February 1978 $2.00

73 AMATEUR RADIO

PLUS 35 More Exciting Feature Articles (see page 5)

IC-211, the 2meter Maximizer

FULL 4 MHz MULTI-MODE TRANSCEIVER

ICOM's new **IC-211** maximizes band coverage, speed, performance and convenience like no other transceiver in the 2 meter world. This Maximizer's single-knob dial provides all 4 MHz in a flash, right to your single fingertip! The **IC-211** maximizes read-out speed with positively no time lag or backlash in display stability, even in modes using 100 Hz steps. The **IC-211**'s freewheeling dial, with its superb inertia clutch, is instantly coordinated with the high speed, computer circuitry controlled synthesizer's seven digit read-out using an optical chopper. There is absolutely no mechanical connection between the smooth, bearing mounted flywheel knob and the **two dual-tracking VFO's,** which come built into your **IC-211.**

- **Single knob frequency selection:** The **IC-211** is synthesized with convenient single knob frequency selection over the entire 4 MHz. No more fussing with two or more knobs just to check what is going on around the band. One easy spin of the dial does it all.
- **Two VFO's built in:** The second VFO, which is an optional tack-on with most other transceivers, is an integral feature in every **IC-211.**
- **Variable offset:** Any offset from 10 KHz through 4 MHz, in multiples of 10 KHz, can be programmed with the LSI synthesizer.
- **Remote programing:** The **IC-211** LSI chip provides for the input of programing digits from a remote key pad, which can be combined with Touch Tone* circuitry to provide simultaneous remote program and tone. Computer control from a PIA interface is also possible.
- **FM stability on SSB and CW:** The **IC-211** synthesis of 100 Hz steps makes SSB as stable as FM. This extended range of operation is attracting many FM'ers who have been operating on the direct channels and have now discovered SSB.

The new **IC-211** is the very best and most versatile 2 meter transceiver made: that's all. For more information and your own hands-on demonstration, see your ICOM dealer. While maximizing performance, the **IC-211** minimizes impatience: yours is ready for delivery now.

Maximize the new repeater band: both the **IC-211** and the **IC-245/SSB** now operate the new FCC repeater spectrum with no modification.

All ICOM radios significantly exceed FCC specifications limiting spurious emissions.

Specifications: ☐ Frequency Coverage: 144.00 to 148.00 MHz ☐ Modes: SSB (A3J), FM (F3), CW (A1) ☐ Supply Voltage: DC, 13.8V ± 15%; AC, 117V ± 10% ☐ Size: 141mm(h) x 241mm(w) x 264mm(d) ☐ Weight: 6.8 Kg ☐ TX Output: A3J, 10W (PEP); A1 & F3, 10W ☐ Spurious Radiation: −60 dB below Carrier ☐ Microphone Impedance: 600 Ohms ☐ Sensitivity: A3J & A1, 0.5 microvolt 10 dB S+N/N; F3, 0.6 microvolt for 20 dB quieting ☐ Spurious Response: −60 dB or better ☐ Synthesizer Frequency Range: 144.00 MHz to 148.00 MHz ☐ Synthesizer Step Size: 100 Hz or 5 KHz for SSB, 5 KHz for FM

Supplied with hand held microphone, AC cord, DC cord, fuses and owner's manual.

VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT

ICOM

Distributed by:

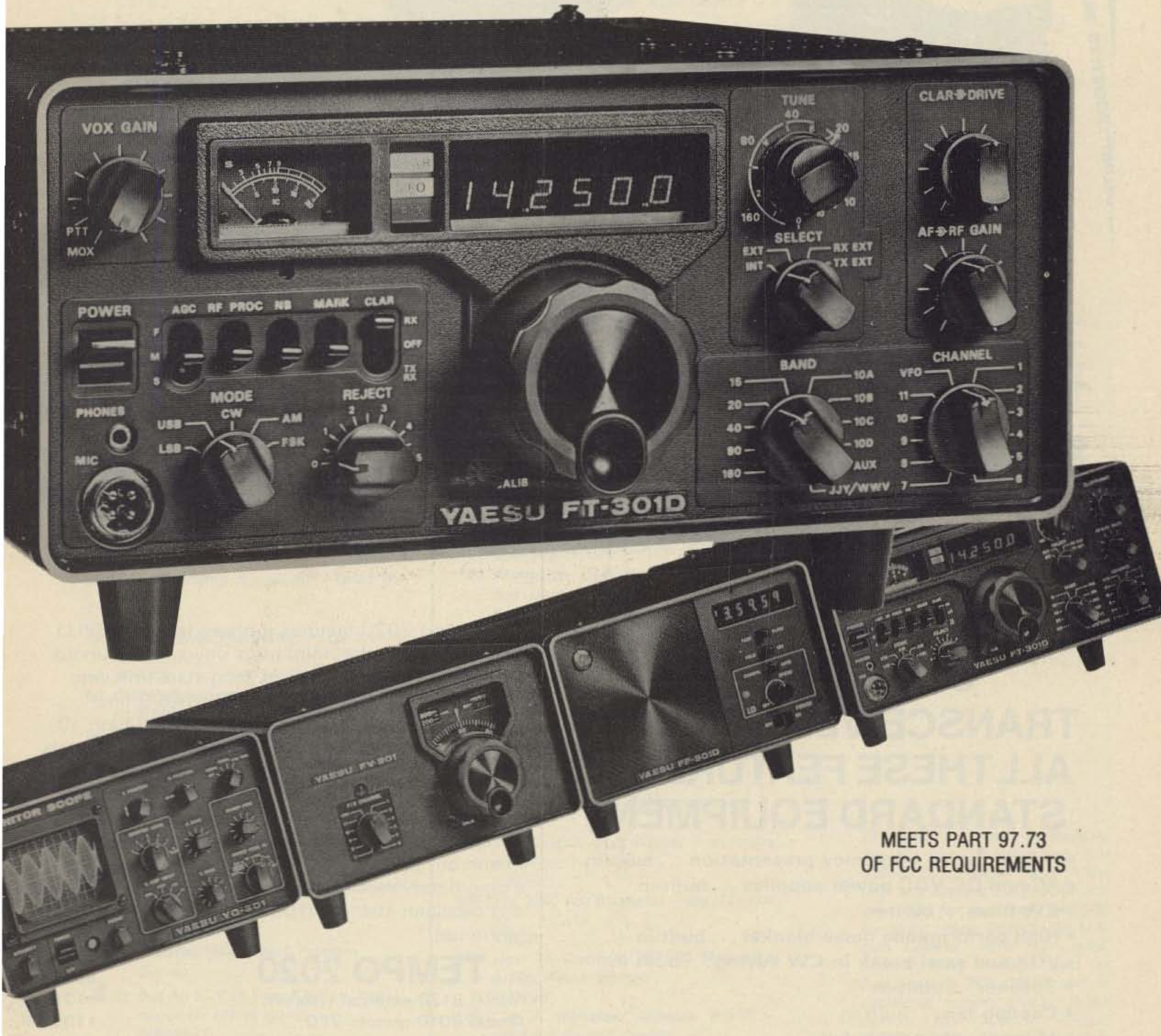
ICOM WEST, INC.
Suite 3
13256 Northrup Way
Bellevue, Wash. 98005
(206) 747-9020

ICOM EAST, INC.
Suite 307
3331 Towerwood Drive
Dallas, Texas 75234
(214) 620-2780

ICOM CANADA
7087 Victoria Drive
Vancouver B.C. V5P 3Y9
Canada
(604) 321-1833

YEARS AHEAD WITH YAESU!

YOUR DREAM STATION COME TRUE!
ALL SOLID STATE FAMILY



MEETS PART 97.73
OF FCC REQUIREMENTS

- Yaesu Electronics Corp., 15954 Downey Ave., Paramount, CA 90723 · (213) 633-4007
- Eastern Service Ctr., 613 Redna Terrace Cincinnati, OH 45215

YAESU
The radio.

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

CONTESTS

ARRL DX COMPETITION
Phone
Starts: 0001 GMT Saturday, February 4
Ends: 2359 GMT Sunday, February 5
Starts: 0001 GMT Saturday, March 4
Ends: 2359 GMT Sunday, March 5
CW
Starts: 0001 GMT Saturday, February 18
Ends: 2359 GMT Sunday, February 19
Starts: 0001 GMT Saturday, March 18
Ends: 2359 GMT Sunday, March 19

These rules were taken from last year's contest. Please check the December issue of *QST* for complete rules and any last minute changes.

Briefly, the rules are as follows: All fixed station amateurs, worldwide, are invited to participate. All amateurs in the 48 states and Canada will try to work as many stations in other parts of the world as possible. All other stations will work only W/VE stations. Entries may be in either the CW or phone section; each is scored independently. Entries are further classified as single- or multiple-operator stations. Single-transmitter, multi-operator stations will be recognized as a distinct category from multi-transmitter, multi-operator stations. Two transmitters on the band at the same time are prohibited. Single-operator stations may enter in either the all band, high band, or low band categories. High band is 20, 15, and 10 meters, while low band is 160, 80, and 40 meters. Operating on a band not allowed in your class is permitted, but those points will not be counted toward your total score. Crossband and crossmode contacts are not allowed.

EXCHANGE:

W/VE stations will send RS(T) and state or province. All others send RS(T) and power. KH6 and KL7 are considered DX.

SCORING:

Score 3 points for each completed QSO. Each station may be worked once on each band on each mode for contact and multiplier credit. Final score is the total number of QSO points times the total number of countries on each band (for W/VE stations), or the total number of continental states plus VE/VO licensing areas worked on each band (for DX).

AWARDS:

A plaque will be awarded to the highest single operator DX phone and CW station (non-W/VE) in each continent. On both phone and CW, a certificate will be awarded to the highest scoring station in each category and classification in KL7, KH6, each ARRL section, and each country where a valid entry is received. Also, a certificate will be awarded to each non-country winner DX entrant making 1000 or more QSOs on either mode. ARRL-affiliated clubs may also participate in club competition as described in *QST*.

LOGS:

A summary sheet, log sheets, and DX check-off sheet for each band used is required from all W/VE entries. DX entries must submit log sheets and a summary sheet. Separate logs, summaries, and check sheets are required for each mode used from all entries (no check sheets for DX). Logs and forms are available from: ARRL, 225 Main St., Newington CT 06111.

ARRL NOVICE ROUNDUP
Starts: 0001 GMT Saturday, February 4
Ends: 2359 GMT Sunday, February 12

The contest is open to all amateurs in any ARRL section. Operating time must not exceed 30 hours total during the 9 day period, while off periods may not be less than 15 minutes at a time. Times on and off must be entered in your log. Crossband contacts are not allowed. Novices may work anyone, while non-Novices must work Novices only. Each station may be worked only once regardless of band.

EXCHANGE:

RST and ARRL section.

SCORING:

Each completed QSO counts one point. The total multiplier is the number of ARRL sections and foreign countries worked. VE8 counts as a separate section. The final score is the number of QSO points plus your ARRL code proficiency credit (15 wpm = 15 pts.) times the total multiplier.

AWARDS:

Certificates will be awarded to the highest scoring Novice in each ARRL section. Multi-operator or high class licenses are not eligible for awards, but the top ten scores will be listed in the results.

LOGS:

Use official ARRL forms available from: ARRL, 225 Main St., Newington CT 06111. All entries should be sent to this same address.

Please check the January issue of QST *for any last minute changes in rules or operating times.*

QCWA QSO Party
Starts: 2400 GMT Friday, February 10
Ends: 2400 GMT Sunday, February 12

Points based on number of QCWA members contacted multiplied by the total number of chapters contacted. Contest open to members only. Sample log and complete rules included in

Continued on page 23

CALENDAR

Feb 4-5	ARRL DX Contest – Phone
Feb 4-12	ARRL Novice Roundup
Feb 10-12	QCWA QSO Party
Feb 11-12	10-10 International Net Winter QSO Party
Feb 18-19	ARRL DX Contest – CW
Feb 25-26	French Contest – Phone
Mar 4-5	ARRL DX Contest – Phone
Mar 18-19	ARRL DX Contest – CW
Mar 25	BARTG Spring RTTY Contest
Apr 1-2	TENN QSO Party
Apr 1-3	QRP QSO Party
Apr 8-9	Open ARRL CD Party – CW
Apr 15-16	Open ARRL CD Party – Phone
Apr 22-23	Zero District QSO Party
June 3-4	IARS/CHC/FHC/HTH QSO Party
June 10-11	ARRL VHF QSO Party
June 24-25	ARRL Field Day
June 24-25	First REF Ten Day
July 4	ARRL Straight Key Night
July 8-9	IARU Radiosport Competition
Sept 9-10	ARRL VHF QSO Party
Oct 14-15	ARRL CD Party – CW
Oct 21-22	ARRL CD Party – Phone
Nov 4-5	ARRL Sweepstakes – CW
Nov 18-19	ARRL Sweepstakes – Phone
Nov 18-19	Second REF Ten Day
Dec 2-3	ARRL 160 Meter Contest
Dec 9-10	ARRL 10 Meter Contest

RESULTS

RESULTS OF 1977 WASHINGTON STATE QSO PARTY

Top 10 out-of-state scorers:

N6MU	Calif	10,944 points
K9BG	Ill	6,840
W7ZMD	Ariz	5,684
WB2VWW	NJ	5,096
K6XO	Calif	4,872
K9WA	Ill	4,648
VE4RF	Manitoba	4,032
WBØEVQ	S Dak	3,942
KL7IUN	Alaska	3,888
N9AW	Wisc	3,872

Top 10 Washington state scorers:

VE7ZZ/W7	Clark county	260,952 points
W7VRO	Whatcom	238,422
N7GM	Walla Walla	211,442
K7SS + K7RA	King	109,872
WA7GVM	Skagit	103,896
N7AM	Kitsap	60,156
K7LFY/7	Mason	58,688
WA7YCZ	Whatcom	55,440
WB7BFK	Island	45,312
K7NF/7	Jefferson	37,000

Special note: W7GHT operated mobile from 24 different counties during the contest period, being the only station entering from 15 of the 24 counties!

Looking West

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

I'd like to introduce a new friend to you – John Zell WA6AEH. John is a very special person to me and others because of something he has just completed. No, not a new DX championship or anything like that. John has just released his first record album, titled "My Tribute – Thank You, Lord."

For the past ten years, John has been solo trumpet player for a rather well-known orchestra, that of Lawrence Welk. Many of you probably have seen John on TV hundreds of times. He is the young-looking fellow in the extreme left of the orchestra's trumpet section. However, I guess that very few, if any, of you knew that John was also an active amateur operating both low bands and VHF FM. Those of us who have come to know John on a personal level, to have him as a friend, consider ourselves honored – not because of his celebrity status, but because in John one finds the epitome of a good human being, a person who possesses true love for all mankind.

Listening to John play, especially solo, this love of all people shines through. You can actually feel it. His new album on Manna Records (MS-2053) is of Christian music. It's an album he has dedicated to his belief in God and in his fellow man. I am not a Christian, yet the feeling of love and joy that surrounds me each time I play this album is almost overwhelming. I feel happy listening, and I know of no greater gift that any man can give others than sharing happiness. Therefore, we dedicate this month's "Looking West" to John Zell WA6AEH and the joy of his music. Ham radio needs more like John.

THE "WHERE DO WE GO FROM HERE" DEPARTMENT

I'd be lying if I said that I was upset over the Commission's last minute decision to "stay" implementation of the Report and Order on Docket 21033. I've probably spent way too much time on this topic already, but, as you are well aware, the stay places this whole matter in a new light. It gives us time to reassess our needs and values, to reach for better alternatives. In my just-filed reply comments, I may have stumbled across a few. For your consideration, here they are.

Yes, I suggested that the Commission open 144.5 through 145.5 MHz to relay activity, but that it not permit FM repeaters to utilize this spectrum. Rather, I suggested that the FCC approve only relay systems that meet the criteria of already existing narrowband spectral activity, such entities as SSB repeaters and linear translators. In this way, new frontiers of technological growth can be fostered while the rights of all spectrum users are retained. I requested the same for 220 as well. I also requested that the FCC open the entire six meter band, 50 through 54 MHz, to amateur relay activity as an alternative to expansion of either two or 220. It's my feeling that we must populate six or lose it. I prefer a large amateur population.


John Zell WA6AEH with his boss, Lawrence Welk.

As I have stated herein before, I want to see "WR" special repeater callsigns retained. Suppose all amateurs could put up a repeater whether such systems were needed or not. They have the money to buy the machine and an ego that says "go do it." Ah . . . but there is no space for their new "ego box." So, they plop down atop existing activity and begin wreaking havoc on amateur society. Finally, after everything else has been tried to no avail, the local coordinator seeks a "show cause/cease and desist order" from the FCC. Does the machine go away? No. It simply changes callsign and the whole process begins again. The "bad guy" simply transfers ownership of the repeater system to a friend. The way the Report and Order presents itself, that probably would happen more times than not. Eventually, if things got far enough out of hand, one of two things might happen. For sure, the Commission would probably return to a very strict filing system before any amateur could place a repeater in operation, or even continue to operate one now in operation. Remember, the FCC always tends to overreact to most situations. The other alternative might be to require "mandatory" channel coordination prior to issuance of a repeater callsign. At present, coordination is not required by the Commission, but all amateurs of good will do avail themselves of local voluntary coordinators and councils to minimize potential conflicts with others. Right now it's voluntary, but if things went wrong in repeater deregulation, the reaction might find us all having to go to the FCC itself to get a repeater pair. That is, if they felt our proposed system had merit! I'd rather deal with my amateur peer group than a federal bureaucracy. I suspect that you would, too.

Therefore, I requested (again) that special WR prefixes and specific licensing of all repeater stations be retained. I additionally asked that they make the remote/base concept of operation inherent in each amateur's license as a method of stimulating individual and collective experimentation into the frontiers of relay communication not yet explored. An inherent remote/base privilege, along with separate recognition and minimal regulation of such by the Commission, will be a stimulus to technological growth.

There's more – more that will probably make me somewhat unpopular with the die-hard "FM Repeaters Forever" crowd. However, as has been stated before, this world is made of people, not black boxes on hilltops. If I have to make a choice, my vote goes with the long-established concept of the "human being" every time. We have a chance to reassess our needs and values, to make more efficient use of what we now have, and to show that we place the value of any one single human being far above any machine. If we use this chance, we will all be the better for it.

The current state of affairs does place coordinators and councils in a rather awkward position. Many coordination entities acted fast, possibly too fast, in divvying up the "new-found wealth," only to find themselves standing with a bit of egg on their faces when the news of the stay hit. In other places, like Texas and here in Southern California, the councils had taken a "wait and see, let's not jump in head first" attitude. The question that we and others would face on "deregulation day" would be, "What would happen?" Would there be an uncoordinated land rush to grab what could be grabbed, or would things continue on as if nothing happened?

At about 10 am on "Repeater Deregulation Day, '77," I began to SWL the new spectrum from the two-way radio store belonging to a friend of mine. I had at my disposal virtually any radio I needed. I chose an Icom 211 for SSB monitoring and a Midland 13-510 for listening to FM. The reason for the choice of equipment was the proximity of one radio to the other (they were sitting next to each other).

The results were quite interesting. I soon realized that I was not the only person involved in this SWL activity. I came across a number of AM QSOs and the tone of most of the conversations overheard was not very friendly to FM or repeaters. In fact, I had the distinct feeling that the AM crowd had assembled to "wage war" on anything that even remotely sounded like a repeater. On SSB, I found little activity during my entire six-hour stint as a VHF SWL. SSB is very heavy in the evenings in the spectrum between 144.950 and 145.230, but is fairly dead the rest of the day. The one SSB QSO I came across on 145.100 was involved in a discussion of the same topic, but along different lines. It dealt with possible legal action to stop the implementation, a discussion that I understand had been going on in SSB circles for weeks. It was very obvious that neither local AM nor SSB interests were all that happy with the deregulation and with the expected mass influx of repeaters.

By noon, I had logged seven signals that were obvious relay devices; only one, though, was an obvious local. The rest could have been anyplace within maybe a hundred miles. Only one had an ID, and later checks showed this to be out of the area administered by SCRA. In total, by the time I left my friend's shop, I had logged eleven obvious relay devices, but could not identify the location of most. The antenna used was an omni-type, as I was interested in logging total numbers rather than location. Also, I was a guest in someone's place of business and had to keep a low profile to remain welcome. No confrontations between FM repeaters and other modes had developed, at least none that I was witness to.

Continued on page 26

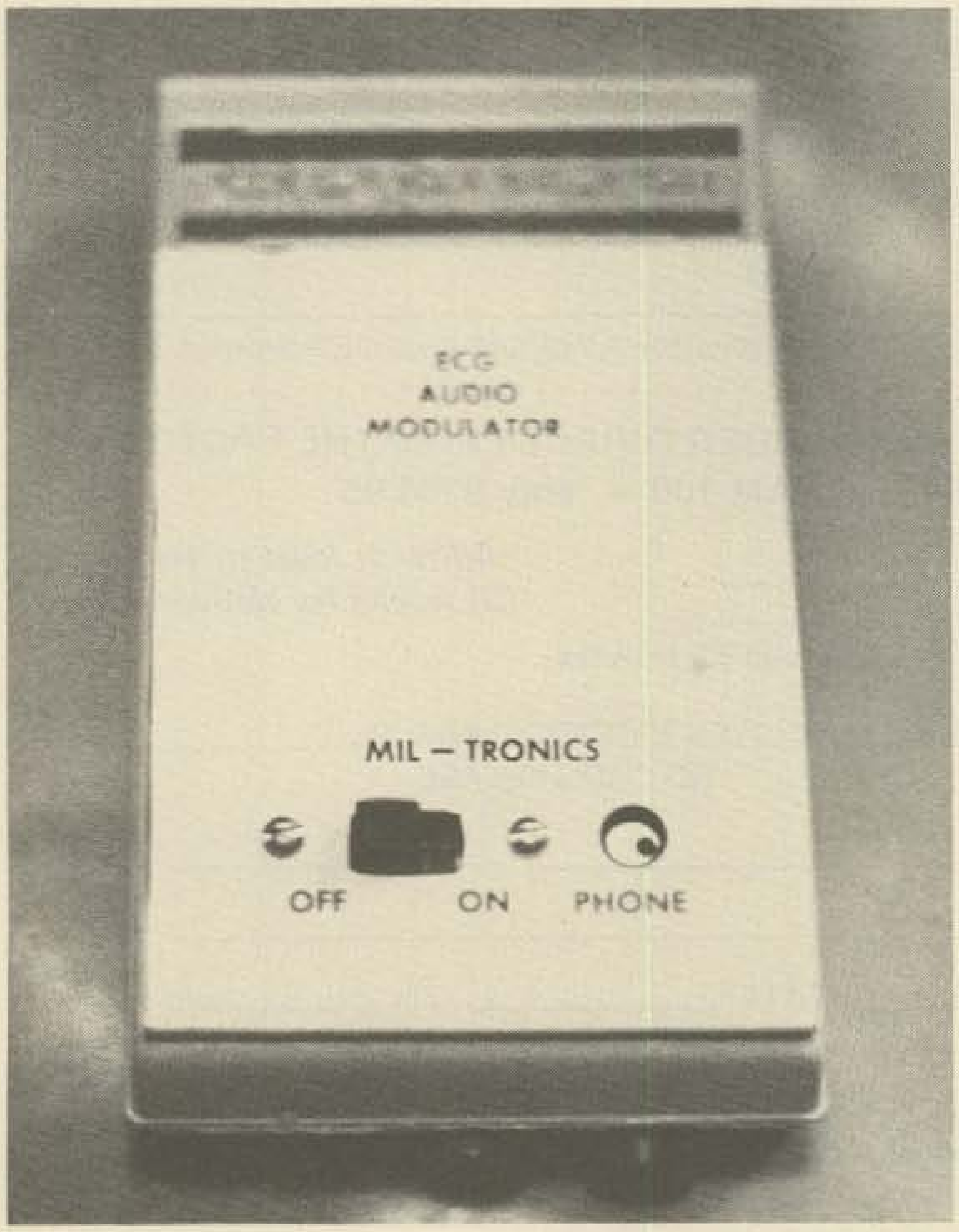
Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Inexpensive EKG Encoder

WARNING: Use or sale of this or similar devices is restricted under Federal Law to physicians or on their orders. No attempt should be made to diagnose or treat patients without trained medical supervision.

Amateur radio has long been known for its service to those in need. One of the outstanding accomplishments of our hobby has been the remote handling of medical emergencies. This service has normally entailed transmission of detailed history and physical findings which, when relayed to a physician with key laboratory information, can effect a diagnosis. Now, however, greater emphasis is being placed on transmission of hard patient data. The electrocardiogram (EKG) is just such a piece of data. EKGs have been relayed over HF links and even through OSCAR to monitoring physicians. The encoder used in transmitting EKGs costs several hundred dollars when obtained commercially. This article will explain the derivation of the EKG and will present an encoder which can be constructed for less than forty dollars.

The EKG (or ECG, as it is sometimes called) is a representation of the total electrical activity in the heart during the cardiac cycle. Fig. 1 diagrams the basic anatomy of the heart. The two atria and two ventricles form a pump which has two separate, although related, fluid paths. Blood from the body enters the heart through the great veins, the superior and inferior vena cavae. It traverses the right atrium, goes through the tricuspid valve, and enters the right ventricle. The blood is pumped out of the right ventricle, through the pulmonic valve, to the pulmonary artery. It is then sent to the lungs, where carbon dioxide waste is discharged and fresh oxygen is obtained. The blood reenters the heart through the pulmonary vein, going this time to the *left* atrium. Then, through the mitral valve, the blood enters the left ventricle, from which it is pumped out, over the aortic valve, to the aorta, where



Overall view of completed unit.

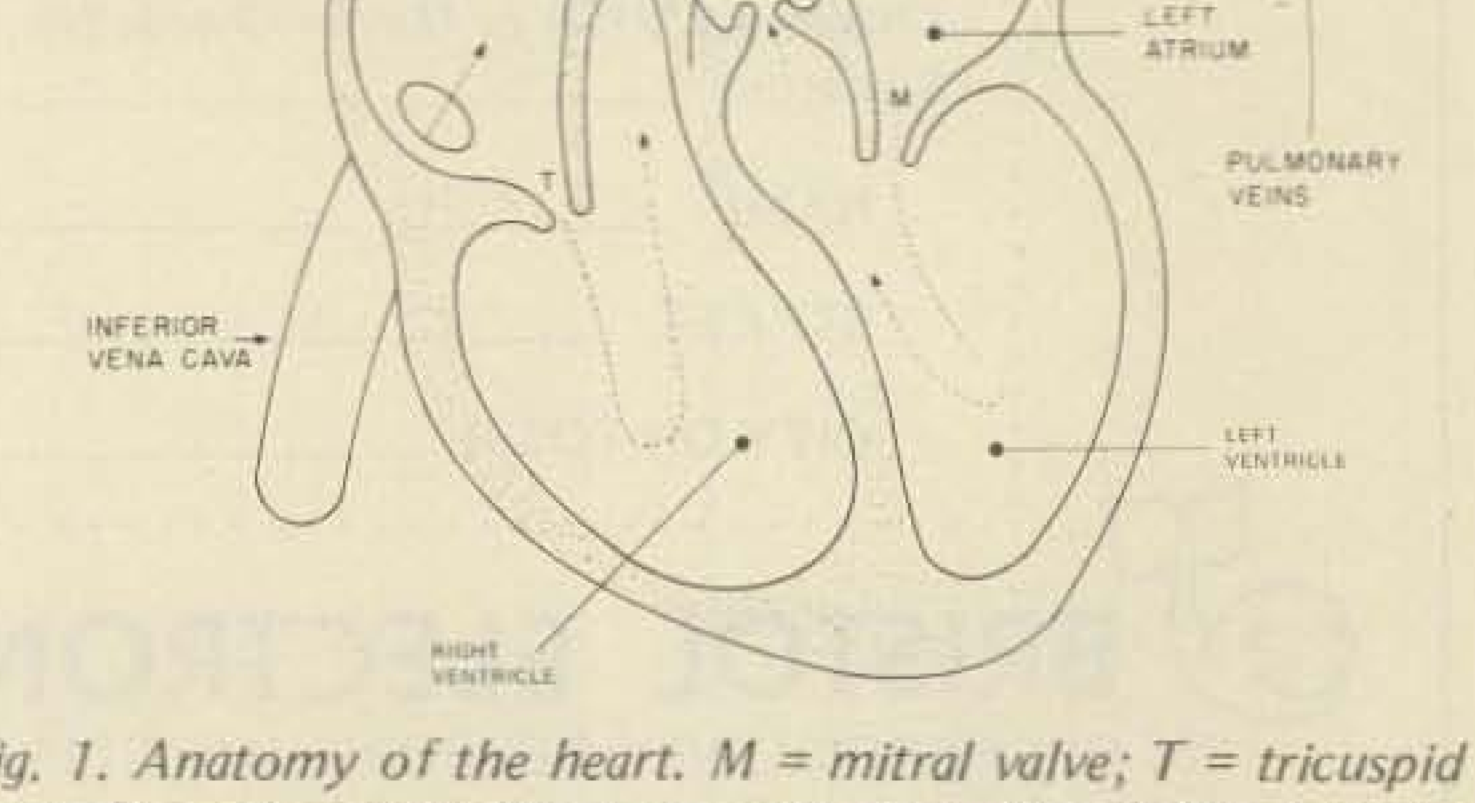
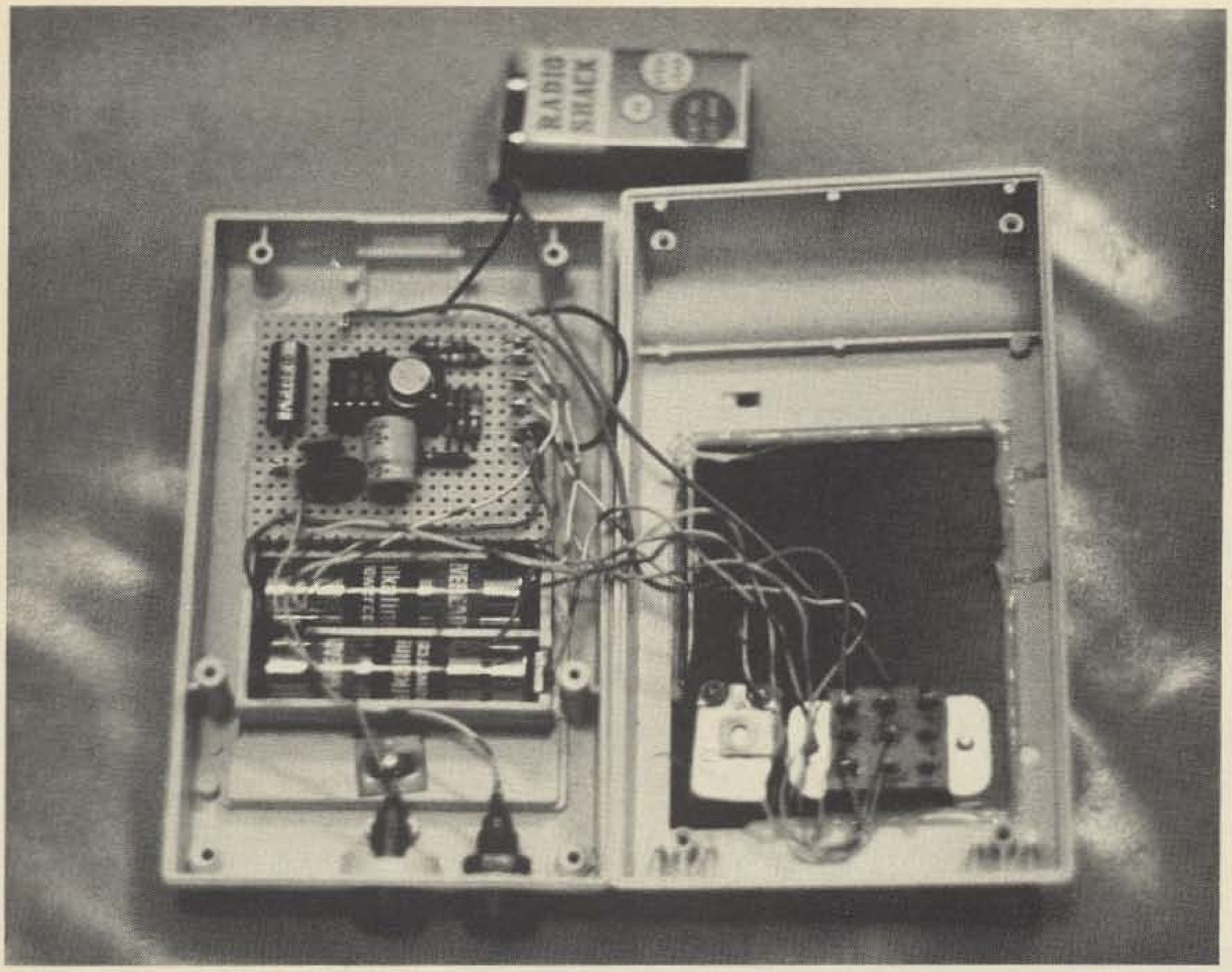


Fig. 1. Anatomy of the heart. M = mitral valve; T = tricuspid valve; P = pulmonic valve; A = aortic valve. Blood flow is in the direction of the dotted arrows.



Internal view of completed unit. Note the 3PDT slide switch used to switch all three batteries and the small, square surplus speaker.

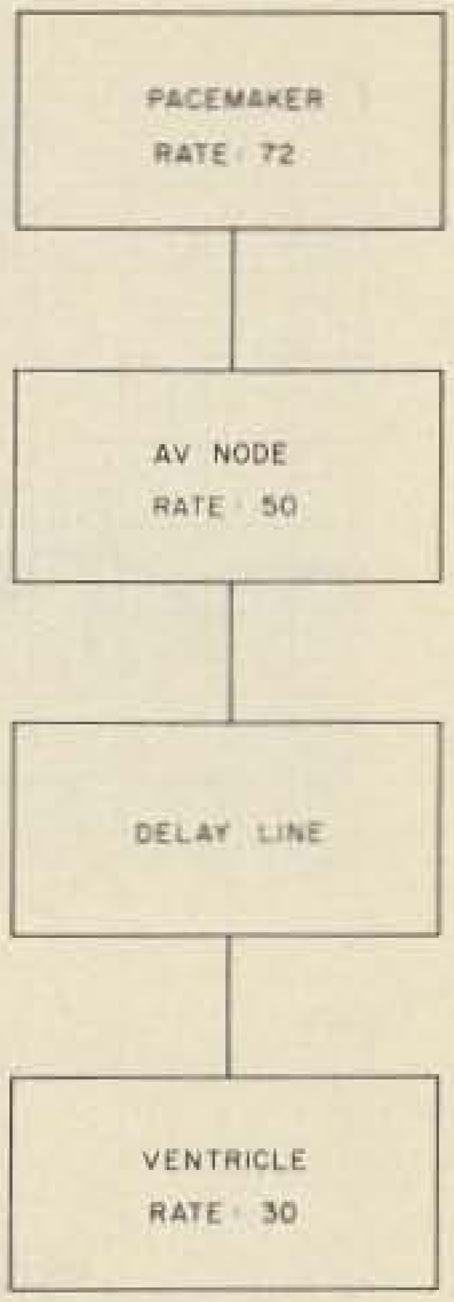


Fig. 3. Conduction pathway.

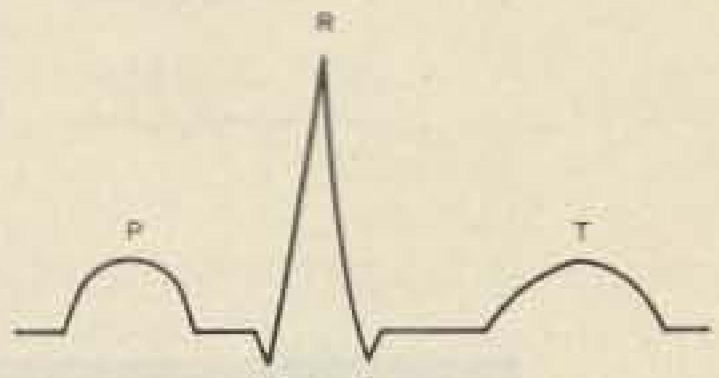


Fig. 4. Normal electrocardiogram.

distribution to the body originates.

But . . . how does it work? It is easy to explain why blood flows in the direction it does: All the valves are one way! The muscle contracts because of electrical excitation, and that's how we are going to get an EKG.

Take a look at Fig. 2. I have superimposed the conduction system of the heart on the anatomy of Fig. 1. This system, by the way, is anatomically demonstrable, not just the figment of some physiologist's mind. Impulses originate in the heart's pacemaker, a cluster of cells located high on the right atrium. Activity is transmitted along the atria until it reaches the AV (atrio-ventricular) node, where a brief delay is experienced. Impulses are then sent out again, first over a common Bundle of His (rhymes with bliss) and then over the right and left bundles. It is important to note that, although the pacemaker normally controls the rate of the heart, failing that, other lower sources can take over the rhythm. An analogy to an electronic circuit may help to clarify this.

Fig. 3 shows such an analogy. The pacemaker is represented by an astable multivibrator with a rate of 72/minute. This is directly connected to another astable with a rate of 50/minute. It then goes through a delay line to a final astable with a rate of 30/minute. *The fastest operating astable will normally control the system.* Neat, huh?

As each of these impulses is being propagated in one direction, a voltmeter connected across the heart will show a potential difference, varying with the stage of depolarization. Because it is difficult, in a living individual, to hook test leads directly to the heart, we can use the arms as convenient probes. Sweeping the voltage through time produces the tracing shown in Fig. 4. By changing the position of the leads, as by using combinations of arms and legs, different waveforms may be obtained. This is due to vector differences in the depolarization and is beyond the scope of this article. However, all have basic elements in common. The first deflection is the P wave, denoting atrial depolarization. The PR seg-

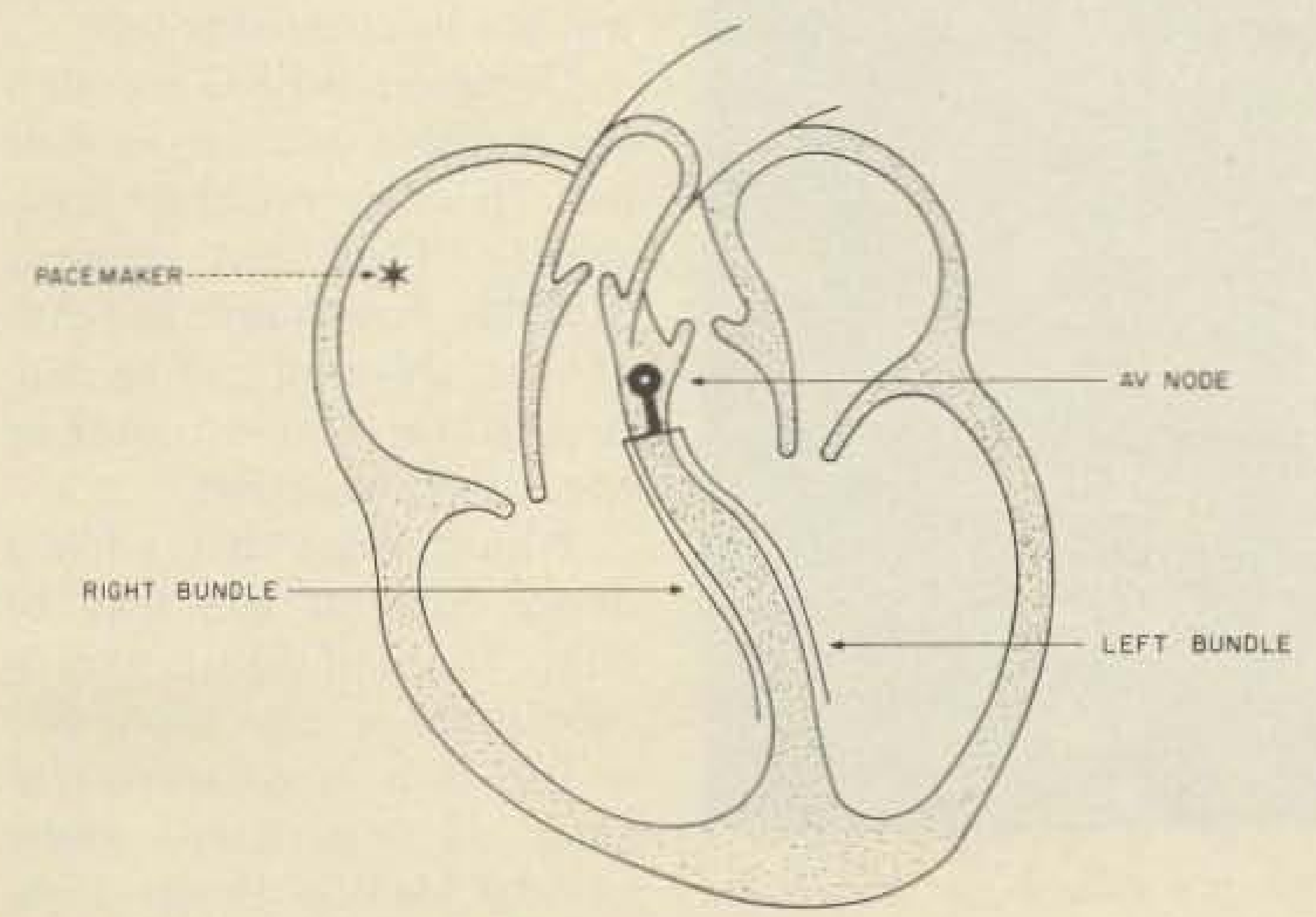


Fig. 2. Conduction system.

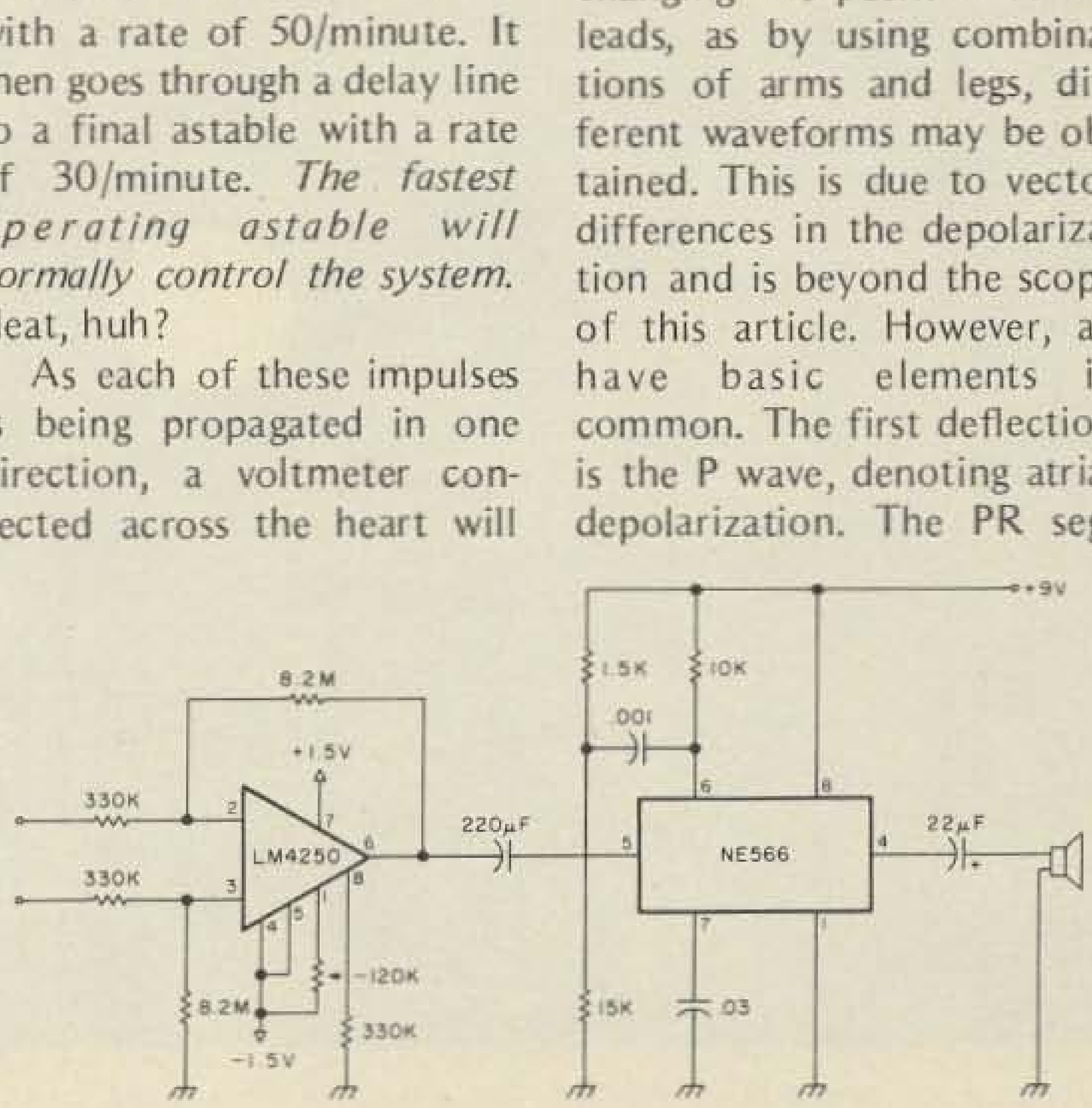


Fig. 5. Schematic diagram.

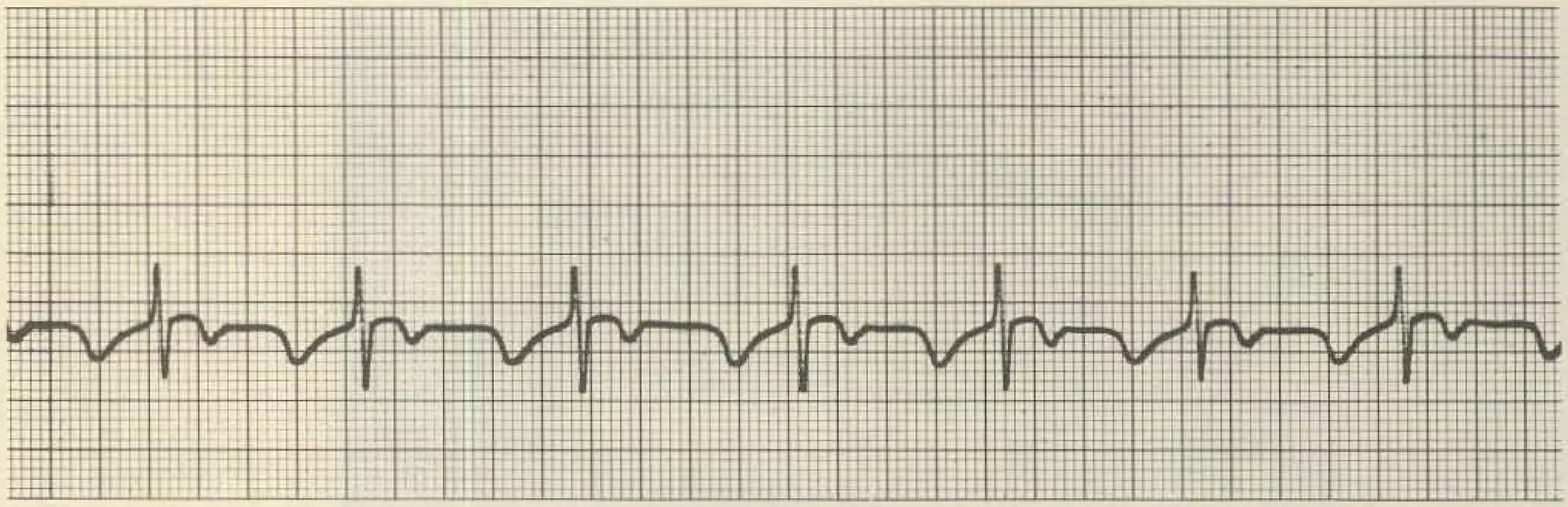


Fig. 6. Typical transmitted EKG.

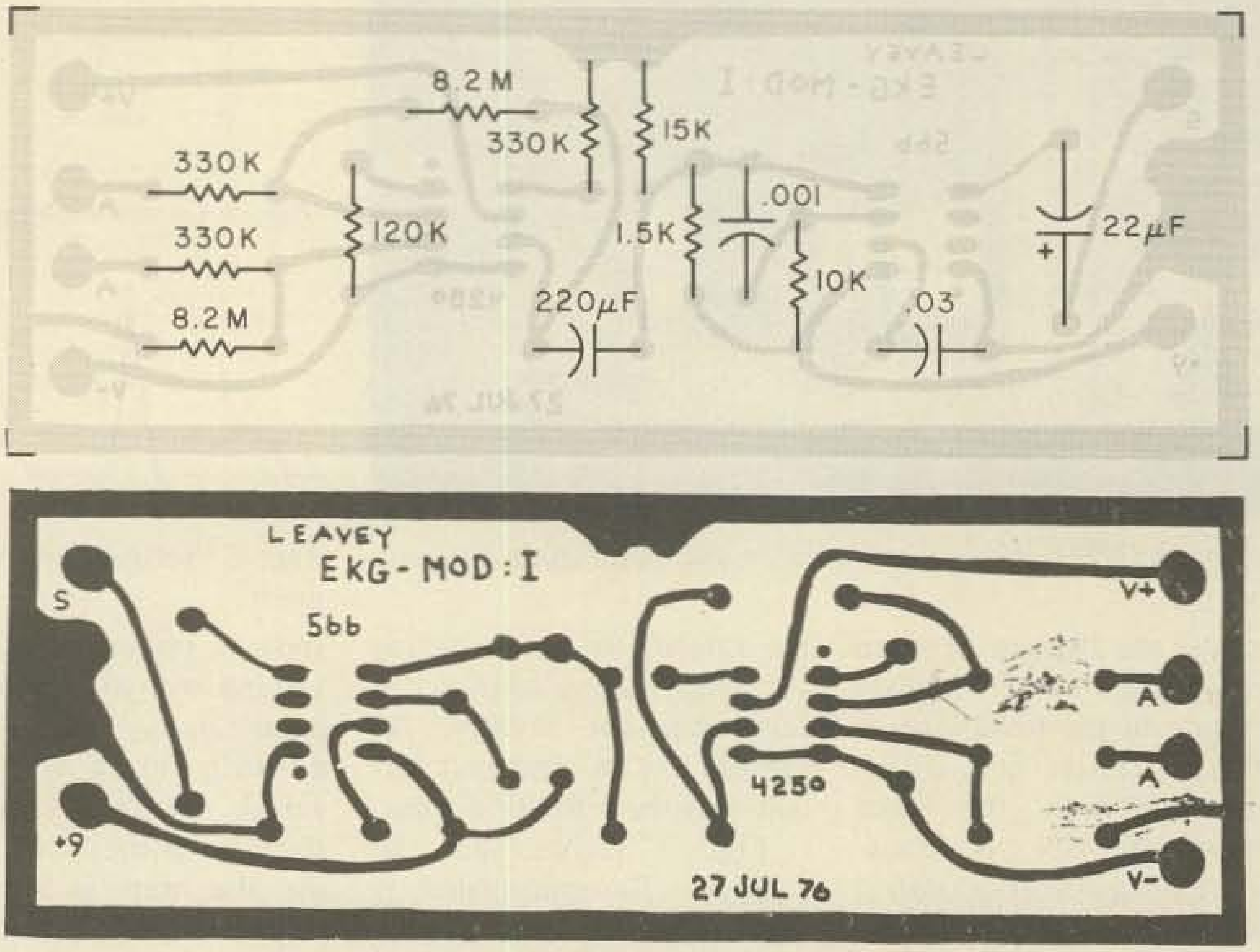
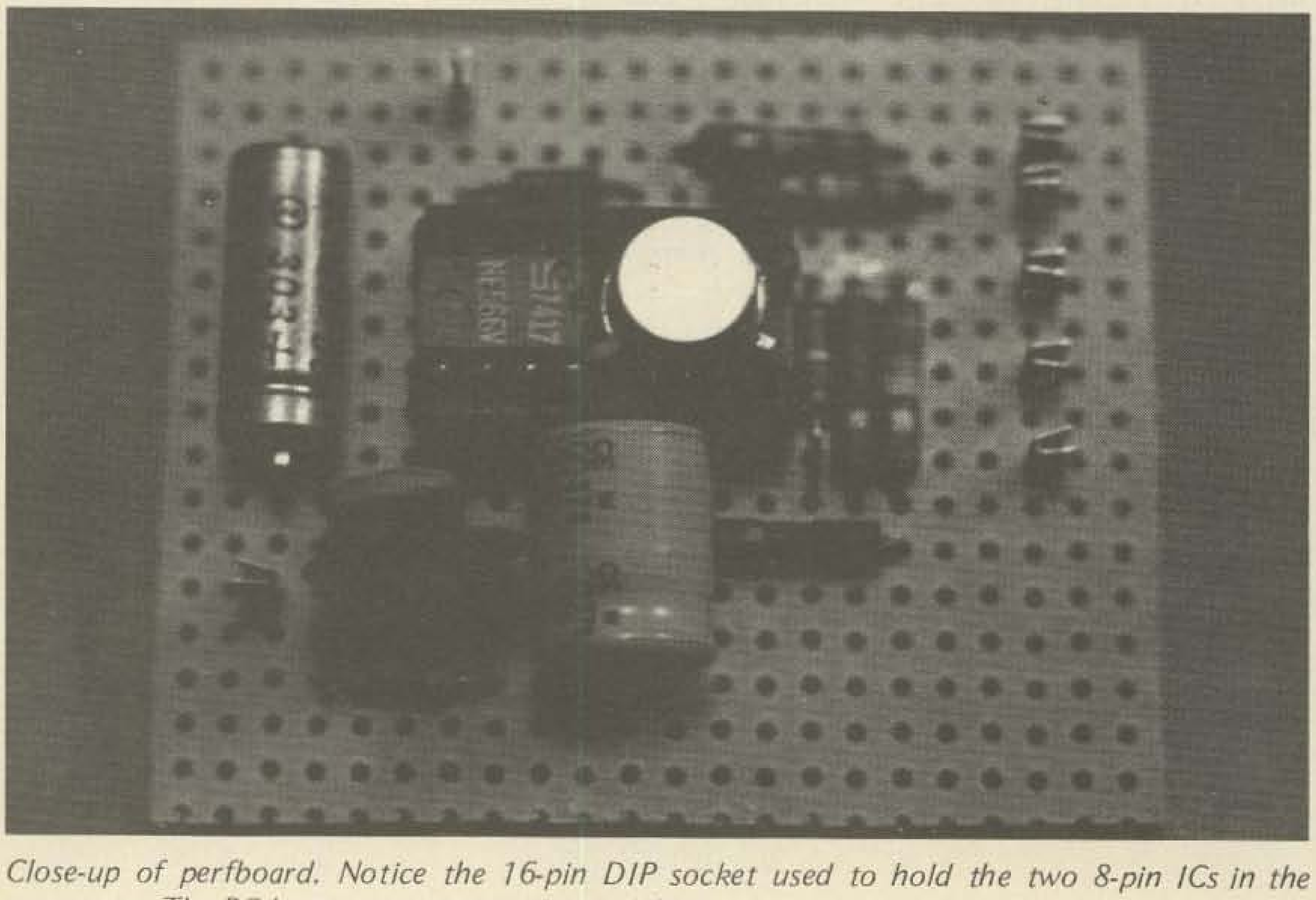


Fig. 7. Printed circuit parts layout.



Close-up of perfboard. Notice the 16-pin DIP socket used to hold the two 8-pin ICs in the prototype. The PC layout uses two separate sockets.

ment demarcates the "delay line" of the AV node. The large QRS complex represents ventricular depolarization and the subsequent T-wave restitution of the electrical energy, or repolarization. Again, changes in shape, amplitude, or timing, as well as the presence or absence of certain elements, are critical to interpretation and utilization of the EKG. But such is the stuff of which books are written and is far too much to even summarize here.

The EKG, then, represents a tiny voltage change directed across the heart. To record this change, a differential amplifier with high gain is connected across the chest, and the output is fed to a strip recorder. To transmit this data over telephone or radio links, the changing voltage is converted to AFSK, which can be transmitted by conventional means. Decoding the AFSK through use of a PLL is fairly straightforward, but it is not the subject of this article, so it will not be covered here.

Commercial EKG encoders are available and are in wide use in the medical community. They cost upwards of $300. For about one-tenth of that, this unit can be constructed for demonstration or educational purposes.

I must stress that, while a device such as this may be built for individual experimentation or education, sale or use of it in actual patient care is restricted under Federal Medical Device legislation. Readers who are physicians are welcome to offer evaluations and comments.

The EKG from the patient is fed to an LM-4250 programmable op amp. After amplification, the EKG signal is used to modulate a vco, formed by a 566 IC. Output is coupled directly from the 566 to a small speaker and may be acoustically fed to a mike or telephone handset.

The schematic is shown in Fig. 5. Notice that two power supplies are required — a +9-volt supply for the vco and a ±1.5-volt supply for the op amp. In the prototype, these are provided by a standard 9-volt transistor battery and two 1.5-volt AA cells. Connection to the patient may be through standard adhesive monitoring electrodes or, in their absence, small discs (about 1 to 2 cm^2) of metal, held to the wrists with rubber bands or watchbands. A saline solution should be put under each disc to lower resistance.

The prototype was constructed in a calculator case, available at low cost through several sources. The only necessary control, an ON-OFF switch, is mounted on the front panel. Pin jacks are provided for the patient cables. A printed circuit board layout is shown for those who might wish to duplicate this construction.

To use this, connect the patient cables to electrodes on each wrist, and turn the unit on. The tone, after stabilizing, will be heard to shift frequency with each pulse beat. The shift may be up or down, depending upon the orientation of the leads; reversal will invert the output. When fed to a suitable decoder, strip-recorded EKGs may be obtained. These can be interpreted to aid in the management of patients.

There you have it — one-half of a telemetry system! Any comments or questions are welcome, but please include an SASE. ■

CONTESTS

from page 16

December issue of *QCWA News*. This year's contest is sponsored by the Northern NJ Chapter. Logs to be checked must be in the hands of the contest committee by March 4.

TEN-TEN NET
WINTER QSO PARTY
Starts: 0000 GMT Saturday, February 11
Ends: 2400 GMT Sunday, February 12

The contest is sponsored by the Ten-Ten International Net of Southern California, Inc., and is open to all amateurs, but only 10-10 members are eligible for awards. All contacts must be made on 10 meters, any mode, and a station may be counted only once.

EXCHANGE:

Name, QTH, and 10-10 number.

SCORING:

1 point for each contact plus 1 point if with a 10-10 member. Maximum of 2 points for any one contact.

LOGS:

Logs should include date and time of each contact as well as the required exchange information.

AWARDS (for 10-10 members only):

Certificates to first and second place winners in each US district, Alaska, Hawaii; each VE district; Central America and Caribbean; South America; Europe; Africa and South Atlantic; Asia and Northern Pacific; Australia, New Zealand, and South Pacific. Send logs to: Grace Dunlap K5MRU, Box 445, La Feria TX 78559, by March 31. For complete results, see the *10-10 Net Summer Bulletin*.

FIRST U.S. SSTV CONTEST

You've surely noticed the increasing amount of slow scan TV activity on our high frequency bands during recent months. This mode of communication has obviously reached the level of warranting a U.S. sponsored SSTV contest, so we're initiating such a competition March 4-5, 1978, and early each March thereafter. The period of early March was selected because it doesn't appear to conflict with other contest activities.

Plans for this contest began forming late last year. The enthusiasm exhibited by SSTVers was overwhelming, so we decided to conduct the first contest during 1978. Apologies for the brief notice. If you've been operating SSTV recently or keeping track of the SSTV Net (14.230 kHz, Saturdays, 1800 GMT), however, you've been hearing of this contest for several months.

As this announcement is being written, plans are also being made for at least one trophy, which will be awarded to a high scoring contester. Formal presentation of this award will be conducted at the Dayton Hamvention in April.

In order for any contest to be dubbed successful, a substantial number of entry logs must be recorded. *Your* log is vitally important, regardless of its size or score. We're presently considering such tactics as random-selecting a log and awarding a prize to that person, so send in that log! Photos will also be ogled and published with the contest results in *73*. Published photos will be paid for at regular rates.

The purpose of this contest is twofold: to prove SSTV acceptance and to have some true fun on the air during the cold winter. Contest hours were thus arranged for one's comfort rather than one's endurance. You'll also have weekend time for family chores — and sleep.

I would like to emphasize checking OSCAR orbits which may be used for your area, and giving mode A (2 meters to 10 meters) a try during the appropriate times. When using the satellite(s), however, establish contact via SSB before briefly exchanging pictures to avoid unnecessary loading of the transponder. I, for one, will be enthusiastically looking for SSTV contacts via satellite (W1JKF and I, however, will not be competing for awards, as we are contest sponsors).

All aspects considered, the contest should be a real blast. We'll be looking forward to seeing all of you then.

Dave Ingram K4TWJ
Brooks Kendall W1JKF

RESULTS

RESULTS OF THE 1977 CAN-AM CONTEST

Trophy Winners:

Canadian Champion Trophy — Lee Sawkins CY7CC
American Champion Trophy — Gary Coldwell WA6VEF
Canadian Phone Trophy — Sid Kemp VA7BGK
American Phone Trophy — Alan Brubaker K6XO
Canadian CW Trophy — Jim Bearman VE5DX
American CW Trophy — Fred Minnis KØMM
Multi-Operator Trophy — University of Manitoba ARC VC9UM
Special Plaque (Multi-Op Champion) — Yuri Blanarovich VE3BMV
Club Competition Plaque — Toronto DX Club

Top Ten Combined:

VE — Single-Op	
CY7CC	1,008,527
VA7BGK	570,222
CY3EDC	382,566
VE3KZ	356,150
VE5UA	350,106
CY4SW	308,716
VE5DX	288,982
CY3BBH	222,219
VE7AV	210,697
VE6MP	194,186

VE-W Multi-Op	
VE3BMV	822,527
VC9UM	628,385
W8LT	242,834
VE2BPT	194,680
WA3UKY	192,199
CY1NN	180,351
VE1AWN	145,262
W4NVU	124,212
N4UF	74,470
VE8ML	72,312

W — Single-Op	
WA6VEF	695,756
KØMM	303,871
K4BAI	189,230
K6XO	187,293
K5NW	165,447
N6MU	159,619
W5JW	149,030
K1ZZ	144,508
N4UF	132,209
W6OKK	130,475

Top Ten:

Phone:	*CW:*
VE	*VE*
CY7CC	CY7CC
VA7BGK	VE5DX
VE7UA	CY3EDC
CY4SW	VE3KZ
CY3BBH	VE3IR
VE3KZ	VE2HY
VE6MP	VE7AV
VE7AV	CY1AGP
VE8RO/6	VE7DSA
VE3MR	VE2YU
W	*W*
WA6VEF	WA6VEF
K6XO	KØMM
N4UF	K4BAI
KØMM	K5NW
WA6NEL	N6MU
W6OKK	K1ZZ
K8MR	W5JW
WBØPYD	N5CT
WDØBRJ	W2SC
WA4NTP	W6BIP
Multi	*Multi*
VE3BMV	VE3BMV
VC9UM	VC9UM
CY1NN	VE2BPT
VE1AWN	W8LT
W8LT	WA3UKY
WA3UKY	N4UF
W4NVU	WD8KDR
VE8ML	W4NVU
W9WI	CY1NN
WB3GPR	

SSTV CONTEST
Saturday, March 4

Continued on page 129

What Are They Showing On SSTV?

— have you been missing something?

Dave Ingram K4TWJ
Eastwood Village
#1201 So.
Rt. 11, Box 499
Birmingham AL 35201

During the first years of SSTV, most picture transmissions were comprised of lettered information and simple sketches. Commercially-manufactured equipment was not available, thus all slow scanners used home brew monitors and scanning devices. Pictures received from the few amateurs using home brew SSTV cameras were often individually characterized by blemishes created from their TV stations — pullout vidicons or plumbicons.

Then came the advent of commercially-manufactured SSTV gear, and situations changed immensely. A large number of amateurs began operating SSTV and acquiring their first views of distant contacts. Technical advancements were extensive during this particular period, and SSTV soon proved its capability as a worldwide communications tool. Many of these SSTV advancements have appeared in various amateur publications, and several more innovations are presently approaching completion. Next year, for example, projected SSTV expansions will include full color, motion, computer-reprocessed, high-resolution pictures with accompanying audio, and much more. Practically all slow scanners will be able to home modify their equipment to include these features. The cost will be approximately two hundred dollars. Naturally, we slow scanners are proud of such technical and operational accomplishments.

As most of the published articles on slow scan TV have been technically related, the casual reader is seldom exposed to the "operations," or fun, side of SSTV. This article will attempt to fill that void and exemplify how SSTV is expanding horizons as we increase our knowledge and share our personal interest with others. We hope you enjoy the views and may soon consider joining our ranks. The accompanying pictures illustrate a typical one or two evening's SSTV activity in the "1977 style." Keep in mind that photographs of TV pictures usually

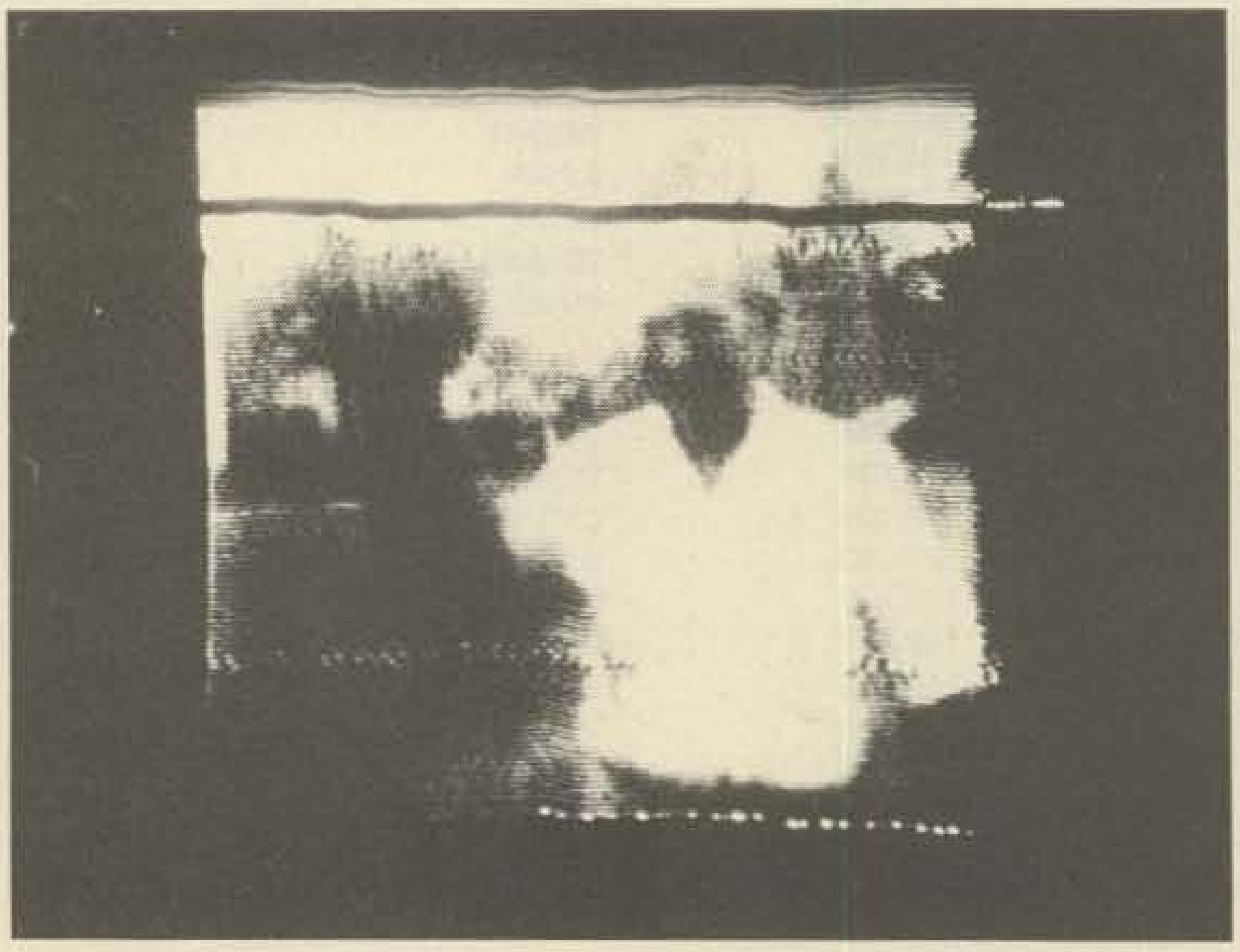


Photo 1. W5DUU.

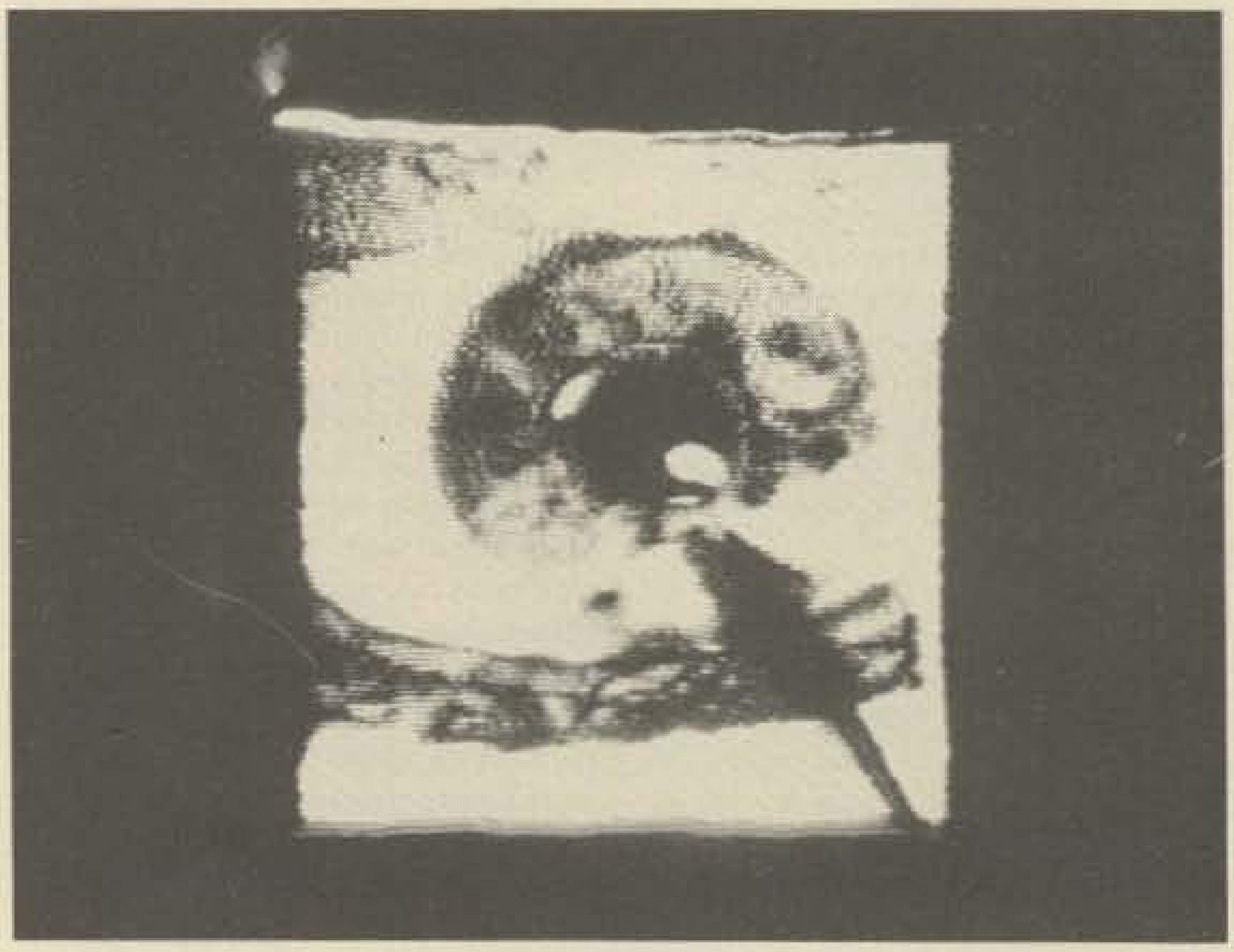


Photo 2. W6KZL.

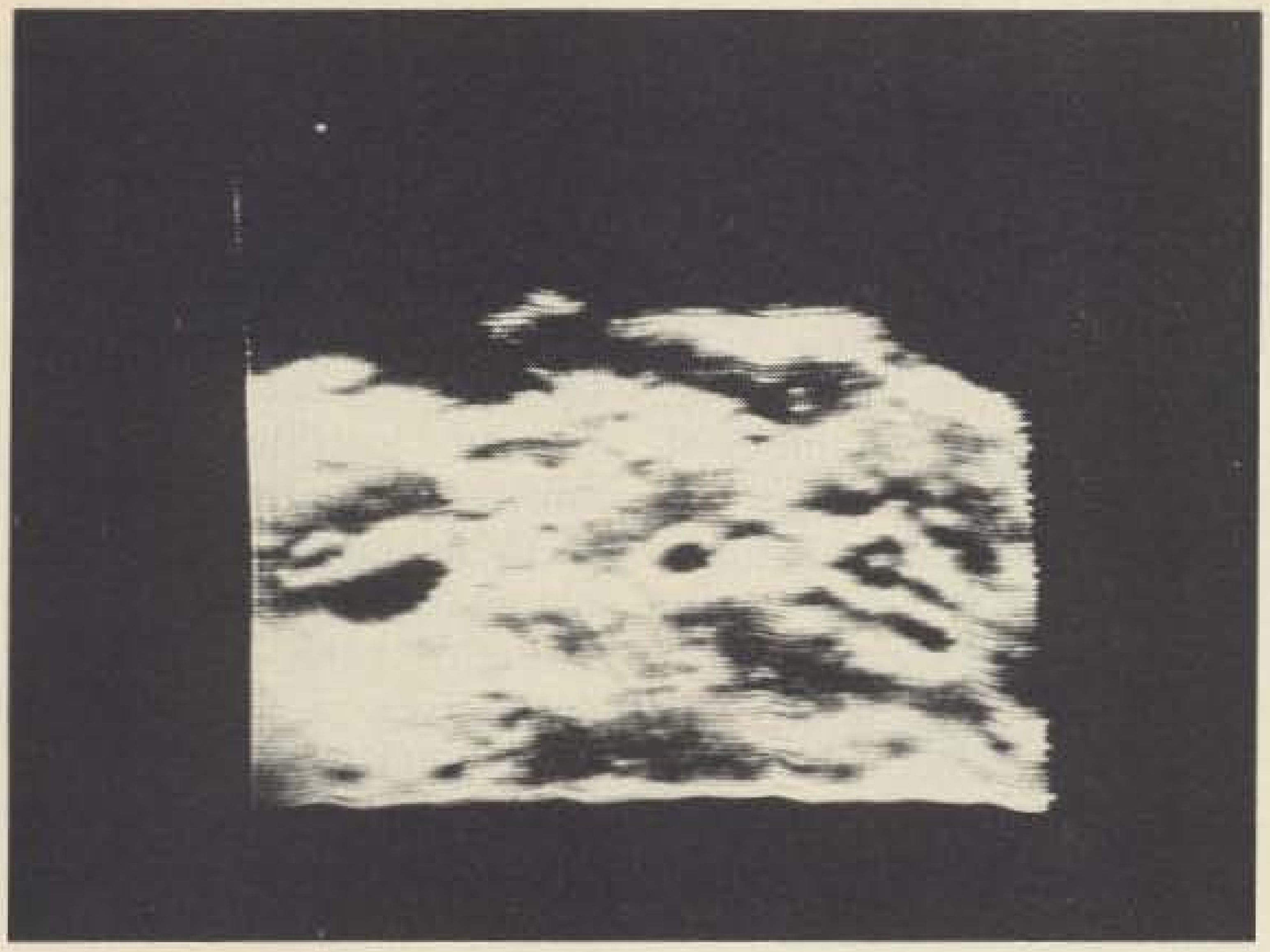


Photo 3. N6V.

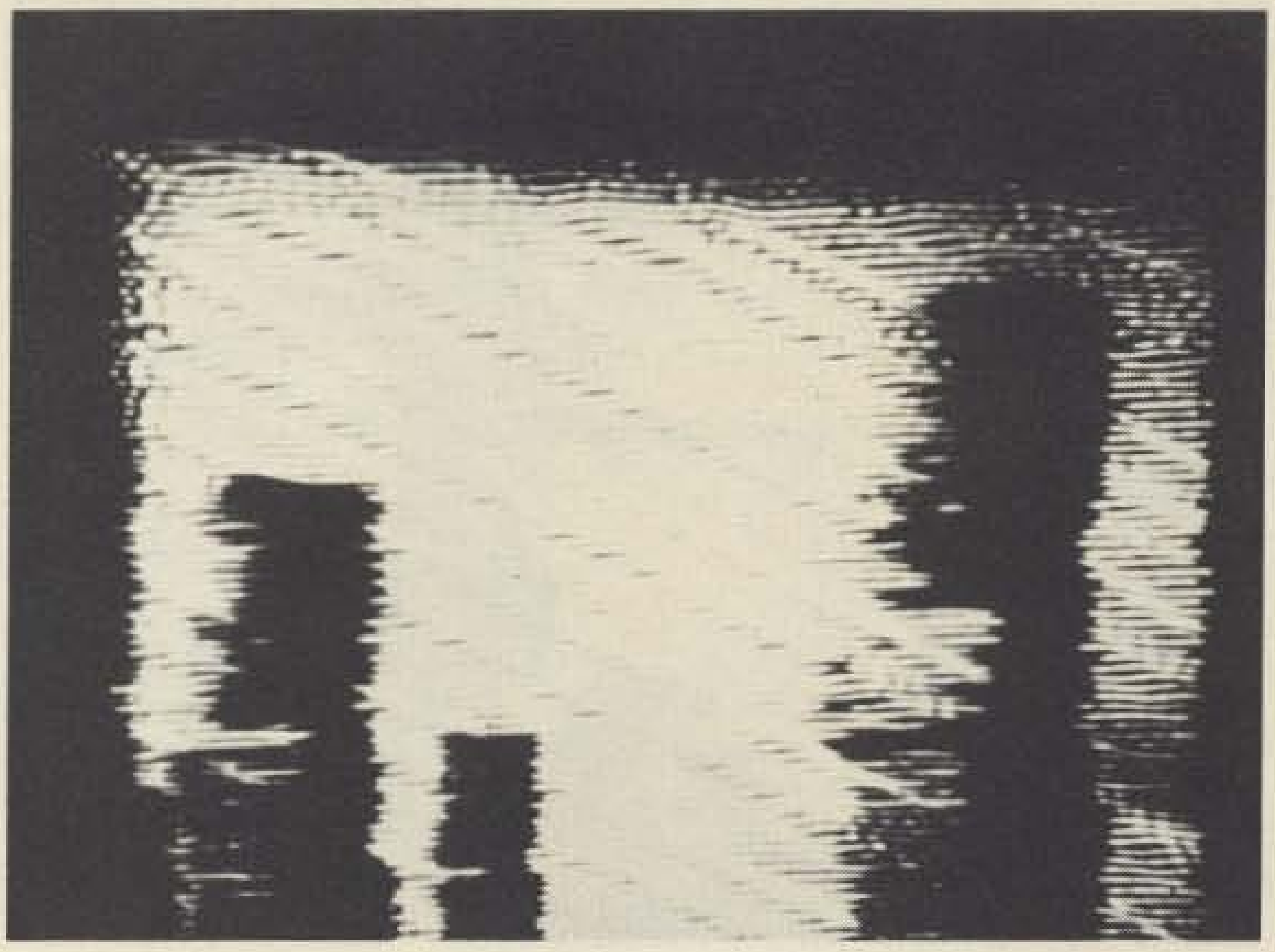


Photo 4. XE2JOF.

reproduce somewhat differently than when originally viewed because of variables like camera f-stops, monitor dot intensity, etc. Also, a certain amount of definition is lost each time a picture is reproduced. These pictures were produced four times for this article. They will have a more authentic slow scan appearance if they are viewed at arm's length.

Photo 1 was received from Dave W5DUU, an accomplished optical surgeon, as he described one of the highly-specialized eye operations he performs. This operation, which corrects glaucoma or cataracts of the eye, consists of surgically opening the eye from the 9 o'clock to the 2 o'clock position, removing the affected tissue, and slipping a corrective lens into the eye. The lens is then moved into position over the pupil and iris, and the eye is resealed. SSTV Photo 1 shows such an eye, with the lens in place and a dark pointer indicating where the initial incision to the eye is made. This highly critical and delicate operation is performed under a microscope. Dave relates that some of the medical concepts of this operation were acquired during World War II, when airline pilots crashed and windshield particles penetrated their eyes.

Photo 2 is an SSTVer's view of Glen W6KZL holding one of his 3½-pound radishes. In addition to being an avid DXer and SSTVer, Glen also enjoys growing large plants and vegetables in his two hydroponic greenhouses. Each greenhouse includes two 9-foot by 8-foot growing trays, plus complete air-conditioning systems. The trays are filled with fertilizer-enriched water and gravel. Plants thrive on the specially-formulated water, while wrapping their roots around the gravel for support. Among the other homegrown vegetables Glen has shown on SSTV are 22-inch cucumbers and 16-ounce tomatoes. Yes, they are quite edible, and they grow year round in the greenhouses. Hopefully, we'll soon get Glen to show more pictures from inside his greenhouses.

Photo 3 is an SSTV scene of Phobos, the second moon of Mars. This classic picture was originally received at the Jet Propulsion Labs in Pasadena, California, and then retransmitted to SSTVers around the world by their club station N6V (the regular club call is W6VIO; N6V was issued for this special event). JPL's assignment was the tracking, data acquisition, and mission control of Viking 6. This picture was received at JPL as the Viking spacecraft passed within 500 miles of Phobos while enroute to Mars. Picture aspect is 5.6 miles wide by 5 miles high and represents the most detailed view ever acquired of this small roughly-cratered moon. The large crater on the left side of Phobos is approximately .8 miles across. Shadows on Phobos are highly defined when com-

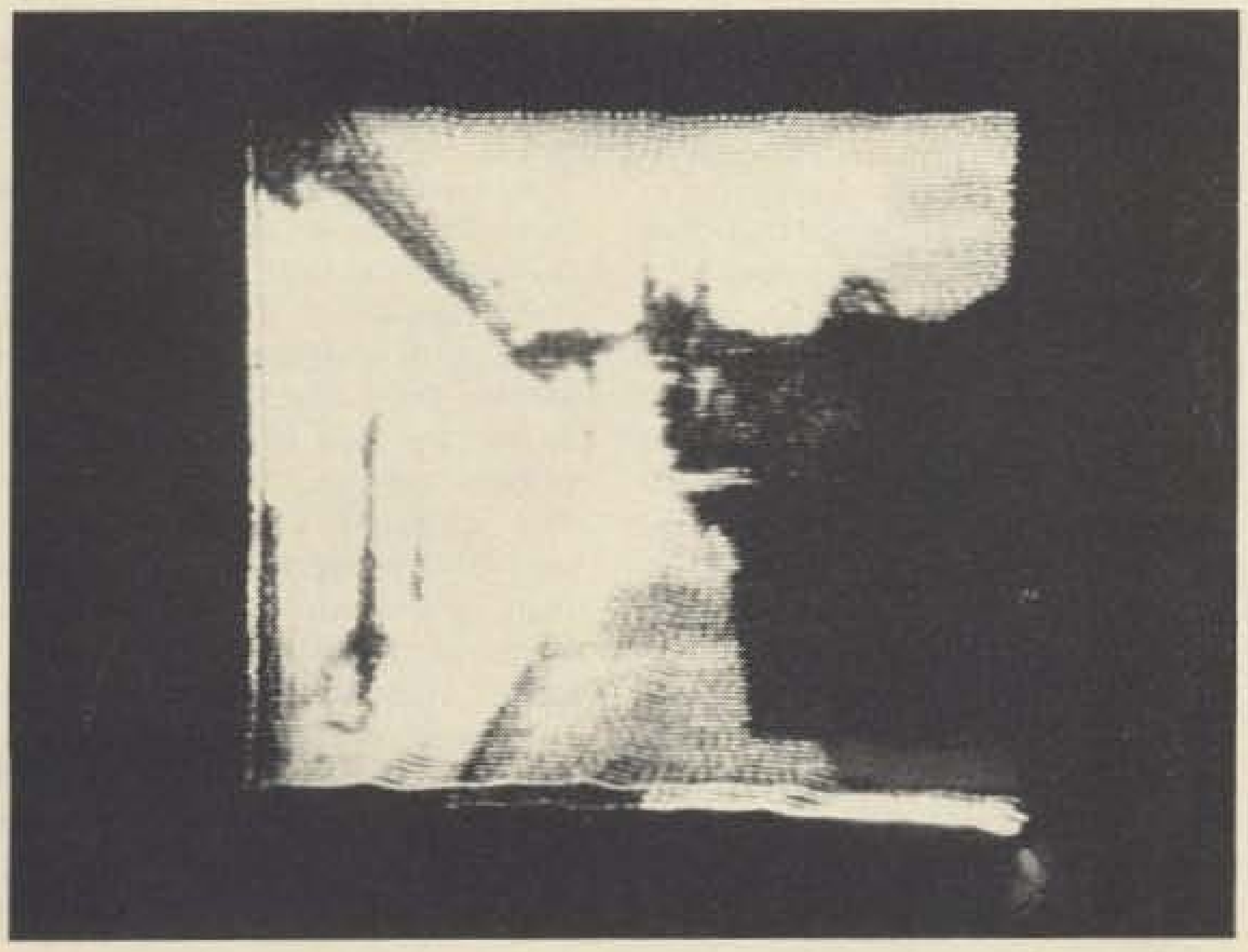


Photo 5. XE2JOF.

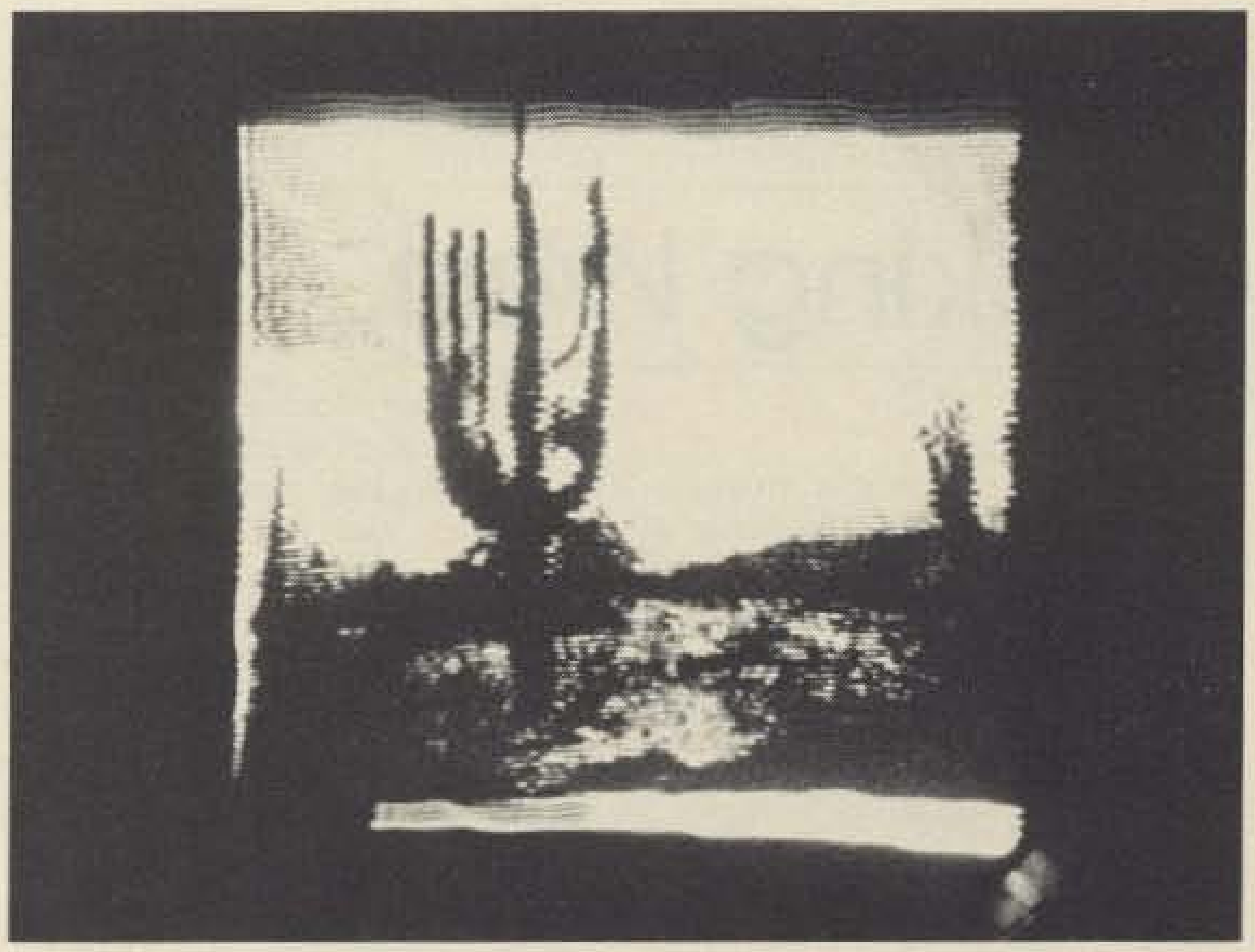


Photo 6. N7TV.

Photo 7. W1BGW.

pared with shadows on Mars, due to the different atmospheres.

SSTVers viewed this picture and many similar Mars pictures before commercial news media received them. Many times during this historical event, SSTVers provided news media with similar ringside-seat views of Mars which were relayed by N6V. During 1978, N6V also plans to provide SSTV coverage of the flyby views of Jupiter and Saturn. During the 1980s, N6V, or W6VIO, will also provide SSTV coverage of the Jupiter orbit and atmospheric probe which is scheduled to be launched along with our space shuttle.

Photo 4 was received from Sergio XE2JOF in Mexico City as he briefly described some of the unusual sights near his area. These giant idols are somewhat similar to the idols found on Easter Island, and they bear the same mysterious legends of origination. (This picture was initially photographed with 35mm slide film and shown during a hamfest program on SSTV. A local photographic technician, Robert Perkins, later converted the slide to a photographic print. As this picture underwent one additional processing step, you can get an idea of the previously mentioned degradation of reproduced SSTV pictures.)

Photo 5 is a street scene which was also received from XE2JOF. Although late afternoon shadows block part of our view, the old world Mexican-type achitecture is quite apparent on the picture's left side. Among the other interesting pictures which Sergio has shared with SSTVers are the Our Lady of Guadeloupe Shrine, Aztec Calendars, and the Mexican Pyramids.

Photo 6, received from Bob N7TV, shows a saguaro cactus which grows in the desert land slightly east of his Tucson, Arizona, home. This cactus grows for hundreds of years and reaches heights of 40 to 60 feet (super antenna support, eh?). The white blossom which appears on the tips of this cactus is the state flower of Arizona.

Bob describes the desert as being alive with flowers and colors which are particularly beautiful during the spring. The Sonoran Desert and the Saguaro National Forest, for example, are very popular tourist attractions. As you've seen in old western movies, all the desert seems to look alike once camping or hiking enthusiasts lose sight of civilization. Compasses and water canteens continue to be vital traveling instruments in this area. Desert heat can sneak up on people because of the low humidity.

Photo 7 is an SSTV-reprocessed weather satellite picture which was received from W1BGW in Massachusetts. Jack acquired this picture from our NOAA-5 satellite as it transmitted cloud cover pictures on the 136 MHz band. The satellite was passing over our eastern seaboard at the time, and the photo shows a fairly well-defined east coast on the right side of the picture, with Lakes Erie and Ontario at the top right. The mid-U.S. (near middle of picture) is covered by heavy clouds. The line through the center of the picture is due to satellite processing of the picture.

Several other SSTVers are also working extensively with weather satellite reception, and their frequent display of SSTV pictures is truly fascinating. One of the most interesting pictures I remember seeing was a view of the Devil's Triangle, which revealed an actual triangular shaped formation in the Atlantic.

This galley of pictures illustrates some of the ways we are using and enjoying SSTV today. Each night's slow scan operation continues to bring more unique experiences, and each day's discussions bring more technical advancements. We SSTVers are having the time of our lives and would like to share our enjoyment with others. If you're tiring of "ordinary" QSOs and are considering a change of pace in amateur radio, we're sure that you, too, will like the fascinating world of SSTV.

The majority of current SSTV activity centers ±10 kHz of the following frequencies (in order of activity): 14,230 kHz; 3845 kHz; 28,680 kHz; 21,340 kHz; and 7171 kHz. The U.S. SSTV Net meets each Saturday at 1800 GMT on 14,230 kHz. We'll be looking forward to seeing you there and learning about your area and special interests, also. ■

Looking West

from page 18

It was about 3:30 that afternoon when the news of the stay reached us here in the Southland. It came as a phone call to SCRA Chairman Jim Hendershot from ARRL Southwestern Vice-Director Jay Holliday W6EJJ. Jay had received word directly from ARRL HQ about this almost unprecedented FCC action. As we were to soon learn, thanks to Jay, we were possibly the first council to get the news. In fact, many other areas got the news from phone calls we made to them looking for reactions on their part. Most said that this was the first inkling they had on the matter. All those that I spoke with were surprised at the news, a few thought I was playing an early "April Fool" joke, some were dismayed, one or two were mad, but the majority seemed almost relieved.

By the am rush hour the next morning, word had spread locally, thanks to announcements made on a couple of key area repeaters. Just about everyone knew that "Repeater/Remote" deregulation had been halted for the moment. I expected to hear some rather bitter reaction from "Joe Ham"; instead, on the three busy repeaters I listened to, there was nary a word on the topic. On one, I broke in and brought up the topic, but there seemed to be total disinterest among the user group on hand. They were far more concerned about a tie-up on the San Diego Freeway than about deregulation of repeaters. I began to wonder if the only people who were really concerned were those who wanted to put up a repeater of their own. Listening around for the next week bore this out. At least out here, the only people who were really upset over the stay were potential repeater "putter-uppers." "Joe Ham" could have cared less.

As I write this on December 4, all is calm. There is no word yet from the Commission as to the outcome of the "reconsideration." Everyone is speculating as to what the next FCC move will be. Daily I receive at least a half dozen calls from amateurs who claim to have "officially" heard this or that. The "officially" usually turns out to be a QSO someplace. I can only say that, in this one, I know about as much as you. The Commission is silent. They are waiting to receive comments on the stay, ideas as to what you and I want them to do. If you have any feelings at all, now is the time to let the FCC know what they are. If you wait, and the final action

Continued on page 49

IC-215 FM

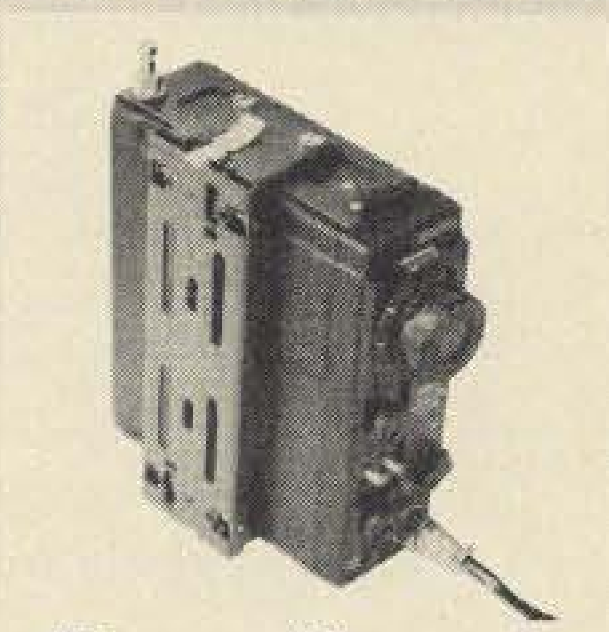
PORTABLE/MOBILE

- 15 channels (12 on dial/3 priority)
- Fully collapsible antenna or "rubber duck"
- Compatible mount for mobile operation
- Dual power (3 watts high/400mw low)
- External power and antenna easily accessible for mobile operation
- Lighted dial and meter
- Double-size, long-lasting internal batteries with optional Ni-Cd pack and charger available

ICOM's **IC-215** is the FM radio that puts good times on the go. Now an outstanding mobile mount and quick-change features for external power, speaker and antenna conversions make moving from base, to vehicle, to hill top fast and easy: and the **IC-215 portable/mobile** provides continuous contact for even the busiest FM enthusiast.

The **IC-215**'s three narrow filters provide quality not usually found in portable VHF equipment. With 15 channel capacity and an MOS FET RF amp with 5 tuned circuits in the front end, the **IC-215** gives optimum FM portable performance.

You'll be carrying quality, performance and versatility with your **IC-215 FM portable/mobile.**



This new mobile mount is now available for your IC-215. Fast insertion and removal is a snap, and the mount is collapsable when not in use.

Specifications: ☐ Frequency Range: 146-148 MHz ☐ Voltage: 13.8 VDC negative ground ☐ Size: 183mm(h) x 61mm(w) x 162mm(d) ☐ Weight: 1.9 kg ☐ Number of Channels: 15 total, 12 on main switch, 3 priority ☐ Power Output: 3.0 W or 0.5 W ☐ Microphone Impedance: 600 ohms ☐ Spurious Level: lower than −60 dB ☐ Receiver Sensitivity: 4 dB below 1 UV or lower ☐ Spurious Response: 60 dB or better

All ICOM radios significantly exceed FCC specifications limiting spurious emissions.

HF/VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT | **DISTRIBUTED BY:**

ICOM

ICOM WEST, INC.
Suite 3
13256 Northrup Way
Bellevue, Wash. 98005
(206) 747-9020

ICOM EAST, INC.
Suite 307
3331 Towerwood Drive
Dallas, Texas 75234
(214) 620-2780

ICOM CANADA
7087 Victoria Drive
Vancouver B.C. V5P 3Y9
Canada
(604) 321-1833

Edgar V. Poirer
P.O. Box 53
Charlo, N.B.
Canada E0B 1M0

Build A Better Phone Patch

—hybrid—op amps—the works

The function of a hybrid in a phone patch is to connect a bidirectional land line to a transmitter and receiver while isolating the received signal from the transmitter. All this can be done without any switching by the operator.

The most common hybrid, a passive transformer type, has a certain amount of loss and not all that much attenuation of the received signal at the transmitter input. It is also subject to some phase shifting, which makes the attenuation over the full range of audio frequencies very difficult. A typical circuit is shown in Fig. 1. RX and CX are chosen to null the receiver signal at the transmitter. Their value depends on line characteristics. Note the dots near the transformer windings. These indicate winding direction, and this is very important for the proper operation of the hybrid. The main disadvantage of the transformer hybrid is the relatively low amount of attenuation at the null.

While looking at some notes on op amps, it suddenly struck me that an op amp could be used to make a better hybrid. By using an op amp difference amplifier to compare the signal coming directly from the receiver with the same signal at the toll line, a high degree of isolation could be achieved. However, a signal from the toll line would be amplified only if some isolation were provided between the receiver and the line transformer. This could easily be accomplished by another op amp used as a noninverting line amplifier.

The op amp difference amplifier compares the levels of the signals reaching both the inverting and noninverting inputs and amplifies the difference. If both signals are identical, the output is zero. See Fig. 2 for details.

The final circuit for the

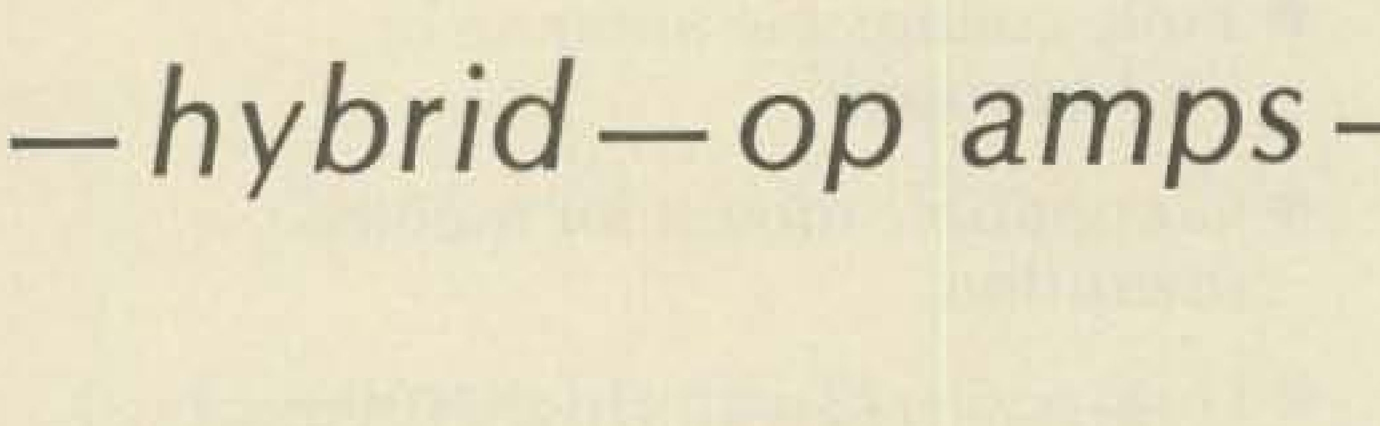


Fig. 1. Typical transformer hybrid.

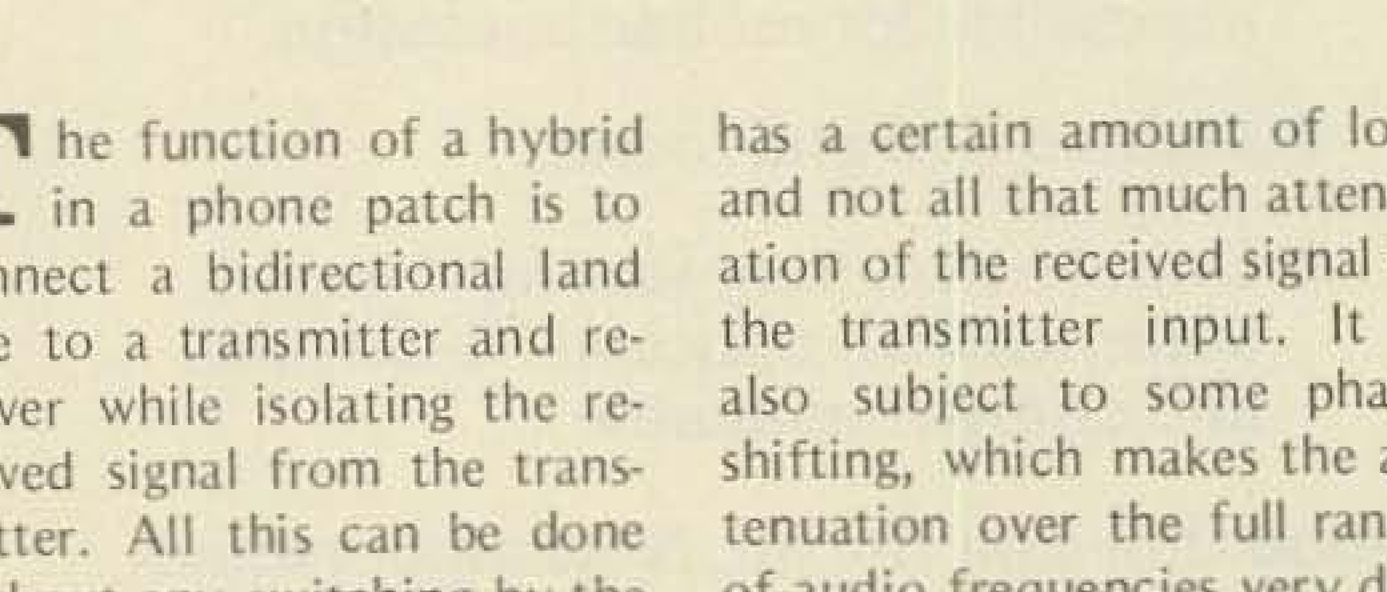


Fig. 2 Difference amplifier.

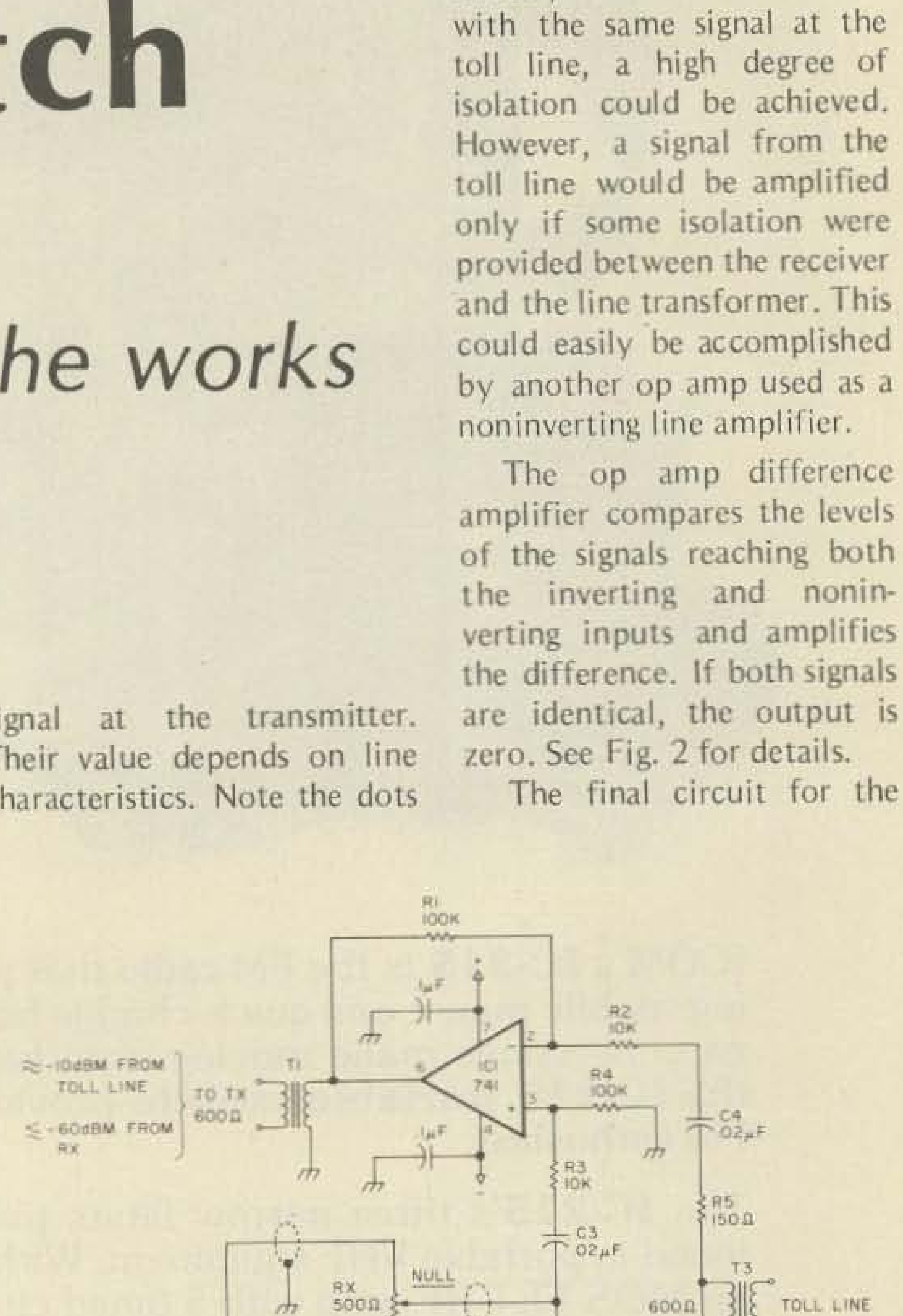


Fig. 3. Solid state hybrid. Note: The resistors are ½ W; the capacitors are mylar; T1, T2, and T3 are 600Ω to 600Ω.

solid state hybrid is shown in Fig. 3. To prevent excessive phasing problems, R5 and R10 are used to couple the two op amps, rather than a transformer. Some phase shifting may still occur in IC2. In order to compensate, we introduce CX. RX and CX form the balancing network. RX is mainly used to adjust for differences in levels, but, with CX, it also introduces a variable phase shift. To properly adjust RX and CX, we must go back and forth from one to the other until the signal from T2 is no longer present at T1. A typical value for CX is 0.002 uF, with RX near the center of its range. A capacitance substitution box is almost indispensable to find the value of CX. For proper operation, phase shifts in the circuit must be held to a minimum. No frequency response shaping networks should be used at the op amps. If these are required, they should be included outside the hybrid. Capacitors should be avoided. C3 and C4 are acceptable, however, as any small phase shift they introduce can be corrected for by CX and RX if they are fairly well matched.

R7 and R8 are used to attenuate the received signal to the proper level at the roll line and are dependent on the level of the received signal. R1 and R4 set the gain of IC1 and could be altered for a different set of requirements, or another amplifier could be included between T1 and IC1. The gain of IC1 should not be increased, since this would make nulling much more critical.

This particular circuit was designed for a system that uses compression amplifiers after T1 and before T2. These insure that any changes in the receiver or toll line levels will not affect the duplex operation. A simple compressor/expander as described in the January, 1977, issue of *73* would be ideal. The levels in Fig. 3 are typical for the circuit shown. The transformers T1 and T2 may not be required if a balanced line is not used. The installation for which this circuit was built is a marine radio land station operated by the Canadian Ministry of Transport. It was designed for use in a ship-to-shore duplex system.

I would suggest that printed circuit construction be used as well as shielded wiring, since some of the audio levels are as low as -40 dBm. The circuit should also be in a shielded enclosure to further reduce the possibility of noise. Power supply requirements are not too critical. A simple power supply, such as that shown in Fig. 4, should be adequate. Good construction practice is a must to keep hum and noise down. T4 should be positioned to minimize hum.

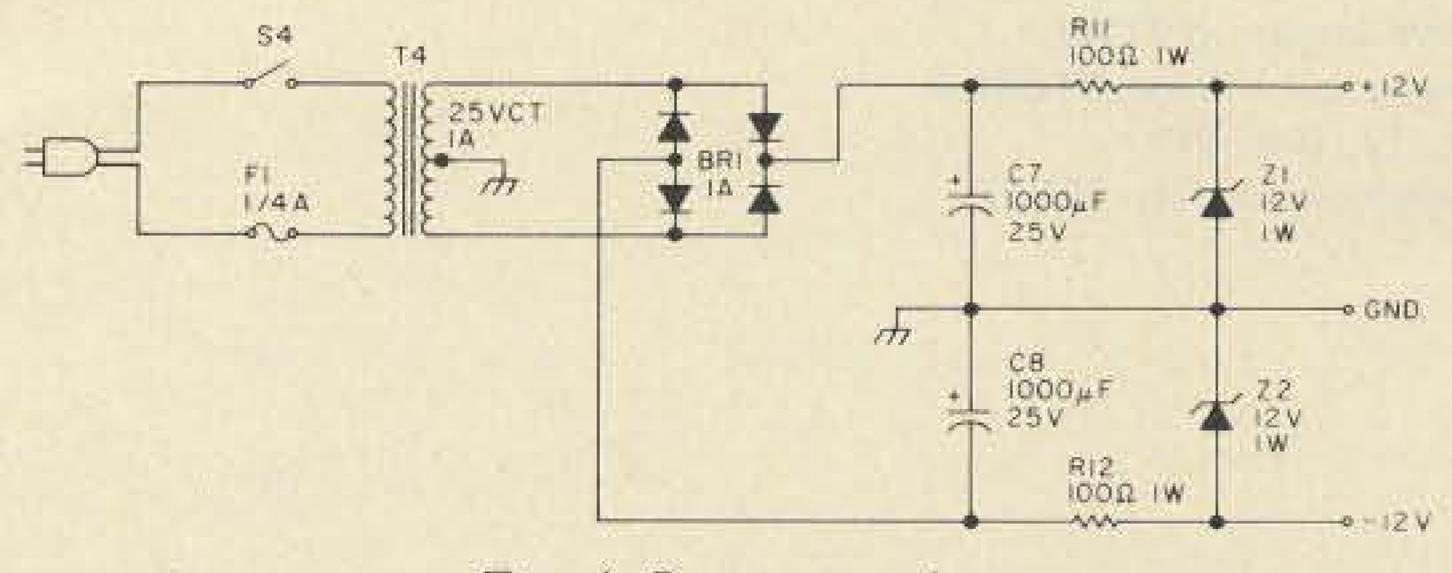


Fig. 4. Power supply.

This circuit is very economical and is a practical approach to building a good phone patch. T3 may have to be connected to the toll line through a coupler. Details on obtaining one should be available through local telephone offices. This circuit is very flexible and may be adapted to different installations without any great difficulties.

My thanks to Bernard Cormier and the staff for their help in proving the design. ■

Dave Ingram K4TWJ
Eastwood Village #1201 S.
Rt. 11, Box 499
Birmingham AL 35201

Drake TR-4CW Review

Recently, I was confronted with the very pleasant task of selecting a new transceiver for my low-band setup at home. Such occasions are rather rare in my life, so I gathered information on every available unit and went over it with a fine-tooth comb. I wanted (among other things) a state-of-the-art rig with reliability, service, and station compatibility. As I have an extensive electronics background and could afford any one of the popular transceivers, my final choice was to be based on what I considered the best all-around rig.

While pondering this decision, I continued to enjoy my ever-faithful Drake TR-4 transceiver (five years service without any problems). I kept thinking, also, of the entanglements I've had trying to get parts for my Japanese-manufactured 2 meter handie-talkie (service was merely a legend).

Then R. L. Drake Company announced their TR-4CW transceiver, and I knew that my decision had been made. If this transceiver performed half as well as my older TR-4, it would be a winner. If I ran into a problem that I couldn't solve in a few minutes time, I could phone the service department of Drake Company and get assistance. I could purchase any necessary parts from a local distributor. Now that's reliability! Another detail that I appreciated was being able to purchase extra Drake knobs and cabinets for my home brew linear amplifier, SSTV monitor, and station control. This really added the "professional matching touch" to all my gear.

The R. L. Drake TR-4CW runs 300 Watts SSB input and 260 Watts CW input on the 80 through 10 meter amateur bands. A generous overcoverage on most bands permits tuning any band expansions that might evolve in 1979. The dial is calibrated in 1 kHz increments, and visual interpolation to 250 Hz or 500 Hz is quite easy. Receiver sensitivity is better than .5 uV for a 10 dB signal plus noise ratio, which means that you can hear those weak stations without straining. One of the outstanding features of the TR-4CW is its superb agc action – less than 3 dB variation for 60 dB change in input signals. This means that an S2 signal and a 40 dB over S9 signal produce practically the same audio volume from the speaker. This feature is a super advantage if you like working DX, contests, or don't like a blaring rig when someone throws a 2 kW signal on frequency. The TR-4CW's 8-pole SSB filter has the same shaping factor and ultimate rejection as any 8-pole filter, but less in-circuit loss. It has an initial bandpass of 2.1 kHz and does a beautiful job of eliminating adjacent-channel interference. The big news on the TR-4CW is its 500 Hz CW filter. This filter is standard equipment – not an option – and it really pulls weak stations out of the mud. Either the SSB or CW filter can be front panel selected for CW use. If you like comfortable operating and a quiet but highly sensitive rig, the TR-4CW will spoil you!

The R. L. Drake TR-4CW.

Several front panel controls increase the rig's flexibility by serving a dual purpose. The transmitter gain control functions as an rf output level control on CW/tune and as a mike gain control on SSB. The VOX sensitivity tracks with this control during SSB operation, but it can also be independently adjusted by a side-mounted control, if desired. In other words, should you decide to talk softer, you merely increase the transmitter gain and the VOX will follow it. The VOX can be overridden by merely keying the mike's push to talk. Another side-mounted control

Shoestring Switching For CW

Skip Baldwin
Box 76
FPO San Francisco CA 96637

There are quite a number of us who are just getting into ham radio. We don't have much money to buy some of the nicer and very expensive transceivers that are on the market today. So we are forced to turn to the role of the modifier and experimenter. Having become one of the aforementioned through necessity, I have developed a working system for the switching of a receiver and transmitter for low power CW work.

The circuit is quite easy to make and utilizes a minimum of parts and dollars. It uses a standard telephone switching relay, which has at least two transfer switches. Let me explain what I mean by transfer switches. They are the levers of the switch that either make (close) or break (open), depending on the operation of the relay. By utilizing these transfer switches and their operation, you can switch the antenna inputs between a transmitter and a receiver. Thus, a hands-off operation is made using the relay. Operation is made possible by a foot switch made from a push-button SPST switch. This is mounted on a board which is laid on the floor.

Construction

Mount the relay on a board or in a small cabinet (one would be available at Radio Shack or any other electronics store). You can get the relay from Radio Shack, another electronics store, or an outlet that stocks surplus telephone equipment. This switch doesn't have to have two transfer switches, but, if it does, you will be able to also have a switched ground. Mount your antenna leads to the relay as in Fig. 1. Also, mount your transmitter and receiver to the relay as in Fig. 1. The antenna mounts on the lever or moving arm of the relay. The transmitter mounts to the contact, which is closed with the lever switch when power is applied. In most relays this is the bottom contact. The receiver mounts to the contact, which is closed when power is applied to the relay. Also, do the same with the coax ground on another transfer switch.

Mount the switch on a board, or some other piece of metal or plastic, to form a pedal. Leave enough slack in the wire for a change in position, or to move it out of the way when not in use. Wire the switch in series to the coil of the relay and a 12 V dc power supply. This power supply may be a standard ac to dc or a 12 V battery. The supply input should be mounted on the board with the relay.

That's about all there is to it, except that this should only be used with a low power rig, and the transmitter and the receiver should be kept a distance away from each other, so there will be no spurious emissions that the receiver might pick up. If you get a relay with three transfer switches, it would be possible to key the relay from your speaker on the receiver. Keep an eye on the relay contacts for charring, the first couple of times you use this. It should work well with 25 Watts or less on CW. Total cost of this project should be in the neighborhood of $5.00. ■

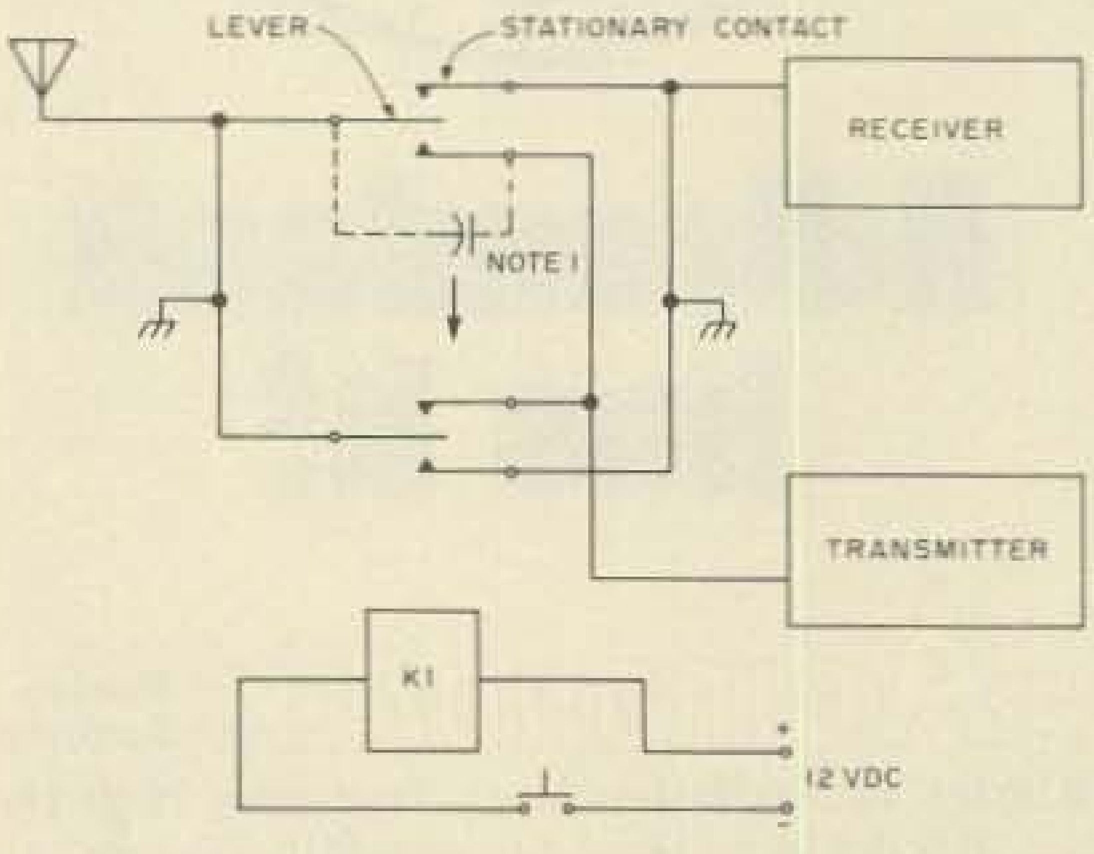


Fig. 1. Note 1: A 1000 uF capacitor may be put across the contacts if arcing occurs. No power must be applied from the transmitter during switching.

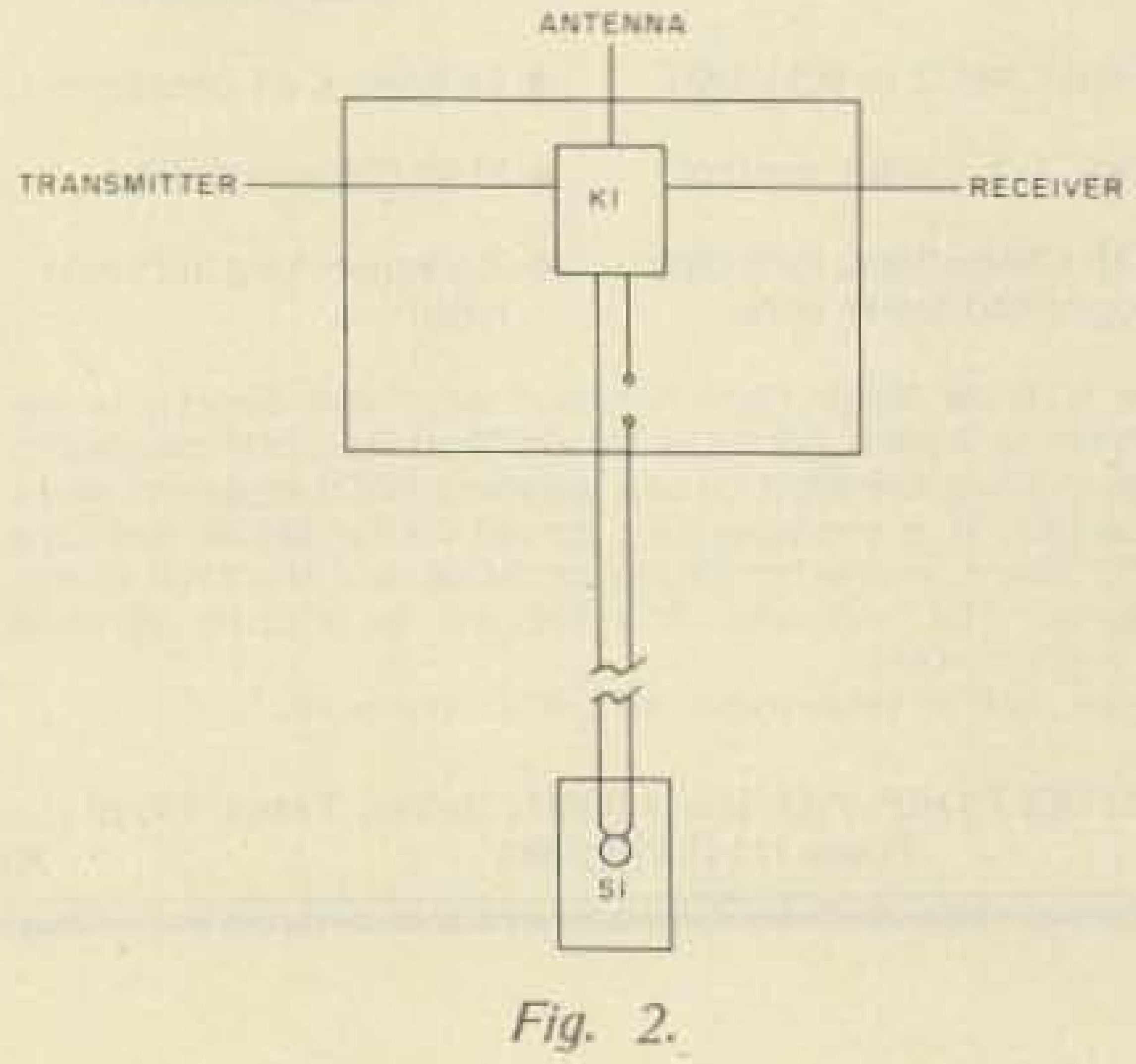


Fig. 2.

Ralph A. Giffone N2RG
963 East 105 Street
Brooklyn NY 11236

Relaying For Fun and No Profit

The National Traffic System (NTS) is a major traffic network composed of many building blocks called nets. Through well-planned schedules and routing of traffic, NTS can take traffic from anywhere to everywhere in a matter of hours. The most fundamental of all NTS nets is the section net. Your traffic handling adventure begins here.

In my opinion, if you can function on a CW net, you can function on a phone and RTTY net. Not so the other way around. I will therefore put my first emphasis on CW traffic handling and CW net procedures and branch off later in the article to cover all facets of traffic handling.

Amateur Message Form

The first time that you check into your section net, you will probably want to listen in and get the feel of the net. Soon, however, you'll want to take part in the net's activity. The first traffic that you are likely to handle will be one of your own origination. It is essential, therefore, that you know how to originate third party traffic.

Fig. 1 shows the ARRL's CD Operating Aid 9, which explains the *Amateur Message Form*. Every message that you ever send or receive must be in this form. To some, it seems rather complex; to others, it is just part of the game! Let's break it down and find the significance of each part.

The first major section is called the preamble. This is specifically for the benefit of the station receiving the message (hereafter referred to as the *relay station* or *relay*). The preamble is broken up into eight parts, a-h. Please use Fig. 1 as a guide.

a. *Message Number* – Each and every message must have a number. You begin with NR 1 and continue sequentially. This number is for filing purposes and reference purposes (to be clearly explained later). Some stations begin with NR 1 each month, some each year. It's completely up to the operator's preferences.

b. *Precedence* – The precedence is extremely important. There are four precedences: Emergency, Priority, Inquiry, and Routine. They are handled in that order also. An *emergency* message will *always* be handled before all others. The same is true for the other precedences – the higher the precedence, the quicker it must be handled. Fig. 1 has a list of precedences. I suggest that you read it carefully and understand it fully. Virtually every message that you will handle will be a *routine* message unless there is an emergency. This, however, is extremely *rare*. Note: On CW, routine is R, inquiry is Q, and priority is P, but emergency is always spelled out completely.

c. *Handling Instructions* – Handling instructions are optional, that is, they are not essential for proper handling of traffic. There may be, however, some special duty that the originating station requests of the delivering station. For instance: HXE tells the delivering station to originate a reply for the addressee. If you are very demanding and wish to combine two or more instructions, you may. HXCE means to not only get a reply, but to also report the date and time of delivery. (Note that some handling instructions, like HXA, may be followed by a number.) I suggest that you read all the different handling instructions, though it isn't necessary to memorize every single one.

d. *Station of Origin* – The station who originally sent the message. This is very important, as you will see later.

e. *Check* – The check is the number of words in the text of the message. It is very helpful because it allows the relay station to *check* if he has received your message completely. If his "word count" does not agree with the check, he is then alerted that something is wrong.

f. *Place of Origination* – This is quite obvious. It is not trivial, however, as its importance will be clear later.

g. *Time Filed* – This is optional and most messages do not include this unless there is some specific time limit on the delivery of the message (see HXB).

h. *Date* – Simply the date that the message was filed. Note that if you include the time, the date must agree with that time: If the time is UTC, it may be a different day by UTC than it is locally, so be observant!

The preamble is a well-designed introduction which has many helps for the relay and delivering station. More references to this later.

The second part of the radiogram is the *address*. The address should be as complete as one you would put on an envelope. (The delivering station may have to mail it.) You should include the phone number if you have it.

When the address is sent, it is necessary to separate each line of the address with $\overline{\text{AA}}$ (di*dah*di*dah*, not di*dah* di*dah*). *This is an absolute must.* You would not address an envelope using only one line, would you? No. After the last line, however, you must send $\overline{\text{BT}}$ instead of $\overline{\text{AA}}$.

The third part of the radiogram is called the text (of the message). Remember that there is *no punctuation whatever*. All thoughts are separated by *X*. If you have a question, you may send the word QUERY after it, but *never* dididahdahdidit (i.e., "How are you query I am fine X 73").

The text begins with $\overline{\text{BT}}$ (break) and ends with $\overline{\text{BT}}$. Remember the check? It is the number of words between both $\overline{\text{BT}}$s. (X and query are counted as words; $\overline{\text{BT}}$ is not.)

The fourth and last part of the radiogram is the signature. It is sent after the last $\overline{\text{BT}}$. The signature is followed by $\overline{\text{AR}}$. If there is another message to follow, you send $\overline{\text{AR}}$ B. If there is no other message, $\overline{\text{AR}}$ N is proper.

The Amateur Message Form is not really difficult, but it is essential for proper traffic handling. It should be *very* familiar to you before continuing on.

Throughout the rest of the article I will be using Q signals and abbreviations that will be most unfamiliar to you. They are listed in Fig. 2, which displays the flip side of CD Operating Aid 9 mentioned earlier.

When you feel that you are ready to check in (QNI) to your section net, tune in the net's frequency at net time and wait for the Net Control Station (NCS) to "call up" the net. He will call up the net by sending CQ followed by the net's respective designation. For example, the net designation for the New York City-Long Island Slow Speed Section Net is *NLS*. At 6 pm on 3.730 MHz, the NCS for that night will send: "CQ NLS CQ NLS DE WB2YKG NLS THE NEW YORK CITY AND LONG ISLAND SLOW SPEED SECTION NET *QND QNZ* NLS DE WB2YKG *QNI K* . . .". He will then listen for people trying to check in. If you wish to check in, send a Morse code character to the NCS, and, if he sends it back, you may then check in. For example, he sends *NLS K* and you send *dididahdit*. If he sends back *diddidahdit*, that means that you can call him and list your traffic. You check in this way: WB2YKG

AMATEUR MESSAGE FORM

Every message originated and handled should contain the following component parts in the order given.

I PREAMBLE
- *a.* Number (begin with 1 each month or year)
- *b.* Precedence (R, Q, P or EMERGENCY)
- *c.* Handling instructions (optional, see text)
- *d.* Station of Origin (first amateur handler)
- *e.* Check (number of words/groups in text only)
- *f.* Place of Origin (not necessarily location of station of origin)
- *g.* Time Filed (optional with originating station)
- *h.* Date (must agree with date of time filed)

II ADDRESS (as complete as possible, include zip code and telephone number)

III TEXT (limit to 25 words or less, if possible)

IV SIGNATURE

CW MESSAGE EXAMPLE

I NR 1 R HXA W1AW 8 NEWINGTON CONN 1830Z July 1
(a b c d e f g h)

II DONALD R SMITH $\overline{\text{AA}}$
164 EAST SIXTH AVE $\overline{\text{AA}}$
NORTH RIVER CITY MO 00789 $\overline{\text{AA}}$
FONE 733 3967 $\overline{\text{BT}}$

III HAPPY BIRTHDAY X SEE YOU SOON X LOVE $\overline{\text{BT}}$

IV DIANA $\overline{\text{AR}}$

CW: Note that X, when used in the text as punctuation, counts as a word. The prosign $\overline{\text{AA}}$ separates the parts of the address, $\overline{\text{BT}}$ separates the address from the text and the text from the signature. $\overline{\text{AR}}$ marks end of message; this is followed by B if there is another message to follow, by N if this is the only or last message. It is customary to copy the preamble, parts of the address, text and signature on seperate lines.

RTTY: Same as cw procedure above, except (1) use extra space between parts of address, instead of $\overline{\text{AA}}$; (2) omit cw procedure sign $\overline{\text{BT}}$ to separate text from address and signature, using line spaces instead; (3) add a CFM line under the signature, consisting of all names, numerals and unusual words in the message in the order transmitted.

PHONE: In general, use *prowords* in place of procedural signals or *prosigns*. The above message on phone would go something like this: "*Message Follows* Number one, routine, HX Alpha, W1AW, *check* eight, Newington, Connecticut, one eight thuhree zero zulu, July one, *to* Donald *Initial* R Smith, *Figures* one six fower, East Sixth Avenue, North River City, Missouri zero zero seven eight nine, Fone seven thuhree thuhree, thuhree niyen six eight. *Break* Happy Birthday X-ray see you soon X-ray love *Break* Diana. *End of Message. Over.*" Speak in measured tones, emphasizing *every* syllable. Spell out phonetically all difficult or unusual words, but do *not* spell out common ones.

PRECEDENCES

The precedence will follow the message number. For example, on cw 207R or 207 EMERGENCY. On phone, "Two Zero Seven, Routine (or Emergency)."

EMERGENCY – Any message having life and death urgency to any person or group of persons, which is transmitted by amateur radio in the absence of regular commercial facilities. This includes official messages of welfare agencies during emergencies requesting supplies, materials or instructions vital to relief of stricken populace in emergency areas. During normal times, it will be *very rare*. On cw, this designation will *always* be spelled out. When in doubt, do *not* use it.

PRIORITY – Important messages having a specific time limit. Official messages not covered in the "Emergency" category. Press dispatches and other emergency-related traffic not of the utmost urgency. Notification of death or injury in a disaster area, personal or official. Use the abbreviation P on cw.

INQUIRY – Messages pertaining to the health or welfare of persons in a disaster should carry this precedence, which is abbreviated to Q on cw. These messages are handled *after* PRIORITY traffic but before ROUTINE.

ROUTINE – Most traffic in normal times will bear this designation. In disaster situations, traffic labeled "Routine" (R on cw) should be handled *last*, or not at all when circuits are busy with emergency, priority or inquiry traffic. Most traffic handled on amateur circuits in normal times will fall in this category.

Handling Instructions

HXA – (Followed by number.) Collect landline delivery authorized by addressee within . . . . miles. (If no number, authorization is unlimited.)

HXB – (Followed by number.) Cancel message if not delivered within . . . . hours of filing time; service originating station.)

HXC – Report date and time of delivery (TOD) to originating station.

HXD – Report to originating station the identity of station from which received, plus date and time. Report identity of station to which relayed, plus date and time, or if delivered report date, time and method of delivery.

HXE – Delivering station get reply from addressee, originate message back.

HXF – (Followed by number.) Hold delivery until . . . . (date).

HXG – Delivery by mail or landline toll call not required. If toll or other expense involved, cancel message and service originating station.

This prosign (when used) will be inserted in the message preamble before the station of origin, thus: NR 207 R HXA50 W1AW 12 . . . . (etc.). If more than one HX prosign is used, they can be combined if no numbers are to be inserted, otherwise the HX should be repeated, thus: NR 207 R HXAC W1AW . . . . (etc.), but: NR 207 R HXA50 HXC W1AW . . . . (etc.); On phone, use phonetics for the letter or letters following the HX, to insure accuracy.

OPAID 9

ARRL, 225 Main St., Newington, CT 06111

Fig. 1. ARRL's CD Operating Aid 9, the Amateur Message Form.

ARRL QN SIGNALS FOR CW NET USE

QNA*	Answer in prearranged order.
QNB*	Act as relay Between.... and....
QNC	All net stations Copy. I have a message for all net stations.
QND*	Net is Directed (controlled by net control station).
QNE*	Entire net stand by.
QNF	Net is Free (not controlled).
QNG	Take over as net control station.
QNH	Your net frequency is High.
QNI	Net stations report In.* I am reporting into the net. (Follow with a list of traffic or QRU.)
QNJ	Can you copy me? Can you copy.....?
QNK*	Transmit messages for.....to.....
QNL	Your net frequency is Low.
QNM*	You are QRMing the net. Stand by.
QNN	Net control station is..... What station has net control?
QNO	Station is leaving the net.
QNP	Unable to copy you. Unable to copy.....
QNQ*	Move frequency to....and wait for.....to finish handling traffic. Then send him traffic for.....
QNR*	Answer.....and Receive traffic.
QNS	Following Stations are in the net.* (Follow with list.) Request list of stations in the net.
QNT	I request permission to leave the net for....minutes.
QNU*	The net has traffic for you. Stand by.
QNV*	Establish contact with....on this frequency. If successful, move to....and send him traffic for....
QNW	How do I route messages for....?
QNX	You are excused from the net.* Request to be excused from the net.
QNY*	Shift to another frequency (or to....kHz) to clear traffic with....
QNZ	Zero beat your signal with mine.

*For use only by the Net Control Station.

Notes on Use of QN Signals

The QN signals listed above are special ARRL signals for use in amateur cw nets only. They are not for use in casual amateur conversation. Other meanings that may be used in other services do not apply. Do not use QN signals on phone nets. Say it with words. QN signals need not be followed by a question mark, even though the meaning may be interrogatory.

INTERNATIONAL Q SIGNALS

A Q signal followed by a ? asks a question. A Q signal without the ? answers the question affirmatively, unless otherwise indicated. See the ARRL *Handbook* and *Operating an Amateur Radio Station* for an expanded list.

QRA	What is the name of your station?
QRG	What's my exact frequency?
QRH	Does my frequency vary?
QRI	How is my tone? (1-3)
QRK	What is my signal intelligibility? (1-5)
QRL	Are you busy?
QRM	Is my transmission being interfered with?
QRN	Are you troubled by static?
QRO	Shall I increase transmitter power?
QRP	Shall I decrease transmitter power?
QRQ	Shall I send faster?
QRS	Shall I send slower?
QRT	Shall I stop sending?
QRU	Have you anything for me? (Answer in negative.)
QRV	Are you ready?
QRW	Shall I tell....you're calling him?
QRX	When will you call again?
QRZ	Who is calling me?
QSA	What is my signal strength? (1-5)
QSB	Are my signals fading?
QSD	Are my signals mutilated?
QSG	Shall I send....messages at a time?
QSK	Can you work breakin?
QSL	Can you acknowledge receipt?
QSM	Shall I repeat the last message sent?
QSO	Can you communicate with....direct?
QSP	Will you relay to....?
QSV	Shall I send a series of V's?
QSW	Will you transmit on....?
QSX	Will you listen for....on....?
QSY	Shall I change frequency?
QSZ	Shall I send each word/group more than once? (Answer, send twice or....)
QTA	Shall I cancel number....?
QTB	Do you agree with my word count? (Answer negative.)
QTC	How many messages have you to send?
QTH	What is your location?
QTR	What is your time?
QTV	Shall I stand guard for you....?
QTX	Will you keep your station open for further communication with me?
QUA	Have you news of....?

ABBREVIATIONS, PROSIGNS, PROWORDS

CW	PHONE (meaning or purpose, exception obvious)
$\overline{\text{AA}}$	(Separation between parts of address or signature.)
AA	All after (used to get fills).
AB	All before (used to get fills).
ADEE	Addressee (name of person to whom message addressed).
ADR	Address (second part of message).
$\overline{\text{AR}}$	End of message (end of record copy).
ARL	(Used with "check," indicates use of ARRL numbered message in text.)
$\overline{\text{AS}}$	Stand by; wait.
B	More (another message to follow).
BK	Break; break me; break-in. (Interrupt transmission on cw. Quick check on phone.)
$\overline{\text{BT}}$	Separation (break) between address and text; between text and signature.
C	Correct; yes.
CFM	Confirm. (Check me on this.)
CK	Check.
DE	From; this is (preceding identification).
FONE	Phone; telephone.
$\overline{\text{HH}}$	(Error in sending. Transmission continues with last word correctly sent.)

-over-

CW	PHONE (meaning or purpose, exception obvious)
HX	(Handling instructions. Optional part of preamble.)
....	Initial(s). Single letter(s) to follow.
$\overline{\text{IMI}}$	Repeat; I say again. (Difficult or unusual words or groups.)
K	Go ahead; over; reply expected. (Invitation to transmit.)
N	Negative; incorrect; no more. (No more messages to follow.)
NR	Number. (Message follow.)
PBL	Preamble (first part of message).
....	Read back. (Repeat as received.)
R	Roger; point. (Received; decimal point.)
SIG	Signed; signature (last part of message).
$\overline{\text{SK}}$	Out; clear (end of communication, no reply expected).
TU	Thank you.
WA	Word after (used to get fills).
WB	Word before (used to get fills).
....	Speak slower.
....	Speak faster.

Printed in U.S.A.

Fig. 2. Q signals and abbreviations.

STATION ACTIVITY REPORT To SCM of NL1 ARRL Section

Amateur Radio Station WB2XXX Appointment(s) ORS Month AUGUST

Major Activity: (Tfc, DX, etc.) TRAFFIC

TRAFFIC*	
Originated	5
Received	13
Sent	7
Delivered	10
Total	35
No. of Oprs	1

SCHEDULES AND NET AFFILIATIONS:	Time	Frequency
NLS	6:00 pm	3730
NL/PN	5:30 am	3930

REMARKS to assist SCM with report (changes in rig, AREC/RACES drills, prospects for appointment, outstanding records, special stunts, items of general interest, etc.):

GOT A NEW RIG — JUST PASSED FCC TEST — EXPERIMENTING WITH NEW BEAM — ETC.

Signed

* Originated: A message originated by someone other than yourself, filed for initial transmission at your station. Received: Any message received over the air at your station. Sent: Any message sent over the air from your station. Delivered: Any message received at your station and delivered to someone other than yourself. See Operating an Amateur Radio Station for further details.

Form 1 Printed in U.S.A.

Public Service Honor Roll

This listing is available to amateurs whose public service during the reported month qualifies for 40 or more total points in the nine categories below. Please note the maximum points for each category.

Category	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	
Max. Pts.	10	10	12	12	12	20	3	–	5	
Your Totals										=

Category Key: (1) Checking into cw nets, 1 point each; (2) Checking into phone/RTTY nets, 1 point each; (3) NCS cw nets, 3 points each; (4) NCS phone/RTTY nets, 3 points each; (5) Performing assigned liaison, 3 points each; (6) Legal phone patches, 1 point each; (7) Making BPL, 3 points regardless of traffic total; (8) Handling emergency traffic directly with a disaster area, 1 point each message; (9) Serving as net manager for the entire month, 5 points.

Single-Op. *I certify the above to be true and correct.*

Multiop. *Signature* *Call*

Fig. 3. Station Activity Report.

DE WB2XXX GE RALPH QTC BRONX 1 $\overline{AA}$ RONKONKOMA 2 $\overline{AA}$ 2RN 1 $\overline{AR}$. Note how the traffic is listed: Place Number $\overline{AA}$ Place Number $\overline{AA}$. In essence, you are saying, "I have one message for the Bronx, two messages for Ronkonkoma, and one message for the Second Region Net (2RN)." Note that any traffic whose destination is out of the section is sent to the region net. Any traffic for within the section is listed by its destination. This is because the net will have people from the section to take your traffic. (Note: If you wish to check in but have no traffic, send "QRU" in place of "QTC", etc.)

The NCS will continue calling up the net and accepting check-ins throughout the net session, so don't get upset if you don't get to check in the minute the net starts.

When a station that can handle your traffic checks in, the NCS will send you both *off frequency* (QNY). "WB2XXX (you) WB2YYY (the relay) UP 5 BRONX 1 U5 . . ." This indicates that you and the relay are to go up five kilohertz and pass your Bronx traffic.

Let's see what happens off frequency. You'll begin by *listening* up five kilohertz because *the relay station always calls the station with the traffic.* The NCS said to go up five, but don't just listen up five, tune around and listen, because if there was another station up five, WB2YYY would not just start calling you on top of him (I hope).

When contact is established, you will ask the relay station, "QRV?" (Are you ready?) If he is ready, he will answer, "QRV." (I am ready.) You will then send your traffic.

If, while copying your traffic, the relay station misses a couple of words (or even a lot of words), he must go through a process known as "getting fills" (to fill in the missing words). When you get a fill, be sure to use the proper abbreviations given at the bottom of Fig. 2; on CW, speed is essential.

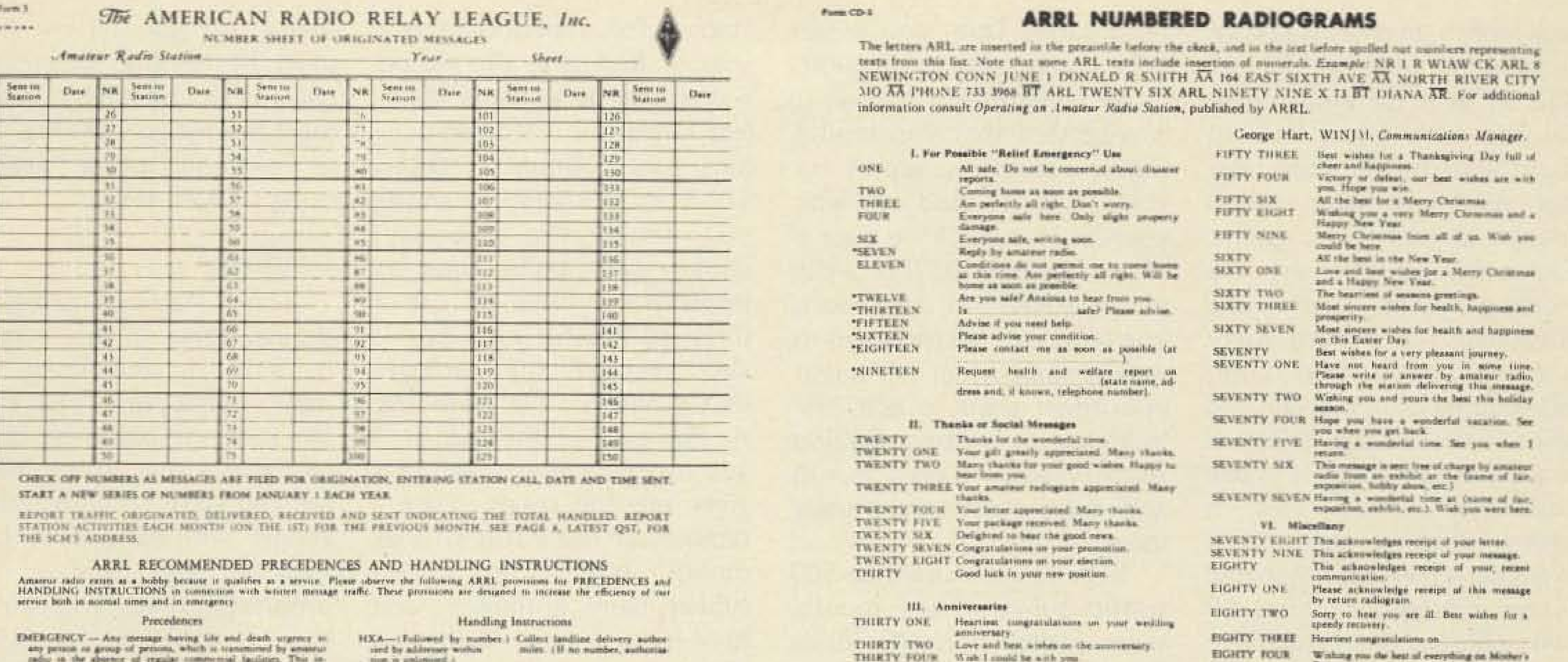
Let's see how they're used. Suppose that this was what the relay station had copied: "HAPPY X SEE SOON X LOVE $\overline{BT}$ . . ." He would then ask for fills in the following manner: WA HAPPY? . . . WB SOON?, etc. You would then send the respective fills that were asked for.

When the relay station has copied the *entire* message and is *sure* of every part, he may "QSL" the message and acknowledge receipt. I'd like to say something very important, something that most traffic handlers forget. Any time that you receive a piece of traffic, it is your responsibility and obligation to see that it is delivered or relayed properly and intact. A good traffic handler knows that every message, though unimportant to him, is very important to its sender and its recipient. *Therefore, be sure before you QSL* (even if you must ask for ten fills and fifteen confirmations). Some people think that the sending station might look down on them if they ask for many fills. I say that if you *don't* ask for fills, you are a poorer traffic handler because you don't care enough to do it right. End of sermon.

When the relay has QSLed the message, the two of you must *identify*, and then you may return to the net frequency. Don't disappear; there may be other traffic for you. Upon your return to the net frequency, you wait until a call-up and then send the last three letters of your call. The NCS will acknowledge your return by sending those three letters back to you. Then you must wait for further instructions. In the event that the NCS doesn't hear and acknowledge your return, it's no big deal . . . just try again on the next call-up.

If during the course of the net you have to say or ask something of the NCS, send the last three letters of your call, and when he sends them back, that means that you have permission to say your piece. *Never* just start sending without permission, because the NCS is exactly what his name implies — net control, in *control* of the net!

After you have been on the net for about ten minutes, if there is no traffic for you, you will be excused from the net (QNX). *Never* ask to be excused unless you truly cannot stay on the air. If, when you check in, you know that you can only be on for a couple of minutes, tell the NCS: "GE Ralph QRU ES PSE QNX 7 (minutes) $\overline{AR}$." He will then excuse you before or in seven minutes.


THE AMERICAN RADIO RELAY LEAGUE, Inc.

NUMBER SHEET OF ORIGINATED MESSAGES

CHECK OFF NUMBERS AS MESSAGES ARE FILED FOR ORIGINATION, ENTERING STATION CALL, DATE AND TIME SENT. START A NEW SERIES OF NUMBERS FROM JANUARY 1 EACH YEAR.

ARRL RECOMMENDED PRECEDENCES AND HANDLING INSTRUCTIONS

OBSERVE PRECEDENCE. SEND OR DELIVER THE MESSAGE OF HIGHER PRECEDENCE FIRST.

ARRL NUMBERED RADIOGRAMS

Fig. 4. ARRL Form CD-3, with ARL numbered texts.

When you are on the nets, use your common sense and try not to tie up the net. Send only when absolutely necessary. *Do not* repeat things unless you are requested. Try to say as much as possible with as little sending as possible.

Phone and RTTY Nets

The procedures on phone and RTTY traffic nets are virtually the same as outlined above. On phone, one must be sure to "say it with words" instead of the abbreviations that accompany CW traffic handling. Also, most of the traffic on the phone net is passed on frequency rather than off frequency. For our purposes, that is all that you need to know. For a more involved explanation of phone and RTTY traffic handling, read the *ARRL Operating Manual*.

That wraps it up for the actual net operation. You now know enough to QNI, QNY, QSP, and QNX. This is enough in itself, but there are other things that you should know, the helpful hints that develop a top-notch traffic handler.

Originating and Delivering Traffic

To gain experience, you should try to handle as much traffic as possible. The bulk of your initial messages will be those of your own origination. Since you already know the form of the message, now you must find the message! Neighbors, friends, relatives, and even yourself are good sources for traffic. One thing to remember is that the message may not be in any code; it must be in plain language (English, Spanish, etc.). You are not permitted to send "commercial messages" (i.e., messages concerning business transactions, etc.).

When you deliver a message, the usual procedure is to read it over the phone to its recipient. If there is no phone number, however, you might mail the message. It is a common courtesy for the delivering station to explain how the message got there and offer to send a reply. You might want to leave your phone number so that the party might be a future source of originations. This kind of thing pleases people and gives them a very nice impression of amateur radio.

Service Messages

A service message is a message from one ham to another concerning a piece of traffic. It is used mainly to inform the originating station as to the whereabouts of his traffic. Perhaps you were unable to deliver a message. You would then service the originating station: NR 12 R WB2XXX 16 BROOKLYN NY JULY 12 WB2NNN A̅A̅ SARATOGA NY B̅T̅ REF(erence) UR NR 42 R UNDELIVERABLE X WRONG ADDRESS AND PHONE X PSE ADVISE X 73 BT JOE WB2XXX A̅R̅.

Remember that I mentioned the importance of the place and station of origin, as well as the message number? This is where it comes in — when you must service the originating station. This would be done with a service message, in the manner previously outlined.

Counting Traffic

Each message is counted as a certain number of points. These points are to be totaled and sent to the Section Communications Manager (SCM)

NR 13 R HXE WB2XXX ARL 5 BROOKLYN NY JULY 13
JOHN BRAZZLE A̅A̅
17 NORTHEND DR A̅A̅
SHANTYTOWN CO 10008 A̅A̅
FONE 758 6274 B̅T̅ ARL FIFTY X ARL SEVEN B̅T̅ JOAN AND HARRY A̅R̅

Fig. 5. Message using an ARL text.

each month, in what is known as a *Station Activity Report* (Fig. 3). It is therefore essential that you know how to count your traffic. Each message sent from your station counts as one sent point. Each one received counts as a received point. Each one originated for a third party (someone other than yourself) counts as one originated point. Each message delivered to a third party counts as one delivered point. This is trickier than it seems. For example, a message originated for your neighbor counts for two points: one originated and one sent. A message delivered to your neighbor counts as one received and one delivered, thus two points. A *service message* received by you counts only as one received and not as a delivery, since it is for yourself and not for a third party. If you send a service message, you do not get an origination point for the same reason – it is not being originated for a third party. Thus, you would only receive one sent point.

As I mentioned before, it is suggested that you send a station activities report to your SCM. To find out who your SCM is, look on page 8 of any current *QST* or write to the ARRL. In this report, you send your traffic totals as well as some other trivia that you might want to add. The SCM has to write a Section Activity Report each month and these items are usually included.

If you have more than 500 traffic points in any month, you qualify for the Brass Pounders League (BPL), a coveted traffic award given by the ARRL. You may also qualify by having 100 originations *plus* deliveries. If you make BPL three times, you qualify for the beautiful BPL medallion.

It is required by the FCC that all third party traffic be logged. That means that you must keep every message that you send or receive at your station for a period of one year. I find that the easiest way to log is to use a looseleaf notebook. Fold one page into four columns – ORIG SENT RCVD DLVD – and as you pass traffic each day, stroke each point into its respective column (I use a different line for each day). I also keep all the messages that I send in this loose-leaf. At the end of the month, I add up each column, and that gives me the totals. Then I remove all the traffic of that month, roll it up, put a rubber band around it, and hold it for a year. At the end of one year you may chuck it in the wastebasket.

ARL Texts

Fig. 4 displays ARRL Form CD-3, which contains a list of the ARL numbered texts. These are the most common messages sent via NTS, and it saves lots of time and effort if you use them. There are some things to be remembered when using them: (1) the letters ARL must be inserted before the check. (2) The ARL numbers must be *spelled out*. Fig. 5 is an example of a message using an ARL text.

Conclusion

This is traffic handling. Although there might seem to be a lot to remember, the more traffic that you pass, the easier it becomes. Don't be timid, either; check into a net and start handling traffic. People will be glad to help you out and clear up any problems that you might have. If you're not proficient at CW, try a slow speed CW net. It's sure to bring up your code speed. You might also try a phone net. Those who have RTTY setups might look for a RTTY net in their area. And, of course, for the brass pounders who can zip out 15-20 wpm code, there's the "fast speed" net.

NTS has something for everyone. Hope to CU all on NTS! ■

ALUMA TOWERS

VERO BEACH, FLORIDA 32960

MFG'S OF ALUMINUM TOWERS

- ★ TELESCOPING (Crank Up)
- ★ WALL MOUNTED
- ★ TILT-OVER
- ★ GUYED MODELS (to 100 Ft.)

Excellent for Ham Communications.

HIGH QUALITY — LOW PRICES

MADE IN LONG-LASTING NO-RUST ALUMINUM!

McCLARAN SALES TAKES IN ANYTHING ON TRADE FOR NEW ALUMA TOWERS.

NEED: Scanners, CB, 2 Meter, Marine, Antiques, Coins, Ham Gear. A47

We accept Master Charge & Visa Cards

FOR SALES & TRADES CONTACT

R.D. McCLARAN SALES

430 Franklyn at Beach
Indialantic, Florida 32903
(305) 723-4793

DUPLEXERS

*Patent Pending

OUR NEW BANDPASS-REJECT DUPLEXERS WITH OUR EXCLUSIVE

BpBr CIRCUIT*

. . . provides superior performance, especially at close frequency spacing.

Models available for all Ham bands. Special price for Amateur Repeater Clubs

CALL OR WRITE FOR DETAILS:

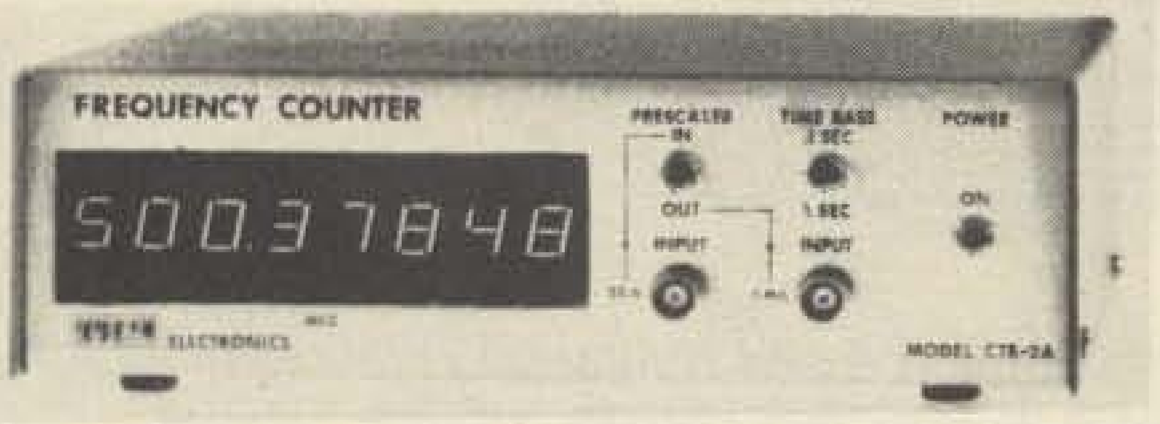
WACOM PRODUCTS, INC.
Box 7307
Waco, Texas 76710
817/776-4444

"THE PROFESSIONALS"

NEW MODEL CTR-2A • 500 MHz & 1 GHz COUNTERS

NEW Period Measurement

1 us to 1 sec.



NEW Built-in Pre-Amp

10 mv @ 150 MHz

The New Model CTR-2A Series Counters are designed and built to the highest standards to fulfill the needs of commercial communications, engineering labs and serious experimentors. With an accuracy of + .00005% (oven option) the CTR-2A can handle the most critical measurements and is about half the cost of other commercial counters.

If you need a reliable counter at an affordable price, the CTR-2A is the answer.

- Built-in Pre-Amp 10 mv @ 150 MHz
- 8 Digit .3" LED Display
- High Stability TCXO Time Base
- Built-in VHF-UHF Prescaler
- Automatic Dp Placement
- TCXO Std. ± 2 ppm
- Period Measurement (Optional)
- Input Diode Protected
- 12V-DC Operation (Optional)
- Oven Controlled Crystal (Optional) ± .5 ppm
- Selectible Gate Times - .1 & 1 sec.

500 MHz Kit CTR-2A-500K	$249.95
500 MHz Assembled CTR-2A-500A	349.95
1GHz Kit CTR-2A-1000K	399.95
1GHz Assembled CTR-2A-1000A	549.95

OPTIONS . . . .

02) Oven Crystal	$49.95	05) 10 sec. Time Base	$ 5.00
03) .43" LED	10.00	06) Period	15.00
04) 12 V-DC	10.00	07) Handle	10.00

PROBES Hi-Z $15.00 • Low Pass $15.00

DAVIS D10

DAVIS ELECTRONICS 636 Sheridan Dr., Tonawanda, N.Y. 14150 716/874-5848

MADISON BIG SIGNAL BUYS

OMNI-J 2-meter mobile or portable antenna. 3/8" thread, 5-dB gain (1.5-dB gain over conventional 5/8-wave mobile whip antenna). $29.95; 450 MHz $27.95. Guaranteed results.

PREMAX 4 ft. ground rod + clamp $4.50

MIDLAND 23-136 dual meter reads SWR and relative power. Handles 1 kW from 3-150 MHz. $21.95

YAESU FT 301 + FP301 AC Supply $750.00

YAESU FT-301D + FP301 AC Supply $935.00

HY GAIN 18AVT/WB + 100 feet RG8 coax.................................. $100.00

HY GAIN 18V vertical $19.95

Model 214 2m Yagi $21.50

HY-Gain 208 2m Yagi $15.95

VHF SPECIALS: Kenwood TS 700S List . . . $679 .... Call for quote

KLM: Antennas, Linears, Accessories All In Stock

FREE balun w/2 meter base antenna.

JANEL PREAMPS: In Stock. Technical Books (ARRL, Sams, Tab, RCA, T.I., etc.)

HAM X ROTOR (New Model) Turns 28 sq. ft. of antenna List . . . $325 Order Now .... Your Price — $249.00

CDE HAM 3 $129.00

BIRD 43 WATTMETERS plus slugs in stock.

SWAN METERS: WM 6200 VHF Wattmeter $49.95; SWR 3 Mobile $9.95

TELEX HEADSETS: In Stock

CETRON 572B................. $24.95 ea.

RAYTHEON 811A

Sealed Cartons $16.00/pair

ADEL nibbling tool, $6.45; punch $3.50

CABLE 5/32", 6-strand, soft-drawn guy cable. For mast or light tower, 3¢ foot.

BELDEN COAX CABLE: 8237 RG8 19¢ ft. 8214 RG8 foam 23¢ ft., 8448 8-wire rotor cable 14¢ ft., 8210 72 ohm kw twinlead $19/100 ft., 8235 300 ohm kw twinlead $12/100 ft., Amphenol silver-plate PL 259 59¢ ea. UG175 adapter 19¢, PL-258 dbl female $1.00.

NYLON CORD 5000 ft. + per roll $15.00

BELDEN 14 gauge copper stranded antenna wire.................. $5.00/100 ft.

BELDEN 9888 Double Shield RG8 Foam-direct bury — 100% braid 39¢/ft.

22 gauge plastic covered ant. wire for long wire, radials. .... $3.50/1000 ft.

KESTER SOLDER 1 lb. 60/40, .062 .... $6.50

Leader — Amateur Test Equip. — 10% off list.

Mallory 2.5A/1000PIV epoxy diode 19¢ ea. .001 MFD 20KV CAP $1.95

CALL FOR QUOTES ON:

Yaesu FT301D, FT301, Denwood TS520S, TS820S, TS600A, TR7400A, TR7500, FT227B & ETO-ALPHA. All in sealed cartons. Call for quotes on items not listed.

CALL FOR FAST QUOTE, OR WRITE AND INCLUDE TELEPHONE NUMBER. IF WE HAVE YOUR BARGAIN, WE'LL CALL YOU PREPAID.

TERMS: All prices FOB Houston. Prices subject to change without notice. All Items Guaranteed. Some items subject to prior sale. Send letterhead for Amateur dealers price list. Texas residents add 5% tax. Please add postage estimate, excess refunded.

MADISON
ELECTRONICS SUPPLY, INC.
1508 McKinney • Houston TX 77002
(713) 658-0268 • Nites (713) 497-5683

Tim Ahrens WA5VQK/5
2200 Sorret Treet Ct.
Austin TX 78744

Build A 3½ Digit DVM

—replaces old meters!

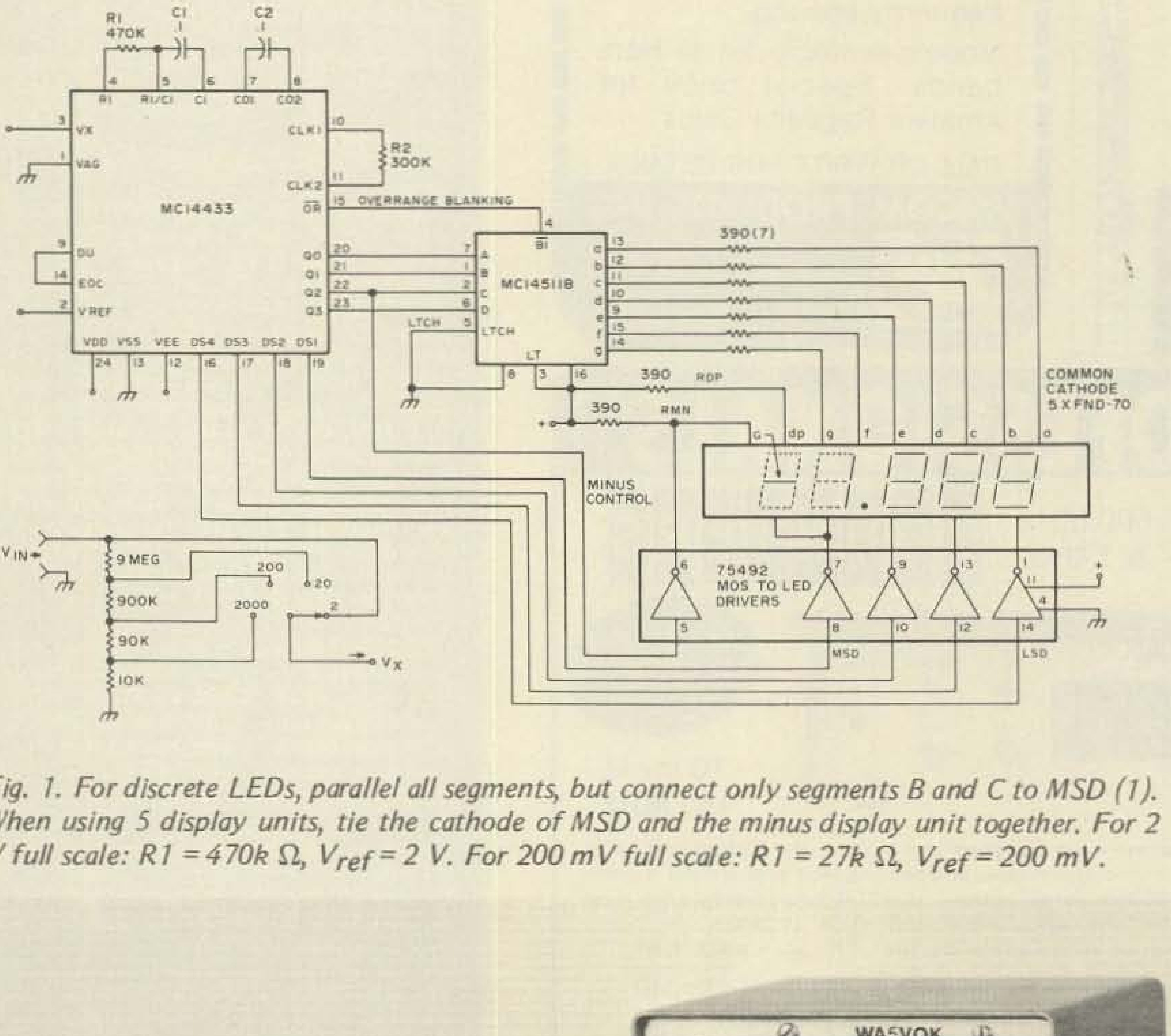
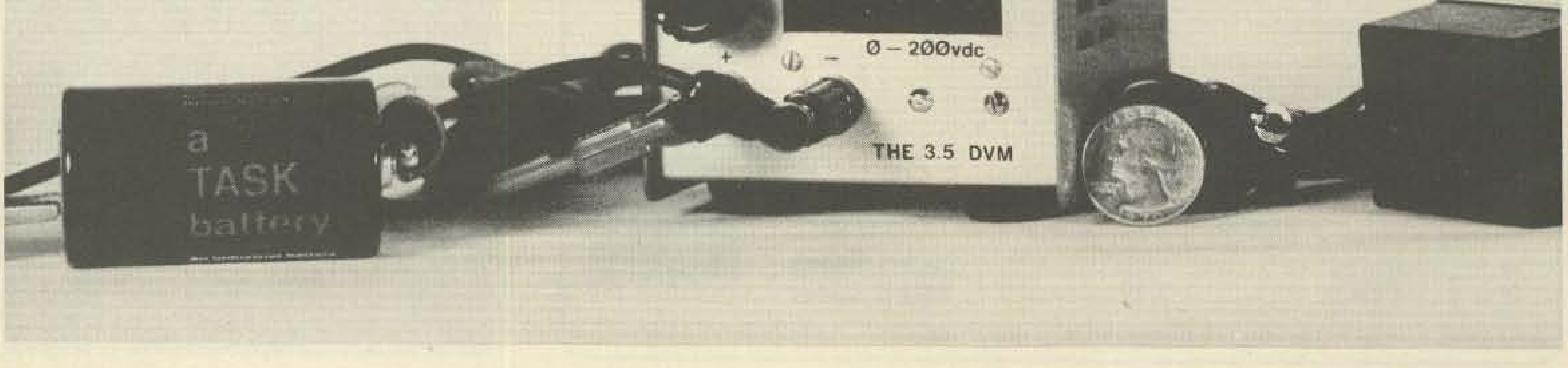


Fig. 1. For discrete LEDs, parallel all segments, but connect only segments B and C to MSD (1). When using 5 display units, tie the cathode of MSD and the minus display unit together. For 2 V full scale: R1 = 470k Ω, V_{ref} = 2 V. For 200 mV full scale: R1 = 27k Ω, V_{ref} = 200 mV.

For many months now, I have been looking for something to update my Simpson 260, as it is on its last legs. The price of a new meter scared me away, as I am a penny-pincher at heart, and the price of the portable digital voltmeter that I had my eye on is enough to make me appreciate the old 260.

About a week ago, I was introduced to one of Motorola's new CMOS devices — the MC14433. This little jewel is an analog-to-digital converter with a multiplexed 3½ digit display which can be set up for either a 200 mV or 2 V full scale reading. The MC14433 is a high performance, low power 3½ digit A/D converter combining both linear CMOS and digital CMOS circuits on a single monolithic IC. It is designed



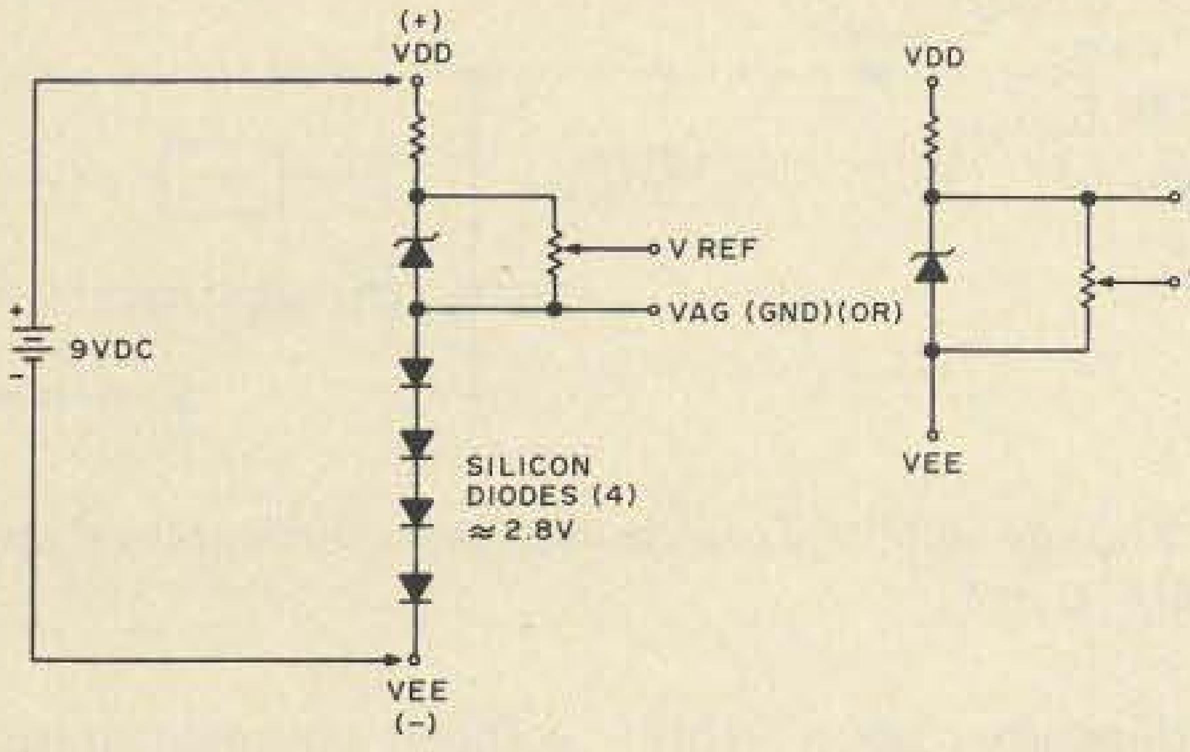


Fig. 2. This circuit is not recommended for use with LED displays.

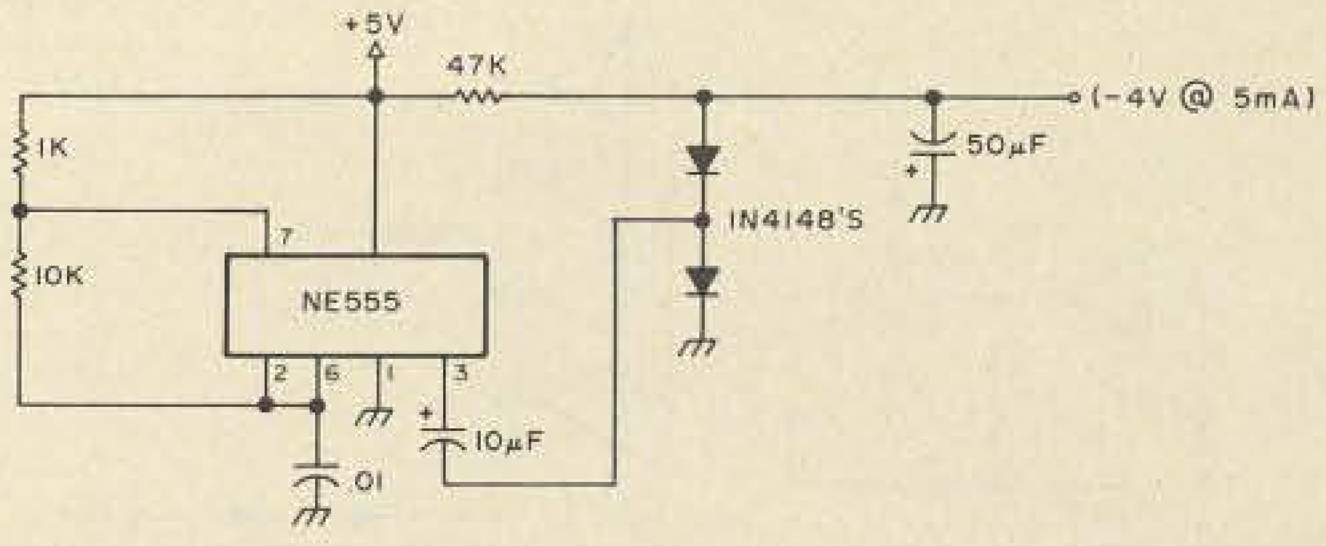


Fig. 3. Positive voltage to negative supply.

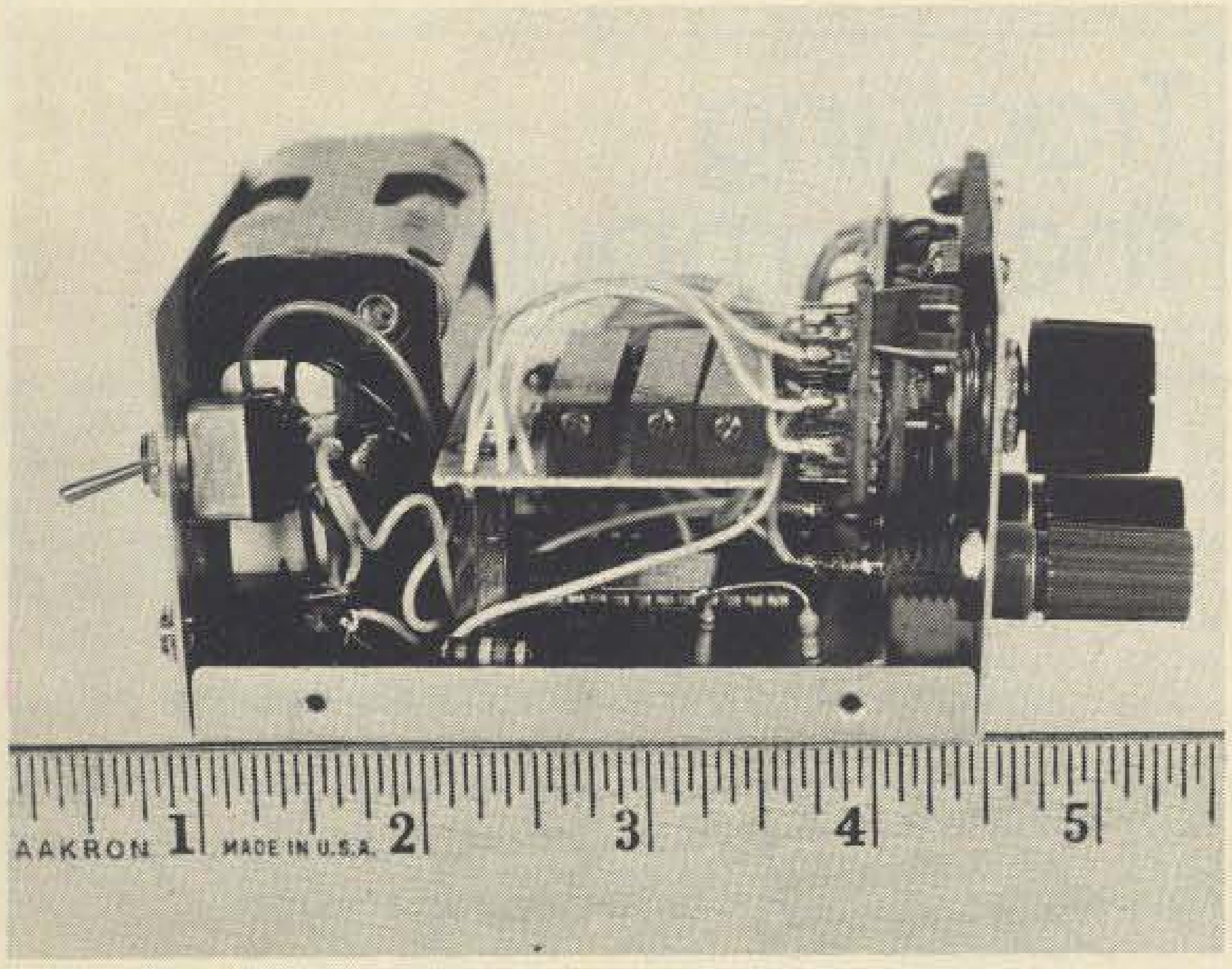
to minimize the use of external components, and with two external resistors and two external capacitors, the system forms a dual slope A/D converter with automatic zero correction and automatic polarity selection. For ease of use with batteries, the MC14433 may operate over a wide range of power supply voltages.

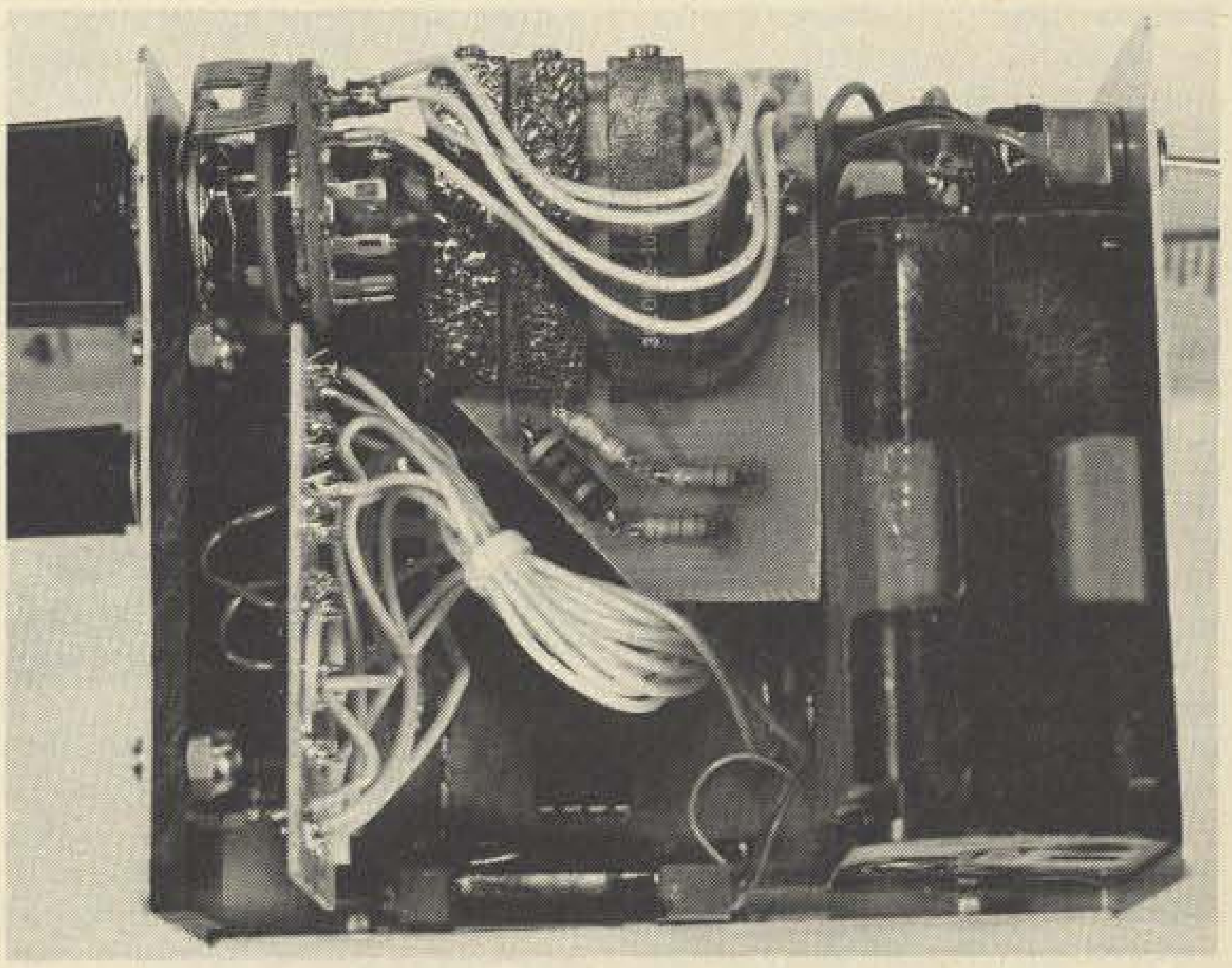
OK, so now I have one of these things in my hot little hand. What do I do with it? Well, first I make sure that it is on its own little piece of conductive foam, and don't take it off until I am ready to put it on the circuit/perfboard. I always use a socket with these things, as after I unsolder all of the 24 pins, I'll probably see that I forgot to hook up the power supply! Enough said.

This project is really a "bare bones" layout with a minimum amount of functions, but all that is required to upgrade to a full function DVM is a few more resistors and switches. Since the MC14433 requires both a positive and a negative supply, it necessitates either the use of two batteries, or some other way to generate a negative voltage from a positive source. This is really quite easy, and there are a couple of different methods to obtain it. One easy way to get it is by the method shown in Fig. 2. In this example, a nine volt supply can be used, with 3 V between V_{ag} and V_{ee}, leaving 6 V for V_{dd} to V_{ag}. This system leaves a comfortable margin for battery degeneration (end of life). Note that due to the current requirements of the LEDs, this method is recommended for use only with LCDs. Another method is shown in Fig. 3. This method uses the old reliable NE555. Since this thing generates a square wave, why not use only the negative cycle? Very good, Watson, a splendid idea! Looking at the circuit, we see that the 555 is connected in a regular oscillator fashion. The output, pin 3, is fed through a capacitor to the junction of two diodes. D1 allows the negative cycle to pass through it, and D2 allows the positive cycle to go through it to ground. After filtering, this negative wave is amazingly transformed into dc!

An idea for saving money is to use potentiometers in the area of precision resistors on the input circuitry. Sure, precision resistors would be the way to go, but as long as we are being cheap about this thing, let's go all the way. There are definite values of resistors required for proper operation of the input circuitry, but instead of trying to find the closest thing in your junk box and hoping for the best, we will start with a value less than what is required and supplement it with a miniature ten turn pot, which on the surplus market is relatively inexpensive. That way, you will have an even more precise resistor combination than you could get by ordering it.

Although I made my DVM on a printed circuit board, a perfboard with sockets will do just fine, as parts layout is not really critical. One precaution, though: Try to keep wires away from the clock resistor and wave-forming circuits. Now, the first time I tried the circuit, it didn't work. Very understandable, as Murphy makes his permanent home of record on my workbench. Well, after many hours and wonderings as to the state of my sanity, I came to the conclusion that I was doing something wrong. What an understatement! This is where I found that, unlike with TTL devices, one cannot leave unconnected leads unconnected. Due to the extremely high impedance of these CMOS devices, you must tie the unused leads to a high or to a low. Look at the truth tables for this. This circuit can be used with LEDs or LCDs with some changes, but in the interest of the local economy (my wallet), I decided to go with the popular FND-70 common cathode





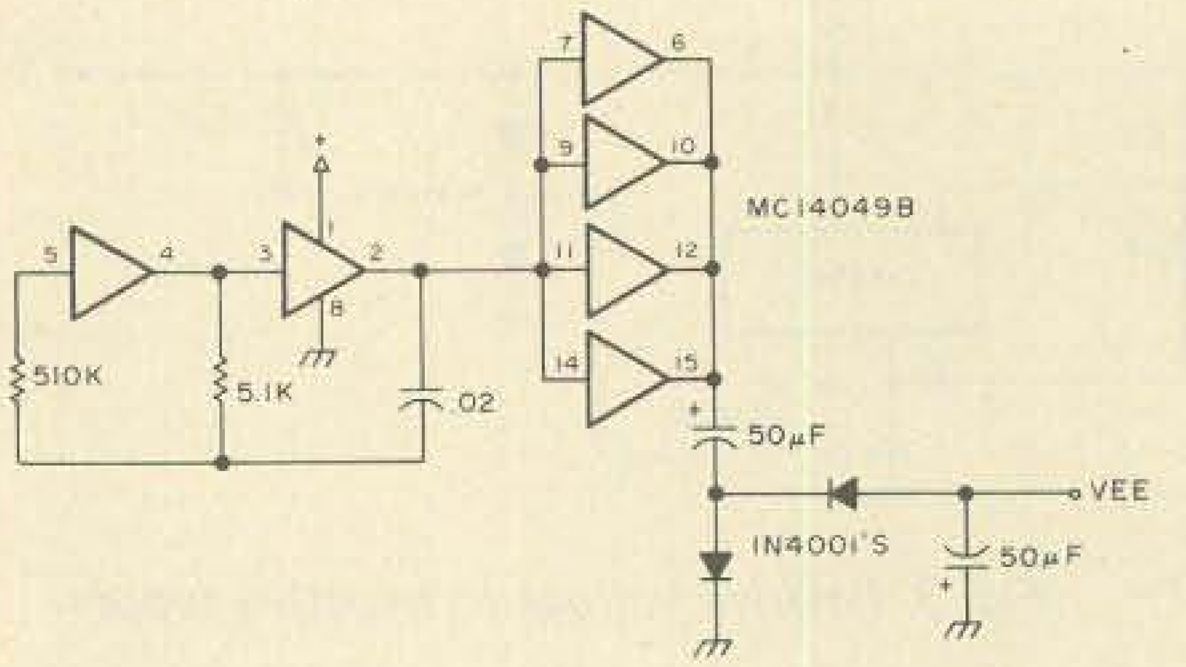


Fig. 4. Another method of obtaining a negative supply from a positive supply. When only +5 volts is available, a negative supply voltage can be generated with this circuit. Two inverters from CMOS hex inverter are used as an oscillator, with the remaining inverters used as buffers for higher current output. This square wave output from the oscillator is level-translated into a negative-going signal. This signal is rectified and filtered. A voltage of +5 V will result in a -4.3 V output.

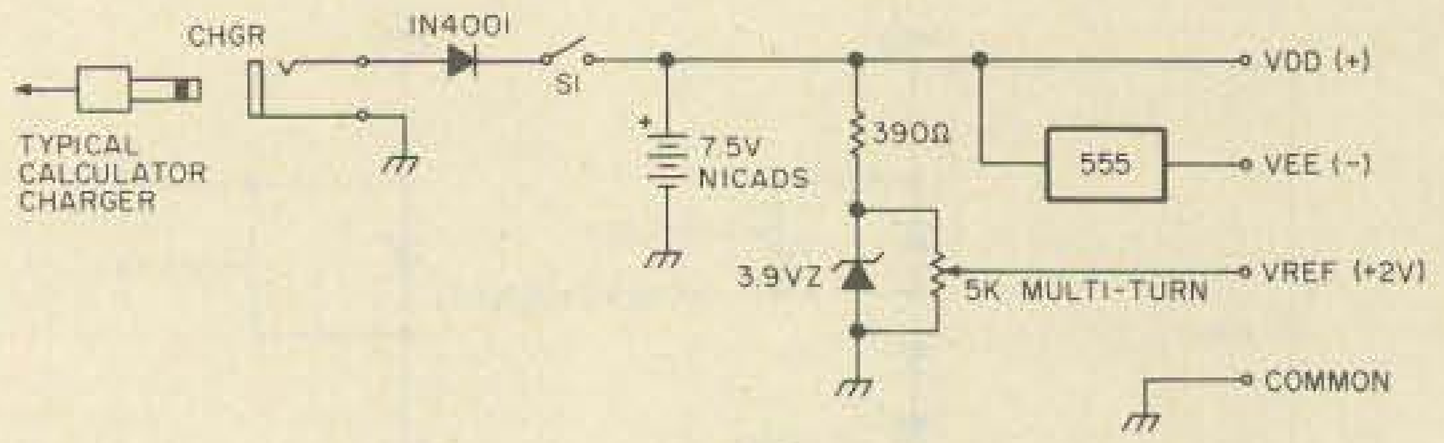


Fig. 5. Voltage chart. Total power requirements are approximately 60-70 mA.

LEDs.

More about printed circuit boards. Double-sided PC boards with plated-through holes are available, and the price will be in the vicinity of 4 to 6 dollars (it hasn't been decided yet). This board has provision for a few more frills than the article described, and the price of a kit using that board sells for $39.95. Write for details to Dactron, Inc., 12609 Blackfoot Trail, Round Rock TX 78664.

Calibration: The first thing to do in the way of calibration is to set the 200 mV reference voltage (or 2 volts, depending on which option you take). Do this with any accurate meter or another DVM, as the accuracy of the DVM depends upon this setting. Next, with an ohmmeter, set the value of your resistor strings to equal the required resistance, e.g., 5 megohms with a 5 meg pot for the required 9 megohms. Do this with all the resistors. When you have adjusted these to their approximate value, insert them into the circuit. Now you can fine tune the pots to the exact value. Note that when you adjust one pot, it will affect the values of the other ranges. This may take a while, but when it is complete, you will have a very accurate voltmeter.

Operation: This is the easiest of all. All that is required is that you feed it the voltage commensurate with the range it is in. While other common voltmeters can take a few "prangs" with the meter movement, do not try to measure 150 volts with the switch in the 2 volt range, for if you do, you will find yourself ordering another MC14433.

Well, that about wraps it up. Other plans which are in the mill are an autoranging, full function DVM, and the incorporation of LCDs for a micropower VOM.

My thanks go out to Joe Magee WA5ACA for his technical expertise and moral support, and Bert Mau WB5UBR for his excellent photographic work. ■

AMSAT

AMATEUR RADIO CLUBS OF THE JPL AND HUGHES AIRCRAFT COMPANY TEST FLY AMSAT AO-D MODE J (JAMSAT) TRANSPONDER OVER SOUTHERN CALIFORNIA

For an hour and a half, Booth Hartley N6BH piloted his Beechcraft Bonanza over Southern California on November 5 carrying a prototype model of the AO-D Mode J transponder. Booth is a member of the JPL Amateur Radio Club. Maurice Piroumian WA6OPB, a member of the Hughes Aircraft Company Amateur Radio Club, also aboard Booth's plane, operated an Echo II 432/435 MHz KLM transceiver to monitor the output of the Mode J transponder. The flight was in preparation for the full-scale all-day test flight to be held on December 3, 1977. The December 3 flight was to have covered all of the state of California, starting from Van Nuys Airport early in the morning. It was to go on to San Diego, then north to Palo Alto where the fliers were to stop for luncheon and refueling. After lunch they were to continue to Sacramento and then return south through the inland valleys to Van Nuys Airport.

Just before the flight on November 5, tests were made on the ground with Skip Reymann W6PAJ (JPLARC) and Gene Halaas WB6GSP of Van Nuys, transmitting SSB signals on 2 meters through the transponder. Norm Chalfin K6PGX operated FM through the transponder, transmitting on 2 meters from a new WE-800 Wilson. The transponder output was received on an inexpensive battery-operated portable tuned down from its nominal 450-470 MHz commercial band operation.

The JAMSAT transponder beacon was keyed by a PROM-operated keyer putting out "Hi, Hi, Hi, Hi, de WA3NDS AA 4." The keyer was built by Dick Ulrich K6KCY. Dick was to have been aboard the plane also, but was grounded by a strep throat. He did manage, however, to complete the equipment modifications necessary for the flight despite his discomfort. Dick is a member of the JPL club.

At the QTH of Don Bostrom N6IC on November 5, there were three ground stations set up:

John Dessel WA6JML operated the downlink position, receiving signals in the 435.125-435.140 MHz band from the airborne transponder on a Kenwood TS-820 equipped with a Hamtronics 435 MHz converter.

Elliot Oseas WA6KGN operated the uplink position using a Kenwood TS-700A for transmissions in the 145.890-145.905 MHz range.

Dick Handlen WA6SLB maintained ground-to-air and air-to-ground communication via a 220 MHz repeater, WR6AJI on Mt. Wilson, using the Midland 13-509.

Don, John, Elliot, and Dick are members of the Hughes club. Tom McInnes WB6ZEB, President of the HAC club, and Sam Weise, another member, set up and maintained ground station antenna facilities which included beams, ground planes, and vertical units.

John Swancara WA6LOD and John Gerlach K6BRD, also of the Hughes club, also participated in the operations.

Dr. Sandra Bostrom (Don's XYL) provided a delightful buffet. Also in the wings was Mrs. Nancy Reymann, Skip's XYL.

About 10 calls were heard in the narrow passband during the very short flight. On the ground tests of the Mode J transponder at the airport, Skip reported that the bandwidth was 18 kHz.

Calls heard were: WB6GSP (SSB), W6PAJ (SSB), K6PGX (FM), W6LO (SSB), W6TCQ (SSB), W6XT (CW), N6IC (SSB).

There were no interfering signals heard aboard the aircraft or on the ground and no interference was reported from the transponder to other amateur services.

Tracking the Hamburglar

RIPPED OFF: Regency HR-2B, registration number 2200-363 engraved on the left front side, speaker terminal strip replaced with mini-plug. Transceiver was bracketed to an AR-2 Regency amplifier. If seen, notify Sandusky Police Dept., Sandusky OH 44870, or call Earl Carrier K8WLP, (419)-625-1817 collect.

STOLEN: From the Cornell University Amateur Radio Club: Heathkit SB-220, serial #139137602; Drake R-4B, serial #7567B; Drake T-4XB, serial #18678; Drake AC-4, serial #38777. Equipment is identified as property of the Cornell ARC by engraving on back of each unit. Anyone with information should contact Phil Karn WB2AJX, 112 Edgemoor Lane, Ithaca NY 14850, (607)-272-2747.

STOLEN: Heath HW-2036 2 meter transceiver. SS No. etched on back. Contact Bobby Sorrow WA4GBM, 130 Sunset Dr., Athens GA 30606, (404) 548-6691, or the Athens police, (404) 543-1431.

Vhf engineering Shows you 3 ways to get on 220.

1 Put it all together for only $234.95

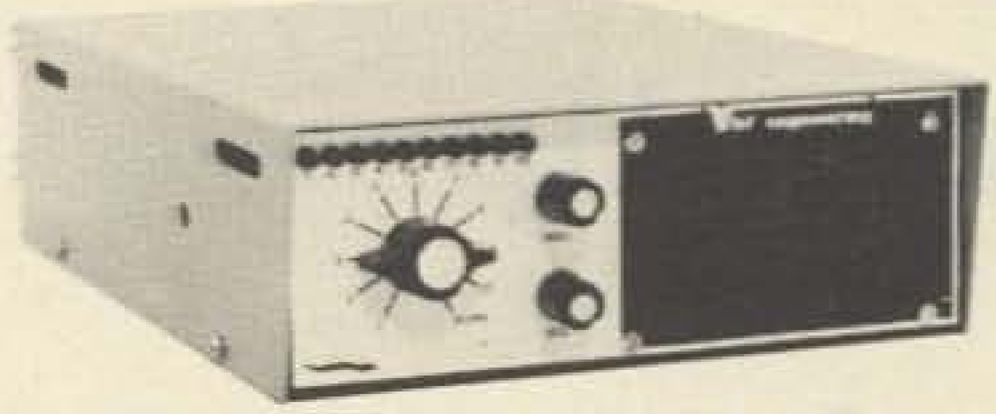
TR220 – Transmitter Kit

$34.95

A one watt exciter using four RF transistors, two diodes, and one integrated circuit. The RF transistors are operating well below their ratings allowing long keying periods without damage. • Nominal output 1½ watts • Deviation adjusted to 10KHz • IC audio with clipping and active filter • All spurious outputs down 30db or more • Temperature compensation crystal trimmer • Zener regulated oscillator • Uses readily available 12 or 18 MHz crystals (18MHz for 220) • All tuning coils prewound • Predrilled and tinned G-10 Circuit board

TRX220 – Transceiver Kit
All units as shown – $234.95

TRC-2 Case and Accessories – $49.95

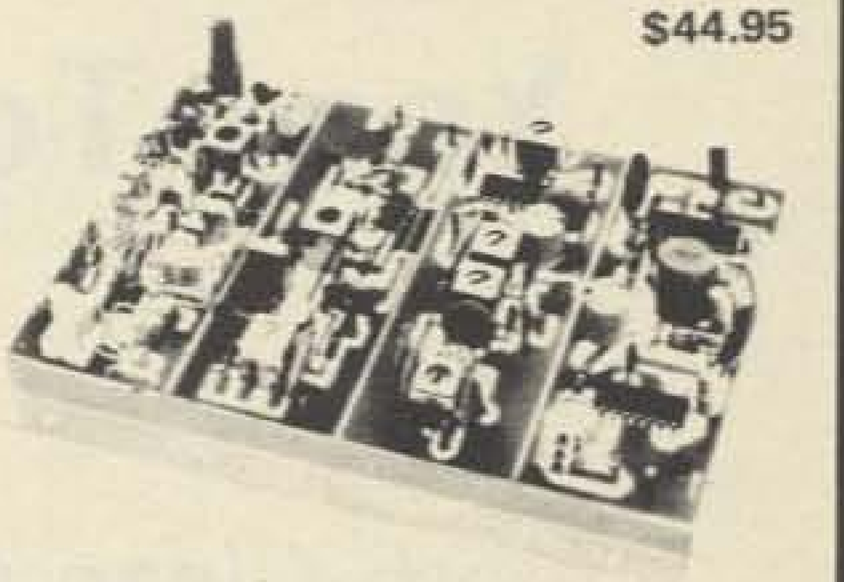


Similiar units available for 6 meters, 2 meters, and 432 MHz.

PA220-15 – 15 Watt Power Amplifier

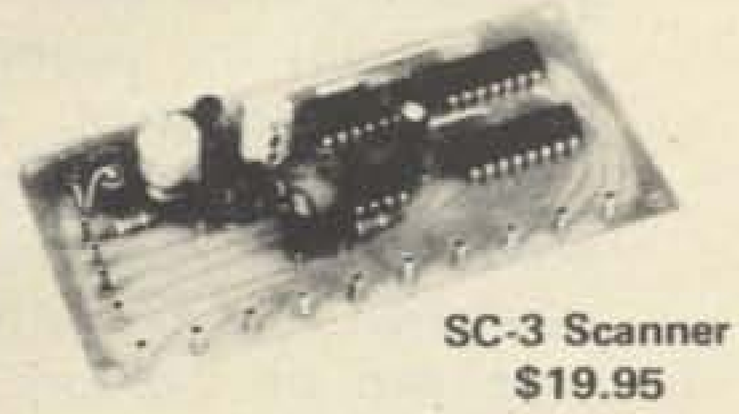
POWER GAIN; 12 db nominal, INPUT POWER; 2 watts max., INPUT VOLTAGE; 12 to 14 volts DC negative ground, INPUT CURRENT; 4 amps max., STANDBY CURRENT; virtually insignificant, INSERTION LOSS; less than 1 db on receive, DUTY CYCLE; 50% or less. Consists of drilled glass PC Board, heat sink and all components.

$44.95



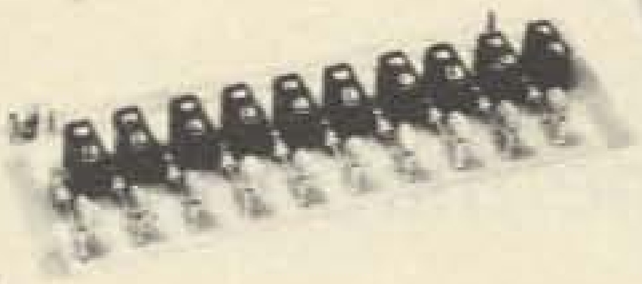
SC-3 Scanner
$19.95

Capable of scanning up to 10 channels. Scan delay allows both sides of a conversation to be monitored without the scan starting each time the carrier drops. The priority feature allows the user to program the scanner to return to his favorite channel whenever it is active.
A ten channel receiver crystal deck which utilizes diode switching to select the crystal position required.



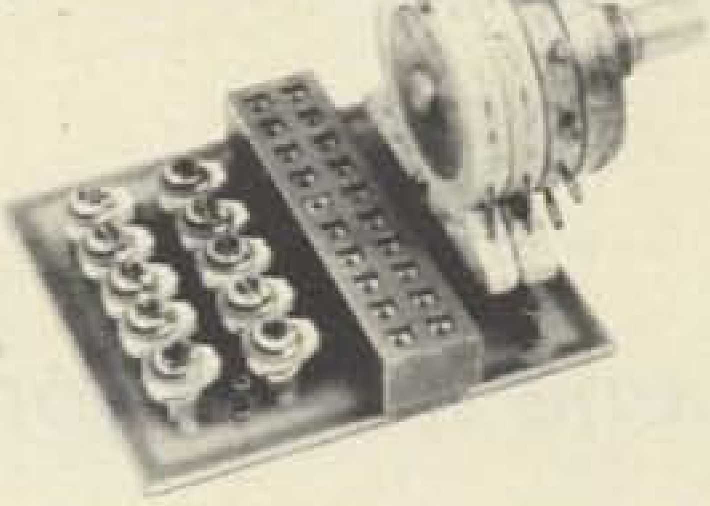
CD-1 Crystal Deck
$7.95

A ten channel receiver crystal deck which utilizes diode switching to select the crystal position required.



CD-2 Crystal Deck – $15.50

Designed to provide multi-channel operation for the TX-series transmitters. It features an extra set of contacts that may be wired to the CD-1 crystal deck for 10 channel transceive. The extra contacts may also be used to switch L.E.D. indicators. The switch has 11 positions.



RX220C Receiver Kit – $74.95

SENSITIVITY .3uV for 20db quieting. SQUELCH THRESHOLD .2uV. AUDIO OUTPUT 2 watts. STABILITY better than –.002. IMAGE REJECTION 60db. SPURIOUS REJECTION greater than 60db. IF REJECTION 80db. FIRST IF 10.7 Mhz. SECOND IF 455 Khz. BANDWIDTH 15 Khz at 3db, 60 Khz at 30db (40 Khz with optional 4 pole filter). CRYSTAL 45 Mhz parallel at 20pf (HC/25U holder).

2 Add our synthesizer 220 to your present rig.

Compatable with virtually all 220 transceivers; Clegg, Midland, Cobra, etc. . . .

The Synthesizer 220 is a 1¼ meter frequency synthesizer. Frequency is adjustable in 5 KHz steps from 220.00 MHz to 225.00 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 100 KHz to 10 MHz. No additional components are necessary!

Kit – $169.95 / Wired & Tested – $239.95

FEATURES

- T^2L Logic
- Maximum offset versatility – easily programmed to any IF and transmitter offset between 100 KHz and 30 MHz in even 100 KHz increments.
- Simple jumper wire change enables use on rigs with 18, 9, 6 MHz transmit crystals.
- All frequencies locked to one master crystal oscillator.
- 2 pole output filter on receive line.
- Virtually no measurable difference in spurious outputs between crystal or SYN 220.
- Lockup time typically 150 milliseconds.
- Easily interfaced to most rigs.
- Also available for 2 meters.

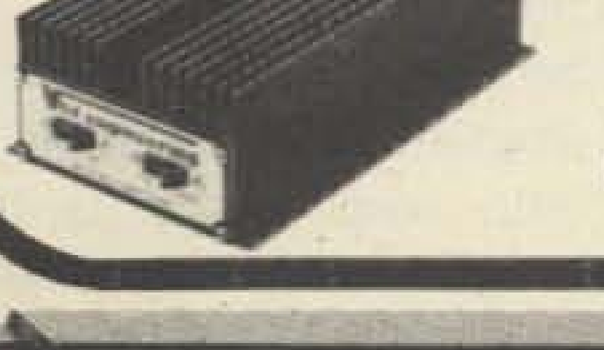
SPECIFICATIONS

- Frequency: 220 – 225 MHz
- Transmit offsets: Simplex, +1.6 MHz, –1.6 MHz plus 3 additional field programmable offsets.
- Output: 3 volts to a 50^ load.
- Input voltage: 11 – 18 VDC at .900 amps.
- Size: 8" long x 5½" wide x 2¼" high
  20.32CM x 13.97CM x 5.715CM
- Complete kit including all electronics, crystal, thumb wheel switch, cabinet, etc.
- Shipping weight 2 lb. 4 oz.

Similiar units available for 6 meters, 2 meters, and 432 MHz.

3 or add any of the above modules to your existing equipment.

IF YOU NEED MORE POWER, DON'T FORGET OUR BLUE LINE!



MODEL	BAND	EMISSION	Power Input	Power Output	Wired & Tested Price
BLD 2/60	220 MHz	CW-FM-SSB/AM	2W	60W	$164.95
BLD 10/60	220 MHz	CW-FM-SSB/AM	10W	60W	$159.95
BLD 10/120	220 MHz	CW-FM-SSB/AM	10W	120W	$259.95

Similiar units available for 6 meters, 2 meters, and 432 MHz.

FEATURES
- High efficiency means low current drain.
- Broad band design (no tuning).
- Direct 12 volt DC operation.
- Indicator lamps for on/off and FM/SSB.
- Relay switching (allows you to put amplifier in or out of circuit at the flip of a switch).
- Insertion loss of less than 1 dB.
- One year limited warranty on parts and labor

F.O.B. Binghamton / Prices subject to change. / Export prices are slightly higher.

Vhf engineering
DIVISION OF BROWNIAN ELECTRONICS CORP.

V5

WE HONOR master charge THE INTERBANK CARD

VISA

member arma amateur radio manufacturer's association

BOX S / 320 WATER STREET / BINGHAMTON, N.Y. 13901 / Phone 607-723-9574

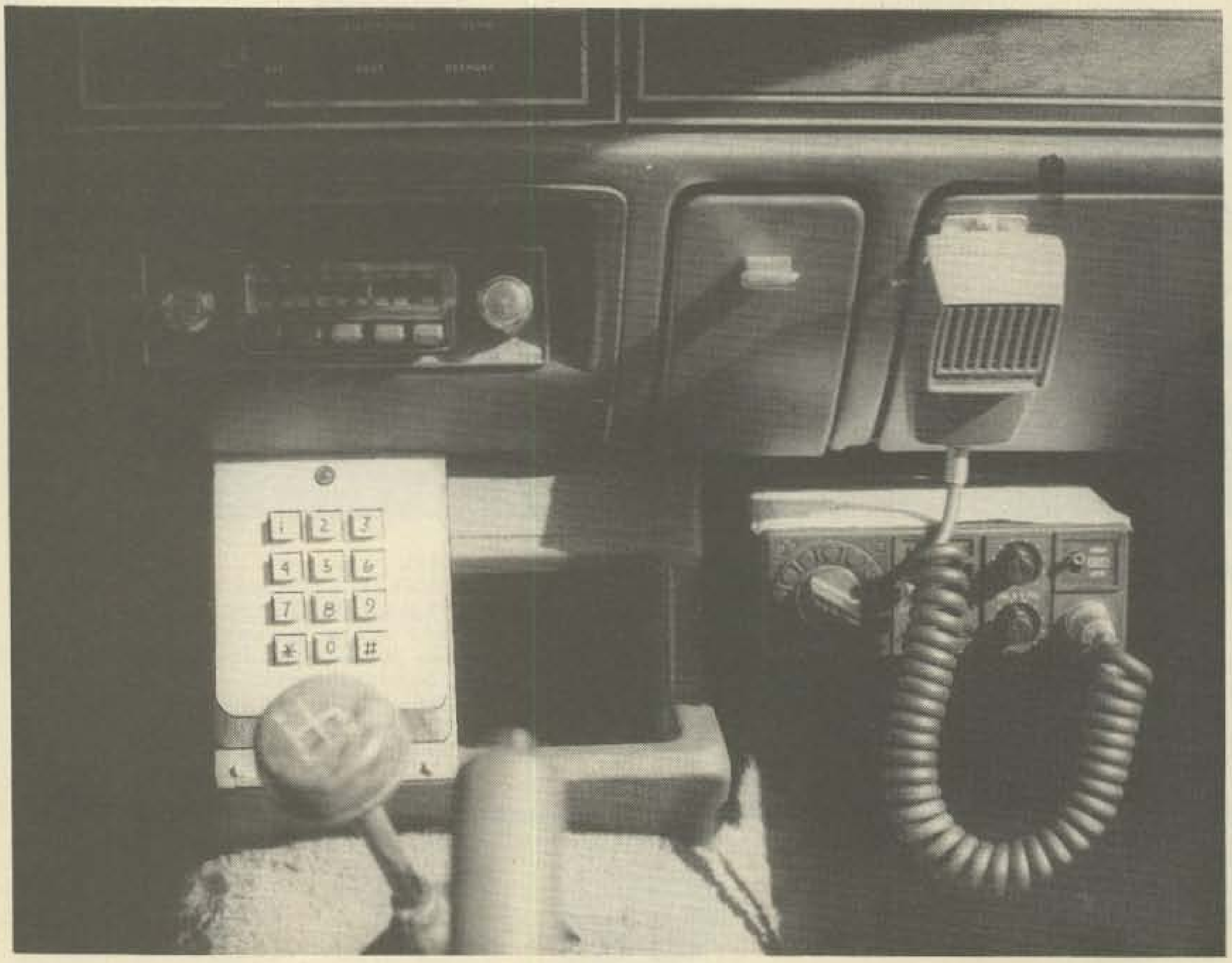
E. Doren WA6THG
6218 Calle Empinada
San Diego CA 92120

Clean Up Your Touchtone™ Act

—with Clean Gene's touchtone machine

Once repeaters were on the air, it was only natural that someone would come along and dream up the autopatch. Basically, the autopatch decodes the received two-tone signal and, receiving the correct combination of tones, switches a telephone touchtone™ line into the repeater.

Here in San Diego, the accepted procedure for accessing the machine is first to identify yourself and then to depress the star (*) button on your pad. This action takes a combination of two tones from the pad and transmits these tones to the waiting autopatch facility. The decoder in the autopatch determines if the tone combinations are the correct frequencies and, if they are, proceeds to bring up the phone line into the repeater transmitter. You hear the dial tone, which indicates a successful access, and then proceed to punch up the seven digits required to make your call. Upon completion of the call, the pound (#) button is depressed, which clears the patch facility. All very clever, all very neat, if you have the necessary touchtone pad or two-tone generator and a suitable means of properly injecting the signals into your rig.



Although there are various commercial units designed to interface into most transceivers on the market, they all suffer from one terrible problem. They're expensive! The expense varies from $50 to $100 and perhaps more. I was fortunate to get a Western Electric #35NIA pad and, with this, proceeded to build my own unit.

I use an Icom 22A in the car on two meters. It's a nice rig, but in the past, I was unsuccessful in using a commercial combination touchtone/microphone pad with it. All reports said the mike was beautiful, but I learned, after many unsuccessful attempts at bringing up the autopatch, that the low frequency tones just weren't getting through with enough level.

I pulled the Icom out of the car and sat down at the bench. Examination of the diagram showed the mike preamp stage to be an IC followed by a deviation set control, a low-pass filter, and an interstage transformer. From here, through a .02 uF coupling capacitor, the audio is fed into the phase modulator. The IC also acts as a clipper circuit and is quite effective. However, you must be very careful in not clipping or limiting the two-tone signal from your touchtone pad, because the autopatch just won't work with this kind of distorted signal.

I decided that the best place to inject the two-tone was after the mike preamp stage, but that .02 uF coupling capacitor bothered me.

Pulling out the trusty SR-52 calculator, I learned that the capacitive reactance of that .02 uF capacitor was a staggering 11,417 Ohms at the lowest touchtone frequency of 697 Hz. It's a small wonder that the low frequencies weren't getting through. A few more rapid calculations showed that a .33 uF or .47 uF would do the trick. I choose what I had in the junk box and used the .47 uF unit. Things began to click. (See Fig. 3.)

Now that I had the problem in the Icom 22A resolved, I turned my attention to the pad. I had decided at the start that feeding the touchtone signals into the mike left much to be desired, what with the clipper action and all. This dictated, then, that the signals must be injected directly into the phase modulator, bypassing all the mike preamp stages. This required a high impedance driving source from the pad so that impedances in the transmitter would not be upset. An isolation stage was called for.

Circuit Description

The audio out of the touchtone pad is developed across the 560-Ohm resistor, R3. A 1 uF coupling capacitor, C3, isolates the dc component from the pad and feeds the two-tone audio across the 25,000-Ohm level-set control R4. From there through C4, the audio is fed to the base of the amplifier/isolation stage utilizing a common 2N2222A. This

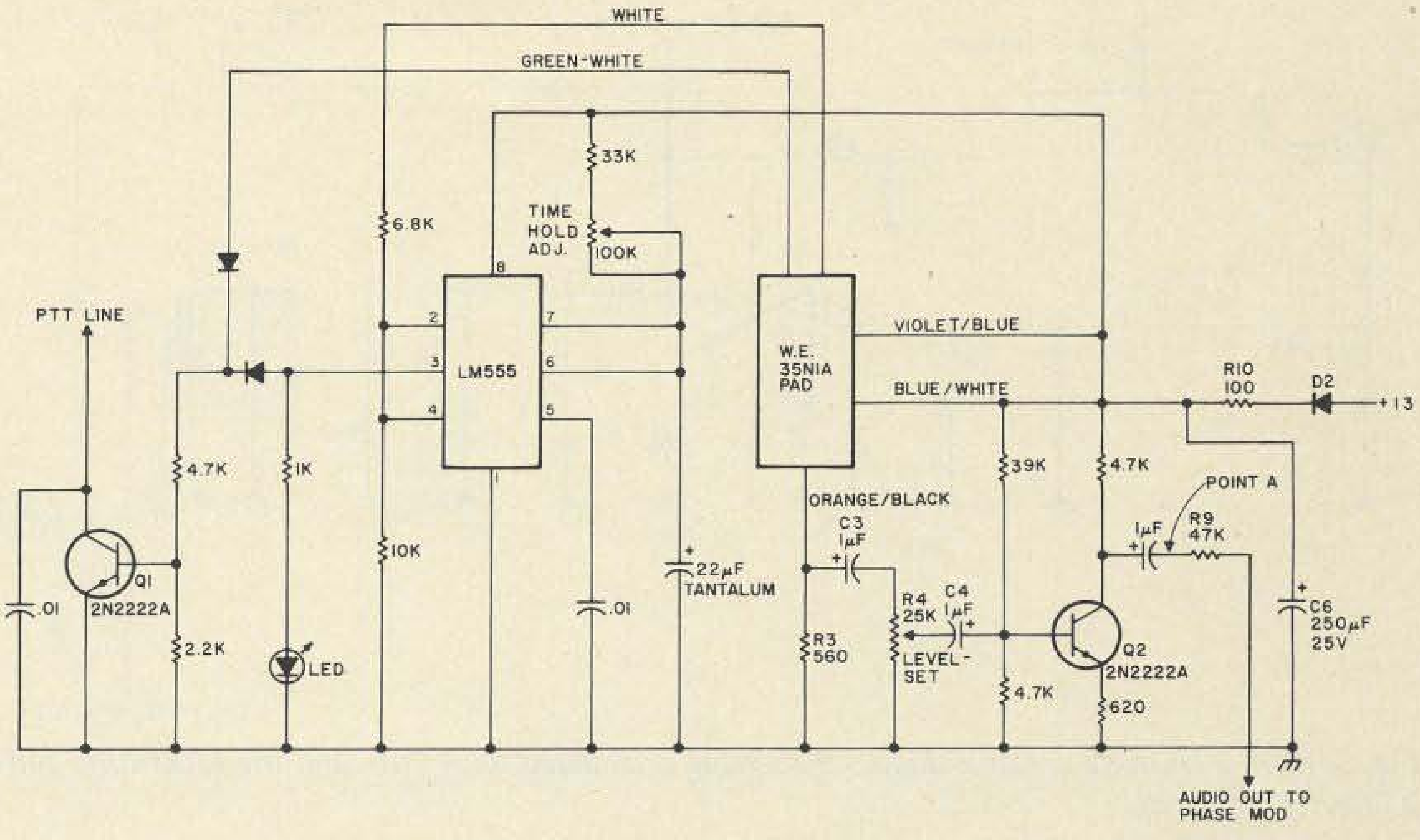


Fig. 1.

transistor is a very inexpensive unit, generally available for 15¢ to 25¢. It is silicon and, in this application, should be literally indestructible. With the 47,000-Ohm build-out resistor, the output impedance is around 52,000 Ohms. This allows paralleling the stage directly across the phase modulator without the use of switches.

Meanwhile, back at the pad, I discovered that the white wire leaving the pad had full battery voltage on it until a button on the pad was depressed, at which time the voltage was switched off. This voltage, switched low, provides the necessary negative pulse required to trigger the LM555 timer chip into its timing period. Release of the button on the pad pulls the trigger pin back to its high state, thereby completing the formation of the negative trigger pulse. The setting of the 100k pot combined with the 22 uF tantalum capacitor determines the timing period of the 555 chip. It is imperative that the 22 uF capacitor be a tantalum unit for lowest leakage and stability. While "on," the timer chip's output at pin 3 goes to full battery voltage. This voltage is used to light the LED, visually indicating the timing period, and, in addition, is used to saturate the second 2N2222A transistor used as a solid state switch across the push-to-talk line. Who wants mechanical relays when a nice 15¢ transistor can do a better job? This 2N2222A can handle a maximum of 75 volts at 800 mA and is more than enough to satisfy the requirements of switching today's solid state transceivers. I find that hold-in time for the timer chip seems best around two seconds or slightly shorter. This provides enough time to depress one button after another on the pad without the transmitter being continuously keyed on and off between digits. The LED could be omitted for the sake of simplicity, but I like gadgets and blinking lights. The combination of R10 and C6 provides decoupling from the auto electronics and effectively removes any spikes or transients from the incoming 13 volt line. D2 acts as a steering diode and simply prevents any possible damage to the pad or electronics should battery voltage be reversed. It seems always better to be safe than sorry.

There is nothing critical at all in the circuit, and it should work the first time, barring cockpit errors. Neither is there anything critical in its layout. I put mine into the same box with the pad, using a small piece of vector perfboard. Using parts and values shown, the unit will deliver more than 10 volts of very clean undistorted audio at the collector of the amplifier/isolation stage. This should be more than enough audio to drive the modulator of most transmitters directly. It should be noted, however,

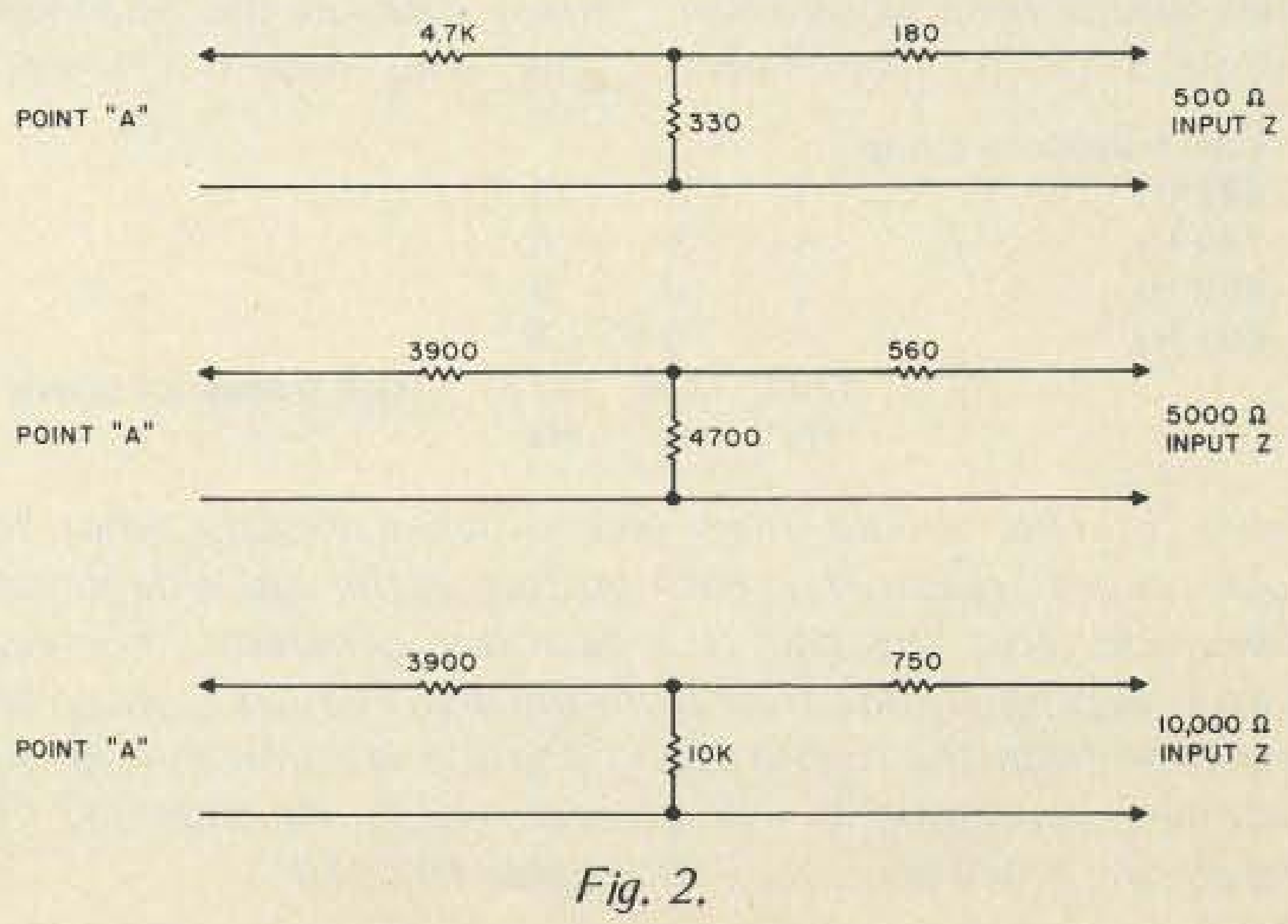


Fig. 2.

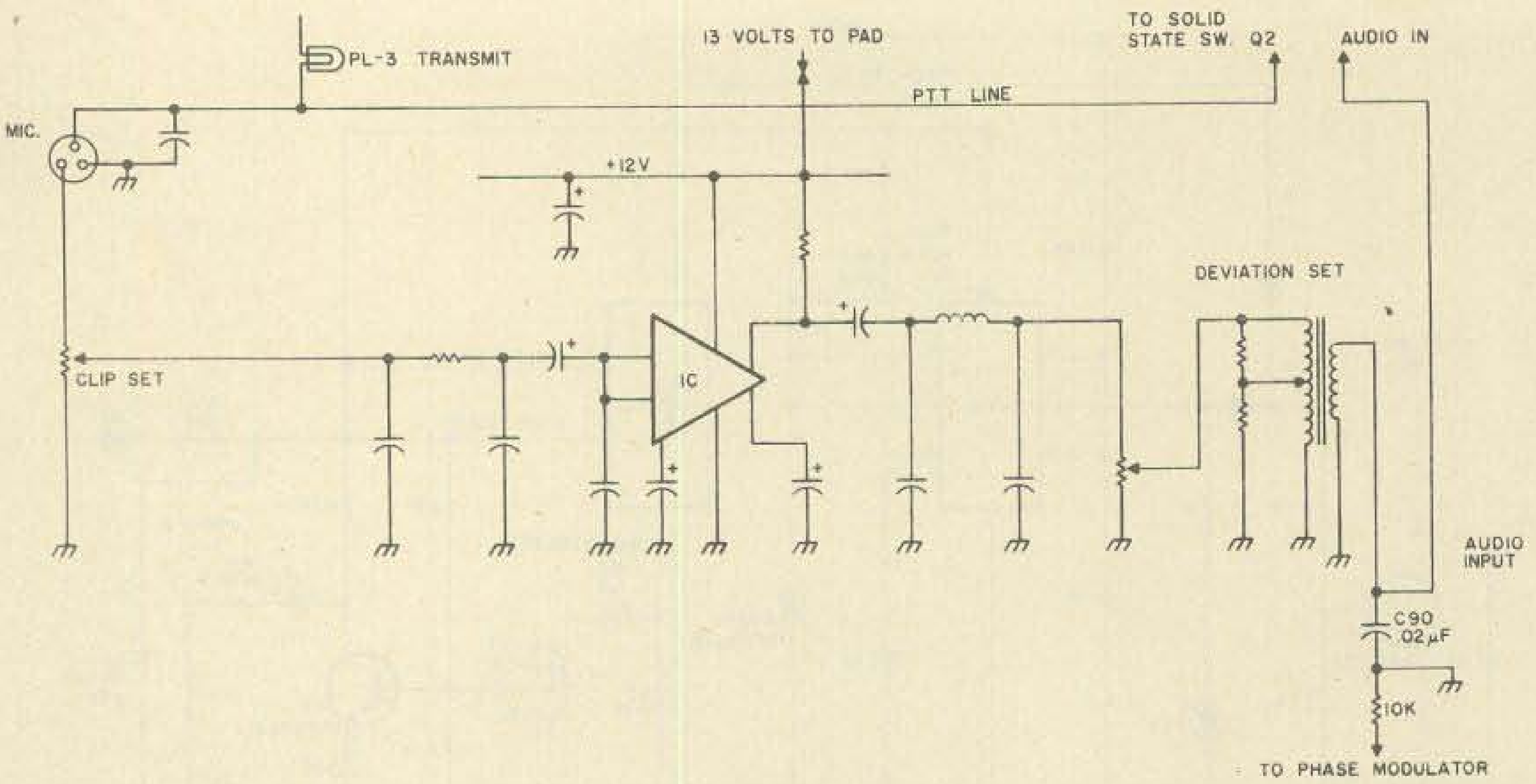


Fig. 3. Icom 22A mike preamp stage. C90's value is changed to .47 uF, and the touchtone audio is injected as noted.

that the 47,000-Ohm built-out resistor used to provide the high impedance to the transmitter will drop this voltage to something less than the abovementioned 10 volts. The procedure I used was to first select the point of injection into the modulator and then, speaking in my normal voice into the station mike, measure the peak-to-peak audio voltage on a scope and set the two-tone level at the output of the 47k resistor while coupled into the transceiver at slightly less than voice modulation. This is perhaps the safest and most foolproof method of initial setup. However, should a scope be lacking, simply start with the level set control in the pad amplifier at zero and begin depressing the necessary access button on the pad while slowly bringing up the audio. It shouldn't take more than a minute to determine what audio level your local autopatch facility likes. There will generally be someone on the frequency who is more than eager to help you.

Care should be taken, however, not to overdrive Q2 or the following modulator stage in your rig. Most autopatch facilities don't seem to work well when receiving overdeviated signals.

A few final comments are worth noting. It has been observed, on the San Diego machine, that many people experienced early difficulties. For proper operation, remember that your transmitter must be on frequency, the two-tone frequencies out of your pad must be precisely correct, and, finally, the deviation of your transmitter must be correct or slightly on the low side.

With a frequency counter, I measured the output frequencies of the Western Electric pad. I found min. to be within 3 Hertz in the worst case on the 852-Hertz tone. This tone has a tolerance of ±13 Hz, so it can readily be seen that Western Electric did their job well. Should you find it necessary to adjust your generated frequencies, do so with extreme care. Generally, it is safe to say that unless you suspect someone else has been there before you, it is best to leave well enough alone. The slugs in the Western Electric toroids are adjusted with a special triangular tool, not usually available to the common ham. Trouble occurs when you get overzealous with a pocket screwdriver on the tuning adjustment of the toroid. The results are usually a broken core. If it works the patch, leave it alone.

Although it is not recommended, this unit can drive a mike input stage by eliminating R9 and inserting a suitable attenuator pad between point "A" and the mike input. Shown in Fig. 2 are the values to match the touchtone amplifier output to 500-Ohm, 5,000-Ohm, or 10,000-Ohm input impedance on your transmitter.

Although the values shown for the attenuators are not exact, they represent the closest standard value resistor. The slight difference in values will never be noticed. The pads were designed to take a nominal 7.5 volts of audio at the collector of the amplifier/isolation stage down to 350 mV. This 350-millivolt figure is a ball park value. Should your transceiver need more or less audio, this can be derived by trimming with the level-set control on the input of the amplifier/isolation stage.

Low frequency group				
697 Hz	1	2	3	
770 Hz	4	5	6	
852 Hz	7	8	9	
941 Hz	*	Ø	#	
	1209 Hz	1336 Hz	1477 Hz	High frequency group

Table 1. This should help you visualize exactly what frequencies are generated as each button on the pad is depressed. Remember that the pad is a two-tone generator. For each button depressed, one tone from the low-frequency group and one tone from the high-frequency group are transmitted. For example, depressing Ø will generate 1336 Hz plus 941 Hz. Depressing 6 will generate 770 Hz plus 1477 Hz.

General Notes and Comments

The 2N2222A transistor can be replaced with the following devices: 2N2222, 2N2540, TIS109, TIS111, TN3904, GE-20, HEPS0015, HEPS3001, and ECG 123A.

The total current drawn by the unit is less than 20 mA. About 8 mA of this total current is drawn by the LED when it is lit. The diodes used as steering units are general-purpose silicon. I used 1000 piv at one Amp, only because it is what I had in the junk box. With the exception of D2, all diodes could be 1N914s. D2 should be a silicon unit, and 100 piv would be more than enough. All resistors are ¼ Watt, simply to keep the size of the project down to a minimum. Consideration was given to a small amplifier driving a tiny speaker so that I could hear the tones as they were being keyed up. The idea was discarded due to lack of space within the pad enclosure. As shown in the photo, the pad is mounted outboard of the transmitter with a short 4-conductor cable interconnecting the units. This arrangement of the pad being permanently mounted to the dash is a far better arrangement than any hand-held device. Hand-held units require two hands to operate and, on a fast freeway or city street, can create many problems for those attempting calls while driving. Less the price of the pad, this device could be built for under $7.00, including the price of the enclosure. Local hams have remarked on the "bell-like quality." This, I feel, is the result of doing things right and feeding clean undistorted tones directly to the modulator. Try my method. I'm certain you'll be pleased. ■

Dan Kernan WA2KOK
Rt. 1 Box 310 Front St.
Vincentown NJ 08088

The Tempo 2020

—satisfaction tells all

While it seemed that Kenwood and Yaesu were in tight competition to grab your ham radio dollars, along came Henry Radio with a new offering, the Tempo 2020. Having owned the Tempo One for about five years and feeling it was a great value for the money, I was very much interested in the *73 Magazine* advertisements of the 2020. I became even more interested when a local ham visiting the shack offered to take the old Tempo One off my hands for a good price. While I hated to see it go, on one hand, on the other hand I had been enticed by the ads for the new rig. The deal was made and the purchase of the Tempo 2020 completed a few days prior to the 1976 ARRL November SS phone weekend.

For the uninformed, Tempo is a name Henry Radio places on a number of pieces of electronic gear marketed by them, some imported, and some manufactured in the U.S. The original Tempo One was in fact an undercover Yaesu FT-200. The new model 2020 is manufactured by Uniden. A telephone call to Henry Radio on the west coast prior to the purchase of the new rig revealed that Uniden was big in the radio business in Japan but has not yet received wide recognition in the States. This fear of the unknown, as it were, may cause some unnecessary shyness in making the purchase. I think this article will arrest any of the fears you may have.

Rather than duplicate the instruction manual and specifications in this article, I think it best to focus on the main features of the rig.

PLL Circuitry

The unit employs modern phase locked loop (PLL) circuitry. This allows accurate frequency determination without introducing the spurious signals common in many amateur transceivers. The receiver is the single conversion variety offering excellent protection against unwanted cross-modulation.

Hybrid Dial Display

A glance at the dial display may lead you to believe it has a full digital readout. A slight movement of the tuning knob will confirm that this is not the case. The dial, in fact, offers a combination of digital and analog on its display and could be said to give the best of both worlds. To break this down a bit further, you will see the first full MHz and the first number after the decimal point on the digital display; the remaining numbers in the display appear on the mechanical drum dial. Example: 14.230 MHz – the 14.2 is digital and the 30 is on the mechanical dial drum. The five push-buttons in the lower right of the panel select the digital range after the bandswitch has been set to the desired band in the conventional manner, the dial drum being used to control the last 0 to 100 kHz.

Although this may sound a bit complicated, you soon find yourself going from one frequency to another with the speed of a quick change artist. A two speed tension control lever on the main tuning knob allows for a smooth rapid tuning rate or slower tighter control, the latter being more desirable for mobile operation. I might voice one of my few objections here, that is, the lack of a spinner type control knob.

VFO Stability

On-the-air tests in the receive and transmit modes indicate an extremely stable and linear VFO. The VFO circuit employs FET design and is buffered to prevent instability from mechanical shock or environmental changes.

Receiver Selectivity and Sensitivity

The receiver is rated at a fantastic 0.3 microvolts for a 10 dB (signal+noise) to noise ratio at 14 MHz for SSB and CW. In the absence of accurate test instruments, I can assure you after some 200 contacts in the November SS contest, it is indeed very sensitive with even the weakest signals being heard quite easily with the rf gain and rf attenuator turned down as much as 75%. At the peak of these contest operating conditions, the receiver never once exhibited any cross-modulation or intermodulation problems even on the strongest signals. The receiver employs dual gate MOSFET transistors and separate and shielded transmit/receive rf circuits.

Receiver Incremental Tuning

The 2020 has a dual range RIT control allowing for ± 5 kHz or a narrow ± 1 kHz variation for fine tuning of the received signal. A small red LED located near the control indicates when it is activated.

Final Amplifier Section

With the exception of the final amplifier section, the unit is completely solid state. The final amplifier employs a 12BY7A driver and a pair of 6146Bs in the final rated at 120 Watts nominal PEP output on SSB and 100 Watts nominal dc output on CW. The nominal dc output on AM is 25 Watts. The built-in cooling fan results in a cool running final and no doubt contributes to extended tube life. The final amplifier section is well shielded in its own compartment.

General Features

The 2020 contains its own ac/dc power supply and comes with a hand-held mic and built-in speaker. The 25 kHz calibrator is standard. There are provisions for external frequency control with the model 8010 external VFO, which also contains provision for 10 fixed channel positions and an additional dual range RIT control. There is a separate power switch for the heaters for a mere 28 Watts of power with the heaters off in the receive mode. The unit offers a choice of VOX, manual, or push-to-talk control with an accessory socket for a foot switch if desired. Living in a rural area and not having done any mobile operation, the performance of the built-in noise blanker has yet to be evaluated under high noise conditions. The front panel adjustable AGC control works well in all modes or can be shut off for weak signal reception. The bandswitch has two receive only positions for 15 MHz and the 11 meter band. There are provisions on the rear for low power output for transverter use and, in fact, my Yaesu FTV-650 6 meter transverter performs very well with the 2020 and the aid of an external power supply. All the major circuitry is constructed on 15 separate circuit boards with accessibility being enhanced by a fold down front panel.

Summary of Operation and Performance

Were I to sum up this unit in a word, that word would have to be unique — unique in that the unit performs without a hitch on all bands flawlessly, as experienced by the 24 hour contest weekend operation. It is unique in the features that are standard on the rig when you take it out of the box.

One of the most impressive of these is the built-in 600 kHz CW filter which has me back working and enjoying CW more than I have in years. This feature should please even the most demanding brass pounder. This unit is a pleasure to operate, the controls are well thought out and well located, the knobs are made for man size hands, and the unit is a bit larger (14.75" wide x 6.5" high x 13.25" deep) and heavier (39.6 lbs.) than most other units in its class, giving it a good solid look and feel which seem to have gone out with the passing of some of the old boat anchors of yesteryear. This is the point in the article on new products where the writer finishes with the negative features concerning the operation and/or performance of the shiny new box. Well, I must apologize, for I have yet to discover them. ■

Looking West

from page 26

taken is not to your liking, then the only one you can blame is the guy in the mirror.

AGAIN ELMO

I think I received the following information last month — that there was a new open two meter system in New Jersey and that the caller was WA2DW?. The answering machine cut him off, so I really cannot be sure. The reason I bring this up is that a number of you who have tried to leave a message for "LW" did not heed the specific instructions I gave as to how it must be done. Let me review once again. When Elmo answers, you will hear me with a fifteen-second message. This is followed by a tone. As soon as the tone stops, you will have exactly fifteen seconds to leave your message. The best way to do this is by jotting down on a piece of paper what you want to say prior to making your call, especially if it's long distance. When you hear the tone, and after the tone stops, start with your name and callsign, and then give your message. When you hear the second tone, the time is up. If you have something very significant that will take longer than fifteen seconds, leave a telephone number so that I can call back. However, if you speak quickly and distinctly, there is a lot of information that you can leave in fifteen seconds. The fifteen-second time limit is not of my choosing. That's the way Elmo operates, and though I have tried to slow him down, so far I have met with little success. For those interested, he is a magnetic disc-type machine manufactured many long years ago. I think his age makes him a bit ornery, but after trying many of the new cassette-type units, he still is far more reliable than anything else I have come across to date. The "LW Hotline" number is (805)-259-8243. It's good 24 hours a day, seven days a week.

My thanks to WA2DW? for trying. If you drop me a note with the information, it will be used here in Looking West.

"SOLAR POWER ON A HILL" DEPARTMENT

WR6AUG is an open 220 repeater. Fact is, AUG has been around for some time now. However, of late there is a difference in AUG that will probably interest you. About three months ago, WR6AUG became the first Southern California repeater to go total "solar power."

Now, this is not the first repeater along these lines. There have been at least two other systems which have done similar experiments. If memory serves me correctly, one was in New Mexico and the other in Colorado. Both were two meters. As to whether either is still operational, I cannot say. Maybe some of those involved in the original New Mexico and Colorado systems will read this and let me know.

What sets WR6AUG apart from the others is its final site and the band upon which it operates. While presently still in test mode at a temporary location in the Hollywood hills, the plans call for moving WR6AUG to a remote mountaintop, one not served by any power company. According to Joe Schullman K6BWA, who, along with Sam Davis WA1GQY/6 and their remote/base group, designed and built the AUG system, while there are many good potential repeater locations throughout this area, the best ones have never been utilized because the necessary electric service was not available. Some mountaintops have the ability to talk half the state and then some, but a system operational on battery power would be short-lived and not worth the effort. The obvious answer is to solar power such a remote installation, but, until recently, the cost of the most necessary portion of such a system, photocell panels, was beyond the pocketbook of most amateurs.

However, Joe's group lucked out. A company in Chatsworth, California, Arco Solar Technology Incorporated, showed its willingness to partially donate a number of "imperfect" panels to the AUG system. As Joe explained it, the panels worked perfectly, but were best termed "seconds" since some had slight discoloration to the cell structure. They would not meet spec for space travel, but for an amateur repeater installation they were a godsend. By utilizing low current CMOS technology for all control functions and by incorporating a touchtone-controlled user turn-on and turn-off of the overall system so as to minimize standby current drain, a complete 10 Watt repeater package was built and is currently in final test.

Joe Schullman K6BWA with WR6AUG solar panel test.

The repeater itself is built from what has proven to be one of the best bases to start from — the Uniden (i.e., Midland 13-509/Clegg FM-76/Cobra 200) series of 220 MHz radios. Virtually every Southern California 220 MHz repeater in current operation has had this as the generic starting point. While there are some exceptions, in general you will find that one of the aforementioned radios was the main building block. Dollarwise, 220 radios are probably the best buy to be found in amateur radio today.

Operating WR6AUG is only slightly different from any other repeater. As stated earlier, AUG is tone access, but it is an open repeater. The touchtone access system is to conserve power, not keep people off. What you need is a 220 radio of your own, a touchtone pad, and a pair of crystals for 223.24 in/224.84 out. You simply key up, hit the *, and make your call. When finished, you hit the # and turn off everything but the decoder and receiver. This is to prevent random kerchunks and keyups that would shorten the usable time of the system. At present, Joe tells me that AUG is capable of a total of six hours combined transmit/receive duty time daily. Since the solar panels are used to charge a rather high capacity sealed electrolyte automotive battery, system operation is not limited to daylight hours. However, when using the system after dark, it should be remembered that there will be no recharge until daylight again appears. In other words, keep it short after sundown.

It seems that something new and different takes place out here daily. While WR6AUG is not exactly a first for solar power, it is for a full-time 220 MHz open system.

The Trailer Light Solution

—a diode interface for German cars and U.S. trailers

George R. Allen W1HCI
80 Farmstead Lane
Windsor CT 06095

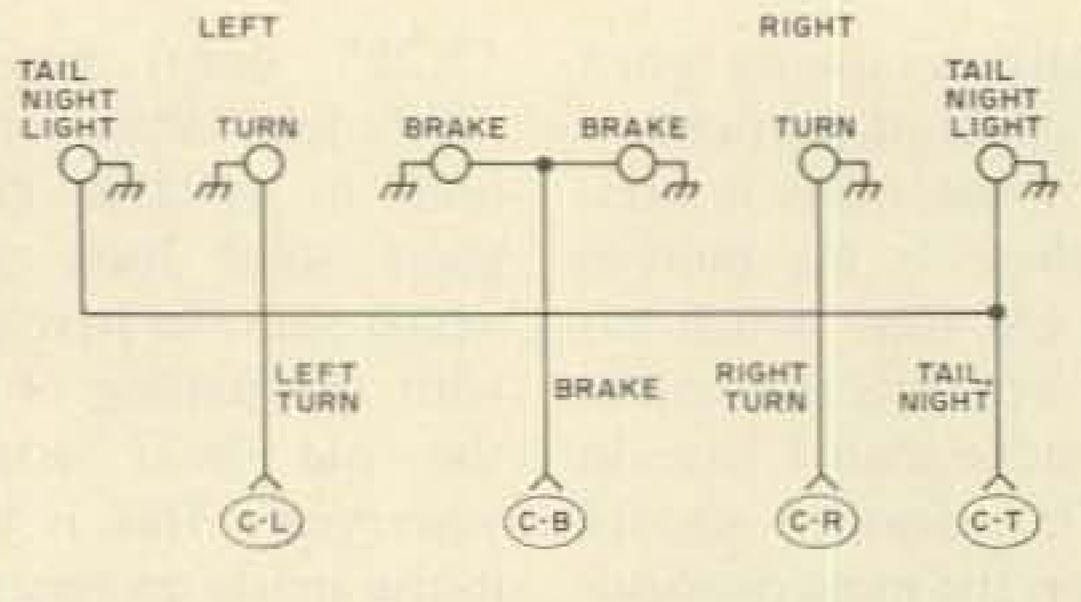


Fig. 1. Typical European car rear light system.

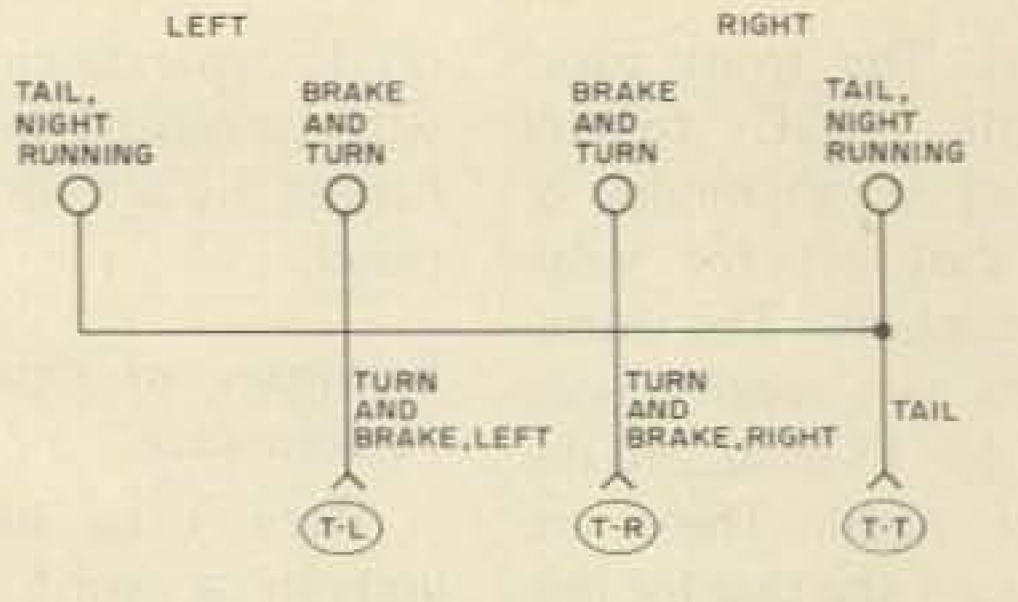


Fig. 2. Typical light trailer rear lighting system.

Most people at one time or another have had reason to rent a trailer from one of the national rental companies or else tow their own trailer. Usually the trailer is hooked to the car and the trailer lights connected without difficulty. Without difficulty, that is, if you have an American car. If you have a European car such as a Volvo, VW, etc., you have a problem. With most European cars you have separate brake lights and separate turn signals (Fig. 1); with American cars and trailers, the turn signals and brakes operate using the same lamps (Fig. 2), producing incompatibility.

I might mention that I have never been refused rental of a trailer even though the lights on the Volvo don't match up with the lights on the trailer. Instead, I've gotten the trailer and, in addition, the verbal solution of "you really don't need turn signals, we'll just hook up the lights." This approach works until you get caught.

Of course, rental trailers are not the only trailers with lighting systems which are incompatible with European cars. Most boat and camp trailers cannot be properly connected to European cars unless an additional light is attached to the trailer. The circuit described in this article provides a simple means of interfacing the European car lighting system to the lighting system on the average trailer. It can be built for less than $3 and can be connected to your car in minutes.

How It Works

Diodes perform the magic in this simple adapter. Diodes are used since they will conduct current in one direction only. Thus they will provide a one way path for current. Diodes D3 and D4 provide a one way path from the car brake wire to each turn signal light. When the car brake is on, the brake lights on the trailer will be on. Since the diodes permit current to flow in one direction only, the turn signals will not interfere with the brake lights on the car. If these diodes were not present, the two turn signals would be shorted together and, in addition, the brake lights would come on when either turn signal was turned on. Diodes D1 and D2 provide a one way path for the turn signals. If these diodes were not present, the turn signals would light when the brake lights light. Use diodes with a minimum 3 A 50 piv rating.

Note that diodes are not perfect conductors in the forward direction. Each diode will have a constant voltage drop of about .7 volts across it when current is passed through it. (You can check this by measuring the voltage across D3 with the trailer lights connected and the brake pedal pressed.) If the normal voltage from the battery with the motor running is 14 volts, the voltage at the trailer lamps will be 14 V less .7 V drop or 13.3 V. The loss in bulb brightness is insignificant for a change from 14 V to 13.3 V.

An alternate solution is to use a series of relays wired to perform the proper function in place of the diodes. Relays are expensive and turn out to be a rather complex solution.

Construction

Construction of this little adapter is not critical at all. The diodes do not get very warm in this application, so it is not necessary to mount the diodes on heat sinks. For my adapter, I mounted all four diodes on a thin piece of plastic sheeting, such as a piece cut from a plastic saucer or plate. I then wrapped the entire unit in a large ball of plastic electrical tape to insulate it and make it waterproof. It looks sloppy (hence no picture), but it works fine. I let the wires hang out of the ball about 18" and labeled them as shown in Fig. 3. Use #16 or larger insulated stranded wire.

Installation

Installation is simple if you use the little gadget as shown in Fig. 4. This device is a simple test lamp for use in determining which wire goes to which light in the car. To use the test lamp, connect the ground clip to a good ground point on the car, such as a point on the frame which has bare metal showing. Find the wiring harness in the trunk which connects to the lights. Turn on the taillight and

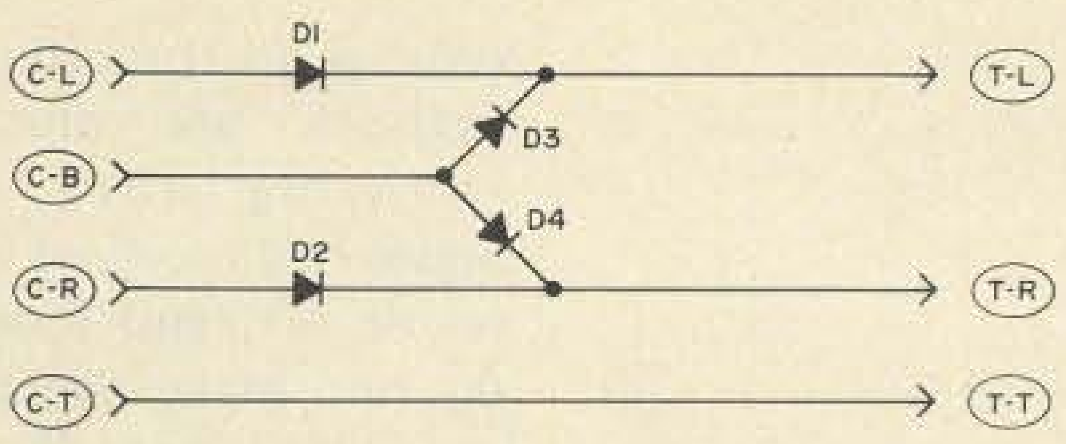


Fig. 3. European car/trailer light adapter.

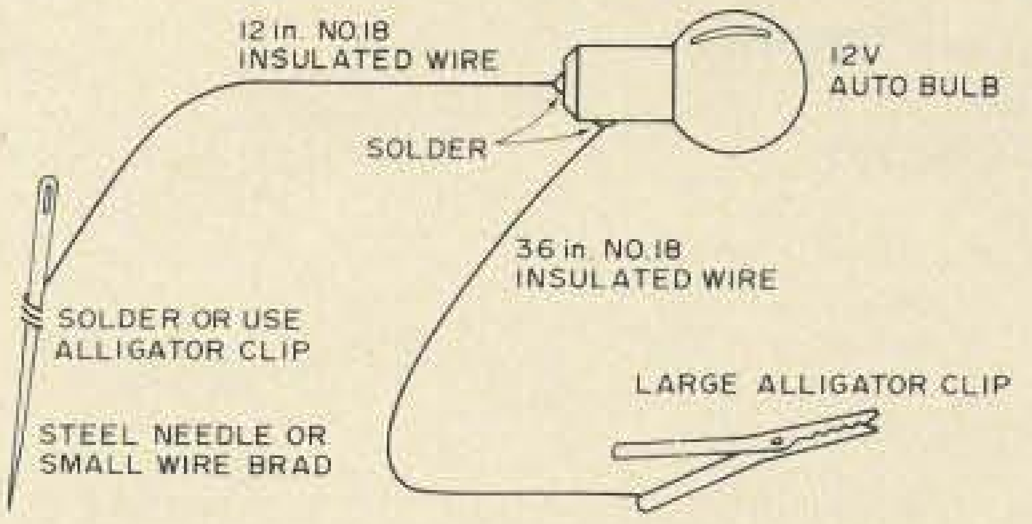


Fig. 4. Test lamp.

stick the pin into the wires one at a time until the bulb lights. Label this wire with a piece of masking tape "C-T". Repeat this procedure with the turn signals and the brake line. Make sure that you label all wires as shown in Fig. 1. From the trailer agency or the trailer manufacturer, find out the connections for the trailer lights and label these connections as shown in Fig. 2. For final hookup, merely match the labeled wires on the adapter to the corresponding wires on the car and the trailer.

Once your unit is built and installed, it requires no maintenance. I built my adapter three years ago and have been using it ever since to connect the lights on our Volvo to the lights on our Coleman camp trailer. ■

LETTERS

from page 11

tically impossible to form a microcomputer fan club in my home town.

But, being a radio ham, I wonder if there is any group or club that meets on the air to discuss microcomputer matters and interchange information. I am sure that many foreign hams may have a similar interest. I wonder if you have knowledge of the existence of such a group or could put a question regarding this in *73 Magazine*.

I am personally active almost every day around 21,350 kHz between 22.00 and 23.00 GMT. I also operate on 10 and 20 meters.

Hans Seemann CE1NF/CE1HB
P.O. Box 24-D
Arica, Chile

JEFF AND JEFFERY

In *73* for November, 1977, you have referred to "16-year old Jeff of Jefftronics."

Jeff-Tronics is a registered trademark owned by Eugene L. Jeffery. Jeff Rose, to whom you referred, is not connected in any way with Jeff-Tronics. I would appreciate it if you would make this known to your readers.

Eugene L. Jeffery
Cleveland OH

Picky-picky. — Wayne.

ESPECIALLY DOTTY

This letter is on behalf of my father as well as myself. We recently moved from Chicago to Bedford NH, and since our move we had not been receiving *73* since August. My Mom placed a call to you while I was in school about 2 weeks ago, and thought you were very nice. Anyway, you connected us with Dotty Gibson. She was very pleasant and helpful, and said she would send out our missing issues by UPS the next day. Well, that was just fine. I had waited this long and could wait a few more days. Then, she really surprised us by offering to drop them off at our house, as she was going shopping out our way.

What can I say, except that we were very pleasantly surprised. I don't think we can thank you — and especially Dotty — for going out of your ways to help us. My father and I both thank you and appreciate it very much. With such great service, I hope it won't be too long before I can subscribe for life (if you still have life subs). I am 16 and plan to live for a few more years and don't plan on being on a bomb squad or a sky diver!

Rob Nelson WB1FNO
Bedford NH

BAD GUYS?

After 15 years of supporting the ARRL and most of its policies and considering you somewhat of a "devil's" advocate," I finally have had it with *QST* and the League. In asking a question about their September editorial on ham gear sale control, I ran head-on into what I feel is inexcusable arrogance and barely disguised contempt for anyone who questions headquarters. My first two letters were completely ignored and the answer to the third (after I told them they had seen the last of my money and supoort) was answered by nitpicking the terms I had used in my letters and, in a very transparent manner, still avoiding my original question as to who the "bad guy" manufacturers were.

This and the "no-good-because-we-didn't-suggest-it" attitude on repeater deregulation have convinced me the League and *QST* are now one and the same and represent the *QST* advertisers rather than me as a ham. I therefore am willing to let *QST* finance themselves through ads without my help. The money I saved by my rebellion is enclosed for my first ever subscription to *73*.

Keep the RTTY articles going — I bought your RTTY issue off the shelf.

Tom Hill WA4ECB
Cocoa Beach FL

No wonder QST *didn't want to answer your letters . . . that would expose their "crusade" for the fantasy it really is. There are no bad guy manufacturers . . . and only a handful of unprincipled dealers who have been reselling ham equipment to CB dealers for the CB market. This market has almost dropped dead right along with CB sales, so the whole thing is just demagoguery. Even the FCC admits that there is no significant problem with CBers coming into the ham bands . . . but this is such a strong emotional issue with many hams that* QST *has deliberately used it, knowing that it is a fake issue. Sadly, thousands of well-meaning and sincere hams have been sucked in by this latest* QST *ploy. — Wayne.*

IMPRESSIONS

Well, my first year's subscription to *73* is just about up, and I thought you might like to know what I thought about the magazine. I wonder if what I'm about to say is on other minds, too — impressions about the magazine and the people who read it.

I like your idea of a large letters section. It's a good source of information and opinions from guys from all over on pertinent (and some not-so-pertinent) topics. It's always one of the first things I read when I get the magazine. But why doesn't Wayne answer the questions anymore? Not that I mind John Molnar, but I was just wondering.

Whatever happened to the "Ancient Aviator" by Green, Sr.? That was a nice touch. Hope nothing happened to him. Same with the guest editorials. Same with the I/O editorial and report.

Speaking of the I/O section: For heaven's sake, guys, don't let it die! It's dangerously close now; don't let it go all the way. Computers are in our future. If *73* doesn't carry the information, who will? I doubt that "other magazine" would. There have been some great articles in that section (I especially liked the one that had a program to decode OSCAR telemetry); keep it going.

As for the rest of the articles, there was always something worth reading in every issue. Although I'm not active in some aspects of ham radio, there are articles which are easy to read and valuable when and if I decide to get into that stuff.

In fact, I've found that most, if not all, of the articles in *73* have a light, easy-to-read tone that makes it worth going through again. I read that "other magazine" when I want to take a nap.

By the way, I'm renewing for 3 years.

Mark Herro WB9LSS
Oconomowoc WI

Bad enough you have to read my editorials without your provoking me to waste space on the letters pages. Now, about I/O . . . no, it shall not die. For some reason, Kilobaud *seemed to drain the input of microcomputer articles during the past year. Now, with several months of computer articles in hand for* Kilobaud*, we are beginning to have more material for* 73 *along this line. With a lot of readers getting both magazines, it seemed to me to be unfair to print the same articles in both, so there has been no duplication. Ancient Aviator Green has been promising for several months to get back to his typewriter. You can bet that he is being reminded frequently, since many readers have been after us for more. — Wayne.*

H.O.L.K.A.R.

I want to bestow upon you the Honorable Order of Knowledge of Amateur Radio. Being a

Continued on page 83

William F. Jordan WB4NAY
422 North Ride
Tallahassee FL 32303

Repeater Procedure

— you haven't tried one yet?

It was natural that as amateurs moved into the VHF and UHF repeater frequencies, they carried with them many of the procedures that proved useful on the lower bands. The habits were (and are) hard to break, but are often disfunctional when applied in repeater operations. The objective of this article is to discuss some of the unfortunate practices occurring in the repeater spectrum and to offer some suggestions which might render repeater operations more functional.

The low bands are typically crowded, subject to fade, drift, and interference from stations which may not hear one another. Under these marginal conditions, operators commonly do whatever they can to assist the communications process. For example, they may begin to "push" the mike a bit in the hope of increasing the average sideband power. They will probably talk continuously for longer periods because they recognize that band conditions may deteriorate and they may not be able to say all they had intended to say. Since words and phrases often fade out, they are likely to pass the QSO to the other operator by using callsigns which are more easily detected than the single word "over." Further, their calls to other stations are commonly long to compensate for fade, noise, and interference. These practices, although useful in the HF region, yield unsatisfactory results when applied to other bands.

First, there is the tendency to "push" the mike, that is, to speak substantially louder than one's average speaking voice. In FM communications systems, the peak "loudness" of one's signal is limited by the clipping action of deviation limiting. Although average deviation can be increased somewhat, it is usually at the expense of intelligibility (due to distortion), especially in transceivers using phase modulation. Consequently, the tendency to speak more loudly than usual in FM communications conditions often results in reduced effectiveness and the practice ought to be avoided.

Long continuous transmissions also cause serious problems. They are also unnecessary. Obviously, while one individual is talking, he is the *only* one talking, and other traffic, possibly emergency traffic, cannot be passed. Some repeater groups consider the rag chewer their most serious problem, and certainly the effectiveness of a repeater must diminish considerably as the number of users declines due to the monopolistic practices of a few. Perhaps a policy of call and switch would reduce these problems. Call on the repeater, then switch to a simplex frequency.

The heavy use of unnecessary transmissions, especially callsigns, crowds the available repeater time and makes monitoring very tiresome. Although regulations require operators to identify only once within ten minute intervals, many insist on much greater frequency and often include the other QSO members' callsigns. The repetition of these redundant callsigns has no communications content. The amateur service is the only one which requires *any* mention of another's callsign, and this is at the *conclusion* of the QSO. Perhaps further FCC rule relaxation will eventually eliminate this contentless requirement also.

Another unfortunate practice is the use of extraneous verbiage in the call-up. Long call-ups are much more annoying than effective. Squelched receivers are either on or off, and long call-ups do not make them "more" on. Also, the call, followed by, "Are you there, Bob?" or some such thing is redundant. The call-up asks the same question.

Aside from the HF holdover habits, other practices and procedures can make repeater operations much more enjoyable and effective. The following are a few of them:

1. Keep radios in good shape. Clubs may wish to sponsor clinics to correct members' radio adjustments. Deviations should be limited to ± 5 kHz and mike gains should be set to minimize distortion. Transmitters should be on frequency.

2. Establish a practice of pausing several seconds between transmissions to permit access for other operators.

3. When breaking into a QSO, operators probably should use their callsigns rather than the word "break." The callsign is the only legal method, and some repeater groups have established the policy of not recognizing entering stations that use "break."

4. Avoid entering a QSO in progress unless substantial content can be provided. It might otherwise be considered a rude interruption.

5. Avoid testing on repeater input frequencies. Especially avoid testing telephone tones on repeaters.

6. Minimize repeater use for base station communications. Simplex operation is probably just as effective and is a much more efficient use of scarce frequency resources.

7. Use no more power than is necessary. Multiple repeater key-ups are becoming a major problem for some groups.

8. Try to avoid repeater DXing. When repeater DX is possible, it is invariably a result of weather conditions.

These conditions make it practically impossible to work into *only* one DX station at a time. Although it may be a thrill to work a repeater 500 miles away, it is likely that *all* repeaters along that 500 mile line (and then some, probably) with the same frequency will be held open during the operation. In some cases, clubs have complained that hand-held portables were unable to work in disaster situations because non-local DXers had captured local repeaters with their powerful signals.

9. When an operator wishes to use a repeater and is willing to talk with anyone, he might simply announce his call or perhaps his call followed by "monitoring" or "listening." "QRZ" does not really make much sense, but it is also occasionally used. But if he desires something in particular, such as road information or a test or to report an accident, he should say as much. Control operators and other listeners often cannot afford the time to engage in conversation for its own sake, but will happily provide needed assistance.

10. After calling a station and receiving no response, amateurs will occasionally announce something like, "Nothing heard, W4XYZ clear" or "W4XYZ clear." Such practices are common in commercial services, but serve no particular function in the amateur service. They probably ought to be avoided.

In summary, the abandonment of certain HF practices and the implementation of other procedures will make repeater operations much more pleasant and effective. These suggestions are offered for consideration. Clubs may wish to adopt them as policy or change them to ones more suitable to their particular operations. In any event, repeater groups probably ought to establish some guidelines to make their systems more manageable. ■

Stanley Sears W2PQG
188 Concord Drive
Paramus NJ 07652

Tighten Up Your SB-102

—*easy alignment cures*

Following assembly of a Heath SB-102 transceiver, a problem was experienced during alignment. While tuning the heterodyne oscillator coils for maximum drive to the 6146s, the meter reading was very erratic. Tapping the cover over these coils, or touching the bandswitch, also caused the grid meter to change reading, and the output to vary on the wattmeter.

Investigation revealed that the trouble was caused by intermittent parallel grounds on the four small PC boards located in this compartment. The trouble-causing extra grounds on these PC boards resulted from their loose fit in the slots of the metal comb attached to the support rail. (Refer to the pictorials on pages 84 and 85 of SB-102 manual.) Any slight movement of these boards caused a make or break contact with the metal comb, resulting in a change in ground current paths.

The problem was corrected by removing the metal comb from the support rail and replacing it with one fabricated from nonconductive plastic. I used a piece of right angle plastic molding obtained in a hardware store. Matching slots were cut using a hacksaw and the old metal comb as a template. *Two* blades were installed in the saw together to provide correct slot width. The plastic comb was then attached to the support rail in the same position as the original metal comb.

Prior to putting the rail and comb back in place, small strips of electrical tape were cut and placed along the bottom edges of the four PC boards. This was done to prevent the cover from touching the ground foil of these boards and causing a similar problem.

Following this modification, the heterodyne oscillator, driver grid, and plate coils were readjusted per Heath instructions.

After a few weeks of operation, one other problem developed with the SB-102. Gradually, a loss in receiver sensitivity and transmitter output developed. This was found to be caused by slippage of the belts on the small pulleys of the driver preselector tuning shaft. The pulleys were coated with a layer of rubber cement to create friction. When the cement dried, the belts were reinstalled and the two capacitors adjusted to track together.

As a final tip, take a look at the tuning range of the final loading capacitor. Heath instructions for pulley mounting are incorrect and, if followed verbatim, will permit only a 90° movement instead of a full 180° swing. Readjustment of the pulley on this capacitor will be required. ■

Michael Conwill N2MW
481 Carlton Road
Wyckoff NJ 07481

QRP Hints

—*for low power freaks*

When I first heard about low power operating (commonly called QRP, from the Q-signal meaning decrease transmitter power), I was a bit skeptical. As a new ham, I had fallen into the high power syndrome and had trouble believing anyone could communicate with a transmitter which used a half Watt resistor for the dummy load. Yet curiosity got the best of me, and soon I had built a QRP transmitter of my own. During my first QRP QSO, I not only discovered that using micropower for reliable communications was possible, but also found I was having a ball at the same time! How was my signal at W8TNL, 300 miles away, during broad daylight on 40m? I received an RST of 589, and power input was under one Watt!

The QRP Station

Getting on the air QRP is not difficult. Since QRP transmitters use a minimum amount of parts, building a QRP rig is an excellent way for the novice builder to get an introduction to construction, without putting his life savings on the line. Being simple and straightforward in design, such rigs are not hard to build, and parts are readily available. Plans for the construction of a number of transmitters in the five Watt region have appeared within the last few years in *73*.

For those who would rather buy than build from scratch, there are a number of reasonably priced QRP transceivers on the market, both in ready-made and kit form. Among the most popular are the Ten-Tec Argonaut and the Heath HW-8. Other, older model QRP rigs, such as the Heath HW-7 and the Ten-Tec PM series, may be purchased very inexpensively at local hamfests and flea markets. These compact units are not only useful for home station use, but also may be powered by batteries and taken to a field day or vacation site as well.

Depending upon the equipment you now have, it may not be necessary to purchase or build a separate QRP rig. Many transmitters may be run QRP by simply turning down the CW level or the microphone gain. Others will give a few Watts output while in the tune position. Experiment with your own transmitter and a sensitive wattmeter to see if either of these methods will work in your case. Remember that many transmitters will give out a Watt or two, even when the front panel meter would seem to indicate that this is not true.

If you decide to obtain separate equipment for your QRP operating, look for solid state equipment. This is especially true if you plan to operate portable, using batteries as the power source. Transistorized rigs are lightweight and compact and also waste less power than do comparable tube rigs.

When choosing a QRP rig, attempt to find one with a vfo (variable frequency oscillator). When using low power, it is sometimes necessary to duck out from under QRM, which is impossible to do when using crystal control. Furthermore, you will find yourself limited in operating space while using crystals, unless you have a large pile of them. From a construction standpoint, a crystal controlled rig is a fine way to start, but you will want to leave provisions for adding a vfo later.

If you do decide to sacrifice frequency coverage for ease of construction when you first operate QRP, build a rig using a variable crystal oscillator (vxo). This will enable you to shift your transmitting frequency a few kilocycles above or below the normal operating frequency of each crystal you have.

Many transmitters designed for QRP work suffer because they are made for only one band. If conditions on that band are poor, you're out of luck. Therefore, buy or build a rig which can be used on at least two bands. Not only will you still be able to operate when conditions on one band are poor, but you will also be able to take advantage of the differing characteristics of the second band.

You may be wondering where you will find a rig which fits all the prerequisites I have placed upon it. If you plan to buy a commercially made rig, don't worry. Almost all commercial gear is solid state, has a vfo, and is multiband. If you're planning to build your rig and have had trouble finding a suitable design, check the July, 1976, issue of *73*. On page 30 is an article by WA7SCB called "The Mini-Mite Allband QRP Rig," which should help you.

One common myth is that a QRP antenna system must be exotic. This is not true. While beams and quads will outperform dipoles and add greatly to the strength of a QRP signal, they are by no means a necessity. The main consideration is antenna efficiency. Is your antenna cut to the correct specifications? Are all joints soldered securely? And is your feedline length kept to a minimum? If you are only sending out a few Watts to start with, it is important to make sure that as much of that as possible is radiated. Personally, I find that my dipoles, which range in height from twenty to thirty feet, do a suitable job.

QRP Operating Hints

When operating with low power, your signal will obviously be less strong than that of a station operating under similar conditions but using higher power. For example, the signal of a station using five Watts will be about three S-units below the signal of a 200 Watt station. Thus, the QRP operator must rely upon operating skill, rather than the ability to overpower another station, to make contacts. There are a number of things that a QRP operator may do in order to increase his reply rate.

Most QRP operators do not call CQ unless they are trying to raise another QRP station. The majority of hams will not answer the call of a weaker station, if there is a stronger station calling elsewhere on the band. Since this is usually the case, calling CQ while QRPing is almost always a waste of time. Instead, answer the call of a station calling CQ or one who is just completing a contact. After he has ended his transmission, he will be listening carefully for stations calling him, and is less likely to pass up a call than the operator who is casually looking for a CQ.

When calling a station, I usually sign my call and add that I am QRP. Many a high power operator will take the extra bit of effort necessary to work a weaker signal, if he knows the station on the other end is using low power. This will also let any other low power operators who may be listening know that you work QRP as well.

Do not be discouraged if it takes a number of calls before you get an answer. Many people who try QRP for the first time make the mistake of assuming that they will get an answer to every call, and they give up after only a few tries if they don't. Be very patient. Chances are, it will take you a while to get used to using low power, but, after you have, you will find that you are getting about as many replies as you did when you operated with high power.

QRP and Rag Chewing

The fact that you are QRP makes a great topic for the rag chewer. I have found that most high power operators are genuinely interested in my QRP experiences. Most ask about power input, antennas, and other equipment-related details, but some even ask how I got interested and express an interest in QRP themselves.

For those who wish to rag chew with other QRPers, low power stations may often be found on the unofficial QRP operating frequencies. On each band they are forty kilohertz above the band edge, with the only exception being twenty meters, where the QRP frequency is 14.065 MHz.

It is my opinion that forty meters is the best band for QRP rag chewing. Conditions are almost invariably reliable, with 500 miles being a typical distance during daytime and many thousands of miles possible at night. At night, though, avoid the broadcast stations. Most hams who run a kilowatt have difficulty competing with the broadcasters, so trying to, when using only a few Watts, is futile.

Whenever I hear another QRP station on the air, I attempt to contact him. Two-way QRP contacts can be very enjoyable and are beneficial. Exchanging operating experiences and hints will be of mutual interest, and the report you receive from the other station will help you judge just how well you are doing as compared to other QRPers. You will receive an honest signal report from the other QRP station because he would want to know truthfully how his signal was, instead of being flattered if he were in your place.

Low Power Contest Operating

Contests offer a great chance for the QRP operator to test his station, gain confidence in his equipment, and polish off stations for any awards he might be chasing. During contests, some of the best operators and stations are on the air, and together they have little trouble picking out the signal of a weaker station, despite QRM on adjacent frequencies. The contacts are quick, so there is no need to worry about fading or sudden changes in band conditions. Furthermore, there are enough stations to keep busy at all times. QRP operators have even won contests which have a low power multiplier, because the multiplier more than made up for the decrease in score caused by operating QRP.

When operating in a large contest, avoid the first few hours. During this time, everyone is on the air and most stations contact the loudest signal they hear. When the action has died down a bit and a station has to hunt for contacts, rather than hearing five returns to his CQ, the operator will have little trouble finding your signal. He will want your contact.

Always make your first call brief. A good contest operator will respond to a simple "de WB2DFO" and complete a contact quicker than if he replies to a louder but longer "WØXYZ de WB2DFO WB2DFO," and quickness is the key to success. Begin your transmission the instant the other station stops his. If you don't succeed at first, try again, making your call longer. It is always faster to make more than one call than to find an unworked station, and not uncommon to work a station on your second call, even if he missed your first.

When contesting QRP, make frequent band changes. This will ensure that you catch band openings that will bring in distant sections that are not always available to the QRP operator, and will also keep the flow of new stations coming in. Balance your activity between the higher frequency bands (20, 15 and 10), which will bring in distant sections, and the lower frequency bands (80 and 40), which will tend to bring in a higher QSO per hour rate. Of course, if the contest is based only on the amount of contacts made, rather than the amount of contacts times the number of different sections, go to where the most activity is.

During a contest, the "no CQ" rule may be broken, although calling CQ should still be the exception rather than the rule. By calling CQ, you can hope to get contacts from those people who are in the contest casually, rather than to win. These stations are important and can do much to build a score.

If you have a few minutes during the weekends, get into the QSO parties. These often have a limited amount of participation, and those who are in it are desperate for contacts. Always send in your contest results, even if you only made a few contacts. You may find yourself getting an attractive award because you were the only entry from your state or section. The sponsors of the smaller contests are always happy to hear about your activity, and, if there is a lack of participation, they may not sponsor the event again the next year.

DXing?

At one time or another most hams are bitten by the DX bug. The QRPer is no exception. A low power operator is curious to see just how far he can get with only a few Watts of rf flowing to the antenna, and, while DXing is obviously more difficult and challenging at QRP levels, it is possible. In fact, a number of QRPers have made the DX Century Club, while using under five Watts, and numerous others have earned Worked All Continents.

A general rule in QRP DXing is use the highest frequency band that is open. When ten meters is open, it can produce amazingly strong signals at the receiving end of a QRP transmission, and its performance is greatly superior to fifteen or twenty meters. Many hams disregard ten and fifteen meters during sunspot minimum, and thereby miss DX openings. When this is the case, the QRP operator has a real advantage, for he may find himself on a band loaded with DX, but with very few DX-hungry American stations taking advantage of the openings. These contacts are there for the asking.

Since it is almost impossible to compete with multi-kilowatt stations and the QRM caused by them, avoid large DX pileups. Instead, tune around the band. You may find that so many DX hounds are involved in the pileup that there are other less rare DX stations who have few people to talk to. When working in the smaller pileups, your best bet is to transmit about a kilohertz above or below the rest of the crowd. If the DX station is having trouble copying due to QRM, there is a good chance he will hear your signal on the side.

When trying QRP DXing, have patience and more patience. Chances are you won't get a DX station on your first call. You may not get him at all. But when you finally do work some DX, congratulate yourself! The pride obtained from raising a DX station while running QRP is immensely greater than that obtained when using high power.

Closing Notes

QRP operators have their own club made up of hams worldwide who enjoy low power operating. The QRP Amateur Radio Club International consists of almost four thousand QRP operators. It sponsors awards and operating activities for the low power enthusiast as well as publishes a quarterly newsletter. Membership information may be obtained from the club secretary, Joseph Szempias W8JKB, 2359 Woodford St., Toledo OH 43605.

Good luck! I hope you decide to give QRP a try. If you do, you'll find out that operating with low power is, indeed, possible and is a great deal of fun. Right now, I think I'll give the bands a check myself. Maybe I'll hear one of the last few states I need for QRP Worked All States! ■

Peter A. Lovelock K6JM
1330 California Ave., #307
Santa Monica CA 90403

Brass Pounding Simplified

—beat the heat!

A while ago I wrote an article titled "Tuning Mr. Morse's Key" (*73 Magazine*, February, 1972), a masterpiece in basics. After submitting it to *73 Magazine*, I had second thoughts that anyone would be inspired by the care and feeding of Morse keys. I had two surprises coming: Surprise no. 1 – *73* accepted and published the article; surprise no. 2 – numerous readers' letters arrived, claiming how helpful they found this article.

As Confucius said, "The simplest things may not be as simple as they appear." Or was it Murphy?

I was not born with a brass Morse key in my hand. I make no claims to being a real hot CW operator. But I did pass the 25 wpm "Marine Wireless Operators" code test and set sail, just after my 18th birthday, in the British Merchant Navy, which means that, commercial and amateur, I've been pounding brass for 36 years.

Now it really hurts me to still hear so many of my fellows uttering agonized cries over increasing their code speed. Despite all the latest learning aids (tapes, records, et al), my friends still complain about that unsurmountable plateau that stops them from attaining 13 or 20 wpm. After months of sweat and tears, sometimes punctuated by repetitive visits to FCC offices, a fair number make it. Some don't. All could make it, and in a much shorter span of time.

Is there a secret way of overcoming Mr. Morse's misery? There surely is a way, though it's no secret if you give it some thought. If there is any secret method, it lies in firmly establishing some basic facts in your mind and sticking with them, simple as they may seem.

Let me illustrate the rationale by boring you with some of my youthful history. Living on the southeast English coast in the mid 30s, my interest was aroused by spluttering squawks invading the low end of the broadcast band. These were emitted by the still prevalent quenched spark gaps on 500 kHz, from freighters passing between the North Sea and English Channel. I learned my basic code eavesdropping on their traffic with GNF, North Foreland coast station. There was a lot of repetitive stuff – "CQ," "de GNF," "QTC1," "QSW 425" – which I soon easily recognized. Casual marine monitoring, plus some SWLing on 40 CW, soon found me fully functional at 10 wpm – enough to qualify for the British "Artificial Aerial License," prerequisite to the radiating "Experimenters License." I was still an avid listener to all and any code stations, since 3 September 1939 terminated transmitting possibilities.

At this level of 10-12 wpm, I arrived at the London Telegraph Training College, which was replete with quenched spark gaps, TRF receivers, and pump-handled telegraph keys. It also had many headsets for learning code at accelerating rates of speed. Just thirty days later, I passed the 25 wpm "Wireless Operators Code Test," administered by a growling General Post Office inspector clutching his official turnip watch. From 10 to 25 wpm in 30 days – it can be done.

Now I can hear you saying, "It's easy for some." Granted, we are each endowed with certain learning capacities, and some find code to be easier than others. But the basics of overcoming the speed hurdle are the same for all. In an effort to help those afflicted by the miseries, I have organized these basics into six "Lovelock's Laws of Learning."

Law No. 1
Eliminate the Dit-Dah Syndrome

Boy Scouts earn merit badges for memorizing the correct numbers and sequence of dots and dashes representing each letter and number. Ham radio primers have attempted to correct this original fallacy by translating it into dits and dahs. This is about as helpful as becoming fluent in French by learning to conjugate the verbs (which few Frenchmen can do).

Lovelock's First Law of Learning states that there are no such things as dits and dahs. Forget 'em. They don't exist. Never permit a dit or dah to cross your mind from this day on. The dit-dah syndrome is a major mental block to code fluency.

What you will get firmly in mind is that each code group has a uniquely different sound pattern, like the vowels and consonants of the spoken word. You will aim for memory recall of this distinct sound pattern, mentally registering a letter or number every time you hear it.

For example, the letter "C" sounds like "murder-murder." There is no other letter that sounds just like it. "I am" is letter "A". "Am I" is letter "N". I'll leave it to you to invent recognition sounds for each character. As an individualist, you are bound to have your own favorites.

Go about your daily chores muttering "murder-murder," and the letter C will soon become indelibly fixed in your mind. If you mutter too loudly, I take no responsibility for any unwanted attention you may attract. Mutter "I am" all you want. Besides improving your code, it does wonders for your ego. Passersby will assume you have joined one of the popular cults. But, to you, "I am" will always mean "A".

Sound pattern recognition is the name of the game, and the faster the better. It's just as when you learned to read – by recognizing the visual pattern as a whole, *not* by recognizing a vertical line, curled atop with a mid-bar, "Oh yes, that's F." You recognized the pattern without thinking. The same goes for the hearing mechanism which, like the eye, recognizes *whole word patterns* without analyzing individual letters.

See? You are already on the threshold of high speed capability. The pros copying 30 to 50 wpm code recognize short words and word groups as total patterns, rather than as letters. Repetitive short words like "the," "and," and "it" are common patterns.

You will master sound pattern recognition. You will enjoy it.

Law No. 2
Eliminate the Time Syndrome

An aspiring amateur golfer once asked the venerable pro Tommy Armor, "How can I learn to play like a real professional?"

"That's easy," replied Tommy, "just play eighteen holes, twice a day, seven days a week for a year, and you'll be amazed how your game will improve."

Lovelock's Second Law states that the speed of accomplishment is proportional to the time invested, as a square law function. "Practice makes perfect" brings back some onerous memories of early school days. But it is an irrefutable fact. At the London Telegraph Training College, it was code copying four hours a day, six days a week. That's 24 hours a week, or about 100 hours in one month, which raised me from 10 wpm to 25 wpm. What is important is that these hours were concentrated into a relatively short period. We copied until our ears retracted and our eyes bugged. We copied at increasing speed rates, mercilessly applied. But with nothing else to do, we soon copied effortlessly those unmistakable sound patterns.

Now if you spread 100 hours of copying code over a year, your rate of achievement will be inversely proportional to the x12 period, which means that diluting the effort won't hack it.

You say that no way can you spare four hours a day. What with a full-time job, night school, civic duties, "honey-dew" home chores, you are lucky to get in a couple of hours a week. Then better forget it and stick to CBing, for it's a long road to that Advanced or Extra class ticket.

Now, you are just excusing yourself from a little effort. There are prerecorded tape cassettes and pocket-sized recorders to play them back. You may have these already. If not, the cheapest is a great investment. And you can record commercial code stations from a general coverage receiver for new copy.

Armed with these, you will copy code any time you are not obliged to listen to something else (like your boss), while commuting to and from work, at lunch time, instead of taking a nap, and instead of cultivating ulcers watching the news on TV. The average American commutes two hours a day, has a one hour lunch period, and suffers at least one hour of TV media newscasts. There, you have that four hours. Need I point out that you do not always have to write the code into letters to memorize the character sound patterns?

In all seriousness, classic code classes attended in person or on the air for a couple of hours a week are just barely helpful if you want to gain speed in a reasonable time. Cram it in your ear every chance you have.

You will listen to code twenty hours a week. You will enjoy it.

Law No. 3
Eliminate the Skip Syndrome

Frustration is letting the mind pause to unravel an unrecognized sound pattern, while five other characters slip by. "Skip it" is the mode you must condition yourself to. It matters not that you might so skip five characters. Keep copying everything you recognize instantly, and shrug off the holes left over. After all, this is a learning state; you are not pretending to be proficient. Continuously pausing and missing easy ones inspires frustration, anger, and, finally, hatred. Keep on copying, and you'll be pleasantly surprised to find that the misses gradually go away.

You will also copy more relaxed, giving no attention to any holes – at this stage no one is keeping score. But, by all means, note those characters you habitually confuse. Q and Y are commonly misread or missed, as are F and L. Both have inversely related sound patterns. Sort them out by muttering their selected word patterns while recalling the appropriate character, and keep this up until they become distinctively recalled.

Lovelock's Third Law says that you don't give a damn about what you don't copy during practice sessions, but stick to getting down those you instantly and naturally recognize.

You will copy relentlessly. You will enjoy it.

Law No. 4
Eliminate the Speed Syndrome

"I can copy ten words per minute fine, but at twelve I fall apart," is a familiar cry. It's obvious that there is some speed that we all fall apart at, but what has that got to do with improvement?

Lovelock's Fourth Law states that you will always practice copying at a speed above your present capability. This seems to be so obvious as to be unworthy of mention. But most of us drop back on that which is easy. Many will continue to copy at a speed at which they can succeed, with the blind faith that somehow, magically, easy copying will cause their speed to increase. Not so.

You must always copy at least two wpm above the level that is comfortable for you, until you attain around 95% proficiency. Then shift gears up two wpm again. Since our capacities vary from day to day, you will have good and bad days. Don't let the bad cause you to slip back in speed to salve your ego or retain interest. Keep on the pressure and forgive yourself the omissions of a bad day, applying Law No. 3.

You will keep on copying code above your capacity. You will enjoy it.

Law No. 5
Eliminate the Frustration Syndrome

"I can't" is the universal expression of defeatism. Lovelock's Fifth Law states that if anyone else can, so can you. The secret here is to stay loose at all times. Never acknowledge that you cannot overcome the current speed plateau. You have heard others say this so often, you have become mentally conditioned.

Every time you have a copying session that's not as good as the last time, your tummy muscles become spastic, you damn the license requirements, wonder if it's all worth it, and lapse into an "I can't" mood.

This is the psychological factor which is synonymous to that impacting everyone facing a test of ability. Getting uptight, self-doubt of ability, and fretting only serve to slow down the learning process. Keeping relaxed and enjoying the challenge sounds easier said than done. It is an absolute fact, as positively proven, that people who engage in any learning process with a carefree attitude progress the fastest. Consider those practice sessions as fun. Let go of your hair. Forget the progress objective, and it will happen. After all, if so many others have succeeded, what makes you the exception? Don't be so vain.

The pro is completely relaxed in effortlessly copying code. Why? Because he has no reason to doubt his ability, knowing that he can "read" it while taking a shower upside down and eating a pizza. He reads the code like the spoken word and can memorize and copy it on paper after leaving the shower. Just get into your mind that code sounds are just another type of language, and you've got it made. Stay relaxed. Losers are those who bust pencils while copying.

You will keep carefree and relaxed while copying code. You will enjoy it.

Law No. 6
The Last Law

You can make 20 wpm in record time, if you really want to.

Summing Up

After reading the above, you'll probably say, "Well, I *know* all that, so what's new?" But if you are suffering from a case of Morse syndromes, knowing may not mean believing. And these simplified laws *will* work for you, if you care enough to apply them.

Let's just review them in brief:

Law 1 – Recognize sound patterns that mentally register characters.

Law 2 – Compress learning into a minimum time period.

Law 3 – Copy what comes naturally. Don't stall on misses.

Law 4 – Keep the speed pressure above your easy level.

Law 5 – Stay loose. Enjoy the experience of learning.

Law 6 – You *can* make it – and much faster than you think.

So far, I have dwelt on copying code without a word about sending. Well, did you learn to write before you could read? Sending is largely a matter of manual dexterity, which also requires its share of practice.

I have often heard beginners say that they can send faster than they can receive. Double baloney. They may think they are speedier senders, but the fellow trying to copy is unlikely to agree. Since sending is a reversal of the receiving function, you can't send good code faster than your recognition capability, *plus* the dexterity that, like driving a car, is manipulation of the key without conscious thought of each manual action. The key becomes an extension of your arm, like a steering wheel, reacting naturally to mental stimulus.

To all of you ambitious to overcome the misery for that coveted license upgrade, like my good friend Ron P., to whom this treatise is dedicated, may these basic laws speed your success. And the day will soon come when your junior op can brag to the neighborhood kids, "Dah-di dit-it." ■

Evert Fruitman W7RXV
2808 W. Rancho Dr.
Phoenix AZ 85017

Custom-Made Thermistors

—for precise values

I had a need for a high resistance thermistor (temperature sensitive resistor). The best that the junk box could do was one with about 700 Ohms at room temperature. The nearest parts house had a batch of unmarked units at the bargain price of ten for $1.39. Well, at that price, how could I lose? Surely there would be some high, medium, and maybe a few low resistance thermistors in a mixed batch that size.

Their room temperature resistance ranged all the way from two and a half Ohms to ten Ohms. That was not quite what I expected from those large, shiny discs. It made me start to wonder how much change in resistance could be obtained by reducing the area of one of the large ten Ohm units.

One of the ten Ohm thermistors was chucked up in the ohmmeter, and the dikes were applied. As bits of material came away with each bite of the steel jaws, the ohmmeter crept up a little bit at a time. When the dust was settled, the ten Ohm unit read 80 Ohms. What had been about a 2:1 change in resistance for a given change in temperature was turned into about a 15:1 change in resistance. With that much change, the new controller design was a snap.

Although the area of the thermistor was cut down, and with it the current carrying capability, the smaller units would still handle the few mA required in this application. With a little care and a coping saw, it should be possible to cut one low resistance unit into two or more higher resistance units, and that cuts costs. ■

Robert Cowan KL7IEP/1
PO Box 2143
Augusta ME 04330

Sterling Haskell W1KIQ
18 Hayford Street
Hallowell ME 04347

UHF Propagation

—believe it

There is a tremendous amount of communications research taking place all over the world, especially in the higher (UHF and above) frequencies. With more and more activity taking place in the 140, 220, 440, and higher bands, a recent report by the Communications Research Centre (CRC) of the Canadian Department of Communications[1] made a number of timely observations.

The purpose of the report was to document existing research at the higher frequencies and summarize the results. While the data reported covered a very broad spectrum, we will be reporting on the findings as they relate to amateur radio. For those of you who are new to this whole radio business, different frequencies travel through the air differently, or, as they say, have different propagational characteristics.

The portions of the 1976 CRC study of interest are: how distance and height affect signal strength, how fading, delay, and Doppler shift can complicate reception, and how well VHF/UHF signals can go through buildings.

Many times there is nothing in ham radio as exciting as turning on the radio and hearing a signal coming from some faraway place you've never heard of, and which you may never hear again. That's what attracted many ham radio operators to this hobby in the first place. But, there's also a challenge to be able to overcome the seemingly random nature of the ham bands and predict when you can talk with that faraway location. Just take a quick look in the back of this magazine and you'll see the propagation prediction for this month. What some people don't think about is that you can also predict propagation in the VHF/UHF bands. With a little bit of paper and pencil, you can answer questions like, "If Joe is 25 miles from me and comes in about S-5, how can I improve reception to an S-9?"

Before we take a look at what the CRC says about propagation as it relates to distance, let's review some of the general terms that are thrown around when talking about antennas and propagation. First, the one element that appears all the time is the "dB" (decibel). Just so we don't overkill with a technical definition, we'll be rather general. The dB is a ratio between two powers, and, like everything else in radio, is expressed by a formula. To find the dB difference between two powers, you use the formula $dB = 10 \log_{10} P_2/P_1$. Don't be overwhelmed by the math. Let's look at an example. Say that you're looking at a 75 Watt amplifier for your 25 Watt 2 meter rig and you want to know how much of a dB increase there will be. OK, first divide 75 by 25 (3, right?). Then take the log of 3 (say, 0.47). Finally, multiply by 10 for the final answer of 4.7 dB. Not too bad? Since you now know the dB figure, you can see what will give you the best coverage for the dollar — the new amplifier or replacing that old ¼ wave dipole you're now using with an economical 4.5 dB gain antenna. You'll also get an improvement in your receive noise level since you won't have to go through all that electronics.

Part of the secret in dealing with all this dB stuff is not to let it get the best of you. Simply, every time you increase your power by 10 dB, you multiply your power in Watts by 10. So, if I have a 10 dB antenna hooked on to a 10 Watt rig, it's just like having 100 Watts running into a dipole. Another simple way to think about dB is that every time you add another 3 dB, you're doubling the power. If I add a 6 dB antenna onto my 10 Watt unit, it's the same as having a 40 Watt transmitter and a dipole. By the way, a dipole is one of the standards used as a reference.

The other thing to remember is that all radio waves lose power as they travel through the air. This is called "path loss," and is generally given in dB. This loss is really quite high, and a signal may lose between 50 and 200 dB between your transmitter and the receiver on the other end! So, the idea is to keep losses as low as possible.

Signal Strength and Distance

Of particular interest in the CRC report was a formula that allows you to calculate your radio's range for 90% coverage — that is to say, the range at which you would cover 90% of the area 90% of the time. Here's the formula, but don't let it freak you out; we'll walk through it in a moment:

$$D_{90} = \left[\frac{7.9 \times 10^{11} H_T^2 H_R^2 P_T G_T G_R}{f^2 L_N L_L L_S S}\right]^{1/4}$$

OK, let's look at the parts. First, "D_{90}" will be the answer — your range (distance) in miles 90% of the time. "H_T" and "H_R" are the transmitter and receiver antenna heights above the average terrain level in feet. "P_T" is the power of your transmitter in Watts. "G_T" and "G_R" are the antenna gains at the transmitter site and receiver location. "f" is simply the frequency in MHz. "L_N" is the receiver noise figure. If you don't know what it is, just plug in the following values: 50-54 MHz = 3; 144-148 and 220-225 MHz = 5; 420-450 MHz = 10.[2] "L_L" is the frequency factor and you plug in the following appropriate number here: 50-54 MHz = 13; 144-148 and 220-225 MHz = 25; 420-440 MHz = 50. "L_S" is the loss of signal due to the length and type of coax, both at the transmitter and receiver. Finally, "S" is the receiver sensitivity in Watts. Ready to try it out?

All you have to do is pull out your calculator and plug in the values. Let's say you want to see if you will be able to talk with your friend Fred once all of the 2 meter gear he ordered comes in. Your antenna height is about 30 feet above the average terrain and Fred's will be 40 feet (H_T = 30; H_R = 40). You're running 10 Watts (P_T = 10) in the 2 meter band (f = 146). Your Ringo Ranger has a gain of 4.5 and Fred's beam will have a gain of 7.5 (G_T = 4.5; G_R = 7.5). Since you don't know Fred's receiver noise factor, you use the value for 144 MHz (L_N = 5). You then plug in 25 as the correct frequency factor of 144 MHz (L_L = 25). Then you throw in the line loss of the coax you and Fred will be using. Let's just say you and Fred will be using RG-8, which has a line loss of about 2 dB per 100 feet, and you each have just about 100 feet of coax between the transmitter/receiver and the antennas (L_S = 4). Finally, the receiver sensitivity in Watts. This is one of the more difficult parts to figure out and we're still not sure if we have all the answers, but 5.0×10^{-14} seems to be in the ball park for most receivers.

Now, if we throw all of it together it looks like this:

$$D_{90} = \left[\frac{(7.9 \times 10^{-11})(30)^2(40)^2(10)(4.5)(7.5)}{(146)^2(5)(25)(4)(5.0 \times 10^{-14})}\right]^{1/4}$$

By the way, don't forget to take the ¼ root of whatever you come up with in the brackets. Another way of stating it would be — take the square root of the square root of the answer in the brackets. After you work the formula, you should come up with an answer near 16.38 miles. That means if Fred is closer than 16.38 miles, you two should be able to talk 90% of the time, or, for that matter, you now have a range, dependent upon terrain, of about 16 miles, provided other hams have a setup similar to Fred's.

The CRC points out that these formulas, while helpful, are only predictive tools. There is considerable variation due to buildings or hills which may either stop signals from reaching you or may reflect signals your way.

Signal Strength and Height

The CRC report cites some rather interesting findings about transmitter heights. First, the variation of losses through the air is essentially the same from 200 to 2,000 MHz. Second, for low height antennas, where receivers are about 6 miles or so away, the antenna gain increases by 6 dB each time the antenna height is doubled. Third, if you are using a repeater on a high hill and are working mobiles about 20 miles or further away, the power increase is 9 dB each time the height is doubled. However, the CRC notes an English study which observed as much as 15 dB increase each time the antenna height was doubled. While no reason for the variation was given, with the cost of amplifiers these days, it sure seems worth it to put the antenna as high in the old oak tree as it will go.

For the receiving antenna, "the higher the better" still holds true. For example, by increasing the height of your antenna from 5 feet to 10 feet, you can add another 3 dB. But, if you double the height again, to say 20 feet, you can add another 7.5 dB. Of particular interest was the finding that, depending upon frequency and location, the gain at 30 feet relative to that at 10 feet varied in many of the studies from 7 to 18 dB. This may give incentive to putting the mobile rig antenna a little higher than just on the roof of the car.

Fading

Most everyone who owns a 2 meter mobile rig and has operated while driving has noticed a rather rapid fading. If you can see your signal strength meter while driving, and not run off the road, you'll notice the rapid fading even more. While this may seem a minor problem, for those hams who will be getting into data transmission and telemetry from their cars, it can mean real trouble. As the CRC states, studies in Manhattan show variations of up to 15 dB per foot of travel! The rate of fade can be determined from the formula:

F = (0.003)(Frequency in MHz) (vehicle speed in meters/sec). For those who are non-metric, the metric vehicle speed could be replaced by (miles per hour/2.24). At 30 miles per hour, the rate of fade at 146 MHz would be about 6 Hz, and at 440 MHz, the fade rate would be 18 Hz.

Delay

In a city with many large buildings, the VHF/UHF signal can bounce around like a pinball down the streets and up alleys. Hence, since an omnidirectional antenna is generally used, signals will be scattering all over the city streets and one or more waves may arrive at your receiver a little later than others due to the longer overall path. These multiple path problems, or "multipath," can create a variety of time delays. The CRC cites a New York study in which these delays ranged almost up to 10 microseconds and could change dramatically if the receiver were moved as little as one foot!

The CRC concludes that, in light of the delay problems, data transmission must be less than 30 kbps, for an error rate below 10^{-3} over 90% of the time.

Doppler Shift

Because VHF/UHF signals are reflected around a city so much, a moving car may be heading towards the reflecting source or away from it and the apparent frequency may be shifted either higher or lower respectively. The report notes that most VHF/UHF signals travel up and down the streets and that the Doppler shift is at its maximum at 900 MHz. At a vehicle speed of 30 miles per hour, the Doppler shift ranges up to, and tends to peak at, about ±40 Hz.

Penetration of Buildings

Finally, it was interesting to read that measurements made in office buildings in Washington show an average attenuation of 25 dB for frequencies between 450 and 900 MHz. The CRC concludes that buildings reflect rather than pass signals, but that signals may be picked up on the side of the building away from the transmitter (shadow side) due to multipath.

Conclusion

Before reading the CRC report, we knew little about propagation prediction or how VHF/UHF signals crashed around in an urban environment. Now we can use the formula in this report and "simulate" changes in our stations to see what we might gain from this or that modification. But after wading through the formulas, the fading, and multipath problems, there came a renewed respect for "radio" in general and an amazement that it even works at all, in spite of the apparent odds to the contrary. ■

References

[1] Palmer, F. H. *Review of propagation in the 470-890 MHz band with emphasis on land mobile and cellular systems (CRC No. 1288).* Ottawa, Canada: Communications Research Centre, Canadian Department of Communications, February, 1976. (NTIS No. N76-27450)

[2] Tilton, E. P., & Blakeslee, D. A. *The Radio Amateur's VHF Manual.* Newington, Conn., ARRL, 1972. Page 24.

Neil Rosenberg WB1FFQ
5 Footpath Road
Chelmsford MA 01824

Tune-Up Aids For the Blind

—practical metering circuits

Most ham radio operators are very capable of making quite functional home brew equipment, yet it usually comes out looking like a relic from the old Erector set. Specifically, human factors are usually ignored, in both self-built and commercial gear, yielding uncomfortable and confusing controls. These poor designs can typically be overcome by the sighted amateur, but the blind operator is much more influenced by the control layout, shapes, and materials. His range of perception is limited to the tactual and other nonvisual realms. To expect him to search for controls, or rapidly dart from one corner of a panel to another, puts a real strain on his abilities.

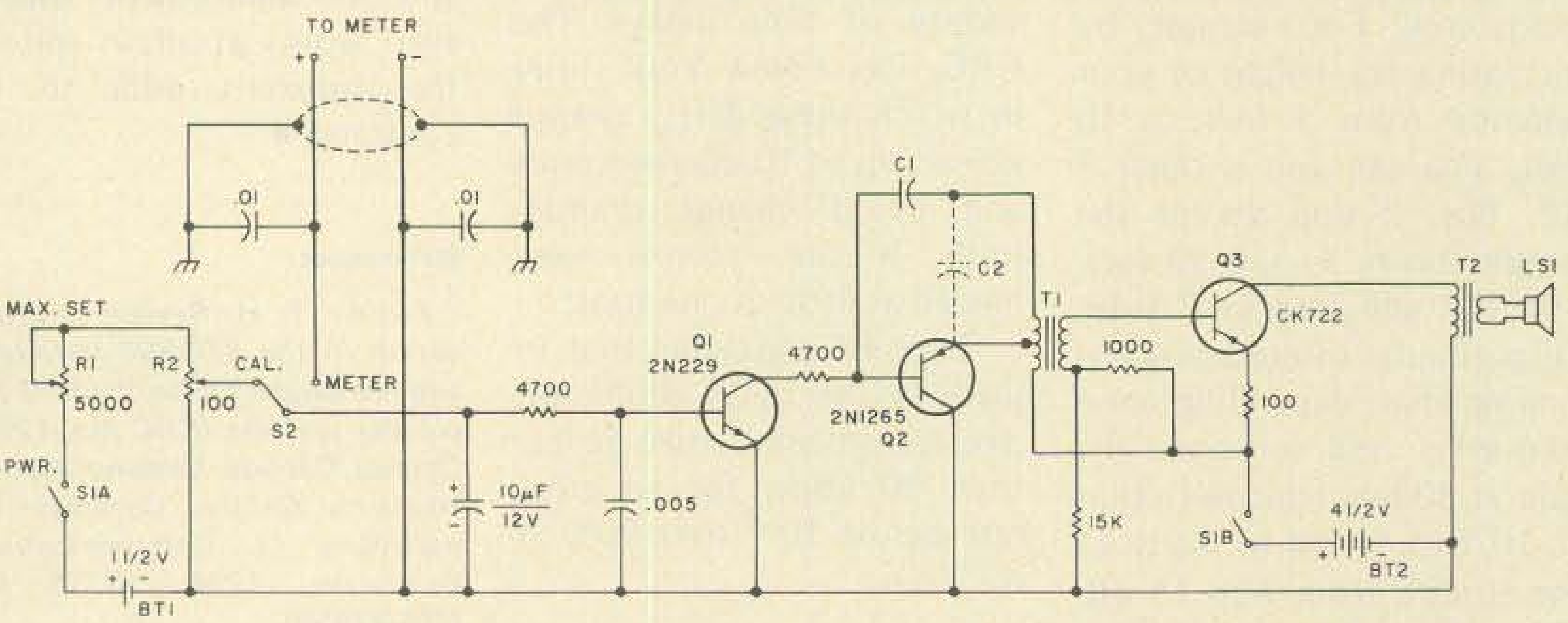


Fig. 1. Circuit of the meter reader. Capacitances are in uF and resistances in Ohms. Fixed capacitors not listed in parts list are ceramic, except that polarity marking indicates electrolytic. Resistors are ½ Watt.

As a design challenge, I decided to make a package which represented good human factors awareness and, additionally, demonstrates that such design is not inherently expensive. The chosen task was to make a product which will enable the unsighted individual to use his tactile and auditory senses to read an analog meter, like the kind found in almost all ham gear, and most accessory equipment (swr bridges, VTVMs, etc.). The person will thus be able to operate the great majority of gear for tune-up, alignment, and measurement. This gives him the independence which is so highly valued by all.

The priorities that must be considered, in rough order of importance, are:

1. Safety, freedom from dangerous shock.
2. Reliable operation, easy maintenance.
3. Ease of control location and operation.
4. Good comfort of use.

All of these factors fall under the broad heading of human factors engineering, since each deals with an aspect of the man-machine interface.

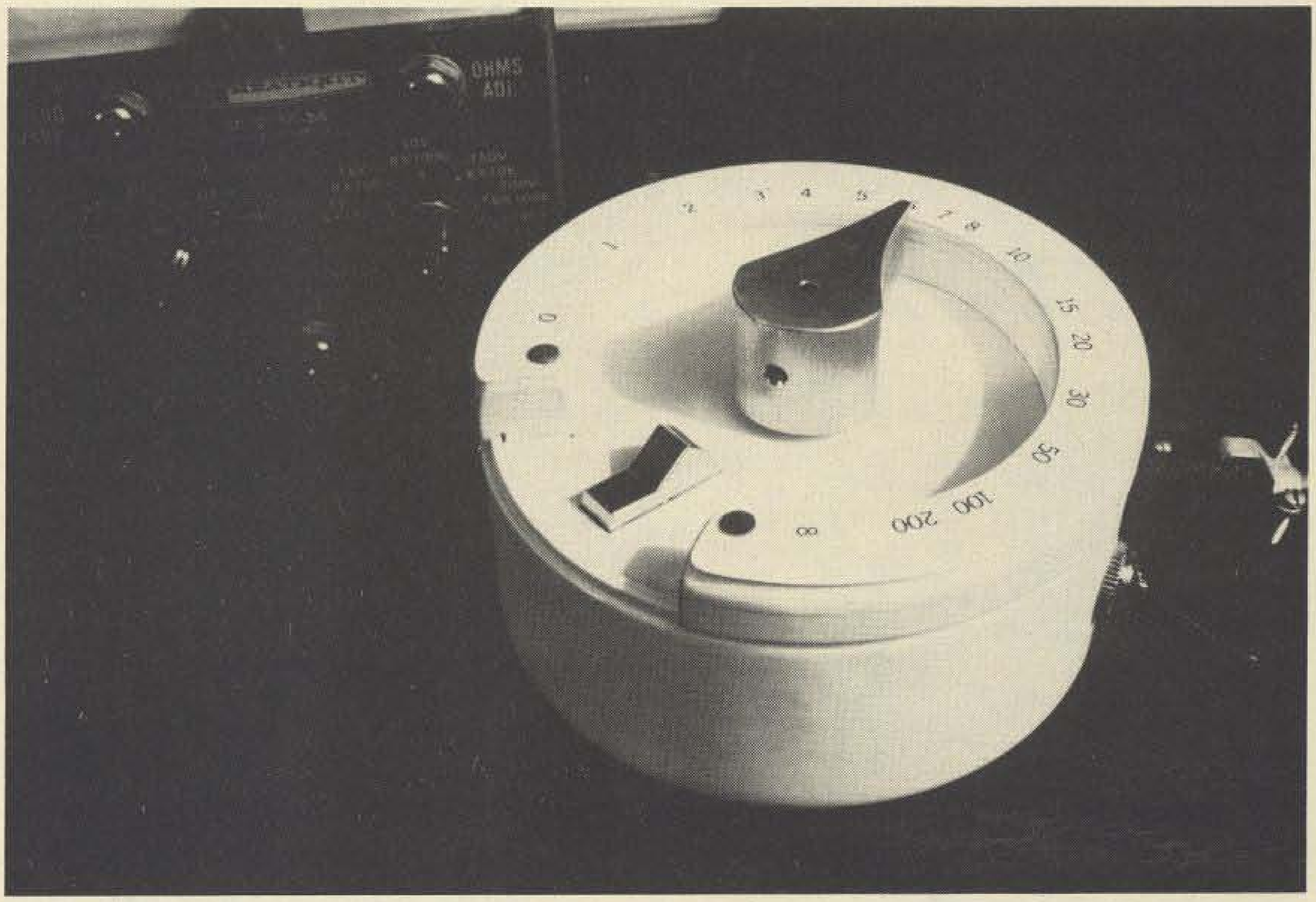
The circuit used is three stage (Fig. 1)*, consisting of dc amplifier Q1, audio oscillator Q2, and output amplifier Q3. The basic operating scheme consists of connecting the Sound-Tune to the appropriate analog meter terminals, which could be in any of the gear in use. The dc amp increases this signal to a level which can control the frequency of the oscillator stage. In this way, the frequency is directly proportional to the reading on the meter. Alternately, the dc amp can be fed by voltage divider R1-R2, as determined by S2. Thus, a direct relationship can be made between the value of variable R2 and the meter deflection, by adjusting R2 until the tones heard in both positions of S2 are identical.

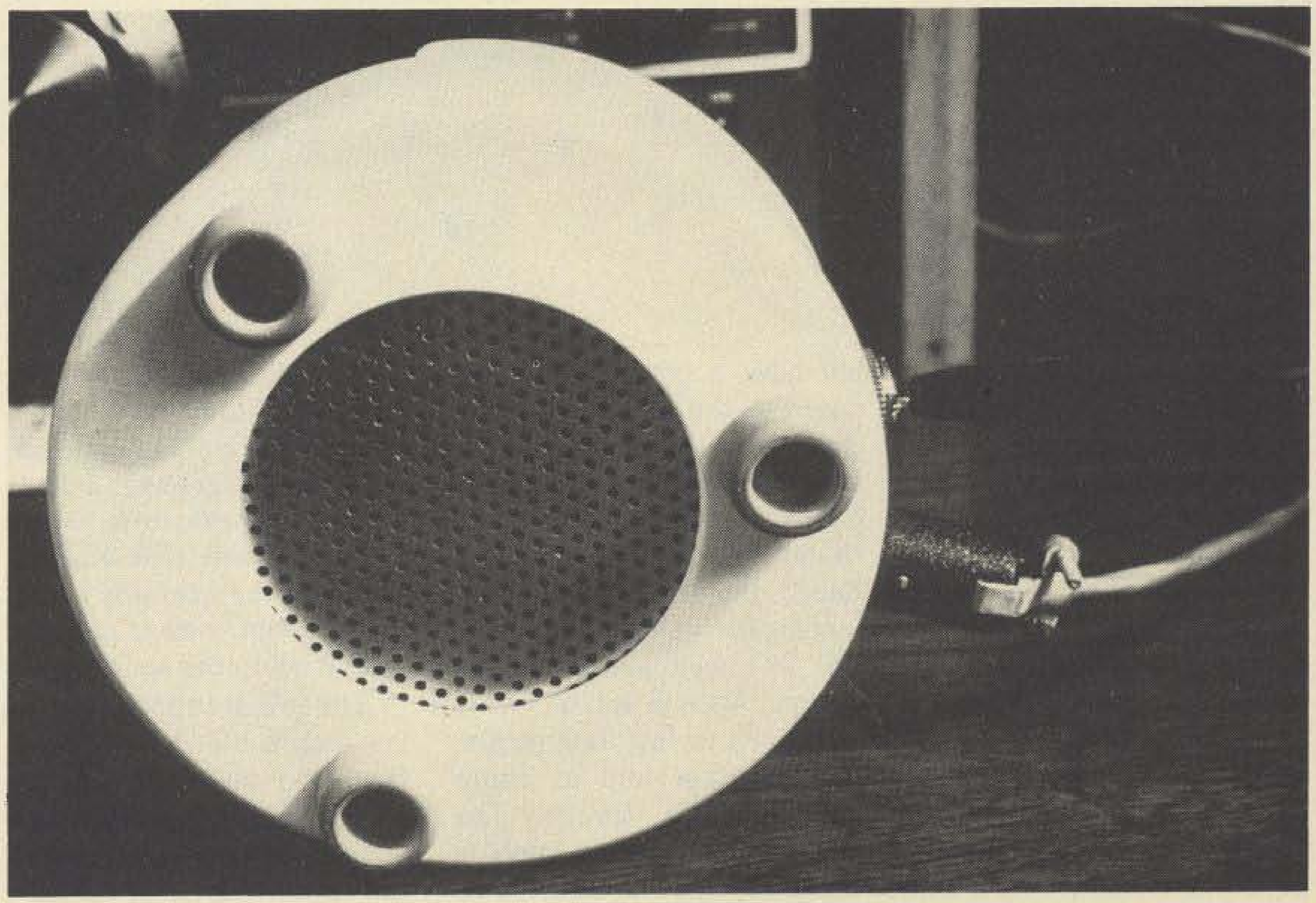
In order to initially calibrate the dial scale of R2, you must make the dynamic range of divider R1-R2 the same as the range supplied by the zero to full scale deflection of the meter. This is accomplished by adjusting R1 to give a tone match when the meter is at full scale and R2 is full clockwise. Once this is done, a calibrated (Braille) scale can be produced by setting the meter to specific points and finding the match point on R2. Those points are then marked on the scale and will be accurate until R1 is changed, or a different meter is connected.

This circuit is unchanged from the original, since it works very reliably and efficiently. Also, it can be constructed from even a meager supply of surplus parts, or from easily available new components, and can be put in a small enough package without the use of ICs. Besides, the purpose of this project was to create a design which was well suited to the needs of the blind community, not to prove how small or complex the circuitry can be made.

Upon building the first unit, I realized a valuable usage not mentioned in prior articles. The Sound-Tune can be used "backwards." That is, one can preset R2 to a desired reading and then adjust the related gear to give a tone match. In this way, one can easily set the bias on an amplifier, adjust a power supply, or do just about any other task which requires setting a control for a static value.

In either direction, it has been found that, once the detachable scale has been calibrated for a particular meter, excellent accuracy can be achieved. Since the ham usually has a variety of meters in frequent usage, he needs to be able to easily flip from one to another. This can be solved in a number of ways, depending on the particular needs of the user. Each meter could have its own output cable and associated scale for the Sound-Tune, which can be plugged

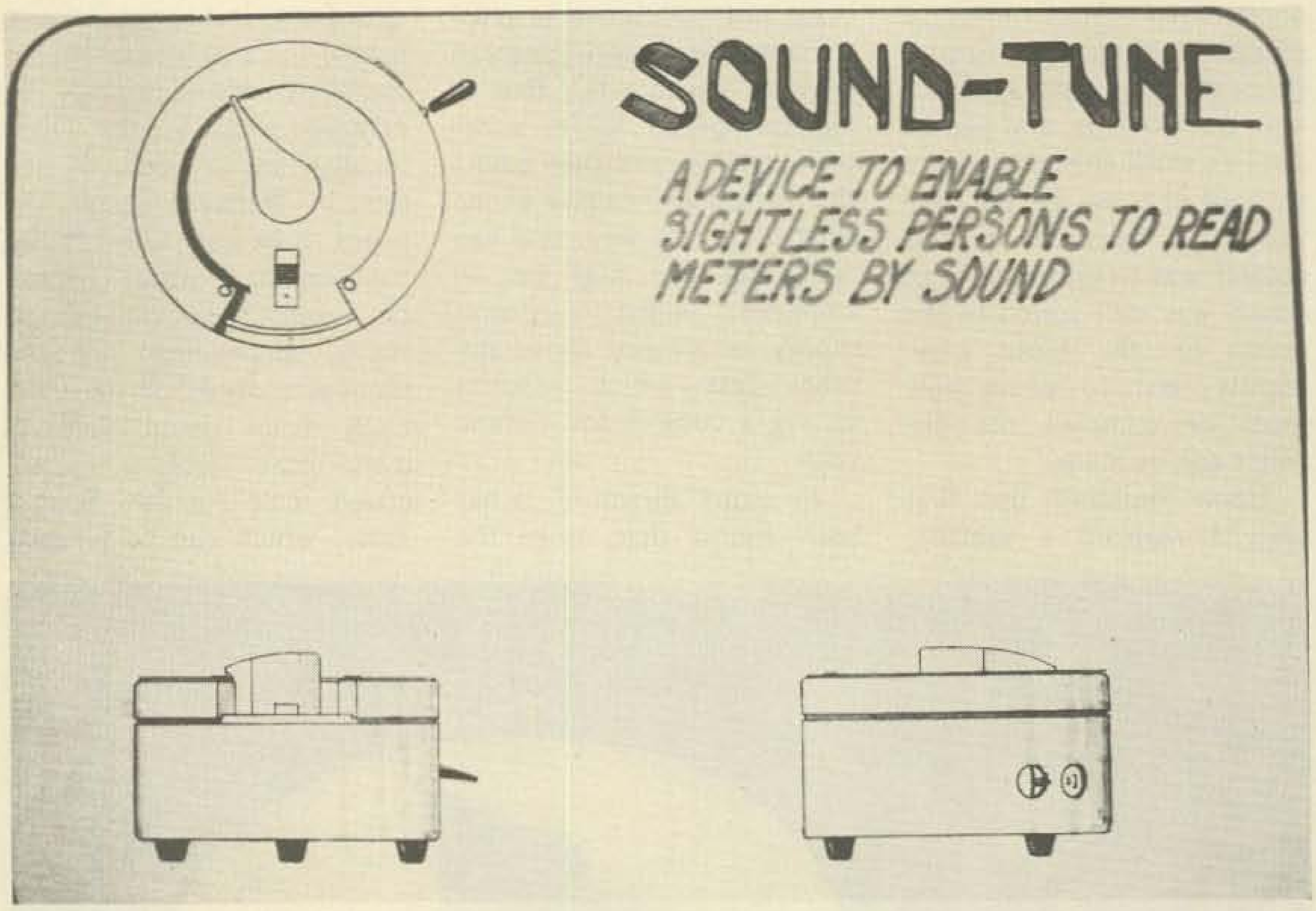


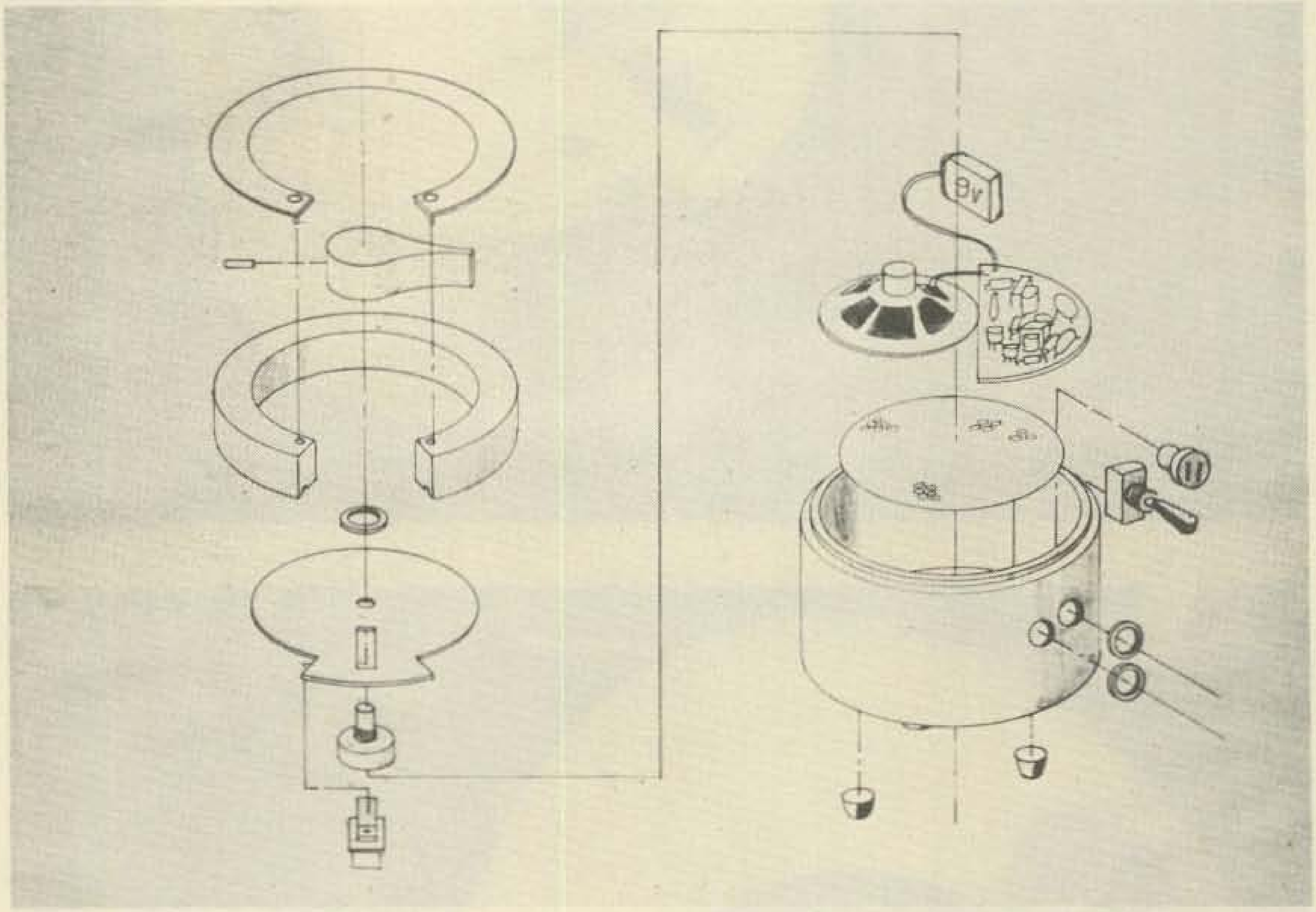


*"An Audio Meter Reader for the Sightless," Ken Blaney W6PIV, *QST*, April, 1963.

SOUND-TUNE

A DEVICE TO ENABLE SIGHTLESS PERSONS TO READ METERS BY SOUND





in and clipped on respectively. Another approach is to have a multiscale dial on R2 and a rotary switch which inserts preset values for R1 for the different movements. However it is accomplished, the design must accommodate the restricted "finding" ability of the blind, by localizing and using good sense when designing these controls.

Material choices and the quality of machining/assembly have a great bearing on how well the device will interface with the user. For example, wherever possible, corners were generously rounded, and it was determined that the conventional rectangular shaped cabinet was not well suited to the device. Also, a lot of effort was given to facilitate proper control usage and to insure nonambiguous layout. The main potentiometer knob is designed with a small centering indent, to get the user "on target" quickly. Similarly, the circular ridge on which the scale is affixed has a 30 to 45 degree break in it, where the potentiometer is inactive. This way the operator knows from feel how he is oriented in relation to the scale.

The cabinet top is roughly 2½ inches off the table surface, and all operations are conducted in a downward direction. Therefore, the user can rest his hand comfortably upon the top, which helps prevent fatigue of the arm. Also, owing to its small size, the unit can be placed almost anywhere on the counter, to suit any arm position.

The material used has an effect on the utility of the device, as well. Since it will be in contact with the bare hand, one would not want to choose a material which is abrasive or one which has high thermal conductivity. Also, one must be careful to choose a color which will not heat up in direct sunlight, as this can affect the calibration, and make it too hot to touch.

The prototype constructed for this project is basically cylindrical, machined on a lathe out of ABS plastic stock, available from most plumbing supply houses. The speaker is mounted facing down, and the sound travels out through a perforated aluminum grill. A set of three rubber feet support the unit off the table surface, both to allow sound out and to provide a nonskid bottom.

The main knob for R2 was machined out of aluminum, but there are a number of arrow-type pointers which will serve the function. One important design consideration is to make sure that the pointer does not cover the scale, but, instead, guides the finger down naturally to the numbers or markings, without obscuring them. The choice of materials, aluminum for the knob and ABS or styrene for the case, are both very free cutting, can be hand-machined easily, and will produce a satin surface when finish sanded with a #400 silicon carbide abrasive paper. Any bare aluminum surfaces should be coated with a clear lacquer to prevent oxide rub-off onto the hands.

At first, a linear slide control was considered for R2, mainly for aesthetic reasons. However, rotary potentiometers have some distinct advantages over the linear type. The rotating types are relatively immune to dirt, are easy to locate and control accurately, and are available in a wider variety of ranges and tapers. It was, therefore, an easy choice to select this kind. Once having fixed upon this, the shape of the device followed naturally, but I do not consider the prototype to represent the penultimate in design. Rather, it is an excursion into a fairly freewheeling approach, which can mature into a very good design. It is about time we get away from the notion that equipment must be shaped to mount in a rack to be of any value.

The rest of the controls follow suit. Switch S2 is located at the base of R2, in a position which will encourage rapid switching between standard and source inputs with an easy thumb movement. Power switch S1 is placed in a convenient spot for actuation by the remaining fingers. In the prototype, it is on the side for right-handed operation, but there is no reason a duplicate can't be placed on the left side for the southpaws. The top of the case slips on in a friction fit; a mating circular tongue and groove top and bottom assure reliable assembly, with a minimum of loose parts, and assure easy access to the batteries for replacement. Once inside, the penlight batteries can be replaced by feel, by placing the flat (negative) terminal of the batteries against the spring contacts in the holders. Battery drain is rather low, and unless it is inadvertently left on overnight, should last through about a year of normal use. Except for a rare recalibration, battery replacement is the only reason to access the inside. As a further precaution, the power switch is placed so that it takes an upward thrust to turn it on, thus minimizing the possibility of accidental activation by placing something on top of it.

The layout used is, of course, only one of many possible variations, but it represents a first crack at a design suited for better comfort and convenience. For example, the scale can be made larger to accommodate more than one scale on each clip. The prototype cost roughly fifteen dollars to build, assuming all new parts and free labor. Indeed, it is curious why this kind of "medium technology" is not more available at low cost to the handicapped. Blind people are typically not wealthy, but this must not prevent them from active participation in the arts of hamming. The more that is done to make the handicapped more independent and as self-reliant as possible, the more all of us will benefit, and the more hamming will become a truly cooperative hobby. ■

Parts List

BT1	Single penlight cell
BT2	Three penlight cells in series
C1	Paper or ceramic capacitor, 0.002 to 0.1 uF, as necessary to set oscillator minimum frequency
C2	If required, select values within the range given for C1
LS1	2-inch loudspeaker
Q1	Sylvania 2N229 or equivalent
Q2, Q3	Raytheon CK722, Sylvania 2N165 or equivalent
R1	Miniature control, screwdriver shaft
R2	Linear wire-wound control (CRL WW-101)
S1	DPST slide switch
S2	DPDT slide switch, poles connected in parallel for low resistance
T1	Transistor driver transformer, 10,000 to 2,000 Ohms, c.t., center — tapped secondary used as primary (Thoro XFM-2 or similar)
T2	Transistor output transformer, 500 to 3.2 Ohms (Thoro XFM-3 or similar)

Clifton W. Pittelkau W4CQI
Rte. 1
Warrenton VA 22186

KIM-1 Can Do It!

Of the several thousand KIM-1 microcomputer systems produced since the system's introduction, many are now being used by hams in a number of interesting applications. The KIM-1 may be adapted to function as a versatile RTTY terminal at nominal cost. This article discusses methods of interfacing KIM-1 to a typical Baudot TTY loop, as well as some of the software requirements. All of the options to be described have been tested and will work successfully. However, there are some considerations to keep in mind before deciding which method might be preferred.

Since all amateur RTTY operation uses the Baudot code, it is necessary to convert the incoming data to the ASCII code for video display presentation, or to operate an ASCII hard-copy printer. Conversely, ASCII characters from the keyboard, or from memory, must be converted to Baudot for transmission. In addition, the system should also perform some of the other functions normally expected of a RTTY terminal.

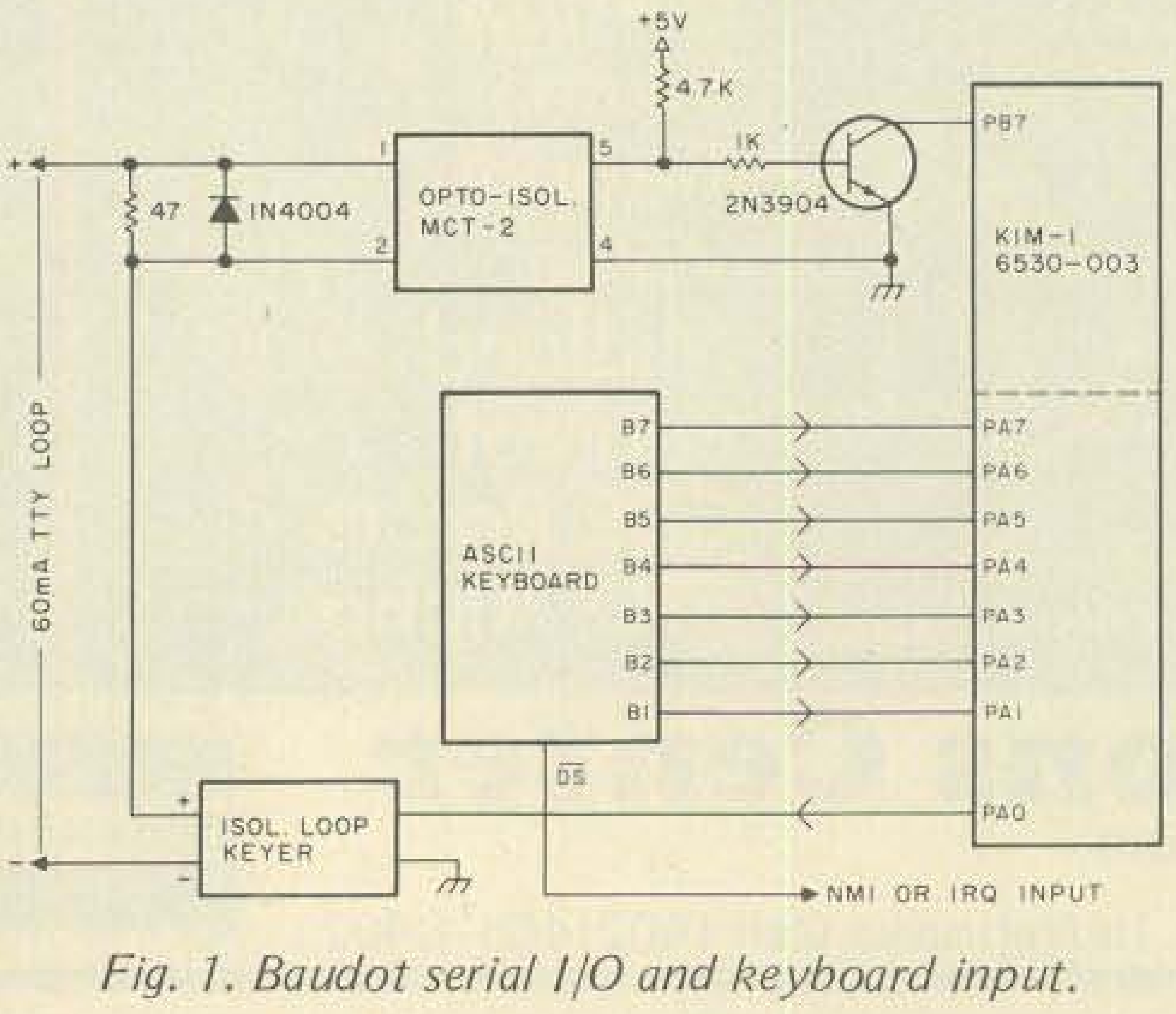


Fig. 1. Baudot serial I/O and keyboard input.

KIM-1 RTTY Functions

The program I am currently using performs nearly all of the required functions, and it can be expanded to accommodate others. These functions may be summarized as follows:

1. Baudot to ASCII conversion (receive mode), with unshift on space.
2. ASCII to Baudot conversion (send mode).
3. Automatic end-of-line (EOL) functions (2 CR 1 LF) in send mode. Keyboard line feed generates the same EOL functions.
4. Store messages from keyboard in selected memory blocks. These may be CQ calls and other canned messages, such as the station brag tape. Error correction is provided in case typing errors are made during keyboard entry.
5. Read previously stored messages for transmission. CQ calls may be repeated automatically as many times as desired.
6. Send "DE (callsign)," followed by the time generated by a real-time clock.
7. The real-time clock uses a simple crystal-controlled 1 PPS generator connected to the NMI (non-maskable interrupt) line. (The 1 PPS output of some digital clocks can be used for this purpose.) The clock is updated from the keyboard with the current time after program execution. The 1 PPS generator is turned on at the exact minute entered.
8. CW ID (Morse identification). This routine is a modified version of WB2DFA's KIM-1 Morse keyboard program, published in January, 1977, *73*. However, the CW ID is read from a table, rather than typed from the keyboard.
9. Keyboard control of all functions. One control key is used to select the receive mode, which is disabled if any other key is depressed.

The RTTY Program

To fully implement all of the above, 892 bytes of on-board memory are presently used with the parallel I/O configuration to be described later. This includes lookup tables for the code conversion. An additional 2K bytes of an S.D. Sales 4K memory expansion board is allocated to message buffer storage. The program is suitable for firmware (ROM or EROM), with the exception of the real-time clock "digit" locations, which must be in RAM. This portion of the program can be modified.

Table 1 lists the keyboard control functions. Some ASCII keyboards are not properly coded, so you may have to make some changes to the keyboard control routine, if yours is different.

Table 2 is a combination memory map and hex listing of the program. Data in zero page locations 0000-000F is variable and does not have to be saved when making a tape recording of the program. Canned messages may be saved and loaded into memory as part of the program, so they do not have to be re-entered.

For my display, Baudot carriage return is converted to a null and does nothing. Line feed is converted to space. The ASCII carriage return is converted to a blank, since the line feed takes care of EOL functions, as previously noted.

Morse equivalents for the CW ID table are listed in the lookup table in the Morse keyboard program referred to above. If any locations in the table are not filled, place word spaces (00) at the beginning or end of the table.

Serial I/O

The type of interfacing required for the external Baudot TTY loop will depend upon the user's choice of serial or parallel input/output. This will, of course, affect the software as well.

The simplest interface, from a hardware standpoint, is the serial I/O shown in Fig. 1. The interval timer of the 6530 peripheral interface is normally programmed for 45.5 baud (60 wpm) operation, but it may be changed to any other speed. On the input side, the start bit is sampled at midpoint, 11 ms after detection, and succeeding bits are sampled every 22 ms thereafter. If desired, presence of a stop bit may also be tested, and the character rejected if the stop bit is not received.

The only time a character may be displayed by the video terminal (i.e., TV typewriter) is during the stop pulse, nominally 31 ms at 60 wpm. The video terminal serial interface must be set for something faster than 300 baud, preferably at least 600 baud. The KIM monitor OUTCH routine is used to output characters to the terminal. The keyboard is connected for interrupt operation, as shown in Fig. 1, rather than to the terminal input. Therefore, terminal baud rate cannot be determined by sampling the RUBOUT key start bit, as normally done by the KIM monitor program. The data for the KIM monitor CNTL30 and CNTH30 locations (17F2 and 17F3, respectively) was read once with the keyboard connected to the terminal, and these locations are then initialized accordingly when the program is executed.

On the output side, keyboard characters are stored in a 256-byte buffer by the FIFO (first in, first out) input routine. Characters are output any time there is something in the buffer. When fetched from the FIFO, and prior to further processing, the character is displayed. This takes a finite time and adds to the Baudot output stop pulse length. Again, the interval timer is used to output serial bits. The length of the stop bit to be added by the serial output routine depends on the character display time. If the TVT clock rate is 600 baud (approximately 17 ms), an additional 22 ms stop bit will give a total of about 39 ms, slightly longer than normal, but acceptable.

Since Baudot figures and letters shift functions are generated by the program and are not displayed, a stop pulse delay to compensate must be added, using a separate interval timer routine. This same routine must be used after the line feed function of the automatic EOL.

Parallel Input

To eliminate possible software timing problems in the receive mode, the circuit of Fig. 2 was tried. This uses the receive side of a UART chip to convert the Baudot serial input to parallel outputs, which are connected to the 6530 "B" side inputs. This works somewhat in the same manner as a 6820 or 6520 PIA, but is simpler to program, since there is no control register. PB7 is the input for the "data available" flag, while PB5 is used as an output to reset the flag. This method works perfectly. Serial output and keyboard inputs were left as previously described.

Since the keyboard is not connected to the KIM-1 TTY input when using the foregoing configuration, the hex keyboard and display must be used when loading the program or otherwise using the KIM monitor. The TTY/KB switch should be placed in the KB position and returned to the TTY position after executing the program with the GO key.

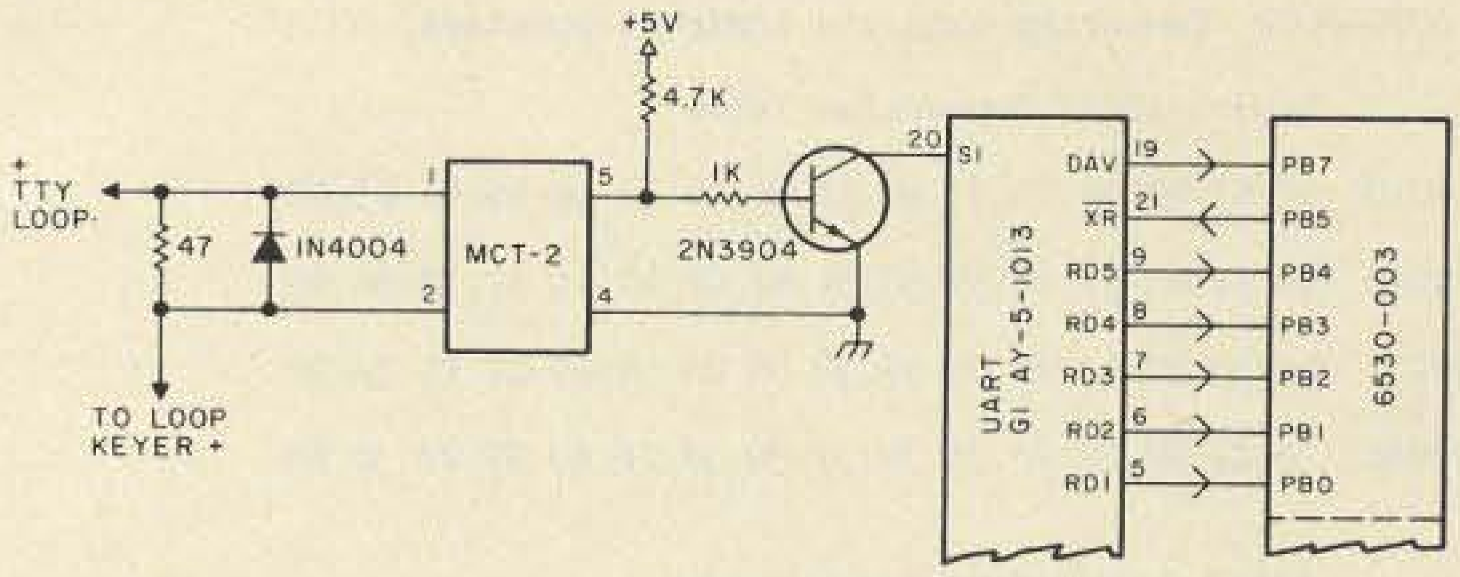


Fig. 2. Baudot parallel input (serial output and KBD input as per Fig. 1).

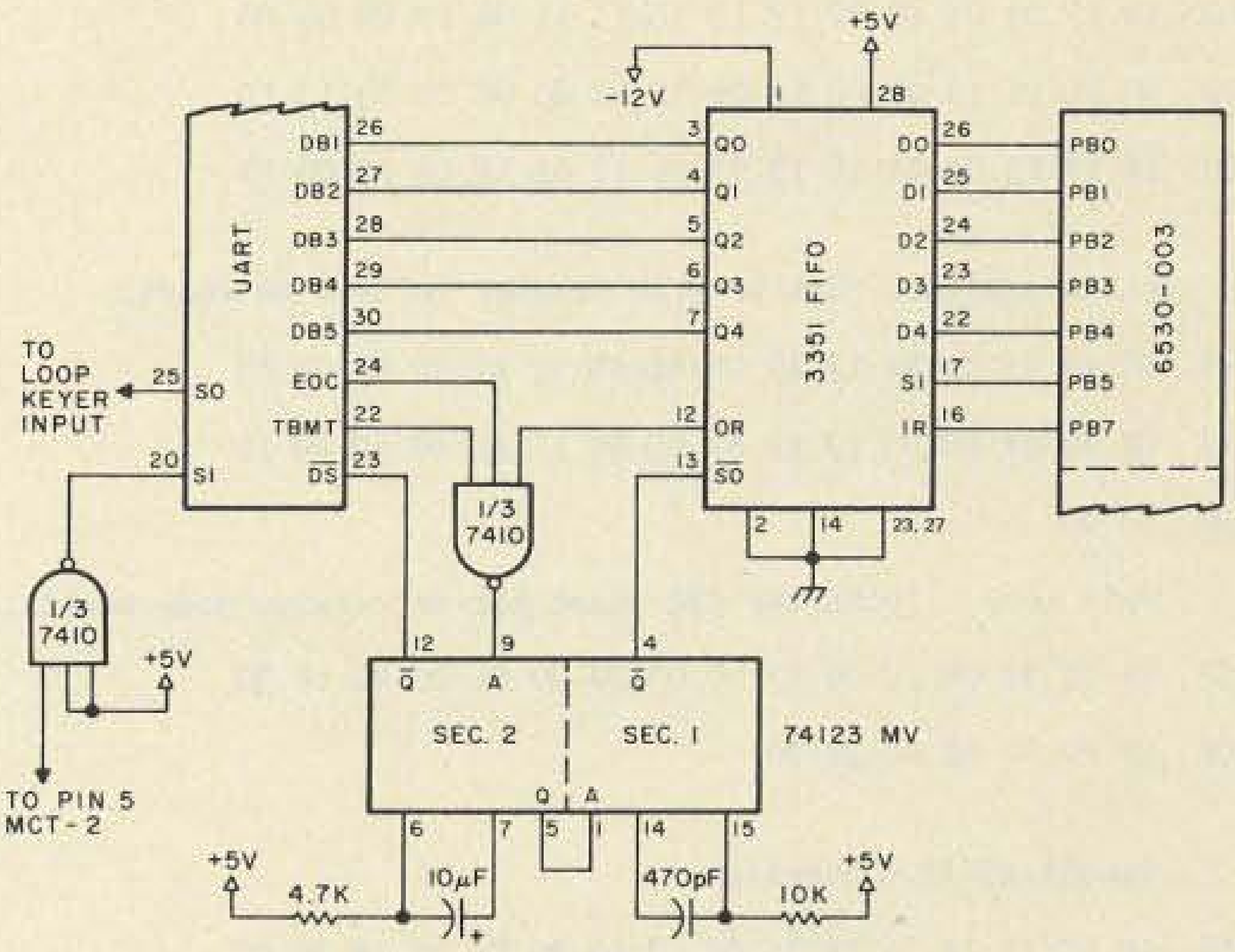


Fig. 3. Baudot parallel output with FIFO buffer.

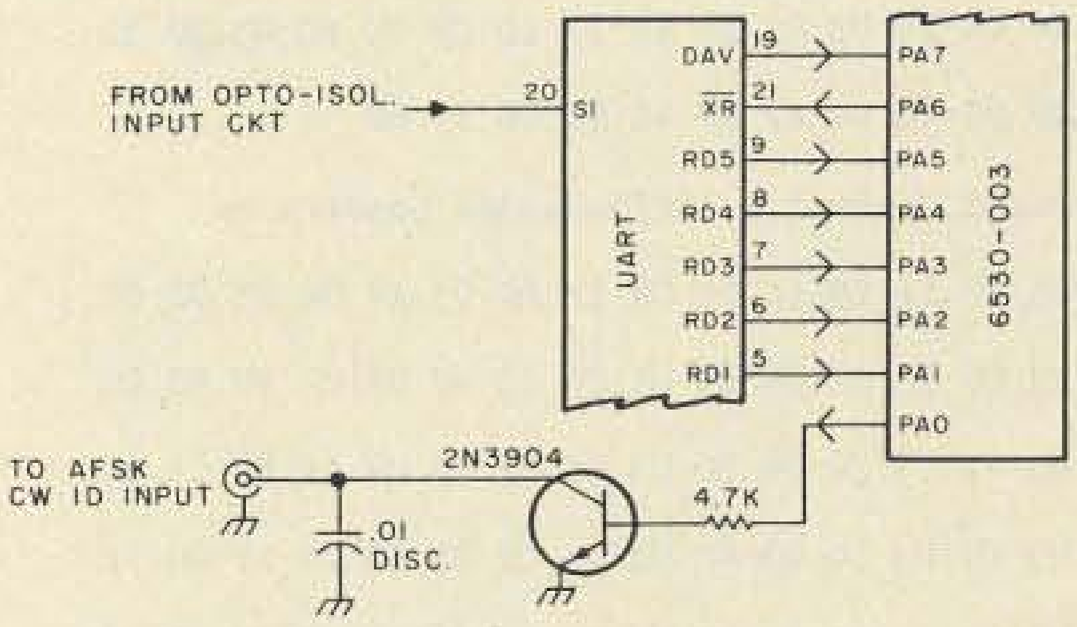


Fig. 4. Baudot parallel input and CW ID output.

ESC	Sets receive mode.
ETX (CTRL C)	Time update for real-time clock. Type in four digits using 24-hour format.
ENQ (CTRL E)	DE (callsign) and time.
DC1 (CTRL Q)	CW ID.
STX (CTRL B)	Store message (follow by 1, 2, 3, or 4).
@ (AT Sign)	Read message (follow by 1, 2, 3, or 4).
*** (Asterisk)**	End of transmission. Last character typed to end store mode. Also added by store routine, if end of message block, to prevent overwriting into next block. Message is not repeated.
+ (Plus sign)	Repeat message. Last character typed, if message is to be repeated. Location 034F contains number of times to be sent. CR LF ends transmission after last line.
<	Error correction. This is effectively a backspace and decrements the message store pointer. Used when storing a message from keyboard.

Table 1. Keyboard control functions.

Parallel Output

Having gone this far, I decided to change the output

```
0000-000F  Temporary data and indirect pointers.

      Baudot-ASCII Conversion Table
0010  00 45 20 41 20 53 49 55 00 44 52 4A 4E 46 43 4B
0020  54 5A 4C 57 48 59 50 51 4F 42 47 00 4D 58 56 00
0030  00 33 20 2D 20 00 38 37 00 24 34 27 2C 21 3A 28
0040  35 22 29 32 23 36 30 31 39 3F 26 00 2E 2F 3B 00

      ASCII-Baudot Conversion Table
0050  00 03 19 0E 09 01 0D 1A 14 06 0B 0F 12 1C 0C 18
0060  16 17 0A 05 10 07 1E 13 1D 15 11 00 1F 00 00 00
0070  00 0D 11 14 09 00 1A 0B 0F 12 00 00 0C 03 1C 1D
0080  16 17 13 01 0A 10 15 07 06 18 0E 1E 00 00 00 19

      Initialization.  Set program counter to 0090 to start.
0090  D8 A9 25 8D FA 17 A9 04 8D FB 17 A9 00 85 01 85
00A0  02 A9 3F 8D 03 17 A9 41 8D 01 17 A9 40 8D 00 17
00B0  85 03
      Wait Loop.  Looks for KBD start bit or receive mode enable.
00B2  24 02 30 08 2C 00 17 10 03 20 00 01 2C 40 17 30
00C2  EF 20 00 02 4C B2 00

      Baudot-ASCII Conversion
0100  AD 00 17 4A 29 1F 85 00 C9 04 F0 0F C9 1B D0 07
0110  A9 80 85 01 4C 31 01 C9 1F D0 04 A9 00 85 01 A5
0120  00 24 01 10 02 69 20 AA B5 10 C9 00 F0 03 20 A0
0130  1E A9 00 8D 00 17 A9 40 8D 00 17 60
      Keyboard Control & ASCII-Baudot Conversion
0200  84 05 20 5A 1E A4 05 C9 1B D0 05 A9 00 85 02 60
0210  48 A9 80 85 02 68 C9 02 D0 03 4C 0E 02 C9 40 D0
0220  03 4C 4F 03 C9 05 D0 03 4C 8E 03 C9 11 D0 03 4C
0230  A9 03 C9 03 D0 03 4C 7A 04 C9 0D D0 05 A9 00 4C
0240  86 02 C9 0A D0 03 4C 99 02 C9 20 D0 0D C8 C0 43
0250  30 03 4C 99 02 A9 04 4C 86 02 85 04 24 04 70 09
0260  24 03 50 10 A9 1B 4C 6F 02 24 03 70 07 A9 1F 20
0270  86 02 A5 04 85 03 29 3F AA B5 50 C8 C0 48 D0 06
0280  20 86 02 4C 99 02 8D 02 17 09 20 8D 02 17 A9 00
0290  8D 02 17 2C 02 17 10 FB 60 A0 00 A9 08 20 86 02
02A0  A9 08 20 86 02 A9 02 20 86 02 60

      Message Select 1, 2, 3 or 4.  Used by Read & Store routines).
02AB  20 5A 1E C9 31 D0 13 A9 00 85 07 85 0D A9 05 85
02BB  08 85 0E 85 0A A9 7F 85 09 60 C9 32 D0 13 A9 80
02CB  85 07 85 0D A9 05 85 08 85 0E 85 0A A9 FF 85 09
02DB  60 C9 33 D0 15 A9 00 85 07 A9 0D A9 06 85 08 85
02EB  0E A9 FF 85 09 A9 07 85 0A 60 C9 34 D0 4E A9 00
02FB  85 07 85 0D A9 08 85 08 85 0E A9 FF 85 09 A9 0B
020B  85 0A 60
      Store Message
030E  20 AB 02 A2 00 20 5A 1E 81 07 C9 2A F0 32 C9 2B
031E  F0 2E C9 3C D0 0D C6 07 A9 FF C5 07 D0 E7 C6 08
032E  4C 13 03 E6 07 A9 00 C5 07 D0 02 E6 08 A5 09 C5
033E  07 D0 D2 A5 0A C5 08 D0 CC A9 2A 81 07 20 A0 1E
034E  60

      Read Message
034F  A9 0A 85 0B 20 AB 02 A2 00 A1 07 C9 2A F0 2F C9
035F  2B D0 12 C6 0B D0 03 4C 99 02 A5 0D 85 07 A5 0E
036F  85 08 4C 56 03 84 05 48 20 A0 1E 68 A4 05 20 39
037F  02 E6 07 A9 00 C5 07 D0 CE E6 08 4C 56 03 60

      DE CALL
038E  A9 99 85 07 A9 03 85 08 4C 56 03
      Call Table & Time.  Enter ASCII equivalent of call sign in
                          null locations 039C to 03A1.
0399  44 45 20 00 00 00 00 00 00 20 30 30 30 30 5A 2A

      CW ID
03A9  A2 00 BD 18 04 85 0D E8 E0 0B D0 01 60 C9 00 D0
03B9  06 20 EA 03 4C AB 03 29 FC 85 0E A5 0D 29 07 AB
03C9  C0 00 D0 06 20 F1 03 4C AB 03 88 06 0E 90 09 20
03D9  F8 03 20 FF 03 4C C9 03 20 FF 03 20 FF 03 4C 09
03E9  03 98 48 A0 06 4C 06 04 98 48 A0 02 4C 06 04 98
03F9  48 A0 03 4C 03 04 98 48 A0 01 EE 00 17 88 A9 37
0409  8D 07 17 CD 07 17 10 FB C0 00 D0 F1 68 A8 60
0418-0421  CW ID Table.  Enter Morse equivalents for DE (space)
                         (Call Sign).

      Real-Time Clock (NMI routine).
0425  48 E6 0C A5 0C C9 3C D0 4A A9 00 85 0C EE A6 03
0435  AD A6 03 C9 3A D0 08 29 30 8D A6 03 EE A5 03 AD
0445  A5 03 C9 36 D0 08 29 30 8D A5 03 EE A4 03 AD A4
0455  03 C9 3A D0 08 29 30 8D A4 03 EE A3 03 AD A4 03
0465  C9 34 D0 0F AD A3 03 C9 32 D0 08 A9 30 8D A4 03
0475  8D A3 03 68 40

      Time Update
047A  A9 00 85 0C A2 00 20 5A 1E 9D A3 03 E8 E0 04 D0
048A  F5 60

0500-057F  MSG Block 1 (128 bytes)
0580-05FF  MSG Block 2  (128 bytes)
0600-07FF  MSG Block 3 (512 bytes)
0800-0BFF  MSG Block 4 (1024 bytes)
```

Table 2. Memory map and program listing.

to parallel operation also, as shown in Fig. 3. To make things easier, the parallel input was changed over to the 6530 "A" side, so PAØ could be programmed for the CW ID output. Now the "B" side is used for the output, as seen in Fig. 4.

Obviously, this configuration leaves no parallel input ports for the keyboard. It is connected to the TVT in the normal manner, and the KIM monitor GETCH routine is used to fetch keyboard characters. The software FIFO, therefore, cannot be used. The solution to this is to make a trade-off and use a

Fairchild 3351 FIFO chip. Note that, in this case, the FIFO is on the Baudot output rather than the keyboard input. Although the 3351 has a capacity of only 40 characters, this is adequate to absorb data at normal typing rates somewhat in excess of six characters per second, as well as providing buffering for the Baudot figures and letters shifts and EOL functions. PB5 is the data strobe for the 3351 shift in (SI) input, and PB7 serves as the input ready (IR) flag.

The UART is configured for five bits per character and one stop bit. The actual time between characters on transmit is set by the 74123 dual MV timing and results in characters being shifted out of the FIFO at a smooth rate. A crystal-controlled clock is not necessary. At low data rates, a 555 timer clock is perfectly adequate and rarely needs adjustment. The clock is set to 728 Hz for 45.5 baud operation.

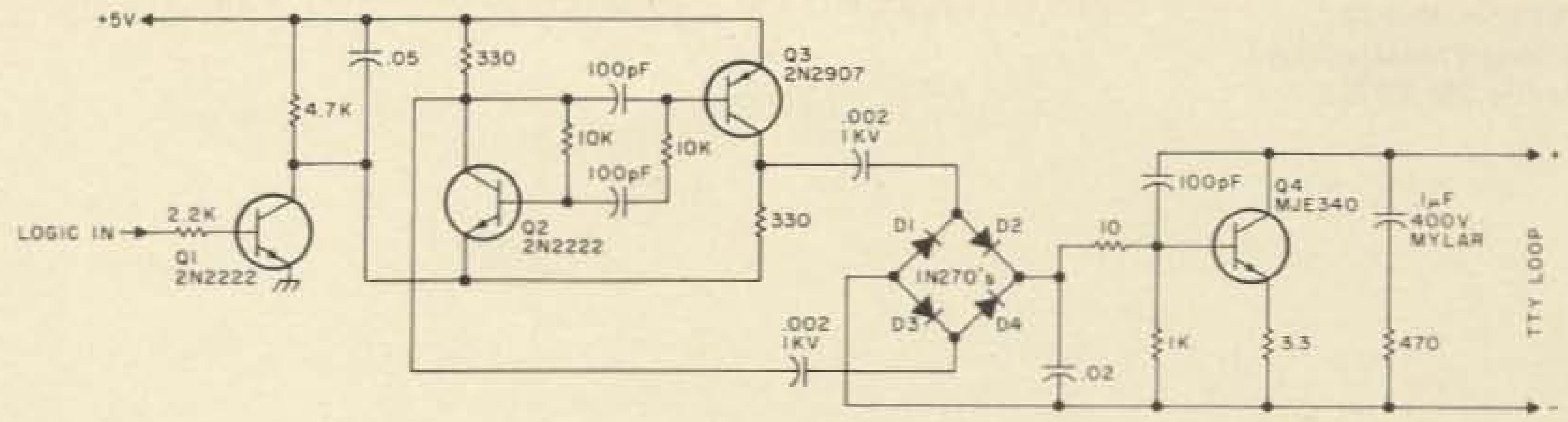


Fig. 5. Isolated loop keyer. Mark — high; space — low. Resistors — ¼ W; capacitors — disc ceramic, except as noted.

Loop Isolation

I use a 60 mA loop, which is common for both send and receive. A printer is always in the line for hard copy. The optoisolator is one of several available types, such as the Motorola MCT2. The loop-keyer output is completely isolated from ground and the input. Fig. 5 is a schematic diagram of the loop keyer. It's a keyed, balanced multivibrator, running at about 750 kHz, capacitively coupled to a diode bridge rectifier and loop-keying transistor, Q4. The keying transistor can be any high-voltage NPN-type, such as the MJE340, 2N5655, or 2N3440. Q1, Q2, and Q3 can be any small-signal switching transistors. Note that Q3 must be a PNP type.

The loop keyer is sensitive to nearby rf fields when you operate a transmitter at high power, so each side of the loop jack at the KIM-1 end must be bypassed to ground. If CW ID output is used, the output jack should be bypassed for the same reason. A shielded cable to the AFSK input should be used. KIM-1 and all associated boards appear to be immune to rf, even unshielded. I have not had any problems in this respect since taking the precautions just mentioned.

Conclusion

I hope the foregoing information will be of help to anyone wishing to use his KIM-1 for RTTY. Unfortunately, space does not permit an assembly-type program listing due to its length. I will be glad to answer all correspondence, but please include a self-addressed stamped envelope. I should be able to provide a copy of the program (and perhaps a cassette tape) at reasonable cost to help defray the expenses involved in preparation. ■

Bill Welborn K9PTI
2221 West Franklin Street
Evansville IN 47712

A Secret Weapon For Road Rallies

Aside from ham radio and computers, one of the more enjoyable hobbies I pursue from time to time is that of driving (or navigating) in TSD road rallies. The letters stand for "time, speed, and distance." If you run rallies, or know a friend who does, your computer can give you a secret weapon to help you win.

These events are not races, at least not in the conventional sense. You are given a set of instructions. Then you follow them. Sound dull? Well, it isn't! The object of the rally is to exactly follow the instructions, to maintain an exact speed, and to get where you are supposed to get after a precise elapsed time. Penalty points are given for being either early or late at the destinations. Usually, there are several destinations – called checkpoints – in every TSD rally. To give you some idea of the precision driving required, a penalty point is equal to an arrival time (early or late) of one-hundredth minute (.6 sec) from the scheduled time. A typical winner, in our club, will have a score of 50 to 100, indicating a total error of one-half minute, after three or four *hours* of driving. Of course, low score wins.

Several things are added for spice. When you start the rally, you don't know how far the first checkpoint is (or any of the others, for that matter). Nor do you even know where the checkpoints are, or the necessary average speed to get there on time, or the time you must expend in getting there. Distances are seldom marked on the instructions. All this information is known only to the rallymaster and his workers.

The instructions are rather like a computer program. Here is a short excerpt from a recent one:

. . . .

CAST 30
Right at Kenny Road
Left at "Y"
Left after SRIP "Garage"
CAST 42
Right 3d opportunity

. . . .

. . . .

This would be interpreted as follows: Change Average Speed To thirty miles per hour; when you get to Kenny Road, make a right turn; at the next "Y" in the road, after your right turn, take the left fork; you should see a Sign that Reads In Part "Garage" – take the next left (it may be right there, or it may be miles down the road); as soon as you turn, Change Average Speed To forty-two miles per hour; at the third chance thereafter that you have to do so, turn right; and so on.

Of course, the sign with "Garage" on it may be faded and half-covered with weeds, the road may be one on which no sane person would go over 20 mph, one of the three "opportunities" will doubtless be impossible to spot (or between the first and second road will be a long private drive that gets counted as an "opportunity" by half the contestants when it isn't), and so on. These are the *simple* traps you will encounter; rallymasters delight in messing you up. Anyway, you get the point – it is a real job just to stay on course.

Besides helping the driver stay on course and keeping up with the instructions, the navigator has the job of calculating the average speed of the car. It is to make this job easier that this article was written.

Time, speed, and distance problems are all solved by the simple formula: D=RT, where D is distance, R is rate (speed), and T is time. Know any two, and you can find the other. In a rally, you will know distance and time from the last speed change in the instructions; you will be trying to calculate average speed in miles per hour by the formula: $R_{mph} = (D/T)*60$. You will probably want to make a calculation every mile, because tenths of a second are important, and there might never be a chance to make good the loss of even a few seconds.

The navigator is necessarily going to be busy with a stopwatch, pencil, calculator, and odometer for the entire rally. He may get so busy that he loses track of where his car is.

You *can* buy an electromechanical gadget that will keep track of elapsed time and of average speed, but they are very expensive. If you are a ham, you might kludge up a small terminal to your mobile rig and have a program running on the computer at home, which will make your calculations for you. But terminals aren't that cheap, either. (And watch sending ASCII over the air!)

The program shown here (Fig. 1) is a cheap and simple answer. It allows you to work in time, not average speed. It is far more helpful to know that you are three seconds ahead of time than to know you are averaging 43.2 mph, when the instructions call for 42 mph. (Why? Because the more miles you drive with a constant error in speed, the further off you become in time. In the heat of a rally, a fraction of mph speed error may not impress you as important, even though you've traveled eight or more miles.)

```
05 REM THIS PROGRAM CALCULATES TIME IN  MINUTES  AND TENTHS OF MIN.
10 REM  SET UP THE OUTER LOOP.  R=SPEED IN MPH.
20 FOR R=25 TO 55
30 REM  PRINT THE HEADINGS.
40 PRINT "SPEED","DISTANCE","TIME"
50 REM  SET UP THE INNER LOOP.  D=DISTANCE IN MILES
60 FOR D=1 TO 20  STEP .5
70 REM  CALCULATE TIME
80 LET T=(D/R)*60
90 REM  PRINT IT ALL OUT UNDER THE CORRECT HEADING
100 PRINT R,D,T
110 REM  CYCLE THE INNER LOOP -- WHEN FINISHED, PRINT BLANK LINE AND
115 REM  CYCLE THE OUTER LOOP.
120 NEXT D
130 PRINT
140 NEXT R
160 REM  WHEN R=55, THE PROGRAM ENDS.
170 END
```

Fig. 1. BASIC program to calculate "TIME" in minutes and tenths of minutes. See text for full explanation.

What you get from the program is a printout of speed, distance, and time. Your navigator turns to the sheet with the correct speed for that leg, zeros the mileage indicator in your car, and zeros the stopwatch. Then, every mile or half-mile, he looks at the stopwatch and compares it with the time next to the mileage which you have traveled. He can then tell you how many seconds you are ahead or behind where you should be at that point. It is then a very simple matter for you, the driver, to make whatever correction is necessary. At the end of the next mile, or half-mile, another check is made and further correction taken. And so on, throughout the rally.

Sure, the formula is not that hard to run on a calculator. But, to get time-error that way, the old navigator is going to run two calculations every mile. Try even the simplest calculation in a rally; I've never known any navigator who didn't mess up at least a third of his calculations on the first try. And he has his eyes off the road for too long.

Yes, I *know* you can buy time-speed-distance charts at not too great an expense. But, first of all, they can't be tailored for whatever distance interval you wish. This program can. Secondly, they are much harder to read (in my experience at least) than a computer printout. And, finally, well, heck, you *want* a use for that new micro, don't you?

The program is written in Dartmouth BASIC. It was run on an IBM 370. It should work on most small BASIC interpreters. It will *not* work on an integer system.

It is so simple that it almost explains itself. There are two loops, one nested inside the other. The outer loop contains the average speed. It is shown starting at 25 mph, but this could be any figure – it depends on the minimum speed at which rallies in your area are run. This loop terminates at 55 mph because no rally instructions can tell you to drive at an illegal speed.

For each step of the outer loop, the inner loop (distance) steps 39 times. Each time it steps, the program calculates time. Then, speed, distance, and time are printed out and the inner loop steps again. When distance reaches 20, a blank line is printed, a new heading is printed, and the outer loop steps to the next speed. Then, the whole process is repeated, and repeated, and repeated.

About two *hours* after you type "run," you will have produced fourteen feet of copy. (This is assuming a step of .5 and a 110 baud printer. By the way, CPU time used on an IBM 370 is just over nine seconds.)

If your BASIC does not have the step feature in its "FOR . . . NEXT" statement, just leave that out. The program will give you printout for whole miles. This works just as well. Leave out the "REMARKS" to save space. If your system can use multiple statements per line, great.

If you wish to provide for greater mileage in the inner loop, put in whatever you like. You-all in the wide-open southwest might want to go to thirty miles or even more.

```
20 REM  SET UP OUTER LOOP.  R=SPEED IN MPH
30 FOR R=25 TO 55
40 REM  PRINT THE HEADINGS
50 PRINT "SPEED","DISTANCE","TIME"
60 REM  SET UP THE INNER LOOP.  D=DISTANCE IN MILES
70 FOR D=1 TO 20  STEP .5
80 REM  CALCULATE TIME IN MINUTES AND TENTHS OF MINUTES, FIRST.
90 LET T=(T/R)*60
100 REM  ROUND THIS TO NEAREST ONE-THOUSANTH OF MINUTE
110 LET T1=INT(T*1000+.5)/1000
120 REM  TAKE MINUTES ONLY AND CALL IT T2.
130 LET T2=INT(T1)
140 REM  NOW, GET JUST THE FRACTION AND CALL IT T3
150 LET T3=T1-T2
160 REM  CONVERT THIS FRACTION TO SECONDS AND TENTHS
170 LET T4=T3*60
180 REM  PRINT EVERYTHING IN RIGHT COLUMN.
190 PRINT R,D,T2:":":T4
200 REM  CYCLE THE INNER LOOP
210 NEXT D
220 REM  WHEN OUT OF DISTANCES, PRINT A BLANK LINE AND CYCLE OUTER LOOP.
230 PRINT
240 NEXT R
250 END
```

Fig. 2. The program converted to calculate "TIME" in minutes, seconds, and tenths of seconds.

Frankly, my present version of this printout only goes to fifteen miles. I don't need that much, usually, in the rallies we have around here.

If you just like a lot of paper used up, make the inner loop step = .25. This will give you quarter-mile times for each speed. I doubt you'll ever use it, and it triples the length of the printout.

One very useful change to the program is shown in Fig. 2. This gives printout for time in minutes, seconds, and tenths of seconds instead of minutes and tenths of minutes. Of course, which you use will depend on how your stopwatch is calibrated. The new code will take the decimal fractions of minutes and convert them to seconds and tenths of seconds. A formatting statement inserts a colon for easier reading.

I use the program's output cut into sheets and staple them at the upper left. The navigator simply flips through the pages for the correct speed, as shown for that leg of the instructions. Then he's set. Those of you handy with tools might want to construct a box-like holder with a dowel at the top and bottom. Then the printout could be scrolled past a window cut into the front of the box. For this display, the printout would be better without the headings before each speed. Change the location of that print statement so that it does not pass by on each execution of the outer loop (i.e., move it to the first line of the program).

If you are not into road rallies already, I certainly hope this article has given you the bug, as well as shown you another use for that micro. You certainly don't need a sports car to participate in TSD rallies. Just zap up the secret weapon, find out where your local Sports Car Club of America chapter is going to hold its next rally, and beat 'em all! ■

FCC Math

from page 14

here, you round to the nearest whole number unless, as in the earlier one we did, *all* would be rounded down or *all* up following the nearest whole number rule, thereby introducing unnecessary inaccuracy. Putting these together as we have learned to do for convenient multiplication, we get: $2 \times 3 \times 2 \times 2 \times 10^{7+-2}$, which is 24×10^5. And that's $2.4 \times 10^1 \times 10^5$, which is 2.4×10^6 or 2,400,000 Ohms, one heck of a lot of resistance to flow of current at 21.3 MHz!

At 60 Hz, on the other hand, the reactance of that same coil is 2(3.14)(60)(0.017), which is $2 \times 3 \times (6 \times 10^1) \times (2 \times 10^{-2})$, or $2 \times 3 \times 6 \times 2 \times 10^{-1}$, which is 72×10^{-1} or $7.2 \times 10^1 \times 10^{-1}$, which is 7.2×10^0 or simply 7.2 Ohms (of course, after a while you'd do much or most of that in your head, with no pencil, paper, or calculator necessary!).

That's very little resistance to current flow at 60 Hz. Obviously, coils and capacitors are neat devices for separating one frequency of current from another. You'll notice, too, that they do opposite things. Coils resist the high frequencies, letting low frequencies through, whereas capacitors resist the low frequencies, letting high frequencies through.

Well, enough for this installment. Next time, we'll use the math skills we now possess on all kinds of formulas. In fact, if you have followed along thus far, you now possess the knowledge to handle just about any kind of math that may be thrown your way in FCC exams. It's just a matter now of practicing these skills to the point that they are readily available when needed.

Here's a bit of such practice. Work and answers follow.

Exercise 3:

(1) Compute the reactance of these capacitors at (a) 900 Hz, and (b) 28.5 MHz:

(i) 80 pF (ii) 3 μF

(2) Compute the reactance of these coils at (a) 6 kHz, and (b) 52 MHz:

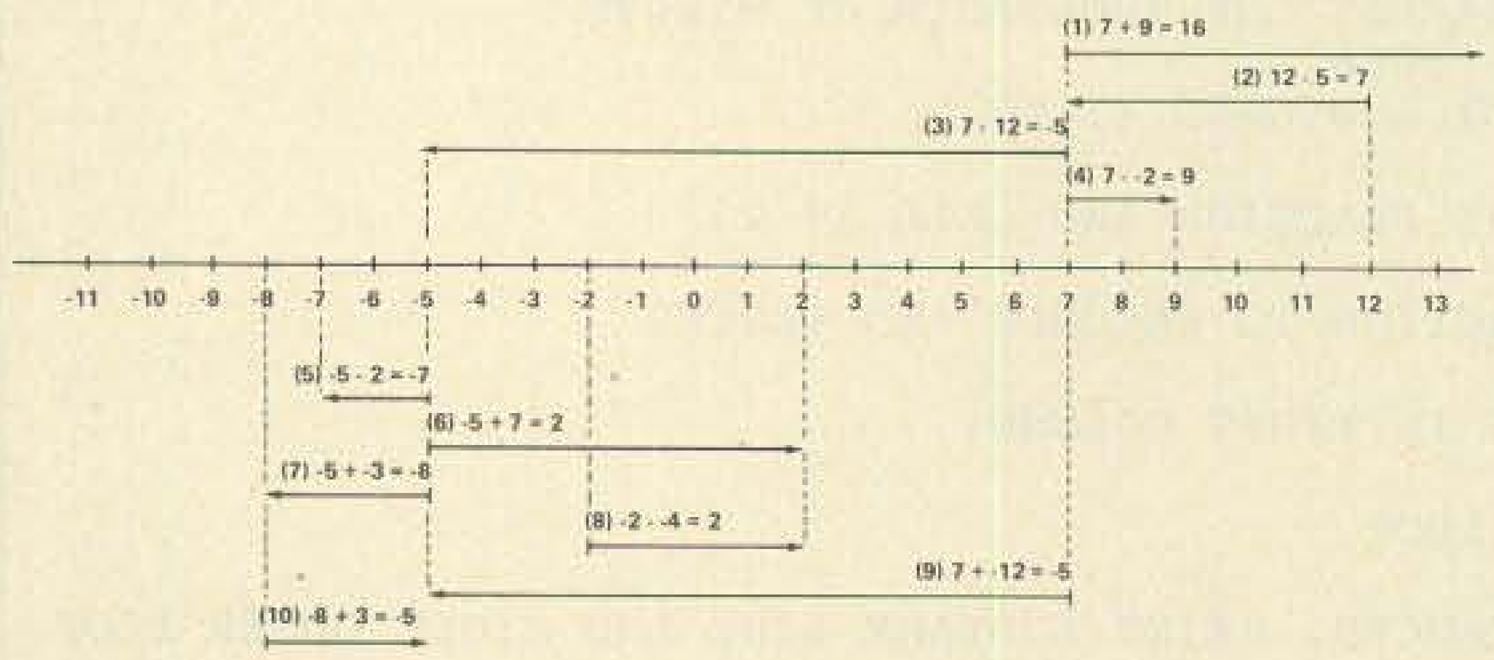
(i) 150 μH (ii) 7 H

WORK AND ANSWERS TO EXERCISES

Exercise 1:

(1) (a) 2.71×10^{-3}	(b) 5.9×10^{-11}	(c) 7.89×10^7	(d) 5×10^{-1}
(2) (a) 0.00725	(b) 0.0000000000086	(c) 9,450,000	

Exercise 2:



Exercise 3:

(1) 900 Hz = 9×10^2 Hz. 28.5 MHz = 28,500,000 Hz = 2.85×10^7. Rounding this to one digit gives 3×10^7. 80 pF is 80×10^{-12} farad or $8.0 \times 10^1 \times 10^{-12}$ farad, 8×10^{-11} farad. 3 μF is 3×10^{-6} farad. We'll round π, pi, to simply 3.

(ia) 80 pF at 900 Hz: $1/(2 \times 3 \times 9 \times 8 \times 10^{2+-11}) = 1/(432 \times 10^{-9})$. $432 \times 10^{-9} = 4.32 \times 10^2 \times 10^{-9}$, rounded down, simply 4×10^{-7}. $(10 \times 10^{-1})/(4 \times 10^{-7}) = 2.5 \times 10^{-1--7}$ or 2.5×10^6, 2,500,000 Ohms.

(ib) 80 pF at 28.5 MHz: The bottom of the fraction is $2 \times 3 \times 3 \times 8 \times 10^{7+-11}$, 144×10^{-4}, which is $1.44 \times 10^2 \times 10^{-4}$, which (rounded) is 1×10^{-2}. The fraction, then, is: $(1 \times 10^0)/(1 \times 10^{-2}) = 1 \times 10^2$, which is 100 Ohms. Notice how the reactance had dropped from 2½ *million* Ohms at 900 Hz to a mere 100 Ohms at 28.5 MHz.

(iia) 3 μF at 900 Hz: The bottom is $2 \times 3 \times 9 \times 3 \times 10^{2+-6} = 162 \times 10^{-4}$ which equals $1.62 \times 10^2 \times 10^{-4}$, which rounded out equals 2×10^{-2}, so the fraction is: $(10 \times 10^{-1})/(2 \times 10^2)$ which gives $5 \times 10^{-1--2}$ or 5×10^1, 50 Ohms.

(iib) 3 μF at 28.5 MHz: The bottom is $2 \times 3 \times 3 \times 3 \times 10^{7+-6} = 54 \times 10^1$, which is 5.4×10^2 or rounded, simply 5×10^2. The fraction then becomes: $(10 \times 10^{-1})/(5 \times 10^2)$, which gives $2 \times 10^{-1--2}$, 2×10^{-3} or 0.002 Ohms. The reactance is not large with this big a capacitor, but 50 Ohms is still one heck of a lot more than 0.002 Ohms!

(2) 6 kHz is 6×10^3 Hz. 52 MHz is 52×10^6 Hz or $5.2 \times 10^1 \times 10^6$ Hz, which (rounded) is 5×10^7 Hz. 150 H is 150×10^{-6}, which is $1.5 \times 10^2 \times 10^{-6}$ or, rounded, 2×10^{-4} H. 7 H is fine as it stands. The formula, remember, is simply $X_L = 2\ fL$.

(ia) 150 μH at 6 kHz: $X_L = 2 \times 3 \times 6 \times 2 \times 10^{3+-4}$, which is 72×10^{-1}, or $7.2 \times 10^1 \times 10^{-1}$, which is 7.2×10^0, 7.2×1, or simply 7.2 Ohms, which rounds out to 7 Ohms (not much resistance to that frequency).

(ib) 150 μH at 52 MHz: $X_L = 2 \times 3 \times 5 \times 2 \times 10^{7+-4}$, 60×10^3, which is $6 \times 10^1 \times 10^3$ or 6×10^4, 60,000 Ohms, or 60 kilohms. Lots of resistance!

(iia) 7 H at 6 kHz: $X_L = 2 \times 3 \times 7 \times 6 \times 10^3$, which is 252×10^3 or $2.52 \times 10^2 \times 10^3$, which is, rounded out, 3×10^5 or 300,000 Ohms, 300 kilohms.

(iib) 7 H at 52 MHz: $X_L = 2 \times 3 \times 7 \times 5 \times 10^7$ or 210×10^7, which is $2.1 \times 10^2 \times 10^7$ or, rounded out, 2×10^9, 2 billion Ohms — again, one heckuva lot!

FCC

Reprinted from the Federal Register.

CHAPTER I—FEDERAL COMMUNICATIONS COMMISSION

[FCC 77-793]

PART 2—FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS: GENERAL RULES AND REGULATIONS

Deleting Footnote NG 13 Pertaining to Amateur Radio Operation in 220–225 MHz Band in Portions of States of Texas and New Mexico

AGENCY: Federal Communications Commission.

ACTION: Rule Amendment.

SUMMARY: This document removes restrictions on the use of the 220-225 MHZ band in portions of Texas and New Mexico by amateur radio operations because those restrictions are no longer necessary.

EFFECTIVE DATE: December 12, 1977.

FOR FURTHER INFORMATION CONTACT:

Benjamin Perez, Spectrum Planning & Coordination Branch, Office of Chief Engineer, 202-632-6350.

ORDER

Adopted: November 22, 1977.

Released: December 1, 1977.

In the matter of amendment of Part 2 of the Commission's Rules and regulations to delete footnote NG 13 pertaining to amateur radio operation in the 220–225 MHz band in portions of the States of Texas and New Mexico.

1. The Commission has been advised by the Office of Telecommunications Policy, that the provisions of footnote NG 13 to the Table of Frequency Allocations, § 2.106 of the Commission's rules are no longer required. The footnote imposes restrictions on the secondary use, by the amateur radio service, of the 220-225 MHz band in certain areas of the United States.

2. The deletion of NG 13 would remove the restriction of the use of the 220-225 MHz band by amateur stations engaged in normal amateur operations between the hours of 0500 and 1800 local time Monday through Friday inclusive, of each week in those portions of the States of Texas and New Mexico in the area bounded on the south by parallel 31°53'N., on the east by longitude 105°40'W., on the north by parallel 33°24'N. and on the west by longitude 106°40'W. The amateur service would then be allowed to operate on the 220–225 MHz band in all portions of the United States subject to the continuing restriction of footnote U.S. 34 (prohibiting harmful interference to the radiolocation service).

3. Since the deletion of NG 13 will have no adverse effect on non-Government licensees, we anticipate no comments in this matter; therefore, compliance with the notice and public procedure provisions of the Administrative Procedure Act, 5 U.S.C. 553 (b) and (c), is believed to be unnecessary (5 U.S.C. 553 (c) (3) (B), 47 CFR 1.412(c)).

4. Furthermore, since the substance of this rule amendment would be to relieve a restriction, compliance with the effective date provision of the Administrative Procedure Act, 5 U.S.C. 553(d) would not be in the public interest (5 U.S.C. 553(d) (1); 47 CFR 1.427).

5. *Accordingly, it is ordered*, That effective December 12, 1977, §2.106 of the rules is amended by deleting footnote NG 13. Authority for this action is contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended.

(Secs. 4, 303, 48 Stat., as amended, 1066, 1082 (47 U.S.C. 154, 303).)

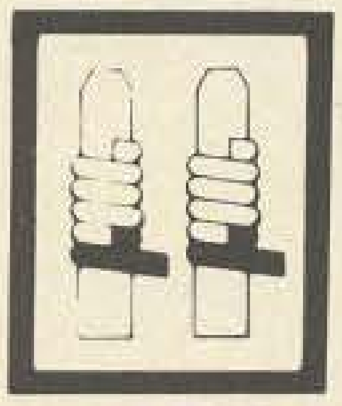
FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Acting Secretary.

ok®

"INDUSTRIAL"
WIRE WRAPPING TOOL

Model BW 520 is a battery operated wire-wrapping tool, also available in reversible models for wrapping and unwrapping operations. The rechargeable nickel cadmium battery is self contained in the handle of the tool. Also available with "Backforce" device to prevent overwrapping.

Uses any 24AWG thru 32AWG wrapping bits and sleeves.



OK MACHINE & TOOL CORPORATION
3455 Conner St., Bronx, N.Y. 10475 / (212) 994-6600 / Telex 125091

Model **BW520** **NEW**

BATTERY WIRE-WRAPPING TOOL

ONLY $108.70

BATTERIES INCLUDED

BIT & SLEEVE NOT INCLUDED

Model **BW928** **NEW**

BATTERY WIRE-WRAPPING TOOL

ONLY $49.95

BATTERIES NOT INCLUDED

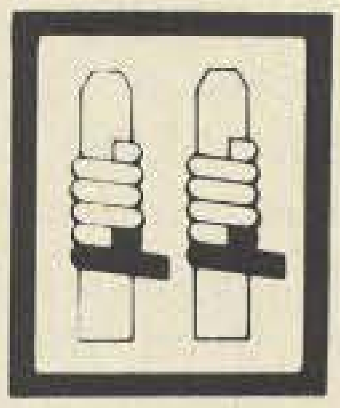
BIT & SLEEVE NOT INCLUDED

ok®

"INSTALLATION AND FIELD SERVICE"
WIRE WRAPPING TOOL

Model BW 928 is a battery operated wire wrapping tool, also available in reversible models for wrapping and unwrapping operations. Exceptionally useful for installation and field service work, or small production jobs. Available with "Backforce" device to prevent overwrapping.

Uses any 24AWG thru 32AWG wrapping bits and sleeves.

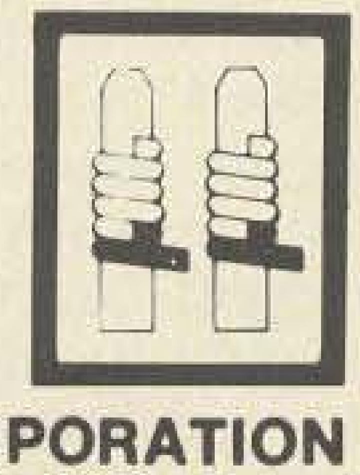


OK MACHINE & TOOL CORPORATION
3455 Conner St., Bronx, N.Y. 10475 / (212) 994-6600 / Telex 125091

ok®

"HOBBY"
WIRE WRAPPING TOOL

For AWG 30, .025" (0.63mm) sq. post, "MODIFIED" wrap, positive indexing, anti-overwrapping device.



O5

OK MACHINE & TOOL CORPORATION
3455 Conner St., Bronx, N.Y. 10475 / (212) 994-6600 / Telex 125091

Model **BW630** **NEW**

BATTERY WIRE-WRAPPING TOOL

ONLY $34.95

BATTERIES NOT INCLUDED

COMPLETE WITH BIT & SLEEVE

Francis J. O'Reilly
42 Markwood Rd.
Ardsley NY 10502

Looking For A Micro?

—consider the KIM-1

If you are in the market for a complete microcomputer, but your funds are somewhat limited, the KIM-1 is for you.

For $245 the KIM-1 comes complete with CPU, 1024 (1K) bytes of random access (read/write) memory, 2048 (2K) bytes of read only memory, a 23-pad keyboard for hexadecimal input and limited front panel capabilities, a six-digit seven-segment series of light emitting diodes (LEDs) for output, a cassette interface, and a serial teleprinter interface. The only thing the KIM-1 lacks is a power supply. If you are going to run a cassette, you will need a +5 V and a +12 V power supply; otherwise, +5 V at 1.2 Amps will be sufficient. The power supply can be built from a schematic supplied in the back of the KIM-1 *User's Manual*, or you can purchase one at a local radio store for under $50.

The CPU is the MCS6502. It is capable of addressing up to 65,536 (64K) bytes of memory. Although the instruction set of the 6502 is somewhat limited when compared to the 8080A, which is the chip used by the Altair 8800B and others, it is more than sufficient for the person who is just starting to program. (The 6502 has 56 instructions, as compared to the 78 instructions for the 8080A.) With some ingenuity, the 6502 instruction set can go quite a long way. The system clock runs at 1 MHz. The instruction execution time runs from 2 to 7 cycles, with 4 cycles being the average. This means the 6502 can execute up to approximately 250,000 instructions per second. This is only half as fast as the machines that use the 8080A; however, it is still fast enough for most applications.

The 1K of random access memory that is provided onboard is not enough to do much in the way of serious programming. It is, however, sufficient to learn basic machine level programming skills.

Input is through a keyboard located at the lower right-hand corner of the board. If you have an ASR-33 teletype with the 20 mA loop, it can be connected directly to the machine. Lacking this, you are restricted to the keyboard. I would like to take this time to comment on the positioning of the keyboard. I am left-handed; as a result, I find that I must be aware of where I rest my hand, as the two interfaces are directly to the left of the keyboard. This could be improved by having the keyboard remote from the machine itself. This is, however, a relatively minor problem. The keys on the keyboard are as follows: O-F hex — instruction and data input; AD — enter address mode; DA — enter data mode; + — increment address by 1; PC — restore program counter; ST — generate interrupt (STOP); GO — begin program at current program counter; RS — reset to monitor control; and SST — a slide switch for single-step execution of programs.

Output is through 6 seven-segment LEDs. The left four LEDs are separated from the right two, making it easy to read the display. The display is located directly above the keyboard.

The 2K bytes of read only memory contain a monitor program which basically controls input/output operations, including cassette operation, and serial teleprinter operation.

My main objection to the design of the KIM is the absence of sockets for the 22 integrated circuits. This is not a problem unless one burns out. If one should burn out, it will take a lot of time and patience to replace it. The board has been silk-screened to prevent accidentally shorting out adjacent foils. It should be noted that a potentiometer has been utilized as part of the onboard audio cassette interface. This potentiometer is preset at the factory and should not be adjusted by the user.

The onboard interfaces are for an audio cassette and a serial teleprinter (specifically the ASR-33). The first expansion recommended for the KIM is to add an audio cassette. When you are working on small programs, it is no big deal to key in your program, turn the machine off, and key the program in at a later time; however, when you start to write long programs, keying in a long program every time you turn on your machine becomes a hassle. If you can store that program and load it without having to key it in, you have overcome this problem.

The primary solution to this problem, employed by microcomputers, is storage on audio cassette tape. This is fine — that is, until you drop a bit. Unlike digital recorders in the big machines, an audio recorder does not go back and make sure it has recorded the data properly. You will not discover the error until you try to load the program, and, for some reason, it doesn't work. This is a major problem with audio cassettes and one not easily reckoned with.

The advantage of audio cassette recorders is that they are inexpensive. However, the serious user will soon find that he needs to go to another form of mass storage, such as floppy disk.

The second interface provided is for a serial teleprinter. The ASR-33 is the recommended machine. While this is a fine machine, it is relatively expensive (between 500 and 1000 dollars). This is one expansion I don't plan to do for a long while. If I had that kind of money, I would have bought a bigger machine. I would recommend to anyone who is looking toward terminals to consider a CRT (Cathode Ray Tube) terminal, as one can be had for around $250, although you'll have to interface it yourself.

The documentation on the KIM is excellent. It consists of three books, a wall chart, and a card listing the instruction set. The books include the *User's Manual*, which should be read first, the *Programming Manual*, and the *Hardware Manual*. The wall chart shows how the hardware is connected, and the instruction set card lists the mnemonics and op codes with variations.

Getting the KIM-1 up and running took me almost a week. The main problem was getting the power supply ready to supply power. My power supply is a Control Data Corporation model, supplied by Electravalue Industrial for $50. Initially, upon unpacking the supply, I was terrified by all the cables. However, upon more careful inspection, I was able to determine how to hook it up to the KIM. The problem lies in the number of connectors coming from the supply and the lack of an ac power cord. It took three days of searching over the greater New York area before I finally found one suitable for the job at Westchester Electronics in White Plains.

Once the power considerations were taken care of, I was able to turn on the machine and run the test problem in the *User's Manual* – a simple 8-bit addition routine to check the operation of the KIM. The program worked perfectly, and I have had no problems with my machine yet.

Overall, the KIM-1 is an excellent beginning machine. Among other things, it teaches you how much you can really do with only 1K of memory, something that is forgotten with today's massive machines. More importantly, however, the KIM-1 (at $245) makes computing available to anyone who wants it, and it is versatile enough to satisfy most people's needs. ■

RTTY Loop

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

Happy New Year! With the long winter nights, who wants to go outdoors and freeze? This is the perfect time to get on the air with RTTY. If you have already jumped in, fine! Welcome to the club! For those of you still unsure of how to act on the green keys, we will have a discussion of on-the-air techniques this month.

To begin with, where do you operate RTTY? There are three great hoards of Teletype™ enthusiasts: the 80, 20, and 2 meter gangs. This is not to say that you won't find RTTY on 28 MHz, but the population is greater on the above noted bands. On HF, operation is in the CW segment of the bands with FSK operation. As a starting point, you might try 3620 kHz and 14,080 kHz, plus or minus 10 kHz. Which one to start? As with other modes, 80 and 20 have propagation characteristics which influence the choice. From here in Baltimore, 80 provides reliable east coast to central communications without difficulty, whereas 20 is the DX band, as always. Stations normally operate on the same frequency and shift, with mark and space zero-beat. By far, 170 Hz shift now predominates.

Two meter AFSK has two camps, AM and FM, and you will have to look around to see what's in your area. Here in Baltimore, AFSK is frequently heard on the BRATS (Baltimore Radio Amateur Television Society) repeater on 147.63/147.03 MHz, and 146.58 MHz FM simplex. Standard 2125/2975 Hz tones are used, with 850 Hz shift dominant.

If you had to draw a parallel, RTTY operation would more closely identify with CW procedure than radiotelephone. Abbreviations, "Q" signals, and operating signs are all in common use. To satisfy the FCC, you must identify *your* station at the beginning and ending of each contact, and at least every ten minutes during one, by a means *other* than RTTY. Typically, this means Morse code, although some AFSK stations have been known to use voice. The Morse can be sent in any number of ways, including (but not limited to) FSK of the same shift as the RTTY, "narrow shift" of 50 Hz or so, so as not to false the demodulator, or make-and-break CW. The Morse may be generated by a conventional hand key, operating the BREAK key on the machine, a special "stunt box," or by a novel use of standard Teletype™ tape, which will be discussed in a future column.

If I had but one bit of advice to give to the newcomer to RTTY, it would be: *Please learn to touch-type!* There are few things as agonizing as watching a biblical (seek and ye shall find) typist, hunting and pecking along. If you just can't learn to type, make the acquisition of punched tape equipment your first priority, and punch a reply tape while the other guy is transmitting. You both will appreciate it.

Another common trap is to overdo the abbreviation bit. Sure, we all use "DE" and "CQ". And somehow, a sign-off would not sound complete without "73" or maybe "BCNU". But don't get carried away into typing: "W3NSD DE WA3AJR RR ON UR XMSN OM ES TNX FER FB QSO . . . QTH HR BLTO MD ABT 30 MI NE OF WASH DC . . . SO HW CPY?????? BK BK CW ID . . ." I mean, really now! No further comment needed.

So, what do you do, you might ask. To call CQ, set up a tape something like this: "CQ CQ CQ CQ CQ CQ CQ CQ CQ CQ CQ CQ CQ CQ DE WA3AJR WA3AJR WA3AJR CQ DE WA3AJR BALTIMORE MARYLAND," which repeats for thirty seconds or a minute. Don't forget to send your call by Morse at the end. Another useful tape is a "brag tape." This gives the rundown on where you are, your transmitter, receiver, RTTY gear, and the like. Frequently sent in the beginning of a contact, it dispenses with all the routine information and often provides a springboard for an interesting QSO. In fact, tape is used to transmit all kinds of things, both spontaneous and prepared. A full discussion of this storage form will also be presented in months to come.

Hopefully, you've got some idea of what to do on RTTY. After monitoring a bit and slinging some of the slang, you should have no trouble at all.

A note from Tom Hill WA4ECB reminded me that there are two kinds of selector magnets: pulling and holding. The rundown given in the September column was correct only for holding magnets. That is, series for 20 mA, parallel for 60 mA operation. The older pulling type are wired in *series* for 60 mA service. Pulling selector magnets depend on magnetic attraction to draw the pole piece to the magnet. With the later holding magnet, a mechanical cam does the work of bringing the pole up; all the magnet need do is hold it there. This requires less energy, thus reducing magnetic "kick-back" and radio interference. Sorry about the confusion, and a tip of the hat to Tom.

Next month, we will consider storage techniques for the masses of material that RTTY produces. In the meantime, I'll keep a lookout for some of you around 3623 kHz. Notes and questions are welcome, and may be sent to me via *73 Magazine* or at the above address. Items of general interest will be answered in this column. Please enclose a stamped, self-addressed envelope if you want a personal reply.

Oscar Orbits

FINDING OSCAR

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

Oscar 7 Orbital Information

Orbit	Date (Feb)	Time (GMT)	Longitude of Eq. Crossing °W
14700 Bbn	1	0152:12	84.1
14712 Abn	2	0051:33	68.9
14725 Bbn	3	0145:50	82.5
14737 Bbn	4	0045:11	67.3
14750 Abn	5	0139:28	80.9
14762 Bbn	6	0038:48	65.8
14775 Bbn	7	0133:05	79.3
14787 Abn	8	0032:26	64.2
14800 Abn	9	0126:43	77.8
14812 Bbn	10	0026:04	62.6
14825 Abn	11	0120:21	76.2
14837 Bbn	12	0019:41	61.1
14850 Bbn	13	0113:59	74.6
14862 Abn	14	0013:19	59.5
14875 Bbn	15	0107:36	73.1
14887 Bbn	16	0006:57	57.9
14900 Abn	17	0101:14	71.5
14912 Bbn	18	0000:35	56.4
14925 Bbn	19	0054:52	69.9
14938 Abn	20	0149:09	83.5
14950 Bbn	21	0048:30	68.4
14963 Bbn	22	0142:47	82.0
14975 Abn	23	0042:07	66.8
14988 Bbn	24	0136:25	80.4
15000 Bbn	25	0035:45	65.2
15013 Abn	26	0130:02	78.8
15025 Bbn	27	0029:23	63.7
15038 Bbn	28	0123:40	77.3

Robert J. Bishop
1143 W. Badillo # E
Covina CA 91722

Fiendish New QUBIC Program

The game of QUBIC® is a three-dimensional extension of ordinary tic-tac-toe. Instead of playing on a 3 x 3 plane, QUBIC is played in a 4 x 4 x 4 cube. The object of the game is for you to get four markers in a straight line before the computer does.

There are many versions of QUBIC around, but the most popular one seems to be the version presented in *101 BASIC Computer Games*, published by Digital Equipment Corporation (DEC). I would like to suggest several changes to the DEC program that might improve its playing and ease of use.

First of all, there seem to be errors in four of the DATA statements. For example, statements 1523 and 1529 both define the same plane, even though they each define different sets of lines through the cube.

Next, the DEC program does not display the game cube; it makes the player keep track of all the moves on a separate piece of paper. This kind of bookkeeping task should be left for the computer to do.

Finally, the program is invariant in its playing. Once you find a way to win, you can *always* win, just by making the very same moves the next time you play.

The QUBIC program presented in this article is my own attempt at producing an improved and original version of the game. In addition to indicating its move, the computer displays the cube, showing you the current state of the game. The program also tests for wins and ties.

Probably the most interesting feature of the program is its ability to play a different game each time. At first thought this may not seem to involve anything more than just using the RND function, right?

Random Selection of "Serial" Candidates

In many kinds of games in which the computer serves as an opponent, it is usually necessary for the computer to generate its move by selecting from many possible candidate moves. Typically, the computer will generate the first candidate move and store it (along with a "score" indicating its "goodness") in some kind of holding register. It then compares successive new candidates, as they are generated (serially), with the move currently being held. If the new candidate's score is better, he replaces the move currently in the register; if it's worse, the new candidate is simply discarded. But what if the two scores are equal? Then it really doesn't matter which candidate is selected, since one is just as good as the other. So, what usually happens is that the new candidate is discarded, since nothing is gained by replacing the one already being held. This means that the computer will always end up selecting the first of all the best candidates it encounters; it will suffer from invariance. How can we correct this problem?

Obviously, sometimes we would like to replace the incumbent candidate with the equivalent new one, and sometimes we would not. But we have to make sure that each candidate has an equal chance of being selected as the returned move. We cannot, therefore, simply flip a coin to see which candidate is chosen; this would always give the last candidate the best chance (50-50), and the first candidate the worst chance. (The first one would have to win every flip of the coin in order to survive.)

If we know in advance how many candidates to expect, then the solution is easy. If there are N candidates to choose from, we

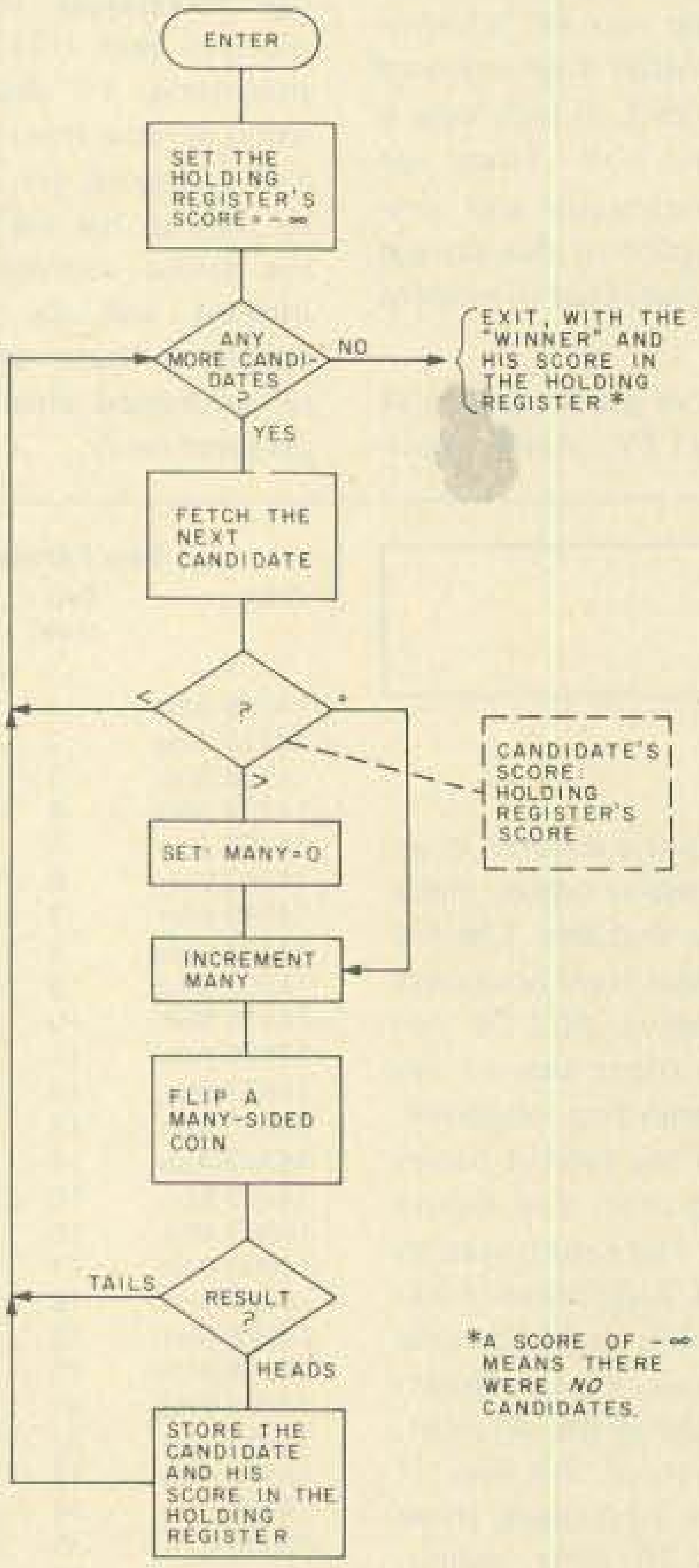


Fig. 1. Flowchart of random selection algorithm.

simply pick a random number r between 1 and N. Then, when the r^{th} guy shows up, we grab him. Unfortunately, we almost never know in advance exactly how many to expect. And it's not always practical to store all the candidates until the end, and then randomly select one.

Let me restate our problem in slightly different terms: Suppose we work in an employment agency, and we are assigned the task of selecting one person to be hired for a particular job. Assume that this particular job has absolutely no prerequisites, so every person who applies is equally qualified. Furthermore, we have no personal preferences regarding any of the applicants. The only requirement for us is that every applicant must have an equal opportunity of being selected. The applicants are lined up outside our office door and, since the room has no windows, we do not know how long the line is. Our office is very small and can hold no more than two applicants at a time. Once we dismiss an applicant, he must leave the room and never return. Our problem is to find a procedure for randomly selecting one candidate from the line.

When I first posed this problem to several of my friends, their initial intuitive response was that it's impossible to give everyone in the line an equal chance if we don't know in advance how many applicants to expect. But, surprisingly enough, there is a solution, and it's really quite simple. Here's what we do: We call the first applicant into the room, and we flip a "one-sided" coin (a Mobius coin?) with one head. If the coin comes up heads (which it must), we let the first applicant stay in the room. Now we bring in the second applicant. This time we flip an ordinary "two-sided" coin, with one head and one tail. If the coin comes up heads, the second applicant stays in the room, and the first is dismissed; otherwise, the first stays, and the second must leave. Next we call in the third candidate and flip a "three-sided" coin. If it comes up heads, he gets to stay; otherwise, he leaves, and the incumbent remains.

We keep repeating this process of flipping an "N-sided" coin for the N^{th} candidate and selecting him to replace the incumbent if the coin comes up heads. When the line runs out, whichever candidate is currently in our office gets the job. This procedure guarantees that each person in line will have had exactly the same chance of being selected.

It's easy to show that everyone actually does have the same chance, no matter where he is in the line. Suppose we consider the j^{th} applicant's chance of ending up with the job. When Mr. J first gets called into the office, his flip of the j-sided coin must come up heads, or he's all through. The probability of a head coming up is $1/j$; the probability of a tail is $(j-1)/j$. If he is ultimately destined to get the job, then all the remaining applicants' coins must come up tails. (The last person who gets heads gets the job.) Thus, the probability that our Mr. "J" will be hired is simply the product of the individual probabilities of his getting a head, with

```
>RUN

        X IN SQUARE?223

        O IN SQUARE 232

- - - -   - - - -   - - - -   - - - -
- - - -   - X - -   - - - -   - - - -
- - - -   - - O -   - - - -   - - - -
- - - -   - - - -   - - - -   - - - -

        X IN SQUARE?441

        O IN SQUARE 333

- - - -   - - - -   - - - -   - - - -
- - - -   - X - -   - - O -   - - - -
- - - -   - - O -   - - - -   - - - -
- - - -   - - - -   - - - -   - - - X

        X IN SQUARE?332

        O IN SQUARE 114

O - - -   - - - -   - - - -   - - - -
- - - -   - X - -   - - O -   - - - -
- - - -   - - O -   - - X -   - - - -
- - - -   - - - -   - - - -   - - - X
```

Fig. 2. Partial sample run of program.

```
>LIST
10000 L=768
10100 FOR K=0 TO 63
10200 POKE L+K,K
10300 NEXT K
10400 L=L+64
11000 A=4:B=16
11100 FOR S=1 TO 4
11200 GOSUB 19000
11300 NEXT S
12000 A=16:B=1
12100 FOR S=1 TO 13 STEP 4
12200 GOSUB 19000
12300 NEXT S
13000 S=1:A=5:B=16: GOSUB 19000
13100 S=13:A=-3:B=16: GOSUB 19000

13200 S=1:A=20:B=1: GOSUB 19000
13300 S=49:A=-12:B=1: GOSUB 19000

13400 S=1:A=17:B=4: GOSUB 19000
13500 S=49:A=-15:B=4: GOSUB 19000

14000 S=1:D=21: GOSUB 18000
14100 S=16:D=11: GOSUB 18000
14200 S=4:D=19: GOSUB 18000
14300 S=13:D=13: GOSUB 18000
15000 END
18000 FOR K=S TO S+3*D STEP D
18100 POKE L,K-1:L=L+1
18200 NEXT K
18300 RETURN
19000 FOR J=S TO S+3*B STEP B
19100 FOR K=J TO J+3*A STEP A
19200 POKE L,K-1:L=L+1
19300 NEXT K
19400 NEXT J
19500 RETURN
```

Program A. Initialization routine.

everyone else after him getting tails. If the line is N applicants long, then this probability is:

p = (1/j)[j/(j+1)]
. . . [(N-1)/N]

which is just 1/N. Since j was arbitrary, we see that each candidate has exactly one chance in N of getting the job.

Fig. 1 shows a flowchart of the complete random selection algorithm.

Apple QUBIC

A random selection algorithm, similar to the one described in the previous section, is incorporated into the QUBIC program presented in this article. Listings are shown in Programs A and B. The program is written in Apple BASIC and runs on an 8K Apple-1 computer. It will also run on an 8K Apple-II with very few changes. Apple BASIC, which is an integer-only BASIC, is ideally suited for programs like QUBIC in that it's fast (no time-consuming floating point operations), and its random number generator acts exactly like an N-sided coin. (You specify N, and it generates a pseudorandom integer from 0 to N-1.)

Because of memory limitations on my Apple-I, the QUBIC program is really two programs. The first part, statements 10000 to 19500 (Program A), serves to initialize a set of lookup tables and must be run once prior to the first use of the second part (Program B), the actual game. After this initialization program has been run, it can be deleted, if necessary, to make room for the second part. (This deletion is not necessary on Apple-II systems; they have enough room to hold both parts of the program at the same time.) The lookup tables start at decimal location 768 and extend to decimal location 1071; this location is determined by the variable L in statements 10 and 10000.

In addition to the lookup tables, the program uses decimal locations 564 to 767 for temporary storage. Since Apple-II uses all this area for its display buffer, it will be necessary for Apple-II owners to change line 10. I would suggest that you merely add some large offset, like 2000, to all the values in the line. Then statement 10 should look like:

10 Q=2546:G=2628:
S=2692: L=2768

(Don't forget to also change the L in statement 10000 to read: L=2768.)

The only other precaution required of Apple-II users is that you set LOMEM to no less than about 4096, or you might destroy the lookup tables. (When you save the program on tape, don't forget to save the tables, too, or you'll have to regenerate them each time you load the program.)

Playing The Game

In my version of the program, you always play X and the computer always plays O. The program will ask for your move by displaying:

X IN SQUARE?

You respond with a three-digit number with each digit in the range from 1 to 4. The first digit indicates the level of the square (level 1 is displayed on the left, 4 on the right), the second digit indicates the column in that level (again numbered from left to right), and the third digit indicates the row (from bottom to top). Thus, the move 324 would indicate 3rd level, 2nd column from the left, 4th row from the bottom. If you make an illegal move, the computer will ask for your move again.

Each time the computer returns its move (about 20-25 seconds), it will produce an updated display of the game cube. A partial game is shown in Fig. 2. ■

Program B. Source listing for QUBIC game.

```
>LIST
    5 DIM E(7)
    7 E(1)=254: E(2)=18: E(3)=2: E(
      4)=1: E(5)=2: E(6)=66: E(7)=255

   10 Q=564: G=628: S=692: L=768
   20 FOR K=G TO G+63:  POKE K, 128
      : NEXT K
   30 FOR K=S TO S+75:  POKE K, 128
      : NEXT K
  100 PRINT : TAB 13: INPUT "X IN SQU
      ARE", X
  110 P=X/100:  IF P<1 OR P>4 THEN
      100
  120 X=X-100*P: C=X/10:  IF C<1 OR
      C>4 THEN 100
  130 R=X-10*C:  IF R<1 OR R>4 THEN
      100
  140 X=16*(P-1)+4*(R-1)+C-1
  150 IF PEEK (G+X)#128 THEN 100

  160 M=-1:  GOSUB 1000
  170 GOSUB 2000
  180 IF W THEN 850
  190 IF T THEN 820
  200 GOSUB 3000
  210 M=1:  GOSUB 1000
  220 GOSUB 2000
  230 IF W THEN 900
  250 GOSUB 7000
  300 IF T THEN 820
  350 GOSUB 9000
  400 GOTO 100
  800 GOSUB 7000:  GOSUB 9000
  810 GOTO 100
  820 PRINT : TAB 13
  830 PRINT "--- TIE GAME ---"
  840 GOTO 950
  850 TAB 13:  PRINT "--- YOU WON ---"

  860 GOTO 950
  900 GOSUB 7000:  TAB 13
  910 PRINT "---- I WON ----"
  950 GOSUB 9000:  PRINT : PRINT

  960 TAB 11:  PRINT "THANKS FOR THE G
      AME"
  970 PRINT : PRINT : PRINT : PRINT
      : PRINT
  980 END
 1000 POKE G+X, 128+M
 1010 FOR K=L TO L+303:  IF PEEK
      (K)#X THEN 1090
 1020 Y=S+(K-L)/4: V= PEEK (Y):  IF
      V=0 THEN 1090
 1030 V=V-128
 1035 IF V=0 THEN 1060
 1040 IF SGN (V)= SGN (M) THEN 1060
```

```
1050 V=0: GOTO 1070
1060 V=V+M+128
1070 POKE Y,V
1090 NEXT K: RETURN
2000 W=0: T=1
2010 FOR K=S TO S+75
2020 V= PEEK (K)
2030 IF V THEN T=0
2040 IF ABS (V-128)=4 THEN W=1
2050 NEXT K: RETURN
3000 FOR K=Q TO Q+63
3010 POKE K,0
3020 NEXT K
3100 FOR K=S TO S+75
3110 N= PEEK (K)-128: IF N=-128
     THEN 3500
3200 Z=E(N+4)
3300 F=L+4*(K-S)
3310 FOR J=F TO F+3
3320 X= PEEK (J): IF PEEK (G+X)
     #128 THEN 3400
3330 V= PEEK (Q+X)
3340 IF V>=254 THEN 3400
3350 V=V+Z: IF Z>=254 THEN V=Z
3380 IF V>255 THEN V=255
3390 POKE Q+X,V
3400 NEXT J
3500 NEXT K
3600 V9=0
3610 FOR K=0 TO 63
3620 V= PEEK (Q+K)
3630 IF V>64 AND V<128 THEN V=V-
     64
3640 IF V>16 AND V<32 THEN V=V-
     16
3650 IF V>V9 THEN V9=V
3680 POKE Q+K,V
3690 NEXT K
3700 IF V9<32 THEN 4000
3800 X=0
3810 IF PEEK (Q+X)=V9 THEN RETURN

3820 X=X+1: GOTO 3810
4000 P4=16
4010 FOR K=L TO L+287 STEP 16
4020 P=0
4030 FOR J=K TO K+15
4040 P=P+ PEEK ( PEEK (J)+G)-128

4050 NEXT J
4060 IF P>P4 THEN 4500
4070 IF P=P4 THEN 4210
4200 P4=P: V4=0: N4=0
4210 FOR J=K TO K+15
4220 X1= PEEK (J)
4230 V= PEEK (Q+X1)
4235 IF V=0 THEN 4400
4240 IF V<V4 THEN 4400
4250 IF V>V4 THEN 4350
4260 N4=N4+1
4270 IF RND (N4) THEN 4400
4280 GOTO 4360
4350 V4=V: N4=1
4360 X=X1
4400 NEXT J
4500 NEXT K
4550 IF V4 THEN RETURN
4600 GOTO 3800
7000 P=X/16+1
7010 X=X-16*(P-1)
7020 R=X/4+1
7030 C=(X MOD 4)+1
7040 TAB 13: PRINT "0 IN SQUARE "
     ;P;C;R
7050 RETURN
9000 PRINT
9010 FOR R=4 TO 1 STEP -1
9020 FOR P=1 TO 4
9030 FOR C=1 TO 4
9040 X=16*(P-1)+4*(R-1)+C-1
9050 V= PEEK (G+X)
9060 IF V=127 THEN PRINT " X";
9070 IF V=128 THEN PRINT " -";
9080 IF V=129 THEN PRINT " 0";
9090 NEXT C: PRINT "  ";
9100 NEXT P: PRINT
9110 NEXT R
9120 RETURN
```

Jeff Duntemann WB9MQY
6424 North Albany Avenue
Chicago IL 60645

Put An ELF In Your Keyer

—sneaky computer strikes again

I know that there are plenty of you who don't believe that computers belong in ham shacks. Perhaps that's because the last time you saw a computer was when you toured the university as a Boy Scout and saw this thing that filled two buildings and made a lot of noise. I'm sure that you have neither two buildings nor a hundred million dollars to spare, but times have changed. Today, computers can save you time and money.

A computer is actually an infinitely programmable switch. It can do almost anything. On your bench you might have a signal generator, frequency counter, RTTY box, and Morse keyer. They're worth a bundle. On the other hand, you could have a single box that does all of that and more. It's the instructions you feed it that make the difference. Your entire test bench could fit in a shoebox — rolled up on Teletype punched tape.

If you have a computer based on the RCA CDP1802 microprocessor (the COSMAC ELF* is the best example), you can start by making a keyer in 34 instruction statements.

The hardware setup is simple. (See Fig. 1.) Parallel all six sections of a CMOS 4050 hex driver. This provides the current needed for the reed relay. The 1N4001 shorts out inductive spikes, which might damage the CMOS logic. Connect the dit side of your paddle directly to EF4 and the dah side to EF3. The center contact is grounded. That's all there is to it.

The program is a good example of several timing loops nested one inside the other. The program sets up a basic timing delay loop of fixed length. (See Fig. 2.) This delay is a very small fraction of a second long. The computer goes through this loop a number of times to generate a dit interval. The number of times this loop occurs is given by the number you set in the toggle switches. The higher the number in the toggles, the more times the computer makes this loop, and the slower your keyer will be.

When you select a dah, the computer executes a third loop on top of the ones described above. This loop makes the computer go through the sequence generating a dit three times. Your dahs are thus three times as long as your dits, regardless of what code speed you select. The interval between dits and dahs is one dit long.

The program works best with a clock frequency of between one and two MHz. You can select any of 256 code speeds, and change speed any time by flicking the toggles. The speed ranges from dits that are several

*Registered trademark of RCA Corporation.

MA	Mach. Code	
00	36	Test for dah.
01	09	
02	3F	Test for dit.
03	00	
04	F8	Set no. of loops
05	01	for dit in
06	A7	R7.
07	30	Go to M(0C).
08	0C	
09	F8	Set no. of loops
0A	03	for dah in
0B	A7	R7.
0C	7B	Turn Q on.
0D	6C	Read number from toggles.
0E	A6	Put number in R6.
0F	F8	Set no. of loops
10	FF	for time delay
11	A5	in R5.
12	25	Subtract 1 from R5.
13	85	Put R5 in accumulator.
14	3A	If R5 is not 0,
15	12	go to M(12) and loop again.
16	26	Subtract 1 from R6.
17	86	Put R6 in accumulator.
18	3A	If R6 is not 0,
19	0F	go to M(0F) and loop again.
1A	39	If Q is off,
1B	00	go to start, else continue.
1C	27	Subtract 1 from R7.
1D	87	Put R7 in accumulator.
1E	3A	If R7 is not 0,
1F	0D	go to M(0D) and loop again.
20	7A	Turn Q off.
21	30	Go to M(0D).
22	0D	

Program A. ELF keyer routine.

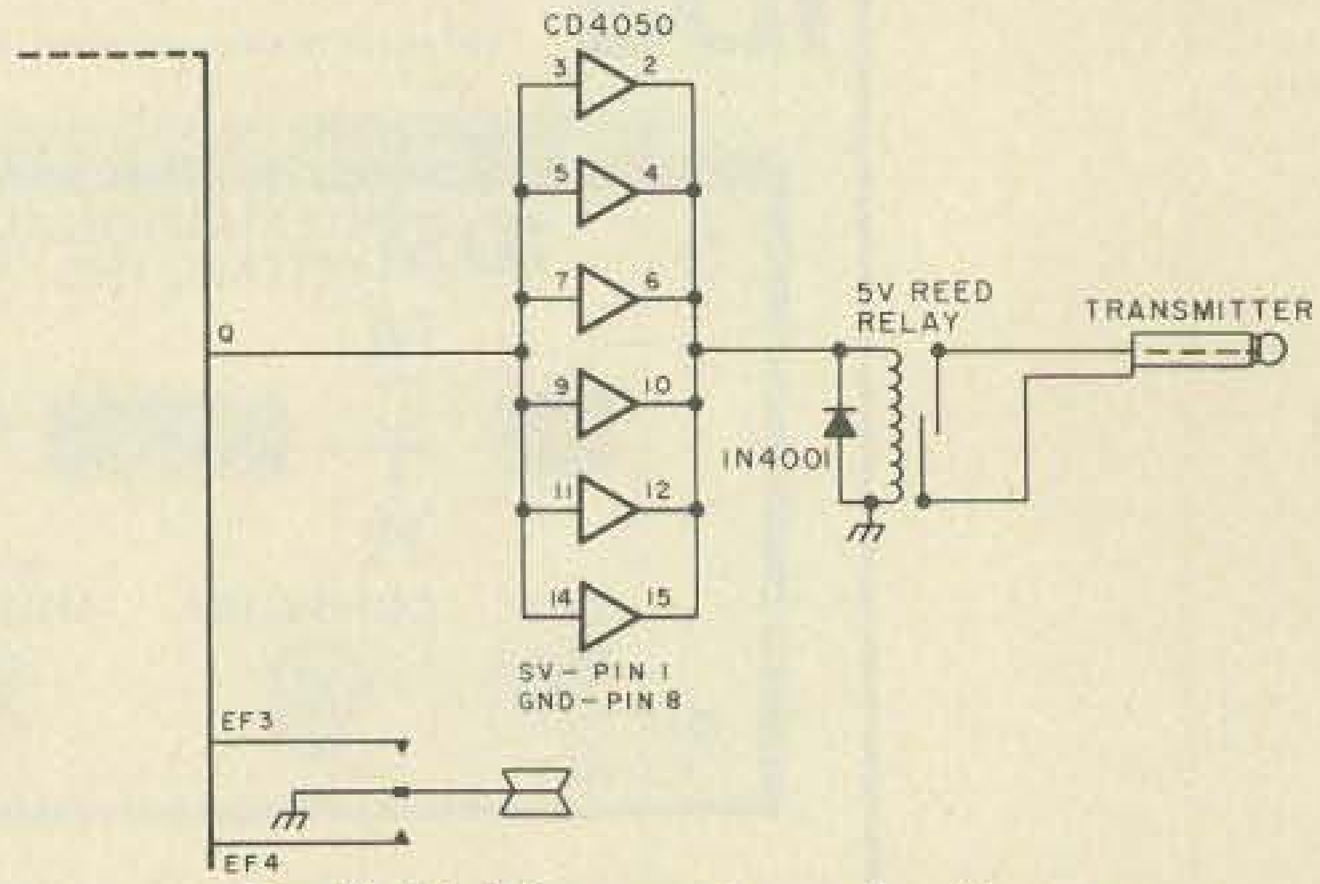


Fig. 1. ELF keyer schematic diagram.

seconds long (by toggling in hex FF) to Morse characters in the low audio range (by toggling in 00).

If your clock frequency is less than 500 kHz, change the delay constant at M(10) to hexadecimal 80. Otherwise, your code speed might never rise above Novice level.

If this program won't run in your 1802 computer, check which N line gates the toggle switch number onto the data bus. The 6C instruction at M(0D) uses the N2 line to do this. If your computer uses a different N line, the number you set in the toggle switches isn't making it into the program. Replace the 6C instruction with the one which corresponds to the N line you're using.

Perhaps you've always looked the other way when the page said "microprocessor." Now's the time to take another look. A good scrounger can make a minimal 1802 computer for under seventy dollars. If it does nothing else, it will teach you a lot about a major new area of electronics, and it makes a dynamite keyer as well. But when was the last time a computer was ever used for just one thing in a ham shack?

I don't think it's happened yet. ■

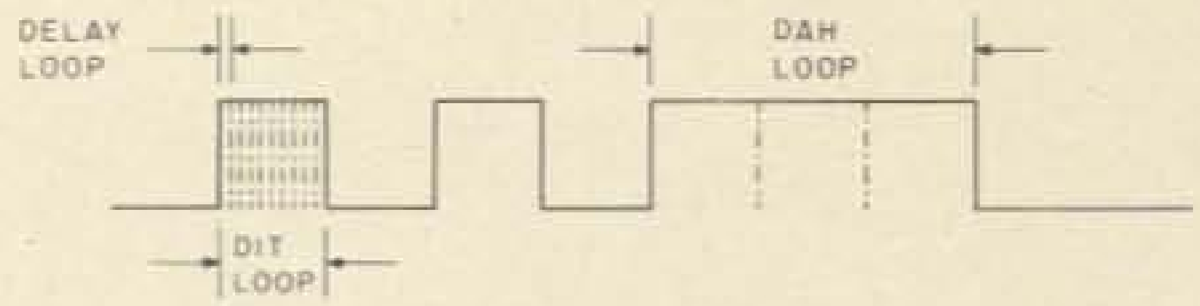


Fig. 2. Timing diagram.

References

1"Build the COSMAC ELF," *Popular Electronics* (Part 1, August, 1976; Part 2, September, 1976; Part 3, March, 1977), Joseph Weisbecker.

2The COSMAC Exogenous Users Group can be joined by writing to Edwin M. Robertson, Jr. WA4MXA, 1535 Hermitage Ct., Durham NC 27707.

LETTERS

from page 51

person of limited electronics skill, after using your *Advanced Class Study Guide*, I was able to "skate" and thoroughly master the Advanced class test, and now am a proud holder of an Advanced class license.

In that strange and unknown tongue, otherwise known as "plain English," you have truly presented an incredible book. The material is precise, thoroughly explained, and contains no extraneous material. I would recommend it to anyone who desires an Advanced class license.

If you ever need an endorsement, I'll do it for free. God bless you.

Charles E. Martin WA4YRA/DA1NR
APO NY

WHAT'S GOING ON?

Just thought I'd drop you a note and ask what's going on up there in the woods. I have really been enjoying *73* for the year and a half I've been a subscriber. Each month's issue seemed to be an improvement over its predecessor — more articles, more editorials, more news, more everything! The last few issues, however, have been disappointing. What happened to the guest editorials? And how about your "Briefs" column? These had quickly become two of my favorite sections in *73*. Now they are missing.

Other changes for the worse were noted, too. The worst of all was the "special issue" idea. The intention was grand, and with this I sympathize. But it crippled the magazine's strongest leg — that of having something (if not a helluva lot) for everyone. Face it. Aside from a few special cases that come up from time to time, the only acceptable subjects for special issues are those with true mass appeal. The only two subjects I feel fit this mold are FM/repeaters and antennas.

I'm not giving up on *73* just yet, though. You've come through before and I trust you still shall. Well, 'nuff said for now. Just tweak those few editorial circuits to eliminate those spurs and everything will again be hunky-dory down here in Virginia!

I just loved Ken Wilson's piece, "Electronics Study Guide," in the November issue. Have filled out the reader's service card noting his as best article!

Steve Silsby WA4BRL
Newport News VA

Nobody said they liked the guest editorials and briefs, so I killed them. Special issues are popular, but perhaps RTTY is too special. — Wayne.

OFF OUR DUFFS

I hope you are doing fine today. It's been about ten years since I've read a *73 Magazine*, as where I've lived the past ten years, it's hard to find any ham magazines. Now I'm getting back into hamming. After reading your editorial, "Never Say Die," you really have me scared, as I'm an HF op and I love the skip bands. I'm on 40 meters most of the time. Let us hope we never lose any more spaces on the HF bands.

I appreciate all you have done for ham radio. When I got my ticket back in 1968 after a 6 year QRT, I was against the incentive jazz proposed by the ARRL. When I got my General class, it was for all frequencies in all bands; a year later I lost some frequencies to the Extra and Advanced classes. I'm still a General. In 1978, I will finally start to study for the Advanced so I can get some more portions of the phone bands. I was against incentive licensing and still am. For I believe it is a hobby; I'm not trying to be an engineer.

After my belly-aching, I wish to say or rather suggest that you work on an idea of mine. My suggestion is that we start a fund to finance ham ambassadors or whatever it takes for us to keep our bands intact. I am ready, willing, and able to send in a ten-spot once in awhile. I'm willing to put money where my mouth is. Wayne, think of some way where all us hams can help, even by sending in just a buck or two. We must get off our duffs and get into action. Thanks for scaring me or rather waking me up.

Albert J. Sweney WA6DBE
FPO San Francisco

If I knew where to send money to do good, I'd be first in line. — Wayne.

BY FAR THE BEST?

73 Magazine is by far the best ham publication I have ever read — even a non-ham could take an interest in it. I found this out at work, when a fireman who is interested in public service VHF saw me reading a copy. I offered to loan it to him. At first he said that he didn't like those ham magazines, but then he spotted an article on a modified Wilson and noticed that *73* was different from those other ham magazines he had seen. Well, to end a long story, he borrowed that issue for the rest of the week, and insisted that I bring in all the other issues that I have. As soon as he gets his house built and running fairly smooth, we will have another person learning the code for his Novice ticket, all because of the many interesting articles presented in *73*.

David J. Johnstone WB1COB
Torrington CT

THE SLEP "GOOD OLD DAYS"

After many years as an amateur, and one who was able to afford buying and trading many thousands of dollars worth of equipment, I have become very disillusioned with the attitude of most dealers. Once they ring up a sale, they feel no responsibility to their customers and God help you if the gear is defective when delivered!

Fate recently brought me in contact with one of your advertisers who is just the opposite. He makes good deals, keeps his word regarding prompt delivery, and, miracle of miracles, stands behind his sale.

The name of this oasis within a desert is Slep Electronics. I advise anyone to try Bill first on your next purchase and get the feel of "the good old days."

George W. Moran W2DGZ
Port Jefferson NY

$25,000 FOR AMSAT

Many thanks for resuming the publication of our AMSAT Phase III "ad" in *73 Magazine*. Realizing that *73 Magazine* space is at a premium, we really appreciate your continuing to run our ad on a space-available basis. The response has been excellent and has brought in over $25,000 in donations in the past six months.

Perry I. Klein W3PK
President, AMSAT
Washington DC

ANCHOR LINE CUT?

I thought you might be interested in knowing about a communication piracy network that has developed in the Bahama and Caribbean Islands. It has to do with the increasing number of U.S. citizens using foreign amateur licenses illegally aboard their pleasure yachts.

As you know, the number of yachts coming to the Virgin Islands is increasing each year. Until recently, the number of illegal maritime stations has been minimal. However, within the last 15 months, it has grown from maybe 4 or 5 to something over 20. In this small area, even 10 is an alarming number and enough to warrant action by foreign governments as well as our own.

The main contributor to this situation is an American with an

Continued on page 101

Try HCAI

—ham computer assisted instruction

Ed Hughot
Denis Nechuta
437-A Aldo Ave.
Santa Clara CA 95050

Since the advent of the affordable computer, many interesting applications have appeared. We have seen the computer used to solve engineering equations, to edit text, to handle the "mail," and even to play games.

One area that seems to be neglected is Computer Assisted Instruction (CAI). Yes,

```
LIST

1 REM== RESISTOR COLOR CODE PROGRAM ==
2 REM      DENIS NECHUTA
3 REM      ED HUGHOT
4 REM      2/24/77
1Ø DIM C$(1Ø)
2Ø DATA BLACK,BROWN,RED,ORANGE,YELLOW,GREEN,BLUE,VIOLET,GRAY,WHITE
4Ø K=1Ø
45 PRINT:PRINT
5Ø PRINT "*** RESISTOR COLOR CODE PRACTICE ***":PRINT
6Ø PRINT "I WILL GIVE YOU THE FIRST THREE COLOR BANDS"
7Ø PRINT "OF A RESISTOR.  YOU TELL ME THE VALUE IN OHMS"
75 PRINT "YOU WILL HAVE" K "RESISTORS"
8Ø PRINT:PRINT
9Ø FOR I=Ø TO 9:READ C$(I):NEXT I
1ØØ PRINT "I'M THINKING OF A RESISTOR  THE COLOR BANDS ARE"
11Ø T=Ø
12Ø FOR I=1 TO K
125 PRINT
13Ø V1=INT(9*RND(1)+.5)
14Ø V2 =INT(9*RND(1)+.5)
15Ø V3=INT(5*RND(1)+.5)
16Ø V=(V1*1Ø+V2)*1Ø↑V3
165 V=INT(V)
167 IF V=Ø THEN 13Ø
17Ø PRINT I".  " C$(V1) " " C$(V2) " " C$(V3)
18Ø INPUT"WHAT IS THE VALUE";X
19Ø X=INT(X)
2ØØ T=T+1
21Ø IF X=V THEN 24Ø
22Ø PRINT"WRONG.";
225 INPUT " WHAT IS THE VALUE"; X
23Ø GOTO 2ØØ
24Ø PRINT"CORRECT"
25Ø NEXT I
255 PRINT:PRINT
26Ø PRINT "YOU MADE" T "ATTEMPTS ON THE" K "RESISTORS I GAVE YOU"
265 PRINT
27Ø PRINT "YOU ARE ";
275 IF T=K GOTO 3ØØ
28Ø IF T>2*K THEN 34Ø
285 S=INT((T-K)/2) + 1
29Ø ON S  GOTO 31Ø,31Ø,32Ø,33Ø,34Ø
295 GOTO 34Ø
3ØØ PRINT"FANTASTIC": GOTO 345
31Ø PRINT"AN EXPERT": GOTO 345
32Ø PRINT"A PROFESSIONAL": GOTO 345
33Ø PRINT"A NOVICE": GOTO 345
34Ø PRINT"KIDDING ME !!"
345 PRINT:PRINT
35Ø INPUT"TRY AGAIN";A$
355 PRINT:PRINT
36Ø IF LEFT$(A$,1)="Y" THEN 1ØØ
37Ø PRINT "GOOD BYE, IT WAS FUN"
999 END
OK
```

Fig. 1. Color code quiz.

```
RUN

*** RESISTOR COLOR CODE PRACTICE ***

I WILL GIVE YOU THE FIRST THREE COLOR BANDS
OF A RESISTOR.  YOU TELL ME THE VALUE IN OHMS
YOU WILL HAVE 1Ø RESISTORS


I'M THINKING OF A RESISTOR  THE COLOR BANDS ARE

 1 .  BLUE GREEN ORANGE
WHAT IS THE VALUE? 65ØØØ
CORRECT

 2 .  BLUE GRAY RED
WHAT IS THE VALUE? 68ØØ
CORRECT

 3 .  GREEN VIOLET ORANGE
WHAT IS THE VALUE? 57ØØØ
CORRECT

 4 .  ORANGE GRAY YELLOW
WHAT IS THE VALUE? 39ØØØØ
WRONG. WHAT IS THE VALUE? 38ØØØØ
CORRECT

 5 .  VIOLET BROWN ORANGE
WHAT IS THE VALUE? 71E3
CORRECT

 6 .  ORANGE RED RED
WHAT IS THE VALUE? 32ØØ
CORRECT

 7 .  GRAY ORANGE BROWN
WHAT IS THE VALUE? 83Ø
CORRECT

 8 .  YELLOW RED YELLOW
WHAT IS THE VALUE? 42ØØØ
WRONG. WHAT IS THE VALUE? 42E4
CORRECT

 9 .  YELLOW WHITE YELLOW
WHAT IS THE VALUE? 49ØØØØ
CORRECT

 1Ø .  ORANGE RED RED
WHAT IS THE VALUE? 32ØØ
CORRECT


YOU MADE 12 ATTEMPTS ON THE 1Ø RESISTORS I GAVE YOU

YOU ARE AN EXPERT


TRY AGAIN? NO


GOOD BYE, IT WAS FUN
```

Fig. 2.

your friendly home brew computer can also be your best buddy when it comes to learning electronics theory. The procedure is quite simple if you program in BASIC. You simply invert the routine for solving an equation. The program asks you questions about the equation and then scores your results.

If you write the program yourself, you win three ways. First, you learn a lot about the equation by programming it. Second, you can drill yourself until the principles are firmly in mind. Third, you learn more about programming at the same time.

When you try CAI, whether you write your own program or not, you will quickly realize the benefits. One of the main advantages is the instant feedback. Unlike the examinations at school, as soon as you answer the question you are told if it's right — no waiting days or weeks. You don't have time to forget why you thought you were selecting the right answer. Another big plus is that you take the test when you feel like it. Just you and your personal computer are all it takes. And the computer adds up your score, so it's very easy to see how well you are really doing.

One example of CAI is a very simple application. At some time or other we have all had to learn the color codes. Fig. 1 is a listing of a program that will help you learn the color codes. Fig. 2 is a printout of a typical run. Note that this program is written so that you feel you are actually conversing with the instructor. It is almost like a game.

Try this program, and see if you agree that it is a lot easier to learn the color codes with the help of a computer. ■

B. S. Field, Jr. W8JJO
16725 Fenmore Ave.
Detroit MI 48235

Raid!

—the radio police strike

The minute that we got back from Toulouse, while we were still taking our bags out of the car, the neighbor's kids came running over to the kitchen door. They were usually shy about talking to "The Foreigners," so their enthusiasm gave both my wife and I the impression that their message was "Something Important." So, after I got the bags out of the car and up the stairs, I left my wife to finish the unpacking and went with the kids over to my neighbor's place of business, his repair garage.

M. Guy was deep in the bowels of one of his client's tractors when I came in, but he pulled his hands out of the transmission and wiped them off on a rag in order to talk to me. In that part of France, especially when talking to foreigners, it is important to have both hands free.

It seems that the Radio Police had been calling on M. Guy. He chose his words carefully, making sure that he was using his French vocabulary. His eyes were large and round. The Radio Police, he told me, had been by his garage three times recently to ask him questions about me and my dipole, interrupting his work. "Flics!" snapped M. Guy. "Cops!" He had a friend, who had a friend in the prefecture, the French government's local administrative center, in Cahors, the chief city of the department, and M. Guy had complained through those channels after the third visit of the "flics." The friend's friend had assured him that these interruptions of his work would stop, and they had.

But then today, the "flics" had phoned M. Guy that they were coming back! His voice rasped bitterly, not only with the exasperation at that further interruption of his work, but also at the shame of admitting that his connections to the prefecture had not kept them out of his hair after all. He twisted the greasy rag on which he had been wiping his hands, then slapped it down on the nearby tractor tire. They had phoned to know when I would be at home. They would come in and look at my radio, they had said. M. Guy had known that we were expecting to return from Toulouse before noon, but he had told them not to come until three. He had wanted to give me time, he said, to be warned and to take measures, just in case I needed to.

I laughed and told him to relax, that I would be glad to have the Radio Police look at my station, and that seemed to reassure him. He had never been too sure how legal my radio station might be. However, over the months he had adopted us as true neighbors and therefore as partisans with him in every French country person's eternal guerrilla war with those malicious city slickers from Paris, that source of liquor regulations and tax collections. He grumbled on, lapsing into patois, about the interferences of all these officious snoops, interrupting an honest man's effort to make a simple living, etc., etc. He turned back to the disembowelled tractor and got to work again.

I went back home and told my wife about it. She wanted to know what the Radio Police would find wrong, and I told her that as far as I knew, there was nothing wrong to find. I had an FT-101B, a license still good for the rest of the year, and a home brew multiband dipole. I usually worked the locals on 80 meters in my halting French, and a little DX on 15 meters when it opened to the States.

At three that afternoon, exactly on schedule, a Peugeot sedan drove up the track from the road to our house and parked next to my car by the kitchen door. A gentleman in a black business suit got out, followed by the driver, a tall blonde man in a tan trench coat, and then by a red-headed woman in a light blue trench coat. They all had that smooth, buffed surface of plainclothes police everywhere in the world. The man in the black suit, short, as short as I am, came toward me as I stood in the kitchen door, while the other two stood by the car, hands in their coat pockets. The smaller, older man stuck out his hand.

"FØBHN?" he said, pronouncing the letters English style. "C'est moi," I said, and, continuing in French, invited him in, calling the same to the other two. The black suit nodded at me, turned to the other two and nodded to them. Then they took their hands out of their coat pockets, smiling now, and came up the steps to the kitchen door, and all three came inside.

The house that we were renting then had been converted from a seventeenth-century barn built along the slope of a hill. It looks unremarkable from the outside, but inside it is a bit spectacular. The kitchen, for instance, has a seventeen-foot ceiling and is dominated by a twenty-foot-long table down the middle, from which my wife was rising as they came in the door. We had both been working there, and the table was covered with her books and papers, and my papers and typewriter. Only the small space at one end where we normally ate was cleared. The three officials were visibly impressed.

I tried to introduce them all to my wife, but I never got their names straight. The confusion was compounded by the insistence of the man in black that he talk English and by my insistence that I talk French. My wife smoothed things over somewhat by offering coffee, cookies, and seats to all. Meanwhile, all three of the visitors were trying at once, two in French and one in English, to explain to us who they were and why they had come, while at the same time I was telling them in my version of French that I already knew that they were the Radio Police. Finally we all ran down, more from frustration than out of any conviction that we had made ourselves understood. The two in trench coats looked nervous and stunned. My wife, a professional writer and educator like myself, and normally a self-contained person, began to see the situation as ridiculous, one of communication overkill, and in order to keep from giggling, she began to join in the act, playing the role of the gabby housewife, until at last she was the only one left talking. I gaped.

The older man in black, as I later deciphered it, was not from the Radio Police – apparently there is no such organization in the French administration – but an inspector in the radio division of the postal and telecommunication ministry of the French government. After some urging on my part, I got him to come upstairs, through the living room, and up more stairs to the bedroom, where I had set up my rig on a table in front of a window. The white coax to the antenna ran up into the ceiling beside a radiator pipe. I turned the rig on and let him play with the knobs. Then we talked radio chitchat for awhile. He was a ham himself. He assured me again, as he had several times down in the kitchen, that this was an amicable inspection, no question of any complaints about TVI, all merely routine. We listened around on 15 meters, but the band was dead, so we switched to 80 and listened to the goulash of polyglot QSOs up and down the band in French, Spanish, Italian, German, English, Dutch, etc. He told me that his "accompanying friends" would like to see my rig, too, and he went down to the kitchen to call one of them to come and to look.

First the red-headed worman in the blue trench coat came up and looked blankly at the rig. She said that she didn't understand these technical matters and went back down to the kitchen. My wife later remarked that they had seemed rather careful never to leave either of us alone. The tall blonde man in the tan trench coat came up next. Evidently, he was glad to get away. My wife had been gabbing away as fast as she could, telling them everything about us, and in exhaustive detail, a tactic that the French call "drowning the fish."

Upstairs, the tan trench coat listened to my rig. The postal inspector in the black suit kept trying to get me to talk English, so when my French vocabulary failed me on some technical terms, I changed to English. I also switched the rig over to twenty meters, to show off some DX QSOs. I asked the tan trench coat what he thought of those, fishing for some expression of amazement that we hams always love to hear about the marvels of radio and DX. But the tan trench coat merely shrugged and said that he didn't understand English. The inspector in black translated some of my English sentences for him – until the tan trench coat, apparently without thinking, corrected him, supplying a more accurate French translation of what I had said than the inspector had!

As it turned out, there was no problem with my rig or my license, at least none that I ever heard about, but at that moment, the evidence that the one in the tan trench coat was dissembling about his English made me a little nervous. However, the sensation passed as we went back down to the kitchen again. My wife was still talking away, and the woman in the blue trench coat was nodding her head with a hypnotized rhythm. My wife served us more coffee, and then I got so self-confident and relaxed that I got into an argument with the inspector about antennas, front-to-back ratios, and impedance matching, a debate of such baroque complexity that soon my wife fell silent and gaped at me.

My neighbor, M. Guy, suddenly appeared at the kitchen door. He was still in his overalls, but his hands were cleaned of grease. My wife invited him in for coffee, and he sat down amid us all, looking around suspiciously as if he thought that the police might be trying to steal the silver. He later told me that he had given them thirty minutes to make a routine inquiry, and when that much time had gone by and they still had not left, he had come over to see if something was wrong. His bright button eyes flashed at everyone, and then he turned and settled down with his elbows on the table, to stare deliberately first at the inspector and then at the man in the tan trench coat.

Eventually the visitors began to make those usual departure noises. We said goodbye at the table, in the doorway, on the back steps, and while the three stood beside the car. The woman in the blue trench coat sat in back, the men up front, with the tan trench coat driving again. The men waved as they drove down the track to the main road, but the woman in back simply leaned her cheek against the side window as if to cool it. I had the sudden intuition that not only had she been wearied by my wife's drowning of the fish, but that she was anticipating the exhausting chore of writing it all down in a report.

After they had left, I explained to M. Guy that the inspector had come merely on a routine and amicable inspection.

"Don't believe it!" snorted M. Guy. I explained that the inspector had brought along the other two, the two trench coats, merely because they had been going his way and had offered him a lift.

"Don't believe it!" snorted M. Guy again. Then he explained that the plainclothesmen had been from the "PJ", the judicial police. In France, no official can enter a home uninvited – unless he's an agent of the *Police Judiciaire*. But an agent of the PJ needs no warrant.

"And the woman?" asked my wife.

M. Guy had no explanation of the woman; he shrugged his Gallic shrug, the corners of the mouth down, the eyebrows and the shoulders up.

It turned out that she was a plainclothes police officer too, or so we heard later. My wife and I considered this inspection as an adventure, that is, as a story to be retold to our French friends over dinners or in cafes over drinks. One of the friends in Cahors hangs out at the aero club at the airport, partly because he likes their restaurant, but partly too because he is an aviation buff. He explained, after I had told my story of the "Amicable Inspection," that someone had been spotted taking mysterious telephoto photographs of the airport during the last month, and when later apprehended, was unable to offer any convincing explanation of why he was doing that. He had been carrying a foreigner's passport. So the French police had become immediately suspicious of all the local foreigners, me included, it seemed. From my description of the red-headed woman in a light blue trench coat, my friend at the aero club claimed to recognize an agent of the French police, perhaps of the counterespionage section, one who had been questioning airport employees, especially the technical personnel and electronics technicians, only a week before she appeared at our house for the amicable inspection of my ham station that bored her so.

None of the hams in the area of Cahors to whom we told our story seemed much impressed by it. "After all," said one old gaffer, who had started out hamming as a bootlegger in the early thirties before finally getting a ticket, and who later had run clandestine traffic in '43 and '44 to Britain, "after all, if I operated in your country, your radio inspectors would visit me, n'est-ce pas?" He refilled my wine glass, then refilled his own. "I'm only surprised," he went on, "that ours did not call on you during the first month that you were on the air. It took them three months to get around to you. Surely your inspectors visit your station at least once a year, n'est-ce pas?"

When I told him that in twenty years with a license I had never been inspected, indeed, that I had never seen any FCC official in the flesh except in an FCC examination room or as a speaker at a hamfest, he gave me only a sidelong glance and sipped his wine. He didn't believe me. ■

L. Foord VE3FLE
763 Gladstone Dr.
Woodstock, Ontario
Canada N4S 5T1

See Q, See Q

—getting started

Camp Getchagotcha
July 3rd

Dear Mom & Dad:

Surprise! Remember how you kept bugging me to write while I'm away? Well, after only three days, here I am.

I must confess, my first impression of this place wasn't very good. They've got the usual stuff, like hiking and crafts, plus some good stuff like baseball and swimming. I was thinking, I'm getting a little old for this summer camp business, when something happened to make it really fantastic.

That something fantastic is called ham radio. One of our counselors (his name is Gary) is a ham. You probably think that's a funny term, but it's slang (the acceptable kind of slang, Mom), and it means he's one of those guys who talks on a radio to other guys *all over the world.* No kidding! He lets us listen all the time (when our chores are done) and sometimes even lets us talk on the radio. Last night I had the biggest thrill of all. We stayed up really late (not that late) and talked to some guys in Guam (that's an island out in the Pacific Ocean). The signals were so good, it was armchair copy (that means you could lean back in your chair and hear perfectly). But I was so excited I couldn't lean back.

Now Gary's been giving me the lowdown, and I really think (actually, I *know*) that I would like to become a ham. Before you get all excited and call it a passing fancy, let me tell you all about it. First of all, it's not one of those things you just go out and buy. (Dad, you'll appreciate this.) You have to study really hard, and learn a bunch of things, and write an exam to get a license. And you can't go on the air (that means talk on the radio) until you get a license.

Boy, some of the exciting things you can do! You get to talk to famous people who are hams, like Barry Goldwater (he's a senator), and King Hussein (the king of Jordan), and Arthur Godfrey (you know him, Dad). Of course, the famous people aren't on every night.

You get a great education from building your own gear (that means equipment) and learn all about electricity and stuff. Gary built his rig (that means equipment, too) from an old TV. I was wondering, since you've been talking about a new TV, could I have our old set? You also need an antenna, nothing fancy — Gary says a piece of wire does just fine. Dad, would it be OK with you if I ran a piece of wire from my bedroom across the yard to that big oak tree? (I'll be careful climbing, Mom.)

One of the first things you have to do is learn the Morse code (that's dots and dashes). Morse code is better than talking into a microphone. I'm not sure exactly why, but it has something to do with cuearem (that's more slang that I think means interference). But it's more fun with a microphone.

Here's the way it goes. You push the button and say "See q, See q?" (that's slang for "is anybody listening?"). Usually, another ham will start talking to you, and you tell each other your names and where you are and what equipment you're using and how strong (loud) his signal is. Then you say seventy-three (more slang, it means goodbye) and go and work (that means talk to) another guy.

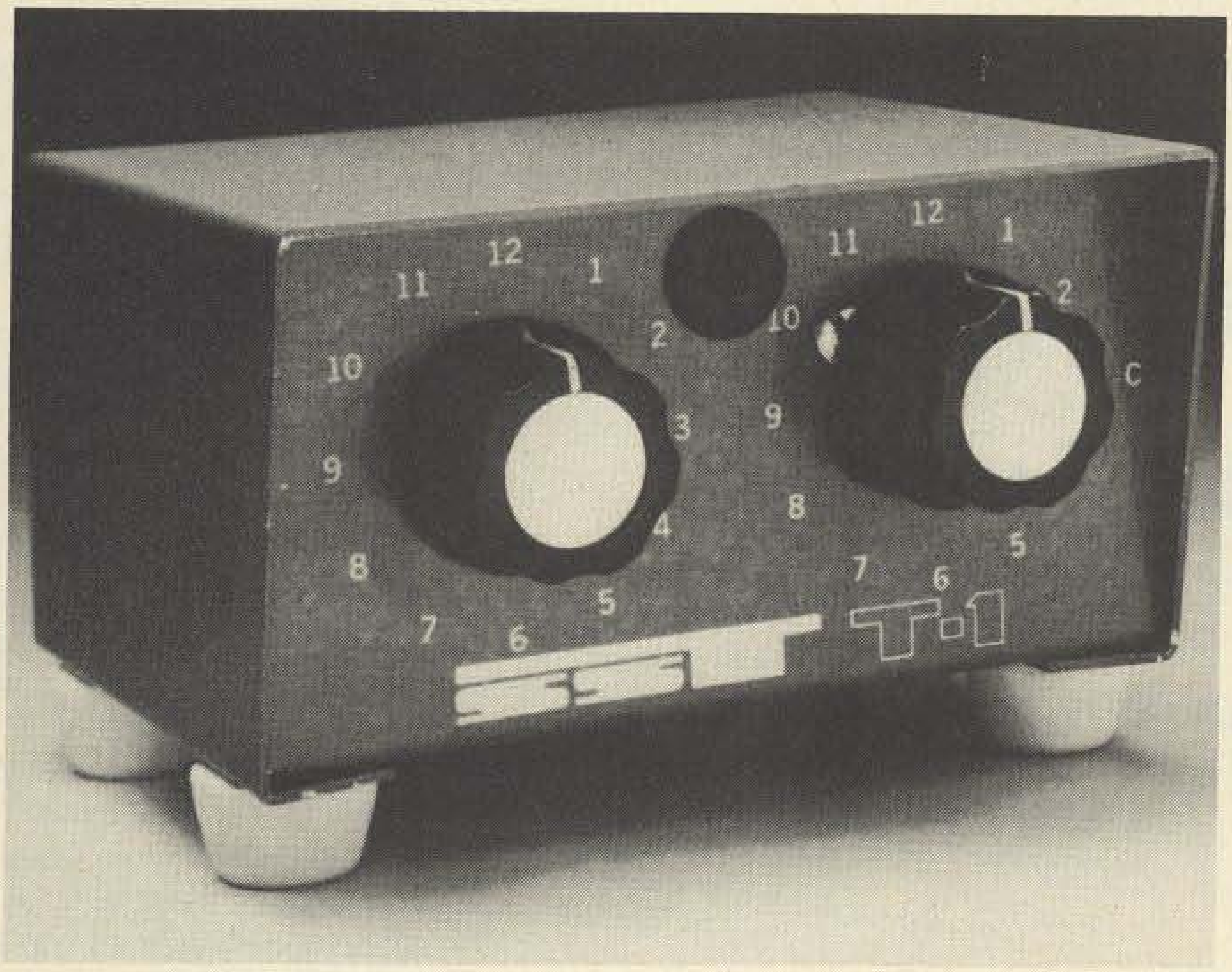
So how about it?

Your loving son,
Albert

P.S. Something else. You learn a lot of geography and things about other countries, and you learn bits of other languages, so it would really help me in school. And, Dad, if I got really good in electronics, it would help me in choosing a career.

P.P.S. Dad, do you think you could advance me some more allowance so I could buy a cheap receiver to get started? ■

SST T-1 RANDOM WIRE ANTENNA TUNER



All band operation (160-10 meters) with any random length of wire. 200 watt **output** power capability—will work with virtually any transceiver. Ideal for portable or home operation. Great for apartments and hotel rooms—simply run a wire inside, out a window, or anyplace available. Toroid inductor for small size: 4-1/4" X 2-3/8" X 3." Built-in neon tune-up indicator. SO-239 connector. Attractive bronze finished enclosure.

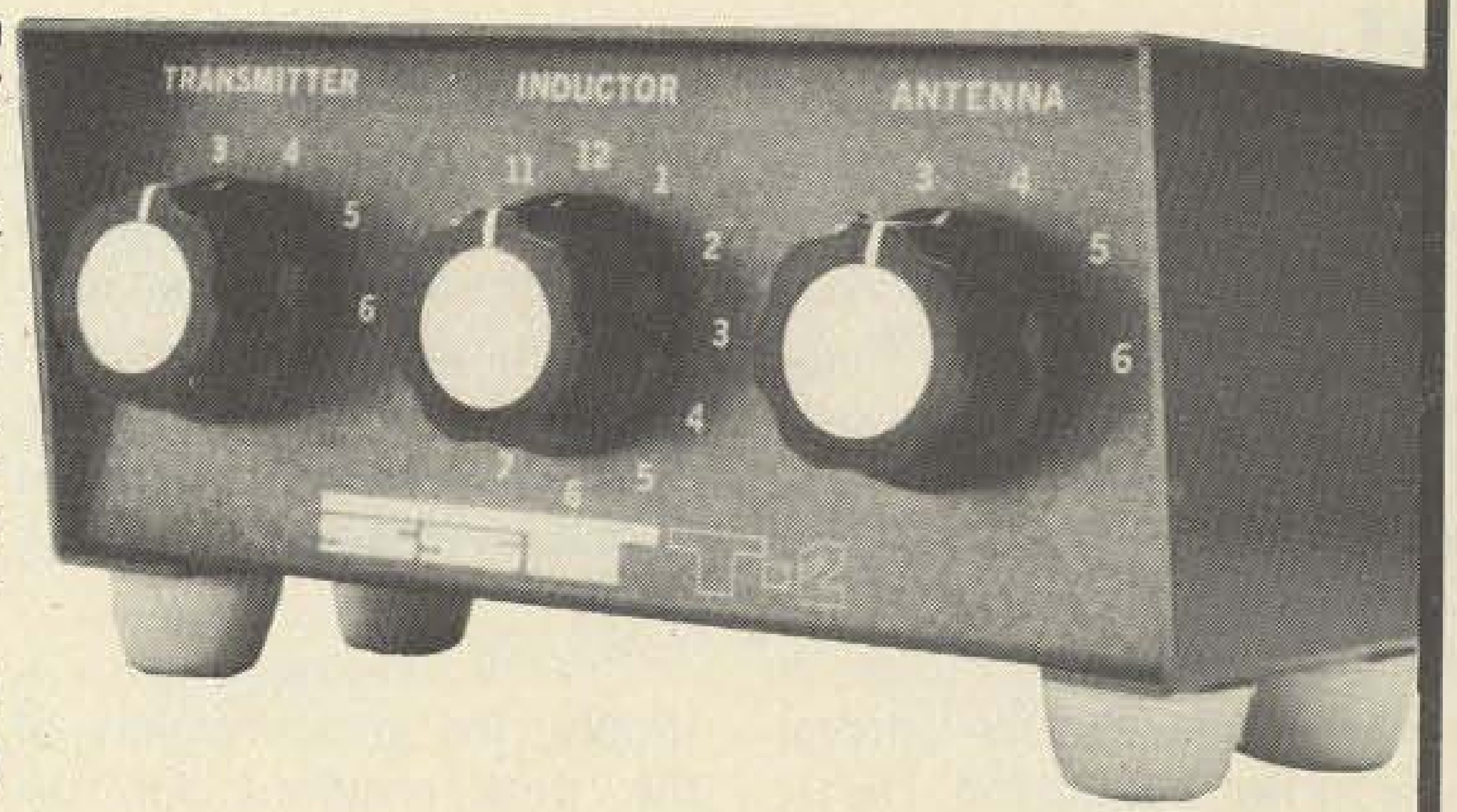
only $29.95

sst t-2 ULTRA TUNER

Tunes out SWR on any coax fed antenna as well as random wires. Works great on all bands (160-10 meters) with any transceiver running up to 200 watts power output.

Increases usable bandwidth of any antenna. Tunes out SWR on mobile whips from inside your car.

Uses toroid inductor and specially made capacitors for small size: 5¼" x 2¼" x 2½." Rugged, yet compact. Attractive bronze finished enclosure. SO-239 coax connectors are used for transmitter input and coax fed antennas. Convenient binding posts are provided for random wire and ground connections.



only $49.95

sst t-3
IMPEDANCE TRANSFORMER

Matches 52 ohm coax to the lower impedance of a mobile whip or vertical. 12 position switch with taps spread between 3 and 52 ohms. Broadband from 1-30 MHz. Will work with virtually any transceiver—300 watt output power capability. SO-239 connectors. Toroid inductor for small size: 2-3/4" X 2" X 2-1/4." Attractive bronze finish.

only $19.95

GUARANTEE

All SST products are guaranteed for 1 year. In addition, they may be returned within 10 days for a full refund (less shipping) if you are not satisfied for any reason. Please add $2 for shipping and handling. Calif. residents, please add sales tax. COD orders OK by phone.

SST ELECTRONICS
P.O.BOX 1 LAWNDALE, CALIF.
90260 · (213) 376-5887 S10

Peter Buyaki K6MWM/5
P.O. Box 807
Pruitt AR 72671

Measure Periods With Your Counter

—a practical addition does it

Necessity first confronted me while I was thinking of a way to measure the frequency of the oscillator for my telescope drive, so that the telescope would always be pointed on a celestial object. It is no problem if one is watching for sunspots; the solar rate is 60.000 Hertz for the little clock motor in the telescope. But the sidereal rate must be 60.164 Hertz, and the lunar rate must be 57.968 Hertz. (Future EME experimenters might keep this in mind.)

Without a period measuring facility, I would have to have a gating time of 1000 seconds, in order to have the desired resolution out to the third digit to the right of the decimal point. Similarly, a piano note is listed as 261.63 Hertz (middle C on the concert scale) and would require 100 seconds of gating to take in the least significant digit on the right. But a piano note will not sustain long enough even for a ten second count, thus precluding any attempt to make a frequency measurement.

Period measurement is simply the measurement of the time required for the completion of one cycle of a given frequency, expressed as $t = 1/f$. Here the numerator is tacitly understood to be one second, and, when 60 Hertz is inserted for f, it will yield .01666 seconds. If the answer is desired in microseconds, merely replace the 1 with 1 million, and the division will yield microseconds, which, for 60 Hertz, gives 16,666 μs. Once the period is indicated on the counter, it would be more familiar, however, if converted back to frequency by the use of the reciprocal of the above formula, which is $f = 1/t$.

The period of a wave is somewhat akin to wavelength. Since radio waves travel with a fixed velocity, a cycle is expressed as so many meters in length instead of microseconds of time.

Altering a counter to measure period, as well as frequency, requires no special technology. In a normal counter the signal is precisely gated for a fixed time and then displayed. Remember, the expression "cycles per second" means exactly that!

Note the comparison of the two simplified block diagrams, Fig. 1 being the normal frequency counter. After it is altered by a switching arrangement, Fig. 2, it is also a period counter. The unknown signal is now controlling the timing circuits.

The unknown signal enters either the first 10:1 or the second 10:1 divider prior to the timer, giving us a choice of a 10-cycle group or a 100-cycle group of the signal, respectively, before the timer activates.

No doubt someone is already thinking, "Why not run the signal direct to the timer, eliminating the previous dividers, thus obtaining timer action on each cycle which is basically one period?"

There are several reasons why I discourage this:

1. There may be noise riding in with the signal, causing the Schmitt trigger to trip slightly earlier or later.
2. The slightly capricious nature of the Schmitt trigger itself, whereby the threshold points may wander slightly.
3. The signal itself may change its voltage within one period, resulting in loss of accuracy, even though the Schmitt trigger may be adhering to a rigid threshold level.

Thus, if there is any slight error incurred between the turn on and turn off interval, it would appear much less significant if averaged in with a 10-cycle group and especially so with a 100-cycle group averaging.

The actual circuit for incorporating a period measurement on a frequency counter is shown in Fig. 3. The period portion is detailed around a frequency counter that was originated by Peter Stark K2OAW.

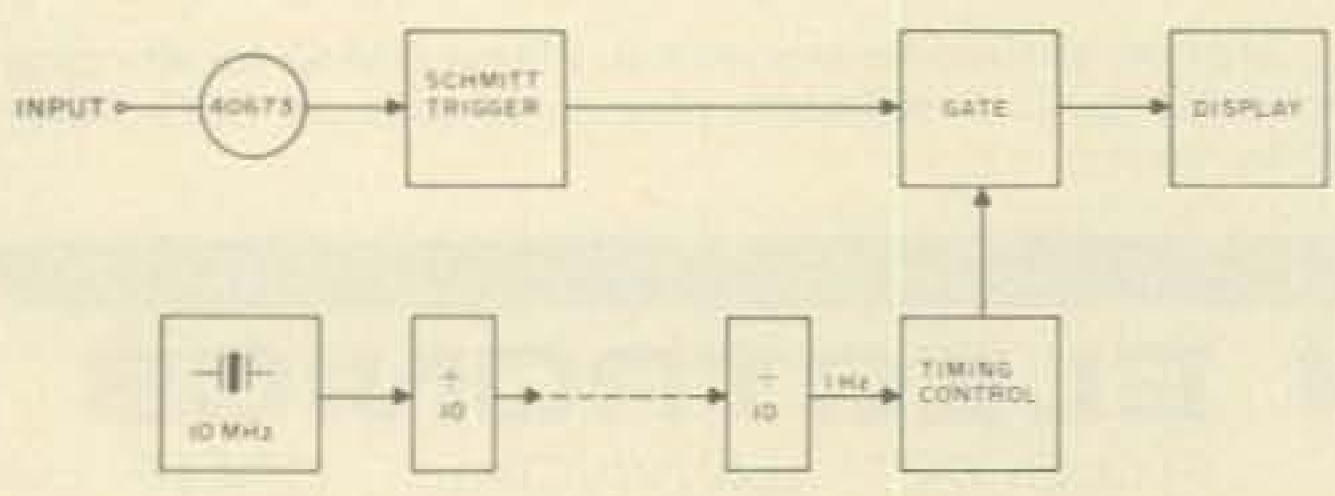


Fig. 1. Simplified block diagram of a frequency counter.

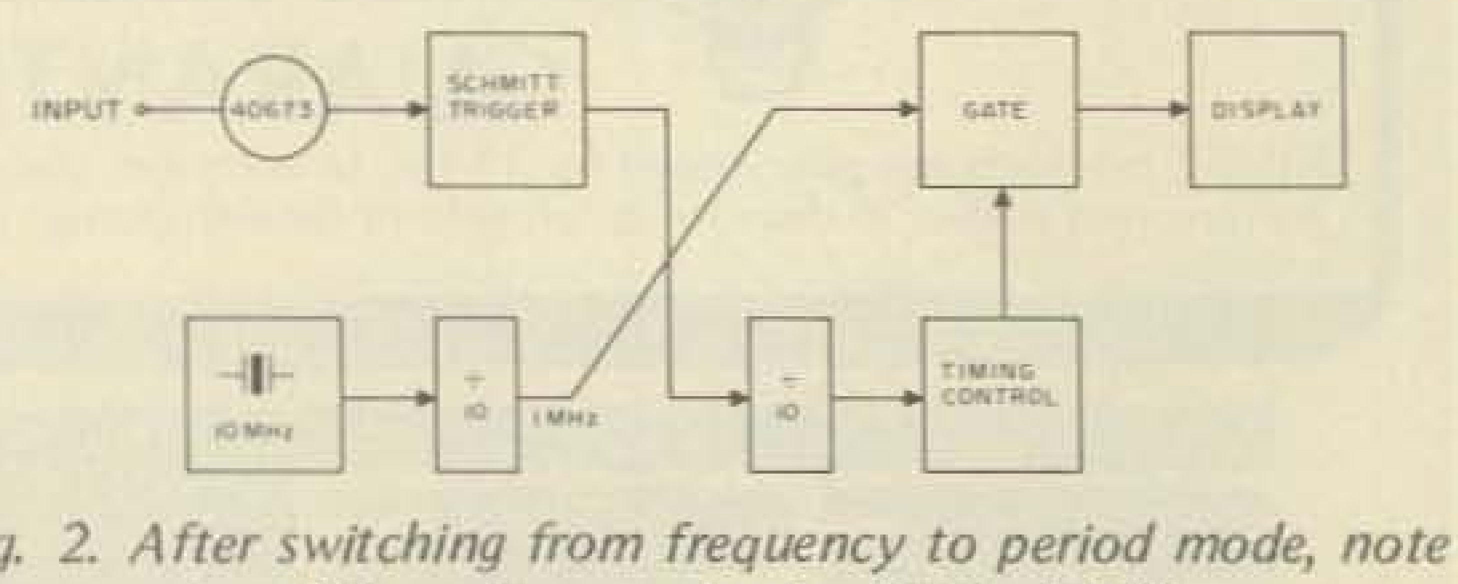


Fig. 2. After switching from frequency to period mode, note the swapping of the unknown signal with the 1 MHz.

Because period measurement was a prime necessity, I had to forego the available printed circuit board and go it alone. I still used some of K2OAW's well thought-out circuits, some of which are included in the schematic to clarify the tie-in of the period function.

The Fig. 3 timing circuit provides only 1 second and 1/10 second signal gating in the frequency mode, which will provide full display with eight display indicators. In the period mode, the gating will be dependent upon either the 10- or the 100-cycle groups.

After studying Figs. 1 and 2, it can be concluded that a DPDT switch would do the trick, and this is true, except for the fact that stray capacitances, etc., may begin to rear their ugly heads.

ICX takes the place of the DPDT switch, which is a 74125 tri-state TTL. To those not familiar with this type of logic chip, it simply means that the third state is a cutoff state, similar to an open circuit appearing on the output when the control on the little triangle is inactivated. This is unlike the output of a NAND gate, which is always either a low or a high, but never such that the outputs of two NAND gates could be paralleled. The outputs of a 74125 can all be paralleled, as long as only one, called a selective gate, is activated at a time.

Assume now that the mode selector switch, S2, is in the μs (microsecond) position and that S3 is momentarily closed, causing a *high* to appear at 8 of ICYc. A low will appear on pin 10 of ICX (because S2 is grounded), enabling the c section of the 74125. The b section will likewise be enabled because a low appears on pin 4 of ICX. The a and d sections of ICX are disabled as a high is sent to pins 1 and 13 from the output of ICYa. There will now be a path from the Schmitt trigger entering pin 5 of ICX and leaving at 6 to enter pin 14 of IC28. The 1 MHz, likewise, has a path via section c of ICX to pin 5 of IC4b.

With the gate length switch, S1, in the upper position (to select timing with the 10-cycle group), a *low* will be imposed on IC31a and b, through a 1N270 diode, causing the counter to measure with the shorter group (ten cycles) and illuminating the first decimal position (between next to the last and the extreme right display indicator).

With S1 in the down position, pins 2, 4, and 5 will go back up to a high, with the assist from the 3.9k pull-up resistor, blocking the path via IC31c, and passing the signal through IC31a, causing the 7476 to cycle on every 100-cycle group. The second decimal point will be selected to indicate the proper microseconds.

If push-button S3 (normally open) is hit momentarily, it will cause ICYc and d to flip as a contact debouncer and will not flip back until a negative-going differentiated pulse is obtained from the 100 pF capacitor. The 1N914 diode is used to sink the positive-going differentiated pulse, as the input should never exceed the power supply voltage. To

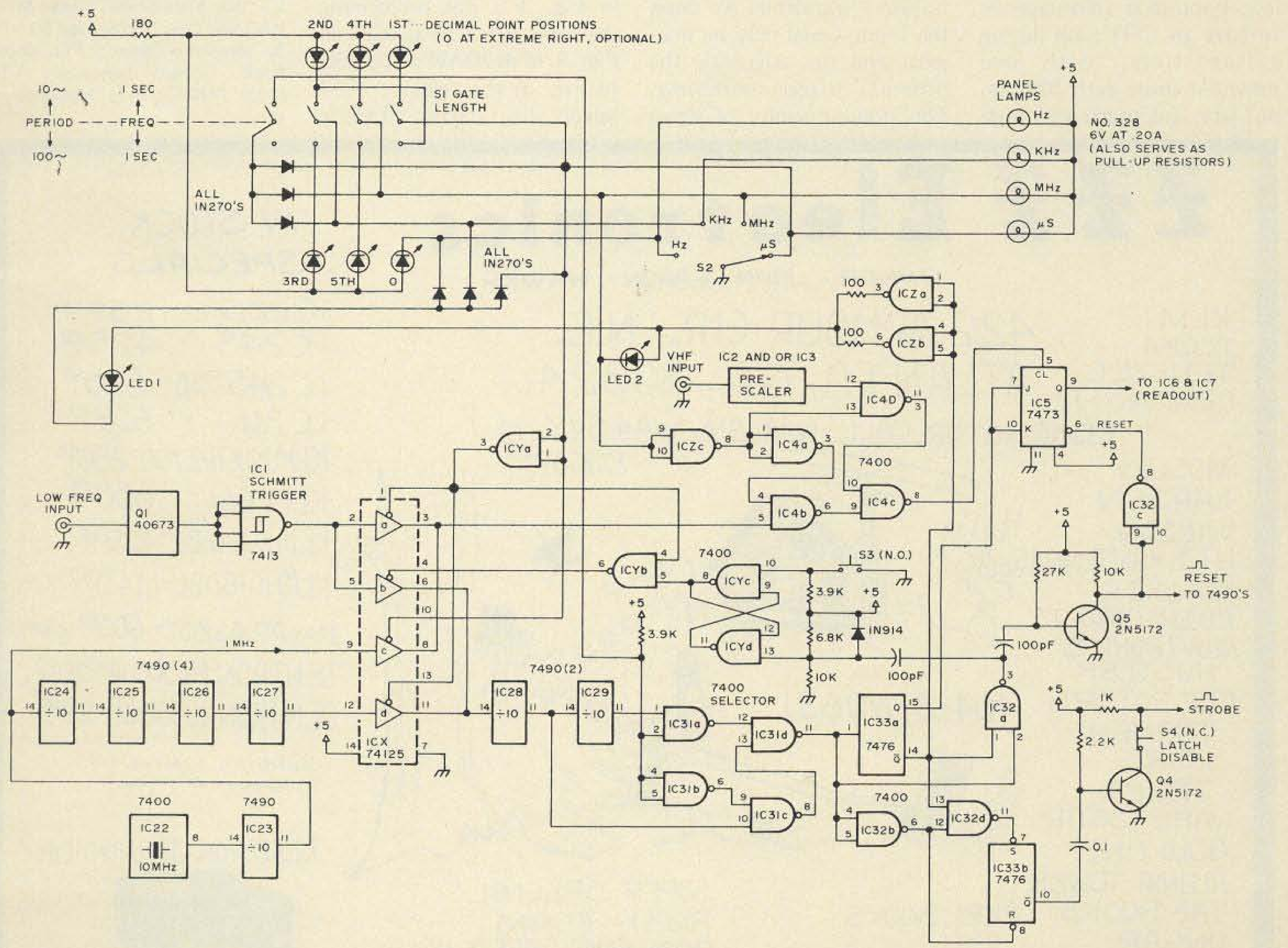


Fig. 3. Frequency and period counter with TTL's ICX and ICY incorporated around K2OAW's circuits, for clarity of functional tie-in. The counter is in period mode with S2 set to microseconds. For circuit continuation and more details, see "A Modern VHF Counter," 73 Magazine, *July, 1972, pgs. 5 to 13.*

confine this undesired transient and not allow it to distribute itself on your +5 volt line, a 1000 pF (or larger) mica capacitor connected to the cathode of the 1N914 (+5 volt side) and ground will tame it down.

For continuous operation, S3 should be held in or else paralleled with an additional switch.

When S2 is switched to Hz, kHz, or MHz, ICYa will have a high on both input pins because the panel indicator lamp for μs will act as a pull-up resistor. This will cause the a and d sections of ICX to be activated. The signal path is identical to Fig. 1 for a normal frequency counter.

After going this far, I managed to indulge in what may be called luxurious embellishment. But, nevertheless, I found it advantageous to have an LED flash during gating time, with one mounted above each BNC input jack and inserted through a small hole in the panel. Either LED 1 or 2 is driven by a pair of NAND gates ICZa and b, and isolated by a pair of 100 Ohm resistors to prevent overloading of the 7400 TTL chip. Each time the 7476 gates the 7473 JK flip-flop, the LED blinks simultaneously with either 1/10 second or 1 second duration in the frequency mode. In the period mode, the duration will depend upon how soon the 10 cycles or the 100 cycles have accumulated, or it may even remain lit continuously, due to the interruption of the signal in question, the 7490s (IC28 and IC29) hanging up as there is nothing to count!

Another helpful move was to install a latch disable switch, S4, a normally closed push-button, in the collector lead of Q4, the strobe (or transfer) transistor. At times the input signal may be marginal and not triggering the Schmitt trigger uniformly. This nonuniformity of signal flow can be ascertained and visualized, if there is a hesitation in the signal count in the frequency mode.

LEDs 1 and 2, as well as the decimal points, can be almost any type, depending on the brightness desired. The drive available from ICZ of 16 mA was adequate with an MV-10B-type LED. The 1N270 diodes handled the current adequately, but almost any surplus diode will work, as long as the forward voltage drop is below .8 volts during conduction; otherwise, IC31 will not switch.

The foregoing was built around an 8-digit nixie display counter and was first built using a pair of 7400s as a DPDT switch, which also worked as well as the 74125. With 8 digits, there was no necessity for the 1 MHz signal. For this reason, IC31 in Fig. 3 is not performing the same function as IC31 in Fig. 9 of K2OAW's counter. In Fig. 3, the selector IC31 selects the 1 Hz or 10 Hz in the frequency mode, and in the period mode it selects the 100-cycle or 10-cycle groups.

To those who did not take the printed circuit route, this should be fairly easy to adapt, but for those with the printed circuit boards, regretfully, it is too arduous a task. A second counter would be easier to build, as I do not sanction ripping up a good counter.

I hope that now you understand the advantage of a period mode at quite low frequencies and why it may be a helpful adjunct to a frequency counter, if the need should arise. ■

References

1. "A Modern VHF Counter," Peter Stark K2OAW, *73 Magazine*, Part I, May, 1972, page 53; Part II, July, 1972, page 5; Part III, Sept., 1972, page 89; corrections, Nov., 1972, page 92; update, Nov., 1974, page 26.
2. "500 MHz Scaler," Peter Stark K2OAW, Oct., 1976, page 62.
3. "Selective-Gates," *TTL Cookbook*, Donald Lancaster, TTL Data 74125, Texas Instruments, Inc.

SCR 1000

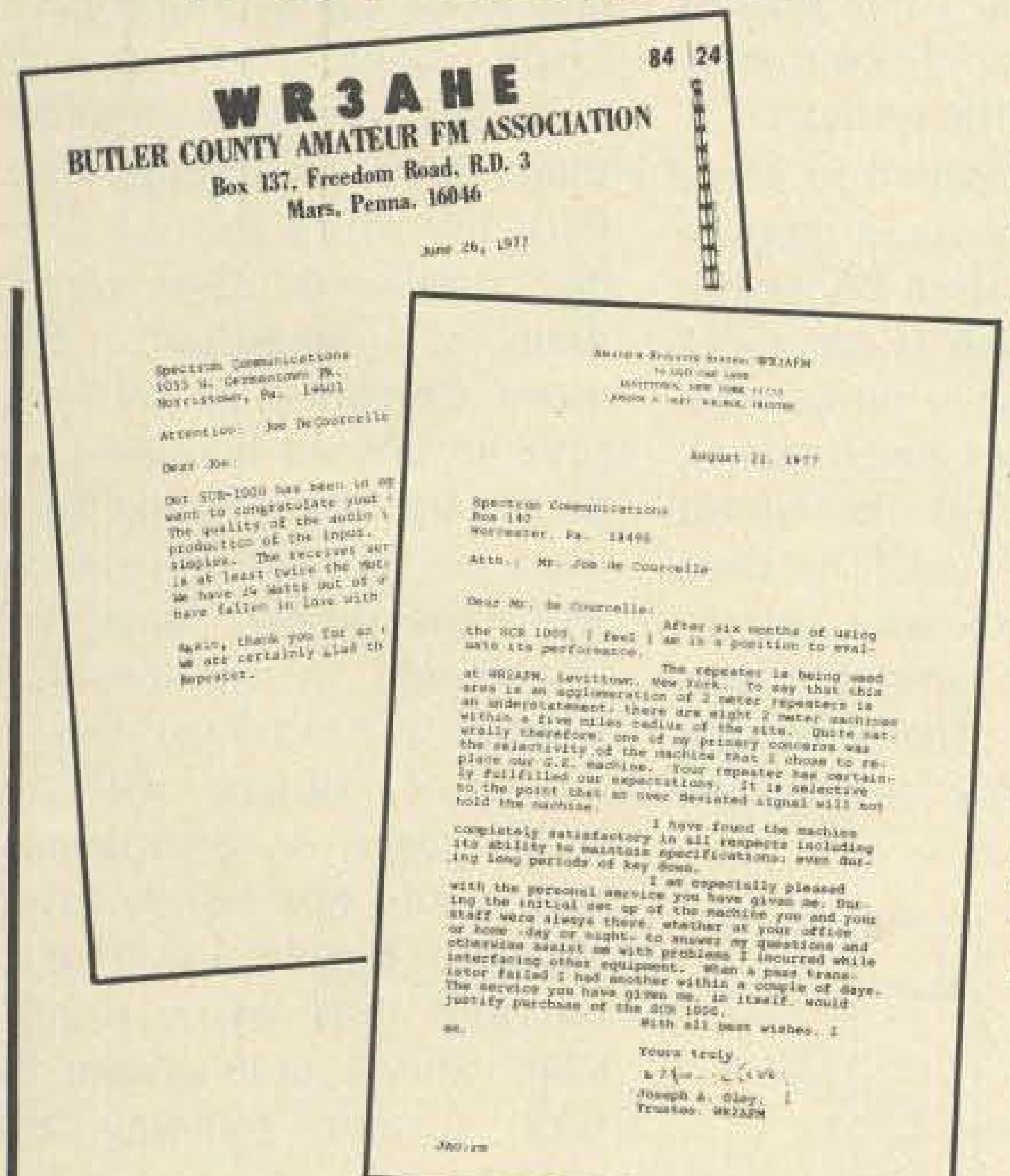
State of the Art in VHF FM Repeaters

2M & now 220 MHz!

Optional Cabinet
$130.00

NOW AVAILABLE WITH AUTOPATCH!

Quality Speaks For Itself!



WR3AHE
BUTLER COUNTY AMATEUR FM ASSOCIATION
Box 137, Freedom Road, R.D. 3
Mars, Penna. 16046

"... The quality of the audio is unbelievable — a true reproduction of the input. It really does sound like simplex. The receiver sensitivity of our Spectrum system is at least twice the Motorola system we had in service. We have 24 Watts out of our Sinclair Duplexer. We all have fallen in love with your machine ... Again, thank you for an excellent piece of equipment. We are certainly glad that we purchased a Spectrum 1000 Repeater."

Jim Wood W3WJK
Trustee WR3AHE
Butler County Amateur
FM Assoc.
Mars PA 16046

"The Model SCR100 Receiver has proven to be a fine unit. We have had it in operation for nearly a year and it has been entirely troublefree."

H. Townsend
Stone Harbor Amateur
Radio Klub (SHARK)
Cape May NJ

"We are quite pleased with the operation of the repeater and are very proud of it. Thanks for producing such a fine product."

D. Totel W9NJM
Wheaton Community
Radio Amateurs, Inc.
Chicago area

"During the first part of the year I bought a repeater from your firm and I thought you might be interested to know it is working out just fine. You have a product that more than meets the specifications you claim ... In the receiver you have a winner, the intermod is negligible ... We have many other repeaters both amateur and commercial in the area and as of yet no problem ... In closing, I would like to thank you for producing a product that does what is expected of it. In this world one seldom gets what he pays for; I feel our group has bought and received our moneys worth."

Jim Todd WA5HTT
Dallas TX

- **The SCR1000 — simply the finest repeater available on the amateur market** ... and often compared to "commercial" units selling for 3-4 times the price! This is a 30Wt. unit, with a very sensitive & selective receiver. Included is a built-in AC Supply, CW IDer, full metering and lighted status indicators/control push-buttons, crystals, local mic, etc. Also provided are jacks for emergency power, remote control, autopatch, etc.
- **A full complement of options are available:** Duplexers, Cable, 'PL', HI/LO Power, Autopatch, Racks, etc. Please Inquire.
- **The Spec Comm Repeater System** ... a sound investment ... available only by direct factory order. $950.00 Amateur Net. Commercial price somewhat higher.
- **REPEATER BOARDS & ASSEMBLIES ALSO AVAILABLE:** SCR 100 Receiver, SCT 110 Exciter/Xmtr., BA10 30Wt. Amp., CTC 100 COR/Timer/Control Board, ID 100 IDer, SCAP Autopatch Board — Inquire. (See previous ads in 73.)

Call or write today and get the details! Send for Data Sheets!

SPECTRUM COMMUNICATIONS S8

1055 W. Germantown Pk., Norristown PA 19401 (215) 631-1710

Formerly of Worcester PA

Super Siren

— it's loud!

J. H. Everhart K3JE/2
313 Mason Rd.
Fairport NY 14450

I love to build gadgets. It's a rare time when I don't have at least two or three projects in the fire. Some, though, never quite get finished, because they fall off the bottom of my priority list. The one described in this article was one of the quickie types that I'd been thinking about for several years. A two-year-old boy, of all people, finally spurred its completion.

Numerous hobbyist publications have printed a variety of circuits for electronic sirens. I've probably breadboarded most of them. They never got beyond the rat's nest circuit stage, because they just didn't sound realistic enough. These simple circuits, because their authors wanted a low parts count, didn't sound to me like a real live siren. But for quite some time I played with these hobby circuits. I had no real need for a siren; I was merely fascinated by the sound.

Then I happened to come across the schematic diagram of a Federal siren-PA amplifier combination (Federal is a company name – no connection with the government). But I looked at the circuit and was horrified. The siren part alone took four transistors, and the amplifier had just as many. The schematic was put in my circuits file because it seemed much too complex.

Then a few months ago, my wife pointed out that our toddler ran to the TV whenever he heard a siren. When an emergency vehicle used one on TV, his face lit up with a smile. It occurred to me that he might like a toy siren of his own. Thus, the siren went to the top of my priority list. A toy for me was unjustifiable, but, if dad builds a toy for his kid, who says he can't play with it?

The Idea Takes Shape

With a more or less concrete goal in mind, it didn't take long for me to decide on the design of the toy. First, it had to be simple to operate. Kevin may be smart for his age (all parents are convinced that their little one is a budding genius), but the aim was for a fun toy, not a test in manual dexterity. The toy had to be fairly unobtrusive. Little people make enough noise by themselves without their toys screaming, too. Plus, my wife's sanity had to be considered. Low power drain was important. Too many Christmas or birthday toys lie unused because they go through batteries like their users go through diapers! To withstand normal usage, the toy should be childproof. I wanted a hand-sized (his – not mine) object, with no sharp edges or protrusions, that would not be too easily damaged. Finally, I wanted to use junk box parts, if possible, and I didn't want to take forever building the gadget.

The Circuit

The circuit was breadboarded twice before I was happy with its performance. The final schematic diagram is shown in Fig. 1. Q1 and Q2 form an emitter-coupled multivibrator, which controls the rate at which the siren wails. The 35 uF capacitor, C1, together with its associated resistors, shapes the square-sided waveform produced by Q2. So the siren's

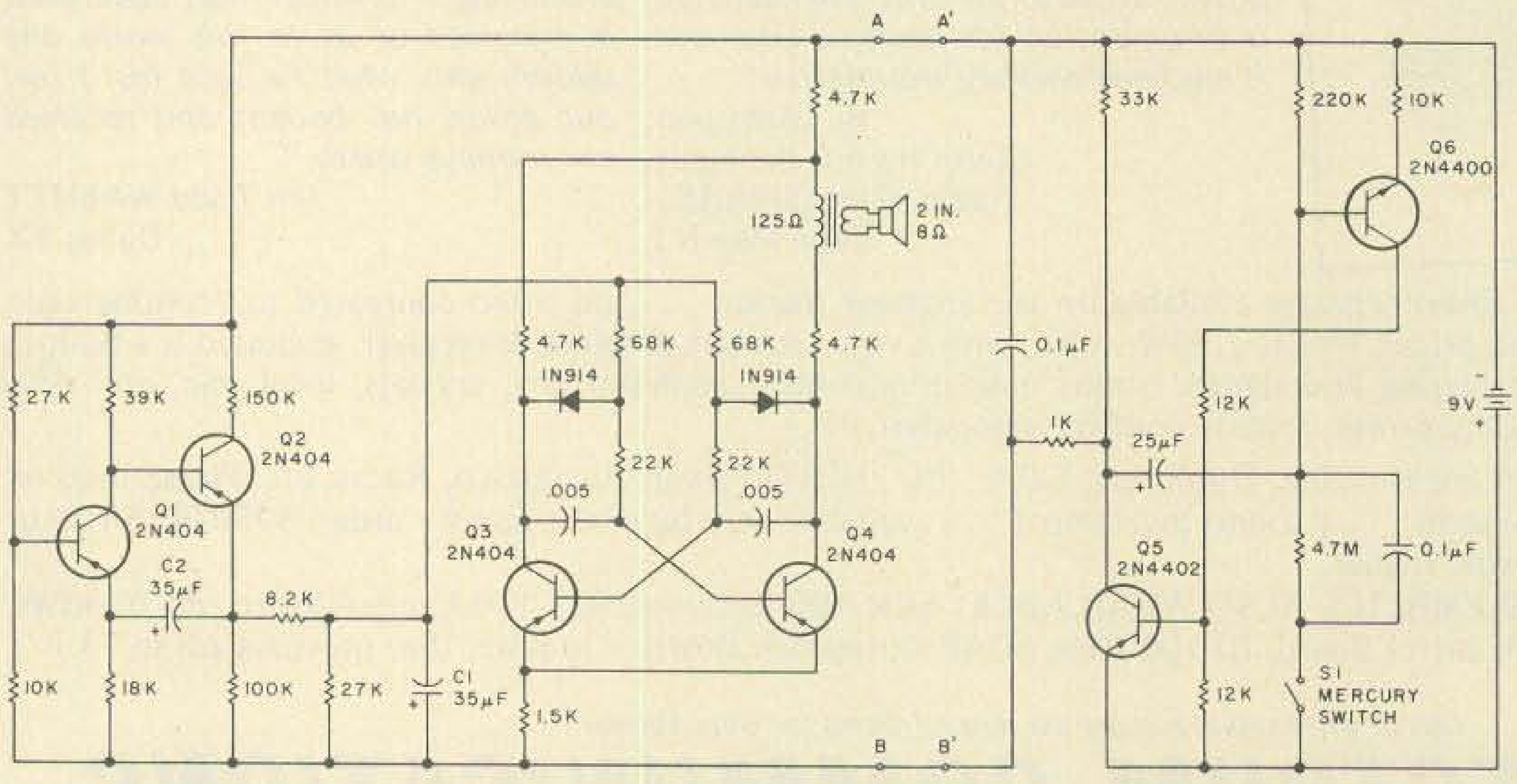


Fig. 1. Toy siren schematic diagram. Q1-Q4 are almost any PNP silicon or germanium transistor. Q5 can be 2N3702, 2N1132, 2N290T, or other PNP silicon. Q6 can be 2N5172, 2N697, 2N2222, or other NPN silicon.

Feb 1978

W. W. Patterson WB6LQE
10914 Benfield Ave.
Downey CA 90241

CB to 10

—part VIII: the Publicom I

Have you noticed all those nice 23-channel CB rigs sitting on the dealers' shelves? Of course you have. But did you know you can buy them for about half price, or maybe less? You probably know that too, but you just can't think of any reason to get excited about it.

I'll give you a reason. Go buy one, and put it on ten meters.

Now, everybody knows that ten hasn't been much good for the last four or five years. But it does have an opening every once in a while, and, now, with the sunspots coming back, things should start picking up on ten.

Where To Go On Ten

Obviously, if you move it into the part of ten that has the most users, you won't be very popular, because most of the users around the region are using SSB and 100 Watts or more. So these 5 Watt AM rigs wouldn't have a chance. I suggest you move it up exactly 1.795 MHz.

The main reason for this choice is that it puts channel 4 on 28.8 MHz, which is Ten-Ten International's AM calling frequency. This gives us a good anchor for making contacts, with plenty of room to QSY up or down after the contact is made. Besides, it will keep us out of the way of the SSB people down below.

The Conversion

So much for the sales talk. I went out and bought one to play with – the Publicom I, a synthesized rig, complete with service manual, a REAL service manual.

This rig uses 6 synthesizer crystals in the 37 MHz region. These I replaced with 39 MHz crystals (39.395/39.445/39.495/39.545/39.595/39.645 MHz), available from Cal Crystal Labs, Inc., 1142 North Gilbert St., Anaheim CA 92801. Or, order some from your favorite quartz dealer.

One word of caution: Be sure to install the new crystals in exactly the same order as the old ones came out. Otherwise, the channels will be all mixed up. It took me about an hour to change the crystals, but this is understandable when you realize that I have 5 times as many thumbs as anyone else I know.

After the crystals are installed, the only thing left is to align the tuned circuits. Now, the service manual tells us that the cores in the coils have been sealed with wax, and the seals should be broken before turning the cores. The only one I found that was sealed was the 39 MHz oscillator coil. My new crystals took off quite happily without touching this, so I left it alone.

The first step is to adjust the receiver rf and mixer coils. These are L101 and L102. Incidentally, they go in (clockwise) to raise the frequency. This is true for all coils in this rig. Use a signal generator if you have one; otherwise, tune for noise.

Now to the transmitter. Connect a wattmeter in the antenna line, and a dummy load to the wattmeter. If you don't have a wattmeter, use an swr meter set in the forward position. It will do the same thing. Hold the mike button down, and adjust L302, L303, and L304 until you get a reading on the wattmeter. These three are the transmitter mixer stage and are pretty critical. It doesn't take much, so work back and forth across them, about a quarter turn at a time, until you get it peaked. Then go on to L305 through L308, tuning for maximum on the wattmeter. And that should about do it. Now get some of your friends to come up on the band and help you check it out on the air.

I don't expect anyone to make DXCC with one of these little peanut whistles, but you should be able to work consistently over 6 to 10 miles. With a beam you should do better. And, if we can get a lot of these rigs on the air, who knows, it could be a lot of fun. ■

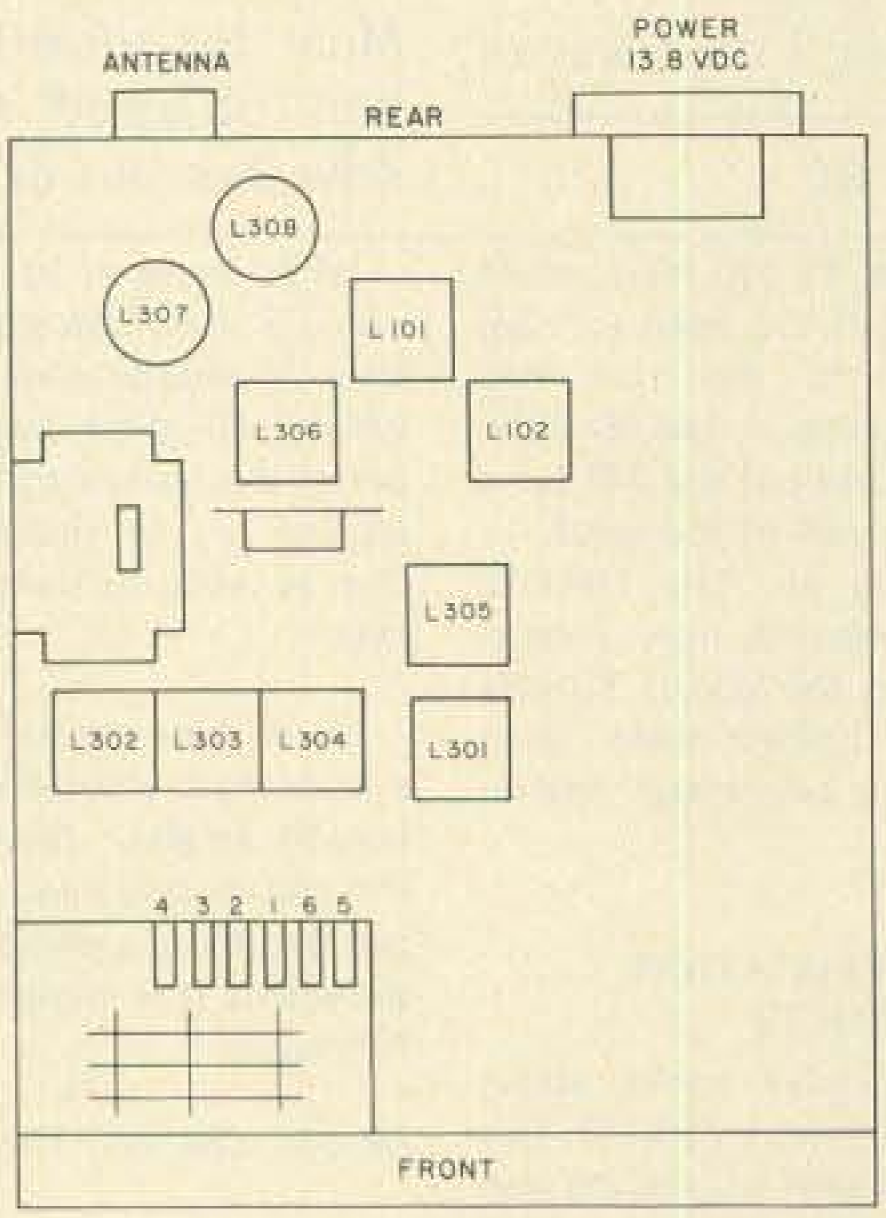


Fig. 1.

L. Foord VE3FLE
763 Gladstone Dr.
Woodstock, Ontario
Canada N4S 5T1

Coming Of Age

—an intro to ham radio

I was in the den, hunched over the rig intently listening to a quiet twenty meters one winter evening, when the knock came. Somehow, even before they actually arrive, one knows these moments are coming, and yet we never seem able to prepare ourselves for them.

"Come in," I said.

The door opened a crack, and there she was. All four feet of her, honey blond hair and dancing mischievous eyes. "Are you on the air, Daddy?" she asked. It was one of the first phrases she had learned, and along with it came the knowledge of the repercussions for not asking.

"No, honey," I smiled. There is something mysteriously sweet and charming about children, especially as they approach bedtime. They become very adult-like, speak in quiet reserved tones, abandon their habits of fidgeting and tormenting; they epitomize perfection in behavior. I have always suspected their innocence is feigned to avoid going to bed, yet I must confess I usually succumb to their charm.

"What are you doing?" she asked, crawling onto my lap.

"Just listening."

"Is Uncle Bill on the radio?" she asked hopefully.

"No, not tonight."

She was silent for a moment, staring attentively at the receiver. "Daddy, how come you can talk on your radio and the other kids' fathers can only listen?"

"Well," I replied, "it's a different kind of radio."

"Do you like talking to people?"

"Sure."

"Jimmy's daddy likes to talk to people, but he can't talk on his radio."

"For this kind of radio," I said proudly, "you need a license."

"Does it cost a lot of money?"

"Not much—13¢ postage."

"Then Jimmy's daddy," she concluded, "must be poor."

"No," I said cautiously. "It's not just the money. You have to learn a lot of things and write a test to get the license."

"Oh." And then after a brief pause, "I guess Jimmy's daddy is stupid."

"Teresa!" I said sharply, switching my role from educator to disciplinarian. "What have you been told about talking like that?"

She frowned at the retribution and then her face lit up as she discovered how to rephrase her statement and still get the same effect. "I guess he's not as smart as you."

"It's not that either," I said firmly. "I'm sure if Jimmy's father wanted to he could get a license. He's probably just not interested."

"Oh, he's interested."

"How do you know?"

"Jimmy told me his dad is always talking about your radio. He even listens to you on his hi-fi."

"Oh," was all I could muster.

"Let's talk to somebody," she suggested.

"O.K." I called CQ a few times and signed. Deathly silence greeted me.

"How come you're not talking to anyone?"

"The band's dead."

"How did it die?"

"It's not really dead. That's just an expression. It means there's no one around right now."

"Oh."

I could tell by her thoughtful silence I had to change the topic, if only to protect myself. "Do you know Daddy's callsign?" I had always been proud of the fact it was one of the first things she had memorized, to her mother's dismay, even before her telephone number.

"Sure. VE3FLE."

"Right. Very good."

"How come you didn't say it when you were talking on the radio?"

"I did. I always do."

"No, you didn't. You said victor echo . . . something."

"It's the same thing. Instead of saying 'v' I say victor. That way no one will mistake it for a 'b' or a 'c', because they sound so much alike."

"My teacher says if you pronounce them right no one will have trouble understanding you." She gave me a knowing smile. How could I possibly contradict her teacher?

"Well, she's right. Except sometimes on the radio it's difficult to understand through the QRM."

"What's QRM?"

"Interference."

"Why did you say QRM if you meant interference?"

"They mean the same thing."

"Oh. I think interference is better than QRM. What does interference mean?"

"Noise."

"Oh."

Parental duties and love aside, I was sure bedtime was overdue. "Guess what time it is?" I asked.

She ignored the hint. "Do you have any buddies?"

"Sure."

"I never hear you call anyone your buddy."

"Even though I don't call them that, I do have friends," I assured her. "Friends and buddies are the same thing."

"I know that. David's father has lots of buddies."

"How do you know?"

"Once when I was at his house David's father let me listen to his radio, and I heard him talking to a whole bunch of his good buddies. Maybe sometime he'll let you talk to them if you don't have any of your own."

The wisdom of youth. "Maybe. Right now I think we better get you off to bed."

"What instrument do you play?" She was still ignoring me.

"What do you mean? I don't play any instrument."

"That's what I thought. But I heard you say you wished you could get on the ten meter band."

"That's a different kind of band."

"Don't they play instruments?"

"No, I'm afraid not."

"Sounds like a silly band to me."

"I suppose. Now, off to bed."

"Good night," she said reluctantly, kissing me and climbing down. When she reached the door she turned and asked, "How come you never say ten-four?"

"Did you hear that at David's, too?"

"Yup. And I heard it on TV too. Don't you know what it means?"

I was hurt and didn't want to try to explain. "No," I said, smiling weakly.

"It means roger," she said. With a big smile she threw me another kiss and closed the door behind her. ■

LETTERS

from page 83

Advanced U.S. license using the foreign call and license of VP5ZZ aboard his yacht "Carina," a U.S. documented vessel. He is one of maybe 40 or more amateurs belonging to the waterway net operating daily on 7268 kHz each morning. He is indeed a knowledgeable person to the point, as he tells others the FCC and ARRL will never take action against anyone using VP5 calls aboard US boats. In this, one almost has to agree. However, there are some who hope to prove him wrong.

Mutual trust and good faith has, in the past, been the accepted rule for most all of the small islands. Most of the foreign licenses that have been given to U.S. citizens have been issued by the Turks and Caicos government in good faith, believing that the recipients of the licenses would use them as others before them had used them, only within their territorial waters or aboard Turks and Caicos registered vessels. However, this was not to be the case. The staunch waterway net member of Advanced standing broke the conditions of both his U.S. and Turks and Caicos licenses, taking his new VP5 call through all the foreign waters down to St. Vincent and Grenada, maritime mobile region 2. Soon others followed, and more and more are on the way.

This has been done before, but it wasn't broadcast to everybody on a boat nor was it supported by so many net members. Consequently, this was enough incentive, so others began to follow. They, too, found no opposition from shoreside amateurs. These phonies were a mixed lot. Some had expired tickets, others were studying for a stateside license; still others were trying to evade the purchase of a marine SSB commercial radiotelephone, and most of them did not even know what the knobs of the transceiver were for. Who helped them? Waterway net members, of course. For nearly 14 months, all could join in on the net frequency, 7268 kHz, no questions asked and no objections offered.

After awhile, the island amateurs began to get their fill of all this VP5 stuff; there were more VP5s than active island amateurs. People began to notice the loud VP5 leader; he could do third party traffic just by giving his stateside call. Then he could go back to his foreign call and use 7120 kHz and chat with other VP5s. Needless to say, this began to go over like a lead balloon. A St. Croix amateur, KV4FZ, broke the net frequency and told them the rules, point by point right out of the book, hoping this action would police the net members so they could police their VP5 buddies. This didn't do much good; some maybe gave it a second thought, but the VP5 leader twisted those facts around so much that it looked to net members that KV4FZ was the person breaking the law rather than the VP5s. This happens when no one cares about the rules.

The ARRL appears to have done nothing and it doesn't look like they will do anything. The FCC, I think, will do something, maybe more than listen to my story. The Turks and Caicos government is doing something about it. They will not renew any license that has been used outside of their waters. Renewal date is 1 January 1978. With no license, what do you think these people will do with their radio gear? Keep using it, of course, breaking enough rules to put amateur privileges in serious jeopardy. Reciprocal agreements going down the drain? Let's hope not. What can we do?

Until three weeks ago, I would say the VP5s could win by default. The ARRL and FCC weren't helping even when they were advised as to what was going on. However, the FCC in Puerto Rico is taking notice, but will they take action and impose a few fines and suspend licenses? I hope they will. The violators have been warned and warned again in the last three weeks. The VP5 leader has known the rules since the first day he left the Turks and Caicos island waters. The number of boats in the Caribbean waters is growing each year and the number of illegal radio operators can grow just as fast.

If this is published in *73* with my name on it, I suppose I will have to take my chances. There will be many people who would like to cut my anchor line one way or another, but if they were to understand the rules governing maritime mobile and why it is important to police our bands, perhaps they could be part of the solution and not part of the problem.

(Name and address submitted)

Let's check 7268 out and ask for details . . . how about it, fellows? — Wayne.

KUDOS FOR KEN

Ken Wilson's brilliant anthology of children's remarks about radio and electronics ("Electronics Study Guide," November, p. 176) was unquestionably one of the warmest and most delightful treatises in the literature. It bridged the gaps of young and old, technical and non-technical, writer and reader.

As a writer, I applaud his style; as an educator, I empathize with his obvious love for children.

Bob Grove WA4PYQ
Ft. Lauderdale FL

PALAVER

Walt Deiter's letter in the November issue amused me a great deal. This "we" business has been on my mind recently, since I have been eavesdropping on two meters in the national capital area. Around here, most of the guys on two seem to be either graduate engineers or nuclear physicists, judging from their palaver, but virtually everyone I hear refers to himself as "we."

Back in the early 1950s, this was kicked around quite a bit on one of the West Virginia nets, along with the new phonetics and symbols. Everybody pretty well agreed that a joker who calls himself "we" must have two heads.

Walt's jab about the "Lindberg complex" probably was wasted, as would have been a reference to Amundsen, Nobile, Judge Crater, or companionate marriage.

Gil Foster W3YNK
Temple Hills MD

DYING GASPS

CQ Magazine
Mr. R. Cowan, Publisher
14 Vanderventer Ave.
Port Washington, L.I., N.Y. 11050

Dear Mr. Cowan:

After reading your stand concerning a possible lawsuit against the ARRL, I and *many* other amateur radio operators became quite furious. This was poor timing, as my renewal notice came the same time as the January, 1978, issue. After talking to approximately 150 amateurs of two large radio clubs in the New England area and on the air waves, this may be the "death blow" to *CQ Magazine*. Your true color has come out!

Your stand is backing up all the illegal activities of some manufacturers and some CBers. It is saying, "The hell with the law — the dollar and big business mean more." The ARRL is not trying to dictate anything, or attempting to make any law — it is just trying to get CBers and manufacturers (and amateurs, as well) to comply with the law.

I have nothing against the CBers (even though they got our 11 meter band), but I do object to them running high power and operating on the amateur bands. What skills are they gaining by buying an amateur high power amplifier and tuning it to 27 MHz? What about manufacturers

Continued on page 117

73 Magazine *Staff*

Put A Sony In Your Shack

– the ICF-5900W's not bad!

How about a 3-30 MHz *portable* receiver in the $100 price range that has double conversion, frequency readout to 2-3 kHz, a built-in crystal calibrator, a product detector for CW/SSB reception, etc.?

It is not often that a consumer shortwave receiver warrants much attention for amateur usage. Usually such receivers have the barest of essentials for good shortwave reception, either on the amateur bands or on the international shortwave broadcasting bands. But the Sony ICF-5900W is a bit different. This receiver is the U.S. export version, just being seen here, of the Sony ICF-5900 domestic model, which has been on the Japanese market for more than a year. The ICF-5900, in turn, is the latest in a group of increasingly sophisticated portable shortwave receivers which Sony has brought forth in response to the booming SWL market in Japan. These receivers are all a far cry from the usual cheapie AM portable with a shortwave band added, although competitive factors still make economic design a primary consideration.

The ICF-5900W, with a solid array of features in a 22.3 x 23.4 x 10.2 cm case, and powered by three D cells, will not qualify as a primary station receiver. But, it has a lot to offer as a secondary receiver, for casual monitoring of the amateur or broadcast shortwave bands, as a receiver for QRP portable operation, and as a receiver for signal monitoring and measurement purposes.

Basically, the ICF-5900W is an AM/FM receiver, with three shortwave bands that cover from 3.9 to 10 MHz, 11.7 to 20 MHz, and 20 MHz to 28 MHz. The circuit feature that makes the ICF-5900W exceptionally different is the use of its FM i-f as the *first* i-f on the shortwave bands and the use of a second local oscillator, tuning at a constant rate, to give a calibrated 300 kHz bandspread over any desired 300 kHz portion of the shortwave spectrum. The second i-f is the usual 455 kHz one.

Fig. 1 shows the circuit diagram in simplified form. The circuit switching that goes on between AM/FM and SW could only be devised by an advanced Japanese engineer, working on consumer-priced products. It is best left for a purchaser to ponder over for several weeks, with the service manual in hand. But, on the AM band, the receiver is the usual single conversion affair with a first mixer/oscillator stage working into a 455 kHz i-f chain. On the FM band, the usual separate FM front end is found (rf amplifier and mixer/oscillator stage) working into a 10.7 kHz i-f. Unlike the usual Japanese AM/FM radio, however, the 455 kHz and 10.7 MHz i-f stages are not totally combined, but are initially separate blocks. In reality, this costs only a few extra transistors and RC components. When switched to the SW bands, the incoming signal is first routed to a doubly-balanced first mixer stage, using a pipolar transistor – an unusual type of circuit to be found in any consumer product, as yet, but logical for this application, due to its immunity from overload à la the Atlas transceiver front end approach. This stage is used as either an up or down converter, depending upon the shortwave band involved, to get the signals in a given band converted into the 10.7 MHz i-f range. The first variable local oscillator working into this stage (controlled by the main tuning dial) is set to zero beat, with the desired marker of a built-in 250 kHz crystal calibrator (for instance, at 7.000 MHz). The built-in bfo is turned on, of course, to obtain the zero beat. The second local oscillator, which converts the 10.7 MHz signal down to the second i-f of 455 kHz, must be set at its "0" position (actually 10,700 kHz) during the above adjustment. This oscillator is variable over the range of 10,550 kHz to 10,850 kHz. Now, when the second local oscillator is tuned (bandspread tuning), it can tune an *incoming* signal range of ±150 kHz (from 6,850 to 7,150 kHz, in the example given).

The bandspread tuning dial is calibrated for +150 kHz and -150 kHz, with markers on the dial at every 10 kHz. Depending on how carefully one calibrates the main tuning dial, etc., one can come to within several kilohertz of an exact frequency. By further marking divisions on the outer dial on the bandspread tuning, one probably could come down to 1 kHz readout. The bandspread tuning calibration is fine, when working on the low end of any band, but a bit awkward on the upper end of some bands. For instance, if one sets the main tuning to the 250 kHz markers at 21,250 kHz, one has to remember this setting, as the actual received frequency is varied ±150 kHz from this setting by the bandspread tuning. The tuning rate is 100 kHz/revolution on the bandspread tuning control, which is not bad at all for even SSB or CW reception with a bit of practice.

The use of the 10.7 MHz i-f as the first i-f does, of course, provide a number of benefits. The frequency is high enough for excellent image rejection, even at 15 and 10 meters – an unusual feature for an expensive receiver. Also, the gain of the first i-f across its bandwidth is flat enough to eliminate the need for complicated multiple-gang tuning circuits. But, the simplified tuning system does have to pay its price at frequencies much above 20 meters. Sensitivity begins to fall off rather rapidly on the highest shortwave band, being in the order of 8-10 uV.

In spite of the apparent poor sensitivity on the higher frequency bands, the receiver is more than suitable for any casual listening purpose on the higher bands and directly usable as a QRP station receiver on the lower bands.

The selectivity on the shortwave bands is determined by the 455 kHz i-f chain and measured about 4.5 kHz at 3 dB down. This is hardly outstanding selectivity, but, by manipulation of the bandspread tuning and treble and bass tone controls, one can do pretty well even on a crowded band. The product detector, as distinguished from the separate AM diode detector, is automatically switched in the circuit when the bfo is turned on.

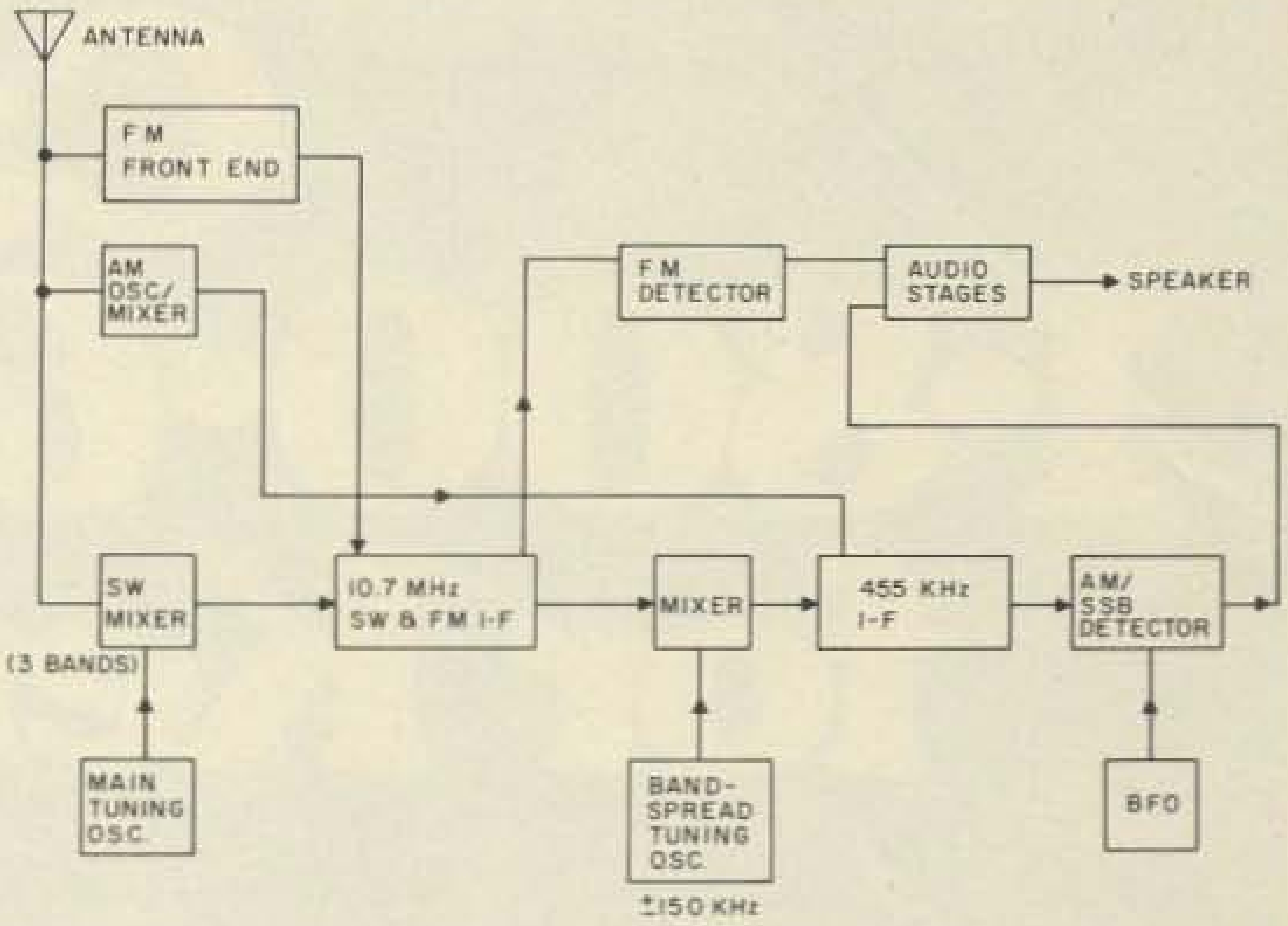


Fig. 1. A functional block diagram of what happens inside the new Sony ICF-5900W receiver. The ICF-5900W is the U.S. export version of a popular AM/FM/SW receiver originally developed for the domestic Japanese market, the ICF-5900.

As it stands, the ICF-5900W is an interesting receiver to consider, for utility usage around the shack or for a youngster who has developed a serious interest in shortwave. There are, of course, numerous things that could be done to improve its performance, and these are best left to the needs of individual users. For instance, the 250 kHz markers are obtained by dividing down a 500 kHz crystal. This crystal could also be divided down to obtain 100 kHz markers and, therefore, provide more convenient bandspread readout on some bands. An active RC filter could greatly improve selectivity, and the bass/treble tone controls could easily be converted into the control pots for such a feature. With real skill (it's a pretty well packed chassis), one could even build a QRP transmitter in the radio in the battery compartment area.

The ICF-5900W is becoming available now through U.S. Sony outlets, or, if you have a friend in JA land, he can get it for you for about $85.00. It is also available through supply houses that cater to SWL buffs. A service manual for it is available at $1.75 from Sony service outlets (or direct by mail order to Sony Corp. of U.S.A. in NYC). The manual contains very specific alignment information, and one could, if he desired, modify the band coverage to cover the lower end of 80 meters or the complete 10 meter band, by giving up some coverage in the 20-21 MHz area. ■

EDITORIAL BY WAYNE GREEN

from page 97

training newcomers for their Novice licenses with class meetings, preferably once a week. It is not absolutely necessary to use the *73* training tapes and license study guides, but it sure won't hurt.

General Classes: Getting newcomers into our crowded CW bands is not enough. Clubs must offer classes to upgrade Novices to General . . . at least.

TVI/RFI: As a service to the members and the community, clubs must have a TVI Committee. It is strongly suggested that this committee offer its services not only to the amateurs in the area, but also to local CB clubs, as a way for amateurs to participate and help the FCC in the reduction of RFI and TVI.

Turkey-Hunting Team: A club must set up a direction-finding team for hunting down any unlicensed operators attempting communications on any amateur band. This team or teams should practice regularly and develop equipment and techniques for the quick location of any illegal station. The team could offer to work with local CB clubs on the location and identification of over-powered CB operators or operators using illegal bands.

Emergency Committee: A club must have an emergency coordinating committee to prepare the club for disaster service. The EC should know the locations of all emergency equipment, repeaters, HTs, generators, and have liaisons with all other radio services in the area, such as CB clubs, police, fire, taxi, truck, etc., radio systems.

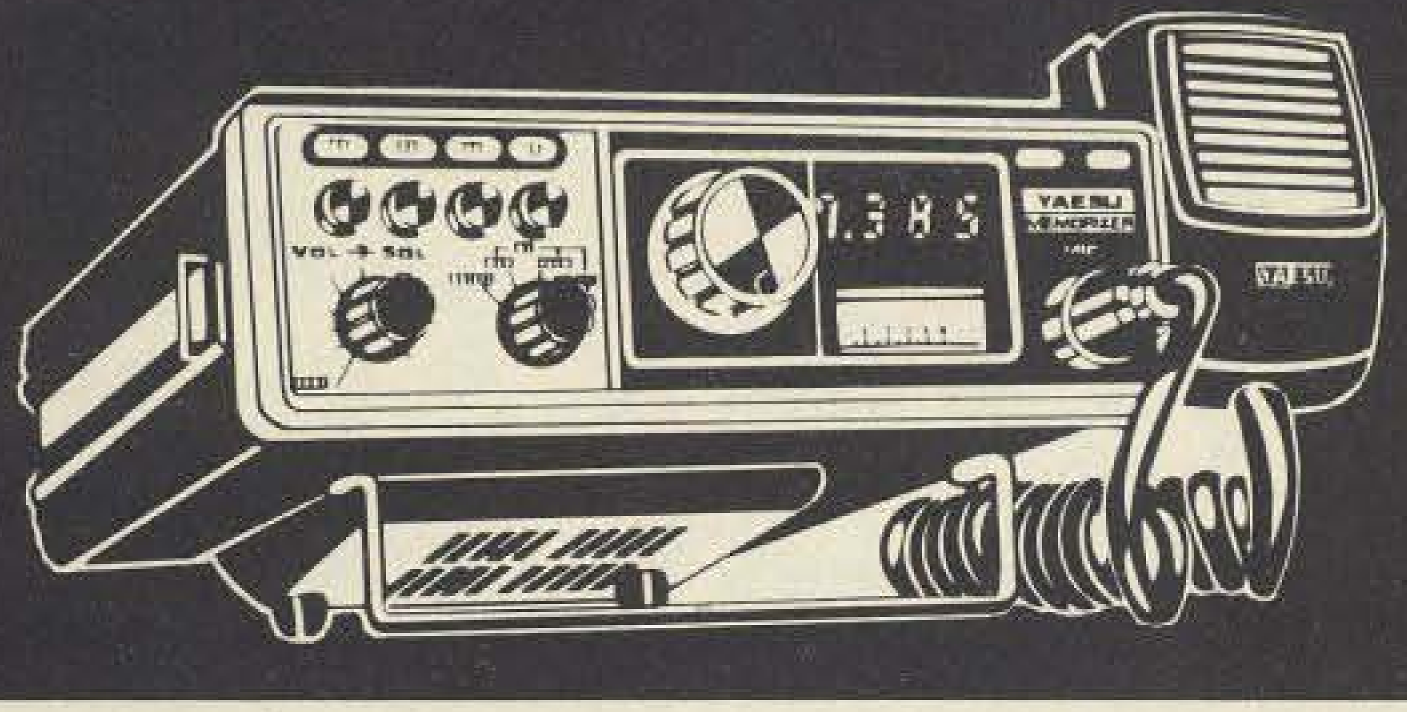
Clubs meeting the above minimum requirements and interested in affiliating with *73 Magazine* should have their club secretary send the details in a letter of application to Morgan Godwin, *73 Magazine*, Peterborough NH 03458. Newspaper clippings backing up club services won't hurt. Copies of the club newsletter will help, too.

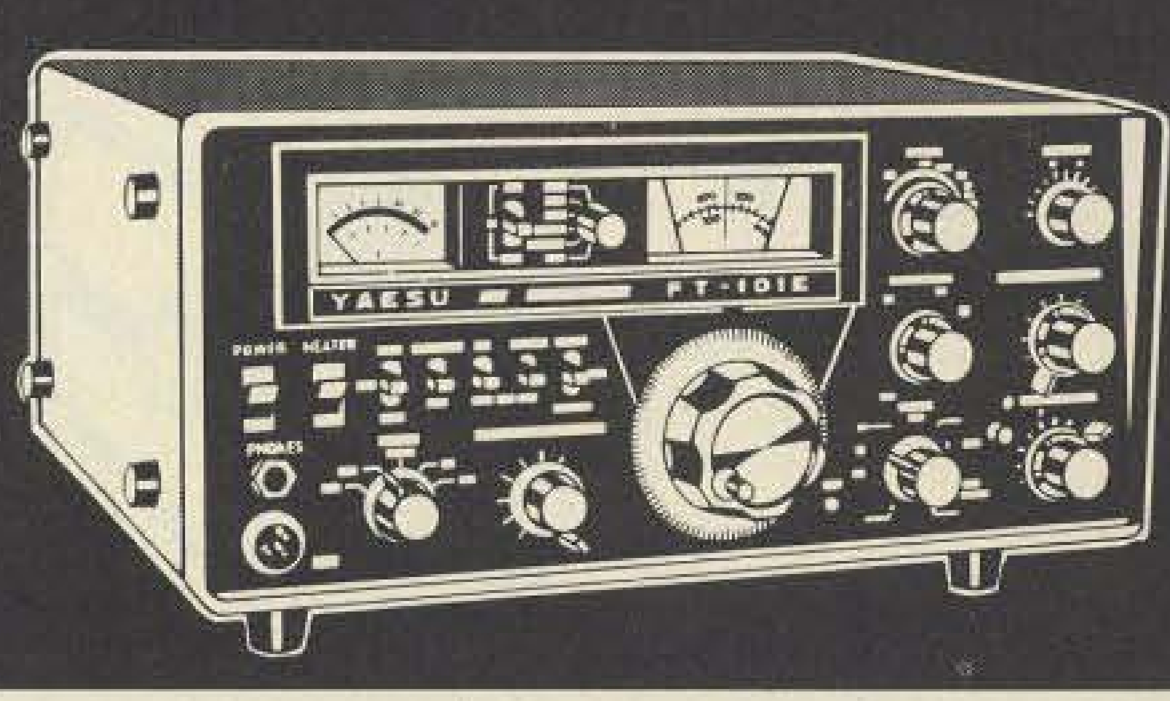
There are no requirements for *73* subscriptions or insistence on the use

Continued on page 125

Call 1-800-633-3410 for Yaesu*

*KENWOOD, DRAKE, ICOM, CDE, HYGAIN, CUSHCRAFT, NPC, TPL, TRISTAO, NEWTRONICS, REGENCY, ROHN, WILSON, TEN-TEC, B&W, DENTRON, & MFJ.





THE NEW YAESU FT-227R "Memorizer"

You'll be years ahead with the FT-227R • One knob channel selection uses optical sensing to select 800 channels • Memory circuit allows instant return to any frequency between 144-148 MHz • Large 4-digit LED readout • Selectable 10 watt/1 watt, plus much, much more!

299.00 Call Toll Free for yours today.

YAESU FT-101E transceiver

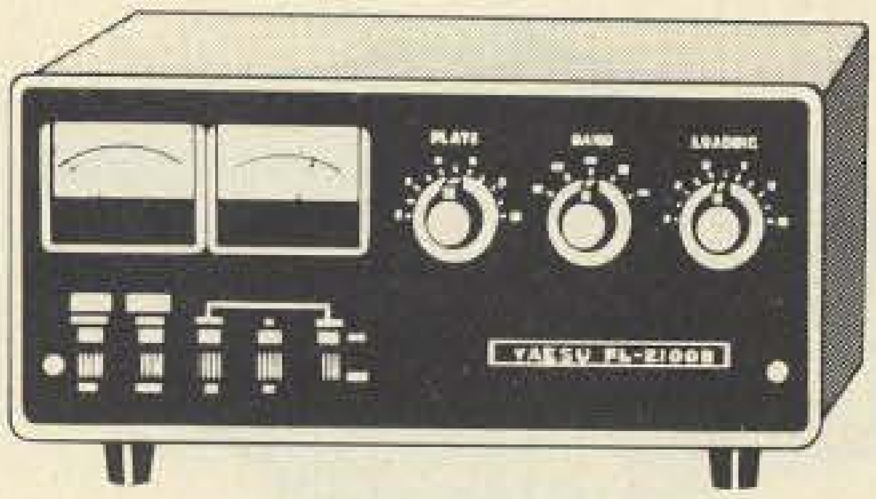
• All solid-state • 160 thru 10 meter coverage • Built-in AC/DC power supplies • Built-in RF speech processor • 260 W PEP on SSB, 180 W on CW, 80 W on AM • Solid-state VFO • VOX • Auto. break-in on CW w/side tone • WWV/JJY reception • High-Q, permeability tuned, RF stages.

729.00 is list price. Call Toll-Free for quote.

YAESU FT-221R 2m transceiver

• 144 to 148 MHz coverage • AC/DC power supplies • Modes: SSB, CW, FM, AM • Selectable ± 600 KHz repeater offset • Noise blanker • VOX and break-in on CW • SSB output: 12 W PEP, FM/CW: 14W, AM: 2.5W • PLL.

595.00 list price. Call for quote.



YAESU FL-2100B linear amplifier

• 1200 watts PEP • Input on 80-10 meters • Primary voltage change: 117 to 234 VAC • Dual meters for plate current and voltage • Adjustable SWR meter • Drive requirement: 30 W to 100 W • Input impedance: 50 ohm unbalanced.

399.00 list price. Call for quote.

YAESU YC-500J frequency counter

• 8-digit readout covers up to 500 MHz • Dual range system • Frequency range: Input 1: 10 to 50 MHz, Input 2: 50 to 500 MHz • Accuracy: 10 PPM • Display: 6-digit LED • Display time: 0.1 or 2 seconds.

249.00 list price. Call for quote.

Remember, you can call TOLL-FREE: **1-800-633-3410** in U.S.A. or call **1-800-292-8668** in Alabama for our low price quote. Hours: 9:00 AM til 5:30 PM, Monday thru Friday.

Your BANKAMERICARD welcome here

Long's Electronics

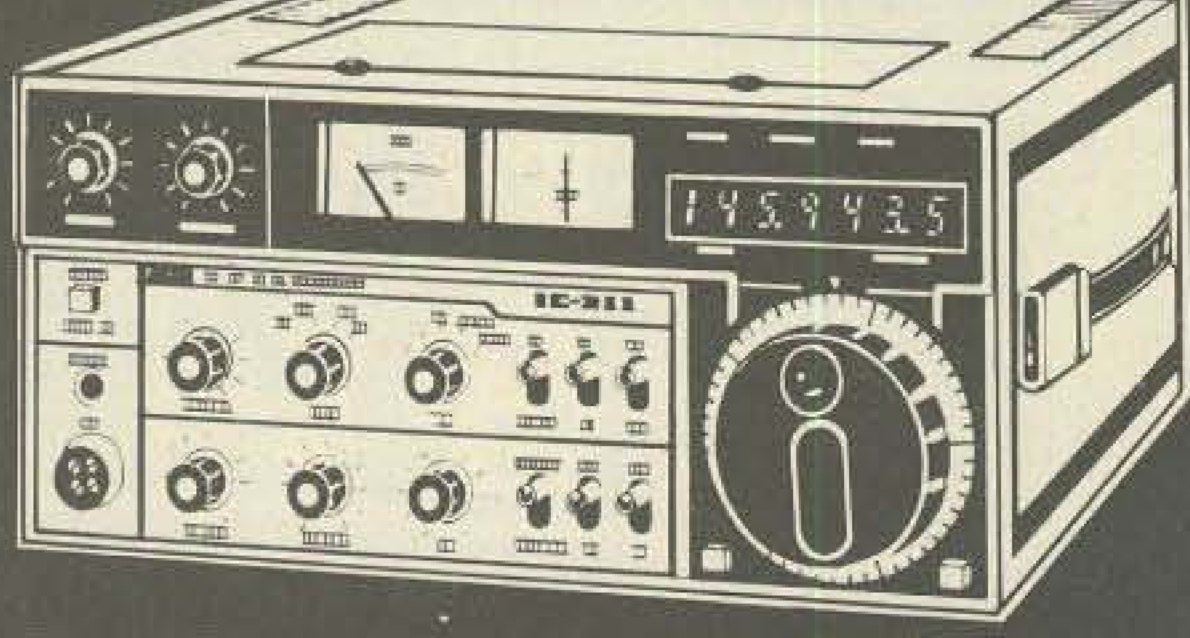
L9

master charge THE INTERBANK CARD

MAIL ORDERS: P.O. BOX 11347 BIRMINGHAM, AL 35202 • STREET ADDRESS: 2808 7TH AVENUE SOUTH BIRMINGHAM, ALABAMA 35233

Call 1-800-633-3410 for ICOM*

*KENWOOD, YAESU, DENTRON, CDE, HYGAIN, CUSHCRAFT, NPC, TPL, TRISTAO, NEWTRONICS, REGENCY, ROHN, WILSON, TEN-TEC, B&W, DRAKE, & MFJ.



ICOM IC-211 2m transceiver

• 144 to 148 MHz coverage • Modes: SSB, CW, FM • LSI synthesizer PLL • 4-digit LED readout • Pulse-type noise blanker • VOX w/adjustable gain • SWR bridge • CW monitor • Automatic power control • AC/DC power supplies • Antenna impedance: 50 ohms unbalanced • TX output: 10W PEP.

749.00 is list price. Call Toll-Free for quote.

ICOM IC-245 2m transceiver

• LSI synthesizer PLL • 4-digit LED readout • Transmit & receive frequencies are independently programable on any separation • Receiver front-end is a balance of low noise, high-gain MOS FET & 5 section filter • TX output: 10 W PEP • Frequency step size: 5 KHz for FM, 100 Hz (with adapter) or 5 KHz for SSB.

499.00 is list price. Call Toll-Free for quote.

ICOM IC-215 2m FM transceiver

• 2 meter FM • 3 W PEP • 15 channels, 12 by selector, 3 by function switch • Dual power level, 3 W HI for long distance, 0.5 W LOW for local • Dial illumination for night use • Power pilot lamp • Frequency range: 146 to 148 MHz.

229.00 list price. Call for quote.

ICOM IC-22S FM transceiver

• Frequency range: 146 to 148 MHz • Preset any 15 KHz channel in the frequency synthesizer by diode matrix board • Output: 10 W HI, 1 W LOW • Excellent spurious attenuation • 22 channels.

299.00 list price. Call for quote.

ICOM IC-30A FM transceiver

• 22 channels, 450 MHz • Modulation F3 • Power output: 10 W HI, 1 W LOW • TX band width: 15 KHz w 5 KHz deviation • Low intermodulation comes from a low noise MOS-FET RF amp. coupled with a 5-section filter.

399.00 list price. Call for quote.

Remember, you can call TOLL-FREE: **1-800-633-3410** in U.S.A. or call **1-800-292-8668** in Alabama for our low price quote. Hours: 9:00 AM til 5:30 PM, Monday thru Friday.

Your BANKAMERICARD welcome here

Long's Electronics

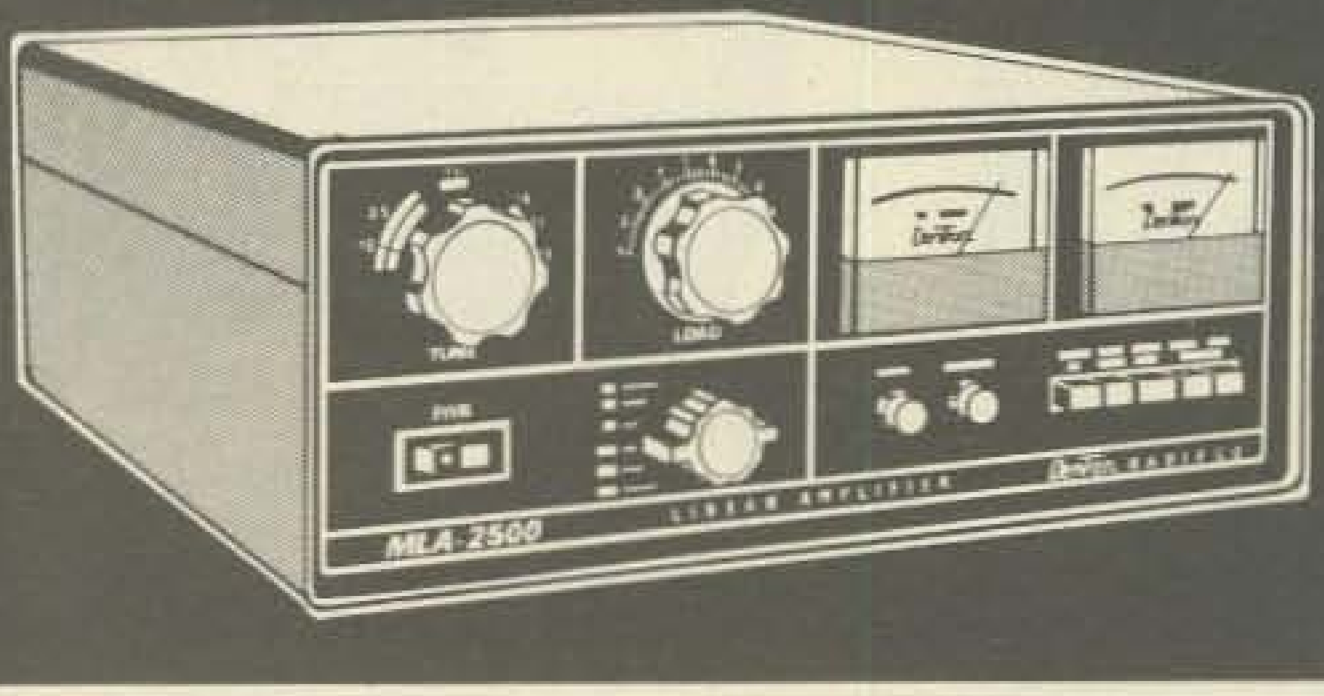
L9

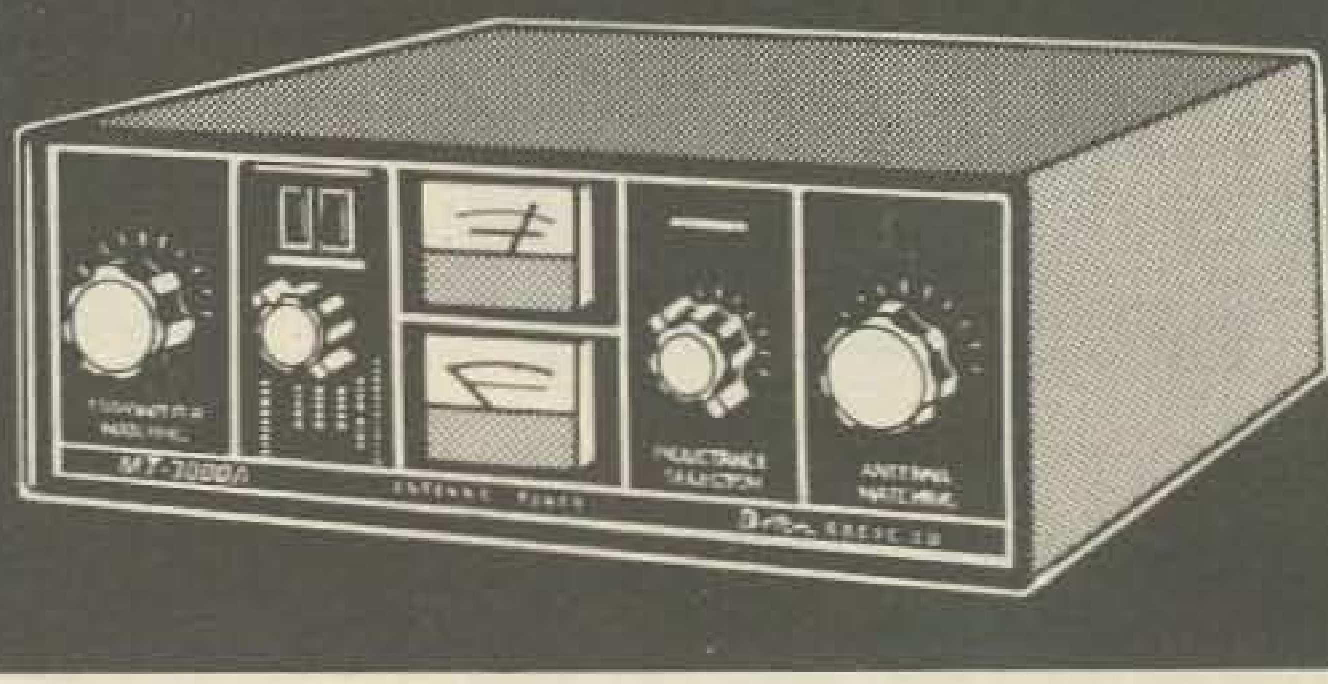
master charge THE INTERBANK CARD

MAIL ORDERS: P.O. BOX 11347 BIRMINGHAM, AL 35202 • STREET ADDRESS: 2808 7TH AVENUE SOUTH BIRMINGHAM, ALABAMA 35233

Call 1-800-633-3410 for Dentron*

*KENWOOD, YAESU, ICOM, CDE, HYGAIN, CUSHCRAFT, NPC, TPL, TRISTAO, NEWTRONICS, REGENCY, ROHN, WILSON, TEN-TEC, B&W, DRAKE, & MFJ.





DENTRON MLA-2500 linear amplifier

• Contunuous duty power supply • 160 thru 10 meter coverage • 2000 + watts PEP input on SSB • 1000 watts DC input on CW, RTTY, SSTV • Two external-anode ceramic/metal triodes operating in grounded grid • Covers MARS w/o modifications • 50 ohm input/output impedance • Built-in RF watt meter.

799.50 is list price. Call Toll-Free for quote.

DENTRON MT-3000A antenna tuner

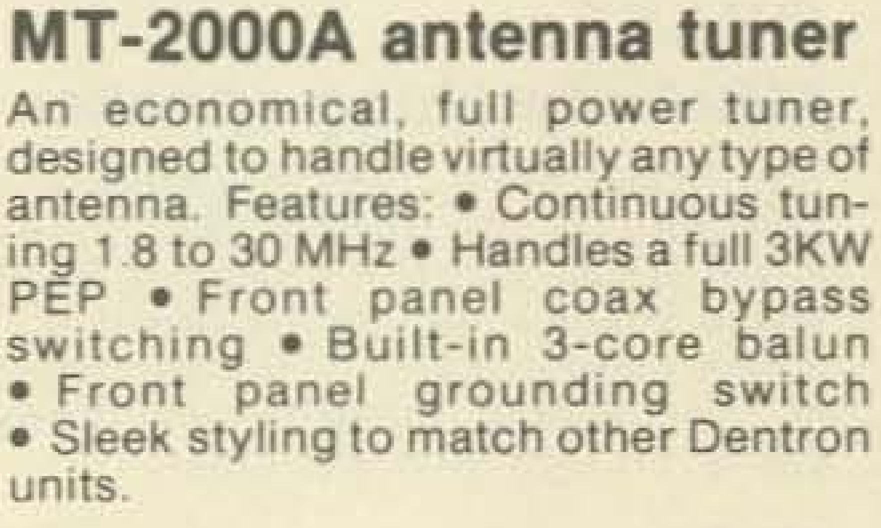
• 160 thru 10 meter coverage • Handles a full 3KW PEP • Continuous tuning 1.8 - 30 mc • Built-in dual watt meters • Built-in 50 ohm dummy load for proper exciter adjustment • Antenna selector switch enables you to by-pass the tuner direct or select the dummy load or 5 other antenna systems.

349.50 is list price. Call Toll-Free for quote.

DENTRON 160-10AT super tuner

Balanced line, coax cable, random, or long wire antennas, the 160-10AT will match it—160 thru 10 meters • Continuous tuning, 1.8-30 mc • 3 inputs • Handles 500 watts DC, 1000 watts PEP • Heavy duty, 2-core Balun (3½" dia. x 3" H) • Tapped inductor #12 ga. wire.

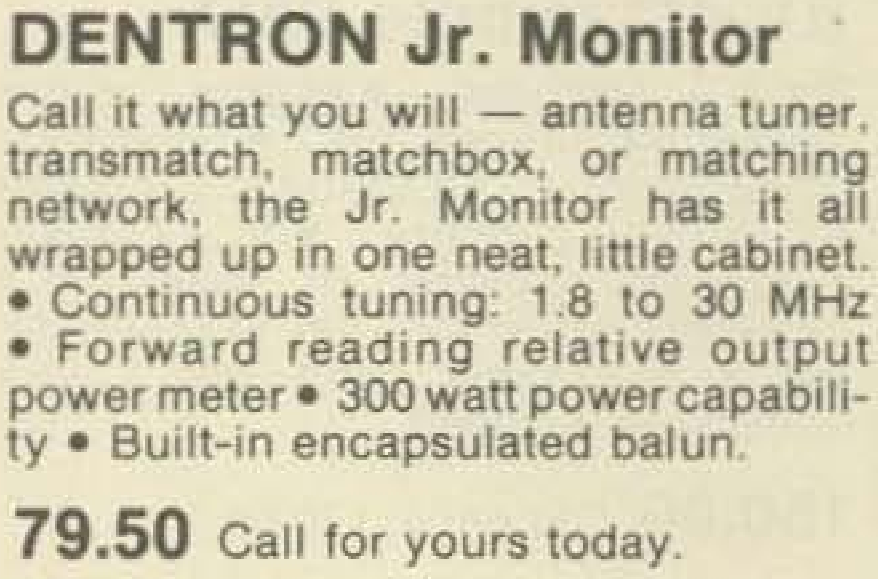
129.50 list price. Call for quote.



DENTRON MT-2000A antenna tuner

An economical, full power tuner, designed to handle virtually any type of antenna. Features: • Continuous tuning 1.8 to 30 MHz • Handles a full 3KW PEP • Front panel coax bypass switching • Built-in 3-core balun • Front panel grounding switch • Sleek styling to match other Dentron units.

199.50 list price. Call for quote.



DENTRON Jr. Monitor

Call it what you will — antenna tuner, transmatch, matchbox, or matching network, the Jr. Monitor has it all wrapped up in one neat, little cabinet. • Continuous tuning: 1.8 to 30 MHz • Forward reading relative output power meter • 300 watt power capability • Built-in encapsulated balun.

79.50 Call for yours today.

Remember, you can call TOLL-FREE: **1-800-633-3410** in U.S.A. or call **1-800-292-8668** in Alabama for our low price quote. Hours: 9:00 AM til 5:30 PM, Monday thru Friday.

Your BANKAMERICARD welcome here

Long's Electronics

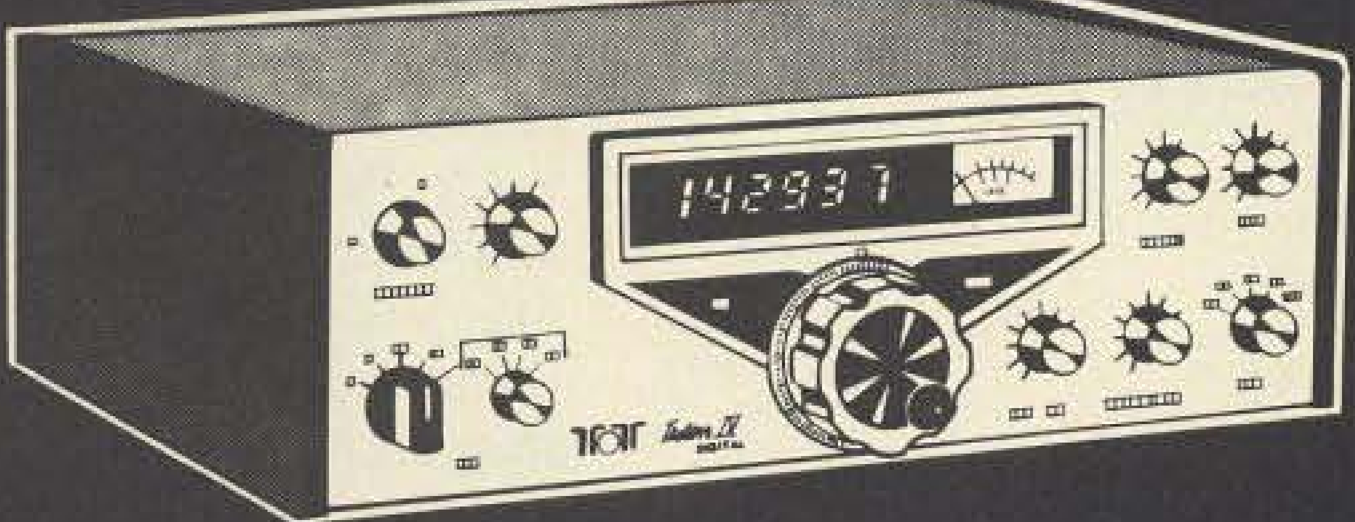
L9

master charge THE INTERBANK CARD

MAIL ORDERS: P.O. BOX 11347 BIRMINGHAM, AL 35202 • STREET ADDRESS: 2808 7TH AVENUE SOUTH BIRMINGHAM, ALABAMA 35233

Call 1-800-633-3410 for Ten-Tec*

*KENWOOD, YAESU, ICOM, CDE, HYGAIN, CUSHCRAFT, NPC, TPL, TRISTAO, NEWTRONICS, REGENCY, ROHN, WILSON, DENTRON, B&W, DRAKE, & MFJ.



TEN-TEC Triton IV digital transceiver

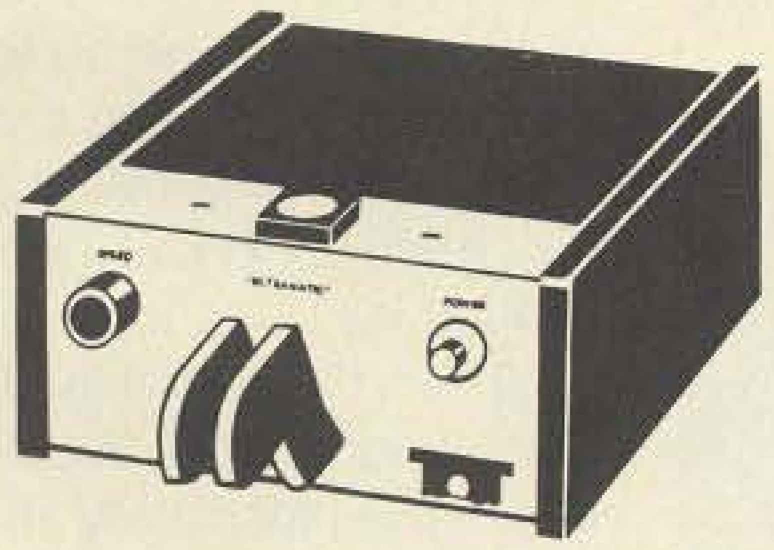
• Solid-state • Instant bank change • Covers 3.5 to 30 MHz • 200 watts input on all bands • Receiver sensitivity: 0.3 micro V • 8-pole crystal IF filter • Large LED readout • Offset receiver tuning • WWV at 10 & 15 MHz • Separate receiving capability • Full CW break-in • S-meter and SWR bridge.

869.00 is list price. Call Toll-Free for quote.

TEN-TEC Century 21 CW transceiver

• Full break-in • 70 watts input • Solid-state • Built-in speaker • Receive CW or SSB • Instant band change • Overload protection • Offset receiver tuning • Sidetone w/adjustable level • Regulated power supply • Full band coverage: 80 thru 20 meters with crystals supplied. Other crystals available.

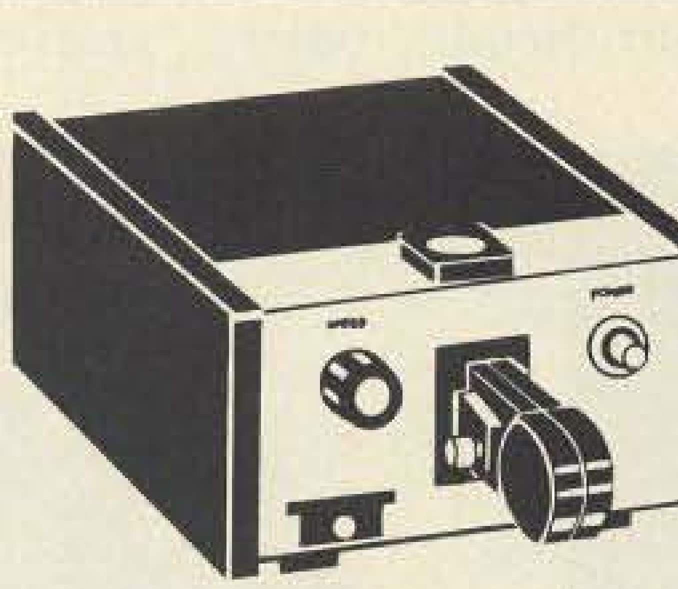
289.00 is list price. Call Toll-Free for quote.



TEN-TEC KR-50 electronic keyer

• Speed range: 6-50 wpm • Weighting ratio range: 50 to 150% of classical dit length • Output: reed relay, contact rating 15 VA, 400 V max. • Sidetone: 500 Hz tone • Dit & dah memories with defeat switches.

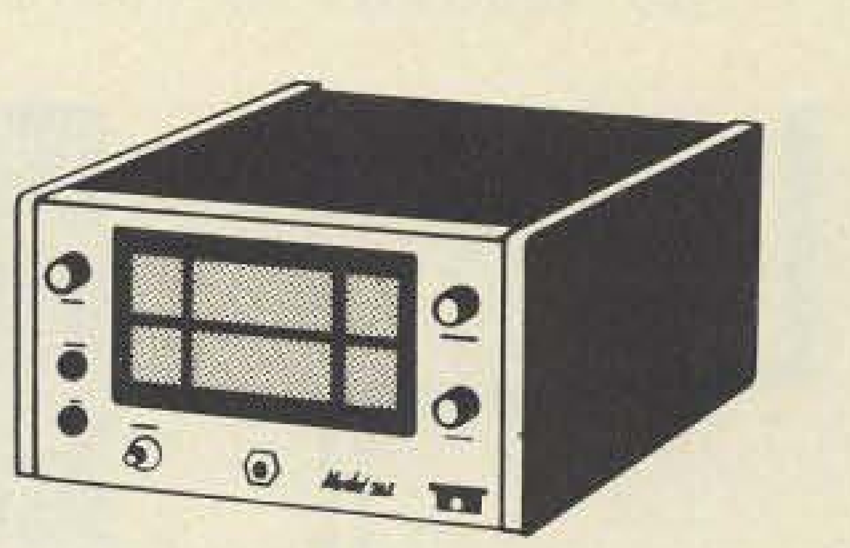
110.00 list price. Call for quote.



TEN-TEC KR-20A electronic keyer

• Keyed output: reed relay: 15 volt-amp. contacts, 400 volts max • Speed range: 6 to 50 wpm • Time base: keyed to start with paddle actuation • Self-completing characters • Side-tone oscillator with adjustable level.

67.50 Call for yours today.



TEN-TEC 262G power supply

• Input voltage: 117 VAC, 50-60 Hz • Output voltage 13.0 VDC • Regulation: Better than 1%, NL to FL @ 117 VAC • Output current: 0 to 18 amps • Sation speaker • VOX circuits • Over current protection.

129.00 list price. Call for quote.

Remember, you can call TOLL-FREE: **1-800-633-3410** in U.S.A. or call **1-800-292-8668** in Alabama for our low price quote. Hours: 9:00 AM til 5:30 PM, Monday thru Friday.

Your BANKAMERICARD *welcome here*

Long's Electronics

L9

master charge THE INTERBANK CARD

MAIL ORDERS: P.O. BOX 11347 BIRMINGHAM, AL 35202 • STREET ADDRESS: 2808 7TH AVENUE SOUTH BIRMINGHAM, ALABAMA 35233

Amanda King VE7AQS
PO Box 46316, Stn. G
Vancouver BC
Canada V6R 4G6

How To Compete With An HT

—join 'em or leave 'em

If a man has a choice between his lady and amateur radio, chances are amateur radio will win out!

Two years ago I found myself competing with a certain hand-held two meter portable. Derrick took it with us on dates, in the car, to restaurants, on walks, and even to the university. He chatted with his two meter pals while I silently hoped no one would think he was a policeman. I winced whenever I heard a squelch break.

I was also introduced to friends of his, dedicated hams. I spent many a social evening trying to show some signs of intelligence while Derrick and his ham friends compared rigs and spewed forth radio jargon.

Gradually I realized I was missing out on something (besides half the conversation and much of my man's attention). There seemed to be a special bond between ham radio enthusiasts — friendship, willingness to help others, satisfaction for the creative ham in designing and building equipment.

Then, as now, I enjoyed "designing and building" stories, poems, and drawings — why not ham radio? So I madly convinced myself I should try for my license.

I mentioned it to Derrick. That Christmas I received a $130.00 Heathkit build-it-yourself QRP rig. At that point I realized he was serious about my decision.

I buckled down and bought books which explained all the theory and regulations I needed to know. I built the Heathkit and in the process learned one end of a soldering iron from the other. I learned what resistors, capacitors, inductors, and integrated circuits look like, what they do if you wire them up correctly, and what they do if you don't.

It wasn't all smooth going, however. It took me a week to understand amplification. (How can a tube *do* that?) Resonance was another big stumbling block, and when the Morse code came along, I despaired.

Learning the Morse code is like learning to read music backwards. You hear the note and put it on paper. If you're very good at it, you can put many of these notes on paper per minute. I was not very good at it.

After the initial hopelessness wore off, I found my code speed increasing at a fair rate (those *73* code cassettes helped a lot). My general understanding of radio theory also improved, to my surprise. Derrick began to make threatening noises about setting a date for my test, so to appease him I made my appointment for the following month.

The day before my test, the weather was uncharacteristically beautiful and warm. We turned down offers to go sailing and spent hours indoors reviewing diagrams for a receiver, transmitter, and a few other, simpler things. I practised Morse code for a couple of hours and worked myself into a nervous snit. That night I didn't sleep at all.

The big day dawned rainy and cold. I drove downtown to Communications Canada. The secretary told me to wait. I waited, feeling my stomach twist into complicated knots. Finally someone beckoned me into a room and gave me the multiple choice theory paper.

The questions were not difficult, but in my state of mind I wasn't able to appreciate it. I weltered through, however, and somehow managed to pass the diagrams and the Morse code sending tests.

But like many other hopefuls before me, I failed my 10 words per minute Morse code receiving test miserably. I walked out of there feeling distinctly relieved. The worst was over, and I was determined to pass the second time.

A week later I did just that.

Ah ... that delicious feeling of hard won success. I floated away with the ink still wet on my license, found a phone booth and called Derrick at work.

"I'm VE7AQS!" I babbled to whoever answered the phone.

A few weeks later I bought a two meter portable and proudly chatted with my two meter pals. I made a few contacts with my Heathkit and even designed and built a power supply for it, which didn't work, but I had fun doing it.

At around that time, coincidentally, Derrick became my fiance, and we were married two months later by another ham, WBØNST, who just happened to be a minister.

It's worth being a ham – not only for the friends you make, the excitement of new contacts, the fun of tinkering – but for the bond you share with other hams. In my case it's a very special bond! ■

David J. Brown W9CGI
RR 5 Box 39
Noblesville IN 46060

S.A.S.E.

—sealed after something escaped?

No, this is not an article about horses, the barn they live in, or the door you didn't close. It's an article about a courtesy, I guess, started by someone, sometime (historian I'm not!), and designed to relieve a burden — financial and otherwise. I refer to the S.A.S.E., SASE, sase, etc., that goes by all of these titles — depending on where you see it — and is the SELF ADDRESSED STAMPED ENVELOPE!

Now that I have your attention — and have probably got the back hair up on many guys who are thinking, "Who is dumb enough not to know that?" — let me point out that I am writing this right after answering my last 8 queries regarding my past articles. If you think I am angered, I am. But for you fellows who are asking me for help, I am only too happy to provide same — if I can and if you will let me!

You can't build anything from this article, but if you follow it you can make your life and building other projects a whole lot easier — if you only write one author for help. If I may, let me give you the what, why, and exceptions in that order. Trivial as some of these things may seem, they are large and often insurmountable problems for authors who offer their wares for publication and then try to help readers really build or learn from their writing. Pure ego makes any author in print interested in someone who reads his offerings. A great many are further willing to help clarify their work. But this article isn't meant to do more than touch on the other fine points of getting a reply from us grouchy old authors. Such things as illegible or confusing questions, etc., are a whole different bag — believe me!

Now if I sound like a grump, follow on. If you did not have a question as to the author's intent, method, idea (parenthood?), etc., you would not have written — right? By the same token, sometimes your questions are as confusing to me as my work was to you. If my answer is not complete or even on the right track, write again. I don't bite!

By all means type your letter to me if you can! I can read longhand (some of it), but it just plain takes longer. A hint to the wise. If it is typewritten, double spaced, and the SASE is enclosed, it gets top priority — same-day-as-I-receive-it priority! If, further, it is from anywhere out of the U.S., it gets doubly special care and attention. I can only say that if you have ever *tried* to be a ham outside our borders, even as a GI, you understand. I'm not slamming any foreign ham or his nation, but just sympathizing with some of the hardships they endure (compared to ours).

But, as I said, the person has gotten his letter to me, stated his problem clearly and as concisely as possible, added a sketch or two where needed, and has perfectly managed to tell me just what he needs or wants from me. What do I look for the minute I open and sort my mail? Yep, the SASE. Now just why the heck is it so important? Since Uncle's Pony Express has settled on the unlucky, expensive, and, all things (service) considered, idiotic figure of 13¢ for the meagerest of small amounts sent through the postal machine, it behooves me to ask for help in my articles in the form of a requested SASE! This is the pure monetary point.

So now, say, you just send two, or even three stamps? Wrong! For your sake more than mine. I *will* dig up an envelope, stamp it with one of your stamps, address it for you if I can read your address, and get you a reply — I ignore nobody — but I'll do it in *my* time, and after the others are taken care of. This may sound like a bitchy attitude, but I please 10 guys who follow the rules for every one I tick off who doesn't and has brought on his own problems.

Just what are the "rules"? They vary a little from author to author I'm sure, but if you go by the following, you won't go wrong. Bear in mind that it is *for* you that I am doing this! I want to help, and so do others.

(1) Use business size envelopes to me and for the SASE. This makes getting the SASE into the letter to me easier for you, and easier for me to get more back to you — all for the same 13¢ fee. If you fold the SASE in three from side to side, it fits nicely and won't jam the postal gearworks.

(2) Make the SASE just that. Put your return address on the SASE in the destination portion — lower right center — and print, for your own sake. Don't forget your zip code. Put the return address in the upper left corner, too. If you found my address for the other letter and envelope, you can easily repeat it up there. And don't forget and put yours up there — the postal persons tell me that really confuses things if one becomes partially obliterated. Evidently they never heard of anyone sending themselves mail, so use mine. Sound nitpicky? NOT really — every little bit helps.

(3) Then there is the self-seal envelope. Send envelopes of this nature at your own risk as SASEs. Their chief problem is that they self-seal — on the way to me — and boy, do they like to stay that way!

(4) Stick the stamp on the SASE for me, too. I'm not trying to make you write the answer, too; it's just that you would be surprised what those little devils can and absolutely will *permanently* stick to besides the desired SASE.

(5) As mentioned earlier, *do* include all of the above — especially the envelope. For any author, any time you can save him generally comes

right back to you in a speedier reply. I resort to a form letter reply *only* when I have to, and then only with added notes to the individual. I use the write-in-the-margins or goodness-knows-what for letter reply material (steno pads, etc.) to get to one objective – a complete *and* speedy reply. Next year, my answer won't help too many people!

(6) Now about some special cases. I mentioned the out-of-U.S. ham before. The obvious language barrier is ever present, so be sure that *you* put your return address on the SASE in the destination spot. I don't know Swedish for street from township, so if you address it you know it is right and will be recognized by your local postal authority. Remember, they have to deliver it to you in the end. As for stamps, the general rule has been IRCs, but I find them to be a pain. If you buy the IRCs there, I have to cash them in here at a post office. A pain, but your intent is appreciated and don't panic if you usually do send them. Not all of us U.S. types feel like me. I happen to collect stamps, too, as most or at least a lot of hams I have talked to do. Even if I do not collect your country, I find all of them interesting and can trade them or keep them. Others may feel the same. Even no attempt at the postage part is fine. A couple of guys sent coins (I hope for not more than the postage) and I found them most interesting. (Matter of note: Be sure it is legal to send coins out of your country.)

I think I have covered about all the bases, or at least the really important ones. Please try to help us help you. That's really all this boils down to – a plea for help.

At the risk of sounding redundant, if there is anything you don't follow about this, an SASE to me will bring you a speedy reply. ■

V. S. Rajagopalan VU2JS
51, 12A Cross Road
Vaiyalikaval
Bangalore 560003
India

A Ham's Life Cycle

—what you're in for

I have held a ticket for the past five years, and during these five years, the practice of this hobby has seen many ups and downs. Its practice is governed by so many factors that I think that it will be useful to summarize them. I am tempted to call them "laws," because they seem to be applicable to a large number of hams. These "laws" pertain to the practitioner rather than the hobby itself.

1. Every ham passes through the novice phase. Note that this has nothing to do with the Novice class of hams in the "W" land. This law is applicable to every ham who gets his ticket for the first time, be it a Novice ticket or Advanced class! Under this condition, the keen new amateur is preoccupied with his amateur radio activity. For most of the time he is thinking of how to acquire a good receiver or transmitter or to put up an antenna. His thirst for knowledge of circuits seems to be boundless, especially if he happens to belong to some profession not connected with electronics. Many times he does not know the merits of his equipment. He does not know when and where to expect DX and how to work it when he finds it. He simply monitors the band at times when no DX can be expected due to propagation conditions. Naturally he does not hear many stations and thinks that his receiver is poor!

His purse permitting, he goes on buying and stocking junk in the belief that it will be useful one day or other. But this belief is justified in VU2 land, where it is very difficult to get some essential components when you badly need them. Many times he is not sure of how much to pay for the junk. Thus at times he falls prey to some unscrupulous people who take undue advantage of the inexperienced keeness of the novice. When he comes across junk, he does not know what to pick up and what to leave out. He is very keen on collecting QSL cards and displays them proudly and prominently in his shack. He also lets his friends and neighbors know about his hobby and sometimes arranges demonstrations. Sometimes such a demonstration is necessary to win over a neighbor to get the necessary permission to tie one end of your dipole on his wall. He promptly becomes a member of the local amateur radio club and regularly attends its meetings.

2. The ability to work DX depends upon your capacity to be awake during most of the night. This "law" has special application to VU2 land and certain types of people. In VU2 land, DX can be had mostly during the night and early morning. The early morning period is brief, and sometimes signals vanish all of a sudden (especially the 7 MHz band). The availability of DX mostly during nighttime only may be due to the propagation conditions and also time differences between the various parts of the globe. It is extremely difficult to get a "W" station in VU2 land during daytime, except perhaps when you have an extremely good receiver and antenna and sufficient power is radiated by the transmitting station.

Regarding people — there are early morning types like me. They get up early and get into top gear mentally and physically during the early morning period and reach their peak around noon. Afterwards, efficiency goes down. By about 9 pm, they are tired mentally and physically and ready to go to bed. Thus DXing suffers. Frustration builds up when your fellow ham says that he works lots of DX during nighttime.

3. The ability to enjoy the hobby is directly proportional to the spare time available. *Corollary*: The ability to continue the hobby after getting XYL controlled depends upon the will and pleasure of the XYL. It is the belief of some hams that you are not likely to be as active as before getting rockbound. Fortunately, it is not the case with me! At least so far!!

4. The ability to enjoy this hobby is directly linked to the state of your health and energy. To be a constructor or DXer needs plenty of patience, and patience will be in short supply when you are not well. This is especially true in construction work. Simple ideas will not come to you when you are tired. But the same will strike you when you start afresh the next day. Problems which were difficult the day before will be solved quickly and easily. As per my own experience, it is better to postpone construction work when you are tired or sick. Otherwise ruined components or equipment or injury to yourself will be the result.

5. The ability to continue as a constructor is directly

proportional to your ability to spend. As you know, home brewing and innovation are one of the main aspects of this hobby. Many people home brew amateur equipment mostly for the satisfaction it yields and to some extent for the economics of it, provided junk is available. For the constructor, the articles in the various ham magazines appear to be simple and useful, and he wants to try them. But, as you know, the limitation lies with your purse. In VU2 land, there is an additional difficulty of availability of components. Just for want of an FET or even something as simple as a variable capacitor, simple but otherwise very useful projects cannot be taken up. Many times I do not dare to look into construction articles for this reason.

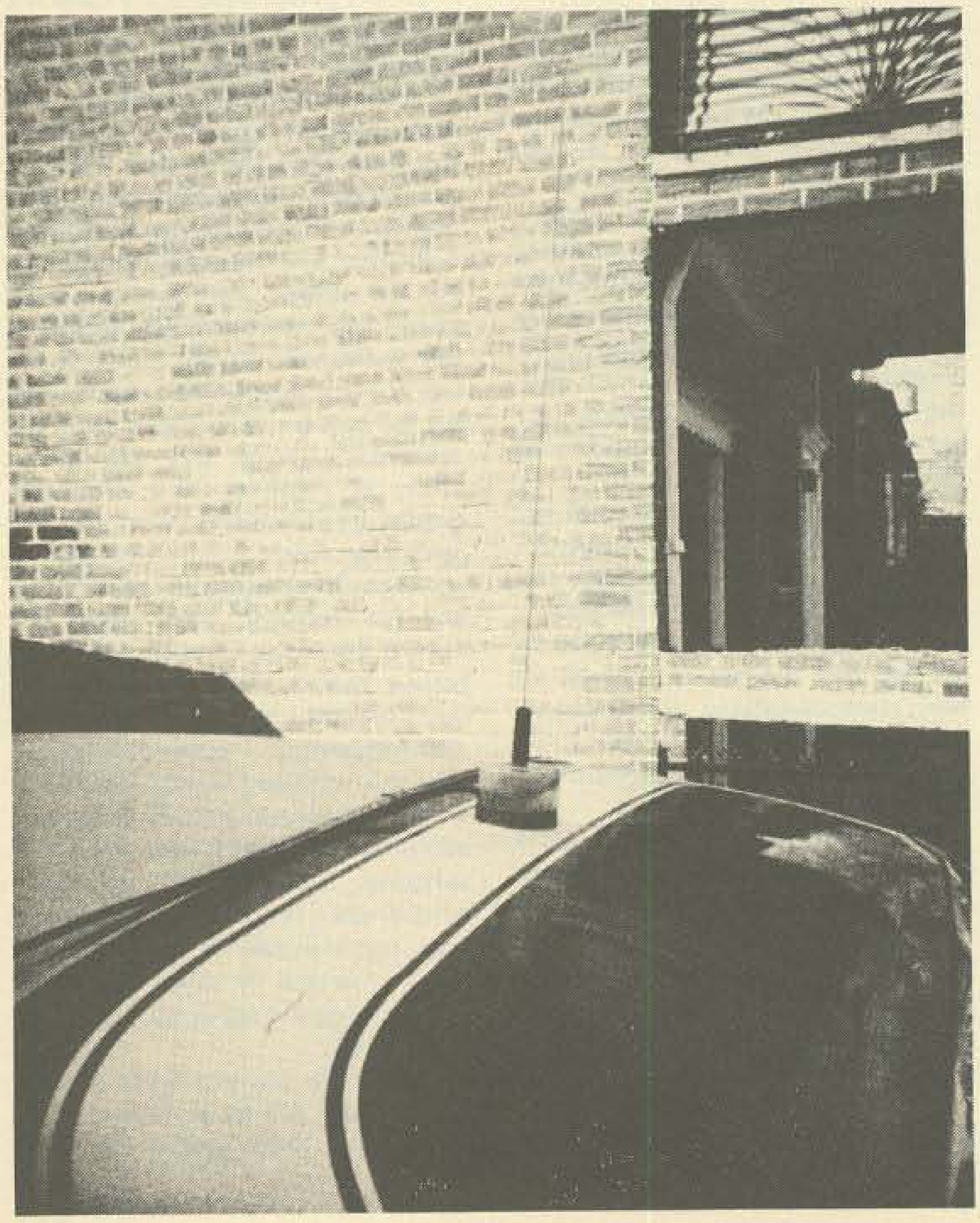
6. The "Contented" Phase: Many hams will pass through the contented phase sooner or later. At this stage, the ham has good operating and constructional experience. He is fully aware of what is possible under the circumstances he is placed in. The limitation of his purse is a main factor. Also he is by now crystal controlled with harmonics. Through a few years of struggle, he has acquired a good station and enough junk. By experience, he has found that the least expensive way of practicing the hobby is to operate the rig. Probably he may switch over from construction to rag chewing! He is no longer mad after construction articles. He is very careful while choosing any project. He will check if the project will clear any of his immediate operating difficulties. Many times he resorts to other less costly aspects of the hobby, like writing articles, organizing local amateur radio clubs, helping the publication of a newsletter for his club, training new entrants, etc. At this stage he may mostly operate the club equipment. ■

Steve Kraman, M.D. WA2UMY
629 Cortelyou Road
Brooklyn NY 11218

The $5 Magnetic Mount

— *cheap and sticky*

All I wanted was a cheap magnet mount to support a ¼-wave two meter whip on my car. Is that too much to ask for? Apparently so. All over New York I trekked — to Lafayette, Radio Shack, and Gem, and everywhere I saw the same thing — mag mounts below, short CB antennas above, and (hopefully, for the CBers using them) a loading coil within. Don't you have just the mount? Nope, sorry. So was I. Eventually I ran into a friend who had this very nice 5/8-wavelength whip on a mag mount that worked well and looked good but would cost about $30.00. That's not cheap! At that point, I decided that it must be possible to roll your own, and so I did. The results, using all new parts, should cost less than $5.00; using my junk box, it cost one dollar. The appearance is almost commercial.



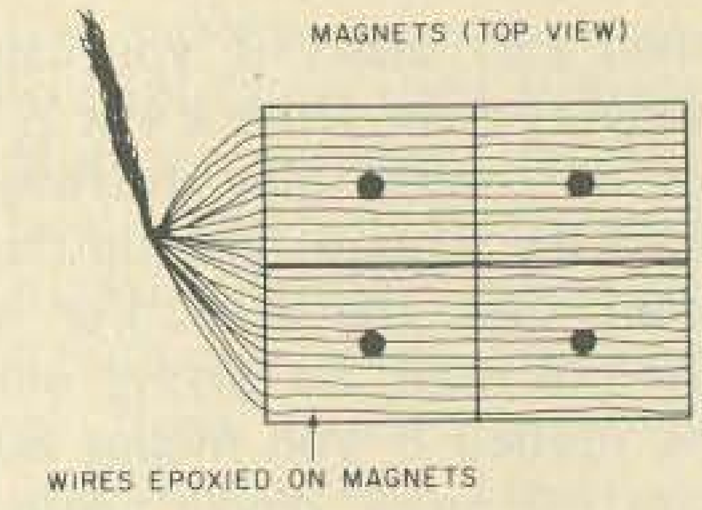


Fig. 1.

The magnets I used are 1 inch by 5/8 inch by 1/8 inch and cost 10 for a dollar at Radio Shack, but any similar square or rectangular magnets would work. I used 8 magnets stuck together in 4 piles of 2 (Fig. 1). The body of the

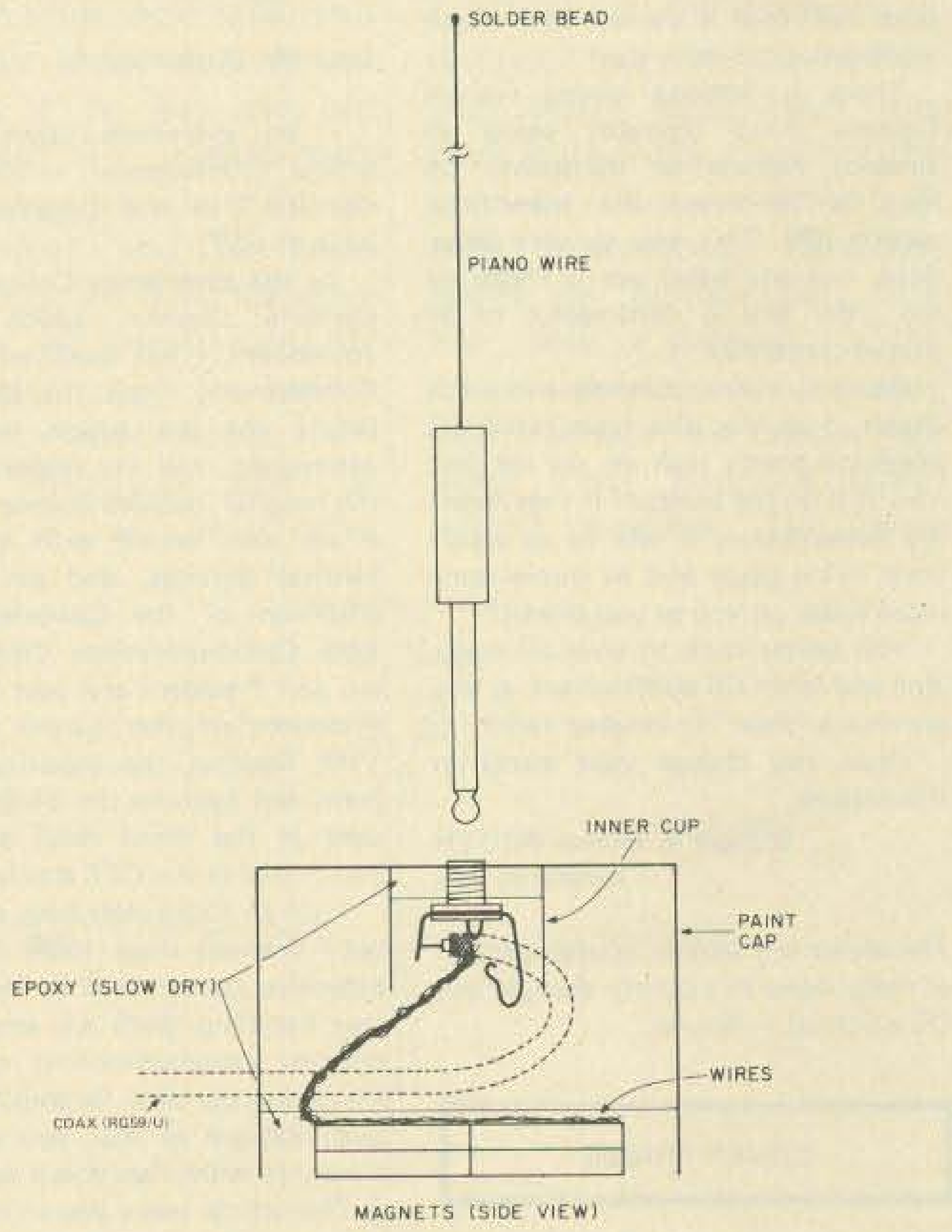


Fig. 2.

mount is the cover from a can of Krylon spray paint (in the color of your choice). Another brand of cover will work, provided that is has the inner cup, as in Fig. 2. Almost any good socket can be used, but I chose a phone socket, since it holds the plug firmly, is simple to mount, and is all I had in the junk box. Avoid RCA phono sockets; the antenna may fall out. If you use an SO-239, solder up the coax before setting it in epoxy. Mount the socket as per the diagram, and fill the inner cup with epoxy to the level necessary to hold the socket firmly without covering the electrical and mechanical parts.

Next, put the magnets together as shown, and paint them with epoxy. Before letting it dry, unravel some cable shielding and lay the wires across the top of the magnets evenly. Place a piece of waxed paper over the wire, and hold it in place with a weight until it's dry. Twist the excess wire together, and solder it to the shield connection of the plug. Then put a small hole in the side of the body of the mount, pass the coax through it and once around the small inner cup, and solder it to the socket.

Fill the larger cup of the cover about ¼ full with epoxy. Place the magnets down on a piece of waxed paper, quickly turn over the cup, and place it over the magnets so that the edges of the cup are tight against the paper. The glue will flow down and cover the magnets, sealing them in place. Put a weight on top of the unit while the epoxy sets to minimize leakage. Nineteen inches of piano wire or clothes-hanger wire soldered to the plug completes the antenna.

On-the-air tests have been excellent, and the magnet mount stays put under all road and wind conditions. And, even better, when you get out of the car, it's very easy to hide the antenna. ■

LETTERS

from page 117

notice the fact that Cambria County turned in a decent score in the 1976 SET. I was the motivating force behind that SET participation, and I will tell you that SET participation has *little or nothing* to do with proper operating in a major disaster such as the Johnstown flood.

Is there anything in the SET that prepares you for complete devastation of your community? How about the fact that almost all of your best operators are unavailable for ham operations because they are either more valuable at work or they were themselves victims of the disaster? Stick that in your SET! Does the SET prepare you for an influx of hundreds of hams from outside, with no clearly qualified individual to take charge of the effort of coordinating them? Not in a pig's eye.

And yet you still cling to the idea that SET participation will cure the ills mentioned in old sanctimonious' letter.

I talked to George Hart on the telephone about five days after the flood, and he indicated that *QST* would be *very* interested in an article about *solutions* to the problems we encountered in Johnstown. As soon as I could get a chance, I wrote that article and submitted it to *QST*. You then sat on it for four months and returned it with a rejection letter.

My article may not have been much, but it sure was better than the garbage in the December *QST*. At least it presented real, concrete solutions – derived from experience – to the problems that we had. No one was more vocal in his criticism of the Johnstown operation than I – *during* the operation. But after it's over, we don't need nonconstructive criticism, and neither does anyone else.

5. *Why are you unable to understand the difference between good ham communications and good communications?* I'll admit that the communications on 34/94 after the flood was darned inelegant. It was *not* good ham communications, as your article points out. However, there is a dichotomy between good ham communications and good communications! We *did* furnish good communications. There were problems; there were fits and starts and a lot of incompetence. But the communications was *good* because it was the only communications we had! Oh, boy, it was good. It was better than anything else in the world after that flood. For many operators, who were unfamiliar with formal traffic handling and with local geography, it took guts to even pick up the mike. These people were united by one desire – the desire to *help*! That's the only qualification they had. So they picked up the mike and they talked, and the life-saving communications that resulted was priceless. Inelegant, but priceless.

Look, I know how bad things were. If you want to use the yardstick used by old sanctimonious, then you're right and we were wrong. But, I'm telling you that you're using the wrong yardstick and your band-aid solutions will not help the next community faced with the set of problems we had.

Before you printed this garbage, couldn't you have contacted someone from the local area? The EC, for instance? Couldn't you have checked the facts and the social ramifications of this article?

I am resigning as EC, for it is obvious that the ARRL has no regard for the post. If you did, you would have contacted me for confirmation before this was printed.

I know that you won't print this entire letter, even though I challenge you to! However, I demand that this be printed in *QST*, at least in the letters section:

"Your article, 'Johnstown – One Man's Opinion,' in the December issue, was a slap in the face to the many fine operators who came to our aid when we needed it.

"The narrow viewpoint espoused by your author, your refusal to print his name, and his unfamiliarity with local conditions render his argument unusable and unhelpful.

"Any SET participation, while valuable, will not prepare a community for a mass disaster such as the Johnstown flood."

/s/ Bill Rogers N3WR

Please print *at least* this condensed version of my viewpoint. It is the least you can do to help erase the harm the article caused. The inflammatory language in the article was particularly distasteful and uncalled for. "Wildfowl preserve," indeed.

I hope that old sanctimonious' home town gets ten inches of rain in as many hours. Let's see what he does *then*! It's easy to breeze into Johnstown five days after the flood and fire a volley of useless criticism. It surprises me, however, how easy it must have been to get this garbage printed in *QST*.

I missed four hours of sleep last night trying to decide whether or not to cancel my *QST* subscription and my ARRL membership. I have decided not to, but it was touch-and-go for a while. I believe that my only reason for hanging on is *tradition*. How many more times the ARRL can screw up and still have tradition on its side is more than I can answer. But after incentive licensing and the other junk from Newington, you guys had better do well at WARC 79! I believe that if Wayne Green is right and WARC 79 is a fiasco for hams, people will desert the ARRL like they would desert any other sinking ship.

William E. Rogers N3WR
Johnstown PA

Bill, the only vote that counts with the ARRL is your money. Keep sending money. – Wayne.

Ham Help

Someone gave the boss's son a Hallicrafters S-38C. I'm not familiar with the rig, nor are the boss and son.

If any of your readers happens to have a manual with schematic on this one, I would appreciate hearing from them (a Xeroxed copy would suffice).

David L. Larson
1301¼ South First
Harlingen TX 78550

Since I'm allergic to tobacco smoke and can't go to club meetings, I and my wife would enjoy meeting fellow hams and their wives who are non-smokers, in the Montgomery County, Maryland area. Besides building and experimenting in electronics, I like to paint portraits in oil and do color photography, developing, and printing.

Zoltan T. Bogar W3CJM
1921 Marymount Road
Silver Spring MD 20906
(301)-598-6137

Our San Jorge Radio Club is a newly-founded organization in this small city and needs any kind of books and literature concerning electronics, antennas, etc. We are also looking for any type of usable equipment, 144 MHz, communication receivers, and materials that our members will certainly repair and put in condition to be on the air. We are lacking funds, so any kind of donation would be happily and sincerely appreciated.

Radio Club San Jorge LU8FFV
P.O. Box 70
2451 – San Jorge (SFe)
Argentina, South America

I'm itching to get on two meter FM. I need the schematic and conversion data on the Motorola Model T43A 150-170 MHz FM transceiver.

Billy L. Nielson WB4APC
PO Box 338
Radcliff KY 40160

Corrections

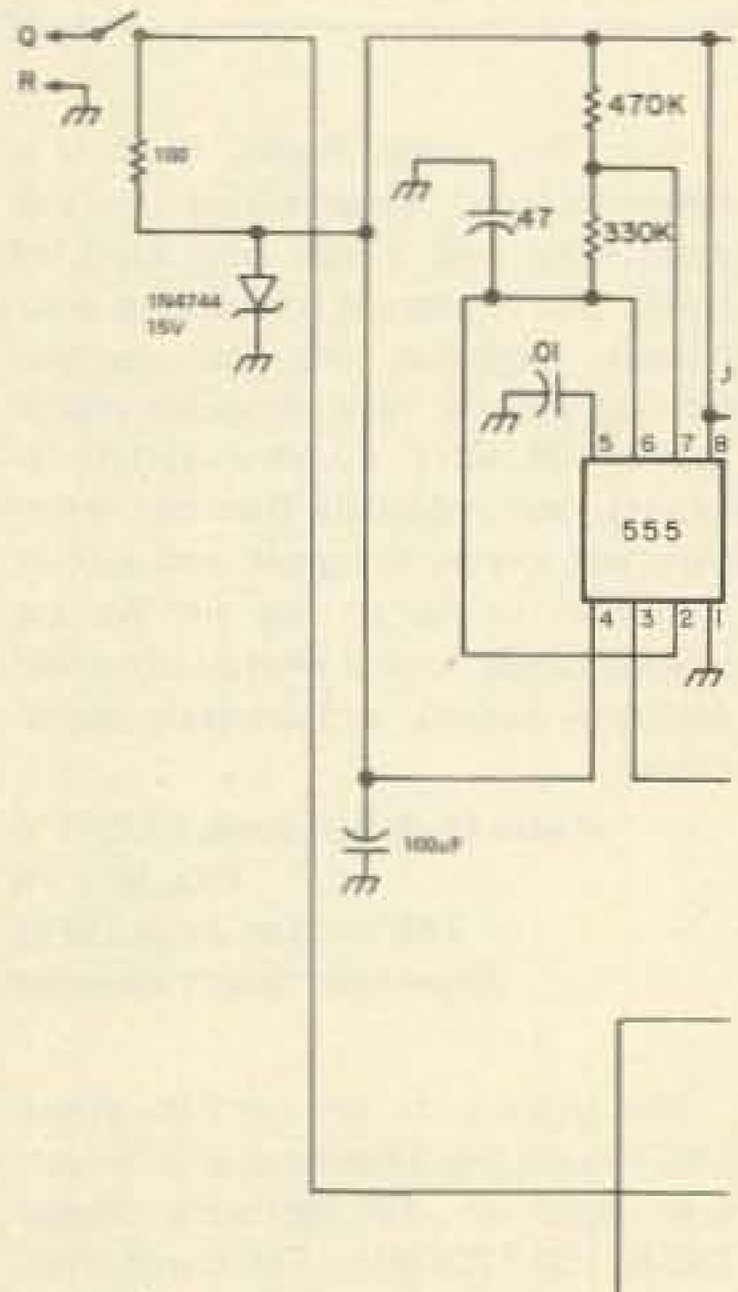
My original Zeppy Vertical antenna as shown in the August, 1977, issue of *73 Magazine* needs an additional component to obtain a 50-Ohm impedance. A one-turn coil approximately 1 inch in diameter directly across the coax termination and shortened driven element (18 inches) gives a perfect match on the prototype antenna. This was checked out on a Bird model 43 wattmeter. The shunt coil size and length of driven element should be cut to length by trial and error until a match is obtained. The spacing of the 57-inch element and 18-inch element is not very critical, although it should not be made too large. Not more than 1.5 inches on 2 meters or 7 inches on the HF bands is reasonable. The antenna can be used on other bands by scaling the dimensions directly with the wavelength.

Experience with several antennas on a sailboat mast shows the Zeppy Vertical to perform better than a ¼-wave ground plane, but not quite as well as a 5/8-wave antenna with ground plane. The addition of the shunt coil makes the antenna electrically the same as a "J" vertical, although the Zeppy Vertical is a slight improvement since mounting is simplified. Also, performance should be the same regardless of which element is driven. If one is better than the other, the coax feedline is probably radiating.

Gene Preston K5GP
Austin TX

Since submitting my article, "Simple Scanner For the IC-22S" (January, 1978), I have found that the operation of the scanner is intermittent with some 4017 chips. This condition can be corrected by modifying the power input to the scanner as shown in this revised version of Fig. 1.

George Tam KH6EM
Honolulu HI



Revised Fig. 1: "Simple Scanner For the IC-22S."

The gremlins have struck again. 3 or 4 corrections for my *FCC Math*, December, pp. 19,20.

(1) P.19, second column, bottom: 5 x 7/5 x 9 = 7/9 should be 5/9 x 7/5 = 7/9.

(2) P.20, left-hand column, top: "Only zeros at the extreme right or left can receive that kind of treatment" should read: "Only zeros at the extreme right or left *of the decimal point* can receive that kind of treatment."

(3) P.20, column 3, 4th paragraph from bottom. That rule, "If you didn't . . ." is hardly a rule.

(4) P.20, right-hand column, Note: "Eight-six billion" should be "Eighty-six billion."

John F. Leahy WB6CKN
Gonzales CA

I thought I would drop you a line to correct an error in the article, "All About Transceivers," Dec., 1977. The Kenwood TS-820 has always been available with an optional dc power module, DS-1A, for $65 list. The new TS-520S no longer includes the dc power module as standard equipment. Both can be fitted easily by either the dealer or purchaser. The appropriate place has a blank plate covering an opening for the module, with holes pre-drilled at the factory.

Furthermore, the specifications on both receiver and transmitter of the TS-520 were upgraded 6 months ago to basically the same as the TS-820 – see sheet #760750SB. Of course, the new TS-520S has a number of changes, making the article somewhat obsolete.

L. Schulman WB9WIC
Northbrook IL

Here are a few corrections and additions for my article entitled, "Baudot to ASCII Converter," which was published in the September, 1977, issue.

CORRECTIONS

Two of the ICs shown on the main schematic have errors in pin numbering. On U13, the 1702, pins 12, 13, 15, 22, and 23 should all go to +5 volts. Only pin 14 is grounded. The PC board is correct. On U18, the 74161, the pin with the small circle on the lower edge of the symbol box should be labeled pin 1. The other numbers on the bottom edge are correct, but refer to pins to the right of each number. Note that there is no connection to pin 11.

UART STRAPPING

The connections to the two UARTs (Table 1) were omitted from the schematic, but are included on the board. No additional wiring is required on the board.

CLOCK GENERATOR MODIFICATION

There has occasionally been trouble with U25 appearing to divide improperly. This can easily be corrected by breaking the line that goes from pin 2 of U25 to pin 15 of U24 and reconnecting it to pin 9 of U24. The effect is to invert the input signal to U25. On the PC board, the modification is simple, because the trace goes right by pin 9. This can be done on any converter, even if the clock already works correctly.

IMPROVED TAPE READER CONTROL

When transmitting Baudot code at 45 baud, the tape control shown in Fig. 9 of the article could only be operated at 3.7 characters per second, in order to allow time for the converter to insert shift characters when required. In addition, the transmitted Baudot was quite uneven.

One simple change will produce an amazing improvement. Simply disconnect the left side of the 500k pot from the +5 volts and connect it instead to the TBMT output of the Baudot UART (pin 22 of U11). Then the control can be operated at 5.5 characters per second with a tape containing only letters and spaces. TBMT will put out a steady 4.5 volts and the 555 timer will operate normally. However, when a tape containing both figures and letters is run through the reader, TBMT will go to 0 volts whenever a shift character is being inserted in the Baudot data stream. The tape control will pause until the internal buffers of the UARTs become empty and then will resume its normal timing cycle.

With this modification, the transmitted Baudot appears to be smooth and even. Note that the theoretical maximum character rate for 45 baud code with one start bit, five data bits, and two stop bits is 5.7 characters per second, so that the system will now operate at essentially the maximum speed.

J. Gary Mills VE4CM
Winnepeg, Manitoba
Canada

Pin	Label	Name	ASCII	Baudot
16	SWE	Status word enable	0	0
21	XR	External reset	0	0
34	CS	Control strobe	+5	+5
35	NP	No parity	0	+5
36	TSB	Two stop bits	+5	+5
37	NB2	Number of bits	+5	0
38	NB1	per character	0	0
39	EPS	Even parity	+5	0

Table 1.

Ham Help

I have a Clegg FM-27A transceiver which I am trying to modify to transmit over the entire 146-148 MHz repeater subband. The transmitter uses a 116 MHz oscillator, which is fed into an FET mixer with a signal around 30 MHz to yield 146 MHz. I had attempted to add a 117 MHz oscillator, of the same design as the 116 MHz oscillator, with a switch to kill power to the undesired oscillator, but the added circuitry loads the system so badly that it kills all output from the transmitter on either band segment. When the new oscillator is disconnected, the transmitter works normally. Does anyone know what I can do to cure the problem? The people at Clegg refused to give me any information. Being relatively new, I do not have a large collection of magazine back issues which may have covered the FM-27A. Here in Lancaster County, the only local open repeater is above 147 MHz. The nearest 146 MHz open repeater is 40 miles away.

Philip E. Galasso WB3EZA
45 Lincoln Avenue
Ephrata PA 17522

I would like to hear from anyone who has easily and successfully converted a Radio Shack Weather Deskcube (#12-181) or similar weather receiver to use as a 2 meter repeater receiver.

Jim Weitzman K3JW
11417 Hounds Way
Rockville MD 20852

I have a preselector Q multiplier or a front end converter by Radio Manufacture Engineer, Inc., Peoria IL. It's model HF 10-20, serial number HR-168, and uses one each of tube types 5Y3, VR150-30, 6AG5, and 6J6. I have searched the San Diego libraries with no luck. Can one your readers identify this and furnish me a schematic? I would like to rebuild it as it originally was.

George N. Andrews WA6DWV
6642 Birchwood St.
San Diego CA 92120

I recently purchased a GE Pacer transmitter/receiver, EG43SA6, FCC type ES27A. Were there any articles on this unit for conversion? NBFM or WBFM? Any information available would be very much appreciated – will pay for any schematics or back issues if available.

John Wora K2KFG
S-4907 Clifton Parkway
Hamburg NY 14075

Help!

What good is a 2 meter rig going to do in my car if I can't check out my electrical system? Can anyone help find a function or selection switch for my Knight Kit model KG-375A auto analyzer? (Radio Shack doesn't carry Knight kit parts.)

Any help would be appreciated.

Eugene E. Binau WA5LAE
308 Debbie Lane
Tecumseh OK 74873

James M. Willis WA5TFK
12 Tamar Drive
Texarkana TX 75503

Versatile Transistor Tester

—save expensive devices

Many of the new transistor testers appearing on the market today provide two unique features:

1. Random lead connection.
2. Identification of transistor leads.

With these features, the test procedure is greatly simplified, and the person performing the test is assured that the test leads are *always* connected correctly to the transistor under test. The advantages become immediately obvious when you are culling through a large assortment of surplus transistors or when performing in-circuit tests on a crowded circuit board where it is often difficult to identify the leads on a transistor.

It is the purpose of this article to show how these features can be incorporated into your present tester, at a very low cost, without having to modify your tester in any way. In fact, this is an outboard accessory, which is connected between the tester and the transistor.

The principle on which this circuit operates is simple. There are only six possible ways in which the leads can be arranged on the base of a transistor. See Fig. 1.

By the simple expedient of interposing a 3-pole, 6-position switch between the test leads and the transistor, it is possible to present to the input of the tester, one by one, all six of the possible lead arrangements. The circuit for this switch is shown in Fig. 2.

Up to this point we have accomplished the goal of random lead connection. To identify the transistor leads, it is necessary to color code the wires from the switch to the transistor. Next, prepare a chart which correlates the switch position with the colored wires and their corresponding connections to the input terminals of the testers. See Table 1.

For convenience, this chart can be attached to the box in which the switch is mounted, or it can be affixed to the transistor tester itself. One thing which should be mentioned is that the leads from the switch to the input of the tester should be connected exactly as shown on the schematic in Fig. 2. If these leads are changed around, you will still retain the random lead connection feature, but you will no longer be able to identify the transistor leads.

When using this switch for the first time, you will notice that there is more than one position which will give an up-scale reading on the meter of your tester. This presents no particular problem in the interpretation of the test results, once you understand why this happens.

To illustrate this, select a good transistor on which you can positively identify the leads, and connect it to your tester. After you have made the initial adjustments on your tester, press the gain button and observe the beta. Now reverse the emitter and collector leads on the transistor, and repeat the test.

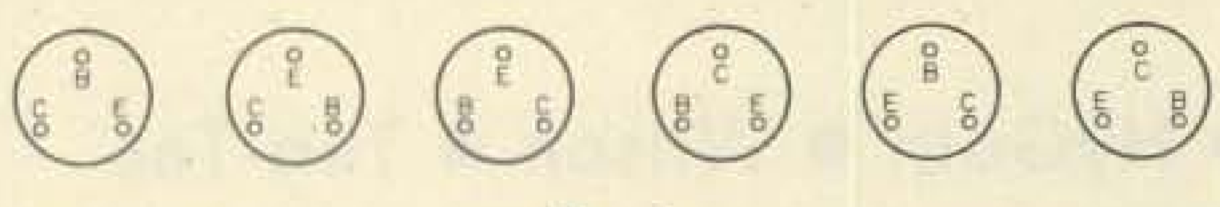


Fig. 1.

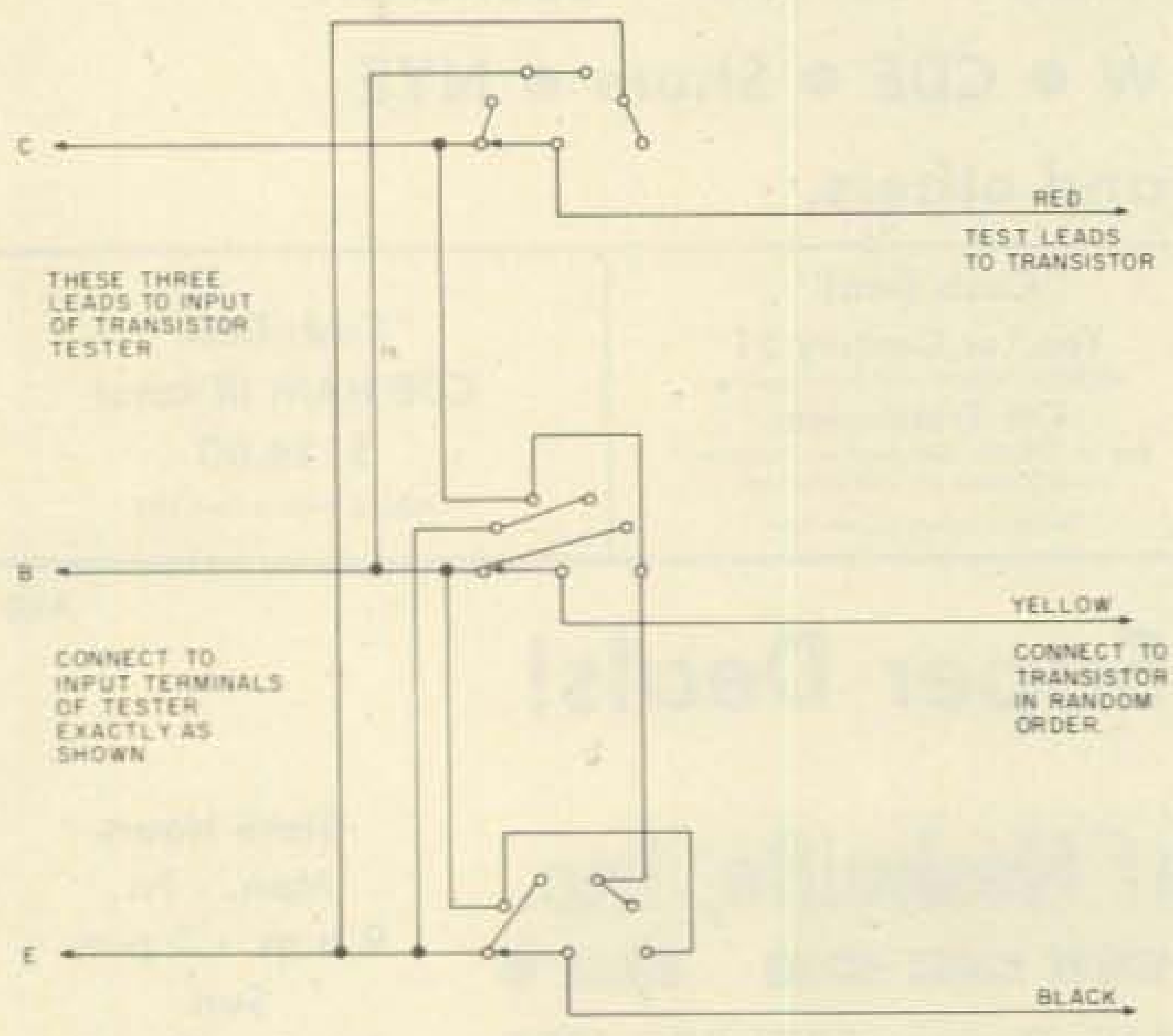


Fig. 2. 3-pole, 6-position switch (Mallory 3236J).

Switch position	Collector	Base	Emitter
#1	red	yellow	black
#2	red	black	yellow
#3	yellow	red	black
#4	black	red	yellow
#5	black	yellow	red
#6	yellow	black	red

Table 1.

You should observe that the transistor still has a forward gain, but the beta will be lower than that obtained previously. Why does this occur?

Actually, nothing strange or contrary to the laws of transistor physics has occurred here. The emitter and collector of any transistor are made of the same type of material and, from a theoretical standpoint at least, we could say that the designation of the emitter and collector are purely arbitrary.

In the real world of transistor design, however, the physical structure of the emitter and collector are different. These differences are dictated by design considerations such as input-output capacitance, collector heat dissipation, and forward gain requirements. From a practical standpoint, all of these factors add up to one thing when testing a transistor. The connection of the emitter and collector test leads which give the highest beta reading on the meter positively identifies the emitter and collector leads on the transistor.

On some testers, a collector-base reversal will give an indication on the meter during the initial setup and adjustment of the tester, but the transistor will not have any forward gain. In this case, the emitter-base junction is forward biased, as it should be, and it is this current that you see indicated on the meter in the first part of the test. The collector circuit, however, is also forward biased, and, therefore, the transistor will not have any forward gain.

I would like to see a more enterprising person adapt the features of this switch to a digital circuit for true no-hands operation. The biggest problem to overcome would be the tendency of such a circuit to lock on to a collector-emitter reversal and give a false indication. ■

New Products

from page 15

The Logitronics Copy One just might be the ideal first purchase for prospective amateurs — one that would never become obsolete regardless of the class of license held and the number of years on the air. And anyone who has let their CW operating slip could be pleasantly surprised by adding a Copy One to the shack. The hold of the unit is subtle and requires a while to capture you, but once it does, the Copy One should become a valued addition to the shack of anyone who operates CW.

Priced at $89.95, the Copy One is available through dealers. For further information, write *Logitronics, 3135 North Cole Road, Boise ID 83704.*

ST-100 WIRE CUT AND STRIP TOOL FOR WIRE-WRAPPING

Featuring a revolutionary new concept for easy and clean stripping of wires for wire-wrapping, electronic, and appliance applications, the ST-100 strips without nicking and automatically generates the proper strip length for wire-wrapping. Bio-mechanically designed for maximum efficiency, its slim design makes it ideal for storing in pocket, belt holster, or tool kit.

The ST-100 is easy to operate. Simply place wires (up to 4) in stripping slot with ends extended beyond cutter blades, press tool, and pull. Wire is cut and stripped to proper "wire-wrapping" length.

Hardened steel cutting blades and sturdy construction insure long life. The stripping blade is easily replaceable. The ST-100 is a handy tool for production field work. It is available for wire sizes from 20 to 30 AWG (0, 8-0, 25mm). *O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475 USA.*

NEW MAX-100 100 MHZ COUNTER FROM CSC

Continental Specialties Corporation's MAX-100 delivers a continuous 8-digit accuracy 8-digit display from 20 Hz to a guaranteed 100 MHz. The crystal-controlled timebase delivers 3 ppm accuracy, and the counter updates every second. The counter input is preamplified to work with as little as 30 mV of signal, and is diode protected up to 200 volts.

Although only 1.75" tall, the MAX-100 features big, bright .6" digits. No range switch is necessary, as the least significant digit always represents 1 Hz. Leading zeroes are blanked. And overrange signals cause the most significant digit to flash. The MAX-100 can be operated on internal alkaline or nicad AA cells, or from automotive or wall power using charger/eliminators. All 8 digits flash to indicate low battery operation, which permits extended battery life when batteries are low.

The input impedance of MAX-100 is a full 1 megohm, shunted by 56 pF. Ac sine wave sensitivity is rated at 30 mV rms from 10 Hz to 50 MHz, 100 mV rms to 80 MHz, 300 mV rms above.

The MAX-100 is accurate enough for most professional field service applications, and, with a suggested price of $134.95, it's economical enough for personal or educational use. A number of accessories are available, including battery charger/eliminators, rf tapoffs, a whip antenna, and a carrying case.

For further information, contact *Continental Specialties Corporation, 44 Kendall Street, New Haven CT 06509; (203)-624-3103, TWX (710)-465-1227.*

DATA TECH INTRODUCES U.S.A. MANUFACTURED $39.00 3½ DIGIT DPM

The Model 73 is a bipolar, 3½ digit, dc-powered, LED display panel meter with a price of $39.00. Also available are choices of various ac-powered units. The Model 73 features .05% accuracy, and is available in four full scale ranges: 200 mV, 2 V, 20 V and 200 V.

The LED display has been designed for maximum visibility — a crisp, clear display that can be viewed from a wide angle and still be easily read. A special lens is utilized to reduce glare without reducing the brilliance. Applications include measurement, control, and data acquisition for the scientific, industrial, and medical fields.

Basic specifications are .05% accuracy, 50 ppm temperature coefficient, .43" LEDs with extra wide viewing angle, 80 dB common mode rejection ratio, and overvoltage protection. Overload is indicated by blinking the display. The unit fits 3.17" to 3.20" W x 1.77" to 1.79" H cut-out with an optional version for the 9.25 x 4.55 cm DIN standard cut-out at no additional cost. The Model 73 is the only low-cost DPM on the market backed up by an extensive quality control program and over 100 hours of powered temperature cycled burn-ins. *Data Tech, 2700 South Fairview, Santa Ana CA 92704; (714) 546-7160, TWX: (910) 595-1570.*

FULL WAVE BRIDGE RECTIFIERS HANDLE 400 AMP SURGES

Motorola's new MDA2500 series of full wave bridge rectifiers require only one inch square mounting surfaces to produce 25 A continuous, 400 A surge performance. Available in voltage ratings from 50 to 400 V, the series derives its economy from high assembly yields, the result of mounting four pretested MR2500 type cells on an electrically isolated aluminum heat sink.

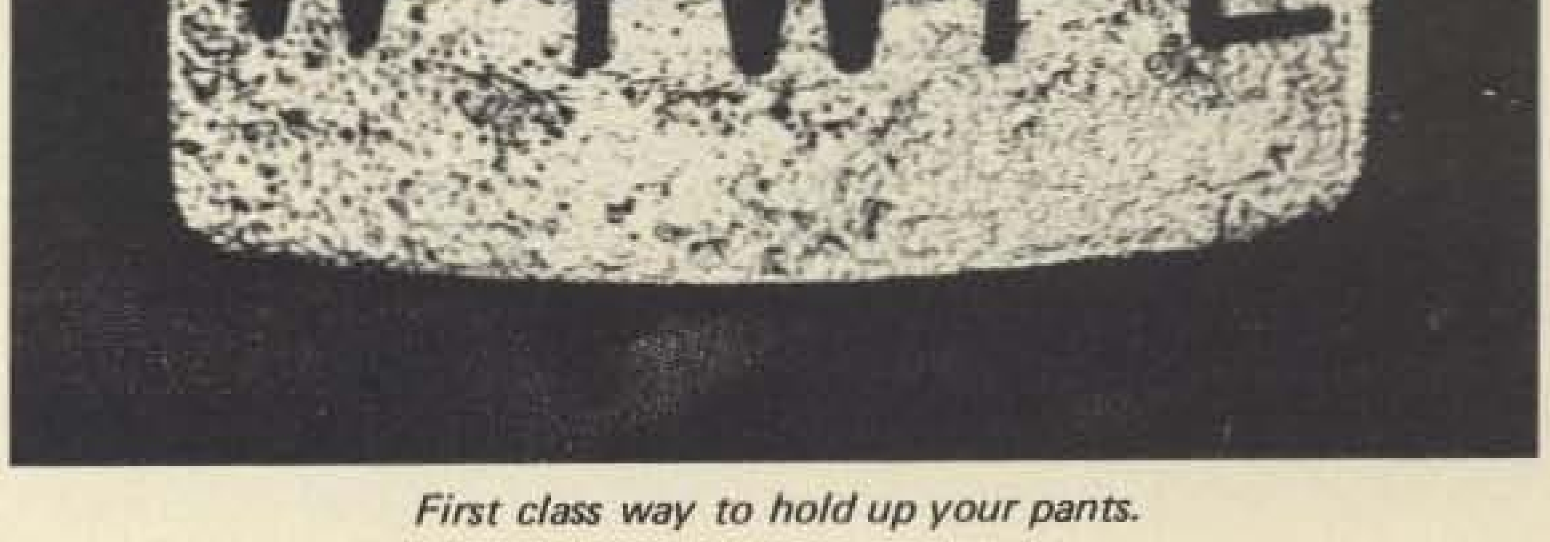
The thermally conductive case is intended for single-bolt heat sink mounting, and features terminals suitable for either soldering or ¼" slip-on connectors.

Available from distributors, unit prices in 100 piece quantities are about $2.00. *Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix AZ 85036; phone (602)-244-6900.*

A GREAT WAY TO HOLD YOUR PANTS UP

A giant call letter belt buckle cast in solid bronze or sterling silver not only helps to hold your pants up, but also looks terrific and is a great conversational ice-breaker. The Colorado Silver Company individually cast each buckle in a manner that insures that no two are exactly alike. Engraved with your call letters, they make great gifts for yourself or others.

Each buckle is engraved with care and backed with an unconditional guarantee that if it ever fails, it will be repaired or replaced free of charge. The cast bronze buckle is only $12.95; the sterling silver buckle costs $65.00 (for a little more, go first class!). Please add $1.00 per buckle for postage and handling. *Colorado Silver Company, P.O. 1755, Aspen CO 81611.*



First class way to hold up your pants.

James P. Berry K4FFW
512 Guilford Road
Rock Hill SC 29733

Autopatch Digit Suppressor

—avoid huge phone bills!

Since our local club is small and operates with rather limited funds, we were slow in getting a repeater on the air to serve our area. After the repeater was on the air for several years, the club members were anxious to have an autopatch, but it was only after we received pledges to pay the phone bill that we felt the club could afford this luxury. So, it was with great anticipation that we began installing our newly purchased autopatch.

To our dismay, within an hour after we began installing and adjusting the patch, malicious interference began to come in through the repeater. Someone with a touchtone pad was turning the patch on and just leaving it on and was turning the patch off when someone would try to use it. This continued incessantly for several weeks.

We could have lived with these problems, as the patch had an automatic disconnect which would turn the patch off after a preset time if there was no one with a tone pad monitoring. However, our "friend" began turning the patch on, dialing the operator, and then disappearing. We realized it wouldn't take much of that before the local telephone company (independent) would take a disliking to our operation. It was apparent, also, that our "friend" could begin dialing long distance numbers and run up a nice telephone bill for the club. The malicious incidents became so frequent that it appeared that we would have to remove the patch from service.

We knew that devices were available which prevent dialing the operator or long distance, but this option was beyond our means. None of our members had any digital design experience, so I decided to attack the problem with my limited experience with digital circuits. The circuits which appear in Figs. 1 and 2 were the result.

It may not be the cleverest or best way to do the trick, but it is simple, straightforward, uses common TTL devices (as they're the only ones I knew anything about), and works. If a one or a zero is dialed as the first digit, the patch is automatically disconnected. This prevents dialing the operator, direct dial long distance, and directory assistance (which is a toll call now).

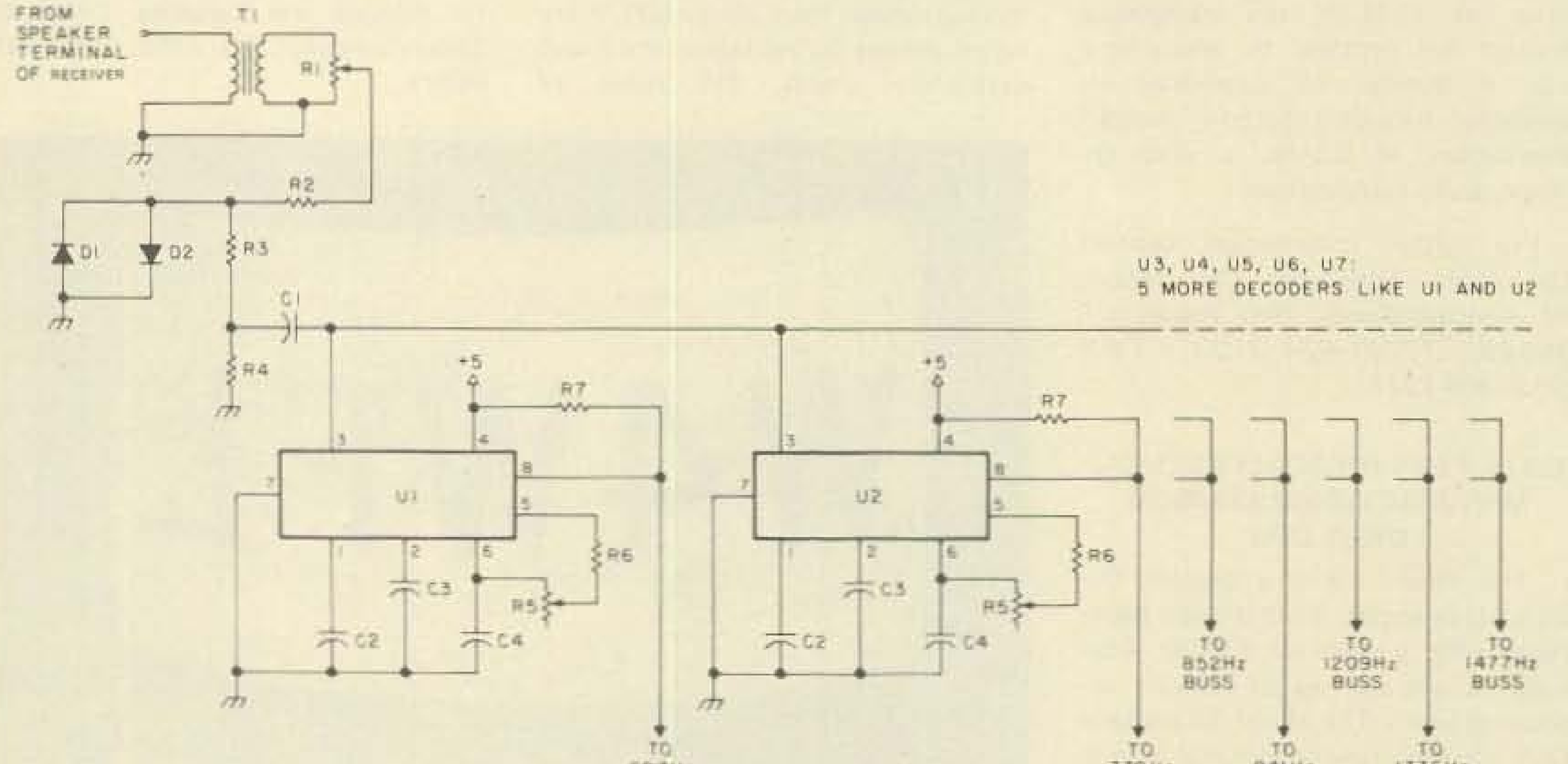


Fig. 1.

Circuit Description

Audio from the speaker terminals of the repeater's receiver, raised to a higher impedance by T1, passes through the voltage divider-limiter network composed of R2, R3, R4, D1, and D2 and is fed through C1 to the seven NE567 tone decoders, U1 through U7. Pin 8 of the decoders is held high by +5 volts applied through R7. When the decoder is activated by the proper tone, pin 8 is grounded, producing a low on the corresponding bus.

The normally high outputs of the decoders are inverted to lows by U26 through U32. This results in a low on both inputs of all of the digit select NAND gates, U8 through U19, producing a high on their outputs.

The normally high outputs of the * and # NAND gates, U16 and U17, are applied to the inputs of U20, producing a low output, which is inverted to a high and applied to the preset of U24. When a low is placed on the preset pin of U24, the low (grounded) at the data input of U24 is transferred to the $\overline{Q}$ output, which places a high on the Q output. This will be the state of U24 from the preset received when the patch was last turned off.

Unless the tones for a one or zero are being received, the output of U21 will be low, assuring a high on the output of U23 and the patch-inhibit terminal of the autopatch. A low applied to the patch-inhibit terminal will turn off the patch.

When the tones which comprise a * (941 Hz and 1209 Hz) are received (to activate the patch), the outputs of those two decoders go low and are inverted to highs. These highs, applied to the inputs of U16, give a low out, producing a high output for U20, which is inverted to a low on the preset pin of U24. This low at the preset of U24 places a high on the Q output and the inputs of U22 and U23. This preset state of U24 will remain until a high is received at the clock input.

At this time the patch has been activated by the * tones, and, if the tones for either a one or zero are now received, the output of U18 or U19 will place a low on the input of U21. The output of U21 will be high, and, when this high is applied to the input of U23, along with the high from U24, the output of U23 (patch-inhibit) will go low, turning off the patch.

If, however, the first tones received after activating the patch are for a 2, 3, 4, 5, 6, 7, 8, or 9, then one of the U8 through U15 NAND gates will have a low output, which places a low on one of the inputs to the 8-input NAND, U25. A low input to U25 gives a high out, which is inverted by U33 to a low. This low applied to the input of U22 gives a high out to the clock input of U24, reversing the logic on the Q and $\bar{Q}$ outputs, leaving a low on the Q output. This results in a high out of U23 to the patch-disable terminal of the patch.

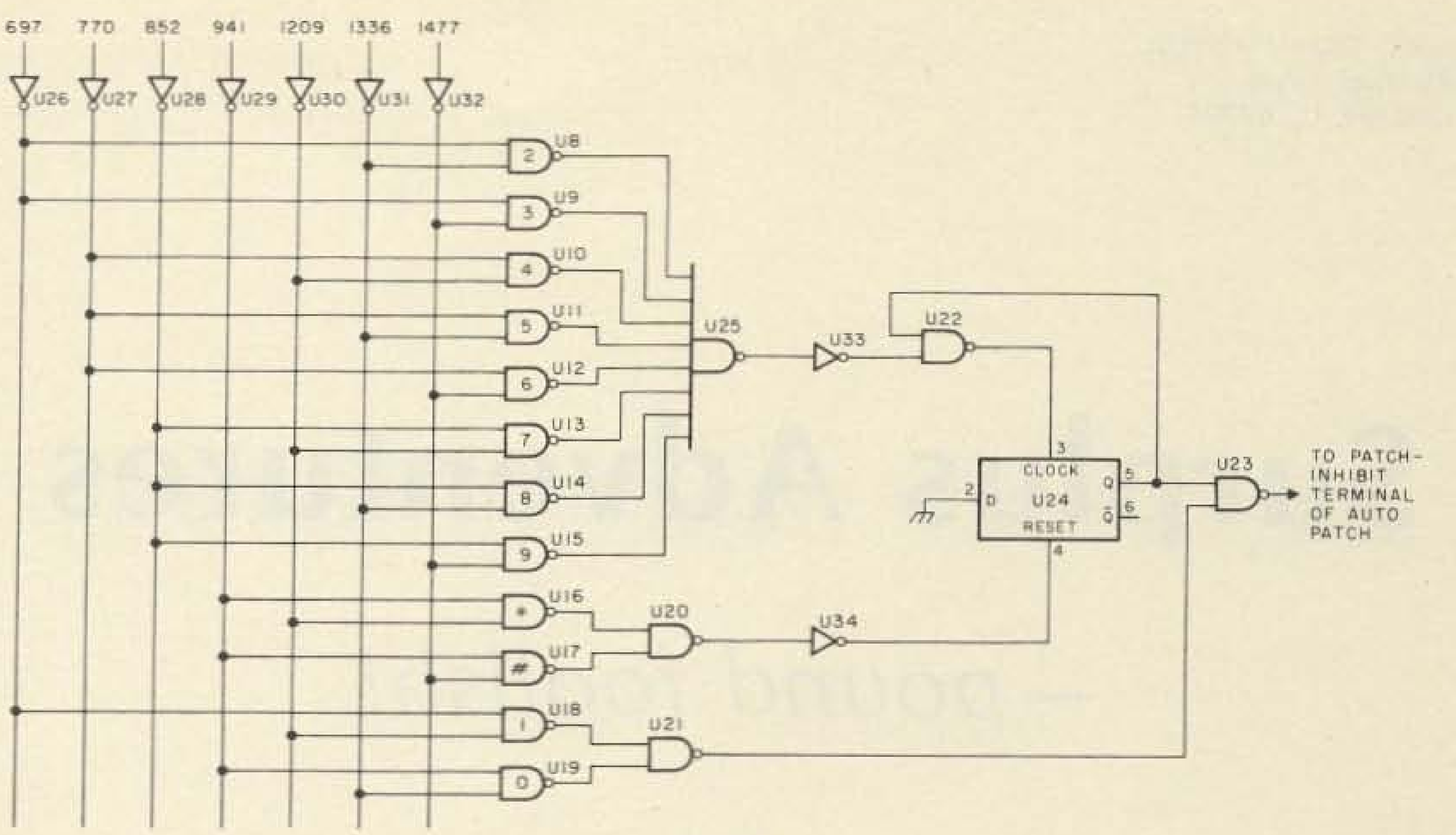


Fig. 2.

The state of U25 will not change (locking a high on the output of U23), unless the clock input returns to a low and then goes high again. This cannot happen unless U24 is preset again by a low on the preset pin, because the low on the Q output is applied to the input of U22, locking a high on the clock input of U24. The next digit received cannot affect the state of U24, and, since there is a low latched on the input of U23, a one or zero can now be received without causing a low at U23's output. When the # tones are received to disconnect the patch, a low on the preset of U24 results, returning U24 to its original state.

Adjustments

Each of the NE567 tone decoders was tuned to the proper frequency by connecting a frequency counter to pin 5 of the NE567s and adjusting R5 until the counter showed the proper frequency for that decoder. Then R1 was adjusted so that the NE567s would decode consistently, with the volume control of the repeater's receiver set in its normal operating position.

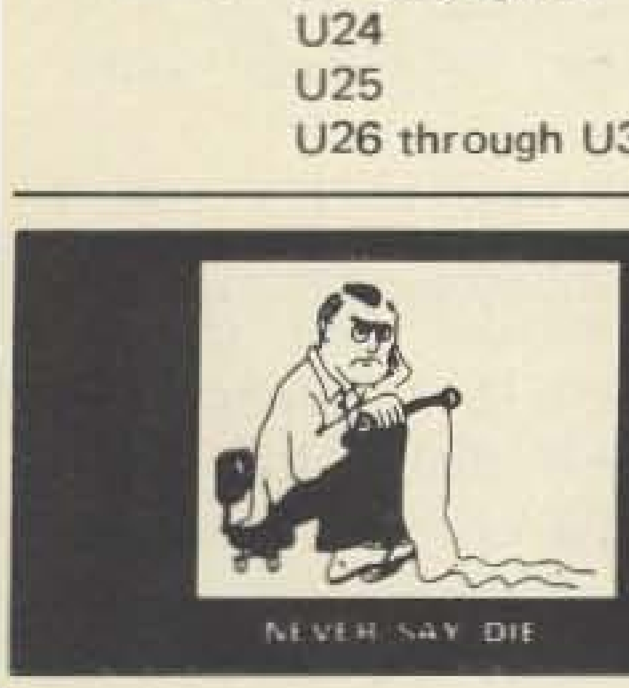
This device has considerably reduced the anxiety of the repeater committee and monitors and was well worth the less than $20 it cost. ■

Parts List

U1 through U7	NE567
C1	0.47 uF
C2	10 uF
C3	1 uF
C4	.1 uF
D1, 2	1N914
R1	10k trimpot
R2	4.7k
R3, 4, 7	2.2k
R5	10k, 10 turn pot
R6	5k
T1	8 Ω, 2k miniature audio
U8 through 03	¼ 7400
U24	½ 7474
U25	7430
U26 through U34	1/6 7404

Parts Needed

Resistors (¼ W)	
4.7k	
2.2k	
5k	
Capacitors	
.47 uF	1
.1 uF	7
1 uF	7
10 uF	7
ICs	
NE567	7
7400	4
7404	2
7430	1
7474	1
Trimpots	
10k	1
10k, 10 turn	7
Diodes	
1N914	2
Transformer	
8 Ω, 2k audio	1



... de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 103

of *73* study materials for the classes. This is not a commercial pitch, just a recognition of the work of outstanding clubs.

SEND CARD, GET LIFE

If you had any idea of how expectantly some advertisers wait for news from us that you would like to have their catalog or literature, you'd never let a *73 Magazine* get onto your shelf without first sending in the Reader Service card.

Just inside the back cover of each issue of *73* is a page with two cards on it. You are supposed to tear out one of these cards, circle the numbers which are keyed to the ads, and mail it in. No one will be upset if you also use the card for a subscription or for ordering books, tapes, etc.

In order to further impress upon you the importance of consummating this required bit of reader duty, we are going to have a drawing each month from the cards returned. The winner will get a life subscription to *73*. With this bounty available, perhaps your subconscious mind will work this over and keep you from getting to sleep before you've filled out the card and returned it.

The advertisers put a lot of store in reader reply response, so propitiate them . . . circle away . . . mail.

NOVEMBER WINNER

Did you miss the "Electronics Study Guide" in our November issue? If you did, you also missed the best article of the month, according to our readers. As the winner of our November popularity poll, Ken Wilson of St. Louis receives from us a bonus check for $100, in addition to his normal article payment. A typical letter praising Ken's piece can be found in this month's "Letters" column, but remember that such missives are not counted as votes. To cast a ballot for your favorite article, simply fill in the appropriate blank on our Reader Service card (after you circle your requests for info from advertisers) and send it in. You'll be doing yourself *and* your favorite author a favor.

James C. Chapel W9HDA
2349 Wiggins Ave.
Springfield IL 62704

Surplus Adventures

—pound foolish!

Over two years ago, a friend at work told me about getting on the U.S. Government surplus sales list. He was even kind enough to give me the back sheet from one of his many catalogs. I filled out the form and waited.

After about three weeks, a form arrived, along with an accompanying booklet of explanation. The range of surplus is amazing – from dental chairs to typewriters, from army jeeps to magnetrons. After selecting my area of interest – mainly electronics-related equipment – and also selecting geographic areas of interest, I returned the form. It wasn't long before catalogs from Ogden, Memphis, and Columbus started arriving. Each lists several hundred items or groups of items available at various military or defense storage areas within that Defense Property Disposal Region. For example, Columbus takes in some of the east, most of the north central states, and even some of the near west. Keep in mind, in filling out the form, that if you find an item of interest, you bid on it, and you win, you must pick it up yourself or hire someone to pick it up. The government does not ship or arrange shipping.

The bid list, besides giving the location and general description of the equipment, also indicates the condition (good, fair, poor, used, or new, and repairs needed or parts missing if applicable). The condition can drastically influence the bid price, making that point an important consideration.

After receiving a few dozen pamphlets or catalogs describing the items of interest, mainly a good AM signal generator, I decided to get my feet wet. I proceeded to bid on a signal generator in Kinross, Michigan. I also bid on a unit in Omaha, Nebraska. As it turned out, the government sends to all bidders, whether high or low, a list of all winning bidders' names and addresses, and the amount they bid. From this list, I found out I missed by $10 in Michigan and was $30 low at Omaha. This list is very helpful even if you lose, since it gives a good indication of the going price of a unit at that location.

After several additional bids without any success, the unit I really wanted appeared at McConnell Air Force Base – an ASM-44A in good condition and packed. Having had the going prices at several similar sales, I added about $20, plus $1 to be just over an even amount.

A week after the bid opening, my notice of award arrived, along with the bill for the remainder of the amount due. With the bid form, it is necessary to include at least a 20% deposit of the total amount bid. I quickly sent the check back to Columbus to insure my purchase of the "new" signal generator.

The government gives successful bidders one month after the award to pick up the equipment. Since McConnell is at Wichita, I came up with the idea of having a friend of a friend pick up the generator and take it to the airport for air freight shipment. Unfortunately, the friend's friend had changed jobs and left town.

Next came an ad in the mail about a directory of packers and shippers at major bases and storage areas. Away went my check, and back came the book by return mail. The directory didn't tell much more than the yellow pages in the Wichita phone book. It was obvious that it would require several phone calls, and even then it was questionable what I would get in the way of service.

Out came the road maps to see how I would drive to Wichita. It calculated out to 450 miles each way, but it was all interstate or toll road. That would mean at least two days off work, plus a night's lodging and at least 4 or 5 meals on the road, skipping a meal or two. That cost, with the driving expense or even by renting a car, didn't look too appealing. Time was growing short, with only a week and a half before the generator had to be picked up.

A call to the local airline showed there were no connecting flights that would get me to Wichita from Springfield and back all in the same day. Another call to another airline discovered a morning flight from St. Louis to Wichita and a return flight back to St. Louis that late afternoon. Everything looked fine, until I checked for reservations on the only day I could go, a Wednesday. I could get there but was wait listed on the return, the only flight at that time back to St. Louis. Well, I picked up the tickets, wait listed or not, and prepared to get back somehow.

I told the boss I was taking off a day on vacation that Wednesday, and proceeded to study maps of Wichita. The airport is on the southwest side, and the base is on the southeast side about 18 miles from the airport. About the only thing to do would be to rent a car when I got to Wichita. A cab (with the waiting time) would be astronomical.

The day arrived and I drove to St. Louis. Everything looked fine until it started to snow. The schedule was such that I had about four and one half hours between scheduled arrival and scheduled departure. Taking no suitcase and only one day officially off work, I began to perspire as the snow continued to come down.

The plane arrived, and about that time the snow let up. Before long we were airborne, and I began to see the new signal generator at home in the lab. Arrival was pretty much on time. Having no baggage, I hastily proceeded to the rental car agencies. One agency had no line and the best rates, so I quickly found out why. They also had no cars available. A quick review of the other agencies showed only reserved cars available. With only $19.47 in my pocket, I knew a cab wouldn't be possible. Again, that warm feeling. Just then the attendant at the first rental agency called. me. She unexpectedly had had a car turned in. I was in business.

The time to the base was only about twenty-five minutes. Upon entering the base, I asked the security guard the directions to property disposal. He sent me to a large, impressive-looking administrative building. When I told an officer in the first office what I was looking for, he scratched his head and informed me I was on the wrong end of the base. The 20¢ per mile figures started clicking in my mind. However, he drew me a map and away I went with the rental odometer clicking.

Everything went fine until I ended up in the officers' housing project with a built-in school. Next, back to the nearest guard house, where I was informed I should have turned right where the quickly-made map went straight. Within eight minutes and another dollar on the rental car, I found the disposal center, an old quonset-type building way over on the far corner of the base. All was fine now, except everyone in the three-person office was out to lunch. After about 10 minutes, everyone returned. The paperwork was completed, and I was taken to an adjoining building where typewriters, engine parts, and tools lay along the aisle. Here it was at last, the signal generator. A quick examination, and it looked like everything was in order. The property disposal official helped me load the generator (in its huge case) into the car. It was so large and heavy with the case that it wouldn't fit in the trunk. The only place it would fit was on the front seat next to me. Well, mission nearly accomplished if I could get it and myself on the plane that afternoon.

Back at the airport with plenty of time to spare, I decided to look thoroughly at the unit. It looked in reasonably good physical shape, except for the tag that stated "repairs required, repairable." After a look through the tech manuals, it looked like an interesting piece of equipment, even if it was 17 years old and in need of repair.

Since it was well past lunch, I decided that I certainly needed something to eat and time to plan the next step, getting the generator on the plane.

After a tasty sandwich and pie for dessert, I decided that the first approach would be to check the generator as baggage. After all, I didn't have a suitcase and the unit was in a sturdy shipping case. The bid description had stated 100 pounds, but that had to be wrong. Besides, maybe I could find an airline agent who didn't mind a little heavy baggage.

A redcap was found and tipped for his help in getting the unit to the check-in counter. A look at the scales showed, gulp, 100 pounds. After 10 minutes of "discussion" with the agent, he talked me into going air freight. He would even arrange to have it transported to the air freight building a half mile away. Over to the freight terminal for the paperwork to get it shipped. After supplying all the information, I was informed that it would be on my plane, assuming I got on.

After turning in the car, a check at the airline counter was made. There was no problem in my getting to Kansas City, but I still didn't have confirmation on the KC to St. Louis section. I decided to give it a try, knowing that my newly-acquired generator would make it even if I didn't. Fortunately, the KC section was well over-reserved and I was able to stay on to St. Louis.

After arriving there, it was over to the freight office to claim my "prize." The young lady there informed me that my package was not on the flight and there of course were no more flights that evening. I had no choice but to arrange transfer upon arrival to the local airline serving my home city, and drive back home with an empty trunk.

The local air freight office was to call Thursday upon arrival of the box. Since I was away on business Thursday, I rushed to work on Friday to check my messages, but no call from the terminal could be found. I proceeded to call them, but no grey box, as I fondly called it, had arrived. At that point I was ready to collect the insurance on the box, hoping it had been lost. Just before noon I called again, and the grey box had "just arrived." After parting with some more cash, the grey box was finally mine.

Most of Saturday and Sunday were spent checking out, repairing, and calibrating the new purchase. As it turned out, the repair was very minor – a shaft on the amplifier tuning capacitor had slipped and it was a relatively simple and quick repair. Calibration, cleanup, and just plain looking took most of the time.

After all my adventures, you may ask, "Was it worth it?" After totaling up all my bills, including redcap, rental car, gasoline, parking, and air freight, it still came out to $150 less than the commercial dealer's price (FOB his location). Right now, I am bidding on a dual trace oscilloscope, but this time it is close enough that I can drive there and back in one day, hopefully. The letter of award just came. I'm off to Omaha! ■

Ham Help

I've found a friend who must use a "talk-board." Some people simply cannot follow as she points out one letter at a time. She wants an LED version.

It is possible to use a numeric character display in a passable alphabet display. Do you have someone among your readers who might take a handful of ICs and slap together a simple readout?

I believe a two-digit code would be possible, if a character-by-character approach were used. If she sketched each character, bar-by-bar, a simpler, but tedious approach would do – light numbered bars, then advance to next character.

If anyone is interested, I'll send his name to her and she will correspond.

Bob Russ W9NWV
C.L.H. Home
Box 98
Walworth WI 53184

Help! When you got me interested in RTTY, you didn't tell me that most of the machines were built before I was. Would you please help me locate a pair of 323B tubes and an NE42 tube for my Model 15 power supply? Also, "RTTY SWLing" (*73*, Sept., 1977) was great, if you live in New Jersey. How about for the west coast? A good strong 60 wpm English news station might keep the XYL from taking an eight-pound sledgehammer to my green keys.

RTTY is really a lot of fun and my thanks to *73* for getting me started. There's not much entertainment here in the Mojave Desert and waiting for the 20 mule team to bring the wire and generator to power a RTTY unit is great fun.

T. A. Nupp WA6WFK
13597 Gilbert St.
N. Edwards CA 93523

I need schematics for an Ameco 2 meter converter, model CB-2, and Tecraft TR-20/144, PTR-2, CC-144.

Bill Mollenhauer WA2FFZ
Box 3, RD 1
Glassboro NJ 08028

Help! I need a schematic of an Eico Model 425 oscilloscope. Manufacturer hasn't been able to help.

David R. Wilks WB5ZRJ
2004 Lakehill Lane
Plano TX 75023

I need an operator's and service manual and schematic for an Eico 753 Tri-Band SSB/AM/CW transceiver. Can anyone help?!

Tony Renna
PO Box 391
Ft. Jones CA 96032

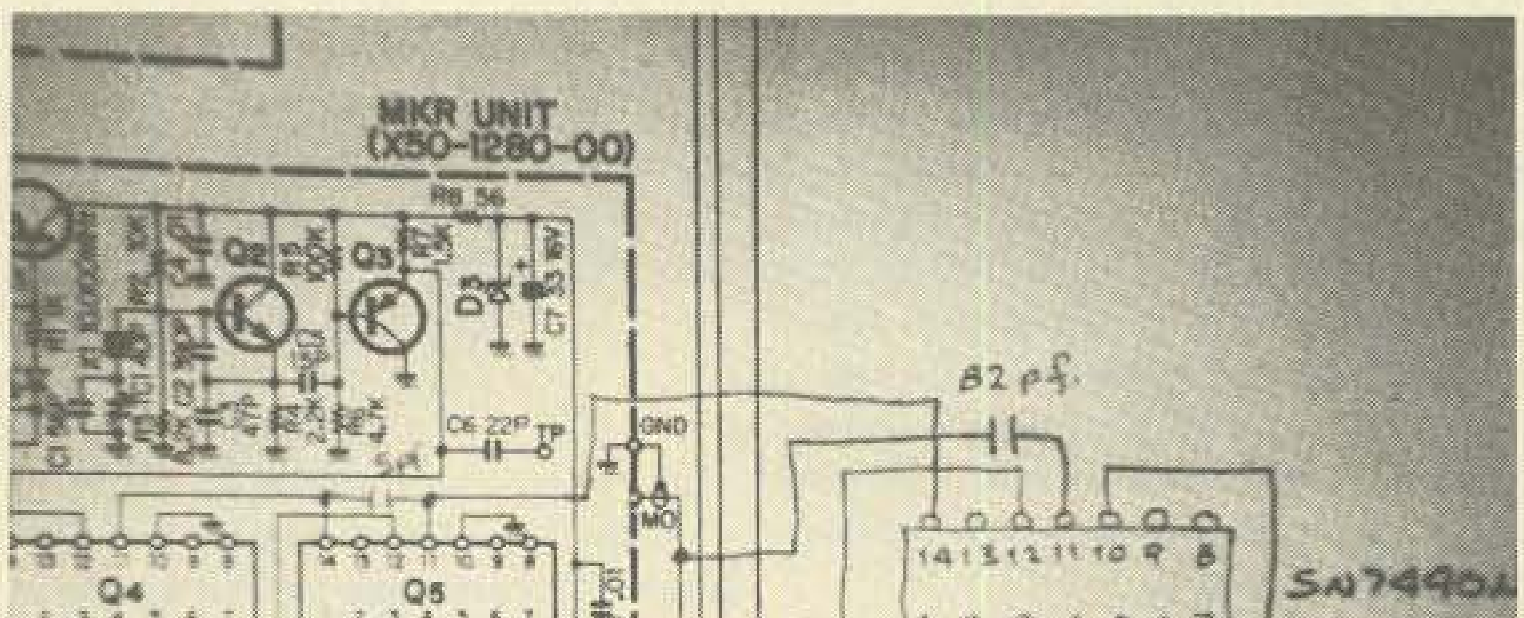
TS-700A Calibrator

—10 kHz steps, no less!

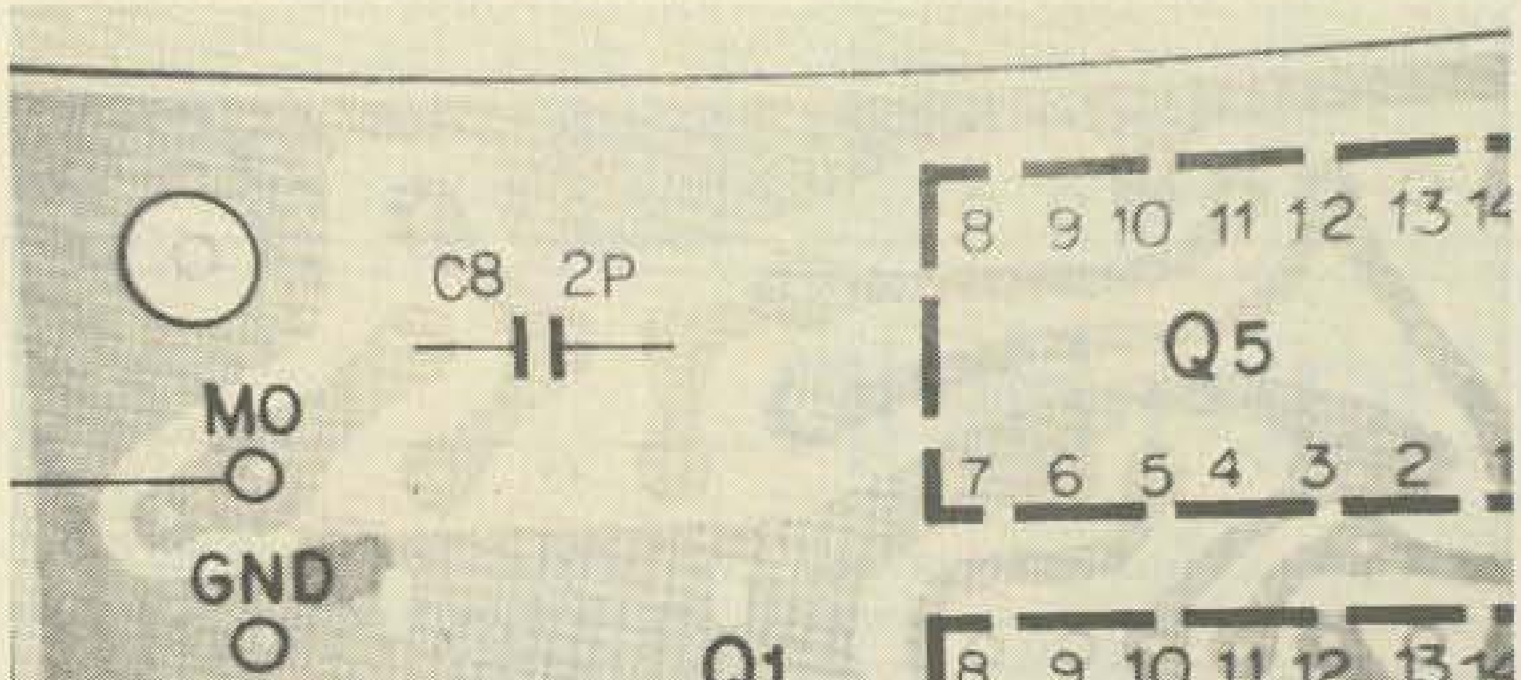
David F. Miller K9POX
7462 Lawler Avenue
Niles IL 60648

Owning a radio like the Kenwood TS-700A with full two meter coverage and all mode operation brings a new pleasure and convenience to operation on that band. The VFO rivals a crystal in its stability and the operating ease of the radio leaves little to be desired . . . except for the following. The TS-700A utilizes a 10 MHz crystal for calibration purposes; the crystal oscillator is then divided by ten to 1 MHz, and then to 100 kHz by the action of two TTL 7490 ICs in series. The system works well and puts a great deal of circuitry into a very small space, but why stop there? Since most repeater inputs and outputs are not on 100 kHz increments, but rather on 10 kHz points *within* these 100 kHz segments, why not add just one more 7490 decade divider IC and end up with calibration points right on the repeater input/output frequencies? It isn't all that difficult to accomplish and will pay dividends for many QSOs to come! Even if you're a dyed-in-the-wool SSB advocate, the vastly increased number of calibration points offers a distinct advantage in knowing exactly where in the band you are at all times. The modification to be described has been made in two different TS-700As, mine and that of K9GBG, and the results have proven to be more than worth the effort involved.

Because of the compactness of the circuitry in this radio, the approach used was perhaps a bit unorthodox, but it ended up looking very neat and the operation is FB. Rather than adding another circuit board (which could be located directly in back of the calibration board), I chose to make it easy on myself and simply "piggy-backed" the additional 7490 IC directly on top of the present 1 MHz to 100 kHz divider IC designated as Q5 on the marker unit board (calibrator board) No. X50-1280-00. The five ground connections on the new IC, which I call Q6, are carefully soldered directly to the corresponding pins on Q5 (pins 2, 3, 6, 7, and 10), giving the new IC (Q6) plenty of mechanical support. The Vcc (+5 V dc) is also picked up from the "host" IC (Q5, pin 5) using a steady hand, low wattage iron with very fine tip, and as little time on the IC pins as possible. Pins 4, 8, 9, and 13 on the new Q6 are not used and should be clipped off at the point where they widen out near the body of the IC. This leaves but four more active pins to be tied down, and they should be bent straight out, 90° from their original position, at the point where they widen out. Of these four remaining pins,



Addition of 7490N IC Q6 to TS-700A Operating Manual.

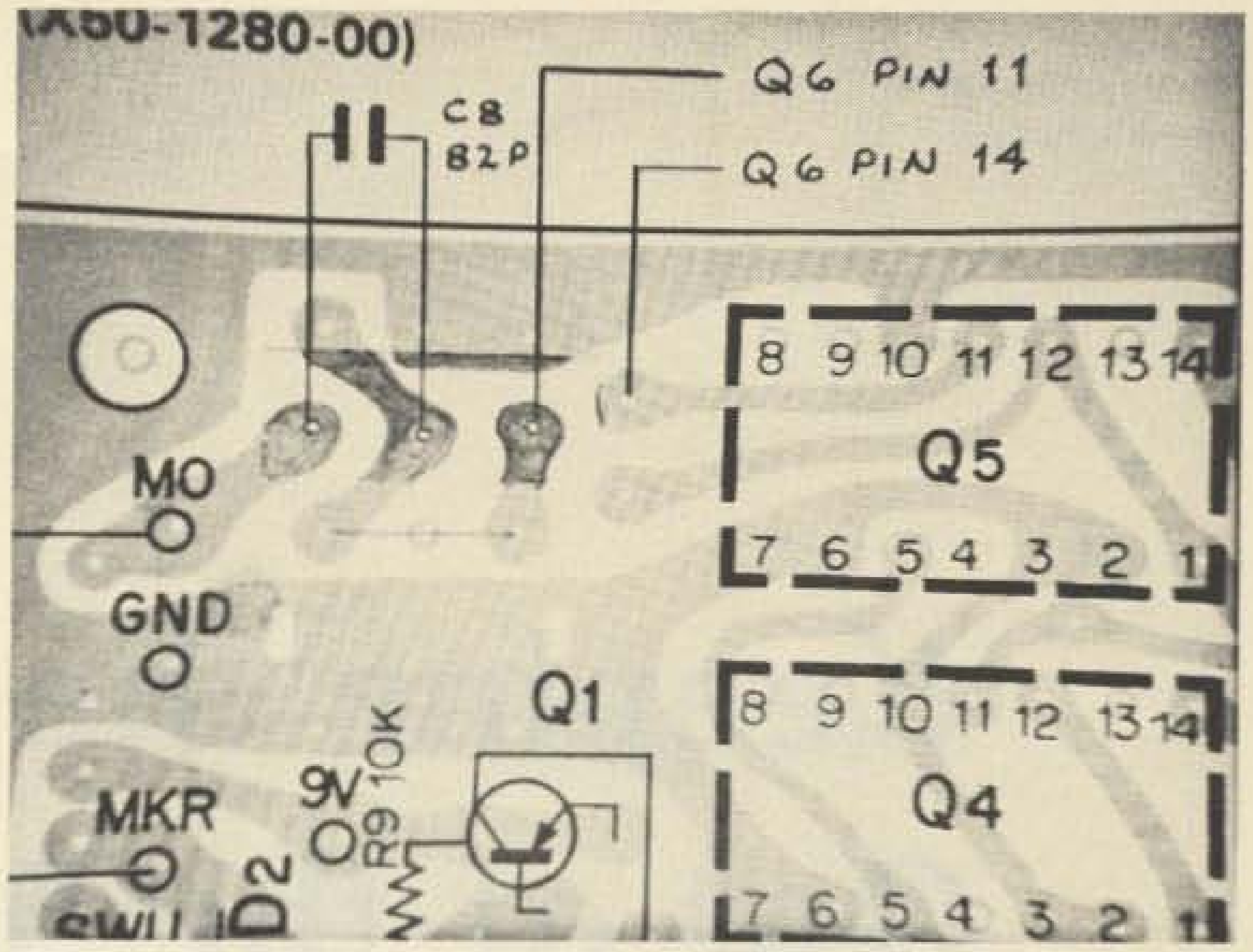


Calibrator board foil layout (bottom view) from TS-700A Service Manual before *modification.*

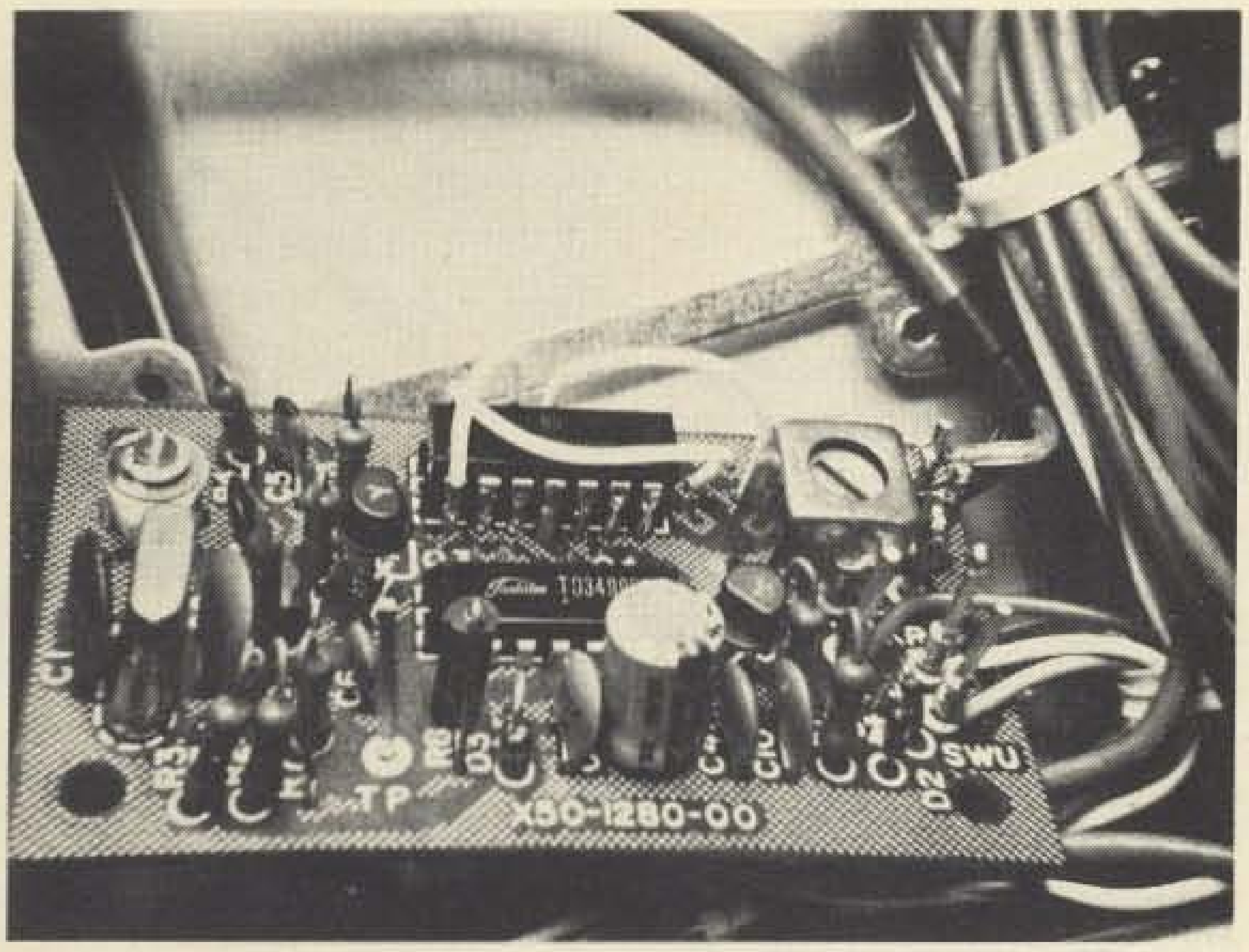
1 and 12 are easy – simply run a short length of hookup wire between them and nothing else. We now arrive at the "input," pin 14, and the "output," pin 11, of Q6.

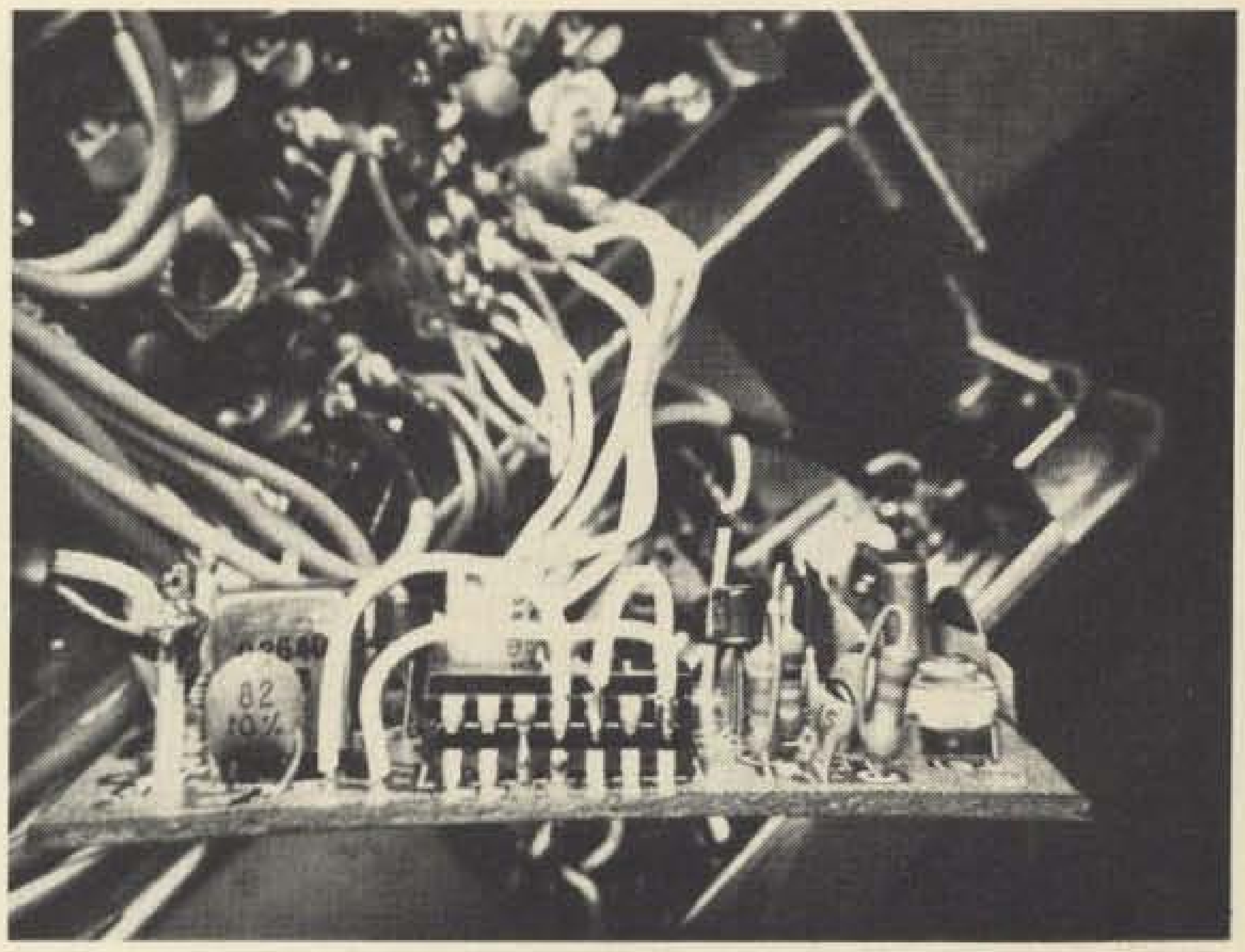
Everything up to this point can be accomplished merely by removing the bottom chassis cover from the TS-700A, but now we must take out the four screws that hold the calibrator board to the chassis bottom frame and turn the board over, carefully. First, remove the 2 pF marker output coupling capacitor C8. Carefully score the printed circuit board foil as is self-explained in the circuit board before and after photos, and remove the foil between the pads. I've found that an X-Acto knife works well for this sort of surgery; heating the foil with an iron after scoring will help to give you a clean liftoff. The output of Q5 is now isolated and can be rerouted to pin 14 (input) of new Q6 using a short piece of hookup wire (see photos of completed modification). Another short length of hookup wire will connect pin 11 (output) of new Q6 to the output coupling capacitor, which should be increased in value to 82 pF (use a disc ceramic of at least 100 WV dc). This change puts the level of the new 10 kHz markers on a par with what you were used to before this modification. I also added another 0.1 uF @ 100 WV dc disc ceramic from +5 V dc to ground as close as possible to pin 5 of Q5 (on the foil side), inasmuch as TTL ICs do tend to generate quite a bit of noise and it is so easy to add this extra bit of insurance at this time.

That's all there is to it; the modification when done as shown will *not* affect the accuracy of the TS-700A internal calibrator as long as reasonable care has been exercised in handling the board and you've stayed away from the trimmer capacitor designated TC-1. Once you've put everything back together again, it's all over except for the fun! I think that you'll agree that, like the TS-700A itself, you'll wonder how you ever got along without it! High accuracy markers every 10 kHz makes an already exceptional transceiver even more so. ■



Calibrator board foil layout (bottom view) from TS-700A Service Manual after *modification.*


Front view photo of calibrator board after *modification.*


Rear view photo of calibrator board after *modification.*

CONTESTS

from page 23

Starts: 1500 GMT
Ends: 2200 GMT
Sunday, March 5
Starts: 1500 GMT
Ends: 2200 GMT

This will be the first U.S. SSTV contest. It has been organized by R. Brooks Kendall W1JKF, Dave Ingram K4TWJ, and Wayne Green W2NSD/1, *73 Magazine*.

BANDS:

All authorized frequencies within the 3.5, 7.0, 14.0, 21, and 28 MHz bands. Slow scan activity centers around the following frequencies: 3845, 7171, 14,230, 21,345, and 28,680 kHz. Outside the Americas, activity on 40 and 80 meters occurs lower in frequency.

EXCHANGE:

Exchange of pictures should include: callsigns, RST report, and contact number, starting with 001. The contact number is irrespective of the band(s) used. Note: FCC rules require SSB/CW exchange of callsigns by U.S. stations. Do not include contact number.

SCORING:

Score one (1) point per contact on 3.5, 14.0, 21.0 MHz bands, and five (5) points per contact on 7.0 and 28.0 MHz bands. There is a multiplier of ten (10) for each continent. Score eight (8) points for each country (ARRL list). Twenty (20) points for each contact worked through OSCAR. The same contact can only be worked once on each band.

LOGS:

Logs should contain: date and time of contact in GMT, band, callsign, report (RST) sent and received, contact number sent and received, points and multiplier per contact, final score, and your signature of the log. Logs must be postmarked no later than March 31, 1978. Send logs to: R. Brooks Kendall W1JKF, 10 Stocker St., Saugus MA 01906, or Dave Ingram K4TWJ, Eastwood Village 1201 So., Rt. 11, Box 499, Birmingham AL 35210.

A complimentary two-year subscription to *73 Magazine* and a certificate will be awarded to the top scorer. A certificate will be awarded to the top scorer for the most countries worked. Certificates will be awarded to those who have worked all call zones Z1/K1 through WØ/KØ. Awards and certificates will be presented at Dayton Hamvention. If winners cannot be present, awards and certificate will be mailed to their QTH. Contest results and photos will appear in *73 Magazine!*

Richard Dundon W7RG
25230 168 Pl. S.E.
Kent WA 98031

Keeping the Zap Out of the Shack

—protection for your two meter lightning rod

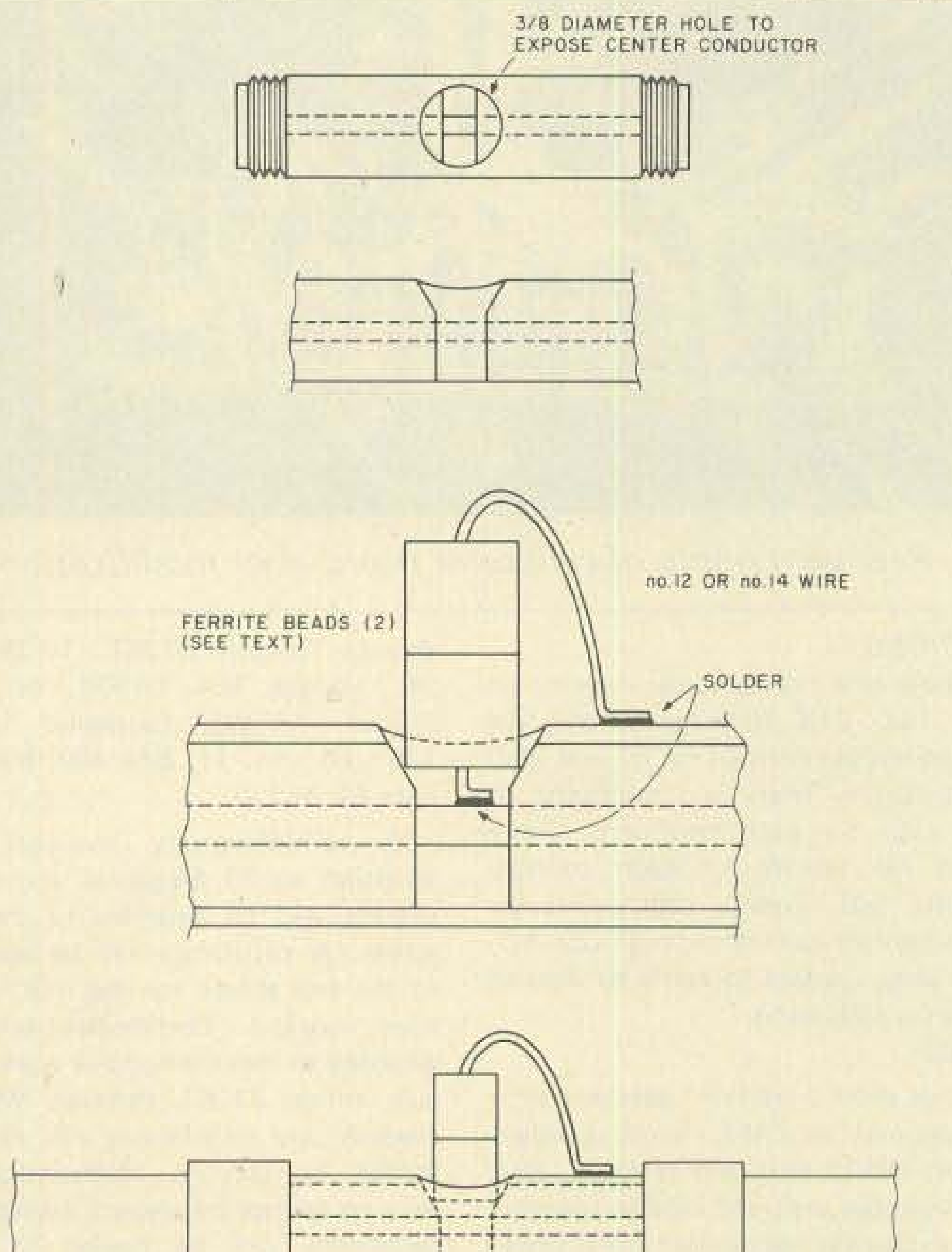


Fig. 1.

With the tremendous increase in 2 meter and up activity, many amateurs are upgrading their antenna systems and installing them higher and higher. A common installation found in all areas of the country is a single or multiple 2 meter beam array topped with a 2 meter moderate-gain vertical. Of course, this vertical inevitably becomes a very good lightning rod — that's where the trouble starts.

Most verticals are not mechanically or internally grounded like the plumber's delight beams. Therefore, any atmospheric static (i.e., rain, snow, or just good old lightning) has nowhere to go except down the center conductor of your coax, right into your nice multidollar rig, and zap!

If you ground all your antennas after each operating session, this article is not necessarily for you. But, if you want a low rf loss dc path to ground at all times, here's one approach which works and is easily constructed, at a minimum cost, with no insertion loss.

Simply put, use a couple of ferrite beads (the large ones) around a piece of no. 12 or no. 14 wire, and you have it. Amidon markets a series of 43-801, 73-801, and 64-801 beads which will handle a no. 12 wire through the center. The no. 43 material covers 50-200 MHz, no. 73 material covers 50 MHz and down, and no. 64 material covers 200 MHz and up.

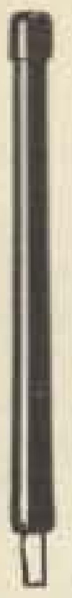
Pick two beads to suit your frequency of operation. Drill a 3/8"-diameter hole in the center of a female coupling. Solder a piece of no. 12 (or no. 14) tinned copper to the exposed center conductor of the coupling. Slip the beads over the wire, down as close as possible to the center conductor of the coupling. Form the wire over the beads to the outer surface of the coupling, and solder to make a good ground connection.

Note that the "N"-type coupling usually has gaps between the insulators at each end of the coupling and allows easy access to the center conductor for soldering. However, if the insulator is solid and continuous, a little more effort will be required to expose the center conductor.

An alternative (I did not try it) could be to use a coaxial "tee," remove the male pin, and substitute a no. 12 wire with the beads slipped inside the male end.

I recommend a good braid ground to attach directly to the modified coupling (use a tubing clamp) to minimize any stray current flow through your rig.

In my installation, there was no identifiable change in power level or swr between the modified "ginderspatch" and an unmodified coupling. ■



HY-GAIN'S MODEL 269

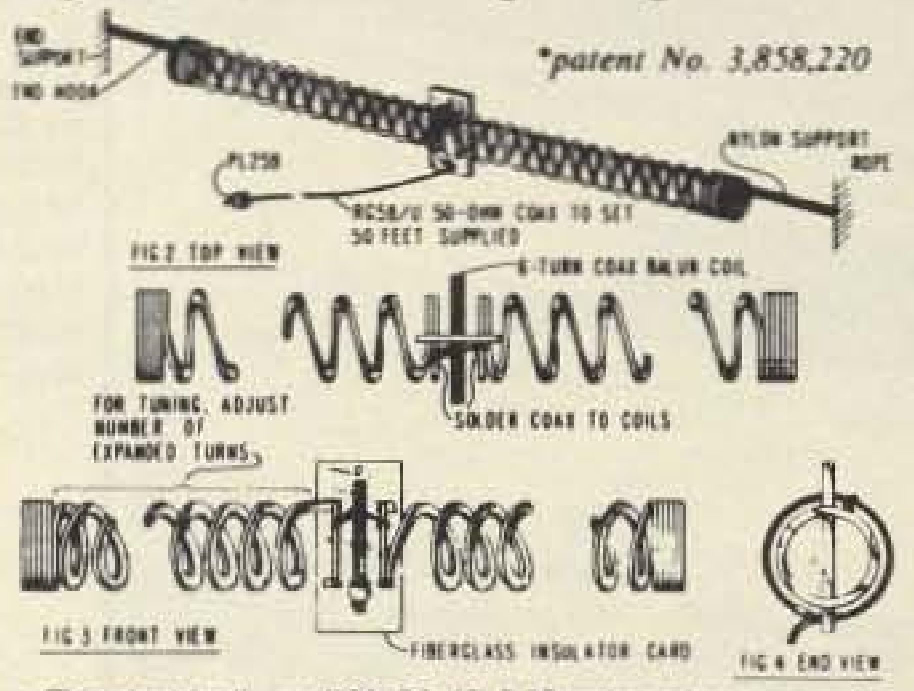
Continuously loaded VHF antenna designed for portable and walkie-talkie applications. Constructed to withstand rough handling, completely insulated with special vinyl coating, it can be bent at all angles without destroying or cracking protective finish. Cannot be accidentally shorted out.

RUBBER DUCKIES

No. 269 — Fits Standard, Motorola, Hy Gain	$8.00
No. 274 — BNE Base	$9.00
No. 226 — TNC Base Wilson 5 Watts	$10.00
No. 228 — "F" Bas & Wilson 2 Watt & Tempo	$10.00
No. 273 — SO 239 Base, Kenwood, Drake	$9.00

SLINKY! $43.95 Kit

A LOT of antenna in a LITTLE space New Slinky® dipole* with helical loading radiates a good signal at 1/10 wavelength long!



• This electrically small 80/75, 40, & 20 meter antenna operates at any length from 24 to 70 feet • no extra balun or transmatch needed • portable—erects & stores in minutes • small enough to fit in attic or apartment • full legal power • low SWR over complete 80/75, 40, & 20 meter bands • much lower atmospheric noise pickup than a vertical and needs no radials • kit includes a pair of **specially-made 4-inch dia. by 4-inch long coils**, containing 335 feet of radiating conductor, balun, 50 ft. RG58/U coax, PL259 connector, nylon rope & instruction manual

ASTATIC MICROPHONES

SILVER EAGLE — $69.95

T-UG8-D104, transistorized	$48.60
T-UG9-D104, "Silver Eagle," transistorized	$69.95
UG-D104, ceramic or crystal	$42.60

YAESU

FT-301 or FT-301D

FT101E	160-10M XCVR	$799
FT101EE	160-10MXCVR	759
FT101EX	160-10M XCVR	699
FL2100B	Linear Amplifier	479
FTV650B	6M Transverter	239
FTV250	2M Transverter	275
FV101B	External VFO	125
SP101B	Speaker	25
SP101PB	Speaker/Patch	64
FA-9	Cooling Fan	18
RFP102	RF Proc. Early 101EE	79
XF30C	600 Hz CW Filter	40
XF30B	AM Filter	40
DC-1	DC-DC Converter (EX)	50
RFP104	RF Proc. Late 101EE	79
--	FT101 Service Manual	25
FT7	80-10 M XCUR 40W Pep	499
ALL SOLID STATE TRANSCEIVERS		
FT301S	160-10M 40W PEP	559
FT301SDig	160-10M 40W PEP	750
FT301	160-10M 240W PEP	769
FT301Dig	160-10M 240W PEP	935
ACCESSORIES		
FFDX50	52 Low Pass Filter	34
FC301	Ant. Tuner	159
ERB	Ext. Relay Box	17
LL301	Phone Patch	49
FL110	Wide Band SSB/CW Amp.	165
FV301	VFO	125
FP301	AC P/S FT301/301S	157
FP301D	AC P/S w/clock and CW Identifier	239
YO301	Monitor Scope	263
SP120	Speaker FT301/221R	25
XF90B	AM Filter	40
XF90C	FM Filter	40
XF92A	SSB & Proc. Filter	45
FR101S	160-2M/SW RCVR	599
FR101SDig	160-10M/SW RCVR	749
FC-6	6M Converter	24
FC-2	2M Converter	25
FM-1	FM Detector	20

XF30D	FM Filter	40
--	AUX/SW Crystals	5
RFP101	RF Proc. (FL101)	79
FL101	S/S 160-10M XMTTR	649
VHF FM & SSB XCVR		
FT227B	2M FM Mobile XCVR	$319
FT221R	2M AM/FM/CW/SSB XCVR	688
FT620B	6M AM/CW/SSB	365
PB1424	Marker Unit 620B	25
--	FT221 Service Manual	15
MOBILE MOUNT BRACKETS		
MMB-1	FT101	23
MMB-2	FT-2A	23
MMB-4	620B, 221, 301	23
MONITOR TEST EQUIPMENT		
YO100	Monitor Scope	$246
YP150	Dummyload Watt Meter	78
YC601	Dig. Readout 101/401	199
YC221	Dig. Readout 221/221R	119
FREQUENCY COUNTERS		
YC500J	500 MHZ 10 PPM	239
YC500S	500 MHZ 1 PPM	399
YC500E	500 MHZ 0.02 PPM	537
MICROPHONES — MISCELLANEOUS		
YH55	Lo-Z Headphone	15
YD844	Hi-Z Base Mike	29
YD844L	Lo-Z Base Mike	29
YD846	Hi-Z Mike 101EX/401B	16
YM86	Lo-Z Hand Mike	16
SP401PB	Speaker/Patch (401)	59
XF31C	600 Hz CW Filter 401	40
FRG-7 Receiver		
	1 to 9	$315
	10 to 25	315
	26 to 49	315
	50 and up	315
QTR-24 World Clock		
	1 to 9	30
	10 to 25	30
	26 to 49	30
	50 and up	30
	FT-901DM	$1299
	FT-901D	1149
	FT-901DE	1149
	FT-901SD	1115
	FM Unit	40
	AM or CW Filter	40
	Keyer Unit	40
	Memory Unit	125
	DC-DC	50

TUFTS CATALOG INDEX

TUFTS

Radio Electronics

209 Mystic Avenue
Medford MA 02155
(617) 395-8280

FREE Gift With Every Order!

Name__________ Call__________

Address__________

City__________ State__________ Zip__________

Order: __________

☐ Check enclosed ☐ Visa ☐ Master Charge ☐ American Express

Credit card #__________

Signature__________ Card expiration date__________

Dealer Programs NOW Available

Master Charge
American Express
Visa

Prices FOB Medford MA. MA residents add 5% sales tax. **Minimum $3.00 for shipping & handling on all orders.**

Dealer programs NOW available!

TUFTS RADIO CATALOG TUFTS RADI

First with SSB HF Digital Tuning, is only the beginning of what the amateur gets from the CIR Astro 200.

Standard Features:

Electronic Tuning/All Solid State/Digitally Synthesized/200 Watts PEP Input/Full RF Filtering/Digital Readout/Noise Blanker/Squelch/ Variable Speech Processing/Full Metering/WWV Receiver/VOX/ LSB-USB-CW

The heart of the ASTRO-200 is the frequency synthesizer. The latest in phase-lock-loop technology is incorporated to provide the built-in versatility of all electronic tuning, crystal frequency stability at each frequency of operation, and over 40,000 HF channels displayed in 100 Hz increments. ±50Hz fine tuning for continuous ham band coverage.

Reliability is built in for years of continued use. Each circuit board is "baked-in" for over 100 hours prior to installation in the transceiver assembly. After system testing, each transceiver is again "baked" prior to final system testing ... your guarantee of on-the-air performance.

Discover the ease and accuracy of electronic tuning. Calibrate all bands with WWV at the turn of a switch. Lowest frequency drift, with no VFO to calibrate. Only 2.8" high x 9.5" wide x 12.3" deep. Ideal for mobile use or, with accessories, provides complete fixed station operation. Net Price $995.00.

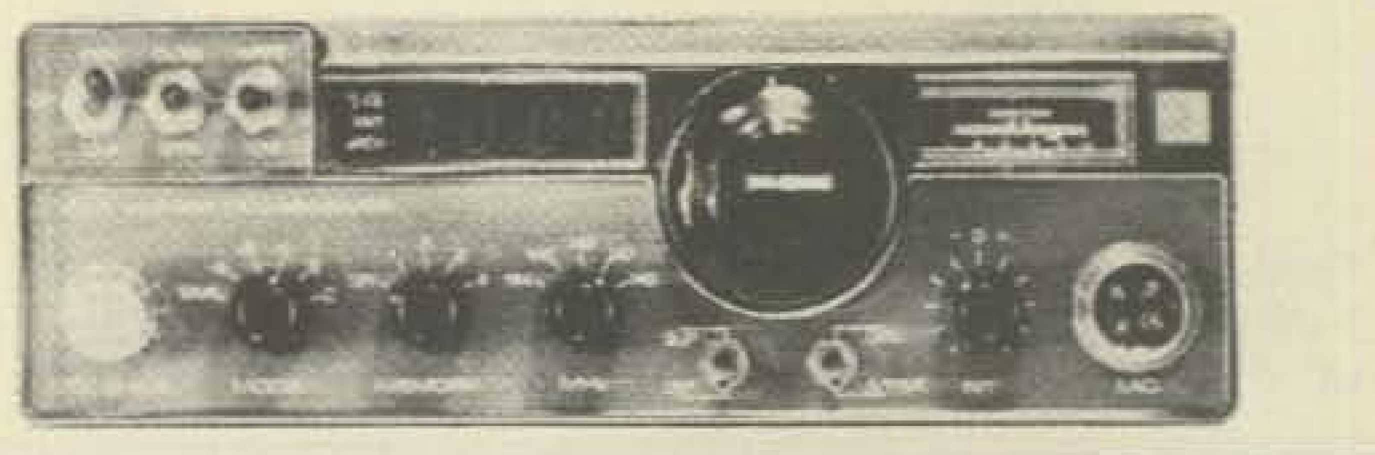
Accessories: AC Power supply $135.00; Speaker in cabinet $29.95. Station operating console with phone patch, 24 hr. digital clock, speaker, 10 min. timer $295.00. Desk microphone $38.00. Mobile mount $12.00. Mobile mic $15.00. 400 Hz narrow band CW filter $50.00.

CIR TRANSCEIVERS

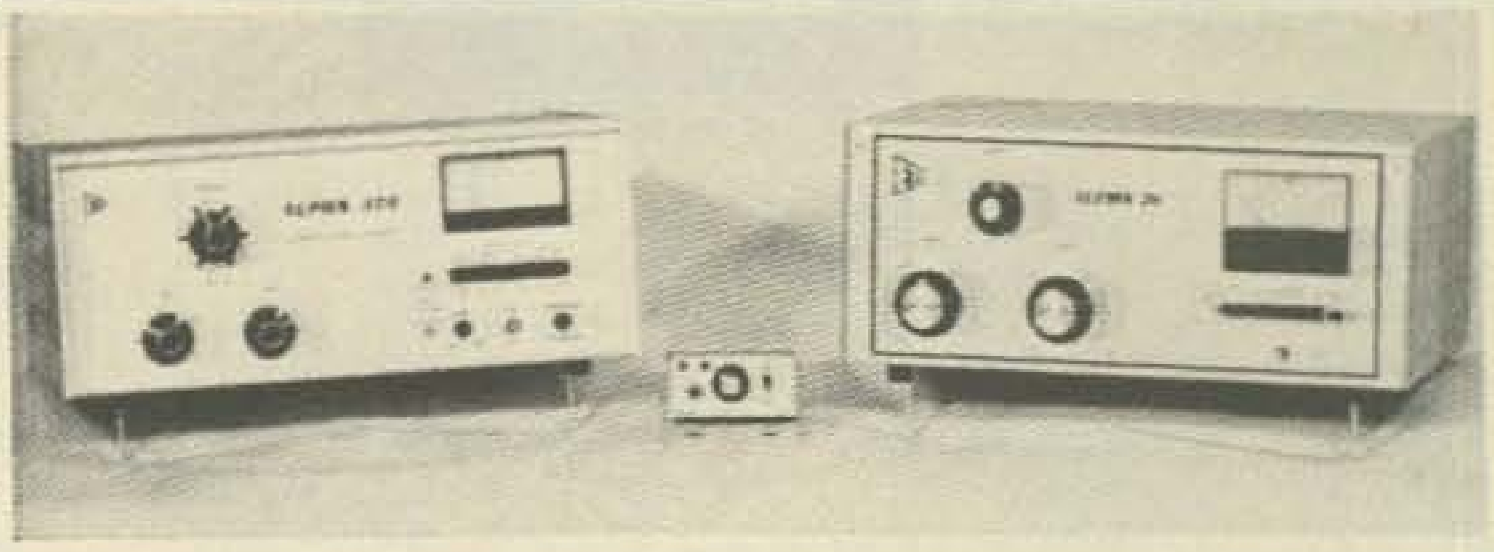
FM 2015 R

All Solid State CMOS PLL digital synthesized - No Crystals to buy! 5KHz steps - 144 - 149 MHz-LED digital readout PLUS MARS-CAP.*
• 5MHzBand Coverage - 1000 Channels (instead of the usual 2MHz to 4MHz - 400 to 800 Channels). 4 CHANNEL RAM IC MEMORY WITH SCANNING-MULTIPLE FREQUENCY OFFSETS - Electronic Auto Tuning, Transmit and Receive-Internal Multipurpose Tone Oscilator-RIT-Discriminator Meter • 15 Watts Output - • Unequaled Receiver Sensitivity and Selectivity-15 Pole Filter-Monolithic Crystal Filter and Automatic Tuned Receiver Front End-COMPARE! • Superb Engineering and Superior Commercial Avionics Grade Quality and Construction Second to None at ANY PRICE.

KDK ... **$399.00**



GET ON TOP WITH ALPHA



A GREAT OPERATING YEAR IS STARTING RIGHT NOW. SUNSPOTS ARE UP — CONDITIONS SHOULD BE THE BEST IN YEARS. THOUSANDS OF ENTHUSIASTIC NEW AMATEURS ARE ON THE BANDS. HAMMING WILL BE TERRIFIC — BUT COMPETITION WILL BE ROUGH!

WHEN QRM RAGES AND THE PILE-UPS DEEPEN, WOULDN'T YOU LIKE TO HAVE...

- ALL THE ROCK-CRUSHING POWER YOUR LICENSE ALLOWS — on *all* modes — with no need to 'baby' your linear, no duty cycle or time limit at all?
- INSTANT BANDCHANGE 'NO-TUNE-UP' all the way from 10 through 80 meters, with the exclusive **ALPHA 374?**
- COVERAGE ALL THE WAY DOWN TO 160 METERS with the smooth-tuning, extra-rugged **ALPHA 76** powerhouse?
- CRISP, PENETRATING "TALK POWER" — as much as 10 dB extra to 'punch through' when the going gets really tough, with the **ALPHA/VOMAX** split band speech processor? It's as effective as the best rf processor, lower in distortion, and very easy to use with *any* rig!
- THE PROTECTION OF A FACTORY WARRANTY THAT RUNS A FULL 18 MONTHS — *six times as long* as competitive units? **(ETO tries to build every ALPHA to last forever . . . and we're making progress: not one single case of ALPHA 76, 77D, or 374 power transformer failure has ever been reported!)**
- THE PURE PLEASURE OF OWNING **ALPHA?**

Alpha 76 - $1195.; Alpha 77D - $3195.; Alpha 374 - $1595.

2 Meters VHF Disguise
ASPS-748 (most cars); ASPS-798 (Ford, Mercury)
ASPR-788 (Chrysler, Dodge, Plymouth)
$45.00 each

Featuring a 5/8 wavelength taper ground stainless steel whip, this antenna provides exceptional performance with the exact appearance of a conventional broadcast receiving antenna. The DURA-CON™ plated whip reduces power losses to deliver more signal. When used with ASPR619 coupler, this antenna will allow simultaneous use of both two-way and broadcast radios. Stub tuning provides 2.5 MHz bandwidth for multiple channel use. Swivel base may be mounted on surface with up to 35° slant. Specify frequency when ordering.

Gain: . . . . 2.5 dB	VSWR: . . . . .Less than 1.5:1
Maximum Power: . . . . 100 watts	Bandwidth: . . . . .2.5 MHz
Frequency Range: . 144-174 MHz (specify frequency)	Nominal Impedance: . . . 50 ohms

HM-180

HM-187

HM-225

HM-179 Low Profile Mount – $25.00
HM-180 Trunk Mount – $27.00
HM-187 Magnet Mount – $32.00
3 dB Gain* HIGH PERFORMANCE VEHICULAR ANTENNA SERIES

All new low profile antennas feature a 5/8 wavelength high conductive whip. Spring and whip may be removed leaving only 1-3/16" high base for minimal car wash clearance.
Coils are low loss, shock resistant, directly fed ungrounded configuration and encased in plastic base. New high conductive whips are made of 17-7 PH stainless steel ... coated with copper and nickel for high conductivity and greater heat dissipation. Mounts are Teflon-insulated, aluminum and plated steel.

ELECTRICAL SPECIFICATIONS

Antenna power rating:	100 watts
Frequency range:	144-148 MHz
VSWR:	1.5:1 or less
Nominal input impedance:	50 ohms
Transformer:	16 AWG copper wire, low loss coil, waterproof cover
**Gain:*	3 dB over 1/4 λ whip

HM-223 Trunk Mount – $26.00

3 dB Gain 5/8 λ Mobile Antenna on easy to install "Quick-Grip" trunk mount. Whip is easily removable for storage or car washes. 17' RG-58/U and connector.

ELECTRICAL SPECIFICATIONS		MECHANICAL SPECIFICATIONS	
Gain:	3 dB	Radiator:	.125 dia. 17-7 PH stainless steel plated with copper and nickel
Bandwidth:	5 MHz		
Power rating:	100 watts	Length:	Whip 30"
Impedance:	50 ohms		

HM-224 Trunk Mount – $36.00

The most powerful mobile antenna available for 1-1/4 meter mobile activity. 4 dB gain is achieved by stacking a 5/8 λ and 1/4 λ radiator. "Quick-Grip" trunk mount means easy no hole mounting. Whip is quickly removed for car washes or storage. 17' RG-58/U and connector.

ELECTRICAL SPECIFICATIONS		MECHANICAL SPECIFICATIONS	
Gain:	4 dB	Radiator:	17-7 PH stainless steel plated with copper and nickel
Bandwidth:	5 MHz		
Power rating:	100 watts	Length:	Whip 48"
Impedance:	50 ohms		

HM-225 Unity Gain (Marine Mobile Service) – $42.00

Unity Gain 3' fiberglass antenna for marine use. No ground plane required. Can be mounted at masthead on sailboats or on any vertical surface on power boats. Comes with 2' RG-58C/U cable.

ELECTRICAL SPECIFICATIONS		MECHANICAL SPECIFICATIONS	
Gain:	Unity ½ λ dipole reference	Length:	Approx. 3'
Power:	25 watts	Radiator material:	Copper encapsulated in fiberglass
Frequency range:	220-224 MHz	Mount:	Anodized aluminum bracket
Impedance:	50 ohms		

ETO EHRHORN TECHNOLOGICAL OPERATIONS, INC.

HMR172 5 Element Yagi – $29.00

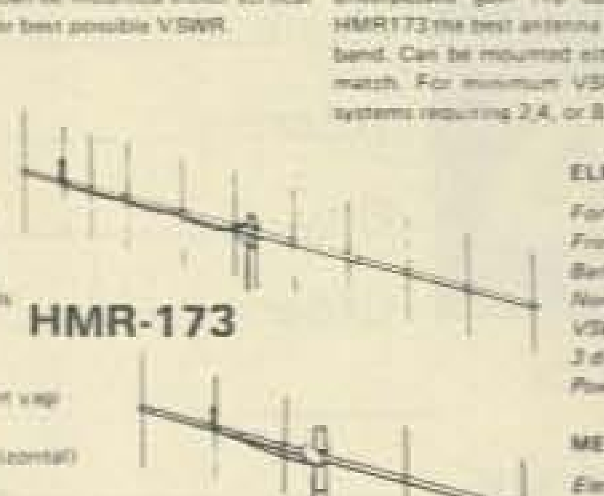
Whether you use a low-powered QRP "lunch box" rig or the full legal limit, the HMR172 offers 10 dB gain and 4 MHz bandwidth for superior performance under any band conditions. Can be mounted either vertical or horizontal. Adjustable gamma match for best possible VSWR.

ELECTRICAL SPECIFICATIONS

Forward gain:	10 dB
Front-to-back ratio:	15 dB
Bandwidth:	4 MHz
Nominal input impedance:	50 ohms
VSWR:	1.5:1
3 dB beamwidth:	58°
Power capability:	500 watts

MECHANICAL SPECIFICATIONS

Element configuration:	5 element yagi
Length:	6'
Turning radius:	3.5' (horizontal)
Weight:	3 lbs.
Rated wind velocity:	100 mph
Windload area:	.53 sq. ft.



HMR-173

HMR-172

HMR173 11 Element Yagi – $49.00

Whether your interest lies in Moon Bounce, Tropo, or meteor scatter, the HMR173 is the solution to long-haul communications. The unsurpassed gain (13 dB) and 38° (3 dB) beamwidth makes the HMR173 the best antenna for the VHF world. Covers the entire 2 meter band. Can be mounted either vertical or horizontal. Adjustable gamma match. For minimum VSWR. — Information available on "high-gain" systems requiring 2,4, or 8 HMR173 yagi antennas.

ELECTRICAL SPECIFICATIONS

Forward gain:	13 dB
Front-to-back ratio:	16 dB
Bandwidth:	4 MHz
Nominal input impedance:	50 ohms
VSWR:	1.5:1
3 dB beamwidth:	38°
Power capability:	800 watts

MECHANICAL SPECIFICATIONS

Element configuration:	11 element yagi
Length:	17'
Turning radius:	9.2' (horizontal)
Weight:	6.5 lbs.
Rated wind velocity:	100 mph
Windload area:	1.25 sq. ft.

HM-20 Marine Mobile Service – $35.00

Unity gain 5' fiber glass antenna for marine use. No ground plane required. Can be mounted at masthead on sailboats or on any vertical surface on power boats. Comes with 2' of RG-58C/U cable.

ELECTRICAL SPECIFICATIONS

Gain:	Unity (reference ½ λ dipole)
Power:	25 watts
Frequency range:	146-148 MHz
Nominal impedance:	50 ohms

MECHANICAL SPECIFICATIONS

Length:	Approximately 5'
Radiator material:	Copper encapsulated in fiberglass
Mount:	Anodized aluminum bracket

ASPR619 Coupler – $16.00

Coupler for simultaneous 2 meter and AM/FM broadcast radio usage.

why waste watts?

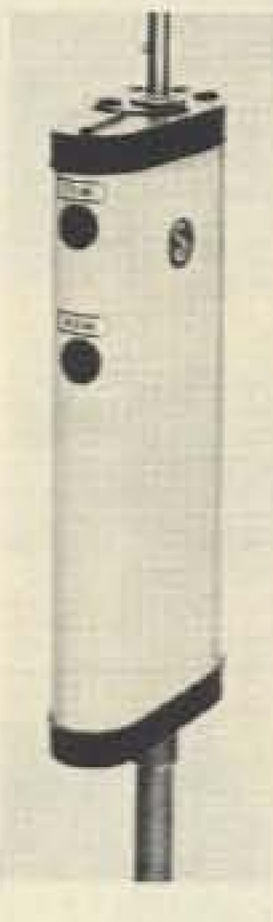
(SWR-1A $29.95)

SWR-1 guards against power loss

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation



DELUXE 742 TRI-BAND MOBILE ANTENNA

- Automatically adjusts to proper resonance for 20, 40 and 75 meters.
- Power rated at 500 Watts P.E.P.
- Includes base section, automaticoil and whip top section. 742 Antenna

Price: $109.95

EXCLUSIVE DELUXE 5-BAND MOBILE 45 ANTENNA

- All band manual switching antenna for 10, 15, 20, 40 and 75 meters.
- Power rated at 1000 Watts P.E.P.
- Includes base section with mobilecoil and six foot whip top section. 45 Antenna

Price: $119.95

SWAN METERS HELP YOU GET IT ALL TOGETHER

These wattmeters tell you what's going on.

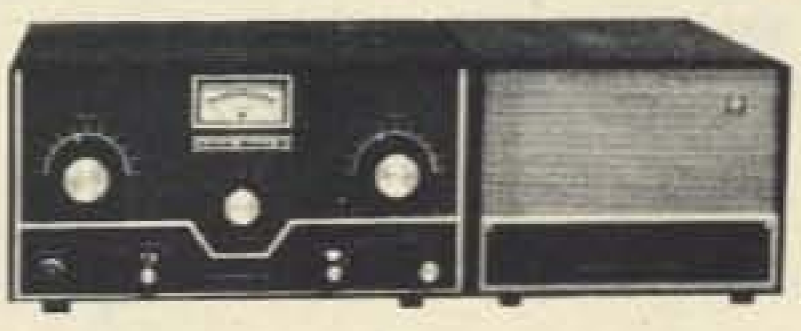
With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you. Use your Swan credit card. Applications at your dealer or write to us.

WM2000 In-Line Wattmeter With Muscle. Scales to 2000 watts. New flat-response directional coupler for maximum accuracy. $87.95

WM3000 Peak-reading Wattmeter. Reads RMS power, then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $87.95

WM1500 High-Accuracy In-Line Wattmeter. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales, 2 to 30 MHz. Forward and reflected power. Use it for trouble-shooting, too. $74.95

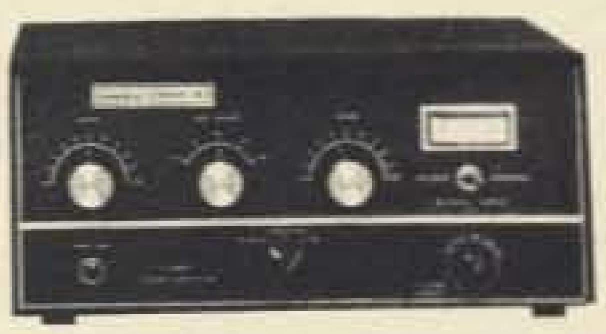
SWAN® ELECTRONICS
A subsidiary of Cubic Corporation



SWAN LINEAR AMPLIFIERS A Mark II 2000 watt P.E.P. full legal input power unit or the 1200X matching Cygnet 1200 watt P.E.P. input powerhouse with built-in power supply. The choice is yours. **$899.95**

NEW Swan MMBX
Mobile Impedance Matcher

It keeps your transmitter and your antenna on speaking terms for a song. **Price: $23.95**



CYGNET 1200X PORTABLE LINEAR AMPLIFIER

To quadruple the output of the 300B Cygnet *de novo*, simply add this matching unit for more than a kilowatt of power. Complete with self-contained power supply and provision for external ALC, this Cygnet offers exceptionally high efficiency and linearity. **$449.95**

Additional Swan products include: fixed and mobile antennas, VFO's telephone patch, VOX, wattmeter, microphones and mounting kits. As another extra service, only Swan Electronics offers factory-backed financing to the amateur radio community. Visit an authorized Swan Electronics dealer for complete details

SWAN ELECTRONICS

JMR MOBIL-EAR™

Two-way-radio headset with superior fidelity Electret-Capacitor boom microphone and palm-held talk switch.

$69.95

FOR BROADCAST-QUALITY TRANSMISSION AND RECEPTION FOR BOTH MOBILE UNITS AND BASE STATIONS.

- Boom-mounted electret-capacitor microphone delivers studio-quality, undistorted voice reproduction. Variable gain control lets you adjust for optimum modulation.
- Cushioned earcup lets you monitor in privacy -- no speaker blare to disturb others. Blocks out environmental noises, too. Made of unbreakable ABS plastic.
- Headband self-adjusts for comfortable wear over long hours. Spring-flex hinge lets you slip headset on and off with just one hand. Reversible for right or left ear.
- Headset can be hung on standard microphone clip.
- Compact palm-held talk switch lets you keep *both* hands on the wheel for safer driving. Made of unbreakable ABS plastic.
- Built-in FET transistor amplifier adapts microphone output to any transceiver impedance.
- Compatible with most two-way radios including 40-channel CB units.
- Built-in Velcro pad for easy mounting of the talk switch.
- Made in U.S.A.

SPECIFICATIONS

Earphone impedance and type:	8 ohms, dynamic
Microphone type:	Electret capacitor
Microphone frequency response:	200–6000 Hz
Amplifier type:	FET transistor, variable gain
Amplifier battery power:	7-volt Mallory TR-175
Switching:	Relay or electronic

IDEAL FOR EVERY TWO-WAY RADIO COMMUNICATIONS NEED . . .

CB operators • Amateur radio operators • Police and fire vehicles • Ambulances and emergency vehicles • Taxis and truckers • Marine pleasure and work boats • Construction and demolition crews • Industrial communications • Security patrols • Airport tower and ground crews • Remote broadcast and TV-camera crews • Foresters and fire-watch units •

SWAN 1200X LINEAR AMPLIFIER. TALK LOUD FOR A SONG.

Everybody likes power and nowhere can you get more of it for $349.95 than with our Cygnet 1200X linear amplifier.

With 100 watts of driving power you're on the air with a solid 1200 watts PEP input and most people won't be able to tell you from somebody operating full bore.

Linearity on the 1200X is excellent, efficiency is outstanding, 117/230 A.C. power supply is built in, and features like provision for external ALC give you the flexibility you need to get the most out of your rig.

Mark II for power and glory, too. But if you've got your heart set on block-buster power we've also got the right linear amp for you.

It's the Mark II, the proven unit everybody thinks of when you talk about workhorse linear amplifiers.

The Mark II dominates the bands with all the power that's allowed—2000 watts PEP—and a clean, linear signal that's music to your ears.

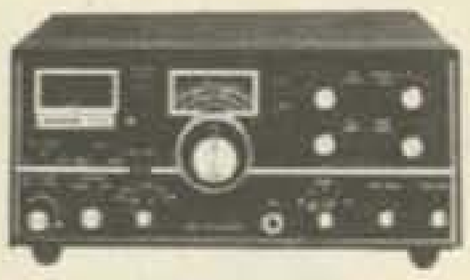
The Mark II features a separate, matching power supply, big, quiet blowers for both the RF deck and the power supply, all bands from 10 to 80 meters and all you need to enjoy it is 100 watts driving power.

Get a Swan 1200X or Mark II linear amplifier today and stop letting people shout you down. Use your Swan credit card. Applications at your dealer or write to us.

Cygnet 1200X 1200-watt linear amplifier complete with built in 110/220V power supply $349.95

Mark II 2000-watt linear amplifier complete with separate 117/230 VAC power supply and two 3-500Z tubes $899.95

NEW TRANSCEIVERS



750 CW — $679.95

If you're ready for 700 loud-talking watts, you're ready for the new 750CW.

- 700 watts P.E.P. input on SSB
- 400 watts DC input on CW
- CW audio filter selectable 80 or 100 Hz.
- CW sidetone monitor with adjustable pitch and volume control
- 80 through 10 meters, USB, LSB, CW
- Selectable 25 or 100 KHz crystal calibrator
- Standard 5.5 Mhz, 2.7 Hz bandwidth crystal filter or optional accessory 16 pole filter available with 140 Db ultimate rejection.

Accessories
- VX-2 Vox
- MK-II Linear amplifier
- DD-76 Digital Dial

The 750CW is a CW man's dream come true. What's more there's a long list of accessories you can add later for increased performance.

350A — $599.95

- 300 watts P.E.P. input SSB
- 200 watts DC input on CW
- 80 through 10 meters, USB, LSB, CW
- 5.5 Mhz, 2.7 KHz bandwidth crystal filter
- Oscillators are solid state and IC regulated for stability
- CW sidetone monitor with adjustable pitch and volume
- CW audio filter 80 and 100 Hz selectable
- Built in 117 VAC power supply and speaker. (220 VAC power supply available on special request)

Accessories
- VX-2 Vox
- 14A DC Converter
- 1200X linear amplifier
- Crystal Calibrator (350A only)

350D — $699.95

- Same basic features as 350A except added feature of:
- 6 Digit LED frequency display with readout to 100 Hz

Both the 350A and the 350D are compatible with the same line of Swan accessories that has built a reputation for reliability and performance that's second to none. Including linear amplifiers to boost your power to the legal limit.

So they're perfect for novices or anyone else because you can build capability as you need it.

OUR NEW M-34 EXPANDABLE MOBILE ANTENNAS

The M-34 mobile antenna gives you 10, 15, and 20 meters and great performance in a tough, rugged design for only $52.75.

Then whenever you want it you can buy the optional 160, 80 or 40 meter coil and top section for $20.00 to $25.00 depending on the band and make a full-capability four-bander out of it. One that never needs coil changes or adjustments after initial tuning.

What's more, at no extra cost you get features like 500 watts PEP, low standing wave ratio at resonance, independent resonance adjustments on each of the four bands, exceptional bandwidth and a neat, clean, low-wind-resistance profile that also goes great with mobile homes, motor homes and apartments.

That's the kind of innovative, problem-solving thinking that goes into Swan mobile antennas. Not just the M-34 but these, too:

742 Automatic. Swan automates mobile antennas with the 742 tri-band antenna. Work 20, 40 or 75 meters with your 742 without need for coil change or other adjustments after initial tuning. A high Q mobile antenna designed for maximum efficiency capable of 500 watts PEP $109.95

Mobile 45. This switch-adjustable 5-band antenna features a Swan HI-Q coil and positive-stop, 9-position switch with GOLD-PLATED contacts. Select 10, 15, 20, 40 plus five positions for 75 meters and go to work knowing this rugged antenna is doing its job $119.95

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

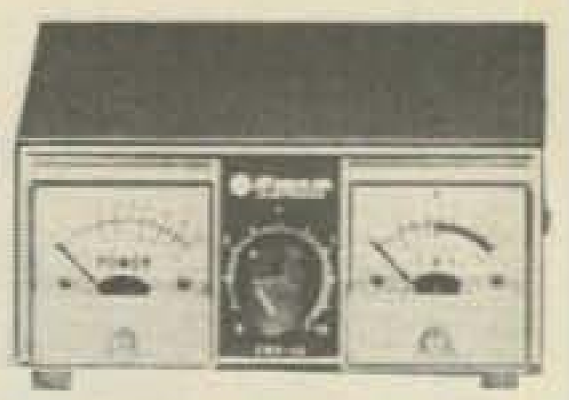
AMERICAN RADIO RELAY LEAGUE PUBLICATIONS

- THE RADIO AMATEUR'S HANDBOOK 1978 Edition ($8.50 Retail)
- THE RADIO AMATEUR'S HANDBOOK 1978 Edition Cloth Bound ($13.50 Retail)
- ARRL ANTENNA BOOK ($5.00 Retail)
- UNDERSTANDING AMATEUR RADIO ($5.00 Retail)
- THE RADIO AMATEUR'S V.H.F. MANUAL ($4.00 Retail)
- FM AND REPEATERS ($4.00 Retail)
- ARRL ELECTRONICS DATA BOOK ($4.00 Retail)
- SINGLE SIDEBAND ($4.00 Retail)
- ARRL HAM RADIO OPERATING GUIDE ($4.00 Retail)
- SPECIALIZED COMMUNICATIONS TECHNIQUES FOR THE RADIO AMATEUR ($4.00 Retail)
- A COURSE IN RADIO FUNDAMENTALS ($4.00 Retail)
- RADIO AMATEUR'S LICENSE MANUAL ($3.00 Retail)
- GETTING TO KNOW OSCAR ($3.00 Retail)
- HINTS AND KINKS ($2.00 Retail)
- LEARNING TO WORK WITH INTEGRATED CIRCUITS ($2.00 Retail)
- SOLID STATE DESIGN ($7.00 Retail)
- TUNE IN THE WORLD WITH HAM RADIO ($7.00 Retail)
  Packages to be sold as a unit consisting of: Workbook, Tape Cassette, Call Area Map
- ARRL CODE KIT ($8.00 Retail)
- ARRL MAP ($3.00 Retail)
- QST BINDER ($5.00 Retail) for 6¾ x 9¾ QST
- LOG BOOK ($1.50 Retail)
- MINILOG ($.75 Retail)
- L/C/F CALCULATOR, Type A ($3.00 Retail)
- Pads of MESSAGE BLANKS ($.50 Retail)

THE SWAN METER SHOWCASE.

Sniffs out radiated power wherever it is. This little unit is so compact it could measure relative radiated power in your pocket. Telescoping antenna and a frequency range of 1.5 MHz all the way to 200 MHz. **FS-1 Field Strength Meter** $13.95

Easy-on-the-pocket pocket SWR. Mighty mite SWR meter with high accuracy. SWR-3 gives you 1:1 to 3:1 SWR at 50 ohms on frequencies from 1.7 to 55 MHz. Precision PC board directional coupler makes it a solid value at a rock-bottom price. **SWR-3 Pocket SWR Meter** $14.95



SWR bridge bridges the price barrier. This little jewel gives you relative forward power and SWR on two 100 microampere meters at a remarkably low price. Indicates 1:1 to infinity VSWR of up to 1000-watt signals on frequencies from 3.5 to 150 MHz. With low insertion loss, it's great for mobile operations, too. **SWR-1A Power Meter and SWR Bridge** $29.95

At last. A precision wattmeter for the 6 and 2-meter man. We design the WM-6200 for the upper-band man who needs to know with ± 7% accuracy. Reads power of 50 to 150 MHz signals on two scales to 200 watts plus SWR on expanded range scale from 1:1 to 3:1 with ± 3% accuracy. **WM-6200 In-Line Wattmeter** $63.95

Put your power up in lights. The new WMD-6200 does everything our WM-6200 does and ends guesswork, interpolation errors and eyestrain besides with a 4-digit readout. 50 to 150 MHz, power to 200 watts with an accuracy of ± 10%. SWR from 1:1 to 19.99:1 with ± 3% accuracy. **WMD-6200 Digital SWR Power Meter** .... $262.00 (requires AC source)

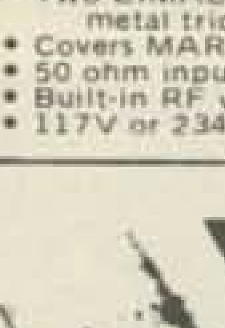
The new WM-200A does it all. As an in-line wattmeter it gives you power to 200 watts on two scales plus SWR from 1:1 to 3:1 for signals from 50 to 150 MHz. And as a peak reader it reads true peak envelope power of your voice modulated signal. Flat response forward or reflected power on scales to 200 watts in switch-selected RMS or peak. **WM-200A Peak Reading Wattmeter** $87.95

Nifty little meter just for VHF mobile. This brand new, easy-to-install swivel-mount unit is the perfect illuminated wattmeter for 2-meter mobile. Compact and capable, it gives you two scales, 0-20 watts and 0-200 watts at 10% accuracy. SWR from 1:1 to 3:1. Frequencies from 50 to 150 MHz. **WMM-200 SWR Power Meter** $45.95

DenTron MLA-2500 $799.50

DenTron Radio has packed all the features a linear amplifier should have into their new MLA-2500. Any Ham who works it can tell you the MLA-2500 really was built to make amateur radio more fun.

- ALC circuit to prevent overloading
- 160 thru 10 meters
- 1000 watts DC input on CW, RTTY or SSTV Continuous Duty
- Variable forced air cooling system
- Self-contained continuous duty power supply
- Two EIMAC 8875 external anode ceramic/metal triodes operating in grounded grid
- Covers MARS frequencies without modifications
- 50 ohm input and output impedance
- Built-in RF wattmeter
- 117V or 234V AC 50-60 hz
- Third order distortion down at least 30 db
- Frequency range:
  1.8MHz (1.8-2.5) 3.5MHz (3.4-4.6)
  7MHz (6.0-9.0) 14MHz (11.0-16.0)
  21MHz (16.0-22.0) 28MHz (28.0-30.0)
- 40 watts drive for 1 KW DC input
- Rack mounting kit available (19" rack)
- Size: 5½" H x 14" W x 14" D Wt. 47 lbs



BOMAR Crystal Company

TWO METERS
CRYSTALS IN STOCK

Novice Crystals (Specify Band Only)

Motorola HT 220 Crystals In Stock!

Standard • Icom • Heathkit • Ken • Clegg • Regency • Wilson • VHF Eng • Drake • And Others!

$4.50 @ Lifetime Guarantee

Make/Model	Xmit Freq.	Rec. Freq.

SUPER AMP from DenTron

If the amplifier you're thinking of buying doesn't deliver at least 1000 to 1200 watts output, to the antenna, you're buying the wrong amplifier.

Our New Super Amp is sweeping the country because hams have realized that the DenTron Amplifier will deliver to the antenna, (output power), what other manufacturers rate as input power.

The Super Amp runs a full 2000 watts P.E.P. input on SSB, and 1000 watts DC on CW, RTTY or SSTV 160-10 meters, the maximum legal power.

The Super Amp is compact, low profile, has a solid one-piece cabinet assuring maximum TVI sheilding.

The heart of our amplifier, the power supply, is a continuous duty, self-contained supply built for contest performance.

We mounted the 4-572B's, industrial workhorse tubes, in a cooling chamber featuring the on-demand variable cooling system.

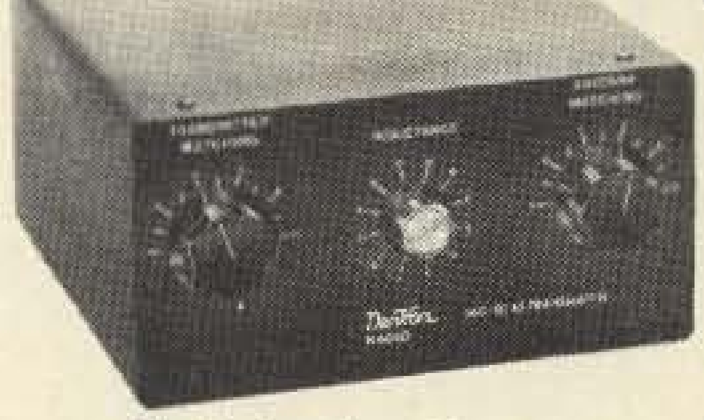
The hams at DenTron pride themselves on quality work, and we fight to keep prices down. That's why the dynamic DenTron Linear Amplifier beats them all

$574.50

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.

$299.50



Meet the SuperTuner

The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

1 KW MODEL **$129.50** 3 KW MODEL **$229.50**

The 80-10 Skymatcher

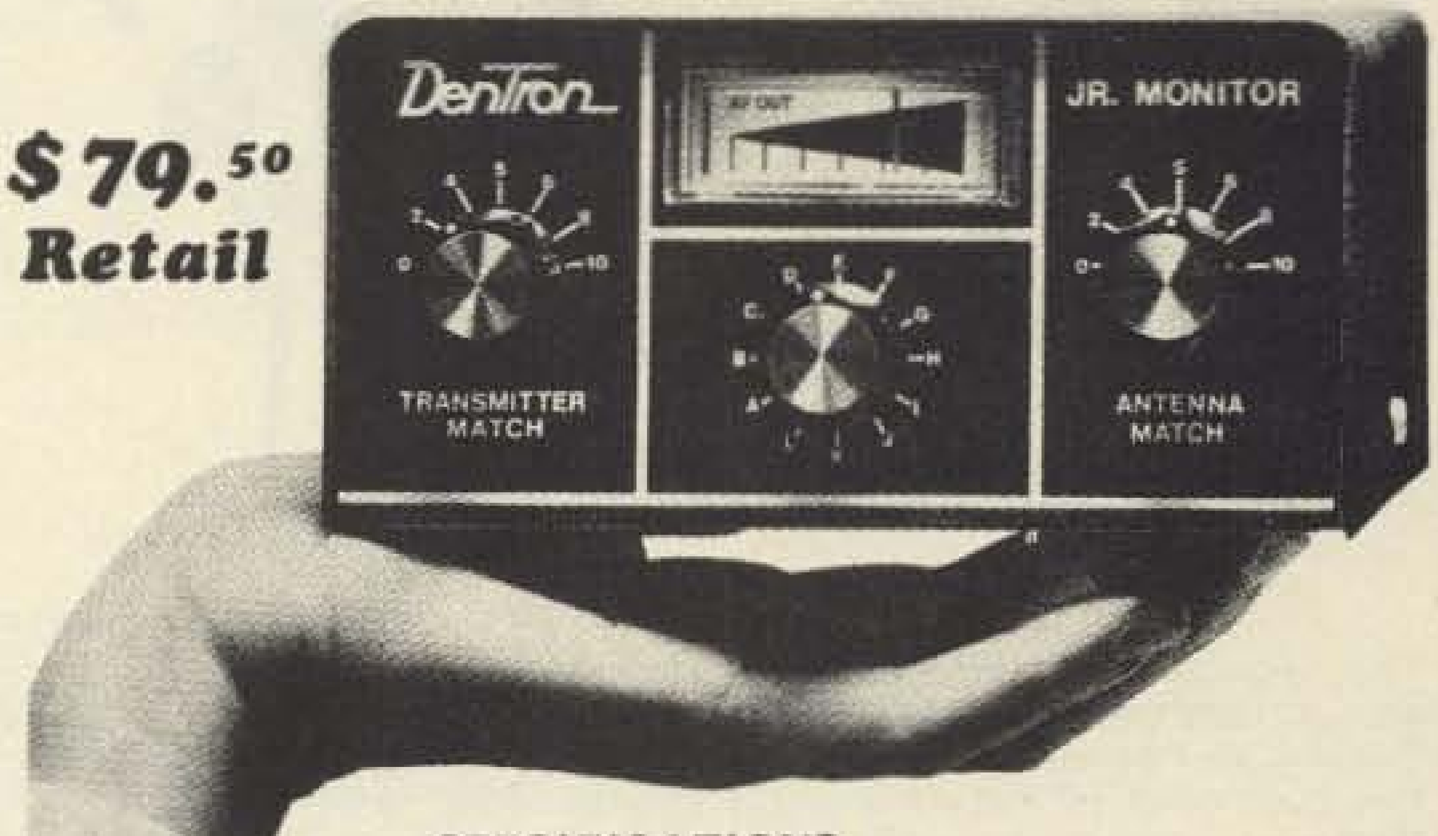
Here's an antenna tuner for 80 through 10 meters, handles 500 w P.E.P. and matches your 52 ohm transceiver to a random wire antenna.

- Continuous tuning 3.2 - 30 mc
- "L" network
- Ceramic 12 position rotary switch
- SO—239 receptional to transmitter
- Random wire tuner
- 3000 volt capacitor spacing
- Tapped inductor
- Ceramic antenna feed thru
- 7" W. 5" H. 8" D., Weight: 5 lbs.

$59.50

Introducing Dentron's NEW Jr. Monitor Antenna Tuner

$79.50 Retail



DenTron

SPECIFICATIONS

- Continuous Tuning 1.8—30 MHz
- Forward reading relative output power meter
- 300 watt power capability
- Built-in encapsulated balun
- Mobile mounting bracket
- Ceramic Rotary Switch 12-position
- Capacitor spacing 1000 volts
- Tapped toroid inductor
- Antenna inputs:
  - a. Coax unbalanced SO239
  - b. Random wire
  - c. Balanced feed line 75—660 Ohm
- 5¼" w. x 2¾" h. x 6" d.
- All metal black wrinkle finish cabinet
- Weight: 2½ pounds

Read forward and reflected watts at the same time

Tired of constant switching and guesswork?

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter.

$99.50

DRAKE TVI FILTERS High Pass Filters for TV Sets provide more than 40 dB attenuation at 52 MHz and lower. Protect the TV set from amateur transmitters 6-160 meters.

Drake TV-300-HP
Model No. 1603
For 300 ohm twin lead
Price: $10.60

Drake TV-75-HP
Model No. 1610
For 75 ohm TV coaxial cable; TV type connectors installed
Price: $13.25

DRAKE TV-3300-LP
1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps TV i-f interference, as well as TV front-end problems. Price: $26.60 Model No. 1608

LOW PASS FILTERS FOR TRANSMITTERS have four pi sections for sharp cut off below channel 2, and to attenuate transmitter harmonics falling in any TV channel and fm band. 52 ohm. SO-239 connectors built in.

DRAKE TV-5200-LP
200 watts to 52 MHz. Ideal for six meters. For operation below six meters, use TV-3300-LP or TV-42-LP. Model No. 1609 Price: $26.60

DRAKE TV-42-LP Model No. 1605
is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for transmitters operating at 30 MHz and lower. Rated 100 watts input. Price: $14.60

TELEX® PROFESSIONAL HEADPHONES & HEADSETS

BOOM MIC HEADSETS

For the ultimate in communications convenience and efficiency select a boom mic headset. Long-time favorites of professional communications, boom mic headsets allow more personal mobility while always keeping the mic properly positioned for fast, precise voice transmission. Boom microphones are completely adjustable to allow perfect positioning. And, boom mic headsets leave both hands free to perform other tasks.

All models are supplied with "close-talking" microphones to limit ambient noise pick-up and provide superior intelligibility. Each model has a convenient, inline push-to-talk switch, which can be wired for either push-to-talk relay control or mic circuit interrupt for voice operated transmitters. The switch may be used as a momentary push-button or it can be locked in the down position. All models have tough, flexible, 8 foot cords which are stripped and tinned, unterminated. Communication grey with black trim.


MODEL CM-1320


MODEL C-1320


MODEL C-1210


MODEL C-610

Dealer Programs NOW Available


MODEL CM-1210


MODEL CM-610


MODEL CM-1320S

MODEL C-610 Economical, dual receiver magnetic headphone. Delivers clear reception. Lightweight and comfortable yet ruggedly constructed for daily use. Earcushions seal out distracting noise and are removable for cleaning. Price: $9.95

MODEL SWL-610 Similar to Model C-610 but with 2000 ohm impedance. Ideal for shortwave receivers requiring high impedance headphones. Price: $11.65

MODEL C-1210 Medium priced, dual receiver dynamic headphone. Precise sound reproduction. Deluxe foam-filled earcushions are extremely comfortable for those long sessions. The removable cushions reduce ambient noise penetration and concentrate signal strength. Great for noisy environments or for digging out weak signals. Price: $28.30

MODEL C-1320 Our finest communications headphone. Audiometric-type dual dynamic receivers assure the ultimate in reception and performance stability. Extremely sensitive receivers provide high output levels even from weak signals. Luxurious foam filled circumaural earcushions are removable for cleaning. Price: $37.90

DUAL MUFF HEADPHONES

The following headphones offer outstanding sound quality and superb comfort for long term wearing. All the models have circumaural earcushions to seal out distracting ambient noise and concentrate the signal at your ear. Foam filled vinyl earcushions on Models C-1210 and C-1320 add an extra margin of comfort. Adjustable headbands and self-aligning earcups assure proper fit. All models are equipped with a five foot cord terminating in a standard .250" diameter phone plug and have 3.2 to 20 Ohm impedance. Communication grey with black trim.

MODEL CM-610 Lightweight, dual receiver magnetic headphone (similar to Model C-610). Ceramic boom microphone with -51 dB output. Can be used with any mobile or base station with high Z mic input and 3.2 to 20 ohm audio output. Price: $42.80.

MODEL CM-1320 Deluxe dual receiver dynamic headphone with audiometric-type headphone elements (similar to Model C-1320). Ceramic boom microphone with -51 dB output. For use with any mobile or base station requiring high impedance mic input and 3.2 to 20 ohm audio output. Price: $68.30.

MODEL CM-1210 Rugged, reliable, dual receiver dynamic headphone (similar to Model C-1210). Ceramic boom microphone with -51 dB output. For use with any mobile or base station with high Z input and 3.2 to 20 ohm audio output. Price: $56.90.

MODEL CM-1320S Deluxe single receiver dynamic headphone with audiometric-type headphone element (similar to Model C-1320). Ceramic boom microphone with -51 dB output. For use with any mobile or base station requiring high impedance mic input and 3.2 to 20 ohm audio output. Price: $54.50.

MODEL	C-610	SWL-610	C-1210	C-1320	CM-610	CM-1210	CM-1320	CM-1320S
Headphone Sensitivity Ref. .0002 Dynes/cm² @1mW input, 1kHz	103dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	105dB SPL ±5dB
Headphone Frequency Response (useable)	40-15,000 Hz	40-15,000 Hz	20-20,000 Hz	20-20,000 Hz	40-15,000 Hz	20-20,000 Hz	20-20,000 Hz	20-20,000 Hz
Headphone Impedance	3.2-20 ohms	2000 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms
Microphone Frequency Response	–	–	–	–	50-8000 Hz	50-8000 Hz	50-8000 Hz	50-8000 Hz
Microphone Impedance	–	–	–	–	High	High	High	High
Microphone Sensitivity Below 1 volt/microbar at 1kHz	–	–	–	–	−51dB ±5dB	−51dB ±5dB	−51dB ±5dB	−51dB ±5dB
Cord	5'	5'	5'	5'	8' (2.4m)	8'	8'	8'
Plug	.250" dia.	.250" dia.	.250" dia.	.250" dia.	unterminated	unterminated	unterminated	unterminated
Gross Weight	8 oz (227g)	8 oz.	12 oz. (341g)	15 oz. (426g)	12 oz.	15 oz.	18 oz. (511g)	12 oz. (341g)
Catalog Number	61630-063	61630-062	61210-031	61320-012	61630-064	61200-058	61320-013	61320-015

KENWOOD

TS-520S **$649.00**

SSB TRANSCEIVER. Proven in the shacks of thousands of discriminating hams, field day sites, DX and contest stations and mobile installations. Superb engineering and styling.

SP-520 **$28.00**

Optional external speaker for better readability.

TV-502 **$249.00**

TRANSVERTER. Puts you on 2M the easy way. 144-145.7 MHz or optional 145-146 MHz.

VFO-820 **$145.00**

Designed exclusively for use with TS-820. RIT circuit and control switch. Fully compatible with optional digital display.

VFO-520 (Not Shown) **$116.00**

Solid State Remote VFO. RIT circuit with LED indicator.

TR-2200A **$229.00**

PORTABLE 2M FM TRANSCEIVER. 12 Ch. capacity. Removable telescoping antenna. External 12 VDC or internal NI-CAD batteries. 146-148 MHz. 6 CH. supplied. Switchable 2W or 400mW output.

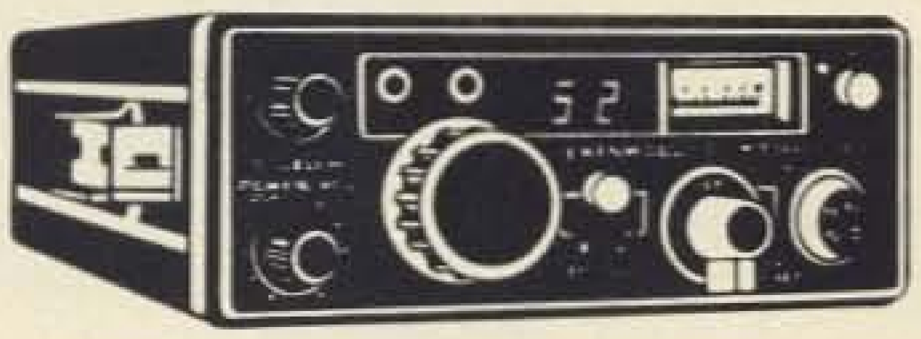
COMMUNICATIONS RECEIVER. 1.8 to 29.7 MHz, WWV and CB band. 50 MHz, 144 MHz converter optional. Stable VFO & oscillator for 5 fixed channels. 1 KHz dial readout. Xtal filters (SSB/8 pole, CW/8 pole, AM/6 pole). Squelch. S meter. Noise blanker.

S-599-$19.94 R-599D-$499.00 T-599A-$499.00

SSB TRANSMITTER. 3.5 to 29.7 MHz. Stable VFO. 1 KHz dial readout. 8 pole Xtal filter. AM Xmission available. Built-in AC pwr supply. Split frequency control available.

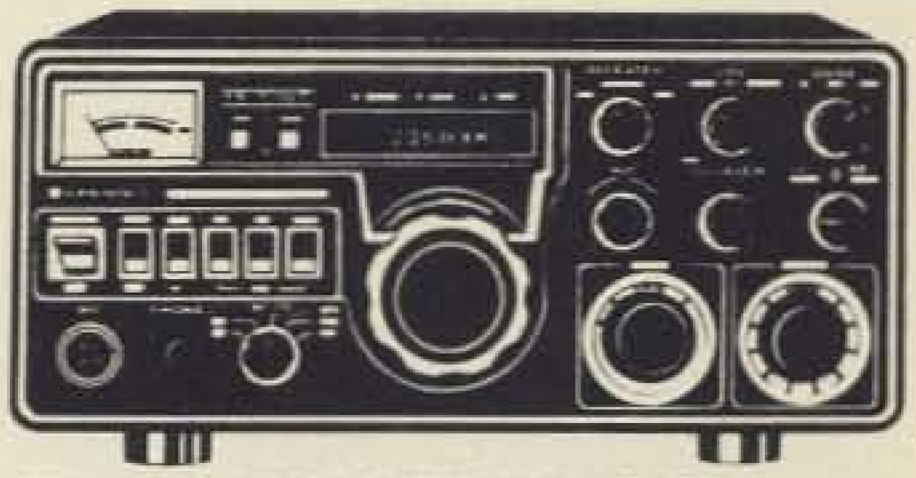
The NEW KENWOOD TS-820S transceiver

TS-820S now has factory installed digital readout • 160 thru 10 meter coverage • 200 watts PEP • Integral IF shift • Noise blanker • VOX & PLL circuitry • DRS dial • IF out, RTTY, XVTR capabilities • Phone patch IN and OUT terminals • RF speech processor. **1048.00**



KENWOOD TR-7500 2m transceiver

The TR-7500: • PLL synthesized • 100 channels (88 preprogramed, 12 extras are diode programmable) • Single-knob channel selection • 2-digit LED frequency display • Powered tone pad connection • 10 watts HI output, 1 watt LOW output. **299.00**



The NEW KENWOOD TS-700S 2m transceiver

TS-700S has these new built-ins: • Digital readout, receiver preamp, VOX, semi-break-in and CW sidetone! Plus: • Solid-state construction • AC or DC capability • 4 band (144 to 148 MHz) coverage • 11 fixed channels • 600 KHz repeater offset. **679.00**

UNIDIRECTIONAL MICROPHONE MODEL 522

$56.85

This is a dynamic microphone with a unidirectional pickup pattern that suppresses unwanted background noise — the type of noise generated by other dispatchers working nearby, ventilating equipment, or office machines in the same area. It also suppresses feedback in public address paging applications. Long-life finger-tip control bar (locking and non-locking action) actuates microphone circuit and normally open external relay circuit. Adjustable height from 248 mm (9¾ inches) to 318 mm (12½ inches) overall. Sturdy, high impact ARMO-DUR® base and case. High or low-impedance selector switch. 2.1 m (7 ft.) four-conductor (two-conductor shielded) cable.

SPECIFICATIONS

FREQUENCY RESPONSE: 60 to 11,000 Hz.

IMPEDANCE AND OUTPUT LEVEL: Dual. 150 ohms +—57 dB*; .10 millivolts/microbar. High ++—57 dB**; 1.42 millivolts/microbar.

*0 dB = 1 milliwatt per 10 microbars
**0 dB = 1 volt per microbar

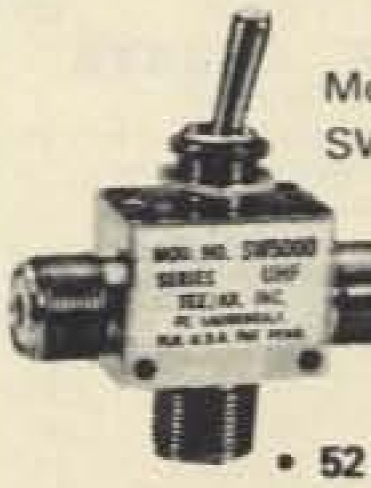
+For connection to microphone inputs rated at 19 to 300 ohms
++For connections to high-impedance microphone inputs

SHURE®

TEE/AX

Coax Toggle Switch $39.95

Coax Relay Version $55.95



Model SW-5000

- 52 ohms
- SPDT, DPDT
- Power 1 KW

- **All Brass Construction**
- **Teflon Insulated**
- **Captivated Internal Contacts**
- **Available in UHF, BNC, N, F, all series**

TUFTS RADIO CATALOG

ATB-34

Cushcraft engineers have incorporated more than 30 years of design experience into the best 3 band HF beam available today. **ATB-34** has superb performance with three active elements on each band, the convenience of easy assembly and modest dimensions. Value through heavy duty all aluminum construction and a price complete with 1-1 balun.

SPECIFICATIONS

FORWARD GAIN -	EXCELLENT	LONGEST ELEMENT -	32'8"
F/B RATIO -	30 dB	TURNING RADIUS -	18'9"
VSWR -	1.5-1	WIND SFC -	5.4 Sq.Ft.
POWER HANDLING -	2000 WATTS PEP	WEIGHT -	42 Lbs.
BOOM LENGTH/DIA. -	18' x 2 1/8"	WIND SURVIVAL -	90 MPH

UPS SHIPPABLE **$239.95 COMPLETE**

ENJOY A NEW WORLD OF DX COMMUNICATIONS WITH ATB-34

VHF - UHF DX-ARRAYS 144, 220, 430 mhz

20 ELEMENT DX - ARRAYS

20 ELEMENT SPECIFICATIONS

Forward Gain ------ 14.2 db
F/B Ratio ----------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 48°
vertical ------------ 26°
Impedance --------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	118"	78"	42"
Width x Depth	75" x 30"	53" x 20"	29" x 11"
Turning Radius	48"	32"	18"
Maximum Mast Dia.	1 1/2"	1 1/2"	1 1/2"
Net Weight Lbs.	8	7	6

Vertical support mast not supplied

2 METER DX-120	1 1/4 METER DX-220	3/4 METER DX-420
Am. Net $42.95	$37.95	$32.95

40 ELEMENT DX - ARRAYS

40 ELEMENT SPECIFICATIONS

Forward Gain -------- 17 db
F/B Ratio ----------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 32°
vertical ------------ 26°
Impedance --------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	118"	78"	42"
Width x Depth	192" x 30"	132" x 20"	72" x 11"
Turning Radius	101"	65"	38"
Maximum Mast Dia.	2 1/2"	2 1/2"	2 1/2"
Net Weight Lbs.	32	22	12
Wind Rating	90 mph	90 mph	90 mph
Stack Kit No.	DXK-140	DXK-240	DXK-440
Amateur Net	$59.95	$54.95	$39.95

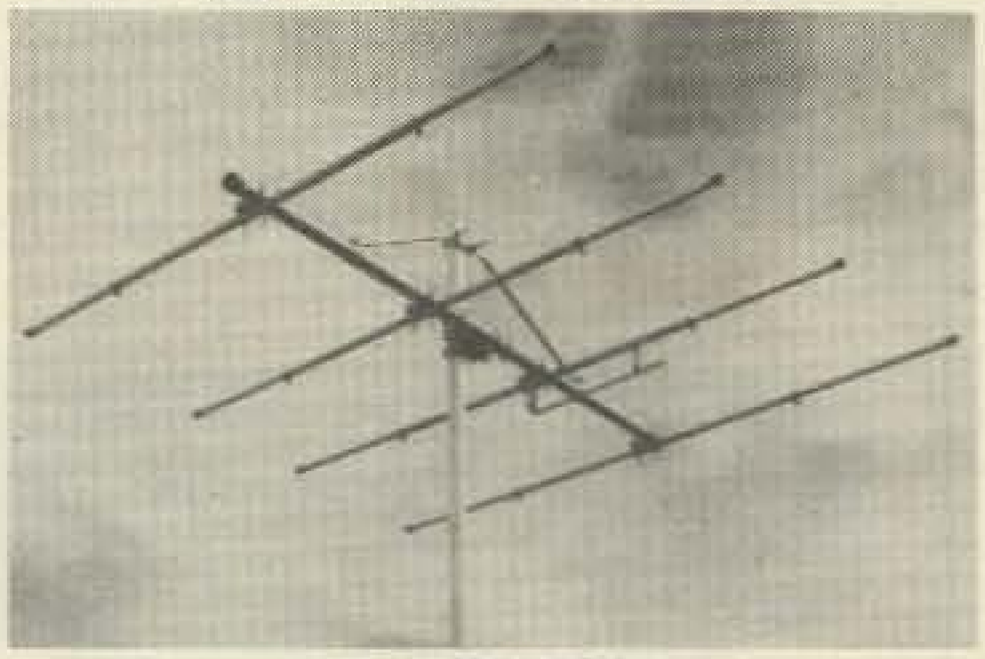
80 ELEMENT DX - ARRAYS

80 ELEMENT SPECIFICATIONS

Forward Gain -------- 20 db
F/B Ratio ----------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 32°
vertical ------------ 12°
Impedance --------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 --- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	275"	182"	97"
Width x Depth	192" x 30"	132" x 20"	72" x 11"
Turning Radius	101"	65"	38"
Maximum Mast Dia.	2 1/2"	2 1/2"	2 1/2"
Wind Rating	90 mph	90 mph	90 mph
Net Weight Lbs.	64	43	24
Stack Kit No.	DXK-180	DXK-280	DXK-480
Amateur Net	$109.95	$89.95	$79.95

HF MONOBEAMS 10 15 20 METERS



10 METERS

3 ELEMENT BEAM: You can have an outstanding signal using this compact three element beam. It is easily mounted on a lightweight rotator and takes only a limited amount of space.
MODEL NO. A28-3 $69.95

4 ELEMENT BEAM: A real DX'ers beam for the active ham who wants a top signal on 10 meters. Mount on a good ham rotator. MODEL NO. A28-4 $79.95

SPECIFICATIONS	A28-3	A28-4
BOOM	1 1/2" x 10'	1 5/8" x 18'
LONGEST ELEMENT	17' 6"	18'
ELEMENT DIAMETER	7/8" - 1/2"	7/8" - 3/4"
TURNING RADIUS	10'	14' 3"
FORWARD GAIN	8 db	10 db
FRONT TO BACK	22 db	25 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	11 lbs.	21 lbs.

15 METERS

3 ELEMENT BEAM: A high quality beam which can be mounted on a mast with other antennas. A heavy duty TV rotator will handle it.
MODEL NO. A21-3 $89.95

4 ELEMENT BEAM: For the 15 meter enthusiast this beam will give real DX performance. When mounted on a good ham rotator it will withstand the most adverse weather conditions.
MODEL NO. A21-4 $119.95

SPECIFICATIONS	A21-3	A21-4
BOOM	1 5/8" x 12'	1 3/4" x 21' 6"
LONGEST ELEMENT	22' 10"	22' 10"
ELEMENT DIAMETER	7/8" - 3/4"	7/8" - 3/4"
TURNING RADIUS	13' - 3"	15' - 8"
FORWARD GAIN	8 db	10 db
FRONT TO BACK	22 db	25 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	16 lbs.	32 lbs.

20 METERS

2 ELEMENT BEAM: Full size beam performance for the active 20 meter ham with limited space and budget.
MODEL NO. A14-2 $109.95

3 ELEMENT BEAM: A real DX-er's beam with full .15 wavelength element spacing. The heavy duty construction gives years of trouble free service. MODEL NO. A14-3 $139.95

SPECIFICATIONS	A14-2	A14-3
BOOM	1 5/8" x 10'	1 5/8" x 20' 6"
LONGEST ELEMENT	35' 10"	35' 10"
ELEMENT DIAMETER	1 1/8" - 3/4"	1 1/8" - 3/4"
TURNING RADIUS	18'	21'
FORWARD GAIN	5 db	8 db
F/B RATIO	13 db	22 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	20 lbs.	35 lbs.

HF VERTICALS 10 through 80 METERS

cushcraft

- EFFICIENT TOP RING
- FIBERGLASS TRAP FORMS
- ENAMELED WIRE COILS
- SOLID ALUMINUM CAPACITORS
- NO TUNING REQUIRED
- FULL COMPRESSION CLAMPS
- OMNIDIRECTIONAL COVERAGE
- REINFORCED BASE
- MAST OR GROUND MOUNTING
- PRE-MARKED SECTIONS
- EASY ASSEMBLY
- SUPERIOR QUALITY

3 BAND
20-15-10 METERS
MODEL ATV-3 $49.95

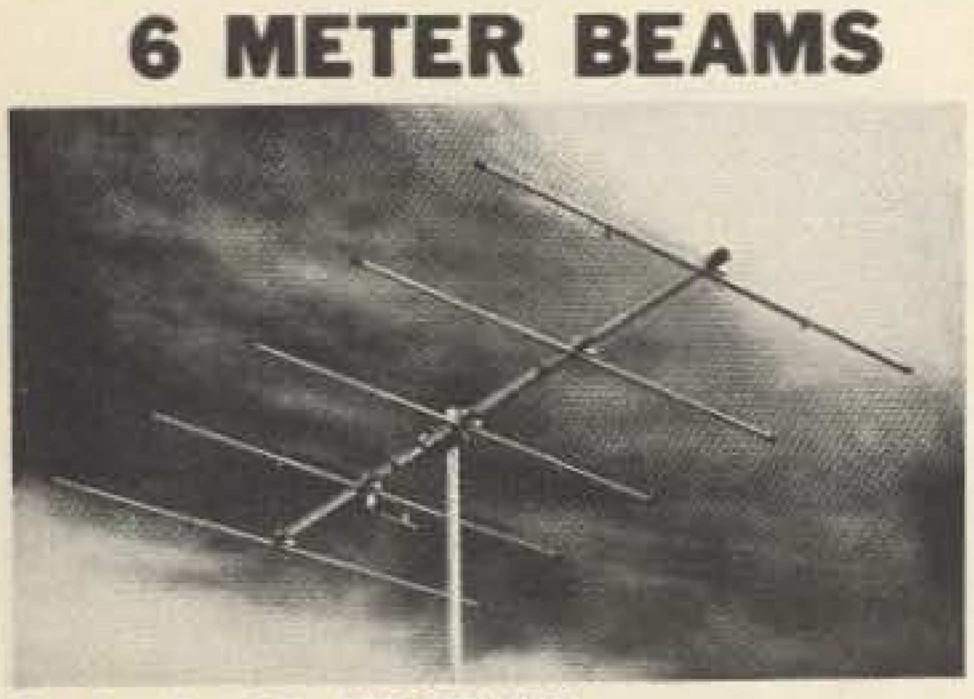
4 BAND
40-20-15-10 METERS
MODEL ATV-4 $89.95

5 BAND
80-40-20-15-10 METERS
MODEL ATV-5 $109.95

ALL MODELS UPS SHIPPABLE

cushcraft
THE ANTENNA COMPANY

6 METER BEAMS



3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

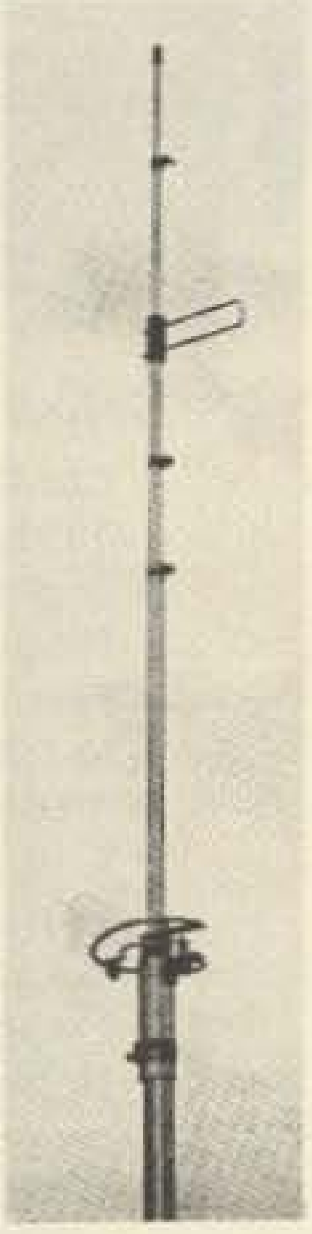
New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50 3	A50 5	A50 6	A50 10
Boom Lngth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

COAXIAL DUAL STACKING KITS

Double your effective radiated power by stacking 6 meter beams. Cush Craft coaxial stacking kits provide a simple and efficient method for realizing 3 db additional gain while maintaining the superior characteristics of our single beams. The stacking kits are complete with RG-59/U cable and preassembled fittings for direct 52 ohm feed.

MODEL NO.	FOR STACKING	AMATEUR NET
A535-SK	A50-3 or A50-5	$15.95
A561-SK	A50-6 or A50-10	$17.95



new RINGO RANGER for FM

4.5 dB* – 6 dB**
Omnidirectional
GAIN
BASE STATION
ANTENNAS
FOR
MAXIMUM
PERFORMANCE
AND
VALUE

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

- * Reference ½ wave dipole.
- ** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 3.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install, 6 meter partly preassembled, all but 450 MHz take 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—Hdlg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.37'	.20'	.10'

B-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 23' 220 MHz — 15', 435 MHz — 8', pattern 360° – 6 dB gain, 180° – 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.85 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK.	complete 4 element stacking kit
A14-SK.	4 element coax harness only
A147-VPK.	complete 11 element stacking kit
A147-SK.	11 element coax harness only
A449-SK.	6 + 11 element coax harness only

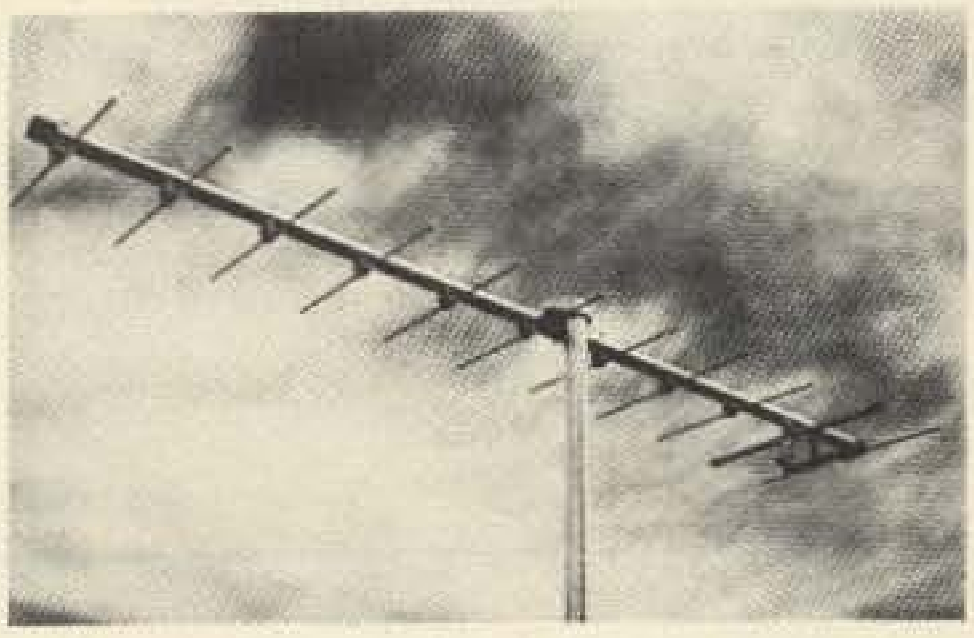
E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/40"	44"/40"	60"/13"	35"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/28	9/20	13.2/28	11/25	13.2/28
½ Power beam	48°	66°	48°	60°	48°
Wind area sq. ft.	1.21	.43	.39	.30	.50
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 130", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

HIGH PERFORMANCE VHF YAGIS



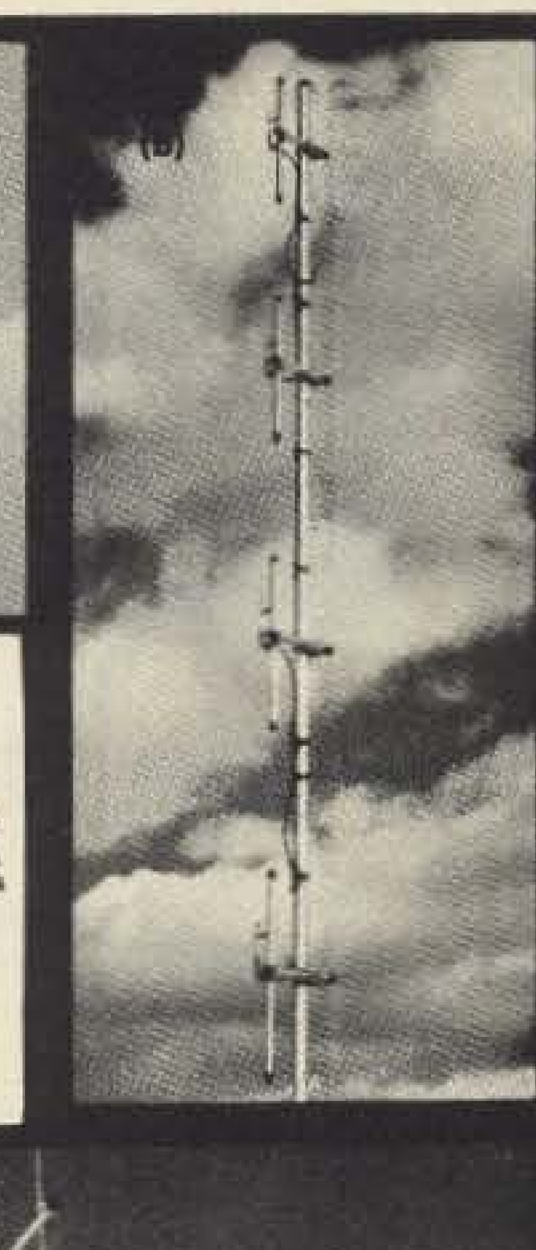
3/4, 1-1/4, 2 METER BEAMS

The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

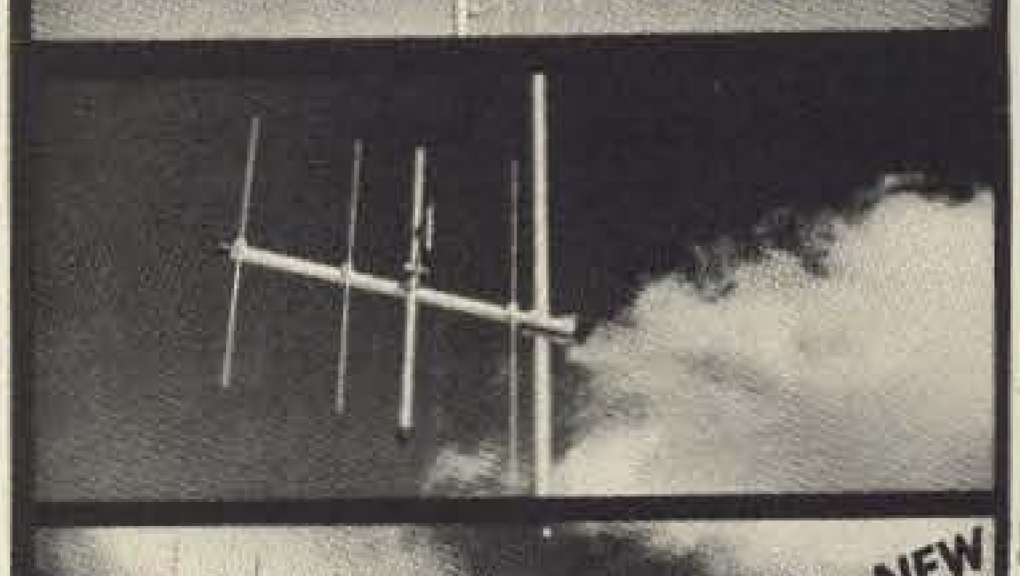
Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O.D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O.D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

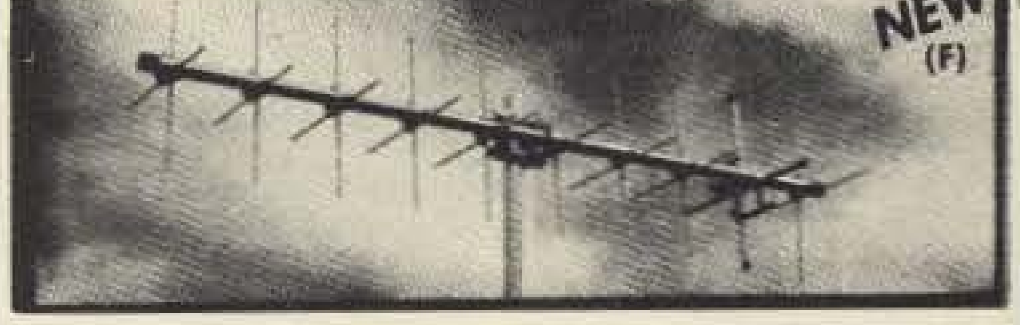
New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No	A144 7	A144 11	A220 11	A430 11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ ½ pwr. pt.	46	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1



cushcraft CORPORATION





VHF/UHF BEAMS

A50-3	$ 32.95	A144-7	21.95
A50-5	49.95	A144-11	32.95
A50-6	69.95	A430-11	24.95
A50-10	99.95		

AMATEUR FM ANTENNAS

A147-4	$ 19.95	AFM-44D	54.95
A147-11	29.95	AR-2	21.95
A147-20T	54.95	AR-6	32.95
A147-22	84.95	AR-25	29.95
A220-7	21.95	AR-220	21.95
A220-11	27.95	AR-450	21.95
A449-6	21.95	ARX-2	32.95
A449-11	27.95	ARX-2K	13.95
AFM-4D	59.95	ARX-220	32.95
AFM-24D	57.95	ARX-450	32.95

	144 MHz.		220 MHz.		432 MHz.	
Description:	Model:	Price:	Model:	Price:	Model:	Price:
20 Element DX-Array	DX-120	42.95	DX-220	37.95	DX-420	32.95
Frame & Harness (40 E.)	DXK-140	59.95	DXK-240	54.95	DXK-440	39.95
Frame & Harness (80 El.)	DXK-180	109.95	DXK-280	89.95	DXK-480	79.95
1-1 52-ohm balun	DX-1BN	12.95	DX-2BN	12.95	DX-4BN	12.95
Vert. Pol. Bracket (20 El.)	DX-VPB	9.95	DX-VPB	9.95	DX-VPB	9.95

- *Remote*
- *Motor Controlled*

RCS-4

COAX ANTENNA SWITCH

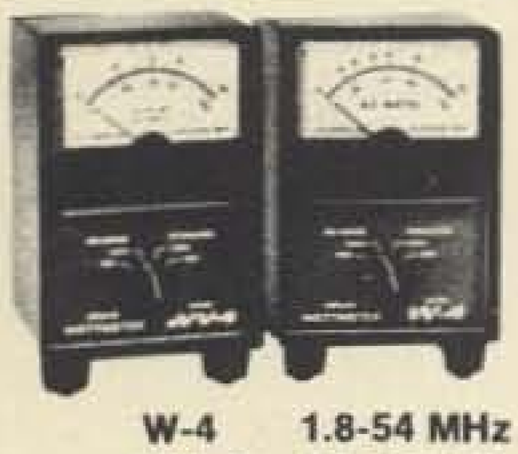
- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. Price: $120.00

MATCHING NETWORKS

MN-4
200 watts
Price: $120.00

MN-2000
2000 watts PEP
Price: $250.00

General: • **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power • **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 • Covers ham bands 80 thru 10 meters • **Switches in or out** with front panel switch • **Size:** 5½"H, 10¾"W, 8"D (14.0 x 27.3 x 20.3 cm), MN-2000, 14¾"D (36.5 cm).
• **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) • **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.



RF WATTMETERS

W-4	**1.8-54 MHz**	Price: $79.00
WV-4	**20-200 MHz**	Price: $89.00

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3¾"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts 2000 watts	(5% of reading + 2 watts) ±(5% of reading + 20 watts)
WV-4	100 watts 1000 watts	±(5% of reading + 1 watt) ±(5% of reading + 10 watts)

DRAKE

SSR-1 COMMUNICATIONS RECEIVER

- Synthesized • General Coverage
- Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands
- Excellent Performance

PRELIMINARY SPECIFICATIONS: • **Coverage:** 500 kHz to 30 MHz • **Frequency** can be read accurately to better than 5 kHz • **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM • **Selectable sidebands** • **Built-in power supply:** 117/234 VAC ± 20% • **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) • **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.
The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.
Price: $350.00

GENERAL: • **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges • **Solid State VFO** with 1 kHz dial divisions • **Modes** SSB Upper and Lower, CW and AM • **Built-in Sidetone** and automatic T/R switching on CW • **30 tubes and semi-conductors** • **Dimensions:** 5½"H, 10¾"W, 14⅜" D (14.0 x 27.3 x 36.5 cm). **Wt.:** 16 lbs. (7.3 kg).
TRANSMIT: • **VOX or PTT** on SSB or AM • **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts • **Adjustable pi-network.**
RECEIVE: • **Sensitivity** better than ½ μV for 10 dB S/N • **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. • **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression • **Diode Detector** for AM reception.

TR-4CW SIDEBAND TRANSCEIVER

Price: $799.00

34-PNB Plug-in Noise Blanker	100.00
FF-1 Crystal Control Unit	46.95
MMK-3 Mobile Mount	7.00
RV-4C Remote VFO	$150.00

POWER SUPPLIES

AC-4 Power Supply	$120.00
DC-4 Power Supply	135.00

2 METER FM PORTABLE TRANSCEIVER Model TR-33C

Amateur Net $229.95

- SCPC* Frequency Control
- 12 Channels with Selectable Xmtr Offsets.
- All FET Front-end and Crystal Filter for Superb Receiver Intermod Rejection.
- Expanded Antenna Choice.
- Low Receiver Battery Drain.
- Traditional R. L. Drake Service Backup.
- Single Crystal Per Channel.

LINEAR AMPLIFIER Model L-4B

L-4B Linear Amplifier $995.00
• 2000 Watts PEP-SSB • Class B Grounded-Grid – two 3-500Z Tubes • Broad Band Tuned-Input • RF Negative Feedback • Transmitting AGC • Directional Wattmeter • Two Tautband Suspension Meters • L-4B 13-15/16" W, 7-7/8" H, 14-5/16" D. Wt.: 32 lbs. • Power Supply 6-3/4" W, 7-7/8" H, 11" D, Wt.: 43 lbs.

POWER SUPPLIES

AC 4 Power Supply	$120.00
DC 4 Power Supply	135.00

Touch-n-go with

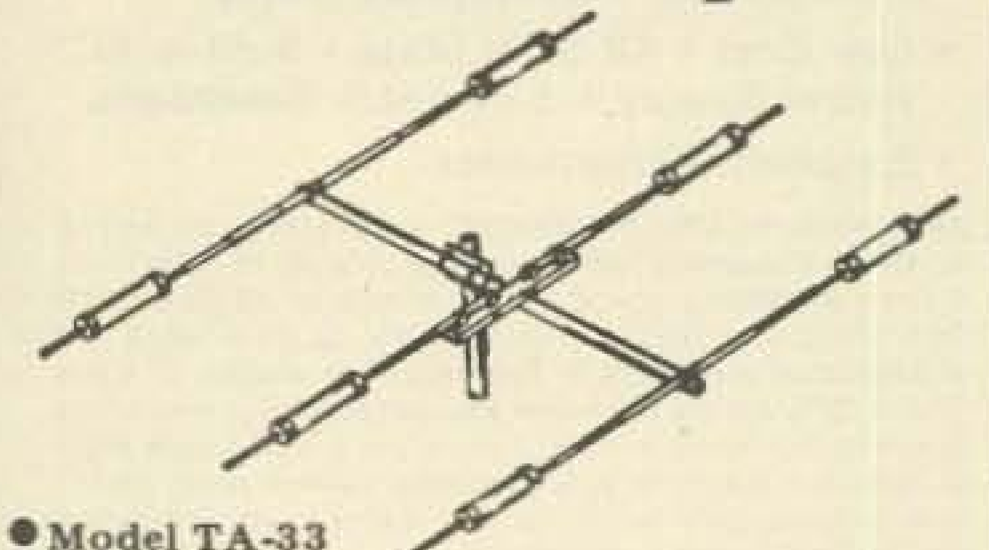
DRAKE 1525EM

Push Button Encoding Mike

Drake 1525EM, microphone with tone encoder and connector for TR-33C, TR-22, TR-22C, ML-2 .... $49.95

- Microphone and auto-patch encoder in single convenient package with coil cord and connector. Fully wired and ready for use.
- High accuracy IC tone generator, no frequency adjustments.
- High reliability Digitran® keyboard.
- Power for tone encoder obtained from transceiver through microphone cable. No battery required. Low current drain.
- Low output impedance allows use with almost all transceivers.
- Four pin microphone plug: directly connects to Drake TR-33C without any modification in transceiver. Compatible with all previous Drake and other 2 meter units with minor modifications.
- Tone level adjustable.
- Hang-up hook supplied.

Mosley



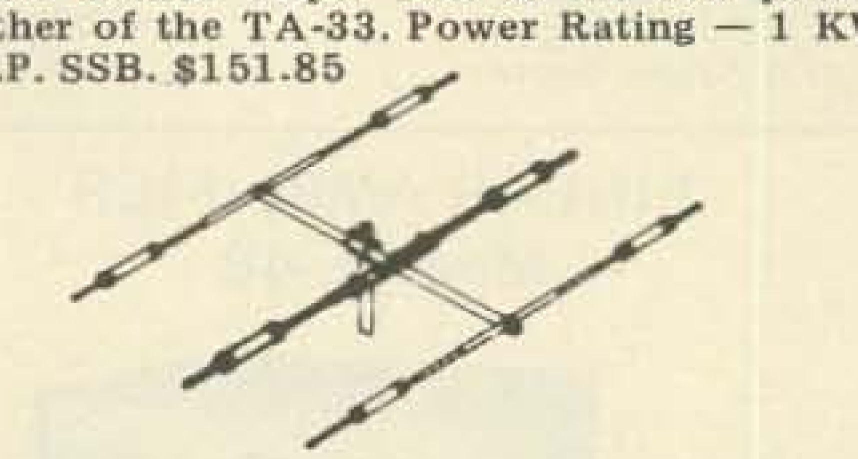
- Model TA-33
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

The Mosley TA-33, 3-element beam provides outstanding 10, 15 and 20 meter performance. Exceptionally broadband — gives excellent results over full Ham bandwidth. Incorporating Mosley Famous Trap-Master traps. Power Rating — 2KW P.E.P. SSB. The TA-33 may also be used on 40 meters with TA-40KR conversion. Complete with hardware. $206.50

MULTI-BAND BEAMS
TRAP MASTER 33 . . . 10, 15 & 20 Meters

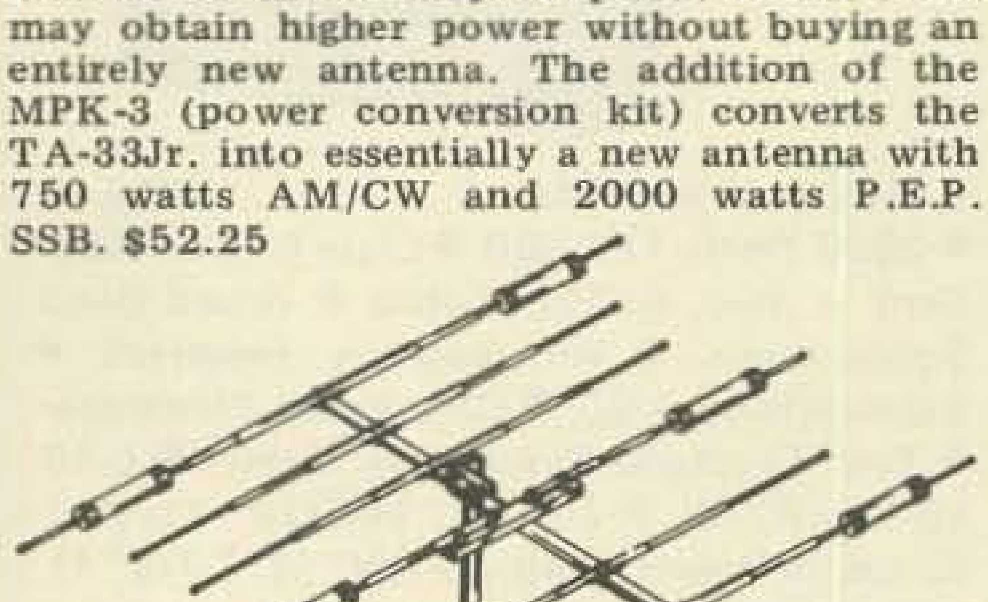
- Model TA-33Jr.
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

The TA-33Jr ... incorporates Mosley Trap-Master Junior traps. This is the low power brother of the TA-33. Power Rating — 1 KW P.E.P. SSB. $151.85



TA-33JR. POWER CONVERSION KIT MODEL MPK-3

Owners of the Mosley Trap-Master TA-33Jr. may obtain higher power without buying an entirely new antenna. The addition of the MPK-3 (power conversion kit) converts the TA-33Jr. into essentially a new antenna with 750 watts AM/CW and 2000 watts P.E.P. SSB. $52.25



TRAP MASTER 36 . . . 10, 15 & 20 Meters

- Model TA-36
- 6 Elements
- Forward Gain (over isotropic source) - 10.1 db on 15 & 20 meters, 11.1 db on 10 meters.

Front-to-Back Ratio on all bands. 20 db.

This wide-spaced, six element configuration employs 4 operating elements on 10 meters, 3 operating elements on 15 meters, and 3 operating elements on 20 meters. Automatic bandswitching is accomplished through Mosley exclusively designed high impedance parallel resonant "Trap Circuit." The TA-36 is designed for 1000 watts AM/CW or 2000 watts P.E.P. SSB. Traps are weather and dirt proof, offering frequency stability under all weather conditions. $335.25

MOSLEY AK-60 MAST PLATE ADAPTER

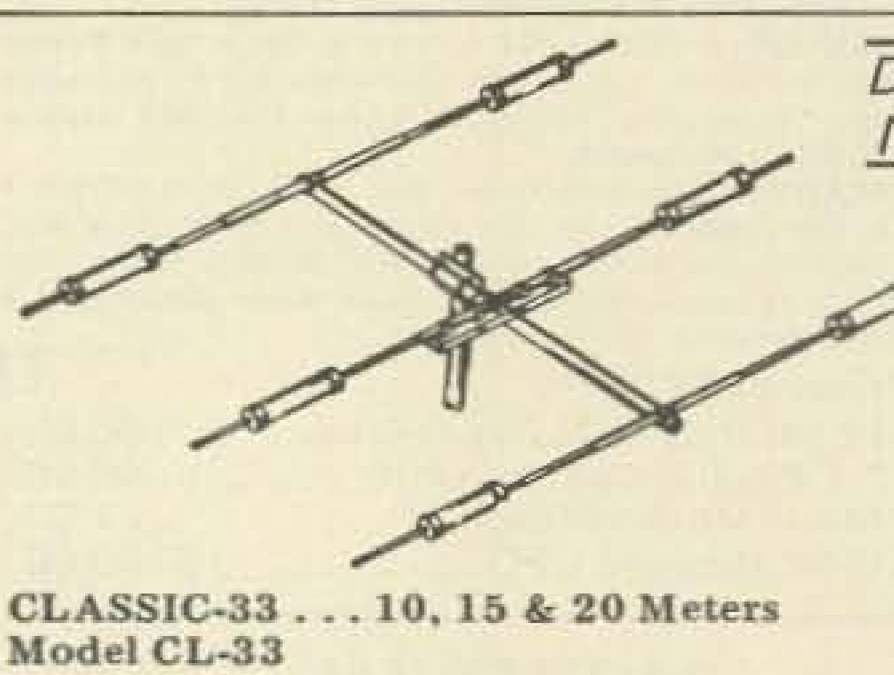
Mast Plate Adapter for adapting your Mosley 1½" mounted beam to fit 2" OD mast. Complete with angle and hardware. $11.15

A brilliant new 2 meter transceiver with every in-demand operating feature and convenience

KLM MULTI-2700 – $695.95

- ★ Synthesizer and VFO.
- ★ All modes: NBFM, WBFM, AM, SSB w/USB/LSB and CW.
  - Frequency synthesizer (PLL) 3 Knob, 600 channels, 10 kHz steps.
  - VXO, plus or minus 7 kHz.
- ★ LED readout on synthesizer.
  - Standard 600 kHz splits plus . . .
  - Two "oddball" splits.
- ★ OSCAR transceive 2 to 10 meter operation.
  - OSCAR receiver built-in.
  - Connectors on rear for separate 2 meter and 10 meter antennas.
  - Built-in VFO (continuous coverage, 144-148 MHz in 1.3 MHz segments. 1 kHz readout).
  - 8 pole SSB filter plus two FM filters.
  - 100 kHz crystal calibrator.
  - Voice operated relay (VOX) or p-t-t.
- ★ Audio speech compression.
  - Noise blanker.
  - RIT, plus or minus 5 kHz.
  - Power out/"S" meter.
  - FM center deviation meter.
  - 10W minimum output power. NO TUNING!
  - Hi-Lo power provision.
  - Built-in AC/DC power supply.
  - Double conversion receiver. 16.9 MHz and 455 kHz I-Fs.
  - Receiver sensitivity:
    FM: 0.5µV for 28 dB S/N.
    SSB/CW: 0.25µV for 14 dB S/N.
    AM: 2µV for 10 dB S/N.
  - Size: Inches: 5H, 14.88W, 12D. MM: 128H, 378W, 305D.
  - Weight: 28 lbs. (13 KG).

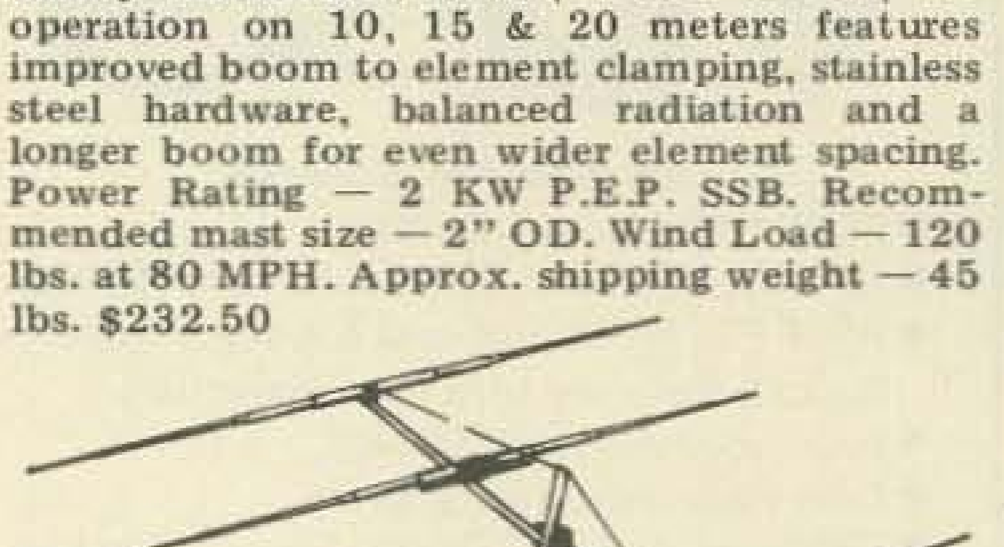
Dealer Programs NOW Available



CLASSIC-33 . . . 10, 15 & 20 Meters
Model CL-33

- 3 Elements
- 10.1 db Forward Gain (over isotropic source) on all bands.
- 20 db Front-to-Back Ratio on 15 & 20 meters, 15 db on 10 meters.

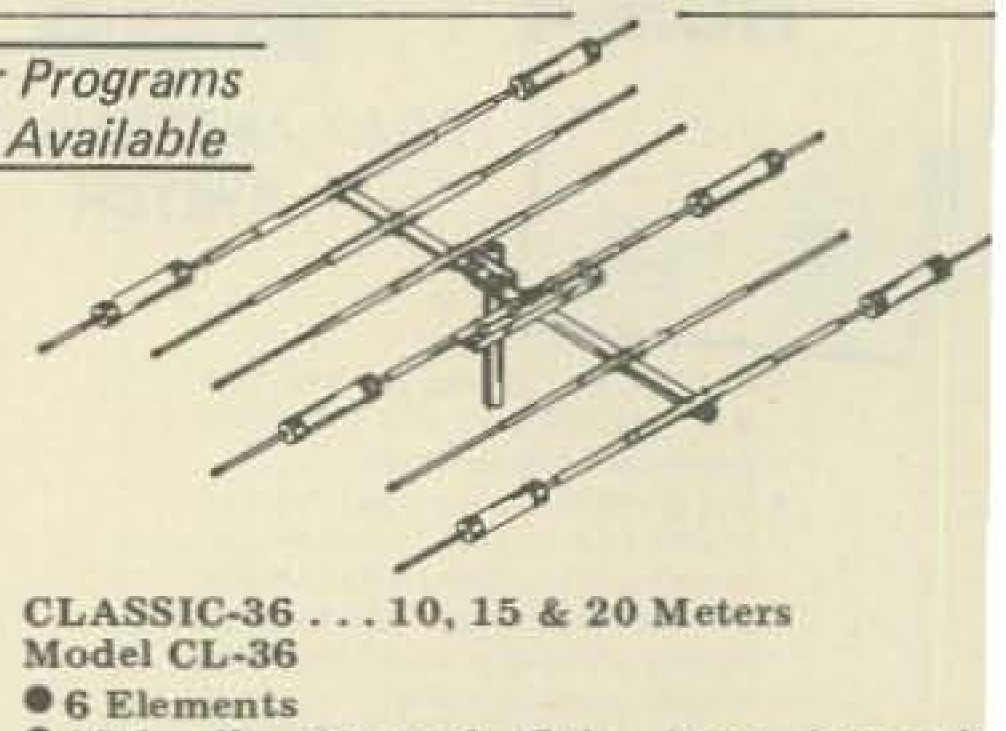
BRIDGING THE GAP ... The Classic 33, combines the best of two Mosley systems. Incorporating Mosley Classic Feed System for a "Balanced Capacitive Matching" system with a feed point impedance of 52 ohms at resonance, and the Famous Mosley Trap-Master Traps for "weather-proof" traps with resonant frequency stability. This extra sturdy multi-band beam, Model CL-33, for operation on 10, 15 & 20 meters features improved boom to element clamping, stainless steel hardware, balanced radiation and a longer boom for even wider element spacing. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Wind Load — 120 lbs. at 80 MPH. Approx. shipping weight — 45 lbs. $232.50



CLASSIC-203 . . . 20 Meters
Model CL-203
3 Elements

- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

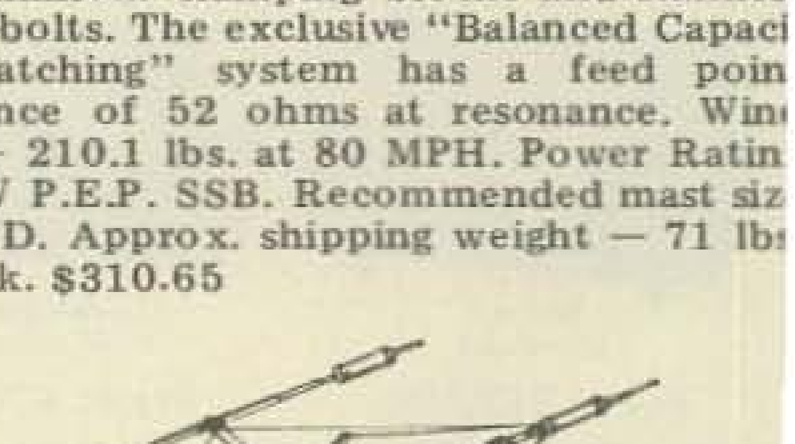
Incorporating the Mosley patented Classic Feed System, this full size 20 meter single-band beam has 1½" to 3/8" dia. "swaged" elements wide spaced on a 2" dia. 24' boom. Maximum element length-37' 8½". The high standards in quality construction established by Mosley in over a quarter-century of manufacturing is reflected in this mono-band . . . Model CL-203. Boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" System has a nominal feed point impedance of 52 Ohms at 2 KW P.E.P. SSB. Recommended mast size-2" O.D. Approx. shipping wt: 42 lbs. via truck. $227.65



CLASSIC-36 . . . 10, 15 & 20 Meters
Model CL-36

- 6 Elements
- 10.1 db Forward Gain (over isotropic source) on 15 & 20 meters, 11.1 db on 10 meters.
- 20 db Front-to-Back Ratio on all bands.

The Classic 36, like the smaller Classic 33 incorporates both the Mosley World-Famous Trap-Master Traps and the Mosley Classic Feed-System. Designed to operate on 10, 15 & 20 meters, this multi-band beam Model CL-36, employs the high standards of quality construction found in all Mosley products. The boom-to-mast clamping assures stability with a time-tested arrangement of mast plate cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" system has a feed point impedance of 52 ohms at resonance. Wind Load — 210.1 lbs. at 80 MPH. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Approx. shipping weight — 71 lbs via truck. $310.65

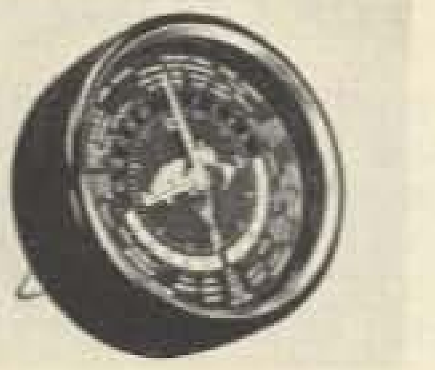


40 METER CONVERSION KIT MODEL TA 40KR

Work 40 meters in addition to 10, 15 & 20 meters by using a TA-40KR conversion kit on the radiator element of the TA-33 and TA-36 (Beams with broad band capacitive matching may not be converted!) Convert the TA-33Jr with the MPK-3 (power conversion kit) before adding the TA-40KR kit. $92.25

SIGNAL-MASTER ANTENNA

Beam Antenna . . . Model S-402 for 40 meters. For a top signal needed to push through forty meter QRM, the Mosley Signal Master S-402 will do the trick! This 100% rust-proof 2-element beauty constructed of rugged heavy-wall aluminum is designed and engineered to provide the performance you need for both DX hunting and relaxing in a QRM free rag-chewing session. Beam is fed through link coupling, resulting in an excellent match over the entire bandwidth. $267.50



A new precision clock which tells time anywhere in the world at a glance, has been announced by **Yaesu Electronics Corporation**. The time in any principal city or time zone can be simultaneously coordinated with local time on a 24 hour basis. After the initial setting, as the clock runs, a Time Zone Hour Disc advances automatically, showing correct time all over the world without further adjustment. The clock is especially designed to withstand shock and may be hung on a wall or placed on its desk mount. The clock will run an entire year on a single 1.5 volt flashlight battery and the mechanism starts as soon as the battery is inserted. It measures six inches in diameter by two and one half inches deep. An excellent item for the business office, ham radio operator, short wave listener, boat owner, and others who want an accurate dependable clock. Price: $30.00 Amateur net.

RADIO AMATEUR callbook

There's nothing like it !

Foreign Radio Amateur Callbook
DX Listings
$12.95
with 3 Service Editions
$18.95

United States Callbook
All W & K Listings
$13.95
with 3 Service Editions **$19.95**

FULLY AIR TESTED — THOUSANDS ALREADY IN USE

#16 40% Copper Weld wire annealed to it handles like soft Copper wire — Rated for better than full legal power AM/CW or SSB-Coaxial or Balanced 50 to 75 ohm feedline — VSWR under 1.5 to 1 at most heights — Stainless Steel hardware — Drop Proof Insulators — Terrific Performance — No coils or traps to break down or change under weather conditions — Completely Assembled ready to put up — Guaranteed 1 year — ONE DESIGN DOES IT ALL.

MOR-GAIN

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/.73	36/10.9
40-10 HD	40/20/15/10	59.50	36/1.01	36/10.9
80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

IO TRAPS — NO COILS — NO STUBS — NO CAPACITORS

MOR-GAIN HD DIPOLES . . . • One half the length of conventional alf-wave dipoles. • Multi-band, Multi-frequency. • Maximum effiiency — no traps, loading coils, or stubs. • Fully assembled and re-tuned — no measuring, no cutting. • All weather rated — 1 KW AM, .5 KW CW or PEP SSB. • Proven performance — more than 15,000 ave been delivered. • Permit use of the full capabilities of today's -band xcvrs. • One feedline for operation on all bands. • Lowest ost/benefit antenna on the market today. • Fast QSY — no feedline witching. • Highest performance for the Novice as well as the xtra-Class Op.

XCLUSIVE 66 FOOT, 75 THRU 10 METER DIPOLES

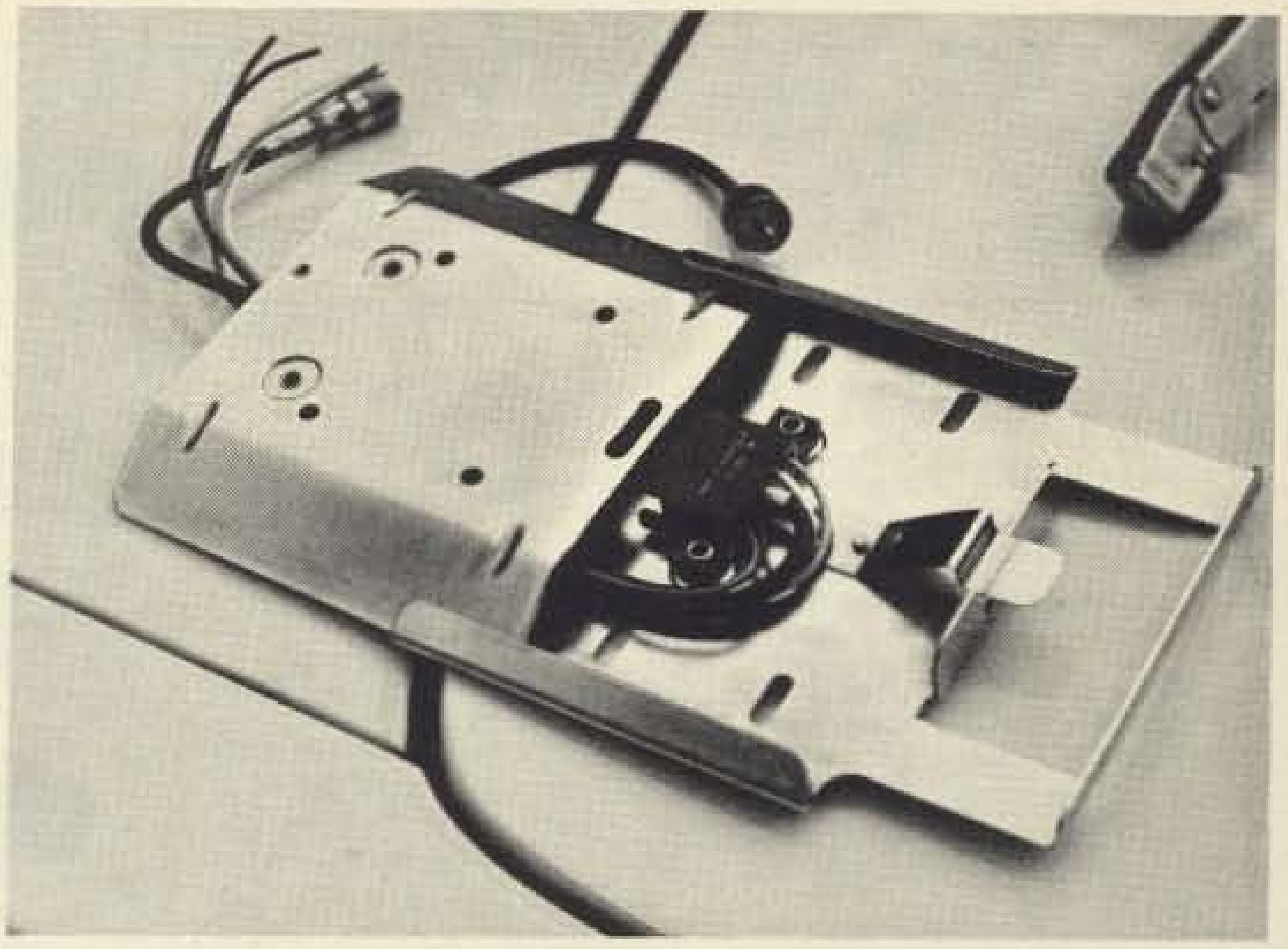
OTES

All models above are furnished with crimp/solder lugs.

All models can be furnished with a SO-239 female coaxial connector : additional cost. The SO-239 mates with the standard PL-259 male oaxial cable connector. To order this factory installed option, add the tter 'A' after the model number. Example: 40-20 HD/A.

75 meter models are factory tuned to resonate at 3950 kHz. (SP) odels are factory tuned to resonate at 3800 kHz. 80 meter models are ctory tuned to resonate at 3650 kHz. See VSWR curves for other esonance data.

STOP A THIEF! SAVE YOUR RADIO!



DESIGNED FOR COMMERCIAL USE UP TO 1000 MHZ.

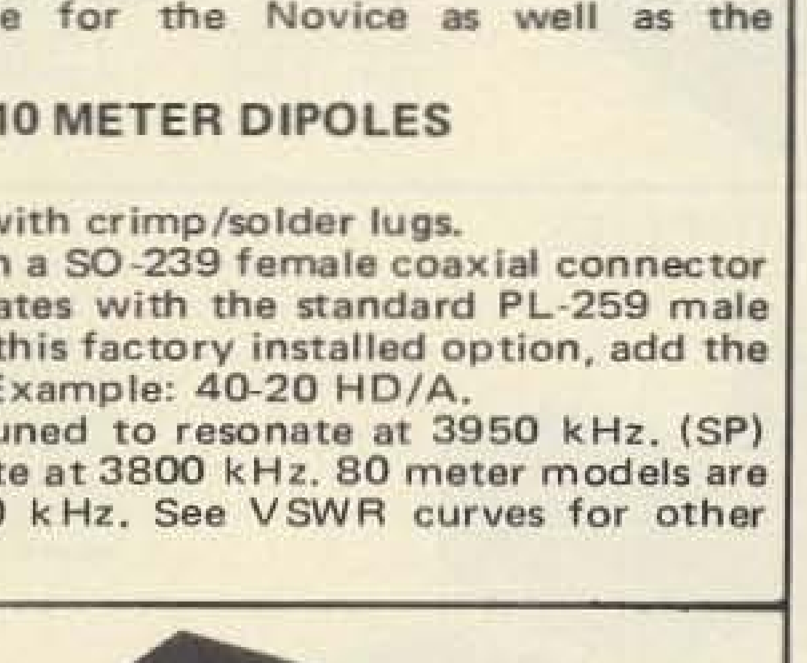
The **TUFTS SAVE-YOUR-RADIO** bracket can save you a bundle . . . and a lot of hassle. Why worry about rig ripoff? The **TUFTS SYR** bracket mounts quickly and easily in your car and makes it possible to snap your rig out of its bracket when you park and put it out of sight.

The connector system has a special coaxial cable connector which will provide you with a lossless connection right up to 1000 MHz! No loss! In addition to the quick coax connector there are also four power and accessory connections which are made automatically when the rig is slid into its bracket . . . just what you need for feeding power and loudspeaker connections to the set.

This is a rugged bracket and connector system . . . it'll take a beating. There is a hole on each side of the 16 gauge steel plate for a padlock in case you want to leave the rig for short periods in its bracket. They'll have to rip out the dash to get it . . . and it won't be the first time for that.

With two of these brackets you can bring the mobile rig into the house and use it in seconds. On trips you can take an AC supply for the rig and use it in your hotel room. Price: $29.95

IYE VIKING
ODE PRACTICE SET



No. 114-404-002

et the RIGHT START!

ith a NYE VIKING Code Practice Set you get a sure, smooth, Speed-X model 0-001 transmitting key, a linear circuit oscillator and amplifier, with a built-in 2" eaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on andard 9V transistor type battery (not included). Units can be connected in parallel that two or more operators can practice sending and receiving to each other. List ice, $18.50.

No. 114-320-003 – $9.90
No. 114-322-003 – Brass – $10.30

No. 114-320-001 – $8.30
No. 114-322-001 – Brass – $8.65

No. 114-310-003 – $8.25
No. 114-312-003 – Brass – $8.65

NYE VIKING SPEED-X KEYS

NYE VIKING Standard Speed-X keys feature smooth, adjustable bearings, heavy-duty silver contacts, and are mounted on a heavy oval die cast base with black wrinkle finish. Available with standard, or Navy knob, with, or without switch, and with nickel or brass plated key arm and hardware.

Pamper yourself with a Gold-Plated NYE VIKING KEY!

Model No. 114-31C-004GP has all the smooth action features of NYE Speed-X keys in a special "presentation" model. All hardware is heavily gold plated and it is mounted on onyx-like jet black plastic sub-base. List price is $50.00.

No. SSK-1 $23.95
No. SSK-1CP-Chrome – $29.95

NYE VIKING SQUEEZE KEY

Extra-long, finger-fitting molded paddles with adjustable spring tension, adjustable contact spacing. Knife-edge bearings and extra large, gold plated silver contacts! Nickel plated brass hardware and heavy, die cast base with non-skid feet. Base and dust cover black crackle finished. SSK-1 — $23.45.

SSK-1CP has heavily chrome-plated base and dust cover. List price, $29.95.

CODE PRACTICE SET

You get a sure, smooth, Speed-X model 310-001 transmitting key, linear circuit oscillator and amplifier, with a built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included). List price, $18.50.

PHONE PATCH Model No. **250-46-1** measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $36.50. **Model 250-46-3**, designed for use with transceivers having a built-in speaker, has its own built-in 2" x 6" 2 watt speaker. Measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $44.50.

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

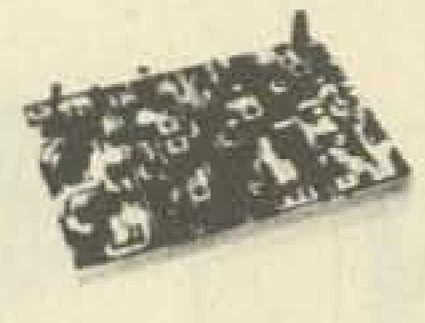
WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

The Synthesizer II is a two meter frequency synthesizer. Frequency is adjustable in 5 kHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 kHz to 10 MHz. No additional components are necessary!

Kit . . . . $169.95 Wired and tested $239.95

Also available for 220 MHz!

RECEIVERS



RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	$ 64.95
RX28C W/T	same as above—wired & tested.	117.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	64.95
RX50C W/T	same as above—wired & tested	117.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX114C W/T	same as above—wired & tested	119.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX220C W/T	same as above—wired & tested	117.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	84.95
RX432C W/T	same as above—wired & tested	129.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.95
RF28 Kit	10 mtr RF front end 10.7 MHz out	13.50
RF50 Kit	6 mtr RF front end 10.7 MHz out	13.50
RF144D Kit	2 mtr RF front end 10.7 MHz out	18.50
RF220D Kit	220 MHz RF front end 10.7 MHz out	18.50
RF432 Kit	432 MHz RF front end 10.7 MHz out	29.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	29.50
FM455 Kit	455 KHz IF stage plus FM detector	18.50
AS2 Kit	audio and squelch board	16.00

TRANSMITTERS

TX50	transmitter exciter, 1 watt, 6 mtr.	44.95
TX50 W/T	same as above—wired & tested	64.95
TX144B Kit	transmitter exciter—1 watt—2 mtrs	34.95
TX144B W/T	same as above—wired & tested.	59.95
TX220B Kit	transmitter exciter—1watt—220 MHz	34.95
TX220B W/T	same as above—wired & tested	59.95
TX432B Kit	transmitter exciter 432 MHz	49.95
TX432B W/T	same as above—wired & tested	79.95
TX150 Kit	300 milliwatt, 2 mtr transmitter	24.95
TX150 W/T	same as above—wired & tested	39.95

POWER AMPLIFIERS

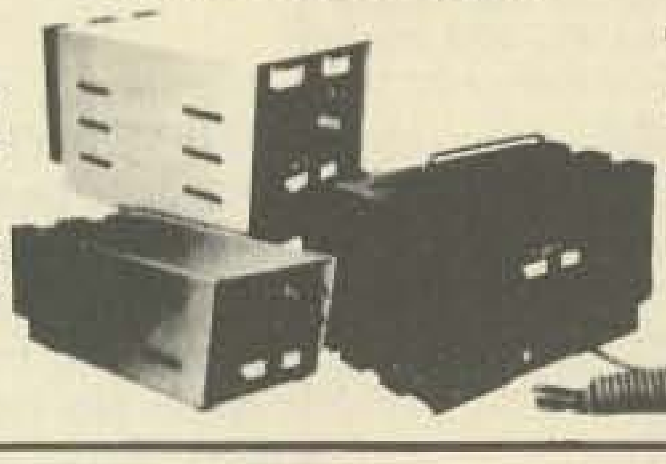


PA2501H Kit	2 mtr power amp—kit 1w in—25w out with solid state switching, case, connectors	64.95
PA4010H Kit	2 mtr power amp—10w in—40w out—relay switching	64.95
PA50/25 Kit	6 mtr power amp, 1w in, 25w out, less case, connectors & switching	54.95
PA144/15 Kit	2 mtr power amp—1w in—15w out—less case, connectors and switching	44.95
PA144/25 Kit	same as PA144/15 kit but 25w	54.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	44.95
PA432/10 Kit	power amp—similar to PA144/15 except 10w and 432 MHz	54.95
PA140/10 W/T	10w in—140w out—2 mtr amp	219.95
PA140/30 W/T	30w in—140w out—2 mtr amp	189.95

Blue Line . . . RF power amp, wired & tested, emission—CW-FM-SSB/AM

Model	BAND	Power Input	Power Output	
BLC 10/70	144 MHz	10W	70W	149.95
BLC 2/70	144 MHz	2W	70W	169.95
BLC 10/150	144 MHz	10W	150W	259.95
BLC 30/150	144 MHz	30W	150W	239.95
BLD 2/60	220 MHz	2W	60W	164.95
BLD 10/60	220 MHz	10W	60W	159.95
BLD 10/120	220 MHz	10W	120W	259.95
BLE 10/40	420 MHz	10W	40W	179.95
BLE 2/40	420 MHz	2W	40W	179.95
BLE 30/80	420 MHz	30W	80W	259.95
BLE 10/80	420 MHz	10W	80W	289.95

POWER SUPPLIES

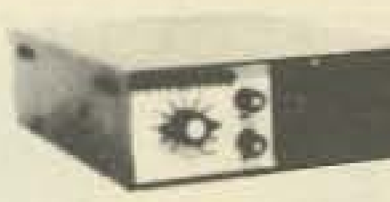


PS15C Kit	15 amp—12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	94.95
PS15C W/T	same as above—wired & tested.	124.95
PS25M Kit	25 amp—12 volt regulated power supply w/case, w/fold-back current limiting and ovp, with meter	154.95
PS 25M W/T	same as above—wired & tested.	179.95
O.V.P.	adds over voltage protection to your power supplies, 15 VDC max.	12.95
PS3A Kit	12 volt—power supply regulator card with fold-back current limiting	10.95
PS3012 W/T	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/fold-back current limiting and overvoltage protection	249.95

REPEATERS

RPT50 Kit	repeater—6 meter	499.95
RPT50	repeater—6 meter, wired & tested	799.95
RPT144 Kit	repeater—2 mtr—15w—complete (less crystals)	499.95
RPT220 Kit	repeater—220 MHz—15w—complete (less crystals)	499.95
RPT432 Kit	repeater—10 watt—432 MHz (less crystals)	579.95
RPT144 W/T	repeater—15 watt—2 mtr.	799.95
RPT220 W/T	repeater—15 watt—220 MHz.	799.95
RPT432 W/T	repeater—10 watt—432 MHz.	849.95
DPLA50	6 mtr close spaced duplexer	575.95
DPLA144	2 mtr, 600 KHz spaced duplexer, wired and tuned to frequency	379.95
DPLA220	220 MHz duplexer, wired and tuned to frequency	379.95
DPLA432	rack mount duplexer	319.95
DSC-U	double shielded duplexer cables with PL259 connectors (pr.)	25.00
DSC-N	same as above with type N connectors (pr.)	25.00

TRANSCEIVERS



TRX50 Kit	Complete 6 mtr FM transceiver kit, 20w out, 10 channel scan with case (less mike and crystals)	244.95
TRX144 Kit	same as above, but 2 mtr & 15w out	234.95
TRX220 Kit	same as above except for 220 MHz	234.95
TRX432 Kit	same as above except 10 watt and 432MHz	254.95
TRC-1	transceiver case only	29.95
TRC-2	transceiver case and accessories	49.95

SYNTHESIZERS

SYN II Kit	2 mtr synthesizer, transmit offsets programmable from 100 KHz—10MHz, (Mars offsets with optional adapters)	169.95
SYN II W/T	same as above—wired & tested.	239.95
SYN 220 Kit	same as SYN II Kit except 220-225 MHz	169.95
SYN 220 W/T	same as above—wired & tested	239.95

Vhf engineering

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching.	$ 7.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	15.50
CD3 Kit	UHF version of CD1 deck, needed for 432 multi-channel operation	13.50
COR2 Kit	carrier operated relay.	22.75
SC3 Kit	10 channel auto-scan adapter for RX with priority	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each).	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
MIC I	2,000 ohm dynamic mike with P.T.T. and coil cord	12.95
TS1 W/T	tone squelch decoder	59.95
TS1 W/T	installed in repeater, including interface accessories	89.95
TD3 Kit	2 tone decoder	35.95
TD3 W/T	same as above—wired & tested	59.95
HL144 W/T	4 pole helical resonator, wired & tested, swept tuned to 144 MHz ban	29.95
HL220 W/T	same as above tuned to 220 MHz ban	29.95
HL432 W/T	same as above tuned to 432 MHz ban	29.95

This NEW MFJ Super Antenna Tuner ... matches everything from 160 thru 10 meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines. Up to 200 Watts RF OUTPUT. Built-in balun, too!

With the NEW MFJ Super Antenna Tuner you can run your full transceiver power output — up to 200 watts RF power output — and match your transmitter to **any** feedline from 160 thru 10 Meters whether you have coax cable, balance line, or random wire.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid state rigs (like the Atlas) and with all tube type rigs.

Quality five way binding posts are used for the balance line inputs (2), random wire input (1), and ground (1).

It travels well, too. Its ultra compact size 5x2x6 inches fits easily in a small corner of your suitcase.

The secret of this tiny, powerful tuner is a wide range 12 position variable inductor made from two stacked toroid cores and high quality capacitors manufactured especially for MFJ. For balanced lines a 1:4 (unbalanced to balanced) balun is built-in. Made in U.S.A. by MFJ Enterprises.

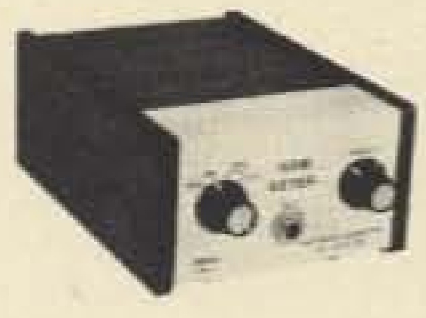
This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas.
Price: $69.95

THE HAM-KEY
NOW 5 MODELS

Dealer Programs NOW Available

NEW
MODEL HK-5
ELECTRONIC KEYER
$69.95



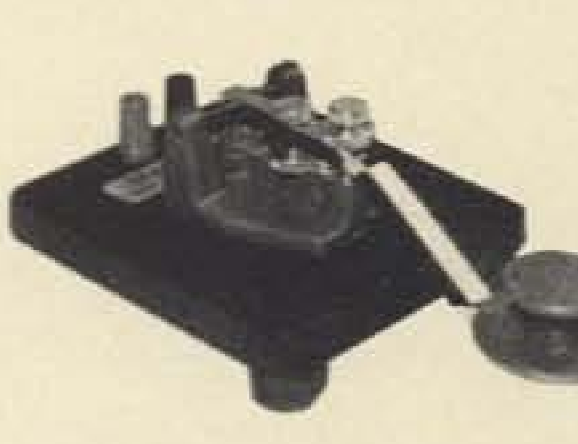
- Iambic circuit for squeeze keying.
- Self completing dots & dashes.
- Dot memory.
- Battery operated with provisions for external power
- Built-in side-tone monitor.
- Speed, Volume, tone & weight controls.
- Grid-block or direct keying.
- Use with external paddle such as HK-1.

Model HK-1 $29.95

- Dual lever squeeze paddle.
- Use with HK-5 or any electronic keyer.
- Heavy base with non-slip rubber feet.
- Paddles reversible for wide or close finger spacing.

Model HK-2 $19.95
- Same as HK-1, less base for those who wish to incorporate in their own Keyer.

Model HK-3 $16.95



- Deluxe straight key.
- Heavy base, no need to attach to desk.
- Velvet smooth action.

Model HK-4 $44.95
- Combination on HK-1 & HK-3 on same base.

This Digital Alarm Clock is also an ID Timer. Assembled, too!

You can get an ID buzz every 9 minutes (up to one hour). Simply set the alarm time to the beginning of your QSO. Then tap the ID/doze button.

You can also set the alarm to the exact minute to remind you of a SKED or simply to wake you up in the morning automatically every 24 hours (no need to remember every night to set the alarm).

Four large .63 inch digits provide precise time to the minute. Seconds appear at the touch of the ID/doze button.

Pressing the ID/doze and fast set buttons reset and hold the seconds to zero for precise setting to WWV until the fast set button is released.

The separate AM or PM LED indicators blink at a 1 Hz rate if the power goes off momentarily. For longer power outs it resets to 12:00 AM and the AM LED blinks.

Setting the time and alarm is simple and fast with the fast and slow set buttons. Even the XYL will find it fun.

110 VAC, 60 Hz. 3-1/8 x 3-3/4 x 3-3/8 inches. One year warranty.
Price: $19.95

400% MORE RF POWER
PLUGS BETWEEN YOUR MICROPHONE AND TRANSMITTER

SUPER LOGARITHMIC SPEECH PROCESSOR

Up to 400% More RF Power is yours with this plug-in unit. Simply plug the MFJ Super Logarithmic Speech Processor between your microphone and transmitter and your voice is suddenly transformed from a whisper to a **Dynamic Output.**

Your signal is full of punch with power to slice through QRM and you go from barely readable to "solid copy OM."

$49.95

LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ¼" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.

$59.95

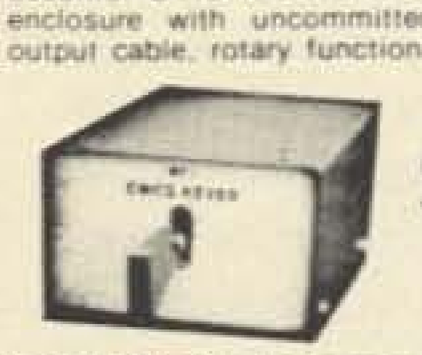
LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

$29.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity. 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in.

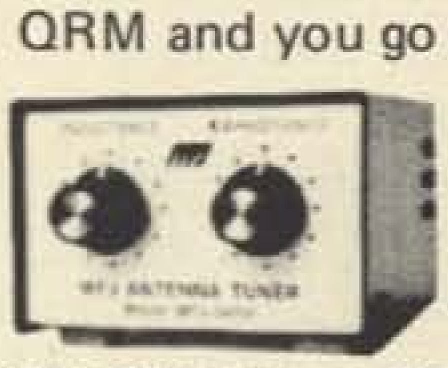


$54.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying • +300 volts max. • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches



$39.95 NEW

MFJ-16010 Antenna Tuner

Now you can operate all band — 160 thru 10 Meters — with a single random wire and run your full transceiver power output — up to 200 watts RF power OUTPUT.

• Small enough to carry in your hip pocket, 2-3/16 x 3-1/4 x 4 inches • Matches low and high impedances by interchanging input and output • SO-239 coaxial connectors • Unique wide range, high performance, 12 position tapped inductor. Uses two stacked toroid cores.

$17.95 NEW

CPO-555 Code Oscillator

For the Newcomer to learn the Morse code.
For the Old Timer to polish his fist.
For the Code Instructor to teach his classes.

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatigue during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches

$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output. • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches

$49.95

MFJ-1030BX Receiver Preselector

Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

• More than 20 dB low noise gain • Separate input and output tuning controls give maximum gain and RF selectivity to significantly reject out-of-band signals and reduce image responses • Dual gate MOS FET for low noise, strong signal handling abilities • Completely stable • Optimized for 10 thru 30 MHz • 9 V battery • 2-1/8 x 3-5/8 x 5-9/16 inches

$29.95

MFJ-40T QRP Transmitter

Work the world with 5 watts on 40 Meter CW.

• No tuning • Matches 50 ohm load • Clean output with low harmonic content • Power amplifier transistor protected against burnout • Switch selects 3 crystals or VFO input • 12 VDC • 2-3/16 x 3-1/4 x 4 inches

MFJ-40V, Companion VFO $27.95
MFJ-12DC, IC Regulated Power Supply, 1 amp, 12 VDC $27.95

H. Lukoff W3HT
506 Dreshertown Road
Fort Washington PA 19034

Painless Touchtone™ Adjustment

The existence of autopatch has brought about much joy. It has also brought some suffering. Listen on your favorite autopatch repeater any evening, and you will invariably find someone playing away at his touchtone™ pad, trying to get it to work. The testing of touchtone pads on the air can be extremely annoying to others monitoring or trying to use the repeater system. Asking another station on the air to judge whether your tones sound okay is, for all practical purposes, a worthless procedure. The human ear just can't provide the calibration that is needed.

Unfortunately, the successful operation of a touchtone pad depends on more than hooking it up correctly and getting audio tones out of it. Some autopatch repeaters feed the received audio tones directly into the telephone lines and do not regenerate the tones. This means that the received tones must meet the telephone system standards, and these are quite critical. Not only must the frequency of the tones be accurate, but the amplitude also has to be controlled. Since a range of tones from 697 Hz to 1477 Hz are transmitted, all must meet the same amplitude specifications. Therefore, the two tones transmitted must be closely balanced with respect to each other.

All FM transmitters use pre-emphasis in their modulation process. This means that the higher audio frequencies are accentuated more than the lower frequencies. To compensate for this at the receiver, de-emphasis is used to restore the audio to its original quality. Unfortunately, there is no firm pre-emphasis/de-emphasis standard in amateur service. In fact, manufacturers will vary the emphasis circuits to provide their own desired sound. You may notice that some manufacturers' radios can be identified by their distinctive sound. It is these circuits that can cause difficulty when hooking up a touchtone pad. Even though the high and low tones may be perfectly in balance when fed into the mike input, they won't be when radiated on the air.

Some repeater systems will retrieve the tones before the receiver de-emphasis circuits and some after. It is important to know what your autopatch repeater system requires. The Philadelphia-area repeater system, with which I am familiar, assumes balanced tones before the de-emphasis circuit. The specific requirements are for a deviation of 4 to 4.5 kHz, which satisfies the amplitude requirement, and for an unbalance of no more than 20% between the high and low tones. Thus, the two critical parameters requiring adjustment in a touchtone pad system are deviation, which sets the amplitude, and tone balance. The frequencies of the tones are usually accurately and stably generated and do not need adjustment for most LC or crystal-controlled oscillator touchtone pads. The frequencies on RC or other free-running-type oscillators should be checked.

The procedure which follows provides a means of making the necessary adjustments without tying up the repeater system.

A separate monitor receiver is required, in addition to your transmitter, and they are both to be tuned to the same simplex frequency. Locate the discriminator output of the receiver prior to the de-emphasis circuit. Be careful; some discriminator test points are made available

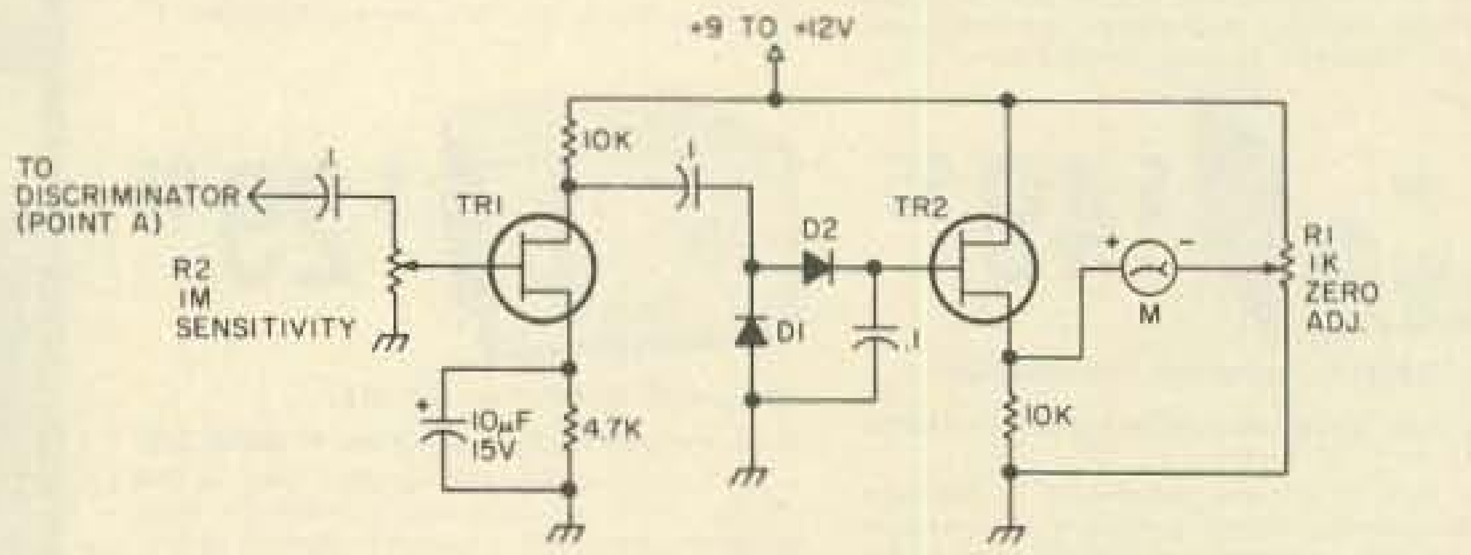


Fig. 1. Detector circuit. TR1, TR2 – 2N5458 or equivalent (HEP F0010) N-channel FET; D1, D2 – germanium computer-type diode (1N34); M – test meter on low voltage scale (3 V).

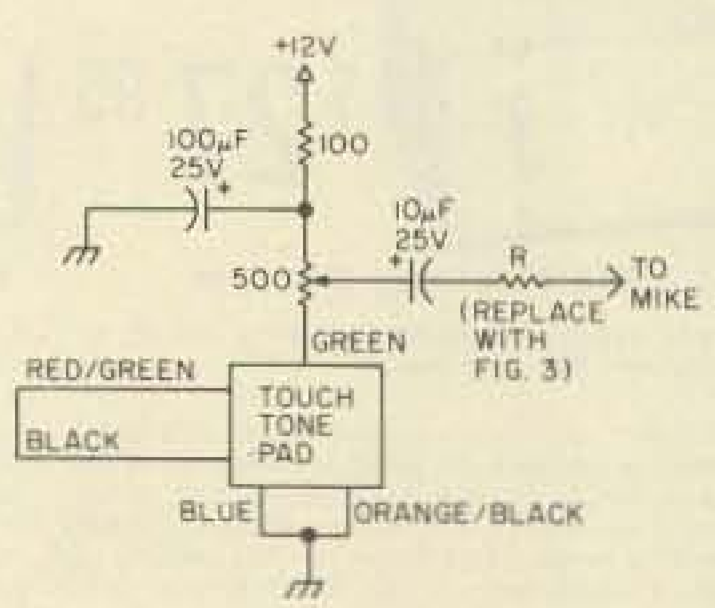


Fig. 2. Basic circuit.

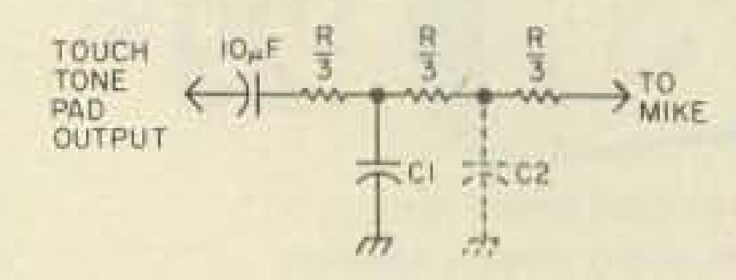


Fig. 3. Frequency correction circuit. $X_c = 1/2\pi fC$; let $X_c = (1/3)(R/3)$; $C = 9/2\pi fR = 9/(6.28)(700)(R) = .00205/R$; $C = 2050/R$ μF.

after the de-emphasis circuit. You will have to look at the schematic drawing to determine where the correct discriminator output is located. In the typical discriminator circuit shown in Fig. 4, the output should be derived from point A through an 18k resistor. Point B is the wrong test point, since it occurs after the de-emphasis circuit. Even with the discriminator output properly selected, the de-emphasis circuit acts as a variable frequency load on the discriminator, and it is capable of creating some error. The error will be less for vacuum tube receivers than for the solid state types because the circuit impedances are higher and the discriminator loading is less.

Perform all adjustments using low power into a dummy load. The procedure requires use of a measuring device, which can be either an oscilloscope (low frequency scope is OK) or a detector circuit (shown in Fig. 1) which uses an ordinary 20,000 Ω/V VOM as an indicator. The oscilloscope is preferred because it can show if any distortion is occurring, but the detector circuit will do an adequate job in most cases and can be constructed quickly on a breadboard. The detector, like the oscilloscope, places essentially no load on the circuit to be measured and responds to peak values of deviation. The meter can follow voice peaks with no problem.

Before using the detector, turn R2 counterclockwise (no input) and adjust R1 for a zero meter reading. The meter should be on a low-voltage dc range (1 to 3 V). The next step is to calibrate the measuring device (oscilloscope or meter circuit) for 5 kHz deviation. This will require some approximation, as most amateurs don't have an accurate 5 kHz deviation standard. Connect the detector to point A of the discriminator. The meter in Fig. 1 will be driven upward as signals are received and audio is heard in the speaker. The amount of meter deflection is controlled by R2. Listen to various channels for several days; the peak meter reading on the louder-sounding signals will probably correspond to 5 kHz deviation. Another method is to yell into your mike on a simplex channel and observe the measuring device. This assumes that your transmitter has been set by the manufacturer at 5 kHz deviation. Adjust R2 so that the meter reads approximately half scale on voice peaks with either of the approaches. Actually, it will be most convenient to set the meter needle via R2 to read 5 while looking at a 10-, 12- or 15-volt scale, even though the meter is set on a lower range. The actual deviation can then be read directly from the meter scale. This is a rough calibration procedure, but it's good enough for our purposes.

Use the touchtone pad circuit shown in Fig. 2. Adjust the 500-Ohm pot one quarter of the way open (from no signal). This is to allow for more signal to be available later, after the frequency corrective network is installed. On the conventional Bell touchtone pad, pushing buttons 2 and 3 simultaneously will generate the low tone (697 Hz) only. Pushing buttons 3 and 6 will generate the high tone (1477 Hz) only. While generating a low tone, determine what value R will produce 5 kHz deviation on your measuring device. R will be around the orders of magnitude shown in Table 1.

With R installed, reduce the setting of the 500-Ohm pot so that the high tone produces about 2.5 kHz deviation. This is to insure that the transmitter audio circuits are not limiting. Generate the low tone and observe the deviation. If it is within 20% of the high tone, your problems are nearly over. However, there is small probability that this will occur because of the pre-emphasis circuits. Don't be surprised to find a 2 to 1 tone unbalance. Assuming that you do have to correct for tone unbalance, divide R into roughly 3 equal parts, as shown in Fig. 3. Compute the value of C1 (μF) = 2050/total resistance.

The value of C1 is not critical. Twenty-five percent variations are allowable. Install C1 and measure the difference between high and low tones again at about 2.5 kHz deviation. You will notice that the high tone is now closer in amplitude to the low tone. In most cases, this is all of the correction that will be required. If the high tones are still too large, install an identical capacitor at C2. If, after doing this, the high tone is less than the low tone (you have overshot), reduce C2 in value until tone balance is obtained.

You have now completed the tone balance and are ready to set the deviation. Press button 3 only, and set the 500-Ohm pot for 4 to 4.5 kHz deviation. This setting should be just below the limiting level of your transmitter.

If you cannot obtain 4.5 kHz deviation when the 500-Ohm pot is turned all of the way up, this is an indication that R is too high. Lower R in 20% steps, and recompute C for each reduction. The corrective network is designed to provide light loading on the mike input and should not affect normal operation. If it does, the alternative is to put a switch in series with the touchtone output lead. The corrective network provides an impedance matching function between the mike input and the touchtone pad output, as well as acting as a frequency equalizer. Needless to say, it is desirable to put the touchtone pad and components into a metal box and use a shielded lead in connecting the pad to the mike input in order to minimize chances of rf pickup.

Although the procedure described above is intended for the conventional Bell touchtone pad, the principles can be applied to other touchtone pads. With some of the new pads, it may not be possible to generate the 697 Hz and 1477 Hz individual tones called for. In this case, push button 3 to generate both tones, and determine an R that will produce 4 to 4.5 kHz deviation with the touchtone pad set for roughly 1/4 output, if there is an output adjustment. Next, disconnect the pad from the 10 μF coupling capacitor, and feed into the capacitor an audio oscillator signal set for first 697 Hz and then 1477 Hz. Proceed as described previously for measuring the unbalance at the two different frequencies and in correcting for it. Be certain the audio generator produces the same amplitude for both tones.

The above procedure should be effective for most touchtone pad/transmitter combinations. If it isn't, it will require the services of a base station operator with an oscilloscope to analyze the problem. ■

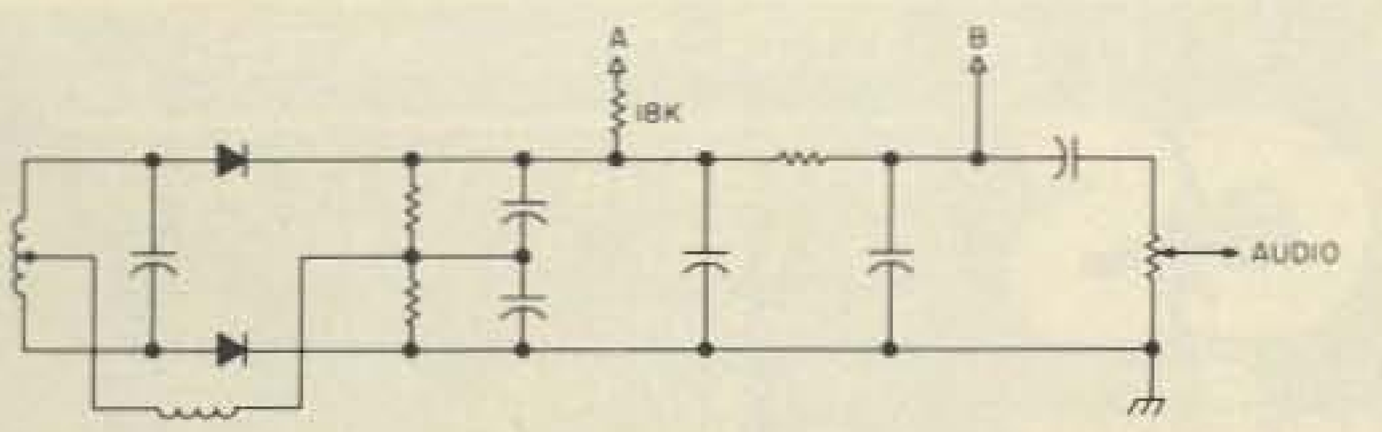


Fig. 4. Discriminator.

Very high impedance (ceramic or crystal mike)	1 meg
High impedance (magnetic mike)	100k
Low impedance (magnetic mike)	10k
Very low impedance (carbon mike)	1k

Table 1.

HAMTRONICS USED GEAR • TEST EQUIPMENT • SPECIALS

30-DAY GUARANTEE ■ 90-DAY FULL CREDIT TRADE-IN ■ FREE SHIPPING VIA UPS ONLY

Limited quantities. First come, first served. *(if weight or size exceeds UPS max., we will ship freight collect)*

Allied

AX-190 Receiver $159

Ameco

PV-50 $ 9
CN-50 29
CN-144 39
TX-62 79
621 VFO 45

B&W Waters

Nuvertor 2+6 Conv. $ 75
6100 SSB Xmitter 395
670 SSB Adaptor 39
Co-Dax Keyer 95

Central Electronics

100V Transmitter 325
MM-2 Scope 69
20-A SSB Adaptor 79

Clegg

22'er FM $129
66'er 6M Xcvr 115
99'er 6M Xcvr 59
Interceptor BRCUR 275
Ant Pre Amp 22
All Bander 69
HT-146 125
2 Vess 259
FM-27-B Xcvr 325

Collins

75 A4 Receiver $395
75S3B Receiver 695
75S1 Receiver 349
KWM-2 Xcvr 595
32S1 Xmitter 349
PM-2 AC Supply 95
516 F2 AC Supply 139
312B5 Console 425
361D2 Mount 29

Drake

2A Receiver $149
2B Receiver 189
2AQ SPKR QMULT 29
R4 Receiver 289
R4-B Receiver 349
R4-C Receiver 399
MS-4 Speaker 19
2NT Transmitter 125
2NT Transitter 99
TR-6 695
TR-22 2 Meter 140
T-4X Transmitter 339
TR-72 2 Meter FM 225
AC-4 AC Supply 95
TR-4-C Transceiver 449
CC-1 Console
CPS-1 Supply
SC-2 Conv
SC-6 Conv
SC-1 Calibrator
The above all assembled complete pkg. Only $200

Dycomm

10-0 2 M Ampl $125
35-0 401N 110 Out 130
470-25 450 MC 120
P-1416 16 Amp Supply 95

Eico

720 Transmitter $ 49
722 VFO 39
730 Modulator 39

Elmac

AF-67 Transmitter $ 45
PMR-8 Receiver 79

Genave

GTX22M FM $165
GTX-200 2M FM 149

Globe/Galaxy

VHF 6+2 Transm $ 39
Chief Transmitter 39
Galaxy III Xcvr 159
Galaxy V Xcvr 189
Galaxy V Mk II 239
GT-550 Xcvr 279
GT-500A Xcvr 329
AC-400 Supply 79
FM-210 2M FM 95

Gonset

Com II 2M $ 75
Com II 6M 69
Com IV 2M 129
GC-105 2M 115
G-28 Xcvr 149
G-50 Xcvr 149

Hallicrafters

S-108 Receiver $ 99
SX-101 Receiver 159
HT-32 Transmitter 179
HT-32B Transmitter 269
SX-99 Receiver 79
SX-115 Receiver 349
HT-37 Transmitter 159
HT-40 Transmitter 49
SX-99 Receiver 99
SX-117 Receiver 189
SR-150 Xcvr 259
SR-160 Xcvr 159
SX-146 Receiver 175
HT-44 Transmitter 159
SX-111 Receiver 149
SX-122 Receiver 249
S-36 UHF Receiver 125

Hammarlund

HQ-110 A VHF Receiver $189
HQ-110C Receiver 119
HQ-110AC Receiver 149
HQ-145X Receiver 169
HQ-170C Receiver 159
HQ-180 Receiver 379
HQ-215 Receiver 259
SP-600 Receiver 179
HX-50 Transmitter 169

Heathkit

SB-300 Receiver $199
SB-301 Receiver 229
HR-10-B Receiver 69
SB-303 Receiver 269
SB-220 Linear Amp 449
SB-102 Trivcvr 379
DX-60B Transmitter 69
HW-32 Transmitter 85
HW-100 Transceiver 249
SB-100 Transceiver 299
SB-401 Transmitter 249
SB-101 Transceiver 349
SB-650 Digital Freq. Display 149
HW-30 Twoer 29
Also Sixer 29
H-10 Monitor 69
VHF-1 Seneca 79
HW-12 Transmitter 75
HP-23 AC Supply 49
HP-23B AC Supply 59
HW-202 2M FM Xcvr 159
SB-620 Spectrum Analyz 120
SB-102 Xcvr 369
SB-610 Scope 95
HA-20 6m Linear 125
SB-634 Ccnsole 175
SB-604 Spkr 29.50
SB-644 VFO 129.50
SB-230 Linear 359
SB-104 Transceiver 625

ICOM

IC-21 2M FM Xcvr $299
IC-230 Demo 369
IC-22A 2M FM Xcvr 185
IC-30A 432 MCFM 269

Johnson

1-KW Matchbox/SWR $195
Courier Linear 139
Ranger I Transmitter 85
Ranger II Transmitter 139
Valiant I Transmitter 129
Invader 2000 Xmitt 495

Kenwood

T-599 Transmitter $289
R-599 Receiver 289
TS-520 Tranc 429
QR-666 259
QR-666 Receiver 239
TV 502 Transvertor 179

Knight

T-60 Transmitter $ 39
r-100 Receiver 59
TR-108 Trancur 2M 79

Lafayette

HA-800 Receiver $ 89
HP-350 Receiver 149
HE-45 Transceiver 49

Midland

509 H.T. $149

Millen

92200 Transmatch $149
90651-A Grid Dipper 95

National

NC-270 Receiver $119
NC-300 Receiver 129
NCX-5 Transceiver 279
NCX-5MKII Transcvr 299
NC-303 Receiver 199
AC-500 AC Supply 69
NCX-500 Transceiver 199
NCX-3 Transceiver 169
NC-190 Receiver 149
NC-105 Receiver 69

Regency

HR-2B 2M FM $169
HR-220 FM 220 MC 185
AR-2 2M Amplifier 85
HR-25 2M FM 225
HR-6 Meter FM 189

SBE

SB-34 Transceiver $249
SB-33 Transceiver 189
SB-144 2M FM 175
SBZ-LP Linear 179

Standard

SRC-146 HT $149
826 M Trnscvr 195
SRC-144 395
SRC-851T 250

Swan

700-CX Xcvr $459
260 Cygnet 289
279 Cygnet 329
500 Xcvr 299
500 CX Xcvr 389
117-XC AC Supply 95
14X DC Module 39
MK II Linear 475
KK VI 6 Meter 550
250 C 6M Xcvr 349
FM 2X2M Xcvr 169
FM-1210A 2M 249
350 Transceiver 269
350C Xcvr 299
600R Receiver 339
600T Transmitter 399
410 VFO 79

Tempo

Tempo one Xcvr $299
AC One Supply 79
FMH 2M H.T. 149
CL-220 Ti ncur 220 MC 179
FMH 2M w/Talkie 149

Ten Tec

PM-3 Trnsur $ 49
Argonaut Xcvr 199
KR-40 Keyer 79
RX-10 Receiver 49
S-30 Signalizer 29
Triton II 479

Yaesu

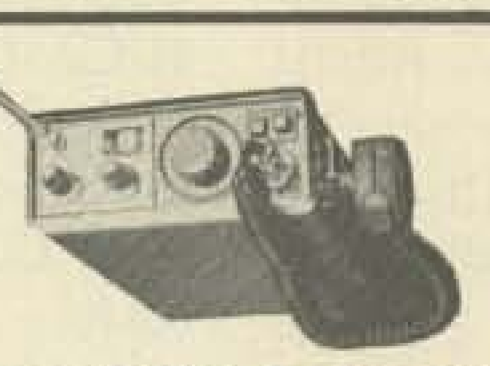
FT-401 Xcvr $499
FRDX 400SD Rec 325
FT 2 Auto 2M FM 249
FT-101B Xcvr 549
FL-2100B Linear 295
FV-101 VFO 79
101E Xcvr Demo 695

Test Equipment Bargains

Boonton "Q" Meter $295
Tektronix 5140 249
Tektronix 545A 950
5 3/54A Plug-in wide band preamp . . . 75
Hickok 695 Generator. 69
Bendix BC221 Freq Meter 39
Polarad Spectrum Analyzers A84T. . . 1695
Hewlett Packard 400C. 75
Precision E-400 Signal Generator. . . . 125
Electro Impulse Spectrum Analyzer . . 395
Dyna/Sciences Model 330 Digital Multimeter 195
Hewlett Packard 4905A Ultra Sonic Detector 550
Hewlett Packard 120A Scope. 250
TS-323/UR Frequency Meter. 175
Hewlett Packard 4910B Open Fault Locator 650
Bird Mod 43 80
General Radio 650A. 150
Measurements Mod 80. 195
Nems Clark 1400. 495
Ballantine 300H 175
PACO Scope Mod-S-50 75
Singer FM-10C 3495
Simpson 260 V.O.M.. . . . . 49.50

ICOM IC22S

Regular $299, save $50; buy an ICOM IC22S for $299 (no trades) and take a $50 credit for another purchase.



KENWOOD TR-2200A

Regular $229, save $30; buy a Kenwood TR2200A for $229 (no trades) and take a $30 credit for another purchase.

MIDLAND 13-510

Regular $399, save $50; buy a Midland 13-510 for $399 (no trades) and take a $50 credit for another purchase.

KENWOOD
TS 820 — $869.00
TS820S — $1048.00

YAESU
FT101E – 799.00
FT101EE – 759.00
FT101EX – 699.00

DRAKE

TR4CW – $799.00

MAIL & PHONE ORDERS WELCOMED. BANK AMERICARD ACCEPTED. ALL UNITS GUARANTEED

HAMTRONICS
DIVISION OF
Trevose Electronics

4033 BROWNSVILLE ROAD
TREVOSE, PA. 19047
Telephone:
(215) 357-1400
(215) 757-5300

I do suggest you code or cable-connect these, so you can't interchange them. Entering the main control unit, this 24 V ac is rectified by a bridge diode pack (Motorola-type), filtered, and regulated by any one of the now commonly available 3-terminal regulators. The regulation allows your settings of charge times in the following circuitry to remain constant without regard to fluctuating power line conditions. One thing the now rectified and regulated dc is used for is the lamp monitor circuit. Leaving the main control unit via a barrier strip or 3-pin plug, as in mine, the 24 V dc is fed to a lamp (28 V, low current, long life) located on a bracket inside the squirrel cage. It has a tube (light pipe) around it to direct the light through the slots in the blower. You can usually mount the photocell (or phototransistor, etc.) directly to the outside shell of the cage enclosure after drilling a ½" hole for the light to get through. Make the mounting as airtight and lighttight around the outside as possible (pill bottle, lid, etc.). Don't shove the drill through the squirrel cage while drilling, and don't reverse the mounting, putting the lamp outside. It is hard to shield the photocell out on a bracket inside the cage, and the vibration of the enclosure of the cage would shorten the life of the lamp if it were mounted on the outer shell (live and learn).

Assuming the normal and proper operation of the motor, belt and load, the lamp shines on the photocell each time the slot in the squirrel cage goes by (several times per revolution). This creates pulses which are ac coupled to the "load detector" circuit. These pulses build up a charge on CT until Q2 pulls in relay K1. K1 breaks the heater lead of the thermal time delay relay (hereafter the TTDR), making its time delay infinite – it never closes – thus the relay K2 never closes, and the NO contacts of K2 keep 120 V ac on the motor for normal running. RC pot is used to set a time period of about 10 seconds worth of pulses for K1 to pull in. In other words, under normal conditions, you have 10 seconds of the pulses detected for K1 to pull in and switch the control unit to normal run mode.

Now, assume the motor stalls, the belt is off at start time, or the squirrel cage is frozen. The thermal TTDR allows 20 seconds of stall and no pulses before its contacts pull in, pulling in K2, and shuts off power to the motor. This allows time for the cooling cycle of the TTDR (about 1 minute in mine), and then it tries again. The switch in the remote alarm box also allows you to choose the mode you use. If it's in the manual position, it lets the unit shut down once, and then you must go down, find the trouble, and reset it manually with the reset button on the main control unit. This allows for times when you are away for extended periods, such as work or vacation. The switch line carries only 24 V, and can be rotor cable or the like, as in all lines to the remote alarm unit.

Another possibility is that the whole works starts okay, then a belt slips, breaks, or jumps off. The pulses must keep coming, or the detector circuit will decay and allow K1 to drop out. Since the TTDR is then reconnected to the 24 V ac, 20 seconds later the TTDR contacts pull in, and K2 pulls in right after, shutting down the motor again.

It should be easy to see how all this applies to my well pump, as well (old style with spokes on the pump drive wheel), or to any other electric motor on which you can attach some pulse-forming wheel to the load end. I say load end, so you can detect belt or drive system failures as well. I have tried to arrange the schematic so you can see what is really located where in my system, and how it all interconnects to the remote alarm unit along with many other sensors and wiring.

I did not place values on RC1, RC2, RD1, RD2, or CT, to allow you to choose your own based on what time you use on the 20-second TTDR or similar unit and on what you have around, and to leave you room to modify it to your own purpose. It is easy to choose ball park figures for them by assuming Q1 is a switch that is on all the time and charges up CT in RC x CT seconds (R in Ohms, C in farads). Depending on the pull-in current for K1, that current is the collector current in Q2. The base current

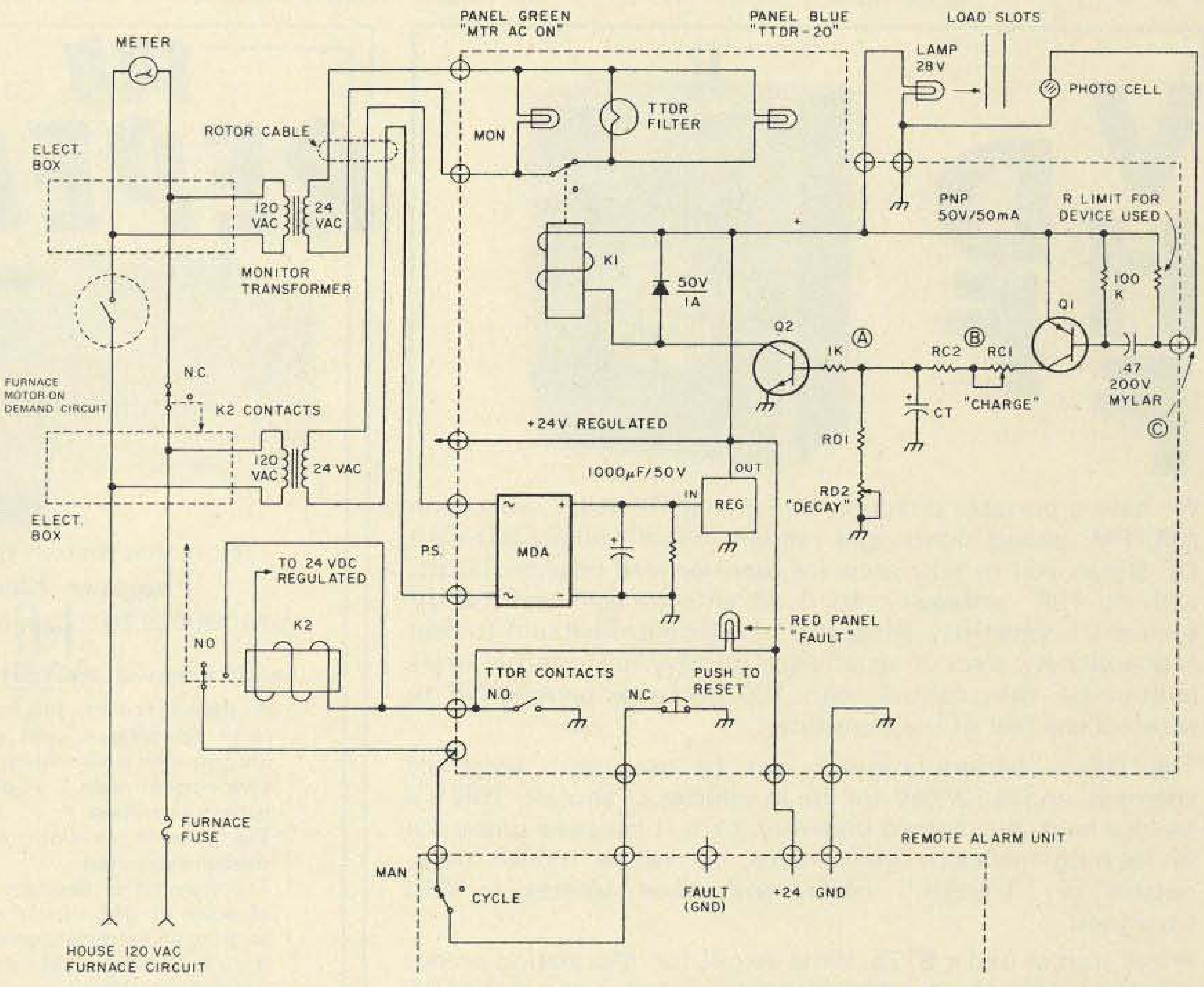


Fig. 1. Stall detector. To test: Open connection at C and run system. 1) Green and blue come on; 2) after 20 seconds, red lights and motor shuts down; 3) reconnect C, and, at 20 seconds, no red and motor runs through normal cycle. Note: If it's in manual at the time of fault, switching to cycle will reset after TTDR cool-off. But this is not recommended, as it defeats the purpose, which is that you investigate the problem.

required to cause that current is going to be roughly the collector current (IC) divided by the beta of the device you use (use a 50 V or higher, NPN silicon, and about 2-5 times the current required by K1). The voltage at point A must be high enough to cause this base current through the 1k base resistor. (When the transistor is on, the voltage at the base is very close to .6 V; therefore, if the voltage at point A was 1.6 V, then there would be 1 V across the 1k resistor for 1 mA of base I. Further, if the Q2 beta was 100, you could pull approximately 100 mA down through the collector circuit including K1. If 100 mA was the pull-in current of K1, then 1.6 V at point A would cause a relay pull-in to occur. The variable part of RC sets how long it takes to get up to this point A level.) An easy out is to make RD1 + RD2 = RC2, so you know it takes twice as much voltage at B as you need at A. Make these resistors at least ten times the 1k base resistor, so the Q2 remains the main control element in the discharge path, since you don't need nearly the delay for a detected failure as you want for a detected "load running" condition.

My two units work fine, and I have simulated every usual failure I have had to contend with over the years. I might add a few notes here about my remote alarm unit. I have burglar, fire, smoke, and another type of "fire situation" detectors all run into one unit, as well as one of the Poly Paks chassis-only AM-FM radios and my intercommunication station. This makes quite a versatile and attractive package which ties up all these units and a power line monitor in the same box. While I was at it, I included an ac carrier current system that allows me to turn on the 2m FM downstairs and then operate it from up there as a "help" device if the phone lines are out. I have, therefore, included only enough to show you how to get your unit going. If you are interested in the rest, drop me a line.

The wiring provides +24 V dc from the main control unit, to drive your alarm device if you need it, a common ground, and a switched line that closes to ground on a fault alarm. Also, the cycle and manual lines come up, for a total of 5 lines, but I suggest you run 8-conductor rotor cable with the +24 V dc and ground on the heavy pair and allow for future additons. After I kept monkeying around for more than 5 years, I did this, and I also ran a 24-pair bus system to and from every room in the house using old pulled-from-service telephone cable. It has saved me many trips back under the house (only a half basement).

I have come up with several possible uses since the initial needs arose. One is to tell me if the beams are frozen up before I burn up the rotor (especially handy, since the 24 to 30 V ac is usually already available as the voltage that runs the motor, and my beams are set up to send down position as digital-code anyway). Another is as a sensor on another project I have tackled each of the past 5 winters, which is to tell me if the car really starts when the timer says for it to (cold mornings are a whole other story not yet perfected). A future use is to detect stalls or no wind conditions (discharge) on a wind generator I hope to get up next summer. This may not seem like much of a ham radio article, but I doubt that many of us haven't cussed the conditions it monitors. If you are amongst the chosen few who have not, just wait!

You help me and I will gladly help you, so, for any questions, the proper SASE will bring a speedy reply (usually same day). ■

DSI

DSI INSTRUMENTS INC.

Be the one who's on FREQUENCY!!

With your *DSI Counter*. . .save the shop cost of tweaking xtals. . . know your frequency. . .from 160 meters through 450 MHz. Now *DSI* offers *the most* counter for your dollar. Latest state-of-the-art technology. . .*DSI* advanced LSI design far exceeds outdated TTL. Go with the leader . . .buy a *DSI FREQUENCY* counter and *SAVE TIME & MONEY!!*

NOT A KIT

MODEL 3500 $139.95

500 MHZ Frequency Counter

- Includes 500 MHz Prescaler — Not an addon
- 7 Large bright — ½ inch LED Readouts
- Temperature compensated crystal timebase
- Accuracy 1 PPM Typ
- Sensitivity 50 MvRms 150 & 250 MHz 150 MvRms 450 MHz
- Gate time light
- No direct RF connection Required
- AC or DC operation
- 50 Hz to 500 MHz typ
- Comprehensive owners manual with complete accurate schematics
- Factory assembled & tested

MODEL 3600A $189.95
Includes oven timebase

600 MHz Frequency Counter

- Includes oven compensated crystal timebase
- Includes built-in 600MHz Prescaler-Not and addon
- 8 Large bright — ½ inch LED Readouts
- Two timebases 0.1 sec & 1. sec
- Resolution 1 Hz Direct 10 Hz Prescaled
- Sensitivity 20 MvRms @ 150 & 220 MHz 100 MvRms 450 MHz
- Accuracy .5 PPM over temperature
- Oven light & Gate time light
- Automatic Decimal point placement
- NO DIRECT RF CONNECTION Required.
- Comprehensive owners manual with complete accurate schematics
- AC or DC operation
- 50 Hz to 600 MHz Typ.
- Factory assembled & tested

Use it in the car or on the bench. . .take it to the repeater site. . .high-impact case. . .light weight—but rugged. . .Designed with the latest readily available LSI, CMOS, Schottky, Mecl-integrated circuits.

NEW PRODUCTS

- 250 MHz 7 Digit Battery operated hand held counter $109.95 available mid-January.
- 3½ Digit Bench Degital Multi-meter AC or Battery operated $99.95 available mid-February.

Visit us at ORLANDO, FLA. ARC ARRL Convention Feb. 17, 18, 19
Booths 37, 39, 40 (Sheraton Towers)

Strongest Warranty in the Counter Field. ONE Year Parts and Labor we pay the return shipping plus. . .if not satisfied, return in ten days for full refund. . . Dennis Romack. . .WA6OYI.
VP-Marketing, DSI

D25

TO ORDER *CALL* COLLECT (714) 565-8402

Name ______ Call ______
Address ______
City ______ State ______ Zip ______
Phone: ______
Order: ______
☐ Check enclosed ☐ Please send more information on your full line of Instruments and Accessories.
☐ BankAmericard ☐ MasterCharge ☐ VISA ☐ R.E.
Credit card # ______ Card expiration date ______ Signature ______

DSI INSTRUMENTS INC.
Div. Diversified Security Ind, Inc.

We pay shipping charges anywhere in the U.S.A. UPS Brown or P.P. — CA Residents please add 6% state sales tax.

- American Express
- MasterCharge
- Bank of America
- VISA

7914 Ronson Road No. G, San Diego, CA 92111

Jim Labo KØOST
6359 South Fenton Court
Littleton CO 80123

Try 220, You'll Like It!

—use it or lose it!

How do we solve the problem of ever-increasing numbers of VHF FMers? The high end of two meters is extremely crowded. All 30 kHz split repeater channels are in use in many metropolitan areas. Where do we expand next? The first option is 15 kHz tertiary channel repeaters. This solution has large technical problems. There is a second, and much easier, solution – expansion into the 220-225 MHz band.

The greatest deterrent to the growth of 220 MHz was the lack of commercially available equipment. There were a few notable exceptions by Gonset, Tecraft, and innumerable converter manufacturers. A determined amateur had to build his own 220 MHz equipment. Their numbers were small because, unfortunately, it takes commercially made equipment to attract large numbers to a new band or mode. With all its advantages, two meter FM had only slow growth during the era of converted surplus high band (150-172 MHz) equipment. Today's fantastic growth occurred only after the introduction of equipment specifically made for the ham market. Ham SSTV had the same growth problem, before the manufacturers took an interest. This is no longer a problem for 225 MHz FM, as the manufacturers are now ready. Take your choice and enjoy the boom.

If you are interested in joining the 225 MHz gang, here is the basic information to get you properly oriented for your new venture. There are three primary questions to be answered:

1. What kind of results can be expected on 220 MHz?
2. Where on the band do I operate?
3. What kind of equipment is now available?

Coverage

The 220 MHz band is very similar to two meters. With comparable 220 MHz equipment, you have similar coverage. This was the second major reason for the lack of 220 MHz growth. A VHF experimenter would move up to 432/450 MHz after two meters, as he wanted something different. This similarity should now be an advantage.

Two-twenty has fewer dead spots then two meters because of the shorter wavelength. Two reflections of the same signal arriving at the antenna out of phase cause dead spots. With the shorter wavelength, the mobile antenna moves less to get back to in-phase reflections, thus has smaller and fewer dead spots.

Band Plans

FCC regulations allow all amateur modes, except wideband TV and pulse, on the entire band. With no official guidelines, some sort of gentleman's agreement is needed for the orderly occupation of the band. In the early seventies, a band plan was adopted with channels every 40 kHz from 220.020 to 224.980 MHz. Repeaters were allocated inputs, Fig. 1, from 221.58 to 221.98 MHz, with outputs 3 MHz higher.

However, the infamous repeater docket (18803) upset this plan by restricting repeaters to only 222 to 225 MHz. It is interesting to note that RACES repeaters can use the full 220-225 MHz band. The 220 to 222 MHz segment apparently was being reserved for a Class "E" Citizens Band. The current 220 MHz band plan eventually adopted is:

220.00 to 220.30 MHz. Narrowband (SSB/CW/AM) modes in the eastern and central portions of the country. The "common frequency" is 220.050 MHz, or an 8.150 MHz crystal. However, due to the usual mismatch between crystal and oscillator circuit, those users are anywhere from 222.020 to 220.070 MHz. The better equipped stations tend to hug the low end, just above 220.00 MHz.

220.30 to 222.00 MHz. Control frequencies and auxiliary links. Two-twenty is the lowest band where the radio control link of a remotely controlled transmitter is permitted.

222.00 to 222.30 MHz. Narrowband modes on the west coast and moonbouncers working the west coast. The 220 MHz band is the lowest, fully shared band with the government radiolocation service, which has priority. TV local oscillators and radar garbage render the low end useless. These problems are present in the rest of the country in varying degrees. But only on the west coast have the narrowbanders moved away from the low end garbage.

222.34 to 223.38 MHz. Repeater inputs. The repeater standards are 40 kHz channels, with repeater outputs 1.60 MHz above inputs. Fig. 2 shows the repeater pairs. The original band plan design called for creation of 20 kHz split repeater channels, when all the 27 repeater pairs were in use. However, in many areas, the 222.00 to 222.30 and 223.60 to 223.90 MHz segments are being allocated for additional repeaters before adopting split repeater channels. These areas need good cooperation/coordination between expansion repeater owners and area 222 MHz narrowbanders. A high powered 222 MHz moonbouncer would wreak havoc if he used the repeater input frequency. Since the 220 MHz band plan was adopted before the phenomenal FM growth, maybe discussion should begin on moving the narrowbanders to just below 222.00 MHz, say 221.70 to 222.00 MHz. This would prevent friction between FMers and narrowbanders and yet leave the narrowbanders high enough to avoid the low end garbage.

223.42 to 223.90 MHz. FM simplex channels. The national simplex channel is

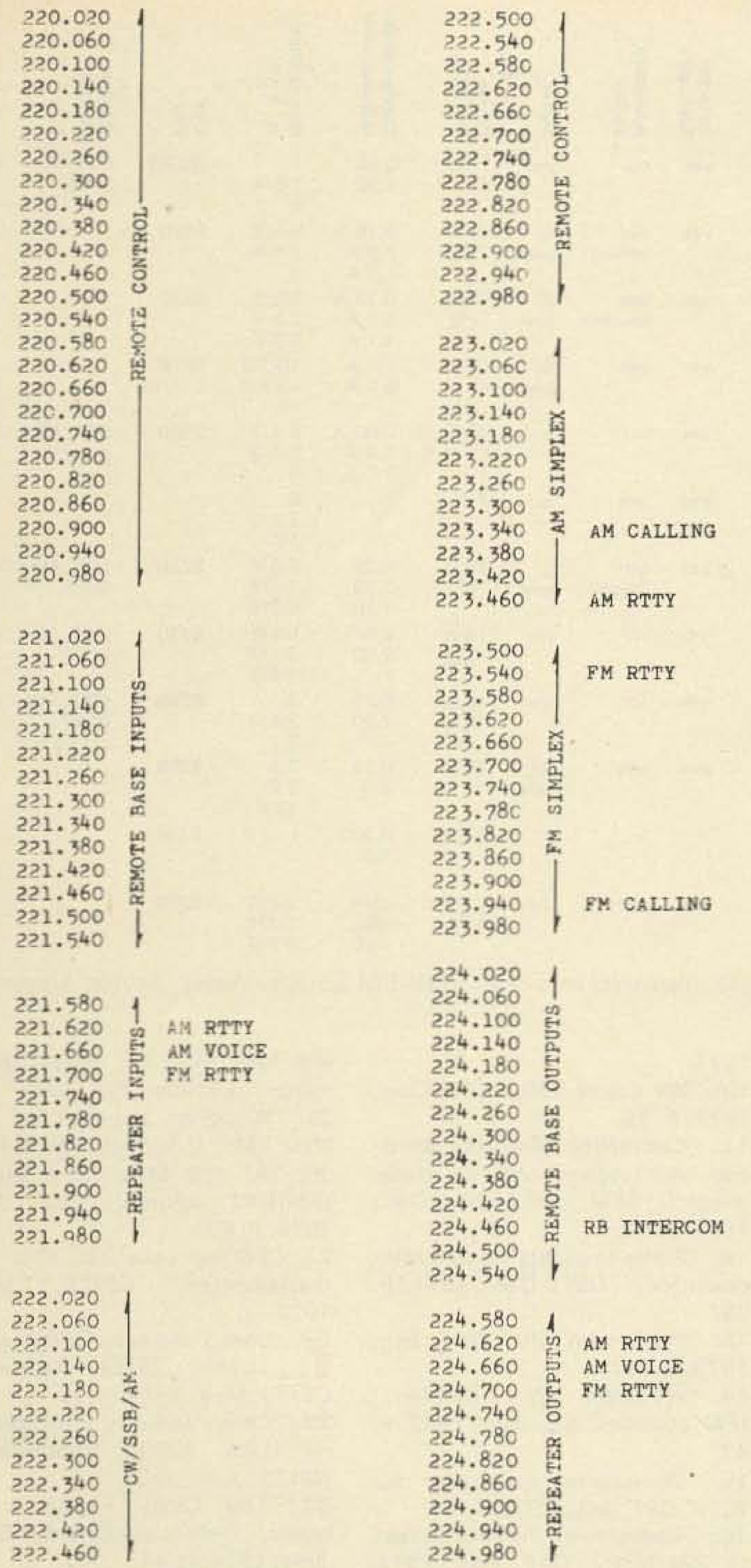


Fig. 1. The original 220 MHz band plan, drawn up in the early seventies. Southern California's influence is shown from there being more remote base than repeater pairs.

223.50 MHz. The recommended expansion order is 223.46, and then 223.54 MHz as simplex activity builds.

223.94 to 224.98 MHz. Repeater outputs. The two most popular pairs are 34/94 – 222.34/223.94 and 223.34/224.94 MHz. The frequencies 223.10/224.70 and 223.70 MHz are reserved for RTTY.

Equipment

To get on 225 MHz FM, there are three basic methods: buy, build, or butcher. If you are interested in the last two, a check of the annual indexes of popular ham magazines for the last ten years should help you. If you are interested in buying a 225 MHz rig, the manufacturers are ready with a wide choice. All the new 225 MHz FM transceivers are multichannel, solid state, with features comparable to their two meter cousins. They come with only the national simplex channel,

REPEATER CHANNELS

INPUT	OUTPUT	
223.38	224.98	
223.34	224.94	
223.30	224.90	
223.26	224.86	
223.22	224.82	
223.18	224.78	
223.14	224.74	
223.10	224.70	(RTTY)
223.06	224.66	
223.02	224.62	
222.98	224.58	
222.94	224.54	
222.90	224.50	
222.86	224.46	
222.82	224.42	
222.78	224.38	
222.74	224.34	
222.70	224.30	
222.66	224.26	
222.62	224.22	
222.58	224.18	
222.54	224.14	
222.50	224.10	
222.46	224.06	
222.42	224.02	
222.38	223.98	
222.34	223.94	

SIMPLEX CHANNELS

223.90	
223.86	
223.82	
223.78	
223.74	
223.70	(RTTY)
223.66	
223.62	
223.58	
223.54	
223.50	NATIONAL SIMPLEX
223.46	
223.42	

REPEATER EXPANSION CHANNELS

INPUT	OUTPUT
222.30	223.90
222.26	223.86
222.22	223.82
222.18	223.78
222.14	223.74
222.10	223.70
222.06	223.66
222.02	223.62

Fig. 2. The repeater and simplex channels under the present 220 MHz band plan.

223.50 MHz, and will need crystals for your 225 MHz repeater. Fig. 3 shows there is quite a range in price and features.

A major consideration in choosing a 225 MHz FM transceiver is receiver image rejection. The problem arises if the receiver uses injection below the desired receive frequency. For 220-225 MHz, using the common 10.7 MHz i-f, the image falls between 198.6 and 203.6 MHz, or TV channel 11. If this channel is in use in your area, your receiver will need excellent input selectivity. Receivers using high side injection have images in the 225-400 MHz military communications band, eliminating the problem.

The VHF Engineering unit is a kit. It is definitely not what you may have become used to with Heathkits, as there are no step-by-step directions. If you have had some building experience, it is a very good buy. The TX-220 and RX-220 can be built now and multichannel, scanning, or power amplifier modules can be added, as interest and finances permit.

The Genave is a good, basic, no frills unit. The ten channels can be ganged or the transmit and receive frequencies separately selected.

The Clegg FM-76, Cobra, and Midland are identical. Features include an S-relative power meter and prewired accessory socket. The four-pin socket has connections to the mike input, +12 V dc on transmit, and discriminator. Group purchase discounts are available. Spectronics handles the Cobra and Midland, while Clegg deals direct. On group purchases, Clegg includes crystals for your repeater as part of the package.

The Tempo unit is in the deluxe class. Features include a built-in discriminator meter, a simplex spot switch, and provisions for an external vfo or crysal oscillator.

The TPL is designed for both 220 MHz FM and AM. It is the only unit completely usable on both modes. The receiver is tunable from

	Channels	Frequency Trimmers	Xmit xtal formula	Rcvr xtal formula	Rcvr Inject. side	Rcvr Sens. 20 dB quiet.	On/Off Sw location	External Spkr. jack	Accessory socket	Meter	Power Output	Current drain lo/hi/rcv only	Size (inches) w - h - d	List Price	Review Articles
Clegg FM-21	12	xmit	F-41/4	----	below	0.22	offset	yes	no	yes	10 W	0.45 1.30	7 2-3/4 9	($320)	*QST*, June '74 p. 44
Clegg FM-76	12	both	F/12	F-10.7/4	below	0.4	pwr level	yes	yes (wired)	S/ pwr	10 W/1 W	0.18 A 3.0 A 1.1 A	6-1/2 2-1/4 9	$190	
Cobra VHF-200	12	both	F/12	F-10.7/4	below	0.5	pwr level	yes	yes (wired)	S/ pwr	10 W/1 W	0.22 A 3.2 A 1.1 A	6-3/8 2-1/4 8-7/8	$230	
Comcraft CST-50	Synthesized 5 kHz step 144-148 & 220-225 MHz				?	0.4	audio level	yes	yes	S/ pwr	28 W	1.0 A 6.0 A	10-1/2 3-3/4 10	$870	
Genave GTX-100	10	xmit	F/16	F+13.1/4	above	0.35	pwr level	yes	no	no	12 W/1 W	0.90 A 5.0 A 1.7 A	6-1/2 2-1/2 9	$150	*QST*, May '76 p. 34
Johnson Messenger 380	6	both	F/12	F-10.7/12	below	0.35	----	yes	yes	no	7 W	---	8 2-1/2 12	----	
Midland 13-509	12	both	F/12	F-10.7/4	below	0.5	pwr level	yes	yes (wired)	S/ pwr	10 W/1 W	0.22 3.10 1.10	6-3/8 2-1/4 8-7/8	$230	*QST*, Mar. '75 p. 52
Regency HR-220	12	xmit	F/18	F+10.7/4	above	0.5	audio level	yes	no	no	10 W/1 W	0.8 2.50 ?	5-1/2 2-1/4 7-1/2	$240	*QST*, May '73 p. 52
Tempo CL-220	12+ext osc	both	F/18	F-10.7/5	below	0.36	pwr level	yes	yes	yes	10 W/3 W	0.25 2.80 ?	6 2-1/4 9	$299	*QST*, May '73 p. 52
TPL 220TR	12+tune rcvr	both	F/27	F+10.7/?	above	0.3	audio level	yes	yes	S/ pwr	15 W	0.15 3.0	8.5 2.9 12.0	$339	
VHF Engineering TX220/RX220	1	xmit	F/12		below	0.4	--	--	--	--	1.5 W	0.200 1.0	--	$110	
Wilson 2202-SM	6	both	F/18	F+10.7/18	above	0.3	pwr level	yes	yes	no	2.5 W 1 W	.014 .05 .025	2-7/8 1-3/4 8-7/8	$240	

Fig. 3. Commercially available 220 MHz transceivers. (This originally appeared in Texas VHF-FM *Society News, Spring-Summer, 1976, p. 15.)*

220-225 MHz or can be crystal controlled.

The Comcraft is a top-of-the-line transceiver. It is fully synthesized in 5 kHz steps, covering both 144-148 and 220-225 MHz. It is equipped with several repeater offsets, or it can be used split mode. The receiver has detectors for both FM and AM; the transmitter is FM only.

Included for completeness are two units that are no longer on the market: the Clegg FM-21 and the Johnson Messenger 380. The units are still available on a second-hand basis. The Clegg FM-21 uses a single crystal for both transmit and receiving on the transmit frequency, and receiving 1.6 MHz higher for repeaters. The Johnson unit never reached the market. Seventy of these units were built circa 1973. Apparently they were a production test run for a Class "E" Citizens Band transceiver. When Class "E" did not materialize, they were sold to the local Waseca amateurs.

As you can see, there is a 225 MHz FM transceiver for almost every pocketbook. With the introduction of this ready-made 225 MHz equipment, activity has been steadily rising. Some areas – New York City, Chicago, and Los Angeles – already have reached the band plan limits for repeaters. With some readjustments to the band plan, thirty-five primary repeater channels should help take the load off two meter FM. Come join the fun on two-twenty. ■

Bibliography

1. "Wide-band FM gear for 220," (mod osc, 316A-6252), *QST*, Mar., 1961, P. 29.
2. "500 Watt FM and CW transmitter for 220 MHz," *QST*, May, 1969, P. 21.
3. "Feedback," *QST*, Sept., 1969, P. 17.
4. "220 Converter for FM pocket receivers," *73*, Feb., 1971, P. 42.
5. "We live on 220," ***RPT***, Oct., 1971, P. 25.
6. "The Motorola 80D on 220 Mc FM: Transmitter," *CQ*, Oct., 1971, P. 16.
7. "The Motorola 80D on 220 Mc FM: Receiver," *CQ*, Nov., 1971, P. 51.
8. "The Motorola 80D on 220 Mc FM: Antennas," *CQ*, Dec., 1971, P. 28.
9. "A 55 MHz to 220 MHz varactor quadrupler," *GL220*,* Nov., 1971.
10. "We live on 220," ***RPT***, Dec., 1971, P. 35.
11. "Converting Motorola Sensicon 'A' receiver and 'G' transmitter," (FM col), *CQ*, Dec., 1971, P. 41.
12. "Some thoughts on 220 MHz operation," *QST*, Dec., 1971, P. 25.
13. "We live on 220," ***RPT***, Jan., 1972, P. 49.
14. "A 5894 FM Amplifier," (FM column), *CQ*, Jan., 1972, P. 47.
15. "A varactor quintupler for 220," *QST*, Jan., 1972, P. 11.
16. "Converting the Pip-Squeak to 220 MHz," *QST*, Feb., 1972, P. 46.
17. "A Converter for 225 MHz FM," (52.525 MHz I.F.), *CQ*, Apr., 1972, P. 14.
18. "A 450 cm new front end for your FM receiver," (220 Conv), *QST*, June, 1972, P. 11.
19. "A Pip-Squeak follower for 220 MHz," *QST*, July, 1972, P. 38.
20. "Osc and audio circuits for 50 and 220 MHz, WBFM with crystal control," *QST*, Oct., 1972, P. 17.
21. "A C.B. rig for 220 MHz," *QST*, Jan., 1973, P. 32.
22. "Tempo CL-220 transceiver," (recent equipment), *QST*, May, 1973, P. 52.
23. "Getting on 220 MHz cheap and easy (450 GE Prog.): receiver," *Decoder*,* Summer, 1973.
24. "Getting on 220 MHz cheap and easy (450 GE Prog.): transmitter," *Decoder*, Fall, 1973.
25. "A power amplifier for 220 MHz FM," ***HR***, Sept., 1973, P. 6.
26. "A 220 MHz band plan," (FM/RPT column), *QST*, Jan., 1974, P. 62.
27. "FM'ing your 220 MHz AM transmitter," *CBITS*,* Mar., 1974.
28. "Cheap and easy 220 repeater rig (Link 2975): receiver," *CBITS*, May, 1974.
29. "Cheap and easy 220 repeater rig (Link 2975): transmitter," *CBITS*, June, 1974.
30. "The Clegg FM-21 transceiver," (recent equipment), *QST*, June, 1974, P. 44.
31. "A 220 MHz frequency synthesizer," ***HR***, Dec., 1974, P. 8.
32. "The Regency HR-220 transceiver," (recent equipment), *QST*, Mar., 1975, P. 52.
33. "Converting the Motorola 'G' transmitter to 220 MHz," *GL220*, Dec., 1975.
34. "Building a 220 MHz repeater," *73*, Apr., 1976, P. 40.
35. "The Genave GTX-100 220 MHz transceiver," (recent equipment), *QST*, May, 1976, P.34.
36. "The VHF Engineering RPT-220 repeater," (recent equipment), *QST*, Nov., 1976, P. 36.

**GL220* = Great Lakes 220 MHz News KØOST; *Decoder* = Crestline Amateur Repeater Organization WR6ACJ; *CBITS* = Cheese Bits/Mt. Airy VHF Radio Club WR3ACD.

Eugene X. Dusina W4NVK
4724 Ridge Grove Rd.
Knoxville TN 37918

How To Dissipate 200,000 Megawatts

—fool Mother Nature

Many who putter with radio eventually evolve to the point where they are sticking poles and wires up into the air which protrude above the trees. Because God loves his children, even those who putter with radio, only a few of these fellows catch all they are fishing for.

I am reminded of a fellow down in Florida who fished for small sharks from a pier. He caught many, but pulled out only a few because they broke his tackle. He remedied this with typical Yankee ingenuity by getting braided leader in a long length which he used for string. All went blissfully well until one day when he caught a manta ray. It yanked him off the pier and nearly drowned him before he got loose from his improved tackle. Even so, one arm was so sprung that he was feeling quite poorly for about a month. You see, this fellow wanted to catch sharks, but he neglected to ponder what else in the environment he might catch and how he would fare if he did.

But let's get back to the innocent radio buff. He seeks to catch signals in the wee microvolt category and frequently neglects to acknowledge that the same tackle may hook onto a large digital signal, known as lightning in layman's terms, which ranges in the million-volt range. This article is to help him ponder the fateful day when he catches that big one which always before got away. Fig. 1 shows the size of some likely catches.

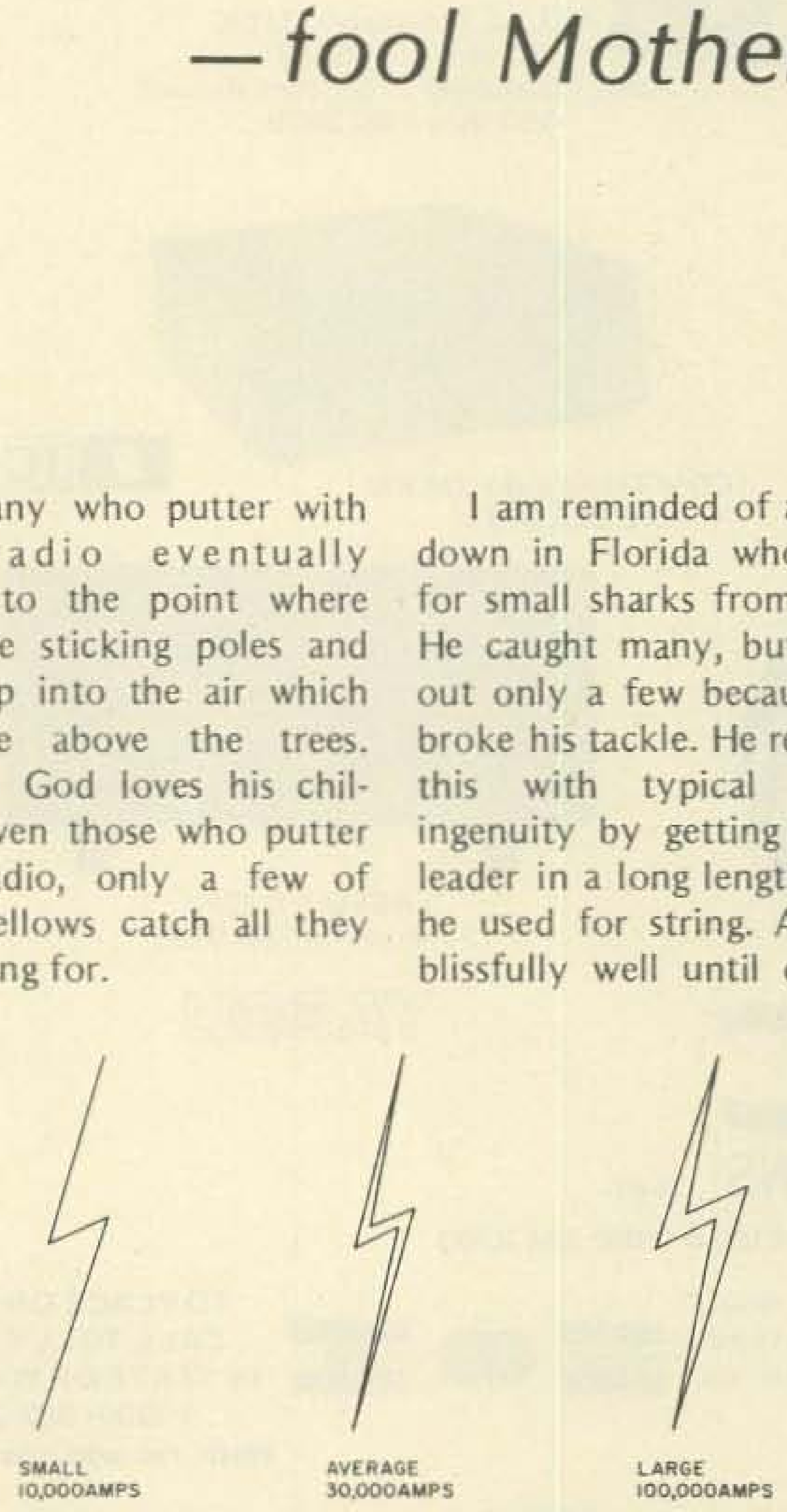


Fig. 1. Typical lighting bolts.

The first commandment to consider is that any metallic protuberance which pokes above other things in the vicinity is a candidate for a direct hit by lightning. It also happens that, although the antenna may only be small wire normally capable of carrying only a few Amps, it can for a few milliseconds carry the entire 100,000 Amps of a large bolt.

Now consider that grounds, even very good ones, have considerable impedance and resistance. You may study the power handbooks to see that ground rods typically have a resistance to earth of over 30 Ohms, and considerable effort must be expended to make one with an earth resistance below 10 Ohms. So let's take as typical a 20-Ohm ground resistance. Multiply the bolt current of 100,000 squared by 20 Ohms, and you can see that power at a rate of two hundred-thousand megawatts will be dissipated in this resistance. To appreciate this number, recall that a typical hydroelectric dam generates power at a rate of only one or two thousand megawatts or that the entire Brown's Ferry nuclear plant generates only 3000 megawatts. That dissipation in the ground resistance is not to be passed over lightly; it is very large, as things go.

It is true, though, that this power will last only for about a millisecond, but, even so, multiplying the dissipation by 1 millisecond still leaves an impulse of two hundred megawatt-seconds. For sizing this number, recall that a 450-volt 100 uF cap stores only 10 Watt-seconds, and that makes a respectable bang when shorted. Two tractor trailers at 55 mph dissipate only one-third of one megawatt-second in a head-on collision, and a dynamite cap

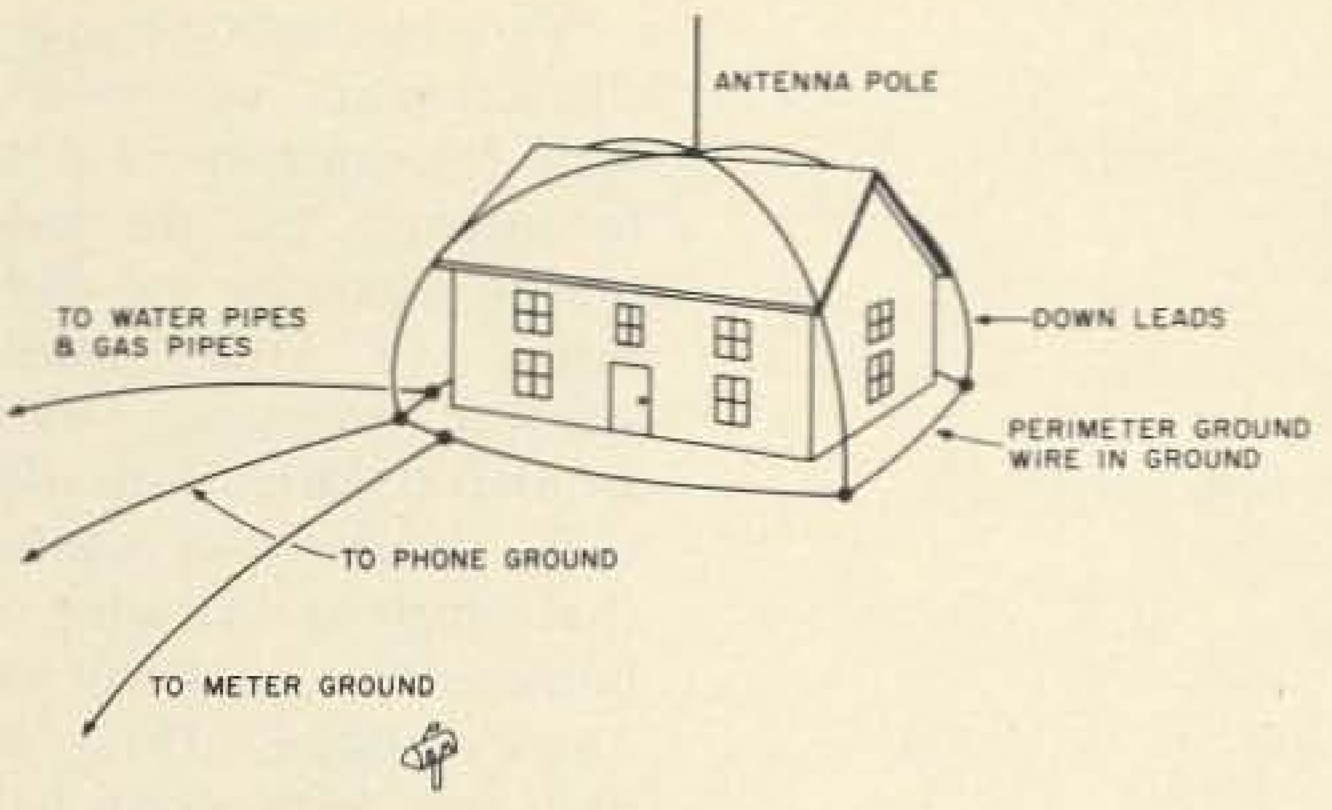


Fig. 2. How to protect the house.

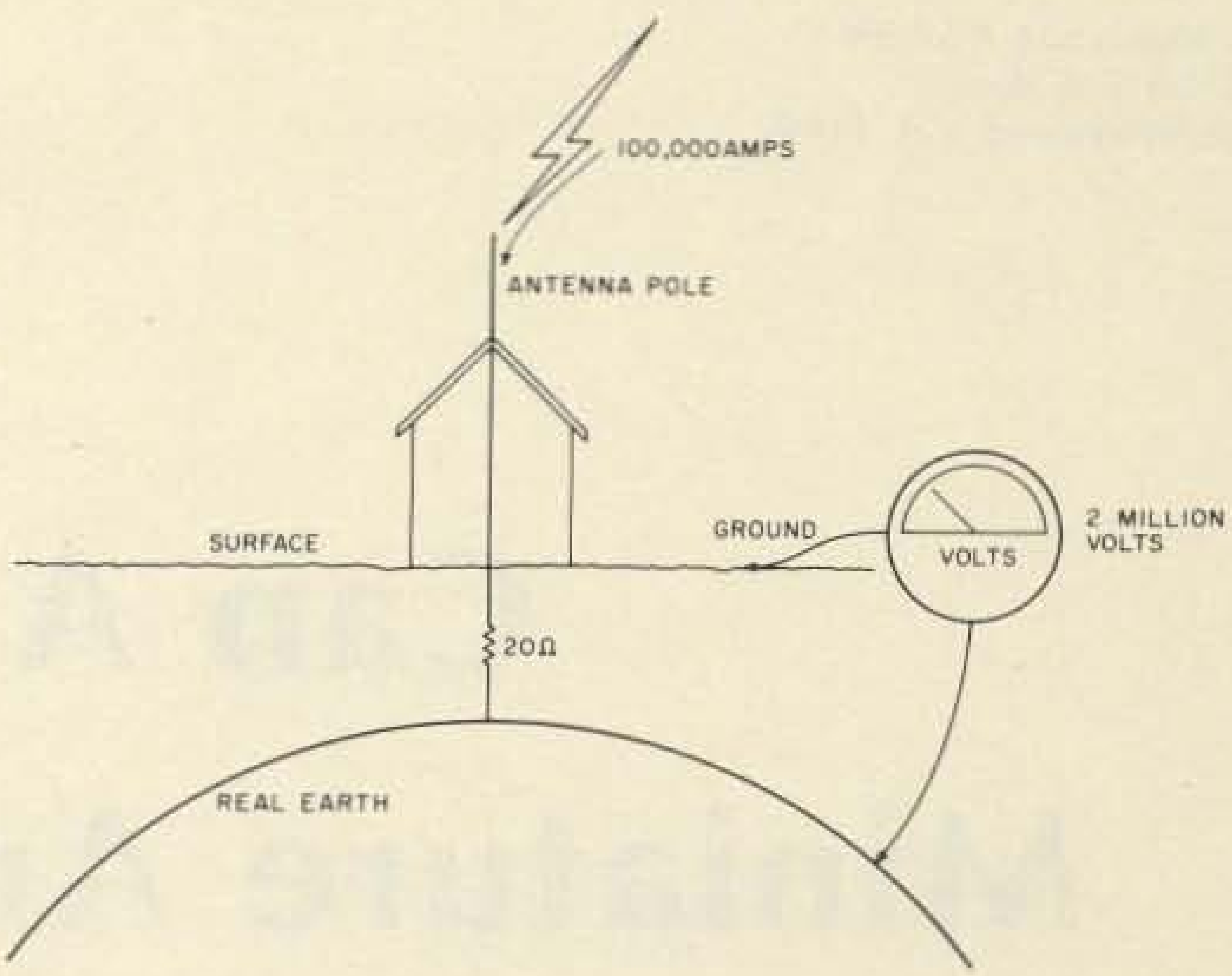


Fig. 3. How voltage drop on a good ground leaves millions of volts to flit around.

explodes with an energy of 600 Watt-seconds. Obviously, a bunch of energy is going to be let loose when that bolt reaches earth. Fortunately, most of it will be dissipated underground where most of that 20 Ohms is, but even very small resistances in the line will share large energy. The truly spectacular display will come wherever the bolt must jump an inch or foot or yard to go from one grounded thing to another. Obviously, an astute radioman should expect some bird's nests and fried PC boards if a bolt ever enters his sanctuary.

The second commandment says no reasonable insulation will insulate against lightning. Recall that it has just busted through about a mile of air to get to you, and that air is a pretty good insulator. You might apply many yards thickness of space-age insulation and discourage it, but that's impractical, so let the commandment rest at that.

The third commandment says lightning cannot be stopped, but it can be led by a sufficiently attractive enticement. Since lightning is only wanting to get to Mother Earth, you may provide it a better path and hope it takes it. If the antenna is outside, you can do this by letting your lead-in pass within a half inch or so of any well-grounded object, and, almost always, the bolt will jump off there and ignore the rest of the house. A simple lightning arrester over at the house will then protect (usually) against the little that sneaks on up the line to the house. This is only so if a very good ground is hooked to the arrester.

If, on the other hand, the pole is on the roof or next to the house, that is another matter entirely. In this case, you could do as many do, and just stretch a bit as the big one goes through. I can tell this upsets you, so cease the clacking and listen close, for perhaps something can be done within reason.

What you must do is run several ground leads down from the tower, around the eaves of the roof, and to ground, as in Fig. 2. This way, the bolt will divide to go down all these leads and not go through the house. You will have led the bolt around the house, which, believe me, is 90% of the task of letting go of the big one.

Looking at the numbers showing voltage drop in the ground system in Fig. 3, you can see you are still far from safe. Normal ground resistance will cause a voltage drop up to about a million volts. That is a lot of juice, and it can easily jump several feet to any object which is not at a similar potential. The power line ground, the phone ground, the water pipes, the sewer pipes, the gas pipes, your own tail, etc., will all be fair game for a thing called a side bolt. This is a lesser bolt of several thousand Amps which will flit about the house from one object to another until lots of things share in that rather large potential difference between stuff inside the house and the ground outside the house.

What you must do to prevent a passel of side bolts is to tie every one of those down leads from the tower to a wire perimeter in the dirt around the outside of the house, and then tie every other grounded thing that enters this circle to it. Run wires up from your perimeter wire to the meter ground, the phone ground, all pipes, etc., which enter the house. Any cables you have running away from the house should have their ground conductor tied to this perimeter. In this way, all these things will rise by the same potential during the bolt's passage through the ground, and there will be little chance of any side bolts inside this shielded cage you have constructed. Needless to say, hell will be raised out at the perimeter of this ring of protection, but you will successfully have kept it from happening inside the house. While this is not perfect, most radio men have learned to live with less than perfection, so they'll be happy.

Remember that a house with a properly grounded antenna above it is safer than a house with no antenna, but one with an improperly grounded antenna is a death trap and can suffer severe damage from a direct hit.

Another bit of advice is that lightning arresters will not protect against a direct hit. They are intended to protect only from induced surges of trivial energy which result when the guy next door gets hit. A perimeter must be set up as described and everything tied to it, including the arrester ground, for this to protect you for the outside antenna situation I described earlier.

When running ground leads, remember that the inductance of wire causes its reactance to far exceed its resistance to pulse currents like lightning. Therefore, very large voltage drops exist along the wire. If you carelessly increase this inductance by making sharp bends, the air may break down, forming a fat arc past the bend. This will blast a big hole in anything that was in the bend, such as the roof. So, make all bends gradual curves — no sharp corners!

Summing up all the above, you can survive a direct lightning hit by leading the bolt around your house and letting it dig up the yard to dissipate its energy. You can do this by building a perimeter of grounded lines around your house and then tying all things entering the house to this common ground. Having done this, your ears will still smart from the noise after a direct hit, but no essential parts will be malfunctioning. What more can one ask who persists in poking poles up where gods are thought to lie about doing their thing? ■

J. M. Mendelson W6AQM
5502 Corteen Place
North Hollywood CA 91607

Can A Miniature Antenna Work?

—relief for the cliff dweller

I have had some interesting results from experimental diminutive high-frequency antenna systems. In the unending search for adequate antenna systems for the apartment dweller with the usual space or landlord dilemma, some old and new ideas have been put to work.

A few months ago, I found myself asking our new landlord if we might discuss the possibility of installing a new antenna on our apartment-house roof. His answer was authoritative: "There shall be no amateur radio station in this building, and it will not be discussed further!"

Since my spouse had shown no desire to move to a location which might be more obliging to my hobby, I moved the hobby to a rented garage room approximately two blocks from our apartment house. Although the surrounding multitude of apartment buildings presented reflection problems, I at least had considerable freedom to carry on some rather interesting experiments toward developing adequate small antennas. What a joy it was to discover that my garage-room landlord became quite fascinated with those experiments.

The first antenna design I tested was a simulated multiturn loop in the shape of a subminiature quad — a diamond, approximately 42½ inches on each side. The multiturn character was contrived from a 5-wire flat ribbon rotor control cable. The end connections are shown in Fig. 1. The series coil was constructed from 7 turns of #12 bare copper wire (house wire stripped of its insulation). The coil was wound over a hoe handle whose diameter was 1-3/8 inches. The turn spacing was approximately 3/16 inch. The coil's dimensions were not critical, as it was used merely as a convenient coax transmission line coupling device. The coax ground, or braid, was connected to one end of the coil. The center lead of the coax was supplied with an alligator clip, to be connected variably to a turn on the coil for impedance matching convenience. Although the coil was used as a coupling device and not as a loading component, a slight adjustment of the antenna's frequency characteristic was possible by closing or expanding the coil turn spacing.

The spider for the crossarms was a 4-way ½-inch sliptype (not threaded) PVC plumbing fixture. The crossarms consisted of 4 pieces of ½-inch medium-wall-thickness (schedule 40) PVC pipe whose lengths, when inserted into the 4-way spider, presented a cross with each complete arm (horizontal and vertical) measuring 5 feet from tip to tip, including attached end caps. Notches the width of the ribbon cable were filed into the caps on the arm tips to act as saddles to accommodate the ribbon. Note the piece of drilled plastic which acts as a cable tightener or a slack adjuster. The four adjacent holes are sized to admit the ribbon with a tight fit.

Very interesting frequency characteristics were observed with this antenna. I found, for instance, that the device's lowest resonance was slightly below 14 MHz, when a similar resonance existed around 21 MHz. Both indications exhibited a comparatively high Q character. This bothered me, as I had never experienced this nonharmonic relationship before in a symmetrically constructed antenna. Of course, the coupling coil was the shady character here. It was apparently acting as a tuned trap with the large interturn capacity of the ribbon cable tuning it.

By carefully adjusting the inductance of the coil, I was able to load the antenna on 14 MHz as well as 21 MHz, with acceptably low swr values. This was too good to be true — a 2-band antenna that allowed me to make many cross-country contacts with a radiating device that cost me less than five dollars. The power output used for these operations and subsequent antenna design adventures was 125 Watts continuous from a Collins KWM 2A. All test contacts were made in the SSB mode.

As I noted earlier, the reflection problem presented by the surrounding buildings made for many frustrations when critical measurements were attempted. I concluded that ham radio sometimes requires that supreme effort of kidnapping one's spouse, tools, test equipment, and antenna, and escaping to the great American desert — a wide-open, unobstructed antenna playground!

We left the San Fernando Valley and many hours later arrived at Ranchito Peso, the desert home of Doc Kernan W6VST, on the California side of the Colorado River. This location is not only ideal country for checking antennas "in the clear," but also there are no telephones, which suggests the neighboring ranchitos use CB for communications.

Doc Kernan took his communication receiver to the next ranchito (about 1000 yards removed), and, with a couple of CB handie-talkies, we were ready to see what our little antenna would do.

We raised the miniature to a 50-foot height on one of Doc's 3 masts and proceeded to check it against a 50-foot-high dipole on 15 meters. The results were disappointing. There was a loss of approximately 2 dB, compared to the dipole.

We decided to sum up the little antenna's potential by proclaiming it a partial success. It was an antenna that could be cheaply constructed, could be installed easily in an attic (hidden), and was efficient enough to allow operation for many pleasant cross-country contacts where it might be impractical for a full-size antenna installation.

However, the question haunted me about the technical failure of the antenna to fulfill my hopes. After much thought and a few helpful conversations with some of my old engineering articles, I concluded the following: The little antenna had less capture area than a full-size antenna. It evidently was a poor radiator.

Let's take that last statement into closer consideration. If you can visualize a curve, where you plot changes in efficiency on the x-axis against changes in antenna construction on the y-axis, you can better analyze the ribbon cable miniature antenna. Let's use, for one extreme antenna construction, a receiving coil with a capacitor tuning it to the desired frequency. Perhaps the coil has many turns and is, perhaps, ¼ inch in diameter. The other extreme construction might be a full-size dipole, cut for the desired frequency. The latter appears at the opposite end of the curve from the former. As you may realize, the receiving coil antenna, due to its extremely small capture area and the internal flow (pattern) of its magnetic field, is an absurd radiator. On the other extreme is the eminently efficient radiator – the full-size dipole.

As far as absorbing wattage fed through a transmission line, it is quite easy to match to a required correct impedance section of either radiator by several methods. I remembered that, just because an antenna absorbs all the energy you feed through the transmission line (swr = 1:1), it doesn't necessarily denote a good radiator. (My dummy load presents an swr of 1:1 and doesn't radiate a darn thing!)

The important lesson I learned from the above was that the 5-wire cable (multi-turn) coil-type antenna had a radiator efficiency at some inferior location on the aforementioned curve between the tuned receiver-type coil (very poor radiator) and the full-size dipole (excellent radiator).

My wife, the equipment, and I left and returned to the San Fernando Valley – back home and back to the drawing board.

Next idea – I would construct a single-loop antenna of the same physical size as the previous miniature radiator. This single-loop antenna, appearing as a single-element quad, showed resonance at approximately 66 MHz.

The only way to lower the resonant frequency to, perhaps, 21 MHz is to increase the L x C (inductance, capacitance product). To increase the L x C without adding a fixed capacitor, a comparatively large inductance (coil) would be needed. Remember, the single loop has (as does a simple dipole) an extremely large L to C ratio. To change the L x C product appreciably, with C practically constant, the antenna's inductance (physical size) would have to be changed radically. If L would remain constant, a very small change in C (physical size) would shift the frequency substantially. The reason an addition of just a small amount of capacity makes a large change in the L x C product is because the characteristic inherent capacity of the antenna might be so small in picofarad value.

Let's, for clarification, see how a dipole may be tuned. What does the capacity value appear as, from one end of the dipole to the other?

The capacity, in the main, is effectively produced by the end (highest impedance) of the dipole appearing as one plate of a capacitor. The other plate may be simulated by earth or ground. Of course, ground or earth are also under, or adjacent to, the opposite end of the dipole and are, therefore, similar to a common plate. The capacitance (in the main) is, therefore, a construction of a 3-plate capacitor, with common earth being one of the three.

If the antenna is several feet removed from earth, you will see that the end-to-end capacity of the dipole is extremely diminutive (on the order of a fraction of a picofarad). For those who like it with numbers:

$LC = 25330/f^2$; with
L in uH,
C in pF,
f in MHz.

Let f = 66 MHz.
Let C = 1 pF.
L = 25330/4356 = 5.81.

Change f to 21 MHz.
L = 25330/441 = 57.43 uH.
Note change of L from
5.81 uH to 57.43 uH,
(which is 5.81 x 9.88).
Change C (from 1 pF),
but let L remain at
original 5.81 uH.
C = 9.88 pF
(LC for 21 MHz = 57.43).

Note that a change from 1 to 10 pF may be easily accomplished with end plates, etc. But to increase L 10 times might present a problem.

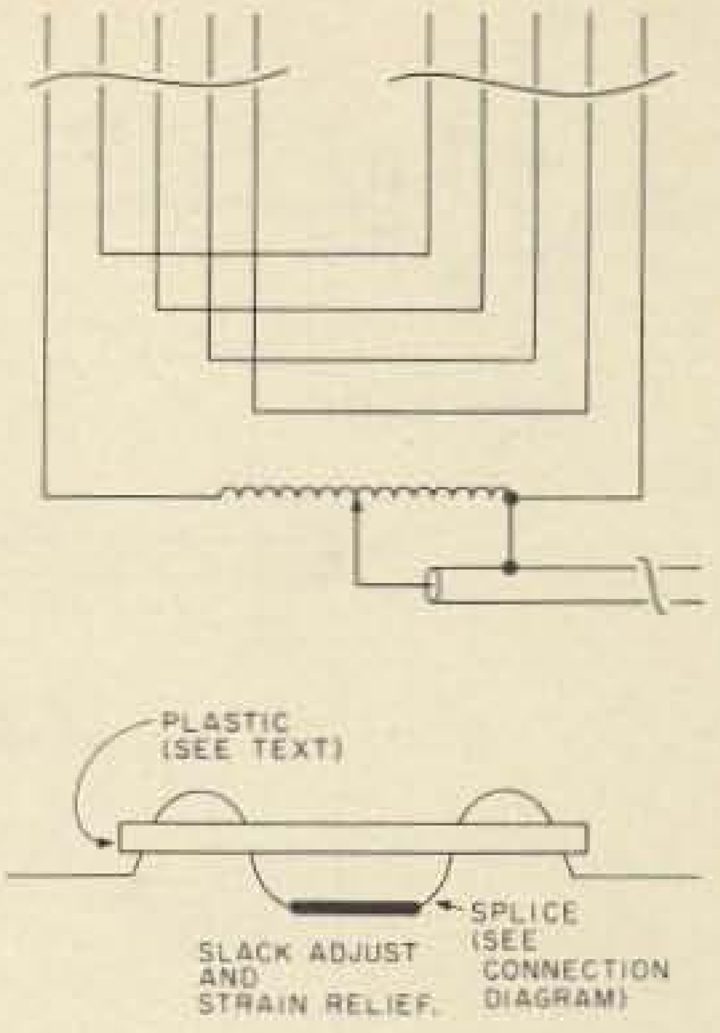


Fig. 1. Connect the ends of the 5-wire rotor flat cable to simulate a 5-turn loop. This also shows the coax connections to the coupling coil.

A driven quad element is a very intelligent device. That is, it says, "Wherever you connect that low-impedance transmission line into me, we'll call that point a low-impedance antenna point." Automatically, the similar point on the opposite side becomes another low-impedance point (½ wavelength removed). If the diamond-shaped square is used, and the antenna is fed at the bottom point, high impedance points are established at the two horizontal arm extremes (¼ wave removed). These characteristic impedance points on a driven quad element may be noted as similar to a stretched-out folded dipole.

If you desire to capacity tune the miniature loop to some lower frequency, the capacitor should be connected to the horizontal extremes of the antenna (high impedance points). If you treat the antenna as you might a tuned coil, the tuning capacitor would conventionally be connected to the coil ends, which are also this device's high impedance points.

I applied the above principle by constructing a capacitor and its vernier as shown in Fig. 2. The method and arrangement in the capacitor's construction

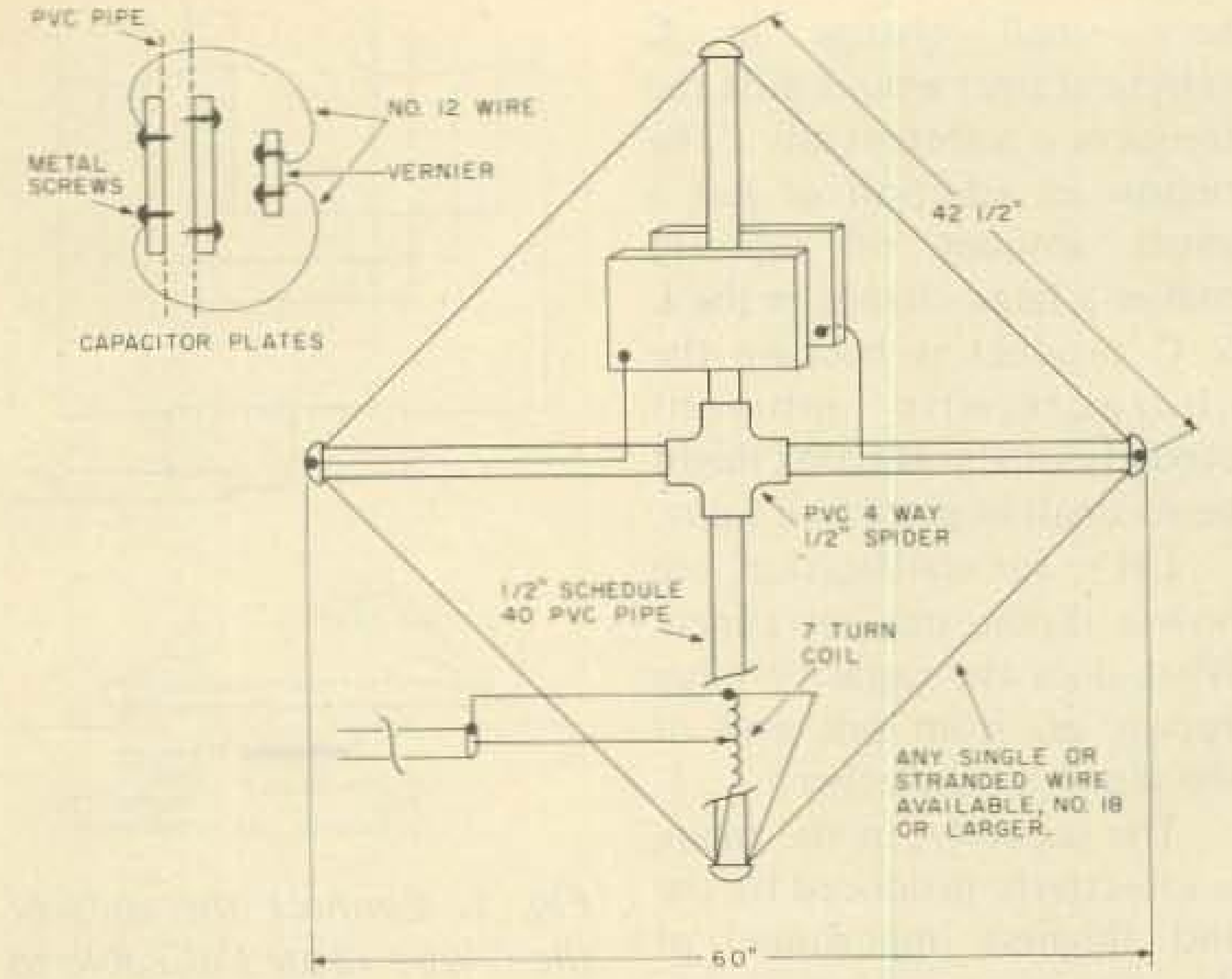


Fig. 2. The tuned loop with the adjustable high-voltage capacitor arrangement. Capacitor plate sizes: 20 meters (14.3 MHz) – 15-5/8" = 60.55 sq. in., vernier 2-3/8" x 3" = 7.125 sq. in., spacing 3/8" to 1/2", coax tap for 75 Ohms = 4th turn; 15 meters (21.3 MHz) – 5-1/16" x 3-7/8" = 19.6 sq. in., vernier spacing = 3/4", coil tap as above; 10 meters (28.6 MHz) 1-3/4" x 3" = 5.25 sq. in., vernier spacing 5/8", coil tap as above.

obviate any high-voltage rf arc-over that is probable from a lesser design. Remember that when approximately 125 Watts is interpreted in terms of extremely high impedance, as at the ends of a dipole, the rf voltage may appear as thousands of arc-over volts. Again, for those who like numbers: Let's pick a random high impedance to simulate the end impedance of a dipole. Let the end impedance approximate 10,000 Ohms in free space.

Where $P = E^2/Z$ or $E^2 = PZ$, it may be seen that, if P is 125 Watts and Z is 75 Ohms, E is 96.82 volts. However, that is the rf voltage developed at the 75-Ohm feedpoint. If we change the point of investigation to the end of the antenna (10,000 Ohms), E becomes a dazzling 1118 volts.

The vernier plate was adjusted for resonance to the desired frequency with the coax line disconnected. My grid-dip oscillator was used in conjunction with the station receiver to substantiate accuracy. The transmission line was then connected to the antenna, and a search for the correct coil turn tap was made, until a minimum swr value for the matching system was found. The coil turn spacing was adjusted very slightly, by compressing or expanding, for rechecking to a lowest swr reading. I had no difficulty in effecting a 1:1 value around the desired operating frequency. The swr held to very acceptable values over several hundred kHz.

I found that, unlike the full-size quad, adding a reflector or director had very little effect on forward gain, front to back ratio, etc., on the miniaturized loops. However, a very interesting effect was accomplished by using a so-called "extra element," not as a reflector or director in its conventional usage, but in the following manner: I first resonated the extra element to the operating frequency by placing it in close proximity to the driven element while said driven element was being driven with a few rf Watts. A field strength meter placed next to the driven element would approach zero-reading when the extra element approached resonance. It might be pertinent to mention that the extra element was constructed as an exact duplicate of the driven element, except for the coax input circuit.

I noticed a distinct increase in forward gain of approximately 4 dB when this extra element was placed in front of the driven element at a distance of 18 inches. This distance was critical, but the tolerance existed for good results from 16 inches to 20 inches. The operating frequency was 21.3 MHz.

The reason for this effect was not related to any conventional phasing enforcement, as with a director. Evidently, placing the extra element in a position near the driven loop's maximum magnetic flux fall-off in its flux pattern caused a distortion or distention in the pattern toward the front side. There's one certainty – the field strength meter (placed at a respectable yardage away) surely kicked up!

Measuring the gain of the above antenna looked rather promising. It was slightly better than the reference dipole at the same center height above ground. It was slightly quieter than the dipole, which was probably due to the slightly narrower bandwidth.

I had not reached any great feeling of accomplishment or satisfaction at this

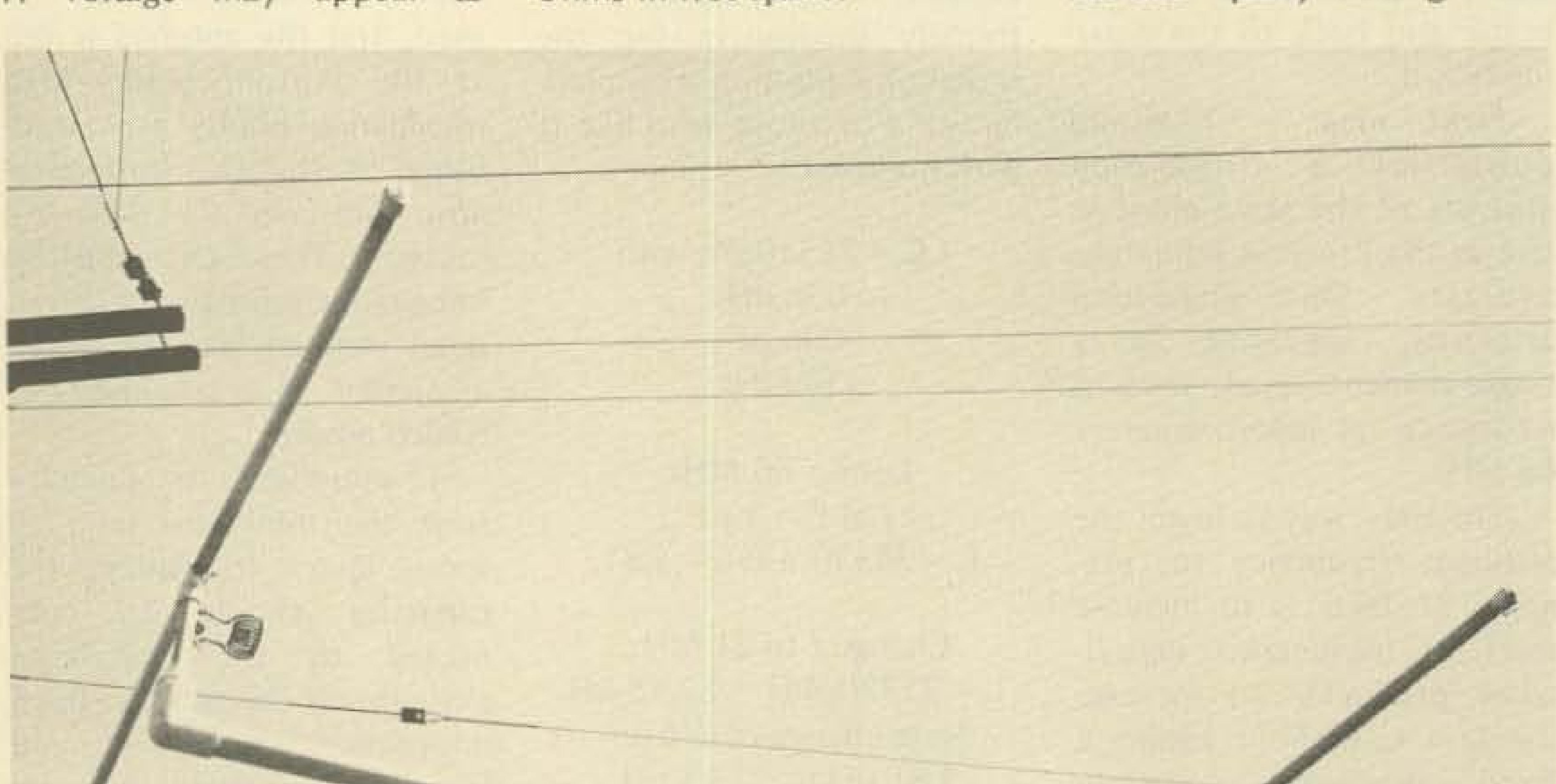


Photo A. Note the 1¼" PVC boom (schedule 40), the 90° elbows, and the 1¼" to ½" adapters to admit the ½" risers for the two elements. The coils are shown including the two alligator clips for finding the proper match for the small home-built balun on the driven dipole.

point. My old, tired feeling that the advantage of normal capture area of standard-size antennas could not be reasonably replaced with the reduced-size concoctions returned, and I found myself slightly discouraged but still looking for improvement. Back to the drawing board.

Next idea – I would construct a simple center-loaded 2-element yagi. This is not noteworthy for being innovative, but I must write down a few notes to let you folks know I hadn't given up!

Instead of merely installing a high inductance at the center of a five-foot length of #12 insulated house wire, I inserted a six-turn 1-3/8" coil, tuned by a fixed 4000-volt ceramic 50-pF capacitor. I drove over to see Mrs. Amidon, who sold me one of her T130-2 toroid cores, on which I wound a cute little 1:1 balun. They sell a kW kit, but this little inexpensive core takes good care of my KWM 2A output.

With one-tenth wave spacing between a director element and the driver, I worked eight South Americans, two New Zealanders, one Hawaiian, and the usual cross-country gang on 15 meters. They were worked starting at approximately 1900Z and, by 2400Z, I had disassembled the antenna and again was ready to conquer new worlds. I didn't care for the antenna's frequency discrimination. The swr was adjusted for the usual 1:1, by the usual procedure, with the exception of the balun's balanced output presenting 2 alligator clips for adjustable tapping to the driver center coil. It had to be operated at a selected frequency or the swr value could be very insulting. The selectivity of the system would put Mr. Collins' and Mr. Yaesu's receivers' front ends to shame. Of course, there are a couple of ways to lessen this difficulty, like reducing the L x C of the tuned center circuits or, perhaps, enlarging the antenna conductors to pipe or conduit size. Or, one could just go back to the drawing board.

Next idea – How about constructing a spiral-wound driven element? This sort of winding has also been given two other names – helical or linear element. I believe the terms "spiral" and "helical" are self-descriptive. The name "linear element" makes for interesting conjecture, if one contemplates the various magnetic wave patterns set up by the many types of radiators. But the term linear for this type of winding refers only to the magnetic intensity pattern or magnetic wave distribution over the length of the element. A straight-wire radiator might be called a linear element, for the obvious reason that the current and voltage loops and nodes are in their correctly-spaced positions. Adversely, the bottom coil loading and coupling arrangements, as used on the multitude of vertical antenna systems, place the above loops and nodes in questionable positions on the radiator, making for distortions and inefficiencies in the systems' propagation ability.

The Five-By-Five Yagi

This presently-used antenna has the same basic PVC material and element length as do the previous antennas described, except for the wire type and its winding shape.

The driven element has an overall dimension of five feet, including pipe end caps. Within the five-foot length there is a plumbing T-fixture. It is also of PVC material and is called by the plumber a "slip, slip, slip" type (as opposed to the threaded type). It allows the ½-inch schedule 40 PVC pipe to be press-fitted into any of the three T-inputs. If you feel you may want to take advantage of its portability, you may do as I have done. I sanded the near ends of the ½-inch pipes so that, while they fit snugly into the horizontal admission ports of the T, they can be readily removed, dropped into a large plastic bag, and buried in the car trunk.

Purchase or dig up a 26-foot length of zip cord (light weight with two #18 wires). Zip the lamp cord to make 2 lengths of wire, each 26 feet long. Insert one of the ½-inch pipes into a horizontal port of the T as far as it will go. At a point ¼ inch down the pipe from the end of the T port entrance, drill 2 holes side by side (separated by approximately ¼ inch). These holes

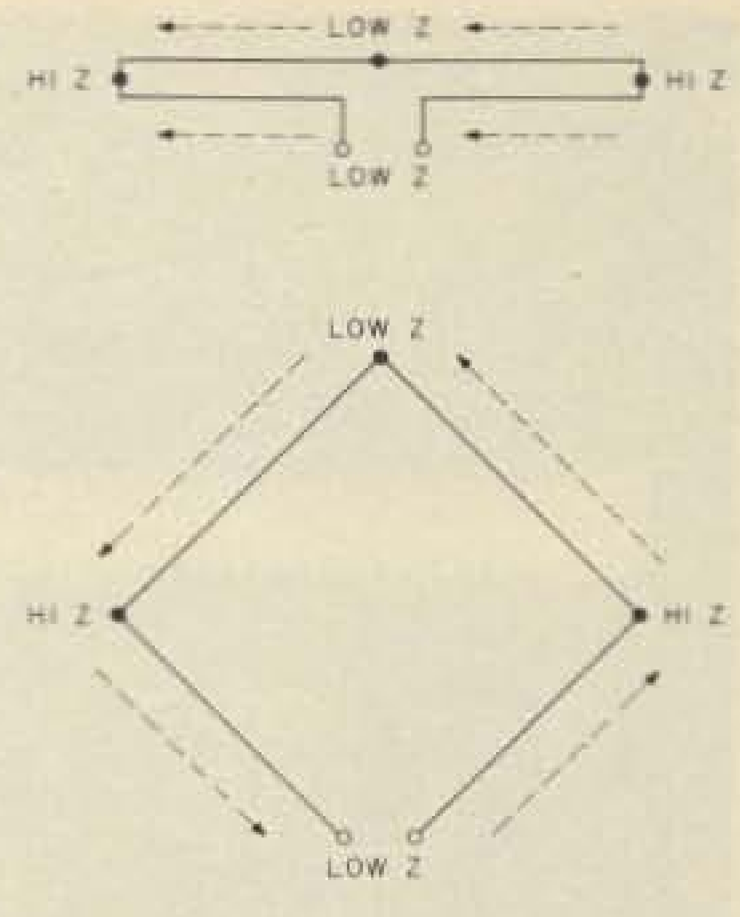


Fig. 3. Folded dipole. Arrows denote flow of rf current during 1/2 cycle. Note that current flow in the quad loop differs from that in the folded dipole at the same instant. Shortened loops, capacitively or inductively loaded, take the character of the antenna type they most nearly approximate, which poses the question: "How large is the loop?"

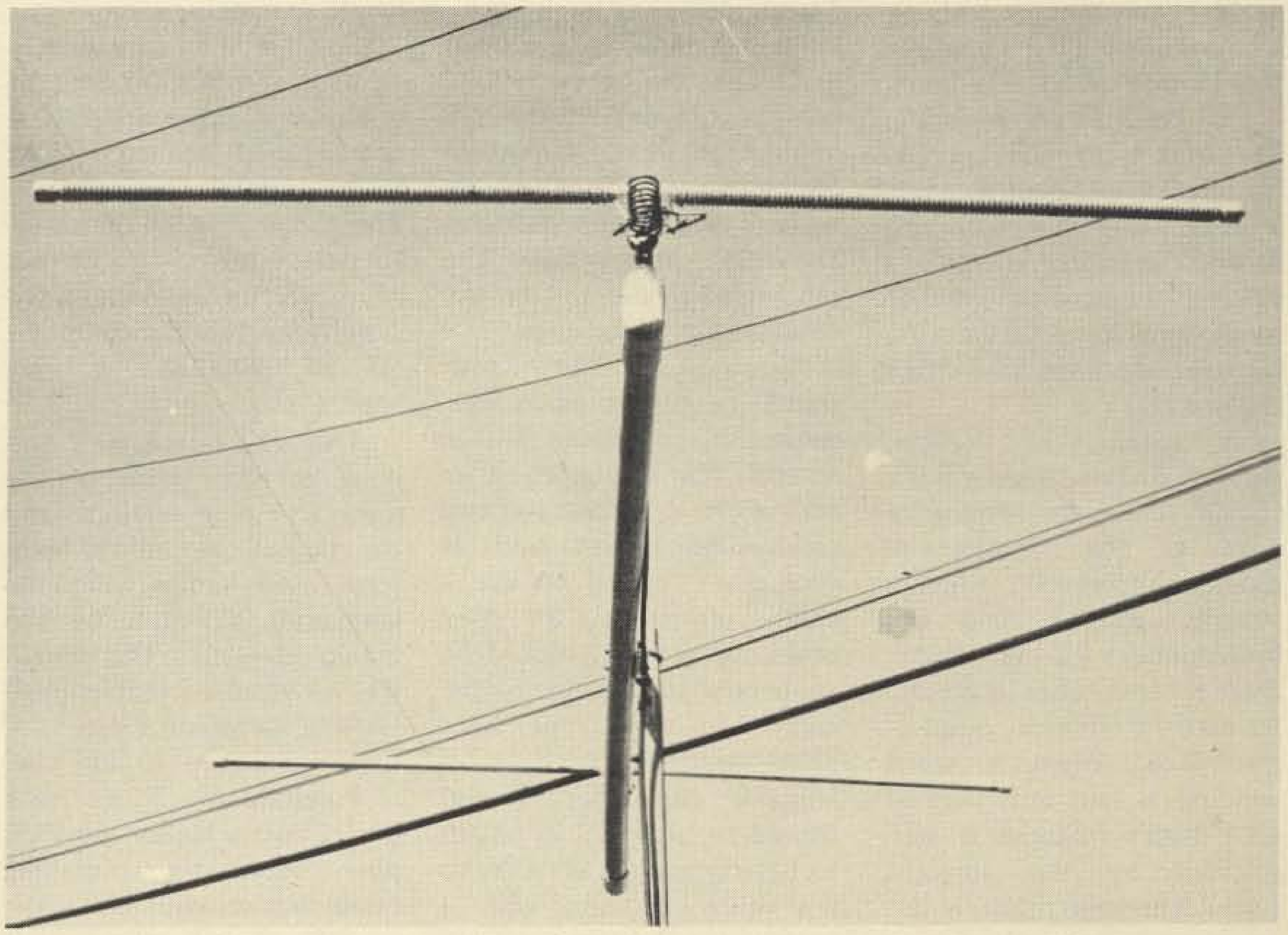


Photo B. Close-up of the coils in Photo A.

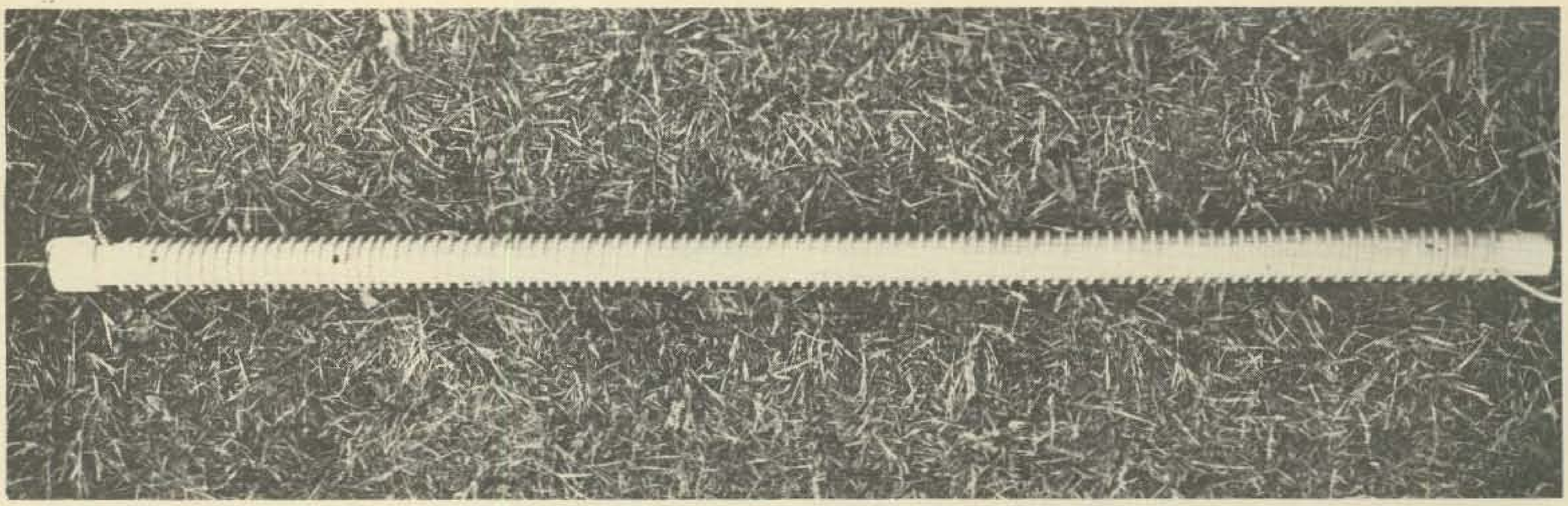


Photo C. One half of the driven element, showing half the zip cord helical winding. Note the straight piece of #12 copper wire on one end (explained in text).

should be sized to just admit the single zipped wire. Feed the wire in and out of these holes so that they anchor the wire to the pipe with 6 inches overhang, and the long wire is ready to start your spiral winding on the pipe's outer surface.

Install the pipe cap at the other end of the pipe. Measuring down the pipe away from the cap bottom, drill 2 holes and position them as at the other end of pipe. Remove the pipe cap. Spiral wind the wire, attempting to put approximately 3/8 inch spacing between turns.

The winding of both sections of the driven element should take about 1½ hours – one hour, if you're lucky. The trick is to have approximately 1½ inches of wire left after you've anchored the end down. You probably will find yourself rewinding several times, each time varying the turn spacing until you strike it correctly.

A spiral, or helical, winding of this shape will use roughly twice the amount of wire as the straight-wire dipole. Apparently, when a straight wire is laid out horizontally (or vertically), there is capacitance to ground (or earth) from every point of the wire. When a spiral winding is laid out, part of each turn's material is self-shielded by the adjacent turns. The end result is less capacitance to earth. So, in order to obtain an L x C product comparable to the 22-foot wire, we must increase the wire length (L) and exposed surface to earth (C). As stated in a previous paragraph, the self-tuning capacitance of the dipole (end-to-end capacitance) is extremely small.

When both sections are completed, insert the pipes into the two horizontal T-ports. Acquire an 8-inch section of ½-inch PVC to be used as a riser, and insert it into the bottom port of the T. Drill a hole into the 8-inch riser to accept a 6/32 machine screw at a location ¼ inch below the bottom of the T-port. Mount a large solder lug under the screw head and make sure the screw is long enough to penetrate the rear of the riser, so you can secure the screw with the proper washers and nut. Repeat this about 3½ inches down the pipe riser. These will be the coupling coil mountings.

The 6-inch wire ends should be connected to their respective coil ends. Either antenna lead may go to either end of the coil (one coil end receives one antenna lead). If you don't intend to use a balun, ultimately, the coax braid, or ground, should be connected to one side of the coil. The center or coax "hot" lead should have an alligator clip attached and should be arranged in length to have tapping availability to any turn of the coil. I mounted a chassis coax UHF connector on the 8-inch riser for disconnect convenience.

I found that this system became more precise as a beam antenna with a 1:1 balun mounted on the 8-inch riser. The beam itself has a tendency to be somewhat off direction (about 15 degrees). This effect was undoubtedly caused by the radiating coax section, which tended to distort (misphase) part of the beam's pattern.

I found that the director appeared to present a noticeable increase in forward gain over the reflector tuning (probably because of the desire to keep the antenna size small, i.e., one-tenth wavelength spacing).

For the director, I used an element identical to that of one of my former designs – a center-tuned loaded 5-foot #12 insulated house wire. The center coil for the director was 6 turns, with an o.d. of 1-3/8 inches. The fixed capacitor across the coil was a 50 pF 4000-volt ceramic type.

The #12 house wire was hung on the inside of the respective pipe sections, and the double mounting holes were used similarly to the lamp-cord situation on the driven element. The length was arranged so that enough starting hang-over existed for the connections to the coil.

Purchase one 5-foot piece of 1¼-inch schedule 40 PVC pipe. Have the plumbing house put on your bill a pair of 90° 1¼-inch elbows that will fit those 1¼-inch 5-foot pipe ends. Also necessary will be a pair of 1¼-inch to ½-inch adapters.

Mount an elbow on each end of the 1¼-inch pipe ends. Align the elbows together in one direction, accurately. Insert the adapters in the elbows' open ends.

That nearly completes the boom. Drill the 2 holes at the boom's middle for an appropriate mounting to your mast. I used Radio Shack hardware as used for TV antenna mounting. (My antenna is approximately the same weight as the average color TV antenna.) I mounted my antenna on an 8-foot aluminum TV mast and dropped it in the lawn one foot, leaving the system 7 feet above ground for tuning convenience. Tuning to resonance to the desired frequency (21.3 MHz) was accomplished with the coax disconnected.

If difficulty is encountered in resonating the driven element, apply the following methods: If the resonant frequency is too low to compensate for by compressing the coupling coil, clip small pieces of the 1½-inch end leads at both extremes of the element. Clip no more than ¼ inch at a time, until the frequency increases sufficiently.

If the resonant frequency is too high, add about 4 inches of #12 copper wire to both ends of the element winding. Anchor these extensions to appropriate screws and washers mounted on the pipe end caps. Then apply the first step, using the clipping procedure.

Next, insert the coax and tap the coax alligator clip (clips if you balunize it) on the coil for lowest swr. Repeat the above two steps for the same purpose.

I found the quickest method for tuning the director was to resonate the director to the radiating driven element. This can be done by placing a field strength meter on the opposite side of the driven element for a medium scale reading with just a few Watts being radiated. Place your free director on a wooden ladder in proximity to the driven element (about 3 feet away). Compress or expand the director coil until the field strength meter declines to a minimum. This is a touchy and critical adjustment, so, to get close, start the procedure by making use of your grid-dip oscillator first. I found that, after using this method, a very slight increase in forward gain was obtained by keeping the director on a slightly higher frequency than the driven element.

As I mentioned before, my new garage-room location was fraught with ghosts, images, reflections, and reflections of the reflections. I finally found a method which lessened the dilemma's impact. I put the field strength meter in storage and warmed up my Millen grid-dip oscillator (this one really is a grid dipper; it's the old one with the tube!). I walked it back to the apartment house. After wrapping one loop of hookup wire around the base of the coil form, I grounded one end of this link wire to the Millen dipper frame. The other end of the link wire was clipped to my disconnected TV lead-in. I turned the dipper on and tuned it to the middle of the 21 MHz SSB section. Then I called up a friend of mine approximately one mile away. No, he couldn't hear the dipper. Great! I went to the ham shack 2 blocks away.

I brought the KWM 2A into the yard where the beam experiments were being performed. With the beam transmission line connected, the dipper signal was S5 when pointed directly for maximum signal. I then added approximately 9 feet of slip-in TV mast, making the height above ground 16 feet. Then things started to happen. Although some of the reflections remained, they were reduced considerably.

I've found that DX stations seem to have improved signal input from my station with the antenna approximately 11 feet above the ground surface. The actual height above true electrical ground in this location is very close to a quarter wave at 21 MHz. (This doesn't hold true for local contacts.) There is another pair of measurements which are not bad for this tiny antenna. The front-to-back ratio had to be checked very early in the morning, when the QRN from various appliances in the neighborhood is at a minimum. The front-to-back was approximately 3 S-units one morning. This is not considered unusual for a full-size 2-element yagi, when the parasitic element is a director. The forward gain over an 11-foot-high reference dipole was a big, fat 5 dB. I emphasize "fat" because, lest we forget, it is a reduced-size affair.

The trouble, I believe, with reducing the quad-loop size is that currents in the quad's opposite sides are out of phase and tend to cause some excessive wave canceling, whereas, if these sides are of some optimum separation, it will serve to help shape the total magnetic pattern to the typical quad advantage. As the sides approach closer and closer proximity, the opposite sides start to take on the folded-dipole character, where both sides are in phase.

All technical articles should wind up by giving a report on the results of the project. Here is mine — Great! ■

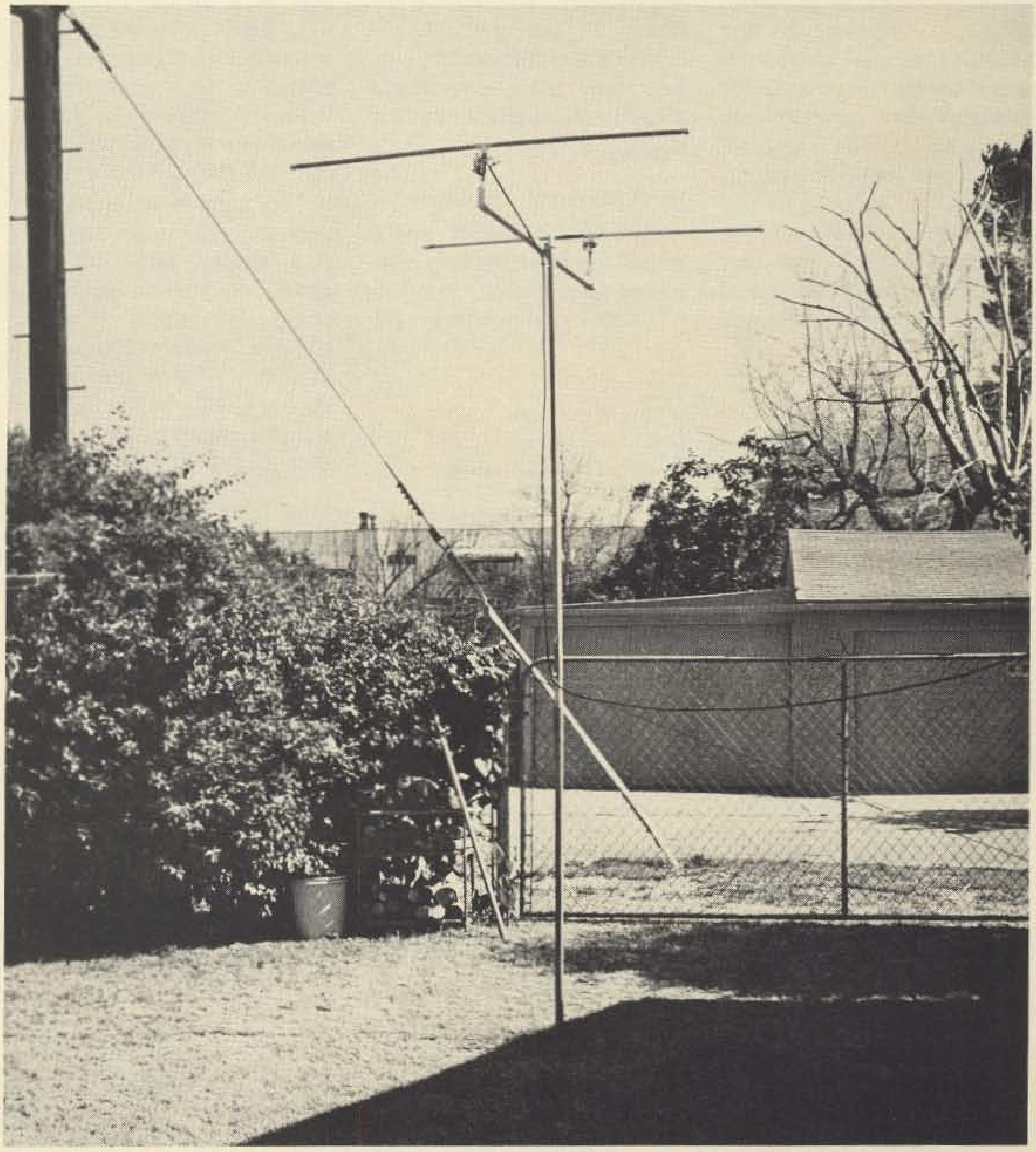


Photo D. Note the cramped quarters. I worked most DX stations at the height pictured — 11 feet.

Joseph J. Carr K4IPV
5440 South 8th Road
Arlington VA 22204

The Op Amp Encyclopedia

—part II

The operational amplifier has proven to be something of a blessing to the amateur designer because it obeys simple rules and, for the most part, is reasonably well behaved. This combination allows sophisticated circuitry to be designed by less sophisticated users. In the first part of this two part series, I covered the basics of the operational amplifier and the derivation of the commonly-seen transfer equations. In this part, I will examine the differential configuration using operational amplifiers and give a practical example.

Dc Differential Amplifiers

The fact that an IC operational amplifier has two complementary inputs, inverting (-) and noninverting (+), makes it a natural for application as a differential amplifier. These circuits produce an output voltage that is proportional to the *difference* (hence "differential") between two input voltages. Recall that the two inputs of an IC op amp have equal but opposite effects on the output. If the same (or two equal) voltage is applied to the two inputs (i.e., a *common-mode* voltage – E3 in Fig. 1), then the output voltage will be zero. The transfer equation for a differential amplifier (see Fig. 1) is:

$$E_{out} = A_V(E1 - E2) \qquad (1)$$

So, if E1 = E2, then $E_{out} = 0$.

The circuit in Fig. 1 shows a simple differential amplifier using a single IC operational amplifier device. The voltage gain (A_V) in this circuit is given by:

$$A_V = R3/R1, \qquad (2)$$

provided that R1 = R2, and R3 = R4. The main appeal of this circuit is that it is economical, requiring just one IC. It will reject common-mode voltages reasonably well if the equal resistors are well matched. It is in this area that one of the glaring weaknesses of the circuit shows up. Even when R4 is made variable, and the two input resistors are a well-matched pair, there will be at least some common-mode gain. Adjustment is made of R4 with the two inputs (points "A" and "B") tied together. This junction is then connected to a signal source of several volts p-p amplitude. R4 is adjusted until the ac output voltage is zero.

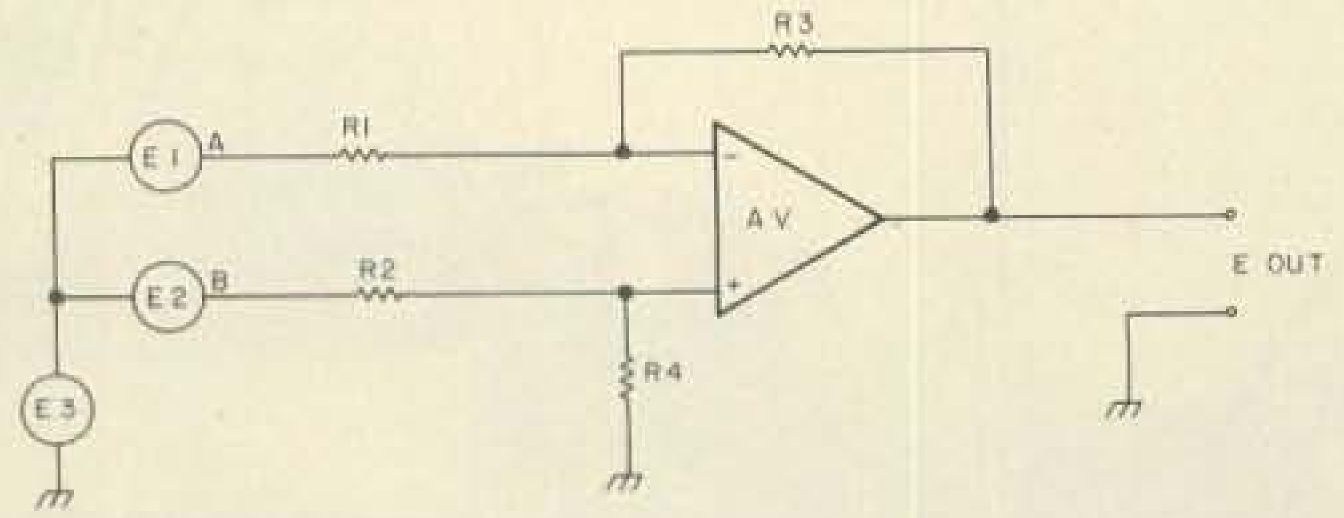
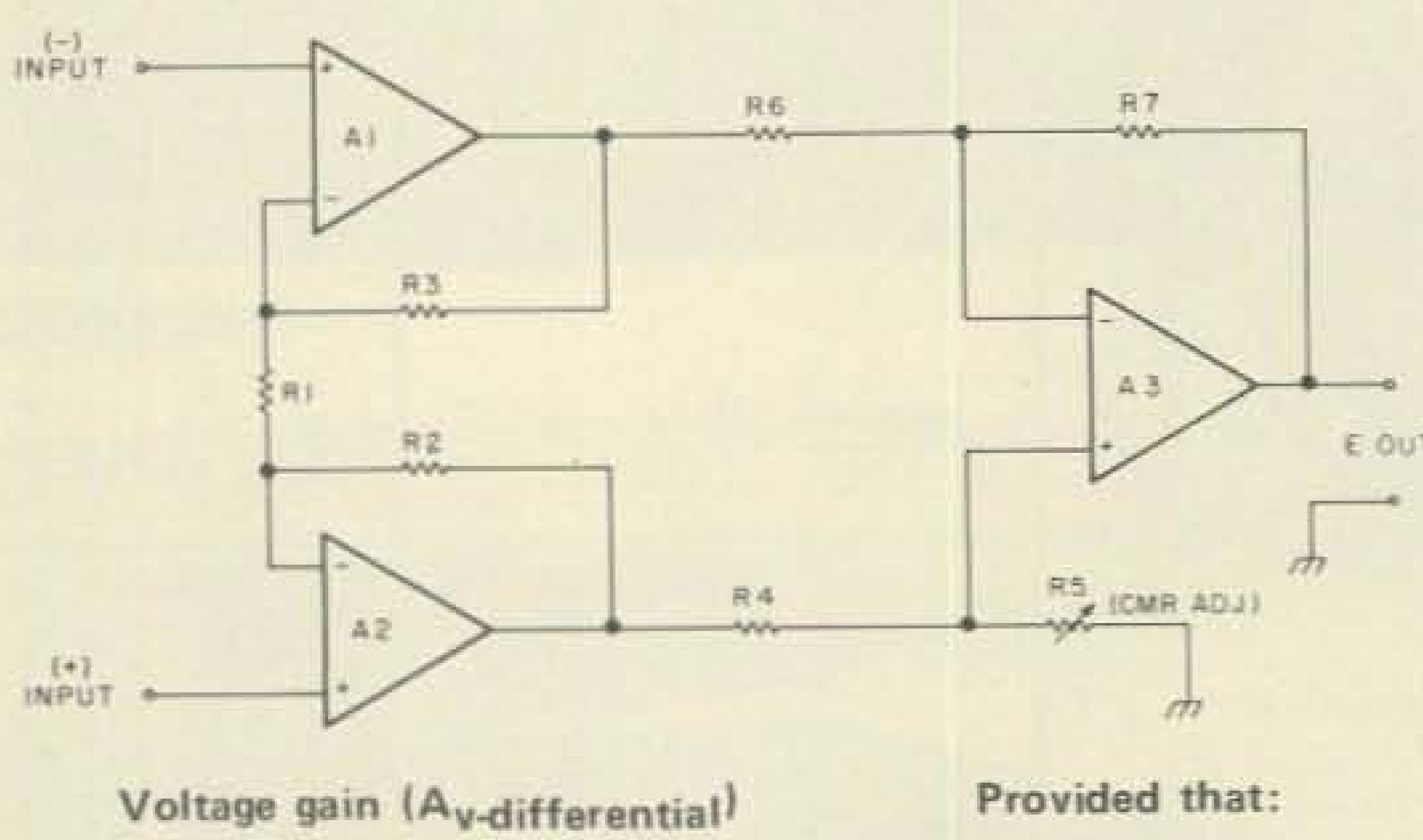


Fig. 1. Simple differential amplifier using just one op amp.



Voltage gain ($A_{V\text{-differential}}$)	Provided that:
(1 + 2R3/R1)	R2 = R3 and R4 = R5 = R6 = R7
(1 + 2R3/R1)(R7/R6)	R2 = R3, R6 = R7, and R4 = R5
R7(R1 + R2 + R3)/R1R6	R7/R6 = R5/R4

Fig. 2. Differential instrumentation amplifier.

Besides the problems occurring when common-mode rejection requirements are high, we also find this single IC differential amplifier suffering from a relatively low input impedance. In the practical world, we also find that it might tend to be a little difficult to tame if high gain is demanded of a single IC op amp. It can be done, but problems in layout are magnified that way.

In recent years, the instrumentation amplifier (I.A.) of Fig. 2 has caught on in popularity because it goes a long way toward alleviating, if not eliminating, the problems associated with the design of Fig. 1. The input stages are noninverting followers, so they will offer the characteristically high impedance input of such stages. Typical input impedance values run to as much as 1000 megohms.

The instrumentation amplifier is relatively tolerant of different resistor ratios used to create voltage gain. In the simplest case, the differential voltage gain is given by:

$$A_V = 1 + (2R3/R1), \qquad (3)$$

provided that: R2 = R3, and R4 = R5 = R6 = R7. It is interesting to note that common-mode rejection is not seriously deteriorated by mismatch of resistors R2 and R3. The only problem created by such a mismatch is an error in differential voltage gain.

The situation created by equation 3 will result in having a gain of unity (1) in amplifier A3, and that is a bit of a waste. If you want gain from amplifier A3, then equation 3 must be rewritten to include the gain factor of that stage, or:

$$A_V = [1 + (2R3/R1)] \cdot (R7/R6), \qquad (4)$$

provided that R2 = R3, R4 = R6, and R5 = R7.

One further equation that is of interest in this type of differential amplifier is the general expression from which the others may be derived:

$$A_V = [R7(R1 + R2 + R3)]/(R1 R6), \quad (5)$$

which is valid provided that the *ratio* R7/R6 = R5/R4. Equation 5 is especially nice since you need not concern yourself with matched pairs of precision resistors, but only with their ratios being equal.

Practical Circuit

I recently had a need for a dc differential preamplifier. I wanted it to operate out to almost 100 kHz. Because the two inputs were to be fed with low-level signals, they were wired with shielded cable. This would deteriorate the signal waveform because of the cable capacitance. In order to compensate for this high-frequency loss, a "capacitance-compensation" or "high-frequency-boost" control had to be designed into the amplifier. Voltage gain was to be approximately ten.

The circuit to the preamplifier is shown in Fig. 3. It is, of course, the instrumentation preamplifier of Fig. 2, with added touches. When the frequency response can be less than about 10 kHz, you may use any of the 741-family devices, including the 741, 747, 1458, and 1456 ICs. But premium performance requires a better operational amplifier. In this case, the most economical and easiest to obtain was the new RCA CA3140AH. This is a high-frequency device using the same basing as the industry standard 741 series. The technology used in manufacture of the 3140 is the RCA "Bimos" process that combines some of the best aspects of CMOS and bipolar design. The inputs are diode-protected MOSFET transistors, so the input impedance is astronomically high. The only criticism I have of RCA is that they seem to have an aversion for the popular mini-DIP (8-pin) package used by almost everybody else. The -AH suffix on the type number, though, will bring you their "DIL-pack," which is a metal can with 8 pins preformed to fit the mini-DIP socket. Common-mode adjustment is provided by potentiometer R10, which should be a ten-turn pot if you want to optimize CMRR. I used 5%-tolerance resistors with little noticeable CMRR problems that could not be "tweaked out" by R10.

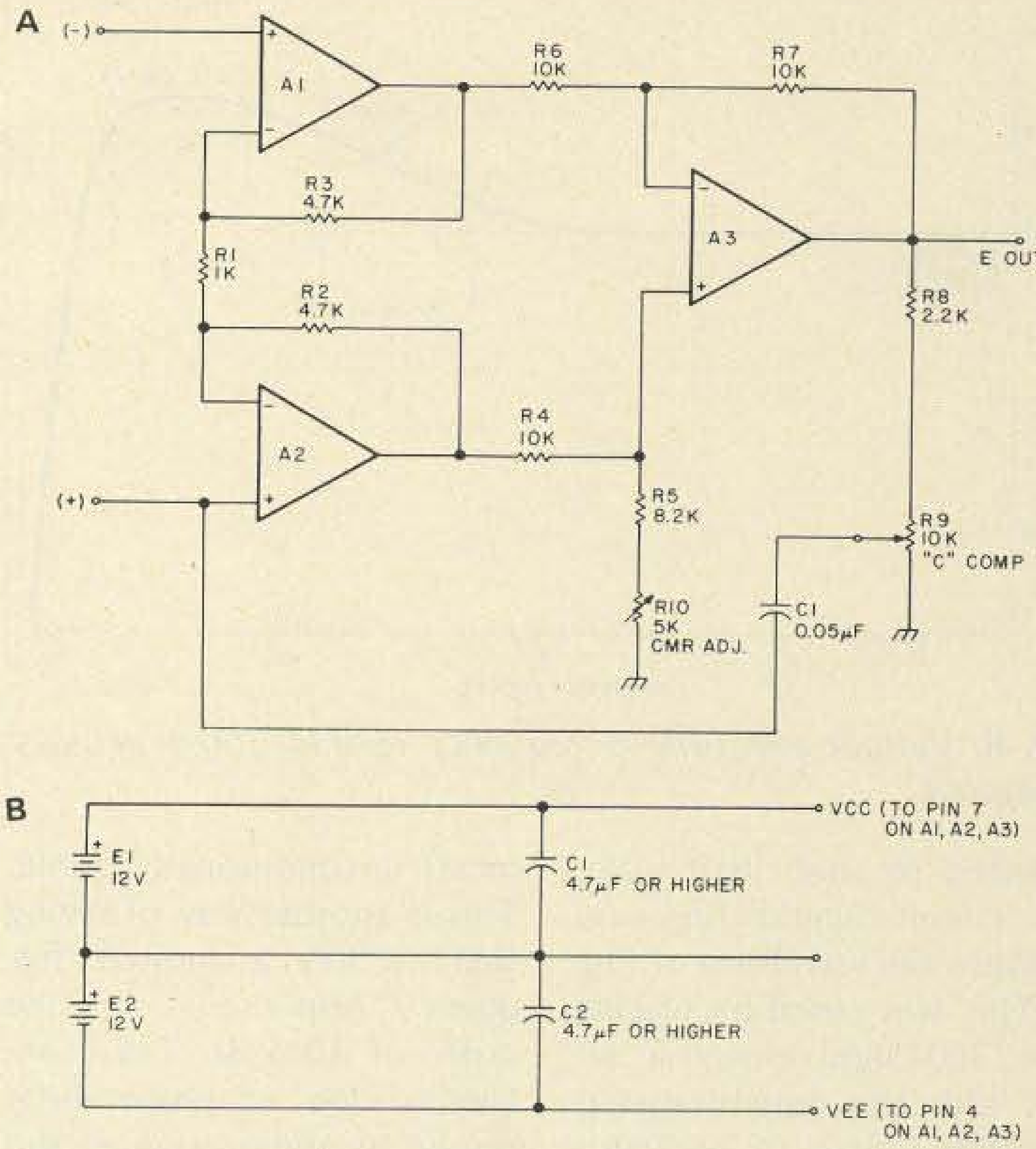


Fig. 3. (a) A gain-of-10 (20 dB) instrumentation amplifier featuring high-frequency compensation. A1, A2, A3 – RCA CA3140AH (DIL-pack). (b) Power supply required for (a).

The frequency response characteristics of this preamplifier are shown by Figs. 4 to 8. The input in each case was a 1000 Hz square wave from a function generator (see *Ham Radio Horizons*, March, 1977). The waveform in Fig. 4 shows the output signal when resistor R9 is set with its wiper closest to ground. Notice that it is essentially square, showing only a small roll-off of high frequencies due to the effects of C1 shunting the (+) input to ground. The waveform shown in Fig. 5 is the same signal when R9 is at maximum resistance. This creates a small amount of regenerative feeback that is not sufficient to start an oscillation but will enhance the high frequencies.

The problem of oscillation can be quite serious, though, if certain precautions are not taken. Originally, the top of the 10k potentiometer (R9) was tied directly to the output of A3. But, when R9 was

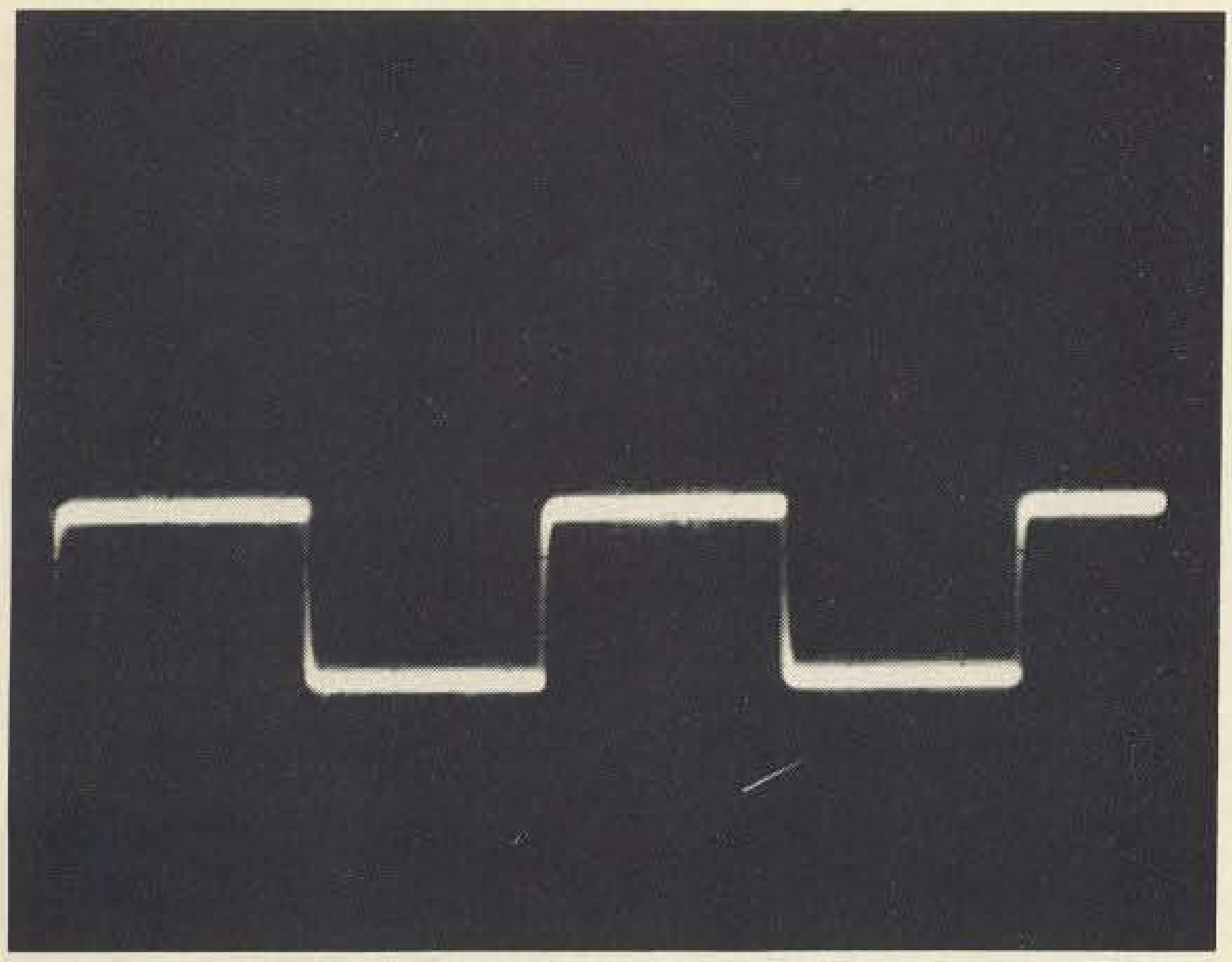


Fig. 4. 1000 Hertz square wave output when R9 [Fig. 3(a)] is set to minimum.

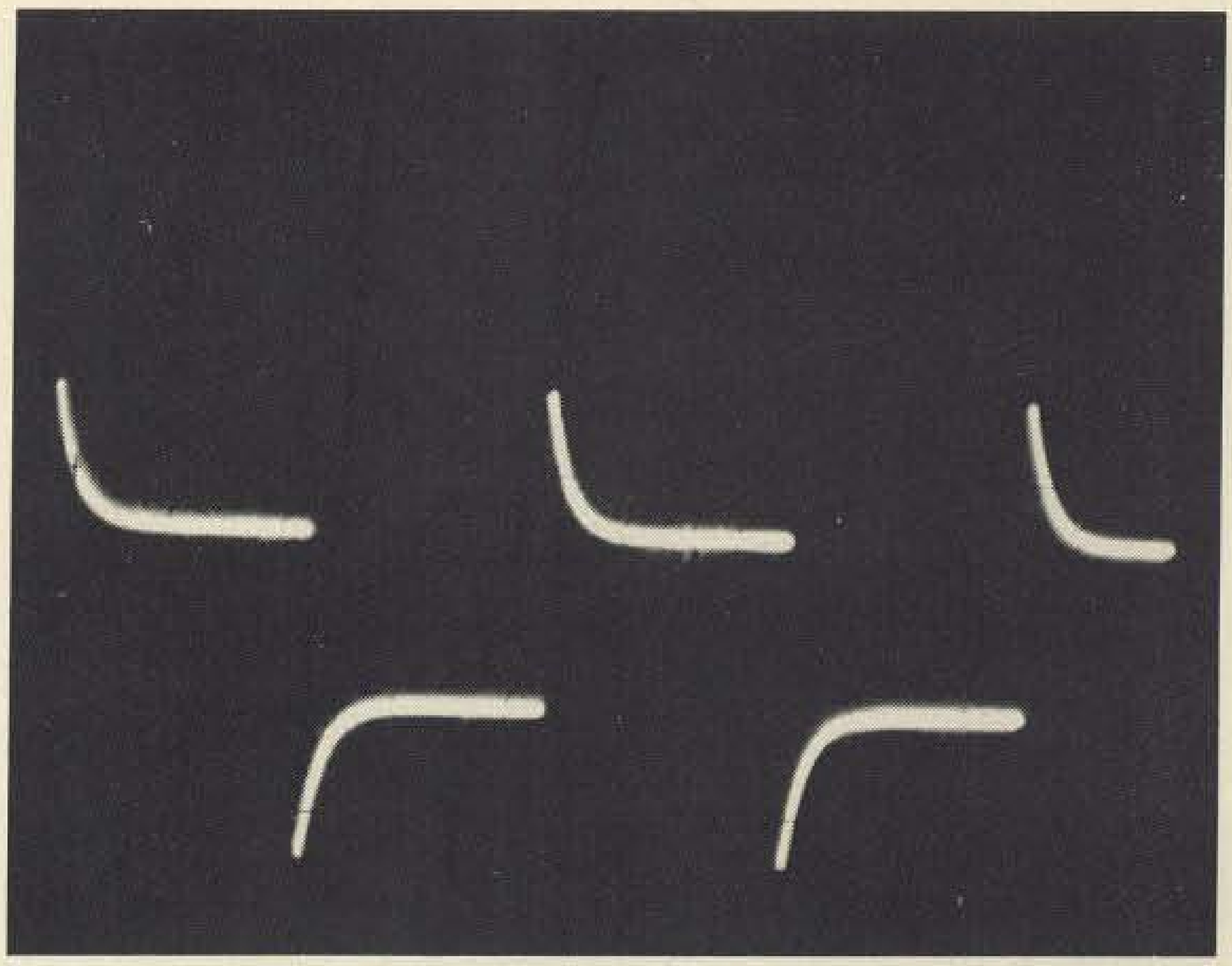


Fig. 5. Enhanced high-frequency response when R9 is set to its maximum resistance position.

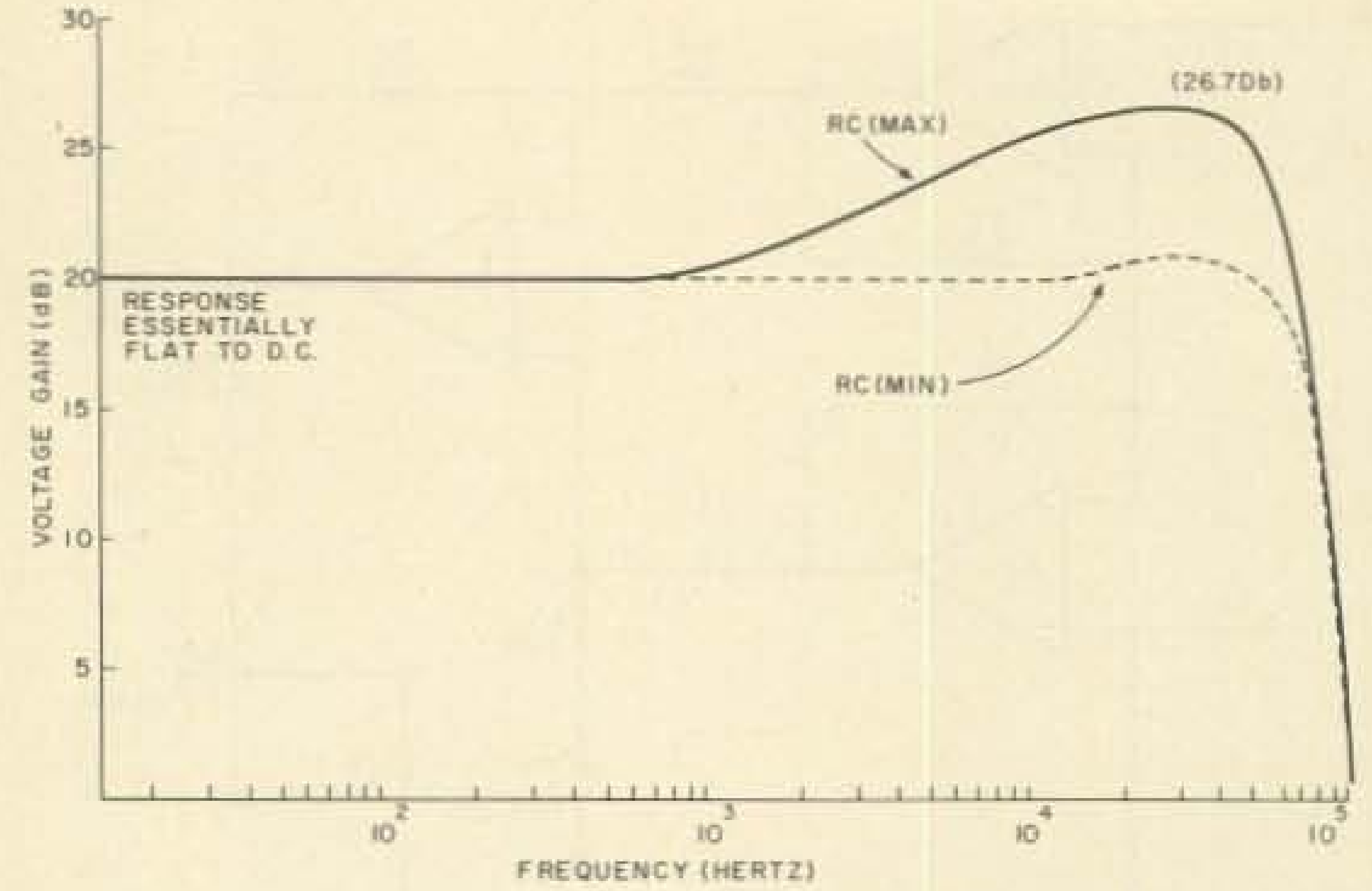


Fig. 6. Voltage gain (dB)-vs-frequency for Fig. 3(a) as actually measured.

adjusted to about half scale, the circuit would ring and produce the waveform of Fig. 7. This was cured by placing the 2200-Ohm resistor in series with the potentiometer. Another source of oscillator action is the value of capacitor C1. When a 0.001 uF or less capacitor was used, it was found that an 80 kHz constant oscillation was created (Fig. 8). The frequency response is shown in Fig. 6. To obtain any particular response, you will have to play with the values of C1 and R9, an inducement to use an oscilloscope. Other types of oscillation may show up when using high-frequency operational amplifiers. The 741 family is considered well behaved because it lacks these problems under most circumstances. It is said to be (almost) unconditionally stable. This is another way of saying that it has a limited frequency response – on the order of 10 kHz. The problem is due to phase shifts caused by the resistances and capacitances associated with the op amp – the input capacitances, for example, as well as the substrate-to-case capacitances. In the inverting-follower configuration, there is a 180° phase shift between input and output. If the phase shifts of the feedback network and input circuit conspire to add another 180° of phase shift at some frequency where the gain of the operational amplifier is greater than unity, then oscillation on that frequency will result. The cure is to reduce the voltage gain at that frequency to less than unity. One easy way is to place a small-value capacitance across the feedback resistance, or an RC network. You may also use either the lead or lag terminals, if there are such features on the particular amplifier. The 741, being a "compensated" type, does not require it. You may also elect to place an RC-series network across the input terminals. You will want to avoid using capacitors from output to ground (instability of another sort) or from either input directly to ground (noisy situation).

Applications of the Differential Amplifier

The differential amplifiers will find applications in many different situations. Of course, it should be recognized immediately that they are required wherever a differential signal voltage is found. Less obvious, perhaps, is that they are used to acquire signals or to operate in control systems in the presence of large noise signals. Many medical applications use the differential amplifier because tiny signal voltages from the body must be acquired in the presence of large 60 Hz fields from the power lines. This is also true of microprocessor or other systems which require an analog input to perform some job in the same type of environment. Let's say that you have a temperature sensor that can be treated as a differential signal. The lines bringing the dc signal from this sensor to the electronic thermometer may well be long enough to pick up 60 Hz interference. If you doubt this, then try grabbing ahold of the input to an audio amplifier or oscilloscope vertical amplifier. It is quite possible to pick up substantial 60 Hz voltages. Various authorities quote figures from 10 mV to 100 mV per foot of unshielded cable. There are even mechanisms where shielded cable is ineffective. The differential amplifier, however, sees the 60 Hz signals on the two input lines as a single common-mode signal. It will therefore reject the 60 Hz interference and accept the transducer input signal. This signal is then amplified and can be applied to the instrument or an A/D converter in a microprocessor system.

Another application, which is perhaps related to that just discussed, is amplification of the output of a Wheatstone bridge, and this is shown in Fig. 9. If one side of the bridge's excitation potential is grounded, the output voltage is a differential voltage. This can be applied to the inputs of a differential or instrumentation amplifier.

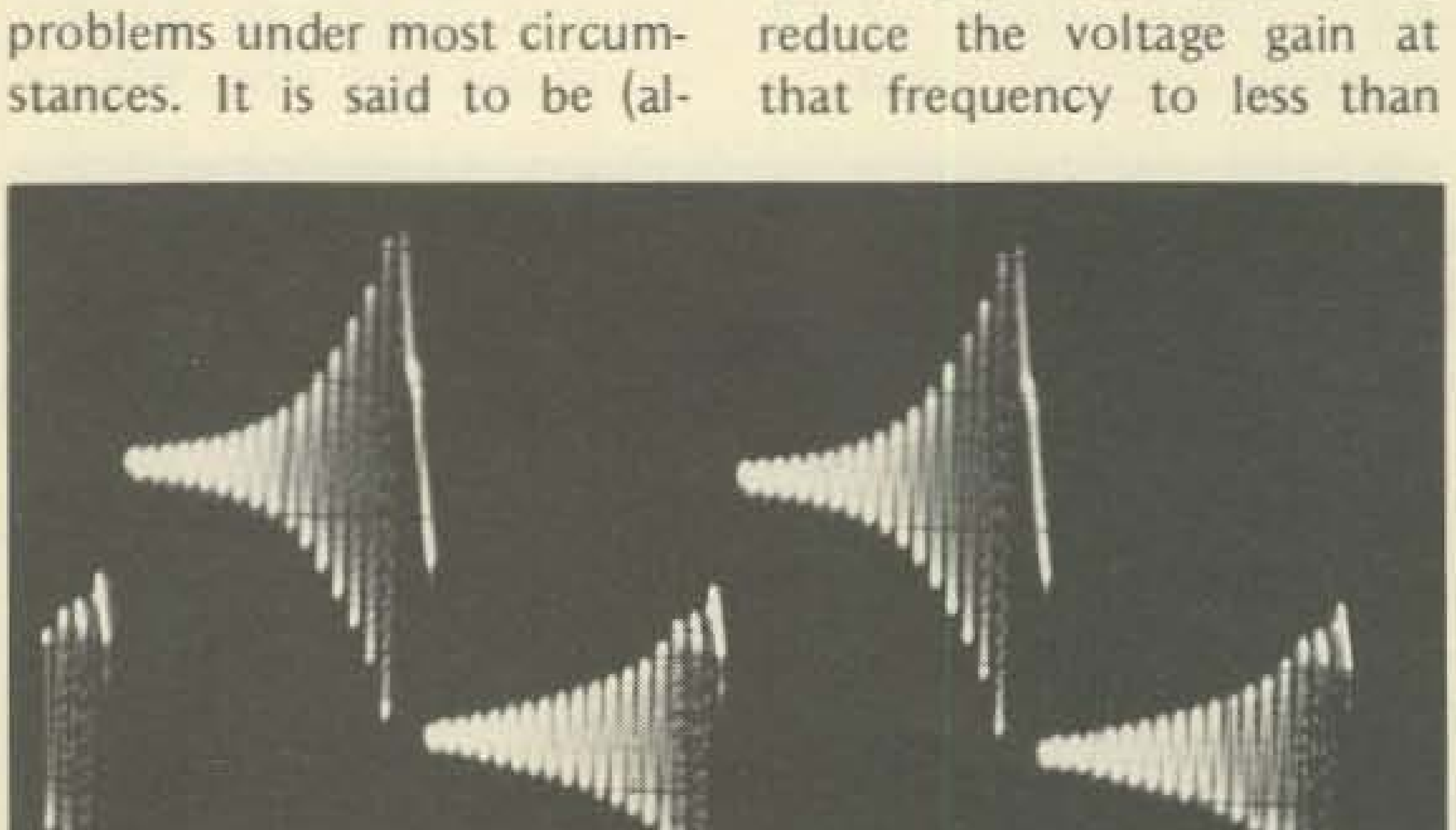


Fig. 7. Ringing will occur if R8 is too small.

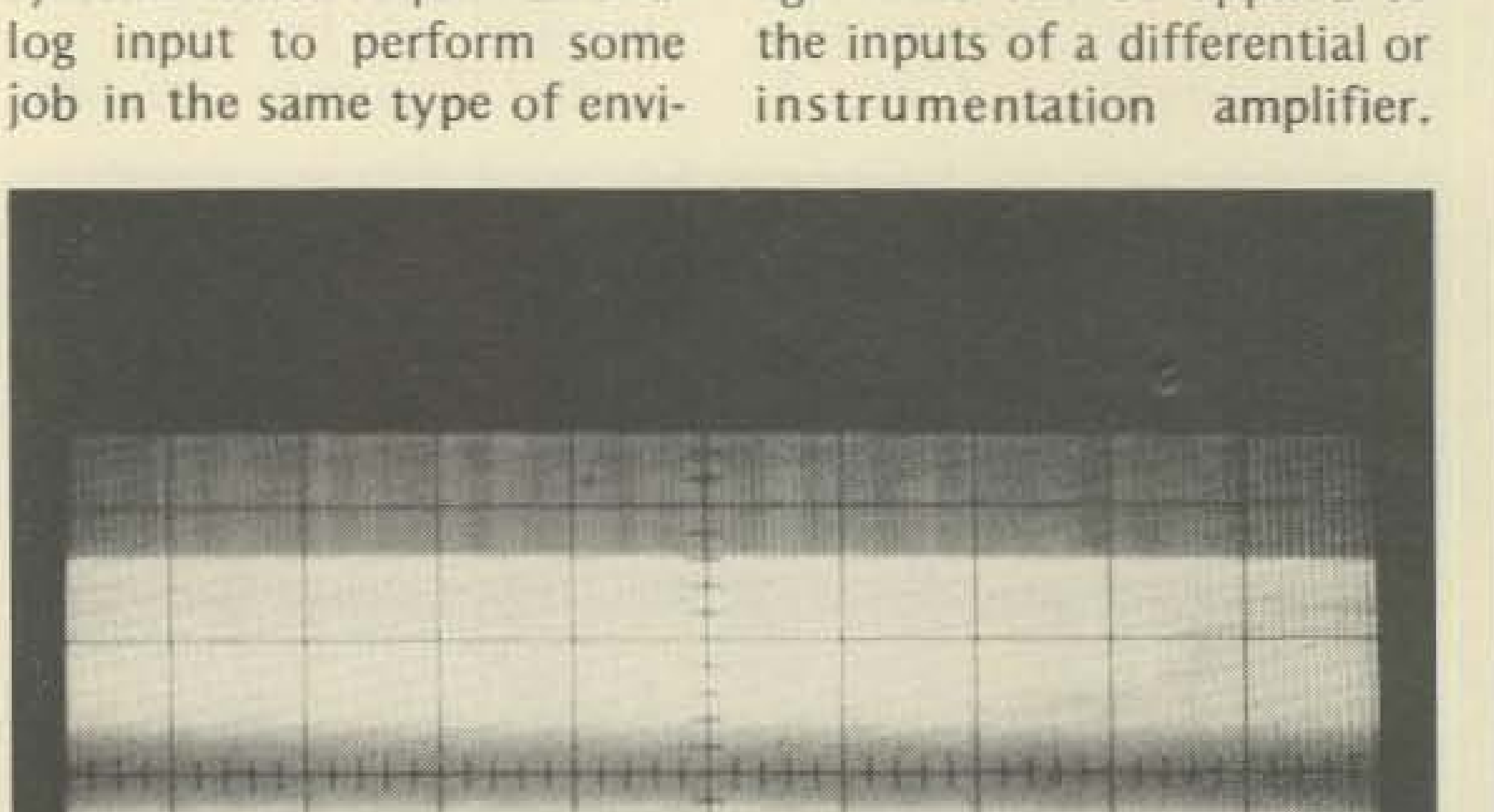


Fig. 8. An 80 kHz oscillation resulting from use of too small a value for C1.

One use for this is to make bridges sensitive to null conditions without having to obtain an expensive 50 or 10 uA meter movement. In addition, the overall sensitivity can be controlled at a later stage (see Fig. 10) by a simple gain control.

A "rear end" useful for almost all operational amplifier instruments and projects is shown in Fig. 10. This circuit consists of three type 741 operational amplifier IC devices. Since they will follow most of the circuit gain, these low-cost devices will suffice even in critical designs. The pinouts shown are for the mini-DIP and metal can cases. Input amplifier A1 can be made to have any gain desired by varying R2. If you want the entire stage to have unity gain, then make R2 = 10k Ohms. The gain of our rear end is given by R2/10,000. The second stage is the gain or sensitivity control. It has a unity gain when R4 is at maximum resistance.

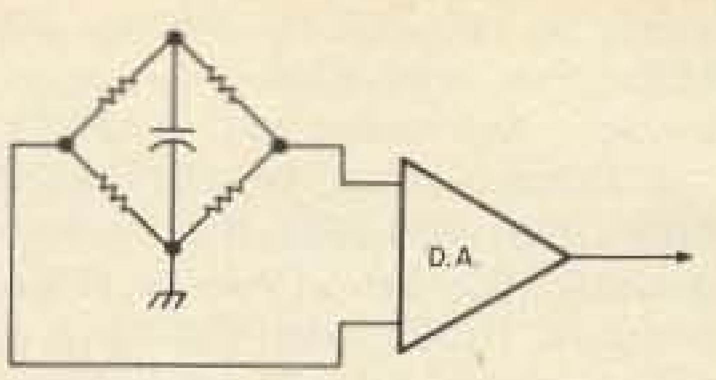


Fig. 9. Wheatstone bridges are made more sensitive if the output is passed through a 20 or 40 dB dc differential amplifier. The output indicator could then be almost any zero-center voltmeter, or a current meter with a series multiplier resistor.

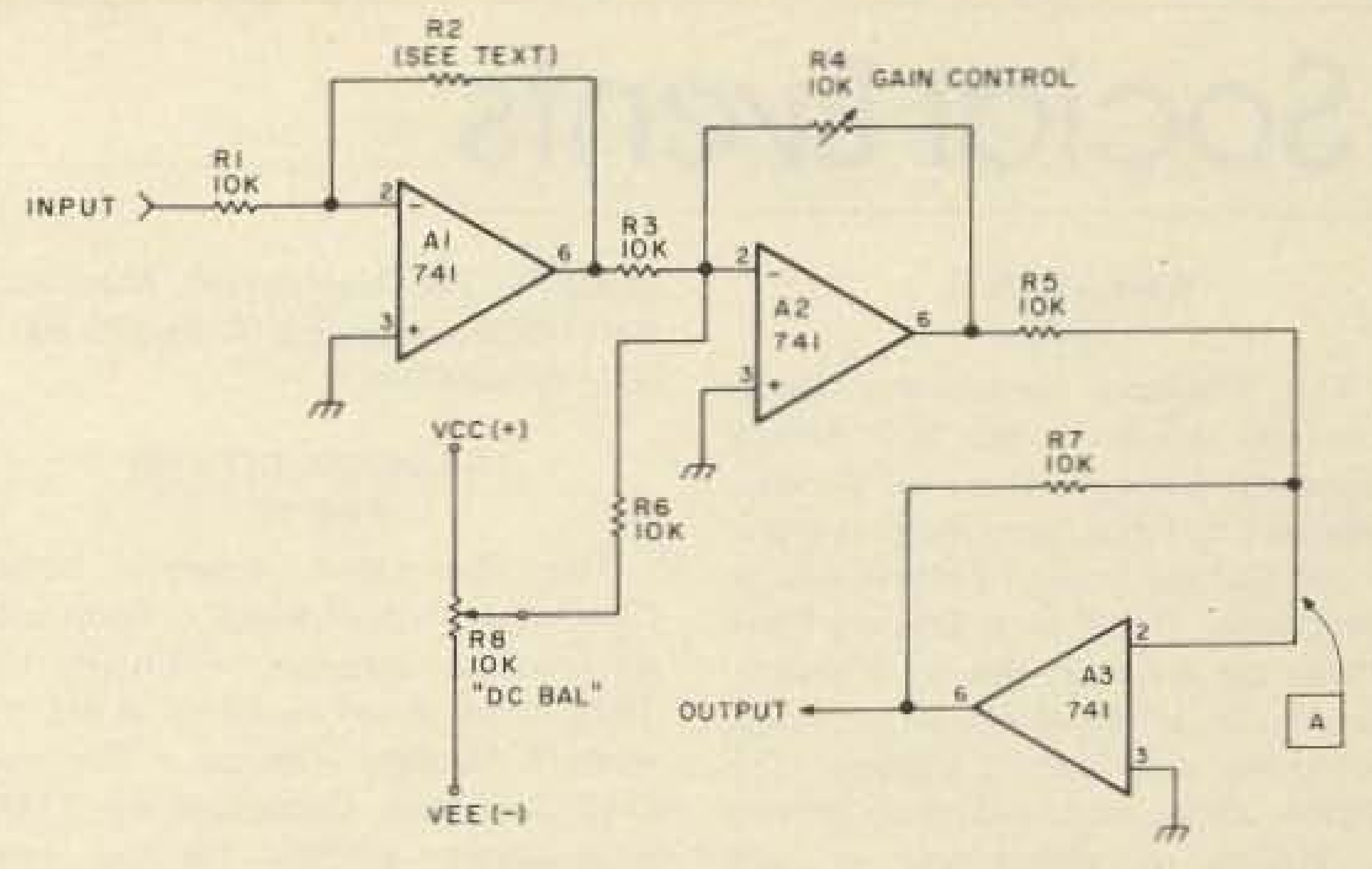


Fig. 10. Universal rear end for operational amplifier projects.

In order to keep the baseline (zero point) from shifting as the gain control is varied, include a dc balance control. This is used to cancel any collective offset voltages from preceding stages. Set the input voltage equal to zero (not at A1, but at the earliest stage in the chain — remember this is an output circuit), and then tweak R8 so that there is no shift in output voltage as the gain control (R4) is varied through its entire range. A dc-coupled oscilloscope or zero-center VTVM is best for this purpose. Avoid digital voltmeters. If you want to give the output some fixed-zero reference other than 0 V dc, or want a "position control" when using this circuit on an oscilloscope or chart recorder, then put a second network, such as R6/R8, at point A.

If RCA CA3140AH operational amplifiers, or some other high-frequency type, are substituted for the 741s specified, and the circuit is connected to a circuit such as Fig. 3(a), then you will have a nice differential preamplifier good up to 100 kHz for a low-cost oscilloscope. Such instruments rarely have more than a single 100 kHz (or slightly better) single-ended vertical amplifier. This project will make it a differential input such as might be found on much more expensive instruments. ■

Social Events

WHEATON IL
FEB 5

The Wheaton Community Radio Amateurs will hold their 16th Annual Midwinter Swap & Shop on Sunday, February 5, 1978, from 8 am to 5 pm, at the DuPage County Fairgrounds on Manchester Road (near County Farm Road) on the west side of Wheaton, Illinois. Some tables will be provided, but bring your own if possible. The WCRA invites anyone with an interest in buying or selling new or used electronic equipment to attend this hamfest, which will be inside four large heated buildings at the fairgrounds. Advance tickets (available until January 23) are $1.50, and tickets at the door are $2.00. Checks should be made payable to the club. Write Don Snyder WB9VFC, 623 Meadows Boulevard, Apartment 3C, Addison IL 60101.

MANSFIELD OH
FEB 5

The Mansfield, Ohio, Mid-Winter Hamfest and Auction will be held on February 5, 1978, at the Richland County Fairgrounds, Mansfield, Ohio. Prizes, flea market, auction. Large heated buildings. Doors open at 8 am. Talk-in on 146.34/146.94. Tickets $1.50 in advance, $2.00 at the door. Contact Harry Frietzhen K8HF (K8JPF), 120 Homewood, Mansfield OH 44906, or phone (419)-529-2801 or (419)-524-1441.

TRAVERSE CITY MI
FEB 11

The Cherryland Amateur Radio Club's 5th Annual Swap n' Shop will be held on Saturday, February 11, 1978, from 9 am to 4 pm, at Northwestern Michigan College in Traverse City, Michigan. Donations are $1.00 in advance or $1.25 at the door. Free display tables for electronic equipment and parts. Everyone is welcome. For more information, write to Greg North WB8TPR, Box 115, Lake Leelanau MI 49653.

WOODBRIDGE NJ
FEB 11

The New Jersey FM Repeater Association of Woodbridge, New Jersey, will hold its annual Valentine Dinner Dance on Saturday, February 11, 1978, at 8 pm at the Masonic Temple on Green Street, Woodbridge, New Jersey. There will be talk-in on 146.22/82. This is New Jersey's largest all-ham dinner dance. This year's gala event will feature a sit-down roast beef dinner, an open bar, and music by the nationally-known band of Frank Mattafore K2KVT. Advance registration of $25.00 per couple is required by January 20, 1978. For reservation information, contact: Sid Lieberman WA2FXB, 146 Grove Avenue, Woodbridge NJ 07095, (201)-634-8955; Bob Boehmer WA2JDU, 536 Barron Avenue, Woodbridge NJ 07095, (201)-636-3947; or Bob Best WB2JDU, 712 New Dover Road, Edison NJ 08817, (201)-382-9625. Please make all checks payable to NJFMRA.

LANCASTER PA
FEB 26

The annual Lancaster Hamfest will be held Sunday, Feb. 26, 1978, from 9 am to 5 pm at the Farm & Home Center, 1383 Arcadia Rd., Lancaster PA. Donation $2.00; no additional fee for indoor tables or tailgating; XYLs and kids free. Food will be available; door prizes will be given away. Talk-in 146.01/.61, 146.52, 222.70/.30. Dealers invited. For further details, write Sercom, P.O. Box 6082, Rohrestown PA 17603.

LIVONIA MI
FEB 26

The Livonia Amateur Radio Club would like to announce that the 8th Annual LARC Swap 'n Shop will be held on Sunday, February 26, 1978, from 8:00 am to 4:00 pm at the Stevenson High School in Livonia, Michigan. There will be plenty of tables, door prizes, refreshments, and free parking. Talk-in on 146.52 simplex. For further information, write Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48150.

BYRAM CT
FEB 26

Dimar Electronics of Greenwich will hold its first annual "Midwinter Hamfest" at the Byram Veterans Hall on Delavan Avenue in Byram, just off the Connecticut Thruway at Exit 2. Doors open at 0900 local. Talk-in on 52-52. Admission is $2.00 at the door. Table space is $1.50 per half table. Sellers will be asked for small equipment donation for door prizes/raffles. Advance reservations for space should be sent to Dimar Electronics, 234 Mill Street, Byram CT 06830, (203)-531-8257.

CUYAHOGA FALLS OH
FEB 26

The Cuyahoga Falls Amateur Radio Club's 24th Annual Electronic Equipment Auction and Flea Market will be held on Sunday, February 26, at North High School, Akron OH, from 9 am to 4 pm. Tickets are $1.50 in advance, $2.00 at the door. Bring your own tables; some will be available at $1.00 each. Refreshments will be available. 5 main prizes, including the grand prize, a Triton IV. Plenty of room for buyers and sellers – over 32,000 sq. ft. Easy access – located on Tallmadge Ave. at off ramp of North Expressway (Rt. 8). Check in on 146.52, 146.04.64, 147.84.24, 223.5. CFARC, PO Box 6, Cuyahoga Falls OH 44222.

Pace-Traps

Box 234
Middlebury CT 06762

MULTI-BAND ANTENNA TRAPS

FG-5 KW rated traps for 80-10 meter systems .... $17.95 pair ppd.
FG-4 KW rated traps for 40-10 meter systems .... $17.95 pair ppd.

Complete two band trap dipole systems, kw rated, factory tuned to suit your operating habits and ready to install! Includes #12 stranded copper-weld, center-insulator, end-insulators, 70 feet of RG59 coax with Pl-259! Each band can be tuned to your specification! Specify combination desired .... phone-phone, phone-cw .... cw-cw in any combination desired!

PT80-40 two band system approximately 105' long .... $44.95 ppd.
PT40-20 two band system approximately 55' long .... $42.50 ppd.
PT20-15 two band system approximately 28' long .... $37.50 ppd.
PT15-10 two band system approximately 18' long .... $35.95 ppd.
* Length depends on frequency combination chosen.
PS-2 weather-proof center-insulator .... $5.95 ea. ppd.
Stranded Copper-weld cut to length:
5 band .... $6.50 + $1. UPS
4 band .... $3.50 + $1. UPS

TWO METER MOBILE OPS

Convert to the low-profile FLYING-DUCKY! Magnetic mount designed to use a rubber-ducky (short quarter-wave vertical) as an external mobile antenna. Super magnet holds even on hard-top. Designed to go with any HT but with adapter plugs available, matches any mobile rig. Provides solid mobile coverage even with the low-power HT. Better than 1/4 wave or 5/8 wave trunk-mounted whips. 10 second install and remove!

Complete mount and cable to suit HT or mobile. Specify either F-type BNC or SO 239 plugs .... $13.95 ppd.
Adapter plug to match cable to rib .... $2.50 ppd.
Rubber-Ducky to suit .... $6.95 ppd.
Roll-up whip for easy packing .... $5.95 ppd.

Check or MO to:
Box 234
Middlebury CT 06762
(203) 758-9228

P15

ALL BAND TRAP ANTENNA !

5 BAND OPERATION - ONLY ONE NEAT SMALL ANTENNA. FOR CONGESTED HOUSING AND APARTMENT DWELLERS!

FOR ALL AMATEUR HF TRANSMITTERS GUARANTEED FOR 2,000 WATTS PEP. POWER. NOVICE & ALL CLASS AMATEURS!

Complete as shown total length 102 ft. with 90 ft. of 52 ohm RG58U coax and PL259 connector - insulator. Dacron cord support. Wt. 3 lbs. MOLDED RESONANT TRAPS. You just switch to desired band for EXCELLENT reports!

NO EXTRA TUNERS OR BALUNS NEEDED! CAN BE USED IN ATTICS, TOPS OF BUILDINGS OR AS INVERTED V's IN MINIMUM SPACE! EASY INSTALLATION! COMPLETELY ASSEMBLED, JUST HANG IT, AND USE IT. FULL DETAILS FURNISHED.

80-40-20-15-10 meter bands. Complete - 998BU - $39.95
40-20-15-10 meter bands. 54-ft. ant. - 1001BU - - $38.95
20-15-10 meter bands. 26-ft. ant. - - 1007BU - - - $37.95

SEND ONLY $5.00 (cash, ck., mo.) and pay postman balance COD plus postage on arrival or send full price for pp. del. in USA, (Canada is $5.00 extra). Bank Americard - VISA - MASTER CHARGE - OR AM. EXP. - by mail or PH 1-308-236-5333. We ship in 2-3 days. Free info. from.

WESTERN ELECTRONICS Dept. A7- 2
Kearney, Nebraska, 68847

ALL BAND TRAP ANTENNA!

Sere-Rose & Spencer Electronics

1465 WELLS STATION ROAD
MEMPHIS, TENN. 38108
PH (901) 683-9125—685-8461

Authorized Dealer

DRAKE—ICOM—KENWOOD
REGENCY—TEMPO—DENTRON

CALL OR WRITE
FOR BEST DEAL

S39

RADIO WORLD

CENTRAL NEW YORK'S FASTEST GROWING HAM DEALER

Featuring Yaesu, Icom, Atlas, Dentron, Ten-Tec, Swan, Regency, Standard, Tempo, KLM, Hy-Gain, Mosley, Larsen, Midland, Wilson, Southwest Technical Products. We service everything we sell! Write or call for quote. YOU WON'T BE DISAPPOINTED.

We are just a few minutes off the NYS Thruway (I-90) Exit 32

R19

RADIO WORLD
ONEIDA COUNTY AIRPORT
TERMINAL BUILDING
ORISKANY, NY 13424
315-337-2622

Warren K2IXN
Bob WA2MSH

KENWOOD 'S TS-520S

YAESU 'S FT301D

WANT TO TRADE — UPGRADE? Call us — for best quote. Large assortment of clean used equipment on hand.

50th Year Serving Amateurs

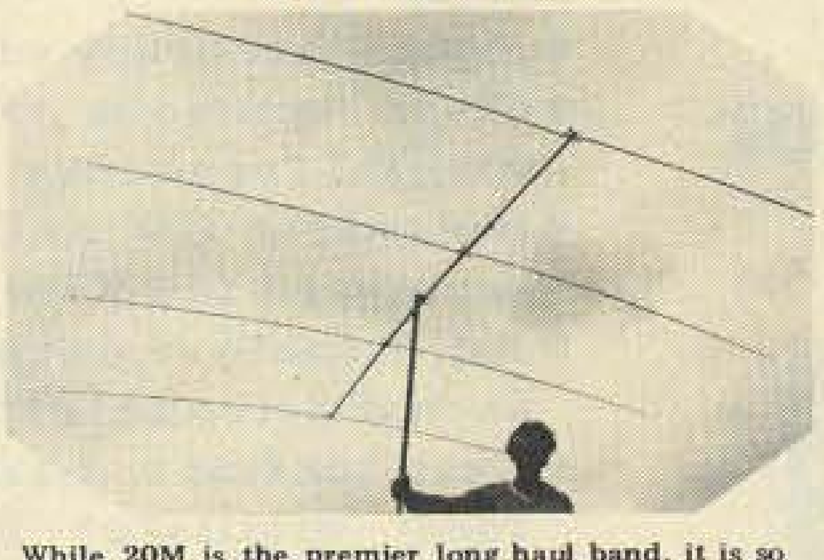
W4WL — W4VOV — K4RJY

Visa Master Charge

FRECK radio & supply co., inc.
252 Patton Ave.,
Asheville, N.C. 28801
PHONE: (704) 254-9551

F3

ANTENNA PROBLEM ON 20?



While 20M is the premier long haul band, it is so crowded that a directional antenna is almost essential. At 8 lbs. the Island Micro is the lightest beam available. With 6dbi. gain, it holds its own in the pileups. Log Periodic feed makes it the only miniature beam that gives full gain, low SWR across the whole band.

In addition to performance, the Micro is convenient. Just put it together, no tuning or matching. Folds up and travels easily as baggage on the airlines. Pacifies landlords, neighbors with its uncanny resemblance to a TV antenna.

Uses four 12' heliwhip elements on a 10½' boom. Wind area under 1 s.f. 8db f/b. VSWR 1.5 max, 14-14.4 MHz. Two week money back guarantee. $149.50 SASE for info.

Island Antennas
Block Island, RI 02807
Custom antennas our specialty.

I19

THE PERSONAL COMMUNICATIONS FOUNDATION

Legal research for the amateur radio and citizens band services.

The Personal Communications Foundation is a non-profit, tax-exempt California corporation established in November, 1976. Its Board of Trustees, Officers and Advisors consist of lawyers, judges and law school professors with substantial experience in the representation of users who have encountered communications related legal problems.

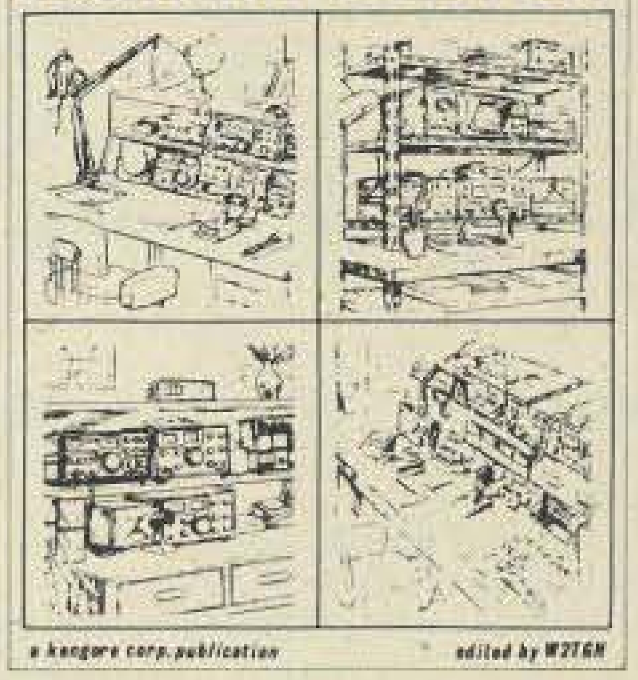
The Foundation has been organized expressly for the purpose of creating a comprehensive personal communications law library. The Foundation continues to collect available court decisions, briefs and legal memoranda relating to personal communications.

The Foundation has already expended thousands of dollars in funding special studies. One study on the issue of Federal Pre-emption has been incorporated into a brief before the California Court of Appeals.

For information, write: PERSONAL COMMUNICATIONS FOUNDATION
10960 Wilshire Boulevard, Suite 1504
Los Angeles, California 90024
or call: (213) 478-1749

NEW 1978 EDITION

No ham library will be complete without a copy of the 1978 Amateur Radio Equipment Directory.



The most complete directory of Amateur Radio Equipment ever published.

$4.00 Postpaid (U.S.)
Canada $5.00, Foreign (Air) $7.00

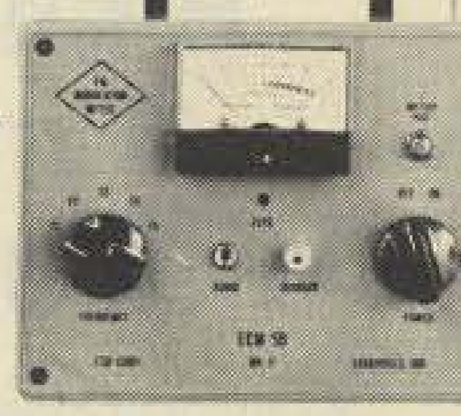
K11

KENGORE CORP — Dept. C
9 James Ave. Kendall Park, NJ 08824

SEND FOR YOUR COPY TODAY

NEW for '78

The FM Deviation Meter Anyone Can Afford



$189
less batteries and crystals

ECM-5B MK-II fm modulation meter

- Now used by the U.S. Government in over 50 locations
- All new unbreakable A.B.S. cabinet
- 0-6 kHz peak reading linear scale
- Operates 25 MHz to 500 MHz
- Crystal controlled for easy operation
- Audio/Scope output with earphone
- Options: NICAD power PAK $34.95
  Charger $39.95

Write or call for complete information. Send check or money order for $189. Shipping prepaid in U.S. Indiana residents add 4% sales tax. Crystals $7.95 each.

ECM
ECM Corporation
412 N. Weinbach Ave.
Evansville IN 47711
812-476-2121

E1

FREQUENCY COUNTERS

FREE

By popular demand we are continuing to offer a Fairchild Clock, Module FCS-8100S (suggested retail $20) with any purchase of $99 or more from 73 advertisements.

Previously kitted for Crescomm Inc. by Hal-Tronix

COMPLETE KITS: CONSISTING OF EVERY ESSENTIAL PART NEEDED TO MAKE YOUR COUNTER COMPLETE.

HAL-600A 7-DIGIT COUNTER WITH FREQUENCY RANGE OF ZERO TO 600 MHz. FEATURES TWO INPUTS: ONE FOR LOW FREQUENCY AND ONE FOR HIGH FREQUENCY; AUTOMATIC ZERO SUPPRESSION. TIME BASE IS 1.0 SEC OR .1 SEC GATE WITH OPTIONAL 10 SEC GATE AVAILABLE. ACCURACY ± .001%, UTILIZES 10-MHz CRYSTAL 5 PPM.
COMPLETE KIT $149.00

HAL-300A 7-DIGIT COUNTER WITH FREQUENCY RANGE OF ZERO TO 300 MHz. FEATURES TWO INPUTS: ONE FOR LOW FREQUENCY AND ONE FOR HIGH FREQUENCY; AUTOMATIC ZERO SUPPRESSION. TIME BASE IS 1.0 SEC OR .1 SEC GATE WITH OPTIONAL 10 SEC GATE AVAILABLE. ACCURACY ± .001%, UTILIZES 10-MHz CRYSTAL 5 PPM.
COMPLETE KIT $124.00

HAL-50A 8-DIGIT COUNTER WITH FREQUENCY RANGE OF ZERO TO 50 MHz OR BETTER. AUTOMATIC DECIMAL POINT, ZERO SUPPRESSION UPON DEMAND. FEATURES TWO INPUTS: ONE FOR LOW FREQUENCY INPUT, AND ONE ON PANEL FOR USE WITH ANY INTERNALLY MOUNTED HAL-TRONIX PRE-SCALER FOR WHICH PROVISIONS HAVE ALREADY BEEN MADE. 1.0 SEC AND .1 SEC TIME GATES. ACCURACY ± .001%. UTILIZES 10-MHz CRYSTAL 5 PPM.
COMPLETE KIT $124.00

HAL-TRONIX BASIC COUNTER KITS STILL AVAILABLE

THE FOLLOWING MATERIAL DOES **NOT** COME WITH THE BASIC KIT: THE CABINET, TRANSFORMER, SWITCHES, COAX FITTINGS, FILTER LENS, FUSE HOLDER, T-03 SOCKET, POWER CORD AND MOUNTING HARDWARE.

HAL-600X (Same Specifications as HAL-600A) $124.00
HAL-300X (Same Specifications as HAL-300A) $99.00
HAL-50X (Same Specifications as HAL-50A) $99.00

PRE-SCALER KITS

HAL-0-300PRE (Pre-drilled G10 board and all components) $19.95

HAL-0-300P/A (Same as above but with preamp) $29.95

HAL-0-600PRE (Pre-drilled G10 board and all components) $39.95

HAL-1GHZ (**New** Item - Available in December) $124.95

PRE-BUILT COUNTERS AVAILABLE

(HAL-600A — $229.00) (HAL-300A — $199.00) HAL-50A — $199.00). ALLOW 4- TO 6-WEEK DELIVERY ON PRE-BUILT UNITS.

"HAL" HAROLD C. NOWLAND W8ZXH

HAL-TRONIX

P. O. BOX 1101
SOUTHGATE, MICH. 48195
PHONE (313) 285-1782

SHIPPING INFORMATION: ORDERS OVER $15.00 WILL BE SHIPPED POSTPAID EXCEPT ON ITEMS WHERE ADDITIONAL CHARGES ARE REQUESTED. ON ORDERS LESS THAN $15.00 PLEASE INCLUDE ADDITIONAL $1.00 FOR HANDLING AND MAILING CHARGES.

SEND **SASE** FOR FREE FLYER

H24

HATRY electronics

500 Ledyard St., Hartford CT 06114
203-527-1881

(1 block east of Wethersfield Ave. off Airport Rd. Rte. 6)

See Ward W1WRQ – John W1JJR
or
Dave WA1HFE

HEADQUARTERS for 2M FM

Tempo VHF/ONE, SSB/ONE adaptor, Tempo VHF amplifiers, FMH-2, FMH-5; Drake TR 33C, AA 10, AC 10; Regency HR 2B, HR 312, AR 2, P 110 & crystals for all lines listed above.

FM GAIN ANTENNAS

For mobile, fixed or portable operation by Cush-Craft, Hy-Gain, Antenna Specialists & New-Tronics.

ANTENNA STUFF

Open wire feedline – #18, #14, #12 ga. bare copperweld wire – #14, #12 enamel copper – insulators – W2AU baluns 1-1 or 4-1 – lowloss coax cable – Rohn 25G towers & accessories – Blitzbug lightning arrestors – glassline guy – B&W antenna switches – Belden 72 & 300 ohm KW twinlead – Amphenol UHF & BNC connectors.

AMATEUR GEAR

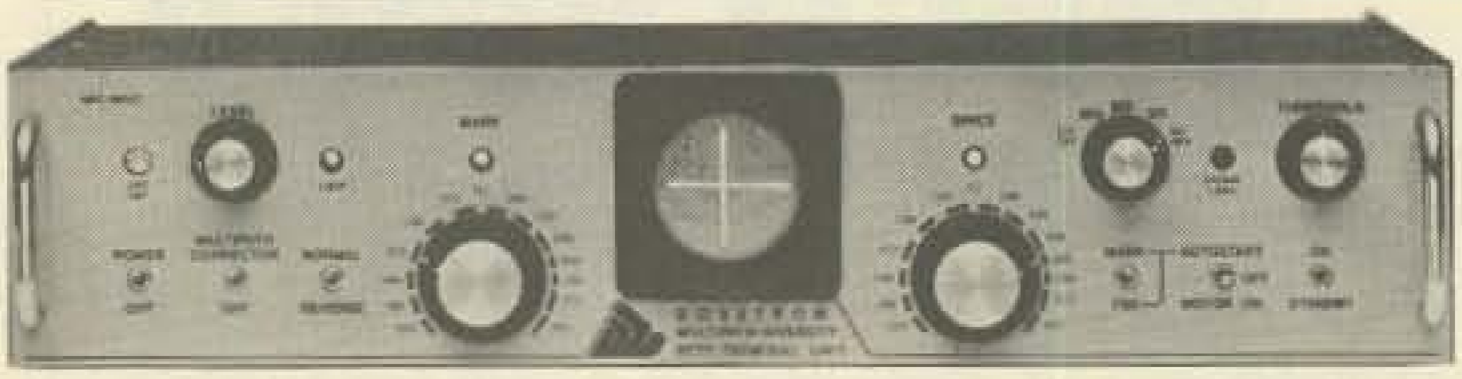
Drake, Swan, Tempo, Ten-Tec, Dentron, Regency, Mosley, Hy-Gain, CushCraft.

(Canadian Amateurs Send U.S. Funds Only)
F.O.B. Hartford
Please include postage

CONNECTICUT'S OLDEST HAM STORE

H15

DOVETRON



MPC-1000C
Multipath-Diversity
Amateur Net: $495.00

The MPC-1000C features MULTIPATH CORRECTION, IN-BAND DIVERSITY (single channel copy during deep selective fades) Operation and a PHASE-CONTINUOUS AFSK TONE KEYER. The Mark and Space channels are CONTINUOUSLY tuneable from 1200 to 3100 Hz. The internal RY GENERATOR and DUAL-MODE AUTOSTART (FSK or MARK) are standard, as are rear panel provisions for SIGNAL REGENERATION and SPEED CONVERSION peripherals.

MPC-1000CR
Signal Regeneration & Up-Down Speed Conversion
Amateur Net: $595.00

The MPC-1000CR combines all the features of the MPC-1000C with the TSR-200 SPEED CONVERTER-REGENERATOR. A front panel SIGNAL SPEED switch provides electronic "gear-shifting" between 60, 66, 75 and 100 WPM speeds. All incoming and outgoing signals are regenerated by a CMOS UART and a crystal-controlled DUAL-CLOCK to less than 0.5% bias distortion, providing an extremely low error-rate on weak and badly distorted signals.

MPC-1000R
Dual-Uart Regeneration, 200 Character Fifo Memory & Word Correction.
Amateur Net: $820.00

The MPC-1000R combines the features of the MPC-1000CR with the TSR-500 SPEED CONVERTER-REGENERATOR and offers 200 characters of FIFO MEMORY, a DUAL-UART REGENERATOR that also provides local copy during all PRELOAD-RECIRCULATE functions, a WORD CORRECTION circuit that permits an incorrect word to be erased from memory by depressing the local keyboard's BLANK key, VARIABLE CHARACTER RATE and automatic BLANK/LTRS DIDDLE. Character OVERRUN during down-speed conversion is prevented by an automatic CHARACTER RATE OVER-RIDE and TEE DEE INHIBIT circuit. Three preset AFSK TONE/SHIFT combinations are selectable from the front panel.

The MPC-1000R (80 characters of memory), MPC-1000CA (Tri-tone AFSK), MPC-1000CRA (Tri-tone Regenerator) and MPC-1000CS (Crypto-Scrambler) are also available.

Your QSL will bring complete specifications, or call: 213-682-3705.

DOVETRON
627 Fremont Ave.
(P. O. Box 267)
South Pasadena, Ca. 91030

D23

- CB
- CB standard
- 2 meter
- Scanners
- Amateur Bands
- General Communication
- Industry
- Marine UHF
- Micro processor crystals

easy to charge — master charge — BANKAMERICARD

JAN CRYSTALS

Send 10¢ for our latest catalog
Write or phone for more details

2400 Crystal Drive
Ft. Myers, Florida 33901
all phones (813) 936-2397

J2

HIGH PERFORMANCE SMOKE DETECTOR

FRAZER & ASSOCIATES

HIGH PERFORMANCE SMOKE DETECTOR NOW — at an Extraordinary $23.00 Savings. List price $49.95 our special sale price only $26.95 Postpaid to your door. The Case for home and office Smoke Detectors is overwhelming: (1) Fire Spreads 1100% in the first 4 minutes. (2) 74% of dwelling victims die upstairs from downstairs fires. (3) Most home fires start between midnight and 6 A.M. while the family sleeps. (4) Someone's home burns every 55 seconds. These and other facts are compelling millions of wise Americans to protect their families and homes against the horrible consequences of fire. Smoke Detectors are now required for all new residential occupancies. With UL Listed High Performance Detectors, you can comply. Free Catalog. HURRY — Supply limited. Frazer & Associates Consulting Engineers, 1888 Century Park East, Century City, CA 90067. F7

P.O. Box 4430M Santa Clara, CA 95054
(408) 988-1640

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

Quest ELECTRONICS

Q3

INTEGRATED CIRCUITS

[illegible]

Sinclair 3½ Digit Multimeter
Batt. oper. 1mV and .1NA resolution. Resistance to 20 meg. 1% accuracy. Small, portable, completely assem. in case. 1 yr. guarantee. Best value ever! **$59.95**

Not a Cheap Clock Kit $14.95
Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions. **Same clock kit with .80" displays. $21.95**

Digital Temperature Meter Kit
Indoor and outdoor. Automatically switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, air or liquid. Very accurate. Complete instructions. **$39.95**

Clock Calendar Kit $19.95
CT7015 direct drive chip displays date and time on .6" LEDS with AM-PM indicator. Alarm/doze feature includes buzzer. Complete with all parts, power supply and instructions, less case.

1977 IC Update Master Manual
Final 1977 closeout $15.00 while they last. 1978 Master available late Jan. 1978 **$30.00.** Complete IC data selector, 1234 pg. master ref. guide, 17,000 cross references. Free update for 1977. Domestic postage $2.00. Foreign $6.00

60 Hz Crystal Time Base Kit $4.75
Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

New Cosmac Super "ELF"
RCA CMOS expandable microcomputer w/HEX keypad input and video output for graphics. Just turn on and start loading your program using the resident monitor on ROM. Pushbutton selection of all four CPU modes. LED indicators of current CPU mode and four CPU states. Single step op. for program debug. Built in pwr. supply, 256 Bytes of RAM, audio amp. & spkr. Detailed assy. man. w/PC board & all parts. Comp. Kit **$106.95** Custom hardwood cab.; drilled front panel **19.75** Nicad Battery Backup Kit w/all parts **4.95** Fully wired and tested in cabinet **151.70** 1802 software xchng. club; write for info.

RCA Cosmac VIP Kit 275.00
Video computer with games and graphics.

Original Cosmac "ELF" kit
with PC board, monitor, power supply plus all parts and instructions. **$89.50**
Board only **14.95**

4½ Digit DMM kit $85.00
Volts—ohms—milliameter accuracy ±1 count. Ranges: Volts—2, 20, 200. Ohms—2K, 2meg, 20 meg. Ma—200, 2000. .4" display. Variable update rate. Comp. w/parts, PC boards, instructs., less case.

Paratronics 100A Logic Analyzer Kit $199.00
Converts an oscilloscope into a digital tester and analyzer. Trace computer program flow, monitor I/O sequences, etc. Trouble shoot all digital, CMOS and MOS families. 128 bit truth table (8 by 16 bits). Complete with case, parts and instructs. Model 10 Trigger Expander Kit expands Model 100A to 24 bits **$229.00.** Model 150 Bus Grabber Kit **$369.00,** a one board logic analyzer for S-100 bus applications. Instant access to 56 S-100 bus signals. Complete kit with all parts and instructs.

2.5 MHz Frequency Counter Kit
Complete kit less case **$37.50**

30 MHz Frequency Counter Kit
Complete kit less case **$47.75**
Prescaler Kit to 350 MHz **$19.95**

Stopwatch Kit $26.95
Full six digit battery operated. 2–5 volts. 3.2768 MHz crystal accuracy. Times to 59 min., 59 sec., 99 1/100 sec. Times std., split and Taylor. 7205 chip, all components minus case. Full instruc. White or black plexiglass case. **$5.00**

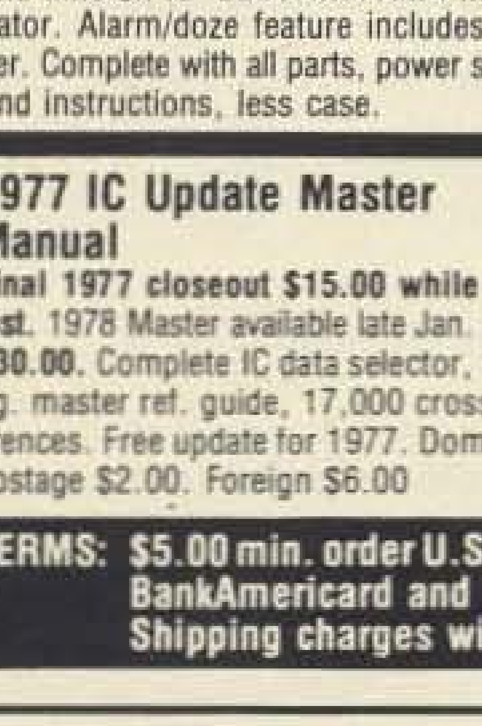
Auto Clock Kit $15.95
DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax. BankAmericard and Master Charge accepted. Shipping charges will be added on charge cards.

FREE: Send for your copy of our NEW 1978 QUEST CATALOG. Include 24¢ stamp.

NOT FOR EVERYONE . . .

ONLY *For The Purist*



- RUGGED
- Seven Elements
- Three Bands (10-15-20)
- Single Feed Line
- Flexible Tuning
- Close To Mono-Bander Specs With Optimum Spacing For: High Forward Gain High F:B & F:S Ratios

For Specifications Write To:

BROOKFIELD MANUFACTURING CO.
50 Whippoorwill Road
Bethel, CT 06801
(203) 792-8944

$269.95

B13

GILFER

G6

"NORTH AMERICA'S SHORTWAVE MAIL ORDER PLACE"

One-Stop Armchair Shopping For All SWL Needs

*Receivers — Drake, Yaesu — special mods for better performance *Frequency Readouts *Receiving Antennas *Antenna Tuners *Frequency Calibrators *Log Books *FM or TV Guides *QSL Albums *AM Pattern Maps *ITU Publications *QSL Address Books *Confidential Frequency List *Clocks *All SWL Books

The New 1978 32nd Edition WORLD RADIO TV HANDBOOK Is Ready!

Listen to the world with this comprehensive directory of stations at your side. Best there is! Only $11.95 ppd.

FREE SWL MINI-CATALOG

GILFER SHORTWAVE
Dept. 73-2, Box 239, Park Ridge, NJ 07656

INTRODUCING THE A.R.O. UNITY RING . . .

"An idea whose time has come." It's new. Personalized and one of a kind. Group III Sales has designed this beautiful 10 karat gold ring for you, the Amateur Radio Operator. Each ring is personalized with your call letters. Both sides are exquisitely handcrafted and display the symbols that are most meaningful to all amateurs. We invite you to QSL for full color brochure and complimentary ring sizer.

No Obligation

Group III Sales Co.
DEPT: 41 P.O. Box 259
Little Neck, N.Y. 11362

©Copyright 1977 G13 Patent Pending

Ring shown approximate actual size

NEW!
THE FUTURE NOW!
FM2015R

KDK

Does Your Unit Cover The New Sub-band 144.5 - 145.5 MHz? The FM2015R Does, PLUS MARS-CAP!*

All Solid State-CMOS PL digital synthesized - No Crystals to Buy! 5KHz steps - 144-149 MHz-LED digital readout PLUS MARS-CAP and MULTIPLE OFFSET.*

• 5 MHz Band Coverage - 1000 Channels (instead of the usual 2MHz to 4MHz-400 to 800 Channels) • 4 CHANNEL RAM IC MEMORY WITH SCANNING • MULTIPLE FREQUENCY OFFSETS • ELECTRONIC AUTO TUNING - TRANSMIT AND RECEIVE • INTERNAL MULTIPURPOSE TONE OSCILLATOR • RIT • DISCRIMINATOR METER - 15 Watts Output - Unequaled Receiver Sensitivity and Selectivity - 15 POLE FILTER, MONOLITHIC CRYSTAL FILTER AND AUTOMATIC TUNED RECEIVER FRONT END, COMPARE! • Superb Engineering and Superior Commercial Avionics Grade Quality and Construction Second to None at ANY PRICE.

FMMC-1* Microphone with Built-in Touch Tone Pad.

WHY BUY LESS? THE FMMC-1 HAS IT *ALL!*

- New! Auto key-up
- LED indicator
- Adj. level and tone balance
- Use with any transceiver
- Only 3-3/4" x 2"

$49.95

INTRODUCTORY PRICE

$399.00

Regulated AC/PS Model FMPS-4R . . . $49.00

- **FREQUENCY RANGE**: Receive and Transmit: 144.00 to 148.995 MHz, 5Khz steps (1000 channels) INCLUDING NEW BAND 144.5-145.5MHz + MARS-CAP and MULTIPLE OFFSET.*
- **LED DIGITAL READOUT.**
- **4 CHANNEL RAM SCANNER WITH IC MEMORY**: Program any 4 frequencies and reprogram at any time using the front panel controls—search for occupied (closed) channel or vacant (open) channels. Internal Ni-Cad included to retain memory (no diode matrix to wire or change).
- **MULTIPLE FREQUENCY OFFSETS**: Three positions A,B,C, provided for installation of optional crystals: EXAMPLE - 1 MHz offset. Duplex Frequency Offset Built in - 600 Khz PLUS or MINUS 5 KHz steps, plus simplex, any frequency.
- **INTERNAL MULTIPURPOSE TONE OSCILLATOR BUILT IN**: 1750Hz tone burst for "whistle on operation" and sub-audible tone operation possible by simply adding a capacitor across the terminals provided. Internal 2 position switch for automatic and manual operation, tone burst or sub audible tone PL - adjustable 60-203Hz (100 Hz provided).
- **AIRCRAFT TYPE FREQUENCY SELECTOR**: Large and small coaxially mounted knobs select 100KHz and 10KHz steps respectively. Switches click-stopped with a home position facilitate frequency changing without need to view LED's while driving and provides the sightless amateur with full Braille dial as standard equipment.
- **FULL AUTOMATIC TUNING OF RECEIVER FRONT END AND TRANSMITTER CIRCUITS**: DC output of PLL fed to varactor diodes in all front end RF tuned circuits provides full sensitivity and optimum intermodulation rejection over the entire band. APC (AUTO POWER CONTROL) - Keeps RF output constant from band edge to band edge. NO OTHER AMATEUR UNIT AT ANY PRICE has these features which are found in only the most sophisticated and expensive aircraft and commercial transceivers.
- **TRUE FM**: Not phase modulation - for superb emphasized hi-fi audio quality second to none.
- **RIT CONTROL**: Used to improve clarity when contacting stations with off frequency carrier.
- **MONITOR LAMPS**: 2 LED's on front panel indicate (1) incoming signal-channel busy, and (2) Transmit.
- **FULLY REGULATED INTEGRAL POWER SUPPLY**: Operating voltage for all 9v circuits independently regulated. Massive Commercial Hash Filter.
- **MODULAR COMMERCIAL GRADE CONSTRUCTION**: 6 Unitized modules eliminate stray coupling and facilitate ease of maintenance.
- **ACCESSORY SOCKET**: Fully wired for touch tone, phone patch, and other accessories. Internal switch connects receiver output to internal speaker when connector is not in use.
- **MULTI-PURPOSE METER**: Triple Function Meter Provides Discriminator Meter, "S" Reading on receive and Power Out on Transmit.
- **RECEIVE**: Better than .25uv sensitivity, 15 POLE FILTER as well as monolithic crystal filter and AUTOMATIC TUNED LC circuits provide superior skirt selectivity - COMPARE!
- **HIGH/LOW POWER OUTPUT**: 15 watts and 1 watt, switch selected. Low power may be adjusted anywhere between 1 and 15 watts. Fully protected-short or open SWR.
- **OTHER FEATURES**: Dynamic Microphone built in speaker, mobile mount, external 5 pin accessory jack, speaker jack, and much, much more. Size 2½ x 7 x 7½. All cords, plugs, fuses, microphone hanger, etc. included. Weight 5 lbs.

Manufactured by one of the world's most distinguished Avionics manufacturers, Kyokuto Denshi Kaisha, Ltd. First in the world with an all solid state 2 meter FM transceiver.

AMATEUR-WHOLESALE ELECTRONICS

master charge · your BANKAMERICARD welcome here

8817 S.W. 129th Terrace, Miami, Florida 33176
Telephone (305) 233-3631 • Telex: 51-5628
U.S. DISTRIBUTOR

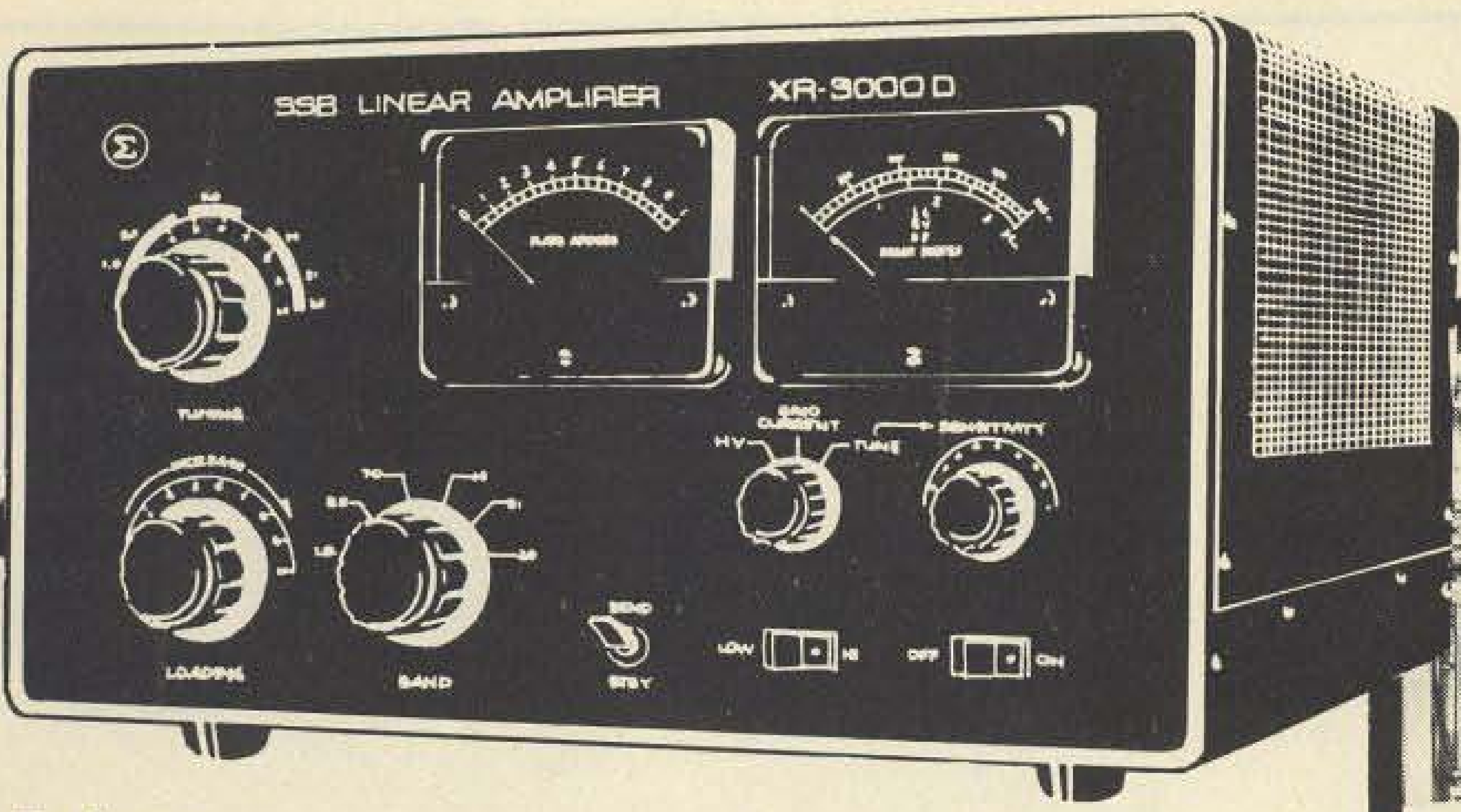
DEALER INQUIRIES INVITED.

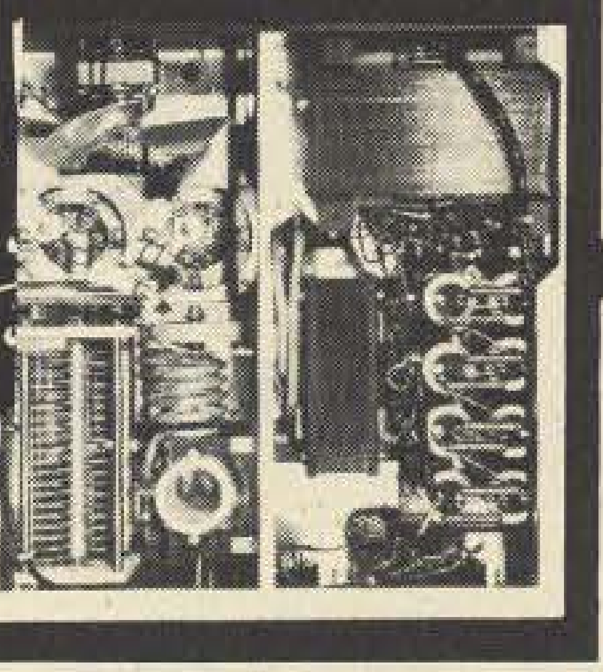
PLEASE ORDER FROM YOUR LOCAL DEALER OR DIRECT IF UNAVAILABLE.

Regional Sales & Service Centers:

West: The Radio Shop, Riverton, Utah, (801) 254-0991
Northeast: Buzzards Bay Electronics, Buzzards Bay, Mass, (617) 759-3376
East: Sanford Communications, Inc. Colonia, N.J. (201) 574-3003
Midwest: Universal Service, Columbus, Ohio, (614) 221-2335

The New Sigma XR3000D Linear Amplifier Compare!





INTRODUCTORY SALE

$699

2 Day Air Shipment
Anywhere in U.S.
Airport to Airport $35
Alaska and Hawaii Slightly Higher

Features:

Custom computer grade commercial components, capacitors, and tube sockets manufactured especially for high power use—heavy duty 10Kw silver plated ceramic band switches • Silver plated copper tubing tank coil • Huge 4" easy to read meters—measure plate current, high voltage, grid current, and relative RF output • Continuous duty power supply built in • State of the art zener diode standby and operating bias provides reduced idling current and greater output efficiency • Built in hum free DC heavy duty antenna change-over relays • AC input 110V or 220V AC, 50-60Hz • Tuned input circuits • ALC-rear panel connections for ALC output to exciter and for relay control • Double internal shielding of all RF enclosures • Heavy duty chassis and cabinet construction and much, much more.

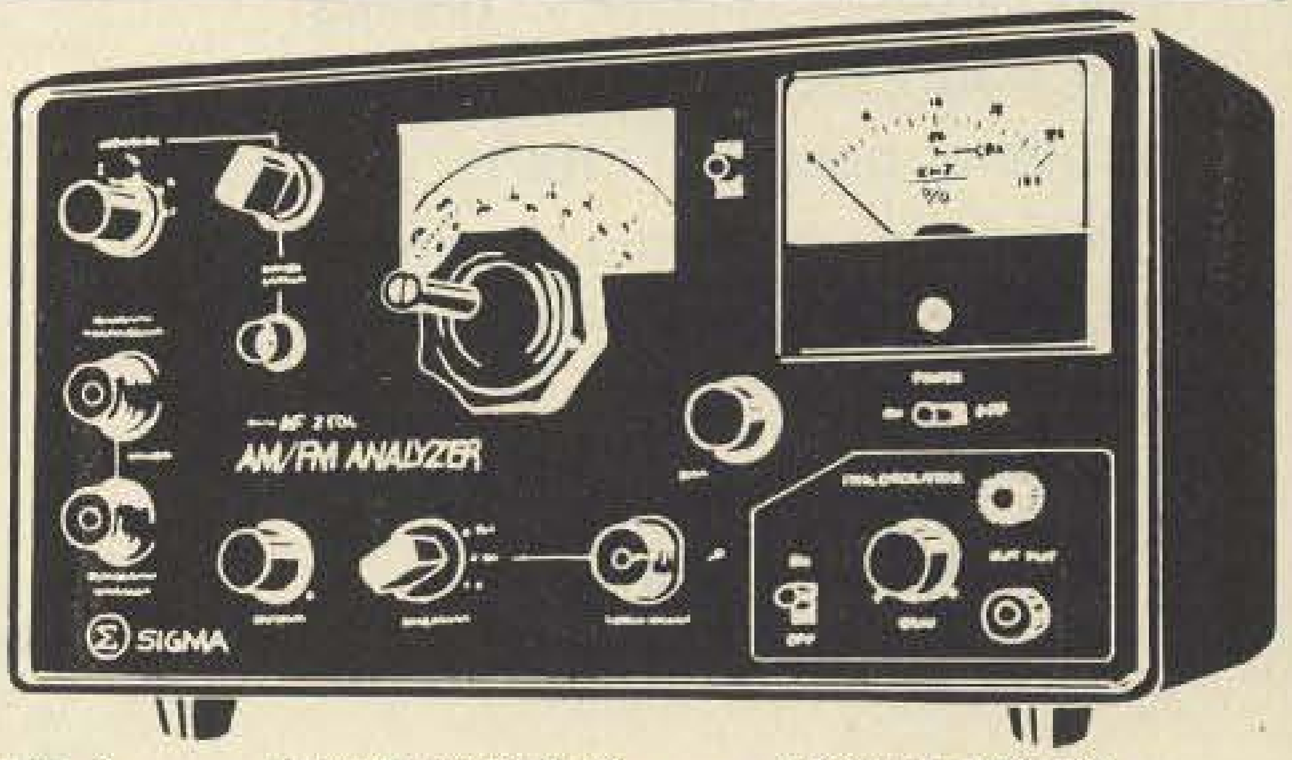
- Full band coverage 160-10 meters including mars.
- 2000 watts P.E.P. SSB input. 1000 watts input continuous duty, CW, RTTY & SSTV.
- Two Eimac 3-500Z conservatively rated finals.
- All major HV and other circuit components mounted on single G-10 glass plug in board. Have a service problem? (Very unlikely) Just unplug board and send to us.
- Heavy duty commercial grade quality and construction second to no other unit at any price!
- Weight: 90 lbs. Size: 9½" (h) x 16" (w) x 15¾" (d).

HOLIDAY INTRODUCTORY SPECIAL!

New! Sigma Model AF250L Deviation/Modulation Meter

INTRODUCTORY SALE

$169



Fully Certifiable for Commercial Use

Features:

Extremely stable local oscillator for easy measurement of HF, VHF, and UHF bands employing negative feedback to insure extremely high stability ● Easy to read, accurate linear scale ● **Direct off the air signal measurement capability.**

Specifications:

Frequency: 1.8MHZ-520MHZ/3 range select (A, B, C, EXT), A range: 26.5 MHZ-40MHZ, B range: 48MHZ-60MHZ, C range: 140MHZ-156MHZ, EXT. range: 1.8MHZ-520MHZ (Need Signal Generator) • Generous overranges • Input level: (1) Through type input level: IW-200W (RF Input Terminal) (2) Direct input level: More than 80db/50ohm impedance • Amplitude modulation degree: 0-100% • Frequency deviation: 0-20KHZ • Accuracy: +/-3% of full scale • Intermediate frequency: 10.7MHZ • Local input frequency (EXT Range) • Measuring frequency +/-10.7MHZ • RF Attenuator: 0-60db variable • Audio signal oscillator: (1) Audio Frequency—1,000HZ (1 KHZ), (2) Output level—More than 1V RMS • Power Source: AC117V • Dimensions: H-5½" (140mm), W-10¼" (260mm), D-7¼" (184mm) • Weight: 7 lbs.

SIGMA RF-2000 SWR & POWER METER

$29
Introductory Price

Shipping Anywhere - $1

Cal PWR Scales 200W-2000W Freq Range 3.5-150 MHz. Please do not confuse the RF2000 with similar appearing lower priced units. RF2000 is an individually calibrated professional quality instrument. Unequaled at many times the price. Size 7" (w) x 2 1/3" (d).

GO PRIVATE! on 2 meters with the FMTD-1*

SPECIAL INTRODUCTORY PRICE $75.00

Touch tone pad (encoder) actuated. Quiets your receiver until other station sends private 3 digit code, selected from front panel. 999 Channels. Receiver can be muted or opened manually or remotely with a touch tone pad. Bright led's indicate muting and reset. State of the art digital circuitry. Works with the KDK FM2015R or any 2-meter rig. 5 pin din plug supplied. Size 5½"D x 6½"W x 1"H. Wt. 12 oz.

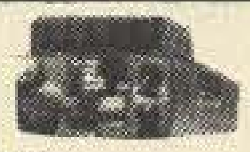
FM2015R Accessories — KDK

FMSS	SUPER SCANNER 1000 Total Scanning Capability	$99
FMPS-4R	Regulated AC/PS	$49
FMMC-1*	Microphone with Built-in Touch Tone Pad	$49.95
FMTD-1*	Private Call Decoder for use with and Programmed by any Touch Tone Pad	$75
MARS-CAP	and Multiple Offset Kit* - Any Frequency, Any Split, No Crystals	$5
FMAT-1	½ Wave Portable Antenna for Hotel, Motel or Apartment	$7.95
Extra DC Cord & Plug		$4.00
Service Manual		$4.00
Mounting Bracket (Extra)		$6.00

SPECIAL SALE FM144 Accessories

FMOF-1	Offset Option Kit - 2 Extra Positions, Crystals Required	$10
FMOF-2	1 MHz Offset Option Kit (No Crystals to Buy)	$10
MARS-CAP	Option Kit - Any Frequency Any Split	$12

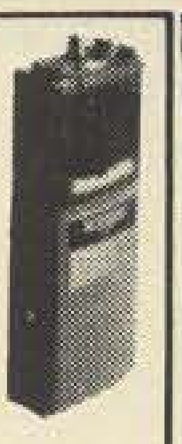
NEW!! ADD
5 CHANS (TOTAL 10)
TO SRC-146A



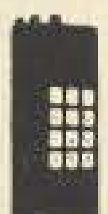
- Simple 10 min. installation
- Same color and quality as SRC-146A
- Completely WIRED & TESTED
- ALSO usable with most other hand helds

Price $29

Standard-New 2 Meter FM Transceivers Model SRC 146A Special Sale



SRC 146A	$314
4 Xtals 34/94 and 94/94	NC
USA 2 Deluxe Base Charger	$47
PT3644 Leather Case	$12
AT 19 Rubber Ant and Whip	$10
N1-cads	$30
Reg.	$413



NEW!!! Touch Tone pad completely wired and ready to plug in-$69.00

Our Price **$289**

COMPARE!

NEW! 6 METER FM50-10SXRII

REG $389 — SPECIAL SALE $289

51.00-53.995 MHz. 600 channels

NEW CDE HAM III ROTATORS—
Reg. $159.95—$125

AMATEUR-WHOLESALE ELECTRONICS

817 S.W. 129th Terrace, Miami, Florida 33176
COURTEOUS PERSONAL SERVICE—SAME DAY SHIPMENT • Prices subject to change without notice.
Telephone: (305) 233-3631 • Telex 51-5628 • Store Hours: 10-5 Mon.-Fri.   A21

BANKAMERICARD   master charge

Atlas 210X-215X and 350-XL
Please write for special bonus and package offers.

IC22S FREQUENCY DISPLAY KIT

Why squint at your channel selector or check charts to know where you are on the band?

- Shows the programmed frequency, tracks the simplex-duplex function
- Works with ANY external programming system, as well as the internal channel selector
- Full six digit display, not 3½ like the others
- No-hole mount — Small size (5.5wxl.2Hx2D) box mounts inconspicuously in the mobile, or under the radio as a stand
- Plugs into the 9 pin accessory socket, can be removed at any time
- Easy one night construction and installation, sockets provided for all ICs, very comprehensive instruction manual
- A perfect match for our scanner kit

COMPLETE KIT $59.95
CABINET EXTRA $8.05
PREASSEMBLED AND TESTED UNIT (CABINET INCLUDED) $89.95

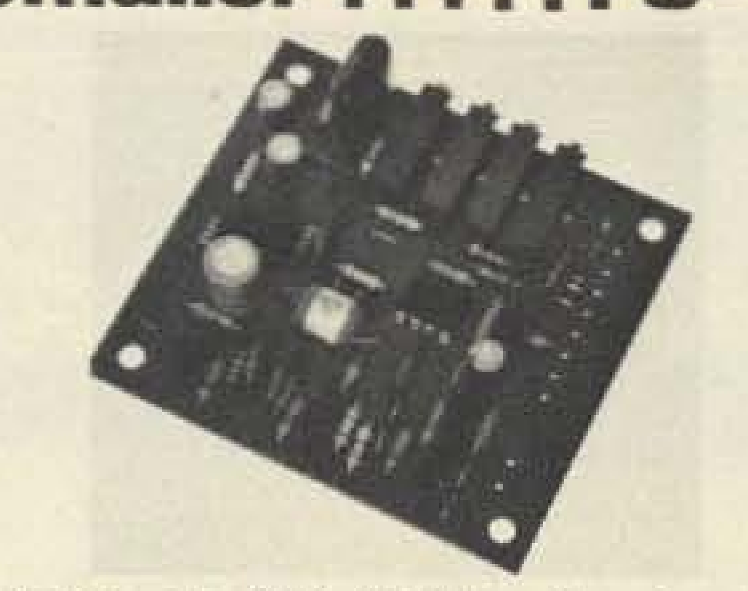
ADD 5% FOR POSTAGE AND HANDLING – DEALER INQUIRIES INVITED

V16

VE 2 AED ELECTRONICS

750 LUCERNE RD
SUITE 120
TEL. 514-737-7293
MONTREAL, QUEBEC
CANADA H3R 2H6

smaller FS-1



Audio Frequency Shift Oscillator with universal mounting allows adaptation to all units by wiring direct or by use of plug-in edge connector 170HZ or 850 HZ Shift.

$23.95 Kit — $34.95 Wired

FLESHER CORP.
P.O. Box 976
Topeka, Kansas 66601
(913) 234-0198

F5

VISA — master charge

IC22S OWNERS SCANNER KIT

- You don't need a digital readout to work anyone on the band and your scanner shouldn't cost almost as much as your rig
- Continuously scans 2m band from 145.35 – 147.975 in 15 kHz steps.
- LED indicator tells when rig is scanning
- Switch modification on mike allows you to scan past or lock on to any occupied frequency
- Memory circuit allows scanner to hold last frequency locked in for at least 2 hours after power is turned off
- Uses one matrix position leaving the other 21 usable for manual programming
- Complete kit with detailed instructions, installs inside rig, no obtrusive external connections, no drilling, rig could be returned to original condition if desired

COMPLETE KIT $29.95

PREASSEMBLED AND TESTED BOARD $39.95

ADD 5% FOR POSTAGE AND HANDLING – DEALER INQUIRIES INVITED

V16

VE 2 AED ELECTRONICS

750 LUCERNE RD
SUITE 120
TEL. 514-737-7293
MONTREAL, QUEBEC
CANADA H3R 2H6

THE PERSONAL COMMUNICATIONS FOUNDATION

Legal research for the amateur radio and citizens band services.

The Personal Communications Foundation is a non-profit, tax-exempt California corporation established in November, 1976. Its Board of Trustees, Officers and Advisors consist of lawyers, judges and law school professors with substantial experience in the representation of users who have encountered communications related legal problems.

The Foundation has been organized expressly for the purpose of creating a comprehensive personal communications law library. The Foundation continues to collect available court decisions, briefs and legal memoranda relating to personal communications.

The Foundation has already expended thousands of dollars in funding special studies. One study on the issue of Federal Pre-emption has been incorporated into a brief before the California Court of Appeals.

For information, write: PERSONAL COMMUNICATIONS FOUNDATION
10960 Wilshire Boulevard, Suite 1504
Los Angeles, California 90024
or call: (213) 478-1749

. . . at last . . . your shack organized!

A beautiful piece of furniture — your XYL will love it!

$139.95 S-F RADIO DESK

Deluxe - Ready to Assemble

Designed with **angled** rear shelf for your viewing comfort and ease of operation.

FINISHES: Walnut or Teak Stain.
Also available in Unfinished Birch, $124.95.

Additional Information on Request.

Checks, Money Orders, BankAmericard and Master Charge Accepted. S33

F.O.B. Culver City. (In Calif. Add 6% Sales Tax.)

S-F AMATEUR RADIO SERVICES
4384 KEYSTONE AVENUE • CULVER CITY, CALIF. 90230 — PHONE (213) 837-4870

ATTENTION GARY AND SABTRONIX OWNERS!

. . . .Come let us tweak your pots! If you just built the Gary Model 101 or the Sabtronix model 2000 we can calibrate it for you to factory specs.

We use custom built lab calibration equipment designed expressly for these meters. You get a professional job!

Sabtronix 2000 $24.95
Gary model 101 $10.95

Also add $3.95 per unit for special delicate equipment packing, insurance, and postage.

Send via Air Mail or Parcel Post to:

custom cal service
Gary McClellan and Co.
PO Box 2085
1001 W. Imperial Hwy.
La Habra CA 90631

G10

"The TOUCH" by Regency

- AUTOMATIC CONTINUOUS SEARCH!
- FIND "SECRET" FREQUENCIES
- SEVERE WEATHER ALERT!
- NEVER BUY CRYSTALS!
- PRIORITY CHANNEL!
- LO, HI, & UHF BANDS!
- SIXTEEN CHANNELS!
- 2 METERS & 450 MHz

$249 Shipped Prepaid in USA

Check with order MASTER CHARGE or VISA — sorry, no COD

Frequency Ranges
LOW VHF .... 30-50 MHz
HIGH VHF .... 146-174 MHz
UHF .... 440-512 MHz

Brynn Corporation 393 WEST STREET 603-352-8676
KEENE, NEW HAMPSHIRE 03431 B25

For once in your life...live.

A sleek graceful sailing vessel glides across the sometimes green, sometimes blue Caribbean. The cargo: you. And an intimate group of lively, fun-loving shipmates.

Uniform of the day: Shorts and tee shirts. Or your bikini if you want. And bare feet.

Mission: A leisurely cruise to remote islands with names like Martinique, Grenada, Antigua—those are the ones you've heard of. Before the cruise ends, you'll

know the names of many more. You'll know intimitely the enchanting different mood of each...and its own beauty and charm.

Life aboard your big sailing yacht is informal Relaxed. Romantic.

There's good food. And 'grog'. And a few pleasant comforts... but any resemblance to a plush pretentious resort hotel is accidental.

Spend 6 days exploring paradise.

Spend six nights watching the moon rise and getting to know interesting people. It could be the most meaningful experience of your life ...and it's easily the best vacation you've had.

A cruise is forming now. Your share from $290. Write Cap'n Mike for your free adventure booklet in full color.

Come on and live.

Windjammer Cruises.

W10

Name __________

Address __________

City __________ State __________ Zip __________

Phone __________

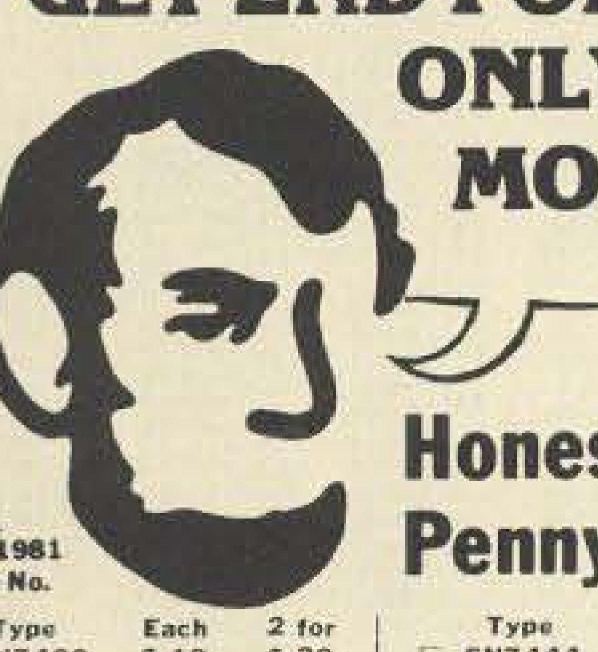
P.O. Box 122, Dept. 622 Miami Beach, Fl 33139

THIS SPECIAL ONE CENT SALE IS FOR MAGAZINE ADS ONLY

POLY PAKS® BIGGEST 1¢ GIVEAWAY SALE!

IT MAKES "CENTS" TO GIVE OUR CUSTOMERS THE BEST BARGAINS!

TTL'S, BUY ONE AT SALE PRICE, GET 2ND FOR ONLY 1¢ MORE



Honest Abe Penny Sale!

Order By Cat. No. 2A1981 & Type No.

Type	Each	2 for
SN7400	$.19	$.20
SN7401	.19	.20
SN7402	.35	.36
SN7403	.19	.20
SN7404	.25	.26
SN7405	.19	.20
SN7406	.19	.20
SN7408	.21	.22
SN7410	.19	.20
SN7413	.39	.40
SN7414	.65	.66
SN7416	.29	.30
SN7417	.35	.36
SN7420	.19	.20
SN7423	.29	.30
SN7426	.25	.26
SN7427	.25	.26
SN7430	.29	.30
SN7432	.25	.26
SN7437	.25	.26
SN7438	.29	.30
SN7440	.19	.20
SN7442	.69	.70
SN7443	.69	.70
SN7444	.65	.66
SN7445	.99	1.00
SN7446	1.35	1.36
SN7447	1.25	1.26
SN7448	1.35	1.36
SN7450	.19	.20
SN7451	.19	.20
SN7453	.19	.20
SN7454	.19	.20
SN7455	.19	.20
SN7460	.19	.20
SN7462	.19	.20
SN7464	.19	.20
SN7465	.19	.20
SN7470	.25	.26
SN7471	.25	.26
SN7472	.25	.26
SN7473	.55	.56
SN7474	.29	.30
SN7475	.79	.80
SN7476	.59	.60
SN7478	.59	.60
SN7480	.29	.30
SN7482	.39	.40
SN7483	.99	1.00
SN7485	1.49	1.50
SN7486	.39	.40
SN7488	1.95	1.96
SN7490	.69	.70
SN7491	.79	.80
SN7492	.45	.46
SN7493	.49	.50
SN7494	.69	.70
SN7495	.69	.70
SN7496	.69	.70
SN7498	.69	.70
SN74100	1.49	1.50
SN74107	.39	.40
SN74112	.25	.26
SN74113	.19	.20
SN74114	.25	.26
SN74121	.49	.50
SN74123	.69	.70
SN74125	.59	.60
SN74126	.39	.40
SN74132	1.25	1.26
SN74140	.99	1.00
SN74141	1.49	1.50
SN74145	1.25	1.26
SN74148	1.75	1.76
SN74150	.99	1.00
SN74151	.99	1.00
SN74153	.99	1.00
SN74154	1.75	1.76
SN74155	.79	.80
SN74156	.69	.70
SN74157	.99	1.00
SN74158	.99	1.00
SN74160	1.25	1.26
SN74161	1.25	1.26
SN74163	1.19	1.20
SN74164	.99	1.00
SN74165	1.25	1.26
SN74166	1.25	1.26
SN74173	1.25	1.26
SN74174	1.49	1.50
SN74175	.99	1.00
SN74177	.79	.80
SN74179	1.49	1.50
SN74180	.49	.50
SN74182	.69	.70
SN74190	1.49	1.50
SN74191	1.75	1.76
SN74192	.85	.86
SN74193	.85	.86
SN74194	1.25	1.26
SN74195	.49	.50
SN74197	.75	.76
SN74199	1.75	1.76
SN74200	5.50	5.51
SN74251	1.75	1.76
SN74284	4.50	4.51
SN74285	4.25	4.26

POP-AMPS AT "CENT-CIBLE" PRICES

Buy ONE At Sale Price, Get 2ND For Only 1¢ More - Order By Type No.

Type	Each	2 for
LM300H	$.49	$.50
LM301H-V	.45	.46
LM307V-N	.45	.46
LM308V-H	.79	.80
LM309K	1.79	1.80
LM311H-V	.79	.80
LM318V	1.29	1.30
LM320H-5, 12, 15	1.19	1.20
LM320K-12, 15	1.19	1.20
LM320T-6, 15, 24	1.19	1.20
LM322N	1.19	1.20
LM324N	1.75	1.76
LM339N	1.09	1.10
LM340K-5, 6, 8, 12, 15, 18, 24V	1.19	1.20
LM340T-5, 6, 8, 12, 15, 18, 24	1.19	1.20
LM350N	.59	.60
LM370N-H	1.29	1.30
LM374H	1.79	1.80
LM376V	.29	.30
LM377N	2.25	2.26
LM379	7.95	7.96
LM381N	1.69	1.70
LM387V	1.19	1.20
LM531H	1.49	1.50
LM532H-N	.29	.30
LM555V	.75	.76
LM558V	.79	.80
LM561N	1.00	1.01
LM565N	.99	1.00
LM567V	1.95	1.96
LM703H	.49	.50
LM704H	.29	.30
LM709N-H	.25	.26
LM710N	.39	.40
LM733N	.79	.80
LM739N	.89	.90
LM741V-N-H	.29	.30
LM1304	.79	.80
LM1310	.99	1.00
LM1312	1.99	2.00
LM1414V	.79	.80
LM1458V	.69	.70
LM1800N	.99	1.00
LM3028H	.65	.66
LM3900N	.49	.50
LM3909V	1.75	1.76
LM4195	1.95	1.96
LM4250	1.19	1.20
LM75451	.39	.40
LM75453	.39	.40
LM75491	.79	.80
LM75492	.79	.80
LM75494	.59	.60
PA239	1.29	1.30
PA263	1.50	1.51

PENNY SALE PRICES LISTED ARE GOOD TILL MAR. 15, 1978
WE RESERVE THE RIGHT TO LIMIT QUANTITIES!!!!!!

WOW! MORE 'PENNY SALE' ITEMS!

TRANSFORMER PENNY SALE!

BUY ONE AT SALE PRICE, 2ND FOR ONLY 1¢ MORE

• 110VAC Primaries

Cat. No.	Output V.	Amps	Misc.	Sale Each	1¢ Sale 2 for
2A3399	6.3V	500ma	Metal encased	$1.98	$1.99
2A3814	6.3V	1A	Open frame	$2.49	$2.50
2A3412	12V	300ma	Open frame	$1.95	$1.96
2A4029	12V	1A	Open frame	$2.49	$2.50
2A4028	12V	1A	Metal encased	$2.95	$2.96
2A3323	24VCT	300ma	Open frame	$1.95	$1.96
2A3937	24V	1A	Open frame	$1.95	$1.96
2A2773	48VCT	2A	Metal encased	$2.95	$2.96
2A3875	110V	300ma	Isolation	$1.19	$1.20

1N4000 Epoxy Rectifiers PENNY SALE!

• Miniature!
• 1.5 Amp!

Order by Cat. No. and Type No.

Cat. No.	Type No.	PIV	Sale	1¢ Sale
2A2377	1N4001	50	10 for $.65	20 for $.66
2A2378	1N4002	100	10 for .75	20 for .76
2A2379	1N4003	200	10 for .85	20 for .86
2A2380	1N4004	400	10 for .99	20 for 1.00
2A2381	1N4005	600	10 for 1.29	20 for 1.30
2A2382	1N4006	800	10 for 1.39	20 for 1.40

DIP SWITCHES

BUY ONE AT SALE PRICE, 2ND FOR ONLY 1¢ MORE!

Cat. No.	Switches	Sale Each	2 for
2A3668	2	$.77	$.78
2A3669	3	.88	.89
2A3021	4	.99	1.00
2A3670	5	1.19	1.20
2A3671	6	1.29	1.30
2A2677	7	1.79	1.80

2-Amp Epoxy Bridge Rectifiers

PENNY SALE! BUY ONE AT SALE PRICE, GET 2ND FOR ONLY 1¢ MORE

• Full Wave! • TO-5 case!

Order by Cat. No. 2A1346 and PIV

PIV	Sale Each	1¢ Sale 2 for
50	$.59	$.60
100	.69	.70
200	.79	.80
400	.89	.90
600	.99	1.00
800	1.19	1.20
1000	1.29	1.30

MICROPROCESSORS! MEMORIES SUPPORT!

Order By Cat. No. 2A3459 & Type No.

Type	Sale
MC6800L	$24.95
8080A	14.95
8008	9.95
1101	.69
1103	1.29
1702A	5.95
2102-L1	1.69
2111	5.95
2112	2.49
2708	19.95
MK4200P11	3.95
MM5202	6.95
MM5203	8.95
MM5260	.99
MM5262	.99
8212	3.95
8216	3.95
8224	4.95
8228	9.95
8251	11.50
8255	11.95

3/8"Sq. POTENTIOMETERS PENNY SALE!

SPECTROL 'SKINNY-TRIMS'

☐ 2A3863 25 Turn upright, type 64
☐ 2A3864 25 Turn flat, type 64
☐ 2A3866 Single turn flat, type 63

3/8" square, Screwdriver shaft, 20% tolerance, 1/2 watt, Cermet construction, PC-leads, Order by Cat. No. and Value.

Choose any 2 for 70¢ $.69 each

OHMS: 10 **, 20 **, 50 **, 100 *, 200 *, 500 *, 1K *, 2K *, 5K *, 10K *, 20K *, 50K **, 100K **, 200K **, 500K **, 1 Meg**

*Available in all types
**Available in Cat. No. 2A3863 only.

1st Time Offered! It's Different! It's Inflation Fighting! New!

KIT KING®

KITS BY POLY PAKS®

SUPER ECONO KITS

ONLY $1.98 BUY 10 KITS & CHOOSE 11TH FREE!

* MONEY BACK GUARANTEE * AVG WT. 6 OZS.

Quantity Description (Order by Cat. No., see paranthesis) Sale

☐ 10—CALCULATOR KEYBOARDS, up to 20 keys (2A1524) $1.98
☐ 8—LINE CORDS, 8-ft. lg, twin #18 wire, plug (2A3843) 1.98
☐ 30—NEON LAMPS, NE-2 style, red glow, leads (2A2613) 1.98
☐ 3—1702A ROMS, factory fallouts, hobby, useable (2A3729) 1.98
☐ 40-FT SHIELD CABLE, 1-cond.-n-shield, #22 wire, vinyl jack (2A3577) 1.98
☐ 50—TRANSISTOR ELECTRO'S, asstd values, uprites, axials (2A2747) 1.98
☐ 3—SOUND TRIGGERS, handclap triggers scr, w/amp (2A3625) 1.98
☐ 8—IC SOCKETS, incl. 4-14's and 4-18's, low prof (2A3621) 1.98
☐ 15—6V TEST INDICATORS, w/leads, grain-o-wheat (2A1526) 1.98
☐ 3—GLOW'N PANELS, 3x1", 110vac, glow-n-dark, green (2A3650) 1.98
☐ 400 PARTS ON A BOARD, greatest asst on p.c. boards (2A3401) 1.98
☐ 150—METAL FILM RESISTORS, 1/4 watts, color-coded, leads (2A3413) 1.98
☐ 15—JUMBO "LEDS" RED, prime, leads, like MV5054 (2A3369) 1.98
☐ 30—MINI TRIM POTS, to 1 meg, 1 turn, 1/4W (2A3345) 1.98
☐ 10—VOLTAGE REGULATORS, TO-3 case, 309K etc. hobby (2A3330) 1.98
☐ 30—PANEL SWITCHES, rotaries, slide, mod, 110vac, etc. (2A3268) 1.98
☐ 200-PC. RESISTOR SPECIAL, 1/4 to 2W, metal, carbon (2A3054) 1.98
☐ 40—AXIAL ELECTRO'S, asstd values to 100 mf, volts (2A3227) 1.98
☐ 40—UPRIGHT ELECTRO'S, asstd volts, values to 110mf (2A3226) 1.98
☐ 150—MOLEX SOCKETS, pins fit all ic's, most pop'lr (2A3144) 1.98
☐ 100—TERMINAL STRIPS, tie, to 8 lugs, for solder (2A3136) 1.98
☐ 15—SLIDE CONTROLS, asst values, vol, trble, bass, etc. (2A3057) 1.98
☐ 10—PHOTO ELECTRIC CELLS, CDS pancake styles, asst (2A3052) 1.98
☐ 200—HALF WATTERS, color coded, carbon, prec, metal (2A3046) 1.98
☐ 100—NATIONAL IC BONANZA, linears, 7400's, roms, clocks, untested (2A2860) 1.98
☐ 40—HOBBY LEDS, asst shapes, red, untested mostly useable (2A2859) 1.98
☐ 15—LM340T VOLTAGE REGS hobby, useable 5 to 24V, TO-220 (2A2635) 1.98
☐ 100—CAPACITOR SPECIAL, poly's, dips, molded, mica, discs (2A2735) 1.98
☐ 100—TWO WATTERS, carbon, metal, prec, etc, marked, leads (2A2735) 1.98
☐ 100—POLYSTYRENE CAPS, asst values, voltages, hi-Q (2A2729) 1.98
☐ 30—SLIDE SWITCHES, spst to dpdt, many types (2A2726) 1.98
☐ 15—NPN POWER TRANSISTORS, TO-3 2N3055 rejects, useable (2A2617) 1.98
☐ 200—PRE-FORMED RESISTORS, color-coded, p.c. work, asst values (2A2609) 1.98
☐ 100—PLASTIC TRANSISTORS, TO-92, asst values, mostly useable (2A2604) 1.98
☐ 100—DISC CAPS, npo's, N750, long leads (2A2598) 1.98
☐ 60—DIPPED MYLAR CAPS, asst values & voltages, finest (2A2597) 1.98
☐ 200—PRECISION RESISTORS, 1%, 1/4 to 2, marked, leads (2A2428) 1.98
☐ 30—VOLUME CONTROLS, single, doubles, asst shafts values (2A2421 .... 1.98
☐ 150—SWITCHING DIODES, 1N4148, most pop'lr, mostly good (2A2418) 1.98
☐ 75—SN7400 IC's, marked, mostly useable, wide asst of SN#'s (2A2415) 1.98
☐ 100—1N4000 RECTIFIERS, 1 amp, sil, most pop, asst. mostly good (2A2417) 1.98

"KIT KING" $1.19 KITS - "The Econo's"

BUY 5 KITS — CHOOSE THE 6TH FREE! MONEY BACK GUARANTEE!

Quantity Description (Order by Cat. No., see paranthesis) Sale

☐ 30—RADIO-N-TV KNOBS, asst sizes, colors, shapes (2A217) $1.19
☐ 10—PRS PHONO PLUGS-N-JACKS, RCA style, 10 plugs, 10 jacks (2A35-402) 1.19
☐ 35—DIPPED SILVER MICA CAPS, includes rect types too, asst (2A455) 1.19
☐ 75—PREFORMED DISC CAPS, for p.c. use, asst values, up to 2KV (2A1219) 1.19
☐ 10—NE-2's WITH RESISTOR, for 110vac use, neon, leads (2A1222) 1.19
☐ 12—TO-5 HEAT SINKS, for TO-5 metal & plastic transistors, fin type (2A1832) 1.19
☐ 12—TRANSISTOR SOCKETS, asst styles for NPN n PNP types (2A1905) 1.19
☐ 20—THERMISTORS, a resistor that changes with temp, protects! (2A2048) 1.19
☐ 40—INSULATED RF CHOKES, resistor n sq. styles, coded (2A3203) 1.19
☐ 30—WIRE NUTS, ties, 2 bare ended wires together (2A3724) 1.19
☐ 3—BLANK PC BOARDS, 4x6's, double sided, G-10 (2A3833) 1.19
☐ 2—BLANK PC BOARDS, 6x6's, double sided, G-10 (2A3824) 1.19
☐ 10—OPEN FACE READOUTS, singles, doubles, some missing segs (2A3952) 1.19
☐ 3—"PIGGY-BACK" IC SOCKETS, will hold 2-14 pin IC's-on-a-slab (2A3486) 1.19
☐ FIBER OPTIC LIGHT PIPE, 12" long highly polished ends, vinyl jack (2A2693) 1.19
☐ 4—FERRITE "STICK" ANTENNA, 7"x1/2", HH Scott, Fisher hi-fi eqpt (2A3400) 1.19
☐ 60—TUBULAR CAPS, asst molded, plastic, mylar, values, volts (2A219) 1.19
☐ 55—LOW NOISE RESISTORS, for hi-fi, metal films 5% 1/4 to 2W (2A220) 1.19
☐ 50—POWER RESISTORS, wirewound, vit, sq, up 25 w. asst (2A228) 1.19
☐ 60—COILS AND CHOKES, r-f, ant, parasitic, i-f, etc. (2A297) 1.19
☐ 75—HALF WATTERS, resistors, color-coded, carbo-film, most pop (2A454) 1.19
☐ 10—SOLAR CHIPS, silicon, "broken energy", each chip 0.5v. asst mils (2A5083) 1.19

Low Power ICs

Order By Cat. No. 2A3667 & Type No.

Type	Sale
74LS00	$.32
74LS02	.32
74LS04	.35
74LS08	.32
74LS10	.32
74LS11	.32
74LS13	.64
74LS20	.32
74LS21	.32
74LS22	.32
74LS27	.39
74LS30	.32
74LS32	.39
74LS37	.45
74LS38	.45
74LS42	1.19
74LS47	.99
74LS74	.49
74LS90	.89
74LS92	.89
74LS93	.89
74LS109	.58
74LS112	.58
74LS113	.58
74LS114	.49
74LS132	1.19
74LS138	1.24
74LS139	1.24
74LS151	1.25
74LS153	1.25
74LS155	1.25
74LS160	1.47
74LS161	1.47
74LS162	1.47
74LS163	1.47
74LS168	1.68
74LS169	1.68
74LS173	1.68
74LS174	1.05
74LS190	1.77
74LS191	1.75
74LS192	1.75
74LS193	1.75
74LS195	1.25
74LS197	1.25
74LS257	1.35
74LS266	.54
74LS366	.66
74LS368	.69
74LS390	2.95

C-MOS

Order By Cat. No. 2R2320 & Type No.

Type	Sale
CD4000	$.29
CD4001	.29
CD4002	.29
CD4006	1.19
CD4007	.29
CD4008	.79
CD4009	.59
CD4010	.59
CD4011	.29
CD4012	.29
CD4013	.69
CD4015	1.19
CD4016	.49
CD4017	1.19
CD4018	1.19
CD4019	.49
CD4020	.99
CD4021	1.29
CD4022	1.19
CD4023	.29
CD4024	.79
CD4025	.34
CD4027	.69
CD4028	.89
CD4029	1.19
CD4030	.49
CD4033	1.60
CD4035	.99
CD4040	1.19
CD4041	1.25
CD4042	.88
CD4046	1.79
CD4049	.49
CD4066	.79
CD4071	.29

FREE! DOUBLE BONUS

CHOOSE ANY $1.19 ITEM, PLUS OUR $25* SURPRIZE PAK FREE

GET BOTH ITEMS FREE WITH ANY $15 ORDER!

*We think, add 25c for handling!

Send for your FREE POLY PAKS CATALOG

FEATURING THE WORLD'S

BEST BARGAINS

IN ELECTRONICS

Terms: Add postage Rated: net 30
Phone: Wakefield, Mass. (617) 245-3829
Retail: 16-18 Del Carmine St., Wakefield.

MINIMUM ORDER — $6.00

POLY PAKS®

C.O.D.'s MAY BE PHONED

P.O. BOX 942 A
LYNNFIELD, MA.

Expedition 'round the world

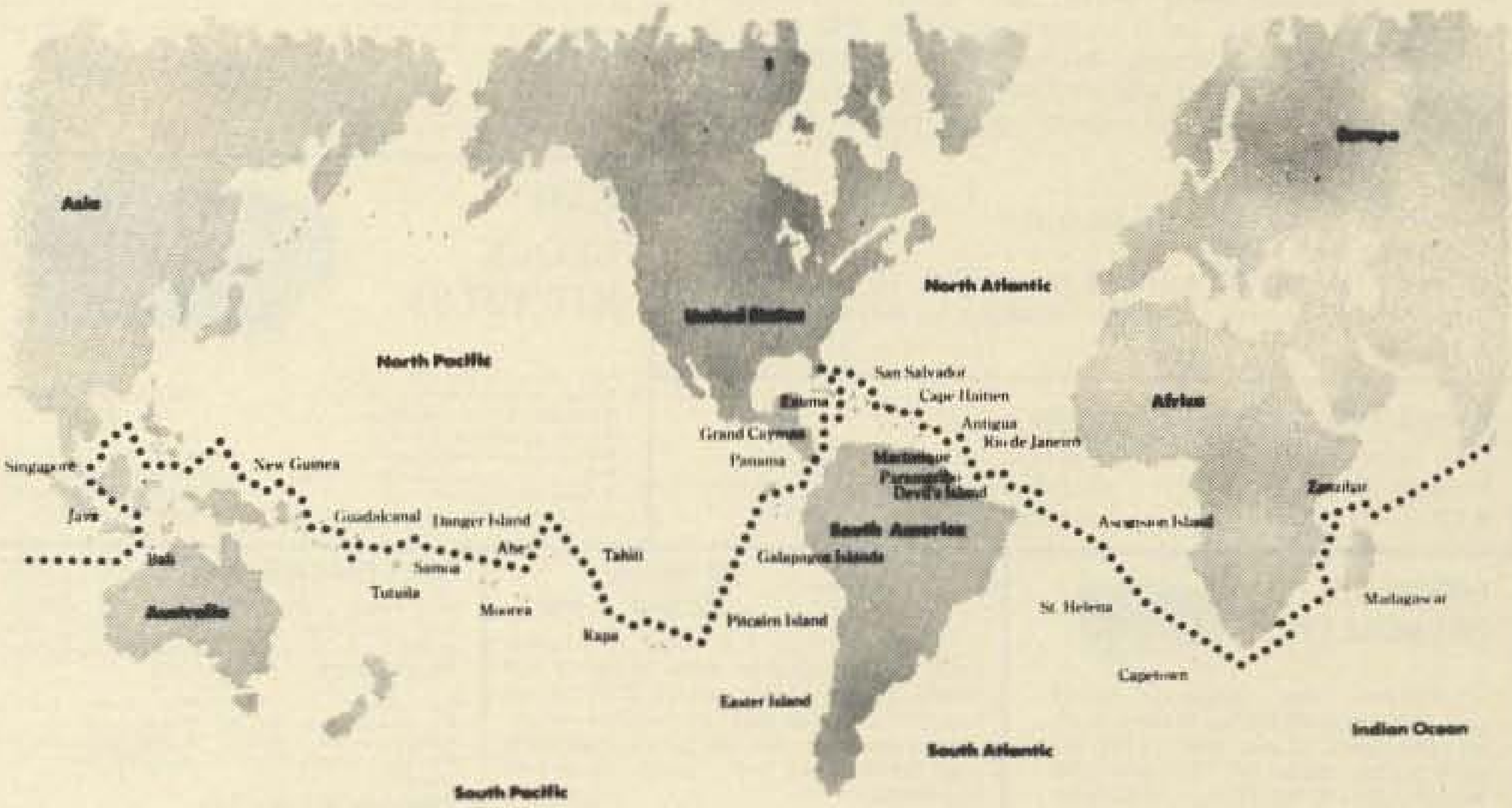
Meet adventure head on. Shipmates wanted who yearn to achieve for themselves rather than be pampered aboard plush, pretentious cruise ships. Share this adventure with a small congenial group in a highly informal atmosphere without regimentation or timetable. In this age of luxury and self-indulgence our expedition offers a unique, exciting opportunity.

YANKEE TRADER
(Famous oceanographic vessel)
Length 180. Beam 31.5, 1106 tons

9 MONTHS — SHARE EXPENSES

Ports of call

Cape Haitien. San Salvador. Panama. Pitcairn Island. Easter Island. Rapa. Tahiti. Ahe. Moorea. Galapagos. Samoa. Tutuila. Danger Island. Guadacanal. Tulagi. Bali. New Guinea. Java. Madagascar. Zanzibar. Beira. Capetown. St. Helena. Ascension Island. Rio. Devil's Island. Paramariba. Martinique. Antigua. Exuma. Nassau.



Please send me your free 'round the world expedition booklet.

Name ____________________

Address ____________________

City ____________________

State ____________ Zip ____________

P. O. Box 120, Dept. RW
Miami Beach, Florida 33139

Windjammer Cruises.

NEW

Frequency Counter

$79.95 kit

UTILIZES NEW MOS-LSI CIRCUITRY

You've requested it, and now it's here! The CT-50 frequency counter kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 V dc as it does on 110 V ac. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $79.95. Order yours today!

CT-50, 60 MHz counter kit $79.95
CT-50 WT, 60 MHz counter, wired and tested 159.95
CT-600, 600 MHz prescaler option for CT-50, add 29.95

SPECIFICATIONS

Sensitivity: less than 25 mv.
Frequency range: 5 Hz to 60 MHz, typically 65 MHz
Gatetime: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 10 ppm, .001 ppm with TV time base!
Input: BNC, 1 megohm direct, 50 Ohm with prescale option
Power: 110 V ac 5 Watts or 12 V dc @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case

Color burst adapter for .001 ppm accuracy

CB-1, kit $14.95

CLOCK KIT
6 digit 12/24 hour

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits, Polaroid lens filter, extruded aluminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour. assembly time. Colors: silver, gold, black, bronze, blue (specify).

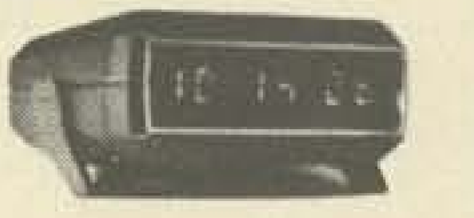
Clock kit, DC-5 .... $22.95
Alarm clock, DC-8, 12 hr only 24.95
Mobile clock, DC-7 .... 25.95
Clock kit with 10 min ID timer, DC-10 ... 25.95
Assembled and tested clocks available, add $10.00

VIDEO TERMINAL KIT $149.95

A compact 5 x 10-inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard operated cursor and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block-type see-thru cursor, Keyboard/computer control backspaces, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit	$149.95
TH3216, Assembled and Tested	239.95
VD-1, Video to RF Modulator Kit	6.95

CAR CLOCK KIT $27.95



12/24-Hour 12-Volt AC or DC
- High Accuracy (1 minute/month)
- 6 jumbo .4" LED readouts
- Easy, no-polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super instructions

Complete Kit, DC-11 $27.95

AUTO-DIMMER $2.50

Automatically adjusts display brightness according to ambient light level. For DC-11 Car Clock.

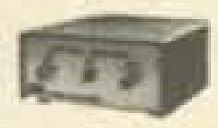
CHEAP CLOCK KIT $8.95

DC-4 Features:
- 6 digit .4" LED
- 12 or 24 format

Does not include board or transformer

PC Board $2.95
Transformer $1.49

600 MHz PRESCALER



Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. Specify ÷10 or ÷100

Wired, tested, PS-1B $59.95
Kit, PS-1B $44.95

30 watt 2 meter Power Amp

The famous RE class C power amp now available mail order! Four Watts in for 30 Watts out, 2 in for 15 out, 1 in for 8 out, incredible value, complete with all parts, instructions and details on T-R relay. Case not included.

Complete Kit, PA-1 .... $22.95

CALENDAR ALARM CLOCK

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car!

FEATURES:
- 6 Digits, .5" High LED
- 12/24 Hour Format
- Calendar shows mo./day
- Snooze button
- True 24 Hour Alarm
- 7001 chip does all!!
- Battery back up with built in on chip time base

Complete Kit, less case, DC-9 .... $34.95

		LINEAR		REGULATOR		TRANSISTORS	
5314 Clock	$2.95	555	$ .50	78MG	$1.49	MRF-238 30W VHF	$11.95
74S00	.35	556	.75	309k	.89	NPN 2N3904 type	10/$1.00
74S112	.75	566	1.49	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.49	340K-12	.99	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.89	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.89	FET MPF-102 type	3/$2.00
7490A	.55	75491	.50	7815	.89	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.89	2N3055 NPN Power	.75

SPECIAL

DIODES: 1KV,2.5A .... 5/$1.00 100V,1A .... 10/$1.00 1N914A type .... 50/$2.00

LED DISPLAYS

FND 359 ...... .75
FND 510 ...... 1.25
DL 707 .... 1.25
HP 7730 ...... 1.25
Red Polaroid Filter ... 4.25" X 1.125" ... .59

741 OP-AMP SPECIAL

Factory prime mini dip with both Xerox and 741 part numbers

10 for $2.00

SOCKETS

14 PIN	5/$1.00
16 PIN	5/$1.00
24 PIN	2/$1.00
40 PIN	3/$2.00

FERRITE BEADS

with info and specs
15/$1.00
6 hole Balun Beads
5/$1.00

MINI-KITS

TONE DECODER KIT

A complete tone decoder on a single PC Board. Features: 400-5000 Hz adjustable frequency range, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.

Complete Kit, TD-1 .... $4.95

SUPER-SNOOP AMPLIFIER

A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.

Complete Kit, BN-9 .... $4.95

FM WIRELESS MIKE KIT

Transmit up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9 V. Type FM-2 has added super sensitive mike preamp.

FM-1 ...... $2.95 FM-2 ...... $4.95

COLOR ORGAN/MUSIC LIGHTS

See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.

Complete Kit, ML-1 .... $7.95

LED BLINKY KIT

A great attention getter which alternately flashes 2 Jumbo LEDs. Use for name badges, buttons, or warning type panel lights. Runs on 3 to 9 volts.

Complete Kit $2.95

POWER SUPPLY KIT

Complete triple regulated power supply provides variable ±15 volts at 200 mA and +5 volts at 1 Amp. 50 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8 V at 1 Amp and 18 to 30 VCT.

Complete Kit, PS-3LT $6.95

SIREN KIT

Produces upward and downward wail characteristic of police siren. 5 watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.

Complete Kit, SM-3 .... $2.95

DECADE COUNTER PARTS

Includes: 7490A, 7475, 7447, LED readout, current limit resistors, and instructions on an easy to build low cost frequency counter.

Kit of parts, DCU-1 .... $3.50

ramsey electronics
P.O. Box 4072 Rochester NY 14610
(716) 271-6487

TELEPHONE ORDERS WELCOME

master charge
BANKAMERICARD

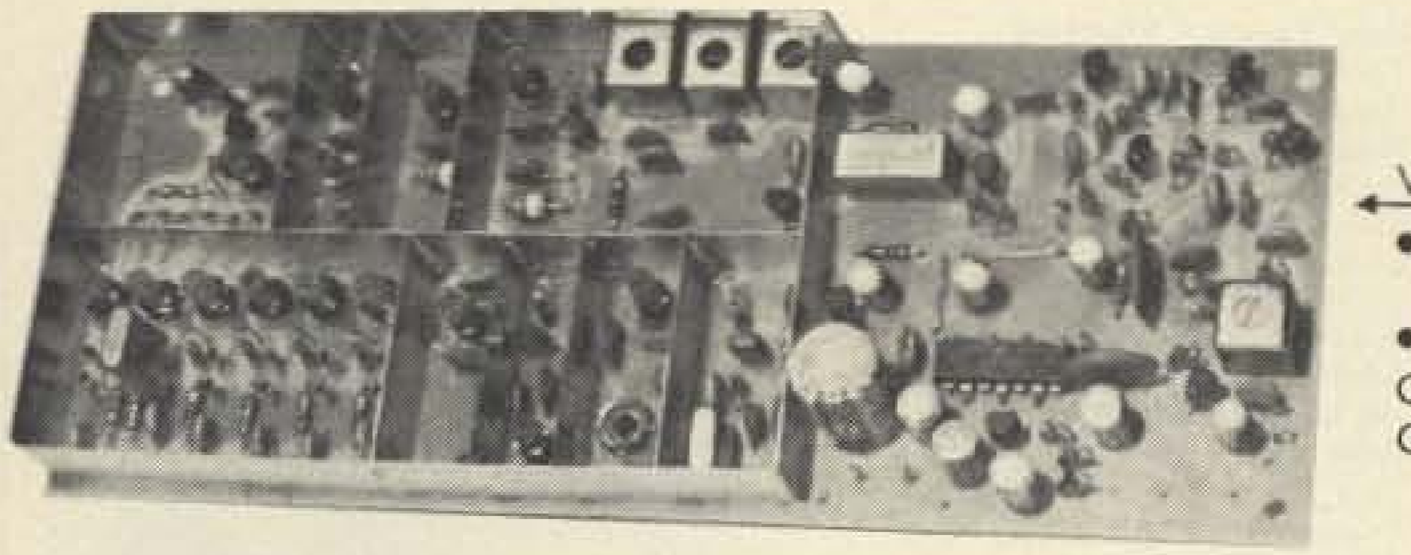
Satisfaction guaranteed or money refunded. COD, add $1.00. Orders under $10.00 add $.75. NY residents add 7% tax.

ANNOUNCING--A New Generation of VHF/UHF FM RECEIVER KITS

More Sensitive, More Selective, Easier to Build, Smaller Than Ever Before!

CHECK THESE FEATURES-

- Lower system cost than ever before
- Better selectivity, 70-80 dB adjacent channel, over 100 dB with crystal filter option
- Six channels at no extra cost
- 60 dB image rejection
- Latest design — new easy-to-wind high Q coils, compartmentized shielding
- Easy to build, test circuits on board allow tune up with only sig gen & vtvm



VHF MODEL R70 $69.95

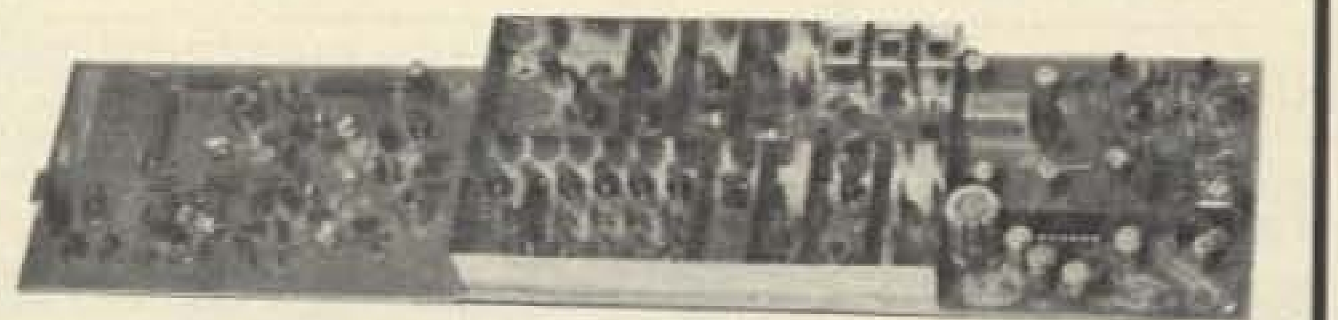
- Available for 2M, 6M, 10M, 220 MHz, or com'l bands
- Sensitivity 0.4uV for 20 dB

Optional Crystal Filter Kit $10
Channel Crystals $5.95 ea

UHF MODEL R90 $89.95

- For any 2 MHz segment of the 380-520 MHz range
- Sensitivity 0.8uV

Optional crystal filter kit $10
Channel crystals $5.95 ea



These new CONVERTER KITS

let you receive OSCAR signals and other exciting VHF & UHF activity on your present HF receiver.

either one
ONLY $34.95
including crystal

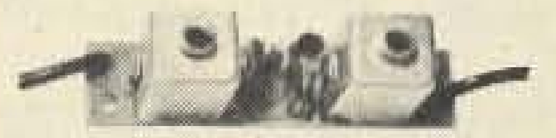
MODEL	RF RANGE (MHZ)	IF RANGE
C50	50-52	28-30
C144	144-146	28-30
C145	145-147	28-30
C146	146-148	28-30
C220	p/o 220-230	28-30
Special	Other rf & i-f ranges are available on special request	

MODEL	RF RANGE (MHZ)	IF RANGE
C432-2	432-434	28-30
C432-5	435-437	28-30
C432-9	439.25 (ATV)	61.25
Special	Other rf & i-f ranges are available on special request	

An extruded aluminum case is available for vhf and uhf converters at $12.95, including connectors and hardware.

These low noise PREAMPS let you hear the weak ones!

Great for OSCAR, SSB, FM, ATV. Over 8000 in use throughout the world.



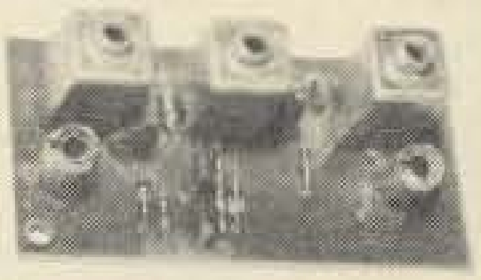
P8 KIT $10.95
P16 Wired $21.95
Miniature model for tight spaces - only 1/2 x 2-3/8 inches

- 20dB gain
- Covers any 4 MHz band in range

MODEL	RANGE
P8-LO	20-83 MHz
P8-HI	83-190 MHz
P8-220	220-230 MHz
P16 Wired	Give exact band

P9 KIT $12.95
P14 Wired $24.95

Deluxe model for applications where space permits.



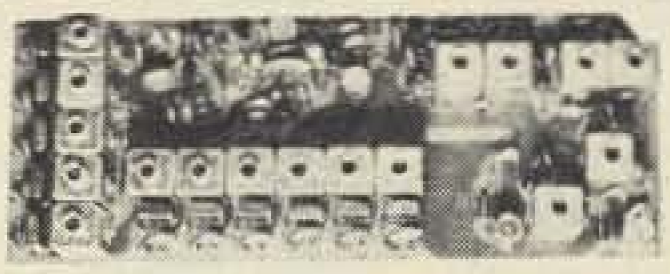
- 1-1/2 x 3 inches
- Covers any 4 MHz band in range
- Ideal for OSCAR
- Diode protection
- Connectors
- 20 dB gain

MODEL	RANGE
P9-LO	26-88 MHz
P9-HI	88-172 MHz
P9-220	172-230 MHz
P14 Wired	Give specific band

P15 KIT $18.95
P35 Wired $34.95

- Covers any 6 MHz band in band in range of 380-520 MHz
- 20 dB gain

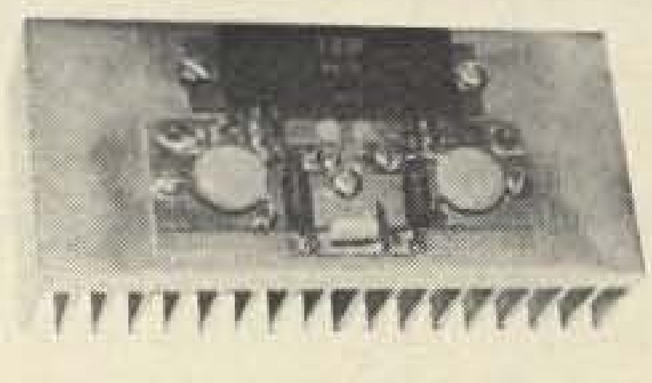
FM/CW TRANSMITTER KITS



200 MW EXCITER MODULE KITS

T40 Eleven Channel Exciter Kit for 2M or 6M band.............................. $39.95

T20 Tripler/Driver Module Kit, 150 mW 2M input, 200 mW 450 MHz output $19.95



RF POWER AMPLIFIER MODULES

- NO TUNING
- VSWR PROTECTED
- COMPLETELY STABLE
- 150MW DRIVE

T80-150, 140-175 MHz, 20-25W output, wired and tested, simply connect your cables.. $79.95

T80-450, 430-470 MHz, 13-15W....... $79.95

TEST PROBE KITS

only $9.95 ea

Contain scope type probe, ground clip, cable, & all components except plug for test equipment.

TE-3	RF Detector Probe for vtvm; good from 100 kHz to over 500 MHz
TE-4	Direct Probe for ac/ohms, etc.
TE-5	DC Probe w/res for 11 meg input vtvm
TE-6	Blocking Capacitor Probe for counter, signal generator, etc.
TE-7	Wideband Detector Probe for scopes
TE-8	High Z/Low Capacitance scope probe

hamtronics, inc.

182-B Belmont Rd; Rochester, NY 14612
Dealer Inquiries Invited H16

*FREE 1978 CATALOG

is yours for the asking. NEW 40 page catalog gives details on these and other kits, including scanner adapters, receiver multicouplers, NPC power supplies, M-tech PA's, CES tone pads & mics, Hy-Gain HT's & hf rigs, & antennas. GET YOURS TODAY!

FREE SHIPPING ON LARGE STOCK OF ANTENNAS!!! We now offer free delivery of Cushcraft, Larsen, & Hy-Gain antennas in the 48 states. Popular models such as Ringo Rangers, VHF & triband beams, magnet mount whips, hf verticals, rubber duckies, lightning arrestors, Reyco traps, W2AU & Hy-Gain baluns. Call or write NOW! We'll be glad to send free catalogs.

IN CANADA:
Send order to COMTEC; 5605 Westluke Ave.; Montreal, Que H4W 2N3 or call 514-482-2640. Add 28% to prices shown above to cover customs duty, exchange rate, and federal tax.

It's Easy To Order!

- CALL OR WRITE NOW FOR FREE CATALOG OR TO PLACE ORDER!
- PHONE 716-663-9254. (Answering service for evenings and weekends for your convenience. Personal service 9-5 eastern.)
- Use credit card, COD, check, m.o.
- Add $2.00 shipping & handling.

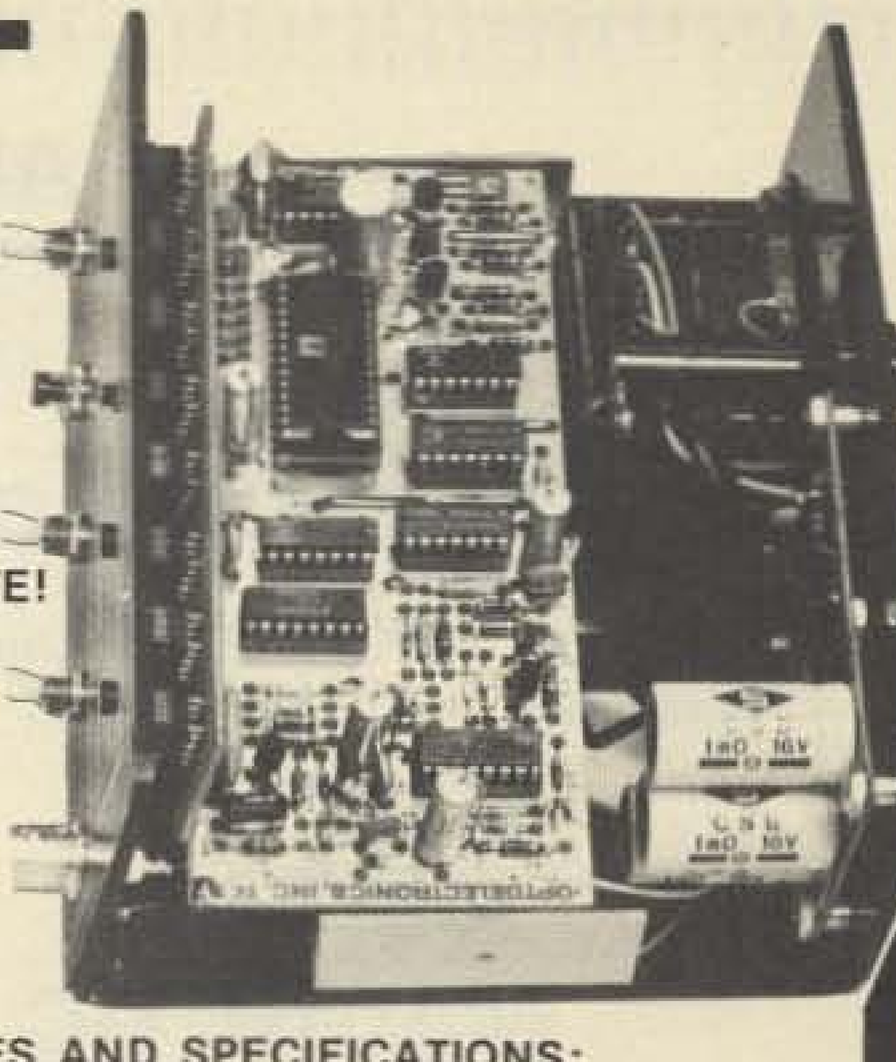
NEW LSI TECHNOLOGY

FREQUENCY COUNTER

TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION [PORTABLE BATTERY OPERATION IS NOW PRACTICAL], DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!

KIT #FC-50 C .... 60 MHZ COUNTER WITH CABINET & P.S. ...... $119.95 COMPLETE!
KIT #PSL-650 .... 650 MHZ PRESCALER [NOT SHOWN] 29.95
MODEL #FC-50WT .... 60 MHZ COUNTER WIRED, TESTED & CAL. 165.95
MODEL #FC-50/600 WT .. 600 MHZ COUNTER WIRED, TESTED & CAL. 199.95

SIZE:
3" High
6" Wide
5½" Deep



FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
PRESCALER WILL FIT INSIDE COUNTER CABINET
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [± .0001%]; AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5 V DC REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED.

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

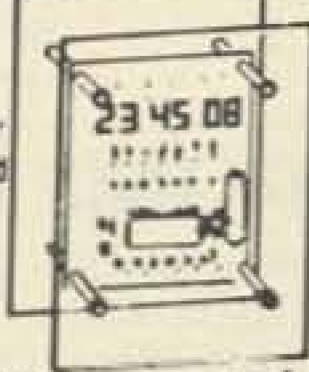
CABINET I 3"H,6¼"W,5½"D
CABINET II 2½"H,5"W,4"D
Black, White or Clear Cover
$6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" 95¢ ea. 4/$3

SEE THE WORKS Clock Kit
Clear Plexiglas Stand

- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included

Plexiglas is Pre-cut & drilled



Kit #850-4CP
Size: 6"H,4½"W,3"D
$23.50 ea. 2/$45. Assembled $29.95

60 HZ. XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC.
1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM
#TB-1 (Adjustable)
Complete Kit $4.95
Wir & Cal $9.95

SPECIAL PRICING!
PRIME - HIGH SPEED RAM
21L02-3 400 NS
LOW POWER - FACTORY FRESH

1-24	$1.75 ea.	100-199	$1.45 ea.
25-99	1.60 ea.	200-999	1.39 ea.

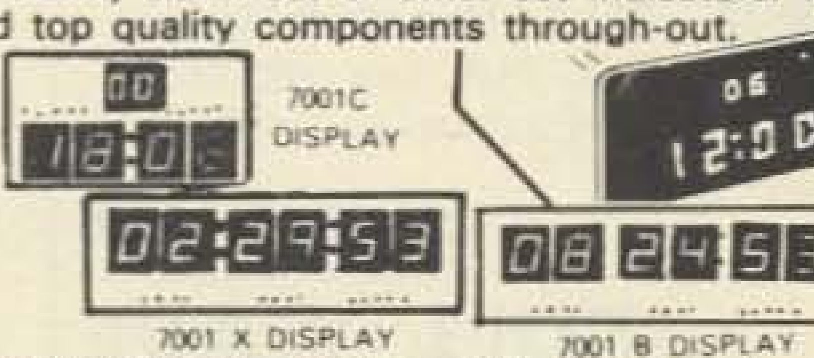
1000 AND OVER $1.29 ea.

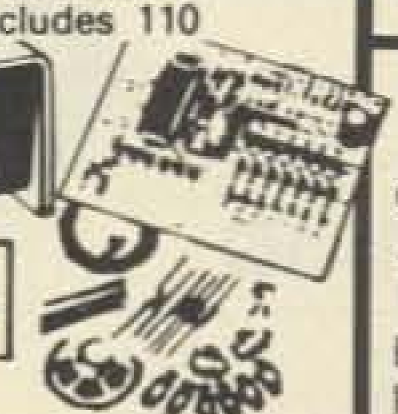
6-DIGIT LED CLOCK CALENDAR KIT
DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.

KIT-7001B WITH 6 - .5" DIGITS $39.95
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
KIT - 7001X WITH 6 - .6" DIGITS $45.95





KITS ARE COMPLETE (LESS CABINET)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT # TB-1

JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer, Line Cord, Switches and all Parts. Ideal Fit in Cabinet II

Kit #5314-5 $19.95 2/$38.

JUMBO DIGIT CONVERSTION KIT $9.95 ea.

Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.
Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.

Specify for 7001 B, C or X - $7.95

MOBILE LED CLOCK
12/24 HR .4" DIGITS!

MODEL #2001
12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off in Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT $27.95 EA. 3 OR MORE $25.95 ea.
115 VAC Power Pack #AC-1 $2.50 EA.

ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] Wired for 12-Hr. Op. if not otherwise specified. $37.95 EA. 3 OR MORE $35.95 ea.

AUTO BURGLAR ALARM KIT

AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND. KEYLESS ALARM HAS PROVISION FOR POS & GROUNDING SWITCHES OR SENSORS. WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN. KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD. UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED. CMOS RELIABILITY RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM. DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS OR AVAILABLE WIRED AND TESTED

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

OPTOELECTRONICS, INC.

BOX 219 HOLLYWOOD, FLA. 33022
PHONE [305] 921-2056 / 921-4425

ORDER BY PHONE OR MAIL
COD ORDERS WELCOME

ORDERS TO USA & CANADA ADD 5% FOR SHIPPING, HANDLING & INSURANCE. ALL OTHERS ADD 10%. ADDITIONAL $1.00 CHARGE FOR ORDERS UNDER $15.00 - COD FEE $1.00. FLA. RES. ADD 4% STATE TAX.

master charge
BANKAMERICARD welcome here

O3

★ ALL AMERICAN IC COUNTER KIT ★

ALL THIS FOR **$1.99** WITH DATA!

TTL DECADE COUNTER KIT WITH LED READOUT! INCLUDES:

1 – 7447 LED DRIVER
1 – OPCOA SLA-1 LED READOUT
1 – 7490 DECADE COUNTER
1 – 7475 BCD LATCH

DIGITAL COUNTER FOR LESS THAN $2 PER DECADE!

NO DEALERS PLEASE!

PRECISION POT

10 Turn. 100K OHM. 1% Linearity. Removed from eqmt.. Like New! A $20.00 Value!

$2.50 ea.

COMPUTER GRADE CAPACITORS

34,000 MFD. 30 WVDC. Brand New! By SPRAGUE

$3.95 ea.

8 AMP 200 PIV SCR
TO-220 CASE 4 FOR $1

8 AMP 200 PIV TRIAC
TO-220 CASE 3 FOR $1

MAGNETIC REED SWITCH

By Hamlin. Rated 250 VAC 15W. Perfect for alarm systems.

4/$1.00

SALE!

PRIME NEW TTL IC'S

7401 - 12¢	7475 - 49¢
7447 - 59¢	7490 - 49¢
7448 - 59¢	7491 - 49¢
7473 - 25¢	7492 - 42¢
7474 - 25¢	7493 - 42¢

P.C. BOARD FOR LED READOUTS

Holds up to 9FND-70 or FND 359. Small Size: Only 2¾" by ¾"

$1.00 ea.

MM5320 TV SYNC GENERATOR

Generates all SYNC pulses for camera or video terminals.
Perfect for use with MOTOROLA MCM6571A character generator.
WITH SPECS.
PERFECT FOR MAKING YOUR OWN VIDEO TERMINAL!
We include FREE a reprint from "73" Magazine showing how to build a high quality video display.

By NATIONAL SEMI. 16 Pin DIP.

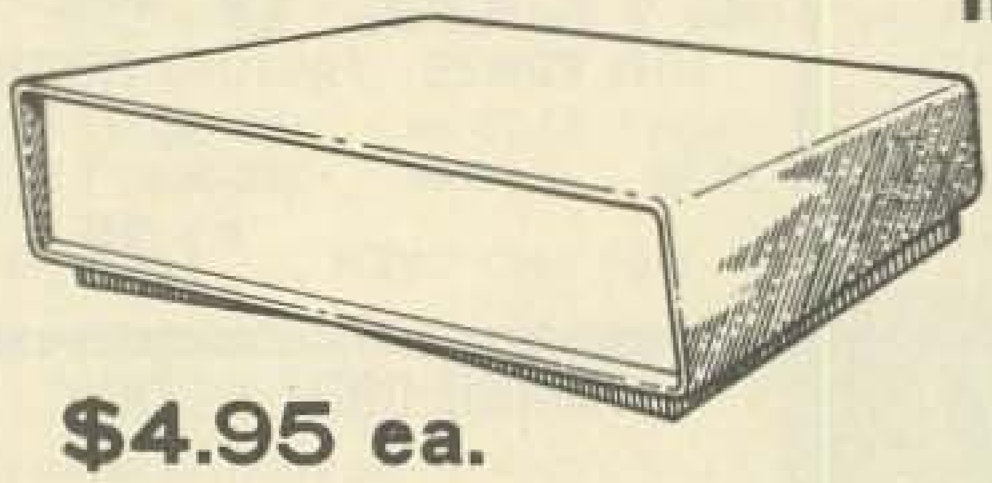
$8.95 each

RCA POWER TRANSISTOR

Number 40254
PNP Germanium
75 Watt 60V 5 Amp.
Same as HEP6013.

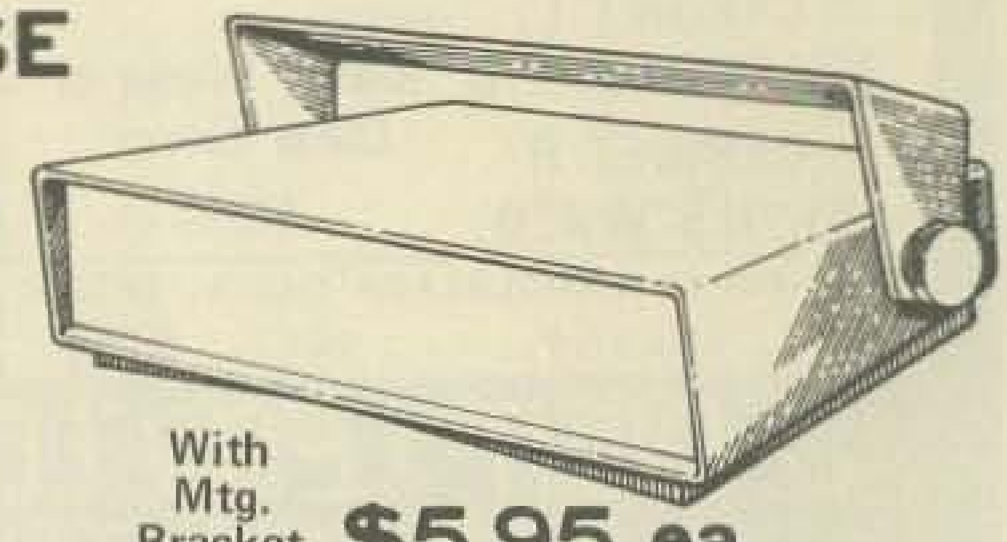
2/$1.00

INSTRUMENT CASE



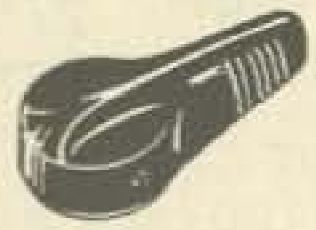
$4.95 ea.

The perfect project enclosure. High impact plastic with aluminum front plate. Front plate can be removed for drilling. 8x2½x4¼ inches. These were originally used for bank security equipment. They are Beautiful! Optional mounting bracket swivels from top to bottom for easy mounting. Knurled thumb screws lock the bracket in any position.



With Mtg. Bracket **$5.95 ea.**

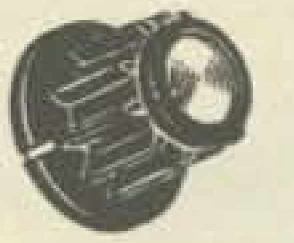
INSTRUMENT KNOB



Black with set screw. Fits standard shaft.

3/$1.00

INSTRUMENT KNOB #2



Black. Has aluminum insert. Has hex set screw. Fits standard shaft.

3/$1.00

ROTARY SWITCH #2

Two pole, three position. One position is spring return.

79¢ ea.

BYPASS CAPS

.1 MFD 10 WVDC. BY CENTRALAB.
LONG LEADS.
.25 INCH SPACING.
NEW UNITS

15 For $1

FULL WAVE BRIDGE

25amp 50PIV

$1.25

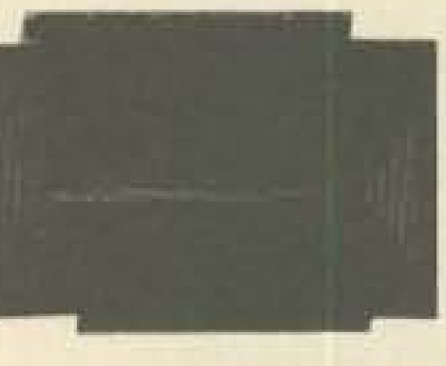
TI DRIVER TRANSISTOR

TO-92. HIGH CURRENT NPN.
IC – 400MA VCEO – 40
HFE 100 TO 300

#TIS-92 10/$1.00

S-100 REVERSING EXTENDER BOARD

$24.95



WITH CONNECTOR

Turns the board under test around so that the foil side is facing you. Makes trouble shooting and debugging a SNAP! P.C. layout designed to minimize noise and stray capacitance.

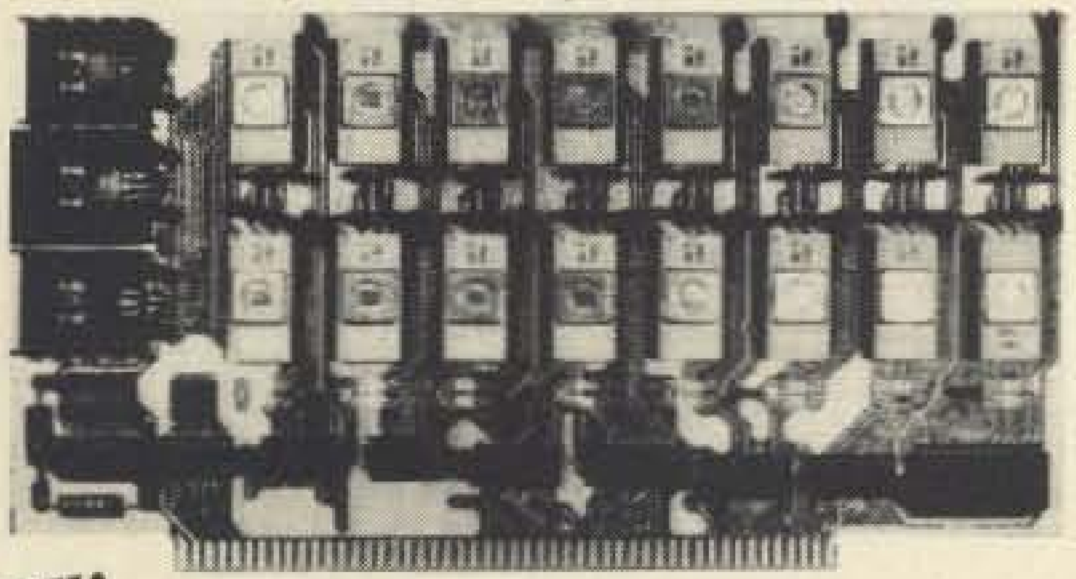
Digital Research Corporation

LOW PROFILE IC SOCKETS	RECTIFIER SPECIAL	TRIMMER CAP	NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.
14 PIN - $.18 22 PIN - $.33 16 PIN - $.20 28 PIN - $.48 18 PIN - $.25	1.5 AMP 100 PIV EPOXY CASE AXIAL LEADS **15 FOR $1**	2 - 20 PF. CER. **4/$1** Mil. Quality	

16K E-PROM CARD

$69.95 (KIT)

S-100 (IMSAI/ALTAIR) BUSS COMPATIBLE



IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

KIT FEATURES:

1. Double sided PC Board with solder mask and silk screen and Gold plated contact fingers.
2. Selectable wait states.
3. **All** address lines and data lines buffered!
4. All sockets included.
5. On card regulators.

USES 2708's!

KIT INCLUDES ALL PARTS AND SOCKETS! (EXCEPT 2708's)

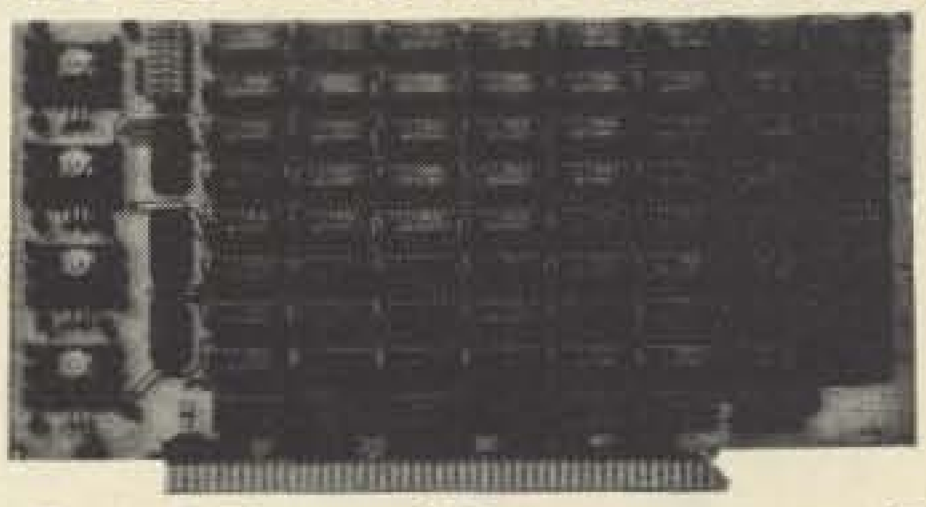
WOW! DEALER INQUIRES INVITED

ADD $25 FOR ASSEMBLED AND TESTED

SPECIAL OFFER: Our 2708's (450 NS) are **$12.95** when purchased with above kit.

FULLY STATIC! $149.00 KIT

8K LOW POWER RAM KIT!



USES 21LO2-1 RAM'S.

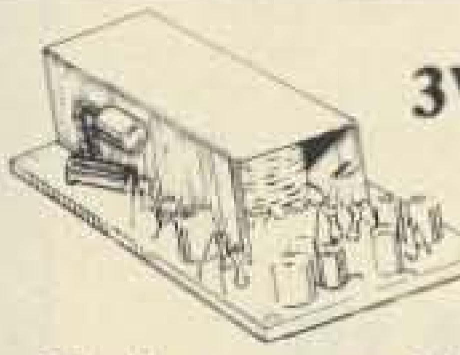
KIT FEATURES:

1. Double sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included!
3. **Fully** buffered on all address and data lines.
4. **Phantom** is jumper selectable to pin 67.
5. **FOUR** 7805 regulators are provided on card.

S-100 (IMSAI/ALTAIR) BUSS COMPATIBLE

PRICE WAR!
For a limited time only:
Buy two 8K Kits for **$129 ea.**

Fully Assembled and Burned In —	**$179.00**
Blank PC Board With Documentation —	**29.95**
Low Profile Socket Set –	13.50
Support IC's (TTL and Regulators) –	9.75
Bypass CAP's (Disc and Tantalums) –	4.50



3W AUDIO AMP MODULE

Fully assembled and tested. With schematic. 4, 8 or 16 OHMS.

$3.95 NEW!

JUMBO RED LED'S

New by G.E. Like MV5024 #SSL-22

6 FOR $1 **25 FOR $3.75**

POWER RECTIFIER

Stud Mount. 1N1204A. Has an NCR House number. 12 AMP 400 PIV.

75c ea. 4/$2.50

NEW! **4K STATIC RAM'S** NEW!

2114. The industry standard. 18 PIN DIP. Arranged as 1K X 4. Equivalent to FOUR 21LO2's in ONE package! TWO chips give 1K X 8, with data.

2 FOR $24 **450 N.S.!** **8 FOR $85**

MOTOROLA 7805R VOLTAGE REGULATOR

Same as standard 7805 except 750 MA OUTPUT. TO-220. 5VDC OUTPUT.

$ .44 each **10 FOR $3.95**

450 NS! **2708 EPROMS** **450 NS!**

Now Full Speed! Prime new units from a major U.S. Mfg. 450 N.S. Access time. 1K x 8. Equiv. to 4 1702 A's in one package!

$15.75 ea. Special Offer: **$12.95 ea.** when purchased with our 16K EPROM Kit.

Z - 80 PROGRAMMING MANUAL

By MOSTEK, the major Z - 80 second source. The most detailed explanation ever on the workings of the Z - 80 CPU CHIPS. At least one full page on **each** of the 158 Z - 80 instructions. A **MUST** reference manual for any user of the Z - 80. 300 pages. Just off the press! A D.R.C. exclusive! **$12.95**

CMOS QUAD BILATERAL SWITCH

SOLITRON CM4116. AN IMPROVED CD 4016. PIN FOR PIN. NEW UNITS! **3/$1.00**

Perfect for Music Synthesizers!

TERMS: ORDERS UNDER $15 ADD $ .75. NO C.O.D. WE ACCEPT VISA, MASTER CHARGE AND AMERICAN EXPRESS CARDS. MONEY BACK GUARANTEE ON ALL ITEMS. TEXAS RESIDENTS ADD 5% SALES TAX.

Digital Research Corporation

CALL FOR OUR CATALOG!

WE PAY POSTAGE!

P. O. BOX 401247 • GARLAND, TEXAS 75040 • (214) 271-2461 D20

Popular products, at proper prices.

CMOS

4000........$0.25
4001.........0.29
4002.........0.34
4007.........0.29
4008.........1.28
4009.........0.53
4010.........0.53
4011.........0.29
4012.........0.29
4013.........0.50
4014.........1.23
4015.........0.90
4016.........0.45
4017.........1.23
4019.........0.55
4020.........1.50
4021.........1.23
4022.........1.20
4023.........0.29
4024.........1.03
4025.........0.29
4027.........0.75
4028.........1.00
4029.........1.73
4030.........0.53
4033.........1.50
4037.........0.50
4040.........1.50
4041.........0.85
4042.........0.85
4043.........0.60
4044.........0.60
4047.........1.63
4049.........0.50
4050.........0.50
4051.........1.03
4052.........1.03
4053.........1.03
4060.........1.48
4066.........0.58
4069B/74C04..0.33
4070.........0.60
4071.........0.33
4073.........0.33
4075.........0.33
4076B/74C173.1.63
4081.........0.33
4116.........0.50
14511........2.00

74LS TTL

74LS00.......0.30
74LS01.......0.30
74LS02.......0.30
74LS04.......0.33
74LS08.......0.36
74LS10.......0.30
74LS11.......0.36
74LS12.......0.33
74LS14.......1.38
74LS15.......0.30
74LS20.......0.30
74LS21.......0.33
74LS22.......0.33
74LS26.......0.43
74LS27.......0.36
74LS30.......0.30
74LS32.......0.38
74LS37.......0.45
74LS38.......0.45
74LS42.......0.98
74LS47.......1.00
74LS48.......0.98
74LS74.......0.50
74LS75.......0.68
74LS76.......0.50
74LS86.......0.50
74LS109......0.50
74LS125......0.63
74LS126......0.63
74LS132......1.25
74LS138......1.10
74LS139......1.15
74LS151......0.95
74LS155......1.38
74LS157......0.95
74LS160......1.40
74LS161......1.40
74LS162......1.40
74LS163......1.40
74LS168......1.87
74LS169......1.87
74LS173......1.65
74LS174......1.25
74LS175......1.15
74LS240......1.88
74LS257......1.25
74LS258......1.25
74LS266......0.53
74LS283......1.20
74LS365/
80LS95......0.75
74LS366/
80LS96......0.75
74LS367/
80LS97......0.75
74LS368/
80LS98......0.75
74LS386......0.55
81LS95.......1.13
81LS96.......1.13
81LS97.......1.13
81LS98.......1.13

TTL

7400.........0.18
7401.........0.20
7402.........0.20
7403.........0.20
7404.........0.21
7405.........0.22
7406.........0.33
7407.........0.36
7408.........0.23
7409.........0.23
7410.........0.18
7411.........0.22
7413.........0.45
7414.........1.05
7416.........0.30
7417.........0.33
7420.........0.18
7422.........0.23
7425.........0.30
7426.........0.25
7427.........0.29
7430.........0.26
7432.........0.30
7437.........0.36
7438.........0.36
7439.........0.45
7440.........0.19
7442.........0.55
7444.........0.45
7445.........0.63
7446.........0.85
7447.........0.80
7448.........0.83
7450.........0.18
7454.........0.18
7460.........0.18
7472.........0.29
7473.........0.36
7474.........0.36
7475.........0.65
7476.........0.36
7483.........0.89
7485.........0.99
7486.........0.36
7489.........1.75
7490.........0.60
7492.........0.63
7495.........0.90
7496.........0.90
74107........0.36
74109........0.53
74121........0.45
74123........0.65
74125/8093...0.50
74126/8094...0.53
74128........0.65
74145........0.63
74148........1.25
74150........1.07
74151........0.71
74153........0.71
74154........1.23
74155........0.71
74156........0.90
74157........0.71
74159........2.20
74160........0.89
74161........0.89
74162........0.89
74163........0.89
74164........1.34
74165........1.34
74173........1.34
74174........1.52
74175........1.34
74176........0.89
74177........0.88
74179........0.75
74180........0.98
74181........2.23
74182........0.80
74190........1.00
74191........1.00
74192........1.34
74193........1.34
74194........1.34
74195........0.71
74196........0.98
74197........0.98
74198........1.96
74199........1.96
74273........1.89
74S287/
6301/
82S129......4.38
74S288/8223..2.50
74365........0.69
74366........0.69
74367........0.69
74368........0.69
74390........1.50
74393........1.50
74S471.......7.50
75325........0.65
75492........0.80

SPECIALS

¼" phone jacks: mono, closed circuit.

The real thing---Switchcraft---for less than the imported kind:

10/$3.00

Cable ties: can accomodate bundles of wire or cable from 1/16" to 3/4" in diameter.

100/$2.95

MEMORIES

ECONORAM II™

This is the 8K X 8 static memory that started it all...plug it into your Altair, IMSAI, or other S-100 buss computer, and you've got a memory that just goes on working and working and working. Configured as 2 independent 4K blocks, with separate protect for each block and vector interrupt provision if you try to write into protected memory. Handles DMA devices. All address and data lines fully buffered. Tri-state outputs for use with bi-directional busses. Selectable write strobe (writes on either $\overline{PWR}$ or MWRITE), and dip switch selectable address. We guarantee 450 ns speed, although many users report running this board in conjunction with 4 MHz Z-80s without using the on board wait state provision. The mechanical quality matches the design, with gold-plated edge fingers, legended and solder masked board, sockets for all ICs, and industrial grade or better components. Join the thousands who have made this our most popular board!

Kit form.......................................$135.00
Assembled, tested, warranted for 1 year.......$155.00
Special! 3 kits (24K of memory)............3/$375.00

ECONORAM III™

Here is the first 8K **dynamic** RAM that performs well enough to merit the ECONORAM trade mark. Thanks to the "SynchroFresh"* timing process, refresh fits naturally into the timing of the S-100 buss...now you can have half the power of statics, but without the traditional timing hassles you've come to associate with dynamic memories.

In addition to low power, this board runs at zero wait states with an 8080 CPU, and is configured as 2 separate blocks for maximum versatility. **Not a kit:** shipped assembled, tested, and ready to plug into any S-100 buss computer (Altair, IMSAI, etc.). 1 year warranty, parts and performance..............$149.00

*SynchroFresh is a trade mark of Thinker Toys

ECONORAM VI™

We proudly welcome our newest memory board family member, designed from the ground up for full compatibility with the Heath Company H8. Organized as 2 independent blocks for flexibility: one 8K block (locatable on any 8K boundary) and one 4K block locatable on any 4K boundary. Has the same basic features of our **ECONORAM II**tm---all static design, dip switch address selection, switch selected write protect and phantom, sockets for all ICs, full buffering---plus the required hardware, and edge connector, to mate mechanically with the H8. Now you can have our 12K board for the price of the Heath Company's 8K...with the performance you've come to expect from products carrying the ECONORAM trade mark. **Kit form: $235.00**

Also available: H8 4K to 8K conversion kit (**$90**). If you have a Heath Company 4K memory, plug in these ICs and you'll have a full 8K. Kit includes eight TI4044 memories and matching sockets.

Send for our flyer

TERMS: Please allow up to 5% for shipping; excess refunded. Californians add tax. COD orders accepted but we must have street address for UPS. For VISA* or Mastercharge* orders ($15 minimum) call our 24 hour order desk at **(415) 562-0636**. Prices good through cover month of magazine. Thank you!

GODBOUT
BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614
G4

Feb-1978

7400N TTL

SN7400N	.16	SN7472N	.39	SN74160N	1.25
SN7401N	.18	SN7473N	.39	SN74161N	.99
SN7402N	.20	SN7474N	.35	SN74162N	1.95
SN7403N	.20	SN7475N	.50	SN74163N	.99
SN7404N	.20	SN7476N	.35	SN74164N	.99
SN7405N	.20	SN7479N	5.00	SN74165N	.99
SN7406N	.35	SN7480N	.50	SN74166N	1.25
SN7407N	.35	SN7482N	.99	SN74167N	3.25
SN7408N	.20	SN7483N	.70	SN74170N	2.10
SN7409N	.25	SN7485N	.89	SN74172N	6.00
SN7410N	.20	SN7486N	.39	SN74173N	1.50
SN7411N	.30	SN7488N	3.50	SN74174N	1.25
SN7412N	.35	SN7489N	2.49	SN74175N	.99
SN7413N	.69	SN7490N	.45	SN74176N	.79
SN7414N	.70	SN7491N	.75	SN74177N	.79
SN7416N	.35	SN7492N	.49	SN74179N	2.49
SN7417N	.35	SN7493N	.49	SN74180N	.99
SN7420N	.20	SN7494N	.79	SN74181N	2.49
SN7421N	.39	SN7495N	.79	SN74182N	.95
SN7422N	.49	SN7496N	.79	SN74184N	1.95
SN7423N	.37	SN7497N	3.00	SN74185N	1.95
SN7425N	.29	SN74100N	1.25	SN74186N	15.00
SN7426N	.29	SN74107N	.39	SN74187N	6.00
SN7427N	.37	SN74109N	.95	SN74188N	3.95
SN7429N	.42	SN74116N	1.95	SN74190N	1.79
SN7430N	.25	SN74121N	.39	SN74191N	1.25
SN7432N	.25	SN74122N	.39	SN74192N	.89
SN7437N	.35	SN74123N	.50	SN74193N	.89
SN7438N	.35	SN74125N	.60	SN74194N	1.25
SN7439N	.25	SN74126N	.60	SN74195N	.75
SN7440N	.21	SN74132N	1.25	SN74196N	1.00
SN7441N	.89	SN74136N	.95	SN74197N	1.00
SN7442N	.69	SN74141N	1.15	SN74198N	1.75
SN7443N	.75	SN74142N	2.95	SN74199N	1.75
SN7444N	.75	SN74143N	3.25	SN74200N	5.59
SN7445N	.75	SN74144N	3.00	SN74251N	1.79
SN7446N	.89	SN74145N	1.15	SN74279N	.90
SN7447N	.69	SN74147N	2.35	SN74283N	2.25
SN7448N	.89	SN74148N	2.00	SN74284N	6.00
SN7450N	.25	SN74150N	1.25	SN74285N	6.00
SN7451N	.25	SN74151N	.79	SN74365N	.75
SN7453N	.25	SN74153N	.89	SN74366N	.75
SN7454N	.25	SN74154N	1.25	SN74367N	.75
SN7459A	.25	SN74155N	.89	SN74368N	.75
SN7460N	.25	SN74156N	.89	SN74390N	2.25
SN7470N	.45	SN74157N	.89	SN74393N	2.25

20% Discount for 100 Combined 7400's

CMOS

CD4000	.23	CD4044	.89	CD4520	1.29
CD4001	.23	CD4046	1.79	MC14562	14.50
CD4002	.23	CD4047	2.50	CD4566	2.25
CD4006	1.19	CD4048	1.35	MC14583	3.50
CD4007	.25	CD4049	.49	**74C00 Series**	
CD4009	.49	CD4050	.49	74C00	.39
CD4010	.49	CD4051	1.19	74C02	.55
CD4011	.23	CD4053	1.19	74C04	.75
CD4012	.25	CD4056	1.49	74C10	.65
CD4013	.39	CD4059	9.95	74C14	3.00
CD4014	1.39	CD4060	1.49	74C20	.65
CD4015	1.19	CD4066	.79	74C30	.65
CD4016	.49	CD4068	.39	74C42	2.15
CD4017	1.19	CD4069	.45	74C73	1.50
CD4018	.99	CD4070	.55	74C74	1.15
CD4019	.49	CD4071	.23	74C89	4.00
CD4020	1.19	CD4072	.49	74C90	3.00
CD4021	1.39	CD4076	1.39	74C93	2.00
CD4022	1.19	CD4081	.23	74C95	2.00
CD4023	.23	CD4082	.23	74C107	1.25
CD4024	.79	CD4098	2.49	74C151	2.90
CD4025	.23	MC14409	14.95	74C154	3.00
CD4026	2.25	MC14410	14.95	74C157	2.15
CD4027	.69	MC14411	14.95	74C160	3.25
CD4028	.89	MC14419	4.95	74C161	3.25
CD4029	1.19	MC14506	.75	74C163	3.00
CD4030	.49	MC14507	.99	74C164	3.25
CD4035	.99	CD4508	3.95	74C173	2.60
CD4040	1.19	CD4510	1.39	74C193	2.75
CD4041	1.25	CD4511	1.29	74C195	2.75
CD4042	.99	CD4515	2.95	80C95	1.50
		CD4518	1.29	80C97	1.50

LINEAR

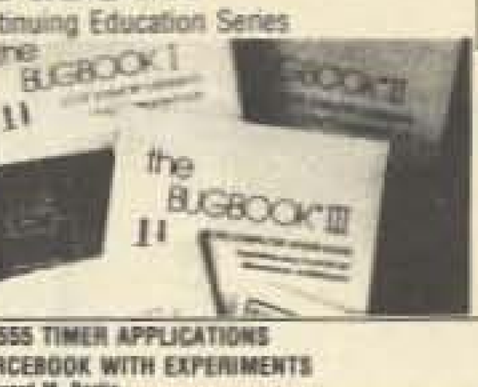
LM300H	.80	LM340T-8	1.25	LM739N	1.19
LM301H	.35	LM340T-12	1.25	LM741CH	.35
LM301CN	.35	LM340T-15	1.25	LM741CN	.35
LM302H	.75	LM340T-18	1.25	LM741-14N	.39
LM304H	1.00	LM340T-24	1.25	LM747H	.79
LM305H	.60	LM350N	1.00	LM747N	.79
LM307CN	.35	LM351CN	.65	LM748H	.39
LM308H	1.00	78MG	1.75	LM748N	.39
LM308CN	1.00	LM370N	1.15	LM1303N	.90
LM309H	1.10	LM373N	3.25	LM1304N	1.19
LM309K	1.25	LM377N	4.00	LM1305N	1.40
LM310CN	1.15	LM380N	1.25	LM1307N	.85
LM311H	.90	LM380CN	.99	LM1310N	2.95
LM311N	.90	LM381N	1.79	LM1351N	1.65
LM317K	7.50	LM382N	1.79	LM1414N	1.75
LM318CN	1.50	NE501K	8.00	LM1458CN	.59
LM319N	1.30	NE510A	6.00	LM1496N	.95
LM320K-5	1.35	NE529A	4.95	LM1556V	1.75
LM320K-5.2	1.35	NE531H	3.00	LM2111N	1.95
LM320K-12	1.35	NE536T	6.00	LM2901N	2.95
LM320K-15	1.35	NE540L	6.00	LM3053	1.50
LM320T-5	1.25	NE550N	1.30	LM3065N	.69
LM320T-5.2	1.25	NE555V	.39	LM3900N(3401)	.49
LM320T-8	1.25	NE560B	5.00	LM3905N	.89
LM320T-12	1.25	NE561B	5.00	LM3909	1.25
LM320T-15	1.25	NE562B	5.00	LM5556N	1.85
LM320T-18	1.25	NE565H	1.75	MC5558V	1.00
LM320T-24	1.25	NE565N	1.25	LM7525N	.90
LM323K-5	5.95	NE566CN	1.75	LM7534N	.75
LM324N	1.80	NE567H	1.95	8038B	4.95
LM339N	.99	NE567V	1.49	LM75450	.49
LM340K-5	1.35	LM703CN	.45	75451CN	.39
LM340K-6	1.35	LM709H	.29	75452CN	.39
LM340K-8	1.35	LM709N	.29	75453CN	.39
LM340K-12	1.35	LM710N	.79	75454CN	.39
LM340K-15	1.35	LM711N	.39	75491CN	.79
LM340K-18	1.35	LM723H	.55	75492CN	.89
LM340K-24	1.35	LM723N	.55	75494CN	.89
LM340T-5	1.25	LM733N	1.00	RC4194	5.95
LM340T-6	1.25			RC4195	3.25

74LS00 TTL

74LS00	.29			74LS155	1.25
74LS02	.29			74LS157	1.50
74LS03	.29	74LS75	.69	74LS160	1.95
74LS04	.35	74LS76	.49	74LS161	1.95
74LS05	.35	74LS83	1.75	74LS162	1.95
74LS08	.29	74LS85	2.49	74LS163	1.95
74LS10	.29	74LS86	.49	74LS164	1.95
74LS13	.69	74LS90	.89	74LS175	1.95
74LS14	1.75	74LS92	.89	74LS181	3.69
74LS20	.29	74LS93	.89	74LS190	2.49
74LS26	.39	74LS95	1.50	74LS191	2.49
74LS27	.39	74LS96	1.89	74LS192	2.49
74LS28	.39	74LS107	.59	74LS193	2.49
74LS30	.29	74LS109	.59	74LS194	1.89
74LS32	.39	74LS112	.59	74LS195	1.89
74LS40	.39	74LS123	1.25	74LS253	1.75
74LS42	1.25	74LS132	1.25	74LS257	1.75
74LS47	1.25	74LS136	.59	74LS260	.55
74LS51	.29	74LS138	1.25	74LS279	.79
74LS55	.29	74LS139	1.25	74LS367	.99
74LS73	.49	74LS151	1.25	74LS368	.99
74LS74	.49	74LS153	1.25	74LS670	3.95

BUGBOOK®

Continuing Education Series



BUGBOOKS I and II — $17.00 per set
by Peter R. Rony, David G. Larsen, WB4HYJ

Sold as a set these two books outline over 90 experiments designed to teach the reader all he will need to know about TTL logic chips to use them in conjunction with microprocessor systems. You'll learn about the basic concepts of digital electronics including gates, flip-flops, latches, buses, decoders, multiplexers, demultiplexers, LED displays, RAM's, ROM's, and much, much more.

BUGBOOK IIa — $5.00
by Peter R. Rony, David G. Larsen, WB4HYJ

This volume will introduce you to the fabulous UART chip — that all important interface between data terminals, etc., and your microcomputer. It also covers current loops, and the RS 232C interface standard. Particularly recommended for any RTTY enthusiast.

THE 555 TIMER APPLICATIONS SOURCEBOOK WITH EXPERIMENTS — $6.95
by Howard M. Berlin

This book shows you what the 555 timer is and how to use it. Included are over 100 various design techniques, equations and graphs to create "ready-to-go" timers, generators, power supplies, measurement and control circuits, party games, circuits for the home and automobile, photography, music and Amateur Radio.

BUGBOOK III — $15.00
by Peter R. Rony, David G. Larsen, WB4HYJ, Jonathan A. Titus

Here is the book that puts it all together. Besides having much valuable text there are a series of experiments in which the reader completely explores the 8080 chip pin by pin and introduces you to the Mark 80 microcomputer, a unique easily interfaced system. It is recommended that you have the background on the BUGBOOKS I & II before proceeding with BUGBOOK III.

INSTRUCTOR'S MANUAL — $3.00
Necessary for instruction of Bugbook I and II. Answers questions regarding experiments, suggestions for further reading, philosophy of authors approach to digital electronics. A must for self-teaching individuals.

BUGBOOK V and VI — $19.00 per set
by David G. Larsen, Peter R. Rony, Jonathan A. Titus

Experiments in digital electronics, 8080A microcomputer programming and 8080A microcomputer interfacing. An integrated approach to self-instructed basic digital electronics, breadboarding and 8080A interfacing/programming. Bugbook VI integrates the digital concepts of Bugbook V into a treatment of 8080A microcomputer programming and interfacing. Detail & laboratory experiments included with each book.

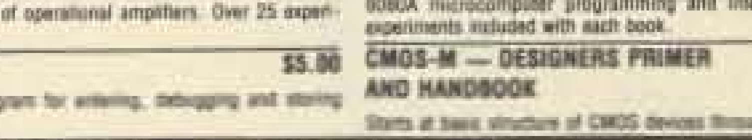
OP AMP MANUAL — $9.00
An experiment guide to application of operational amplifiers. Over 25 experiments on all phases of Op Amps.

DBUG — $5.00
8080 interpretive debugger. A program for entering, debugging and storing assembly language programs.

CMOS-M — DESIGNERS PRIMER AND HANDBOOK — $6.00
Starts at basic structure of CMOS devices through integration into MSI.

COMPLETE MANUAL FOR DIGITAL CLOCKS by John Weiss and John Brooks
Familiarizes technician or hobbyist with basic theories behind digital clocks. Includes trouble shooting guides, basic characteristics of clocks, soldering techniques, clock component data sheets and construction tips. — $3.95

DISCRETE LEDS



.125" dia.			.190" dia.		
XC209	Red	5/$1	XC111	Red	10/$1
XC209	Green	4/$1	XC111	Green	4/$1
XC209	Orange	4/$1	XC111	Yellow	4/$1
XC209	Yellow	4/$1	XC111	Orange	4/$1

.200" dia			.185" dia.			.200" dia.			.085" dia.
XC22	Red	5/$1	XC526	Red	5/$1	XC556	Red	5/$1	MV50 - Red - 6/$1
XC22	Green	4/$1	XC526	Green	4/$1	XC556	Green	4/$1	
XC22	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Yellow	4/$1	INFRA-RED LED ¼" x ¼" x 1/16" Flat 5/$1.00
XC22	Orange	4/$1	XC526	Clear	4/$1	XC556	Orange	4/$1	
SSL-22	RT	4/$1				XC556	Clear	7/$1	

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95
MAN 2	5 x 7 Dot Matrix-red	.300	4.95
MAN 3	Common Cathode-red	.125	.39
MAN 4	Common Cathode-red	.187	1.95
MAN 7	Common Anode-red	.270	1.25
MAN 7G	Common Anode-green	.270	1.95
MAN 7Y	Common Anode-yellow	.270	1.95
MAN 52	Common Anode-green	.300	1.00
MAN 71	Common Anode-red	.300	1.25
MAN 72	Common Anode-red	.300	1.25
MAN 74	Common Cathode-red	.300	1.50
MAN 81	Common Anode-yellow	.300	1.00
MAN 82	Common Anode-yellow	.300	1.00
MAN 84	Common Cathode-yellow	.300	1.00
MAN 3620	Common Anode-orange	.300	1.00
MAN 3630	Common Anode-orange ±1	.300	1.35
MAN 3640	Common Cathode-orange	.300	1.75
MAN 4610	Common Anode-orange	.300	1.00
MAN 4640	Common Cathode-orange	.400	1.00
MAN 4710	Common Anode-red ±1	.400	1.00
MAN 4730	Common Anode-red	.400	1.00
MAN 4740	Common Cathode-red	.400	1.00
MAN 4810	Common Anode-yellow	.400	1.00
MAN 6610	Common Anode-orange-D.D.	.560	1.25
MAN 6630	Common Anode-orange	.560	1.25
MAN 6640	Common Cathode-orange-D.D.	.560	1.25
MAN 6650	Common Cathode-orange ±1	.560	1.25
MAN 6660	Common Anode-orange	.560	1.25
MAN 6680	Common Cathode-orange	.560	1.25
MAN 6710	Common Anode-red-D.D.	.560	1.25
MAN 6730	Common Anode-red ±1	.560	1.25
MAN 6740	Common Cathode-red-D.D.	.560	1.25
MAN 6750	Common Cathode-red ±1	.560	1.25
MAN 6760	Common Anode-red	.560	1.25
MAN 6780	Common Cathode-red	.560	1.25
DL701	Common Anode-red ±1	.300	1.00
DL702	Common Cathode-red	.300	1.25
DL704	Common Cathode-red	.300	1.50
DL707	Common Anode-red	.300	1.50
DL741	Common Anode-red	.600	1.95
DL746	Common Anode-red ±1	.630	1.95
DL747	Common Anode-red	.600	2.25
DL749	Common Cathode-red ±1	.630	1.95
DL750	Common Cathode-red	.600	2.49
DL338	Common Cathode-red	.110	.69
FND70	Common Cathode (FND359)	.250	.75
FND503	Common Cathode (FND500)	.500	1.29
FND507	Common Anode (FND510)	.500	1.29
5082-7300	4 x 7 Sgl. Digit-RHDP	.600	19.95
5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
5082-7304	Overrange character (±1)	.600	15.00
5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

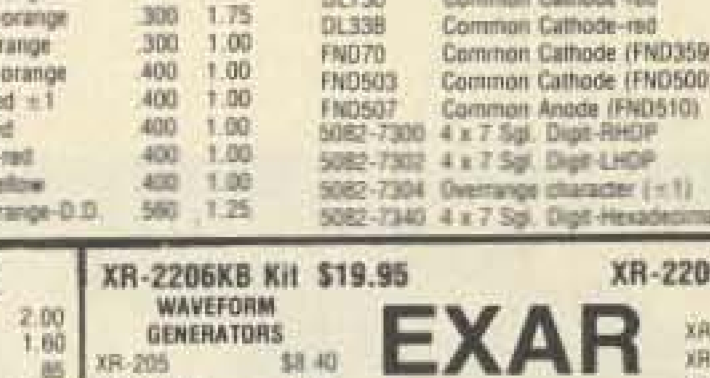
CA3013	2.15	CA3082	2.00
CA3023	2.56	CA3083	1.60
CA3035	2.48	CA3086	.85
CA3039	1.35	CA3089	3.75
CA3046	1.30	CA3091	3.50
CA3053	1.50	CA3102	2.95
CA3059	3.25	CA3123	2.15
CA3060	3.25	CA3130	1.39
CA3080	.85	CA3140	1.25
CA3081	2.00	CA3401	.49
		CA3600	1.75

EXAR

XR-2206KB Kit $19.95 — XR-2206KA Kit $14.95

WAVEFORM GENERATORS		MISCELLANEOUS		TIMERS	
XR-205	$8.40	XR-2211CP	$6.70	XR-555CP	$.49
XR-2206CP	5.50	XR-4136	2.00	XR-320P	1.55
XR-2207CP	3.85	XR-1468	3.85	XR-556CP	1.85
STEREO DECODERS		XR-1488	5.80	XR-2556CP	3.20
XR-1310CP	$3.20	XR-1489	4.80	XR-2240CP	4.80
XR-1310EP	3.20	XR-2208	5.20	**PHASE LOCKED LOOPS**	
XR-1800P	3.20			XR-210	5.20
XR-2567	2.99			XR-215	6.60
				XR-567CP	1.95
				XR-567CT	1.70

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS



	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	.16	.15	24 pin	$.38	.37	.36
14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	.25	.24	28 pin	$.99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.59	1.45	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

8 pin	$.40	.38	.35	22 pin	.95	.85	.75
10 pin	.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	1/4 WATT 5% - 50 PCS.
ASST. 2	5 ea.	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	1/4 WATT 5% - 50 PCS.
ASST. 3	5 ea.	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	1/4 WATT 5% - 50 PCS.
ASST. 4	5 ea.	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	1/4 WATT 5% - 50 PCS.
ASST. 5	5 ea.	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	1/4 WATT 5% - 50 PCS.
ASST. 6	5 ea.	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	1/4 WATT 5% - 50 PCS.
ASST. 7	5 ea.	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	1/4 WATT 5% - 50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1978 Catalog
Dealer Information Available

NOW OPEN SATURDAYS

James ELECTRONICS

1978 CATALOG NOW AVAILABLE

1021-A HOWARD AVE., SAN CARLOS, CA. 94070
PHONE ORDERS WELCOME — (415) 592-8097

Advertised Prices Good Thru February

J1

HOBBY-WRAP TOOL-BW-630

- Battery Operated (Size C)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)

Complete with built-in bit and sleeve

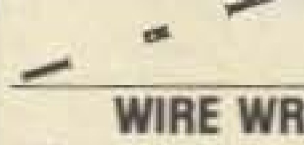
$34.95 (batteries not included)

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$11.95



WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP - $5.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.45 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red **$1.98/spool**

DIP/IC INSERTION TOOL WITH PIN STRAIGHTEN
Inserts both 14 and 16 pin packages. Pin Straightener built into Handle.
Model INS-1416 **$3.49/ea.**

HP 5082-7400 SERIES — MULTI-DIGIT

		1	10+
• ⅛" ht. • Common Cathode Red	2 Digit	$.49	.39
• 3-5 volts @ 5 mils/second	3 Digit	.59	.49
• 7 segment Monolithic	4 Digit	.69	.59
• Dip Package	5 Digit	.79	.69

TV GAME CHIP SET — $9.95

Includes AY-3-8500-1 Chip and 2.010 mhz crystal
(2.010 crystal — $1.95 ea/AY-3-8500-1 Chip — $8.95 ea.)

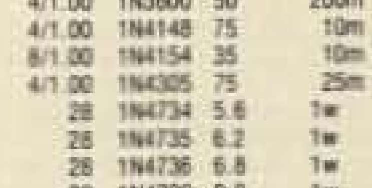
ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	.28	1N4734	5.6	1w	.28
1N5234	6.2	500m	.28	1N4735	6.2	1w	.28
1N5235	6.8	500m	.28	1N4736	6.8	1w	.28
1N5236	7.5	500m	.28	1N4738	8.2	1w	.28
1N456	25	40m	6/1.00	1N4742	12	1w	.28
1N458	150	7m	6/1.00	1N4744	15	1w	.28
1N485A	180	10m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.50
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 200V	SCR	1.95
2N2328	1.6A @ 200V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

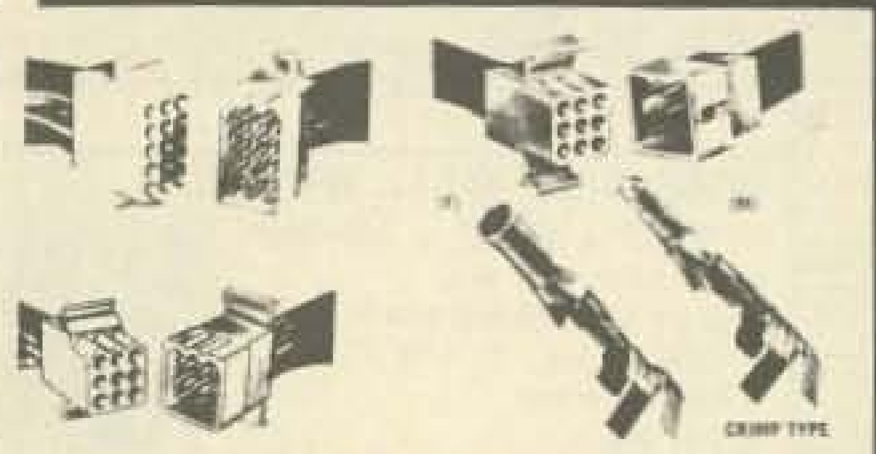


MPS A05	5/$1.00			PN4250	4/$1.00
MPS A06	5/$1.00			2N4400	4/$1.00
2N918	4/$1.00			2N4401	4/$1.00
2N2219A	3/$1.00	2N3638	5/$1.00	2N4402	4/$1.00
2N2221	4/$1.00	2N3702	5/$1.00	2N4403	4/$1.00
2N2222A	5/$1.00	2N3704	5/$1.00	2N4409	5/$1.00
2N2368	5/$1.00	2N3705	5/$1.00	2N5086	4/$1.00
2N2369A	4/$1.00	2N3706	5/$1.00	2N5087	4/$1.00
2N2484	4/$1.00	2N3707	5/$1.00	2N5088	4/$1.00
2N2906A	4/$1.00	2N3711	5/$1.00	2N5089	4/$1.00
2N2907A	5/$1.00	2N3724	$.65	2N5129	5/$1.00
2N2925	5/$1.00	2N3725	$1.00	2N5138	5/$1.00
2N3035	2/$1.00	2N3772	$2.25	2N5139	5/$1.00
2N3055	$.89	2N3903	5/$1.00	2N5209	5/$1.00
MJE2955	$1.25	2N3904	4/$1.00	2N5210	5/$1.00
MJE3055	$1.00	2N3905	4/$1.00	2N5432	$2.00
2N3392	5/$1.00	2N3906	4/$1.00	2N5449	3/$1.00
2N3398	5/$1.00	2N4013	3/$1.00	2N5951	5/$1.00
PN3567	3/$1.00	2N4014	3/$1.00	C106B1SCR	2/$1.00
PN3568	4/$1.00	2N4123	6/$1.00	40409	$1.75
PN3569	4/$1.00	PN4249	4/$1.00	40410	$1.75

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				**Radial Lead**			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26



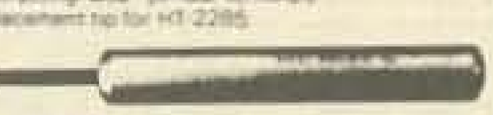
Complete Connectors Per Pkg. | **NYLON CONNECTORS** | Mfg. by Molex

Complete Connectors Per Pkg.	Type No.	Class	Description	Price Ea. Pkg.
5	1625-1PRT	Min.(.062")	1 Circuit	$1.75
3	1625-2PRT	"	2 Circuit	1.90
3	1625-3PRT	"	3 Circuit	2.10
2	1625-4PRT	"	4 Circuit	2.10
2	1625-5PRT	"	5 Circuit	2.20
2	1625-6PRT	"	6 Circuit	2.35
1	1649-8PRT	"	8 Circuit	1.55
1	1625-9PRT	"	9 Circuit	1.75
1	1625-12PRT	"	12 Circuit	1.90
1	1625-15PRT	"	15 Circuit	2.30
1	1625-24PRT	"	24 Circuit	3.25
1	1772-36PRT	"	36 Circuit	4.55
5	1619PRT	Std.(.093")	1 Circuit	1.75
3	1545PRT	"	2 Circuit	1.90
3	1396PRT	"	3 Circuit	2.10
2	1490PRT	"	4 Circuit	2.10
2	1653PRT	"	5 Circuit	2.20
2	1261PRT	"	6 Circuit	2.35
1	1292PRT	"	9 Circuit	1.80
1	1360PRT	"	12 Circuit	1.90
1	1375PRT	"	15 Circuit	2.45

Prototype hand tools combine efficiency with economy. Ideal for prototype or limited production runs.
HT-1919 for .093" pin dia. terminals $8.95 each
HT-1921 for .062" pin dia. terminals $8.95 each

Econo-Extractor removes terminal from nylon connector housing with smoothness and ease.
HT-2054 for extracting .093" pin dia. terminals $2.25 each
HT-2023 for extracting .062" pin dia. terminals $2.25 each

Deluxe ejector tools, spring loaded for simple, efficient removal of terminal from nylon connector housing extracts either male or female terminals of same pin diameter.
HT-2038 for extracting .093" pin dia. terminals $6.70 each
HT-1010-282 Replacement tip for HT-2038 $2.50 each
HT-2285 for extracting .062" pin dia. terminals $6.70 each
HT-1672-3 replacement tip for HT-2285 $2.50 each



INTEGRATED CIRCUITS

555 Timer 8 pin mini-DIP	.49
741 Compensated OP-Amp 8 pin DIP	.37
LM 1889N RF Video Modulator	7.45
CA3130 Bipolar/Mos-FET Op Amp	1.19
CA3140 MOS-FET Op Amp, Bi-polar out	.99
LM3909 Lo Voltage Led Pulser	1.50
LM3911 Temp Control CHIP	1.50
Signetics 2504TA 1024 bit S.R. memory (1404A)	$1.75
MCM 6571P Character Generator	9.95
MCM6571AP Character Generator	9.95
MCM6575P Character generator	$14.88
50240 Top octave generator	$14.95
LH0070-1H Precision (.3%) 10V Reference Amp	5.35
LH0070-2H Extra Precise (.05%) 10V Reference Amp	10.55
LM399H Temp Stabilized Zener	5.95
AF100-1CJ Active Filter, State Variable	7.50
LM2907N Tachometer F/V Converter	2.65
LM1812N Ultra-sonic Transceiver	9.15
LM1815 Adaptive Sense Amp for Tachometer	5.73
TL170 TO-92 Hall effect switch w/spec sheets	1.25
MC14409P Telephone Rotary Pulser	10.98
MC14419P Touch Pad Converter for 14409	4.25
MC14411P Baud Rate Generator	11.98
MC14412VP CMOS Modem Chip	16.95
MM57109N Number Cruncher Micro	18.95
74C915 7 Segment to BCD Converter	2.99
74C922 16 Key Keyboard Encoder	6.35
74C923 20 key Keyboard Encoder	6.45
74C925 4 Decade Counter w/latches	12.00
74C926 4 Decade Counter w/carry	12.00
74C935-1 3½ Digit DVM CMOS Chip	16.98
9601 Retriggerable One shot	.50
MC4015P Hi Speed quad "D" low power TTL	$1.00

New UHF Prescaler IC. Nationals' DS8629 is a fixed ratio, divide by 100 counter combining ECL and lo-power Schottky. Single and or differential mode. Operates from D.C. to typically 160 MHz (135 Guaranteed minimum) TTL compatible, single supply, positive or negative edge trigger. 100mV to 1V input.
DS8629N $6.14
Specs .... .40

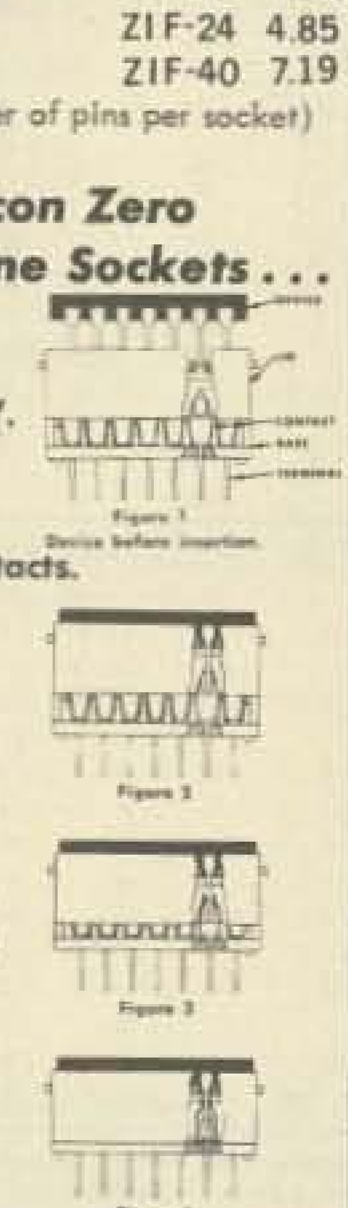
Annie SEZ
Whenever you need a new part
And quality is close to your heart
Be good to yourselves
Try Tri-Teks' shelves
For a deal that is both sweet and smart

ZIF-14	$3.20	ZIF-22	4.50
ZIF-16	3.49	ZIF-24	4.85
ZIF-18	3.95	ZIF-40	7.19

(Last two digits of part number show number of pins per socket)

Unique Features of the Welcon Zero Insertion Force Dual-In-Line Sockets . . .

- **Capability to accept devices with up to .070" lead spread variation.**
- **Accepts lead lengths as short as .075".**
- **Sturdy terminals that fit .025" diameter printed circuit board holes.**
- **"Zero" insertion, positive wiping contacts.**
- **"ZIF" eliminates costly damage to fragile LSI devices**



Why struggle to insert DIP's into sockets when you can do it the easy way . . . the Welcon way . . . with a new design concept that provides "zero insertion force" and positive wiping.

The "604" series of sockets, with all of its positive features and higher reliability, is small in size. High density packaging can be achieved for burn-in and production.

OPERATION: Lid is moved to up position stop (Fig. 2). This cams contacts into "open" position. DIP device can then be dropped into open contacts. In Fig. 3 DIP is pushed downward and contacts begin to close. When tip of device lead is past contact point (Fig. 4), contacts close and wipe on lead for remaining distance.

S-100 BUS CONNECTORS (IMSAI TYPE)

2x50x.125 x .25 Rows.

Gold, Solder tail for Mother boards $4.50, 4/$17.00
Tin-Nickel, (NASGLO) Solder tail $3.75, 4/$14.00
Gold, wire-wrap .... $4.50, 4/$17.00
Tin-Nickel, (NASGLO) wire-wrap $3.75, 4/$14.00

I.C. SOCKETS

Lo Profile Tin Solder Tail Dip Sockets

8 pin	10/$1.50	100/$14.00	1000/$120.00
14 pin	10/$1.70	100/$16.00	1000/$140.00
16 pin	10/$1.90	100/$18.00	1000/$160.00

VOLTAGE REGULATORS

7805-06-08-12-15-24 TO220	95¢ 5/$4.50
7905-06-08-12-15-24 TO 220	95¢ 5/$4.50
78L05A-12-15 4% 100 mA TO-92 Plastic	50¢
78H05KC 5V 5A TO-3	9.15
78H12KC 12V 5A TO-3	9.15
78H15KC 15V 5A TO-3	9.15
Lm317K 1.5A *Adjustable* TO-3	4.99
Lm317T 1.5A *Adjustable* TO-220	3.99
Lm317MP .5A *Adjustable* TO-202	13.95
TL430C Adjustable Zener-*Think About It*	1.50
TL497C Switching Reg. & Inductor	9.50
RCA CA 3085 100 mA *Adjustable*	.60

Adjustable 3A Regulator. LM350 is an adjustable 3-terminal regulator capable of supplying in EXCESS of 3 Amps over a 1.2V to 33V range. Standard TO-3 package for easy mounting. Full protection from thermal, current and safe area overload. Completely floating and can be used to regulate at any voltage level as long as input-output difference is less than 35Volts. 0.1% regulation!
LM350K $10.95
Specs .... .80

DIODES AND BRIDGES

IN4003 200 V 1 amp	12/$1.00
IN4004 400 V 1 amp	10/$1.00
IN4148 Hi Speed Signal	15/$1.00 100/$5.00
D-600 115 V, 100 mA Hi Speed Signal	20/$1.00
D2131 200 V, 25A Stud	85¢
D2135 400 V, 25A Stud	1.00
D2138 600 V, 25A Stud	1.55
D3289R 200 V, 160A Stud Anode	5.85
D3909-4 50 V, 45A Fast Recovery	2.00
IN4732A-47A 1W 5% Zeners	4/$1.00
13 Assorted *Brand New* Zener Diodes	1.00
50V 3 amp Epoxy Bridge	79¢
200V 30 amp Bridge	2.00
600V 4 amp Epoxy Bridge	1.49
600V 3 amp Stud Bridge	.89
SI-2 200V, 1.5A Gold Leads	15/$1.00
D1A-0030 30V DIAC	10/$1.00

MISCELLANEOUS

RG-174 Miniature 50 Ω coax	50'/4.25
WSU-30 Wire Wrap/unwrap tool	5.95
WSU-30M Modified Wrap/unwrap tool	6.95
BW-630 Battery Operated Wrap Tool	34.95
—Free Wire with any Wrap Tool—	
Miniature Square .05/100V Monolithic Cap	10/2.00
2N4036 90V, 1A PNP Silicon TO-5	.50
2N6101 80V, 10A NPN HI GAIN TO-220	.50
SE7005 250V, ½A NPN Silicon TO-5 W/Flange	.60
6.3 VCT, 1.2A Transformer F41X	2.49
12V, 1A Transformer with 6' Power Cord	2.88

Fairchild Linear Data Book. Huge volume has 17 chapters of data, applications and definitions. Probably the biggest volume of its type today $4.50ppd

Fairchild Bipolar Memory Data Book. ROMS, PROMS and RAMS are covered in this work with full engineering data. Price includes shipping! $3.75

Raytheon Linear Data Book. Covers many of the familiar as well as those for which Raytheon is the inovator. Contains valuable applications data as well as complete specifications $2.95ppd

Raytheon Micro Computer Components Book. Covers Raytheons' offerings in the field from the micro-puter to memories and adapters $2.95ppd

tri-tek, inc.
7808 North 27th Avenue
Phoenix, Arizona 85021
(602) 995-9352

T1

- Please give street address for UPS shipping when possible.
- C.O.D. NO parcel post C.O.D. UPS C.O.D. Add $1⁵⁰ to order.
- Any correspondence not connected with your order, please use separate sheet and include SASE for reply.
- Orders less than $10 ($15 foreign) please add $1 handling.
- Prices are subject to change without notice.
- Any refunds will be by check, not credit vouchers.
- Terms, Check, money order, credit card. Net 30 days to rated firms, schools and government agencies.
- If we should be temporarily out of stock on an item, it will be placed on back order. If we cannot ship in 30 days, you will be notified of the expected shipping date and furnished with a postage paid card with which to cancel your order if desired.
- We pay surface shipping only in USA, Canada and Mexico.
- For premium shipping (first class, special handling, etc.) add extra. Excess will be refunded.
- Foreign orders (except Canada and Mexico) estimate and add shipping. Excess will be refunded.

Charge card telephone orders ($20 min.) will be accepted 9-5:30 P.M. except weekends. Telephone 995-9352. No collect calls please.

ALDELCO ELECTRONIC CENTER

TRANSFORMERS
110/18 VAC 1 Amp............$1.50
110/12 VAC 300 mA............1.25
110/20-40 VAC 2 Amps..........2.50
110/5 VAC 6 Amps.............4.95
SPECIAL 110/12 VAC plug in
500 mA.......................1.50
For each 1-5 Xmfrs add $1.00 shipping

CAPACITOR ASSORTMENT
5 pf to .1 Discs 50 for $1.49
.047 400 Volt Ceramic Radial....$.10
50 MFD @ 150 VDC.......3 for $1.00
3 MFD @ 12 VDC........15 for $1.00
.01 30 Volt Disc.........25 for $1.00

POWER SUPPLY "KITS OF PARTS"
Model PS 1 5 Volt 6 Amps.....$17.95
Model PS2 + 15 Volt & – 15 Volt $16.95
Includes Schematic

PUSH BUTTON SWITCHES
S.P. N/O................3 for $1.00
S.P. N/O & N/C.................$.65
MOLEX PINS...........60 for $1.00

SPEAKERS
2'' 8 Ohm Round.........$ .65
2 ¼'' 8 Ohm Round...........75
2 ½'' 8 Ohm Round..........1.00
2 ½'' 100 Ohm Round..........1.25
add 10 cents per speaker shipping

Actual Size – 1.75" x 3.05"

National MA1003

BRIGHT .3 FLUORESCENT DISPLAY
Same unit supplied as original equipment in many new automobiles • 12 volt DC • Xtal time base • 12 hour format • completely assembled unit • dims to comfortable viewing when car lights are on • low standby power consumption. **ONLY! $19.95**

PLUS–FREE 3 Push Switches & choice of green, blue, or amber filter.

NEW extruded aluminum cabinet for surface mount of mA 1003 ....$6.95

100' Spool Green #30 wire
Wrap Wire $2.75
OK Wire Hand Tool
WSU 30 ....5.95
WSU30M (modified wrap) . 6.95
Battery operated wire-wrap tool
BW 630 Wraps #30 wire 34.95
Uses 2 C Batt. not inc.
2 General Electric C Batteries and plug-in charger 11.95

• RECTIFIERS
2 amp 50 volt 20 for $1.00
2 amp 1000 volt 10 for $1.00
2 amp 1500 volt .5 for 1.00
10 amp stud 50 volt . . 1.50
10 amp stud 600 volt . 4.50
40 amp stud 50 volt . . 1.20
40 amp stud 750 volt . 2.05
100 amp. stud 200 v. 8.50

BRIDGES
2 amp T05 50 volt.....35
2 amp T05 200 volt....50
2 amp T05 600 volt . . 1.25
3 amp. 50 volt 50
3 amp. 400 volt 1.10
25 amp. 200 volt 1.50
25 amp. 600 volt 5.50
25 amp. 1000 volt ... 8.50

VOLTAGE REGULATORS
TO220 Package $ 1.25 each

Positive $1.00	Negative $1.25
7805	7905
7806	7906
7808	7912
7812	7915
7815	7918

LM309H TO5.........$1.10
LM309K TO3..........1.10
LM723 14 pin or TO5....55

• FETS
40673 ....1.55
MPF102..........55
2N3819 35
2N5457 50
2N5458 50
2N5459 55
2N5485 50

• DARLINGTON
MPSA 13 80
MPSA 14 40
2N5306 50

• SCR
C 106A 55
C 106B 65
C 122B 85

LOGIC PROBE KIT
Aldelco is now the sole distributor of the **DIGAPEAKE-A** logic probe kit. Now you can buy direct and save. Probe measures logic 1, logic 0, and pulsing circuits conditions formerly sold for $14.95.
SPECIAL $11.95

ACCUKEYER KIT Similar to the famous ARRL Handbook version, Kit includes PC board, IC sockets, ICs, speaker switch and all parts and instructions.
ONLY $19.95

ACCUKEYER MEMORY KIT
Adaptable to many keyers. Can store 2 canned messages of 30 characters each. PC board IC sockets, ICs instructions and all parts. $19.95

CLOCK CHIPS
5313 ....3.49
5314 ....3.49
5316 ....3.95
5375 ....3.95
CT7001 ....6.95

RF DEVICES

2N2876	18W	200 MHz	TO60	$12.35
2N3375	3.0W	400 MHz	TO60	5.60
2N3553	2.5W	175 MHz	TO39	1.40
2N3866	1.0W	400 MHz	TO39	1.25
2N3926	7.0W	175 MHz	TO60	6.30
2N4427	1.0W	175 MHz	TO39	1.35
2N5589	3.0W	175 MHz	MT71	4.75
2N5590	10W	175 MHz	MT72	7.80
2N5591	25W	175 MHz	MT72	10.25
2N5913	1.75W	175 MHz	TO39	1.70
2N6080	4.0W	175 MHz	MT72	5.40
2N6081	15W	175 MHz	MT72	8.45
2N6082	25W	175 MHz	MT72	10.95
2N6083	30W	175 MHz	MT72	12.30
2N6084	40W	175 MHz	MT72	16.30
2N6094	4.0W	175 MHz	X106 PNP	6.60
2N6095	15W	175 MHz	X106 PNP	8.50
2N6096	30W	175 MHz	X106 PNP	10.35
2N6097	40W	175 MHz	X106 PNP	20.00
GE28	12W	50 MHz	X51	2.15
GE46	6.0W	27 MHz	TO5	6.42
GE215	5.5W	50 MHz	TO220	4.65
GE216	15W	50 MHz	TO220	8.97
GE226	10W	50 MHz	X81	2.00

ZENERS

1N746 to 1N759	400 Mw	ea. 25
1N4728 to 1N4764	1 watt	28
1N5333 to 1N5378	5 watt	2 10
1N2970 to 1N3005	10 watt	2 40
1N3305 to 1N3340	50 watt	4 75

2N3055	99
2N3904 or 2N3906	25
2N5496 or 2N6108	70
741 or 709 14 Pin DIP	25
555 Timer	.49
1N914 1N4148	15 for .99
1N34 1N60 1N64	10 for .99
CA 3028 Dif. Amp	1 50
LM309K Volt Reg	1 10
2N5401 (rep 2N4888)	.95
2N2369	.20
2N6103	89
LM709 or 741 Min DIP Op Amp	45
14 or 16 Pin IC Sockets	30

ALDELCO KITS

• NEW IMPROVED ALARM CLOCK KIT
Digital alarm clock • Six big .5 display LEDs • New on board AC Transformer • 12 Hour format with 24 hour Alarm • Snooze Feature • Elapsed time indicator.
A natural for cars, campers and mobile homes. Use on 12 volt dc with optional crystal time base (not including cabinet)
$19.95

• CRYSTAL TIME BASE KIT $4.95

• Cabinets In simulated walnut grain or black leather....................$4.95

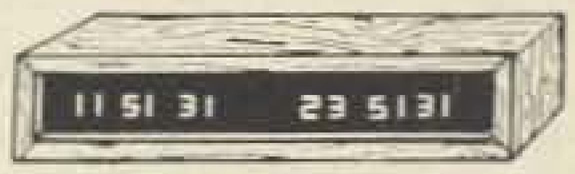
• Plastic Cabinets — blue, black, white or smoke......................$3.95

• RED CLOCK FILTERS..........$.60

• 12 or 24 hour DIGITAL CLOCK KIT uses .5 display LED. 5314 clock chip fits our standard cabinet. Freeze feature. $18.95

• Blinky Flasher Kit
PC board, 555 & all parts works on 9 volts — $2.50. Mouse button — $1.00

DUAL DIGITAL 12/24 HOUR CLOCK KIT NOW WITH A NEW WALNUT GRAIN WOOD CABINET



Features:
12 or 24 Hour Operation on either clock
Each Clock separately controlled
Freeze feature for time set
Easy assembly for clock and cabinet

MODEL ALD 5-W ONLY $49.95

Same kit as above in unassembled Black Plastic cabinet with Red Filter.

Model ALD 5-P
Only $44.95

Model ALD 7-P Dual 0.3 Nixie Tube Display With Deep Blue Plastic Cabinet with Blue Filter $34.95
Model ALD 7-W Dual Nixie in Wood Cabinet described above
add 5% shipping on all clock kits......................$39.95

ADJUSTABLE POWER SUPPLY KITS
5 to 15 Volts 500 mA..............................$6.95
12 to 20 Volts 500 mA.............................$6.95
add $1.00 per kit shipping

NEW TURNABLE HAM TV CONVERTER
Receive Fast Scan Amateur TV in the 420 to 450 MHz Band with any TV set. Low noise, high gain rf Amp with Varactor tuned input and outputs. Built in AC supply. Comes in two tone walnut & beige cabinet measuring 1 7/8" × 4 1/4" × 41/8".
Factory wired with 2 year guarantee..................$49.95
Kit (critical circuits prewired).........................$39.99

ALDELCO DOES IT AGAIN—ANOTHER UNBELIEVABLE VALUE—OUR BATTERY OPERATED FREQUENCY COUNTER & DIGITAL CLOCK NOW AVAILABLE—ASSEMBLED AND TESTED AT THE KIT PRICE ONLY! $99.95

COMPARE OUR FEATURES—COMPARE THEIR FEATURES THEN—COMPARE OUR PRICE AGAINST THEIRS

- Portable use when 8 AA Batteries are installed
- Comes in attractive Black & White metal cabinet
- Leds turn off to conserve battery power
- Freq. Range 100 Hz to 40 MHz Typical
- Mobile use 12 Volt DC input makes ideal mobile set up
- .00005% accuracy and rock stable
- Switchable from counter to clock without losing time
- 110 Volt Power Supply/Battery Charger option—perfect for use in Ham Shack
- Clock can be either 4 or 6 digit, 12 or 24 hour
- Clock keeps time even in off position
- Six big 0.4 Display leds.

8 Gould or GE size AA NiCad Batteries.............................$17.50
110 Volt AC Plug In Power Supply & Battery Charger.................4.95
Coming Soon 600 MHz Presealer

ALDELCO

2281A BABYLON TURNPIKE, MERRICK NY 11566
516-378-4555

Add 5% Shipping. Add $1.00 for orders under $10.00. Out of U.S.A., Mexico or Canada add 15% shipping and certified check or money order in U.S. Funds

A2

WHAT HAVE YOU MISSED?

The back issues of 73 are a gold mine of interesting articles . . . just take a look at what's been covered . . . every possible interest. This is the most important library you can have for hamming.

The supply of these back issues is very limited . . . and when these are gone, that will be it. Don't miss out by procrastinating. Treat yourself (or a ham friend) to a fantastic bargain.

JUNE 63. Surplus Issue: DMO-2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 bandspread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor-tuning, transistor cw monitor, BC-442 ant relay conversion, mobile loading coils, increasing Two-er selectivity, TV with the ART-26 tx, TRC-8 rx on 220, ARC-5 hf rx & tx, ARC-3 tx on 2M.

AUG 63. Battery-op 6M stn, diode noise gen, video modulation, magic T-R switch, ant gain, halo mods, cw breakin, VEE beam design, coax losses, RF wattmeter, TX Tube Guide, diode pwr supply, "Lunchbox" squelch, SWR explanation, vertical ant info, info on Windom ant.

OCT 63. WBFM transceiver ideas, HF propagation, cheap fone patch, remote-tuned Yagi, construction hints, ant coupler, $5 Vertical, filament xformer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mike amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad Issue: 432 Quad-quad quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half-quad, three el quad, 20M quad, tiltover quad, easy-to-erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "dB," HF SSB/cw rx, geometric circuit design, GSB-201 transceive, FET converter for 10-20M, hi-pass rx filters.

JULY 67. VE ham radio, VEØ hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, G4ZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodics, rotatable dipole, gamma-match cap, old-time dxing, modern dxing.

JUNE 68. Surplus Issue: Transformer tricks, BC-1206 rx, APS-13 ATV tx, low voltage dc supply, surplus scopes, FM rig commercial xtal types, Wilcox F-3 rx, restoring old equipment, 75A1 rx mods, TRA-19 on 432, freq counter uses, transceiver pwr supply, uses for cheap tape recorders, Surplus Conversion Bibliography, RT-209 walkie on 2M, ARC-1 guard rx, RTTY tx TU.

JULY 68. Wooden tower construction, tiltover towers, erecting a telephone pole, IC AF osc, "dB" explained, ham club tips (Part 1).

SEPT 68. Mobile vhf, 432 FET preamps, converting TV Tuners, xtal osc stability, parallel Tee design, moonbounce rhombic, 6M xciter (corrections Jan 69), 6M transceiver (corrections Jan 69), 2M dsb amp, ham club tips (Part 3).

NOV 68. SSB xtal filters, s... state troubleshooting, IC freq cou... ...ny errors & omissions), "cv" tr... ...s, space comm odyssey, pulsar ... wire ants, 40M transistor cw tx ... 48M double conversion, multifun... ...r, copper wire specs, thermistor a... ...tions, hi-voltage transistor list, ham club tips (Part 5). SOLD OUT

JAN 69. Suppressor compressor, HW-12 on 160, beam tuning, AC voltage control, 2M transistor tx, LC power reducer, spectrum analysis info, 6M transistor rx, operating console, RTTY autostart, calculating osc stability, lo-pwr 40 cw tx, sequential relay switching, sightless operator's bridge, ham club tips (Part 7).

FEB 69. SSTV camera mod for fast-scan, tri-band linear, selective af filter, unijunction transistor info, Nikola Tesla biography, mobile installation hints, extra-class license study (Part 1).

MAR 69. Surplus issue: TCS tx mods, cheap compressor/amp, RXZ calculations, transistor keyer, better balanced modulator, transistor oscillators, using blowers, halfwave feedline info, Surplus Conversion Bibliography, extra license study (Part 2).

APR 69. 2-channel scope amp, rx preamp, Two-er PTT, variable DC load, SWR bridge, 100 kHz marker gene, some transistor specs, SB-610 monitorscope mods, portable 6M AM tx, 2M converter, extra license study (Part 3).

MAY 69. 2M Turnstile, 2M Slot, rx attenuator, generator filter, short VEE, quad tuning, using antennascope, measuring ant gain, phone patch regs, SWR indicator, 160M short verticals, 15M antenna, HF propagation angles, FSK exciter, KW dummy load, hi-power linear, extra license study (part 4), all band curtain array.

JUNE 69. Microwave pwr generation, 6M ssb tx, 432-er tx/rx, 6M converter, 2M 5/8 wave whip, UHF tv tuners, ATV video modulator, UHF FET preamps, RTTY monitorscope, extra license study (part 5), building uhf cavities, mini-VEE for 10-20M, vhf vfo.

JULY 69. AM modulator, SSTV sig gen, 6M kw linear, 432 KW amp, 432-er tx/rx, 6M IC converter, radio controlled models, RTTY IC TU, audio notch filter, VRC-19 conversion, tube substitution, 2M transistor xciter, extra license study (part 6), hf FET vfo.

AUG 69. FET regen for 3.5 MHz up, FM crystal switching, 5/8 wave vertical, introduction to ICs, RTTY tone gen, good/bad transistor checker, 2M AM tx, measure transistor Ft, 160M propagation, triac applications, simple IF sweep gen, transistor keyer, SB-100 on 6M, xtal freq measurement, extra license study (part 7), FM deviation meter, qrp am 6M tx, circular quads, FM noise figure, transistor parameter tracer.

SEPT 69. Tunnel diode theory, majic tee, soldering techniques, wave travel theory, cable shielding, transistor theory, AM noise limiter, AFSK gen, transistor amp debugging, measure meter resistance, diode-stack pwr supply, transistor testing, 2½W 6M tx, HX-10 neutralizing, capacitor useage, radio propagation, AM mod percentage, extra class license study (part 8), 3-400Z linear, ATV vidicon camera, 2 transistor testers, FET compressor, rf plate choke.

OCT 69. Super gain 40M ant, FET chirper, telephone info, scope calibrator, thyrector surge protector, slower tuning rates, identify calibrator harmonics, FM adaptor for AM tx, CB sets on 6M, proportional control xtal oven, xtal filter installation, Q-multiplier, transceiver pwr supply, extra class study (part 9).

NOV 69. NCX-3 on 6M, IF notch filters, dial calibration, HW32A external VFO, 6M converter, feedline info, rf z-bridge, fm mobile hints, umbrella ant, 432-er tx (part 1), pwr supply tricks with diodes, transistor keyer, transistor bias design, xtal vhf sign gen, electronic variac, SB33 mods, extra class study (part 10), SB34 linear improvements.

DEC 69. Transistor-diode checker, dummy load/attenuator, tuned filter chokes, bandswitching Swan 250 & TV-2, 88mh selectivity, match exercizes, rtl xtal calibrator, transistor pa design, hv mobile p.s., 1-10 gHz freqmeter, CB rig on 6M, extra license study (part 11), 1970 buyer's guide.

JAN 70. Transceiver accessory unit, bench power supply, SSTV color method, base-tuned center-loaded ant, 6M bandpass filter, extra license study (part 12, rectifier diode useage, facsimile info.

FEB 70. 18-inch 15M dipole, 6M converter, high-density pc board, camper-mobile hints, 2M freq synthesizer, encoding/decoding for repeaters, DX-35 mods, panoramic vhf rx, variable-Z HF mobile mount, extra license study (part 13), linear IC info, qrp 40M tx, IC Q-multiplier.

MAR 70. Gdo applications, charger for drycells, FM freq meter, pc board construction, ham fm standards, cheap rf wattmeter, multifreq fm osc, "IF" system modules (part 1), Six-er mods, gdo dip lite, Motorola 41V conversion, cw monitor, buying surplus logic, SSQ-23A sonobuoy conversion, GRC-9 rx/tx conversion, extra class study (part 14), intro to vhf fm.

APR 70. Noise blanker, 2M hotcarrier diode converter, repeater controller, understanding COR repeater, 7/8-wave 2M ant, extra class study (part 15), inexpensive semiconductors, removating surplus meters, linear amp bias regulator, hi performance if amp & agc system, SSB bfo for shortwave radio, vacuum tube load box, general fm dope & repeater guide, megger-ing your ant.

MAY 70. Comments on "fm docket" #18803, future of cw, fm-am rx aligner, 5/8-wave verticals, using 2M intelligently, auto burglar alarms, pwr supplies from surplus components, "IF" system modules (part 2), vhf FET preamps, educated "idiot" lites, postage stamp 6M tx, extra class study (part 16), Bishop IFNL, low band police monitor, mobile cw tx, Wichita auto patch.

JUNE 70. DDRR ant, vfo circuit, remote SWR indicator, indoor hf vertical, two rx on one antenna, environment & coax loss, 2 el trap verticals, buying surplus, two 40M qrp tx, 21dB 2M beam, extra class study (part 17).

DEC 70. Solid state vhf exciter, delta fre control for SSB, 2M transistor FM tx, HW100 offset tuning, "little gate" dipper, 3-500Z hf linear, general class study (part 5), "transi-test" (no good – errors!), transistor p.s. current limiter.

JAN 71. Split fones for dxing, Heath Ten-er mods, cw duty cycle, repeater zero-beater, HEP IC projects, 10-15-20M parabolic ideas, lightning protection, IC rx accessory, attic ants, double-balanced mixers, permanent marker tool, ham license study questions.

FEB 71. Metal locator, varactor theory, AFSK unit, SSTV patch box, ATV hints, RTTY tuning indicator, tone encoder/decoder, 220 MHz converter, SSTV magnetic deflection, IC code osc, 6M tx beeper, general class study (part 6), RTTY intro, perf-board terminal, low-ohmmeter.

MAR 71. IC audio filter, IC 6M converter, trap vertical ideas, digi counter info, surplus equipment identification, hf linear, simple fone patch, repeater audio mixer, digi RTTY accessories, coathanger gndplane, general class study (part 7).

APR 71. Intro to fm, noise b...ker, repeater problems, Motorola HT... ...icrowave repeater linking, di... ...uneable 2M fm rx/tx, rep... ...s, fm marketplace, meter ev... ...ctor modulator, simple sig gen, touc... ...e hookup, hf preselector, 10M 12W tx. SOLD OUT

MAY 71. 75M mobile whip, 2M preamp, transistor amp design, 10M dsb tx, portable fm transceiver directory, audio compressor-clipper, transistor LM freqmeter, 450 MHz link tx, simple af filter, 1 tube 2M transceiver, surplus 2M power amp, general class study (part 8).

JUNE 71. 2M beam experiments, 3 el 2M quad, multi-band dipole patterns, weather balloon vertical, pocket-pager squelch, two-er vfo, tuning mobile whips, transistor pwr supply, capacity decade box, 40M gain ant, general class study (part 9).

JULY 71. IC audio processor, audio sig gen, cw filter, 2M fm osc, 2M collinear vertical, FM supplier directory, Motorola G-strip conversion, transistor beta tester, general class study (part 10).

AUG 71. Ham facsimile (part 1), 500 Watt linear, dimensions for July collinear, 4-tube 80/40 station, vfo digi readout, Jupiter on 15M, general class study (part 11), pink ticket wavemeter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor agc, multichannel HT-200, ham facsimile (part 2), causes of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heat sinking, IC pulse gen, fone-patch isolation, hcd wattmeters.

OCT 71. Emergency repeater cor, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3-el 75M beam, motor-tuned gnd plane, 2M gain vertical, transistor biasing, split-site repeater, fox-hunting, audio filter, transistor/diode tester, xtal tester, 6M kw amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp compressor, Six-er mods, fone patch, Two-er info, solar info, SCR regulator for HVPS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigartube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nano-ampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc-diode converter, rtl decade and nixie driver, plus-minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY selcal, IC trf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi-Z voltmeter, Nikola Tesla story, vhf swr meter, transistor regen rx, 432 SSB transverter, AC arc welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M gndplane, IC logic demonstrator, overload protection, if/rf sweep generator, digi freq counter, aural tx tuning.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT-220 touchtone, 3-el 20M yagi, 50 MHz freq counter, speech processor, 2-tone gen, fm test set, tilt-over tower, 6M converter using modules, tuneable af filter, six band linear, 10M IF tuner, diode noise limiter, cw/ssb agc, HW22a transceiver 40M mod, HAL ID-1 mod.

FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, act... ...r, time freq measurement (part 2) ... ...ing control, SSTV circuits f... ...converter using modules, r... ...etering, FET biasing, freq cou... ...p, TR22 hi-power mod, transistor ...ower amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info. SOLD OUT

APR 73. FM deviation meter, 2M FET preamp, two 2M power amps, repeater control (part 1), repeater licensing, European 2M fm, fm scanner adaptor, RCA CMU15 mods, lightning detector, cb alignment gadget, transistor rf power amps (part 2), repeater economics.

JUNE 73. 220 MHz sig gen, uhf power meter, repeater licensing info, RTTY autoswitch, 40M hybrid vfo tx, ant polar mount, 10-15-20M quad, K2OAW counter mods, double coax ant, ham summer job, tone decoder, field strength meter, nicad battery pack, ohm meter, FCC regs (part 1).

AUG 73. Log-periodics (part 1), tone burst gen, rf power amp design, transistor radio intercom, 160M ant, SSTV monitor, low cost freq counter, VOM design, qrp 40M tx, 432 MHz exciter, fm audio processing, FCC regs (part 3).

SEPT 73. Repeater control system, log periodics (part 2), 2M rx calibrator, PLL ic applications, TT pad hookup, Heath HW7 "s" meter, Oscar-6 doppler, 2M coaxial ant, 2M converter, IC keyer, measure ant Z, FCC regs (part 4).

OCT 73. GE Pocketmate mods, microwave freq measurement, CA3102E 2M frontend, 2 kw hf linear, rf wattmeter, meter repair, 60/40 dipole, IC "hi" gen, vhf freq multiplier, FCC regs (part 5).

NOV 73. 450 MHz exciter, intro to ATV circuits, nicad voltage monitor, autopatch connections, IC meter amplifier, TR22 ac supply, indoor vertical, IC af filter, momentary power failure protection, 160M ant acoupler, Motorola HT info, SSTV ISB, Class-B af amp, FCC regs (part 6).

DEC 73. Code speed display, 2M kw amp, IC keyer, 8038 waveform gen, helical resonator design, sensitive rf voltmeter, proximity control switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, cw filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amps, scope sweep gen, 15/20M vertical, telephone line control system, pc board construction, var-Q af filter, blown-fuse indicator, 40m cw stn with Ten-Tec modules, simple preamp compressor, single IC rx, "432-er" final assembly, transistor keying circuit, 7 segment readout with nixie driver.

APR 74. Vox for repeaters, tone-operated relay, hf transverter, 10-to-2m tx converter, remote control panel for scanner, RCA fm tx tuning, subaudible tone gen, FCC regs (part 9), Repeater Atlas.

MAY 74. Cd car ignition, audio compressor info, interference suppression for boats, auto burglar alarms, 2m ic preamp, 10m fet converter.

JULY 74. 4-1000A linear, universal freq gen, universal afsk gen, 555 IC timer, 80M phased array, 135 kHz-432 MHz preamps, 10M qrp am tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 450 MHz FET preamp, use gdo to find "c", Trimline tt pad hookup, R390 & R392 rx mods, tracking cw filter, aural voltmeter, universal regulated supply, sstv scan converter, ttl logic problems, ID timer.

SEPT 74. MOSKEY electronic keyer (part 1), ex warning system, Heath 10-103 scope mods, qrp 6M am tx, rf speech clipper, audio noise limiter, wx satellite on SSTV monitor, universal IC tester, miniature rig construction, tower construction, infinite rf attenuator, electronic

(More)

photo flash ideas, IC "select-o-ject."

OCT 74. Microtransistor circuits, synthesized HT-220 (part 1), repeater government regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi power lo pass filter, 6M preamp, 3-wire dipole, ATV sync gen, NCX-5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas, TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 index.

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar 7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16 wave 2M ant, Hallicrafters SX-111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T-44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

There's little to get stale in back issues of 73 (our magazine is not padded . . . like others . . . with reams of activity reports), you or "giftee" have a fantastic time reading them. Most of the articles are still exciting to read . . . and old editorials are even more fun for most of the dire predictions by Green have now come to pass. Incentive licensing was every bit the debacle he predicted . . . and more. You'll really get a kick out of the back issues.

OCT 75. A deluxe TTY keyboard (part 1), Op Amps: a basic primer, an introduction to microprocessors, 2m Synthesizer (conclusion), Satellite Fax System (conclusion), regulated supplies (dispelling the mystery), Digital Logic made simple, FCC interview, a contest uP system, digital clock time bases, the operating desk, QRP 432, ham PR.

NOV-DEC 75. Blockbuster double issue! Flip-flops exposed, breakthrough in fast scan ATV, strobing displays is cool, the tuned lunch box (antenna tuner for HF transceivers), a deluxe TTY keyboard (part 2), the 127' rotating mast, less than $100 multi-purpose scope for your shack (part 1), predicting third order intermod, feedline primer, QRMing the Third Reich, why tubes haven't died, instant circuits — build your own IC test rig, the K2OAW synthesizer PROM-oted, a ham's intro to microprocessing, Ground Fault Interrupter (a keep alive circuit for yourself), a $1 strip chart recorder, an even simpler clock osc., the Fun City surplus scene, updating the Heath IB-1101 counter, 256 pages!

JAN 76. Clocks — Really Simplified, De-Str... your Ham—M, An Automatic Dialer for the Deluxe Mi... ...ing Dead Nicads to Life, The Computer QSO Ma... ...ered Counter, Save Money on Coax, Ho... ..., Using a Bargain Surplus Keyboard, Impr... with the FRAMER, and more. The first 73 in new lar... ...at (Includes 1975 Index to 73). SOLD OUT

FEB 76. Build a Starfleet Communicator — Trekkies Special, Synthesized IC Frequency Standard, You Can Make Photo PC Boards, How's Your Speech Quality?, ASCII to Baudot Converter, RTTY Autocall — the Digital Way, Improving the FT-101, Night DXing on 10 and 15m, Really Soup Up Your 2m Receiver, Put Your SB-10 on 160m.

MAR 76. Special Surplus Issue — ... Receiver Strips, Surplus Circuit Boa... ...Space Age Jumper, A PC Board Bona... ...Is It All Gone?, Stereo — A New Type o... ...ter, Build This Exciting New TVT, The Smart Power Supply, How to Use Surplus Pots. SOLD OUT

APR 76. Special FM Issue — A Program... , Put That AM Rig on FM, A COR for your Rec... Amplifier, Build a 220 MHz Repeater ... Your Regency, Long Distance C... ...ew TT Decoder, One IC Tone Burster, Th... ...ater, A Versatile TTY Generator, The PLL — Exp... , HR-22 Tips, Computers Are Ridiculously Simple. SOLD OUT

MAY 76. Special Antenna Issue — The Magnificent Seven Microhelix, An Allband Inverted Vee, Closed Loop Antenna Tuning, The 75-80m Broadbander, The Magic of a Matchmaker, How to Coax Your Antenna, 40m DXing — City Style, The Secret 2m Mobile Antenna, An Inverted Vee for 160/80m, The Dipole Dangler, Amateur Weather Satellite Reception, Scan Your HR212, A Very Cheap I/O — the MOdel 15, Code Converter Using PROMs, A Nifty Cassette-Computer System, The Ins and Outs of TTL, Build a CW Memory, 5/8 Wave Power for Your HT, 555 Timer Sweep Circuit for SSTV, AM is Not Dead — It Never Existed at All, Computer Languages — Simplified.

JUN 76. VHF Special — Super COR — Digital of Course!, Touchtone Decoder — Using a Calculator Readout, Simple Amateur TV Transmitter, Amateur TV Receiving System, Mobile Autodialer, Autocall '76 — Using a Touchtone Decoder, Build This Lab Type Bridge — and Measure Transformer Impedances, How Those Triangle Things Work — a Sort of Op Amp Handbook, Those Exciting Memory Chips — RAMs, ROMs, PROMs, etc., ASCII/Baudot with a PROM — for Ribbonless RTTY on Computers, Aim Your Beam Right — With a Programmable Calculator.

JUL 76. Perfect CW — Drive 'em Crazy with the Keycoder I, The Mini-Mini Allband QRP Rig — A Mighty 7 Watts, A Fun Counter Project — Under $50, Build a FAX from Scratch — Then Get Satellite Pictures and Other Things, Der Repeatermeister — Repeater Control with ID, The Giant Nixie Clock, Creative SSTV Programming, CW Regenerator/Processor, What's Up on 156 MHz?, TT Pad for the Wilson HT, Power Supply Testing — To Save Your Digital Circuits, A RTTY/Computer Display Unit, Your Computer Can Talk Morse, Gain for Your HT — a Half Wave Whip, The Super Transmatch, Simple VHF Monitor.

AUG 76. How Do You Use ICs? — Fundamentals, Surprising Miniature Low Band Antenna — the DDRR (Part I), MINI-MOS — the Best Keyer Yet?, The Skinflint's Delight Breadboard — Cheap Imitation of a Commercial IC DIP Board, More PLL Magic, The Logic Grabber — Selected Interval Logic Tracer, Global Calculations for the DXer — Using a Hand Calculator, Instant Counter Calibration — Using Your TV Set, Simple 450 MHz Rig — Go ATV With a $42.50 Module, The First Computer Controlled Ham Station — Grand Prize Winner, The Which Chip Dilemma! — 4, 8, 12, or 16 bits: pros and cons, Meaningful Conversations with your Computer — What All Those Mysterious Languages Are All About, A Baudot Monitor/Editor System, A Logic Probe You Can Hear, Satellite Orbit Predicting — Using a Pocket Calculator, FSK with the SB-401, Build the Safari RTTY Terminal, El Cheapo Signal Tracer — Test Gear for the Cheapskate.

SEP 76. The Surprising DDRR Low Noise Antenna (part II), Ultrasimple Regulation with New IC — Power Supply Design Greatly Simplified, Can an Indoor Antenna Work — Making the Best Out of a Bad Bargain, Inexpensive 12 Volts for Your Base Station, A Test Lab Bonanza — Using a Transistor Radio, Protect Your VHF Converter — Novel Antenna Relay, Ridiculously Simple RTTY System, How to Catch a CBer, A 450 MHz Transceiver for Under $130, Space Age Jumper II, PROM Memory Revisited, Eight Trace Scope Adapter, The PROM Zapper, Sneaky Baudot — With an ASCII Keyboard!, Simple Graphics Terminal — Using surplus, Counters are Not Magic — They're Simple.

OCT 76. Build a Weird 2 Band Mobile Antenna, Build a Counter for Your Receiver, How do You Use ICs? (part II), QRP Fun on 40 and 80 — Have a Real Ball with Just 5 Watts, The Hybrid Quad — Low Windload, Expense, Hassle!, Frequency Detector for Your Counter, Programmable CW ID Unit — for RTTY, Repeaters, Mobile, etc., New ICs for the Counter Culture — Simpler Counters with Less Used Power, Is My Rig Working or Not? — Build an Effective Radiated Field Meter and Know!, Quickie Collinears for 15 and 10 — a Satisfaction Guaranteed, Build a Super Standard — Goes Right Down to 1 Hz, The Incredible Lambda Diode, Mechanical RTTY Buffer, Have You Used a Triac Yet?, How to Interface a Clock Chip — Baudot, BCD, or ASCII Conversion, A TTL Tester — Great for Unmarked Bargain ICs, The New Ham Programmer — Making Those Confounded uPs Work, BASIC? What's That? — the Basics of BASIC, The Soft Art of Programming (part I).

NOV 76. Blockbuster 288 pg issue! Cordless Iron Tips, Bicycle Mobile, Build a Simple Lab Scope — Costs Less Than $70!, Get on Six with Surplus — The El Cheapo RT-70 is a Natural, The Beam Saver — Rotor Memory System, Updated Universal Frequency Generator, The Shirt Pocket Touchtone, Liquid Crystal Display Guide, Self-Powered Mike Preamp, The Wind Counter, The 538 is Not Dead!, The Amazing Inverted L — Antenna for 20, 40, and 80m, Battery Chargers Exposed, How Do You Use ICs (part III), Thirty Years of Ham RTTY, Big Noise Burglar Alarm, Dandy Digital Dial Decoder, Weather Satellite Display Control, Ham Time-Sharing is Here for You!, The Soft Art of Programming (part II), OSCAR Orbits on Your Altair, ASCII/Baudot Converter for Your TVT, The Smoke Tester — Power Supply Tester, The Man Who Invented AC — Tesla, the Greatest Pioneer of Them All!, Baudot to ASCII — You Want to Learn Programming?, Baudot and BASIC — an Interpreter for a Baudot Computer, Toward a More Perfect Touchtone Decoder, Using a Wireless Broadcaster, The Quiet Spy — Amateur Uncovers Spy Ring in the US!, The Benefits of Sidetone Monitoring — And How to Do It.

DEC 76. Go Tone for Ten — Simple Subaudible Encoder, World's Simplest Five Band Receiver?, How Do You Use ICs? (part IV), A Super Cheapo CW IDer, The ZF Special Antenna, CT7001 Clockbuster, Saving a CBer, A Ham's Computer, What's All This LSI Bunk? — an Ostrich's Eye View of the Microprocessor, The Soft Art of Programming (part III), Put Snap into Your SSTV Pictures — Using a $20 Frequency Standard, What's all This Wire-Wrap Stuff? — Talk About Cold Solder Joints!, Exploding the Power Myth, Exploding the SWR Myth, The IC-22 Walkie — Portabilization with Nicads, Watch DX with a Spectrum Analyzer, DXing with a Weather Map.

HOLIDAY 76. 55 article issue! An Inexpensive 400 Watt HF amplifier, How Do You Use ICs? (part V), Mobile Smokey Detector — 10.5 GHz: Use It or Lose It!, Add RIT to Your Transceiver, DXpedition: Memories for a Lifetime — Reflections of HK1TL, Design Your Own QRP Dummy Load, Failsafe Super Charger — Multi-rate too!, The Amazing 18" Antenna for 160m, Replacing the Knife Switch — Simple TR System for the Novice, Now You Can Synthesize — the VHF Engineering Approach to 2m Happiness, Hutchinson's Remedy — the Chirpless CW Machine, The Mod Squad Does the Pocket Scanner — Radio Shack Pro-4 Update, TR-22 Mod Squad, What Computers Can and Can't Do, A Ham Shack File Handler — Program in BASIC for QSLs, Repeaters, etc., Print Your Own Logbook — On Your Nearest Computer, Shoeing Your HT, Cash In on the CB — Installation for Fun and Profit, Tuning Those Big Antenna Coils, The 2m Mod Squad Tackles the Weather Radio — and Wins!, Hamming by Laser, A 60 Foot Antenna on a 20 Foot Lot — Solving a 40m Novice problem, Dual Voltage Power Supply, An Autopatch Busy Signal, Inside the GLB — a Gutsy Look at a Synthesizer, How to Bug an Automatic Keyer, A 450 Duplexer — That Fits in Your Car, Will Silver-Zinc Replace the Nicad?

BACK ISSUES

73 MAGAZINE CLASSICS

ALL 1977 ISSUES ARE STILL AVAILABLE!

☐ JUNE 63 ☐ AUG 63 ☐ OCT 63 ☐ FEB 64 ☐ MAY 67 ☐ JULY 67 ☐ OCT 67 ☐ JUNE 68 ☐ JULY 68 ☐ SEPT 68 ☐ JAN 69 ☐ FEB 69 ☐ MAR 69 ☐ APR 69 ☐ MAY 69 ☐ JUNE 69 ☐ JULY 69 ☐ AUG 69 ☐ SEPT 69 ☐ OCT 69 ☐ NOV 69 ☐ DEC 69 ☐ JAN 70 ☐ FEB 70 ☐ MAR 70 ☐ APR 70

☐ MAY 70 ☐ JUNE 70 ☐ DEC 70 ☐ JAN 71 ☐ FEB 71 ☐ MAR 71 ☐ MAY 71 ☐ JUNE 71 ☐ JULY 71 ☐ AUG 71 ☐ SEPT 71 ☐ OCT 71 ☐ NOV 71 ☐ AUG 72 ☐ SEPT 72 ☐ OCT 72 ☐ NOV 72 ☐ DEC 72 ☐ JAN 73 ☐ APR 73 ☐ JUNE 73 ☐ AUG 73 ☐ SEPT 73 ☐ OCT 73

☐ NOV 73 ☐ DEC 73 ☐ FEB 74 ☐ APR 74 ☐ MAY 74 ☐ JULY 74 ☐ AUG 74 ☐ SEPT 74 ☐ OCT 74 ☐ NOV 74 ☐ DEC 74 ☐ FEB 75 ☐ APR 75 ☐ AUG 75 ☐ SEPT 75 ☐ OCT 75 ☐ NOV/DEC 75 ☐ JAN 76 ☐ FEB 76 ☐ MAR 76 ☐ MAY 76 ☐ JUNE 76 ☐ JULY 76 ☐ AUG 76 ☐ SEPT 76 ☐ OCT 76 ☐ NOV 76 ☐ DEC 76 ☐ HOLIDAY 76

☐ $1.50* — single issues (indicate your choice at left)
☐ $12* — 10 issues (indicate your choice at left)
☐ $20* — 25 issues (indicate your choice at left)
☐ $10* — 25 issues — our choice
☐ Cash, check, money order enclosed

Name________

Call________

Address________

City________

State______ Zip______

Charge: ☐ American Express ☐ BankAmericard ☐ Master Charge

Credit card________

Expiration date________

Signature________

*Add $1.00 shipping and handling charge

SEND TO: 73 BACK ISSUES PETERBOROUGH NH 03458 2/78

RADIO BOOKSHOP

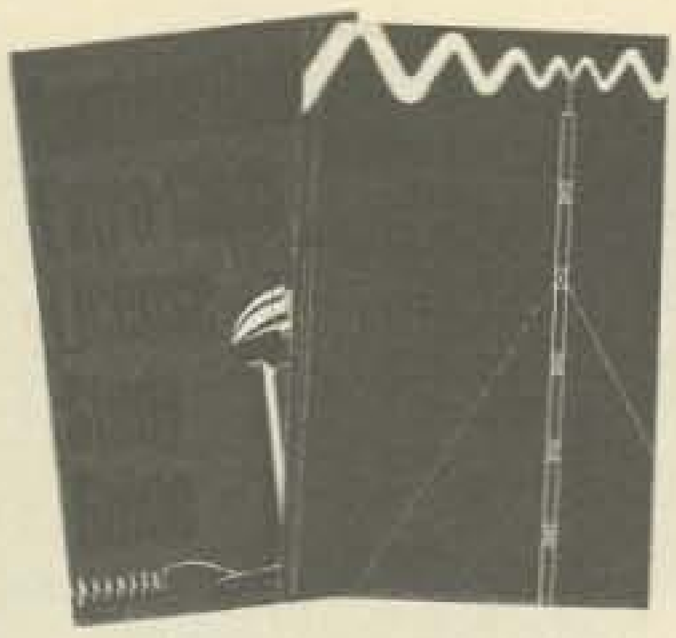
The *ONLY* Complete License Study Guides

● **NOVICE STUDY GUIDE** – Here is a completely new study guide and reference book for the potential ham. This is not a question/answer memorization course. Electronic and radio fundamentals are presented and explained in an easy-to-understand fashion, preparing the beginner for the Novice exam. Includes the latest FCC amateur regulations, as well as application forms. Easily the best path into the exciting world of ham radio! $4.95.*

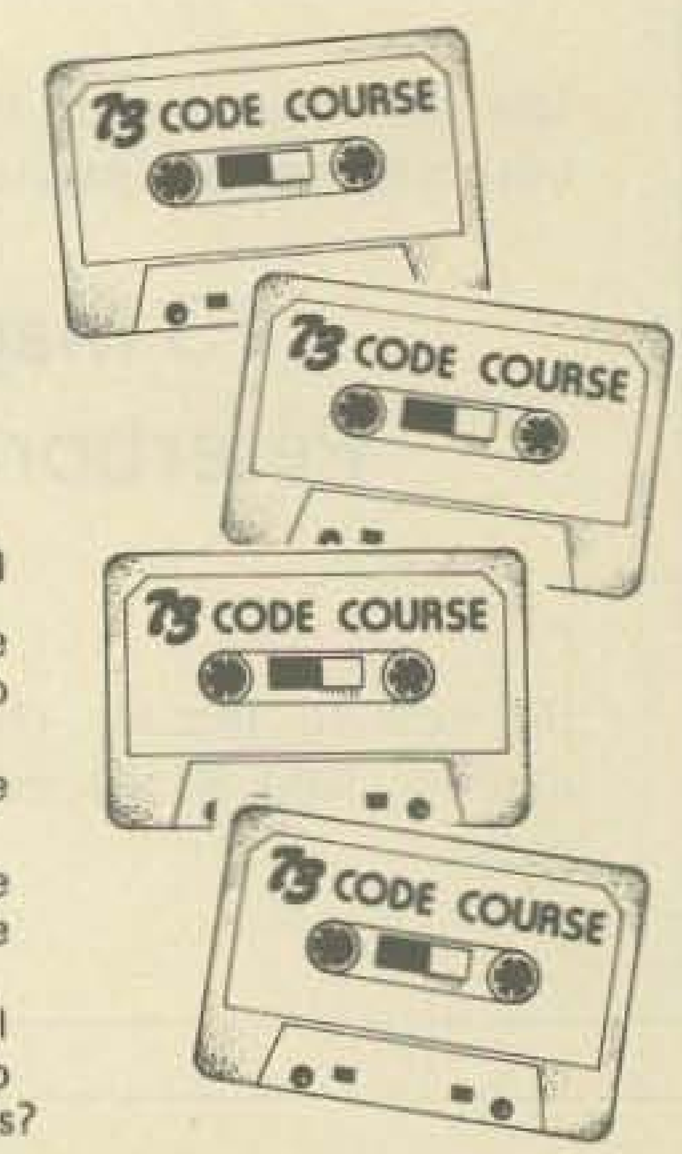
● **GENERAL CLASS STUDY GUIDE** – A complete theory course for the prospective General or Technician. This reference explains transistor, amplifier, and general radio theory, while preparing the Novice for the "big" ticket. After getting your ticket, you'll use this guide again and again as an electronic reference source. Not a question/answer guide that becomes dated when the FCC updates the amateur exams. $5.95.*

● **ADVANCED CLASS STUDY GUIDE** – Ready to upgrade your license? To prevent retaking the FCC theory exam, you need the *73* Advanced theory guide. SSB, antenna theory, transmitters, and electronic measuring techniques are covered in detail in this easy-to-follow study guide. Special modes and techniques, such as RTTY, are also treated. An engineering degree is *not* necessary to master Advanced theory – try this book before visiting the examiner's office! $3.95.*

● **EXTRA CLASS LICENSE STUDY GUIDE** – Before going for your 1 x 2 call, it pays to be a master of the Extra class electronic theory. This study guide is the logical extension of the *73* theory course. All the theory necessary to pass the exam is presented. Antennas, transmission lines, swr are discussed, as well as noise, propagation, and specialized communication techniques. This book is not a classroom lecture or memorization guide, but rather a logical presentation of the material that must be *understood* before attempting the Extra exam. Save yourself a return trip to the FCC and try the *73* method first! $5.95.*



novice theory tapes



Startling Learning Breakthrough

You'll be astounded at how really simple the theory is when you hear it explained on these tapes. Three tapes of theory and one of questions and answers from the latest Novice exams give you the edge you need to breeze through your exam.

73 is interested in helping get more amateurs, so we're giving you the complete set of our tapes for the incredibly low price of ONLY $15.95.*

Scientists have proven that you learn faster by listening than by reading because you can play a cassette tape over and over in your spare time – even while you're driving! You get more and more info each time you hear it.

You can't progress without solid fundamentals. These four hour-long tapes give you all the basics you'll need to pass the Novice exam easily. You'll have an understanding of the basics which will be invaluable to you for the rest of your life! Can you afford to take your Novice exam without first listening to your tapes?

FOUR TAPES for $15.95 $4.95 EACH

NEW CODE SYSTEM – Four Speeds Available

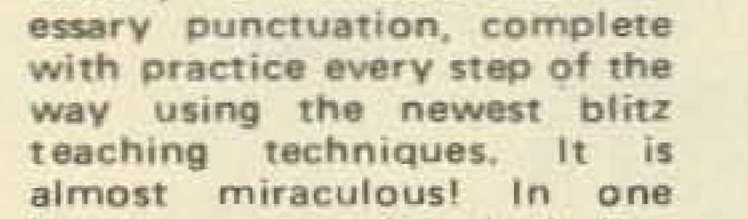
5 WPM This is the beginning tape for people who do not know the code at all. It takes them through the 26 letters, 10 numbers and necessary punctuation, complete with practice every step of the way using the newest blitz teaching techniques. It is almost miraculous! In one hour many people – including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

6+ WPM 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. Practice this one during lunch, while in the car, anywhere, and you'll be more than prepared for the easy FCC exam.

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

20+ WPM 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. No one who can copy these tapes can possibly fail the FCC test. Remove all fear of the code forever with these tapes.

ONLY 4 for $15.95!* 73 is in the publishing business, not tapes, so these are priced much lower than anyone else could sell them. Have you ever seen one hour cassettes for under $6? For 1st class mail add 25¢ per tape ordered.



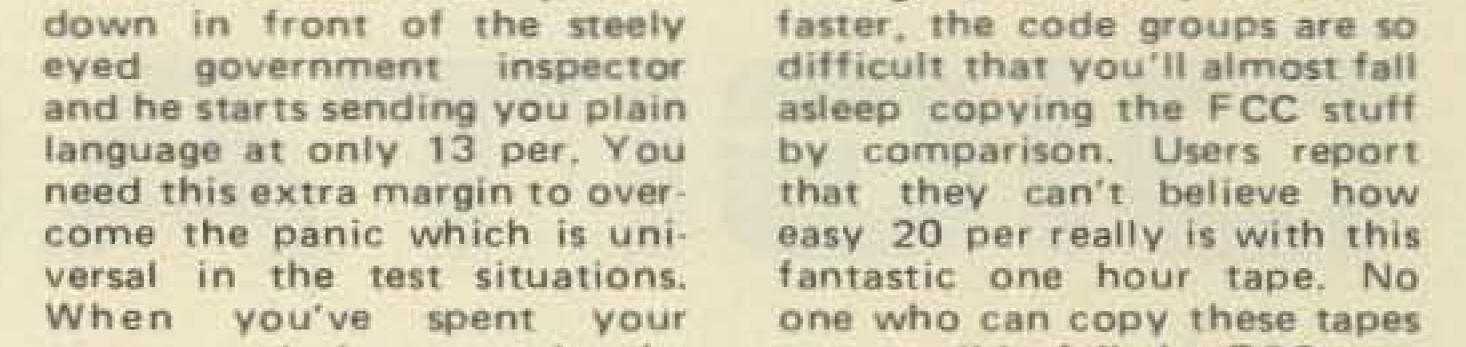
LIBRARY SHELF BOOK BOXES
$2.00 each*
2/$3.00* ● 8/$10.00*

BUMPER STICKERS:
RADIO AMATEURS TALK TO THE WORLD!!
AUTHORIZED VEHICLE
SUPPORT YOUR LOCAL POLICE
50¢ each*; any 3 for $1.00*

BINDERS – Red Binders with gold lettering keep your 1976 & 1977 73s safe from being lost or damaged. Each binder holds 12 issues. $6.00 ea.,* 2 for $11.00.*

Back Issue Bundle! 73 Magazine Classics, issues containing hundreds of articles & projects. Great for nostalgia buffs. 20 copies (all different) for $12.00.*

QSLs!



Style X – Black type, blue satellite

Style W – Black type, blue world

Style Y (yellow card; black type)

Only $8.95 for 250
$13.95 for 500*

QSO information is standard form on back of all cards. (DOMESTIC ORDERS ONLY) Allow 6-8 weeks for delivery.

Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to:
73 Radio Bookshop ● Peterborough, NH 03458. Be sure to include check or detailed credit card information.
* Add $1.00 shipping & handling charge for each order. Note: Price subject to change on books not published by 73 Magazine.

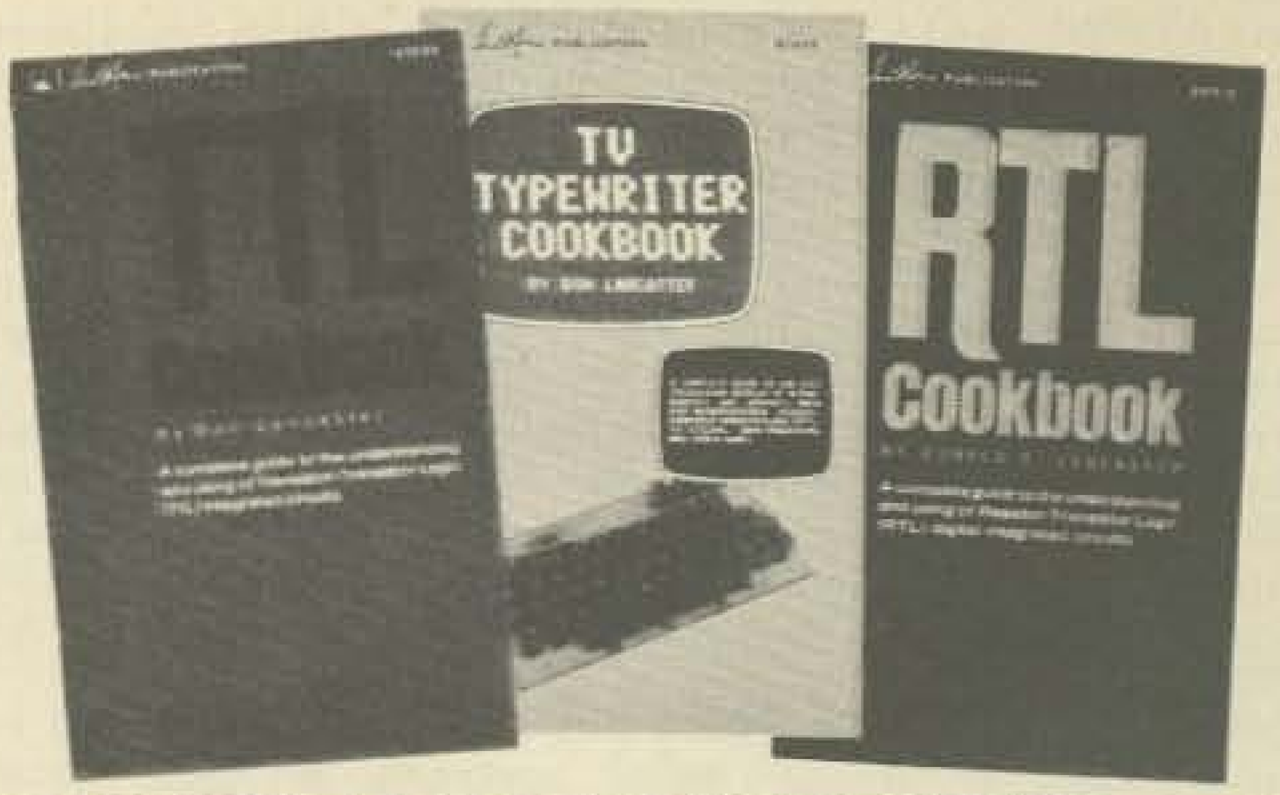
RADIO BOOKSHOP

RADIO BOOKSHOP

• RTL COOKBOOK by Donald Lancaster. Explains the how and why of RTL (Resistor-Transistor Logic) and gives design information that can be put to practical use. Gives a multitude of digital applications ranging from the basic switch to the sophisticated counter. 240 pages; 5½ x 8½; softbound. $5.50.*

• TTL COOKBOOK by Donald Lancaster. Explains what TTL is, how it works, and how to use it. Discusses practical applications, such as a digital counter and display system, events counter, electronic stopwatch, digital voltmeter, and a digital tachometer. 336 pages; 5½ x 8½; softbound. $8.95.*

• TVT COOKBOOK by Donald Lancaster. Describes the use of a standard television receiver as a microprocessor CRT terminal. Explains and describes character generation, cursor control and interface information in typical, easy-to-understand Lancaster style. This book is a required text for both the microcomputer enthusiast and the amateur RTTY operator who desires a quiet alternative to noisy teletype machines. $9.95.*



• FASCINATING WORLD OF RADIO COMMUNICATION Interesting stories in the history of radio pioneering and discovery. Also includes the fundamentals of broadcast band DXing. A must for every radio amateur. $3.95.*

• PRACTICAL TEST INSTRUMENTS YOU CAN BUILD 37 simple test instruments you can make — covers VOMs, VTVMs, semiconductor testing units, dip meters, wattmeters, and just about anything else you might need around the test lab and ham shack. $4.95.*

• 1001 PRACTICAL ELECTRONIC CIRCUITS Tab's new 1001 circuits is available for only $9.95 ppd. The next time you want a circuit for just about anything, eat your heart out that you didn't send for this book the first time you read about it. You'd better order the book right away, before they run out. $9.95.*

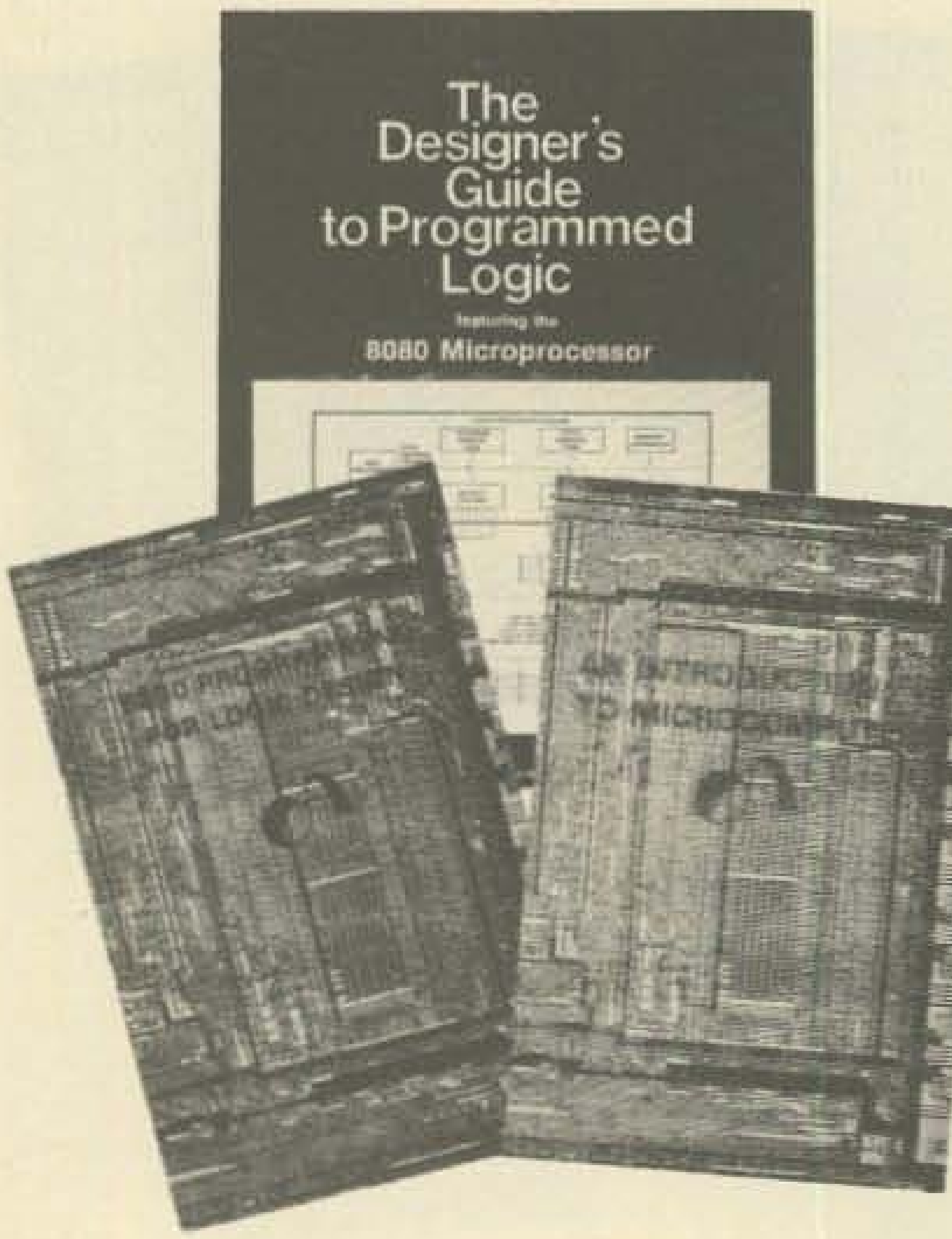
• HOW TO MAKE BETTER QSLs Be proud of your QSL cards . . . have a card which gets front space on every hamshack wall . . . win prizes at hamfests. The only way to have a truly outstanding card is to make it yourself, which is easy when you have this new book. $2.00*

• WHAT TO DO AFTER YOU HIT RETURN PCC's first book of computer games . . . 48 different computer games you can play in BASIC . . . programs, descriptions, muchly illustrated. Lunar Landing, Hammurabi, King, Civil 2, Qubic 5, Taxman, Star Trek, Crash, Market, etc. $6.95.*

• 101 GAMES IN BASIC 101 games for you, from very simple to real buggers. You get the games, a description of the games, the listing to put in your computer and a sample run to show you how they work. Fun. Any one game will be worth more than the price of the book for the fun you and your family will have with it. $7.50.*

• BASIC by Bob Albrecht. Self-teaching guide to the computer language you will need to know for use with your microcomputer. 324 pages. This is one of the easiest ways to learn computer programming. $4.95.*

• THE UNDERGROUND BUYING GUIDE Here is a handy guide for the electronics enthusiast. Over 600 sources of equipment and literature are provided; some are mail-order-only outfits that do not advertise. Sources are listed alphabetically, by service or product, and by state. The guide is cross-referenced for ease of use. Electronic publishing houses are also listed. Publisned by PMS Publishing Co., $5.95.*



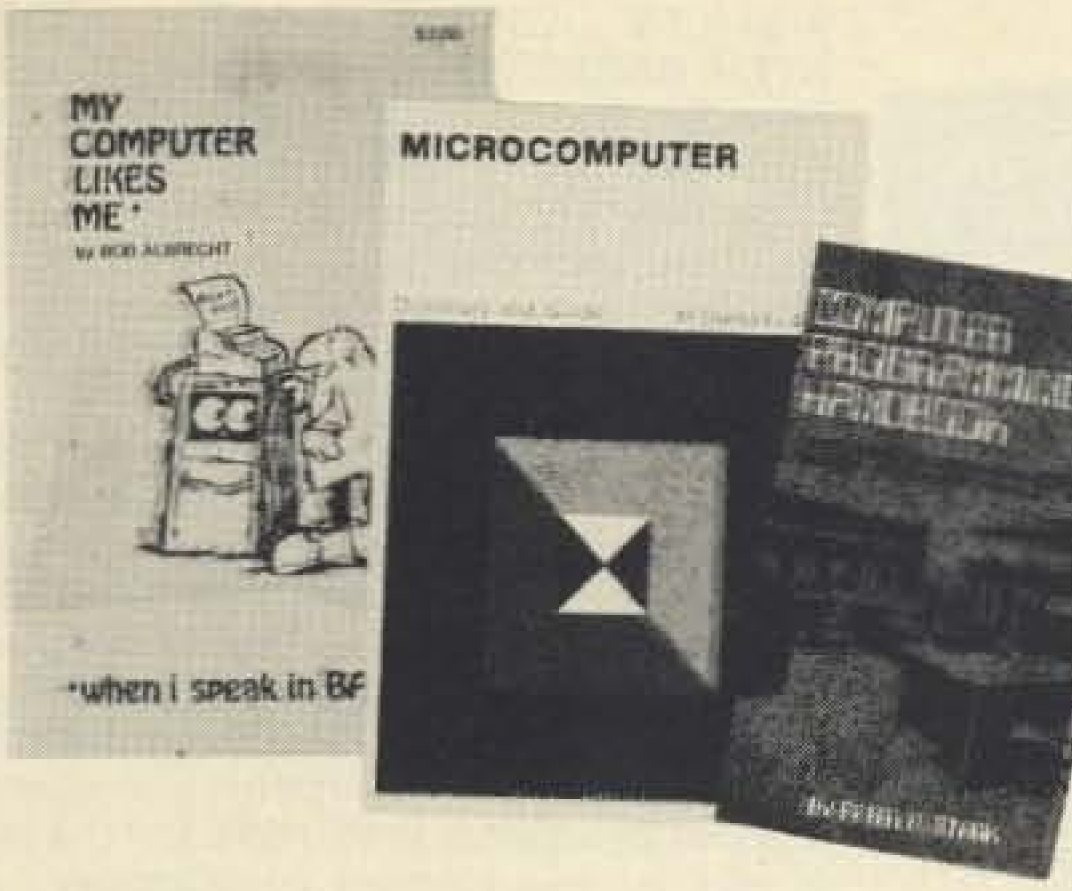
• AN INTRODUCTION TO MICROCOMPUTERS, VOLS. 1 AND 2 by Adam Osborne Associates, are references dealing with microcomputer architecture in general and specifically with details about most of the common chips. These books are not software-oriented, but are invaluable for the hobbyist who is into building his own interfaces and processors. Volume 1 is dedicated to general hardware theory related to micros, and Volume 2 discusses the practical details of each micro chip. (Detailed review in *Kilobaud* #2) Published by Osborne Associates, Vol. I – $7.50*; Vol. II – $12.50.*

• 8080 PROGRAMMING FOR LOGIC DESIGN Ideal reference for the person desiring an in-depth understanding of the 8080 processor. The works is application-oriented, and the 8080 is discussed in light of replacing conventional, hard-wired logic systems. Both hardware and software is described. Practical design considerations are provided for the implementation of an 8080-based control system. (Detailed review in *Kilobaud* #1) Published by Osborne Associates, $7.50.*

• 6800 PROGRAMMING FOR LOGIC DESIGN Oriented toward the industrial user, describes the process by which conventional logic can be replaced by a 6800 microprocessor. Hardware, software, and interfacing techniques are discussed. This reference provides practical information that allows an experimenter to design a complete micro control system from the "ground up." An excellent reference! Published by Osbnrne Associates. $7.50.*

Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to:
73 Radio Bookshop • Peterborough, NH 03458. Be sure to include check or detailed credit card information.
* Add $1.00 shipping & handling charge for each order. Note: Price subject to change on books not published by 73 Magazine.

RADIO BOOKSHOP



• BRAND NEW DICTIONARY This microcomputer dictionary fills the urgent need to become quickly acquainted with the terminology and nomenclature of the revolution in computers. Over 5000 definitions and explanations of terms and concepts (704 pages) relating to microprocessors, microcomputers and microcontrollers. There is also a comprehensive electronics/computer abbreviations and acronyms section. $15.95.*

• COMPUTER PROGRAMMING HANDBOOK by Peter Stark. A complete guide to computer programming and data processing. Includes many worked out examples and history of computers. $8.95.*

• MY COMPUTER LIKES ME ... WHEN I SPEAK BASIC An introduction to BASIC . . . simple enough for your kids. If you want to teach BASIC to anyone quickly, this booklet is the way to go. $2.00.*

• SCELBI'S GALAXY GAME FOR THE "6800" "Galaxy" pits the operator of a spaceship against alien craft, as well as such variables as speed, time, and ammunition. No two games are the same! $14.95.*

• 6800 SOFTWARE GOURMET GUIDE & COOKBOOK This manual describes sorting, searching, and many other routines for the 8080 user. $9.95.*

• 8080 SOFTWARE GOURMET GUIDE AND COOKBOOK Describes sorting, searching, and many other routines for the 8080 user. $9.95.*

• CMOS COOKBOOK by Don Lancaster. Another winner from the author of the *RTL* and *TTL Cookbooks*. Details the application of CMOS, the low power logic family suitable for most applications presently dominated by TTL. Eight chapters cover all facets of CMOS logic, prefaced by 100 pages detailing the characteristics of most CMOS circuits. Required reading for every serious digital experimenter. $9.95.*

• HOBBY COMPUTERS ARE HERE If you (or a friend) want to come up to speed on how computers work . . . hardware and software . . . this is an excellent book. It starts with the fundamentals and explains the circuits, the basics of programming, along with a couple TVT construction projects, ASCII-Baudot, etc. It has the highest recommendations as a teaching aid for newcomers. $4.95.*

• FUN WITH COMPUTERS AND BASIC by Donald D. Spencer, contains an easy-to-understand explanation of the BASIC Programming Language and is intended for persons who have had no previous exposure to computer programming but want to learn BASIC quickly, easily, and interestingly. Over half the book is devoted to problems using games, puzzles, and mathematical recreations (you don't need a math background to understand most of the problems in this book). A superior book for self-teaching and learning computer programming. $6.95.*

• THE STORY OF COMPUTERS by Donald D. Spencer is to computer books what *Dick and Jane* is to novels . . . extremely elementary, gives the non-computerist a fair idea of what the hobbyist is talking about when he speaks computer lingo. Attempts to explain what computers are and can do. $4.95.*

• SCELBI'S FIRST BOOK OF COMPUTER GAMES Need a game for your 8008 or 8080 microprocessor? Describes three popular games, "Space Capture," "Hexpawn," and "Hangman." Complete flowcharts, logic description, program listing, and instructions are provided. A must for the game freak! $14.95.*

• MICROCOMPUTER PRIMER by Mitchell Waite and Michael Pardee. Describes basic computer theory, describes the world of microcomputing in "real world" terminology, explains numbering systems, and introduces the reader to the world of programming. There is probably no better way of getting involved with the exciting new hobby of microcomputing. $7.95.*

• INTRODUCTION TO MICROPROCESSORS by Charles Rockwell of MICROLOG. An ideal reference for the individual desiring to understand the hardware aspects of microprocessor systems. Describes the hardware details of computer devices in terms the beginner can understand, instead of treating the micro chip as "black box." Addressing schemes, registers, control, and memory are all explained. General information about hardware systems is provided. Specific systems are not described and programming is only briefly discussed. $17.50* US and Canada, $20 elsewhere.

• THE NEW HOBBY COMPUTERS! This book takes it from where "Hobby Computers Are Here" leaves off, with chapters on Large Scale Integration, how to choose a microprocessor chip, an introduction to programming, low cost I/O for a computer, computer arithmetic, checking memory boards, a Baudot monitor/editor system, an audible logic probe for finding those tough problems, a ham's computer, a computer QSO machine . . . and much, much more! $4.95.*

• KILOBAUD The Small Computer Magazine written for the non-PhD computer hobbyist who wants to know what's new. $2.00 each at the newsstand, $15.00 for 1 year sub.

Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to:
73 Radio Bookshop • Peterborough, NH 03458. Be sure to include check or detailed credit card information.
* Add $1.00 shipping & handling charge for each order. Note: Price subject to change on books not published by 73 Magazine.

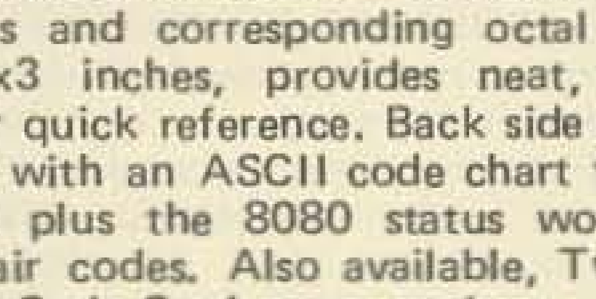
RADIO BOOKSHOP

RADIO BOOKSHOP

● **COMPUTER DICTIONARY** by Donald D. Spencer. Defines words and acronums used by computerists in a clear, easy to understand style. Over 2000 definitions are provided. This reference is a must for the individual getting started in the world of microcomputers. Published by Camelot Press, $5.95.*

● **CHEMISTRY WITH A COMPUTER** by Paul A. Cauchon. Contains a collection of tutorial, simulation and problem-generation computer programs. Simulations provide models of lengthy laboratory experimentation beyond the limited classroom timeframe and enhancement of course studies by encouraging prelaboratory research. Useable with almost any chemistry course at the high school or college level. Written in BASIC. Price $9.95.*

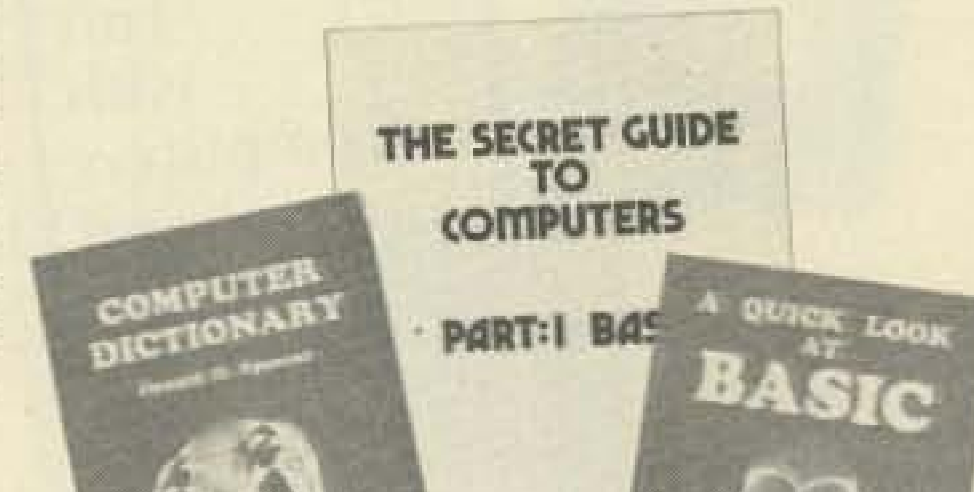
● **TYCHON'S 8080 OCTAL CODE CARD** Slide rule-like aid for programming and debugging 8080 software . . . contains all the mnemonics and corresponding octal codes. Only 6½x3 inches, provides neat, logical format for quick reference. Back side of card is printed with an ASCII code chart for 128 characters plus the 8080 status word and register pair codes. Also available, Tychon's *8080 Hex Code Card,* same as above only has hex codes instead of octal. Only $3.00* each.



● **1976 PERIODICAL GUIDE FOR COMPUTERISTS** is a 20 page book which indexes over 1,000 personal computing articles for the entire year of 1976 from Byte, Creative Computing, Digital Design, Dr. Dobbs Journal, EDN, Electronic Design, Electronics, Interface Age, Microtrek, Peoples Computer Company, Popular Electronics, QST, Radio Electronics, SCCS Interface and 73. Articles are indexed under more than 100 subject categories. Price $3.00.* New January – June 1977 Edition – $3.00.*

● **A QUICK LOOK AT BASIC** by Donald D. Spencer. A perfect reference for the beginning programmer. Assumes that the reader has no previous programming experience. A self-teaching guide for the individual desiring to learn the fundamentals of BASIC, the most common hobbyist programming language. Price: $4.95*

● **HOME COMPUTERS: 2^10 Questions & Answers** by Rich Didday. Two books aimed exclusively at the novice computer hobbyist/home computer user. Written in a rather unusual style which has a beginner asking questions which are answered by a person with a substantial background in computers and personal computing. The questions are just the kind beginners come up with . . . and the answers are presented in easy-to-understand terms (usually with a diagram to illustrate the point). Both the hardware and software aspects of home computing are covered from A to Z. An index in both books makes them ideal as reference material *for anyone.* Volume I: Hardware – $7.95*; Volume 2: Software – $6.95*.



● **SIXTY CHALLENGING PROBLEMS WITH BASIC SOLUTIONS** Donald Spencer. Provides the serious student of BASIC programming with interesting problems and solutions. No knowledge of math above algebra required. Includes games, programs for financial interest, conversions and numeric manipulations. Price: $6.95*

● **SOME COMMON BASIC PROGRAMS** published by Adam Osborne & Associates, Inc. Perfect for non-technical computerists requiring ready to use programs. Business programs like depreciation formulas, loan payment solutions and loan interest rates; math routines containing statistical packages and polynomial derivations . . . plus miscellaneous programs. Invaluable for the user who is not an experienced programmer. All will operate in the stand-alone mode. $7.50* paperback.

● **THE SECRET GUIDE TO COMPUTERS** Parts 1, 2, and 3 by Russ Walter. **Part One** describes computers in general, and after reading for ten minutes you will be writing simple BASIC programs! Employs a step-by-step teaching process, the end result being a working knowledge of BASIC. **Part Two** discusses computer applications. It's one thing to master the syntax of a language such as BASIC and another to solve problems using the new tool. This also provides useful techniques in problem solving. **Part Three** describes programming languages. Ever heard of APL and QLISP? BASIC is not the only language used to program computers, and as the hobby industry grows additional languages will become commonplace. 7th edition. Part I – $2.75*; Part II – $2.50*; Part III – $3.50.*

● **FORTRAN PROGRAMMING** By Donald Spencer. If you are familiar with BASIC you will appreciate the additional capabilities of FORTRAN, a computer language with most of BASIC's features, and much more! FORTRAN was designed for complex numeric calculations; and possesses extended I/O capability. It is easily learned, as it is an English-like computer language. $7.50.*

● **FORTRAN WORKBOOK** by Donald Spencer. Provides practical examples and problems to solve. Almost all micros support BASIC – it won't be long before FORTRAN is commonplace. Don't miss the programming boat . . . learn FORTRAN; and be ready for the next language boom! $3.95.*

● **Scientific Research Instruments' BASIC SOFTWARE LIBRARY** is a complete do-it-yourself kit. Written in everybody's BASIC immediately executable in ANY computer with at least 4K, no other peripherals needed. Over 700 pages of source codes, descriptions and instructions. Vol. I contains business and recreational programs and is 300 pages. Vol. II is 260 pages and contains math, engineering, statistics and plotting programs. Vol. III contains money managing, advanced business programs such as billing, A/R, inventory, payroll, etc. Vol. IV contains general purpose programs like loans, rates, retirement, plus games: Poker, Enterprise (take charge while Capt. Kirk is away), Football and more! Vol. V is filled with experimenter's programs including games, pictures and misc. problems like "logic." Vols. I & II $24.95,* Vol. III $39.95,* Vol. IV & V $9.95 each.*

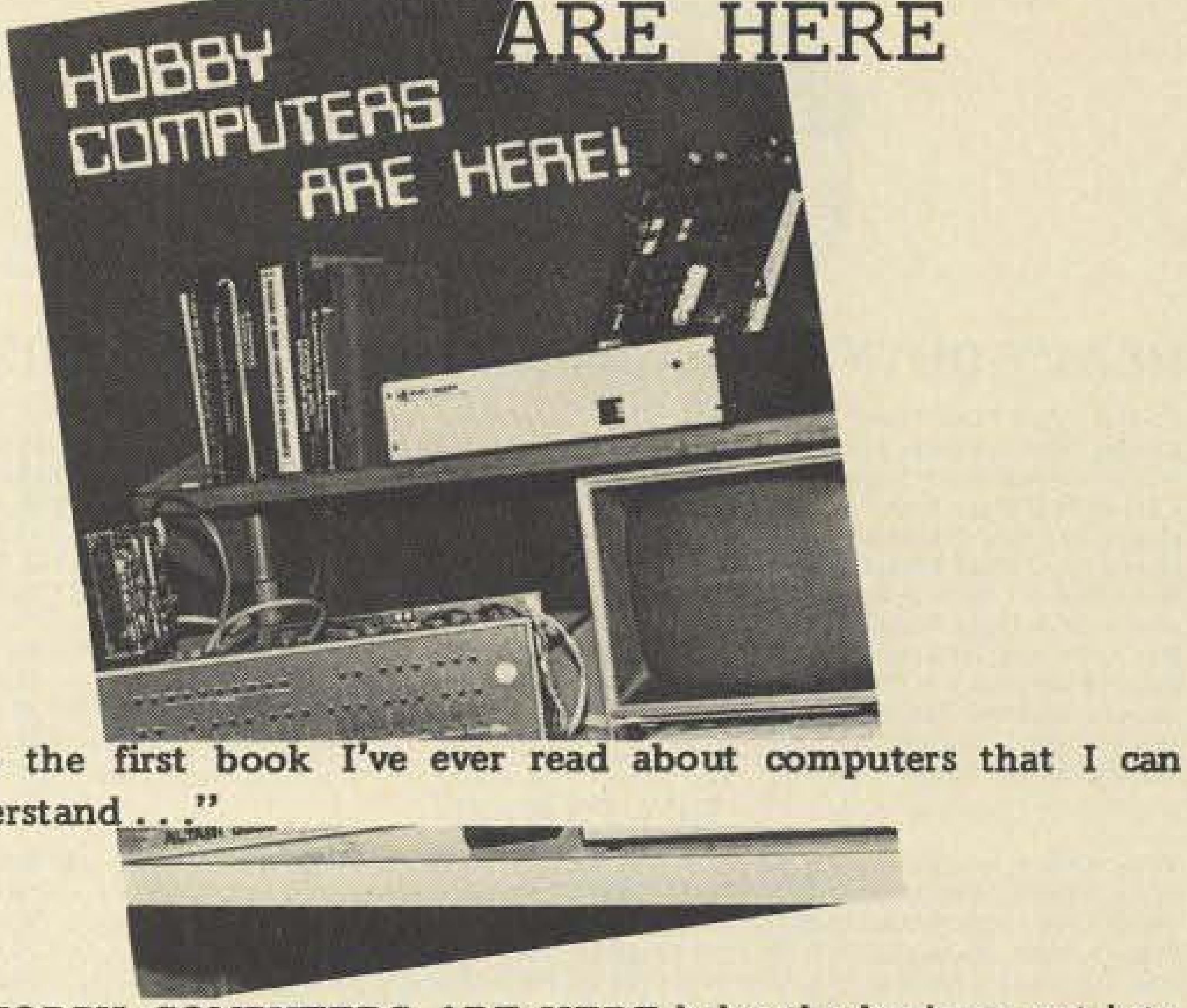
Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to:
73 Radio Bookshop ● Peterborough, NH 03458. Be sure to include check or detailed credit card information.
*Add $1.00 shipping & handling charge for each order. Note: Price subject to change on books not published by 73 Magazine.

RADIO BOOKSHOP

The NEW HOBBY COMPUTERS

This book takes it from where "Hobby Computers Are Here" leaves off, with chapters on Large Scale Integration, how to choose a microprocessor chip, an introduction to programming, low cost I/O for a computer, computer arithmetic, checking memory boards, a Baudot monitor/editor system, an audible logic probe for finding those tough problems, a ham's computer, a computer QSO machine . . . and much, much more! Everything of interest is there in one volume, ready to be enjoyed by you. Don't miss this tremendous value! Only $4.95*

HOBBY COMPUTERS ARE HERE



"It's the first book I've ever read about computers that I can understand . . ."

HOBBY COMPUTERS ARE HERE helps the beginner get into the world of microcomputers. Some chapters: What's a Computer?, Is Digital New?, How Computers Figure, Computer Languages, How Gates Work, TTL – Best Logic Yet, Ins and Outs of TTL, Flip-Flops Exposed, New Cassette System Standard, Build this TVT, Using Surplus Keyboards, Morse to RTTY Converter, ASCII to Baudot via a PROM, PLUS reprints of some of the 73 editorials on computers. Don't miss out any longer on the fun of hobby computing and the fantastic applications of these incredible devices! $4.95*

73 magazine Dept. HC
Peterborough NH 03458

For ease in ordering, please use order card in the back of this magazine.

**Be sure to add $1.00 shipping & handling charge to each order.*

73's NEW QSL CARDS

U.S.A. ONLY • NO C.O.D.'s!

73 Magazine's Newest Design in QSL Cards!

You want your QSL card to stand out on every wall, don't you? Well, here's one which no shack visitor in the world will be able to miss. It's got jet black call letters . . . great big call letters that can be read all the way across the room – black letters on a bright yellow background to make them really stand out. When pictures of DX shacks are published in the magazines you'll see your card clearly.

How can 73 turn out these fantastic QSL cards at about half the cost of having them made elsewhere? These are done as a fill-in between printing books and other items in the 73 Print Shop. That's why we don't promise anything faster than 8 weeks delivery. We usually get them out a lot faster than that, but we could get tied up with a new edition of the Repeater Atlas or something and be slow.

The regular QSO information is printed on the back of the card . . . all you need to have the card acceptable for any awards. There's room to list your equipment on the back, if you want. A nice gift idea, too!

Style Y
Your name, call & address in black letters on a bright yellow background!
Actual size = 5½" x 3½"!

W2NSD/1
Wayne Green • Pine Street • Peterborough NH 03458

W2NSD/1
Wayne Green • Pine Street • Peterborough NH 03458

Please send me:
☐ 250 Style Y cards – $ 8.95*
☐ 500 Style Y cards – $13.95*

$ ______ Enclosed ☐ Cash ☐ Check ☐ Money Order
☐ American Express ☐ BankAmericard ☐ Master Charge

Credit Card # ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Expiration date ______ Signature ______

Name ______ Call ______

Address ______

City ______ State ______ Zip ______

**Add $1.00 shipping & handling charge.*

73 Magazine QSLs
Peterborough NH 03458
73/2/78

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	3	3	7	14	14	14A
ARGENTINA	14	7B	7B	7	7	7	14	14	14A	21	14A	14
AUSTRALIA	14A	14	7B	7B	7B	7	7	14	14	14B	14	21
CANAL ZONE	14	7	7	7	7	7	7A	14	21	21	14A	14
ENGLAND	7	7	7	3	7	7	7A	14A	14A	14	14	7
HAWAII	14	14	7B	7	7	7	7	7	7B	14	14A	14A
INDIA	7	7	7B	7B	7B	7B	7B	14	14	7B	7B	7
JAPAN	14	7B	7B	7B	7	7	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	14A	21	14A	14
PHILIPPINES	14	7B	7B	7B	7B	3B	7	7	7	7B	7B	7B
PUERTO RICO	7A	7	7	7	3A	3A	7A	14	14	14	14	14
SOUTH AFRICA	7A	7	7	7	7B	7B	14	14A	21	21	14A	14
U. S. S. R.	7	7	3	3A	7	7B	14	14	14	7B	7B	7
WEST COAST	14	14	7	7	7	7	7	14	14	14A	21	14A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	3	3	3	3	3	7	14	14	14A
ARGENTINA	14	14	7B	7	7	7	7	14	14	14A	21	14A
AUSTRALIA	21	14	7B	7B	7B	7	7	7	7A	14B	14	14A
CANAL ZONE	14	14	7	7	7	7	7	14	14A	21	21	14A
ENGLAND	7	7	7	3	7	3	7B	14	14A	14	7B	7
HAWAII	14A	14	7B	7	7	7	7	7	7B	14	14A	21
INDIA	7	7A	7B	7B	7B	7B	3B	7A	14	7	7B	7B
JAPAN	14	14	7B	7B	7	7	3	7	7	7B	7B	14
MEXICO	14	7	7	3A	7	3	3	7	14	14	14	14
PHILIPPINES	14	14	7B	7B	3B	7B	7	7	7	7	7B	7B
PUERTO RICO	14	7	7	7	7	7	7	14	14A	14A	14	14
SOUTH AFRICA	14B	7	7	7	7B	7B	7B	14	21	14A	14A	14
U. S. S. R.	7	3	3	3	7	7	7B	7A	14	7B	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14A	14	7B	7	7	7	7	14	14	14	14A	21
AUSTRALIA	21	21	14	7B	7	7	7	7	7	7A	14	14A
CANAL ZONE	14A	14	7	7	7	7	7	14	14A	21	21	14A
ENGLAND	7	7	7	3	7	7	3B	7B	14	14	7B	7B
HAWAII	21A	14A	14	7	7	7	7	3A	7	14	14A	21
INDIA	7B	14	14B	3B	3B	3B	3B	3A	7	7	7B	7B
JAPAN	14A	14	14	7	7	7	7	3	7	7	7B	14
MEXICO	14	14	7	7	7	7	7	7	14	14A	14A	14A
PHILIPPINES	14A	14	14	7B	3B	7B	7B	3A	7	7	7B	14
PUERTO RICO	14	7A	7	7	7	7	7	14	14A	21	21	14A
SOUTH AFRICA	14B	7	7	7	7B	7B	7B	7B	14	14A	14A	14
U. S. S. R.	7	7	3	3	3	7	7	7	7A	7A	7B	7B
EAST COAST	14	14	7	7	7	7	7	14	14	14A	21	14A

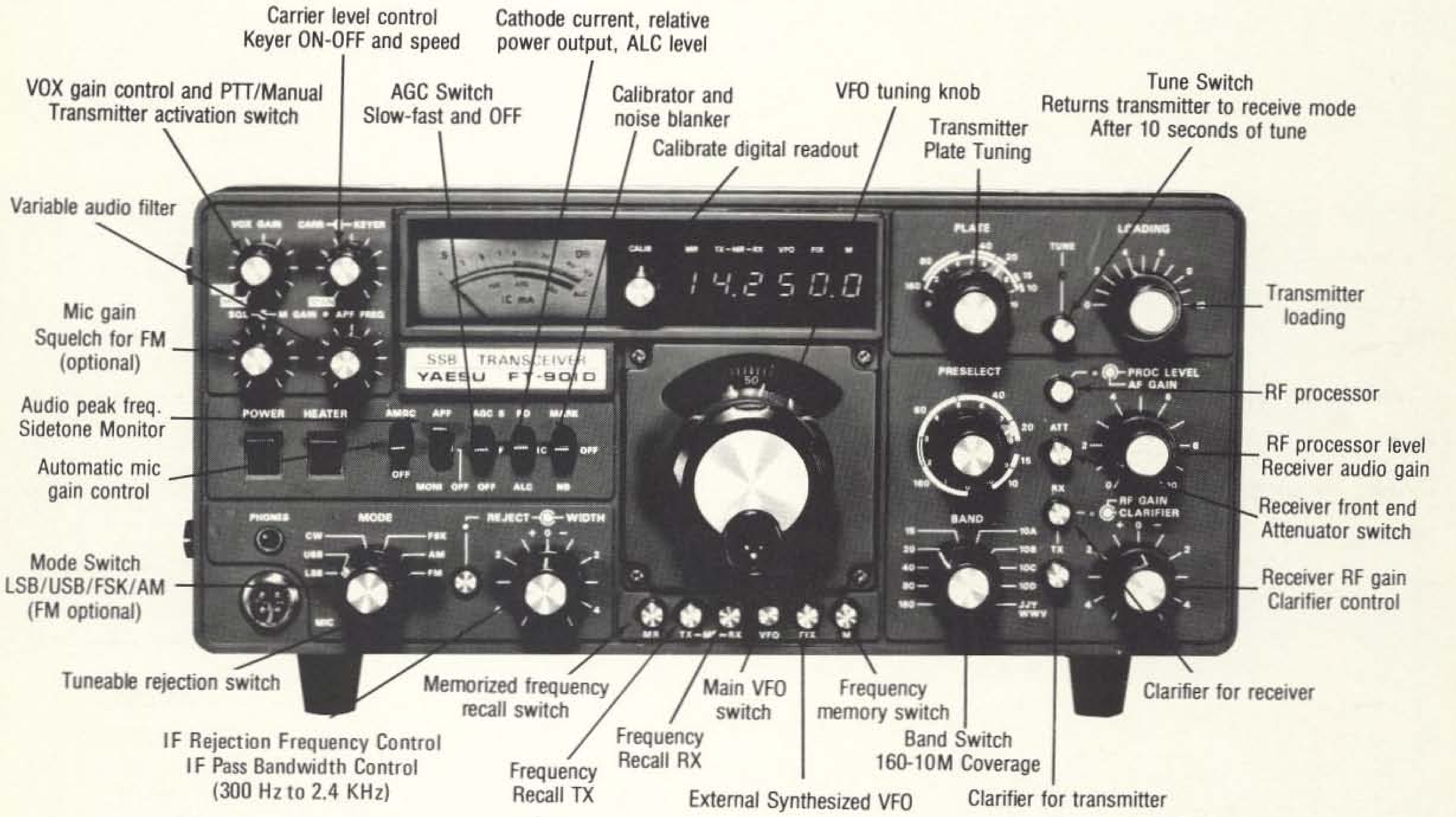
A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor

february

sun	mon	tue	wed	thu	fri	sat
			1 G	2 F	3 F	4 G
5 G	6 G	7 F	8 F	9 G	10 G	11 G
12 G	13 G	14 G	15 G	16 F	17 P	18 P
19 F	20 F	21 P	22 F	23 G	24 G	25 G
26 F	27 F	28 F				

YAESU PROUDLY ANNOUNCES THE SENSATIONAL

NEW SMART FT-901DM—YEARS AHEAD WITH YAESU!



■ Two rugged 6146B's in the final, with negative feedback ■ A variable IF bandwidth that allows 300 Hz to 2.4 KHz selectivity at the turn of a knob ■ IF rejection tuning to notch out interfering signals ■ Optional synthesized VFO, or enlarged frequency memory bank ■ Selectable AGC ■ Built in speech processor ■ Built in Curtis Keyer ■ Full range 160-10M coverage ■ Provision for new WARC frequencies ■ Meets Part 97.73 of FCC requirements. . . . at your dealers soon!

Design And Specifications Subject To Change Without Notice Or Obligation

member arma amateur radio manufacturer's association

YAESU

The smart radio

YAESU ELECTRONICS CORP., 15954 Downey Ave., Paramount, CA 90723 (213) 633-4007
YAESU ELECTRONICS CORP., Eastern Service Ctr., 613 Redna Ter., Cincinnati, OH 45215

1A78

TL-922/TS-820S SERIES

Limited quantities available in the Spring!

Give yourself the "big signal" that commands attention on today's crowded bands, with Kenwood's TL-922 linear amplifier. It runs the full legal limit on all the ham bands from 160-10 meters and is compatible with most amateur exciters. The TL-922 is a must in any Kenwood station.

And, of course, the TS-820S series is still the most desirable station around. Note the SP-820 speaker . . . special features and a perfect complement to the TS-820S.

KENWOOD
. . . pacesetter in amateur radio

TRIO-KENWOOD COMMUNICATIONS INC. 1111 WEST WALNUT/COMPTON, CALIFORNIA 90220