, and profitable. King Midas should have had it so good.

I recently purchased a brand spanking new Azden 2m rig. As I was installing it in the mobile, I came to the realization that my total cost was $2.50—yes, that is correct—two dollars and fifty cents! No, it was not "hot!" I paid a local dealer full list price.

Knowing that many brother hams are also amateur photographers, I thought they might have an interest in how to obtain goodies for the shack at a relatively low cost. The secret is in silver reclamation.

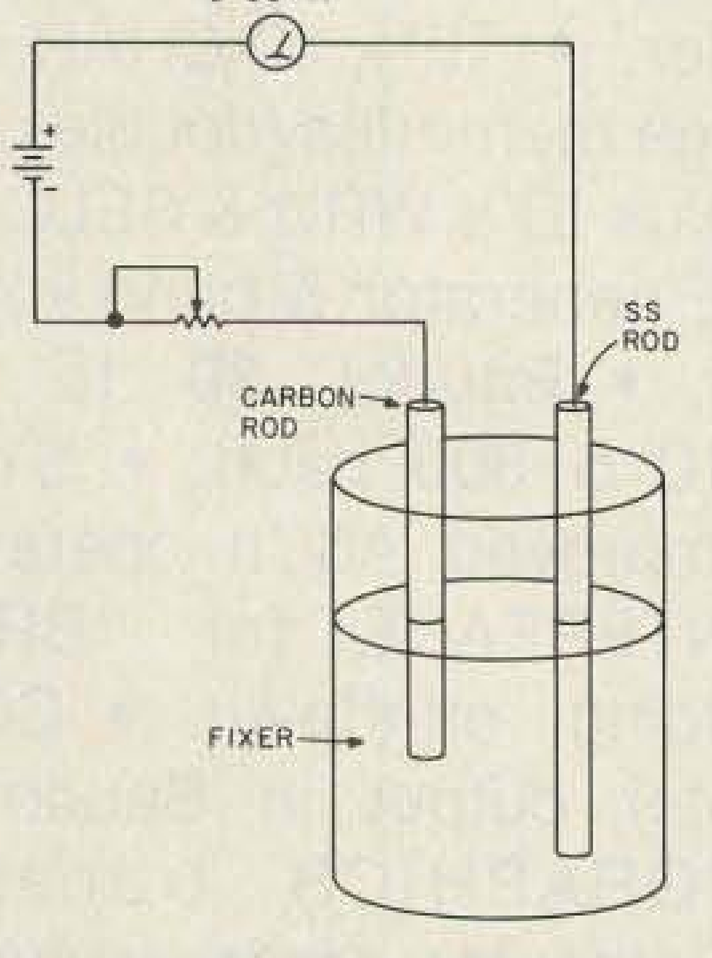


Fig. 1. Typical electrolysis circuit.

Silver reclamation is generally thought to require expensive capital equipment and in large photo labs it does, but for the amateur, the equipment can be very simple. How simple is determined by the amount of silver-saturated solution you have, how rapidly you obtain it, and how fast you want to reclaim it.

The silver-saturated solution referred to is the photographic fixer in every darkroom. The process of fixing photographic film removes the unexposed silver crystals from the film. This silver remains in solution in the fixer. The more film processed, the more silver in solution.

With the price of silver what it is, it doesn't take much math to find the "break-even" point at which investment in capital equipment is desirable.

For hams, using their innate ability to scavenge junk boxes to produce working apparatus, there is an inexpensive, easy method to reclaim impressive amounts of silver at very low cost.

The method I use is electrolysis. Basically, it is accomplished by passing a current (dc) through the solution, thereby "plating" out the silver. Industrial concerns use large containers with large currents and constant circulation of the solution.

I will not get into the math required to determine the current and voltages; the important parameter is the current density required to reclaim 90% to 98% pure silver. The current density needed is determined by the amount of silver in solution, the surface area of the electrodes, and the level of circulation of the solution. A typical electrolysis circuit is shown in Fig. 1.

Any dc supply can be used; regulation is not required. A simple half-wave rectifier without filtering will do fine.

The simple system I use is a 1.5-V alkaline battery, a potentiometer, a 0-50 mA dc meter, a stainless steel rod, and a carbon rod. The 1.5-V battery and the pot can be replaced by any available power supply, with an increase in the cost of silver recovery.

When a dc current is passed through the solution, the silver is plated out onto the stainless steel rod.

It is important to monitor this plating process until you arrive at the correct dc current (current density) for your individual setup. The plated silver should appear white to light cream-colored. If it appears dark cream to brown, the current density is too high. A darker color means that higher amounts of contaminants are being plated out.

Reduce the current. The color changes can be seen in seconds, so if it has not been dark for more than a few minutes, no harm has been done.

High current densities without circulation of the solution will result in lowered purity of the plated-out silver plus a chemical change in the fixer that will reduce the amount of silver you can reclaim.

When the silver has built up to a thickness of between 1/8 inch to 1/4 inch, remove the stainless steel bar holding the silver, rinse it in warm water, and let it dry.

To remove the silver, spread out a plastic or paper sheet, strike the plating sharply with a screwdriver, and it will crack. Simply chip off the plating until it is all removed. Return the stainless steel bar to the silver mine and continue.

Of course, this mine is not bottomless. The fixer solution will eventually become so low in silver content that it must be replaced with fresh solution. Fresh solution, in this case, means solution that has been used to process film and is no longer useful for fixing film because it is saturated with silver.

There are many methods to determine the useful plating life, i.e., silver content, of the fixer. The easiest but least accurate is the color of the solution. When it turns the color of medium strength tea, replace it. The more accurate method is to use the Kodak Silver Estimating Test Papers, cat. no. 1965466. When dipped in the solution, this test paper will turn from its normal yellow to some shade of brown. The darker the color, the higher the silver content remaining in solution. There is a color comparison chart on the back of the Kodak folder. I generally discard the fixer at a remaining silver level of 1 gram/liter.

To set up this simple silver mine, I used a carbon rod from a discarded D-cell battery, a 6-inch stainless steel rod, a 1-lb. plastic margarine container, and a battery, pot, and meter as previously described.

With no agitation of the solution, I maintain a current of 5 mA. I have been plating out approximately 3 ounces troy of silver per month. I am blessed with the availability of 12 gallons of fixer every 12 weeks that has a silver content of approximately 10 grams/liter. The amount of silver you recover per liter will depend upon its starting silver content, i.e., how much film has been processed through it and the average image content of the film.

The effect of the film image on silver content is that a very dark image has most of the silver left in the film. Conversely, a light image has had most of the silver removed. The Kodak test papers can be used to determine this silver content and, barring the probable contamination of the fixer with other chemicals, can be used as a guide to the useful life of the fixer.

The above method requires monitoring but twice daily and fixer replacement when required. If you have plenty of fixer and/or want a faster recovery rate, simply provide a means of gentle agitation. I have successfully used an old clock motor with a plastic shaft with a ½-inch by 2-inch paddle connected to the sweep second-hand shaft immersed in the fixer. This has yielded about an ounce a week. Larger electrodes, higher currents, greater agitation, and larger solution containers will of course increase the recovery rate.

So why throw good money down the drain? Dig into that silver mine and buy some more ham gear. ■

✓See List of Advertisers on page 114

Fun-Equipment Revisited

Here are higher-band versions of the ever-popular Fun-Mitter and Fun-Amp. They are based on the Fun-Philosophy: cheap and simple.

*Mark Oman WA0RBR
528 Deines Court
Ft. Collins CO 80525*

Home-brewing is alive and well! I reached this conclusion following the response to the publication of my series of "Fun" home-brew gear.[1-4] Response to the simple, low-cost home-brew units has been great, indicating that hams are still building at least some of their own gear. From nearly-Novices to long-time Extras, hams have built the Fun rigs and have discovered that building is easy, fun, and very rewarding.

Many requests have been received asking for different band coverage of the Fun-Mitter and its companions. This article is the result of those requests. It describes a simple CW transmitter for 15 or 20 meters operating off 24 volts and modification of the 20-Watt Fun-Amp for operation on the same bands.

The Fun-Ceiver and Fun-Oscillator are not included in this article on modifications due to instability problems at higher frequencies. Frequency stability is of prime importance with today's rigs and it is just too difficult to obtain the type of results desired on the higher frequencies and still maintain the objectives of the gear.

This second version of the Fun-Mitter is a five-Watt-output, crystal-controlled CW transmitter that uses either low-cost FT243 crystals at one-third the operating frequency or HC6U fundamental crystals on the operating frequency. If the variable crystal oscillator (vxo) capacitor is installed (C option), the frequency can be varied by as much as 10 kHz from the crystal frequency, using HC6U crystals.

This coverage allows enough flexibility to provide plenty of frequencies with only a few crystals. Crystals are cheap, easy to obtain, reliable, and very stable. They make simple transmitters easy for all of us to build!

Philosophy

An early objective with the Fun-Mitter and Fun-Amp was to design simple gear that was easy to build with parts that could be obtained from Radio Shack. The Mark II versions of these rigs follow the same objective with only the crystal and its socket not being found at Radio Shack. Other objectives: costs of less than $25 each, no tuning adjustments, and same size PC boards (2¼"×3").

These objectives are continued in the higher-band versions. A twenty-meter transmitter and amplifier can easily be built in an afternoon and put on the air without adjustments. (The reader is strongly urged to review the articles on the Fun-Mitter and Fun-Amp for detailed construction and design descriptions.)

Circuit

The circuits remain unchanged from the original designs. The resonant circuit and filter values, however, must be changed to allow operation on the higher frequencies. Radio Shack rf chokes and disc ceramic capacitors again were used.

The Fun-Mitter schematic is reproduced in Fig. 1. The Pierce oscillator operates on the operating frequency using either third overtone or fundamental crystals. (A third overtone is simply three times the value marked on the crystal.) For example, to operate the transmitter on 14.060 MHz, either a 14.060-MHz fundamental crystal can be used or a 4.383-MHz crystal can be operated on its third overtone. (This allows the use of cheaper FT243 crystals in the Fun-Mitter.) Also, on fifteen meters many of the same crystals used for forty meters, when operating on their third overtone, will provide the frequency coverage desired.

Fundamental mode crystals in an HC6U holder do, however, have the advantage of more frequency range when used with the vxo capacitor (C option). I have had several HC6U crystals, however, that do not provide a stable, clean oscil-

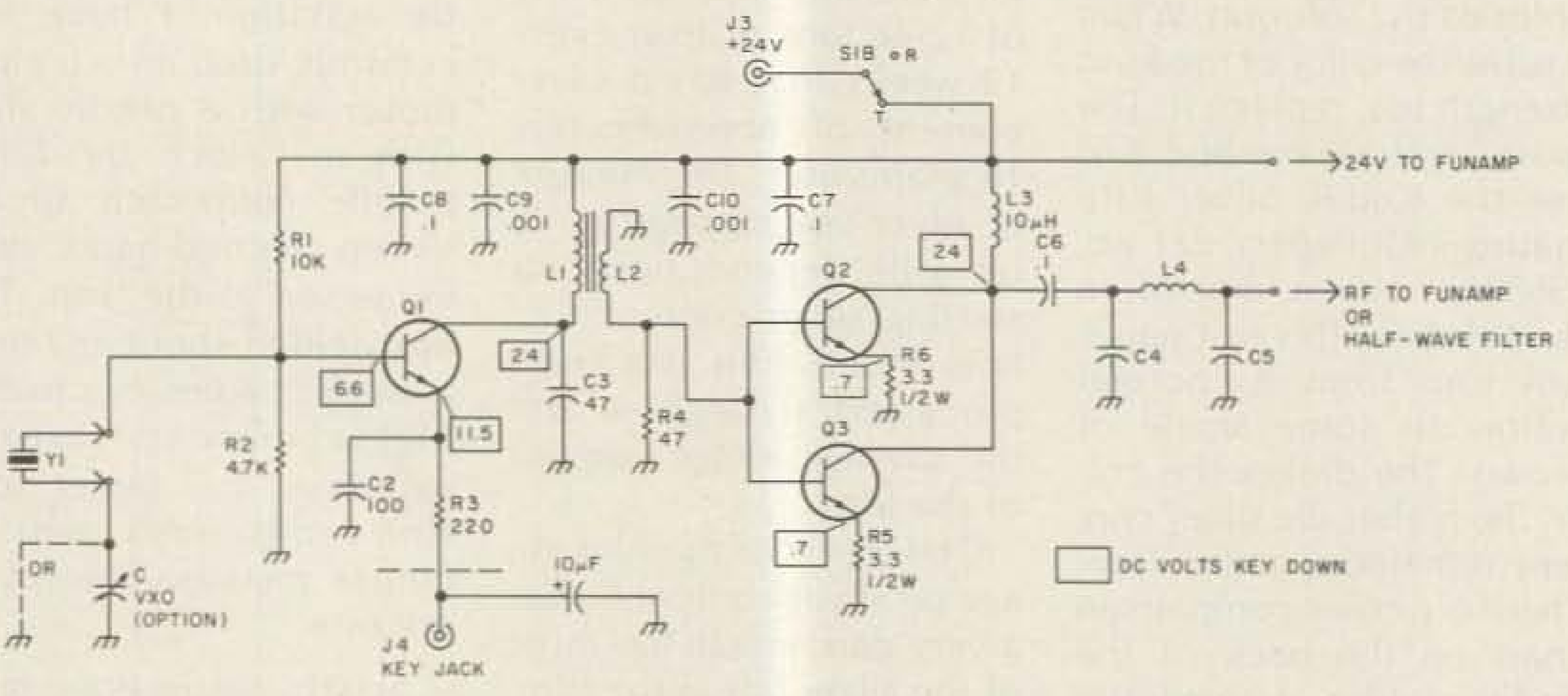


Fig. 1. Schematic of 15/20-meter Fun-Mitter. Reference designators remain the same as in the original Fun-Mitter article in order to match the parts locator for the PC board. Capacitance values less than 1 are in uF.

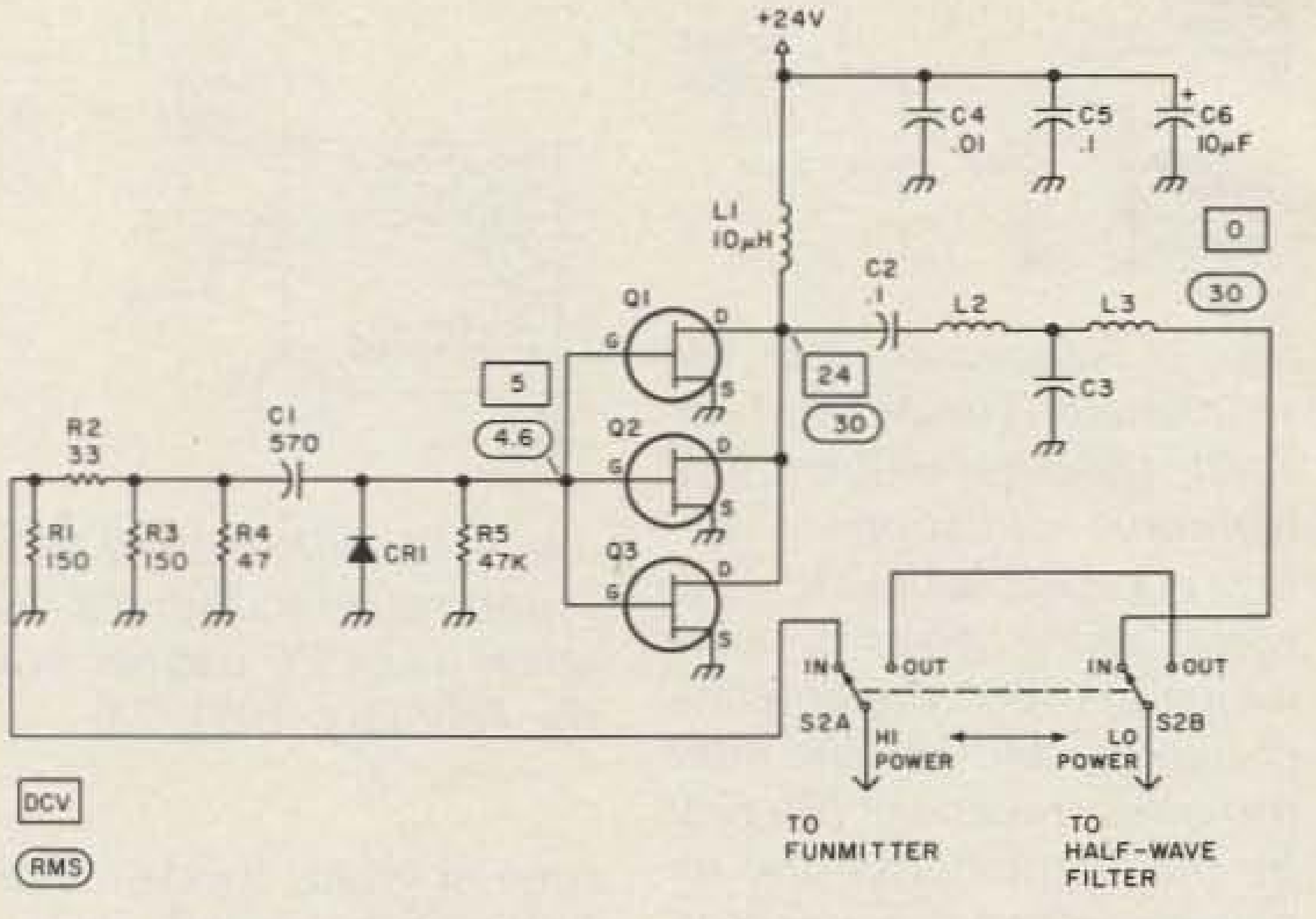


Fig. 2. Schematic of 15/20-meter Fun-Amp.

Photo A. Front view of twenty-meter version of Fun-Mitter/Fun-Amp.

lator signal, probably due to the higher-than-normal power used in the Fun-Mitter oscillator stage. Although the FT243 will have a range of only approximately 1 kHz with the vxo, it will provide better and more reliable operation. (FT243 4.3- or 7-MHz crystals for use on twenty or fifteen third overtone will not oscillate on exactly three times the marked frequency. Depending on the crystal, they may be as much as 10 kHz lower than the marked frequency. Keep this in mind when ordering.)

L1 and C3 determine the resonant frequency of the oscillator. If L1 is constructed correctly, the oscillator should oscillate with no adjustments. A three-turn winding (L2) over L1 operates as a transformer to match the collector impedance of Q1 to the base impedance of Q2, Q3 and provide drive. Q2 and Q3 operate in parallel as a class C amplifier which provides good efficiency.

These 2N3866 transistors, Q2 and Q3, are being pushed to their limits in the Fun-Mitter circuit. Under some load conditions, some hams have discovered that Q2 and Q3 can be destroyed. To avoid this, either reduce the supply voltage to 20 to 22 volts or increase the value of R5 and R6 to 4 to 5 Ohms. Also, the 2N3866 part can be replaced with the much more rugged 2N3553. The only other components needing change are C4, C5, and L4 which, together, comprise a pi-network filter. Component values are given in the Parts Lists.

The Fun-Amp schematic is reproduced in Fig. 2. Using the Fun-Amp on other frequencies is even easier than using the Fun-Mitter on other frequencies. Only L2, L3, and C3 need to be modified. The input circuit remains completely un-

Parts Lists

Fun-Mitter—Fig. 1

C1-C10	Ceramic disc	272-xxx
C3	20m—47 pF 15m—47 pF	
C4,C5	20m—220 pF 15m—160 pF (2 220 in series, 1 47 in parallel)	
C option	Broadcast variable (any small variable with maximum capacitance of 100 to 300 pF will work)	
J3	Phono jack	274-386
J4	Phone jack	274-252
L1	20m—20 turns removed 15m—24 turns removed	273-101 273-101
L2	3 turns wound over Q1 end of L1	
L3	10 μH	273-101
L4	20m—25 turns removed 15m—27 turns removed	273-101 273-101
Q1	RS-2009	276-2009
Q2,Q3	RS-2038	276-2038
R1-R4	¼ Watt	271-1xxx
R5, R6	Each is three 10 Ω, ½ W 271-001 in parallel	
S1	DPDT toggle	275-1546
Y1	Crystal—FT243, HC6U	

Fun-Amp—Fig. 2

C1-C5	Ceramic disc	272-xxx
C1	570 pF (470 and 100 in par.)	
C3	20m—250 pF (2 47 pF in series, 1 220 in parallel) 15m—160 pF (2 220 pF in series, 1 47 pF in parallel)	
C6	10 μF, 35 V dc	272-1013
CR1	1N914 small signal silicon	276-1122
L1	10 μH	273-101
L2	20m—26 turns removed 15m—28 turns removed	273-101 273-101
L3	20m—24 turns removed 15m—26 turns removed	273-101 273-101
Q1-Q3	VN67AF VMOS FET	276-2071
R1,R3	150Ω, ½ W	271-013
R2	33Ω, ½ W	271-007
R4	47Ω, ½ W	271-009
R5	47kΩ, ¼ W	271-1342
S2	DPDT toggle	275-1546
	TO-220 heat sink (3)	276-1363
	Case	270-252
	Hardware	64-3012 64-3019
	Wire	
	Coax	

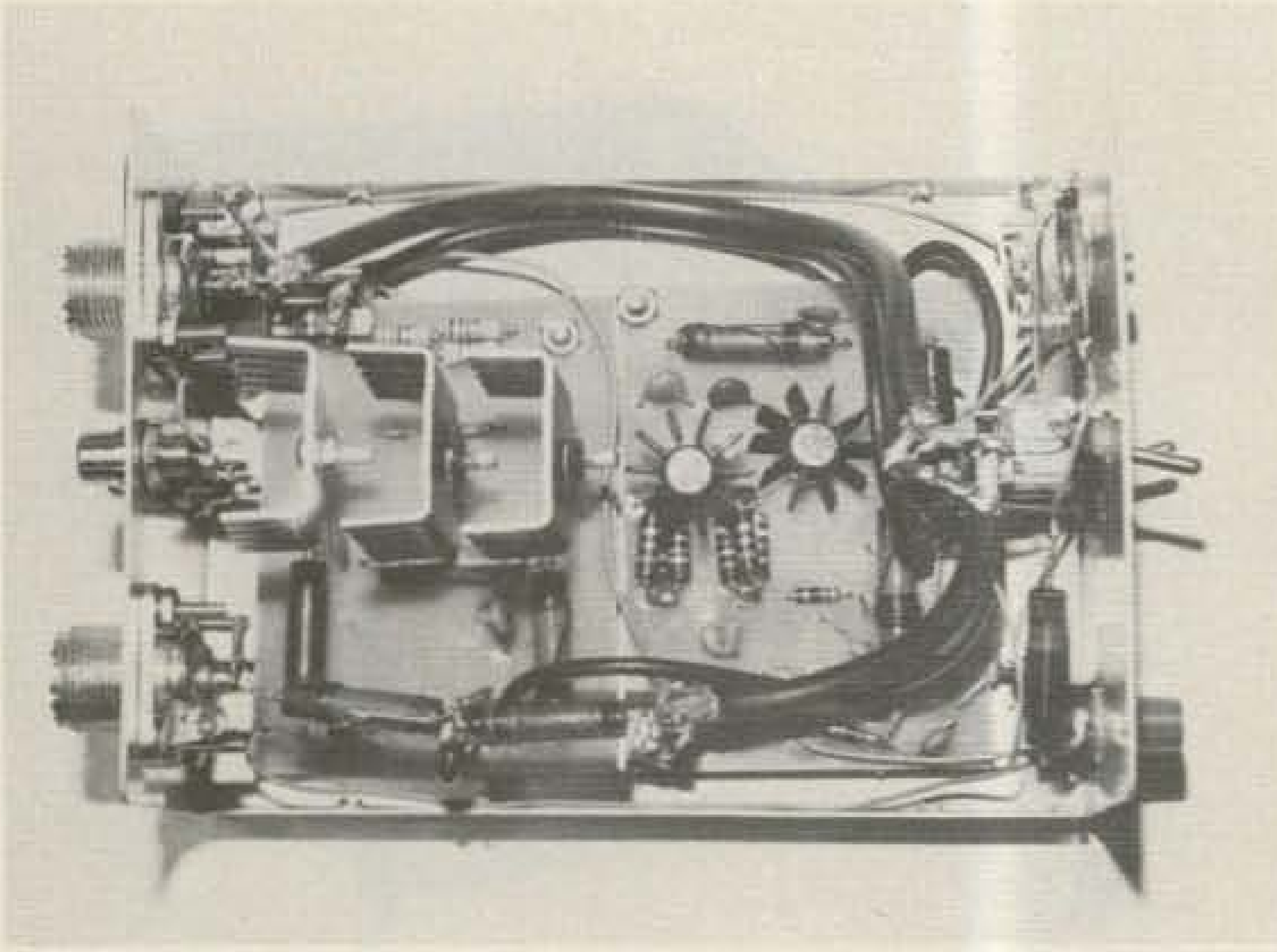


Photo B. Inside view of twenty-meter version of Fun-Mitter/Fun-Amp. The coil shown connected between the crystal and C (optional) does not exist in the final version of the Fun-Mitter.

changed. This circuit operates very well at 15 and 20 meters due to the excellent frequency characteristics of Q1-Q3. A detailed circuit description is given in the Fun-Amp article.

Two additions have been made to the higher-frequency versions of the transmitter and amp. Fig. 3 shows a half-wave harmonic filter which reduces harmonic radiation. Also, a 10-μF capacitor (272-1013) has been added at the key jack (J4) to shape the keyed waveform and eliminate any key clicks.

Construction

Even though the Fun-Amp and Fun-Mitter are "goofproof" projects, care and thought must be put into their construction. Although the fifteen- and twenty-meter versions are as simple as the earlier models, it might be helpful to review some pitfalls to watch for.

For best results, use of a PC board is strongly recommended.[5] Refer to the earlier articles for the patterns and component locators. The 2¼" by 3" format shown in Photo B is small enough to allow mounting flexibility. I would suggest that this format be followed. Combining several bands, amplifier, transmitter, etc., on one board can lead to problems, particularly if you are inexperienced in homebrew.

Before building, develop a plan as to how you will load the boards, assemble the unit, and test. After the plan is developed, proceed carefully. Most problems are due to misloaded parts, poorly soldered connections (rosin-core solder is a must!), faulty components, and hasty build-and-test. Most of these problems can be avoided by developing a plan and carefully and thoughtfully following it.

Radio Shack rf chokes are used as inductors by removing turns as necessary. Fifteen- and twenty-meter circuits require less inductance and, therefore, the coils will have fewer turns. In constructing the coils, be sure that the exact number of turns is removed and that insulation is scraped from the end of the wire that will be resoldered to the coil form. The three-turn Fun-Mitter coil (L2) that is wound over L1 should be wound in the same direction as the turns of L1. Also, wind it over the end of L1 that is mounted nearest Q1. The excess wire cut off when the turns are removed is excellent for wiring L2. Refer to Photo B for a view of the coils.

It is best to construct a

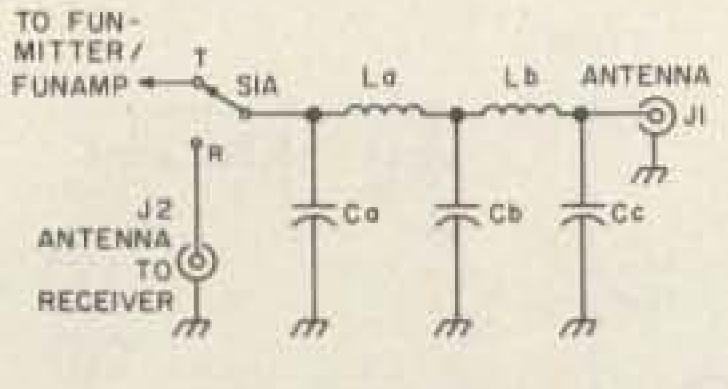


Fig. 3. Half-wave filter for 15/20-meter Fun-Mitter/Fun-Amp. The filter reduces any harmonic radiation to below acceptable levels. It is wired using point-to-point wiring between the antenna connector and S1. The filter provides receiver filtering by placing it before the receiver antenna connector. Values are as follows: use 273-101 10 uH rf choke with turns removed; 272-xxx series ceramic caps.

	20m	15m
Ca	220	150 (100 & 47 in parallel)
Cb	440 (2 220 in parallel)	320 (100 & 220 in parallel)
Cc	220	150 (100 & 47 in parallel)
La	26 turns removed	28 turns removed
Lb	26 turns removed	28 turns removed

single band in one box rather than combining bands. This is slightly more costly due to duplication of some parts, but it eliminates switching problems completely.

An advantageous modification to the Fun-Mitter is to allow a "spotting" function. This is helpful when finding your frequency on your receiver without transmitting on the air. This is accomplished by continuously applying 24 V to the oscillator stage. To do this, break the connection between L1 and L3, then connect L1 directly to 24 V. Also, one end of R1 is removed from the circuit board and a wire from it run to the 24-V side of L1. With this modification, pressing the key will produce a note in the receiver with the send/receive switch set to receive. See Fig. 4 for details of the modification.

Crystals can be obtained very easily. After deciding on either FT243 third over-

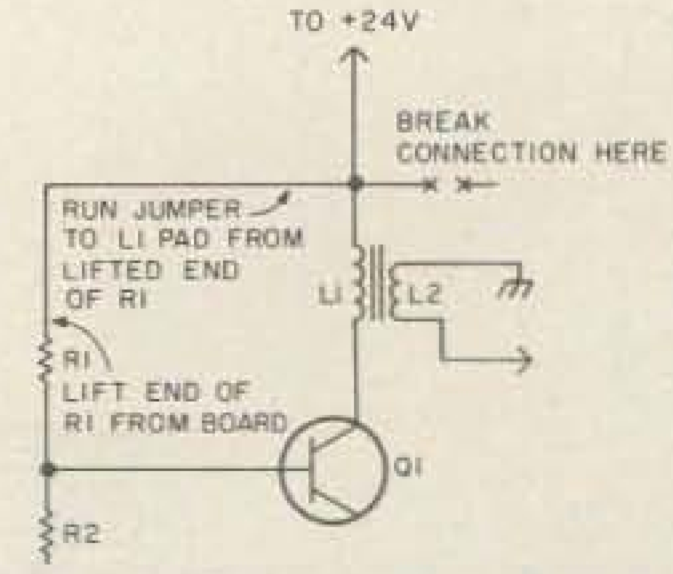


Fig. 4. Modification to allow "spotting" of transmitter (use when using PC pattern from the February, 1981, 73).

tone or HC6U fundamental, both crystals and sockets can be ordered from a supplier such as CW Crystals or Jan Crystals.[6]

Adjustment

Adjusting the high-frequency Fun-Mitter and Fun-Amp is just as easy as with the low-band versions. Again by thinking carefully through the process, the rig can be set up without problems in a short time.

If possible, find a VOM to use at this stage. Although not absolutely necessary, it is much more helpful and educational to see what is happening during tune-up. Begin by ensuring that you do indeed have a 24-V source (either lantern batteries or the Fun-Mitter power supply). Measure the voltage. With +24 V disconnected, measure the resistance at the voltage-input connector to ensure that no shorts exist to ground (use Ohms scale).

It is essential that a dummy load be connected to the antenna connector at all times during tune-up. For the Fun-Mitter/Fun-Amp combination, a dummy load capable of dissipating 20 Watts will be needed. Without a load, the transistors will be destroyed quickly.

The final step in tune-up is to attach an ammeter and begin testing! Connect an ammeter capable of measuring at least 1.5 Amps in series in the +24 line going to the gear. Set the T/R switch (S1) to "transmit." With the Fun-Amp switched out, the meter should read around 300 mA with the key pressed. Switching the Fun-Amp in should produce a reading of around 1.2 Amps with the key down, indicating a power input of around 30 Watts.

As can be seen, there are no adjustments to be made. This is one of the beauties of the gear. After building the units carefully, they should work the first time with no adjustments!

If trouble is encountered, check the following:

1. Isolate the problem to a stage—Fun-Mitter, Fun-Amp; if Fun-Mitter, does oscillator work?

2. Measure voltages at collectors and drains of transistors with T/R switch in T position (should read 24 V).

3. Check for wiring errors.

4. Check soldering.

Operating

The thrill of home-brew construction comes in the actual operation. Making contacts with gear you built yourself is fun! The high-frequency Fun-Mitter and Fun-Amp easily will produce worldwide contacts. Twenty Watts on 15 or 20 meters can bring in contacts from all continents easily.

With the capability of 15- through 80-meter operation with the Fun gear, WAS, WAC, and DXCC are all within reach. Good luck! ■

References

1. "The Fun-Mitter—A Goof-Proof Rf Project," *73*, February, 1981.
2. "The Fun-Ceiver," *73*, July, 1981.
3. "The Fun-Oscillator," *73*, February, 1982.
4. "The Fun-Amp," *73*, May, 1982.
5. PC boards may be obtained from the author for $7.00 ppd. each. (For both originals and modified.)
6. CW Crystals, 570 N. Buffalo St., Marshfield MO 65106; Jan Crystals, 2400 Crystal Drive, Ft. Myers FL 33906.

✓See List of Advertisers on page 114

Frank R. Portune N6BW
2351 Nina Street
Pasadena CA 91107

The Ultimate Breadboard

There used to be two styles of prototypes—rat's nest and cramped. Now there is a third style—simple.

There are at least a dozen different boards on the market intended for prototyping and one-of-a-kind construction projects. Most that I have used in my ham activities, in the classes at Los Angeles Access, and professionally have either been lacking in flexibility and ease of construction or are difficult to circuit trace.

Of the commonly-available types, the wire-wrap board, for example, is extremely difficult to circuit trace, especially when the component density reaches a certain point. This is complicated by the fact that components must be placed in IC header plugs.

The widely-used perfboard-type with general-purpose foil pads is much too cramped, lacks definite locations for ICs, is too difficult to circuit trace, and is prone to solder bridges.

The third common type, consisting of many small squares, works reasonably well for small projects. However, it becomes entirely too large for bigger circuits. It also lacks definite locations for components, especially ICs.

The board shown here solves many of the problems by combining a number of the good features of all systems into one, all contained on a standard 4½″×6½″ 22-pin edge-connect card. The connector may be cut off easily if it is not used.

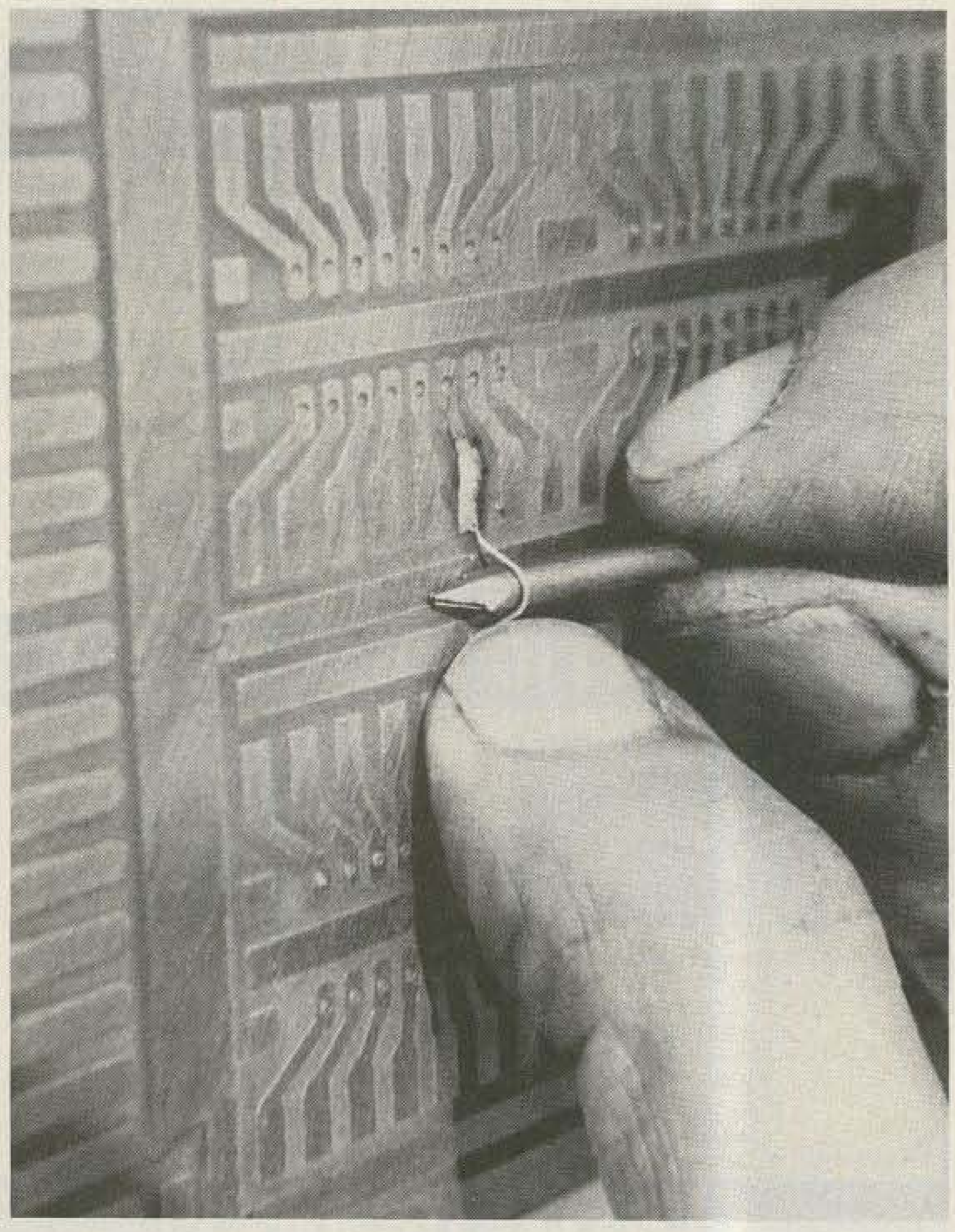
The basic features of the board are sixteen 16-pin DIP patterns for small ICs and one 40-pin pattern for larger ICs such as microprocessors, UARTs, etc. Alternately, the larger pattern will accommodate two additional 16-pin ICs.

Two continuous power rails run throughout the board and are available on both sides of all IC patterns. There is also a set of pads and a foil area for a 3-terminal tab-type regulator. On the opposite end from the edge connector are a number of small pads for switches or indicator LEDs.

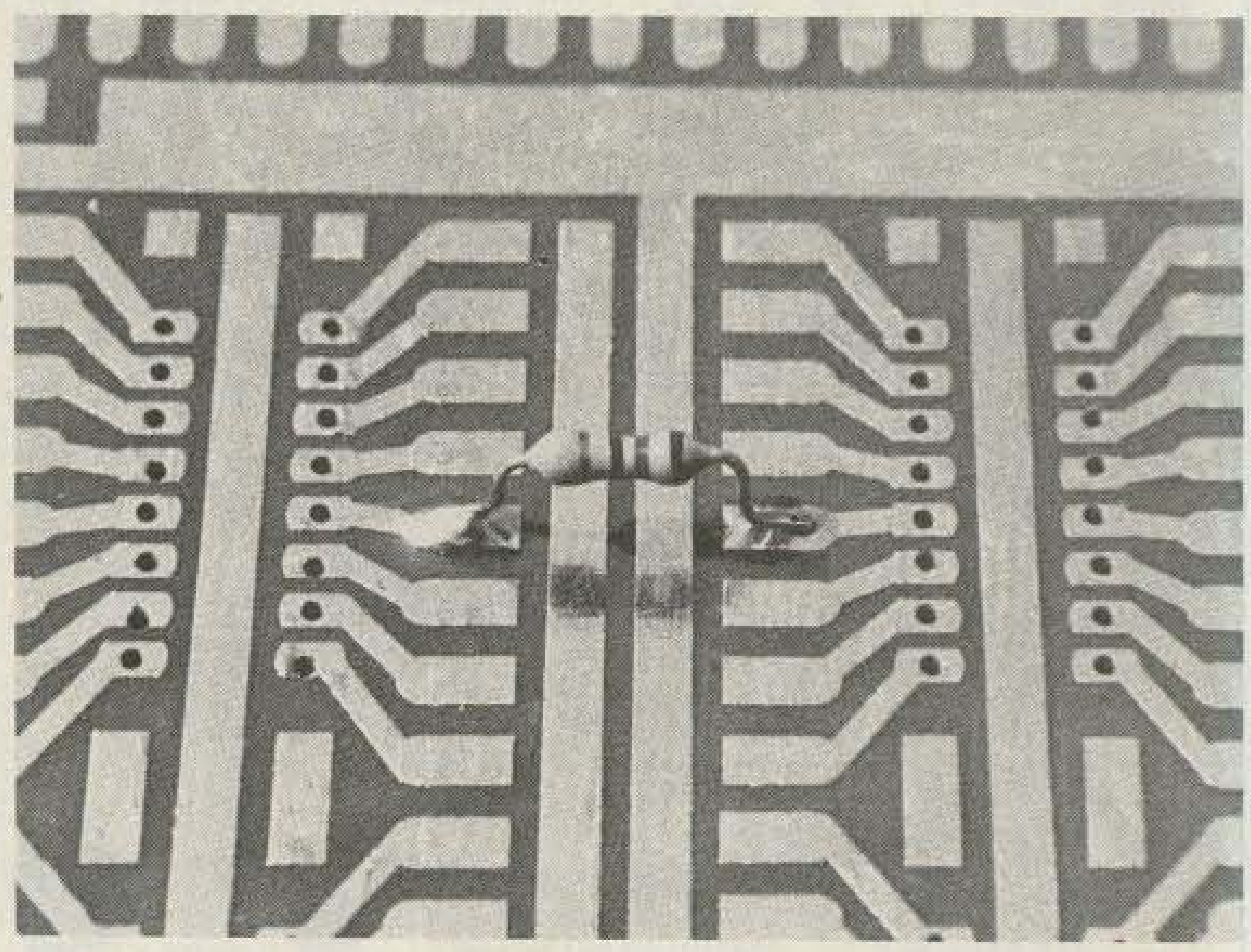
Locating Components

Components may be mounted on either side of the board. In some cases, #60 holes will have to be drilled in the plain pads for this. For experimenting, however, all components including the ICs are best placed on the foil side. This leaves the entire circuit in view without turning the board over. In this way, the circuit is much easier to visualize.

For more permanent projects, some of the larger components and the ICs are best placed on the non-foil side. Buses of many wires are also better on the back to keep them out of the way during testing and repair. Resistors, small capacitors, and most interconnecting wires should be on the foil side.



Forming a short jumper from bare wire using a small round tool and the end of your finger.



A component properly formed and soldered to the board.

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- **FULL-BAND SCAN:** All channels may be scanned in either "busy" or "vacant" mode. This is especially useful for locating repeater frequencies in an unfamiliar area. AUTO RESUME. **COMPARE!**
- **INSTANT MEMORY-1 RECALL:** By pressing a button on the microphone **or** front panel, memory channel 1 may be recalled for immediate use.
- **MIC-CONTROLLED VOLUME AND SQUELCH:** Volume and squelch can be adjusted from the microphone for convenience in mobile operation.
- **DIRECT FREQUENCY READOUT:** LED display shows operating frequency, **NOT** channel number. **COMPARE!**
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- **DIGITAL S/RF METER:** LEDs indicate signal strength and power output. No more mechanical meter movements to fall apart!
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Attaching Components

The biggest mistake most first-time users of the board make is looping components too high. Keep everything as tight against the board as possible. All components should be preformed, with leads kept as short as possible. After soldering, give the component or wire a gentle bend back and forth to relieve lead stress. This is important, especially when connecting another component to the same spot, as it will prevent the first component from moving when the solder is remelted.

Do not connect components in midair. Even if you have to tie one end of a component to an unused pad and complete the connection with a piece of wire, the final result will be much neater and less likely to be damaged by subsequent handling. By the same token, it is wise to use the same technique to avoid crossing components over ICs. If you have to replace the IC at a later date, it will be much easier if you do not have to remove other components.

For long interconnections, use insulated wire. For close or adjacent pads, bare tinned wire is best. To jump over a pad or rail, form the bare wire as you install it. Using a long piece, solder one end first. After the solder hardens, bend the long end up at about a 45° angle. Next place a small round tool, like a common nail, on the pad to be jumpered. It will be easy, then, to bend the wire down over the nail into contact with the pad to which it is to be soldered. Clip the end with small diagonal cutters and then solder.

I recommend wire-wrap wire for use on the board. It is available in inexpensive small rolls at most electronic parts stores. It has solid conductor and heat-proof insulation. Stranded wire or wire with ordinary PVC plastic insulation is very hard to work with. You also may need to buy a little stripping tool—ordinary strippers often work poorly on wire-wrap wire.

Plan Your Work

It is quite a temptation, because of the ease of construction using the board, to simply grab components, wire, and solder and to begin building without planning. Even if you are doing original design work, give the layout of the board some preliminary thought. I find it invaluable to literally draw out the project in pencil. The main benefit is in reducing the number of "across-the-board" wires. It's not possible to eliminate them all, but a little planning reduces the number and makes the final board much neater and easier to repair in the future.

Conclusion

For original design work, for student use, and for producing permanent repeater control systems, the board has become very popular in my local group. Personally, I like it best for "one-of-a-kind" projects that appear in ham magazines. Many articles do not contain board layouts. The board has provided a very satisfactory and quick means to build such projects. It also greatly facilitates modification of published circuits to one's own needs in a form that is genuinely permanent.

The prototype board is available commercially from W6ELECTRONICS, PO Box 5515, Pasadena CA 91107, for $6.95 (California residents add 6% sales tax). For home construction, a photographic negative is available for $4.95. The board is made of G-10 glass epoxy, drilled, and rosin-coated. ■

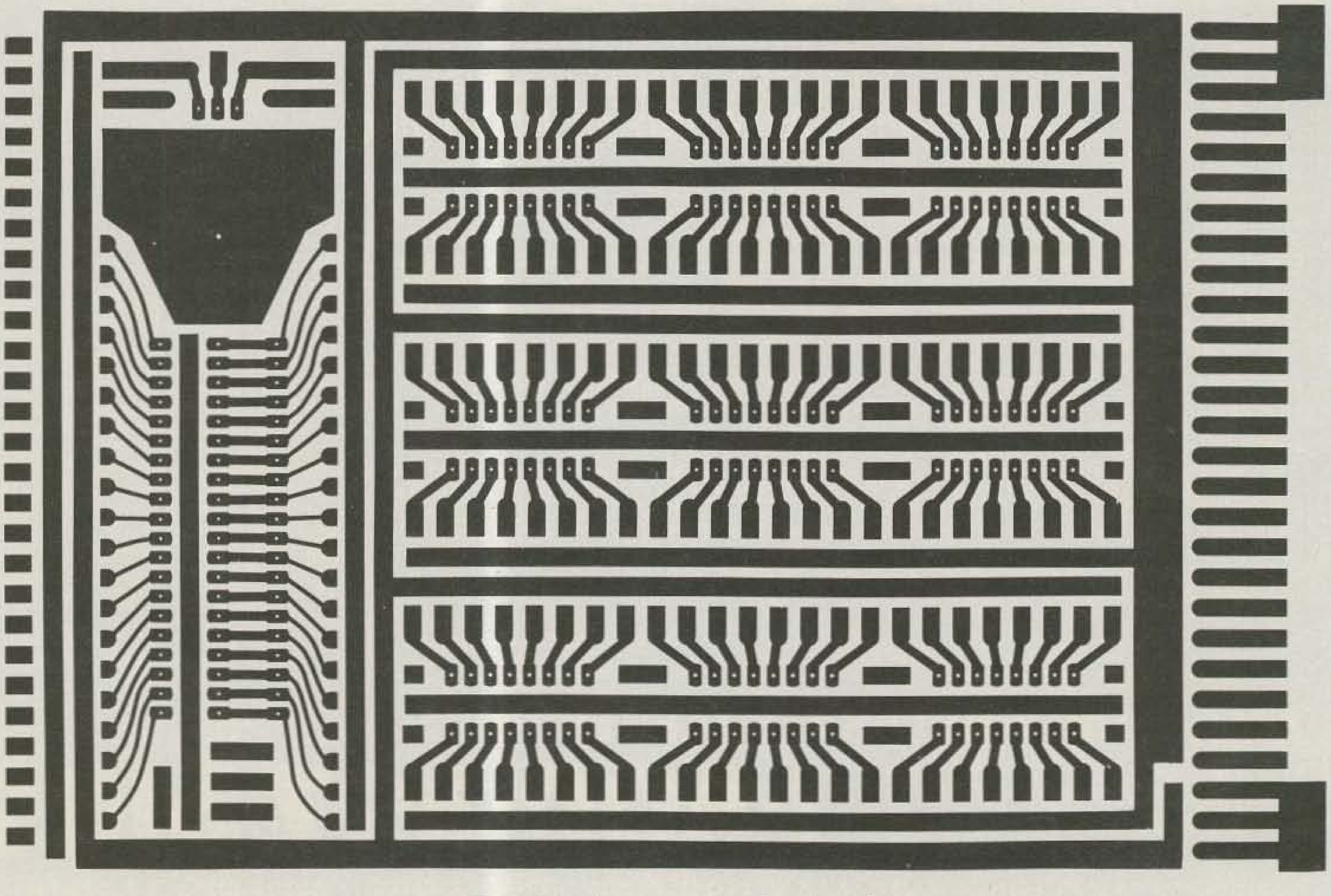

Fig. 1. The better prototyping board.

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Beating the Untraceable Buzz

Man-made interference doesn't have to destroy reception. Not when you use W1GV's buzz-beating antennas.

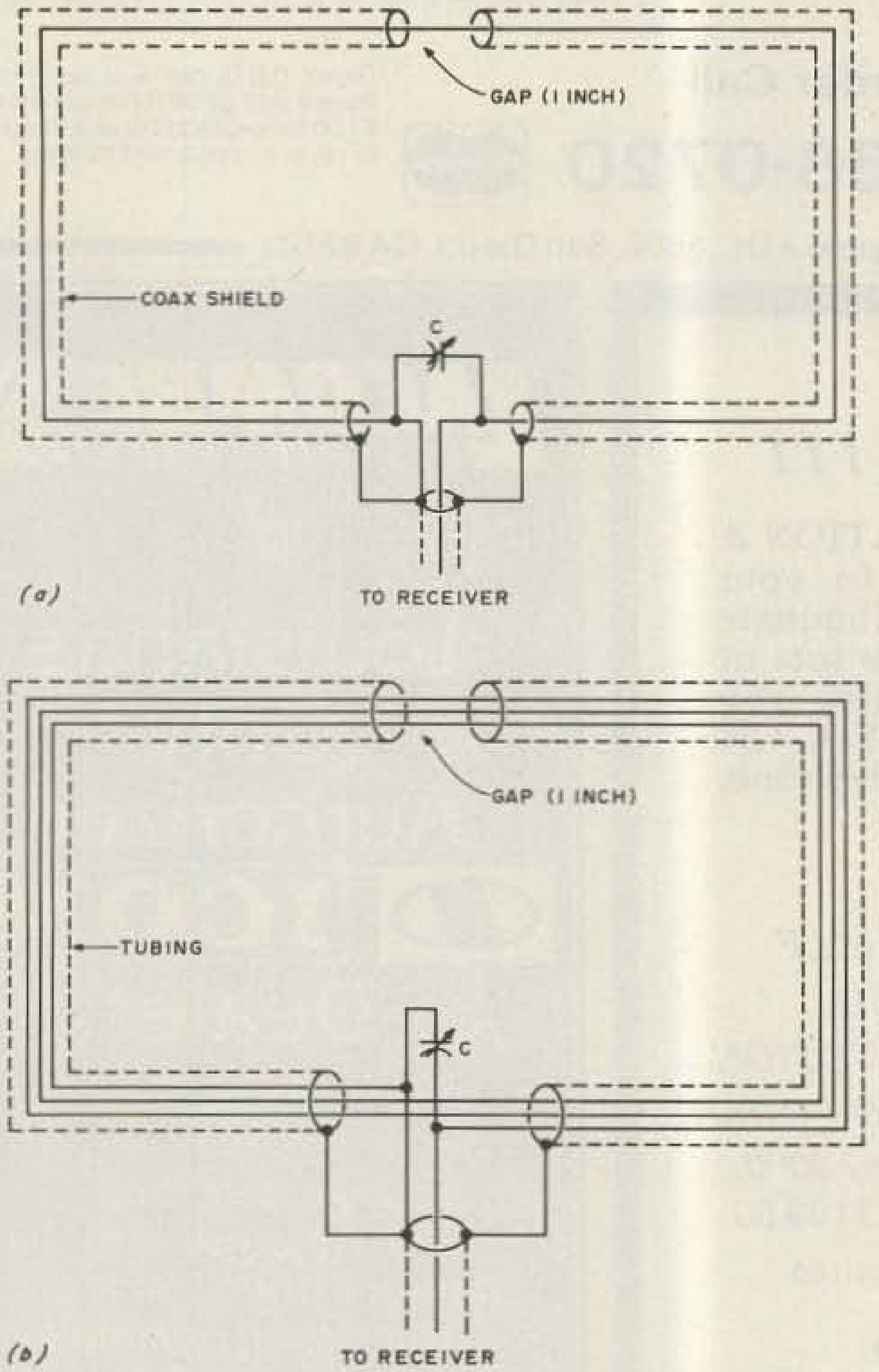

Fig. 1. Two versions of the shielded loop. (a) A single-turn version may be constructed using tubing and heavy wire or by using coaxial cable. The value of C will have to be determined by experimentation, although a 365-pF receiving-type variable usually will suffice. (b) A multi-turn loop is shown. Circumference of the loop should be about 0.15 wavelength in either case, although it may be considerably less if a preamplifier is used. See text.

Stan Gibilisco W1GV/4
PO Box 561652
Miami FL 33156

You've just moved into a new apartment or a new house for rent and the landlord has given his okay to your putting up a four-band trap vertical on the roof. (Miracles do happen!) So you blithely install your new station console, trying to improve the layout still further over what you had the last time; you painstakingly solder every PL-259 onto the interconnecting cables. You ground your equipment with a bus bar of 1/4-inch copper tubing running to a cold-water pipe only three feet away. You install 20 radials on the roof for each band (80 in all, and with the best stranded No. 16 wire). Finally, everything is ready to go.

Frequency	Circumference	
MHz	Feet	Meters
1.8	78	(24)
3.5	40	(12)
7	20	(6.1)
10	14	(4.3)
14	10	(3.1)
18	8	(2.4)
21	7	(2.0)
24	6	(1.8)
28	5	(1.5)

Table 1. Circumference of a shielded loop for various frequencies. These circumferences represent 0.15 wavelength for the indicated bands. If a preamplifier is used, the loop may be used at frequencies below that where it is 0.15 wavelength.

You turn on the receiver. A solid installation, this, you proudly think to yourself. Not a DX killer, to be sure, but it's well built and there should be plenty of good hamming ahead. The S-meter reads a steady S9 + 20. You turn up the volume: ZZZZZZ! Up and down the band you tune. The noise limiter does no good; the pulses must be too broad. ZZZZZZ! So much for 20 meters.

Switch to 40. Peak up the preselector. ZZZZZZ! S9 + 30. Damn. Switch to 15. Peak it up. ZZZZZZ! Only S9. Oh, great! Why even try 10? Why make yourself depressed needlessly?

The Search Begins

The next step, of course, is to switch off everything in the place except the rig. Thwack! Thwack! Thwack! One circuit breaker after another. And from the shack, several rooms away, you can hear the receiver with the volume up to 3:00: ZZZZZZZ—it stops! Your heart leaps. Whoops, that was the shack. Thwack! ZZZZZZZ...

The XYL shouts, "Will you turn that thing down and stop fussing with the lights? I'm trying to watch TV and iron!"

All your clocks were set to WWV from your watch, which you had to set at a friend's QTH because you can't even hear WWV at yours. Now all the clocks are out of whack since you played with the breakers.

You run all over the yard, using a little, plastic 6-transistor AM radio your Aunt Jenny gave you for Christmas back in '65 and you've hardly used for anything until now. Some places the noise is louder, some places softer. But there is no logical pattern. It's everywhere, but it's centered nowhere.

You try to DF (direction find) using the ferrite loopstick in the little radio. There is a sharp null in the direction of either the elm tree out front, or else 180 degrees opposite, from somewhere under the driveway. Move into the backyard. It's either coming from the rising full moon or else from the base of the swing set.

No power transformers of any consequence in the area. The noise is constant, around the clock. You get up at 5:00 am: ZZZZZZ! You come home for lunch (actually, instead of lunch). ZZZZZZ! Your stomach growls.

You'll never get rid of it.

You Could Search More

Oh, yes, eventually, if you search long and hard enough, you'll find it. Maybe it's an electric blanket in a neighbor's house. But, then, who uses an electric blanket for 24 hours out of every day? A refrigerator? Maybe, but they don't run continuously, unless... unless there is not enough of that coolant stuff in them. Hmmm.

It's not a street lamp starter, since it happens during the day. A fluorescent lamp starter, maybe? Well, who leaves a fluorescent lamp on for 24 hours a day? You might snoop around the neighborhood at 4:00 am or so and see if anybody has any fluorescents on. But, no, you might get arrested or mugged or something.

Maybe it's a thermostat mechanism. God help you.

What Can You Do?

Although I've made light of all this, it's not exactly funny when it happens. And sometimes you just will not, by any reasonable means, be able to locate and/or eliminate a source of man-made noise. If it's somebody's refrigerator without coolant, maybe it will burn up some day. A noisy fluorescent light starter will eventually fail and have to be replaced. Lot of good that does you now.

The situation is not hopeless, though. Noise has different characteristics than signals. There are ways of getting your antenna system to favor those single-frequency signals that you *want* to hear, while discouraging that wide-band hash that you *can't stand* to hear.

There are basically three methods of doing this. You can use them in combination if necessary. They will almost always provide significant improvement. These methods are: 1) Shielded-loop antennas; 2) High-Q antennas; 3) Noise-cancelling antennas. Let's look at these one by one.

Incidentally, these antennas are for receiving only. If you have a transceiver, some sort of switching device, such as a relay, will have to be used. These antennas will all prove quite lousy for transmitting.

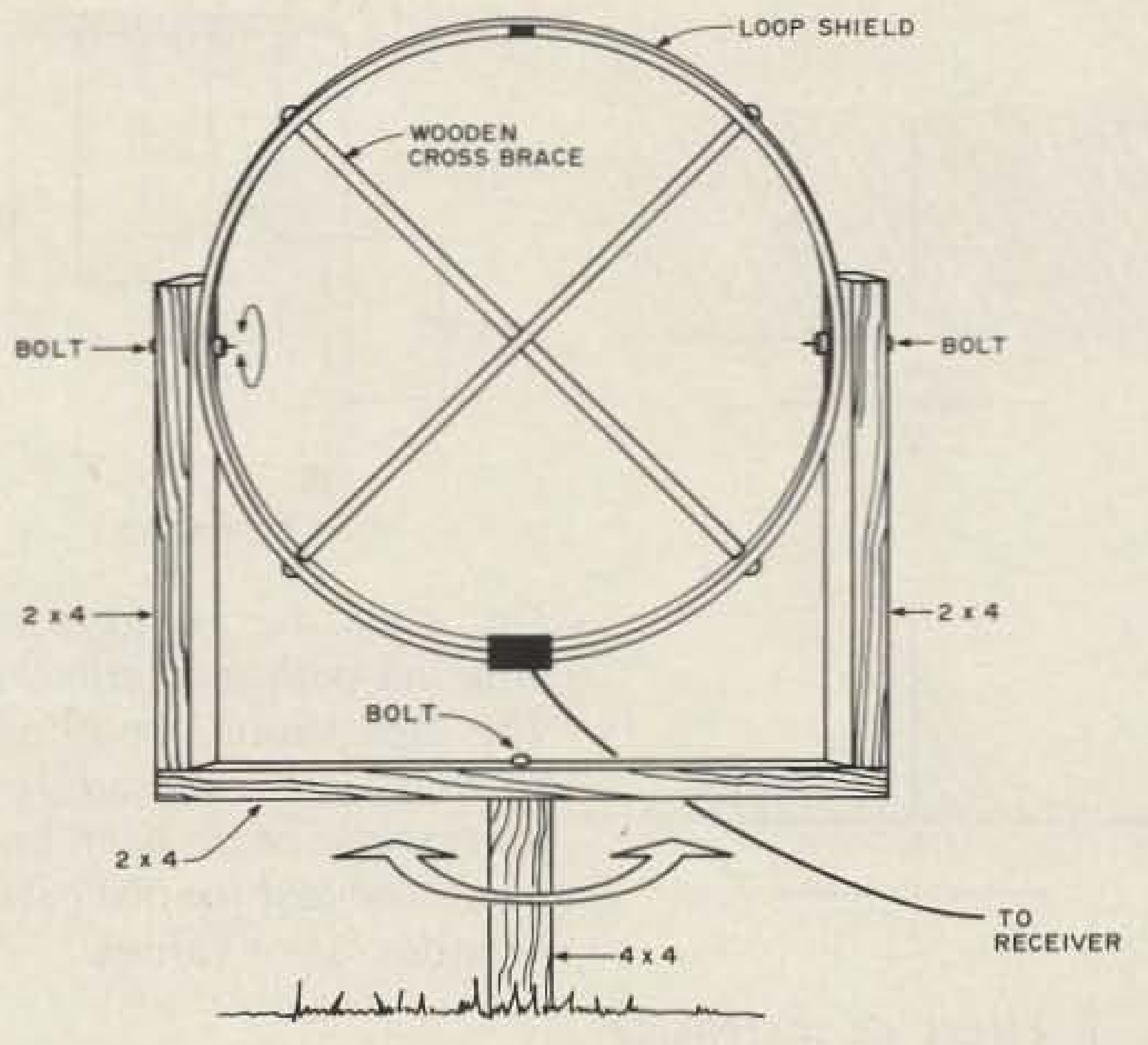

Fig. 2. A method of azimuth/elevation mounting that allows the shielded loop to be pointed towards the focal direction of a noise source. This kind of mount is practical only up to a certain size—about an 8-foot-diameter loop. The loop shield should be constructed from copper tubing if this kind of mounting is used.

The Shielded Loop

Fig. 1 shows two types of shielded-loop antennas. Fig. 1(a) is a schematic diagram of a single-turn loop, which may be constructed from coaxial cable. The loop is tuned to resonance by capacitor C, which may be a common 365-pF receiving-type variable available at most Radio Shack stores. It may be necessary to parallel this capacitor with a 330-pF fixed capacitor if resonance cannot be obtained with the variable by itself.

The loop should have an overall circumference of about 0.15 wavelength. Essentially, it is a single-band affair. If used on a band much lower than where it is 0.15 wavelength, the antenna will not pick up signals very well. If used on a much higher frequency, the antenna will pick up more noise. Nevertheless, you can probably get away with using it at half the design frequency and still get fair results. The loop may be placed on an "X" brace made out of wooden dowels or 2 by 4s, taped to an inside closet wall, or even put up in a tree.

The "shielding" of the loop obviously is not complete. Actually, it is electrostatic (Faraday) shielding, which shorts out the electric component of the signal while letting the magnetic part pass. For some reason, man-made noise seems to be transmitted mostly by capacitive coupling, as an electric field. But signals have both a magnetic and electric component. The result is that the noise gets attenuated more than the signals.

At Fig. 1(b), we have a multi-turn shielded antenna. The overall physical circumference should still be 0.15 wavelength. The shield may be constructed out of copper or aluminum tubing. The loop should have four to six turns; too many turns will lower the Q of the antenna and this will adversely affect its noise per-

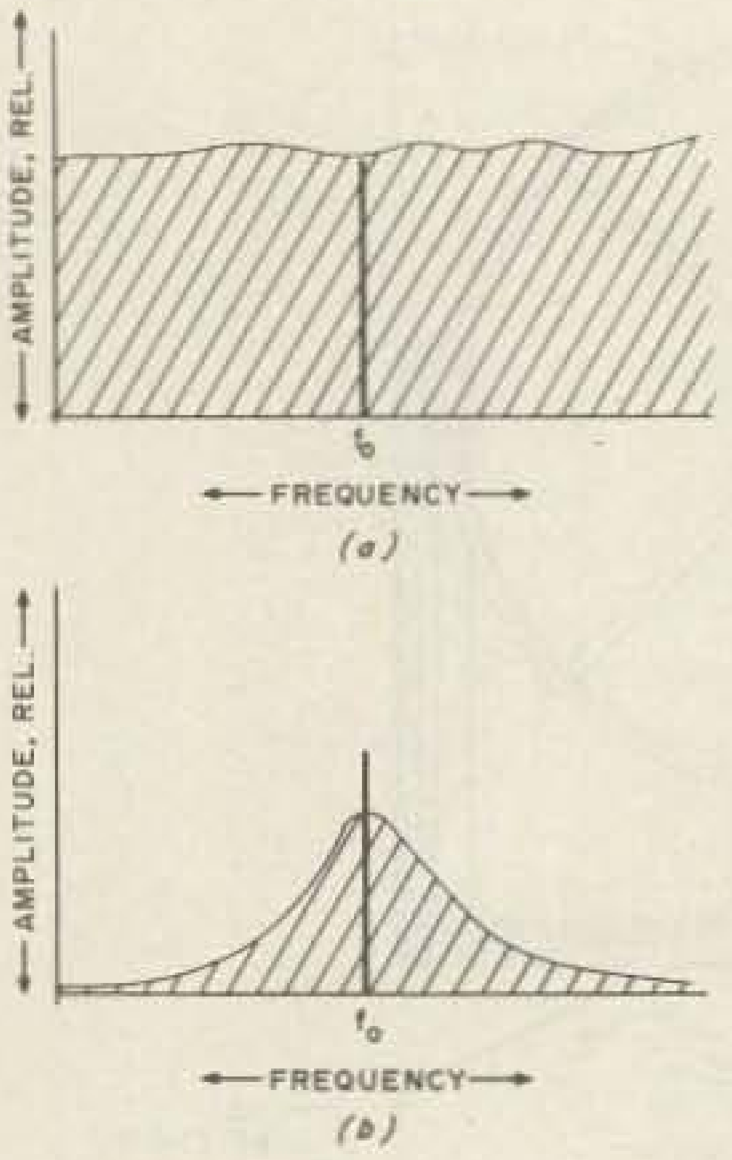

Fig. 3. Effect of increasing the Q of an antenna system. (a) The antenna system has essentially no selectivity. The signal, at frequency f_o, is buried in the noise. (b) A selective circuit is used in the antenna system. The total amount of noise (area under the curve) is smaller and this results in fewer high-order mixing products, which actually reduces the noise level at f_o. But the signal level remains unchanged, improving the signal-to-noise ratio.

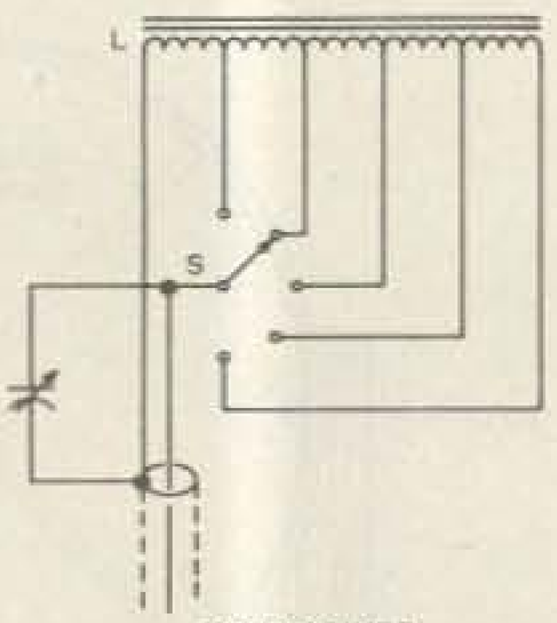

Fig. 4. A ferrite loopstick antenna with multiple taps. The taps should be chosen so that C may be adjusted for resonance on each band used. See text for discussion of inductance values.

formance. (Part of the noise attenuation of the shielded loop is the result of its high Q, which we will discuss later.) Several turns, however, provide for more "sensitivity" than just one. One word of warning: It is a physical contortion of considerable difficulty to find a way to get several turns through the tubing without a good deal of cussing and high blood pressure.

Table 1 gives the circumference of an 0.15-wavelength loop at various frequencies. The loop may be a square, pentagon, hexagon, octagon, or perfect circle. The circle is geometrically best. A long, skinny rectangle will not work too well. You should try to get the largest possible area for the circumference allowed, and keep it all in the same plane.

A shielded loop does have a directional pattern. The antenna will respond to signals in any direction except right along the axis. There is a sharp null in the line of the axis. The null is so sharp that signals propagated via the sky wave will never fall into it because of their multipath nature. Local signals might possibly fall into the null; just move the antenna a little and they'll come up. Of course, the noise can be nulled out if the antenna is oriented just right. This will provide even more attenuation to an already weakened foe.

Nulling It Out

The noise that is causing you so much frustration may originate in a single device, but it is probably being transmitted all over the place by the ac power lines. Therefore, it may be coming from all around. However, noise will always have a *focal direction*. Mathematically, all the noise combines in such a way that it may be considered to be coming from one single direction. (It's sort of like gravity. Even parts of the Earth that aren't straight under you are pulling at you, but it all averages out to a straight down force.) This axiom holds true as long as it's only one fluorescent light, thermostat, or elm tree that is responsible. If there are two independent culprits, each one will have its own focal direction, and you won't be able to null them both out at once. But chances are that there is only one source of noise. (It is just too horrible to even consider that there might be more!)

Fig. 2 shows a method of mounting a shielded loop so that its null can be pointed in any direction. The focal direction might even be straight overhead, so the antenna must be capable of pointing in the vertical as well as the horizontal plane. The XYL won't let you put such a contraption in the living room? Well, try the attic or the backyard, then. Or even the roof.

It may take some time to find the focal direction of the noise, since the antenna null is so sharp. But once you've found it, there may be as much as a 20-dB drop in the noise level—and this is in addition to the improvement that results from the electrostatic shielding. *Now* you should be able to hear some signals. Let that guy's refrigerator run until it burns itself out.

High-Q Antennas: The Ferrite Loopstick

Man-made noise differs in another way from signals. The signal you want to hear is never more than 3 kHz wide on the HF bands (unless you want to listen to AM shortwave music broadcasts, which take up about 10 kHz). The noise, however, is hundreds or even thousands of kHz wide.

The higher the Q (the narrower the bandwidth) of the antenna system, the smaller the total amount of noise that gets into the receiver. But that little 3-kHz signal will all be passed. This effect is shown in Fig. 3. The less total noise that gets to the receiver front end, the less noise that will appear within that 3-kHz signal "window," since there will be a lower level of high-order mixing products. Thus, the signal-to-noise ratio will be better.

The shielded-loop antenna, discussed earlier, has a fairly high Q. It can be maximized by using a single turn of very heavy wire inside a piece of tubing, or else by using RG-8/U coaxial cable for the loop section. A preamplifier with rf tuning may be added at the receiver input with any antenna in order to increase the Q. There are several commercially made units available. Ameco Equipment Company (12033 Otsego Street, North Hollywood CA 91607) makes one called the PT-2 that tunes 160 through 6 meters.

An antenna with very high Q can be constructed using a ferrite rod. Just wind several turns of enameled copper wire on the ferrite core from the antenna in Aunt Jenny's at-last-useful AM transistor job. Ferrite sticks are available commercially from Amidon Associates (275 Hillside Avenue, Williston Park NY 11596). The coil should be tuned to resonance using a variable capacitor. Fig. 4 shows a multiband ferrite antenna system with multiple taps.

The exact number of turns that will provide resonance on the desired band using a 365-pF variable capacitor at C will have to be found by trial and error, unless there is data included showing inductance vs. number of turns for your particular stick. Table 2 shows the values of inductance that will provide resonance with 200 pF of capacitance (about the middle of the range of a 365-pF variable) at various frequencies.

A ferrite antenna, complete with azimuth/elevation mount and a built-in

Frequency MHz	Inductance µH
1.8	39
3.5	10
7	2.6
10	1.3
14	0.65
18	0.39
21	0.29
24	0.22
28	0.16

Table 2. Inductance required to resonate with 200 pF of capacitance (the middle range of a 365-pF variable) at various frequencies. This data may be used in conjunction with data provided with commercially available ferrite rods, for the purpose of making a ferrite loopstick antenna.

preamplifier, is available from Palomar Engineers (Box 455, Escondido CA 92025) at the time of writing.

The ferrite loopstick is not electrostatically shielded, but it does tend to favor inductive coupling over capacitive. It is easier to work with mechanically, especially at lower frequencies. Simply orient the loopstick until a null occurs in the noise background. The null will be very sharp.

Need this last comment be made? Let's not take any chances. Don't try using a toroid core for this antenna. It won't work.

Noise-Cancelling Antennas

There's still another characteristic of noise that makes it different from signals. Oddly enough, this is the very resemblance of noise to a signal, with a unique focal direction. You hear the noise on the same frequency as a given signal; the noise may be thought of as a local signal. As such, using two antennas to combine the noise in opposite phase, the noise can be "cancelled out."

Fig. 5 illustrates one such system. The spacing between the two inductively-loaded vertical dipoles need not be very great, but it should be as large as practical without exceeding a quarter wavelength. The elements themselves may be very short. In fact, shortening them increases the Q, which will add to the noise-reducing effectiveness.

One antenna is fed 180 degrees out of phase with respect to the other. The easiest way to do this is to make the phasing lines the same length, but feed one of the antennas upside down with respect to the other. That is, if one antenna has the feedline center conductor going to the top section, the other antenna should have its feedline going to the bottom. In the plane equidistant from the two antennas, phase cancellation will occur. This is a vertically-oriented plane, and by rotating the entire system through 180 degrees, any focal direction can be put into the null plane.

It is possible, but not likely, that a signal will arrive from a direction that lies in the same plane as the noise, once the noise has been cancelled out. Sky-wave signals, since they arrive from a varying direction (ionospheric shift), may fade more if this happens. Local signals will be attenuated considerably.

This particular kind of antenna is mentioned here to illustrate the third way that signals can be distinguished from noise. As described, it will not work as well as the shielded loop or the ferrite antenna. But this scheme could conceivably be used with *two* shielded loops or ferrite antennas! Actually, pointing these two types of antennas at the focal direction of the noise is a means of phase cancellation. But even more cancellation could be obtained by using two such antennas, both pointed at the focal direction of the noise and then combined so that the small amount of remaining noise from each antenna arrives at the receiver in opposing phase.

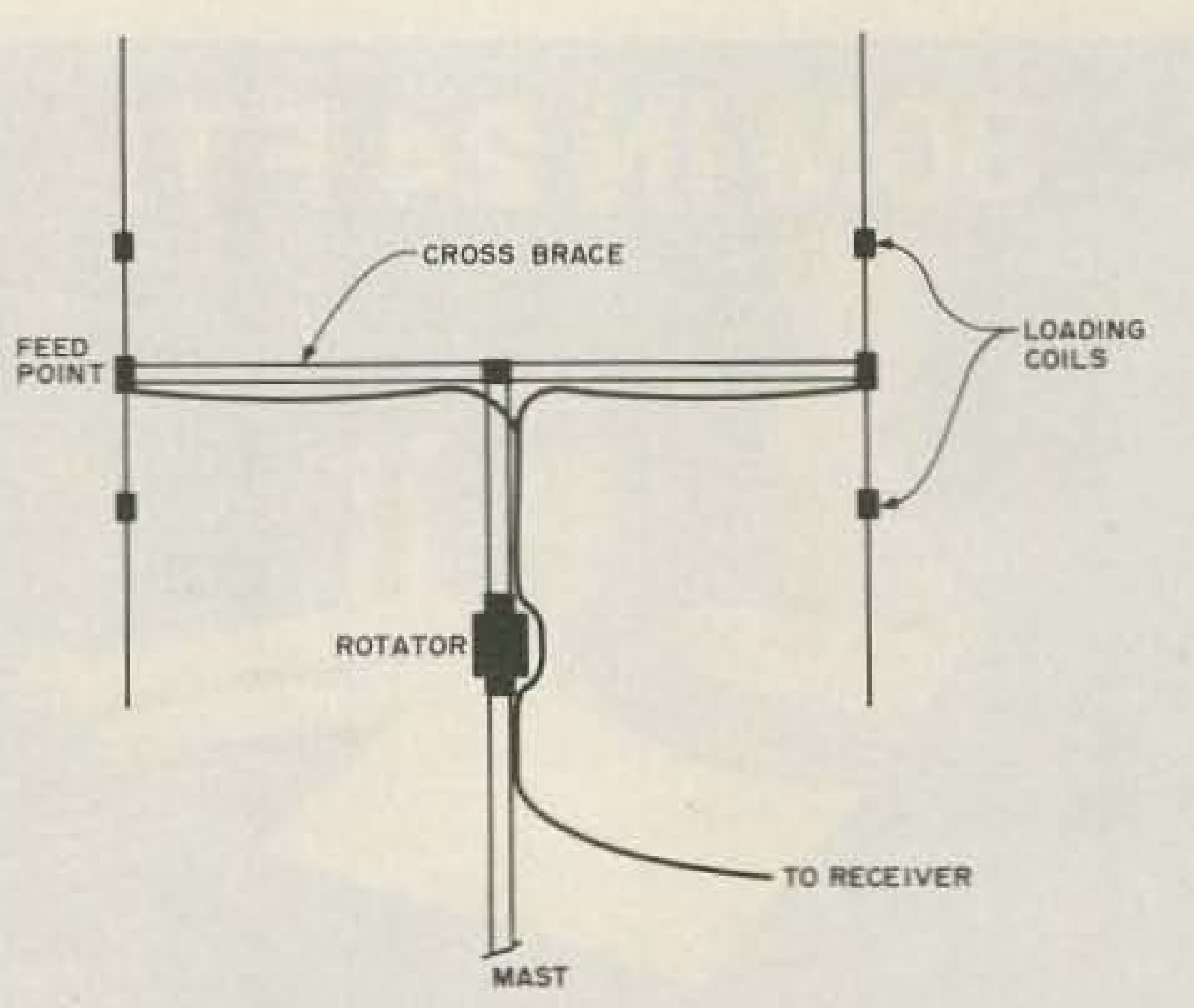

Fig. 5. Using two antennas to obtain phase cancellation of the noise. This particular system uses two inductively-loaded vertical dipoles. This system is illustrated primarily to demonstrate the third difference between signals and noise; this antenna by itself will not work as well as a shielded loop or a ferrite antenna.

Which One?

In a noisy environment, probably the best choice is the shielded loop. Using a selective preamplifier, one shielded loop can be used on several bands; it should be constructed for the highest band used. On lower frequencies, the value of capacitor C will have to be increased by paralleling it with fixed capacitors. The preamplifier will allow reception on lower bands because of its gain.

Perhaps there is no good place to put a shielded loop with azimuth/elevation mounting, and you can't get enough noise attenuation unless the antenna can be oriented towards the focal direction of the noise. Then, the next best choice is the ferrite loopstick. It can be put right at the operating desk! The ferrite antenna will probably not be quite as effective as a shielded loop. The null will not be as well defined (though still quite sharp) and its discrimination against electrostatic coupling will not be quite as good. But it can still be used to advantage.

Conclusion

Noise differs from signals in three ways: 1) Noise is transferred mostly by electrostatic coupling, but signals are transferred by electromagnetic fields; 2) Noise is broadbanded, but signals occupy only a small part of the spectrum; 3) Noise has a unique and usually constant focal direction at a given frequency, and it will usually be in a different focal direction than desired signals. These three differences are taken advantage of by: 1) Faraday shielding; 2) High-Q antenna circuits; 3) Phase cancellation.

These three methods of dealing with noise may be used individually or in combination. A shielded loop with azimuth/elevation mounting takes advantage of all three of the differences between signals and noise. It has electrostatic shielding, has a high Q, and may be oriented to null out the noise. A ferrite loop can be used when the shielded loop is impractical because of space limitations, either in reality or in the imagination of an XYL or landlord.

Good luck! Carry on the search for the noise source by all means. But at least get on the air in the meantime. ■

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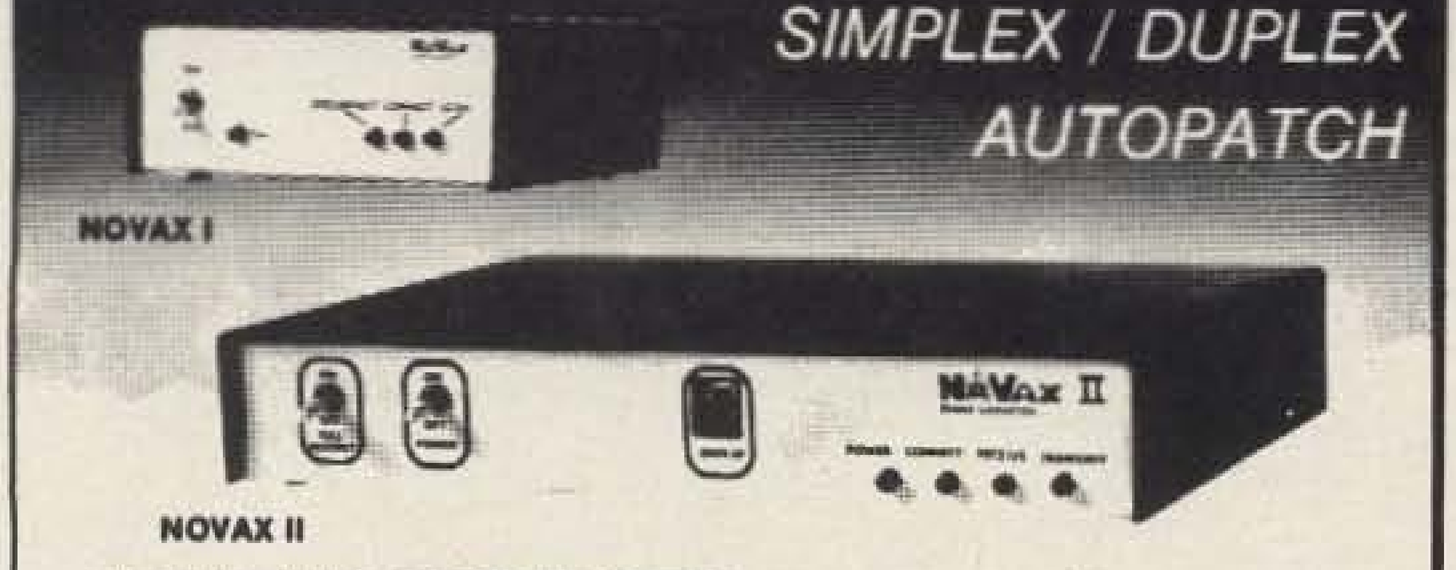

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The Care and Feeding of Optoelectronics

There are many ways to make these devices earn their keep. Here is one.

Can you really see which way the wind is blowing with optoelectronics?

The answer to that question is yes—with a little help from you.

The subject of this article is General Electric's H21A1 photo-coupler interrupter module. This module has two components: an infrared LED light source called the emitter, and a photo transistor called the detector.

I think you are safe in believing this so far, because I just read it in an optoelectronics manual.

The H21A1 module has a gap in its housing. The emitter is mounted on one side of the gap and the detector on the other. You may think someone planned it that way because now, if you want to, you can make this little black thing do something to earn its keep. For instance, if you pass something opaque through the gap, you will interrupt the output of the emitter. Do you think that's why GE calls it a photo-coupler interrupter module?

Photo A. Wind-direction indicator with the weather cover removed.

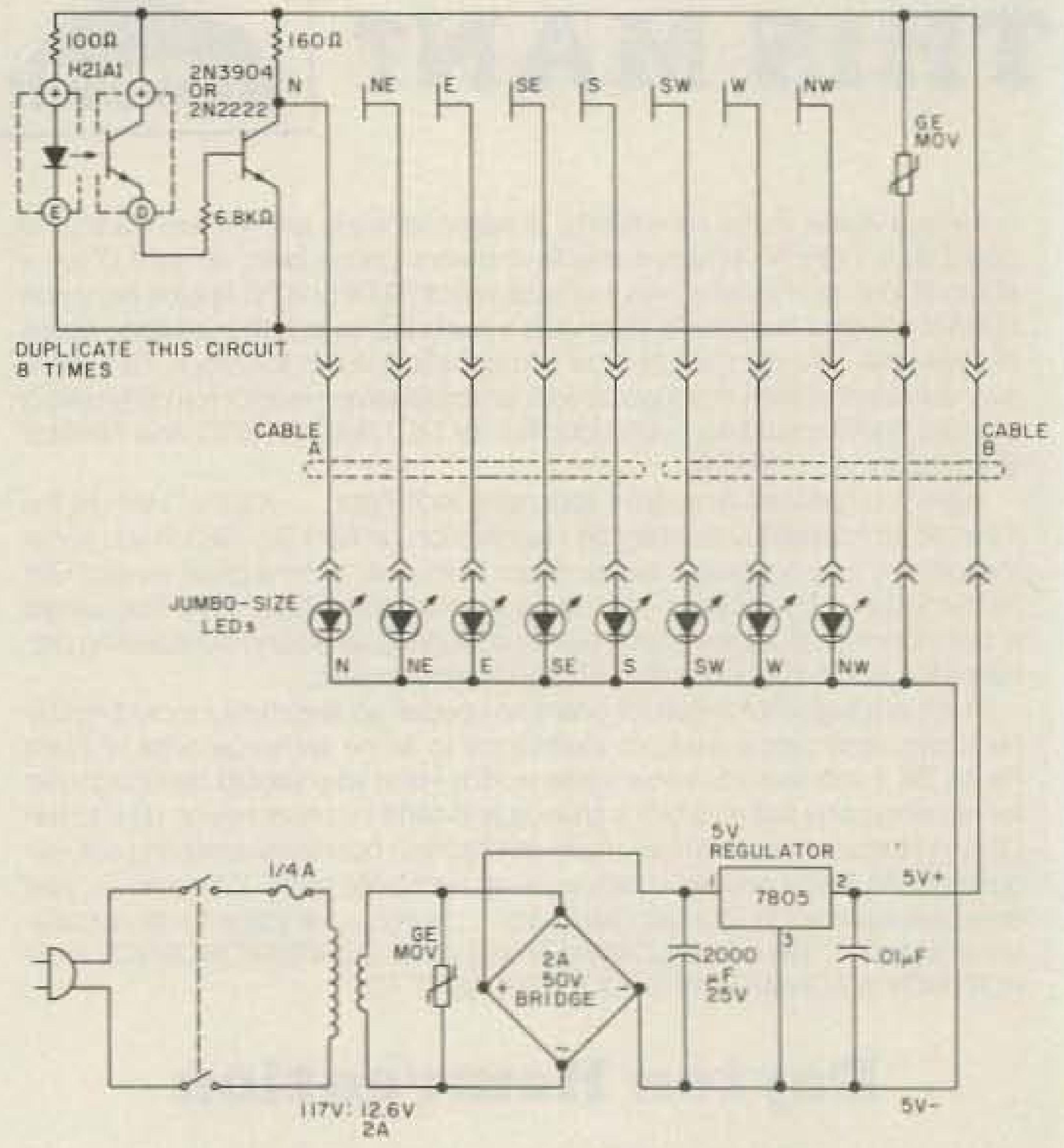

Fig. 1. The H21A1, detector side, is not shown physically correctly drawn here—look on top of the device for the correct pinout. All resistors are 1/4 Watt; capacitors are µF.

The interrupter module is just one of many types of photo couplers. To mention a few, the reflector module could be used somewhat like the interrupter module except that the light source must be bounced off a reflective surface and back to the detector. There are discrete emitter and detector units, and also a whole family of optocouplers in which the emitter and detector are sealed into one cube with no way of anything getting between them, which offer as high as 4000-volts isolation between the input and the output. I have mentioned but a few that are available (most of them cheap). And that brings me to the reason for my taking your time while you read this.

My purpose is to tell you how I used an interrupter-type module in a project and to get you interested enough to think about using optoelectronics in *your* next project. The more you know about them the more jobs you will see that they can do for you .

I sort of hinted at the beginning that I know how to make the H21A1 (actually, 8 of them) tell which way the wind is blowing, so I better get to it. The construction part is a mix of electronics and mechanics. The device, in case you haven't guessed, is a wind-direction indicator.

As you can see in the photos, there are some machined parts used on the model. Don't let this scare you; in almost every case, there is an alternative way to fabricate the same part with hand tools. I will suggest ways as we go along. On the other hand, the fellow with a lathe or machine shop could have a good time developing this project even further. The model pictured here has been perfected only to the point that it works reliably in all weather experienced here in Pennsylvania, and it should continue to work for many years. That is to say, don't be afraid to use the ideas and hardware available to you.

The most important points to remember when planning your construction are that (1) the bearing friction should be low enough so that a gentle breeze will have enough force on the tail of the vane to keep it headed into the wind, (2) you must devise a way of mounting it to your tower or pole, and (3) when it's all finished you must have some means of weather-sealing it.

Photo A shows the wind-direction indicator fully assembled except for the weather cover. The vane boom is 3/16 × 12-inches-long aircraft aluminum rod. (I might mention at this time that all parts were made from T3 aluminum.) The tail is 1/16 × 6 inches and has just about 13 square inches of surface. The vane boom is mounted to the axle or vertical shaft 2/3 of the length of the boom in front of the tail, or 1/3 of the way back of the nose. So, to balance this boom, the nose must be proportionately heavier than the tail. The nose is 1 × 3 inches long and is threaded onto the boom. A 1/16-inch slit has been milled into the boom to accept the tail, but a flat surface filed on the boom with the tail screwed to it would be just as good. The nose could be epoxied to the boom if there is no threading tool available.

The axle or vertical shaft is a 1/4 × 9-inch rod with a a 3/16-inch hole drilled in it near the top to accept the vane boom. A hole was drilled and tapped into the end of the shaft down through the vane boom and on into the shaft another half inch to secure the boom to the shaft.

Photo B is an exploded view. It shows the next component on the way down the shaft—the top bearing weather seal. This rotates with the shaft and, together with a piece of pipe that is epoxied to the top support frame, prevents the elements from getting into the bearing.

The top support frame is 4-7/16 inches deep (as viewed in Photo B) and 4-5/8 inches wide. It provides a mounting surface in the back and was formed from 1/8-inch stock. The back two corners were welded for strength. The inner bear-

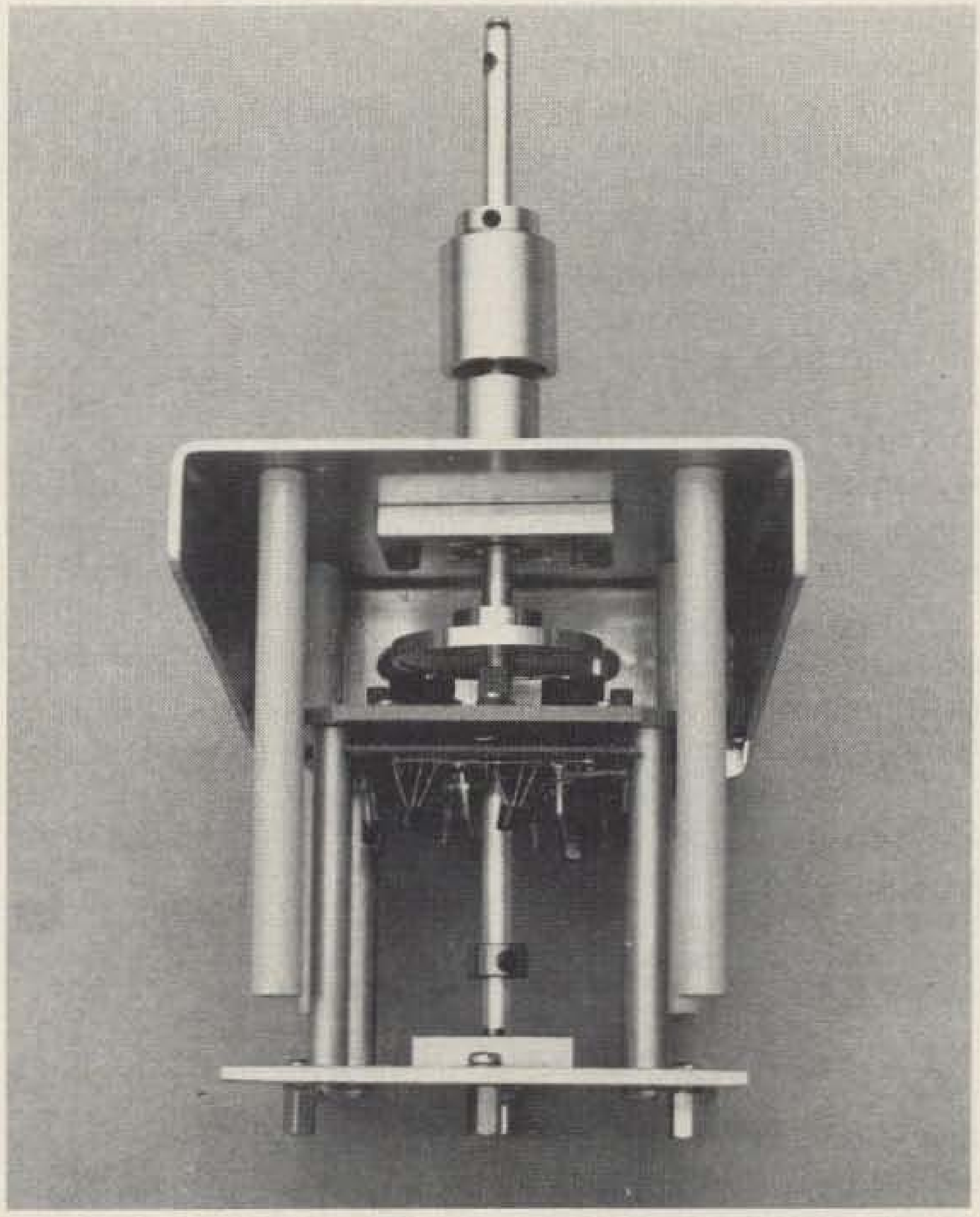

Photo B. An exploded view with the vane boom removed.

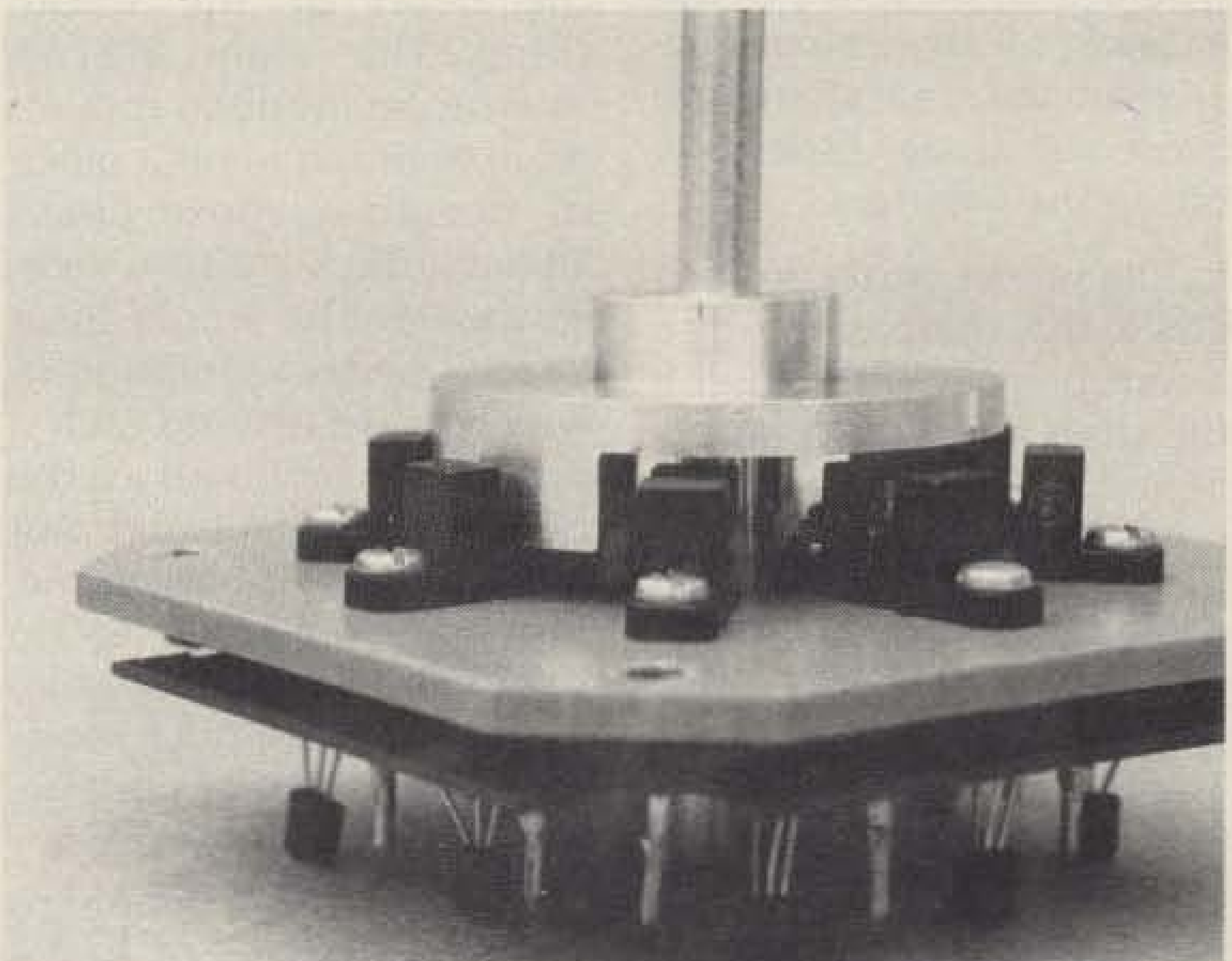

Photo C. A view of the H21A1s mounted on their fiberglass substrate and the disc interrupter tab rotating through the H21A1 gap. Mounted underneath is the PC board with the rest of the circuit components.

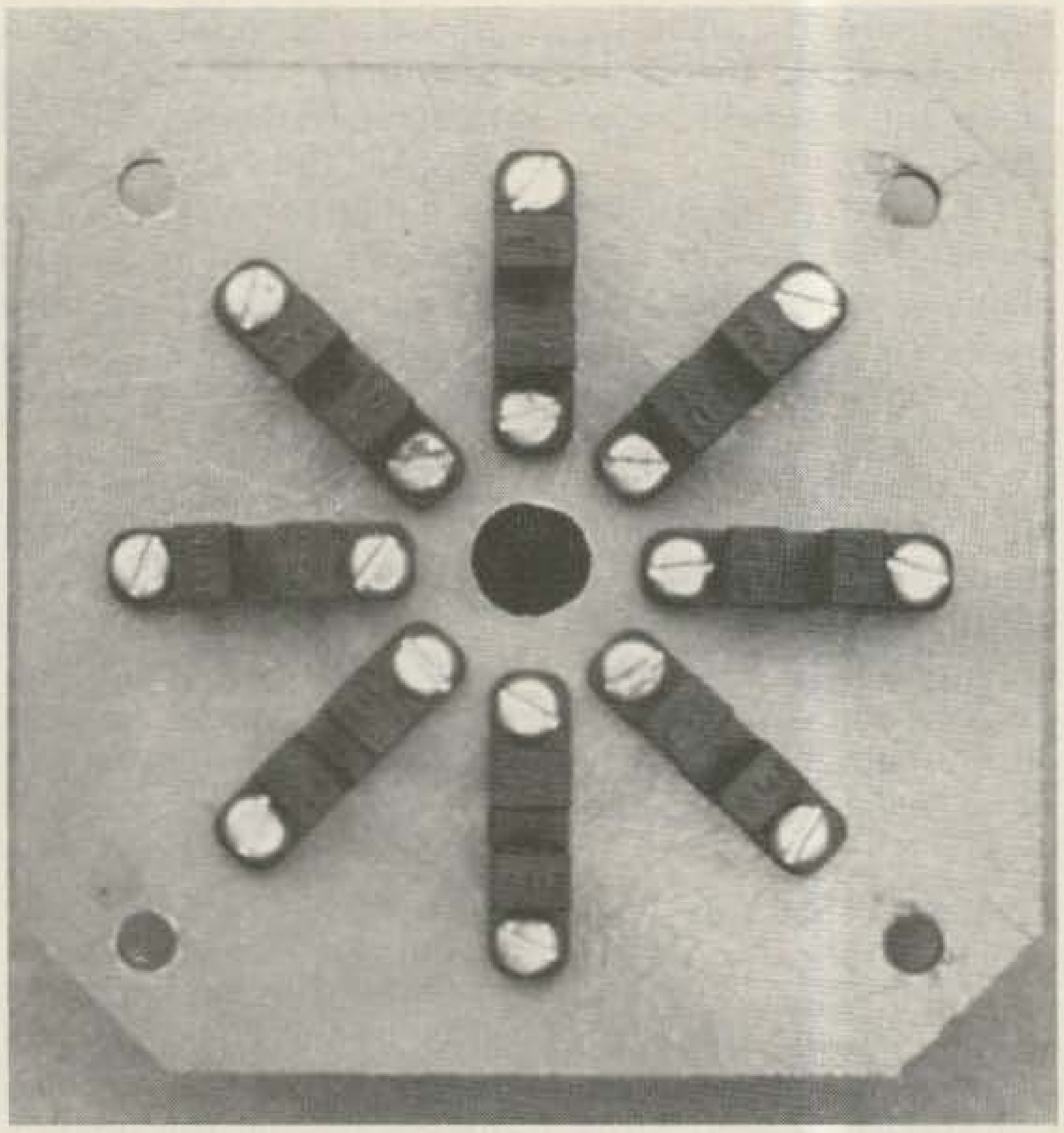

Photo D. The eight H21A1s in a 1-11/16" circle (measured to the center of the gap).

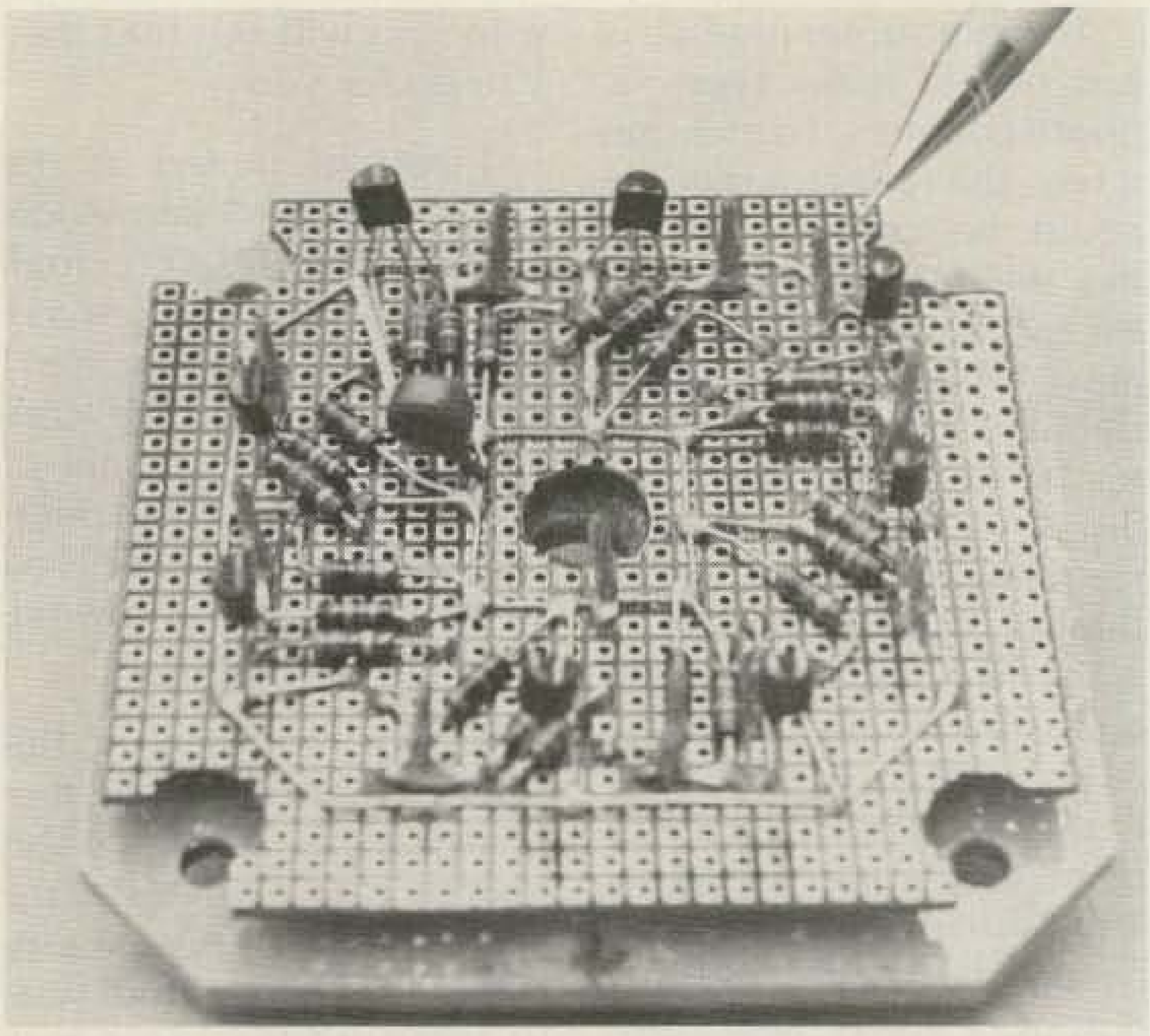

Photo E. The electronic components mounted on what we call a "do all" PC board. The pencil is pointed at one of the ten pins used to terminate the cable coming from the readout LEDs in the shack. The component at 10:00 o'clock near the shaft hole that looks like an overweight disc capacitor is the MOV.

ing seal is 3/4-inch i.d. conduit 1-1/8 inches high. The outer bearing seal is 5/8-inches i.d. × 1-3/8 inches high.

The next component down the shaft is the top bearing. I used ball bearings pressed into a bearing block to facilitate mounting and alignment, but a neat hole in a hunk of brass would be just as good. It would then be smart to use a brass or steel shaft, because brass and aluminum don't get along, especially out in the weather.

The next component down the shaft is the disc interrupter. It rotates with the shaft and is the component that actually tells the optoelectronics interrupter module which way the wind is blowing. (More about that later.) The disc interrupter used in this model was machined from a piece of solid round stock. As seen in Photo C, it is merely a disc with a collar and set screw to secure it to the shaft, and with a right angle tab on it. An easier way to make the disc would be to use the top portion of a small soup can and epoxy a collar to the top to secure it to the shaft. My disc-interrupter tab runs in a 1-11/16-inch circle and is 3/8-inch deep. The width of the tab is cut so that it covers two interrupter modules. (More about that later.) The H21A1's gap is 3/32-inch wide so I made the tab 1/16-inch thick.

Photo D is a top view of the heart of the whole thing, the eight H21A1 interrupter modules mounted in their circle on a piece of fiberglass epoxy board 1/8-inch thick × 3-1/4 inches square. This would have been a perfect situation in which to design and etch a printed circuit board. At the time, however, I did not have on hand PC board material thick enough to do the job. I think it should be at least 1/8-inch-thick stock to get the thermal and mechanical stability needed.

As you can see in Photo E, I used a piece of Radio Shack "do all" board. The leads from the H21A1s were stuck through the board and soldered first, to set the spacing between the two boards. Then the positive bus (near the center of the board) and the negative bus (around the outside of the board) were put down. After that, it's just as the schematic shows. The pencil in Photo E is pointing to the terminal pin on the negative bus. There are 10 pins on the board; two are for power (+5 V and −5 V), and the other eight are the direction signals that are being sent down to the wind direction LED readout in the shack. The male pins on the board will mate with female pins on the end of the cable going to the shack.

I tried various methods of reducing the number of conductors needed in the interconnection cable, BCD, etc., but when the smoke cleared (get it?), two runs of inexpensive 5-conductor TV-antenna rotor wire were found to work fine.

The eight H21A1s are spaced every 45° around the circle. Consequently, with the eight LEDs placed on the compass rose in the shack, you are able to determine if the wind is out of the north, northeast, east, southeast, south, southwest, west, or northwest merely by observing the LEDs. However, by making the disc interrupter tab wide enough to cover two adjacent interrupter modules, two LEDs are lit. So, for example, if the south and the southeast LEDs are lit, we can assume that the wind is out of the south-southeast, or approximately 157°. Obviously, more H21A1s could be added to increase the resolution. At this point, some method of reducing the number of cable conductors between the aerial unit and the readout panel would be necessary.

The electronic theory is super simple. When the disc interrupter tab interrupts the emitter light source, the photo transistor turns off, turning the 2N3904 off, hence allowing the appropriate LED to light.

Any 5-volt power supply that can deliver at least 500 mA continuously will work. The General Electric MOV is for transient voltage-spike protection. I used the

V47ZA7 because I had them; a better choice could be made.

So far, there has been no need for rf suppression, but that is not to say you may not need to add a bypass capacitor or two.

The next to last thing on the shaft is the 1/4-inch collar. It is secured to the shaft with a set screw and rests on top of the lower bearing. It prevents the shaft from falling through. As you can see in Photo B, the collar is not in place because this is an exploded view.

Photo F shows an exploded view with the 3-3/4-inch spacer screws removed from the bottom plate. You also can see the four small 3/4-inch spacers on the bottom of the bottom bearing plate. These spacers will be used to secure the weather cover.

All of the spacers could be substituted for with all-thread rod, and then you would use the nuts to adjust your spacing. The bottom bearing and bearing block are identical to the top bearing and bearing block.

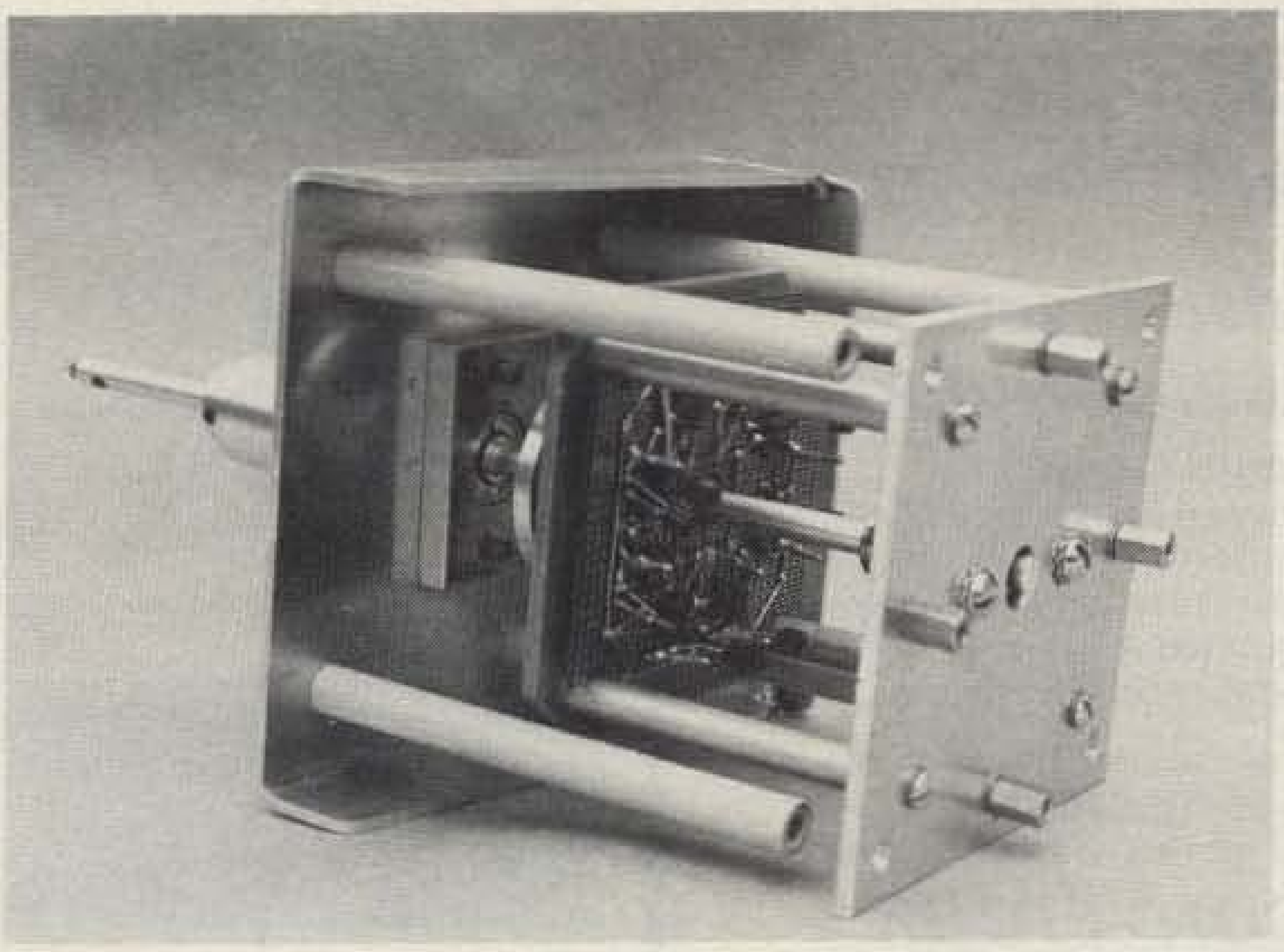

Photo F. An exploded view from the front looking up at the wind-direction indicator.

The weather cover is nothing more than a five-sided box that slides up over the lower bearing plate and butts against a cork gasket glued to the bottom side of the top support frame (gasket or cover not pictured). A fruit or soup can of the proper size also would work for a weather cover.

After the machine was fully assembled and tested, I disassembled it so that I could wash all the metal parts with dishwashing detergent. Then everything was sprayed with clear Krylon™, including the electronics board but excluding the H21A1 board.

Photo G is a view of the wind-direction readout panel with its eight LEDs, etc. On a sub-panel on the rear, the power-supply components and cable terminal blocks are located. On the right is the companion meter that I hope in the near future will indicate wind velocity (not ac Amps). My plans for this meter as they stand now are to perfect a 4-inch cup anemometer to the point that it will indicate wind velocity with the additional feature of generating 7 to 10 Watts to be used to light a small lamp or to charge the HT battery.

Tune-up of this little gem is pot pie. Just mount it in the air on whatever structure you plan to use. Point the nose of the wind vane north and by using the set screw in the disc interrupter collar, clamp the tab so it is centered through the H21A1 that you have designated north. Be sure the vane still rotates freely. Secure the weather cover in place, then go down to the shack, turn the power supply on, and watch the LEDs blink. It is that simple. Of course, you knew it was going to work before you put it in the air. Hi, hi!

A word about finding parts and materials. If you can't get the H21A1s locally, see Reference 1. I found a shop in my area where I can buy a foot of this and an inch of that, plus getting some good advice to boot. I found this shop by talking to a fellow who is building an experimental aircraft. They use the same types of material. Perhaps you can find an experimental aircraft club in your area, or you can get your material where I got mine. See Reference 2.

I would be very remiss if I did not implicate my collaborators in this project: Fred Jones K3CVM,

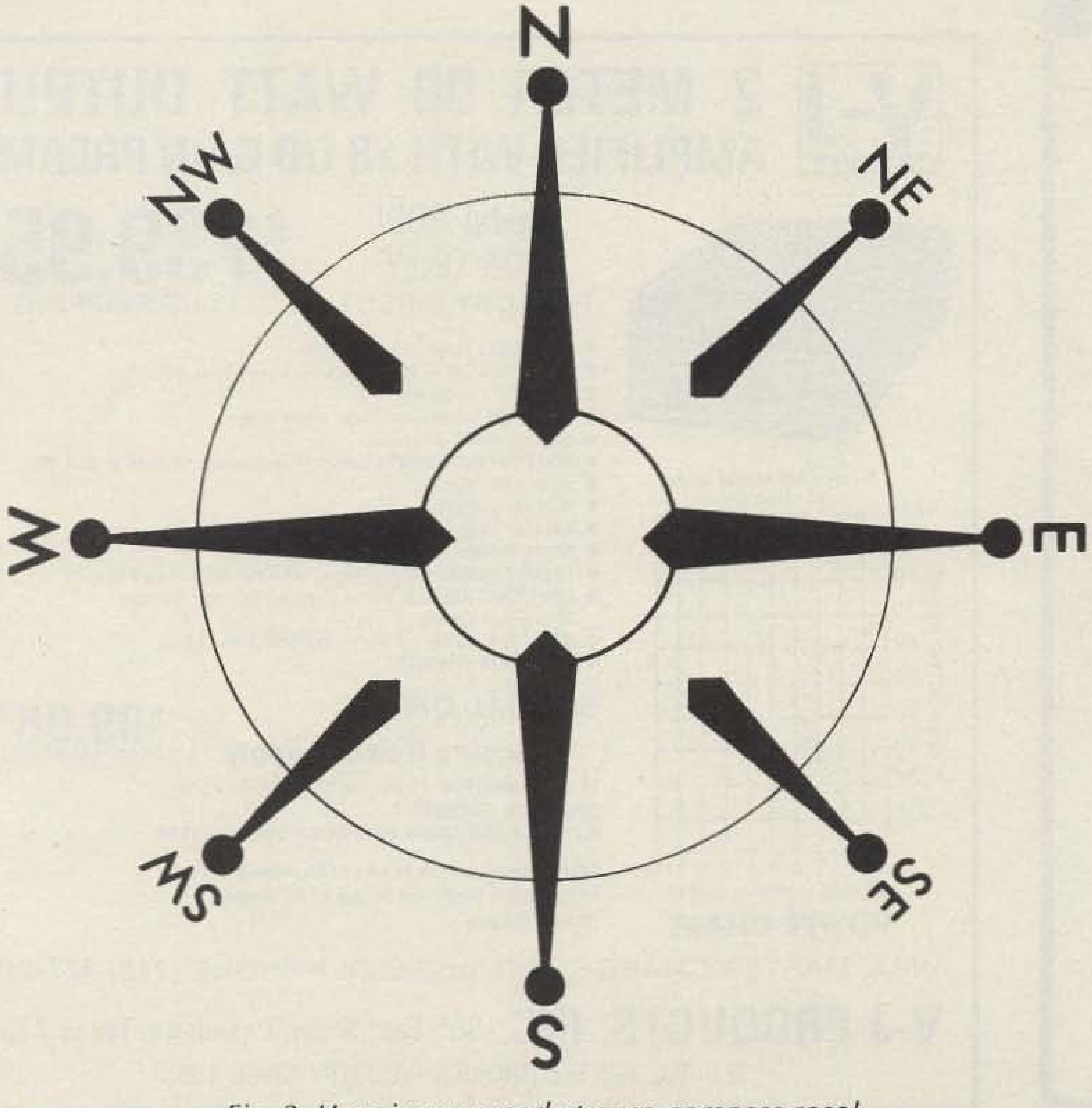

Fig. 2. Here is your ready-to-use compass rose!

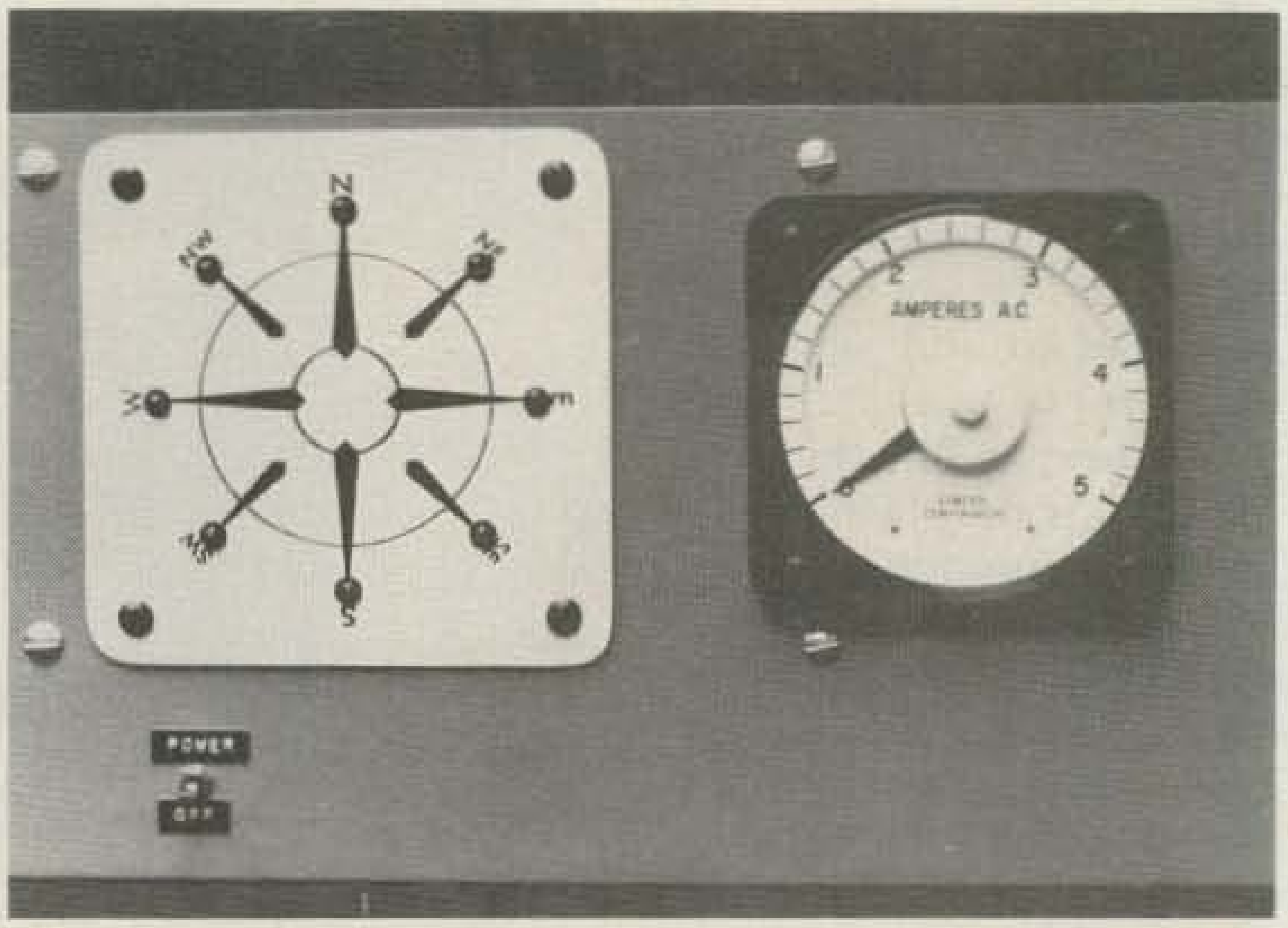

Photo C. The readout panel with the eight-point compass rose on the left and the meter that will indicate wind velocity on the right.

Don Zarfos K3OAP, Tim Burke WA3KYD, Jim Erisman WB3ERZ, Russ Hut, and Jim Williams. Thanks, fellows. ■

References

1. Rosen Electronics, Inc.
   215 S. George St.
   York PA 17403
   (717)-843-7881
2. The Dillsburg Aeroplane Works
   RD #3
   Dillsburg PA 17019
   (717)-432-4589
3. Optoelectronics
   General Electric Co.
4. *Transient Voltage Suppression Manual*
   Second Edition
   General Electric Co.

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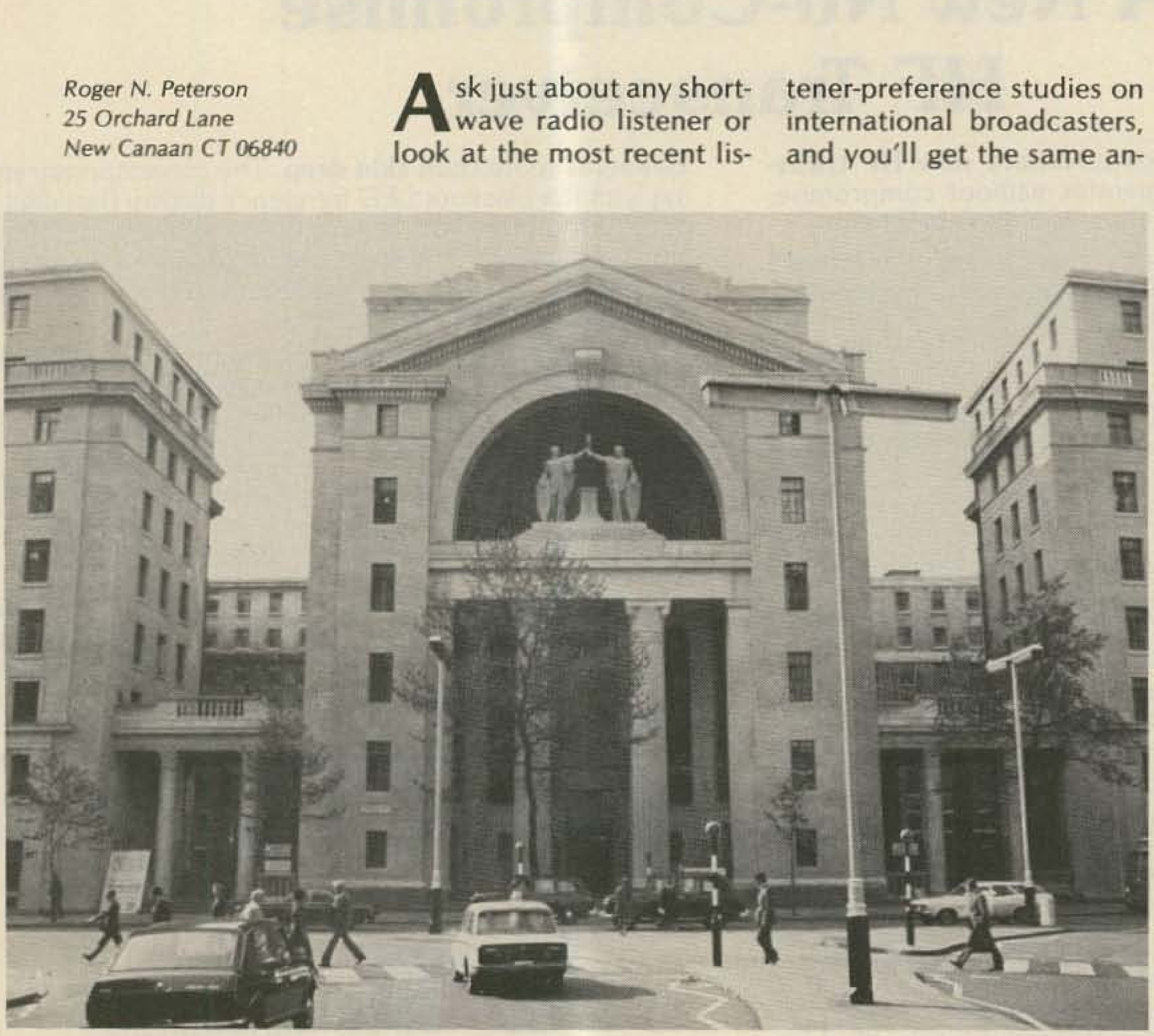
Ask just about any shortwave radio listener or look at the most recent listener-preference studies on international broadcasters, and you'll get the same answer. The British Broadcasting Corporation (BBC) ranks number one.



Bush House, home of the BBC's External Services, in The Strand, London. (All photos BBC copyright.)

There are a number of reasons for this popularity ranking, and I was turning them over in my mind as I walked down The Strand in London on a sunny day on my way to the BBC headquarters in Bush House, near Fleet Street. Some cynics say that the only reason for BBC popularity is that it is on the air more often and on more places on the dial than any other international broadcaster.

There is some truth to this, although the facts are not quite as above. The BBC ranks only fifth among international broadcasters for the amount of time on the air, per week. The USSR is first, followed by the US (Voice of America plus Radio Free Europe), the Republic of China (Radio Peking), and West Germany (Deutsche Welle). However, from the standpoint of programs in English that can be heard here in North America, the BBC does indeed lead all the others. You can hear the BBC round-the-clock in the US and Canada, and this beats such big North American broadcasters as the Voice of America, AFRTS (US Armed Forces Radio), and the popular CBC Northern Service in Canada.

It also is true that BBC programs are often "all over the dial" on your receiver. During many hours of the day, you can pick up their broadcasts on three, four, or even more different frequencies. This is because of its unusually strong transmission facilities—79 transmitters, 47 of them in four different locations in Britain and 32 in eight overseas relay stations, including the US, Canada, and the Caribbean. At certain hours, the Russians offer even more frequencies to the US listener, but only the BBC provides this multiband reception for most of the twenty-four hours.

While these technical advantages give the BBC a big boost over competition, they are not the only reasons for its popularity among listeners. The great reputation for world news coverage makes the BBC unique among international

The control room at Bush House, London, home of the BBC External Services. World Service programs are broadcast 24 hours a day from these facilities in English and 38 other languages.

broadcasters. The BBC broadcasts more than 250 news programs a day from its headquarters in London. They are all prepared in an ultra-modern newsroom with electronic readout aids of all kinds, and with a staff that numbers over 100. It may be the world's largest newsroom and, at this writing, certainly the most modern as it was completed just over a year ago.

News is fed into this giant news machine by BBC correspondents from all over the world and by the international news agencies. Another important source is the famous BBC Monitoring Service. This BBC Division, located at Caversham Park, some 50 miles from London, provides round-the-clock reports on the contents of selected broadcasts from foreign radio stations. This supplements the agencies' and foreign correspondents' reports.

The BBC Monitoring Service provides a *Summary of World Broadcasts* every day and, in addition to sending

A GUIDE TO BBC WORLD NEWS BROADCASTS

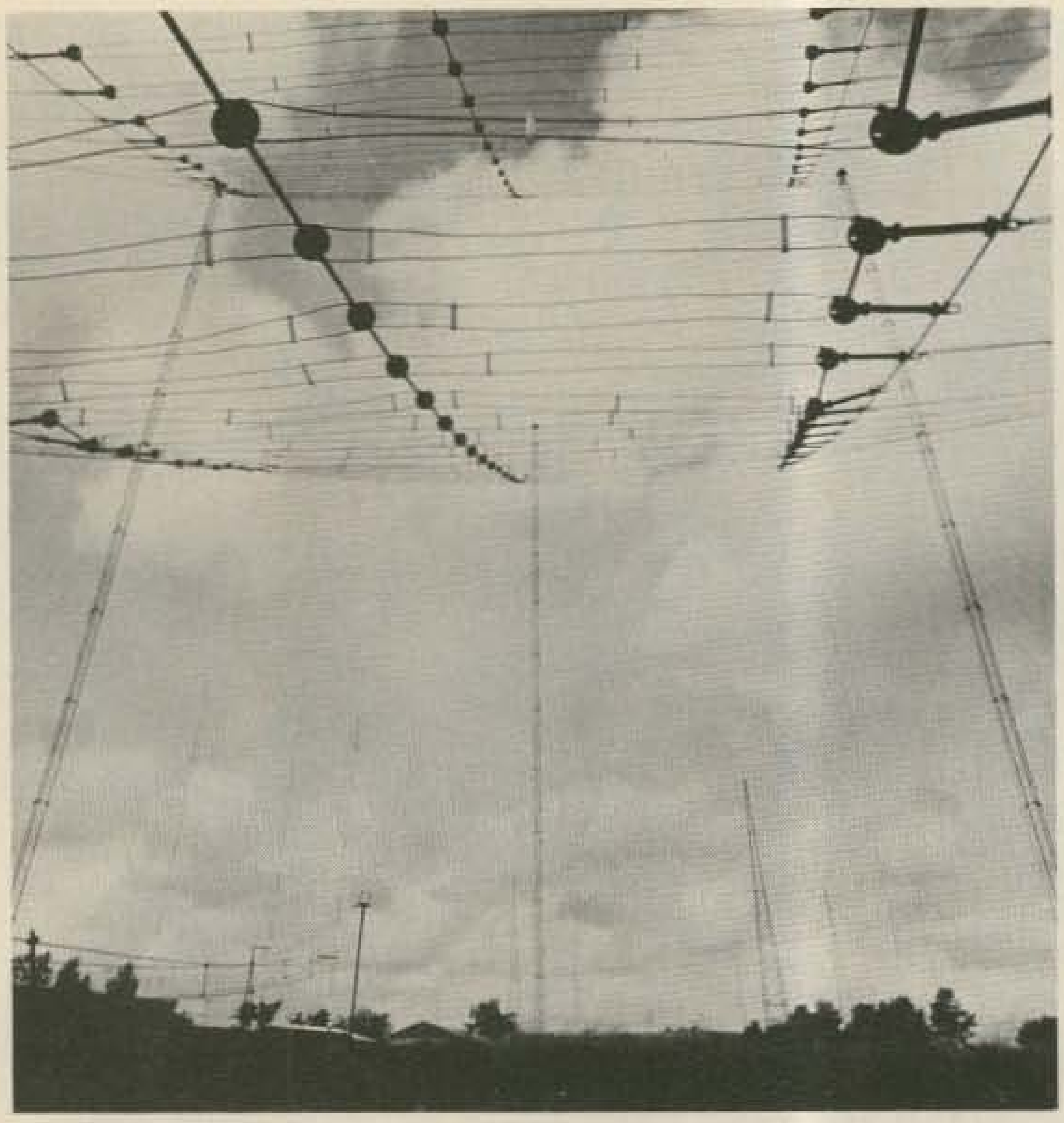
Time (GMT)	Best Frequencies (MHz)
0000, 0200, and 0300	5.975, 6.12, 6.175, 7.325, 11.750, 15.260
0400, 0500, and 0600	5.975, 6.175, 9.510, 15.070
0700	6.175, 9.510, 15.070
0800 and 0900	9.510, 15.070
1100 and 1300	6.195, 9.510, 11.775, 15.070
1600 and 1700	15.070, 15.260, 17.830, 21.710
1800	15.070, 21.71
2000	6.175, 15.070
2300	5.975, 6.175, 7.325, 15.070

BBC AND THE FALKLAND ISLANDS CRISIS

BBC is at its best reporting on significant news events, and the Falkland Islands crisis certainly was a good example. First of all, the regular news broadcasts generally were an hour or so ahead of the wire services or what your local radio or TV station reported. You heard it first on BBC if you tuned it in. Second, BBC has special programs to deal with current newsworthy events, and the Falkland situation was no exception. On May 2, right after the air attack on the Argentine-held airfields on the Islands, the BBC preempted one of its most popular programs, Letter From America, for an interview with several military experts.

These special programs generally come right after major news programs such as their 1100, 2000, 0000, and 0200 GMT broadcasts, but they can come at any time, as the BBC thinks nothing of interrupting regular programs for something special.

Finally, the BBC has always had a special weekly broadcast to the Falklands on Sunday afternoon from 2209 to 2245 GMT on 9.915 and 12.040 MHz. I heard the one right after the Argentine invasion on April 4, and it was excellent. It included a message from the British Foreign Secretary, a review of British press opinions, and even special messages to relatives. The program was very easy to receive in the Northeast, where I reside. Check it out at the above times and frequencies.



A view of the antenna farm for the BBC's broadcasts to North America. The signal is loud and strong to the US.

it to the BBC News Staff, supplies it on a subscription basis to other governments, news agencies and newspapers, universities, research institutes, industrial and commercial organizations, and private individuals.

World news can be heard in North America seventeen times a day (see box). In addition, back-up programs on the world events are offered daily. Some of the most popular of these (as of last year) are:

- *Outlook*—an up-to-the-minute look at people, events, and opinions together with the latest UK news, sports, and weather.
- *Twenty-Four Hours*—analysis of the main news of the day plus reviews of the British press.
- *The World Today*—examines thoroughly one topical aspect of the international scene.

SOME POPULAR BBC PROGRAMS
(All Times GMT)

Letter From America (Alistair Cooke)	Sundays 0545, 1115, 1645, 2315
Letterbox	Fridays 1415; Saturdays 2315; Sundays 0515, 2015
Look Ahead (Program Previews)	Daily 0940; weekdays 1943
In The Meantime	Thursdays 2120; Fridays 0150, 1115
Outlook	Weekdays 1900, 1515, 0115 (Tuesday-Saturday)
Anything Goes	Saturdays 1215; Mondays 0330, 0830
Concert Hall	Sundays 1515
Top Twenty (Hit Records)	Wednesdays 1830, 2330; Thursdays 1215
New Ideas	Saturdays 0530, 1015, 2230; Wednesdays 1725
Good Books	Saturdays 2015; Sundays 0215
Jazz For The Asking	Wednesdays 2130

- *Commentary*—background to the news from a wide range of specialists.
- *Radio Newsreel*—news of events as they happen, and dispatches from BBC correspondents all over the world.
- *New About Britain.*
- *British Press Review*—Survey of editorial opinion in the press.
- *Financial News*—including news of commodity prices and significant moves in currency and stock markets.

In addition to these daily reports, the BBC also offers a number of weekly review-type programs on current events and special interest subjects. Among the most popular:

- *Financial Review*—a look back at the financial week.
- *Business Matters*—a weekly survey of commercial and financial news.
- *From Our Own Correspondent*—BBC reporters comment on the background to the news.
- *From the Weeklies*—a review of the British weekly press.
- *Listening Post*—a weekly survey of comment from radio stations around the world.

While the BBC has no rival for its extensive coverage of news, it also leads the way in many other types of programs—sport, drama, light entertainment, and music. These can be divided into two categories—monthly features and regular programs.

A typical month will have anywhere from 12 to 16 feature programs. These range from general interest to special interest subjects. Some are only for the "intellectuals," and others are for the "common man." In June, for example, the Queen's Birthday Parade (better known as "Trooping the Colours") is broadcast from London with all the music and pageantry you would expect. The BBC also has had weekly programs called " The Poetry of Europe," "The Movie Moguls," and "Medical Hypnosis."

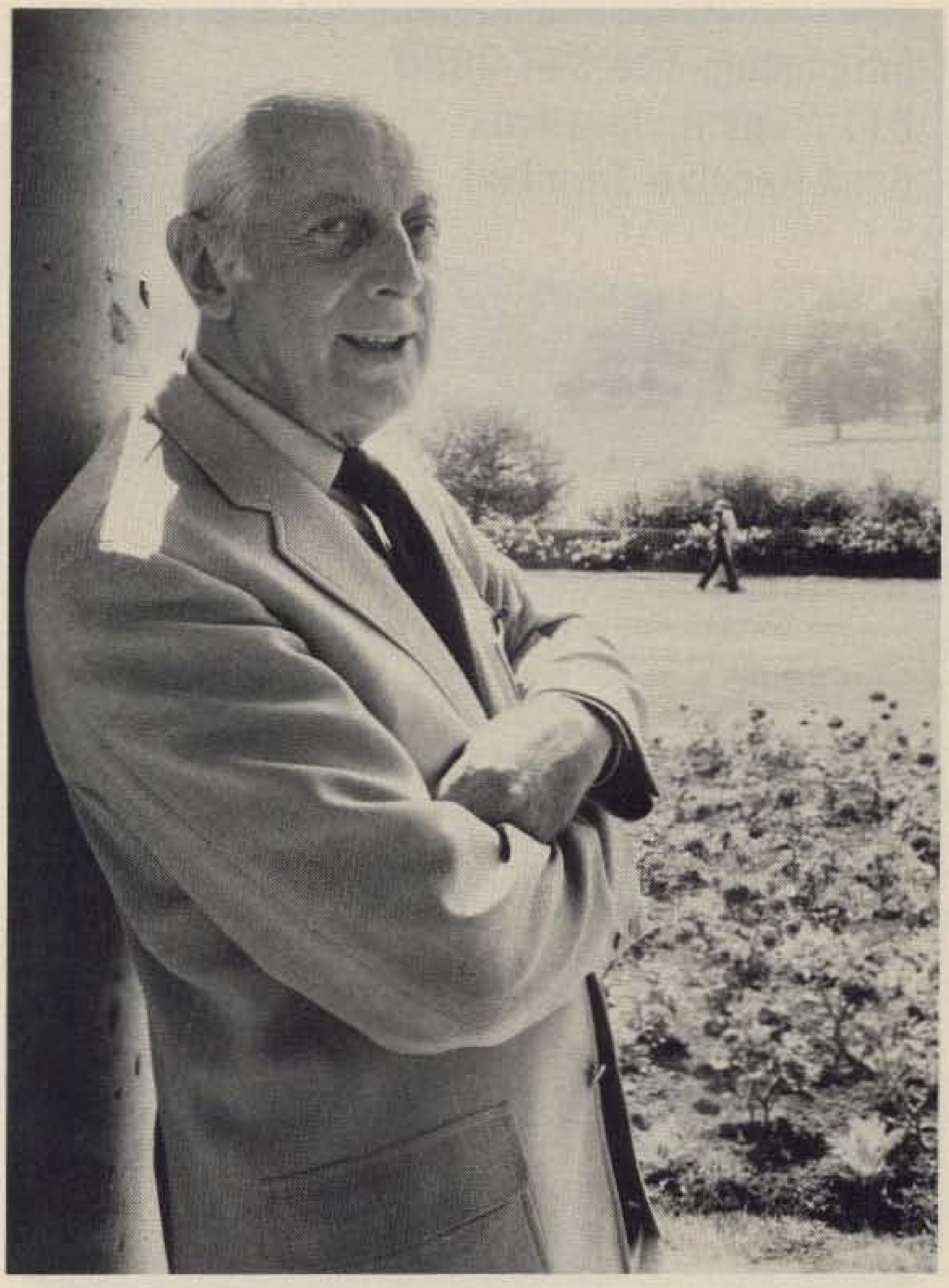
Music is an important part of BBC programming. In fact, no other international broadcaster comes close to providing the number of musical programs—both classical and "Pops"—as does the BBC. Every month there are eight or nine special programs making their bows. Regular music programs include "Concert Hall," "Talking about Music," and a long-time BBC favorite, "The Pleasure's Yours," where Gordon Clyde plays classical requests. Another, "Classical Record Review," reports on new releases.

Classical music is not the only thing that the BBC provides listeners who dig instruments and vocal sounds. For the rock devotee, there is the weekly "John Peel" show where the host selects tracks from a newly released album and singles from the progressive rock scene in London. "Jazz for the Asking" is a popular weekly request show, and "Top Twenty" lets you listen to all the big hits. "Terry Wogan's Album Time" is a weekly show for those people who like the easy-listening kind of music, and there are many more of the same on the BBC every week.

Another area where BBC programming leads the way is in drama. There are four regular weekly features plus specials for the particular month. Total air time per week for this type of show is about 16 hours. A regular drama program is "Thirty Minute Theater." This often shows plays by such famous writers as Dorothy L. Sayers, Terrence Rattigan, and Oscar Wilde.

"Play of the Week," "Radio Theater," and "Short Story" are other regular drama programs.

Margaret Howard hosts the very popular "Letterbox" program on the BBC. Hear it on Fridays at 1415, Saturdays at 2315, or Sundays at 0515 and 2015 GMT.



Alistair Cooke is heard every Sunday on the BBC with his popular "Letter From America" program. Listen to it at 0545, 1115, 1645, or 2315 GMT.

Book lovers hear the following programs every week: "Book Choice," "Good Books," and "Paperback Choice." For those interested in science and hobbies, "Discovery" covers advanced developments in science, "New Ideas" gives you news of the latest British products and inventions of particular interest to the home owner and small businessman, "Science in Action" lives up to its name, and "Time Off" is a program devoted to hobbies, pastimes, and entertainment.

Religion is not overlooked at the BBC, either. Services broadcast from famous English cathedrals and churches can be heard on Sundays and Mondays. Two other programs are "Report on Religion," a weekly magazine of religious news and views, and a daily program called "Reflections."

Sports occupy a prominent part of the BBC weekly schedule, but a good many of these broadcasts are "very British indeed"—rugby, cricket, British football—and do not have a great appeal to the average US audience. If you have any British expatriates in your area, you can get them really excited by inviting them over to hear something like England versus Scotland in football.

BBC programs are very carefully researched by surveys and opinion polls. A Listener Panel (of which I am a member) is made up of 88% foreign nationals and 12% British expatriates and is asked to vote on individual programs and/or subjects on a regular basis. Panel voting accounts for the unusual number of drama programs and for the addition of a new business news program ("Financial Review," mentioned above). Over 50% of the panel apparently wanted more business news.

Research indicates that one of the most popular BBC weekly programs is Alistair Cooke's "Letter from America." Back in 1946, the BBC commissioned Cooke to deliver a series of radio talks on the subject of the USA where he had been living and working for more than a decade. The original plan called for thirteen weekly programs, but it has never stopped in all these years. It may well be the longest-running series in radio history. Listen to it on Sundays at 0545, 1115, 1645, or 2315 GMT.

One other BBC program that continues to score high marks is "Letterbox." This is a show where several people simply read letters (often complaints or suggestions for BBC programming) from listeners, and the BBC replies. On the surface, it doesn't sound very fantastic. However, the people on the show are so funny—with British wit and satire—that it has become one of the big BBC hits. Hear it on Fridays at 1415, Saturdays at 2315, and Sundays at 1515 and 2015 GMT.

At this point you might well be thinking about why the British go to all the trouble and expense of providing such a wealth of programs to the shortwave radio listeners of the world. To understand their motives we should examine the basics of the whole BBC foundation.

The letters "BBC" were first used in 1922 when the

British Broadcasting Company was formed and when regular daily broadcasts began. In those days, the BBC was a commercial organization, but one that operated under a license on conditions which would have prevented it—even if it wanted to—from turning broadcasting into a moneymaker for the shareholders. From the start, it placed the interests of the public above all. The result was that the British developed a genuine public service broadcasting system, paid for by its audience through their receiving licenses. In 1927, the Company became the British Broadcasting Corporation. It is a public corporation constituted by Royal Charter and holding a license from the Minister responsible for broadcasting. Thus the BBC is neither a government department nor a commercial concern.

The External Services, which is what we hear on our shortwave receivers, are an integral part of the BBC, operating under the same charter as the domestic service and sharing the same traditions. Unlike the domestic service (which is financed by annual "listener licenses"), the External Service is paid for by Parliamentary grants-in-aid. The government prescribes the languages which are broadcast and the length of time each is on the air, but editorial control rests with the BBC.

External broadcasting from Great Britain began in 1932 with a service in English. A few years later, the BBC was asked by the government to broadcast in other languages, the first of which was Arabic. During the early days of World War II, the BBC was a constant ray of hope for the people in France and other Nazi-occupied countries. I can well remember, as an airman shot down in France a few weeks before the invasion and hiding in a French farmhouse, listening to the BBC on the family radio. The BBC used to send coded messages to the French underground during those days.

Today, the External Services broadcast to the world in English and 38 other languages for over 100 hours every day. These programs originate mainly from the 52 studios in Bush House in London.

While the British Empire is no longer the world power that it once was and no longer has all those colonies on which "the sun never sets," it still has thousands of citizens and expatriates living abroad. The BBC brings information and entertainment from home and helps them keep their ties to the mother country. This, of course, is a prime objective of BBC broadcasting overseas.

Naturally, the BBC is interested also in presenting its own point of view to citizens of other countries around the world. The BBC estimates that about 75 million adults listen regularly (once a week or more) to its External Services. The English broadcasts are heard by about 25 million.

Like all international shortwave broadcasters, BBC programs and frequencies change from month to month. How can you keep up-to-date with these constant changes? Basically there are two ways to do it—by your radio receiver and by print. The BBC has three programs which will help you keep abreast of things. First is a show called "Look Ahead" which previews programs for each day. "In the Meantime" is a program which tells you what is new in BBC programs. And third, there is a program called "Waveguide" which covers frequency changes, propagation estimates, and other things which help you to keep tuned well to the BBC.

Serious listeners to the BBC will be interested in receiving a monthly copy of "London Calling." This publication is sent airmail from London every month, previewing programs and giving frequency changes so that the listener is right on top of BBC broadcasts a month ahead of time. Unfortunately, this is not a free publication and the cost to subscribers in the US is $13.00 per year. You can get a free sample copy, however, by writing BBC World Service, PO Box 76, Bush House, London WC2B 4PH. Or, to save yourself the cost of an overseas airmail stamp, direct your order to: British Broadcasting Corporation, 630 Fifth Avenue, New York NY 10019.■

BEST BBC FREQUENCIES FOR NORTH AMERICA

Time (GMT)	Frequencies (MHz)
0000-0230	15.07, 15.26, 11.75, 7.325, 6.175, 6.12, 5.975
0230-0330	11.75, 9.60, 9.51, 7.325, 6.175, 6.12, 5.975
0330-0630	9.51, 6.175, 5.975, 15.07
0630-0730	15.07, 9.51
0915-1100	11.750, 9.740, 15.07
1100-1330	21.55, 15.07, 11.75, 9.51, 6.195
1300-1500	21.71, 15.07
1500-1745	21.71, 17.83, 15.40, 15.26, 15.07
1745-2000	15.07, 9.41, 12.095
2000-2100	21.56, 15.26, 15.07, 6.175
2100-0000	15.26, 15.07, 6.175
2200-0000	15.42, 11.75, 9.59, 9.51, 6.12, 15.07
2300-0000	7.325, 5.975

This chart effective summer, 1982. Some changes will take place in the fall.

Reader Service for facing page ✓5 →

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	30W output	MML144-30-LS	1W or 3W in	$124.95
	25W output	MML144-25	3W input	$114.95
432 MHz:	100W output	MML432-100	10W input	$444.95
	50W output	MML432-50	10W input	$239.95
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✓See List of Advertisers on page 114

Active-Filter Design Made Easy

Using this BASIC program, if you don't like the design, then scrap it. All you lose is a few seconds.

B. E. Taylor WD4HPC
922 Reaves Street
Jackson MS 39204

There have been many articles on active bandpass filters in the electronics/amateur publications. Most of the articles are recipes, i.e., if you want my performance, duplicate my circuit. The rest have been tutorial articles which are mathematical in nature.[1,2] There is a section on multiple-feedback bandpass (MFB) filter design in the 1979 ARRL *Handbook*,[3] and there are at least two books devoted to active filter design.[4,5]

The equations used in designing the most common type of active bandpass filter—the second-order, MFB filter—can be solved nearly as easily as the name of the filter can be pronounced. The problem is that all of the design parameters and the component values are interdependent. Changing any one can lead to changes in others, which leads to more calculations.

This is just the sort of calculation that is ideally suited for computer evaluation. The program described in

Program listing.

```
10 REM BANDPASS BASIC
20 REM BY B. E. TAYLOR WD4HPC
30 REM FOR SECOND ORDER MULTIPLE FEEDBACK BANDPASS FILTERS
100 R1=0
199 REM INPUT SECTION - OPTIONS FOLLOW
200 PRINT"YOUR CHOICES ARE AS FOLLOWS"
210 PRINT "1 - CHOOSE R1, R3, R5 AND C"
220 PRINT "2 - CHOOSE G, Q, F AND C"
230 PRINT "3 - CHOOSE R1, F, Q AND C"
240 PRINT "4 - SCALE FREQUENCY BY CHANGING CAPACITORS"
250 PRINT "5 - SCALE FREQUENCY BY CHANGING RESISTORS"
260 PRINT "6 - SCALE IMPEDANCE OF COMPONENTS"
270 PRINT "7 - DO CALCULATIONS FOR CASCADED SECTIONS"
280 INPUT "ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE";M
300 IF M=1 THEN 1000
310 IF M=2 THEN 2000
320 IF M=3 THEN 3000
330 IF M=4 THEN 5000
340 IF M=5 THEN 5300
350 IF M=6 THEN 5600
360 IF M=7 THEN 6000
370 GOTO 280
999 REM DESIGN A FILTER BY SPECIFYING ALL COMPONENTS
1000 INPUT "R1";R1,"R3";R3,"R5";R5,"C";C
1010 C=C*1E-6
1020 G=.5*R5/R1
1030 Q=SQR((R1*R5+R3*R5)/(4*R1*R3))
1040 F=Q/(6.2832*R1*C*G)
1050 GOTO 4000
1999 REM DESIGN A FILTER BY SPECIFYING ALL PARAMETERS AND C
2000 INPUT "G";G,"F";F,"Q";Q,"C";C
2010 W=6.2832*F
2020 C=C*1E-6
2030 R1=Q/(W*G*C)
2040 R5=2*G*R1
2050 R3=R1*R5/(4*Q*Q*R1-R5)
2060 IF 0>R3  THEN PRINT "NOTE - NEGATIVE VALUE OF R3"
2070 GOTO 4000
2999 REM DESIGN BY SPECIFYING INPUT IMPEDANCE, Q,F AND C
3000 INPUT "R1";R1,"Q";Q,"F";F,"C";C
3010 W=6.2832*F
3020 C=C*1E-6
3030 G=Q/(W*R1*C)
3040 R5=2*G*R1
3050 R3=R1*R5/(4*Q*Q*R1-R5)
3060 IF 0>R3 THEN PRINT "NOTE - NEGATIVE VALUE OF R3"
3070 GOTO 4000
3999 REM OUTPUT SECTION FOR ABOVE SEGMENTS
4000 PRINT
4010 PRINT
4020 PRINT "FOR THIS DESIGN"
4030 PRINT "R1=";R1;"OHMS"
4040 PRINT "R3=";R3;"OHMS"
4050 PRINT "R5=";R5;"OHMS"
4060 C1=C*1E6
4070 PRINT "C=";C1;"MICROFARADS"
4080 PRINT "F=";F;"HERTZ"
4090 PRINT "Q=";Q
4100 PRINT "G=";G
4110 PRINT
4120 PRINT
4130 INPUT "DO YOU WISH TO CONTINUE - Y OR N";X$
4140 Y1$="N"
4150 Y2$="Y"
4160 IF X$=Y1$ THEN 9999
4170 IF X$=Y2$ THEN 200
4180 GOTO 4130
4999 REM SCALE FREQUENCY BY CHANGING CAPACITORS
5000 IF R1>0 THEN 5030
5010 PRINT "CANNOT SCALE UNTIL VALUES ARE DETERMINED"
5020 GOTO 200
5030 INPUT "NEW FREQUENCY";F0
5040 C=C*F/F0
5050 F=F0
5060 GOTO 4000
5299 REM SCALE FREQUENCY BY CHANGING RESISTORS
5300 IF R1=0 THEN 5010
5310 INPUT "NEW FREQUENCY";F0
5320 D=F/F0
5330 R1=R1*D
5340 R3=R3*D
5350 R5=R5*D
5360 F=F0
5370 GOTO 4000
5599 REM SCALE IMPEDANCE OF ALL COMPONENTS
5600 IF R1=0 THEN 5010
5610  INPUT "NEW VALUE OF CAPACITOR";C0
5720 D=C0*1E-6/C
5730 C=C0*1E-6
5740 R1=R1/D
5750 R3=R3/D
5760 R5=R5/D
5770 GOTO 4000
5999 REM CASCADE IDENTICAL SECTIONS
6000 INPUT "HOW MANY SECOND ORDER SECTIONS";N
6010 INPUT "Q PER SECTION";Q1,"GAIN PER SECTION";G1
6020 B=2+(EXP(LOG(2)/N)-1)/(Q1*Q1)
6030 W1=.5*B+.5*SQR(B*B-4)
6040 W2=.5*B-.5*SQR(B*B-4)
6050 Q=SQR(W1)-SQR(W2)
6060 Q=1/Q
6070 PRINT "FOR";N;"SECTIONS EACH OF Q=";Q1
6080 PRINT "THE TOTAL Q IS";Q
6090 G=EXP(N*LOG(G1))
6100 PRINT "THE GAIN OF THE SYSTEM IS";G
6110 PRINT
6120 GOTO 4120
9999 END
```

this article was written to allow one to perform computer-aided design of second-order MFB filters.

The circuit diagram of an MFB filter is shown in Fig. 1. The labeling of the components is the same as that used in the program. The equations for performing the design are listed in Table 1. Most general-purpose op amps can be used in the filter.

This program has been written in such a manner as to be as versatile as possible. It should be helpful to the person wishing to design a filter of specified parameters and equally useful to the person who wishes to alter some parameter or component value in an existing MFB filter design. Take note: There are intrinsic limitations on the Q, gain, and center frequency of MFB filters which are not discussed in this article. The reader who is unfamiliar with these limitations should consult one of the references at the end of this article.

The program has seven possibilities for design, as follows:

1) Specify the values for R1, R3, and R5 in Ohms and C in uF. The program will calculate Q, G (the passband gain), and F (the center frequency, in Hz). This segment is useful in checking the parameters of a filter using the values of the available components.

Sample printout.

```
YOUR CHOICES ARE AS FOLLOWS
1 - CHOOSE R1, R3, R5 AND C
2 - CHOOSE G, Q, F AND C
3 - CHOOSE R1, F, Q AND C
4 - SCALE FREQUENCY BY CHANGING CAPACITORS
5 - SCALE FREQUENCY BY CHANGING RESISTORS
6 - SCALE IMPEDANCE OF COMPONENTS
7 - DO CALCULATIONS FOR CASCADED SECTIONS
ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE? 1
R1? 68E3
R3? 4.3E3
R5? 180E3
C? .015


FOR THIS DESIGN
R1= 68000 OHMS
R3= 4300 OHMS
R5= 180000 OHMS
C= .015 MICROFARADS
F= 393.253 HERTZ
Q= 3.3357
G= 1.32353


DO YOU WISH TO CONTINUE - Y OR N? Y
YOUR CHOICES ARE AS FOLLOWS
1 - CHOOSE R1, R3, R5 AND C
2 - CHOOSE G, Q, F AND C
3 - CHOOSE R1, F, Q AND C
4 - SCALE FREQUENCY BY CHANGING CAPACITORS
5 - SCALE FREQUENCY BY CHANGING RESISTORS
6 - SCALE IMPEDANCE OF COMPONENTS
7 - DO CALCULATIONS FOR CASCADED SECTIONS
ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE? 2
G? 1.33
F? 400
Q? 3.0
C? .015


FOR THIS DESIGN
R1= 59832.5 OHMS
R3= 4773.68 OHMS
R5= 159155 OHMS
C= .015 MICROFARADS
F= 400 HERTZ
Q= 3
G= 1.33


DO YOU WISH TO CONTINUE - Y OR N? Y
YOUR CHOICES ARE AS FOLLOWS
1 - CHOOSE R1, R3, R5 AND C
2 - CHOOSE G, Q, F AND C
3 - CHOOSE R1, F, Q AND C
4 - SCALE FREQUENCY BY CHANGING CAPACITORS
5 - SCALE FREQUENCY BY CHANGING RESISTORS
6 - SCALE IMPEDANCE OF COMPONENTS
7 - DO CALCULATIONS FOR CASCADED SECTIONS
ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE? 3
R1? 50E3
Q? 3
F? 400
C? .015


FOR THIS DESIGN
R1= 50000 OHMS
R3= 4849.77 OHMS
R5= 159155 OHMS
C= .015 MICROFARADS
F= 400 HERTZ
Q= 3
G= 1.59155


DO YOU WISH TO CONTINUE - Y OR N? Y
YOUR CHOICES ARE AS FOLLOWS
1 - CHOOSE R1, R3, R5 AND C
2 - CHOOSE G, Q, F AND C
3 - CHOOSE R1, F, Q AND C
4 - SCALE FREQUENCY BY CHANGING CAPACITORS
5 - SCALE FREQUENCY BY CHANGING RESISTORS
6 - SCALE IMPEDANCE OF COMPONENTS
7 - DO CALCULATIONS FOR CASCADED SECTIONS
ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE? 4
NEW FREQUENCY? 600


FOR THIS DESIGN
R1= 50000 OHMS
R3= 4849.77 OHMS
R5= 159155 OHMS
C= .01 MICROFARADS
F= 600 HERTZ
Q= 3
G= 1.59155


DO YOU WISH TO CONTINUE - Y OR N? Y
YOUR CHOICES ARE AS FOLLOWS
1 - CHOOSE R1, R3, R5 AND C
2 - CHOOSE G, Q, F AND C
3 - CHOOSE R1, F, Q AND C
4 - SCALE FREQUENCY BY CHANGING CAPACITORS
5 - SCALE FREQUENCY BY CHANGING RESISTORS
6 - SCALE IMPEDANCE OF COMPONENTS
7 - DO CALCULATIONS FOR CASCADED SECTIONS
ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE? 5
NEW FREQUENCY? 800


FOR THIS DESIGN
R1= 37500 OHMS
R3= 3637.33 OHMS
R5= 119366 OHMS
C= .01 MICROFARADS
F= 800 HERTZ
Q= 3
G= 1.59155


DO YOU WISH TO CONTINUE - Y OR N? Y
YOUR CHOICES ARE AS FOLLOWS
1 - CHOOSE R1, R3, R5 AND C
2 - CHOOSE G, Q, F AND C
3 - CHOOSE R1, F, Q AND C
4 - SCALE FREQUENCY BY CHANGING CAPACITORS
5 - SCALE FREQUENCY BY CHANGING RESISTORS
6 - SCALE IMPEDANCE OF COMPONENTS
7 - DO CALCULATIONS FOR CASCADED SECTIONS
ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE? 6
NEW VALUE OF CAPACITOR? .02


FOR THIS DESIGN
R1= 18750 OHMS
R3= 1818.67 OHMS
R5= 59683 OHMS
C= .02 MICROFARADS
F= 800 HERTZ
Q= 3
G= 1.59155


DO YOU WISH TO CONTINUE - Y OR N? Y
YOUR CHOICES ARE AS FOLLOWS
1 - CHOOSE R1, R3, R5 AND C
2 - CHOOSE G, Q, F AND C
3 - CHOOSE R1, F, Q AND C
4 - SCALE FREQUENCY BY CHANGING CAPACITORS
5 - SCALE FREQUENCY BY CHANGING RESISTORS
6 - SCALE IMPEDANCE OF COMPONENTS
7 - DO CALCULATIONS FOR CASCADED SECTIONS
ENTER THE NUMBER CORRESPONDING TO YOUR CHOICE? 7
HOW MANY SECOND ORDER SECTIONS? 4
Q PER SECTION? 3
GAIN PER SECTION? 1.59
FOR 4 SECTIONS EACH OF Q= 3
THE TOTAL Q IS 6.89688
THE GAIN OF THE SYSTEM IS 6.39129
```

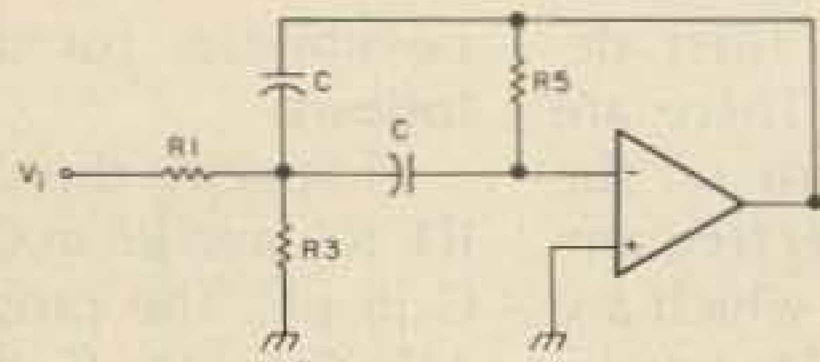

Fig. 1. Schematic of a second-order, multiple-feedback bandpass filter. The notation is the same as that of the program.

$$R1 = \frac{Q}{2\pi FGC}$$

$$R3 = \frac{Q}{2\pi FC(2Q^2 - G)}$$

$$R5 = \frac{Q}{\pi CF}$$

Table 1.

2) Specify the values of G, F, Q, and C. The program will calculate the values of R1, R3, and R5. Since resistors are usually more readily available than capacitors, this portion should be useful when the gain, Q, and center frequency are critical to the proper operation of the device.

3) Specify the values of R1, Q, F, and C. This segment is useful if one is trying to achieve a certain input impedance and the gain is not too critical.

4) This section allows one to change the center frequency of a previously designed filter by changing the value of the capacitors.

5) In this segment, one can change the center frequency by changing the value of the resistors.

6) This segment scales the impedance of the components in an MFB filter while retaining the same F, Q, and G. One chooses the new value for the capacitors and the program calculates the values of the resistors to maintain the same Q, F, and G. This is a useful feature if the desired values of C are not available and substitutes must be used.

7) This section allows one to predict the net Q and G of cascaded identical MFB sections. For example, three sections each of gain 2.0 and Q = 1.0 yield a net gain of 8.0 and a net Q of 1.96. Thus, there is a law of diminishing returns for the Q of cascaded sections. An unrealistic calculation shows that 120 cascaded sections each of Q = 2.0 would yield a net Q of 26.3!

The program has been written so that only the desired sections need be entered into the computer, in case a mass-storage device is not available. The program should run with no difficulty on any computer in which the BASIC has both floating-point arithmetic and string variables. Only minor modification would be needed to run the program on a machine that does not have string variables. This program has been run successfully on an 8K Pet.

To illustrate the use of the program, a sample printout has been included. It should be mentioned that several of the computer-generated designs were built on a breadboard and that the measured performance agreed very well with the theoretically predicted performance. ■

References

1. "Design Your Own Active Filters," H. M. Berlin, *QST*, June, 1977.
2. "Active Bandpass Filters," T. A. Conboy, *Ham Radio*, December, 1977.
3. *The Radio Amateur's Handbook*, Fifty-sixth edition, American Radio Relay League, Newington CT.
4. *The Active Filter Cookbook*, #21168, Howard W. Sams, Indianapolis IN, 1975.
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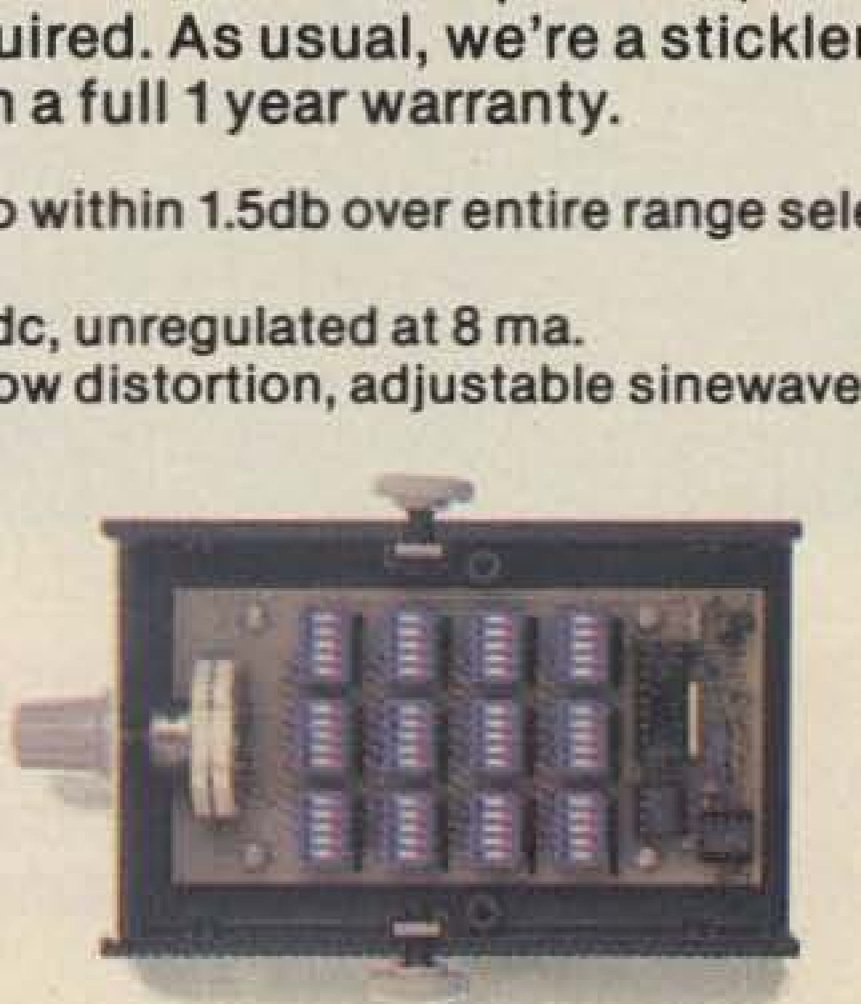

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74.4 WA	91.5 ZZ	110.9 2Z	136.5 4Z	167.9 6Z	
77.0 XB	94.8 ZA	114.8 2A	141.3 4A	173.8 6A	
79.7 SP	97.4 ZB	118.8 2B	146.2 4B	179.9 6B	
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Heat is a hazard to all electronics projects. Many electronics enthusiasts have experienced the displeasure of watching a prized project destroy itself with heat. Understanding heat transfer and heat-sink selection is necessary to avoid this hazard.

This article explains the fundamentals of heat-sink selection, which are easy to understand and apply. It begins with a review of the ways heat is transferred, explains how to calculate the temperature inside a semiconductor component, provides an example of heat-sink selection, and contributes some hints for interpreting semiconductor and heat-sink thermal specifications.

The Review

"Heat transfer" is more accurate in describing the removal of heat than "heat flow." The word "flow" limits the possibilities we associate with the phenomenon to a single action—such as water flowing. Heat is transferred by *three* mechanisms.

It is transferred by radiation as an electromagnetic wave. The heat transmitted from the sun through the vacuum of space to the Earth is an example of radiation.

Heat is transferred by conduction when two objects are in contact. A soldering iron melts solder by conduction.

Heat is transferred by convection when a fluid medium, such as air, moves across the surface of an object. The air drawn through the radiator of your automobile cools the radiator by convection. When air is blown across an object, it is called *forced* convection. But, the air surrounding a warm object will rise, causing cooler air to replace it without the aid of a fan. When air is allowed to circulate by heating, it is called *natural* convection.

Heat is transferred from semiconductor devices by all three mechanisms, as illustrated by the transistor in Fig. 1. It is radiated from the transistor chip to the case (a) and is conducted to the case where the substrate and case are in contact (b). The heat transferred to the case distributes itself throughout the case by conduction and, then, is transferred to the surrounding air by convection (c). If a heat sink is attached to the transistor, heat is transferred from the transistor case to the heat sink by conduction and to the surrounding air by convection. Also, it is radiated from the case and heat sink to objects nearby.

However, the amount of heat transferred by radiation is a small percentage of the heat transferred by convection. For this reason, the heat transfer equations typically used in heat-sink selection calculate only the heat transferred by natural convection. Similarly, the heat transferred by radiation from the chip to the case does not receive special attention in the calculations. And despite the inaccuracy, convenience makes us think of heat as flowing. These simplifications ease the analysis process.

Not all heat generated in the transistor is transferred to the air. Each segment of

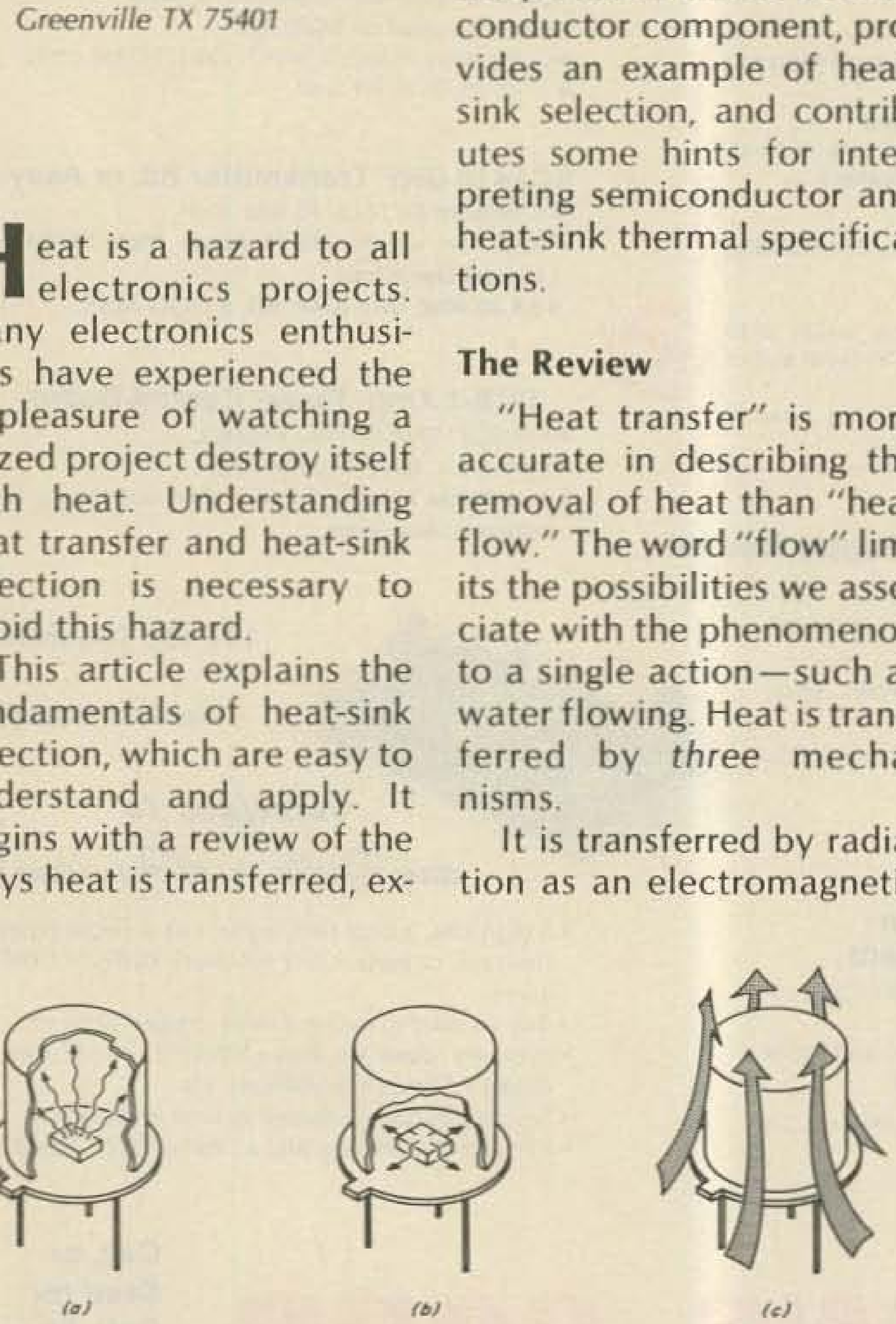

Fig. 1. Heat transfer from a transistor: (a) from chip to case by radiation; (b) from chip to case by conduction; (c) from case to air by convection.

the path between the chip and the air resists heat flow in a manner similar to a resistor resisting current flow. The heat retained in the transistor because of this impedance causes the temperature of the chip to rise. Our goal is to determine the temperature of the transistor chip. The chances of its destruction then can be evaluated.

The Fundamentals

In classical physics, equations have been developed for calculating the amount of heat transferred; they are not complicated. However, their solution depends upon parameters which are difficult to evaluate in practice. For this reason, engineers have devised equations which do not use these parameters, but which make heat flow analogous to electric current flow. In this analogy, a heat source is analogous to a current source, thermal resistance to electrical resistance, and temperature to voltage. The equation relating them is like Ohm's Law and says that *the difference in temperature (voltage drop) across a thermal resistance is equal to the thermal resistance multiplied by the heat (current) flowing through the resistance.* This thermal equivalent to Ohm's Law is expressed by the equation $T = \theta P$.

The symbol θ, with subscripts to indicate the circuit connections, commonly represents thermal resistance. For example, θ_{JC} is the thermal resistance between the transistor chip and its case. (The capital "J", for junction, is used widely to represent the source of heat in semiconductor components.) Values of thermal resistance for semiconductor components and heat sinks are usually obtained from their respective specifications. In an electronic component, heat originates as power dissipated by the device. The thermal analogy carries this into the electrical thermal model by making power, identified by a capital "P," equal to heat. (Sometimes the lowercase "q" is used to represent power because this symbol is used for heat in physics.)

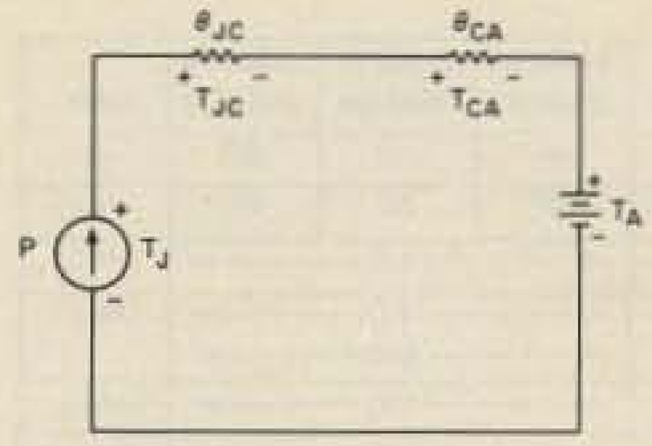

Fig. 2. Thermal circuit for a semiconductor.

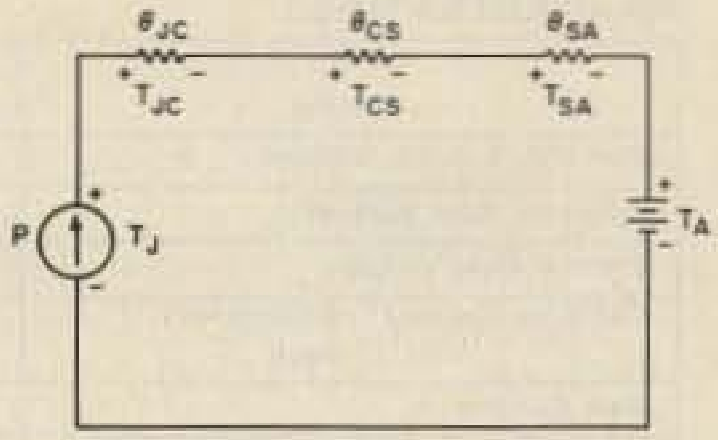

Fig. 3. Thermal circuit for a semiconductor with a heat sink.

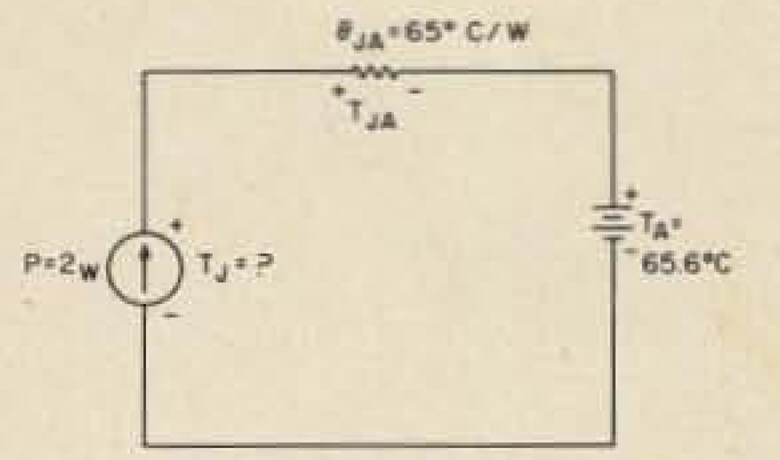

Fig. 4. Thermal circuit for the example without a heat sink.

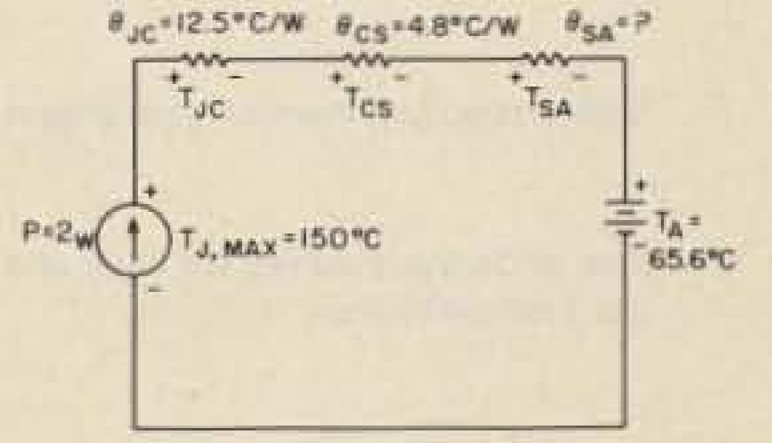

Fig. 5. Thermal circuit for the example with a heat sink.

The Calculations

Our goal is twofold. First, we must determine the temperature of the semiconductor chip. If this temperature exceeds a safe value, we must determine the thermal specifications for a heat sink which will provide adequate transfer away from the transistor. Using the electrical thermal analogy, the calculations involved in both tasks are similar to electric circuit calculations.

A diagram for the thermal circuit of a transistor is illustrated in Fig. 2. The unique feature of this diagram is the voltage source labeled T_A. This addition does not alter the validity of the model. The properties of the theoretically perfect current source (labeled P) do not allow current to flow backward through it. Since it is the only source of current in the circuit, the current flowing through the circuit equals P. The voltage source is simply a way of representing the temperature of the surrounding air (called the *ambient temperature*). It is convenient to include it so that the ambient temperature appears in Kirchoff's voltage equations for the circuit. Some people, choosing to account for T_A later in the analysis, do not include this source.

A resistor represents the thermal resistance of each segment along the path between the semiconductor junction and the ambient. Each segment can be identified by the letters comprising its subscripts. Beginning at the junction, these are JC for junction-to-case and CA for case-to-ambient.

The thermal analogy for Kirchoff's Voltage Law says that the temperature of a semiconductor chip is equal to the sum of the temperature drops around the remainder of the circuit. This is expressed by the equation $T_J = T_{JC} + T_{CA} + T_A$, where T_J is the semiconductor chip temperature, T_{JC} is the temperature drop across θ_{JC}, T_{CA} is the temperature drop across θ_{CA}, and T_A is the ambient temperature. The values of T_{JC} and T_{CA} can be calculated from the thermal equivalent of Ohm's Law. Substituting these into the above equation, the junction temperature equation becomes $T_J = (\theta_{JC} + \theta_{CA})\,P + T_A$.

Many times, a manufacturer specifies a value for θ_{JA}, which is the thermal resistance between the junction and the ambient. θ_{JA} is equal to the sum of θ_{JC} and θ_{CA} and may be used in the preceding equation instead.

A thermal circuit which includes the thermal resistances associated with a heat sink is illustrated in Fig. 3. The case-to-ambient resistance, θ_{CA}, has been replaced by two resistances, the case-to-sink resistance, θ_{CS}, and the sink-to-ambient resistance, θ_{SA}. When these are substituted for θ_{CA}, the equation for the semiconductor junction temperature becomes $T_J = (\theta_{JC} + \theta_{CS} + \theta_{SA})P + T_A$. A heat sink is selected on the basis of its θ_{SA}, which characterizes its ability to transfer heat into the surrounding air. To determine the largest value of θ_{SA} that will maintain a safe semiconductor temperature, the equation is solved for θ_{SA}. This yields the following equation: $\theta_{SA} = [(T_J - T_A)/P] - (\theta_{JC} + \theta_{CS})$.

An Example

Suppose you are designing an audio amplifier. You have estimated the power dissipation of the output transistor at 2 Watts. Having selected a transistor, you determine the relevant parameters from the transistor data sheet. These parameters are the maximum allowable power dissipation (P_{max}), the maximum operating junction temperature ($T_{J,max}$), the junction-to-case thermal resistance (θ_{JC}), and the junction-to-ambient thermal resistance (θ_{JA}). The values you found are listed below.

$P_{max} = 10$ Watts
$T_{J,max} = 150°$ C
$\theta_{JC} = 12.5°$ C/W
$\theta_{JA} = 65°$ C/W

Also, you note that the

Item 3: maximum junction operating temperature.

Item 4: specified thermal resistance θ_{JC}.

Item 6: derating curves for case and ambient temperatures.

Item 1: maximum power dissipation at specified case temperature and derating.

Item 2: maximum power dissipation at specified ambient temperature and derating.

Item 5: specified thermal resistance θ_{JA}.

MAXIMUM RATINGS

Rating	Symbol	2N6034 2N6037	2N6035 2N6038	2N6036 2N6039	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	Vdc
Collector-Base Voltage	V_{CB}	40	60	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous Peak	I_C	4.0 8.0			Adc
Base Current	I_B	100			mAdc
Total Power Dissipation @ $T_C = 25°C$ Derate above 25°C	P_D	40 0.32			Watts W/°C
Total Power Dissipation @ $T_A = 25°C$ Derate above 25°C	P_D	1.5 0.012			Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	3.12	°C/W
Thermal Resistance, Junction to Ambient	θ_{JA}	83.3	°C/W

*Indicates JEDEC Registered Data.

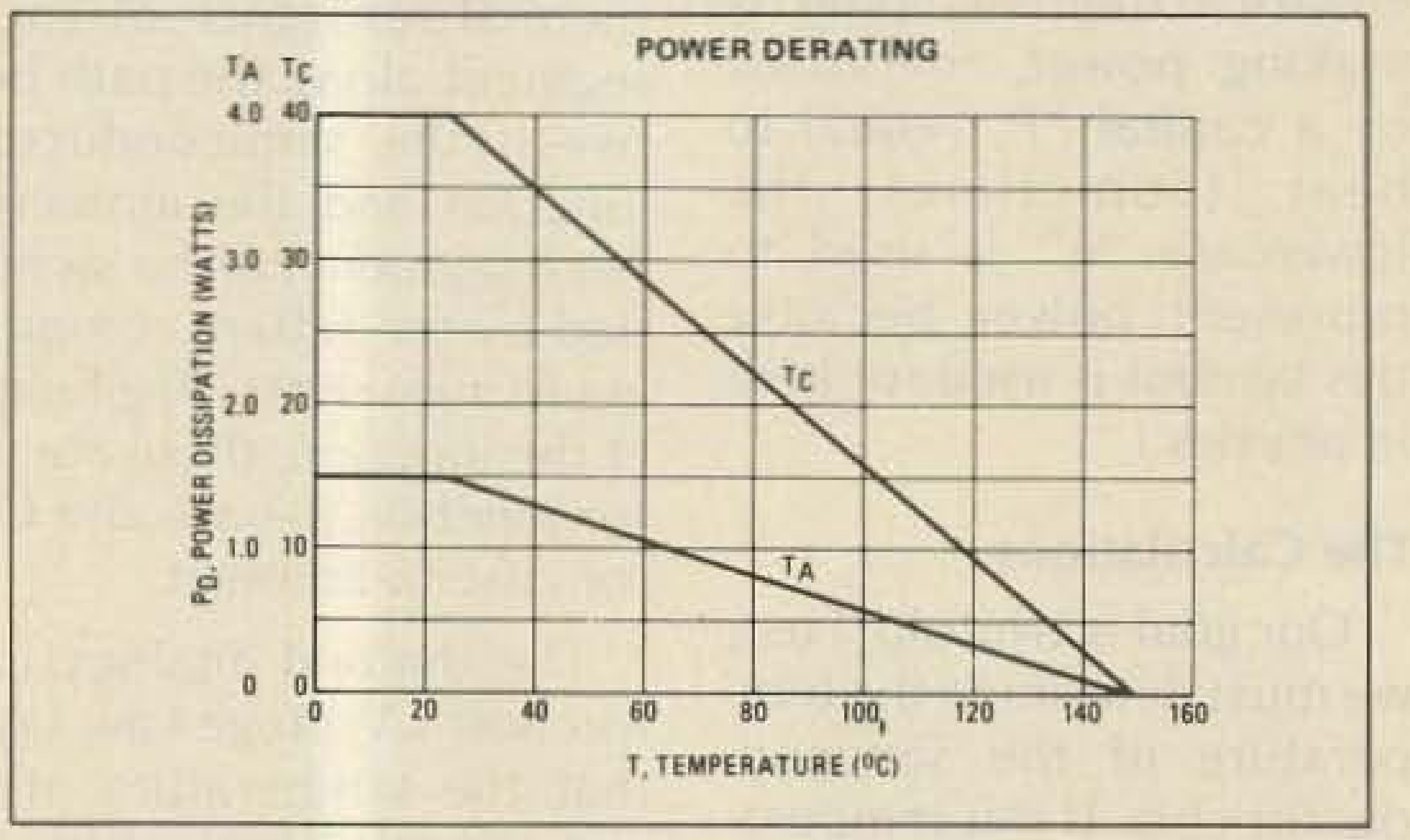

Fig. 6. Semiconductor thermal specifications and parameters.

transistor is in a TO-202 (plastic) case. In addition to these specified parameters, you have ascertained that the temperature of the air surrounding the transistor will not exceed 150° F (65.6° C). Good design practice suggests that you use a value between 10 and 20 percent greater than your estimated value for this temperature, as a safety factor, which you have done. (A diagram of the thermal circuit is shown in Fig. 4.)

Because your first concern is whether your transistor needs a heat sink, you use the value specified for θ_{JA} to calculate T_J as follows:

$T_J = (\theta_{JA})P + T_A$

$T_J = (65)2 + 65.6$

$T_J = 195.6° C$

The calculated value of T_J is greater than the specified maximum operating junction temperature ($T_{J,max}$) by 45.6° C.

The next step is to determine the thermal resistance required of the heat sink. This is accomplished by solving the equation for θ_{SA} after substituting the value of $T_{J,max}$ for T_J. However, the value of one other parameter, the case-to-sink thermal resistance, θ_{CS}, must be determined before

Case Style	Metal-to-Metal Dry	Metal-to-Metal Lubricated	Insulated Dry	Insulated Lubricated
TO-3	0.5	0.1	1.3	0.36
TO-66	1.5	0.5	2.3	0.9
TO-83	—	0.1	—	—
TO-94	—	0.1	—	—
TO-126	2.0	1.3	4.3	3.3
TO-127	1.6	0.8	2.6	1.8
TO-202	1.3	0.9	4.8	2.0
TO-220	1.2	1.0	3.4	1.6

Table 1. Case-to-sink thermal resistance in °C/W.

this equation can be solved. θ_{CS} depends upon the method used to mount the transistor. It usually is provided in a table by heat-sink manufacturers and, occasionally, semiconductor manufacturers. Table 1 lists values of θ_{CS} for some common transistor case types and mounting methods.

After obtaining a value of 4.8° C/W for θ_{CS}, the completed thermal diagram is shown in Fig. 5. θ_{SA} is calculated as follows:

$\theta_{SA} = [(150 - 65.6)/2] - (12.5 + 4.8)$

$\theta_{SA} = 24.9° C/W$

A heat sink with a thermal resistance of 24.9° C/W or less will provide adequate heat transfer. A number of small, inexpensive heat sinks with a θ_{SA} of 20° C/W for the TO-202 case style are available. You simply select one which meets your mounting requirements.

The Semiconductor Specs

Except for saying that they are found in the manufacturers' data sheets, details of how the values for thermal resistances are obtained have not been discussed. Yet determining these values from the specifications sometimes requires skill. Familiarity with the types of data most likely to appear in the data sheet is necessary to success. With the aid of the data sheet appearing in Fig. 6, this data and its interpretation are described in the following paragraphs.

The data sheet in Fig. 6. was chosen to illustrate common methods of specifying semiconductor thermal specifications for two reasons. First, all of the specifications are labeled clearly and are arranged into a single, logical area of the specification. This is not true of all semiconductor data sheets. Often, thermal specifications, particularly for linear integrated circuits, are placed in notes. (The entire data sheet should be read before concluding that they have been omitted.) The second reason for selecting the data sheet shown in Fig. 6 was that it contained all of the data relating to thermal specification. A typical data sheet will provide only a portion.

Thermal resistance is specified by direct specification, by derating, and by thermal-related parameters. A manufacturer uses direct specification when he tabulates thermal resistance in data sheets. The designer simply inserts the specified values into his thermal equations. Items 4 and 5 of Fig. 6 illustrate direct specifications.

A derating specifies how quickly the maximum power dissipation must be decreased as the case or ambient temperature increases. A derating may be given by statement (illustrated by items 1 and 2) or by curve (illustrated by item 6). A numeric value for thermal resistance is needed for the thermal analysis. The technique for determining a number from this kind of specification is more easily explained using an example.

The derating (item 1) indicates that the 2N6034 has a maximum power dissipation of 40 Watts at a case temperature of 25° C. It also indicates that this should be derated at 0.32 W/°C above 25° C. The derating is assumed to be linear above the specified temperature unless otherwise specified. This means that for every degree increase in case temperature, the dissipated power must be decreased by 0.32 Watts.

An examination of the electrical thermal model in Fig. 2 causes us to conclude that the power has to be decreased because junction-to-case thermal resistance is limiting heat flow from the device. Furthermore, the rate at which the power must be decreased as the temperature increases is related to the value of this thermal resistance. Actually, *the rate of derating is the reciprocal of the thermal resistance.* Thus, the junction-to-case thermal resistance for the 2N6034 can be calculated:

$\Theta_{JC} = 1/0.32$

$\Theta_{JC} = 3.125° \text{ C/W}$

The same technique can be applied to determine the junction-to-ambient thermal resistance from the derating in item 2.

The type of thermal resistance specified is indicated by the location of the specified temperature. The subscript attached to the temperature symbol identifies this location.

Frequently, a manufacturer will provide a derating curve, such as the one illustrated in Fig. 7, which provides the same information in graphical form. The horizontal axis indicates temperature. In this curve, it is temperature at the case. The vertical axis is the maximum dissipated power allowed at the indicated temperature. To find the thermal resistance from a derating curve, divide the difference in temperature by the difference in dissipated power. From Fig. 7, the temperature changes from 25° C to 150° C, which is 125° C. The change in dissipated power over this temperature range is from 40 Watts to 0 Watts, a difference of 40 Watts. Thus, Θ_{JC} is calculated by dividing 125 by 40.

$\Theta_{JC} = 125/40$

$\Theta_{JC} = 3.215° \text{ C/W}$

Notice (in item 6 of Fig. 6) that Motorola gave a derating curve for both case and ambient temperatures. Each curve is labeled with the appropriate temperature.

A manufacturer may not specify either a thermal resistance or a derating. However, a knowledgeable designer can determine a derating specification from other specifications and calculate the thermal resistance from this derating.

The key to determining a derating curve for a semiconductor is to find two points of the curve above the temperature where it begins to slope downward. Among other parameters, the derating curve specifies the temperature above which the device can no longer be operated, that is, $T_{J,max}$ (see Fig. 7). At this temperature, the power must be zero. This is equivalent to saying that the current must equal zero in the electrical thermal circuit (Fig. 2).

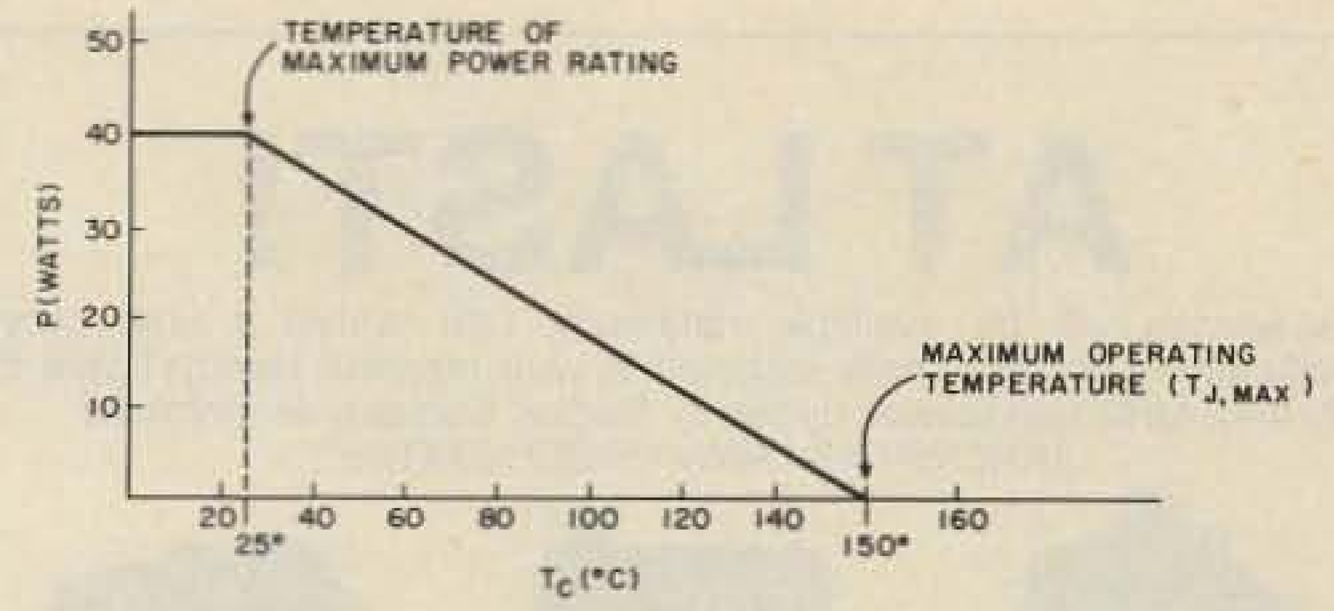

Fig. 7. Transistor power derating curve.

Because no current is flowing in the circuit, no temperature is dropped across either Θ_{JC} or Θ_{CA}. Thus, the maximum operating temperature of the device must equal the maximum operating ambient temperature and the maximum operating case temperature. When the manufacturer specifies $T_{J,max}$, one point on both the ambient and the case temperature derating curves is known. The second point on the derating curve is established as the temperature where the maximum power dissipation is specified.

For example, the following are specified for the 2N6034 (items 1 and 3).

$P_{max} = 40 \text{ Watts} @ T_C = 25° \text{ C}$

$T_{J,max} = 150° \text{ C}$

The fact that this data agrees with the derating curve can be verified by comparing these two points on the derating curve labeled T_C in Fig. 6, item 6. Though Motorola seems to specify P_{max} as part of the derating specification, the appearance is created by the organization of the data sheet. The common practice is to specify that parameter, though no derating is specified.

Typically, the values of thermal resistance calculated from the derating curve and from the power and temperature specifications will agree with the specified thermal resistances within a few percent. Have you calculated Θ_{JA} by the above methods to find how closely they agree to its specified value?

As a designer searches for thermal specifications, he will discover that either Θ_{JA} or Θ_{JC}, but not both, is specified for a number of devices. Also, these specifications will be void of data which allows calculation of the unspecified value. This is true because manufacturers specify the parameters they believe relevant to the use of the device being specified, as they understand its application. In this regard, a device may fall into one of three categories.

It may have a specific function and the designer is not expected to concern himself directly with the power dissipation versus temperature relationship. For example, an SN7400 TTL quad NAND logic gate has a specific function. In this case, the manufacturer specifies the maximum temperature of operation for the device. The designer is expected to limit the ambient temperature to a value such that the specified value is not exceeded.

A device may be designed for use with or without a heat sink. These devices, being rated between 0.25 and 5 Watts dissipation without a heat sink, usually are classified as small or intermediate power devices. An example is the 2N6034 Darlington used in the above examples. Both θ_{JA} and θ_{JC} are specified for these devices.

Lastly, a device may be classified for use only with a heat sink. These are the high-power devices, such as the 2N3055. The data manuals commonly provide only the data required to determine the heat-sink requirements.

The Heat-Sink Specs

Values of thermal resistance for heat sinks are more easily determined from data sheets than are those for semiconductors. Thermal resistance for a heat sink can be provided by either of two methods. The first is by direct statement, as in the case of semiconductors. The second method is by curve, as illustrated in Fig. 8. The horizontal axis is heat as power dissipated. The vertical axis shows the temperature difference between the heat sink and ambient caused by the heat flow. To find the thermal resistance, simply find the temperature difference caused by the heat flowing in your thermal circuit. Then, divide the temperature difference by that power.

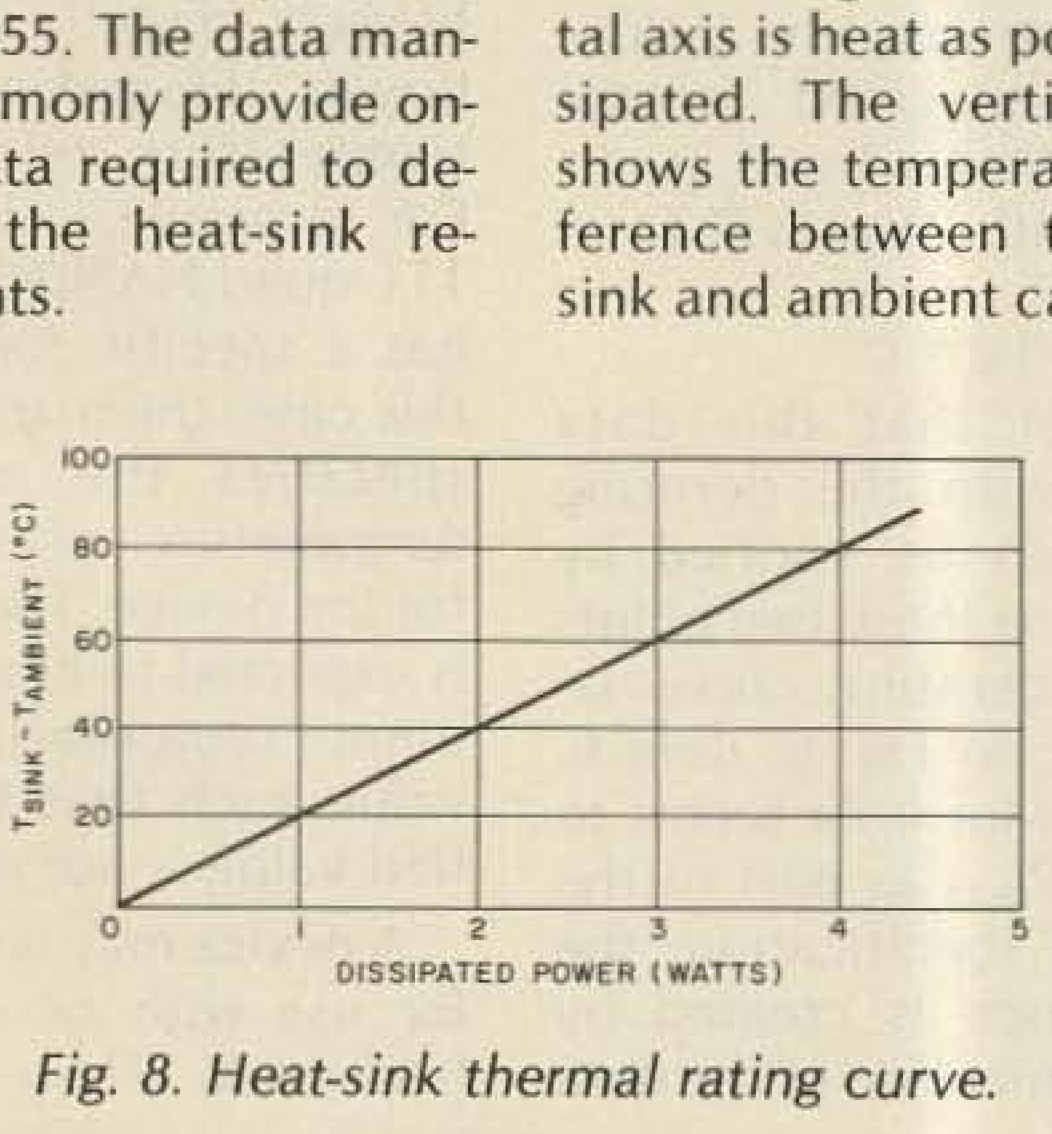

Fig. 8. Heat-sink thermal rating curve.

In the example where we calculated θ_{SA}, the audio output transistor dissipated 2 Watts. The curve in Fig. 8 shows a temperature difference of 40° C at a 2-Watt power dissipation. Thus, the thermal resistance is:

$\theta_{SA} = 40/2$

$\theta_{SA} = 20° \text{ C/W}$

Sometimes, the thermal resistance curve is nonlinear, meaning that θ_{SA} changes as the dissipated power increases. Thus, it will not be a straight line, as shown in Fig. 8. Usually, it is straight. In either case, this technique determines θ_{SA} easily.

All manufacturers provide curves with essentially the same data. The only difference is the axis labeling. For example, IERC labels the vertical axis on some of their data sheets "maximum sink temperature rise above ambient (°C)." To avoid confusion, simply remember the thermal equivalent of Ohm's Law: A temperature difference is caused by heat flowing through a thermal resistance.

One other factor must be considered during heat-sink selection. The thermal resistance of a heat sink is specified for a specific physical orientation of the heat sink. (This is true of semiconductors, also.) Except for heat sinks which are designed for special applications, the manufacturer specifies the resistance for *maximum unobstructed natural convection.* To understand the meaning of this, recall that natural convection depends upon heated air rising to be replaced by cooler air. A heat sink operates properly when air can circulate freely across the maximum area of every fin. This means that it should be mounted with its fins vertical. Also, the ends should be kept clear to allow unobstructed entry of air between the fins at the bottom and exit from the top. *Your mounting constraints should always be considered during heat-sink selection.*

Summary

The principles involved in heat-sink selection are now complete. The thermal circuit and its electrical equivalent provide a theoretical model for easy analysis of thermal phenomena. Thermal resistances for an equivalent circuit are determined from the manufacturers' data sheets. Applied to the thermal circuit, Ohm's Law and Kirchoff's Voltage Law, which are understood by those who work with electrical circuits, allow calculation of the semiconductor junction temperature. The calculated temperature is compared to the maximum temperature specified by the manufacturer to determine the necessity of a heat sink. If a heat sink is required, the maximum semiconductor temperature is substituted into the equations to determine the maximum thermal resistance for a heat sink which will limit the junction temperature to a safe value.

Two criteria are used to select a heat sink: Its thermal resistance must be less than the calculated maximum value and its mounting must be consistent with the designer's application. Heat-sink selection using these criteria completes the process.

Acknowledgements

The semiconductor data contained in Fig. 6 was reproduced from page 4-195 of the *Power Device Data Manual,* 1st Edition, copyright 1978 by Motorola Semiconductor Products, Inc., Phoenix, Arizona. Permission to print this portion of the manual was provided by Motorola. ■

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Promises, promises. How can any SSB exciter be inexpensive when an i-f filter is needed? I have been regaled with plans for inexpensive SSB generators, but the operative paragraph usually describes how the filter was found deep in the bowels of the faithful junk box or bought for a song from an unsuspecting entrepreneur at the last flea market. I have always arrived just as the last treasure has been sold. The promise of an inexpensive exciter eluded me.

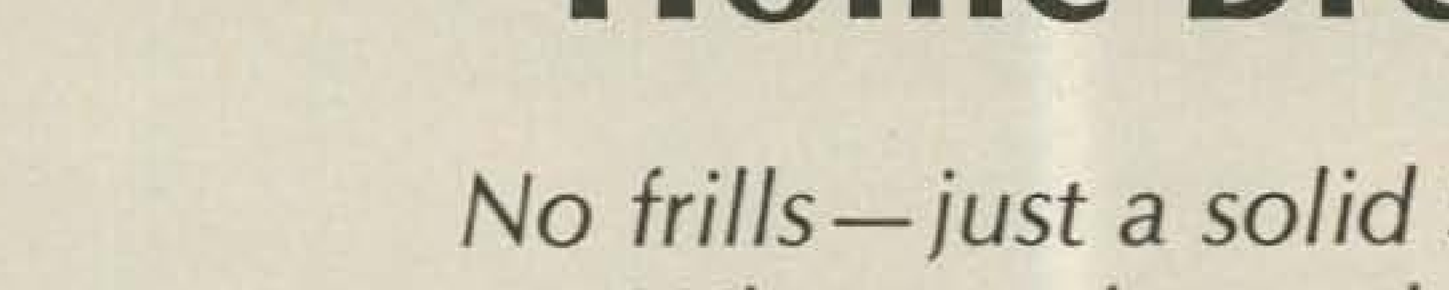
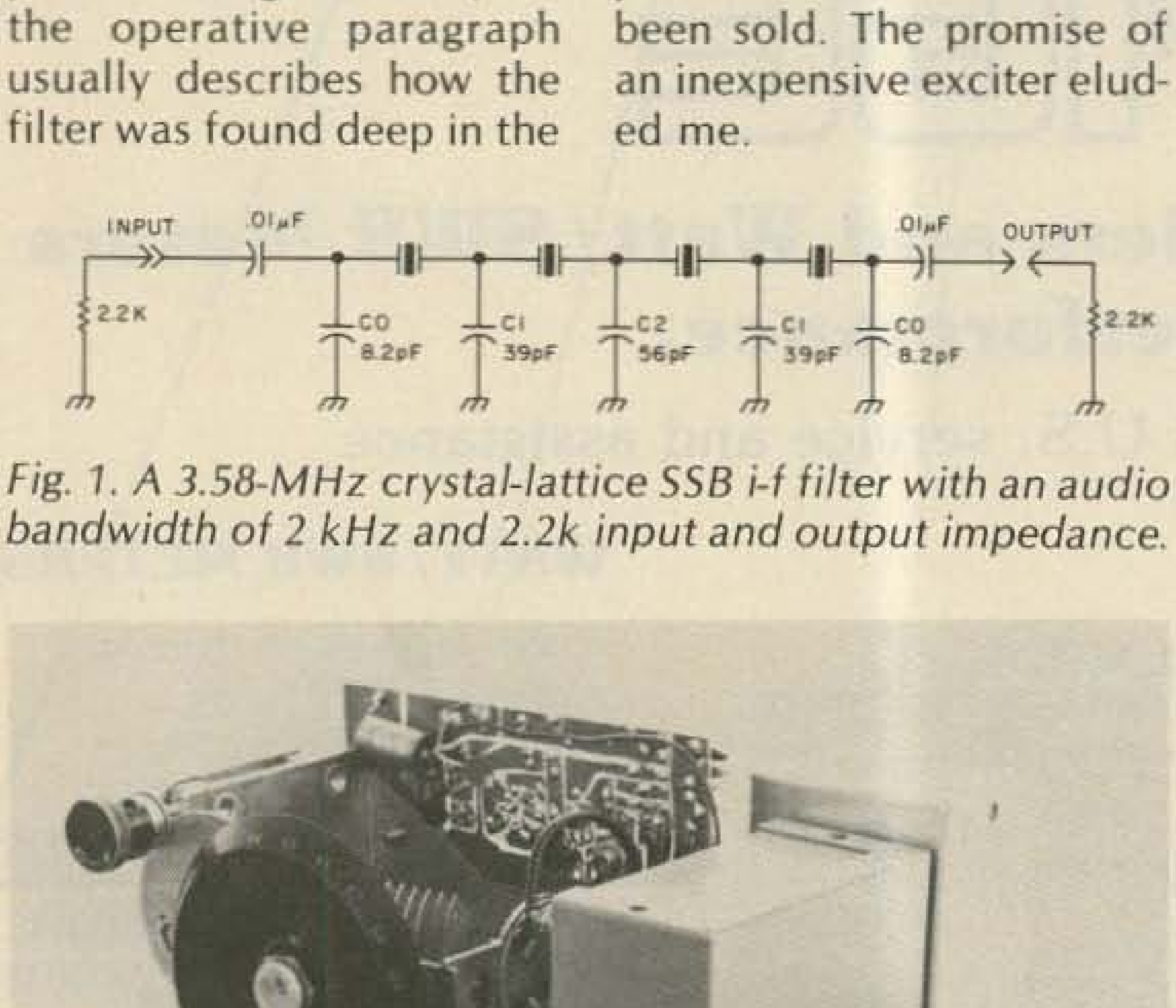


Fig. 1. A 3.58-MHz crystal-lattice SSB i-f filter with an audio bandwidth of 2 kHz and 2.2k input and output impedance.

So what am I offering you? Another inexpensive SSB exciter. This time the operative paragraphs will describe how you can make a very satisfactory crystal i-f filter for less than $10.00 which needs no critical tuning or messy and unpredictable crystal grinding. I will then describe how I used it in a 15-meter exciter.

This simple filter is made using four of the ubiquitous 3.58-MHz television crystals in a ladder configuration as shown in Fig. 1. If all you want is a simple i-f filter, this could be built as described by the schematic and you would be pleasantly impressed by its performance. For those who are innovators and have other crystals which are the same in frequency, there are general design rules for making two-, three-, and four-crystal filters. Fig. 2 gives the normalized capacitance values for these. To find the actual value of



The prototype 15-meter SSB exciter.

The exciter displaying the crystal filter mounted in a minibox for shielding.

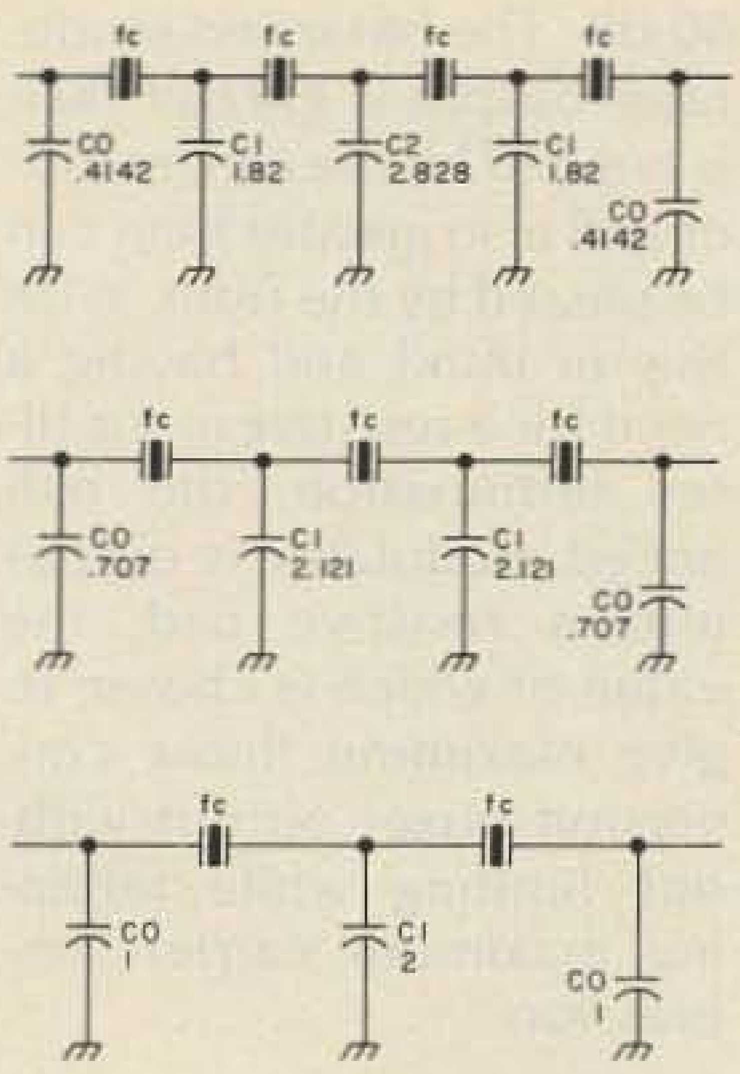


Fig. 2. To find the actual value of the shunt capacitors, multiply the coefficient beside each capacitor by 1/(2πfR), where f is the crystal frequency and R is the filter design impedance.

each capacitor, the coefficient beside each capacitor must be multiplied by 1/(2πfR) where f is the resonant frequency of the crystals in Hertz and R is the design input and output impedance in Ohms. For the suggested filter using the 3.58-MHz crystals, R was chosen to be 2.2k Ohms—thus 1/(2πfR) = 20 pF. C_0 = .4142 × 20 pF = 8.284 pF = 8.2 pF; C_1 = 1.82 × 20 pF = 36.40 pF = 39 pF; C_2 = 2.828 × 20 pF = 56.56 pF = 56 pF.

If the impedance was chosen to be 1.8k Ohms, then C_0 = 10 pF, C_1 = 47 pF, and C_2 = 68 pF. Thus, the impedance which is chosen to work toward is flexible, but there are a few considerations to notice. As the impedance is lowered, the passband of the filter is reduced and the insertion loss will increase. On the other hand, as the impedance is increased, the passband widens but the ripple in the passband also increases. As well, the low capacitance values for higher impedances make stray capacitance more troublesome.

This technique has been used by others to make filters using surplus crystals in the 8-to-12-MHz ranges as well. It was stated that a design impedance of 800 to 1000 Ohms was usable at that frequency for an SSB filter. A design impedance of 1500 Ohms was usable at 5 MHz.

In putting this filter into a circuit, it is imperative that it be properly terminated in its design impedance, both on the input and output. Neglecting this can give a very high passband ripple.

Now, you may think, we have the filter, but there is always a need for carrier-oscillator crystals. Good news! The series resonant frequency of the crystals controls the lower limit of the passband, so one more crystal identical to those used in the crystal filter will allow selection of the upper sideband. How easy can it be?

Listening to OSCAR 8, mode A has whet my appetite for a taste of operating through this satellite. One constraint seems to be that one should have full-duplex capabilities for the most success, but I had no VHF equipment and only one HF transceiver. I built a simple transmitting converter with five Watts output on 2 meters for one-milliwatt input on 15 meters. This gave me VHF capability. I first proposed to excite this with a CW signal; then the idea of a DSB exciter was entertained before I discovered the inexpensive crystal filter just described. I then could proceed with a full SSB exciter with an output power of one milliwatt on 15 meters. The design philosophy was very simple—I used the parts I had easily available to build a basic transmitter without bells and whistles. This was done and I am happy with the results.

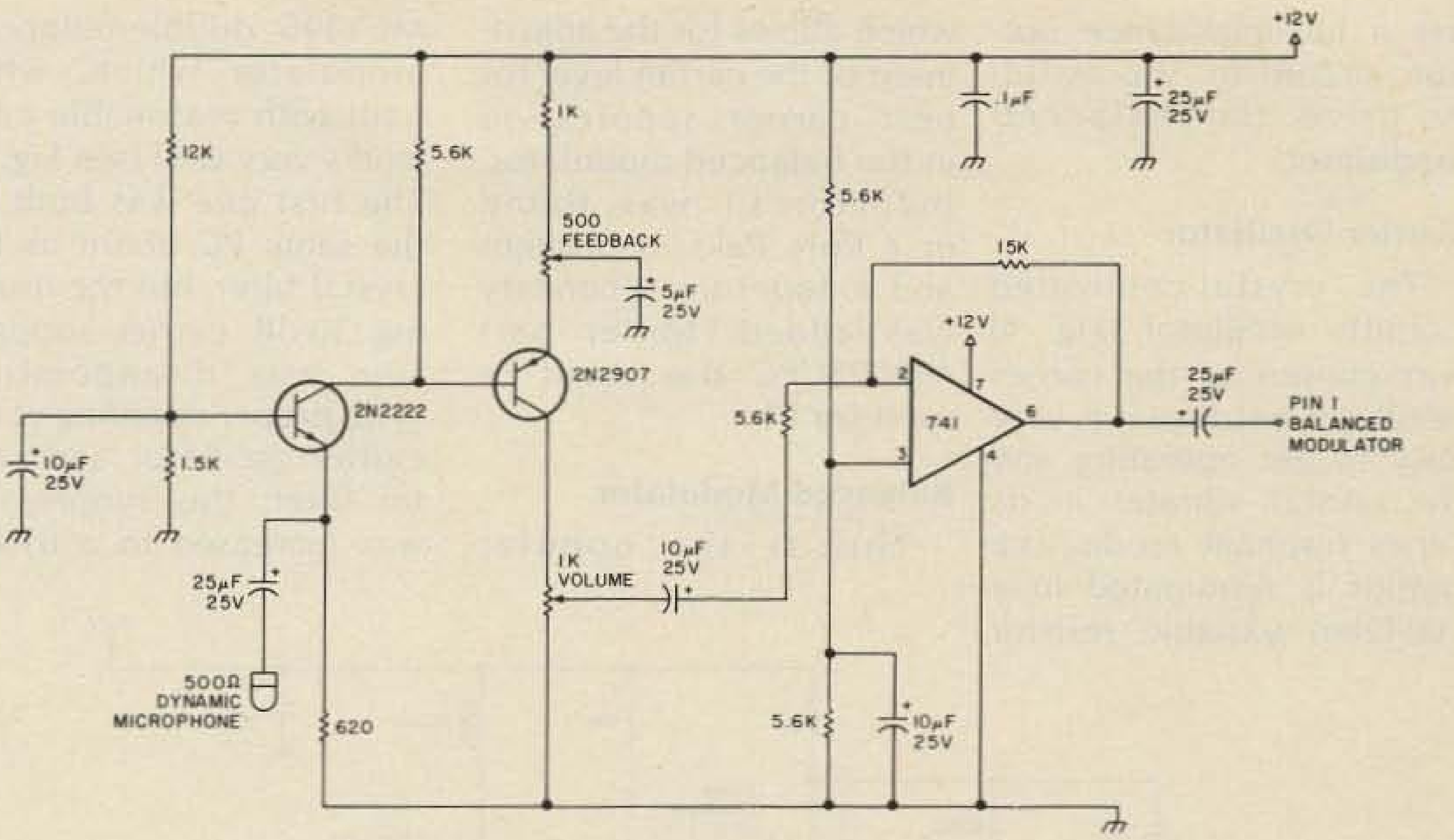


Fig. 3. Microphone amplifier.

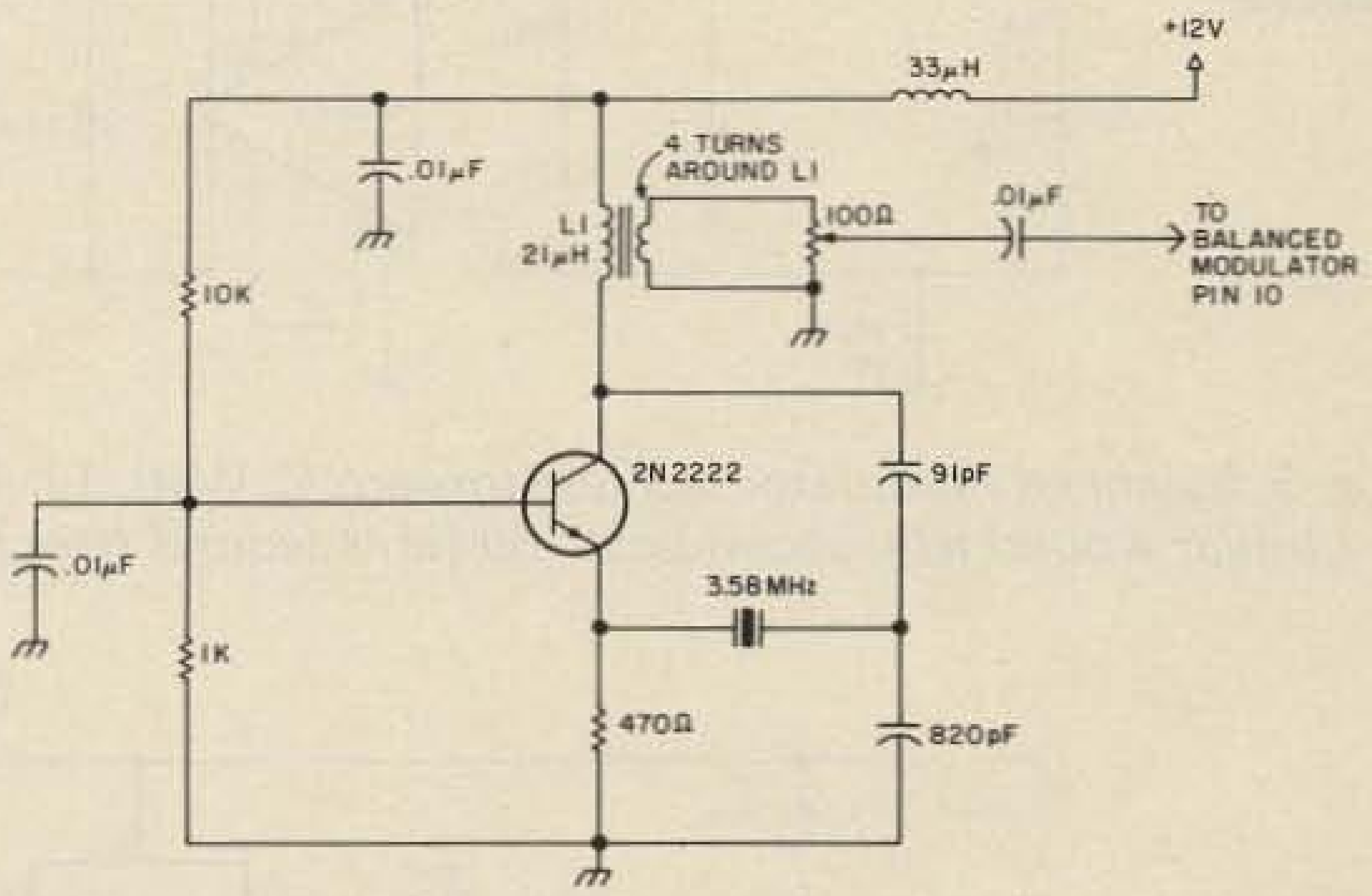


Fig. 4. Carrier oscillator. All resistors are ¼ Watt. L1 could be Miller part 46A225CPC with a 4-turn secondary added, available from Radiokit, Box 411H, Greenville NH 03048.

Microphone Amplifier

The microphone amplifier described in Fig. 3 must match a low-impedance dynamic microphone to a low-impedance, balanced-modulator input while increasing the microphone output of 2 mV to one volt. The first stage is a common base amplifier to take advantage of the low input impedance and high voltage gain of this configuration. This directly drives a common emitter amplifier with adjustable feedback in the emitter to control the gain of this stage. The output stage is the common 741 operational amplifier, used for its very low output impedance which easily drives the 100-Ohm audio input of the balanced modulator. If you have other microphones, you will need different amplifier circuits than this. Just remember to use a low-impedance output circuit to successfully drive the balanced modulator.

Carrier Oscillator

The crystal-controlled Colpitts oscillator (Fig. 4) was chosen as the carrier oscillator because it is very easy to get operating and the crystal vibrates in its series resonant mode. The output is terminated in a 100-Ohm variable resistor which allows for the adjustment of the carrier level for best carrier suppression in the balanced modulator. Inductor L1 was found in a Poly Paks assortment and a four-turn secondary was added. Miller part 46A225CPC also could be used for L1.

Balanced Modulator

This is the popular MC1496 double-balanced modulator which, when built with reasonable care, works very well (see Fig. 5). The first one was built on the same PC board as the crystal filter, but the resulting 30-dB carrier suppression was disappointing. With proper shielding of the carrier oscillator and crystal filter, this suppression was increased to a usable 50 dB. The balanced-modulator output is greater than is needed by the carrier mixer and also greater than can be passed by the filter. With this in mind and having a need for a resistive input-filter termination, the balanced modulator is output into a resistive pad, the value of which is chosen to give maximum linear conversion mixer output without limiting while retaining maximum carrier suppression.

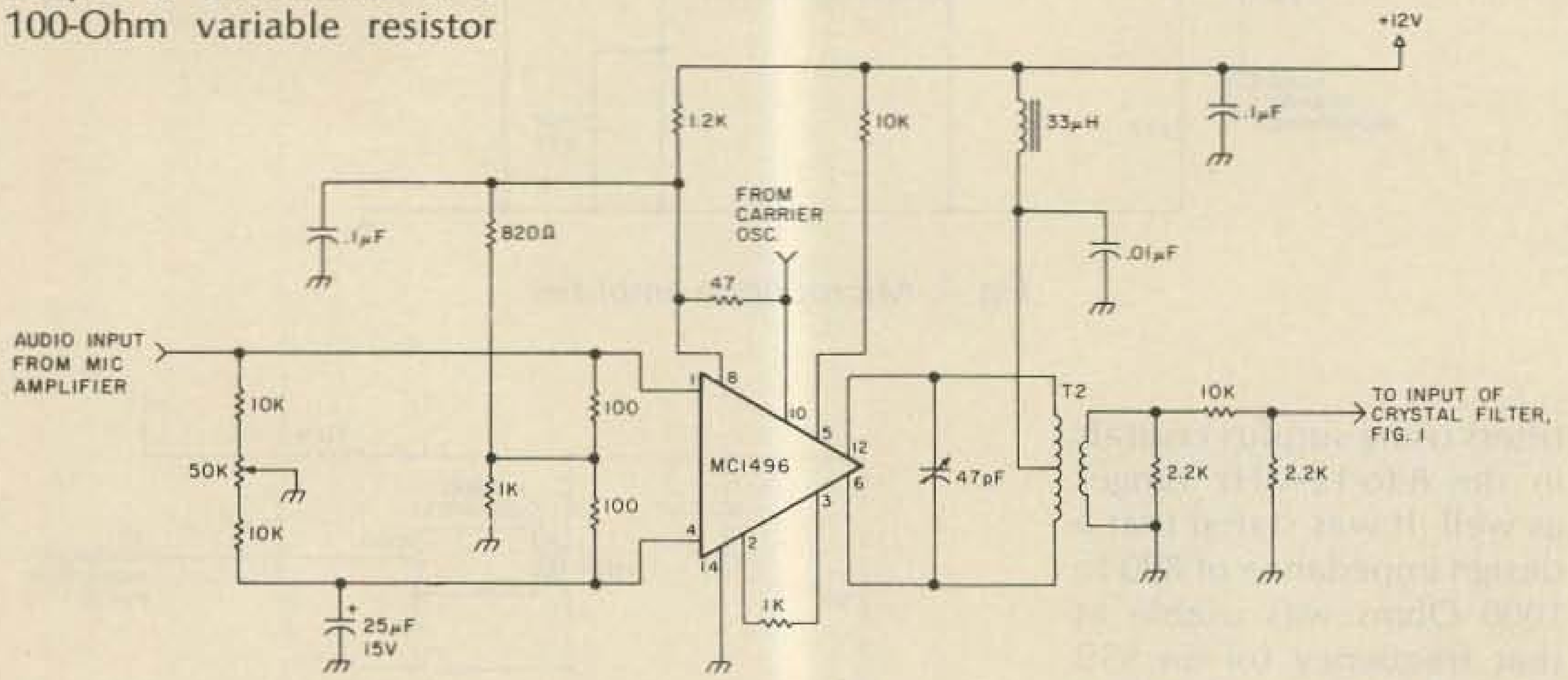


Fig. 5. Balanced modulator. All resistors are ¼ Watt. T2: 42 uH; primary—T50-2—91 turns c-t bifilar wound #34; secondary—30 turns wound over primary.

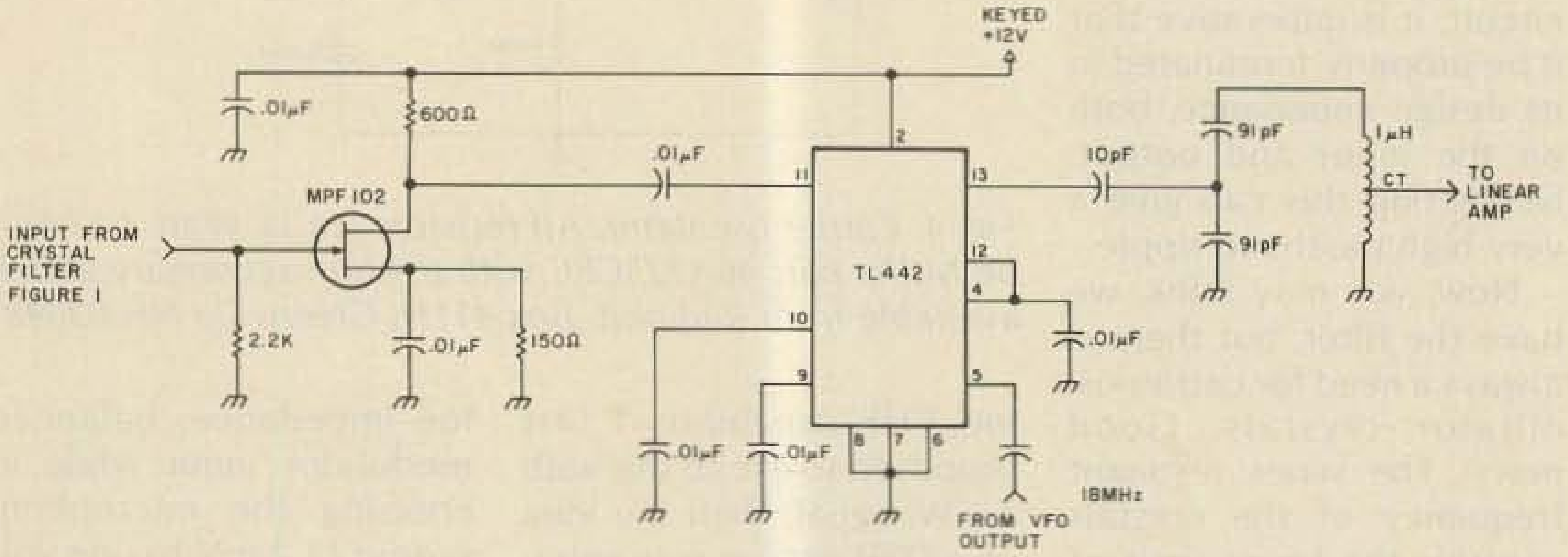


Fig. 6. Carrier mixer.

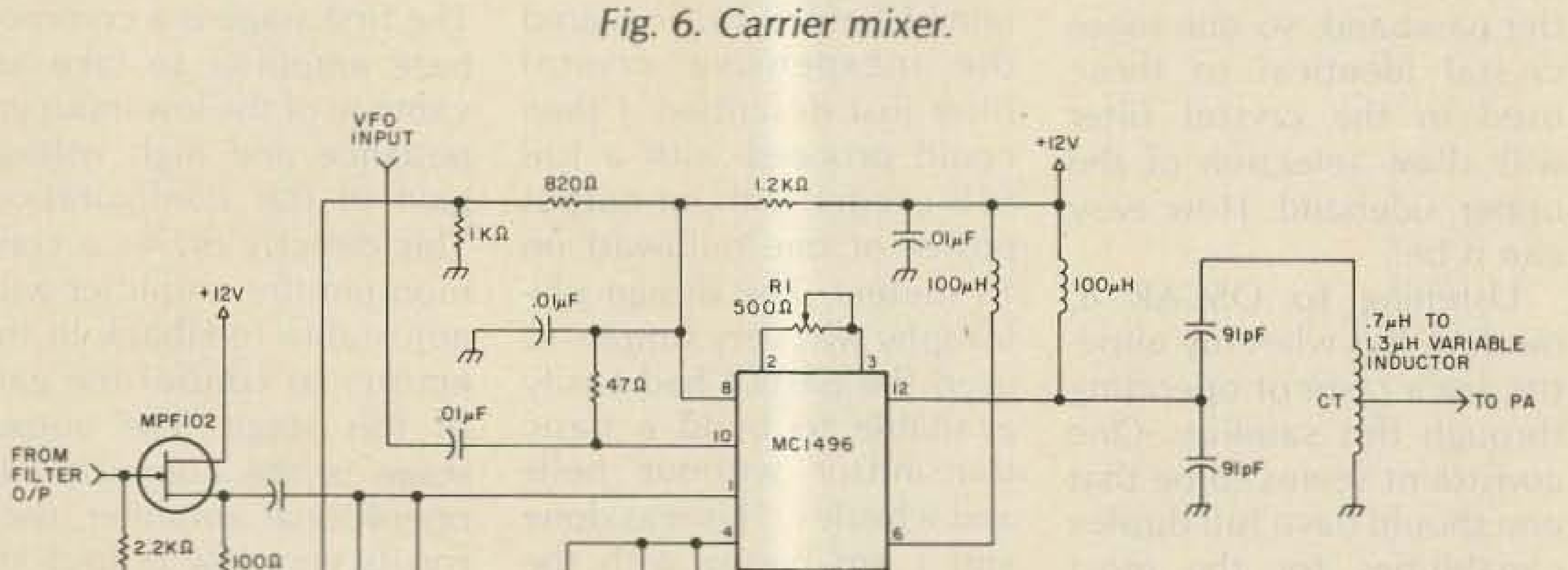


Fig. 7. Carrier mixer using the MC1496 double-balanced mixer.

Carrier Mixer

The 3.58-MHz single-sideband output of the crystal filter must be converted to the desired 21.5-MHz band to be usable. In order to properly terminate the filter and provide impedance conversion, an FET buffer amplifier is included which drives the 600-Ohm input of the TL442 balanced mixer (Fig. 6). This integrated circuit was chosen as it uses few biasing components and has good carrier suppression without balancing controls. If desired, the MC1496 could be used with equally good results if the TL442 is hard to find.

With this situation in mind, a carrier mixer was built using the easily found MC1496 double-balanced mixer. I had good success with it as well. This mixer circuit, shown in Fig. 7, is almost identical to the balanced modulator. R1, between pins 2 and 3, was made variable, enabling me to set the gain of the stage and thus control the drive to my transmitting converter. The output was made single-ended instead of balanced, so I could use the same tuned circuit as was used for the TL442 mixer. The input drive circuit was made a source follower to properly match the lower input impedance of the new circuit. The SSB drive level into the mixer is adjusted so that the maximum input does not cause the output

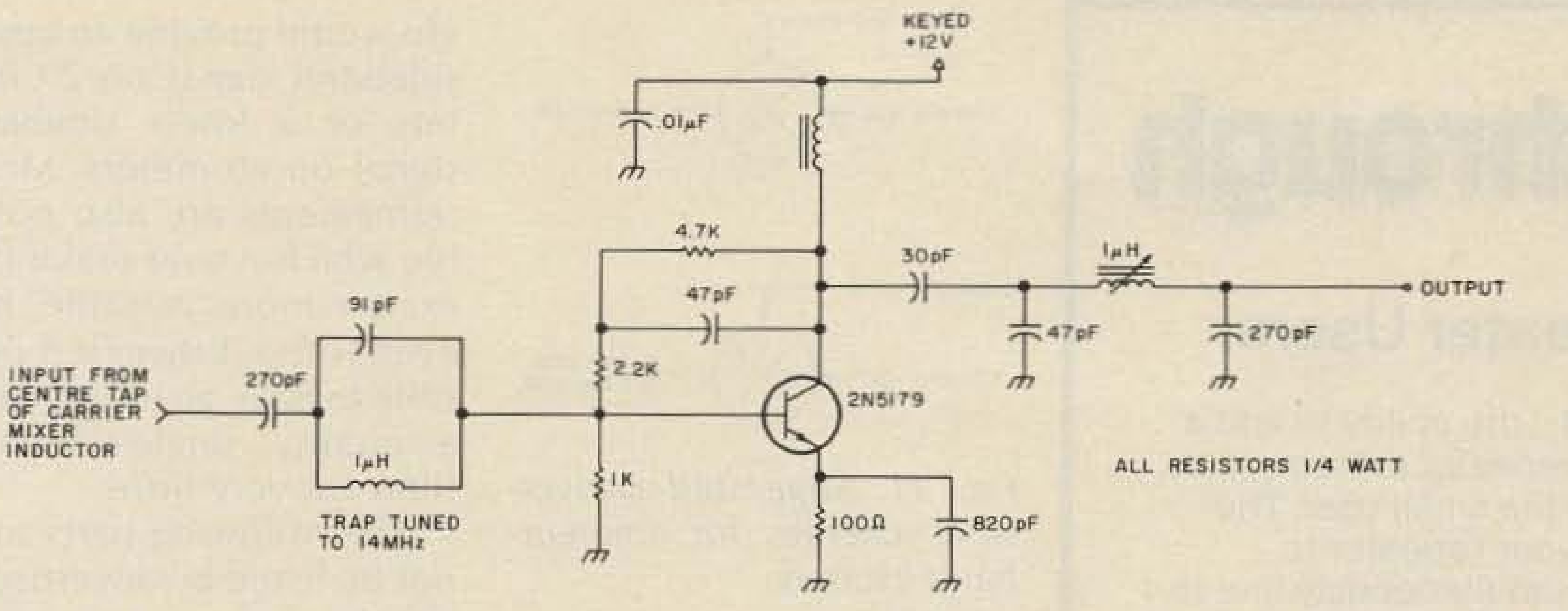


Fig. 8. Linear amplifier.

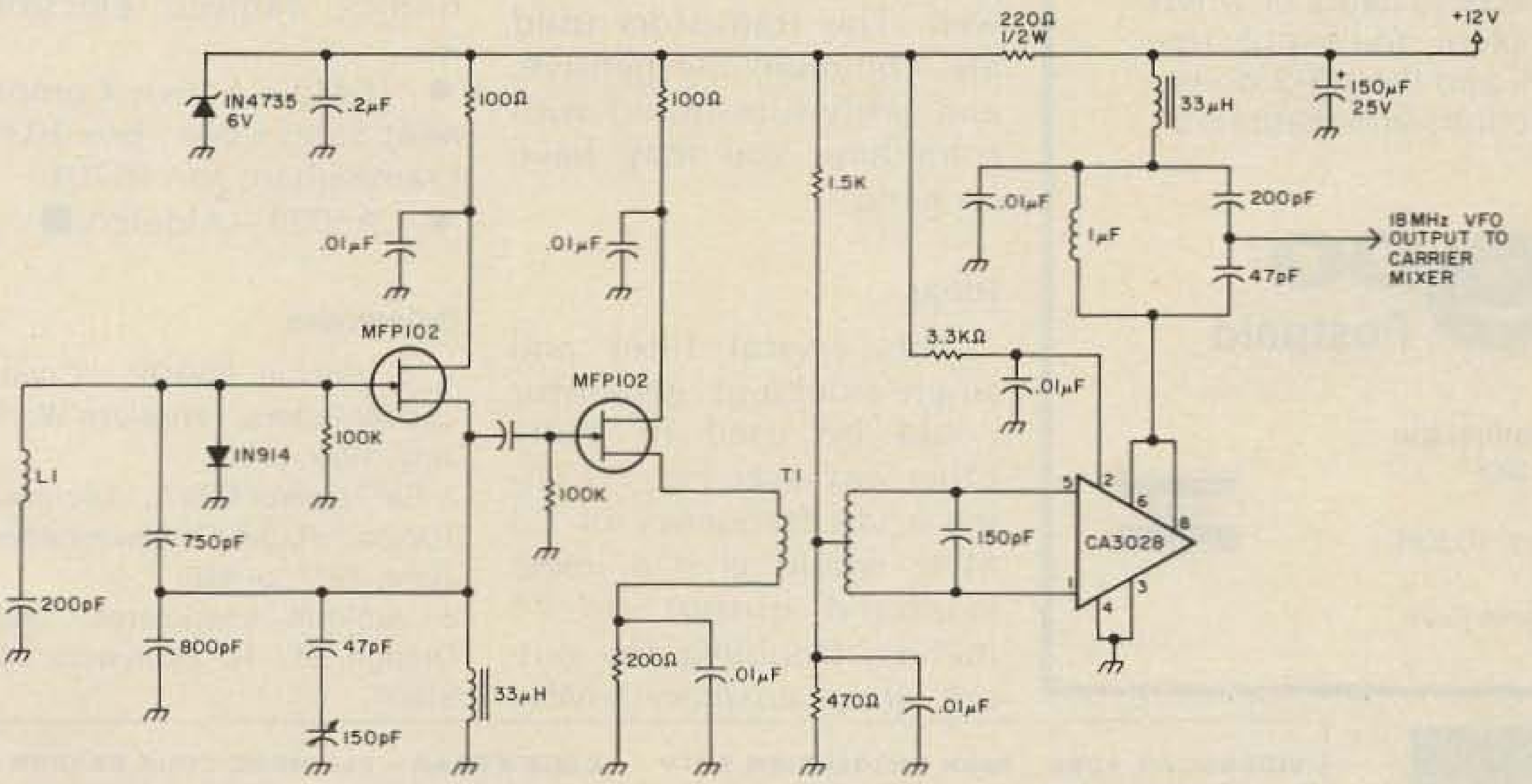


Fig. 9. Vfo. L1: 23 turns of #22 enameled wire close-wound on 3/8"-diameter ceramic form. T1: Primary—25 turns #34 enameled wire on Amidon toroid T25-6; secondary—28 turns center-tapped #34 enameled wire wound over primary.

to limit. The output is adjusted by R1 to properly drive the PA stage, and the carrier null potentiometer is adjusted for minimum vfo output. Usually it will be sufficient, in this service, to set the null pot at its midpoint. Carrier suppression is less critical here than in the balanced modulator.

Linear Amplifier

The linear amplifier (Fig. 8) supplies about 1 milliwatt output, sufficient to drive my transmitting converter to full output. An input series trap tuned to 14 MHz was included to reduce the level of the undesired mixer product (probably an unnecessary frill but, having the parts, it was easy to include). If greater output is desired, the collector-base negative feedback could be reduced or more stages of amplification included.

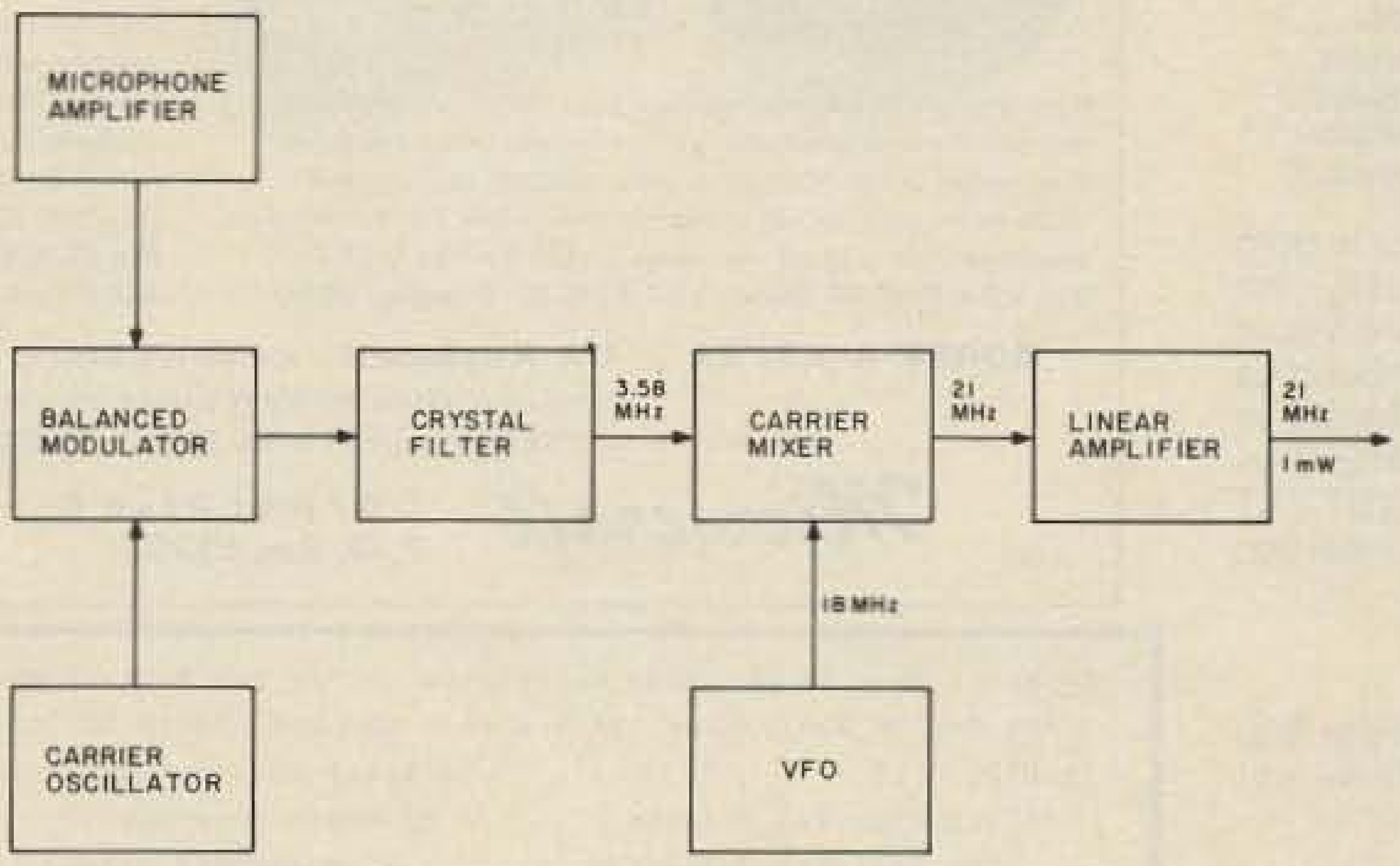


Fig. 10. Block diagram of exciter.

Vfo

The variable frequency oscillator (Fig. 9) is the series-tuned Colpitts or Clapp oscillator driving a push-push doubler to provide an 18-MHz carrier for the conversion mixer. The doubler is made with a CA3028 differential amplifier with its outputs in parallel.

Building Ideas

This exciter was built in the modular configuration which allowed for engineering changes at a whim (also called mistake rectification), and many ideas were tried as I went along. All circuits were put on printed circuit boards as this makes for neat construction. The vfo and carrier oscillator are on single-sided board and the others are on double-sided board. I also put the carrier oscillator and the crystal filter in their own shielded enclosures to reduce the carrier feedthrough, interconnecting the units with RG-174 coaxial cable and audio-cable connectors. A block diagram of my exciter is shown in Fig. 10.

Many parts values may be questioned, and I assure you that I would not argue for their absolute value. My choice has been controlled very much by availability. I had some 1-uH variable inductors bought from Digital Research Corporation of Texas, a bag of assorted inductors and chokes from Poly Paks, some dipped-mica capacitors removed from surplus boards, and assorted resistors.

What I had was used to design circuits that would do the job without my buying every component as a special part. For example, bias circuits can usually be changed if the voltage division provided remains the same. Tuned circuits are flexible because resonance is controlled by both L and C and both can be changed to meet your needs. Amidon Associates can supply a flyer containing a very accurate chart for winding inductors on their various toroid cores if you have a particular capacitor you want to use in a resonant circuit. Bypass capacitors can be chosen from many values which will effectively provide a short to ground for the signal frequency. A command transmitter capacitor was used to provide vfo tuning, but any

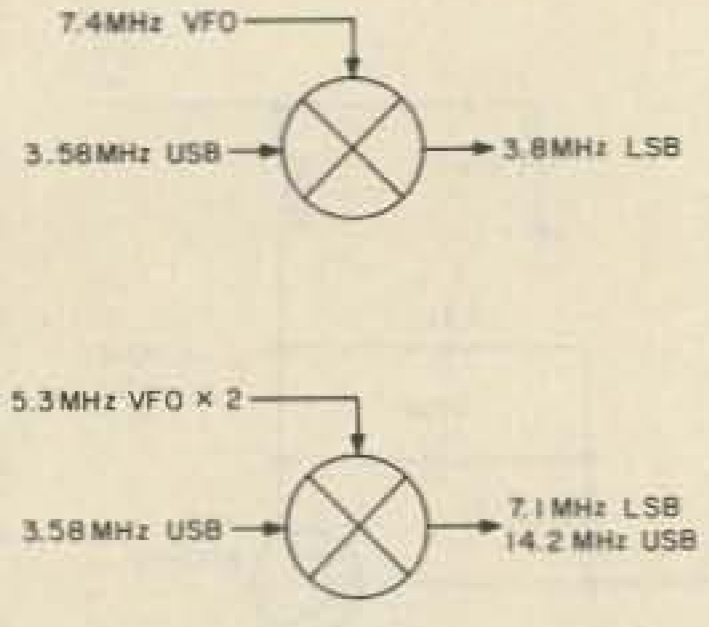


Fig. 11. Suggested conversion schemes for amateur-band exciters.

comparable variable capacitor would do just as well. The transistors used are common, inexpensive, and easily substituted with something you may have on hand.

Ideas

This crystal filter and single-sideband generator could be used in many other ways (see Fig. 11). Using a vfo frequency of 7.3 MHz would give a lower sideband output on 75 meters. Doubling the output of an auxiliary 5-MHz vfo would provide an upper sideband signal on 20 meters or a lower sideband signal on 40 meters. Many refinements are also possible which would make this exciter more versatile, but even without them it is possible to have an exciter with a quality single-sideband filter for very little.

The following parts may not be listed by advertisers, but they usually can supply them:

- MC1496—Godbout Electronics, Jameco Electronics.
- TL442—Active Component Sales Corp., Box 1035, Framingham MA 01701.
- CA3028—Aldelco. ■

References

1. J. Pochet F6BQP, "Crystal Ladder Filters," *Wireless World*, July, 1977, p. 62.
2. Pat Hawker G3VA, "Technical Topics," *Radio Communication*, June, 1977, p. 448.
3. Amidon Associates, 12033 Otsego St., N. Hollywood CA 91607.

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- ☐ **General Random**-10, 12, 14 and 16 WPM $5.95
- ☐ **Extra Random**-16, 18, 20 and 22 WPM $5.95

Gradient Series

Push yourself gradually with slowly increasing code generated by computer to exact Morse specifications. Tape transcripts included.

- ☐ **Novice Gradient**-4 to 9 WPM $6.95
- ☐ **General Gradient**-7 to 15 WPM $6.95
- ☐ **Extra Gradient**-13 to 23 WPM $6.95
- ☐ **High-Speed Gradient**-18 to 30 WPM $6.95

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Combines "enhanced" code with gradual increases in speed for easier copying. Transcript of the QSOs and exam included with each tape.

- ☐ **Novice Super QSO Gradient**-4 to 9 WPM $6.95
- ☐ **General Super QSO Gradient**-7 to 15 WPM $6.95
- ☐ **Extra Super QSO Gradient**-13 to 23 WPM $6.95
- ☐ **High-Speed Super QSO Gradient**-18 to 30 WPM $6.95

QSO Tape Series

Simulated "on-the-air" conversations designed for the current-style FCC tests. Tape transcripts and fill-in-the-blank exams included.

- ☐ **QSO Tape**-7.5, 10, 13 and 15 WPM $5.95
- ☐ **QSO-2 Tape**-another hour of QSOs at 7.5, 10, 13 and 15 WPM $5.95
- ☐ **QSO-13 Tape**-all 13 WPM $5.95

Super Tapes

Kantronics Super tapes generate characters sent at higher speeds with longer spaces for easier copying. Great for learning code and breaking copying barriers! Transcripts included.

- ☐ **Super 5 WPM**-Instructor teaches code from characters to words and sentences. $5.95
- ☐ **Super QSO**-QSOs at 7.5, 10, 13 and 15 WPM, with exam $5.95
- ☐ **Super QSO 13**-QSO format with enhanced code at 13 WPM. $5.95
- ☐ **Super QXX**-High-speed QSOs at 25, 30, 35 and 40 WPM, with exam $5.95

QXX Tapes

"On-the-air" format at Extra-class speeds. Tape transcripts included.

- ☐ **QXX Tape**-20, 23 and 26 WPM with exam $5.95
- ☐ **QXX-2 Tape**-another hour of QSOs at 20, 23 and 26 WPM $5.95
- ☐ **Q-Signals and Short Words**-Learn to hear groups of letters as units at high speed. 22, 33 and 40 WPM $5.95

Bookshelf

- ☐ **General-Class Amateur License Study Guide**-By Phil Anderson, WØXI. $6.50
- ☐ **Computers and the Radio Amateur** -Phil Anderson, WØXI $18.95
- ☐ **Morse Code, Breaking the Barrier (with flashcards)**- by Phil Anderson, WØXI $3.00
- ☐ **FCC Amateur Radio Exams Syllabi for Novice through Extra Class**-Edited by Phil Anderson, WØXI $2.50

Educational Software

Use your Apple II plus computer as the tool to help you upgrade. Each program is available on 5¼" diskette.

CW Tutorial for Apple — Computer generated code gives perfect practice on random letters and numbers, call signs, QSO's, and abbreviations. Operator can select 5 to 50 WPM. Excellent for Novice to Extra. $29.95

Theory Diskettes for Apple — Over one hundred multiple choice questions about Amateur radio theory give great practice for the FCC exams. An explanation follows each answer giving the opportunity to learn.

- ☐ **Novice Theory Diskette** - $19.95
- ☐ **General Theory Diskette** - 19.95
- ☐ **Advanced Theory Diskette** - 19.95
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Address ______
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Please include $1 shipping/handling for single tapes, $2 for multiple tape orders. Please allow 2-4 weeks for delivery. All cassettes 60 minutes.

Phone: (913) 842-7745

Address: 1202 East 23rd St. Lawrence, Ks. 66044

King of the Pulse Generators

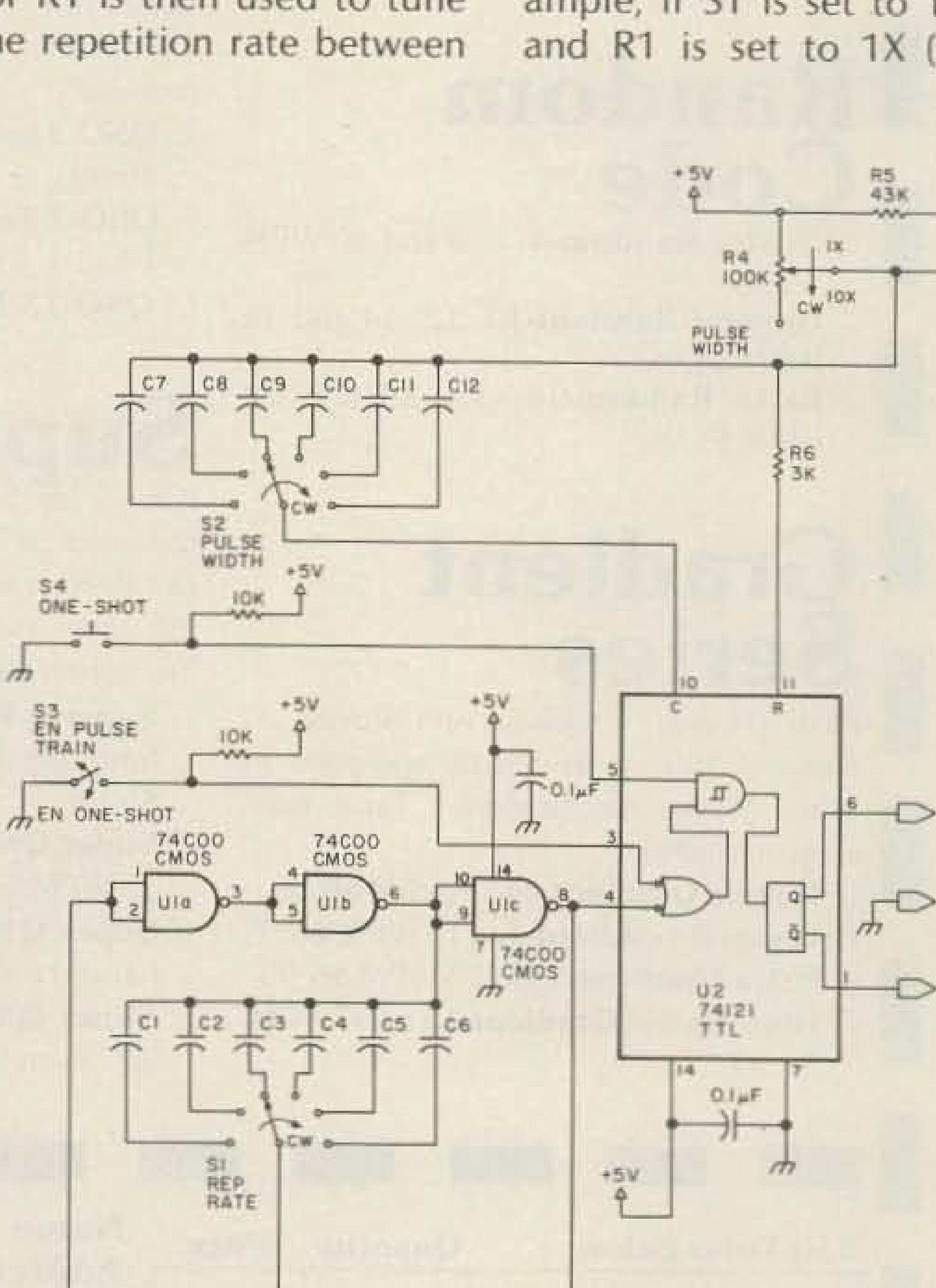
One-shot or a train, TTL or CMOS, this generator will fit the bill. It's just what your test bench always wanted.

Ronald A. Miara WA3RJS
8803 Enfield Court, #22
Laurel MD 20708

This handy pulse generator is built around two commonly available under-a-dollar ICs. Both pulse width and repetition rate are continuously variable over six decade ranges from one microsecond to one second. Normal and inverted pulse train outputs are available, and a one-shot feature allows the user to output a single pulse by depressing a front-panel push-button switch. The outputs are TTL and 5-V-dc CMOS compatible.

To operate the generator, the desired repetition rate range is selected with switch S1. (Repetition rate is the time between the occurrence of each pulse and is equal to the reciprocal of the frequency of the pulse train.) The ranges that may be selected by S1 are: 1 μs, 10 μs, 100 μs, 1 ms, 10 ms, and 100 ms. Variable resistor R1 is then used to tune the repetition rate between one and ten times the range value selected by S1. For example, if S1 is set to 10 μs and R1 is set to 1X (fully

Pulse generator.



C1	47pF	(1μS)
C2	470pF	(10μS)
C3	4700pF	(100μS)
C4	.047μF	(1mS)
C5	.47μF	(10mS)
C6	4.7μF	(100mS)
C7	470pF	(1μS)
C8	4700pF	(10μS)
C9	.047μF	(100μS)
C10	.47μF	(1mS)
C11	4.7μF	(10mS)
C12	47μF	(100mS)

Fig. 1.

counterclockwise), a pulse will occur every 10 μs. R1 may then be tuned up to ten times this value (10X, fully clockwise), in which case a pulse will be output every 100 μs.

Pulse width is similarly set with S2 and R4. S2 selects the same range values as S1, and R4 is used to tune the pulse width from one to ten times the value selected by S1. Pulse widths with duty cycles up to 90% may be set up. (Duty cycle is defined as the ratio of time the pulse is on to the time of a complete cycle, times one hundred. An ordinary square wave would then have a 50% duty cycle since it is on half the time of a complete cycle.)

To use the pulse generator as a one-shot, switch S3 is closed, disabling the output pulse train. Push-button switch S4 is then depressed and released to output a single pulse from U2.

Refer to the schematic (Fig. 1) to understand how the pulse generator works. Three NAND gates in U1 are configured with capacitors C1 through C6, variable resistor R1, and resistors R2 and R3 to form a square-wave oscillator. The frequency of this oscillator determines the repetition rate of the generator. The resistors were chosen to produce repetition rates in convenient decade ranges. The oscillator drives one-shot generator U2. Capacitors C7 through C12, variable resistor R4, and resistors R5 and R6 determine the width of the pulses output from U2. The values of these resistors and capacitors were also chosen to produce pulse widths in decade ranges. Since the oscillator driving U2 causes pulses to be output at a periodic rate, the output of U2 becomes the output of the pulse generator.

Construction of this unit is not critical. Short lead lengths and an all-metal enclosure should be used to ensure a clean and stable pulse-train output. U1 (74C00) should be CMOS, not TTL, to ensure that the oscillator will work. The accuracy of the pulse width and repetition rate depends on the tolerance of the resistors and capacitors used and how carefully the front-panel multiplier controls are labeled (from 1X to 10X). Since I normally use an oscilloscope to set up my pulse generator, I used simple front-panel labeling and rely on the scope for calibration of the pulse train. Simple front-panel labeling also keeps the cabinet size small since less space is required on the front panel. My unit is powered by four penlight batteries which drive a miniature three-terminal +5-V-dc regulator IC (LM309H).

The small size and low cost of this handy pulse generator should make it a nice addition to any ham's workbench. ■

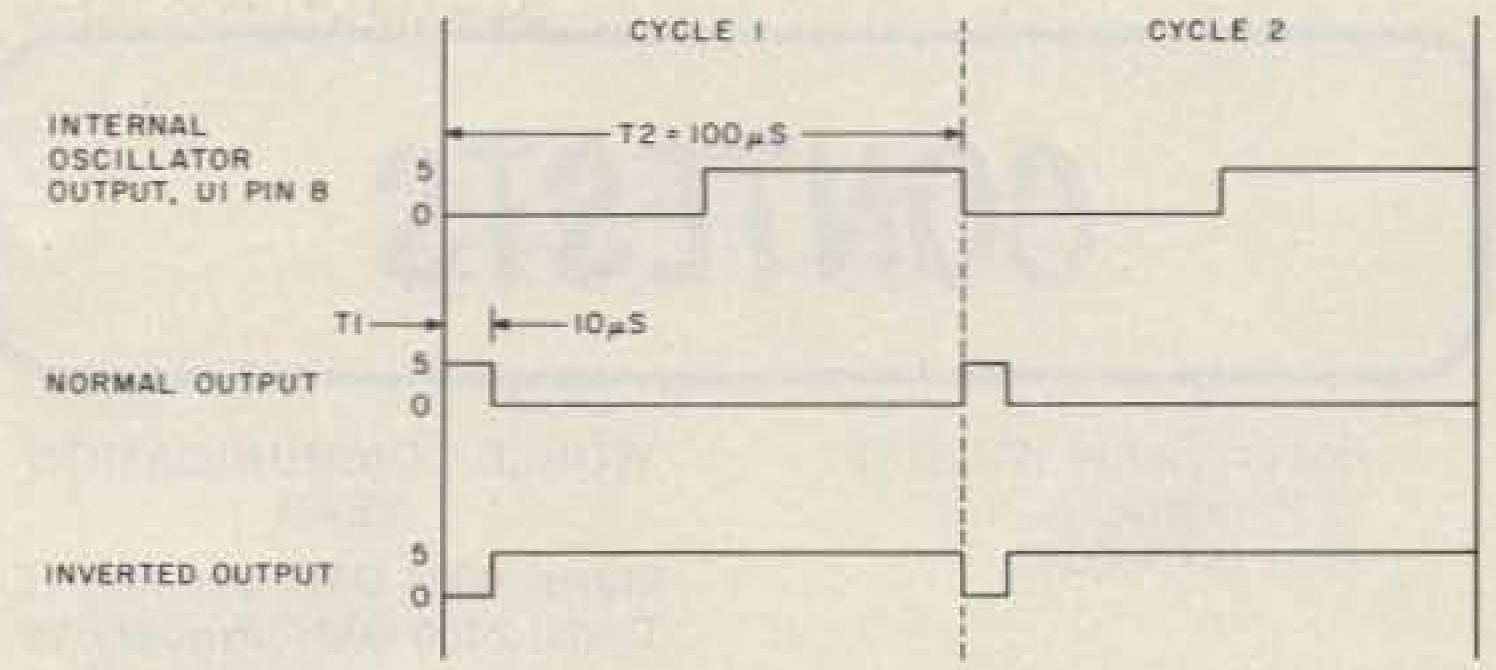


Fig. 2. Pulse generator timing diagram. This shows a pulse train which has a 10-μs pulse width and a 100-μs repetition rate. The duty cycle is equal to 10 μs divided by 100 μs times one hundred percent, which equals 10 percent.

SATELLITES

Late September brought amateur satellite enthusiasts something to cheer about for a change. On the 20th, the University of Surrey amateur scientific satellite (UoSAT) was rescued from oblivion when ground controllers managed to turn its telemetry beacons off for the first time since April. By the time you read this, UoSAT may already be back in full operation.

The trouble with UoSAT (also known as UoSAT-OSCAR 9 or, more simply, UO-9) began when both the 2-meter and 70-cm beacons were accidentally commanded on at the same time. The effect was to desense both receivers aboard the bird, making it impossible for UoSAT to "hear" instructions from the ground. Even the massive 26-dB-gain 2-meter EME array of K1WHS proved insufficient to break through.

After an enormous expenditure of time and effort, the spell was finally broken on 70 cm when the UoSAT salvage team obtained the services of a little-used 150-foot dish antenna at SRI International in California. With a gain at 70 cm of 46 dB and an erp approaching 12 megawatts, the big dish did the trick, though not without practically being rebuilt by the UoSAT gang in the process.

Fortunately, UoSAT seems none the worse for the experience. The satellite, which does not carry communications transponders, continues to send a steady stream of scientific data earthward. In addition to telemetry beacons at 145.825 and 435 MHz, look for HF beacons at 7.05, 14.002, 21.002, and 28.510 MHz. An on-board TV camera may be activated as well.

Ever since the failure of the European Space Agency (ESA) Ariane rocket during its fifth flight (September 9), the date for the launch of AMSAT's Phase IIIB satellite has been anyone's guess. The best bet is now sometime in mid-April, assuming no further problems arise.

Thanks to AMSAT *Satellite Report*.—Jeff DeTray WB8BTH, *73* Staff.

Amateur Satellite Reference Orbits

Date	OSCAR 8 UTC	EQX	RS-5 UTC	EQX	RS-6 UTC	EQX	RS-7 UTC	EQX	RS-8 UTC	EQX	Date
Jan 1	0113	97	0041	38	0008	33	0108	46	0041	36	1
2	0118	98	0036	38	0152	61	0059	45	0038	37	2
3	0122	99	0030	38	0136	59	0049	44	0035	38	3
4	0127	101	0025	39	0121	56	0039	43	0032	39	4
5	0131	102	0020	39	0105	54	0030	42	0030	39	5
6	0135	103	0014	39	0050	52	0020	41	0027	40	6
7	0140	104	0009	39	0035	49	0010	40	0024	41	7
8	0001	79	0004	39	0019	47	0001	39	0021	42	8
9	0006	80	0158	69	0004	45	0150	68	0018	43	9
10	0010	82	0153	70	0147	72	0141	67	0016	44	10
11	0014	83	0147	70	0132	70	0131	67	0013	44	11
12	0019	84	0142	70	0116	67	0121	66	0010	45	12
13	0023	85	0137	70	0101	65	0112	65	0007	46	13
14	0028	86	0131	70	0046	63	0102	64	0004	47	14
15	0032	87	0126	71	0030	60	0053	63	0001	48	15
16	0036	88	0121	71	0015	58	0043	62	0158	79	16
17	0041	90	0115	71	0158	86	0033	61	0156	79	17
18	0045	91	0110	71	0143	83	0024	60	0153	80	18
19	0050	92	0105	71	0127	81	0014	59	0150	81	19
20	0054	93	0059	72	0112	79	0004	59	0147	82	20
21	0059	94	0054	72	0056	76	0154	88	0144	83	21
22	0103	95	0049	72	0041	74	0144	87	0142	84	22
23	0107	96	0043	72	0026	72	0135	86	0139	84	23
24	0112	98	0038	72	0010	69	0125	85	0136	85	24
25	0116	99	0033	72	0154	97	0115	84	0133	86	25
26	0121	100	0027	73	0138	94	0106	83	0130	87	26
27	0125	101	0022	73	0123	92	0056	82	0127	88	27
28	0129	102	0017	73	0107	90	0046	81	0125	88	28
29	0134	103	0011	73	0052	87	0037	81	0122	89	29
30	0138	104	0006	73	0037	85	0027	80	0119	90	30
31	0143	105	0001	74	0021	83	0017	79	0116	91	31
Feb 1	0004	81	0155	104	0006	80	0008	78	0113	92	1
2	0008	82	0149	104	0149	108	0157	107	0111	93	2
3	0013	83	0144	104	0134	106	0148	106	0108	93	3
4	0017	84	0139	104	0118	103	0138	105	0105	94	4
5	0022	85	0133	105	0103	101	0128	104	0102	95	5
6	0026	86	0128	105	0048	99	0119	103	0059	96	6
7	0030	88	0123	105	0032	96	0109	102	0056	97	7
8	0035	89	0117	105	0017	94	0059	102	0054	98	8
9	0039	90	0112	105	0001	92	0050	101	0051	98	9
10	0044	91	0107	106	0145	119	0040	100	0048	99	10
11	0048	92	0101	106	0129	117	0030	99	0045	100	11
12	0052	93	0056	106	0114	114	0021	98	0042	101	12
13	0057	94	0051	106	0059	112	0011	97	0040	102	13
14	0101	96	0045	106	0043	110	0002	96	0037	102	14

CONTESTS

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

ZERO-DISTRICT QSO PARTY

Starts: 2000 GMT January 8
Ends: 0200 GMT January 10

Organized by the Mississippi Valley Radio Club. Stations outside of zero district will work zero stations only, zeros may work any station. The same station may be worked once on each band and each mode. However, mobile stations may be worked each time they change counties.

EXCHANGE:

RS(T) and ARRL section. Zero-district stations also must send county.

FREQUENCIES:

3560, 7060, 14060, 21060, 28060, 3900, 7270, 14300, 21370, 28570, 3725, 7125, 21125, and 28125.

SCORING:

Multiply the number of zero-district counties by the number of contacts. Zeros score by adding ARRL sections, zero-district counties, and DXCC countries worked and then multiplying by total contacts.

ENTRIES & AWARDS:

Certificates will be issued to all entrants who submit a log and an SASE. Endorsements will be given for the high score in each ARRL section, DX country, and Novice/Technician Class. Mail logs by February 15th to: WØSI, 3528 W. Columbia, Davenport IA 52804. Include an SASE for log forms or results.

WORLD COMMUNICATION YEAR

Starts: 0001 GMT January 15
Ends: 2400 GMT January 15

On November 19, 1981, the United Nations General Assembly adopted a resolution proclaiming 1983 a "World Communication Year: Development of Communications Infrastructures." The basic objectives of the WCY are: (1) to provide the opportunity for all countries to undertake an in-depth review and analysis of their policies on communications development, and (2) to stimulate the accelerated development of communications infrastructures. The Potomac Valley Radio Club is sponsoring this contest in support of the World Communication Year.

All licensed radio amateurs worldwide are eligible to participate. There will be two categories: single operator and multi-operator. Both categories are mixed-mode. Only stations using one transmitter are eligible for an award. The same station may be worked once on each band. Telephony (including SSTV) and Telegraphy (including RTTY) emissions count as separate bands. No cross-emission contacts are allowed. The main objective is to contact as many other amateurs as possible, anywhere in the world, using 1.8 MHz to 275 GHz, excluding the 10-, 18-, and 24-MHz bands.

EXCHANGE:

All stations will send their ITU region and their ITU zone. For example, the following stations would send the listed exchanges: DL1AA, 128; W1AAA, 208; and JA1AAA, 345.

SCORING:

QSO points are 4 points per QSO outside your ITU region, 2 points if inside your ITU region but outside your zone, and 1 point if inside your ITU zone. The multiplier is the number of ITU zones worked on each band. For final score, multiply the total QSO points for all bands by the total zones worked for all bands.

AWARDS:

A plaque will be awarded to the high-scoring station of each category (single- and multi-operator) in each of the three ITU regions. A certificate will be awarded to the high-scoring entrant of each category in each ITU zone. In addition, a certificate will be awarded to one UHF/microwave station of each ITU zone judged to have displayed the most outstanding achievement. Members of PVRC may not receive awards.

ENTRIES:

All entrants are to use a suitable log form and summary sheet of their choice. Logs should include times in GMT, bands, calls, complete exchange, and QSO points for each QSO. Multipliers should be clearly marked in each log. Cross-check sheets (dupe sheets) are required if more than 200 QSOs are made on any band.

Summary sheets should be a single page and show number of QSOs, QSO points, zone multiplier for each band, and the total score. The summary sheet must contain the entrant's callsign, region, zone, name, and address. Multi-operator stations must list the name and call (if any) of each operator. Entries for the special UHF/microwave award should be indicated on the front of the summary sheet with a description of the basis of the UHF/microwave award written on the back of the summary sheet.

Entries must be postmarked by February 28th and mailed to: PVRC, PO Box 337, Crownsville MD 21032.

Each entrant agrees to be bound by the provisions of the rules, by the regulations of his licensing authority, and by the decisions of the Amateur Radio Activity Awards Committee. An entry may be disqualified if the overall score is reduced by more than two percent. An entry will be disqualified if more than two percent of duplicates are left in the log. A penalty of 8 QSO points will be assessed for each duplicate QSO or for each miscopied callsign or exchange found by the awards committee.

HUNTING LIONS IN THE AIR CONTEST

Starts: 1200 GMT January 15
Ends: 1200 GMT January 16

The contest is sponsored by Lions Club International and coordinated by Lions Club Rio de Janeiro Arpoador, Brazil. Participation in the contest is open to all duly licensed radio operators, Lion and non-Lion. There are two modes: phone and CW. Participation in both modes is allowed but points are counted separately. All amateur stations participating must operate within their licensing regulation. Separate categories will exist for single operators and radio clubs/societies. Multi-operators may participate, but each prefix must be listed on the log.

Use all bands, 80 through 10 meters. Only one QSO with the same station on each band may be counted. Remember that phone and CW are counted separately!

EXCHANGE:

RS(T) and sequential QSO number. When a contact is made with any Lion,

The RaRa Rag

NEWSLETTER OF THE MONTH

Beauty is not just skin deep. At least, not in the winner of this month's newsletter contest, *The RaRa Rag*, published by the Rochester Amateur Radio Association.

The thoroughly professional look of *The Rag* includes typeset and printed text, with even margins on both sides, headlines, cutoff lines, and clean graphics. It is all printed in booklet format on heavy paper.

But the beauty doesn't stop there. *The Rag's* contents go way beyond the usual list of upcoming events, meeting dates, and president's message. One extra feature of the newsletter is "Cop's Corner," which keeps members posted on local street construction and emergency service.

For history buffs, there is "*The RaRa Rag* 20 Years Ago," and to bring the reader up to date, the editors have included news shorts from the *W5YI Report* and other news services. Other features include news of the club's various special interest groups, a fitting forum for what appears to be an exceptionally active club.

Congratulations to Editor Ronald Jakubowski K2RJ and his staff for putting together a club newsletter that reads as good as it looks.

To enter your club's newsletter in our contest, send a copy to: Editorial Offices, *73*, Peterborough NH 03458.

CALENDAR

Jan 1	ARRL Straight Key Night
Jan 8	73 40-Meter Worldwide SSB Championship
Jan 8-9	ARRL QSO Party—CW
Jan 8-10	Zero-District QSO Party
Jan 9	73 80-Meter Worldwide SSB Championship
Jan 9-10	ARRL QSO Party—Phone
Jan 15	World Communication Year Amateur Radio Activity
Jan 15-16	73 160-Meter Worldwide SSB Championship
Jan 15-16	Hunting Lions in the Air Contest
Jan 15-16	QRP CW Contest
Jan 15-16	ARRL VHF Sweepstakes
Jan 22-23	Texas QSO Party
Jan 22-23	North Dakota QSO Party
Jan 29-Feb 6	ARRL Novice Roundup
Feb 5-6	New Hampshire QSO Party
Feb 5-6	South Carolina QSO Party
Feb 19-20	YL ISSB QSO Party—Phone
Feb 19-20	ARRL International DX Contest—CW
Feb 26	RTTY World Championship Contest
Mar 5-6	ARRL International DX Contest—Phone
Mar 12-13	YL ISSB QSO Party—CW
Apr 9-10	CARF Commonwealth Phone Contest
Apr 9-10	ARRL QSO Party—CW
Apr 16-17	ARRL QSO Party—Phone
Jun 11-12	ARRL VHF QSO Party
Jun 25-26	ARRL Field Day
Jul 9-10	IARU Radiosport Championship

VOLUNTEERS NEEDED

How would you like to be on the "inside" of a major amateur-radio contest? Here's your chance!

We're looking for volunteers to become members of the *73* Contest Committee. Anyone with an interest in contesting and a willingness to work hard is welcome. Committee members will help with the following:

1. Contest rules and ethics
2. Forms and correspondence
3. Log checking and scoring
4. Filling out and mailing awards

Heading up the contest committee is KE7C. Please drop him a note (with SASE) and let him know you can help. Write to Bill Gosney KE7C, *73* Contest Committee, 2665 North Busby Road, Oak Harbor WA 98277.

We want YOU on the *73* Contest Team!

Leo, or Lioness, the name of the club contacted should be clearly identified.

SCORING:

QSOs within the same continent count 1 point while those between different continents count 3 points. Score 1 extra bonus point for each QSO with a member of a Lions Club, Leo Club, or Lioness Club and 5 points for a QSO with a member of the Lions Club Rio de Janeiro Arpoador. Contacts between Brazilian stations will count only 2 extra points. Contacts between members of the Arpoador club will not count any bonus points.

AWARDS:

For single-operator entries the Lions Club International will present trophies for first, second, and third place on both modes. Fourth through tenth places will receive plaques. A trophy will be presented to the first-place radio club/society on both modes. In addition, each log sent by participants with a minimum of 5 contacts will receive a special certificate. The contest committee will also select and award the most active Lions Club participating in the contest.

ENTRIES:

Keep a separate log for each mode. Each participant will note in the logs the callsign and information exchanged. Confirmation of contacts will be made by comparing the logs of the participants. Participants should send their logs by air mail not later than 30 days after the contest to: Contest Committee, Hunting Lions in the Air, Lions Club of Rio de Janeiro Arpoador, Rua Souza Lima #149, Apt. 402, 22081 Rio de Janeiro, RJ, Brazil.

MICHIGAN QRP CLUB CW CONTEST

Starts: 1500 GMT January 15
Ends: 1500 GMT January 16

This is a CW-only, all-bands (160-10-meter) QRP contest sponsored by the Michigan QRP Club. The contest is open to all amateurs and all are eligible for awards. General call will be "CQ QRP DE . . ." Each station will be competing within their own state, province, or country in one of three categories: 1) one Watt or less of output power, 2) five Watts or less of output power, and 3) over five Watts of output power.

EXCHANGE:

RST, QSO number, and power output.

SCORING:

Each contact is worth one QSO point. Multiply total QSO points (all bands) by the number of states, provinces, and countries worked per band for total points. If using emergency power (100% natural and 100% battery) then apply a 1.5 bonus multiplier.

AWARDS:

Certificates will be awarded to the highest-scoring stations in each state, province, or country.

ENTRIES:

Log information must include: full log data with a separate log for each band, name, address, equipment used, and power output. Logs must be received by the contest manager no later than six weeks after the end of the contest. W/VE stations please send an SASE, all others please send 2 IRCs if contest results are desired. Address all entries to: Contest Manager, Michigan QRP Club, 281 Crescent Drive, Portland MI 48875.

THE NORTH DAKOTA QSO PARTY

0000 to 0800 and 1600 to 2400 GMT January 22, 0800 to 1600 GMT January 23

Sponsored again by the Red River Radio Amateurs of Fargo, North Dakota. Work stations once per band and mode.

EXCHANGE:

RS(T) and state, province, country, or North Dakota county. Novices, please indicate Novice status.

FREQUENCIES:

Phone—1835, 3905, 7280, 14295, 21380, 28580.

CW—1810, 3540, 7035, 14035, 21035, 28035.

Novice—3725, 7125, 21125, 28125.

SCORING:

Phone contacts count 10 points, CW 20 points, and RTTY 50 points. North Dakota stations count an additional 100-point bonus for working five Novices. North Dakota stations multiply score by total of states, provinces, and countries worked (max 53).

ENTRIES & AWARDS:

Certificates to state, province, and country winners. Plaque to North Dakota winner and highest scorer outside North Dakota. Mail logs by February 28th to: Bill Snyder WØLHS, Box 2784, Fargo ND 58108-2784. Include a large SASE for results.

TEXAS QSO PARTY

Starts: 0000 GMT January 22
Ends: 2400 GMT January 23

Sponsored by the West Texas Amateur Radio Club of Odessa, Texas. Use all bands and modes. Each station may be worked again upon each county change. Single-operator entries only. CW QSOs must be in CW subbands only.

EXCHANGE:

QSO number (beginning with 001) and state, province, country, or Texas county.

FREQUENCIES:

Novice—3710, 7110, 21110, 28110.

Phone—3940, 7260, 14280, 21370, 28600.

CW—3565, 7065, 14065, 21065, 28065.

SCORING:

All non-Texas stations score points as follows: Phone contact with fixed station in Texas—1 point. CW contact with fixed station in Texas—2 points. Phone contact with mobile station in Texas—5 points. CW contact with mobile station in Texas—7 points. Multiply by the number of Texas counties worked (254 max).

All Texas stations score 1 point per contact on phone, 2 points on CW regardless whether fixed or mobile. Multiply by the number of states, countries, and Canadian provinces worked.

AWARDS:

Plaques to top scores: US, US Novice, DX, Canada, Texas fixed, Texas mobile, Texas Novice. Certificates to top score in each state, country, and province. Certificates also to top 10 Texas stations. Special awards as activity dictates.

ENTRIES:

All logs must be received by March 15th. Mail entries to: WTARC, PO Box 9944, Odessa TX 79762-0041.

RESULTS

THE 1ST ANNUAL 40/80 PHONE CONTEST —A TREMENDOUS SUCCESS—

"Truly unbelievable, it was fantastic, like catchin' fish in a barrel . . ." Those were the words and phrases echoed by nearly every contestant in *73*'s First Annual 40- and 80-Meter Phone Contest. There is little doubt that this event will remain on the contest calendar for many years to come. We are grateful to those who made it all happen!

After the dust had finally settled, VE5DX became the World 40-Meter Phone Champion for single-operator stations. Congratulations to you Jim, a superb performance. I4YNO and company firmly took the World 40-Meter Championship for the multi-operator category. Fantastic job, fellas!

On 80 Meters, I3MAU is the World Single-Operator Phone Champion, and the group at N9NC tied down the winning score to take the world multi-operator title. Fabulous scores for such a difficult band.

Combining both the 40- and 80-meter contest scores, CN8CO became the 1982 Low-Band Champion for single operators while VE2ZP and crew took top honors in the multi-operator category. Take a look at the scoring summary, to see an impressive job by two top-notch stations.

Who made the most contacts, you ask? Among 40-meter single ops, VE5DX made 972 QSOs, followed by KK9A (856) and W9RE (851). In the 40-meter multi-op standings, N9NB was credited with 1098 QSOs, followed by a distant second, KD4TQ, with a demanding 972 contact total. On 80 meters, considering band conditions, the competition was just as fierce. N7DF from Utah tallied 700 QSOs for the single-operator category, while VE5XK accumulated 672 contacts on the band. In the 80-meter multi-operator class, N9NC and crew mustered 793 contacts with VE2ZP (597) and W4CN (564) trailing.

Looking at the combined contest scores for both bands, N7DF turned in 1188 QSOs with 931 QSOs registered by second-place finisher KC4OV in the single-operator category. For multi-ops, VE2ZP recorded 1271 QSOs followed by N4BAA of Florida with 1066 contacts.

Was the band open? Well on 40-meters the following stations turned in 30 or more DX country multipliers: I4YNO (59), I5MPK (44), YV5ANE (44), W9RE (41), N3AMK (40), VE5DX (39), VE2ZP (38), CN8CO (38), JA2BAY (35), LX1JX (35), N4BAA (33), N9NB (31), and KJ9D (31). As expected, the 80-meter DX totals were somewhat less with the following stations scoring 20 or more DX multipliers: I3MAU (58), CN8CO (53), KQ2M (39), DA1RE (34), WB2DHY (30), I5MPK (29), N4BAA (28), KØCS (28), DF9ZP (27), ZF2DX (27), N7DF (24), JA1ELY (22), AK1A (22), and OK1KZ (22).

One of the most interesting aspects of tallying any contest is the opportunity to summarize the equipment used by competing stations. Every year brings new surprises.

Which antenna dominated on which band? Naturally the wire (economy version) array led the pack. Look at the statistics:

40-Meter Antennas	
Dipole/inverted vees	39.8%
Monoband vertical	11.6%
Delta loop	9.3%
Trap vertical	9.3%
2-element yagi	7.0%
¼-wave sloper	4.6%
2-element delta loop	4.6%
2-element wire beam, bobtail curtains, 2-element quads, 3-element yagis, and phased verticals	2.3% each

80-Meter Antennas	
Delta loop	11.1%
¼-wave sloper	11.1%
Full-wave vertical	8.3%
Trap vertical	8.3%
Phased verticals	5.5%
3-element wire yagi	5.5%
Inverted-L	2.7%
2-element delta loop	2.7%

Of all the stations that turned in entries, 28% declared that they were running completely "barefoot" while 2% stated that they were running 500 Watts, 15% were running a kilowatt, and a dramatic 55% were radiating two kilos! What were they using as exciters? 39.7% of the contestants claimed to be running Kenwoods, 21.3% were running Yaesu gear, 22.4% were operating Drake equipment, 6.5% were Collins, while the remaining 10.1% were divided amongst Ten-Tec, Icom, Heathkit, Tempo, and yes, even home-brew equipment.

So what does all this add up to?. . . a debut not to be forgotten, an event full of surprises which left a lasting impression on all who witnessed this two-day extravaganza.

This brings us to the second annual event which is just around the corner. Look for the 40- and 80-meter contest announcement in last month's issue of *73*. This year the event is being split into two separate parts. The World 40-Meter Phone Championship will be held on January 8, while the World 80-Meter Phone Championship event is scheduled for the following day, January 9, 1983. Each promises to become a record breaker in its own right. For all the details, send your SASE directly to the official contest address, attention Billy Maddox, 468 Century Vista Drive, Arnold MD 21012.

So start pruning your antennas. I intend to work each one of you on both bands so mark the dates on your calendar. Get on the band right now and begin telling other amateurs about the contest, especially the DX stations. Pitch in and pass the word! Good luck in the contest.

Continued

40/80-METER CONTEST SOAPBOX

"Glad to take part, even if it was just a little bit. Really enjoyed it!"—N1BMV.
"Lots of fun. Am going to try 80 meters next year."—KA1CDC.
"Super contest. . . I know I'll be back next year!"—WA1ZAM.
"Too many carriers and foreign broadcasts on 40!"—KA2HTH.
"My first contest ever. Really enjoyed it and am looking forward to next year."—WB2IWJ.
"The gang here had a blast."—KF2X.
"Fine contest but I suggest limiting the action to the general portion of the band."—N3AWS.
"Would have liked to have participated more. Look for me again next year."—W3ICM.
"You've got another winner!"—K3IXD.
"Great contest—lots of great contacts were made on the 40 this weekend."—KF3M.
"Hope to get a vfo and increase my multiplier total. Sure enjoyed the contest."—KC3N.
"Enjoyed the contest and, once and for all, recognized the District of Columbia as a separate multiplier!"—W3USS.
"Good propagation at times. Fantastic turnout. Should be a classic event."—N4BAA.
"Great contest with lots of potential as the years go by."—N4UH.
"Had a very good time and worked some new states."—N5AFV.
"TNX for sponsoring this enjoyable contest. Had a great time on 40."—N5CPO.
"Whooee, quite an event!"—KC5NQ.
"Learned a lot about my station. Looking forward to next year."—WB5YWO.
"Better to have the 40-meter test on CW rather than SSB."—N6JM.
"A very good contest. Not much heard during the daytime."—W6YMH.
"Thanks for staging this contest, I enjoyed it immensely. Hope to be back next year to improve the score."—KA7AKQ.
"Where were the VEs? Great stateside turnout!"—N7DF.
"Where were the JAs?"—KB7G.
"Let's do it again next year!"—AK7J.
"Great contest and I'll be back next year!"—K7PGL.
"Fine contest idea, thanks to 73. Lots of activity on the bands. Wish there was more DX on 40."—N8ATR.
"Damn fun despite the tremendous big guns. I'll give it a shot again next year."—KC8GN.
"Very successful debut. Good time of year too! See you next year for sure!"—W8VEN.
"I seem to have scored very well. Lots of good contacts to be had."—KK9A.
"Everyone involved has my congratulations. I wish all contests were this much fun."—KJ9D.
"Surprised at the number of stations on the 40-meter band. Broadcast stations really got fierce! Will try 80-meters next year."—K9FMR.
"Bands were in great shape. Had a great time."—KB9TI.
"Activity and band conditions were excellent. Korea on 15 was a new one for me!"—KØCS.
"Great contest. Nice to work a contest that doesn't take up all weekend. Family-man special!"—WAØIDK.
"Excellent contest. Definitely will be back next year."—KØUK.
"WB4OXZ and I found it rough going on 80. Worth every minute of it though. Had a ball."—C6ADV.
"Definitely should become one of the biggies! Unbelievable participation for a first time event!"—CN8CO.
"Fun contest. I'll tell more Europeans about it."—DL8UI.
"I know why CW is beautiful now—very hard on phone with 50 Watts. There's always next year."—G3WKS.
"My first touch of 40- and 80-meter contesting and I loved it."—H44SH.
"Marvelous contest though conditions weren't the best for me. Am looking forward to next year."—HI8GB.
"Nice contest indeed. We hope to do better next year."—I4YNO.
"Very good contest. Not much activity in JA-land on contest."—JA1FFY.
"Lots of activity on 40-meters but not many Europeans. See you again next year."—LA5YF.
"Good propagation but no Europeans in the contest. Maybe next year it will get more attention."—LX1JX.
"Very good idea to establish this contest. Hope more Europeans hear about it! See you next year."—OK2BLG.
"Thanks for the contest, a very good idea. Enjoyed 80 meters."—OX3ZM.
"Didn't work a single North American station."—PA3AZM.
"Nice contest with good propagation. Wish W/VEs would listen below 3.800 MHz. Very strong in Europe!"—SM4CAN.
"Great contest and is sure to grow as it gets more publicity."—VE1AJJ.
"Thoroughly enjoyed the contest. Very well conceived, very well attended—a definite winner!"—VE2ZP.
"Appreciate the contests. 80 was very difficult with 20+ static. USA stations forget we can only work 3.5-3.7 on phone."—VK5BW.
"Very little activity in Romania. Maybe advertisements will help."—YO4BXX.

W/VE 40-METER SINGLE OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
VE5DX(W)	SASK	972	1192	56	39	113240
W9RE*	IN	851	1084	56	41	105148
N3AMK*	PA	771	1042	55	40	99180
KK9A(-)	IL	856	1093	57	25	87440
KA1XN*	MA	761	802	56	23	63358
WB8JBM*	OH	759	823	56	19	61725
KC4OV*	TN	600	736	67	14	59616
KC5NQ*	TX	663	730	55	18	53290
KC3N(-)	PA	674	872	53	3	48832
N8AKY(-)	MI	441	598	53	21	44252
KF3M	PA	675	829	48	5	43937
WAØIDK*	MN	539	639	51	13	40896
N7DF*	UT	488	547	51	11	38290
KA1CDC(-)	MA	516	661	48	4	34372
KC8JH(-)	OH	400	460	52	20	33120
N8ATR	OH	477	637	45	6	32487
VE2RV*	QU	305	397	55	25	31760
KL7HHX(-)	AK	289	570	40	14	30780
K3MRG	PA	380	551	53		29203
K4HAV(-)	GA	434	535	45	9	28890
WD4IBO	GA	484	570	47	2	27360
K9MWM(-)	CO	468	495	50	5	27225
W1MX(KA1R)	MA	370	444	46	15	27084
K5ZD(-)	TX	353	372	52	10	23064
WBØUFL(-)	IA	286	397	46	10	22052
W3BGN	PA	259	430	42	8	21500
WA8YTM(-)	WV	423	483	34	7	19703
NF4F(-)	TN	348	357	45	5	17850
K7PGL(-)	MT	284	297	42	13	16335
KA4RKD(-)	AL	278	335	44	4	16080
K3IXD(-)	MD	220	259	45	3	15022
WB2THN*	NY	263	266	48	6	14364
NR4S	TN	218	349	38	3	14309
WA2HFI/O	IL	250	269	45	4	13181
WAØTKJ(-)	KS	135	198	35	28	12474
KA9CTM	IL	196	240	46	1	11280
AA4FF(-)	VA	161	189	40	19	11151
W8ANM	OH	196	259	37	4	10619
N4ARO	TN	213	243	39	3	10026
WB9UZR	IL	174	290	32	2	9860
W5PWG	TX	154	184	43	9	9568
KJ7R(-)	ID	161	183	40	11	9333
VE1AJJ*	NB	143	179	42	10	9308
KR8X	OH	262	262	35		9170
AK3J	PA	144	208	38	5	8944
W2FTY(-)	NY	114	162	36	13	7938
N8TN	OH	200	233	32	3	7922
WA4LRO	TN	123	133	38	11	6517
K5UCV	TX	127	164	35	3	6232
W8DN	OH	112	139	41	2	5977
N9AML(-)	IN	107	161	37		5957
KB7G(-)	WA	120	136	37	6	5848
KD4WY(-)	NC	140	157	33		5181
W3ARK	PA	206	206	24		4944
WB5YWO(-)	OK	121	130	35	3	4940
WD8MOV	OH	53	111	24	20	4884
K1NCD(-)	CT	106	165	29		4785
W3ETB	PA	125	167	25	3	4676
WA3JXW	PA	136	136	34		4624
KI7M(-)	OR	89	107	30	13	4601
WB9OBX(-)	WI	157	157	29		4553
WA2HCC(-)	NJ	110	156	25	3	4368
N5CPO	TX	94	118	37		4366
N5CMF	TX	81	97	43		4171
N5AFV	OK	102	119	35		4165
KF1B	CT	77	98	29	13	4116
N4DEF	GA	108	127	29	3	4064
K4FPF	VA	82	111	31	4	3885
N3AWS	PA	93	123	29		3567
W8VEN	WV	96	98	34	1	3430
KJ2N	NJ	63	92	20	16	3312
K3ND	PA	89	99	32	6	3267
W5GVP	TX	80	94	30	4	3196
W3AP	PA	73	100	27	4	3100
W6YMH*	CA	72	81	28	9	2997
K1VUT	MA	94	98	26	4	2940
NØCZO(-)	ND	81	95	29		2755
W4KMS	VA	87	87	29		2523
KJ9R	IL	84	84	30		2520
WB8YEW	OH	78	78	32		2496
KC7EH	OR	52	68	24	12	2312
K8CV	MI	56	63	29	7	2268
KC8P	MI	66	66	32		2112
KC8GN	OH	66	67	30		2010
K8JOS	OH	64	80	25		2000

WA2IFS	NJ	35	59	9	17	1534
NL7D	AK	34	67	20	1	1407
KBØC(-)	MN	51	52	24	1	1300
KA7AKQ	WA	48	49	24	1	1225
K3ZJ(-)	DC	70	70	16		1120
N1ADX	MA	46	91	10		910
WD8OYF	OH	53	53	16		848
WD8MRF	OH	49	82	15		735
WAØWWW	MN	32	32	32		704
W3YA	PA	44	44	15		660
W7ABX(-)	NV	26	30	14	4	540
KB9IT	IL	39	39	11		429
N6JM	CA	19	20	15	1	320
AK7F	WA	10	10	8		80
N2DCH	NY	9	9	7		56

* District champion
(-) State/provincial champion
(W) Contest winner

W/VE 40-METER MULTI-OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
N9NB(W)	IN	1098	1329	54	31	112965
KD4TQ*	KY	972	1208	55	24	95432
VE2ZP*	QUE	704	909	57	38	86355
KJ9D*	IN	681	927	53	31	77868
N4BAA(-)	FL	645	772	53	33	66392
KF2X*	NY	565	774	48	27	58050
N4FKF	KY	303				16069
KA2HTH(-)	NY	267	422	28		11816
W3YA*	PA	44	44	15		660

* District champion
(-) State/provincial champion
(W) Contest winner

DX 40-METER SINGLE OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
YV5ANE(W)	Venezuela	359	732	46	44	65880
CN8CO*	Morocco	361	744	44	38	61008
H44SH*	Solomon Is.	291	581	45	20	37765
LA5YF*	Norway	221	513	37	26	32319
JA2BAY*	Japan	205	390	38	35	28470
HI4AGE*	Dom. Rep.	209	417	45	17	24603
CT4KO*	Portugal	169	350	33	20	18550
YV3BQS	Venezuela	155	312	32	23	17160
VK5BW*	Australia	157	306	21	22	13158
LX1JX*	Luxembourg	119	246	1	35	8856
DL8UI*	West Germany	72	139	19	16	4865
JA1ELY	Japan	68	130	22	15	4810
SM4CAN*	Sweden	23	46	15		690
OK1AGN*	Czechoslovakia	17	50	1	12	650
I4CSP*	Italy	21	38	1	12	494
G3WKS*	England	14	44		6	264
YO9CUF/3*	Romania	18	23		10	230
G5EBA	England	11	22		9	198
JA1FFY	Japan	9	17	3	5	136
PA3AZM*	Netherlands	9	18		6	108
YO4BXX	Romania	10	20		5	100
YO3KWJ	Romania	3	6		3	18

(W) Contest winner
* DX country champion

DX 40-METER MULTI-OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
I4YNO (W)	Italy	672	1400	33	59	128800
I5MPK*	Italy	590	1206	44	45	107334

(W) Contest winner
* DX country champion

W/VE 80-METER SINGLE OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
KQ2M(W)	NY	510	666	52	39	60606
N7DF*	UT	700	739	54	24	57642
KØCS*	MO	552	635	53	28	51435
WB2DHY*	NY	346	545	48	30	42510
VE5XK*	SASK	672	681	54	8	42222
K2SWP(-)	NY	492	530	50	15	34450
KB9MW*	IL	530	570	52	7	33630
N8ATR*	OH	311	326	47	11	32487
NA6T*	CA	373	454	51	19	31850
N8AKY(-)	MI	439	453	50	11	27633
KØUK(-)	CO	407	417	49	7	23352
KC4OV*	TN	331	342	46	10	19152
KC8JH(-)	OH	335	342	46	7	18126
WA1ZAM*	MA	363	367	45	4	17983
KB3ND*	PA	294	305	45	10	16775
KI7M(-)	OR	232	271	53	6	15989
N4ARO(-)	TN	254	259	49	4	13727
AK1A(-)	NH	168	206	41	22	12978
W6TPH(-)	CA	228	240	41	12	12720
KD4XR(-)	AL	244	248	41	3	10912
W4PZV(-)	FL	141	161	46	18	10304
VE1AJJ*	NB	149	178	40	17	10146
W3BGN(-)	PA	152	198	30	19	9702
KA1R(-)	MA	202	209	30	7	7733
KC5LK*	MS	159	161	45	2	7567
WA1TCA(-)	CT	149	154	40	5	6930
W3AP	PA	144	160	38	3	6560
NØZA	CO	112	125	41	11	6500
WA2IFS(-)	NJ	128	133	42	5	6251
KB8WB	OH	119	126	42	7	6174
KK8L	OH	150	150	36		5400
WB2TKB	NY	126	131	36	4	5240
N8TN	OH	153	153	33		5049
W5PWG(-)	TX	114	119	39	3	4998
WAØWWW	MN	118	118	38		4484
KF1B	CT	94	102	35	8	4386
WD8MRF	OH	90	95	37	3	3800
N1SR	MA	90	99	33	5	3762
KR8X	OH	133	133	28		3724
WB8YEW	OH	94	96	37		3552
W8VEN(-)	WV	97	97	34		3298
W8ANM	OH	88	88	36		3168
KJ2N	NJ	87	99	31	6	3069
N1BMV	CT	100	100	27		2700
W1GOM(-)	OK	71	74	32	3	2590
K3ND	PA	71	78	29	5	2516
W4KMS(-)	VA	76	76	31		2356
W3ETB	PA	82	86	25	1	2336
K3ZJ(-)	DC	94	95	22	1	2185
VE1QO*	QUE	74	79	22	5	2133
WD8MOV	OH	55	59	29	2	1829
KB7M(-)	WY	55	55	30		1650
WB2IWJ	NY	72	72	20		1440
W2FTY	NY	47	48	27	1	1344
K1NCD	CT	58	58	22		1276
AK7F(-)	WA	43	45	26	2	1250
WB9OBX(-)	WI	51	51	21		1155
W1LUG	MA	52	52	21		1092
K8CV	MI	40	40	27		1080
WD8OYF	OH	47	47	20		940
KB9IT	IL	43	43	19		817
K4FPF	VA	41	41	19		779
NØCMC(-)	ND	26	26	20		520
W6YMH	CA	28	28	17		476
AK7J(-)	AZ	19	19	16		304
W3ICM(-)	MD	21	22	10	1	242
N2DCH	NY	20	20	11		220
W7ABX(-)	NV	20	20	10		200
NL7D(-)	AK	11	20	3	1	80
KA7AKQ	WA	8	8	3		24

* District
(-) State/provincial
(W) Contest winner

W/VE 80-METER MULTI-OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
N9NC(W)	IN	793	812	54	17	57652
VE2ZP*	QUE	567	597	53	18	42387
N4BAA*	FL	421	456	52	28	36480
W4CN(-)	KY	564	581	50	11	35441
KF2X*	NY	413	432	48	11	25488
AJ1E*	MA	345	369	40	17	21033
N4FKF	KY	212				8692
WBØTCF*	MO	93	118	37		4366
W3YA*	PA	2	2	1		2

* District
(-) State
(W) Contest winner

DX 80-METER SINGLE OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
I3MAU(W)	Italy	507	983	40	58	96334
CN8CO*	Morocco	441	882	23	53	67032
C6ADV*	Bahamas	296	316	52	16	21488
HI8GBG*	Dom. Rep.	149	294	49	9	17052
OK1MSM*	Czechoslovakia	165	320	52		16640
HI8GB	Dom. Rep.	145	284	41	10	14484

DF9ZP*	West Germany	121	239	26	27	12667
ZF2DX*	Grand Cayman	149	178	42	27	12282
OX3ZM*	Greenland	117	234	28	18	10810
YV3BQS*	Venezuela	96	192	35	16	9792
JA1ELY*	Japan	128	216	18	22	8240
DA1RE	West Germany	107	200		34	6800
H44SH*	Solomon Is.	69	137	19	15	5658
8P6KX*	Barbados	78	106	25	17	4452
JH7JGG	Japan	89	159	14	9	3657
OK1KZ	Czechoslovakia	52	89	1	22	2047
OK1AGN	Czechoslovakia	37	73	4	15	1387
SM4CAN*	Sweden	30	60	11	9	1200
OK2BLG	Czechoslovakia	26	51	14	7	1071
I4CSP*	Italy	38	70	1	14	1050
G5EBA*	England	32	62		14	868
DL8UI	West Germany	20	39	7	6	507
YO4BXX*	Romania	21	41		9	369
PA3AZM*	Netherlands	18	36		10	360
DF3AO	West Germany	17	34	6	4	340
JA5AUC	Japan	16	28	7	3	280
VK5BW*	Australia	13	22	1	9	220
JA3HTT	Japan	9	16		6	96
YO3KWJ	Romania	6	11		4	44

* DX country
(W) Contest winner
Check log: YO6LV

DX 80-METER MULTI-OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
I5MPK(W)	Italy	191	376	30	29	22184

(W) Contest winner

W/VE COMBINED 40/80-METER SINGLE OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
N7DF(W)	UT	1188	1286	105	33	180040
KC4OV*	TN	931	1078	113	24	147686
N8AKY*	MI	880	1051	103	32	141885
N8ATR	OH	788	963	92	17	104967
KC8JH	OH	735	802	98	27	100250
W3BGN*	PA	411	628	72	27	62172
N4ARO	TN	467	502	88	7	47690
VE1AJJ*	NB	297	357	82	27	38913
KI7M*	OR	321	378	83	19	38556
W5PWG*	TX	268	303	82	12	28482
W8ANM	OH	284	347	73	4	26719
N8TN	OH	353	386	65	2	25862
KR8X	OH	395	395	53		20935
W3AP	PA	217	260	65	7	18720
KF1B*	CT	171	200	64	21	17000
W2FTY*	NY	161	210	63	14	16170
WA2IFS	NJ	163	192	51	23	14016
KJ2N	NJ	150	191	51	22	13943
W3ETB	PA	207	253	50	4	13662
W8VEN	WV	193	195	68	1	13455

WB8YEW	OH	108	170	53	22	12750
K3ND	PA	160	177	61	11	12744
K1NCD	CT	164	223	51		11373
WAØWWW*	MN	150	150	70		10500
WB9OBX*	WI	208	208	50		10400
W4KMS	VA	163	163	60		9780
WD8MRF	OH	139	177	52	3	9735
K4FPF	VA	123	152	50	4	8208
K8CV	MI	96	103	56	7	6489
K3ZJ	DC	164	165	38	1	6435
W6YMH*	CA	100	109	45	9	5886
WD8OYF	OH	100	100	36		3600
KB9IT	IL	82	82	30		2460
NL7D	AK	45	87	23	2	2175
AK7F	WA	53	55	34	2	1980
KA7AKQ	WA	56	57	27	1	1596
W7ABX	NV	46	50	24	4	1400
N2DCH	NY	29	29	18		522

* District award
(W) Contest winner

W/VE COMBINED 40/80-METER MULTI-OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
VE2ZP(W)	QUE	1271	1506	110	56	249996
N4BAA	FL	1066	1228	105	61	205076
KF2X	NY	978	1206	96	38	161604
W3YA	PA	46	46	16		736

(W) Contest winner

DX COMBINED 40/80-METER SINGLE OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
CN8CO(W)	Morocco	802	1626	67	91	256908
H44SH	Solomon Is.	360	718	64	35	71082
YV3BQS	Venezuela	251	504	67	39	53424
JA1ELY	Japan	196	346	40	37	26642
VK5BW	Australia	170	328	22	31	17384
DL8UI	West Germany	92	178	26	22	8544
OK1AGN	Czechoslovakia	54	123	5	27	3936
SM4CAN	Sweden	53	106	26	9	3710
I4CSP	Italy	59	108	2	26	3024
G5EBA	England	43	84		23	1932
PA3AZM	Netherlands	17	54		16	864
YO4BXX	Romania	31	61		14	854
YO3KWJ	Romania	9	17		7	119

(W) Contest winner

DX COMBINED 40/80-METER MULTI-OPERATOR

Callsign	QTH	QSOs	QSO Pts.	St./Pr.	DX	Total
I5MPK(W)	Italy	781	1582	74	74	234136

KK9A.

From left to right: I4ZNU, I4OUT, I4JMY, and I4YNO.

W9RE AND W8NGO
160-METER WORLD CHAMPIONS

"The most activity ever heard on 160"... "Best contest I've ever operated"... "An absolute winner!"... "Definitely will try again next year." These welcome comments were heard again and again in the wake of 73's 1982 "top-band" event. "Wrapped up my Worked All States"... "Thanks to the contest I worked another new country!" These were some of the rewards earned for just a few hours of contest operation by nearly 1500 participants.

If you're a supporter of 160 meters, you can't help but notice how much the contest has grown since its inception some 3 years ago. The bright future of this world-championship event seems assured.

Year	Participants
1980	569
1981	917
1982	1482

This year, W9RE single-handedly produced 1118 QSOs, 58 states and provinces, and 8 DX counties to become the 1982 World 160-Meter Phone Champion for single-operator stations. Mike managed to beat second-place finisher and 1981 World Champion W8LRL by a margin of 136 QSOs and 20,000 points. A race as close as this, involving two of the most prominent stations on the band, sets the stage for our 1983 event just around the corner. The upcoming contest will decide the best two out of three.

Both W9RE and W8LRL are to be congratulated for their superb performance in our own "survival of the fittest." Who will surpass W9RE's 1118 QSOs which now establishes a world record on 160?

In the multi-operator category, the crew members at W8NGO are the 1982 World Champions. They compiled 877 QSOs, 56 states and provinces, and 4 DX countries for a total score of 273,900 contest points. The gang at W4CN, last year's World Championship station, finished second with a total of 238,950 points. It was a very close race for the top slot, with only 73 QSOs and 1 multiplier separating the two stations. Here again, the 1983 contest will decide the best two out of three, since last year's champions finished second this time.

Of all the single-operator entries, the following stations compiled 500 or more QSOs: W9RE (1118), W8LRL (982), WB3GCG (932), WD8CRY (762), WB0CMM (722), W1CF (697), KJ9D (622), N8ATR (582), N5JB (579), KC8P (561), K9QLL (552), W3BGN (524), and N5CG (502).

In the multi-operator class, 500 or more QSOs were earned by the following stations: W8NGO (877), W4CN (804), AK2E (688), K9ZUH (677), W9ZX (512), and K9YUG (504).

W9RE worked the most states and provinces (58) for the single-operator class, followed by W8LRL and WB3GCG with 57; K9RJ with 56; KC8P, WD8CRY, KJ9D, N5JB, WB0CMM, and K9QLL with 55; W1CF, W9DUB, and W0CM with 54; N5CG, W4VKK, KB8HW, and W2FJ with 53; K1MNS, W5YZ, KA0HIG, and KA7BTQ with 52; and KC4OV, K0STF, WA2GZB, N7DF, and K1LPS with 51 W/VE multipliers.

For the multi-operator category, W8NGO, K9YUG, and K9ZUH accumulated the most W/VE multipliers, with 56 each; AK2E had 54, W4CN had 53, K0UK had 52, and W9ZX had 51 states and provinces.

Screening all logsheets, EA5ET worked 17 DX countries, followed by G3XWZ/A with 15 countries; W8LRL with 13; N4IN, OK1AVG, and W1CF with 12; WB3GCG and VE1YX with 11; and ZF2DX with 10.

After all the contest entries have been tabulated, it is rewarding to analyze the station equipment and antennas used by the participants. The tables below tell the story.

Equipment	Usage
Kenwood	38.5%
Yaesu	27.0%
Drake	20.5%
Icom	4.9%
Ten-Tec	3.3%
Collins	2.4%
Hy-Gain, Astro, Heath, Signal One	.85% each

Equipment used in the 160-Meter Phone Contest.

Antenna	Usage
Dipole/inverted vee	37.3%
Inverted-L	15.3%
¼-wave sloper	9.3%
Trap vertical	9.3%
Shunt-fed tower	7.9%
Vertical (½, full wave)	7.9%
Long wire	5.7%
½-wave sloper	2.8%
Quad, delta loop, 5-element yagi, windom, zepp	.9% each
Receive antennas only:	
Beverage	10.7%
Loop configuration	1.9%

Antennas used in the 160-Meter Phone Contest.

The success of this very popular contest would not have been possible without the dedication of two superb gentlemen of the "gentleman's band." Our special thanks to Dan WA2GZB and Ed K3IXD who both tackled the responsibilities of scoring all the entries and corresponding with the entrants. These gents have been involved with this world-championship contest ever since its founding some three years ago. Both have burned the midnight oil countless nights when the rest of us were enjoying the openings on the band.

The 4th annual contest is just around the corner. After you read these results, pass them on to your friends on 160. Be sure they're aware of our world-championship contest, scheduled for January 15-16, 1983. If you think this year's scores were record breakers, wait until January 1983! With the relaxation of the FCC rules on this band, we expect to see nearly 2,000 stations participating. I'll be there, how about you?

WORLD 160-METER PHONE CHAMPIONSHIP MULTI-OPERATOR STATIONS

Callsign	State	QSO	St./Pr.	DX	Points
W8NGO (W)	MI	877	56	4	273,900
W4CN*	KY	804	53	6	238,950
AK2E*	NY	688	54	8	224,750
K9ZUH*	IN	677	56	6	213,280
K9YUG	IL	504	56	4	152,400
K0UK*	CO	467	53	5	137,120
W9ZX	IL	512	51	—	130,560
N8AKY*	MI	369	50	3	98,580
KB0TJ	CO	324	50	—	81,000
AA1K/3*	DE	279	46	7	75,525
KB8AC*	OH	244	44	1	56,350
N4DBR	KY	219	40	—	43,800
K0UR*	KS	189	43	1	41,800
W0CEM	KS	143	45	1	31,970
WD8NJR	MI	133	40	1	27,470
KB0SF	CO	136	40	—	27,200
DF5ZD/A*	Germany	35	—	6	3,135

(W) World Champion for 1982
* State/Provincial/DX Country Champion
Disqualified: WB8JBM

160-METER CONTEST SOAPBOX

"A very excellent test. Something should be done about improving the conditions, however (hi)."—W1BB.

"Suggest you give a multiplier of zero for all kW stations. With their excess power, that would certainly thin the results considerably."—AA1K.

"My first try at a contest. Hope I help those needing Rhode Island."—W1LOV.

"Excellent conditions the first night. Sure was a fantastic contest and I'm really looking forward to next year, now more than ever."—K1LPS.

"Lots of activity. The band was extremely crowded."—K1NBN.

"A very fine event! Many big signals, and there were more stations on the band than I have ever heard on 160 meters!"—K2DWI.

"Had nothing but antenna problems the 1st night. Blew a borrowed rig to top it off. I'll be back next year though."—AK2E.

"Excellent first-night European opening."—N4IN.

"Score would have been higher but had 300 kHz interference from an op who lives just down the road. He deliberately QRMs and the FCC has given him warnings about it."—W4PZV.

"My first 73 contest. Had a great time. Will have a better receiving setup next year."—W4TMR.

"The most enjoyable contest I've ever been in!"—W4TWW.

"A bunch of activity on the band. Hardly any DX."—WB4ZPF.

"Must say there was much activity and I certainly enjoyed it very much."—N5CG.

"Enjoyed the contest. Sounded like 20 meters. The strobe light atop my 300 vertical gave my receiver fits throughout the contest."—W5GFR.

"Thanks for a fine 160-meter contest."—AE5H.

"Nice contest. Ended up doing surgery and missed half of it, unfortunately."—K5JZN.

"Lots and lots of QRM!"—W5LFG.

"Very interesting contest. Sure enjoyed it."—KC5LK.

"Sure had lots of fun in the contest. Lots of QSOs and lots of QRM."—K6ANP.

"Great contest. Wish I could have worked the entire event."—WD6EFU.

"Enjoyed it, as I'm sure everybody did. Second night was not as good as the first. Doubled last year's score, though."—W6WBY.

"Had to work both nights but managed to slip in a few Nevada multipliers for the stations on the band."—W7ABX.

"Sounds like the contest is growing every year. Had a great time as did everyone I talked to."—KA7BTQ.

"Daytime contacts are okay but too bad you couldn't work a station a second time if you worked him the night before."—N7DF.

"Sure enjoyed the contest. Lots of stations heard on the band."—WB7FDQ.

"Super contest! I did better than last year and it sure helps toward my 6-band WAS award. See you again next year."—AK7H.

"Very enjoyable contest. Amazed at the number of stations on the band. All were very courteous. It was a real gentleman's contest."—K7SFN.

"Great contest. Heard a lot of activity from my QTH here in Montana. Plenty of QRM, too."—K7VIC.

"Daytime bonus points should be deleted."—KC8A.

"Had lots of fun and looking forward to 1983. The contest is definitely growing each year. Thank you, 73!"—N8AKY.

"S-9 power-line noise throughout the contest!"—W3CV.

Continued

"A fun, gentlemanly affair. Worked maybe 12 calls on 160 the last 35 years. This weekend I managed over 700 contacts!"—WD8CRY.
"Sounded like everyone had a great time."—K8HF.
"42 states worked. Not bad for a 25-foot helical-wound vertical with only 5 radials."—KC8NR.
"Enjoyed the contest very much. I think it is the best one held on 160!"—KC8P.
"Sure enjoyed the contest. Lots and lots of stations were on, I see."—AA8S.
"Daytime bonus was confusing. Had a great time, though."—K8US.
"The first 160-meter contest ever for me. I invited the Smoke Valley ARC over to help me out."—WØCEM.
"Unbelievable activity this year. 73 has done it again!"—WBØCMM.
"My first effort on 160-meter contesting. I was really impressed with the turnout. Had loads of fun."—KAØHIG.
"Sorry, no US stations heard on the band... just Europeans."—DF5ZD/A.
"Had a special 160-meter license and heard only Europeans."—EA3CCN.
"A very popular contest according to the turnout. Good luck."—KH6IJ.

WORLD 160-METER PHONE CHAMPIONSHIP
SINGLE-OPERATOR STATIONS

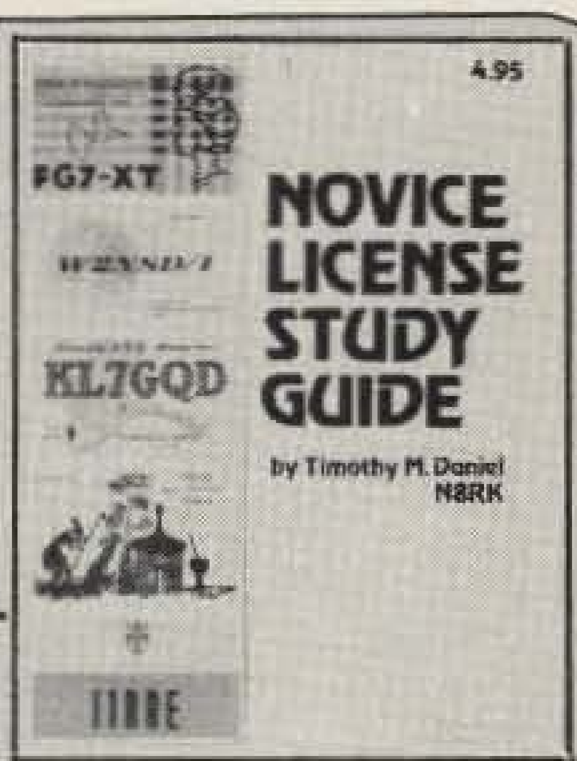
Callsign	State	QSO	St./Pr.	DX	Points
W9RE (W)	IN	1118	58	8	371,580
W8LRL*	WV	982	57	13	350,700
WB3GCG*	MD	932	57	11	322,660
W1CF*	MA	697	54	12	236,280
WD8CRY*	MI	762	55	6	234,240
WBØCMM*	CO	722	55	8	230,895
KJ9D*	IN	622	55	4	184,670
KC8P	MI	561	55	5	169,800
N5JB*	TX	579	55	3	169,650
N8ATR*	OH	582	50	5	164,640
K9QLL*	IL	552	55	3	160,950
WØCM*	KS	484	54	6	147,600
K9RJ	IL	471	56	4	142,500
KB8HW	MI	491	53	3	138,320
N5CG*	OK	502	53	1	135,810
W3BGN*	PA	524	45	4	135,730
W9DUB*	WI	473	54	3	135,660
KC4OV*	TN	479	51	3	130,140
K1MNS*	NH	436	52	3	120,725
K1LPS*	VT	440	51	3	119,610
W4TMR*	NC	461	48	6	117,720
KA7BTQ*	ID	368	52	7	111,805
KØSTF*	SD	401	51	3	109,080
W4VKK*	GA	367	53	4	106,020
W2FJ*	NJ	347	53	6	104,430
N7DF*	UT	362	51	5	103,880
N4IN*	FL	318	48	12	101,100
KAØHIG*	IA	338	52	3	93,775
W5YZ*	NM	333	52	3	92,950
K4AQQ	FL	331	49	5	90,720
VE1YX*	NS	292	47	11	88,740
N4MM*	VA	336	48	4	88,400
K2BQ*	NY	285	49	8	84,075
KD4NI	VA	315	49	3	78,645
KG4W	VA	347	46	1	77,315
VE2ZP*	Quebec	343	42	2	75,900
W4PZV	FL	259	49	7	74,760
K7SFN*	NV	293	50	1	74,715
N4ARO	TN	289	48	3	74,460
N3CO	MD	283	43	3	73,580
WB7FDQ*	AZ	266	50	3	71,285
K7VIC*	MT	263	49	4	70,490
WA2GZB	NJ	253	51	3	69,120
NA4D*	KY	251	49	3	66,040
W8QBF	OH	303	39	3	62,730
NØAN	IA	246	50	—	61,500
WAØOFH*	WA	179	48	7	61,410
K3IXD	MD	252	47	1	60,960
WØHW*	MN	235	50	1	60,435
AA8S	OH	304	36	2	58,140
W5GFR	TX	240	41	5	56,350
K3LGC*	DE	237	40	2	54,600
KB3MI	PA	215	46	3	53,410
AE5H*	MS	254	40	1	52,480
W3ICM	MD	243	39	3	51,650
VP9BO*	Bermuda	251	35	5	51,200
KK8L	OH	251	38	2	51,000
WB4TUO	TN	192	48	4	50,960
K2DWI	NY	245	39	2	50,635
KC8A	MI	253	37	1	48,260
K4CNW*	SC	215	44	—	47,300
K6ANP*	CA	201	42	3	45,900
W3AP	PA	235	35	2	44,955
N8TN	OH	233	37	1	44,460
WB1CWZ*	CT	252	33	2	44,450
KC5LK	MS	206	41	1	43,680
VE4WR*	Manitoba	176	49	—	43,120
W4OWJ	FL	167	45	5	43,000
KC8NR	WV	190	44	1	42,750
AE3T	PA	185	42	2	41,140
K2FL	NJ	200	34	3	40,600
WBØUFL	IA	196	43	—	40,140
W4TWW	SC	179	41	3	40,040
W8DN	OH	177	39	2	36,285
K1NBN*	ME	175	39	2	35,465
WB7OZM*	OR	191	33	1	32,980
AIØZ	IA	154	41	1	32,550
WB4ZPF	VA	154	39	2	31,980
W4YZX	NC	165	35	1	30,880
AK7H	WA	130	42	4	30,820
WA5NFC*	AR	156	34	2	28,620
WA9FTV	IL	130	41	1	27,510
KC8JH	OH	123	41	2	26,660
K3SXA/MM	NY/MM	124	34	6	26,400
K4YFH	NC	176	30	—	26,400
K1ECK	MA	167	24	5	24,505
K8US	OH	143	34	—	24,310
K5JZN	OK	110	43	—	23,650
NØZA	CO	99	43	2	22,725
N7AKU	NV	138	31	1	22,400
WA9RHU	IL	118	35	1	21,420
ZF2DX*	Grand Cayman	82	37	10	21,150
VE7WJ*	BC	110	33	3	20,160
VE6OU*	Alt.	127	30	1	19,995
W3CV	PA	92	40	1	19,270
VE7ERY	BC	100	38	—	19,000
WB9LFD/1	CT	119	29	2	18,755
W4KMS	VA	109	31	2	18,315
AA4FF	VA	126	27	2	18,270
K4OD	VA	112	30	1	17,515
W6WBY	CA	105	32	1	17,490
K8SVT	OH	116	30	—	17,400
WA2ORX	NY	103	31	1	16,640
VE1BPY*	PEI	93	33	2	16,625
VE2OG	Quebec	93	34	—	15,810
K8AQM	MI	117	27	—	15,795
VE2QO	Quebec	101	27	3	15,300
K9CGD	IL	89	31	2	14,585
KB8YE	OH	85	30	1	13,330
W5LFG	TX	98	27	—	13,230
K2MN	NY	95	26	1	13,095
W1BB	MA	72	30	3	12,375
WD8LCD	MI	101	22	—	11,110
W1LUG/4	VA	85	23	1	10,320
W4HVU	FL	71	25	2	10,260
W1LOV*	RI	94	21	—	10,185
KBØW/6	CA	71	26	—	9,230
WD8MRF	OH	73	24	—	8,760
VE5XU*	Sask.	60	26	—	7,930
WD8LCN	MI	62	25	—	7,750
KB7M*	WY	58	23	3	7,540
G3XWZ/A*	England	94	—	15	7,450
K8HF	OH	59	23	—	6,785
EA6ET*	Balearic Is.	57	1	17	5,130
WD6EFU	CA	44	20	—	4,600
OK1AVG*	Czech.	71	—	12	4,260
W7ABX	NV	50	17	—	4,250
KB8UQ	MI	62	13	—	4,030
KB7WN	WY	33	20	—	3,400
W1GOM/5	OK	35	18	—	3,150
EA3CCN*	Spain	26	—	8	3,120
AK7F	WA	40	13	1	2,870
KJ7I	AZ	35	15	—	2,625
K8CV	MI	32	16	—	2,560
KA7HBS	WY	28	16	—	2,240
KH6IJ*	HI	29	15	—	2,175
KA8MSQ	MI	50	7	—	1,750
8P6KZ*	Barbados	16	7	6	1,495
VE7FBS	BC	23	10	—	1,150
W3ETB	PA	14	10	1	825
N8ASB	MI	13	1	—	130
KA8ALO	MI	8	1	—	80
K9GDF	WI	4	2	—	40

(W) World Champion for 1982
* State/Provincial/DX Country Champion

✓See List of Advertisers on page 114

RADIO BOOKSHOP

FOR THE NOVICE



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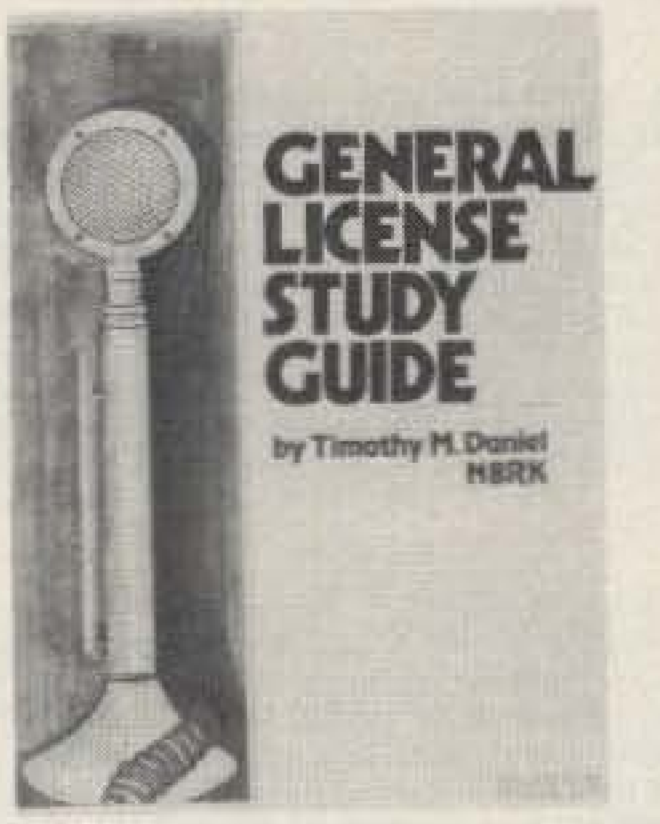

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"GENESIS"

5 WPM—CT7305—This is the beginning tape for people who do not know the code at all. It takes them through the 26 letters, 10 numbers and necessary punctuation, complete with practice every step of the way using the newest blitz teaching techniques. It is almost miraculous! In one hour many people—including kids of ten—are able to master the code. The ease of learning gives confidence to beginners who might otherwise drop out.

"THE STICKLER"

6+ WPM—CT7306—This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly—under pressure—faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five.

"BACK BREAKER"

13+ WPM—CT7313—Code groups again, at a brisk 14 per so you will be at ease when you sit down in front of the steely-eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test, you'll thank heaven you had this back-breaking tape.

"COURAGEOUS"

20+ WPM—CT7320—Code is what gets you when you go for the Extra class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape.

"OUTRAGEOUS"

25+ WPM—CT7325—This is the tape for that small group of overachieving hams who wouldn't be content to simply satisfy the code requirements of the Extra Class license. It's the toughest tape we've got and we keep a permanent file of hams who have mastered it. Let us know when you're up to speed and we'll inscribe your name in 73's CW "Hall of Fame."

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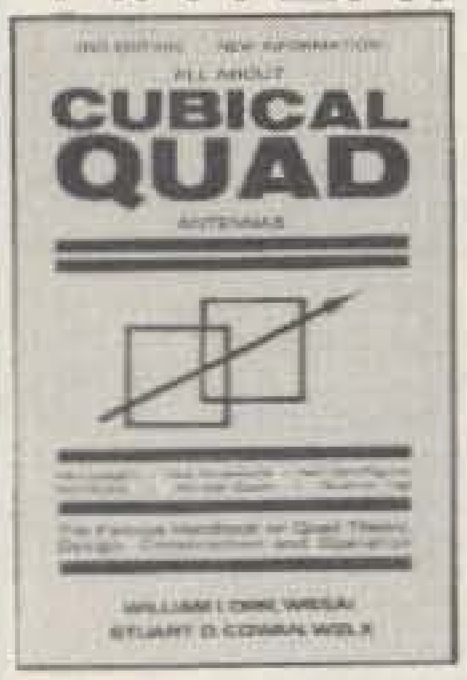

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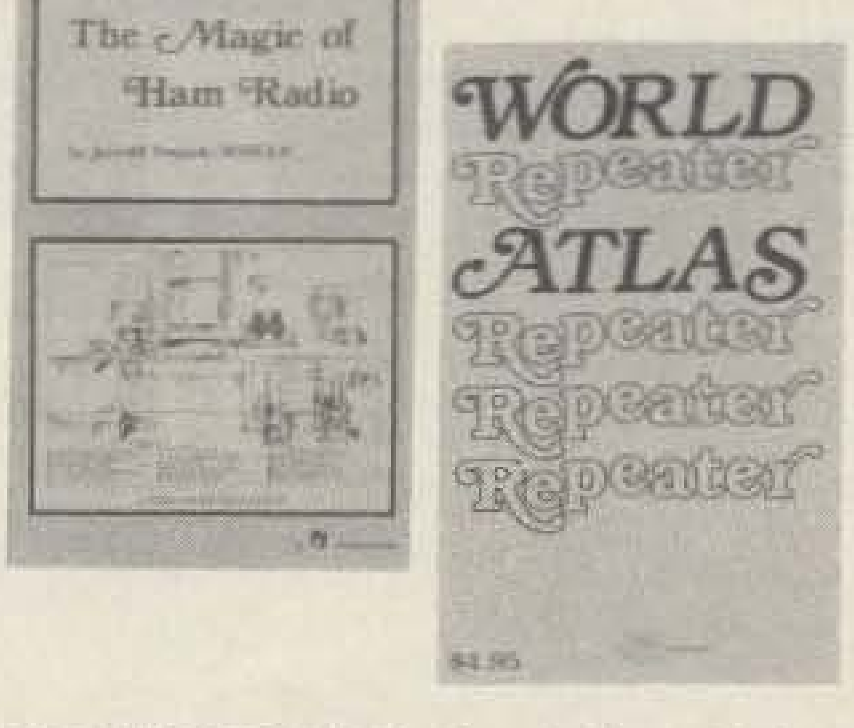

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SOUTH BEND IN
JAN 2

A hamfest swap & shop will be held on Sunday, January 2, 1983, at Century Center, downtown on US 33 One Way North between the St. Joseph Bank building and the river, South Bend IN. Tables are $3.00 each in a carpeted, half-acre room. The Industrial History Museum is in the same building. Four-lane highways lead to the door from all directions. Talk-in on .52/.52, .99/.39, .93/.33, .78/.18, .69/.09, 145.43, and 145.29. For more information, contact Wayne Werts K9IXU, 1889 Riverside Drive, South Bend IN 46616, or phone (219)-233-5307.

WEST ALLIS WI
JAN 8

The West Allis Radio Amateur Club will hold its 11th annual Midwinter Swapfest on Saturday, January 8, 1983, beginning at 8:00 am, at the Waukesha County Exposition Center. Tickets are $2.00 in advance and $3.00 at the door. Tables are $2.00 in advance and $3.00 at the door. For advance reservations, send an SASE to WARAC, PO Box 1072, Milwaukee WI 53201.

OAK PARK MI
JAN 9

The Oak Park Amateur Radio Club will hold its annual Swap 'n Shop on Sunday, January 9, 1983, from 8:00 am to 3:00 pm, at Oak Park High School, southwest corner of Coolidge and Oak Park Boulevard, Oak Park MI. There will be ample parking and refreshments. Talk-in on 146.52. For prepaid table reservations, write OPARC, 14300 Oak Park Boulevard, Oak Park MI 48237.

RICHMOND VA
JAN 16

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

SOUTHFIELD MI
JAN 30

The Southfield High School Amateur Radio Club will hold their 18th annual Swap & Shop on January 30, 1983, from 8:00 am to 3:00 pm, at Southfield High School, 24675 Lahser, Southfield MI. Doors will open at 6:00 am for exhibitors. Admission is $2.50. Reserved tables (payable in advance) are $18.00 for two 8-foot tables and $9.00 for each additional reserved table. Tables also will be available at the door. There will be food and parking. All profits go toward electronics scholarships and to support the activities of Southfield High School's amateur radio club. For more information or reservations, write Robert Younker, Southfield High School, 24675 Lahser, Southfield MI 48034, or phone (313)-354-7372 from 8:00 am to 10:30 am or (313)-354-8210 from 10:30 am to 3:00 pm Monday through Friday.

ARLINGTON HEIGHTS IL
FEB 6

The Wheaton Community Radio Amateurs will hold their hamfest on February 6, 1983, at Arlington Park Race Track Expo Center, Arlington Heights IL. Tickets are $3.00 at the entrance and $2.50 in advance. Doors will open at 8:00 am. Flea market tables are free and plenty of floor space will be available. There will be a large commercial area (including a computer section), awards, and clear, paved parking. Talk-in on 146.01/.61 and 146.94. For general information, call W9JTO at (312)-231-9524. For advance tickets, send an SASE to WCRA, PO Box QSL, Wheaton IL 60187.

MANSFIELD OH
FEB 13

The ARRL-approved Midwinter Hamfest/Auction will be held on Sunday, February 13, 1983, beginning at 8:00 am, at the Richland County Fairgrounds, Mansfield OH. Tickets are $2.00 in advance and $3.00 at the door. Tables are $5.00 in advance and $6.00 at the door. Half tables are available. Talk-in on 146.34/.94. For additional information or advance tickets, contact Harry Frietchen K8HF, 120 Homewood Road, Mansfield OH 44906, or phone (419)-529-2801 or (419)-524-1441.

MARLBOROUGH MA
FEB 20

The Algonquin Amateur Radio Club will hold its annual flea market on Sunday, February 20, 1983, at the Marlborough Jr. High School, Marlborough MA. Admission is $1.00 and children under 12 will be admitted free. The doors will open at 9:00 am for dealers and 10:00 am for buyers. Refreshments will be available. Tables reserved before February 12, 1983, are $7.00; any remaining tables will be $10.00 at the door. Talk-in on 146.01/.61 and 146.52. For table reservations or more information, contact Algonquin ARC, PO Box 258, Marlborough MA 01752.

GLASGOW KY
FEB 26

The Glasgow Swapfest will be held on Saturday, February 26, 1983, beginning at 8:00 am Central time, at the Glasgow Flea Market Building, 2 miles south of Glasgow just off highway 31E, Glasgow KY. Admission is $2.00 per person. There is no additional charge for exhibitors. The first table per exhibitor will be free, and extra tables will be available for $3.00 each. There will be a large heated building, free parking, free coffee, and a large flea market. Talk-in on 146.34/.94 or 147.63/.03. For further information, write Bernie Schwitzgebel WA4JZO, 121 Adairland Court, Glasgow KY 42141.

✔See List of Advertisers on page 114

LETTERS

FIGHT CITY HALL

OK, Wayne, I've sat here every month and read how you think that the code requirement is hindering the growth of amateur radio. I think you are missing a problem facing amateur radio that is much bigger than a code requirement. The problem that I am referring to is local ordinances that restrict or prohibit amateur towers and antennas.

I can only imagine the number of hams who have worked hard to upgrade and feel that now is the time to put up that dreamed-of antenna system only to have their local government say it's illegal, so take it down. Why upgrade anymore? In fact, why even continue on with ham radio? It is truly disheartening to be told not to practice your hobby to its ultimate limit and enjoyment.

Believe me, fighting city hall is no fun (well, maybe a little fun when you win). I speak from experience. In my city, Cerritos, California, it took about 2 years of fighting city hall to get our ordinance changed. Led by George Goumas N6AWF, we outlasted our city officials by getting to meetings at 7:00 pm and often not being able even to begin our presentation as to why our ordinance should be changed until 1:00 or 2:00 am. Well, our perseverance paid off with a new ordinance that allowed us to go to 70 feet with a conditional use permit.

Wayne, if it had not been for many out-of-town hams who came and helped to fill up the council chambers, we would never have made it. Of the 100-plus hams in our city, only a handful were interested enough to come out for our hearings. It was the backing of the out-of-towners that saved our bottoms.

I applied for the first permit under the new ordinance. It was granted after a two-hour discussion with neighbors who claimed I was causing them continuous interference. A well-kept log book blew that argument away. I really thought that my permit was to end up on the scrap pile after a 137-signature petition against me was presented to the council. For a number of reasons that I won't go into, it had no effect.

From these experiences I have come to some conclusions that I would like to share with all amateurs. First of all, most of you don't care about what is going on around you until it hits you square in the face. Amateurs need to fight for their property rights as home owners. I have a little 50' × 100' piece of property that I'd like to call mine, but it is never mine when I have people telling me I can't practice a hobby that's not noisy or harmful. It's a lot easier to keep restrictive laws off the books than it is to change existing laws. Each amateur should make it his (or her) business to keep tabs on what is going on in his city. Finally, don't assume that because the guy a mile away has up a tower and antennas that there are no laws against it in your city. It may be that no one has complained to the city so they just haven't taken the time to tell the amateur to remove it.

Wayne, as much as I dislike fighting with my local government, I'll never stop fighting. It looks as if I will be moving in the next year so that I will probably have to go through the permit process again. Local governments are slowly taking away our personal freedoms. If you don't believe it, just check to see what kinds of no-nos are on your local government's books. These ordinances will range from what color you are allowed to paint *your* house to what you are allowed to park in *your* driveway. Believe me, restrictive antenna ordinances are becoming more of a widespread problem than you will ever know and are certainly more of a problem than a code test.

Carol Green KK6V
Cerritos CA

P.S. Since writing you this letter, our city is trying to pull the wool over our eyes again. They have decided to take the new ordinance and put it back into the Planning Commission for further study. So far through all of this, we have received no League backing. If the ARRL won't help us this time then I suspect that 100-plus amateurs in this city will no longer have any reason for belonging to the League because amateurs that cannot operate have no reason for belonging to an organization that deals with the operation of amateur radio stations.

HYPOCRISY

How far have we progressed in ham radio? Is it possible that our technology has passed our intelligence? Can it be that many of our population lean towards hypocrisy?

One of the most common comments one hears on the air is, "Ham radio is so great, it has something for everyone." I suppose they speak of the hobby where, if you have the money, you can own monobanders on each band, several transceivers, and amplifiers. Do we include the other guy? The one who lives by the dipole and no amplifier? Which hobbyist is more important?

Looking back, more than half of what I now have collected I owe to a list or a net of some kind. Myself, I have never taken a relayed report, which some seem so concerned about. The percentage of people who operate with the same self-dignity set of rules I operate with is probably 98 percent.

I have sat in awe at my station listening to what some say is the only way to work a DX station (the pileup). I have heard gentlemen such as FB8WG and A51PN (and the list could go on) try to dig a call or just a letter out of the pileup; being unable to do so because people kept calling so long, they just go QRT or QSY.

Gentlemen, channel efforts towards making ham radio a better hobby. During contests, for example, stations all over the bands run 20-30 kHz wide. These guys don't care, because it keeps others from moving close. Why not focus support towards allotting overlapped segments of the General and Advanced band, i.e., 14250-14300 kHz. This way, non-contesters are not forced out of their weekend of operating. How many lists or nets mess up the whole band for others throughout the entire weekend? I suppose that's OK, though, because somewhere, someone up there likes contests.

I firmly believe that the majority of the old-timers that are against lists or such have all or nearly all of their countries and have done so during times when the ham population was one-tenth what it is today. I would like to see them start over with a dipole and barefoot.

I hope any kind of stand against lists and/or nets is only a rumor. Let us consider how much control any organization which is supposed to help hams should have over how we make a contact.

I feel the desire for the coveted accomplishment in each of us will stop the taking of the invalid report. Those who are dishonest will find a way to be dishonest in every facet of ham radio, no matter what rules are set.

Gentlemen, ponder this and let's all try to improve what we have and not take away that which each of us is entitled to.

Philip Pritchett N6ATS
Mounds OK

VENDOR SERVICES

You know the cliche: Each of us is eager and ready to take pen in hand and complain, grumble, bellyache, etc., against or about some vendor or products or services. But to say something nice about someone or something, that is another scenario, and here comes one.

I have been a ham for about four years, starting at the tender age of 57. In this relatively brief period I have sampled the wares and services of many vendors selling to amateur radio people. Overall, it has been a pleasant experience, but let me single (or is it double) out two vendors from the many I have experienced.

First—Trio Kenwood, makers of fine rigs for two-meter and HF operation along with excellent, if somewhat expensive, audio gear. I have been particularly impressed with service out of their Compton, California, site. They are professional and timely, either by mail or through the reception desk. One gets to speak to a technician right up front, and if the one serving you is not familiar with your particular rig he goes for help in the back room. The rule is courtesy and the proper amount of sympathy. When appropriate, charges are less than the "minimum" posted in the reception area. Service time is often less than posted minimum time. All in all, *real* service after the sale!

I am equally happy with the products and service from Communications Specialists, Orange, California, makers of tone generators for PL applications. Customer service by telephone has always been polite and efficient. You get the feeling that they care about their customers. On several occasions, they have given no-charge service well after the end of the warranty period, sevice required by my clumsiness rather than product failure. Again, a company that unstintingly backs up its product.

I would like to hear from other hams with similar experiences.

I. Olitzky KA6CLE
Venice CA

BE AN ELMER

For the past several months I have been reading letters directed to you by proponents and opponents of code-free licensing. I have yet to read one letter that addresses the central issue, which I believe is how we as amateurs propose to make our hobby better.

I struggled with the code and theory as, probably, most do . . . my callsign attests to that. The pivotal feature is that perseverance and desire can get most everyone past the hurdles. I do not feel that 20-wpm code . . . 13-wpm code . . . nay, even 5-wpm code, nor Mr. Bash's crib text detract from amateur radio; neither do I feel that those things support ham radio. I feel amateur radio's biggest asset lies in the individual hams who comprise our society and the fact that ham radio is a challenging and just plain fun hobby.

Each and every one of us, the already-licensed hams, should do our part to fascinate, encourage, instruct, and support non-hams in the acquisition of an amateur license. We should, on an individual basis, be Elmers to any who show an interest. We should, as groups or clubs, promote and participate in spreading the word that ham radio is fun by supporting and teaching classes. Learning aids are available. *73*, Heathkit®, the ARRL, Ameco, and others publish many fine learning aids. The FCC, while not always as responsive as we would like, is the arbiter of our licensing exams and makes those exams available on schedule and without prejudice.

What may be missing is the incentive for us as individual hams or groups of hams to encourage others. I propose that *73* spearhead an effort to encourage hams to teach others about ham radio. How?

1) Awards: I propose that *73* offer awards to individuals and clubs, similar to operating awards, for getting amateurs licensed.

2) Instructor training: Most of us can learn but many require help in the form of syllabi, group instructional aids, and teaching techniques to enable us to help others. Publish these aids.

3) Public knowledge: Advertise to make the public aware of amateur radio. The ARRL does this to some extent—more is needed.

4) Hotline: Match Elmers (either individuals or clubs) with prospective amateurs needing help. Might work like an computer dating service. A national 800 number hotline is one possibility.

5) Service awards: Encourage clubs to promote themselves by offering club awards for participation in activities like SETs, RACES, MARS, etc.

These are some of the possibilities. There are probably many more ideas which would work better or attack a different front. Not everyone wants to become a radio amateur. For one thing it requires some discipline and effort and not everyone is willing to devote the necessary energy. I feel that everyone who is willing to make the necessary commitments should be given all the help possible by all of us amateur radio operators everywhere.

Jeff Barstow WD8DLK
Rodney MI

BASH REFORM

I am a 15-year-old at Hereford High, and I am writing about the public outcry (what little there is of it) towards Bash Educational Services. In *73* for November, you reported the failure of 89 percent of one of Bash's classes and restated your opposition to the books and classes. I must admit that I have great respect for anyone who takes a firm stand for their own opinions. However, I do disagree with you on the "Bash Book" debacle.

When you really think about it, Bash's system was a radical concept, but as with all once-new ideas, an improvement is needed (not a ban).

Now think about this: You have to admit that for anyone intent on passing "Big Brother's" exam for upgrade it is a Herculean effort to find all of the information (much less, carry the ton of books needed) for passing the bewitching exam; even the *ARRL Study Guide* is nowhere near enough. Anyone who has no prior knowledge of the theory will quickly find out that the *Study Guide* is a good book for introducing them to the theory but in no way prepares them for the double- and triple-talk used by the FCC to befuddle our minds. If you get all of the necessary books to study out of, you wind up studying a lot of information, 70 percent of which you will probably never use or want to know or is not even on the test. All of this useless information mainly serves its purpose by wandering around our minds and mingling with the facts needed. This usually causes a nasty surprise in the form of a failure.

My idea for improvement is a simple change. Continue collecting Qs and As from tests but not for printing in cheat books. I would simply use these and take all of the ham-radio-related books I could get (if I had the sources) and find all I could in the way of theory and facts to back up all of the answers. Take these arranged facts and write them into an easy-to-understand form of writing with flavor and a small vocabulary (you want more young hams; write it so we can understand you). Without using boring, dragging wording, present the theory well, and towards the end of the book introduce readers to the language used by the FCC and get them very familiar with it. Also, a copy of the regs in FCC form with simple English definitions would be desired by many people.

I think that anyone bringing out such a book would end the era of the Bash Books. I know that my idea is not new, but I have yet to see it in the print of a large magazine.

Thank you for your good magazine and for your time.

Glen White NA5Z
Hereford TX

YOU'RE MY TYPE

Your last two issues of *73*, namely October and November, have been more my type of magazine. Since I keep my own notebook of the interesting articles I see in the mags, you have kept me busy lately. You see, I look for articles that look interesting to put on the breadboard and play with and when I've played with one long enough and it looks like a good project to finish, so much the better.

In regard to your continually pressing for more amateurs, I feel that I must put in my two bits' worth. Of all the 50 or more Novices that have passed their exams around here the past two years or so, there are only about two or so on the air. Everyone is interested in DX—how far can we get out, etc. The biggest problem seems to be money. Very few seem to be interested in building. Frankly, I think we need a good set of textbooks that will take the prospective ham from beginning to end.

I'm all for your computer networks, but so far your computer articles are way over my head and I cannot afford the price of a computer to figure them out. The day you can show me *73* articles where I can borrow my wife's portable TV set and, with the minimum of cost, put it on the air, that will be the day. You'll have to hurry, though: I'm 74 years old.

Laurence A. Knutson W9SFL
La Crosse WI

SCHOLARSHIPS

The officers and directors of the ARRL Foundation announce the recipients of two awards for the 1982-83 academic year. The Long Island School Scholarship, for youths attending Long Island colleges or universities, has been granted to Paul Michael Silverman KA2DSP, of Levittown NY. He entered State University of New York at Farmingdale in September to pursue courses in electronics technology. The $250 ARRL Foundation-administered award was given to this young man for demonstrated interest and excellence in promoting amateur radio and for aspiring to an electronics carreer.

The YL ISSB Memorial Scholarship has been awarded, for the second successive year, to Larry Edwin Smith, Jr. WB9UKE. The awarding of $709 to Larry concludes the ARRL Foundation's administration of this scholarship fund for YL ISSB. Larry pursues associate and bachelor's degrees in electronics engineering, aspires to a career with NASA communications, holds amateur Extra and 2nd class commercial licenses, has maintained an A academic average, and has been very active in extracurricular activities at Vincennes University.

ARRL Foundation-administered scholarships are open to all applicants, qualifications and specific criteria being reviewed by screening boards consisting of ARRL Foundation officers and directors and panels provided by sponsoring organizations. Application closing date is May 1, 1983, for the next academic year.

Andrea T. Parker K1WLX
Secretary, ARRL Foundation
Newington CT

FINDING BIRDS

Finally, I have found why the RS-n satellites aren't where they were supposed to be: The tracking program was wrong! I'm referring to "Tracker—The Ultimate OSCAR Finder," p. 88, *73 Magazine*, January, 1981. The computation for satellite longitude is correct only for satellites with inclination greater than 90 degrees. The sign of the variable SO needs to be changed for satellites like the recent Russian ones with inclination less than 90 degrees. I take care of it in my revised Apple version this way:

```
2Ø1Ø CA = COS(IN):SO = − SO*CA/
     (ABS (CA)) + CO*RD + RD*TI/4
```

There are *many* ways to accomplish this sign change; this is the mathematician's way.

Actually, this program is not the only place this error is made. The RSGB *VHF Handbook* puts that correction for inclination on the TI/4 term. The reference that I found to explain this correction is by Bryan Leipper, "Circulation Orbits with Simple Computing Systems," *QST*, February, 1979, pp. 38-42.

Dr. Gerald N. Johnson KØCQ
Ames IA

Thanks for the tip, Gerald. We thought the Russians were just being obstinate.—Eds.

NO FAULT, PCBs

I just finished reading "Avoiding the Electrical Nightmare," on page 64 of the October issue regarding the unusual voltages encountered by N4UH of Cleveland, North Carolina. I was prompted to write because, while his technical analysis is correct, his terminology is not. There is a great difference between a "ground fault" and the condition he describes which is an "open neutral."

A true ground-fault condition is just what the name implies—a fault to ground, or earth. Visualize your electrical panel and the wires in it for a moment. The black wire from the breaker is the neutral or return part of the circuit. An electric light connected between the black and white conductors completes the circuit. The current flowing "out" the black wire is equal in magnitude to the current flowing "in" the white wire. If we introduce a fault into the circuit (such as a broken insulation protecting the black wire from shorting to the panelboard box), then current will flow through the light fixture and back out as before, but also through the black wire to the insulation fault to ground and back to the neutral at the point where the neutral and ground are common. This is a ground fault and the current flowing in the ground conductor is not equal to the current flowing in the neutral return.

Ground-fault circuit interrupters (GFI or GFCI) are devices that sense the current flowing out the black wire and the current flowing in the white wire. If the difference is greater than 5 mA (for the typical residential units), then the device interrupts the current. If the fault from the black wire to ground was through your arm, you would be most appreciative.

The fault described in the article is an entirely different problem. The problem experienced by N4UH was an open neutral. The return conductor (the white wire) was open, creating a voltage-divider effect between the legs of the power system.

The National Electrical Code (NFPA-70-1981) requires that all electrical systems be grounded. The grounding should be accomplished at a single location. This location, as required by the code, is at the supply side of the service at the main service disconnect. This is the only location where the neutral and ground are brought together. All of the uninsulated ground wires running around in your Romex are for the purpose of extending this ground point to each and every receptable and light fixture in your house. A ground fault at any location in your home will cause the ground conductor to carry the return current back to the common point with the neutral at the service disconnect.

It should be noted that the type of problem encountered is rare and should not cause alarm on the part of those with aluminum service-entrance conductors. Utility practices vary but always account for the problems of aluminum oxidation. Aluminum connections, if properly made, are very reliable and need not be of concern to the homeowner. (This applies to the larger sizes of aluminum and not necessarily to aluminum branch-circuit wiring, but that would be the subject of an entire article in itself.)

As long as I am writing, I also would like to extend a word of caution regarding the article on page 29, "Dissertation Upon Roast Pig," by N6TO. The transformers obtained from the utility most likely were immersed in mineral oil. A few transformers are still in circulation, however, which contain polychlorinated biphenyl (PCB). PCB is a major component in coolant known as "Askarel." This is nasty stuff which is very toxic and must be disposed of in accordance with EPA regulations. Under no circumstances should you attempt to use a transformer that contained this coolant. The utility should not even consider selling you a transformer which contains PCB. Because the utility may not know which transformers contain PCB, you may discover one by mistake. In addition to transformers, some high-voltage capacitors used in commercial equipment a few years back also contained PCB insulating material. Be cautious with all surplus and used electrical components containing oil for cooling or insulation.

Dave Olsen KL7K
Anchorage AK

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 8

bringing world reports to *73* could do the job.

We do have a world hobby, so let's see if we can get it together more.

HAMMING FOR CREDIT?

Down in Georgia there is a proposal to have ham classes count for educational credits. That's a good move.

There is a desperate need to get amateur radio going again in our schools and this approach could generate some interest for the students. It would be a way of, so to say, paying the students back with credits as well as in fun.

Though it is old hat to *73* readers to read about the needs America has for technical people...I've been writing about that for several years now...I see that the general media are getting more concerned over the problem. Even the normally liberal writers are getting to worry about the overwhelming loss of technical consumer products to Japan.

With the increasingly rapid development of video technology, microcomputers, data access over the phone or via television stations, video teleconferencing, satellite services, 100-channel TV cables, and so on, it is getting ever more difficult for the general public to ignore the coming developments. They've even been noticing that almost all of the recent developments have been coming from Japan and figured out that this just might make it difficult for America to catch up once we fall seriously behind.

Articles about this have been appearing with increasing regularity in *Newsweek, Time, Business Week, Fortune*, and so on. The situation is getting so serious that a small handful of our educators is beginning to get uneasy. When a problem reaches that level, you know it has to be serious.

Naturally, there are pressures for our government to force Americans to buy more expensive and technically-inferior products just because they are made here instead of in Asia... just as there are heavy pressures to force Americans to buy crummier cars because they are made here. I'd like to see more interest in American productivity, American pride in perfection, and American unions promoting something besides the highest pay possible...with the result that the products are priced out of the market.

But that's another problem... to some degree. The key to any American success in communications and computers in the next twenty years lies in our having the technically-qualified people to invent the products, manufacture them, sell them, operate them, and service them. This is going to take an enormous number of engineers, technicians, and scientists... vastly beyond anything which we even have in prospect to develop in this country.

Only Japan has laid the groundwork to develop the high-technology people who are going to be needed to provide the whole world with video, computers, information, and other technical services which are going to be the key to personal happiness, business success, and educational achievement in, say, twenty years.

While we're busy lowering our academic standards and seeing our proponents of liberal-arts education winning most of the battles in academia, we see Japan loading their schools with enthusiastic technically-inclined students. Do you realize that there are over 900,000 amateur radio operators in Japan today? They have us outnumbered in active hams by a margin of at least three to one...possibly four to one...and Japan has only half of our population! They are running rings around us.

Amateur radio has never been a very popular hobby in America. Even when we were growing at our greatest rate, back in the 1950s, we were growing at only about 11% per year, which was about 22,000 newcomers. Then, with the "incentive licensing" disaster of the 1960s, we fell to zero growth (and worse). Now we're back into a growth mode, but not an impressive one.

Unless the Japanese technology program runs out of steam, their teenagers will be doubling the number of hams in Japan in the next three years, while at our rate of growth we are looking at about eight years for a doubling of our hams.

There has been some criticism of calls for more engineers with a reminder that only a few years ago massive numbers of engineers were dumped and were unable to find work. To a degree, that is right. But what is glossed over in that response is that the engineers and technicians who joined the unemployed were those who had not kept up with the changes in technology. There has never been any surplus of technically-trained people.

Remember that by 1970 it had dawned on even the most backward of firms that solid state was here and unavoidable. This was when the axe fell. Those engineers who were living in the good old tube days were suddenly not needed. This axe was wielded again when the industry discovered ICs and had no further use for engineers who could not cope with them. Each new generation of electronics is going to be ruthless in weeding out the people who do not adapt.

Today, the need is for young engineers and technicians. Our schools have been almost totally emptied of these talented people, leaving the over-40 remnants of previous technologies to try to teach things they haven't bothered to fully understand. This does not bode well for our schools or the next generation of kids...the ones we're depending on to cope with the Japanese incursions.

Amateur radio can help, at least to a degree. By interesting teenagers in a high-tech hobby, we may be able to develop the engineers and technicians we need, both for industry and for our schools as teachers. Of course, the exceedingly slow growth of amateur radio over the last twenty years has meant that the average age of amateurs has been rising steadily, with the result that within our ranks we have few qualified teachers to get new hams started. The technical competence of hams as compared with industry has been dropping for twenty years, where at one time hams were a cut above the average engineer or technician.

I can remember the time when hams were responsible for virtually every major breakthrough in radio communications. Now we can merely point out that long ago hams pioneered FM, NBFM, SSB, SSTV, RTTY, and so on. We old, doddering relics of the past can remember the pride of those olden days. But the world is ruthless; it wants to know what you've done for it lately. Not much.

The plan for giving scholastic credits for ham classes is a fine move; let's see if we can get that idea spread around. I'll be interested in getting articles for *73* on proven ways of getting teenagers interested in amateur radio and on successful programs to get amateur radio growing.

In the meanwhile, I'd like to see a lot more articles in *73* on current technologies. Perhaps we can get amateur radio back into developing some inventors and pioneers of new techniques. Running articles on designing and building kilowatt tube-powered linear amplifiers is not it...unless someone designs a digital automatic-tuning device.

There is no shortage of things to invent which are well within our technical capability...if we let ourselves go and get cracking on it. For instance, we could use a system for automatic identification of transmitters so that our receivers would indicate the call of the station being tuned in as we tune. This could be done via an ASCII signal sent on a subcarrier, thus furnishing the receiver a reference signal to use for automatic tuning. Once we have that development, we will be ready for receiver-tuning systems which will be automatic, alerting you when chosen prefixes or calls are tuned in.

This could be a great stride ahead for amateur radio, pioneering a new digital communications technology which could be quickly applied to CB, two-way, and most other communications services. It could help to bring about some extensive changes in amateur radio operation, too...perhaps the first real changes in over 50 years. Except for the development of

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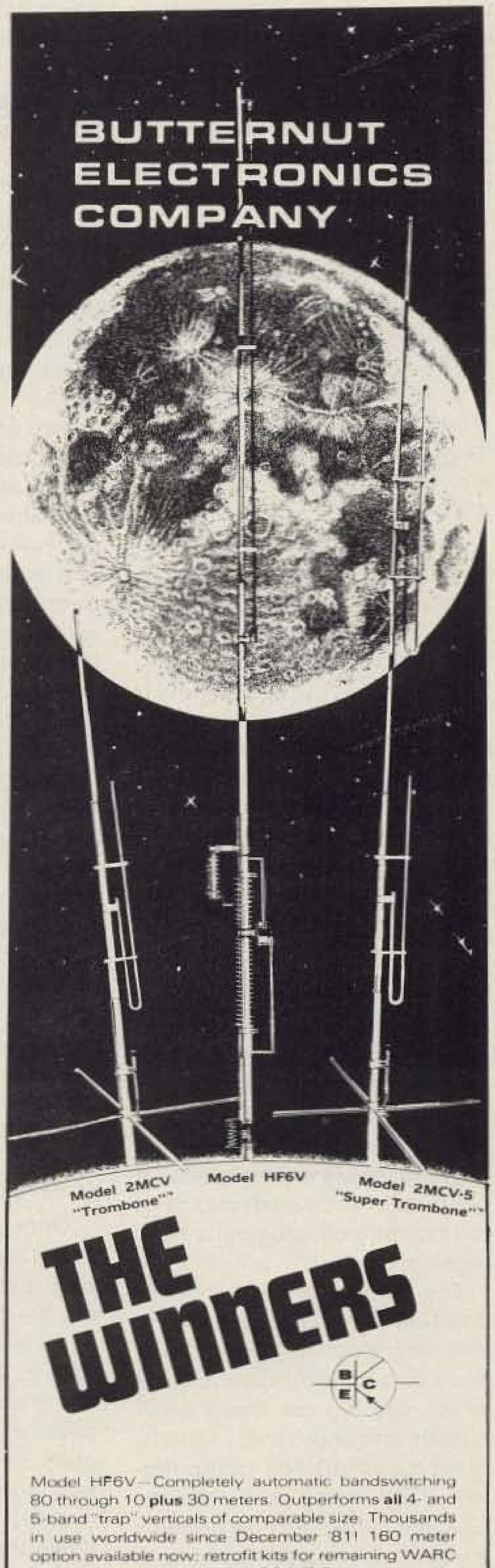

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the vfo, our Morse-code communications has changed hardly at all in 50 years. And other than the shift to SSB, phone communications is almost identical to hamming of 50 years ago, complete with pileups on DX, jamming, endless nets, and so on.

We've had practical RTTY on the ham bands for over thirty years and there still is no noticeable dent in traffic handling as a result. Amateur radio, which at one time was the spawning ground for new technologies, has turned into the most rigid and unchangeable remnant of the past.

You invent it and we'll publish it. . . okay? Let's get amateur radio into gear for the first time in years. The last change of any sort was over ten years ago when we went to FM and repeaters on two meters. Unfortunately we contributed little technically in this move, merely taking advantage of the already-existing technology developed for two-way commercial operating. Now let's do some pioneering for a change.

DIGITAL MANIA

With the new freedoms being granted by the FCC, I'd like to see some serious experimenting on our bands with digital techniques. Ham radio is never going to go anywhere unless we get busy and take advantage of the recent technological advantages in ICs.

For one thing, isn't it about time that the RTTY crowd stopped puttering around, dodging QRM, and came up with some circuits which will dig out those weak signals and copy them? I tried a recently-advertised computerized-RTTY setup and was astounded to find out how crummy it was. . . even as compared with the circuits we were building back in 1948. Almost any kind of interference sent it into spasms of incomprehension.

Fellows, I have some news for you. You should be designing RTTY gear which uses the el cheapo computers such as the Timex 1000 (Sinclair ZX81), the Atari 400, the VIC-20 and so on. Your circuit should make it duck soup to tune in a signal. . . and copy should be 100%, despite CW or other neighboring RTTY signals. You should copy through QRM, QRN, jamming, fading, with any shift, and so on. Let's get cracking at this and stop horsing around with junk which falls apart as soon as a vindictive CW-monger gets on channel. There is, as you may not know, apparently an unlimited supply of CW jammers, all with unlimited time to sit and trash RTTYers. Perhaps we should devise a certificate, with yearly awards.

And while one contingent is doing the inventing which should have been done several years ago but which was prevented by the FCC, bless 'em, others of you should grab your chips and start working seriously on automatic identification for transmitters. Some early experiments indicated that a system would work using a frequency-shifted subaudible tone, but we need to do a lot more work on this. If someone can come up with a relatively simple system which can be built into every transmitter, we can save the several eons of time every year which are presently wasted with redundant identification. Just think of the saving on pileups alone, where perhaps around five thousand stations are giving their calls from fifty to one hundred times per minute, hour after hour. There is a zero in Minnesota with the unofficial record of 117 complete identifications in one minute! A record to be envied. I understand there is a move to get this amazing chap on "People Are Weird."

Once we have a fairly fast automatic-identification system, we'll be able to instantly read out the call of any station tuned in on our receiver. We'll also be able to build in a microprocessor to check the call for wanted calls or prefixes. Those rare ones can come and go pretty fast sometimes, so why miss one just because he is 50 kHz down the band from where you are working? With an automatic tuning system (dual tuning, of course), one receiver tuner will be on your channel for you while the other is scanning the band, checking out the prefixes.

And a couple of years later, the whole thing will be in an HT for us. Just ask any of the early two-meter folk about the first FM rigs and compare them with the programmable, scanning-all-channel HTs of today. You know what we haven't seen yet? Anything!

So, while all you old-timers sit around and fondle your 807s, we're looking to the youngsters to stop fooling around with girls, get going with with their pile of ICs, and invent us out of the 1930s morass that amateur radio is in today. The technology is here. The parts are here. The need is here. . . and riches are awaiting the entrepreneurs who make it happen.

One thing is for sure. . . if you invent it, I'm anxious to publish your articles in *73* and get the ball rolling.

HELP!

Every now and then I see a notice that the League is looking for some hams to add to their staff. Fine, I suppose, though my understanding is that the place is very, very structured. It also isn't growing much, in case you haven't read their yearly report. When I say it isn't growing much, I mean that the League has been losing members at an increasing rate for the last few years. That would make me nervous.

Now, while they've been shrinking away, my little empire has been growing steadily. They need people to replace those who have bailed out. I need people to help us grow even more. . . and I don't think anyone would really characterize this place as rigidly structured.

In addition to needing a good all-around ham or two to test ham gear and write reviews, to keep the W2NSD/1 hamshack state-of-the-art in RTTY, slow scan, repeaters, antennas, and so on, we also need someone to keep our microcomputers running. We have a hundred or more around here and the darned things keep breaking. I think we could keep a compulsive technician exceedingly happy.

Our audio department has a serious need for a technician to be on top of all the digital recording techniques and assure us that our digital and audio cassettes are first-rate.

For people who for twisted psychological reasons are not particularly interested in living in the finest area of the whole country (the world?), we do have some part-time jobs available which can be done from anywhere. These call for a good deal of responsibility, of course. We're building our national network of sales people and have several nice areas still open. This would entail getting out to visit computer and electronics stores about three days a week to make sure that they are well stocked with our magazines, books, and computer programs.

In Peterborough, we have open positions for people with PR and advertising experience, sales, editing, writing, graphic arts, photography, and so on. In the next year, we expect to add at least 100 people to the staff. . . possibly 200, if we can find them.

We're looking for non-smokers who are more interested in developing careers than in just landing a job. We'll be able to keep up our growth only if we keep up our enthusiasm and innovation. Indeed, we've been growing briskly for seven years now, and by the end of this month, we expect to be about five times the size of the ARRL.

So, if you are not a smoker and you're looking for a place to put your outstanding talents to work where they can do the most good. . . and where you will be able to learn more and grow, think in terms of Peterborough. Send along a letter detailing why we can't go a step further without you. . . and a resume.

COMPUTERIZING

With over 40% of the *73* readers computerized. . . and with thousands more eyeing the Timex computer. . . I'd like to make sure there is no misunderstanding. I want to see you experimenting with amateur radio applications of these contraptions and writing up your results for *73*. The readers are interested in articles on getting rid of computer noise. . . in protecting the computers from interference from the rig. . . in RTTY applications. . . high-speed code. . . beam aiming. . . log keeping. . . automatic QSLing. . . packet communications. . . and so on.

Unless you write up the results of your work, it will be wasted. . . giving only you the benefit. The more you write about what you are doing, the more hams will join you in experimenting and developing new ideas—and we'll all benefit.

Remember, too, that the market is just starting to open up for add-ons for the low-end computer systems. There are millions to be made by those who come up with practical new ideas. We've already seen dozens of new millionaires as a result of the recent microcomputer developments. . . and we haven't seen anything yet. With

hundreds of thousands of Timex computers being sold, just about any useful accessory for it will be able to generate millions in sales.

In order to encourage this development, *Microcomputing* will be devoting a special section to the low-end computers. We need not only interfaces, programs on cassettes, and so forth, but we may also have a need for better ROM character generators and operating systems, plug-in ROM programs, and so on.

I've helped a lot of people get very wealthy in the microcomputer business... and I can help you, if you are seriously interested. I write about this in my editorials in *Microcomputing*, *80 Micro*, and *Selling Micros*, and I'll be covering this aspect in *inCider*, too. It's fun to be rich, and the opportunities are almost unending. As a ham, you have an inside track, if you have the will.

HOW'S THE ARRL DOING?

Too bad you didn't get the *QST* annual report... and read it. In amongst the lavish self-praise... an orgy of it... are the stark financial figures, and they are so dark-cloud that they tend to cut through the baloney. Membership is down. And despite the massive increase in the subscription price for *QST*, the income for the League has not even kept up with inflation. Nowhere near it!

The financial management in any normal business would call for the immediate replacement of the people responsible. Of the 74 stocks and bonds in which the League has put the money they've made in profits in past years... being a nonprofit corporation they have to salt away all that money rather than distribute it to the stockholders... only eight are worth more now than they paid for them. Maybe you were wondering who was investing in oil companies, railroads, and so on. Heh, heh... *you* are.

They seem to have concentrated on economizing on membership benefits such as awards, cutting that by 76% in 1981. This is balanced by an increase in unemployment compensation which went up by 973%... yep, almost ten times, as staffers went through the old revolving door. That's quite a one-year record.

Automobile expenses only went up 370% in the year. Are they providing limousines for the top echelon these days? We did see healthy cuts in such pork-barrel items as ARRL headquarters expenses, which were 70% higher in 1978. And the W1AW expenses came down, too. They were 51% higher in 1980. It looks as if someone made a trip somewhere, because while there were no overseas expenses chalked up in 1980, they managed to spend $17,762 in 1981. That's a very nice trip!

Unless you take a serious interest in League financial matters, you have no beef about what they are doing. You are a stockholder of the corporation and should look into how your money is invested. You might even question why the HQ people are salting away millions in stocks and bonds, losing your shirt for you with poor investments, when perhaps they should be spending your money on more services... or, even better, in encouraging some growth in amateur radio.

A million-dollar budget to produce some first-rate films about the excitement of amateur radio... about the benefits of amateur radio to our country... about how to start a high-school ham club... could get amateur radio growing again. We have plenty of friends in television broadcasting to see that the films would get on the air. And a million dollars wouldn't even put a big dent in the bankroll they've built up. It might keep them from blowing so much on lousy investments ... and, after all, isn't that what the money *should* be used for?

Look, I know you hate to have me carping about the League... but I'm not giving the League hell right now. I'm giving *you*, the League member, hell. The chaps at HQ will do whatever they want with your money if you don't *say* anything. It's only by your being a silent partner to the crime that all this money has just plain been thrown away. You haven't been paying attention. You haven't been insisting on meeting with your directors and finding out from them what the situation at HQ is... and they are not going to level with you unless you push them. They'll put the pressure on for membership benefits... and for promotion of the hobby... but only if you lean on them.

The League, under the direction of the directors you have elected, has been spending a pittance on membership benefits and promotion of the growth of the hobby. Get after 'em... let's see some growth.

MAJOR LEAGUE CHANGES AFOOT?

Knowing how undependable the rumor mills are, I don't put a lot of stock in repeated reports that Skip Tenney will soon be promoted as a replacement for Vic Clark as president. Tenney, well known as the publisher of *Ham Radio* magazine, either has sold or seems about to sell what is left of his magazine, so that would make him both available and eligible for the spot.

The move makes sense, too, when you consider how close Tenney has worked with the League all these years. At times, it has seemed as if he were almost an untitled League official. Being independently wealthy, Tenney wouldn't be restricted by the lack of remuneration which goes with the position.

A lack of expected aggressiveness on the part of the recently-appointed president seems to have sparked the search for someone to help take hold of the organization and get it into shape. Many of the directors feel that it is important to have a businessman with experience helping to guide the League into safer financial waters... and perhaps stem the growing loss of *QST* subscribers.

Others of the directors like Vic and feel that he should have more of a chance to get things turned around... to, so to speak, haul the old boat out of the water and scrape off the barnacles. I've personally always held Vic in the highest regard as a ham and a DXer. The directors should realize that even with a relatively small organization such as they have at HQ, people get set in their ways and it is difficult... often very difficult... to bring about changes, no matter how badly they are needed. My unasked-for council would be to give Vic more time and not rush with Tenney.

BUILDERS VS. BUYERS?

Sometimes I get the impression that people will believe just about *anything*! First, we had a bunch of old hams, probably irritated because they had to change from AM to SSB, grousing that hams weren't building any more. I still hear that chorus when I visit some ham clubs, many of which seem to have been taken over by old old-timers.

When I point out that there are more ads for parts in *73* these days percentage-wise than there were in *QST* forty years ago, they look shifty-eyed and shut up... at least until I'm safely out of earshot. The fact is clear that hams are building as much or more than they ever did. It just isn't the old ones who are doing it. Possibly they're too busy watching television.

The increased coverage of relatively simple building projects in *73* has sparked a lot more interest in building and experimenting. Fine... for that's one of the great pleasures of electronics and hamming. I put quite a few years in at the workbench myself, with a barn full of old gear I built to show for it... and a twisted pelvis from standing on one foot for about twenty years. The local chiropractor has given up trying to straighten it... and I've stopped seriously trying to lift anything heavy. I've paid my dues in building.

There is a gross misunderstanding on the part of some of the manufacturers in the industry. This is odd, because it really means that they have been reacting emotionally and not giving any serious thought with some research.

This has to do with the interesting concept that hams who build are not very good customers for commercial equipment. The facts are the opposite, as even a few moments of contemplation will make clear. The major buyers of new equipment are the exact same people who are also building gadgets. How come? Let's look at it.

First, a little lesson in economics. Way, way back, in the early days of amateur radio, hams built their own receivers and transmitters. There were only a handful of hams then, so there wasn't enough of a market to warrant commercial equipment for them. Then, when the first commercial receiver was put on the market, the home construction of receivers virtually stopped. Hams quickly realized that a home-built project would cost more, have a smaller resale value, and not work as well as a commercial receiver. They did just what you and I would do in the circumstances: They bought their receivers.

I came along just shortly after these halcyon days, getting started as a shortwave listener along about 1936 and doing my first pirate operating (called bootlegging then) in 1938. There were no practical transmitters for hams as of that time, there being only about 40,000 licenses. These came along after WWII, when our ranks had swelled to about 80,000. But we did have some beautiful receivers and the hams ate them up.

As a teenager, I was living in Brooklyn and I made it my business to visit as many of the active hams as I could. In those days virtually every licensed ham was active. I visited well over a hundred hams and found just one who had built his own receiver. It really wasn't practical from any viewpoint.

Once transmitters got practical, hams stopped building transmitters. . . with a few exceptions. We've always had a few stranger-than-normal hams, but not many. I went the same route myself, buying war-surplus rigs and converting them. I did build power amplifiers. . . but only because they weren't commercially available.

Much of my own building was involved with complex RTTY gear, autocall circuits so that my RTTY could work automatically, and so on. Those of us building this sort of stuff were getting into digital electronics. . . back in the late 40s. . . 35 years ago!

But then, as now, we bought our rigs and receivers. Further, then, as now, when we bought our commercial equipment we went for the best and the newest we could get. This was only natural since we were deeply involved with hamming and wanted to get the best out of the hobby. Why would I go to the trouble of spending two weeks designing and building a piece of Teletype® equipment and then hook it to a crummy receiver? No way! I went for the best and so did the rest of the builders. They're still doing this.

Today hams *are* building gadgets and enjoying it. But you can bet that these active hams are also very particular about the commercial gear they buy. You can also bet that they are lying in wait for anything new that comes along. These chaps are the best of customers for the industry because they are the most deeply involved.

It is the older hams who already have their KWM-2s who sit and rag-chew, who talk endlessly on nets, who are the bane of the industry, not the enthusiastic builders and experimenters. We are fortunate in that we do have a magazine in the ham field devoted to these nice old men, complete with pages and pages of "operating news" for them to read each month.

When you consider what an incredible bargain ham gear is today, I get a bit aggravated when I hear someone griping about the high cost of it. Lordy! When I got started in hamming we had crystal-controlled transmitters and each crystal cost about $3.50. Not bad—until you translate that into 1983 dollarettes, which puts those nice little crystals at about $63 each.

The cheapest hunk-of-junk ham receiver on the market, the Hallicrafters Sky Buddy, cost $19.50. Cheap? Well, my friend, if we look at the comparable prices for other things, that comes to about $350 today. The average ham wanted something better, running around $80, or about $1,500 in today's puny money.

No, we're getting incredible bargains today as a result of the solid-state revolution, ICs, and mass production. Japan, with nearly one million licensed hams, has such a huge market for new ham gear that the production quantities have brought down the cost of manufacture to much less than one half what it would be without them. Each doubling of production normally drops the cost of manufacture about 15% or so.

So, though we hams are building more than ever before, we also are buying as much as we can get commercially made. . . and getting incredible value for our investment.

ARE YOU MISSING THE DX?

Now, I suppose I should shut my typewriter off and not let you know what is going on. I've been sneaking around twenty meters lately and I want to let you know that you are missing out. The band has been super in recent weeks, and the DX is rolling in at all hours of the day and night.

Just in the last couple of days, I've had contacts with the following, to give you an idea: ZL2WM, ZL1VY, PY2CYT, PY1BFZ, HR1RBM, 7X2BK, VK6RU, IK7AGT, EZ7BXP, 4Z4JS, EA3CXG, N3RD/VP9, JX1JO, PY0ZZ, HH2MC, TU2HJ, PP6ACP, ZS1DG, ZS6WB, ZS4AF, PR7SSM, S83MMK, TU2LM, ZS6BRD, ZS6BNS, ZS4D, JY3ZH, JY4MB, JY5ZM, YI1BGD, 7X5SI, LX1JAS, Y27FN, Y56FN, SM7DLZ, WB5VIH/DU2, VK6CF, VS6CT, HL9RT, UA0JBN, EA9NG, U9H, UK0SBB, 8Q7AV, 3BD8DB, OD5FB, HZ1AB, 4S7EA, T32AF, F5RV/FC, VU9GI, VU9CK, ZL4OY/A, OH0W. . . and so on.

Besides some bragging about working DX, the above list is indicative of what you can do if you get on the air with a reasonably good rig and antenna. It's there, with thousands of DX operators looking for you. While some put up with contest-style operating, whacking out the contacts for QSLs and the good old ARRL Honor Roll listings, most of them will stop this nonsense and be most interesting to talk with if you ask them some questions. Most of them love to talk. . . and they love most to talk about the most interesting subject in the whole world: themselves.

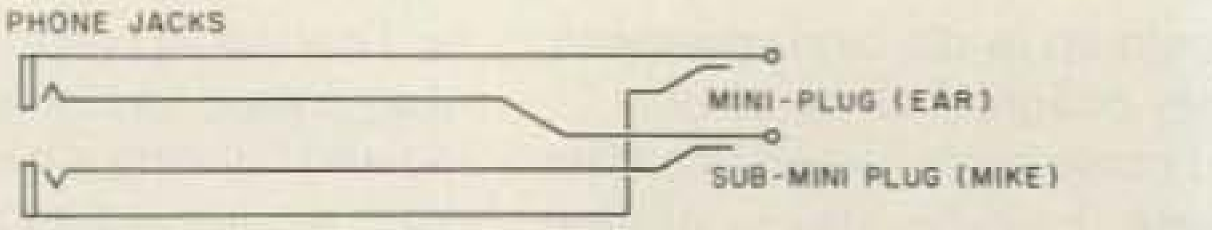
Think what an impression hamming could make on innocent teenagers if they could hear us talking with Christmas Island out in the middle of the Pacific Ocean! Or some chap in Baghdad! They're there, looking for you. Where are *you*?

✓See List of Advertisers on page 114

CIRCUITS

Do you have a technique, modification, or easy-to-duplicate circuit that your fellow readers might be interested in? If so, send us a concise description of it (under two pages, double-spaced) and include a clear diagram or schematic if needed.

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



"STAR-SET" HEADSET CONVERSION: This adapter will enable you to use "Star-Set" headsets with an Icom IC-2AT (or a similar HT). The IC-2AT has about 1-2 volts present in the mike line to power an external electret condenser mike. This voltage is used to power the "Star-Set" as well. To key the PTT, you use the mike mute switch on the belt clip of the "Star-Set." The PTT works by completing the mike circuit. If you want to use the set on both the radio and a telephone, simply unplug it, because no changes are made in the headset. Use shielded wire in the adapter to prevent rf feedback. If you don't receive anything, reverse the plugs, marking them after you have determined the proper placement.—Joe Eisenberg WAØWRI, Lincoln NE.

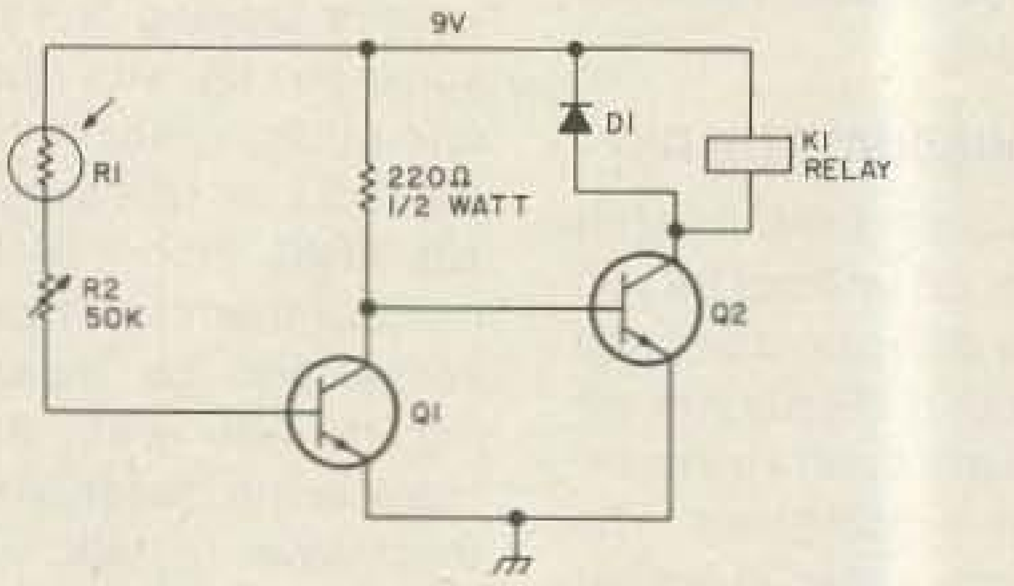


Fig. 1.

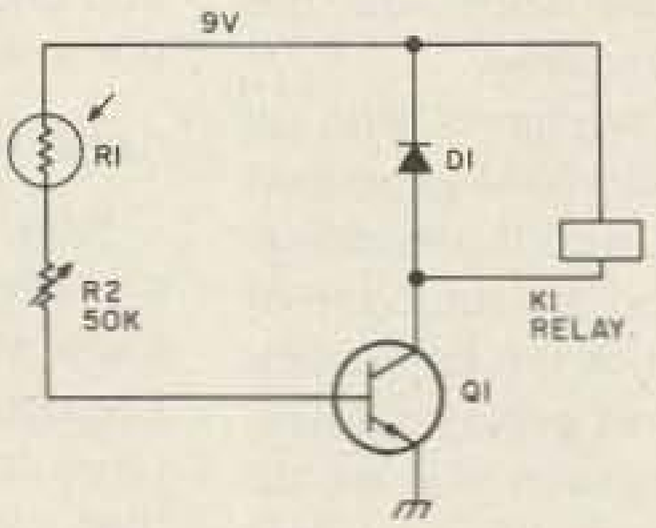


Fig. 2.

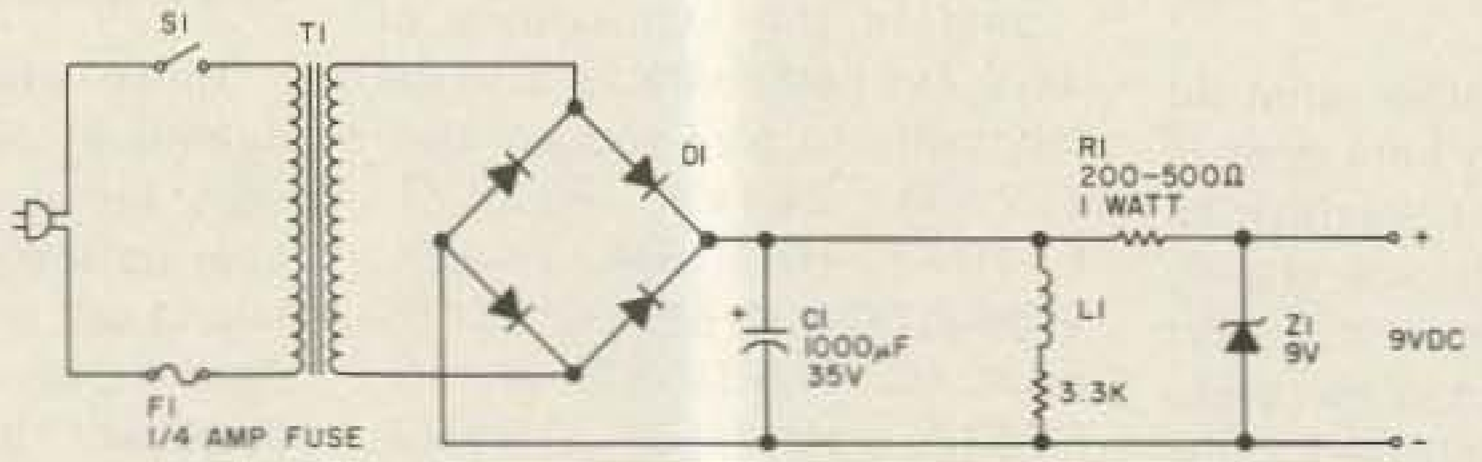
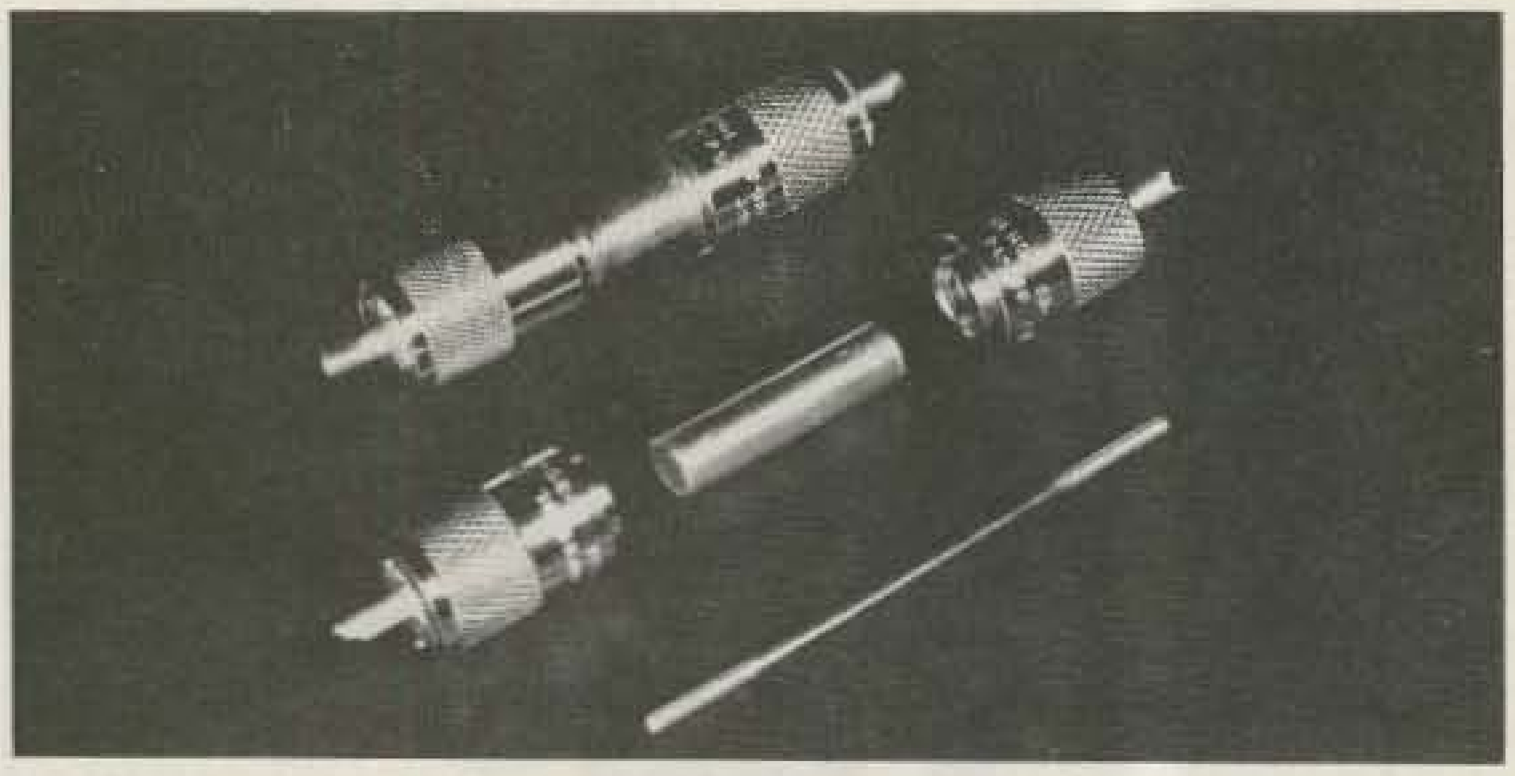


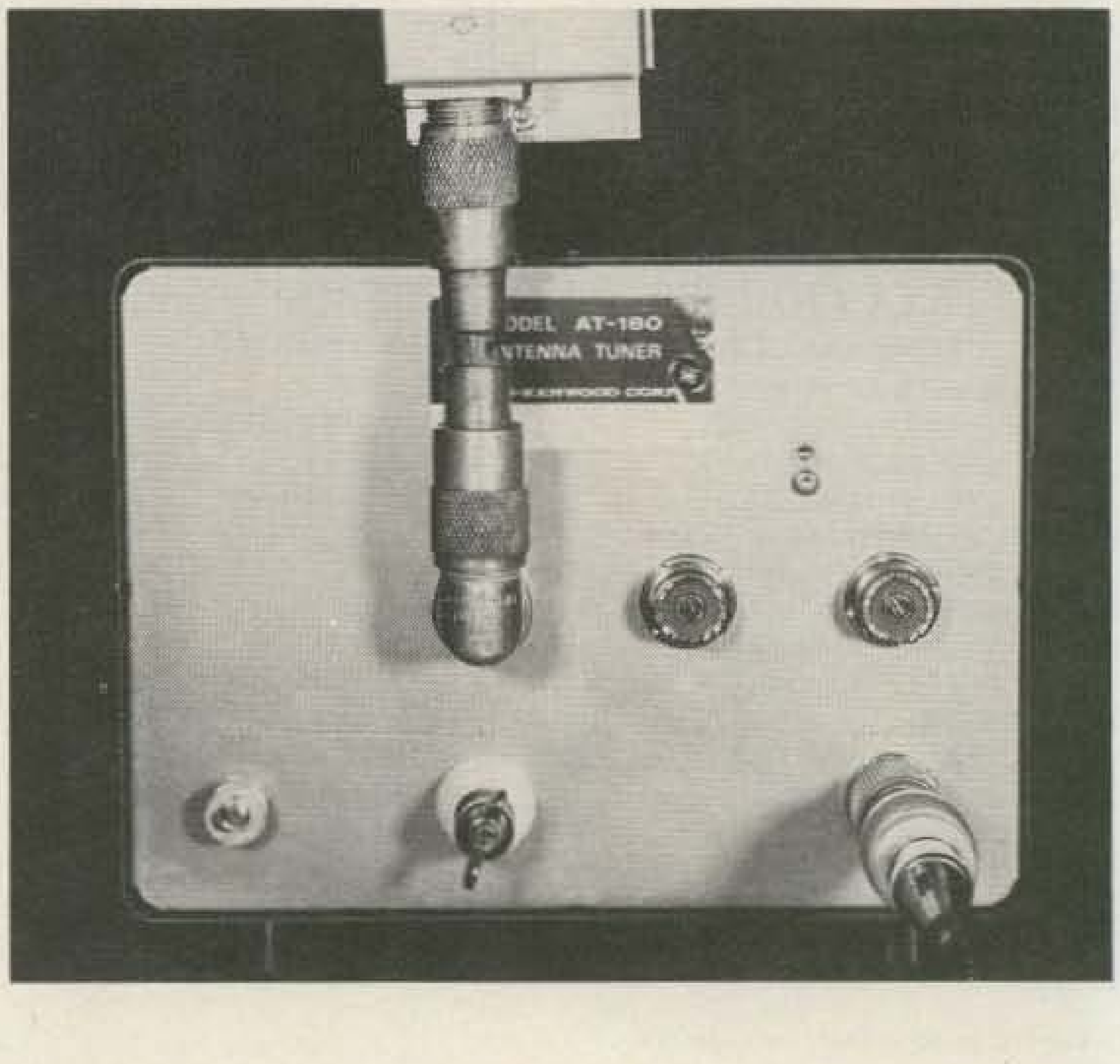
Fig. 3.

LIGHT-ACTIVATED RELAY: Fig. 1 shows a circuit which will trip relay K1 when the light-sensitive resistor R1 is in the darkness. A buzzer can be attached to K1 to indicate that the lights have dimmed. Any small signal diode can be used for D1, which suppresses the high-current inductive kickback, thus protecting Q2. Any NPN transistor can be used for Q1 and Q2. R1 is a cadmium-sulphide resistor which has 5 megohms resistance in darkness and 100 Ohms' in bright light. The resistor can be located away from the rest of the circuit. Fig. 2 is a light-activated relay; the same components are used as in Fig. 1. A power supply circuit is shown in Fig. 3. R1 is a one-Watt resistor valued between 200-500 Ohms.—Alan Weinberg KR7D, Tucson AZ.

CONVERTING THE DRAKE TR-7 TO RECEIVE VLF WITHOUT THE AUX-7: This is a simple modification for the Drake TR-7 which will enable the unit to receive 0-to-1.5 MHz. Open the unit and locate U9003. Remove the wire from pin 14 of this IC. Carefully solder a 6.5-inch insulated hookup wire to pin 14 and connect the other end of the wire to the unused terminal on the STORE switch. Replace the cover. To receive below 1.5 MHz, you must set the bandswitch to 1.5, press STORE, press the DOWN switch once, and then release the STORE switch. The UP/DOWN switch will now select the VLF band in 1.5-MHz segments. Repeat the sequence, and the unit will then tune 0-500 kHz. The antenna for the lower bands should be connected to pin 7 on the accessories connector (see pages 3-7 of the manual). This modification does not affect the usual operation of the STORE switch.—Andrew H. Kilpatrick K4YKZ, Longwood FL.



RIGID MALE-TO-MALE UHF CONNECTOR: Materials required are two PL-259 connectors, a straight length of no. 10 AWG 3-1/2 inches long, and a straight length of 3/8-inch o.d., 5/16-inch i.d. copper tubing, 1-1/8 inches long. (You can find the tubing in the plumbing department of many hardware stores.) After cutting the tubing, be sure to deburr the inside and outside edges of both ends. Then place PL-259s on either end, connecting the center pins with the no. 10 wire. Solder the assembly together using a large enough iron to avoid cold solder joints.—Gary Legel N6TO, Fullerton CA.



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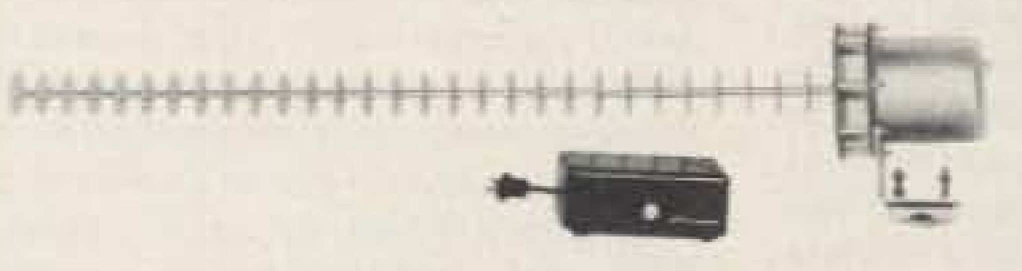
All downconverters use microstrip construction for long and reliable operation. A low noise microwave preamplifier is used for pulling in weak signals. The downconverters also include a broad-band output amplifier matched to 75 ohms. The RP model is recommended for up to 15 miles. Over the range of 15 to 25 miles the RP+ which has a lower noise and higher gain RF amplifier stage, provides better television reception. For installations over 25 miles, an RPC unit which uses a separate antenna is available. All models are transient voltage protected by surge protection on both the power supply and the converter inputs. All models are warranted for one year.

The DCI 466 is a completely self-contained **IMAGE REJECTION DOWN CONVERTER** that is used for TVRO downconversion at the Satellite antenna where optimum signal to noise ratio can be obtained. The DCI 466 converts the TVRO band to 70 Mhz. The unit's DC power and a 17 to 25 volt local oscillator tuning voltage are superimposed on a single RG 59 line for easy installation. The unit has an on board IF amplifier matched to 75 ohms that gives plenty of drive for long cable runs. The overall conversion gain is 25db. Image rejection is a minimum of 20 db. $300 in singles.

Write for details on our low priced model VCO 40 voltage controlled oscillators in the four pin TO-8 package that cover the TVRO band. Also check our 120 degree low noise amplifier for low cost satellite ground stations.



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✓See List of Advertisers on page 114

REVIEW

ELECTRONIC RAINBOW SATELLITE TELEVISION RECEIVER KIT

Like a lot of hams who have developed an interest in satellite TV, I have been reading about and watching the market for the last couple of years for a satellite receiver that had all the features I wanted and the right price as well. Most of these factory-wired units' price tags still hung up there in the high dollar range, while kits for these receivers were few and did not enjoy the best publicity from articles I had read. I felt a kit was the best means to meet my end. Having built quite a variety of electronics kits and semi-kits down through the years, I felt that I could handle a quality kit without too much difficulty.

Browsing around the hamfest at Indianapolis back in July, I spotted a few satellite antennas set up around the area and visited each booth to check out their wares. Most of the equipment was factory-assembled, high-priced, turn-key stuff, not for me. Then I happened by the booth where Electronic Rainbow was showing its latest offering to the industry. The owner Ron Ross and I had met at various hamfests and I knew he handled quality products. Ron had his satellite receiver hooked up and it had a crisp, clear picture. I checked the spec and price sheets he had on hand and was very impressed with the features his satellite kit offered, like built-in rf modulator, detent tuning, variable audio from 5.5 to 7.5 MHz, afc, LNA power supply, remote tuning jacks and baseband jacks for the optional remote tuning control, and stereo decoder along with many other features found only on much higher-priced units.

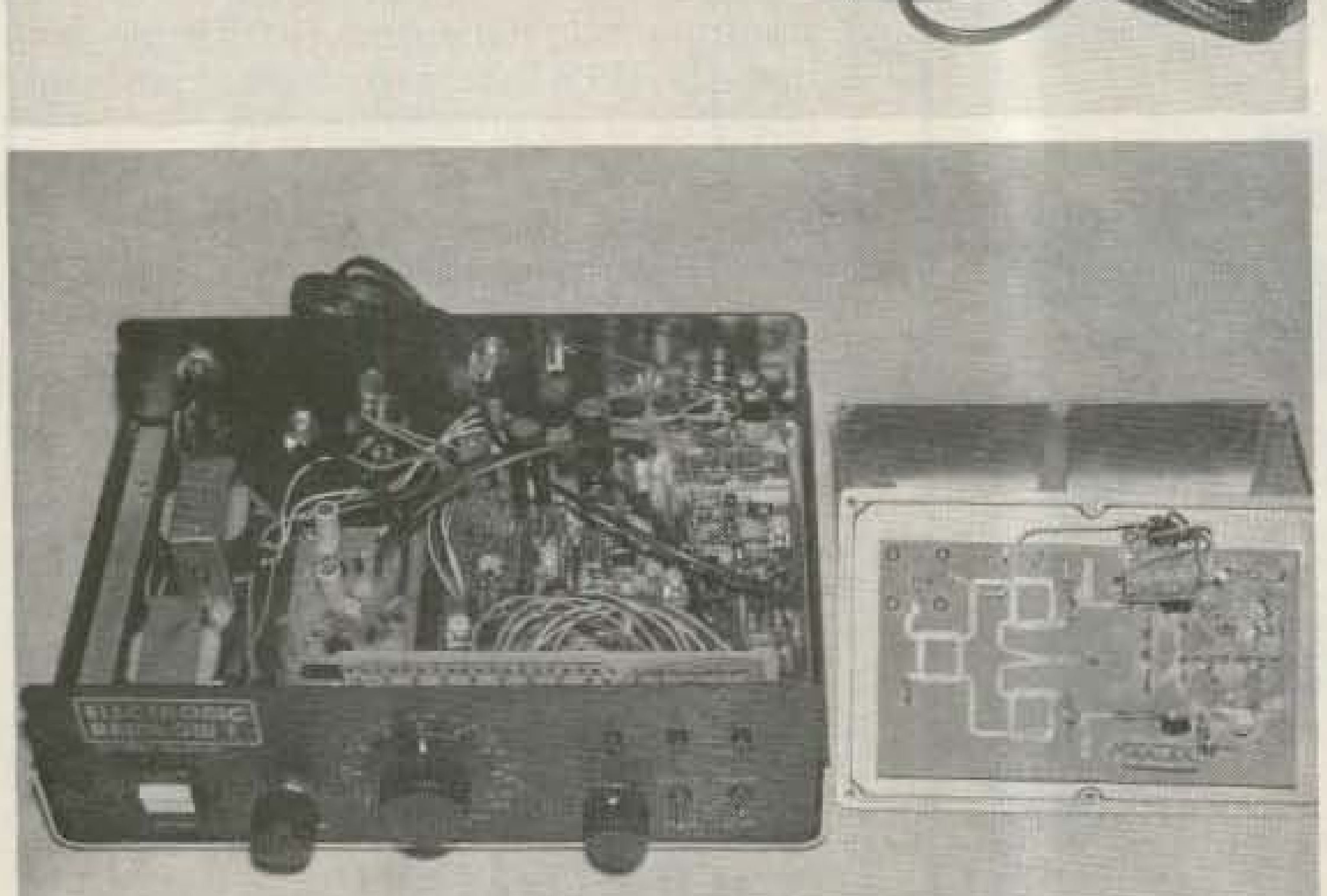
I asked Ron if the units were available yet and he said in a couple of weeks. They were presently getting the assembly manual ready for the printers. I left with an order form and spec sheet so I could review the receiver and make up my mind at home. About a week later, I sent my order in for the kit and looked forward to getting started on my very own satellite TV receiving system.

A few weeks went by and I decided to call Ron and check on my order. He told me that they were just about ready to ship the units with a photocopied manual because the printer did not have the final manuscripts yet.

I immediately saw a chance to get my receiver quicker and help out Ron with comments from the consumer point of view. I suggested that if he could sell me a receiver right away, I would be happy to give him some feedback on the assembly of the units from a builder's standpoint. Ron accepted my offer and I picked up my receiver the next day.

After sorting through the kit and checking parts (a few were missing as we both expected), I dove into the manual and read it from cover to cover, picking out minor errors and missing points that would help a builder do a better job of assembly and ensuring that the unit would work upon completion. I have had a few bad experiences with kits where even experienced builders would pull their hair out trying to figure out the sequence of assembly. This is not the case with the Electronic Rainbow satellite receiver kit. I found the manual to be very easy to follow; there was very little chance for error in the step-by-step assembly of this quality receiver kit.

Photos by David Beightol



The completed Electronic Rainbow satellite TV receiver. At right is the downconverter unit, which is mounted at the antenna.

Fortunately, I had a week's vacation coming and I decided to use it to put together my kit. I was able to assemble the kit in approximately 15 to 20 hours, making numerous trips to Electronic Rainbow for changes in the manual and a few parts that were missing or wrong.

I completed the receiver and was looking forward to checking it out on Ron's antenna, since I did not have one yet. The final alignment was to be done with an actual picture from the satellite. The receiver kit had all the sections, such as the 70-MHz filter, the remote downconverter, and oscillator pre-wired and tested, so final alignment was a simple matter of adjusting the picture, sound, and rf modulator under operating conditions according to the step-by-step instructions in the manual using a VOM to check power-supply voltages.

Even though the main board of the receiver has all the parts on it, the board is divided into six sections with each of the sections having an A and B part for very easy assembly. All the parts are in zip-lock bags for each of the sections of the board, making it much easier to find them.

I had to wait a week or so for Ron's design engineer, Paul Turner, to return from vacation, so his ace assembler, Terri Murphy, and I finished off the few changes in the manual. When the final printing came back from the printer, she could add all the changes to complete and update the fine-quality manual, which was all the individual sections shown in halftones, making placement of the parts on the silk-screened boards a simple matter.

Finally, when Paul returned, Ron asked me over to his shop and the receiver was hooked up along with my downconverter to the bench monitor; when Paul flipped the monitor onto channel 3, there was the picture from transponder 11 MTV, clear as a bell. I was really happy that the unit worked the first time. Paul made his way through the individual trimmers for each of the 24 channels (transponders), peaking and adjusting the sound for a perfect picture on each. He let the unit burn in for about 30 minutes to be sure everything was okay and then put the cover back on the very attractive cabinet. Off I went like a kid with a new toy, proud as could be that my kit was finally ready to go.

In conclusion, I am sure that the Electronic Rainbow satellite TV receiver kit will be a popular item for those builders who have waited so long for just such a product. I plan to use my receiver with a Wilson MD 11 B antenna, Locom LNA, Chapperal super feed, and Beachcraft polarizer. I will be glad to answer any questions about any of these items. Please write only and include a self-addressed stamped envelope.

The complete satellite TV receiver kit costs $395.00. For further information on the receiver, board kit, or manual, contact Ron Ross or Paul Turner at *Electronic Rainbow, Inc., 6254 LaPas Trail, Indianapolis IN 46268, (317)-291-7262.* Reader Service number 477.

J. E. Beightol, Jr. WB9ZNU
Indianapolis IN

ADVANCED COMPUTER CONTROLS' MODEL RC-850 REPEATER CONTROLLER

Imagine, if you will, the amateur repeater that I'm about to describe. It can be controlled via telephone, over a UHF control link, through the main repeater receiver, and, of course, locally at the repeater site. All you need is a touchtone™ encoder and the necessary codes.

If you call the repeater on the telephone, it answers the phone (with a message you've chosen) and waits ten seconds to receive a valid command. After you enter a code, the repeater verifies *in voice* over the telephone the function that has been selected. It does the same if you enter a command through the main receiver, except that the acknowledgement comes back to you over the air.

If you want to check your touchtone pad, you only need to enter a test prefix followed by a series of keys. The repeater reads your entry sequence back to you, again in voice. And that's only the beginning of what the repeater will do for you. It can evaluate received signals for frequency error, deviation, and percent quieting and give a similar voice response back to the user. Maybe you would like to check conditions at the repeater site from the comfort of your favorite armchair. No problem at all. Just ask the right questions with your touchtone pad and the repeater can give you voltage and power output measurements and also the temperature at the site. It will even give you the time of day!

This only begins to describe the features of this particular repeater. Whose repeater is it? It could very easily be yours, just by interfacing your present repeater with the RC-850 repeater controller being manufactured by Advanced Computer Controls of Cupertino, California. And please, don't be put off by the word "interfacing," because in this case you can access most of the features of the controller just by feeding a carrier-operated switch (or relay) logic signal and audio from your receiver into it and by letting the controller feed audio into your transmitter along with a push-to-talk logic signal. Plug the controller's modular jack into a telephone line at your repeater site, supply it with 12 volts dc, adjust one or two audio levels, and you will be able to put much of the power of the controller to work for you right away.

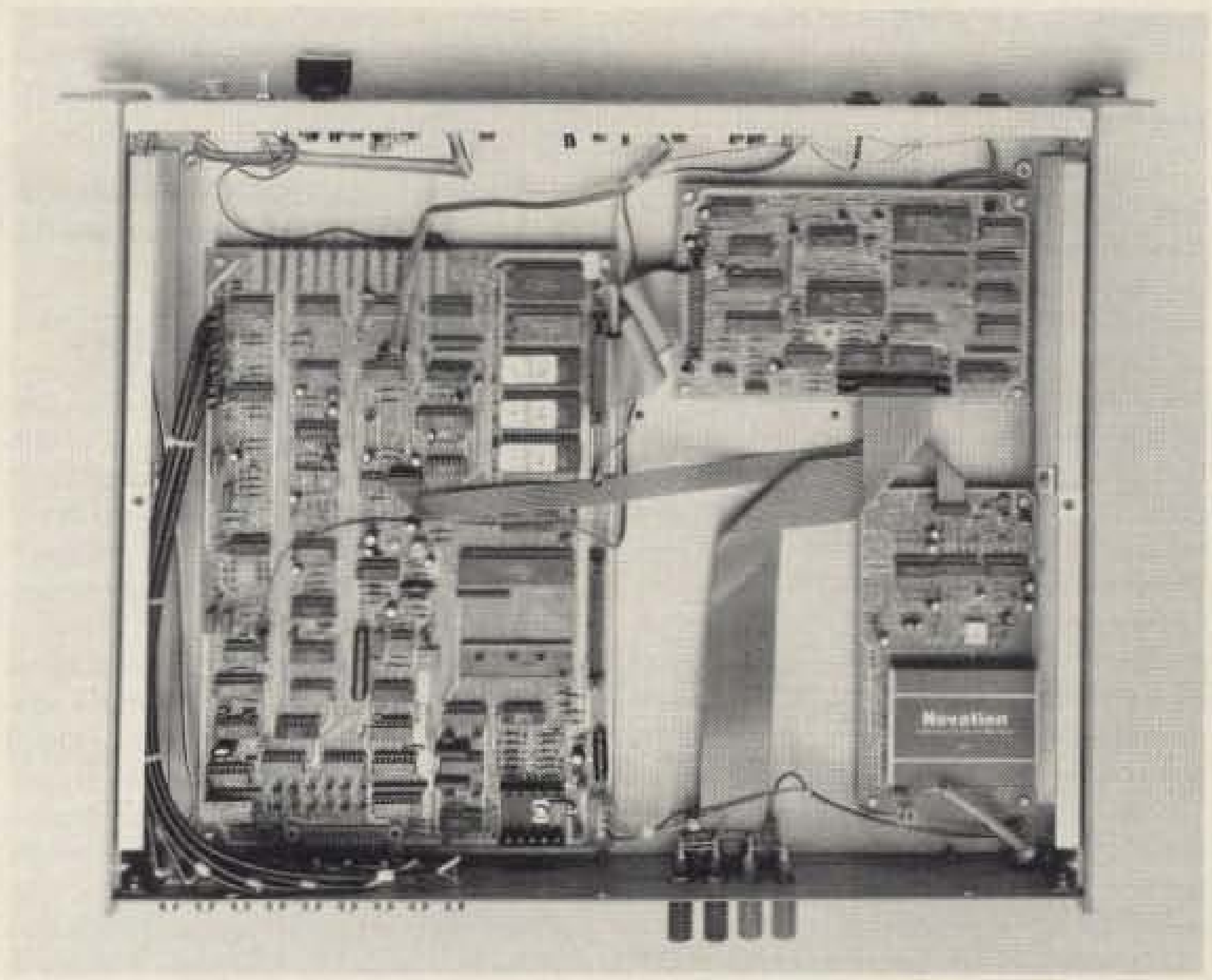
Naturally, other connections need to be made between the controller and the repeater station in order for it to provide received signal reports and other voice response telemetry (VRT) information about the repeater itself. You can even connect the controller's logic outputs to a synthesized transceiver and operate a remote base station, *complete with frequency selection*, through your repeater. This makes it simple to link up with another repeater for nets or public-service activities.

Software-Based

The controller itself, even without the synthesized voice capability, offers features which to my knowledge are not available in any other commercially-manufactured controller or repeater/controller combination. The key to the power of this unit, and the thing that enables ACC to expand the controller's features on a continuing basis, is that it is software-based (or, to be technical, firmware-based in the form of several EPROMs). New releases of the operating system software can enhance the capabilities of your machine, in many cases without any additional wiring or work on your part beyond changing out the EPROMs. It also makes it possible for the manufacturer to incorporate into the controller some additional feature which may be very important to you.

The Blue Knob Repeater Association, which sponsors the highest amateur repeater in Pennsylvania (147.75/.15 MHz), had a special problem which ACC was able to solve through a small amount of

The RC-850 repeater controller from Advanced Computer Controls.



Interior view of the RC-850.

additional programming (which then became available to every user of the controller through an upgraded release of the software). Most of us are familiar with just dialing (or pressing) the number "1" to access the nationwide long-distance telephone network. However, there is a fairly rural telephone system operating at our site on Blue Knob Mountain, and it requires entering "1121" to make a long-distance call. Couple this with the fact that most of our members live outside the local calling area from the exchange at the site and you've got a cumbersome number of digits to enter when operating mobile, a number which can rise to 14 digits in order to place a call outside our own area code. What made this even worse was the fact that while the controller has the capability to store up to 90 telephone numbers in its user autodialer and 10 numbers in its emergency autodialer (these numbers can then be called just by entering an access prefix plus two digits), the storage locations are limited to 11-digit numbers at most. This would present no problem for the typical long-distance number, but it would have severely limited the usefulness of the autodialers in our system. Ed Ingber WA6AXX, who founded ACC, solved the problem just by programming the controller to "see" a leading "1" and substitute an alternate sequence when the number is dialed out (in our case, "1121"). This small change, which was relatively easy to handle by modifying software, would have been far more difficult, if not impossible, in a hardware-based system.

The controller's autopatch, which is logically separated into three different components (basic autopatch, user autodialer, and emergency autodialer) is extremely advanced in design. Phone numbers are read back to the user for confirmation (in voice with the voice-response option installed, and otherwise in CW) before a call is placed. The controller itself enters the number into the landline system in your choice of ten pulses per second, twenty pulses per second, or standard touchtones. This greatly increases the reliability of the autopatch, since tones are not being passed from many different user's touchtone pads directly into the telephone system.

The user autodialer codes can be programmed by the members themselves, or the user autodialer can be "locked" so that only control operators can load and change the telephone numbers to be stored. The access prefix for the autodialer can also be changed if and when necessary.

The emergency autodialer provides for the storage of 10 public-service telephone numbers and associated response messages for each agency (such as "Fire").

With the voice-response option, the reverse autopatch (which requires entering a code sequence after calling the repeater on the telephone) can actually call a repeater user *by callsign*. Forty callsigns can be stored in the controller's memory for use with these directed reverse autopatch calls (or as part of a demonstration message).

Separate timers can be set for each type of autopatch call, and the three functions can be enabled or disabled separately. This can be used as a way of allowing emergency calls to be placed at night, while the other autopatch functions might be turned off. A programmable activity timer functions with all autopatch calls to drop the patch if no activity (or constant keying) comes from the repeater user for the designated period of time.

It's also possible to place a full duplex autopatch call (for simultaneous receiving and transmitting) and a semi-private patch where the repeater-user side of the conversation is not fed through to the transmitter, but instead is replaced with a "cover tone" to alert other users that a call is in progress. If your repeater suffers the misfortune of having someone maliciously dropping the autopatch on legitimate users, you can program the controller to allow *each user* to define his or her own custom hang-up code just before placing a call. Then, only that code or the control operator's override code will terminate the call.

Long-distance calls can be prohibited on the main autopatch, which then allows the entry of a 7-digit number only, which cannot begin with "1" or "0." There is even an "antidialer," which can be loaded with up to five telephone numbers which may *not* be called on the autopatch (such as a local pizza parlor?).

One convenience which anyone who has ever used an autopatch will appreciate is that the controller will give the time and date for you automatically upon completion of a call. This is also very helpful to the repeater owner for the proper logging of autopatch calls.

Identification, Please

The controller handles repeater identification requirements in a similarly sophisticated manner. An "intelligent" ID algorithm directs the unit's handling of several different ID messages in accordance with the activity on the machine. For example, if the repeater has been dormant and is then keyed up, an initial ID (typically a voice greeting) is given. As time progresses from the initial keying of the repeater and with a QSO in progress, the controller will wait for an opportunity to ID again when a user lets the repeater carrier drop. If this opportunity doesn't occur, then the unit becomes anxious to ID, but will still try to avoid IDing over the top of a user transmission. But, if ten minutes pass without even a break in the QSO, then the controller will do a forced CW ID over the top of the user, but at a fast, unobtrusive level.

With the voice-response option, you can use the built-in message editor, either on site or remotely, to program the messages you want for IDs and other responses. The controller has a vocabulary of over 200 letters, numbers, words, and sound effects. You can even have custom words, such as your group's name or location, merged into your controller's software, but these words are not cheap at $200 each!

Probably the second most remarkable feature of the RC-850 (I'll save the first one for later) is that all of your repeater's operating parameters, including timers, courtesy tones (you can select from eight sets that you program yourself), messages, autodial numbers, control operator and user codes, and even an initial power-up configuration (in case power to the unit is temporarily lost), can be changed *remotely*.

Non-Volatile Memory

If you're like me, you're wondering now what happens to all of that information stored in the controller, including the 90 user autodialer numbers and 10 emergency autodialer numbers, if power to the controller does fail. Incredibly, absolutely none of this data is lost, because it has been stored in EEPROMs (Electrically Erasable Programmable Read Only Memory) by the controller's own built-in programmer/eraser. The controller will "awaken" according to the configuration you've programmed as soon as power returns. And, by the way, battery backup circuitry is included in the unit.

Other standard features include several modes of operation based upon a subaudible tone input, touchtone up/down access by users with programmable automatic timeout, logic outputs for remote control of other devices (complete with response messages to indicate their function in your system), provisions for a control receiver, a kerchunker filter that can be switched on or off, spare audio inputs, tone signalling, and a host of others literally too numerous to mention in this review.

One extremely clever feature of the controller is that it suppresses the squelch tails of user transmissions (which makes listening comfortable for users and control operators alike) and also, at your option, touchtones. It does this through the use of a 75-ms analog delay line which allows the controller to cut off audio to the transmitter when the carrier-operated switch signal disappears or when touchtones are properly decoded by the state-of-the-art Mitel chip set. Without actually hearing it operate, it's hard to believe how effective this circuitry really is.

Construction

A review of a product such as this one wouldn't be complete without some description of how it's constructed. I can honestly sum it up with one word: impressive. Machine-contact IC sockets, fully sealed, are used throughout the controller. Signal connectors are gold on gold for long-term reliability. The circuit boards are computer-grade glass epoxy with through-plate holes. They are solder-masked and silk-screened with component designations. And, finally, low-current CMOS circuitry provides highly efficient operation.

Product Support

Another important plus is that the device is fully documented with a comprehensive owner's manual which includes a description of the unit, how to install it, how to operate it, service and maintenance information, and schematics and parts placement drawings. The manual makes liberal use of figures and tables. It's clearly written, but don't expect to skim through it once or twice and completely understand the operation of the controller. Careful reading is necessary due to the many advanced features of the unit.

From my own experience, however, by far the most impressive support for the product comes from the designer himself. Ed Ingber WA6AXX is an electronics engineer, and his background (which includes a Master's Degree) lies primarily in designing test equipment, programming microcomputers, and working with speech synthesis. I have been able to reach him by telephone (he provides owners with both his factory and home numbers) any time our group has needed information or assistance.

I mentioned earlier that I would save the most remarkable feature of the controller for last, which is that *it works just like the manual says it will* (the manual can be purchased by itself for $30), and it sounds terrific on the air. The speech synthesis is so good that during the first few days that we had the controller on-line, we actually had people responding to the female "Good Morning" greeting with a complete rundown of their name, location, and other information, only to be tremendously surprised to learn that they had been talking to a computer!

Few Problems

In our controller, problems were hard to find, and I heard essentially the same thing from other owners before we made our decision to purchase one. Our unit was shipped with an interim version of the controller's operating system software designated as 1.4X, and this version did have a few bugs in it. One example was that giving the controller the code to disable the autopatch *timer* disabled the autopatch itself. Another bug caused two of the front-panel display LED indicators to be reversed. In a way, though, these problems actually point out the strengths of a software-based device, because the final release of this version of the software corrected both of these glitches.

If you haven't guessed by now that the price tag for one of these controllers is pretty hefty, then you might consider price alone to be a drawback. Actually, the RC-850 controller comes in a number of different configurations, ranging in price from $1195 for an assembled and tested control circuit board only up to nearly $2800 for the maximum system, which includes an FCC-registered telephone interface, voice-response telemetry option, and front-panel display option, all contained in a rack mount cabinet ready to install at your repeater site. There are also several versions between these two extremes. For example, you may want to provide your own telephone interface, which reduces the cost of the unit by $349. Or, while you might want to have synthesized voice IDs and the time-of-day clock, you may not really need the 16-channel analog measurement and speech-readback capability provided by the complete VRT option. This would also reduce the cost of the controller. And, it's good to know that you can start out small and expand to a maximum system at a later time with very little difficulty, since the control board has been designed to be upward compatible.

If you want to significantly enhance your repeater's capabilities and at the same time infuse your organization with new enthusiasm and excitement, the RC-850 repeater controller may well be just what you're looking for!

For more information, contact *Advanced Computer Controls, 10816 Northridge Square, Cupertino CA 95014; (408)-253-8085.* Reader Service number 476.

Gerald R. Patton WA3VUP
Duncansville PA

LJM2RK STORM ALERT

My wife does not like ham radio. She despises the funny noises my radio makes, and she would really rather it didn't ride in the car with us. So, I find myself and my rig relegated (or maybe I should say "banished") to a remote corner of the basement.

Now, I don't mind being in the basement, but I'm an Army officer whose specialty is tanks. That means, after years of firing tank guns on various ranges in combat, I'm rather hard of hearing. Consequently, I can't hear when someone is calling me unless I'm right at the radio, and, while I'm a pretty avid ham (my wife thinks too avid), I do occasionally go upstairs to get a cup of coffee or take care of the effects of an earlier cup. So, I've been looking for months for a simple (and affordable) tone decoder I could put on the two-meter rig to alert me to calls. I needed to be able to set up a visible signal to alert me when I was copying CW traffic on the HF bands (since I wear headphones to muffle the sound of the "mill"), and an audible alarm to call me when I was elsewhere in the house. I also needed to mute the audio, since my wife does not have a hearing problem and would have fits on those occasions when the repeater was really busy.

It didn't take me long to find that a simple tone decoder, even if you elect to just buy the parts and home-brew it yourself, isn't all that cheap, while ready-made or kit decoders are downright unreasonable ($50.00 plus is the normal range). I had finally decided the only way out was to home-brew one, with the attendant costs involved in making a circuit board and the costs in time to construct it, when I happened to stop at a hamfest in Lafayette, Indiana.

At one of the booths, a guy (whose name I never did get) was demonstrating something that caused alarms to sound and strobe lights to flash. Intrigued, I stopped to watch what turned out to be a demonstration of exactly the thing I'd been looking for.

He was demonstrating a tone decoder—he called it the "LJM2RK Storm Alert"—in nine different configurations. Each of the nine circuit boards was attached to a big board and each was wired for a different option. All nine were essentially the same—only a few jumper wires were different. The same board, ICs, resistors, etc., were used in each one, and each was constructed exactly the same, except for the jumpers. When the guy running the show told me they cost only $15.00, I picked up two. I had already proven that parts alone would cost that (not counting the cost of constructing a circuit board and my time to find all the parts).

Once I got home, it took me about 45 minutes to build the first one, most of that time spent locating the parts on the board. The second one took about 20 minutes. For such a little company, the kit is a real joy to build. The written instructions, while not elaborate, are more than adequate, and the circuit board is beautifully silk-screened with both a drawing of the component and its reference number (R1, C3, etc.). Orientation of every polarized part is shown on the board and referenced in the instructions.

In only one case are the instructions a little remiss. Two of the LEDs have to be mounted with nylon spacers (if you use the company enclosure). The instructions mention that in passing, but when you go down the list of parts to install, as the instructions suggest, the spacers are listed well after the LEDs. It would be wise to write in "spacer" next to the LED listing, although it won't damage the operation of the device even if you forget the spacer. It just won't fit as neatly in the enclosure.

Once the boards are finished, aligning them is even simpler than building them. First, apply an audio source to the decoder. If you use one of the Metheny enclosure kits, that simply means plugging the thing into the speaker jack. Then attach a power lead and have someone generate a tone. I did mine by hooking my HT into a dummy load and the decoder into my Wilson WE-800. If that is not sufficient attenuation of the signal, leave the antenna off the receiving unit or attach it to a dummy load. At any rate, that hookup attenuated my 100-mW signal enough to allow me to align the decoder. A buddy at the other end of the repeater can do the same for you, if you'd rather.

Transmit the tones you want (I used the number 9, since the local RACES net uses that as an alert signal) and adjust a simple pot for tone B (it's well marked on the board) until an LED on the board lights. (They have thoughtfully provided this LED just for alignment.) Then, still applying the tone, adjust the pot for tone A until another LED comes on (you'll be able to see this LED even after you put the device in the enclosure). The decoder is now aligned and all you have left to set is the delay. Another little pot allows you to set in a delay so the decoder will not do its thing until the tone(s) you choose have been applied for whatever time you want. I use one second, but you can go from instant on to a very long delay.

Electronically, the device is equally simple. It uses two 567 tone decoder ICs, one to control each tone, and then feeds them to an LM7402N quad 2-input NOR gate. Each 567 is adjusted to one of the required tones by varying a single potentiometer (you could easily change the frequency range by modifying the value of the capacitor on the circuit, but since the thing already operates on all the touchtone™ and likely PL® frequencies, you will need to do that only if you use really exotic tones). When the first 567 is triggered, it lights an LED and signals one of the LM7402 gates, which waits for the next 567 to decode the other tone (when using the two-tone option). Once the second tone appears, the gate opens, lights a second LED (labeled "decoding" on the Metheny enclosure), and provides the logic state that causes the LM7402 to activate the delay and, finally, the relay. If either tone is removed too soon, the delay resets. Once activated, the relay does whatever you wired it to do, the usual task being to connect the speaker to the audio line. All the components, save the circuit board, are generally available at well-stocked Radio Shack stores, so repairs should be especially easy. The Metheny enclosure also has a couple of well-placed mounting holes in it to allow attachment of the power source and an external relay, driven by the on-board relay.

Now, let's see what else this thing will do. It has an on-board relay, so the control possibilities are almost unlimited. You can have it take two tones (standard touchtones) to open the audio on your transceiver so the thing stays quiet until you are called. Or you can have the relay sound an alarm or turn something on or off (great possibilities for a repeater system). Metheny even provides a suggestion for a simple timing circuit that will automatically reset your decoder after a preset delay. You can also set it up so one tone turns it on and another turns it off, or one tone turns it on and leaves it on. Delays can be worked on both ends. It can also be set up to turn on with a subaudible tone and off when the tone is removed. And, by changing a single resistor, you can use 12-V-dc, 9-V-dc, or 6-V-dc power sources. All the required controls mount right on the board and are included in the kit.

You can also do a number of other things not mentioned in the Metheny instructions—your imagination will be your only real limitation. With two boards, you can use one dual tone to turn a device on and another to turn it off (retaining all the

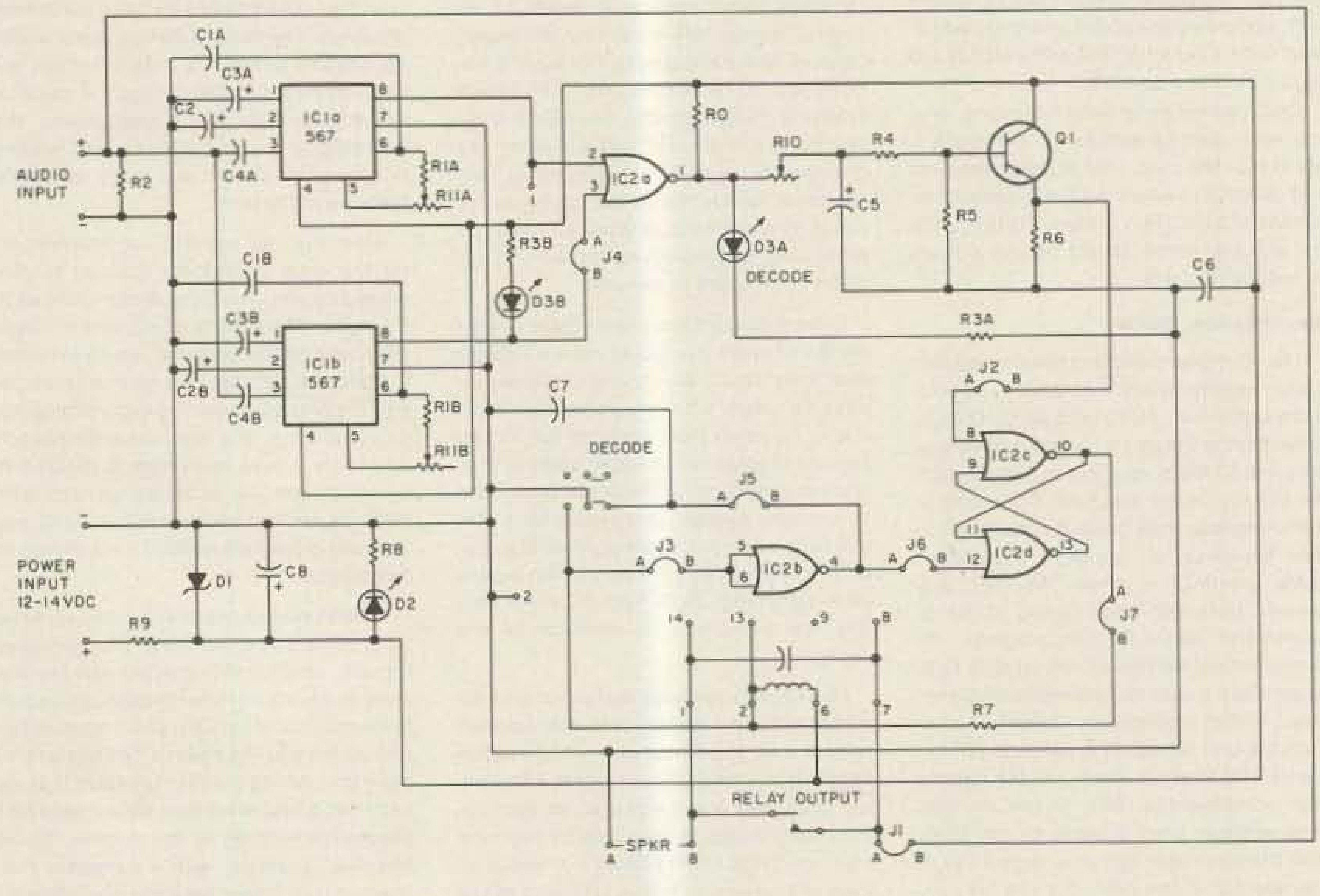
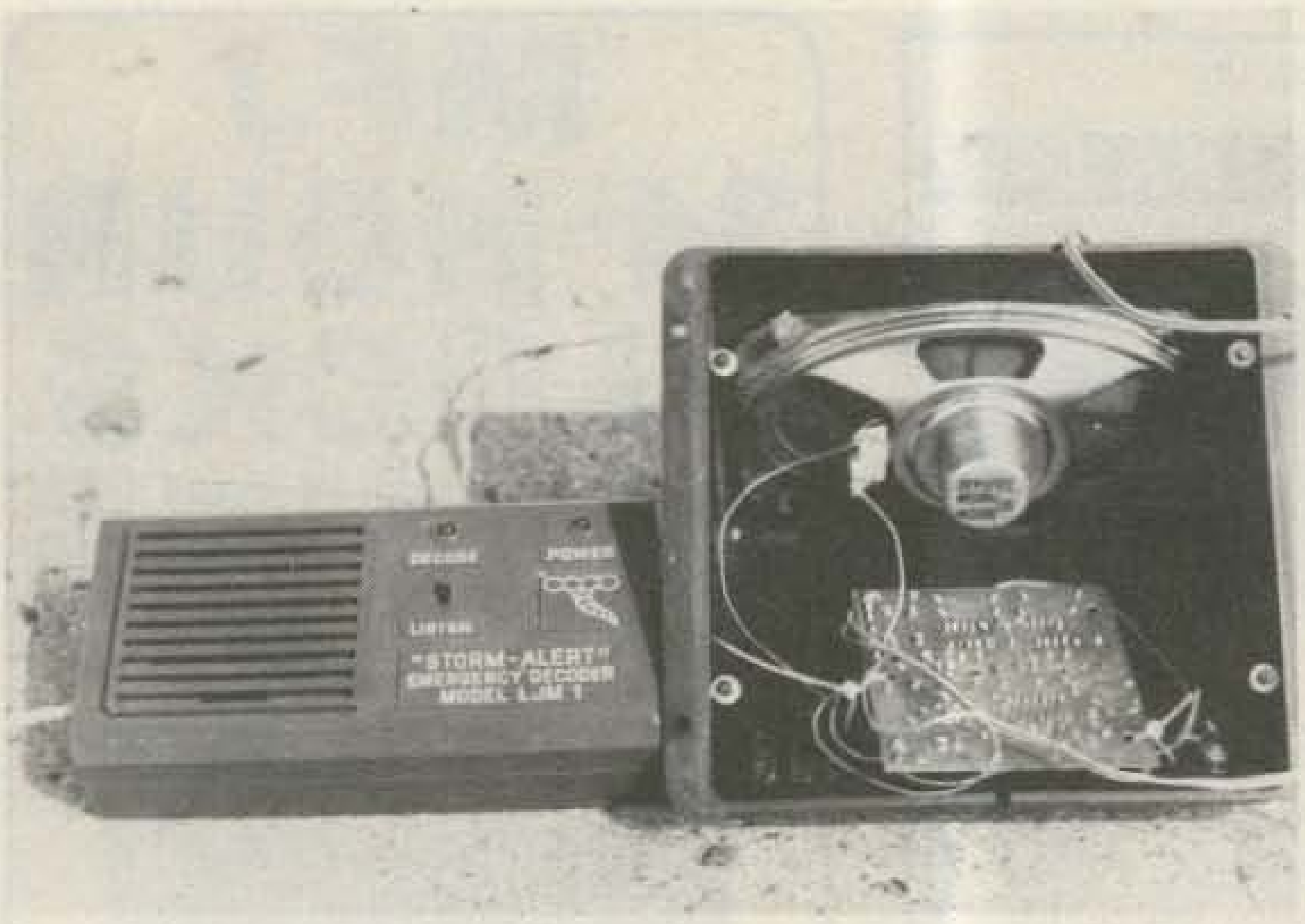
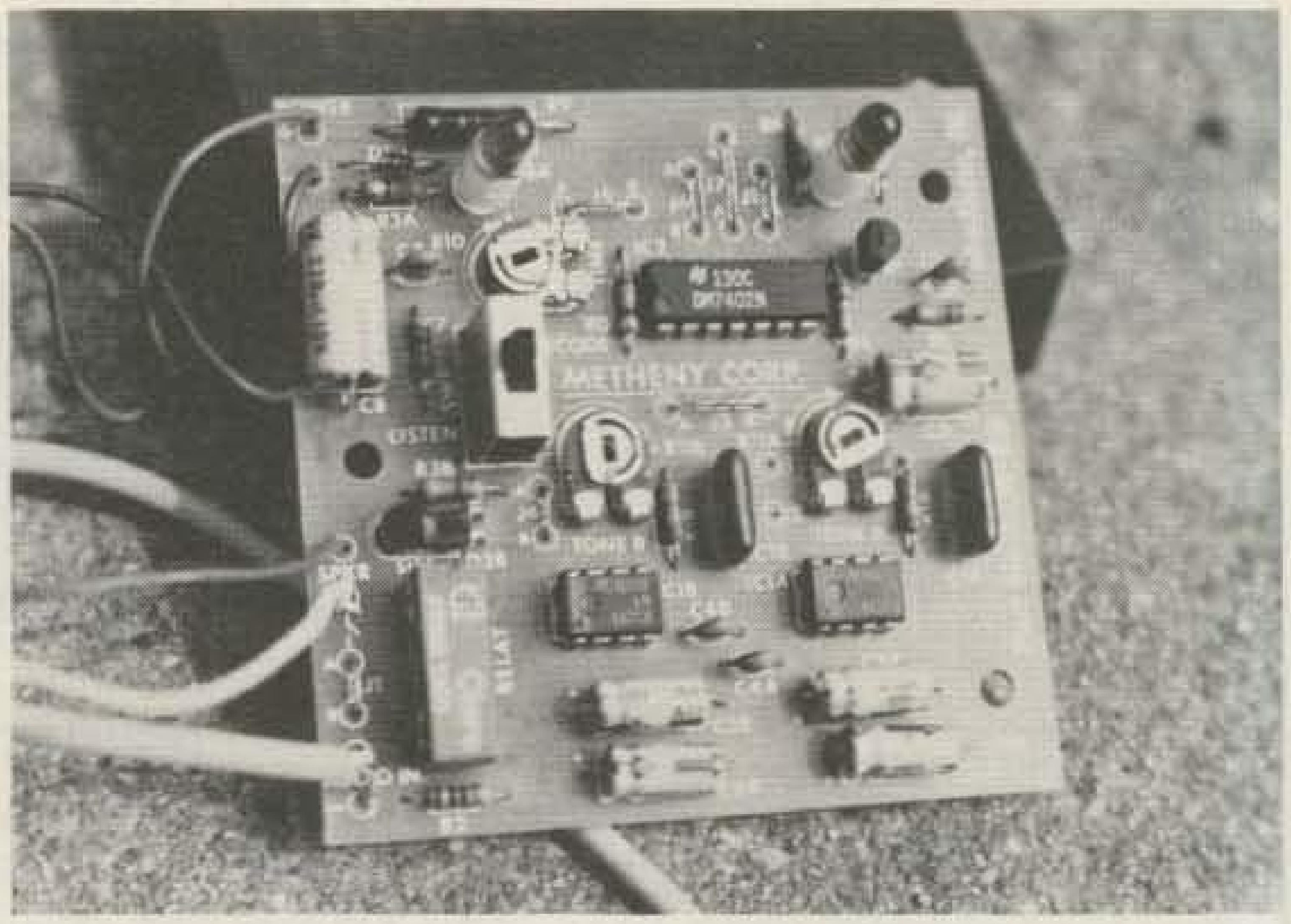


Fig. 1. Schematic.

✓See List of Advertisers on page 114



The front side of the Metheny enclosure, next to the speaker case.



The decoder itself. Note that while it does not leave a lot of wasted space on the board, there is sufficient room to work comfortably.

usual options for each tone). With one board, you can even use sequential single tones with a delay. In this case, a single pot would establish the delay so that, in effect, the device will require that you input both tones within two seconds, or three, or whatever period you program. Using multiple boards, you could do the same thing, but with variable delays between selected digits to safeguard your autopatch from the guy who breaks your code (he's not likely to catch on to the variable delay idea). And if you use the Metheny enclosure, it is easy to add a battery pack, hang it on your belt, and have an inexpensive tone-accessed HT. Or you could forego the speaker and package it in an even smaller enclosure.

It is really nice to see a little outfit like Metheny offer a really useful and inexpensive device like this. If only we had more such little companies in ham radio.

The LJM2KR (I have no idea what those letters mean) is sold for $15.00 plus shipping. The "Storm Alert" enclosure is available for $5.00 plus shipping and includes speaker and patch cable. For more information, contact the *Metheny Corporation, 204 Sunrise Dr., Madison IN 47250.* Reader Service number 478.

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RTTY LOOP

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Happy New Year! I do hope the winter is going well for all of the readership, with projects underway and the like. One such project we have been dealing with in this column has been the design of a computer-based RTTY terminal. This month, another installment: character input and control mechanisms.

It should be obvious that in any complex system there is a need for suitable control mechanisms. Now, while we are not talking about Three-Mile Island here, with a computer-based RTTY terminal there is a need to direct the data flow, fill or empty buffers, change speed, etc. If the terminal being designed operated only on Murray, the job would be relatively easy. The ASCII character set, which most computers use, supports many more characters than could ever be sent on Murray. It would be easy, therefore, to use any or all of those codes, such as control codes, special punctuation, or even lower case, to implement some of these special functions. In fact, an earlier terminal I designed did just that.

However, when designing a terminal which will be able to operate on any of the several modes, including Murray, ASCII, or even Morse, using these extra or control characters becomes difficult, if not impossible. A glance at some of the specialized RTTY terminals on the market reveals the presence of several function switches on the keyboard. These function switches do not send out one ASCII character, but a sequence of characters which can command a task to be carried out.

Such a sequence of codes is normally preceded by the ASCII "ESCAPE" character. Normally abbreviated ESC, this character is 27 in decimal, $1B in hex, or 00011011 in binary. As defined in the ASCII standards, the ESC character is used to shift into another character set, or code grouping. We can use it, as many terminals do, to indicate to the program that the character(s) which follows is not to be sent, but to be treated as a special command.

Once such a protocol is adopted, an essentially infinite number of command sequences become possible. For example, ESC-F might be used to fill a buffer and ESC-S to send it. Numbers appended to the command could denote one of a series of buffers, such as ESC-F-7 to fill buffer number seven. As we have been looking at the design of an "ideal" RTTY terminal, such a technique would appear to fill the bill nicely.

Implementing this scheme is not as hard as it might sound. Fig. 1 is a flowchart of the way a character, once received from the keyboard, might be screened for a command sequence. By use of a flag, input which follows an ESC character can be diverted to initiate the appropriate command sequence. I will add here, for the smarties among you who are worried that you won't be able to send an ESC out over the air even if the distant station requires it because it would be trapped in this sequence, that the command ESC-ESC is normally configured to send the ESC code out. Does that make you happy?

Combining this command input routine with the receive and screen display routines presented in previous months begins to suggest just what this terminal will be able to do. Additional modules will be presented in the months to come, don't worry.

I have a panic note here from Roy E. Denney N5DQX of Roswell, New Mexico. Roy bought a "Transcillator," Mod ZUH II, at a hamfest, and despite being told that it was in fine working order, it isn't. Now, I don't know what this beast is, and Roy notes that the manufacturer, Prossen Industries of Westminister, California, is apparently out of business. I presume it has something to do with RTTY, and so does Roy, and we both address the readers of this column to scrounge around and see if something can't be turned up. If so, send it to me and I will see that Roy gets it.

Thanks to Winston Yancey WA4TFB who relates that RTTY Loop is the first thing he looks for in *73*. He notes being upset if we miss a month and wonders why that happens. For those of you not fully acquainted with the schedule a magazine such as *73* must follow, there is a two- to three-month delay between when I write a column and when you read it. Since I try to delay until just before deadline to keep the material as topical as possible, it becomes very sensitive to unscheduled delays, such as demands from my work (I am a physician in active practice here in the Baltimore area) or family. Hopefully, that's not too often, but it will occasionally happen.

Winston also relates trying to interface his Texas Instruments TI-99/4 computer for RTTY. Apparently little in this vein is available through the users group. I must say that I have noticed TI-99/4s being widely marketed, from computer stores to discount outlets to toy stores. I'm sure somebody out there is writing software that would be useful to the RTTYer, if only we can find it. Hopefully we can collect some here and display it for all to see in a future column. Are you listening, TIers?

Greetings to Kevin A. Muench, Ph.D., a RTTY buff working in the Philippines. He is attempting to interface a Flesner TU-170 to a Teletype® Model 33 and is looking for help. I am afraid that the TU-170 is another piece of equipment I have very little information about, but it is widely used and I am sure someone out there has already accomplished such a mating. If so, let me know so that I can send the details along to Kevin. I am sending Kevin some other material on the 6800 programs detailed here in the past. I am sure that with his 6800/6809 system, Kevin will be interested in following the current "super-terminal" series as it develops.

From one end of the world to another, I have a letter here from John M. Clarke VO1EE, Newfoundland, who is having problems of a different sort. John has been working on the LNW-80 computer and, after building the boards, apparently has trouble getting the thing to work right. He's unable to obtain a good display and thinks that the onboard regulators are running too warm.

Well, John, I will offer two words of advice. First of all, regulators usually run warmer than you think they should, but rarely are they hot. If they are too warm to touch comfortably, something may well be drawing too much current. Which brings me to my second bit of wisdom.

Projects which come on printed circuit boards, especially widely-marketed and complex ones like computers, are usually well designed if they come from reputable manufacturers. In the case of the LNW-80,

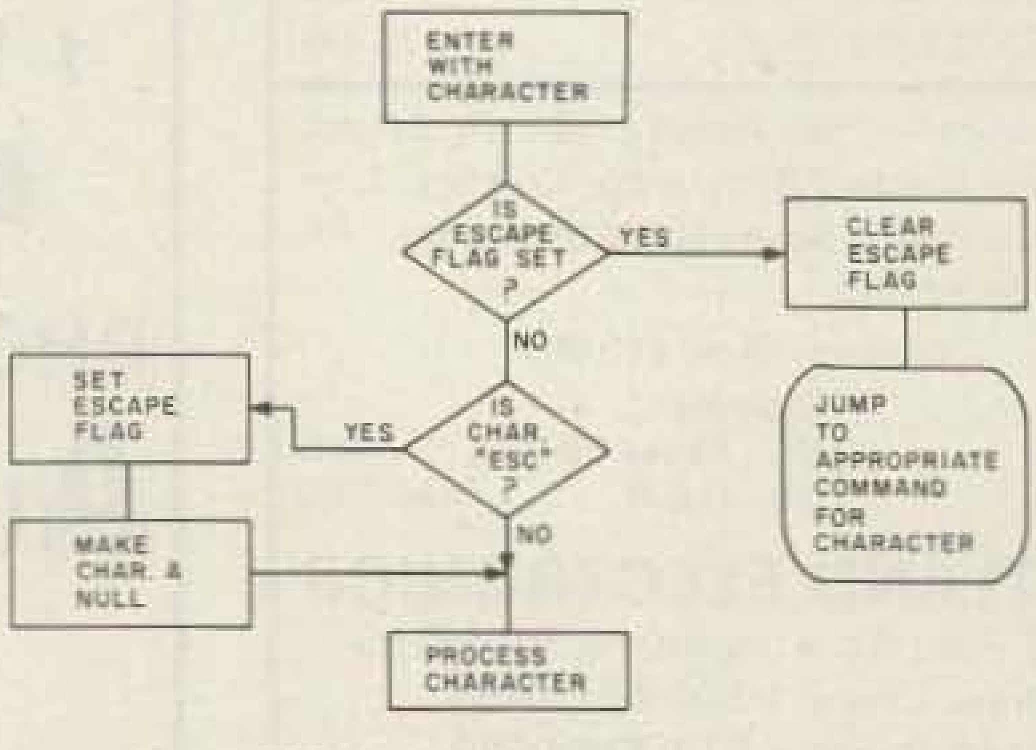

Fig. 1. ESCAPE code processor flowchart.

this is a widely-marketed piece of equipment which has received good reviews. Problems such as you describe can be traced to anything from an integrated circuit installed backwards (that is, 180 degrees out of phase—don't tell me it can't happen, I've done it!) to a solder bridge between two printed circuit tracings (ditto!). The critical thing about this is that if something "happened," the result may be remedied easily by reversing the integrated circuit or clearing the bridged conductors. But circuit damage could be temporary or permanent. If the former, fine, but if the latter, you are in for a lot of headaches unless you really know your way around a circuit.

The moral of this story, if there is one, is to check all the work out *very carefully* for integrated-circuit placement, solder bridges, unsoldered pins, or misplaced plugs *before* you apply power. If something is not working right after power is applied, *stop right there*! Cut the power to the circuit and check again. If you find an error and correct it and the unit still does not function or if you are unable to locate any mistakes at all, seek expert guidance. This may be a friend who has a similar device or the expertise and equipment to troubleshoot complex digital electronics. If all else fails, write a clear description of your problem to the manufacturer, including the model and serial number of your unit. After all, changes in printed circuits or designs may make an early production run and a late one two different animals, and in order to help you, the manufacturer needs to know what you have, what the problem is, and any information such as measurements or the like which will aid in diagnosis. Do not just bundle up the unit and ship it back without the manufacturer's consent unless their book tells you that you can. Doing so will only prompt the string of letters that should have preceded and may have prevented the shipment.

While we are up north, regards to another newcomer, Irvin F. Haworth VE7CVL from West Vancouver, B.C. Irv has a rather complete Apple II setup which he wants to try on RTTY, and he wonders how to proceed. Well, by now I hope Irv has read last month's column with its raft of sources for Apple (and other computer) interfaces. You might ask around in your area to get a feel for what others are using, then visit their shack to see how the various units operate. Let me hear from you when you get on the air, OK?

My Atari 400 is coming along, for those of you who have asked, although it's not yet "on-line." I will be looking into various interfaces and the like in the coming months and will pass along any tips on what I find. I have also been looking into buying eight-inch disk drives and have been having a rather interesting time with a dealer. No details right now, just a caveat to be sure that what you order by mail is really in stock and shipped. It appears that the back-order is a way of life for some mail-order houses. I will pass along more information if the situation warrants it. Stay tuned to this magazine and don't miss next month's RTTY Loop!

FUN!

John Edwards KI2U
78-56 86th Street
Glendale NY 11385

THE YEAR IN REVIEW—1982

Like most years, 1982 was a year of turmoil. In ham radio and the rest of the world change was in the wind. Proposed massive FCC rule changes and the advent of microcomputers were just two areas that may mark 1982 as the year ham radio embarked on a new era.

This month's FUN! takes its annual look at the year just gone. How much can you remember?

ELEMENT 1—CROSSWORD PUZZLE (Illustration 1)

Across

1) Craft announced last year as a 1983 DXpedition site (2 words)
7) CW salutation (abbr.)
8) Critical sunspot point (abbr.)
9) Prompt or pool stick
10) Harvest
11) Pacific prefix
12) Problem
13) Satellite TV (abbr.)
15) Least-crowded DX time
17) Prosign
19) Half a headset
20) Slang for FCC rule
22) Interference (abbr.)
23) Whatever number
24) Your residence
25) What a jammer usually gets on his face
28) Former ARRL president (2 words)

Down

1) Not ordinary
2) Popular 1982 ham accessory
3) New ARRL General Manager
4) Above VHF (abbr.)
5) Potential no-code license class
6) Earthquake, fire, etc.
7) ARRL listener (abbr.)
11) Standby
14) Peru prefix
16) In the airmobile (abbr.)
18) Man who signed new communications bill
21) Avarice
25) Listening organ
27) Summer contest (abbr.)

ELEMENT 2—MULTIPLE CHOICE

1) The year 1982 witnessed one of the greatest turnovers in ARRL upper-level personnel in quite some time. By now, we all know that Vic Clark is the League's new president and Dave Sumner the new General Manager. What, however, was the fate of Richard Baldwin, the old General Manager?
   1) The job of ARRL International Affairs Vice President
   2) The job of ARRL Secretary
   3) The job of ARRL TVI Task Force Chairman
   4) No job
2) What was last year's big news from the Heath Company?
   1) Heath's withdrawal from the amateur radio marketplace
   2) The introduction of Heath's first non-kit amateur transceiver
   3) The introduction of Heath's first solar-powered radio
   4) None of the above
3) Last year's amendment to the Communications Act of 1934 will permit the FCC to perform which of the following actions:
   1) Complete elimination of all code requirements
   2) The addition of a new satellite band
   3) The delegation of amateur testing to local radio clubs
   4) Last year's amendment gave the FCC no new powers

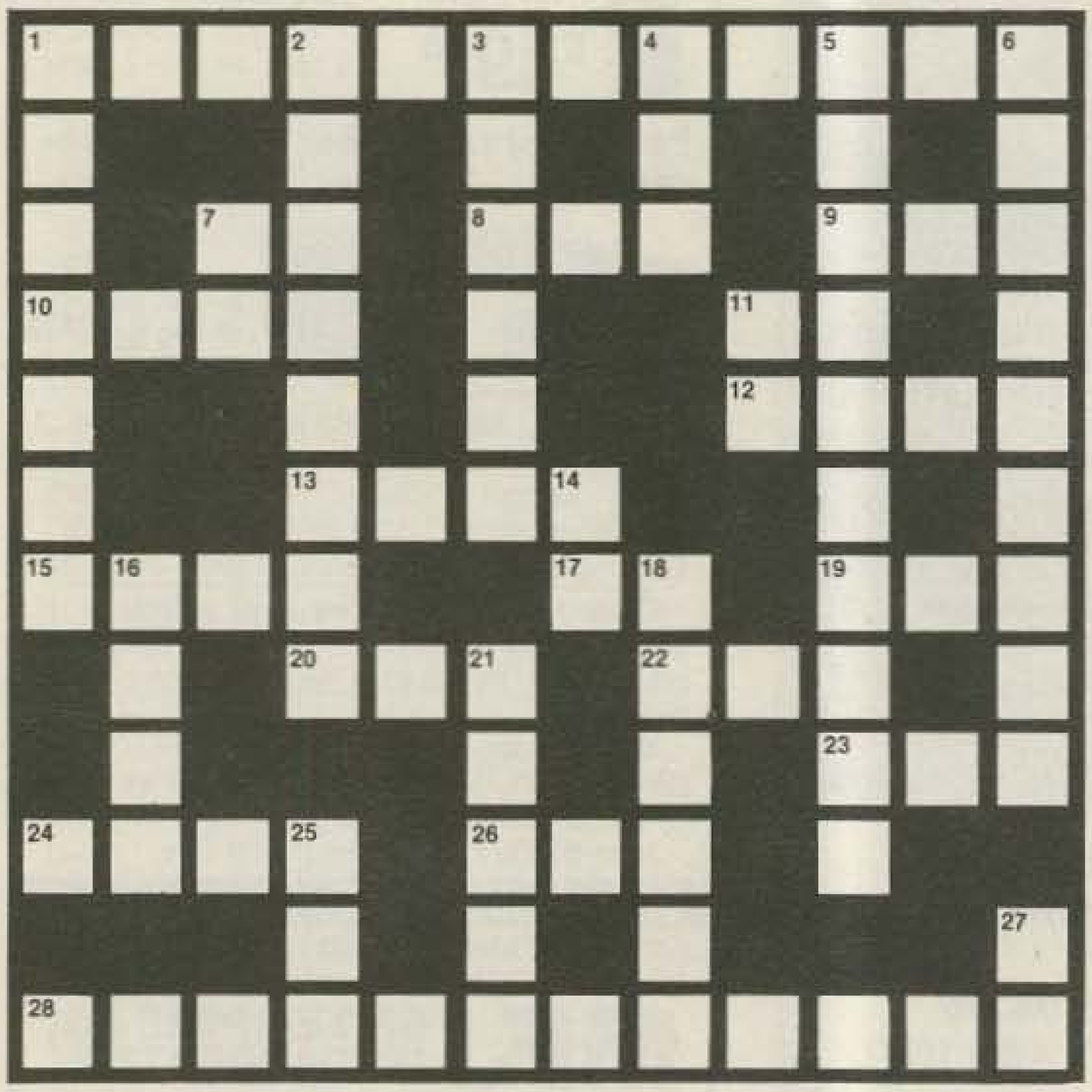

Illustration 1.

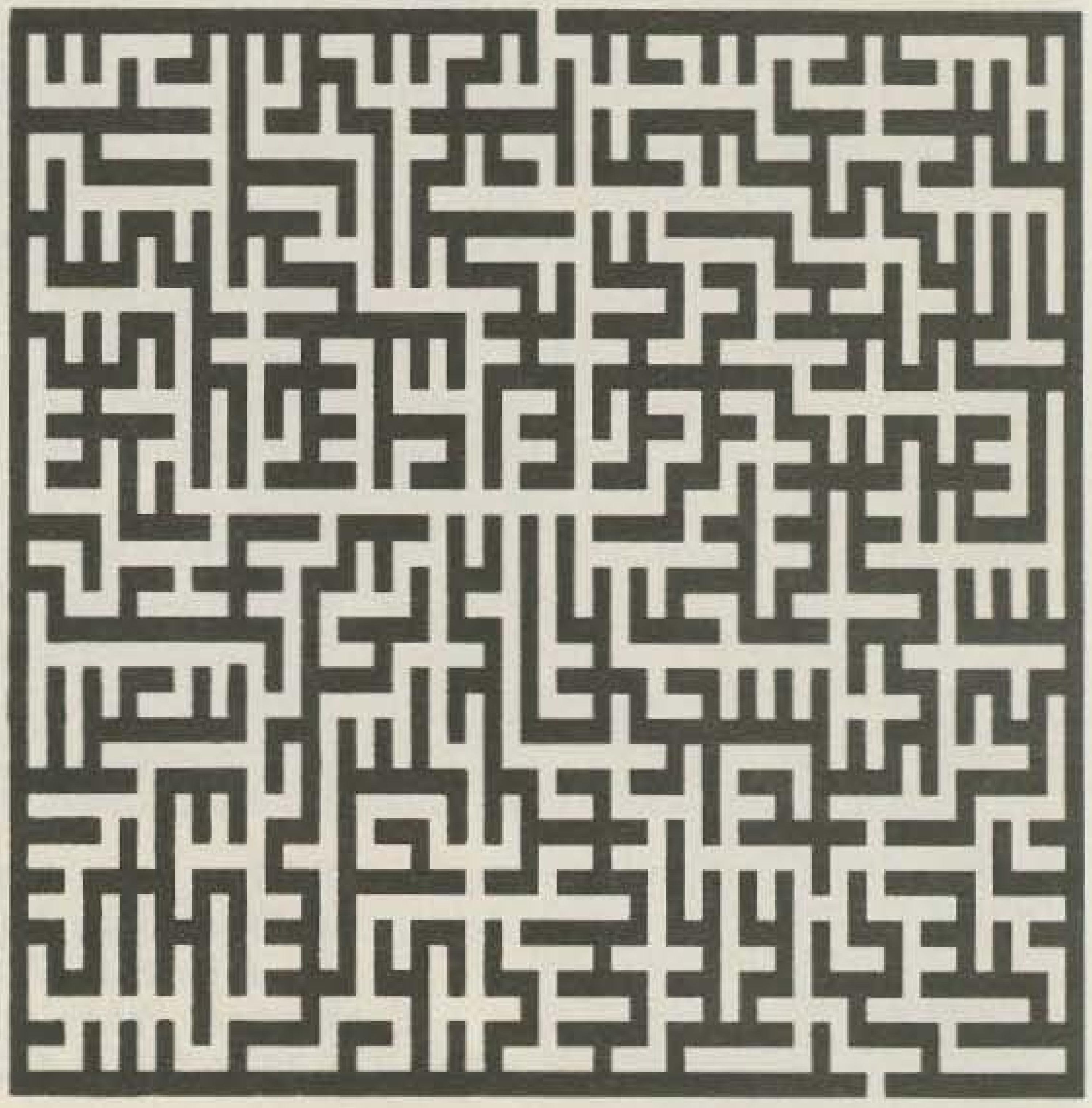

Illustration 2.

See List of Advertisers on page 114

S	P	A	C	E	S	H	U	T	T	L	E
P			O		U		H		E		M
E		O	M		M	U	F		C	U	E
C	R	O	P		N			A	H		R
I			U		E			S	N	A	G
A			T	V	R	O			I		E
L	A	T	E			A	R		C	A	N
	E		R	E	G		E	M	I		C
	R				R		A		A	N	Y
H	O	M	E		E	G	G		N		
			A		E		A				R
H	A	R	R	Y	D	A	N	N	A	L	S

Illustration 1A.

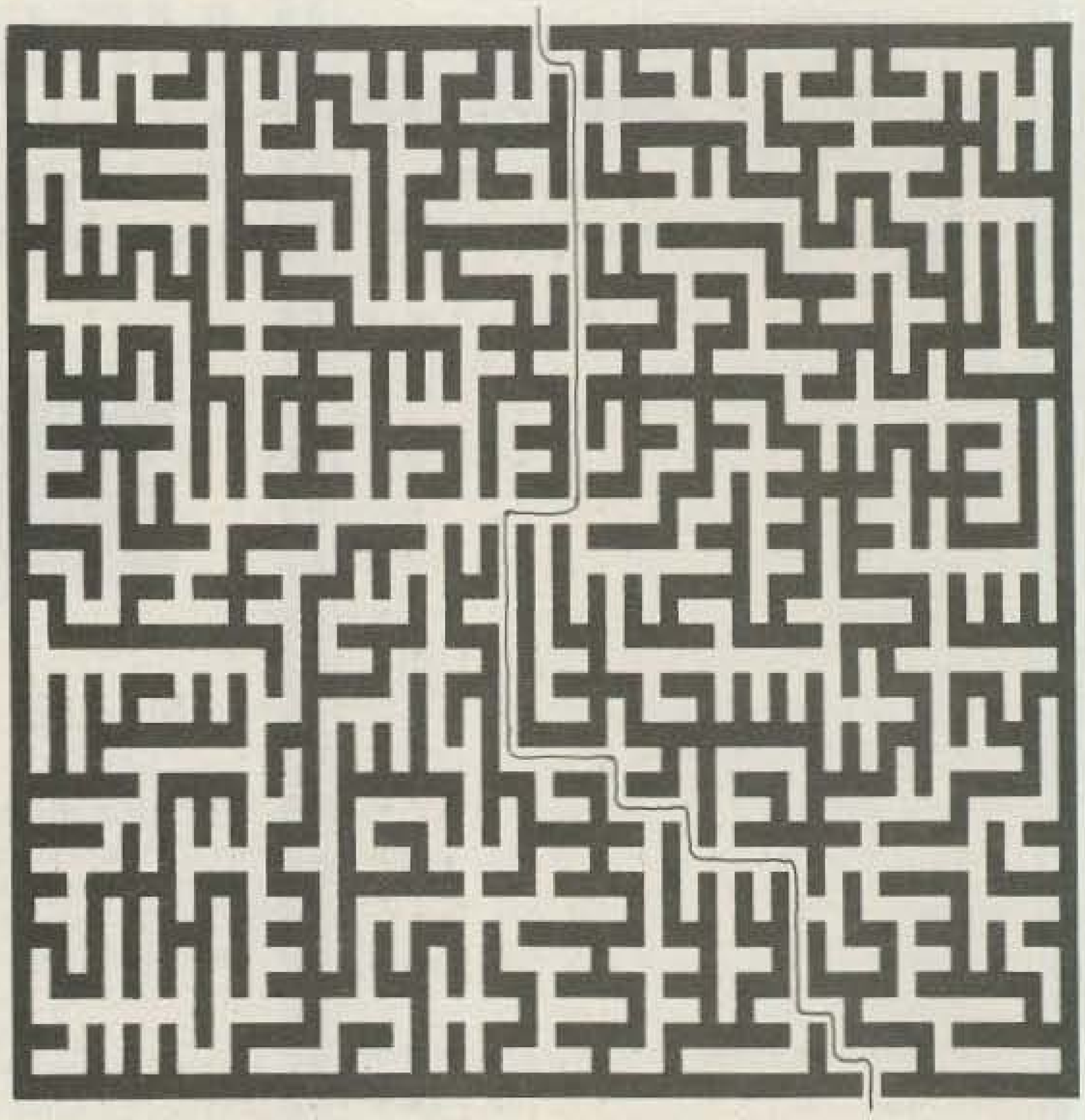

Illustration 2A.

4) Which of the following countries reached a third-party agreement with the US during 1982:

1) Spain
2) Austria
3) Sweden
4) Australia

5) What did the FCC plan to do to our phone bands in 1982?

1) Expand them
2) Contract them
3) Eliminate them
4) Leave them alone

ELEMENT 3—CRYPTIC PUZZLE

By using a standard substitution code, decipher this message: YMUDV CEQ YMJV QHCK QCO KFH MO M JMZKW SWKUDVJ DMOC LVMW.

ELEMENT 4—MAZE
(Illustration 2)

Did 1982 leave you confused? Join the club. This maze certainly won't make you any less dizzy, but at least it isn't very difficult.

THE ANSWERS

Element 1:
See Illustration 1A.

Element 2:
1—1 The man's too young for retirement.
2—2 The SS-9000 computer-controllable rig.
3—3 Soon, perhaps, no more trips to the Federal Building.
4—4 Down Under was the place.
5—1 Much to the irritation of most foreign hams.

Element 3:
Coded as follows—

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
M	U	Y	B	V	P	A	X	Q	Z	I	D	J	H	K	S	R	W	O	C	N	E	F	T	L	G

"CABLE TVI CAME INTO ITS OWN AS A MAJOR PROBLEM LAST YEAR."

Element 4:
See Illustration 2A.

SCORING

Element 1:
Twenty-five points for the completed puzzle, or one-half point for each question correctly answered.

Element 2:
Five points for each correct answer.

Element 3:
Twenty-five points for the completed puzzle.

Element 4:
Twenty-five points for the completed puzzle.

How well did you remember '82?

1-20 points—Skipped the year
21-40 points—Not very well
41-60 points—Bits and pieces
61-80 points—Very well
81-100+ points—Total recall, proceed to '83

FUN! MAILBOX

I just got to the June issue of *73* and began your logic puzzles. Element 3, DXX Couples, is incorrect by your solution as Diane has 206. You say Diane is Stan's wife, but that Frank's wife has more countries than Stan's wife. Therefore, Stan's wife cannot have the highest total. It was given that Diane had 206. The correct solution is:

Stan 198, Wilma 202—Total 400
Frank 194, Diane 206—Total 400
Joe 196, Susan 200—Total 396
Stan has 198
Joe has 196

Bob Gingras WB4JMH
Cocoa Beach FL

Very good, Bob. Don't you like the way I mess up answers just to keep my readers on their toes?—J. E.

CORRECTIONS

In the "Automatic Beam Aimer," which appeared in the November issue, there was an error in the schematic on p. 23. The diodes across K1, K2, and K3 were drawn in the opposite direction from what they should be. In the parts list on the same page, Radio Shack part number 271-1715 refers to a 25k pot. Actually, part 271-1715 is a 10k pot, but it will work equally as well in the circuit.

Avery Jenkins WB8JLG
73 Staff

Our apologies to Steven Katz WB2WIK, author of "Build Yourself A Paralyzed Beam" (December). Readers might better view the photo of the relay box on page 24 by turning the page upside down.

Avery Jenkins WB8JLG
73 Staff

Several errors crept into the "Circuits" feature in recent months. In the September, 1982, issue on p. 92, there were two errors. The first occurred in the description of the "Visual Adjust for Gamma Match," with the sentence beginning, "Even if you use an swr meter at the transmitter end of the scale. . . ." It should read, "Even if you use an swr meter at the transmitter end of the cable. . ." And in the description of the "Electronic Phone Bell," "heat-sink tubing" should be heat-shrink tubing.

On p. 109 of November's issue, there were two errors in "Substitute Transformer for Heath Gear." Circuit author Terry Martin points out that the circuit is a voltage tripler, not a voltage doubler as stated in the text. He also adds that it supplies 950 V, not 450 V.

On p. 112 of the same issue, in "Modification to the Kenwood TS-520S for AFSK," Fig. 3 was incorrectly labeled. Fig. 3 shows the i-f filters of the 530S, not the 520S as implied by the text.

Avery Jenkins WB8JLG
73 Staff

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✓See List of Advertisers on page 114

DX

Chod Harris VP2ML
Box 4881
Santa Rosa CA 95402

NEW YEAR'S RESOLUTIONS

The new year always provides a good time to review operating practices and perhaps improve techniques on the air. Here is my list of New Year's DX resolutions; why don't you come up with your own list and post it next to your rig!

1. I will not tune up on the air without checking the frequency. Instead, I will use a dummy load, mark the controls for each band, or search for a clear frequency before tuning up.

2. I will listen carefully before I call. No more "Who did I just work?" or calling out of turn when the DX station is working by call areas.

3. I will keep well informed, so that I don't have to ask "What's his QSL address?" in the middle of a DX pileup.

4. I will not be a "DX hog." I won't flaunt my (multi-)kilowatts in pileups and then ask the rare DX station to run a few tests with different antennas, etc.

5. I will not be a self-appointed policeman on the DX bands, nor will I talk back to one. The bands are crowded enough without this nonsense.

6. I will keep my transmissions short and listen often, to reduce QRM.

7. I will be courteous at all times to my fellow DXers, no matter what they do.

8. I will QSL promptly, with the card carefully filled out.

9. I will check out my rig to ensure that my signal is clean and not causing QRM.

10. I will try other bands and modes and not sit on 20 SSB.

If we all follow these resolutions, we will have an easier and more pleasant DX experience in 1983. And we'll need every advantage we can get for the big pileups around Heard Island early this year.

HEARD UPDATE

The race is on to Heard Island. One of the most difficult and expensive DXpeditions continues its relentless drive towards this isolated rock (see this column, September, 1982), as the members of the VK6 DX Chasers Club nail down many of the details of the trip.

At the same time that the VK6 DX Chasers are organizing their trip to Heard, the well-known South Pacific DXer, Jim Smith VK9NS, has chartered his own transportation to Heard. Jim sports an impressive record of successful DXpeditions throughout the region and is as knowledgeable and experienced as any DXpeditioner. Jim aims to arrive at Heard a month before the mountaineering group. So after years with absolutely no activity, it looks like Heard might be the subject of not one but two DXpeditions.

As of press time, the operators on the VK6 DX Chasers DXpedition are slated to be: Alan Fisher N8CW, Charles Brady N4BQW, and David Shaw VK3DHF. Alan is a mechanical engineer, which is likely to be a very useful talent on icy, wind-swept Heard. N4BQW is a physician when not DXing, and one hopes *his* specialty will not be needed on this DXpedition. The Australian on the DXpedition team has worked with the Australian meteorology department as an electronics technician. Both meteorology and electronics will certainly be needed on Heard Island.

The vessel taking the hams and mountaineers to Heard is as impressive as the list of operators. The *Anaconda II* is 84' long, 20' wide, and sports a 98' main mast. *Anaconda II* has Antarctic experience, having just completed the Rio De Janeiro Race through the "Roaring Forties" and around Cape Horn. The yacht comes fully equipped with the latest in navigational and electronic systems, including radar, satellite and terrestrial navigation, depth sounder, and access to remote computers. (It's probably too much to hope that they could keep the radio log in their computer...) The hams and mountaineers will use inflatable surf rescue boats to get to the rocky shore of Heard.

The choice of rigs and antennas for the Antarctic DXpedition presents a difficult problem. Sturdy, dependable, easy-to-repair radios are the order of the day. Another key to dependable operation involves taking several of the same radio. Then a malfunctioning radio can be cannibalized for parts if another fails.

The antennas and outside gear will take an even worse beating than the radios. The combination of freezing rains and high winds can destroy most antennas, so specially reinforced antennas are required of the day. Finding lubricants that won't freeze up for the antenna's rotors represents another necessity.

After the hams collect their equipment they must practice its assembly and repair. Each antenna and support system must be put together and taken apart again and again. What tools are needed? Can they be handled with gloves and mittens on? Exactly what hardware is needed for each operation? How many extra nuts and bolts should be taken? What do they do if piece X breaks? The size of the yacht limits the number of spare parts the DXpedition crew can take, so which are the most essential? These are the kinds of decisions which go into a well-planned DXpedition.

But even more important than the hardware is the "software"—the radio skills of the amateur operators. There are definite skills necessary for handling pileups, keeping the contact rate high, and giving everyone a fair chance at a contact. Weather conditions are going to be rough on Heard, and radio conditions might not be much better. Heard is a long, long way from any sizeable collection of amateurs. That means that Heard's signals will be relatively weak, and European, stateside, and Japanese signals will also be weak at Heard. It will take highly-skilled amateurs to keep the pileups under control.

We hope that the Heard Island DXpeditioners will avoid the kind of poor operation shown at the St. Peter and Paul Rocks (PYØ) this fall. There is simply no excuse for spreading out the callers over 100 kilohertz of the 20-meter phone band. Even the Clipperton Island DXpedition used only 75 kHz! There are many ways to spread out the callers without disrupting the entire 20-meter phone band. Non-DXers think poorly enough of the DX fraternity without this kind of bad manners. Perhaps it's time for a standard of DX conduct for DXpeditions. We'll have more to say about this in a future issue.

Meanwhile, the question of money continues. The mountaineering Heard Island trip may well cost $150,000 or more. Donations of equipment, supplies (including warm underwear), and cash have started the ball rolling. The expedition is taking film of the entire trip, to recoup some of their costs. An artist on the expedition team intends to sell paintings of the Heard Island landscape and penguins.

One major source of expedition funds is the amateur community. Both the Northern California DX Foundation (PO Box 2368, Stanford University CA 94305) and the International DX Foundation (PO Box 117, Manahawkin NJ 08050) have pledged $10,000 to the program. And both DX foundations are looking for new members and contributions to assist their work. The Australians organizing the amateur part of the trip are inviting amateurs and others to become associate members of the "Antarctic Adventure," at $30 (Australian). The VK6 DX Chasers are also selling DXpedition T-shirts at $9.50 (Australian). Contact them at Box 10, Perth 6005, Western Australia.

Meanwhile, Jim Smith continues to solicit funds and operators for his assault on Heard. You can send your contributions to Box 103, Norfolk Island, Australia.

Your contributions will help with the Heard Island DXpeditions and future trips to other rare spots.

Who will get to Heard first? Will there be anyone left to work for the second DXpedition? The best way to find out is to turn on your receiver and listen.

MAILING YOUR QSL CARD

If you do work Heard Island this winter, either VKØHI or VKØJS, you will want to get a QSL card confirming the contact. In the last two months we discussed how to design and fill out your QSL. This month we'll look at ways to get your card to the right place. I'll discuss these methods roughly in order from slowest to fastest.

The Bureaus

By far the easiest way to send your QSL to another amateur in another country is via the QSL bureau system. Every civilized country (and some that are not) has an incoming QSL bureau for the benefit of its amateurs. Incoming cards are sorted every so often and distributed to local amateurs.

Some of the bureaus are excellent. The Japanese and West Germans have especially top-notch bureaus. The smaller countries have less formal systems; in some cases, they are essentially nonexistent.

Sending your card to a DX station via the bureau is simply a matter of writing the DX station's call in the upper right corner of the back of the QSL and sending it to the address listed in the IARU information or the *Callbook*. If you have any number of cards going to the same country, the cost is a few cents a card.

An even easier system for ARRL members is the League's on-going DX QSL bureau. A membership label off *QST* and $1.00 per pound of QSLs (about 150) gets the cards off to the DX bureaus for less money (and probably faster) than any other service. Contact the ARRL for more information.

The chief complaint about the bureau method is speed. There isn't any. Three to four months is about as fast a turnaround as anyone can expect. A year or two is not unusual. With Russian QSLs (through the famous Box 88, Moscow), delays of 3-5 years are common and I have seen 10-15-year-old QSLs in packages direct from Box 88. Small wonder that it takes twenty years to get on the honor roll; it can take that long for a bureau card!

Commercial QSL Forwarding Services

There are other outfits which provide the same service as the League's outgoing QSL bureau, plus the added benefit of searching out QSL managers and faster QSL methods. These services advertise in most amateur-radio magazines.

The price per card runs about $0.10-.20, but service depends on the volume of cards and the expertise of the amateur running the operation. W3KT's service used to be the best, before Jesse passed away last year (see this column, September, 1982).

If you want to go this route, contact the operator and find out the number of cards per week he handles, how long the cards sit in his hands, how he arranges for return QSLs, and the calls of some hams who have used the service. Then follow up on this information before depending on the QSL forwarding service.

The same problem applies to this kind of service as to the League bureau system: It can take a long time. A well-run forwarding service can get cards to stateside QSL managers and back quite cheaply and rapidly. But DX QSLs usually go by sea mail and can be months in transit. There is another potential problem with the QSL forwarding services: Their success depends heavily on the skills of the manager. His knowledge of DX and QSLing can make the difference between cards on the wall and wasting your money.

Direct QSLs

Since DXers are an impatient lot, the preferred method involves sending a QSL of an important DX contact directly to the person handling the QSL chores. This person might be the actual DX operator himself or a QSL manager.

To send the card, you need the correct address. Obtaining this accurate address is one of the fine arts of DXing. The first place you look for this information is on the air. Listen to the DX station. Where does *he* say you should send the QSL? The horse's mouth is by far your best source of QSL information.

Next best are second-hand sources, such as DX nets, repeaters, and bulletins. Pulling information out of the bulletins is a time-consuming task, and errors abound. DX nets are a little better, but it helps to know who is providing the information, to help judge its reliability. DX repeaters offer the chance to talk to someone who has already received a card back from that DX station. Whatever method was successful once is worth another try.

If you don't want to spend your DXing time reading every bulletin and monitoring every DX net, you might consider subscribing to one of the DX QSL lists. Look for their ads in the magazines and bulletins. W6GO and K6HHD publish a QSL Manager List with more than 5000 calls. This list is updated monthly and costs $15.00 per year in the US. The address is PO Box 700, Rio Linda CA 95673.

Another possible source of DX address information is the *Callbook*. Some amateurs say they are "OK in any *Callbook*." The *Callbook* also lists QSL bureaus in the various DX countries. The *Callbook* is available at your local radio store or by mail.

Addressing the Envelope

You have finally located what you are sure is the "latest word," the "up-to-the-minute" QSL address. You could just write the address on the back of your card and mail it, but you would get an answer via the incoming QSL bureau or not at all. You probably want to send the card in an envelope, with a self-addressed, stamped envelope (SASE) enclosed.

Avoid the temptation of putting more than one card in an envelope. Say you worked Eric SMØAGD from several of his Pacific locations this past fall (see this column, August, 1982). Please don't put all the cards for SM3CXS (Eric's QSL Manager) into one envelope. Use a separate envelope for each QSL card. Or if you really can't afford to do that, at least send cards for each separate callsign in a separate envelope.

Mixing the calls or cards will only delay the response. Often, different people in different locations handle the cards for different calls, even though the QSL address is the same, as is the case with SM3CXS. If you mix several callsigns, the cards and your return envelope will go to one QSL manager, back to SM3CXS, and so on. Anywhere along the line your cards might get lost or separated from the return envelope. Make everyone's life easier, and speed your return QSL by sending each card in a separate outer envelope.

Should you put the callsign of the DX station on the outer envelope? An excellent question. If the card is going to an address in the States, Western Europe, or Japan, by all means do so. The first callsign on the address should be that of the DX station you worked, the second the call of the QSL manager: VP2ML via K1RH. This allows the QSL manager to sort the cards quickly.

On the other hand, I recommend *leaving off* the callsign on the envelope if the card is going to an African country, Eastern Europe, Turkey, or any other country where amateur radio is illegal or frowned upon. The reason is theft or danger to the DX amateur. Callsigns on the outer envelope may indicate money inside, so many of these envelopes never reach their intended destinations. In the case of Turkey, the DX amateur can run afoul of local authorities by receiving mail with a callsign on the envelope.

The best rule of thumb is, when in doubt, leave it off. And if you ever send personal mail to an active QSL manager, write in large letters, "Not a QSL" on the envelope! Otherwise, it may get thrown in with the QSLs to be answered "tomorrow."

When to Mail

We are all anxious to get our return QSL card, especially one confirming a rare QSO. So many of us rush right out the day we work the DX station and mail off the card. This is fine when the card is going directly to a DX resident in another country. But it is not necessarily the best time to send a QSL card for a DXpedition contact or to a QSL manager.

Many DXpeditioners handle their own QSLing. If you can still read them on the radio, they can't be home answering your QSL. Wait a while. In fact, most DXpeditions don't print the QSLs until they get home and know how many they need. It will often be a month or more before they even have any cards to fill out.

If you really jump the gun and send the card out while the DXpeditioner is still away from home, you can create some unneeded friction between the DXer and his local post office. When I returned from 10 days in the Galapagos, there were *6 bags* of QSLs waiting for me. On one day I received more mail than the rest of the local residents combined! The post office personnel thought I was running some sort of mail scheme and threatened to charge me a commercial rate and storage fees. And somewhere, buried in that tome of mail, were personal letters, bills, and checks. It took a solid day just to pull my personal mail out of the QSLs!

So give the DXer some time to get home, get some cards printed, and catch his breath, before overflowing his PO Box.

The same problem can happen when QSL managers get their log information via the mail. The logs might take weeks or months to get to the QSL manager, before he can look up the contact and answer your QSL.

Some QSL managers get around this by having regular schedules with the DX station. The manager reads the contact information, the DX station checks his log, and the QSO is confirmed. This system worked so well for me at VP2ML that one amateur received his QSL card less than 48 hours after the contact!

Enough about how to get your QSL card to the right place. It's the next step that's the important one anyway: getting the DX stations's QSL card back! Hang on until next month!

AWARDS

Bill Gosney KE7C
Micro-80, Inc.
2665 North Busby Road
Oak Harbor WA 98277

LABRE AWARD

The Worked All American Award has been instituted by LABRE (Liga de Amadores Brasileiros de Radio Emissao) to promote interest in the American area.

The WAA award will be issued to any licensed amateur station presenting proof of contact with forty-five (45) or more countries in the American area.

All applications should be sent to the Awards Manager, LABRE, PO Box 07/0004, Brasilia, Distrito Federal, Brasil, CEP 70.000.

Confirmations must be accompanied by a list of claimed countries to aid in checking. A log verified by the awards manager of the applicant's country league or association will be accepted instead of QSL cards. Logs may also be verified by two amateurs in the applicant's area.

All contacts must be made with licensed amateur stations operating in authorized amateur bands. Contacts must be made only with licensed and based amateur stations. Contacts with ships and aircraft *cannot* be counted.

All stations must be contacted from the same call areas where such areas exist, or from the same country in cases where there are no call areas. One exception is allowed to this rule. If a station moves from one call area to another, or from one country to another, all contacts must be made from within a radius of 150 miles from the initial location.

Contacts may be made over any period of years since November of 1945. Contacts may have been made under different call letters in the same call area (or country) if the license for all was the same.

Any altered or forged confirmations will result in permanent disqualification if observed by the WAA award advisory committee. A minimum readability of 3 (R3) must be recorded for phone and a minimum signal tone of 5 (S5) must be recorded for CW.

All applications must be forwarded with ten IRCs or equivalent for handling and postage and return of QSL cards by registered air mail.

All certificates will be consecutively numbered and an honor roll showing all those issued will be kept by the awards manager of LABRE.

The following list of countries in the American area (North and South America) is presented as a guide. Deleted countries will not be valid.

WAA Countries List

CE	Chile
CE	Easter Island
CE	Juan Fernandez
CE	San Felix
CM-CO	Cuba
CX	Uruguay
FG	Guadeloupe
FM	Martinique
FO8	French Polynesia
FO8X	Clipperton Island
FP	St. Pierre & Miquelon Islands
FS	Saint Martin
FY	French Guiana
HC	Equador
HC8	Galapagos Island
HH	Haiti
HI	Dominican Republic
HK	Colombia
HKØ	Bajo Nuevo
HKØ	Malpelos Island
HKØ	San Andres & Providencia
HP	Panama
HR	Honduras
J3	Grenada
J6	St. Lucia
J7	Dominica
K-W	USA
KC4	Navassa
KG4	Guantanamo Bay
KP7	Alaska
KP4	Puerto Rico
KP4/D	Desecheo Island
KS4	Swan Is. (now HR)
KS4	Serrana Bank (now uses HKØ)
KV4	Virgin Islands
KZ5	Canal Zone (until March 24, 1978)
LU	Argentina
OX	Greenland
PJ	Neth. Antilles
PJ	Saint Maarten
OA	Peru
PP, P2, PR, PS, PT, PU, PW, PY	Brazil
PYØ	Fernando Noronha
PYØ	St. Peter's & St. Paul's
PYØ	Trindade & Martim Vaz Islands
PYØ	Abrolhos Island
PZ	Surinam
TG	Guatemala
TI	Costa Rica
TI9	Cocos Island
VE	Canada
VP1	British Honduras
VP2A	Antigua and Barbuda
VP2E	Anguilla
VP2K	St. Kitts
VP2M	Montserrat
VP2S	St. Vincent
VP2V	British Virgin Islands
VP5	Turks & Caicos Islands
VP7	Bahama Island (Now C6)
VP8	Antarctica
VP8/LU	Falkland Island
VP8/LU	Georgia Island
VP8/LU	So. Orkney Island
VP8/LU	So. Sandwich Island
VP8/LU	So. Shetland Island
VP9	Bermuda
XE	Mexico
XF4	Revilla Gigedo
YN	Nicaragua
YS	El Salvador
YV	Venezuela
YV	Aves Island
ZF1	Cayman Island
ZP	Paraguay
6Y	Jamaica
8P	Barbados
8R	Guyana
9V	Trinidad & Tobago Islands

MARTINIQUE AWARD

The FM DX Group of Martinique is offering a certificate for QSOs with FM7 and FMØ stations. Three hundred points will earn the certificate, with scoring as follows: Contacts with an FM DX Group member count 10 points per QSO, FMØ contacts count 4 points each, and FM7 contacts count 2 points. A phone QSO is worth 1 point, RTTY or ASCII count for 2 points, and a CW contact is worth 3 points.

One point is given for a contact on 10, 15, or 20 meters, a contact on 160 or 80 meters is worth 2 points, and a QSO on any other frequency receives 3 points. One point also is added for each 3,000 miles distance from Martinique.

A minimum of 7 days is required between two QSOs with the same station, and 25 percent of the points must have been made in contact with an FM DX Group member.

Logs and a $5.00 money order should be sent to Gerard Souqui FM7BX, PO Box 152, 97202 Fort de France Cedex, Martinique.

W. VIRGINIA QSO PARTY

The West Virginia QSO Party, sponsored by the West Virginia State Amateur Radio Council, will be from 1700Z January 22 until 1700Z January 23. Single operator only. Exchange signal report, serial number, county (WV only), state, or country. WV stations multiply total by sum of WV counties, states, and countries worked. Others multiply QSO totals by WV counties worked. Multiply score by 1.5 if you run 200 Watts or less. Suggested frequencies Phone—10 kHz from lower edge of General subbands; CW—35 kHz from low ends; Novice—35 kHz from low ends. Repeater contacts permissible. Mail logs by February 11 to K8BS, 950 Gordon Road, Charleston WV 25303.

WISCONSIN SPECIAL EVENT

The Eau Claire, Wisconsin, ARC will operate K9EC/9 during the National 70-Meter Ski Jumping and Nordic Combined Championship on January 29 and 30 from 1400Z to 2300Z. Frequencies: CW—52 kHz up from bottom edge. Phone—3980, 7277, 14282, 21382, and 28620. For an 8½ x 11 certificate, send SASE to N9AIX, PO Box 201, Altoona WI 54720.

GROUNDHOG DAY

The Punxsutawney (Pennsylvania) Amateur Radio Club will operate on 14.290 and 7.230 from 9 am to 5 pm, January 30, 1983, in commemoration of Groundhog Day 1983. We will operate also on 7.230 on February 2, 1983 (Groundhog Day). This special-event station will operate from Gobblers Knob, the home of the Groundhog. Certificate for SASE and QSL card to Art Sweeney K3HWJ, RD #1, Box 371, Punxsutawney PA 15767.

GEORGIA'S 250TH BIRTHDAY

Savannah area amateurs will have a special-events operation in honor of the State of Georgia's and historical Savannah's 250th birthday. Operation will be February 12 and 13, 1500-2000Z on upper 25 kHz, all General phone, and 21.130 to 21.170 kHz Novice. QSOs on 2 meters 146.52 only. For special certificate, send QSL card with QSO number and large SASE to call of contact operator.

GOLDEN SHEARS AWARD

In honor of the 1983 Golden Shears

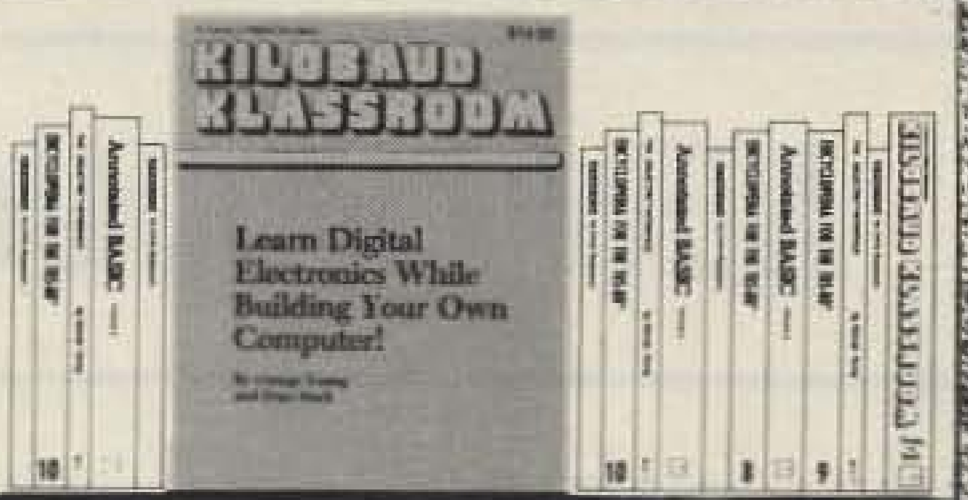
WAYNE GREEN BOOKS

KILOBAUD KLASSROOM

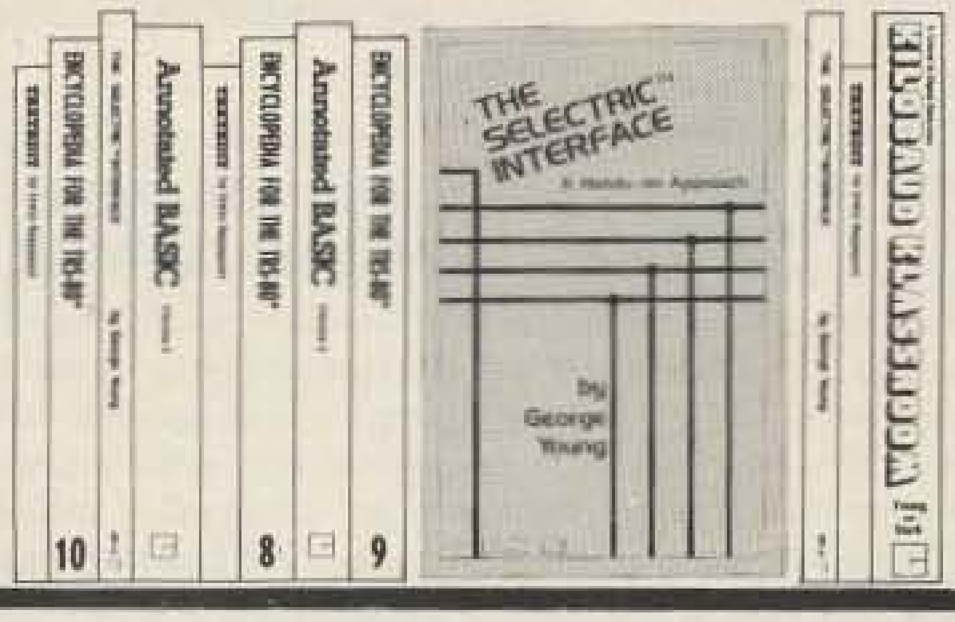
by George Young and Peter Stark

Makes learning electronics fun and easy. First published as a series in *Kilobaud Microcomputing*, the book combines the learning of essential theory with practical, hands-on experience. The course begins with basic electronic projects and culminates in the construction of your own programmable microcomputer. The direct instructional methods of authors Young & Stark make KILOBAUD KLASSROOM a simple way for you to acquire a solid background in digital electronics.

BK7386 (419 pages)..$14.95



THE SELECTRIC INTERFACE by George Young



You need the quality print that a daisy wheel printer provides but the thought of buying one makes your wallet wilt. The SELECTRIC^{TM} INTERFACE, a step-by-step guide to interfacing an IBM Selectric I/O Writer to your microcomputer, will give you that quality at a fraction of the price. George Young, co-author of *Kilobaud Microcomputing* magazine's popular "Kilobaud Klassroom" series, offers a low-cost alternative to buying a daisy wheel printer. The SELECTRIC INTERFACE includes: step-by-step instructions, tips on purchasing a used Selectric, information on various Selectric models, including the 2740, 2980, and Dura 1041, driver software for Z80, 8080, and 6502 chips, tips on interfacing techniques. With The SELECTRIC INTERFACE and some background in electronics, you can have a high-quality, low-cost, letter-quality printer. Petals not included.

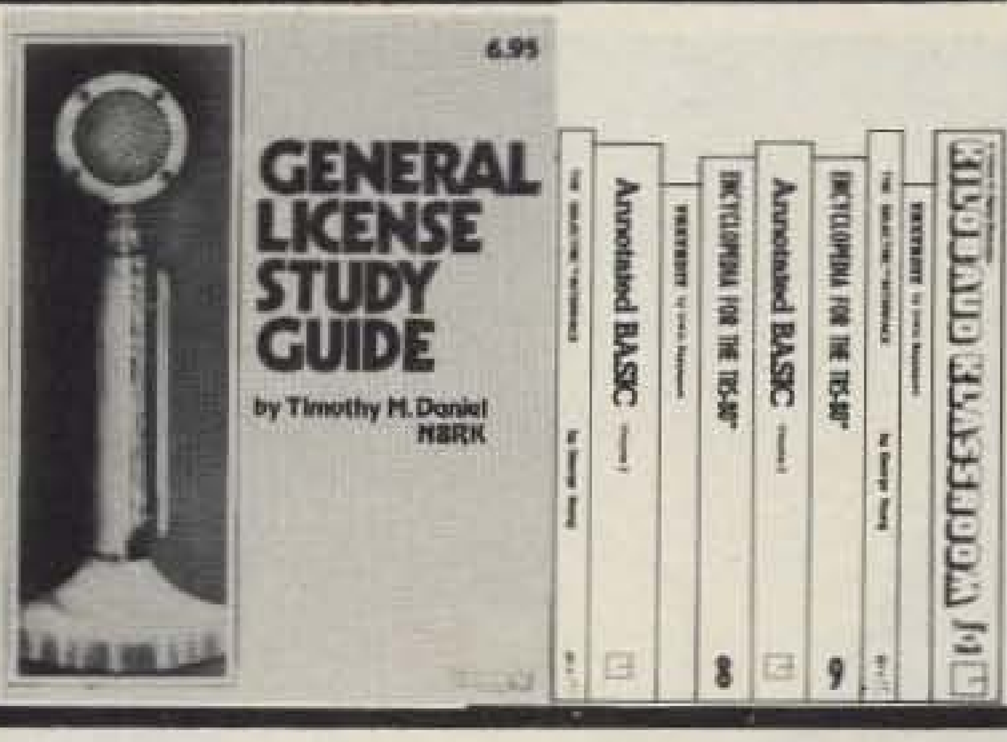
BK7388 (125 pages)..$12.97

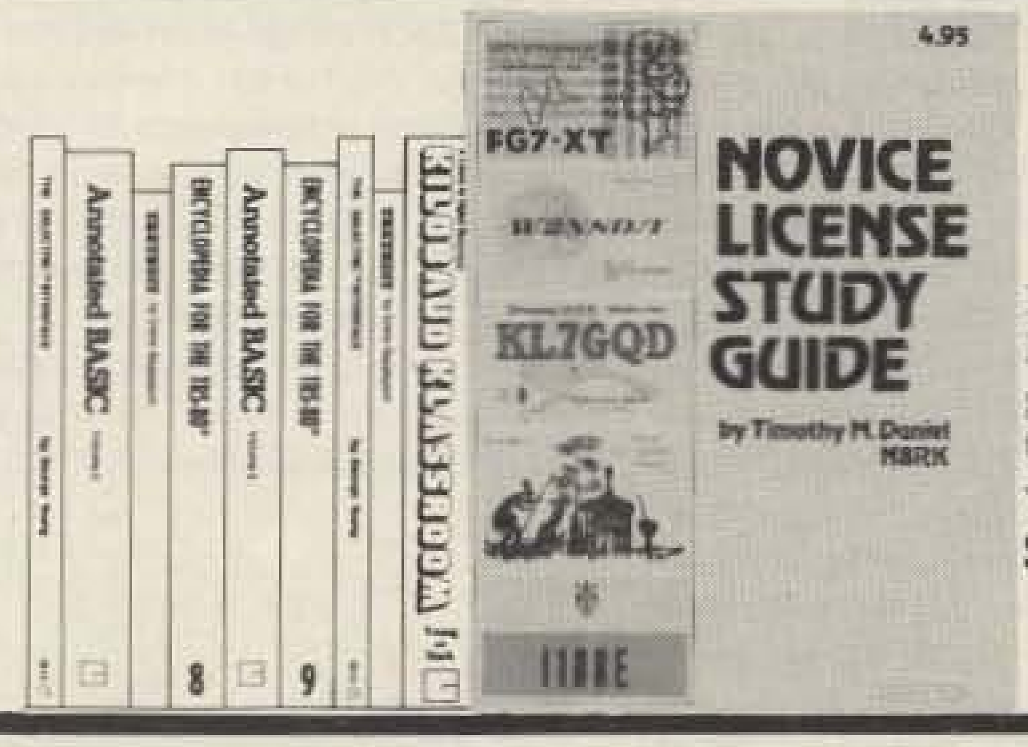
GENERAL LICENSE STUDY GUIDE

By Timothy M. Daniel N8RK

This is the complete guide to the General License. Learning rather than memorizing is the secret. This is not a question-and-answer guide that will gather dust when the FCC issues a new test. Instead, this book will be a helpful reference, useful long after a ham upgrades to General. Includes up-to-date FCC rules and an application form. Order yours today and talk to the world.

SG7358 (87 pages)..$6.95





NOVICE LICENSE STUDY GUIDE

By Timothy M. Daniel N8RK

Here is the most up-to-date novice guide available. It is complete with information about learning Morse code, has the latest FCC amateur regulations and the current FCC application forms. This guide is *not* a question/answer memorization course but rather it emphasizes the practical side of getting a ham license and putting a station on the air. It reflects what the FCC expects a Novice to know without page after page of dull theory. The most current information still available at last year's price.

SG7357 (98 pages)..$4.95

THE NEW WEATHER SATELLITE HANDBOOK by Dr. Ralph E. Taggart WB8DQT

Here is the completely updated and revised edition of the best-selling *Weather Satellite Handbook*—containing all the information on the most sophisticated and effective spacecraft now in orbit. Dr. Taggart has written this book to serve both the experienced amateur satellite enthusiast and the newcomer. The book is an introduction to satellite watching, providing all the information required to construct a complete and highly effective ground station. Not just ideas, but solid hardware designs and all the instruction necessary to operate the equipment are included. For the thousands of experimenters who are operating stations, the book details all procedures necessary to modify their equipment for the new series of spacecraft. Amateur weather satellite activity represents a unique blend of interests encompassing electronics, meteorology and astronautics. Join the privileged few in watching the spectacle of earth as seen from space on your own monitoring equipment.

BK7383 (132 pages)..$8.95

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Sheep Shearing Contest in March, 1983, the members of New Zealand's Branch 46 in Wairarapa are offering an award for contacts made that month with their members.

To be eligible for the award on HF bands, ZL stations must have 10 points, VK stations must have 7 points, and DX stations need 5 points. Net contacts count toward the award.

On VHF, ZL2 stations need 15 points to qualify, other ZL stations have to get 7 points, and DX stations must have 3 points. Repeater QSOs count toward the award, but repeater/net contacts do not.

Scoring is as follows: Golden Shears President ZL2AHU is worth 3 points; club station ZL2OA, a YL operator, farming branch member, or mobile station within Wairarapa are worth 2 points each, and any other member is worth 1 point.

Except for crossband operation, any band/mode combination is allowed. However, only one contact per member is permitted unless the member is operating the club station or working mobile within Wairarapa. No QSLs are required for the award; send your application with $2.00 (NZ) or an equivalent International Money Order to Awards Manager, PO Box 860, Masterton, New Zealand. Entries must be received before August 31, 1983. All proceeds will go toward funding for an operating room for emergency situations.

NEW PRODUCTS

APOLLO X10 ANTENNA

National Microtech, Inc., has just introduced its new Apollo X10 antenna, which utilizes a 10-foot, eight-segment, compression-molded fiberglass reflector. The reflector provides high strength-to-weight ratio and significantly reduces the size of the shipping container, thus providing savings in handling and shipping costs.

The X10 can be erected easily by two installers. The individual reflector segments are interchangeable and field-replaceable, utilizing indexing tabs for position and self-alignment.

The Apollo X10 delivers 40.1 dB gain at 3.95 GHz. Its textured front surface diffuses sunlight and reduces solar heating at the focal point, and the high-quality fiberglass material is impervious to salt, pollutants, and contaminants that may be encountered in coastal and industrial areas.

The center-mounted "button hook" prime feed provides accurate alignment with the focal point without the use of cables and other supporting gear. The LNA is located at the focal point while the rotor is placed at the rear of the dish, permitting rotation of the feed through 360 degrees of polarization by remote control.

For more information, contact *National Microtech, Inc., PO Drawer E, Grenada MS 38901.* Reader Service number 481.

National Microtech's Apollo X10 antenna.

Simpson's model 467E DMM.

UNITED STATES FREQUENCY ALLOCATION CHART

An updated "Varian United States Frequency Allocation Chart" is now available free of charge from Varian Associates Electron Device Group. The four-color chart includes radio, television, point-to-point, microwave, satellite communications, and millimeter wave frequency allocations. This 15" by 21" foldout wall chart features a ledger guide and is both color- and line-coded for easy reference.

Frequency allocations from 3 kHz to 300 GHz are divided into eight one-order-of-magnitude divisions. These divisions are color-coded to illustrate frequency uses of government exclusive, non-government only, and government and non-government shared frequencies. Line coding is then used for the demarcation of 31 specific frequency categories such as fixed satellite, radio navigation, land mobile, broadcasting, and meteorological satellite.

For further information, contact *Varian Associates, Electron Device Group Marketing, 301 Industrial Way, San Carlos CA 94070.* Reader Service number 488.

AZDEN INTRODUCES NEW PCS-4000

Japan Piezo Company, Ltd., and Amateur-Wholesale Electronics have announced their new PCS-4000 2-meter FM transceiver. Like its predecessors, the PCS-4000 utilizes keyboard frequency control, but many new features have been added, making this a truly unique radio.

Some of the features are 8-MHz coverage (142 to 149.995 MHz), extremely small size (2 inches high by 5½ inches wide by 6¾ inches deep), two banks of eight memories which can be scanned separately or together, capability for up to eight nonstandard repeater splits, and two priority channels. Other feaures include a full 16-key touchtone™ pad built in, multicolored display for easy function recognition, discriminator scan centering, repeater reverse button, and free/vacant scan mode selection with auto-resume.

For more information, contact *Amateur-Wholesale Electronics, Inc., 8817 SW 129 Terrace, Miami FL 33176; (303)-233-3631.* Reader Service number 483.

SIMPSON'S MODEL 467E LCD DMM

Simpson Electric Company has introduced a new hand-portable LCD digital multimeter. Model 467E joins the Simpson line of LCD hand-portable DMMs.

Features include peak hold to capture surge currents and voltages, a continuity mode to provide instant visual/audible checks for shorts and opens, and true rms capability for more significant measurements of non-sinusoidal waveforms over a wide frequency range. The 467E has 26 ranges to provide full ac/dc voltage, current, and resistance (including low-power Ohms) measurement capability.

Additional features include 0.1% dc V accuracy, high-voltage transient protection, a double fusing system, and color-coded front-panel graphics. Its size is a compact 2" × 5.6" × 4.6" and its weight is 1½ lbs.

For further information, contact *Simpson Electric Company, 853 Dundee Avenue, Elgin IL 60120; (312)-697-2260.* Reader Service number 486.

SUBMINIATURE CHANNEL SCANNER

Midian Electronics, Inc., has introduced a subminiature channel scanner. It features 6-channel capability on radios employing crystal high switching, 16-channel capability on radios using battery-line binary address, and 8-channel capability on radios using battery or ground switching. The scanner also has a priority channel scan capability as well as a three-second hold timer, manual advance, and an adjustable channel scan length.

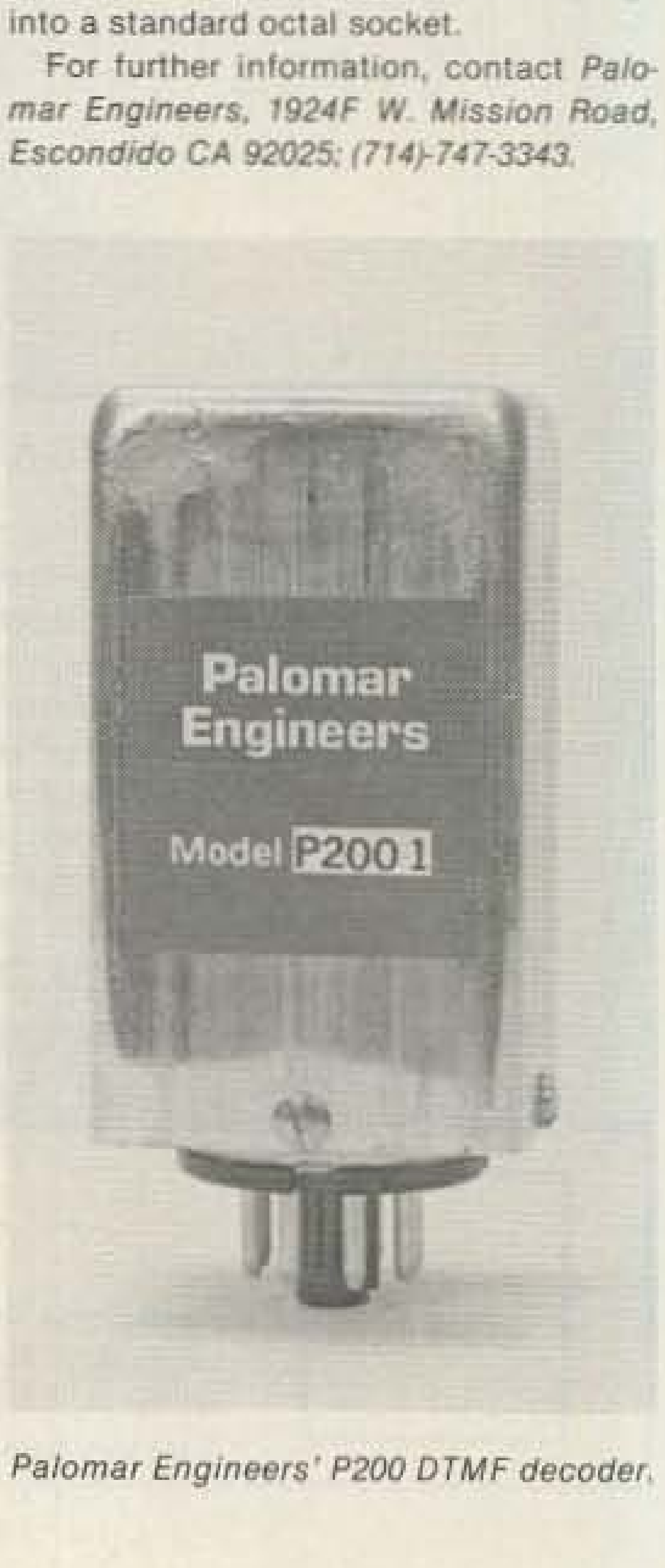
For further information, contact *Midian Electronics, Inc., 5907 E. Pima Street, Tucson AZ 85712; (602)-885-6883.* Reader Service number 487.

PLUG-IN DTMF DECODER

Palomar Engineers has announced a new single-digit decoder which is available for any of the 16 DTMF digits.

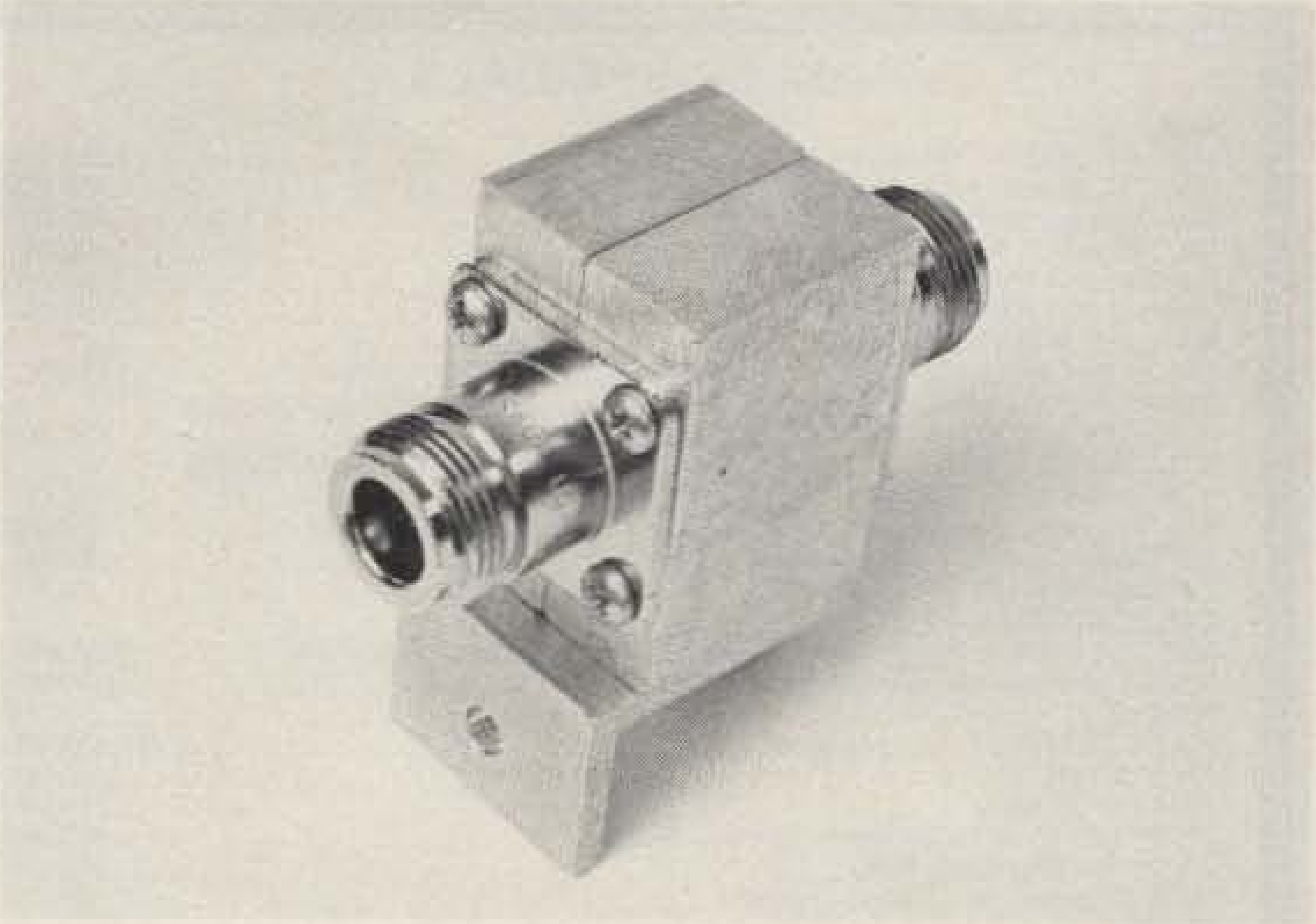
Replacing the firm's older model T2, the new P200 features improved temperature stability, high input impedance (200,000 Ohms), and a ½-Ampere SPDT output relay. It operates from 12 volts dc, signal levels from −25 to +5 dBm, and has a response time of 100 ms. The decoder plugs into a standard octal socket.

For further information, contact *Palomar Engineers, 1924F W. Mission Road, Escondido CA 92025; (714)-747-3343.*



Palomar Engineers' P200 DTMF decoder.

Icom's IC-290H transceiver.



PolyPhaser's new impulse suppressor.

ICOM'S IC-290H

Icom has announced the release of a new 2-meter multimode mobile transceiver, the IC-290H, featuring a powerful 25-Watt output and a highly sunlight-readable green readout in the same compact package as the IC-290A. Other features and styling of the IC-290H are the same as the previous model—the IC-290A. These include: 5 memories for storing your most worked frequencies, a call channel to make your favorite frequency instantly available, 5-kHz FM tuning or 1-kHz/100-Hz tuning on SSB, FM/USB/LSB/CW modes, programmable offsets, a priority channel that monitors 2 frequencies, and scanning of memories or band.

For more information, contact *Icom America, Inc., 2112 116th Avenue NE, Bellevue WA 98004.*

ENCON PHOTOVOLTAIC PANELS

Encon, Inc., distributors of Solarex photovoltaic products for the Midwest, has introduced the new Solarex SX series of semicrystalline photovoltaic panels, using state-of-the-art technology.

Solarex semicrystalline cells offer unique advantages over earlier technology, including lower cost, increased packing efficiency, and higher power output compared with the traditional round single-crystal silicon cells. Semicrystalline cells are made by melting less-than-pure polycrystalline silicon, crystallizing it into rectangular "bricks," and then sawing the bricks into wafers to make rectangular cells. The cost reductions afforded by the new process promise to bring prices down from $100 per Watt to under $20 per Watt within the next few years.

Solarex suppplied the photovoltaic cells for the UoSAT (University of Surrey) OSCAR 9 satellite launched on October 6, 1981. OSCAR 9's four solar panels each contain 408 high-efficiency 2 cm × 2 cm cells. Each panel produces 27 Watts when fully illuminated. The Solarex system is designed to produce 18 Watts peak power and 8 Watts average power in orbit to charge the 14-volt nicad battery.

Encon, Inc., assembles complete photovoltaic power systems for emergency and primary communication applications, as well as residential and commercial packages. Interested amateurs are invited to contact *Encon, Inc., 27584 Schoolcraft, Livonia MI 48150.* Reader Service number 479.

ICOM'S IC-R70 GENERAL-COVERAGE RECEIVER

Icom has just announced its new professional general-coverage receiver, the IC-R70.

It is a full generation newer and features more functions than other less sophisticated general-coverage receivers on the market. Features include squelch on sideband, adjustable-width noise blanker, adjustable-speed agc, passband tuning as standard, and adjustable notch filter as standard.

Other convenient features are high-stability, synthesized tuning with tuning speeds, an optional AM/FM mode, variable CW-filter widths, dial lock, and two vfo's with data transfer. Also, the IC-R70 will operate transceive with the IC-720A, making an ideal combination for the serious DXer or CW buff.

For more information, contact *Icom America, Inc., 2112 116th Avenue NE, Bellevue WA 98004.*

POLYPHASER'S IMPULSE SUPPRESSORS

A new series of bulkhead-style impulse suppressors for coaxial lightning protection was recently introduced by PolyPhaser Corporation. This new IS-B50 series can easily replace older air-gap-type arrestors and can be mounted on up to 1/8"-thick bulkhead panels. These weatherproofed gas tube protectors are designed for repeaters, base stations, and TVROs to 1 GHz, with typical (N) 0.1 dB loss and 1.1-to-1 vswr. Their hefty 20-kA multi-strike and 50-nanosecond turn-on time make protection against most direct strikes possible. They come complete with weather washer and stainless steel hardware in both N and UHF fittings. A tower mounting kit is also available.

For further information, contact *PolyPhaser Corporation, 1500 West Wind Boulevard, Kissimmee FL 32741; (303)-396-1807.* Reader Service number 485.

DC POWER SUPPLY

Many mobile operators would like to be able to operate their mobile equipment at home on ac power mains. Tripp-Lite has just announced a product that meets that desire: a precision regulated dc supply that converts 120 V ac into 13.8 V dc. For example, CB radios, automobile tape players, tape recorders, high-power stereo systems, amateur radio equipment, linear amplifiers, and marine- or business-band radios can now be used at home.

The new low-cost power supply saves the user money, since it also eliminates the expense of having to buy ac equipment. It features a solid-state integrated circuit for precise regulation. A built-in filter ensures low-noise operation, and current-limiting electronic "foldback" is provided for automatic overcurrent protection. Other features include a heavy-duty power transformer for complete line isolation, a maximum ripple voltage of only 0.1 volts from zero to full load, an on/off switch and indicator light on the faceplate, and a UL-listed ac cord and plug (type SPT-2).

For more information, write *Tripp-Lite, 500 N. Orleans, Chicago IL 60610.* Reader Service number 484.

W9AV MORSE CODE TRANSLATOR FOR TRS-80 COLOR COMPUTER

J. C. Sprott W9AV announced some time ago his Morse-code programs for the TRS-80 Mod I/Mod III computers. Now, he has announced the availability of a Morse program in 16K extended color Basic for the TRS-80 color computer. It is believed that this program is the only Morse-code program available for sending and receiving Morse code by way of the computer's cassette port.

With 9 programmable memories of 240 characters each and a random-character "practice" mode, the translator program allows you to send and receive the code by merely plugging the computer cassette plugs directly into the transmitter key jack and the receiver phone jack. Morse code may then be sent at speeds of up to 60 words per minute and received at speeds of up to 30 words per minute.

For more information, write *Professor J. C. Sprott W9AV, 5002 Sheboygan, #207, Madison WI 53705.* Reader Service number 480.

Icom's IC-R70 receiver.

Tripp-Lite's dc power supply.

HAM HELP

I am looking for schematics for a Siltronics LA 550 bi-linear.

Arthur Lee
Route 1, Box 329
Centreville MD 21617

I need help troubleshooting my Spectronics digital readout DD-1C. The display has quit counting, and I need a schematic for it.

Dr. M. R. Klein WA4GUH
201 East Arbor Ave.
Pt. St. Lucie FL 33452

I am looking for a manual for the Tektronix 524D oscilloscope and a meter movement for a Bird model 43 wattmeter. I will pay any reasonable price and postage.

Don DeLung WB4LJE
830 Pinecrest Ave.
Bedford VA 24523

Can anyone help me eliminate the chirp and drift in my Heath HG-10B vfo?

Dave Artman N9CZJ
599 Wheel Estates
Greenwood IN 46142

See List of Advertisers on page 114

RAMSEY ELECTRONIC'S Inc.

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MINI KITS - YOU HAVE SEEN THESE BEFORE NOW HERE ARE OLD FAVORITE AND NEW ONES TOO. GREAT FOR THAT AFTERNOON HOBBY.

FM MINI MIKE

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit $14.95
FM-3 Wired and Tested 19.95

Color Organ

See music come alive! 3 different lights flicker with music. One light each for, high, mid-range and lows. Each individually adjustable and drives up to 300 W. runs on 110 VAC.

Complete kit, ML-1
$8.95

Video Modulator Kit

Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 **$7.95**

Led Blinky Kit

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts.
Complete kit, BL-1
$2.95

Super Sleuth

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker.
Complete kit, BN-9 **$5.95**

CPO-1

Runs on 3-12 Vdc 1 wall out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit **$2.95**

FM Wireless Mike Kit

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit **$3.95** FM-2 kit **$4.95**

Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC.
Complete kit, WL-1
$6.95

Tone Decoder

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
Complete kit, TD-1 **$5.95**

Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit **$5.95**

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC.

MB-1 Kit **$4.95**

Siren Kit

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.
Complete kit, SM-3 **$2.95**

60 Hz Time Base

Runs on 5-15 VDC. Low current (2.5ma) 1 min/month accuracy TB-7 Kit **$5.50**
TB-7 Assy **$9.95**

CLOCK KITS

Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5	**$24.95**
Clock with 10 min. ID timer, 12/24 hour, DC-10	**$29.95**
Alarm clock, 12 hour only, DC-8	**$29.95**
12V DC car clock, DC-7	**$29.95**

For wired and tested clocks add $10.00 to kit price.
SPECIFY 12 OR 24 HOUR FORMAT

SATELLITE TV KIT

THE POPULAR SAT-TEC RECEIVER IN KIT-FORM!

Featured in a Radio Electronics magazine cover story (May 82), the reliable R2B Sat-tec TV receiver is now operating in thousands of locations. The R2B is easy to build; pre-etched, plated boards with screened component layout assures accurate component placement and the critical IF section and local oscillator are pre-assembled and aligned! All parts are included for the R2B; attractive case, power supply, descriptive operating manual as well as complete assembly instructions. Features of the receiver include: dual conversion design for best image rejection, fully tunable audio to recover 'hidden' subcarriers, divide by two PLL demodulator for excellent threshold performance, tight tracking AFC to assure drift free reception, and of course, full 24 channel tunable coverage.

Build your satellite TV system around the R2B, close to ten thousand others already have and now it's available in kit form at a new low price. Order yours today.

A complete Satellite TV System requires a dish antenna, LNA (low noise amplifier), Receiver and Modulator.

R2B Receiver Kit	$359.00
R2B Receiver, Wired and Tested	$595.00
120° K Avantek LNA	$495.00
RM3 RF Modulator	$49.95

Prices include domestic UPS shipping and insurance.

PARTS PARADE

IC SPECIALS

LINEAR

301	$ .35
324	$1.50
380	$1.50
555	$ .45
556	$1.00
565	$1.00
566	$1.00
567	$1.25
741	10/$2.00
1458	$ .50
3900	$ .50
3914	$2.95
3038	$2.95

TTL

74S00	$ .40
7447	$ .65
7475	$ .50
7490	$ .50
74196	$1.35

SPECIAL

11C90	$15.00
10116	$ 1.25
7208	$17.50
7207A	$ 5.50
7216D	$21.00
7107C	$12.50
5314	$ 2.95
5375AB/G	$ 2.95
7001	$ 6.50

CMOS

4011	.50
4013	.50
4046	$1.85
4049	.50
4059	$9.00
4511	$2.00
4518	$1.35
5639	$1.75

FERRITE BEADS

With info and specs 15/$1.00
6 Hole Balun Beads 5/$1.00

READOUTS

FND 359 .4" C.C.	$1.00
FND 507/510 .5" C.A.	1.00
MAN 72/HP7730 .33" C.A.	1.00
HP 7651 .43" C.A.	2.00

Sockets

8 Pin	10/$2.00
14 Pin	10/$2.00
16 Pin	10/$2.00
24 Pin	4/$2.00
28 Pin	4/$2.00
40 Pin	3/$2.00

TRANSISTORS

2N3904 NPN C-F	15/$1.00
2N3906 PNP C-F	15/$1.00
2N4403 PNP C-F	15/$1.00
2N4410 NPN C-F	15/$1.00
2N4916 FET C-F	4/$1.00
2N5401 PNP C-F	5/$1.00
2N6028 C-F	4/$1.00
2N3771 NPN Silicon	$1.50
2N5179 UHF NPN	3/$2.00
Power Tab NPN 40W	3/$1.00
Power Tab PNP 40W	3/1.00
MPF 102/2N5484	$.50
NPN 3904 Type T-R	50/$2.50
PNP 3906 Type T-R	50/$2.50
2N3055	$.60
2N2646 UJT	3/$2.00

Diodes

5.1 V Zener	20/$1.00
1N914 Type	50/$1.00
1KV 2Amp	8/$1.00
100V 1Amp	15/$1.00

25 AMP 100V Bridge $1.50 each

Mini-Bridge 50V 1 AMP 2 for $1.00

Resistor Ass't

Assortment of Popular values - ¼ watt. Cut lead for PC mounting, ½" center, ½" leads, bag of 300 or more. **$1.50**

Crystals

3.579545 MHZ	$1.50
10.00000 MHZ	$5.00
5.248800 MHZ	$5.00

Switches

Mini toggle SPDT **$1.00**
Red Pushbuttons N.O. **3/$1.00**

Earphones

3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc.
5 for $1.00

AC Adapters

Good for clocks, nicad chargers, all 110 VAC plug one end

8.5 vdc @ 20 mA	$1.00
16 vac @ 160mA	$2.50
12 vac @ 250mA	$3.00

Mini 8 ohm Speaker

Approx 2¼" diam. Round type for radios, mike etc. **3 for $2.00**

Solid State Buzzers

small buzzer 450 Hz, 86 dB sound output on 5-12 vdc at 10-30 mA. TTL compatible **$1.50**

Slug Tuned Coils

Small 3/16" Hex Slugs turned coil. 3 turns 10 for $1.00

AC Outlet

Panel Mount with Leads **4/$1.00**

CAPACITORS

TANTALUM Dipped Epoxy	ALUMINUM Electrolytic	DISK CERAMIC
1.5 uF 25V 3/$1.00	1000 uF 16V Radial **$.50**	.01 16V disk **20/$1.00**
1.8 uF 25V 3/$1.00	500 uF 20V Axial **$.50**	.1 16V **15/$1.00**
.22 uF 25V 3/$1.00	150 uF 16V Axial **5/$1.00**	.001 16V **20/$1.00**
	10 uF 15V Radial **10/$1.00**	100 pF **20/$1.00**
		.047 16V **20/$1.00**

DC-DC Converter

+5 vdc input prod. -9 vdc @ 30ma
+9 vdc produces -15 vdc @ 35ma **$1.25**

Ceramic IF Filters
Mini ... kHz
B.W. ... $1.50 ea.
SOLD OUT

25K 20 Turn Trim Pot **$1.00**
1K 20 Turn Trim Pot **$ .50**

Trimmer Caps

Sprague - 3-40 pf
Stable Polypropylene
.50 ea.

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge **$.75**

Mini RG-174 Coax
10 ft. for $1.00

Coax Connector

Chassis mount
BNC type **$1.00**

9 Volt Battery Clips

Nice quality clips **5 for $1.00**
¾" Rubber Grommets **10 for $1.00**

Parts Bag

Asst. of chokes, disc caps, tant., resistors, transistors, diodes, MICA caps etc.
sm. bag (100 pc) **$1.00** lg. bag (300 pc) **$2.50**

Connectors

6 pin type gold contacts for mA-1003 car clock module price **.75 ea.**

Leds - your choice, please specify
Mini Red, Jumbo Red, High Intensity Red, Illuminator Red **8/$1**
Mini Yellow, Jumbo Yellow, Jumbo Green **6/$1**

Varactors

Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range - **.50 each or 3/$1.00**

Audio Prescaler

Make high resolution audio measurments, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit	**$29.95**
PS-2 wired	**$39.95**

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity, specify - 10 or -100

Wired, tested, PS-1B	**$59.95**
Kit, PS-1B	**$44.95**

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit	**$22.95**
TR-1, RF sensed T-R relay kit	**6.95**

MRF-238 transistor as used in PA-1
8-10db gain 150 mhz **$11.95**

RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay
TR-1 Kit **$6.95**

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V @ 1 A and 24 VCT.
Complete kit, PS-3LT **$6.95**

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 ... patible, but 500,000 MEG input z, super low 50 ... power drain.
SOLD OUT
50 for only $9.00 **10 for $2.00**

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size 1" x ⅛" shrink to ⅛". Great for splices **50/$1.00**

Mini TO-92 Heat Sinks

Thermalloy Brand **5 for $1.00**
To-220 Heat Sinks **3 for $1.00**

Opto Isolators - 4N28 type **$.50 ea.**
Opto Reflectors - Photo diode + LED **$1.00 ea.**

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets. **20 strips for $1.00**

CDS Photocells

Resistance varies with light. 250 ohms to over 3 meg **3 for $1.00**

See List of Advertisers on page 114

FACIT 4555 SERIAL PAGE PRINTER

The Facit 4555 alphanumerical serial printer is complete. Equipped with RS232C Interface, printing mechanism, control electronics, drive electronics, power supply and character generator. The adaptation electronics can be modified in four versions:Bit-parallel data transfer, CCITT (EIA, RS232C) for bit-serial data transfer and the current loop (TTY) interface also for bit serial data transfer. The Facit 4555 prints on ordinary paper and is adjustable for different paper widths and formats, 9.5" paper width with 66 lines per page or DIN A4 with 70 lines per page.

SPECIFICATIONS

Print speed	up to 60ch.s.	Char. spacing	2.54mm/1/10" 80ch/line 1.55mm/0.06" 132ch/line
Printing mode	Incremental.		
Max. # of ch/line	80 alt. 132.	Char. Code	ECMA-6 7-bit coded char. set
Matrix	7 X 5 dot matrix.	Char. Set	63 Char. various national versions.
Char. Size Height	2.7mm/1/8"		
Char. Size Width	1.3mm/0.05" 132ch/line 2.1mm/0.083" 80ch/line	Feed mechanism	Sprocket feed.

THESE UNITS WERE PULLED OUT OF SERVICE IN GOOD WORKING CONDITION. WE CHECK EACH UNIT ON A RADIO SHACK TRS-80 COLOR COMPUTER.

PRINTER ONLY $129.99

Printer with linecord, box of paper, inter-connect cable for TRS-80 COLOR COMPUTER. $149.99

GENEVA CALCULATOR WATCH

This attractive watch has the following modes:
Normal Time Setting,
Calendar Setting,
Daily Alarm Time Setting,
Weekly Alarm Time Setting,
Chronograph,
Calculator.

Featured in Black Plastic $24.99 or Featured in Stainless Steel $29.99

SILICON DIODES

MR751	100vdc	6Amps	10/$5.00	100/$38.00
MR510	1000vdc	3Amps	10/$3.75	100/$24.00
HEP170	1000vdc	2Amps	20/$2.00	100/$15.00
1N3209	100vdc	15Amps	$2.00	10/ $15.00
BYX21/200	200vdc	25Amps	$2.00	10/ $15.00
1N2138A	600vdc	60Amps	$5.00	10/ $40.00
DS85-04C	400vdc	80Amps	$10.00	10/ $80.00
1N3269	600vdc	160Amps	$15.00	10/$120.00
275Z41	300vdc	250Amps	$20.00	10/$175.00
7-5754	300vdc	400Amps	$30.00	10/$250.00
RCD-15	15KVDC	20ma.	$3.00	10/ $20.00
SMFR20K	20KVDC	20ma.	$4.00	10/ $30.00
1N4148	signal		30/$1.00	100/ $3.00

FEED THRU SOLDER RF CAPACTORS

470pf +-20%

5/$1.00 or 100/$15.00 or 1000/$100.00

1000pf/.001uf +-10%

4/$1.00 or 100/$20.00 or 1000/$150.00

E PROMS

2708	1024x1	$2.00 each
2716	2048x8	$4.00 each
27L32/25L32		$10.00 each

FAIRCHILD 4116 16K DYNAMIC RAMS 200ns. Part # 16K75

25 For $25.00 or 100 For $90.00 or 1000 For $750.00

HEWLETT PACKARD MICROWAVE DIODES

1N5711	(5082-2800)	Schottky Barrier Diodes	$1.00 or 10 for $ 8.50
1N5712	(5082-2810)	" " "	$1.50 or 10 for $10.00
1N6263	(HSCH-1001)	" " "	$ .75 or 10 for $ 5.00
5082-2835		" " "	$1.50 or 10 for $10.00
5082-2805	Quad Matched	" " "	per set $5.00 or 10 for $40.00

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"MIXERS"

WATKINS JOHNSON WJ-M6 Double Balanced Mixer

LO and RF 0.2 to 300MHz	IF DC to 300MHz	$21.00
Conversion Loss (SSB)	6.5dB Max. 1 to 50MHz 8.5dB Max. .2 to 300MHz	WITH DATA SHEET
Noise Figure (SSB)	same as above 8.5dB Max. 50 to 300MHz	
Conversion Compression	.3dB Typ.	

NEC (NIPPON ELECTRIC CO. LTD. NE57835/2SC2150 Microwave Transistor

NF Min F=2GHz	dB 2.4 Typ.	MAG F=2GHz	dB 12 Typ.	$5.30
F=3GHz	dB 3.4 Typ.	F=3GHz	dB 9 Typ.	
F=4GHz	dB 4.3 Typ.	F=4GHz	dB 6.5 Typ.	

Ft Gain Bandwidth Product at Vce=8v, Ic=10ma. GHz 4 Min. 6 Typ.
Vcbo 25v Vceo 11v Vebo 3v Ic 50ma. Pt. 250mw

UNELCO RF Power and Linear Amplifier Capacitors

These are the famous capacitors used by all the RF Power and Linear Amplifier manufacturers, and described in the RF Data Book.

5pf	10pf	18pf	30pf	43pf	100pf	200pf	1 to 10pcs. $1.00 ea
5.1pf	12pf	22pf	32pf	51pf	110pf	220pf	11 to 50pcs. $ .90 ea
6.8pf	13pf	25pf	33pf	60pf	120pf	470pf	51 up pcs. $ .80 ea
7pf	14pf	27pf	34pf	80pf	130pf	500pf	
8.2pf	15pf	27.5pf	40pf	82pf	140pf	1000pf	

NIPPON ELECTRIC COMPANY TUNNEL DIODES

		MODEL 1S2199	1S2200 $7.50
Peak Pt. Current ma.	Ip	9min. 10Typ. 11max.	9min. 10Typ. 11max.
Valley Pt. Current ma.	Iv	1.2Typ. 1.5max.	1.2Typ. 1.5max.
Peak Pt. Voltage mv.	Vp	95Typ. 120max.	75Typ. 90max.
Projected Peak Pt. Voltage mv.	Vpp Vf=Ip	480min. 550Typ. 630max.	440min. 520Typ. 600max.
Series Res. Ohms	rS	2.5Typ. 4max.	2Typ. 3max.
Terminal Cap. pf.	Ct	1.7Typ. 2max.	5Typ. 8max.
Valley Pt. Voltage mv.	VV	370Typ.	350Typ.

FAIRCHILD / DUMONT Oscilloscope Probes Model 4290B

Input Impedance 10 meg., Input Capacity 6.5 to 12pf., Division Ration (Volts/Div Factor) 10:1, Cable Length 4Ft. , Frequency Range Over 100MHz.
These Probes will work on all Tektronix, Hewlett Packard, and other Oscilloscopes.

PRICE $45.00

MOTOROLA RF DATA BOOK

Listsall Motorola RF Transistors / RF Power Amplifiers, Varactor Diodes and much much more.

PRICE $7.50

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GaAs, TUNNEL DIODES, ETC.

PART	PRICE	PART	PRICE	PART	PRICE
MA47100	$ 3.05	MRF503	$ 6.00	PT4186B	$ POR
MA47202	30.80	MRF504	7.00	PT4209	POR
MA47771	POR	MRF509	5.00	PT4209C	POR
MA47852	POR	MRF511	8.65	PT4566	POR
MA49558	POR	MRF605	20.00	PT4570	POR
MB4021	POR	MRF629	3.47	PT4571	POR
MBD101	1.00	MRF644	23.00	PT4571A	POR
MD0513	POR	MRF816	15.00	PT4577	POR
MHW1171	42.50	MRF823	20.00	PT4590	POR
MHW1182	48.60	MRF901	3.00	PT4612	POR
MHW4171	49.35	MRF8004	2.10	PT4628	POR
MHW4172	51.90	MS261F	POR	PT4640	POR
MHW4342	68.75	MT4150 Fair.	POR	PT4642	POR
MLP102	25.00	MT5126 Fair.	POR	PT5632	POR
MM1500	32.32	MT5481 Fair.	POR	PT5749	POR
MM1550	POR	MT5482 Fair.	POR	PT6612	POR
MM1552	50.00	MT5483 Fair.	POR	PT6626	POR
MM1553	50.00	MT5596 Fair.	POR	PT6709	POR
MM1614	10.00	MT5764 Fair.	POR	PT6720	POR
MM2608	5.00	MT8762 Fair.	POR	PT8510	POR
MM3375A	11.50	MV109	.77	PT8524	POR
MM4429	10.00	MV1401	8.75	PT8609	POR
MM8000	1.15	MV1624	1.42	PT8633	POR
MM8006	2.30	MV1805	15.00	PT8639	POR
MO277L	POR	MV1808	10.00	PT8659	POR
MO283L	POR	MV1817B	10.00	PT8679	POR
MO3757	POR	MV1863B	10.00	PT8708	POR
MP102	POR	MV1864A	10.00	PT8709	POR
MPN3202	10.00	MV1864B	10.00	PT8727	POR
MPN3401	.52	MV1864D	10.00	PT8731	POR
MPN3412	1.00	MV1868D	10.00	PT8742	POR
MPSU31	1.01	MV2101	.90	PT8787	POR
MRA2023-1.5 TRW	42.50	MV2111	.90	PT9790	41.70
MRF212/208	16.10	MV2115	1.55	PT31962	POR
MRF223	13.25	MV2201	.53	PT31963	POR
MRF224	15.50	MV2203	.53	PT31983	POR
MRF237	3.15	MV2209	2.00	PTX6680	POR
MRF238	12.65	MV2215	2.00	RAY-3	24.99
MRF243	25.00	MWA110	7.45	40081	POR
MRF245	34.50	MWA120	7.80	40281	POR
MRF247	34.50	MWA130	8.25	40282	POR
MRF304	43.45	MWA210	7.80	40290	POR
MRF315	23.00	MWA220	8.25	RF110	25.00
MRF420	20.00	MWA230	8.65	SCA3522	POR
MRF421	36.80	MWA310	8.25	SCA3523	POR
MRF422	41.40	MWA320	8.65	SD1065	POR
MRF427	16.10	MWA330	9.50	SS43	POR
MRF428	46.00	NEC57835	5.30	TP1014	POR
MRF450/A	13.80	ON382	5.00	TP1028	POR
MRF453/A	17.25	PPT515-20-3	POR	TRW-3	POR
MRF454/A	19.90	PRT8637	POR	UT0504 Avantek	70.00
MRF455/A	16.00	PSCQ2-160	POR	UT0511 Avantek	75.00
MRF458	19.90	PT3190	POR	V15	4.00
MRF463	25.00	PT3194	POR	V33B	4.00
MRF472	1.00	PT3195	POR	V100B	4.00
MRF475	2.90	PT3537	POR	VAB801EC	25.00
MRF477	11.50	PT4166E	POR	VAB804EC	25.00
MRF502	1.04	PT4176D	POR	VAS21AN20	25.00

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RECALL PHONE MEMORY TELEPHONE WITH 24 NUMBER AUTO DIALER

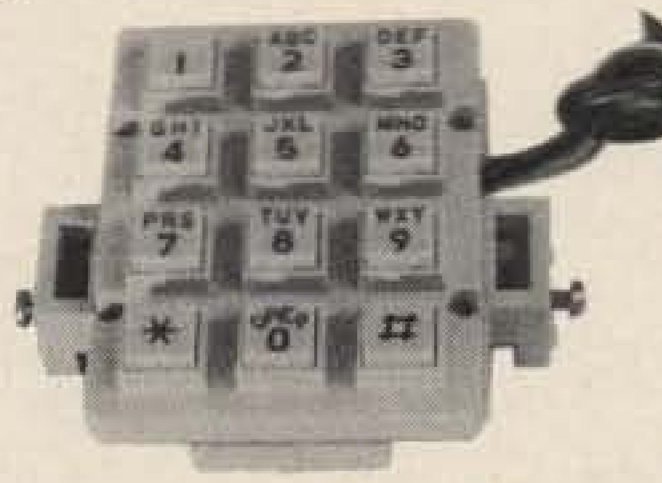
The Recall Phone Telephone employs the latest state of art communications technology. It is a combination telephone and automatic dialer that uses premium-quality, solid-state circuitry to assure high-reliability performance in personal or business applications. $49.99

ARON ALPHA RAPID BONDING GLUE

Super Glue #CE-486 high strength rapid bonding adhesive. Alpha Cyanoacrylate. Set-Time 20 to 40 sec., 0.7fl.oz. (20gm.)
$2.00

TOUCH TONE PAD

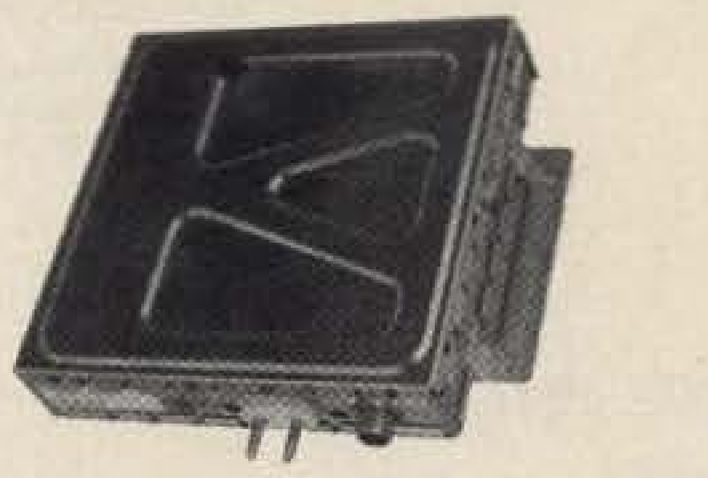
This pad contains all the electronics to produce standard touch-tone tones. New with data.



$9.99 or 10/$89.99

MITSUMI UHF/VHF VARACTOR TUNER MODEL UVE1A

Perfect for those unscrambler projects. New with data.



$19.99 or 10/$149.99

INTEGRATED CIRCUIT.

		1 to 10	11up
MC1372P	Color TV Video Modulator Circuit.	$ 4.42	$2.95
MC1358P	IF Amp., Limiter, FM Detector, Audio Driver, Electronic Attenuator.	5.00	4.00
MC1350P	IF Amplifier	1.50	1.25
MC1330A1P	Low Level Video Detector	1.50	1.15
MC1310P	FM Stereo Demodulator	4.29	3.30
MC1496P	Balanced Modulator/Demodulator	1.50	1.25
LM565N	Phase Locked Loop	2.50	2.00
LM380N14	2Watt Audio Power Amplifier	1.56	1.25
LM1889N	TV Video Modulator	5.00	4.00
NE564N	Phase Locked Loop	10.00	8.00
NE561N	Phase Locked Loop	10.00	8.00

FERRANTI ELECTRONICS AM RADIO RECEIVER MODEL ZN414 INTEGRATED CIRCUIT.

Features:

1.2 to 1.6 volt operating range., Less than 0.5ma current consumption. 150KHz to 3MHz Frequency range., Easy to assemble, no alignment necessary. Effective and variable AGC action., Will drive an earphone direct. Excellent audio quality., Typical power gain of 72dB., TO-18 package. With data. $2.99 or 10 For $24.99

NI CAD RECHARGEABLE BATTERIES

AA Battery Pack of 6 These are Factory New. $5.00

SUB C Pack of 10 2.5Amp/Hr. $10.00

Gates Rechargeable Battery Packs

12vdc at 2.5Amp/Hr. $11.99
12vdc at 5Amp/Hr. $15.99

holiday greetings!

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"SOCKETS AND CHIMNEYS"

EIMAC TUBE SOCKETS AND CHIMNEYS

SK110	Socket	$POR
SK300A	Socket For 4CX5000A,R,J, 4CX10,000D, 4CX15,000A,J	$520.00
SK400	Socket For 4-125A,250A,400A,400C,4PR125A,400A,4-500A,5-500A	260.00
SK406	Chimney For 4-250A,400A,400C,4PR400A	74.00
SK416	Chimney For 3-400Z	36.00
SK500	Socket For 4-1000A/4PR1000A/B	390.00
SK600	Socket For 4CX250B,BC,FG,R,4CX350A,F,FJ	51.00
SK602	Socket For 4CX250B,BC,FG,R,4CX350A,F,FJ	73.00
SK606	Chimney For 4CX250B,BC,FG,R,4CX350A,F,FJ	11.00
SK607	Socket For 4CX600J,JA	60.00
SK610	Socket For 4CX600J,JA	60.00
SK620	Socket For 4CX600J,JA	66.00
SK626	Chimney For 4CX600J,JA	10.00
SK630	Socket For 4CX600J,JA	66.00
SK636B	Chimney For 4CX600J,JA	34.00
SK640	Socket For 4CX600J,JA	36.00
SK646	Chimney For 4CX600J,JA	71.00
SK700	Socket For 4CX300A,Y,4CX125C,F	225.00
SK711A	Socket For 4CX300A,Y,4CX125C,F	225.00
SK740	Socket For 4CX300A,Y,4CX125C,F	86.00
SK770	Socket For 4CX300A,Y,4CX125C,F	86.00
SK800A	Socket For 4CX1000A,4CX1500B	225.00
SK806	Chimney For 4CX1000A,4CX1500B	40.00
SK810	Socket For 4CX1000A,4CX1500B	225.00
SK900	Socket For 4X500A	300.00
SK906	Chimney For 4X500A	57.00
SK1420	Socket For 5CX3000A	650.00
SK1490	Socket For 4CV8000A	585.00

JOHNSON TUBE SOCKETS AND CHIMNEYS

124-111/SK606	Chimney For 4CX250B,BC,FG,R, 4CX350A,F,FJ	$ 10.00
122-0275-001	Socket For 3-500Z, 4-125A, 250A, 400A, 4-500A, 5-500A	(pair)15.00
124-0113-00	Capacitor Ring	15.00
124-116/SK630A	Socket For 4CX250B,BC,FG,R, /4CX350A,F,FJ	55.00
124-115-2/SK620A	Socket For 4CX250B,BC,FG,R, /4CX350A,F,FJ	55.00
	813 Tube Socket	20.00

TUBE CAPS (Plate)

HR1, 4	$11.00
HR2,3, 6 & 7	13.00
HR5, 8	14.00
HR9	17.00
HR10	20.00

CHIP CAPACITORS

.8pf	10pf	100pf*	430pf
1pf	12pf	110pf	470pf
1.1pf	15pf	120pf	510pf
1.4pf	18pf	130pf	560pf
1.5pf	20pf	150pf	620pf
1.8pf	22pf	160pf	680pf
2.2pf	24pf	180pf	820pf
2.7pf	27pf	200pf	1000pf/.001uf*
3.3pf	33pf	220pf*	1800pf/.0018uf
3.6pf	39pf	240pf	2700pf/.0027uf
3.9pf	47pf	270pf	10,000pf/.01uf
4.7pf	51pf	300pf	12,000pf/.012uf
5.6pf	56pf	330pf	15,000pf/.015uf
6.8pf	68pf	360pf	18,000pf/.018uf
8.2pf	82pf	390pf	

PRICES: 1 to 10 - .99¢ 101 to 1000 .60¢ * IS A SPECIAL PRICE: 10 for $7.50
11 to 50 - .90¢ 1001 & UP .35¢ 100 for $65.00
51 to 100 - .80¢ 1000 for $350.00

WATKINS JOHNSON WJ-V907: Voltage Controlled Microwave Oscillator $110.00

Frequency range 3.6 to 4.2GHz, Power ouput, Min. 10dBm typical, 8dBm Guaranteed. Spurious output suppression Harmonic (nf_0), min. 20dB typical, In-Band Non-Harmonic, min. 60dB typical, Residual FM, pk to pk, Max. 5KHz, pushing factor, Max. 8KHz/V, Pulling figure (1.5:1 VSWR), Max. 60MHz, Tuning voltage range +1 to +15volts, Tuning current, Max. -0.1mA, modulation sensitivity range, Max. 120 to 30MHz/V, Input capacitance, Max. 100pf, Oscillator Bias +15 +-0.05 volts @ 55mA, Max.

Toll Free Number
800-528-0180
(For orders only)

MHz electronics

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

"TVRO BOARD LIST"

70 MHZ IF BOARD: This circuit provides about 43dB gain with 50 ohm input and output impedance. It is designed to drive the Demodulator. The on-board bypass filter can be tuned to bandwidths between 20 and 35 MHz with a passband ripple of less than ½ dB. Hybrid IC's are used for the gain stages.

SINGLE AUDIO BOARD: This circuit recovers the audio signals from the 6.8 MHz frequency. The Miller 9051 coils are tuned to pass the 6.8MHz subcarrier and the 9052 coil tunes for recovery of the audio.

DUAL AUDIO BOARD: Duplicate of the single audio but also covers the 6.2 range.

DC CONTROL BOARD: No description.

DUAL AUDIO BOARD		PRICE EACH
Printed Circuit Board		$ 25.00
2	3pf sm	1.00
2	12pf sm	1.00
2	50pf sm	1.00
2	68pf sm	1.00
4	91pf sm	1.00
5	.001mfd	.35
6	.01mfd	.35
2	.047mfd	.35
1	.47mfd 25vdc	.35
2	1mfd 10vdc	.59
4	4.7mfd 35vdc	.59
1	470mfd 25vdc	1.29
2	220K 1/4w	.15
2	150K 1/4w	.15
2	6.8K 1/4w	.15
2	3.3K 1/4w	.15
2	2.2K 1/4w	.15
4	1K 1/4w	.15
2	10 ohm 1/4w	.15
2	50K pots	1.00
1	5K pot	1.00
2	CA3065	2.16
1	LM380	1.56
1	7812 Voltage Reg.	1.17
5	2N2222	.50
4	Miller 9051	5.99
2	Miller 9052	5.99
TOTAL KIT PRICE		97.62

DC CONTROL BOARD		
Printed Circuit Board		15.00
2	470mfd 25vdc	1.29
2	4.7mfd 25vdc	.59
1	1meg 1/4w	.15
3	10K 1/4w	.15
1	3.3K 1/4w	.15
3	2.2K 1/4w	.15
1	1K 1/4w	.15
2	5K 10 turn trimpot	1.00
4	10K 10 turn trimpot	1.00
1	10K 10 turn with dial	10.00
1	7815 Voltage Reg.	1.17
1	LM324	2.50
1	5 pole rotary switch	2.50
1	SPDT switch	1.00
1	DPDT swich	1.00
1	0-1ma meter	5.00
1	18 to 24vdc at 1 amp power supply	24.99
TOTAL KIT PRICE		74.27

DEMODULATOR BOARD		PRICE EACH
Printed Circuit Board		$ 40.00
1	1mfd 35vdc	.59
13	.01mfd 50vdc disc	.35
1	470mfd 25vdc	1.29
2	100mfd 16vdc	.69
2	22mfd 35vdc	.59
3	4.7mfd 35vdc	.59
1	4300pf sm	2.00
1	330pf sm	1.00
1	100pf sm	1.00
1	91pf sm	1.00
2	3pf sm	1.00
1	2 to 8pf ceramic trimmer	1.00
1	100uh choke	1.50
1	4.7uh choke	1.50
1	2.7uh choke	1.50
4	100K 1/4w	.15
1	51 ohm 1/4w	.15
1	27K 1/4w	.15
5	10K 1/4w	.15
1	8.2K 1/4w	.15
2	4.7K 1/4w	.15
1	2.2K 1/4w	.15
1	1.2K 1/4w	.15
3	1K 1/4w	.15
3	560 ohm 1/4w	.15
1	470 ohm 1/4w	.15
1	390 ohm 1/4w	.15
1	300 ohm 1/4w	.15
1	270 ohm 1/4w	.15
1	150 ohm 1/4w	.15
1	41 ohm 1/4w	.15
1	10K pot	1.00
1	NE592/LM733N	2.50
1	NE564	5.00
1	MWA120 (Motorola)	7.80
1	7812 Voltage Reg.	1.17
1	7815 Voltage Reg.	1.17
3	2N2222	.50
2	1N34/38	.50
1	HP5082-2800	2.20
1	5 to 7 volt Zenner	1.00
TOTAL KIT PRICE		92.25

COMPLETE KIT WITH DUAL AUDIO $923.23
COMPLETE KIT WITH SINGLE AUDIO 880.77

LESS 10% ON ALL COMPLETE KIT ORDERS

BOARDS AND PARTS MAY BE PURCHASED SEPERATELY AT THE PRICES LISTED ABOVE.

ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

TVRO BOARD DESCRIPTION AND PARTS LIST

DUAL CONVERSION BOARD: This board provides conversion from the 3.7-4.2 band first to 900 MHz where gain and bandpass filtering are provided and, second, to 70 MHz. The board contains both local oscillators, one fixed and the other variable, and the second mixer. Construction is greatly simplified by the use of Hybrid IC amplifiers for the gain stages.

DEMODULATOR BOARD: This circuit takes the 70 MHz center frequency satellite TV signal in the 10 to 200 millivolt range, detects them using a phase lock loop, de-emphasizes and filters the result to produce standard NTSC video. Other outputs include the audio subcarrier, a DC voltage proportional to the strength of the 70 MHz signal, and AFC voltage centered at about 2 volts DC.

DUAL CONVERSION BOARD		PRICE EACH
Printed Circuit Board		$ 25.00
6	47pf chip caps	1.00
2	4.7mfd 35vdc	.59
2	.01mfd 50vdc disc cap	.35
4	1.5 to 8pf piston trimmer cap	5.99
2	470 ohm 1/4w	.15
2	MWA320 (Motorola)	8.65
1	7815 Voltage Reg.	1.17
1	VTO8090	150.00
1	VTO8240	156.25
2	1N4005	.39
1	DBM500/1100 (Varil)	125.00
1	MLP102 (Engleman)	25.00
8	SMA Male Connector	5.00
TOTAL KIT PRICE		572.64

70 MHZ IF BOARD		
Printed Circuit Board		25.00
3	MWA120	7.80
7	.01mfd 50vdc	.35
2	4.7mfd 35vdc	.59
1	10pf sm	1.00
5	22pf sm	1.00
1	18pf sm	1.00
1	33pf sm	1.00
2	330 ohm 1/4w	.15
5	J.W. Miller 4500-4	4.99
1	7815 Voltage Reg.	1.17
TOTAL KIT PRICE		86.45

SINGLE AUDIO BOARD		PRICE EACH
Printed Circuit Board		$ 15.00
1	3pf sm	1.00
1	12pf sm	1.00
1	50pf sm	1.00
1	68pf sm	1.00
2	91pf sm	1.00
3	.001mfd	.35
3	.01mfd	.35
1	.047mfd	.35
1	.47mfd	.35
1	1mfd 10vdc	.59
3	4.7mfd 35vdc	.59
1	470mfd 25vdc	1.29
1	220K 1/4w	.15
1	150K 1/4w	.15
1	6.8K 1/4w	.15
1	3.3K 1/4w	.15
1	2.2K 1/4w	.15
3	1K 1/4w	.15
1	10 ohm 1/4w	.15
1	50K pot	1.00
1	5K pot	1.00
1	CA3065/MC1358P	2.16
1	LM380	1.56
1	7812 Voltage Reg.	1.17
3	2N2222	.50
2	Miller 9051	5.99
1	Miller 9052	5.99
TOTAL KIT PRICE		55.16

Toll Free Number
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MHz electronics

"CHIPS"

FAIRCHILD VHF AND UHF PRESCALER CHIPS		PRICE
95H90DC	350MC Prescaler divide by 10/11	$ 8.50
95H91DC	350MC Prescaler divide by 5/6	8.50
11C90DC	650MC Prescaler divide by 10/11	15.50
11C91DC	650MC Prescaler divide by 5/6	15.50
11C06DC	UHF Prescaler 750MC D Type Flip Flop	12.30
11C05DC	1GHz Counter Divide by 4 (Regular price $75.00)	50.00
11C01FC	High Speed Dual 5/4 Input NO/NOR Gate	15.40
82S90	Presettable High Speed Decade/Binary Counter used with the 11C90/91 or the 95H90/91 Prescaler can divide by 100. (Signetics)	5.00
11C24DC	This chip is the same as a Motorola MC4024/4324 Dual TTL Voltage Control Multivibrator.	3.37
11C44DC	This chip is the same as a Motorola MC4044/4344 Phase Frequency Detector.	3.37

GENERAL ELECTRIC CO. GUNN DIODE MODEL Y-2167
Freq. Gap (GHZ) 12 to 18, Output (Min.) 100mW, Duty (%) CW, Typ. Bias (Vdc) 8.0, Type. Oper. (MAdc) 550, Max. Thres. (mAdc) 1000, Max. Bias (Vdc) 10.0. **$39.99**

VARIAN GALLIUM ARSENIDE GUNN DIODES MODEL VSX-9201S5
Freq. Coverage 8 to 12.4GHz, Output (Min.) 100mW, Bias Voltage (Max.) 14vdc, Bias current (mAdc) Operating 550 Typ. 750 Max., Threshold 850 Tup. 1000 Max. **$39.99**

VARI-L Co. Inc. MODEL SS-43 AM MODULATOR
Freq. Range 60 10 150MC, Insertion Loss 13dB Nominal, Signal Port Imp. 50ohms Nominal, Signal Port RF Power +10dBm Max., Modulation Port BW DC to 1KHZ, Modulation Port Bias 1ma. Nominal. **$24.99**

AVANTEK CASCADABLE MODULAR AMPLIFIERS	Model UTO-504	UTO-511
Frequency Range	5 to 500 MHz	5 to 500 MHz
Gain	6dB	15dB
Noise Figure	11dB	2.3dB to 3dB
Power Output	+17dB	−2dB to −3dB
Gain Flatness	1dB	1dB
Input Power Vdc	+24	+15
mA	100	10
PRICE	$70.00	$75.00

HEWLETT PACKARD MIXERS MODELS	10514A	10514B
Frequency Range	2MHz to 500MC	2MHz to 500MC
Input/Output Frequency L & R	200KHz to 500MC	200KHz to 500MC
X	DC to 500MC	DC to 500MC
Mixer Conversion Loss (A)	7dB	7dB
(B)	9dB	9dB
Noise Performance (SSB) (A)	7dB	7dB
(B)	9dB	9dB
PRICE	$49.99	$39.99

FREQUENCY SOURCES, INC MODEL MS-74X MICROWAVE SIGNAL SOURCE
MS-74X: Mechanically Tunable Frequency Range (MHz) 10630 to 11230 (10.63 to 11.23GHz) Minimum Output Power (mW) 10, Overall Multiplier Ratio 108, Internal Crystal Oscillator Frequency Range (MHz) 98.4 to 104.0, Maximum Input Current (mA) 400.

The signal source are designed for applications where high stability and low noise are of prime concern. these sources utilize fundamental transistor oscillators with high Q coaxial cavities, followed by broadband stable step recovery diode multipliers. This design allows single screw mechanical adjustment of frequency over standard communications bands. Broadband sampling circuits are used to phase lock the oscillator to a high stability reference which may be either an internal self-contained crystal oscillator, external primary standard or VHF synthesizer. This unique technique allows for optimization of both FM noise and long term stability. List Price is $1158.00 (THESE ARE NEW) **Our Price—$289.**

HEWLETT PACKARD 1N5712 MICROWAVE DIODE
This diode will replace the MBD101, 1N5711, 5082-2800, 5082-2835 ect. This will work like a champ in all those Down Converter projects. **$1.50 or 10/$10.00**

MOTOROLA MHW1172R LOW DISTORTION WIDEBAND AMPLIFIER MODULE.
Frequency Range: 40 to 300 MHz., Power Gain at 50MHz 16.6min. to 17.4max., Gain Flatness ±0.1 Typ. ±0.2 Max. dB., DC Supply Voltage −28vdc, RF Voltage Input +70dBmV **PRICE $29.99**

GENERAL ELECTRIC AA NICADS
Model #41B905HD11-G1
Pack of 6 for $5.00 or 60 Cells, 10 Packs for $45.00
These may be broken down to individual cells.

ORDERING INSTRUCTIONS

DEFECTIVE MATERIAL: All claims for defective material must be made within sixty (60) days after receipt of parcel. All claims must include the defective material (for testing purposes), our invoice number, and the date of purchase. All returns must be packed properly or it will void all warranties.

DELIVERY: Orders are normally shipped within 48 hours after receipt of customer's order. If a part has to be backordered the customer is notified. Our normal shipping method is via First Class Mail or UPS depending on size and weight of the package. On test equipment it is by Air only, FOB shipping point.

FOREIGN ORDERS: All foreign orders must be prepaid with cashier's check or money order made out in U.S. Funds. We are sorry but C.O.D. is not available to foreign countries and Letters of Credit are not an acceptable form of payment either. Further information is available on request.

HOURS: Monday thru Saturday: 8:30 a.m. to 5:00 p.m.

INSURANCE: Please include 25¢ for each additional $100.00 over $100.00, United Parcel only.

ORDER FORMS: New order forms are included with each order for your convenience. Additional forms are available on request.

POSTAGE: Minimum shipping and handling in the US, Canada, and Mexico is $2.50 all other countries is $5.00. On foreign orders include 20% shipping and handling.

PREPAID ORDERS: Order must be accompanied by a check.

PRICES: Prices are subject to change without notice.

RESTOCK CHARGE: If parts are returned to MHZ Electronics due to customer error, customer will be held responsible for all extra fees, will be charged a 15% restocking fee, with the remainder in credit only. All returns must have approval.

SALES TAX: Arizona must add 5% sales tax, unless a signed Arizona resale tax card is currently on file with MHZ Electronics. All orders placed by persons outside of Arizona, but delivered to persons in Arizona are subject to the 5% sales tax.

SHORTAGE OR DAMAGE: All claims for shortages or damages must be made within 5 days after receipt of parcel. Claims must include our invoice number and the date of purchase. Customers which do not notify us within this time period will be held responsible for the entire order as we will consider the order complete.

OUR 800 NUMBER IS STRICTLY FOR ORDERS ONLY
NO INFORMATION WILL BE GIVEN. 1-800-528-0180.

TERMS: DOMESTIC: Prepaid, C.O.D. or Credit Card
FOREIGN: Prepaid only, U.S. Funds—money order or cashier's check only.

C.O.D.: Acceptable by telephone or mail. Payment from customer will be by cash, money order or cashier's check. We are sorry but we cannot accept personal checks for C.O.D.'s.

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CREDIT CARDS: WE ACCEPT MASTERCARD VISA AND AMERICAN EXPRESS.

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6M,2M,220	$595	$745
440	$645	$795

Both kit and wired units are complete with all parts, modules, hardware, and crystals.

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- SELECTIVITY THAT CAN'T BE BEAT! BOTH 8 POLE CRYSTAL FILTER & CERAMIC FILTER FOR GREATER THAN 100 dB AT ± 12KHZ. HELICAL RESONATOR FRONT ENDS. SEE R144, R220, AND R451 SPECS IN RECEIVER AD BELOW.
- OTHER GREAT RECEIVER FEATURES: FLUTTER-PROOF SQUELCH, AFC TO COMPENSATE FOR OFF-FREQ TRANSMITTERS, SEPARATE LOCAL SPEAKER AMPLIFIER & CONTROL.
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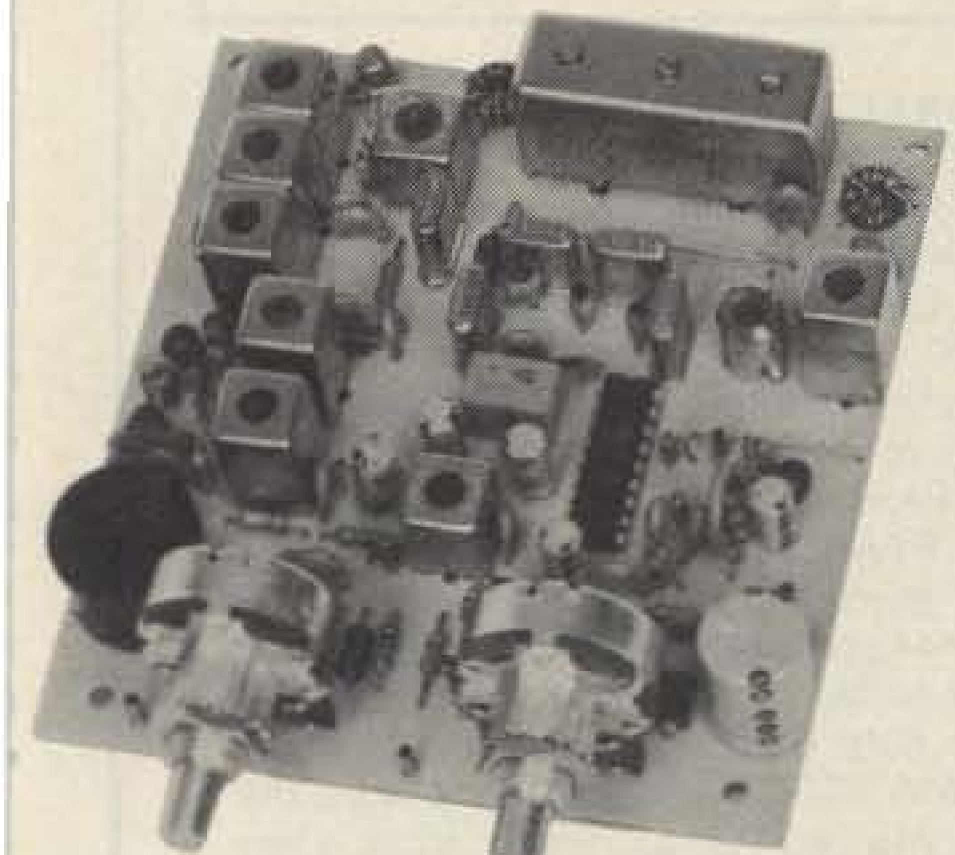

R144 Shown

- **R144/R220 FM RCVRS** for 2M or 220 MHz. 0.15uV sens.; 8 pole xtal filter & ceramic filter in i-f, helical resonator front end for exceptional selectivity (curves at left). AFC incl., xtal oven avail. Kit only $119.95
- **R451 FM RCVR** Same but for uhf. Tuned line front end, 0.2 uV sens. Kit only $119.95.
- **R76 FM RCVR** for 10M, 6M, 2M, 220, or commercial bands. As above, but w/o AFC or hel. res. Kits only $109.95. Also avail w/4 pole filter, only $94.95/ kit.
- **R110 VHF AM RECEIVER** kit for VHF aircraft band or ham bands. Only $84.95.
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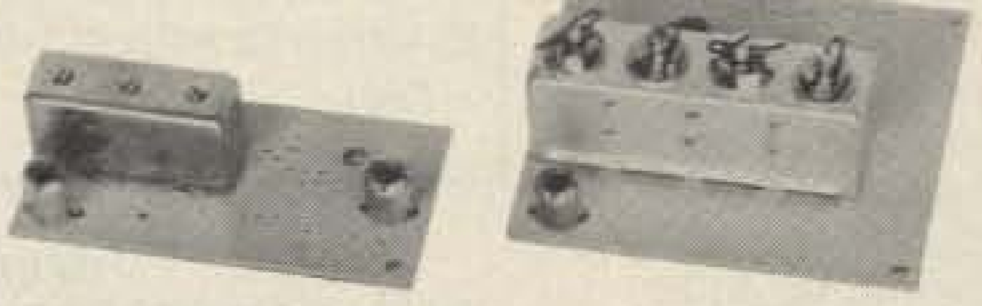
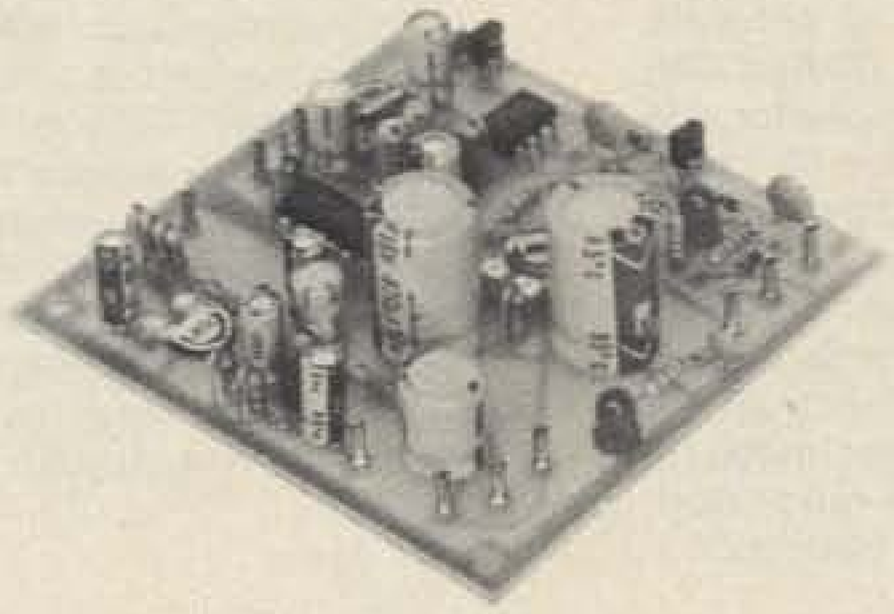


- **HELICAL RESONATOR FILTERS** available separately on pcb w/connectors.

HRF-144 for 143-150 MHz	$34.95
HRF-220 for 213-233 MHz	$34.95
HRF-432 for 420-450 MHz	$44.95

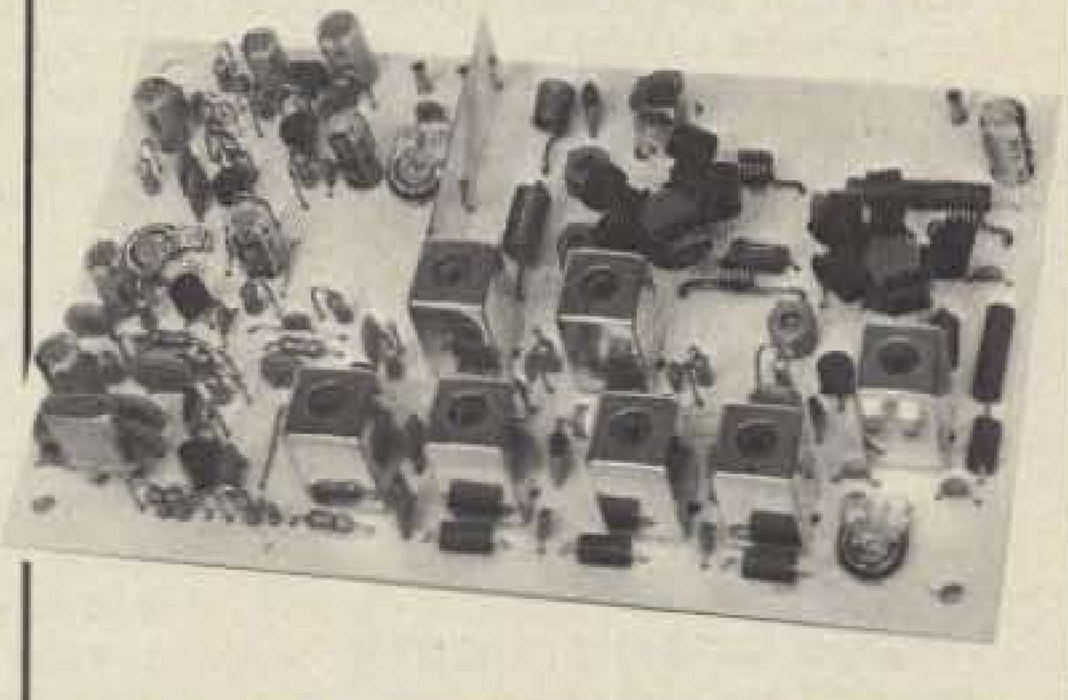
(See selectivity curves at left.)



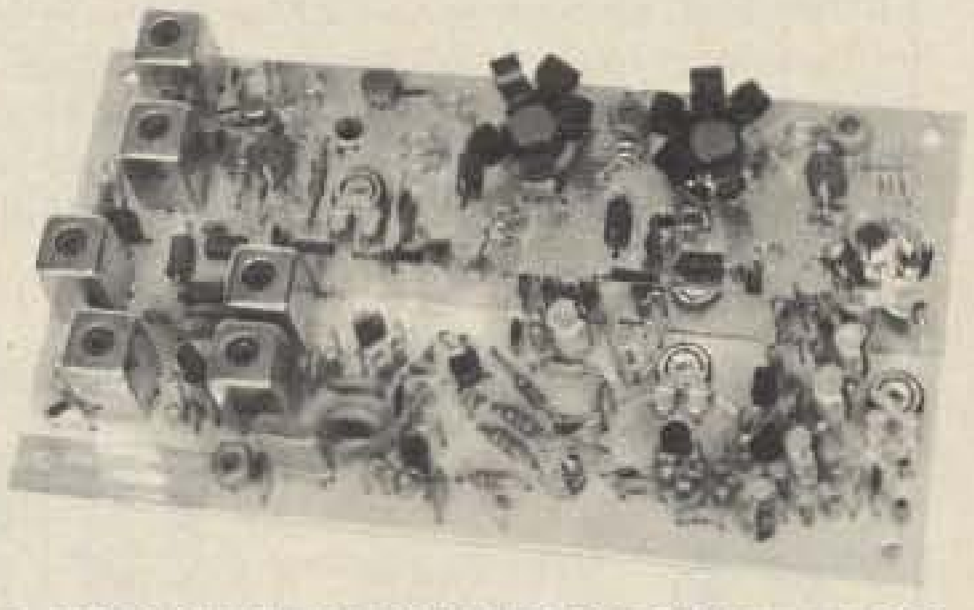
- **COR KITS** With audio mixer and speaker amplifier. Only $29.95.
- **CWID KITS** 158 bits, field programmable, clean audio. Only $59.95.

- **A16 RF TIGHT BOX** Deep drawn alum. case with tight cover and no seams. 7 x 8 x 2 inches. Only $18.00.

TRANSMITTERS AND ACCESSORIES



- **T51 VHF FM EXCITER** for 10M, 6M, 2M, 220 MHz or adjacent bands. 2 Watts continuous. Kits only $59.95



- **T451 UHF FM EXCITER** 2 to 3 Watts on 450 ham band or adjacent. Kits only $69.95.
- **VHF & UHF LINEAR AMPLIFIERS.** Use on either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Kits from $69.95.

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Waveguide & Coaxial Microwave Components & Equipment. Laboratory Grade Test Instruments, Power Supplies. Buy, Sell & Trade all popular makes—HP, GR, FXR, ESI, Sorensen, Singer, etc. **Lectronic Research Labs, 1423 Ferry Ave., Camden NJ 08104, 541-4200.**

Scranton PA

ICOM, Bird, Cushcraft, Beckman, Fluke, Larsen, Hustler, Antenna Specialists, Astron, Avanti, Belden, W2AU/W2VS, CDE, AEA, Vibroplex, Ham-Key, CES, Amphenol, Sony, Fanon/Courier, B&W, Ameco, Shure. **LaRue Electronics, 1112 Grandview St., Scranton PA 18509, 343-2124.**

San Antonio TX

Amateur, Commercial 2-way. Selling Antenna Specialists, Avanti, Azden, Bird, Hy-Gain, Standard, Vibroplex, Midland, Henry, Cushcraft, Dielectric, Hustler, ICOM, MFJ, Nye, Shure, Cubic, Tempo, Ten-Tec and others. **Appliance & Equipment Co., Inc. 2317 Vance Jackson Road, San Antonio TX 78213, 734-7793.**

DEALERS

Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the March. '83 issue must be in our hands by Jan. 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Nancy Ciampa.

DEALER DIRECTORY

PROPAGATION

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4 Plymouth Dr.
Whiting NJ 08759

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14A	7A	7	7	3A	3A	3A	7B	7B	14	21A	21A
ARGENTINA	21	14	7B	7B	7B	7	14	21A	21A	21A	21A	21
AUSTRALIA	21	14	7B	7B	7B	7B	7B	14B	14	14	21	21A
CANAL ZONE	14A	7	7	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7	7	7	3A	3A	7	14	21A	21A	14	7	7
HAWAII	21	14	7B	7	7	7	3A	3B	7A	21A	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	14	14B	7B	7B	7B
JAPAN	21A	7B	7B	7B	7	7	7	7B	7B	7B	14	14
MEXICO	21	7A	7	7	7	7	7	14A	21A	21A	21A	21A
PHILIPPINES	14A	14B	7B	7B	7B	7B	7	7B	7B	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21A	21A	21A	21
SOUTH AFRICA	14	7	7	7	7B	14	21	21A	21A	21A	21	14A
U. S. S. R.	7	7	7	3A	3A	7B	14	21	14	14B	7B	7
WEST COAST	21	14	7	7	7	3A	3A	14	21A	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14A	14	7	7	3A	3A	3A	7	7	14	21A	21A
ARGENTINA	21	14	7B	7B	7B	7	14	21	21A	21A	21A	21A
AUSTRALIA	21A	14	14B	7B	7B	7B	7B	7B	14	14	21	21A
CANAL ZONE	21	14	7	7	7	7	7	14A	21A	21A	21A	21A
ENGLAND	7	7	7	3A	3A	3A	7	14	21A	14	7B	7
HAWAII	21A	14	7B	7	7	7	7	3A	7A	21A	21A	21A
INDIA	7B	14	7B	7B	7B	7B	7B	14B	14B	7B	7B	7B
JAPAN	21A	14B	7B	7B	7	7	7	7	7B	7B	14	21
MEXICO	21	14	7	7	7	7	7	14A	21A	21A	21A	21A
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7B	7B	7B	14
PUERTO RICO	14	7A	7	7	7	7	14	21	21A	21A	21A	21
SOUTH AFRICA	14	7	7	7	7B	7B	14	21A	21A	21A	21	14A
U. S. S. R.	7	7	7	3A	3A	7B	7B	14	14	14B	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	3A	3A	3A	7	7	14	21A	21A
ARGENTINA	21	14	7B	7B	7B	7	7B	14	21	21A	21A	21A
AUSTRALIA	21A	21	14	14B	7B	7B	7B	7B	14	14	21	21A
CANAL ZONE	21A	14	7	7	7	7	7	14	21A	21A	21A	21A
ENGLAND	7B	7	7	3A	3A	3B	7B	14B	21	14	7B	7B
HAWAII	21A	14A	14	7	7	7	7	3A	7A	21A	21A	21A
INDIA	7B	14A	7B	7B	7B	7B	7B	7B	14B	7B	7B	7B
JAPAN	21A	21	7B	7	7	7	7	7	7	7B	14	21A
MEXICO	21	14	7	7	7	7	7	14A	21A	21A	21A	21A
PHILIPPINES	21A	14	14B	7B	7B	7	7	7	7	7B	7B	14A
PUERTO RICO	14A	14	7	7	7	7	7	14	21A	21A	21A	21A
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	21A	21A	21	14A
U. S. S. R.	7B	7	7	3A	3A	7B	7B	14B	14B	14B	7B	7B
EAST COAST	21	14	7	7	7	3A	3A	14	21A	21A	21A	21A

A = Next higher frequency may also be useful.
B = Difficult circuit this period.

First letter = night waves. Second = day waves.
G = Good, F = Fair, P = Poor. * = Chance of solar flares.
 # = Chance of aurora.

NOTE THAT NIGHT WAVE LETTER NOW COMES FIRST.

JANUARY

SUN	MON	TUE	WED	THU	FRI	SAT
						1 F/G
2 G/G	3 G/G	4 G/G	5 F/G	6 F/F	7 G/G	8 G/G
9 G/G	10 F/F	11 F/F	12 F/G	13 G/G	14 G/G	15 F/G
16 F/F	17 P/F	18 F/F	19 F/G	20 G/G	21 G/G	22 F/G
23 F/F 30 F/G	24 F/G 31 G/G	25 G/G	26 G/G	27 G/G*	28 F/F*	29 P/F

FT-230R: QUITE A SIGHT! (AND EASY TO SEE, TOO!!)

Sporting an all-new Liquid Crystal Display, the FT-230R is Yaesu's high-performance answer to your call for a very affordable 2 meter mobile rig with an easy-to-read frequency display! The FT-230R combines microprocessor convenience, a sensitive receiver, a powerful yet clean transmitter strip, and the new dimension of LCD frequency readout. See your Authorized Yaesu Dealer today — and go home with your new FT-230R!

SALE SUBJECT FCC CERTIFICATION

- LCD five-digit frequency readout with night light for high visibility day or night.
- Two VFOs for quick QSY across the band.
- Ten memory slots for storage and recall of favorite channels.
- Selectable synthesizer steps (5 kHz or 10 kHz) in dial or scanning mode.
- Priority channel for checking a favorite frequency for activity while monitoring another.
- Unique VFO/Memory Split mode for covering unusual repeater splits.
- Up/Down band scan plus memory scan for busy or clear channel. Scanning microphone included in purchase price.
- Full 25 watts of RF power output from extremely compact package.
- Built-in automatic or manual tone burst.
- Optional synthesized CTCSS Encode and Encode/Decode boards available.
- Lithium memory backup battery with estimated lifetime of five years.
- Optional YM-49 Speaker/Microphone and YM-50 DTMF Encoding Microphone provide maximum operating versatility.

And don't forget! Yaesu has a complete line of VHF and UHF handheld and battery portable transceivers using LCD display!!!

FT-208R
FM Handheld
2 Meters

FT-708R
FM Handheld
70 cm

FT-290R - 2 Meters
SSB/CW/FM Portable

FT-690R - 6 Meters
USB/CW/AM/FM Portable

Price and Specifications Subject To Change Without Notice or Obligation

YAESU
The radio.

482

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

NEW

Digital DX-terity...

General coverage, Superior dynamic range, 2 VFO's, 8 memories, Scan, Notch...COMPACT!

TS-430S

The TS-430S combines the ultimate in compact styling with advanced circuit design and performance. An all solid-state SSB, CW, and AM transceiver, with FM optional, covering the 160-10 meter Amateur bands, it also incorporates a 150 kHz-30 MHz general coverage receiver having a superior dynamic range, dual digital VFO's, 8 memories, memory scan, programmable band scan, IF shift, notch filter, all-mode squelch, and built-in speech processor.

TS-430S FEATURES:

- **160-10 meter operation, with general coverage receiver**
  With 160-10 meter Amateur band coverage, including WARC 30, 17, and 12 meter bands, it also features a 150 kHz-30 MHz general coverage receiver. Innovative UP-conversion digital PLL circuit, for superior frequency stability and accuracy. UP/DOWN band switches for Amateur bands or 1-MHz steps across entire 150 kHz-30 MHz range. Two digital VFO's continuously tuneable from band to band. Band information output on rear panel.
- **USB, LSB, CW, AM, with optional FM**
  Operates on USB, LSB, CW, and AM, with optional FM, internally installed. AGC time constant automatically selected by mode.
- **Compact, lightweight design**
  Measures only 10-5/8 (270) W x 3-3/4 (96) H x 10-7/8 (275) D, inches (mm), weighs only 14.3 lbs. (6.5 kg.).
- **Superior receiver dynamic range**
  Use of 2SK125 junction-type FET's in the Dyna-Mix high sensitivity, balanced, direct mixer circuit provides superior dynamic range.
- **10-Hz step dual digital VFO's**
  10-Hz step dual digital VFO's operate independently, include band and mode information. Different band and mode cross operation possible. Dial torque adjustable. STEP switch for tuning in 10-Hz or 100-Hz steps. A=B switch quickly shifts "B" VFO to the same frequency and mode as "A" VFO, or vice-versa. VFO LOCK switch provided. RIT control tunes VFO or memory. UP/DOWN manual scan possible using optional microphone.
- **Eight memories store frequency, mode, and band data**
  Memories store frequency, mode, and band data. Eighth memory stores receive and transmit frequencies independently. M.CH switch for operation of memory as independent VFO, or fixed frequency.
- **Lithium battery memory back-up**
  Estimated five-year life.
- **Memory scan**
  Scans memories in which data is stored.
- **Programmable automatic band scan**
  Scans programmed band width. Scan speed adjustable. HOLD switch interrupts band or memory scan.
- **IF shift circuit for minimum QRM.**
  IF passband may be moved to place interferring signals outside the passband, for best interference rejection.
- **Tuneable notch filter built-in**
  Deep, sharp, tuneable, audio notch filter.
- **Narrow-wide filter selection**
  NAR-WIDE switch for IF filter selection on SSB, CW, or AM, when optional filters are installed. (2.4 kHz IF filter built-in.)
- **Speech processor built-in**
  Improves intelligibility, increases average "talk-power."
- **Fluorescent tube digital display**
  Indicates frequency to 100 Hz (10 Hz modifiable).
- **All solid-state technology**
  Input rated 250 W PEP on SSB, 200 DC on CW, 120 W on FM (optional), on AM. Built-in cooling fan, multi-cir final protection. Operates on 12 VDC 120 VAC, or 220/240 VAC with optio PS-430 AC power supply.
- **All-mode squelch circuit, built-in**
- **Noise blanker, built-in**
- **RF attenuator (20 dB)**
- **Vox circuit, plus semi break-in witl side-tone**

Optional accessories:

- PS-430 compact AC power supply.
- PS-30 or KPS-21 AC power supplies.
- SP-430 external speaker.
- MB-430 mobile mounting bracket.
- AT-130 compact antenna tuner, 80-10 m incl. WARC.
- AT-230 base antenna tuner, 160-10 m incl. WARC.
- FM-430 FM unit.
- YK-88C (500 Hz) or YK-88CN (270 H CW filters.
- YK-88SN (1.8 kHz) narrow SSB filter.
- YK-88A (6 kHz) AM filter.
- MC-42S UP/DOWN hand microphone
- MC-60A deluxe desk microphone, UP/DOWN switch.

More information on the TS-430S is available from all authorized dealers o Trio-Kenwood Communications, 1111 W Walnut Street, Compton, California 90

KENWOO

...pacesetter in amateur radio

Specifications and prices are subject to change without notice or obligatio