73 AMATEUR RADIO

DECEMBER 1977
$2.00

FURTHER ADVENTURES OF

The Mobile Marvel

ICOM, VHF MOBILE'S PEERLESS LEADER GOES ONE STEP BEYOND

The matchless **IC-22S,** the measure of quality and performance for all VHF mobile transceivers, now materializes with its splendid new frequency synthesizer as a flexible phenomenon. Faster than a digit switch, able to leap great frequencies in a single bound, the **IC-22S** Mobile Marvel is empowered with instant programming for 256 possible frequencies, making available any frequency on anybody's band-plan in a matter of minutes, while disguised as a mild mannered 22 channel radio.

It "hears through solid walls" with a magnificient high sensitivity receiver, employing a 1st IF monolithic crystal filter and two 2nd IF filters for improved rejection of 15 KHz adjacent channel signals. And with spurious attenuation far exceeding FCC specifications for even commercial type radios, the **ICC-22S** mobilizes 10 Watts of power.

Instantly available from your dealer, the **IC-22S** comes to you ready to perform amazing feats for even less than the cost of most old fashioned crystal controlled units. The meek and the mighty can avail themselves of the most in VHF mobile with the **IC-22S, ICOM's Mobile Marvel.**

VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT

Distributed by:

ICOM

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73

#207 DEC 1977

COVER: Bust of Guglielmo Marconi at his original station location in South Wellfleet MA (see page 6). Photo by W2NSD/1.

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Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity.

HIGHLY EFFECTIVE NOISE BLANKER

An effective noise blanking cricuit developed by Kenwood that virtually eliminates ignition noise is built into the TS-520S.

RF ATTENUATOR

The TS-520S has a built-in 20 dB attentuator that can be activated by a push button swich conveniently located on the front panel.

PROVISION FOR EXTERNAL RECEIVER

A special jack on the rear panel of the TS-520S provides receiver signals to an external receiver for increased station versitility. A switch on the rear panel determines the signal path . . . the receiver in the TS-820 or any external receiver.

VFO-520 — NEW REMOTE VFO

The VFO-520 remote VFO matches the styling of the TS-520S and provides maximum operating flexibility on the band selected on your TS-520S.

AC POWER SUPPLY

The TS-520S is completely self-contained with a rugged AC power supply built-in. The addition of the DS-1A DC-DC converter (optional) allows for mobile operation of the TS-520S.

EASY PHONE PATCH CONNECTION

The TS-520S has 2 convenient RCA phono jacks on the rear panel for PHONE PATCH IN and PHONE PATCH OUT.

CW-520 — CW FILTER (OPTION)

The CW-520-500 Hz filter can be easilly installed and will provide improved operation on CW.

AMPLIFIED TYPE AGC CIRCUIT

The AGC circuit has 3 positions (OFF, FAST, SLOW) to enable the TS-520S to be operated in the optimum condition at all times whether operating CW or SSB.

The TS-520S retains all of the features of the original TS-520 that made it tops in its class: RIT control • 8-pole crystal filter • Built-in 25 KHz calibrator • Front panel carrier level control • Semi-break-in CW with sidetone • VOX/PTT/MOX • TUNE position for low power tune up • Built-in speaker • Built-in Cooling Fan • Provisions for 4 fixed frequency channels • Heater switch.

TS-520 Specifications

Amateur Bands: 160-10 meters plus WWV (receive only)
Modes: USB, LSB, CW
Antenna Impedance: 50-75 Ohms
Frequency Stability: Within ±1 kHz during one hour after one minute of warm-up, and within 100 Hz during any 30 minute period thereafter
Tubes & Semiconductors:
Tubes 3
(S2001A x 2, 12BY7A)
Transistors 52
FETs 19
Diodes 101
Power Requirements: 120/220 V AC, 50/60 Hz, 13.8 V DC (with optional DS-1A)
Power Consumption: Transmit: 280 Watts Receive: 26 Watts (with heater off)
Dimension: 333(13⅛) W x 153 (6-0) H x 335(13-(13-3/16) D mm(inch)
Weight: 16.0 kg(35.2 lbs)

TRANSMITTER
RF Input Power: SSB: 200 Watts PEP CW: 160 Watts DC
Carrier Suppression: Better than -40 dB
Sideband Suppression: Better than -50 dB
Spurious Radiation: Better than -40 dB
Microphone Impedance: 50k Ohms
AF Response: 400 to 2,600 Hz

RECEIVER
Sensitivity: 0.25 uV for 10 dB (S+N)/N
Selectivity: SSB:2.4 kHz/-6 dB, 4.4 kHz/-60 dB
Selectivity: CW: 0.5 kHz/-6 dB, 1.5 kHz/-60 dB (with optional CW-520 filter)
Image Ratio: Better than 50 dB
IF Rejection: Better than 50 dB
AF Output Power: 1.0 Watt (8 Ohm load, with less than 10% distortion)
AF Output Impedance: 4 to 16 Ohms

DG-5
SPECIFICATIONS
Measuring Range: 100 Hz to 40 MHz
Input Impedance: 5 k Ohms
Gate Time: 0.1 Sec.
Input Sensitivity: 100 Hz to 40 MHz . . . 200 mV rms or over, 10 kHz to 10 MHz . . 50 mV or over
Measuring Accuracy: Internal time base accuracy ±0.1 count
Time Base: 10 MHz
Operating Temperature: -10° to 50° C/14° 122° F
Power Requirement: Supplied from TS-520S or 12 to 16 VDC (nominal 13.8 VDC)
Dimensions: 167(6-9/16) W x 43(1-11/16) H x 268(10-9/16) D mm(inch)
Weight: 1.3 kg(2.9 lbs)

DG-5

The luxury of digital readout is available on the TS-520S by connecting the DG-5 readout (option). More than just the average readout circuit, this counter mixes the carrier, VFO, and heterodyne frequencies to give you your exact frequency. This handsomely-styled accessory can be set almost anyplace in your shack for easy to read operation . . . or set it on the dashboard during mobile operation for safety and convenience. Six bold digits display your operating frequency while you transmit and receive. Complete with DH (display hold) switch for frequency memory and 2 position intensity selector. The DG-5 can also be used as a normal frequency counter up to 40 MHz at the touch of a switch. (Input cable provided.)
NOTE: TS-520 owners can use the DG-5 with a DK-520 adapter kit.

TS-600

Experience the excitement of 6 meters. The TS-600 all mode transceiver lets you experience the fun of 6 meter band openings.

This 10 watt, solid state rig covers 50.0-54.0 MHz. The VFO tunes the band in 1 MHz segments. It also has provisions for fixed frequency operation on NETS or to listen for beacons. State of the art features such as an effective noise blanker and the RIT (Receiver Incremental Tuning) circuit make the TS-600 another Kenwood "Pacesetter".

TV-506

An easy way to get on the 6 meter band with your TS-520/520S, TS-820/820S and most other transceivers. Simply plug it in and you're on . . . full band coverage with 10 watts output on SSB and CW.

TR-8300

Experience the luxury of 450 MHz at an economical price.

The TR-8300 offers high quality and superb performance as a result of many years of improving VHF/UHF design techniques. The transceiver is capable of F_3 emission on 23 crystal-controlled channels (3 supplied). The transmitter output is 10 watts.

The TR-8300 incorporates a 5 section helical resonator and a two-pole crystal filter in the IF section of the receiver for improved intermodulation characteristics. Receiver sensitivity, spurious response, and temperature characteristics are excellent.

KENWOOD

...pacesetter in amateur radio

TS-700S

WITH DIGITAL FREQUENCY DISPLAY

Check out the new "built-ins": digital readout, receiver pre-amp, VOX, semi-break in, and CW sidetone! Of course, it's still all mode, 144-148 MHz and VFO controlled.

Features: Digital readout with "Kenwood Blue" digits • High gain receiver pre-amp • 1 watt lower power switch • Built in VOX • Semi-break in on CW • CW sidetone • Operates all modes: SSB (upper & lower), FM, AM and CW • Completely solid state circuitry provides stable, long lasting, trouble-free operation • AC and DC capability (operate from your car, boat, or as a base station through its built-in power supply) • 4 MHz band coverage (144 to 148 MHz) • Automatically switches transmit frequency 600 KHz for repeater operation. Simply dial in your receive frequency and the radio does the rest . . . simplex, repeater, reverse • Or accomplish the same by plugging a single crystal into one of the 11 crystal positions for your favorite channel • Transmit/Receive capability on 44 channels with 11 crystals.

VFO-700S

Handsomely styled and a perfect companion to the TS-700S. This unit provides you with the extra versatility and the luxury of having a second VFO in your shack. Great for split frequency operation and for tuning off frequency to check the band. The function switch on the VFO-700S selects the VFO in use and the appropriate frequency is displayed on the digital readout in the TS-700S. In addition a momentary contact "frequency check" switch allows you to spot check the frequency of the VFO not in use.

TR-7400A

Features Kenwood's unique Continuous Tone Coded Squelch system, 4 MHz band coverage, 25 watt output and fully synthesized 800 channel operation. This compact package gives you the kind of performance specifications you've always wanted in a 2-meter amateur rig.

Outstanding sensitivity, large-sized helical resonators with High Q to minimize undesirable out-of-band interferance, and give a 2-pole 10.7 MHz monolithic crystal filter combine to give your TR-7400A outstanding receiver performance. Intermodulation characteristics (Better than 66dB), spurious (Better than −60dB), image rejection (Better than −70dB), and a versatile squelch system make the TR-7400A tops in its class.

Shown with the PS-8 power supply

(Active filters and Tone Burst Modules optional)

TR-7500

This 100 channel PLL synthesized 146-148 MHz transceiver comes with 88 pre-programmed channels for use on all standard repeater frequencies (as per ARRL Band Plan) and most simplex channels. For added flexibility, there are 6 diode-programmable switch positions. The 15 KHz shift function makes these 6 positions into 12 channels. 10 watt output, ±600 KHz offset and LED digital frequency display are just a few of the many fine features of the TR-7500. The PS-6 is the handsomely styled, matching power supply for the TR-7500. Its 3.5 amp current capacity and built-in speaker make it the perfect companion for home use of the TR-7500.

TR-2200A

The high performance portable 2-meter FM transceiver. 146-148 MHz, 12 channels (6 supplied), 2 watts or 400 mW RF output. Everything you need is included: Ni-Cad battery pack, charger, carrying case and microphone.

KENWOOD

. . . pacesetter in amateur radio

Kenwood developed the T-599D transmitter and R-599D receiver for the most discriminating amateur.

The R-599D is the most complete receiver ever offered. It is entirely solid-state, superbly reliable and compact. It covers the full amateur band, 10 through 160 meters, CW, LSB, USB, AM and FM.

The T-599D is solid-state with the exception of only three tubes, has built-in power supply and full metering. It operates CW, LSB, USB and AM and, of course, is a perfect match to the R-599D receiver.

If you have never considered the advantages of operating a receiver/transmitter combination . . .maybe you should. Because of the larger number of controls and dual VFOs the combination offers flexibility impossible to duplicate with a transceiver.

Compare the specs of the R-599D and the T-599D with any other brand. Remember, the R-599D is all solid state (and includes four filters). Your choice will obviously be the Kenwood.

R-599D T-599D

R-300

Dependable operation, superior specifications and excellent features make the R-300 an unexcelled value for the shortwave listener. It offers full band coverage with a frequency range of 170 KHz to 30.0 MHz • Receives AM, SSB and CW • Features large, easy to read drum dials with fast smooth dial action • Band spread is calibrated for the 10 foreign broadcast bands, easily tuned with the use of a built-in 500 KHz calibrator • Automatic noise limiter • 3-way power supply system (AC/Batteries/External DC) . . . take it anyplace • Automatically switches to battery power in the event of AC power failure.

NEVER SAY DIE

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 6

CB IN PERSPECTIVE

While a lot of amateurs are still uptight over CBers and their often wanton ways, others are busy welcoming the cream of the CB crop into amateur radio. About 80% of the new hams are coming from the CB ranks, a heavy percentage of those being the highly illegal HFers. Oddly enough, despite all sorts of warnings of disaster, the new hams are doing quite well.

But what about the manufacturers? We are now seeing more and more of the CB firms turning to amateur radio . . . how come? In this case we can laugh, for the CB industry went to a lot of expense and trouble to almost mortally wound itself.

Back in the glorious days when everything was back-ordered and the manufacturers were more worried about completion of construction of their new plants than anything else, the bigwigs of the biz did invest some money toward making their future even rosier than it then appeared. They could see the 23 channels then available rapidly filling up and there being not only a need for more channels on 27 MHz, but also a need for two to five megahertz for further CB development, as millions of people got into the act.

The "donations" went to their lobby in Washington. Here the money was spent to put the pressure on the FCC for new bands and for 27 MHz expansion. When they ran into resistance from the FCC, they then went via the OTP (White House) to force the FCC to capitulate. It's actually a bit more sordid than that, but you get the idea.

Through TV, movies, records, and a lot of newspaper and magazine publicity, the pressure was kept on to keep CB growing . . . and it did. Then the plan to expand the 27 MHz band went through the usual FCC heel-dragging, which amateurs are all too familiar with, and suddenly the country was faced with the choice of buying a CB set which would be virtually worthless in six months or else waiting six months for the new 40-channel sets. Sales of CB sets just about stopped, while the factories in Japan kept grinding out the 23-channel sets to further bulge already-bulging warehouses in the U.S.

By the time the 40-channel sets could be purchased, the steam had gone out of the market and the demand for the new sets never really materialized. That lesson having been learned, the pressures for opening a new CB in the VHF or UHF bands cooled quickly. Of course, the lack of pressure has not stopped the FCC from its considerations in this line . . . these things move like a glacier and are as difficult to stop. One of the last things CB manufacturers and dealers need now is a new Citizens Band.

One publisher, anxious to start a new "Communicator" magazine, did manage to pull the FCC to a halt by writing in a nationally-syndicated CB column that the new band would soon be announced. The FCC took this as a challenge and tabled the whole matter. They are not about to be pressured like that.

My plan to encourage ham clubs to institute Novice classes has worked well, and the result has been a substantial growth in amateurs . . . enough so the need for a Communicator class of license is no longer important. The two reasons for the Communicator proposal were to pro-

Continued on page 41

Memorial bust of Marconi at the station site.

Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit		Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
N	23446	1	0030:40	72.5	13923 A	1	0120:03	75.2
NA	23459 BTN	2	0125:35	86.3	13935 B	2	0019:23	60.1
N	23471	3	0025:31	71.3	13948 A	3	0113:40	73.7
NA	23484 BTN	4	0120:27	85.0	13960 B	4	0013:01	58.5
N	23496	5	0020:23	70.0	13973 A	5	0107:18	72.1
NA	23509 BTN	6	0115:19	83.8	13985 B	6	0006:39	56.9
NA	23521 BTN	7	0015:15	68.8	13998 AX	7	0100:56	70.5
N	23534	8	0110:10	82.6	14010 B	8	0000:16	55.4
NA	23546 BTN	9	0010:06	67.6	14023 A	9	0054:34	69.0
N	23559	10	0105:02	81.3	14036 B	10	0148:51	82.5
NA	23571 BTN	11	0004:58	66.3	14048 A	11	0048:11	67.4
N	23584	12	0059:53	80.1	14061 BQ	12	0142:29	81.0
NA	23597 BTN	13	0154:49	93.8	14073 A	13	0041:49	65.8
NA	23609 BTN	14	0054:45	78.8	14086 BX	14	0136:06	79.4
N	23622	15	0149:41	92.6	14098 A	15	0035:27	64.3
NA	23634 BTN	16	0049:37	77.6	14111 B	16	0129:44	77.8
N	23647	17	0144:32	91.3	14123 A	17	0029:05	62.7
NA	23659 BTN	18	0044:28	76.3	14136 B	18	0123:22	76.3
N	23672	19	0139:24	90.1	14148 A	19	0022:43	61.1
NA	23684 BTN	20	0039:20	75.1	14161 B	20	0117:00	74.7
NA	23697 BTN	21	0134:15	88.9	14173 AX	21	0016:20	59.6
N	23709	22	0034:11	73.9	14186 B	22	0110:38	73.1
NA	23722 BTN	23	0129:07	87.6	14198 A	23	0009:58	58.0
N	23734	24	0029:03	72.6	14211 B	24	0104:15	71.6
NA	23747 BTN	25	0123:59	86.4	14223 A	25	0003:36	56.4
N	23759	26	0023:55	71.4	14236 BQ	26	0057:53	70.0
NA	23772 BTN	27	0118:50	85.1	14249 A	27	0152:10	83.6
NA	23784 BTN	28	0018:46	70.1	14261 BX	28	0051:31	68.4
N	23797	29	0113:42	83.9	14274 A	29	0145:48	82.0
NA	23809 BTN	30	0013:38	68.9	14286 B	30	0045:09	66.9
N	23822	31	0108:33	82.6	14299 A	31	0139:26	80.4

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.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

LETTERS

W6LS

I have not seen a Caveat Emptor section in *73 Magazine* for a long time. If you no longer print ads, ignore the two typed below. However, if you still conduct this service, please print the following ads:

CQ and QST 1950-1975 issues for sale. Send SASE if ordering 73, Ham Radio, or other CQ and QST issues. One dollar minimum order, and all issues cost 25¢ each, including USA shipping. Send chronological list and full payment to W6LS, 2814 Empire, Burbank CA 91504.

Certificate for proven two-way radio contacts with amateurs in all ten USA call areas. Award suitable to frame, and proven achievements added on request. SASE brings TAD data sheet from W6LS, 2814 Empire, Burbank CA 91504.

As you may remember, our club has operated a used amateur radio magazines service for more than a decade. It was your donation of *73 Magazines* that enabled us to start this project. We have shipped more than 3000 issues in one month, and we seldom send less than 300 magazines during a month. Our magazine service is appreciated by amateurs, and we have filled requests from every state and about 40 countries. We often receive very kind comments from amateurs who are happy to receive needed issues. Our club is a nonprofit organization, and we regularly donate "income" to worthwhile causes associated with the amateur radio service. As is indicated in our ad, our supplies of *73* and *Ham Radio* issues are always limited, and we have actually been completely out of them several times in the last few years.

We hope you understand that you and your staff are welcome to drop in at W6LS for unannounced visits whenever you are in our area. We are open weekday evenings 4:30-5:30 pm and 7:30-9:30 pm. Actually, W6LS is open and active at least 30 hours per week. Please extend our invitation to your staff. We are pleased to see Bill Pasternak whenever he attends an event at W6LS, and that is usually a couple of times per year.

W6LS is still as active as ever. We help license about 300 amateurs per year in the courses our members teach, including about 150 at W6LS. We actively support amateur-related activities, such as communications for Walk-A-Thons and Bike-A-Thons. We have hosted repeater conferences the last few years, along with meetings of other special interest groups such as SOWP, QCWA, OOTC, Ten-Ten International, Southern California Antique Radio Society, Southern California Radio Teletype, MARS groups, and others. We continue to be active in community affairs, such as through our hosting of the annual volunteers recognition day (Sunday, 25 September 1977) for the Burbank Red Cross. W6LS is also collecting donations of aluminum in 1977, and spending the income to buy refreshments for Red Cross blood donors in Burbank. Our 12th annual convention drew a little more than 3000 attendees, and we have reached the point where we are considering a move to larger quarters. W6LS has served as the receiving point for the ARRL California Incoming DX QSL Bureau during the last few years, and it runs smoothly now with plenty of help. W6LS sorts received SASEs and DX cards according to the first letter in the callsign suffix, and we ship packages to individual suffix sorters, who are members of other clubs in our Los Angeles Area Council of Amateur Radio Clubs. We are so deeply involved in several major projects that our clubroom looks like a combination storage room and junk shop.

I have taken up Herb Brier's (W9AD) old battle to help new amateurs through the Novice column in *CQ Magazine*. As you may recall, I have a lot of interest in the problems faced by new amateurs in general and Novices in particular. I hope to provide them with some help via this column, although I realize it may not last long (since the FCC is making noises about eliminating the Novice class of license).

I established an amateur radio operating award to provide a bit more incentive to new amateurs and to honor our beagle dog (Tad) who spent more time at W6LS than most members while he was alive. The Ten American Districts certificate is increasingly popular with new amateurs, and I have already issued almost 1200 of them to amateurs in all states and about 50 countries.

William Welsh W6DDB
LERC Amateur Radio Club/W6LS
Burbank CA

Hi, Bill . . . congratulations on the column in CQ . . . and sorry we are out of the classified business these days. We'll try to be sure to say hello on our next trip out your way . . . keep up the good work with Novice classes. — Ed.

HOT TICKET

I'm an air conditioning engineer who's worked the past year in Iran, where it's been 102° F. for the past month. I've been a ham for about seven years, and have had callsigns OD5GT and F0AZK. I now operate here in Tehran with callsign EP2GT. We also have a radio club here with about 60 members. Some of these members receive *73* by air mail from their American companies, so I've been able to keep up a bit on ham radio activities through your fine publication.

Bill Schlapfer EP2GT
Tehran, Iran

BRAVO

Bravo for your October editorial, "Can The QCWA Save Amateur Radio?"

I am in accordance with you 100% — this fine organization, above any other, could do the job that ham radio sadly needs.

I, regretfully, am not a member, but am joining as soon as possible. Having been in ham radio about 50 years, I guess I'm about due.

I understand that such an illustrious gentleman as Leo Meyerson has recently been elected as a regional director. Along with many good men in just about every walk of life, who do not seek monetary gain and show no discrimination toward old or new, who else should represent us except (as I have mentioned previously) Wayne Green? . . .

Paddy Labato W8DLU
Cleveland OH

REAL PROBLEMS

Regarding the recent announcement of the Rule and Order on FCC docket #21033: I would like you to consider supporting an addition to this controversial issue (at least in the midwest).

As I am not a Tech, I feel that I am less biased on the subject than most Techs are — but I still feel strongly that the potential problems need immediate consideration and action.

I am very disturbed by the talk in the weak signal portions of our VHF bands of a so-called "war." Now, as in many times in the past, is the time for cooperation between all concerned, not "war." Quoting a recently overheard comment on 145.1 MHz, "I'll throw my kW on the first repeater input down here." War is a two-way affair, and FMs have kWs also.

In general, FMers and low band operators whom I have discussed this with realize that DXing, EME, RTTY, TV and satellites use some of the VHF spectrum, but they don't know how much or where. They have been very receptive and sympathetic to our potential problems, and would support gentlemen's agreements and/or proposals to the FCC to prevent the potential problems.

My personal feeling is that the Rule and Order makes sense, except that it did not go far enough. Gentlemen's agreements can solve the problems of 220 MHz and up if they are made known and are respected by all parties concerned with the use of these bands. Two meters, as I see it, is where the problem lies. No good argument can be made that FM users and repeater operators didn't need the extra 1 MHz given on 2 — the problem is going to be that the 300 kHz that are usable by the Tech class for AM, SSB, CW, TV, RTTY, facsimile, and EME from 145.5 to 145.8 MHz is not going to be enough. General class license holders and above do far more work in the area above 145.0 MHz at present than in the 144 MHz portion, due to the tremendous activity generated by the Tech class. You go where the action is.

As I see it, the only answer is to open up the lower portion of 2 meters to Techs. The 500 kHz from 144 to 144.5 are probably adequate, when combined with the 300 kHz from 145.5 to 145.8, to handle all modes and uses. The bottom 100 or 50 kHz could and probably should be reserved for A1 only.

If the bottom of 2 is not opened to the Techs, I foresee some real problems for all users of the band.

Jerry G. Shepherd WB9YPW
Hoffman Est IL

EARNING

I just finished reading the letter from Mark A. Clark WB4CSK in the September *73*. He may be "just a kid," but he has the attitude of a mature adult and I agree with his feelings 100%. There is no excuse for lowering ticket requirements to gain strength in numbers.

I am working toward my Novice now, and I want the satisfaction of *earning* it. I'm a CBer, somewhat disappointed with CB, and it's my observation that if 90% of the CB operators knew more than how to key the mike and talk, we would have much less trouble with RFI, overmodulation, splatter, and crude manners.

Amateur radio doesn't need this kind of membership.

Dave Dunsmoor KAHB1022
Wahpeton ND

PACING

I have recently become a subscriber to your magazine, after belonging to the ARRL for more years than I care to remember.

I enclose a letter which I wrote to *QST* and which was returned to me with a copy of an old *American Medical Journal* article which merely stated the well-known facts that some later pacemakers have better shielding than some earlier models.

I had hoped that my experience might at least stay on file for the benefit of others who have the problem. Since receiving my letter back, I have withdrawn my permission for *QST* to use my experiences.

Perhaps I had better say that when

Continued on page 32

YAESU Deluxe "101" Series
The Ultimate Station Combination

FL-101 Transmitter

■ 160 thru 10 Meter coverage with two auxiliary bands ■ All mode operation: SSB, CW, AM, and FSK ■ 240 Watts PEP ■ Reliable, plug-in circuit boards ■ Built-in AC supply ■ Built-in, fully adjustable VOX ■ Automatic break-in CW operation with sidetone ■ Indicator light for internal VFO operation ■ Provision for optional RF speech processor ■ Built-in final cooling fan

FR-101 Digital Readout Receiver

■ Total Coverage: 160 thru 2 Meters with optional 6 and 2 Meter converters ■ Provision for all mode reception; SSB, CW, AM, RTTY, and FM with optional filters and FM detector ■ Complete transceive capability with all 101 series equipment ■ Reliable, plug-in circuit boards ■ Selectable fast or slow AGC ■ Built-in, threshold adjustable, noise blanker ■ Better than 1 KHz readout on all bands ■ Fixed channel, crystal-controlled operation ■ ±5 KHz clarifier ■ Built-in calibrator 25 or 100 KHz (selectable) ■ Indicator lights for internal VFO and clarifier ■ Built-in AC and 12V DC power supply

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Y1

FCC Math

John F. Leahy WB6CKN
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In this installment, we'll leisurely play around with Ohm's Law and tie up some loose ends from Part 1.

First, to Ohm's Law. Probably the simplest statement is: voltage = current x resistance. In symbols, $E = IR$ (remember, it's not necessary to put a multiplication sign between letters). And what it means is that the instantaneous voltage or pressure across a purely resistant circuit equals the amount of current flowing times the resistance offered to that flow. I used the words "instantaneous" and "purely resistant" to take care of ac as well as dc circuitry. The further you get into electronics, the more you see of such bothersome little distinctions. Things are just never simple!

Let's now do some algebraic wiggling like we did in Part 1. If $E = IR$ (back to playing with number equations if necessary), then $I = E/R$ and $R = E/I$. Which is to say that the current in a purely resistive circuit equals the voltage (pressure) divided by the resistance (the greater the voltage and the less the resistance, the more the current, just like a hose carrying water), and the resistance in the circuit equals the voltage divided by the current (the greater the voltage and the less the current, the greater the resistance must be).

Now an example: Suppose you wanted to develop 5 volts across a resistor that carried 25 milliamps (mA) of current. What size resistor would you need? Here we're looking for the R of our formula. A good way to remember the Ohm's Law formulas is simply to note that E, voltage, is always on top, never on the bottom of the fraction. $R = E/I$, then, is the form we want here. But there's a problem. The formula works for Ohms, volts and Amps (Amperes), whereas here we have *milliamps*. Using the proper units is always a critical factor in these problems, as it is in any measurement situation. You might be 6 feet tall. You most certainly are not 6 inches tall. The number (6 in this case) means nothing unless it's hooked up with the correct unit of measurement. So in our problem milliamps are no good if we want our answer in Ohms (but, as we shall see, they are fine if we want our answer in kilohms).

But this again brings up the subject of prefixes, which is quite a subject indeed. Milli and kilo (and the mega we saw in our last lesson) are examples. They are hooked onto the front of a unit word and completely change the size of that unit. Milli, for example, means thousan*dths*, kilo means thousan*ds*, mega means millions. So 25 mA is 25 thousandths of an Amp (0.025 A). Notice how much shorter the phrase *25 milliamps* is than the phrase *25 thousandths of an Amp*. Also note that with 0.025 you're into decimals, whereas with 25 you are not. Learning to work with prefixes, abbreviations and other shortcuts is mighty important in electronics computations, unless you don't mind taking up lots of space and time in computations that could be done with dispatch.

But to finish our problems, we now know that 25 milliamps is 0.025 Amps, something that we can plug into our formula even if we have not yet learned shortcut ways of handling decimals. $R = E/I$ becomes $R = 5/0.025$ for our problem. Dividing bottom into top, we get 200. So 200 Ohms is the resistance we want.

Let's check our work. To do so, we'll again use Ohm's Law, but the configuration $E = IR$. If we've done our work correctly, 5 volts should equal 25 mA times 200 Ohms. Multiply 0.025 x 200 and, sure enough, up comes 5. We must have done things the right way.

Before we jump back into prefixes and decimals to tie things together for this installment of our series, let's take further note of units of measurement, since, as we've already seen, keeping these units straight in our work is pretty important. Notice how we multiplied Amps and Ohms together to get volts! Wow, all different units! That often happens with multiplication and division. The units of measurement of the answer may be entirely different from those of the problem. That's not true of addition and subtraction. If I add so many Ohms plus so many Ohms, I'll get Ohms in my answer. If I subtract so many volts from so many volts, I'll get volts in my answer. The reason you get different units with division and multiplication is that units cancel just like numbers cancel: ~~5~~ x 7/~~5~~ x 9 = 7/9. The fives cancel. Or else one unit of measurement is defined in terms of other units so that they can be interchanged with those other units and you're still dealing with the same reality. The thing to remember is that units are handled *logically* in computations. With addition and subtraction, you'll get the same units in the answer as you had in the problem. With multiplication and division, you'll drop some units or get new units, but the units you dropped were canceled out and the new units were just "hidden" in the original units because of the *definition* of those original units. An example: Drive a car at 55 miles per hour for 3 hours and you've gone 165 miles. What happened to the hours? Here's what happened: 55 miles/hour x 3 hours = 165 miles hours/hour. The hours canceled because they were in top and bottom. Note also that when you say *per*, you mean divide. 55 miles per hour means 55 miles/1 hour. That may seem strange, but it all works out very nice and logically.

Another example. 7 miles equals 36,960 feet. How's that? Miles and feet are totally different units! Here's what you didn't see. There are 5,280 feet *per* mile. So we have 7 miles times 5,280 feet/1 mile. The miles cancel and we get 36,960 feet. That kind of thing goes on all the time in electronics. You just take the disappearance and reappearance of units for granted when a multiplication or division is involved.

Now some decimal stuff. There's just no way of avoiding it, though we have skirted around it so far. Perhaps 99% of computations in electronics require good working knowledge of our decimal system.

A decimal system is a *ten* system (from the Latin *decem*, meaning ten). Every time you move to the left, you multiply by ten; every time you move to the right, you divide by ten. In the number 777.7, the left-hand 7 is ten times bigger than the 7 to its right. That one, in turn, is ten times bigger than the one to its right, and so on. 777.7 means 7 hundreds + 7 tens + 7 ones +7 tenths, 700 + 70 + 7 + 7/10.

Naming numbers in our decimal system can be kind of tricky, because there's a variety of ways, all meaning the same thing. 7,700 can be named seven thousand seven hundred, or seventy-seven hundred. 0.025 is normally named 25 thousandths, though it means 2 hundredths and 5 thousandths. Look at the fraction equivalent, and you can see why. 2/100 + 5/1000 = 20/1000 + 5/1000 = 25/1000. Normally numbers smaller than one are named by the last digit to the right. 0.7 (by the way, a zero is usually stuck in before the decimal point just to make sure everyone understands it *is* a decimal point we are dealing with and not a period or something, and that there are no other digits to the left of the decimal) is seven tenths, because the 7 is in the tenths column. 0.93250 is nine-thousand three-hundred and twenty-five ten-thousandths, because the 5 is in the ten-thousandths column (you don't consider zeros to the right of that last non-zero digit, 5 in this case). 0.035 is thirty-five thousandths because the 5 is in the thousandths column. Using prefixes: 325 milliamps (remember, milli means thousandths) is 0.325 A. The 5 goes in the thousandths column because it is the digit to the right. 37 kilohms (remember, kilo means thousands) is 37,000. The 7 is the digit to the right and so goes into the thousands column. You'll notice I snuck one in there. 37 kilohms is not smaller than one! Prefixed numbers follow the rule whether larger or smaller than one.

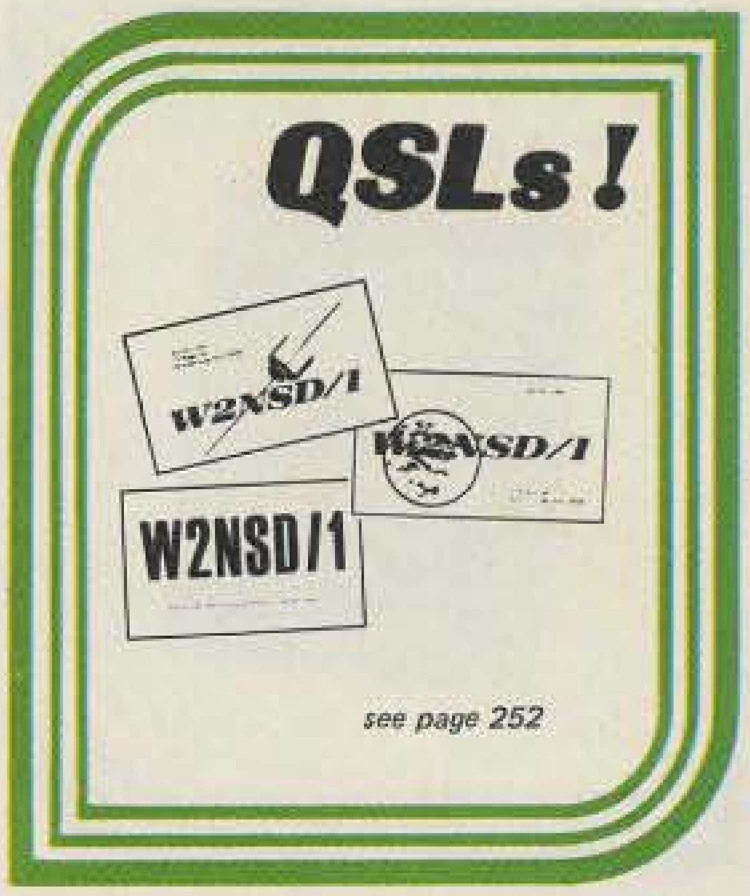

Fig. 1 shows an unwieldly number, 86,732,174,626.908761435 (that's 86 billion, etc.), with the names of each column written above, just in case you're not familiar with those names. If you wish to test your knowledge, you might try translating that monstrous number completely into words. (Check yourself against the note at the end of this piece.)

You will no doubt recall that the rules for adding and subtracting decimals are pretty simple. You just keep the decimal points directly above and below one another. 3.025 volts + 765 volts + 0.00096 volts becomes:

```
    3.025 V
  765     V
+   0.00096 V
```

You can fill in zeros if you want. And note that 765 has an invisible decimal point to its right. Any number in our system has that invisible point if none is showing, and you have to make it visible when doing computations. So you might do the problem:

```
  003.02500 V
  765.00000 V
+ 000.00096 V
  768.02596 volts
```

Notice how those decimals are kept in a straight line.

Subtractions are done pretty much as you might expect. 28.966 milliamps - 0.00046 milliamps becomes:

```
  28.96600 mA
- 00.00046 mA
  28.96554 milliamps
```

ten-billions	billions		hundred-millions	ten-millions	millions		hundred-thousands	ten-thousands	thousands		hundreds	tens	ones		tenths	hundredths	thousandths	ten-thousandths	hundred-thousandths	millionths	ten-millionths	hundred-millionths	billionths
8	6	,	7	3	2	,	1	7	4	,	6	2	6	.	9	0	8	7	6	1	4	3	5

Fig. 1.

Note the zeros we threw into both those problems. It's often quite helpful to throw in or take out zeros like that. (Of course, you can't do it in the middle of a number or between the decimal point and some other digits. 706 is not the same as 76. 0.009 is not the same as 0.9. 73,000 is not the same as 73!) Only zeros at the extreme right or left can receive that kind of treatment.

Multiplying decimals is simple enough. Just multiply as though there were no decimal point, then count up the number of decimal places in both the numbers you multiplied and add those two counts. That's how many places are in the answer. Example: 0.000037 Amps x 26,000 Ohms might be done simply:

```
 26,000
   x 37
 182000
 78000
 962000
```

There are no decimal places in 26,000, but there are 6 in 0.000037. So there will be 0 + 6, or 6 places in our answer. It becomes 0.962000, or, dropping those unnecessary zeros to the right, simply 0.962. (Of course, you have to count the 6 places while the zeros are still there.) If that was an Ohm's Law problem, our answer is 0.962 volts.

Decimal division is more difficult. We'll do a couple problems and state the rule at the same time. Problem: 18.73 volts ÷ 6.9 milliamps (remember, that's 0.0069 Amps).

```
0.0069)18.73
```


Abbreviation	Prefix	Size	Examples
p	pico	trillionths	7 pF means 7 picofarads, 0.000000000007 farads
			5 ps means 5 picoseconds, 0.000000000005 seconds
n	nano	billionths	1 ns means 1 nanosecond, 0.000000001 seconds
			3 nF means 3 nanofarads, 0.000000003 farads
μ	micro	millionths	8 μF means 8 microfarads, 0.000008 farads
			9 μs means 9 microseconds, 0.000009 seconds
			6 μV means 6 microvolts, 0.000006 volts
			4 μH means 4 microhenrys, 0.000004 Henrys
m	milli	thousandths	2 mA means 2 milliamps, 0.002 Amps (Amperes)
			5 mV means 5 millivolts, 0.005 volts
			7 mW means 7 milliwatts, 0.007 Watts
			3 mH means 3 millihenrys, 0.003 Henrys
			1 ms means 1 millisecond, 0.001 second
c	centi	hundredths	6 cm means 6 centimeters, 0.06 meters
k	kilo	thousands	9 km means 9 kilometers, 9000 meters
			8 kV means 8 kilovolts, 8000 volts
			4 kW means 4 kilowatts, 4000 Watts
			2 kΩ means 2 kilohms, 2000 Ohms
			3 k$ means 3 kilobucks, $3000!
M	mega	millions	5 MΩ means 5 megohms, 5,000,000 Ohms
			7 MW means 7 megawatts, 7,000,000 Watts
			6 MV means 6 megavolts, 6,000,000 volts

Table 1. Common abbreviations and prefixes.

(1) 00069.

Rule: Move the decimal point of the divisor (the number you are dividing by) all the way to the right.

(2) 69.

Rule: Drop the unnecessary zeros.

(3) 69

Rule: Let the decimal point become invisible.

(4) 187300.

Rule: Move the decimal point of the dividend (the number you are dividing into) the same number of places to the right as you did for the divisor. Add as many zeros to the right as necessary to do this.

(5) 69)187300.

Rule: Put the problem together with these new numbers and set a decimal point for the answer directly above the point in the dividend.

```
           2714.4
(6)   69)187300.0
         138
(7)       493
          483
(8)        100
            69
           310
           276
            340
            276
             64
```

Rule: Paying no further attention to the decimal point, proceed with the division as you would with any other division, putting each digit of the answer above the last digit to the right of the digit or digits you just divided into.

Rule: If necessary to get a decent-sized answer, add zeros to the right of the decimal point in the dividend. (We added one here, even though it was not necessary.)

Rule: If applicable, fill in the space between the decimal point and the first digit to the right with zeros. (This does not apply here, but will in the next problem.)

In the above problem, we stopped dividing after getting one decimal place in our answer. Actually, we could have stopped a lot sooner. Remember (Part I) that you seldom need more than 2- or 3-digit accuracy in electronics. If this was an Ohm's Law problem, an answer of 2700 Ohms would be plenty accurate in most cases.

Let's try another problem, in order to see where the last rule applies: 12.6 volts ÷ 47 kilohms (remember, that's 47,000 Ohms).

```
47,000)12.6
```

(5) 47000)12.6

Rules: Notice that rules 1, 2, 3, and 4 do not apply, since the decimal point is already to the right in 47,000. This brings us to 5, 6 and 7. And note that to apply 6, we first must use rule 7.

(7) 47000)12.600000

Rule: To get 3-digit accuracy, we have to add 5 zeros to the 12.6.

```
(6)             268
      47000)12.600000
             9 4000
             3 20000
             2 82000
               380000
               376000
                 4000
```

Rule: Note where that first digit of the answer goes (above the last digit to the right that you are dividing into that first-step). Very important! Also important: Keep digits directly above or below the correct digits in the subtraction process. That helps avoid errors.

(8) .000268

Rule: If you didn't leave that space for the 3 zeros, your answer would be incorrect.

Our Ohm's Law answer is 0.000268 Amps, which is 0.268 milliamps or 268 microamps.

These divisions can get mighty hairy. That's why next time we'll get into some pretty clever methods for handling divisions and a lot of things that are simply too difficult otherwise.

This brings us finally to abbreviations and prefixes. Look over the Table 1 above rather carefully. There are other abbreviations and prefixes, but these are the common ones. It'll be quite useful to have these stashed away in your mind for future reference.

Now try this exercise. Check yourself against the work and answers at the end of the column.

(1) Solve for the unknown using Ohm's Law:

(a) 750 V, 330 mA, R = ?

(b) 470 Ω, 11 mA, E = ?

(c) 18 V, 2200 Ω, I = ?

(2) In the same way that we did 777.7, break down this number: 17.352.

Note

Answer: Eight-six billion seven hundred thirty-two million one hundred seventy-four thousand six hundred twenty-six *and* nine hundred eight million seven hundred sixty-one thousand four hundred thirty-five billionths!

Work and Answers to Exercises

(1) (a) $R = \frac{750}{.330}$

```
       2,272
330)750,000
    660
     900
     660
     2400
     2310
       900
       660
       240
```

It's best to round answer out to 2300 Ohms.

(b) E = 470 x 0.011

```
 470
 x11
 470
470
5170
```

There are 3 decimal places in 0.011, so the answer is 5.170 or 5.17 volts.

(c) $I = \frac{18}{2200}$

```
         .00818
2200)18.00000
     17 600
        4000
        2200
        18000
        17600
          400
```

Answer: 0.00818 Amps or 8.18 mA.

(2) 1 ten + 7 ones + 3 tenths + 5 hundredths + 2 thousandths, or

$$10 + 7 + \frac{3}{10} + \frac{5}{100} + \frac{2}{1000}$$

RTTY Loop

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Ham curiosity being what it is, I'm sure any of you with HF receivers have chanced across funny-sounding signals on the low end of 80 or 20. By now, you should be aware that the "tweedle-tweedle-dee" you hear is FSK RTTY. This month we shall investigate, in general terms, methods of decoding transmitted RTTY.

To begin with, recall that there are two methods of transmitting RTTY presently in use: FSK and AFSK. When operating AFSK, you are presented with two audio tones, on standard frequencies (2975 Hz and 2125 Hz), regardless of the rf carrier frequency. FSK, however, presents two rf "tones" which, while their relationship is standard (850 Hz or 170 Hz apart), may be any of an infinite number of discrete frequencies.

Logically, our first task is to convert the FSK into something standardized for decoding – AFSK! Fig. 1 illustrates how one obtains the proper frequencies. Note that the FSK is tuned much in the manner of lower sideband, but that the bfo frequency is set to reproduce the 2 kHz tones rather than speech. For those of you with crystal bfos (such as the Heathkits), a third bfo rock should be used to provide the appropriate offset.

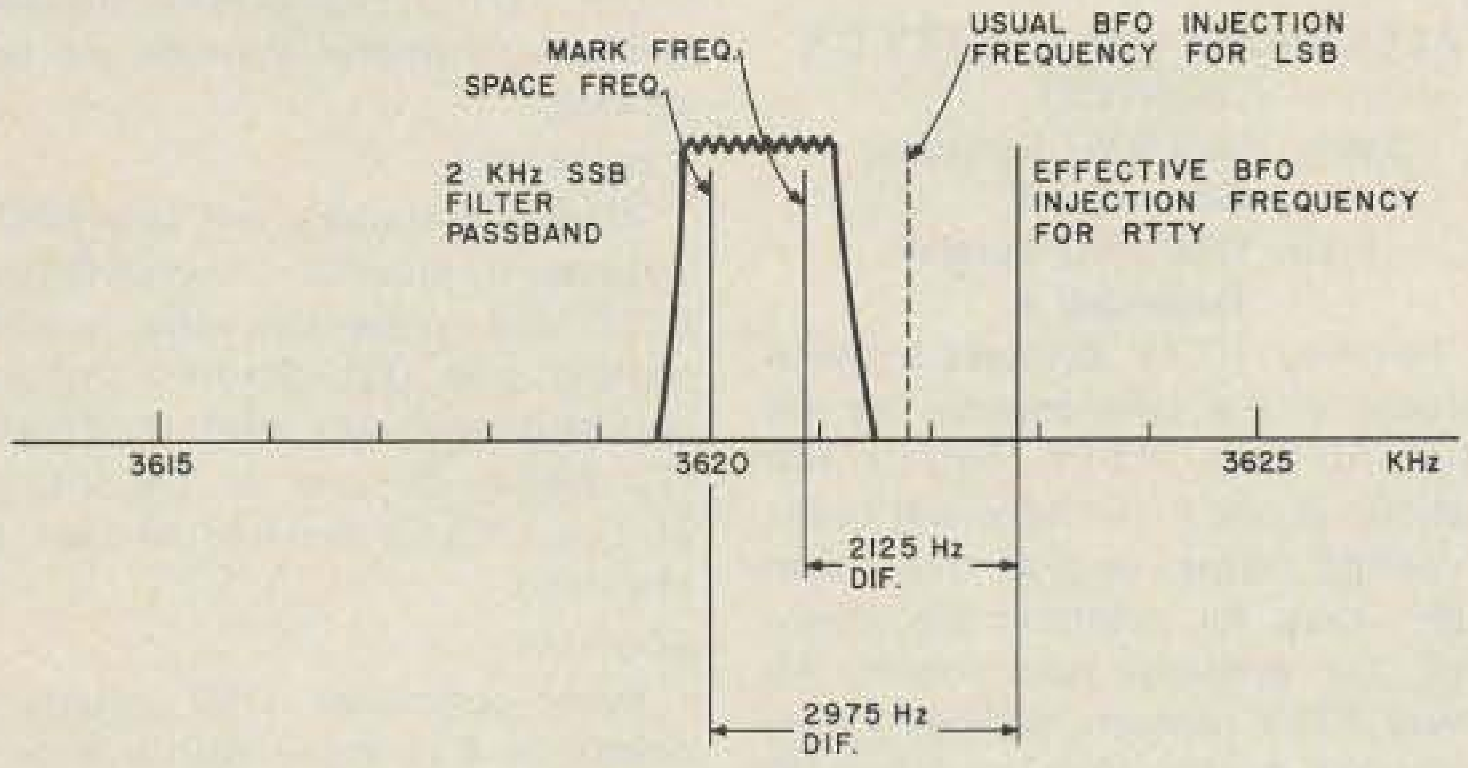


Fig. 1.

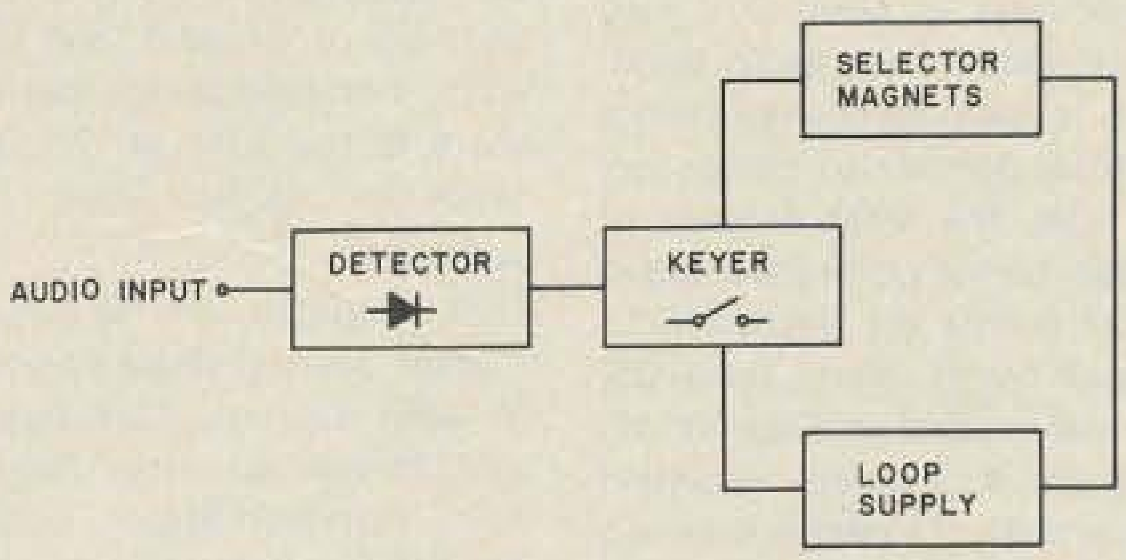


Fig. 2.

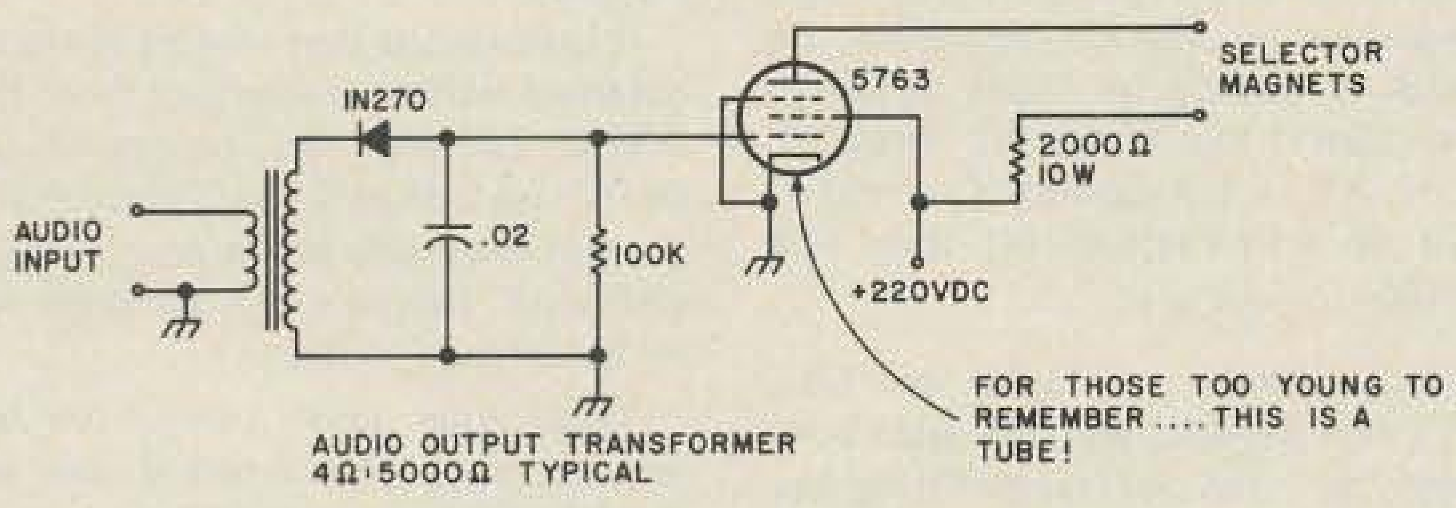


Fig. 3.

By the way, receiving schemes are available which convert not to audio, but to the receiver i-f frequency, typically 455 kHz, and demodulate from there. These systems are analogous to those covered here, but will not be specifically discussed.

So, how do you get the "tweedle-dee" to key your Model 15? Let's take a giant step backward. Remember ON-OFF keying? I told you that would come in useful! Look at the block diagram in Fig. 2. A tone arriving at the input is "detected," i.e., rectified, and applied to a keying stage. The keying stage is an electronic switch that is closed in the absence of a signal, but opens when such a signal is input. Feeding an ON-OFF keyed space signal into this primitive converter would produce a usable output, or, by keying a relay to invert the signal, on-off mark keying could be used.

Of course, we don't use ON-OFF keying, though, so what can we do? The simplest thing is to tune the HF receiver bfo so that the mark frequency is zero beat. The audio is then an 850 Hz (or 170 Hz) ON-OFF keyed space tone, and can be decoded by the practical circuit shown in Fig. 3. This is one of the circuits constructed and used at WA3AJR during the mid-1960s.

A more advanced approach is to use this basic circuit twice, on both the mark and space signals. By using filters tuned to the appropriate frequencies, each tone may be directed through a detector, and to keyers which would alternate polarity for mark and space. A special relay, called a "polar relay," can be driven off this alternating signal to key the loop. This scheme became known as the "W2PAT" converter, after its daddy, and is block-diagrammed in Fig. 4. With a "combiner" stage added to dispense with the polar relay and key the loop directly, this circuit remains an easy-to-understand way to get into RTTY reception.

Upon this foundation comes a whole raft of demodulator designs. Thoughts and concepts such as limiter vs. limiterless detectors, AM vs. FM techniques, and multiple other refinements have been debated. Additional circuits, such as autostart or character recognition, have been tossed about. Lately, an entire new generation of converters based on phase locked loop technology has arisen. Still, the vast majority of hams active on RTTY got their start on circuits such as covered this month. Only after one understands the fundamentals can one branch out into new areas. We'll explore some of those branches another time.

A card from Don Griffith WBØNOU was received, asking for a more detailed explanation of "space." Let's see what I can do.

Consider a wire with a voltage on it. This voltage can be either on or off. We will call the "on" state "1" and the "off" state "0". Now, if we start to turn the voltage on and off in a coded sequence, such as the Baudot teletype code, the line will demonstrate a pattern of rapidly changing 1s and 0s. *By convention*, it has become customary to call the "1" "mark" and the "0" "space." Although I used ON-OFF voltages in this example, it could have been OFF-ON keying, positive and negative, high and low, or changes in ac or rf frequency. The words "mark" and "space" denote a logic state difference, just as do "1" and "0". "Space" has *nothing* to do with the "space" character on a teletype. Any system in which a signal is coded as two states could have a "mark" and "space," even Morse code!

An overview of transmitting circuits is up for next time. Meanwhile, if anyone has specific points or questions for future columns, please send them to me at the above address, or in care of *73*.

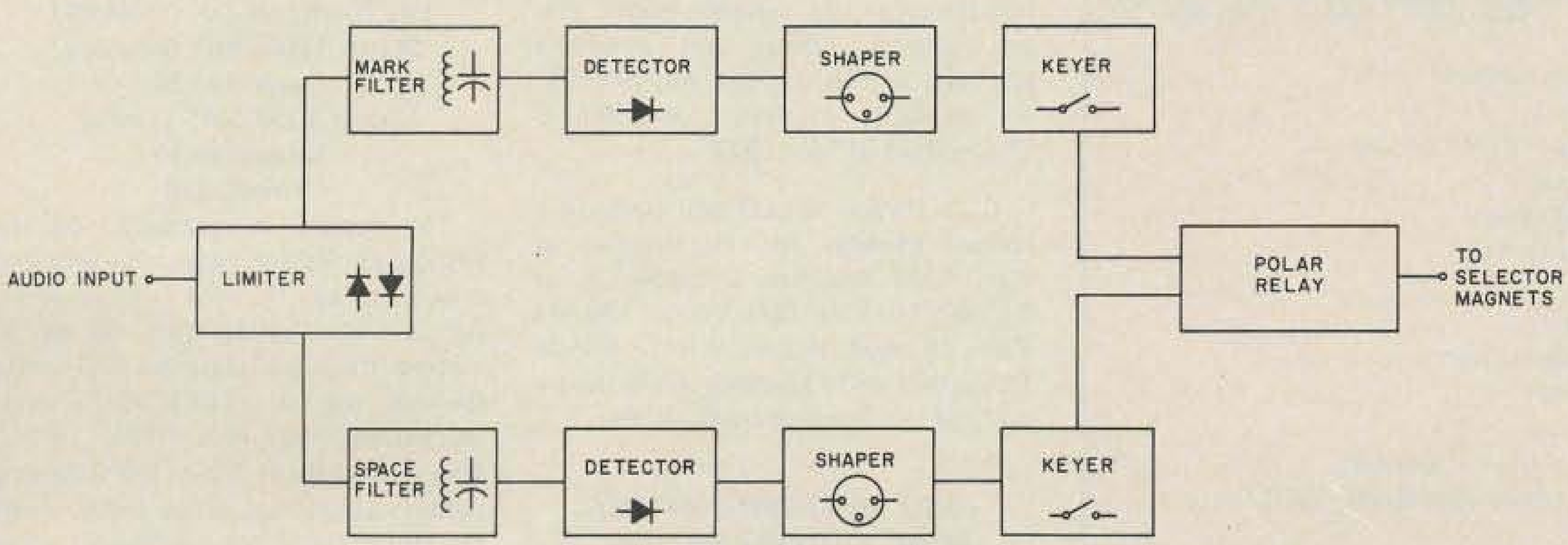


Fig. 4.

CONTESTS

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

ARRL 160 METER CONTEST

Starts: 2200 GMT Friday, December 2
Ends: 1600 GMT Sunday, December 4

The 7th annual ARRL 160 Meter Contest is open to all amateurs on CW only. Multi-operator work is permitted and scores will be listed separately in the results, but they will not be eligible for certificates.

EXCHANGE:

RST and ARRL section or country.

SCORING:

QSOs with amateurs in an ARRL section count 2 points; QSOs with amateurs not in an ARRL section are worth 5 points. DX to DX QSOs do not count. Multiplier is the total number of ARRL sections (74), VE8, and foreign countries worked.

AWARDS:

Certificates will be awarded for section and non-W/VE country high scores. Division high scores will have their section award endorsed with an appropriate seal.

FORMS:

It is suggested that contest forms be obtained from the ARRL, 225 Main St., Newington CT 06111. Check sheets are not required, but a penalty of 3 additional contacts will be made for each duplicate contact.

These rules were taken from last year's contest. For complete rules, see the November issue of QST.

CONNECTICUT QSO PARTY

Starts: 2000 GMT Saturday, December 3
Ends: 0200 GMT Monday, December 5
Rest Period: 0500 to 1200 GMT December 4

The Candlewood ARA has moved its 15th CT QSO party from the traditional first of May to the first weekend of December in an effort to find a time when band conditions are favorable and when other events are minimal. Phone and CW are considered to be the same contest. Stations may be worked once on each band and mode. Out-of-state portables and mobiles operating in CT are requested to identify themselves as such. Counties certificates will be awarded to each station working all 8 CT counties.

EXCHANGE:

QSO number, RS(T), and ARRL section or CT county.

FREQUENCIES:

SSB — 3925, 7250, 14300, 21375, 28540.

CW — 40 kHz up from bottom of each band.

SCORING:

Non-CT stations multiply total number of CT QSOs by number of CT counties worked (8 max.). CT stations multiply total number of QSOs by number of ARRL sections and provinces. Additional DX contacts count for QSO points, but only one DX multiplier is allowed overall. Q1QI, the club station, will be operating CW on odd hours, and SSB on even hours, and counts as 5 QSOs on each band and mode.

ENTRIES:

Logs must show category, date, time (GMT), calls, numbers, bands, QSO points, and claimed scores. Enclose a large SASE for results. Send logs, postmarked by Jan. 15, to CARA, c/o Fred Porter W1VH, 169 Carmen Hill Rd. Nr. 2, New Milford CT 06776.

TOPS CW CONTEST

Starts: 1800 GMT Saturday, December 3
Ends: 1800 GMT Sunday, December 4

General call is "CQ QMF." Entry classes for single/multi-operator. Use 3.5 to 3.6 MHz band only; use low end of band for DX-CW only!

EXCHANGE:

RST and serial number from 001.

SCORING:

Contacts with own country = 1 point; each call area in W/K, VE/VO, VK, and UA count as separate countries. Contacts with stations in same continent count 2 points, other continents = 5 points. Contacts with HQ station GW8WJ or GW6AQ count 25 points. Total score is total number of QSO points times number of prefixes worked (as per WPX award rules).

ENTRIES:

Send logs to Peter Lumb G3IRM, 14 Linton Gardens, Bury Saint Edmunds, Suffolk IP33 2DZ, United Kingdom.

How about some US participation this year? There wasn't a single entry from North America last year!

CALENDAR

Dec 3-4	ARRL 160 Meter Contest
	TOPS CW Contest
	Alexander Volta RTTY Contest
	EA Phone Contest
Dec 3-5	Connecticut QSO Party
Dec 10-11	ARRL 10 Meter Contest
	EA CW Contest
	HA DX Contest
Dec 17-18	SOWP CW Christmas party
Dec 31	Straight Key Night
. . . 1978 . . .	
Jan 14	Hunting Lions in the Air Contest
Feb 11-12	Ten-Ten International Net Winter QSO Party
Aug 19-20	NJ QSO Party

ALEXANDER VOLTA RTTY DX CONTEST

Starts: 1200 GMT Saturday, December 3
Ends: 1200 GMT Sunday, December 4

Two-way RTTY contacts between stations of the same country are not valid. All 2-way RTTY contacts with stations in one's own zone will count 2 points; those outside one's own zone count for points in accordance with the exchange points table. All 2-way RTTY contacts made on 7 MHz are worth double; those on 3.5 or 28 MHz are worth triple points. Stations may only be worked once per band. A multiplier of one is given for each country contacted on each band. Total score is total exchange points times the total number of multipliers times the total the total number of QSOs. Italian bonus points are added last — 1000 points for each I/IS/IT contact on all bands. Note: Each US, Canadian, and Australian District will be considered a separate country! Exchange consists of message number, RST, and zone. Use one log per band. Log forms, score sheets and exchange points table are available for IRCs. Logs must be received before Jan. 20, 1978, to qualify (advisable to use air mail). Send logs and score sheets to: A. V. RTTY DX Contest Committee, SSB & RTTY Club, PO Box 144, 22100 Como, Italy.

This contest is open to SWL RTTYers as well, and the same rules apply as used for transmitting stations; a separate results table will be made for these entries. Contest awards include callbooks, plaques, books, etc. In addition, points and positions achieved in this contest will be valid for inclusion in the "World RTTY Championship" for 1977.

Club station I2LLO will transmit a special message for 10 minutes at 2350 GMT Saturday, December 3, on 21.100 MHz at 300 Watts 170 Hz FSK, 45 baud. A special prize will be forwarded each amateur submitting a copy of the message transmitted.

ARRL 10 METER CONTEST

Starts: 1200 GMT Saturday, December 10
Ends: 2359 GMT Sunday, December 11

The contest is open to all amateurs worldwide. All QSOs must take place on 10 meters, and OSCAR QSOs are valid. Each station can be worked on phone-to-phone and CW-to-CW, and anyone can work anyone. All CW contacts must be made between 28.0 and 28.5 MHz, unless working through OSCAR. When operating on 10 meters, please avoid the OSCAR downlink frequencies.

CLASSES:

Entries will be classified as either single- or multiple-operator stations. Multiple-transmitter stations are not allowed.

EXCHANGE:

All W/VE stations will send RS(T) and state or province. Others will send RS(T) and consecutive serial number starting with 001. Stations that are not land-based will send RS(T) and ITU Region (1, 2 or 3). The District of Columbia is counted as part of Maryland.

SCORING:

Each completed QSO counts 2 points, or 4 points if with a W or K Novice. The multiplier is the sum of the total number of states, Canadian call areas (max. 9), ARRL countries (not US or Canada), and ITU regions from non-land-based stations. Final score is the sum of the QSO points times the total multiplier.

AWARDS:

A certificate will be awarded to the highest scoring single-operator station in each section, Canadian call area, and foreign country. Region awards for non-land-based stations, and awards for multi-operator and Novice stations will be issued if warranted.

FORMS:

It is suggested that contest forms be obtained before the contest from the ARRL, 225 Main St., Newington CT 06111; include an SASE. Check sheets are not required, but a penalty of 3 additional contacts will be made for each duplicate contact.

These rules were taken from last year's contest. For complete rules, see the November issue of QST.

HUNGARIAN DX CONTEST

Starts: 1600 GMT Saturday, December 10
Ends: 1600 GMT Sunday, December 11
(Unofficial)

The contest is sponsored by the Hungarian Radioamateur Society and is open to any licensed radio amateur. All amateur bands from 80 to 10 meters may be used on CW only. General call is "TEST HA," while Hungarians will give "TEST WW." Entries may be in any of the following classes: single op, single band; single op, multi-band; or multi-op, multi-band.

EXCHANGE:
RST and continuous serial number from 001. After their signal report, Hungarian stations will give a two-letter code for their location (county) as follows: BA, BP, BE, BN, BO, CS, FE, GY, HA, HE, KO, NO, PE, SA, SO, SZ, TO, VA, VE, ZA.

SCORING:
Each HA QSO counts 1 point. The same station may be worked only once per band. Each different HA county worked counts 1 multiplier point per band. Final score is total QSO points times sum of multiplier points from each band.

ENTRIES:
Logs must be made in usual form with summary sheet and signed declaration. They should be mailed within 6 weeks after the contest to: Radio Amateur League of Budapest, H-1553 Budapest, P.O. Box 2, Hungary.

AWARDS:
Certificates to first place station from each country in each class or section. Additional places if warranted.

1977 CW CHRISTMAS PARTY

The Society of Wireless Pioneers (SOWP) is planning a membership Christmas on-the-air CW QSO Party for the weekend of December 17 and 18, 1977. The party will cover the full GMT period to allow members around the world to participate. This will be the second Christmas on-the-air party held by the Society.

The purpose of the affair will be to give members an opportunity to meet on the air and to exchange Season's Greetings. There will be no formal exchange requirements and no need for members to submit logs, etc.

All members with amateur licenses are being encouraged to take part. The call will be CQ SOWP. While there will be no certificates or other awards given, everyone who takes part will be a winner by having an opportunity to renew old friendships, establish new ones, and continue a camaraderie developed over the years.

Suggested frequencies for the party are 55 kHz up from the low end of each amateur band. Additional information about this party and the Society can be obtained from the Party Coordinator, Bill Willmot K4TF, 1630 Venus Street, Merritt Island, Florida 32952.

ARRL STRAIGHT KEY NIGHT
0100-0700 GMT Sunday, January 1

Check *QST* for any changes in the rules!

Basically, rules require the use of a straight key only. Send "SKN" instead of "RST" during QSOs, to help identify contest stations. On 80-40-20 meters, try 060 to 080 kHz up from the bottom edge of the band. On Novice bands, try 10 kHz up from the bottom of the Novice band. After the contest period, send a list of calls of the stations contacted during the contest period, plus your vote for the best fist heard. Please mail entries as soon as possible to the ARRL, 225 Main Street, Newington CT 06111.

WORKED ALL NEW ENGLAND AWARD

For working stations in each of the 6 New England states on 50 MHz band or higher. Endorsements on request for all ATV, SSB, CW, OSCAR, etc. All contacts must be on or after Jan. 1, 1976. W/K1 stations work two stations from each state, other work only one station in each state. Send log consisting of date, time, call, name, and state, along with check or money order for $1.50 (DX send 2 IRCs) to: Worked All New England Award, Ronald Pariseau, Chairman, R1 Box 213A, Thompson CT 06277. Make checks payable to Ron Pariseau, Chairman.

TRI-STATE CERTIFICATE

Award is for working stations in the Tri-States of Connecticut, Massachusetts, and Rhode Island. Contacts must be made on or after Jan. 1, 1977. W/K1 stations must work three stations from each state; other call areas and DX stations work one station from each state. QSLs must be in your possession, but need not be sent with application. Cards may, however, be requested later. Log will consist of date, time, call, name, state. The award is open to all amateurs on all bands; hand-written endorsements are available on request. Send logs and $2.00 check or money order to: Tri-State Amateur Radio Club, Award Committee, Box 213A R1, Thompson CT 06277.

RESULTS

RESULTS OF THE TEN-TEN INTERNATIONAL NET SUMMER QSO PARTY – JULY 16-17, 1977

Single Op stations:

U.S. District		
1	W1MR	346/655
	WA1QHS	260/493
2	WA2YYT	548/1013
	K2FW	525/967
3	W3RJ	1041/1871
	WA3YRM	800/1460
4	K4XS	1046/1897
	WB4CHK	716/1316
5	WA5JDU	555/1057
	W5RRR	404/777
6	WA6LLW	350/641
	W6ED	336/638
7	WB7NCD	448/825
	WB7AEB	414/772
8	WB8FAG	507/937
	WB8EDG	253/485
9	WA9IXF	418/784
	WA9PQY	284/539
Ø	WBØQHV	719/1335
	KØJN	632/1178

Multi-Op:

	W9NIN	501/925

VE District		
1	VE1ASU	122/229
2	VE2DZO	252/445
	VE2ADZ	109/206
3	VE3HHS	125/233
	VE3JHA	69/134
4	VE4VV	197/371
	VE4OY	116/221
6	VE6BCC	73/139
7	VE7CMK	223/414
	VE3CXL/7	39/74

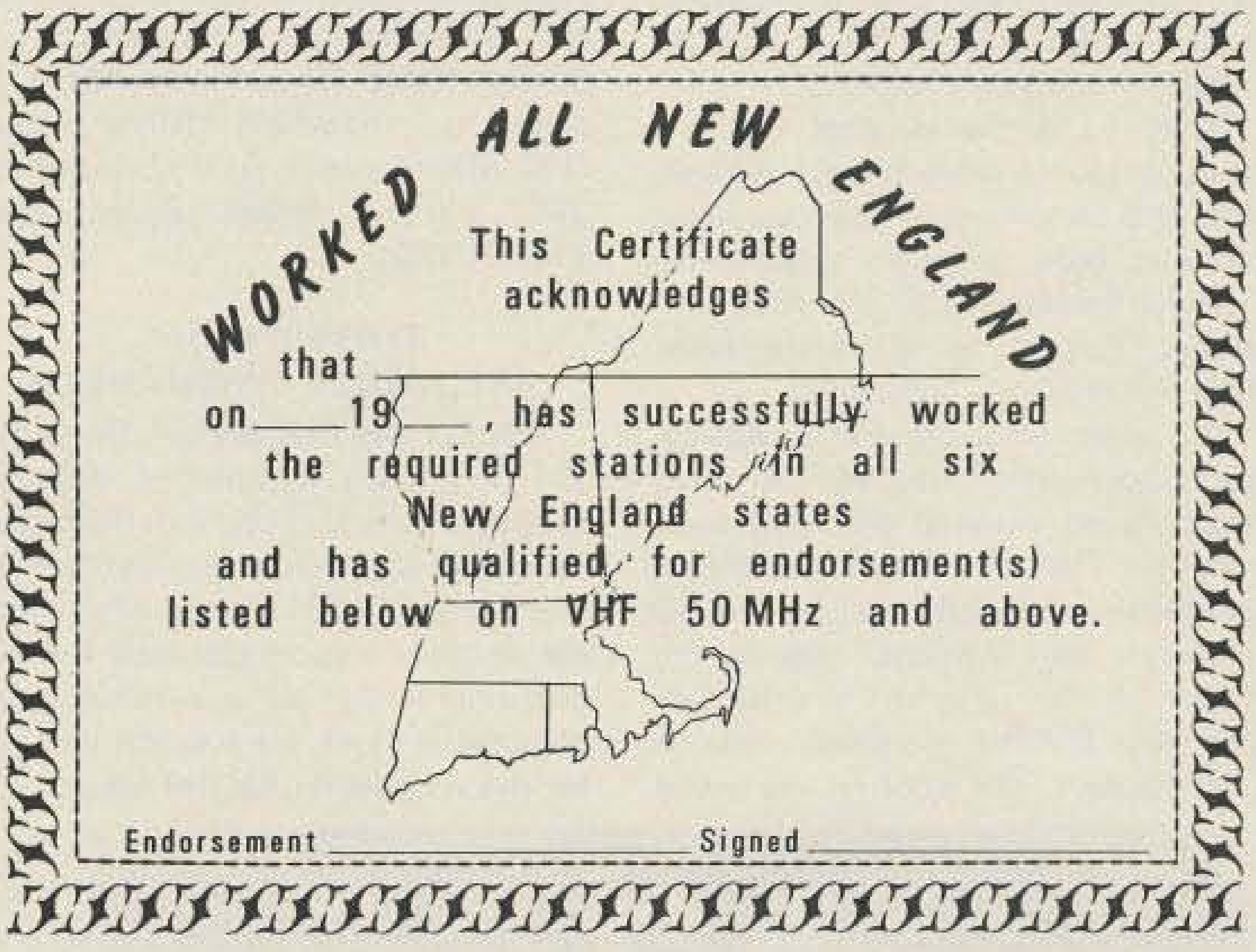
DX		
	ZF1AK	105/199
	KP4DQN	20/39
	LU7FAG	86/162
	LU6DMZ	45/84
	DK5UG	11/16
	JH3BJG	2/4
	JR3GDY	1/2
	VK4JP	52/62

CW Winners:

W5SQW	72/93
WB4NWG	23/29
N9DP	8/10

Chapter Winners:

Colorado 10-10	6942/13425
White House	6347/12144
Gateway	5599/10819
Bay Area	5634/10653
Devil's Triangle	4121/7769
Mo-Kan Tenners	3338/6366
CATT	3304/6293
North Georgia	2588/4815
So. California	2458/4636
LIARS	2366/4513



RESULTS

RESULTS OF 1977 NJ QSO PARTY

NJ winners:					
Bergen	WA2GMO	2,970	Ocean	WB2VWW	9,328
Burlington	N2MM	30,690	Passaic	N2SU	16,352
Cape May	W2VMX	546	Somerset	WA2EJZ	1,586
Essex	K2TA	12,208	Sussex	WB2KBH	10,896
Gloucester	N2CQ	5,292	Union	WB2FUE	2,187
Hunterdon	W2GD	16,400	*Top out-of-state scores:*		
Middlesex	WA2NPP	64,253	K3UEI	E. PA	3,171
Monmouth	WB2GXR	17,697	W2TND/1	NH	2,000
Morris	WA2EPK	8,360	W6ZT/3	W. PA	1,748
			W2FVS	NYC-LI	1,674

New Products

SINGLE CMOS CHIP MAKES INEXPENSIVE 3-3/4 DIGIT PANEL METER

A new addition to the National Semiconductor data conversion line is the "ADD3701," a single CMOS integrated circuit which requires only a display, an external voltage reference, and a digit driver to form a complete 3-3/4 digit DVM (digital voltmeter) that reads up to 3.999 units.

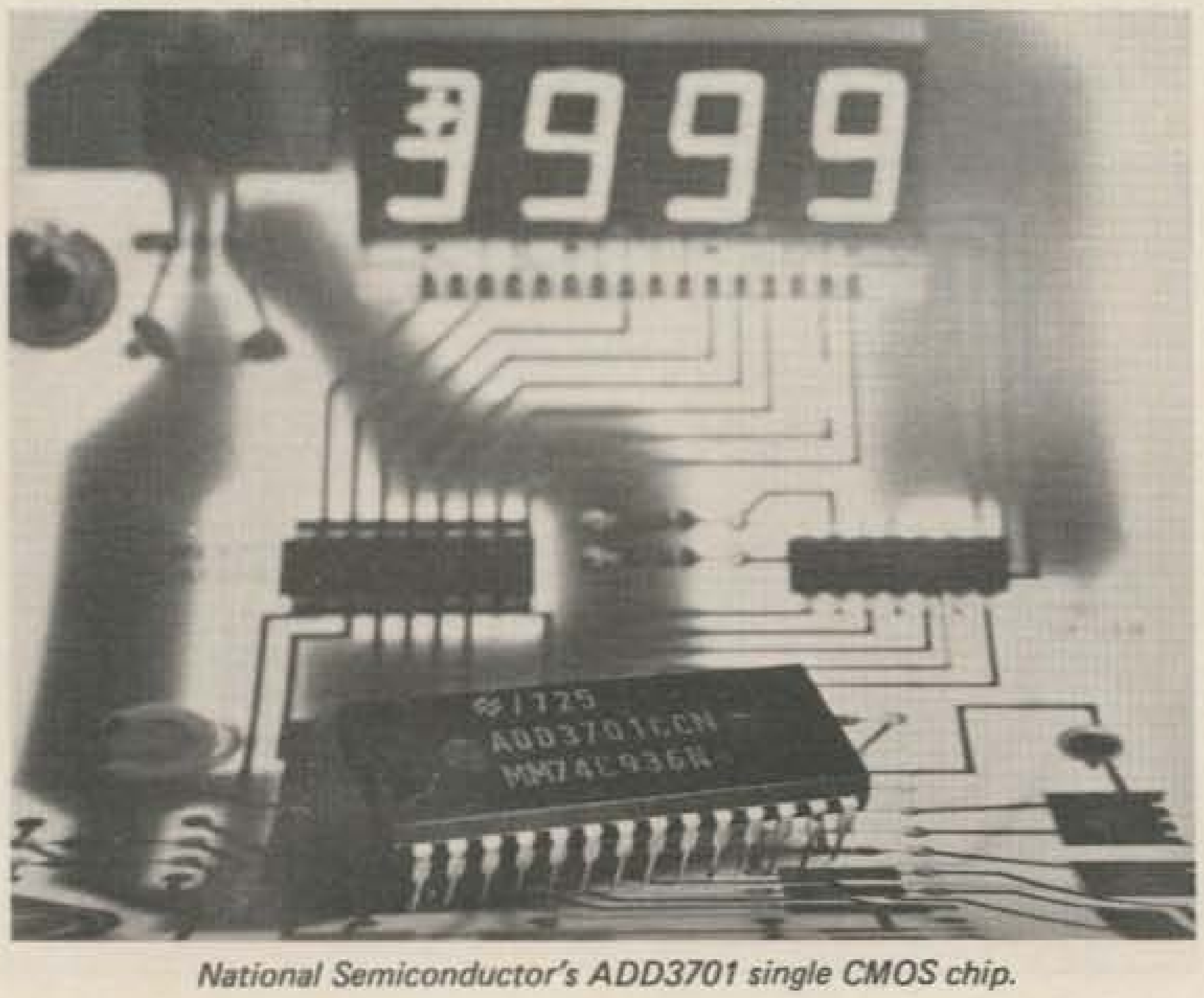
Manufactured using standard CMOS technology, the ADD3701 is an extended-range version of National's "ADD3501" 3½ digit DVM introduced earlier this year, with readings up to 1.999. The additional range of the new DVM chip expands the applications of the device into areas where a reading of 1.999 isn't high enough, such as weight measurement on bathroom scales and measurement of degrees of rotation or temperature.

The ADD3701 utilizes a single five-volt supply to drive a multiplexed seven-segment output directly, and features differential input protection to 200 volts. Overrange condition is displayed by "+OFL" or "-OFL" indication, depending upon whether the input voltage is positive or negative.

The 3701 also features auto-polarity and an on-chip clock that eliminates the need for an external signal timing circuit. This internal oscillator can be set by an external RC network, or the oscillator can be driven from an external frequency source.

When using the external RC network, a square wave output is available. It is important to note that great care has been taken to synchronize digit miltiplexing with the A/D conversion timing, to eliminate noise from power supply transients.

A pulse modulation analog-to-digital conversion method is used, requiring no external precision components. The seven-segment outputs are capable of delivering up to 40 milliamps per segment, making the ADD3701 ideally suited to drive 0.5-inch and 0.7-inch common cathode LED displays. The price of the model "ADD3701CCN" is $11.95 when purchased in lots of 100. Delivery is from stock. *National Semiconductor, 2900 Semiconductor Drive, Santa Clara CA 95051.*



National Semiconductor's ADD3701 single CMOS chip.

THIRD HAND

That's what you need when you are working on PC boards — they just won't hold still. One of our readers out in Hawaii came up with a little clamp arrangement (which is being marketed by a firm in California) called the 3rd Hand. You clamp one part of it to your table, anything from 3/4" to 1½" thick, and then clamp the other part of the gadget to the PC board. There is a piano hinge between the two parts so you can flip the PC board over and work on both sides.

It sells for $6.95 plus postage, tax, etc. *3rd Hand, Box 60579, Sacramento CA 95860.*

TERMINAL STRIPS FOR PC BOARDS

The TS series of terminal strips provides solderless termination of wire leads via positive screw-activated clamping action. Strips are available with 4, 8, or 12 positions, and accommodate wire sizes 14-30 AWG (1, 8-0, 25mm). Pins are silver-plated brass, .040 inch (1mm) diameter, on .200 inch (5mm) centers. Features include unbreakable polyamid bodies and consecutively numbered terminals. Rated 10 Amps at 300 V. In stock for immediate delivery from *O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx, New York 10475.*

SYNTEST SI-101 FREQUENCY SYNTHESIZER

The Syntest Corporation Model SI-101 frequency synthesizer provides excellent general purpose performance at low cost. Typical applications for the Syntest SI-101 instrument include use as a calibration standard for test instrumentation, as a precision programmable clock for systems use, and for the alignment of active filters.

Syntest's Model SI-101 frequency synthesizer.

The Model SI-101 features 4½ digits of resolution from 0.1 Hz to 16 MHz. A high stability internal reference oscillator, ±10 PPM over the temperature range 0-50° C, and fast programming highlight this versatile instrument. The synthesizer provides a continuously adjustable 50 Ohm TTL output. The unit is completely solid state and incorporates a rugged power supply for high reliability.

Power requirements are 115 or 230 V ac, rear panel switch selectable, at 5 W maximum consumption. The SI-101 is housed in an attractive 8.50" W x 3.20" H x 9.00" D enclosure.

An industry standard RETMA rack mount adaptor, as well as a ±1 PPM reference oscillator, are offered as options. Custom configurations are available from the factory.

Price of the Syntest SI-101 frequency synthesizer is $459.00 in unit quantities and availability is stock to 30 days. *Syntest, 169 Millham Street, Marlboro MA 01752.*

NEW 1978 RADIO SHACK CATALOG #289 ISSUED

The new 1978 Radio Shack Catalog, the company's 30th consecutive issue, is now available from Radio Shack stores and dealers, nationwide.

The 164-page catalog includes 100 full-color pages describing the company's exclusive line of products for home entertainment, hobbyists, CBers, and experimenters.

An insert card in the catalog introduces Radio Shack's new TRS-80 Microcomputer System, which, according to Radio Shack president Lewis Kornfeld, is "the most important product ever offered by Radio Shack."

"The TRS-80's importance," Kornfeld stated, "goes far beyond the mere design, construction, and sale of the fine piece of electronic merchandise. Primarily, it signifies the dawn of the microcomputer age in respect to availability and affordability to ordinary people, schools, and businesses every-

where, even for personal use and entertainment.

"Secondarily, the TRS-80 should convince millions of folks that Radio Shack is a technological company as well as a marketing company."

The new catalog also includes coupons offering two Supertapes, either reel-to-reel, 8-track cartridge, or cassette, for the price of one, two P-Box kits for the price of one, and any of the company's project boards for half price.

Among the new items introduced in the catalog are 40-channel Realistic CB two-way radios and a selection of electronic calculators ranging in price from $8.88 to $109.95 for a rechargeable printing calculator with full memory.

The new catalog also lists hundreds of specialized electronics items, parts and accessories, tools, tubes, semiconductors, wire and cable, intercoms, microphones, timers, batteries, and a complete library of Radio Shack's own books on electronics and related subjects.

Radio Shack's 1978 Catalog #289 is available free on request from Radio Shack stores and dealers, nationwide.

Radio Shack, a division of Tandy Corporation (NYSE), has more than 6,000 stores and dealers in all 50 states and Canada, and nearly 500 stores overseas operating under the name Tandy International Electronics. *Tandy Corporation, 2617 West Seventh Street, Fort Worth TX 76107.*

CLEGG COMMUNICATIONS PROFILE

It was a nice day in early May, a nice day to take a ride from Valley Stream, New York, where I was staying, to a more pleasant place. Early in the morning, I drove into Brooklyn to pick up Larry, who had agreed to leave his homemade computer for the day and act as my photographer on this assignment. Our destination some 90 miles away — Lancaster, Pennsylvania, the home of Clegg Communications and the man behind the name, Mr. Edward T. Clegg W3LOY.

The three-hour ride from Brooklyn gave us a chance to reminisce about the old days, the time when VHF meant six meter AM, a time when Clegg reigned supreme. I can remember it as if it were yesterday, though it's now over 16 years ago. I remember my very first transceiver — a rather pretty gray and white box that ran 7 Watts at 100% modulation and featured a super sensitive state-of-the-art (of that day) receiver that gave the popular receiver/converter combinations a good run for the money. I remember placing this little box atop Larry's SX-28 and Techcraft converter to make a comparison. I can even picture the expressions on our faces when we found that the transceiver could hear as well as the Techcraft SX-28 combo. Not a very scientific test, I will admit, but for a pair of teenagers, it was all we needed to be convinced. The radio we literally fell in love with was known as the 99er, and it came from the man we would soon see. The Clegg 99er — a radio that set the industry and six meters both on their proverbial ears, especially when it came on the market at a price that was half of anything comparable.

The 99er was not the first radio from Clegg, nor was it to be the last. Fact is, Ed Clegg was designing and marketing VHF communication equipment for amateur use well before most of the competition considered it fashionable. The 99er was my first personal exposure to the famous "Clegg line," a line of amateur VHF equipment that down through the years has always managed to stay a jump or two ahead of competitors. There was the Thor VI — 60 Watts AM with a VFO that automatically tracked the transmitter to the receiver (commonplace today in HF and VHF SSB, but this was the early sixties and six AM). SSB came to six in the mid-sixties, and one of the first entries was the Venus and its matching Apollo linear amplifier. And who can ever forget the Cadillac of VHF — the radio twins that meant you were on the top — the Clegg Zeus transmitter and matching Interceptor receiver.

When we found FM and two meters, Clegg had already discovered it. The AM 22er gave way quickly to the 22er FM, which eventually itself gave way to the first fully synthesized radio to hit the US marketplace — the famous FM-27, 27A, and 27B. These radios, five to seven years old, still bring a pretty penny at resale time. The FM-27 series of radios was designed to last as long as two meters lasts, regardless of what band plan or split may be in use. It would work anywhere, and that sold it. Soon though, in many cities, two meters was bulging at the seams with activity. What to do? Move up, up to 220 MHz. Again, Clegg was first with his FM-21, a radio that used but one crystal to get both the transmit and receive channels. The FM-21 that . . . we're here . . . the time has flown.

Not one to tarry, Larry set to work photographing everyone and everything in sight while I sat down to eyeball with Ed. We spoke of many things — pending rulemaking, the ARMA organization that Ed is a member of, and finally, the current line of equipment. No matter how much or how little you have to spend, there is a radio in the Clegg line to fill your need. AM has given way to FM, and the entire line shows this. Two meters? We start with the MK-3 — fifteen Watts and twelve channels in a neat little box that comes complete with mic, mic hanger, and mounting bracket. The receiver is double conversion and the price is well under the $200 mark.

Want to be able to work any channel you desire and never have to purchase a crystal? Clegg has two radios that will meet your criteria. At around the $350 mark, there is the FM-28. For your money, you get full 144 to 148 MHz coverage, LED readout, 600 kHz up/down for repeater use, option of other offsets, 5 kHz split ability for repeaters on tertiary channels, and one of the best sounding transmitters found on the air these days.

Top of the Clegg 2 meter line is the FM-DX, a radio that has become a legend in its own time. Fully digitally synthesized with 40 Watts out and coverage from 143.5 to 148.5 MHz, letting the owner work MARS services if he is so associated, along with every other feature that the avid two meter FM enthusiast might want (except a built-in tone pad), the FM-DX is a radio appreciated by many discriminating amateurs. It's not inexpensive, but even at its approximate $600 price, it's well worth the money. Those amateurs who own the FM-DX will settle for nothing else. That says a lot in itself.

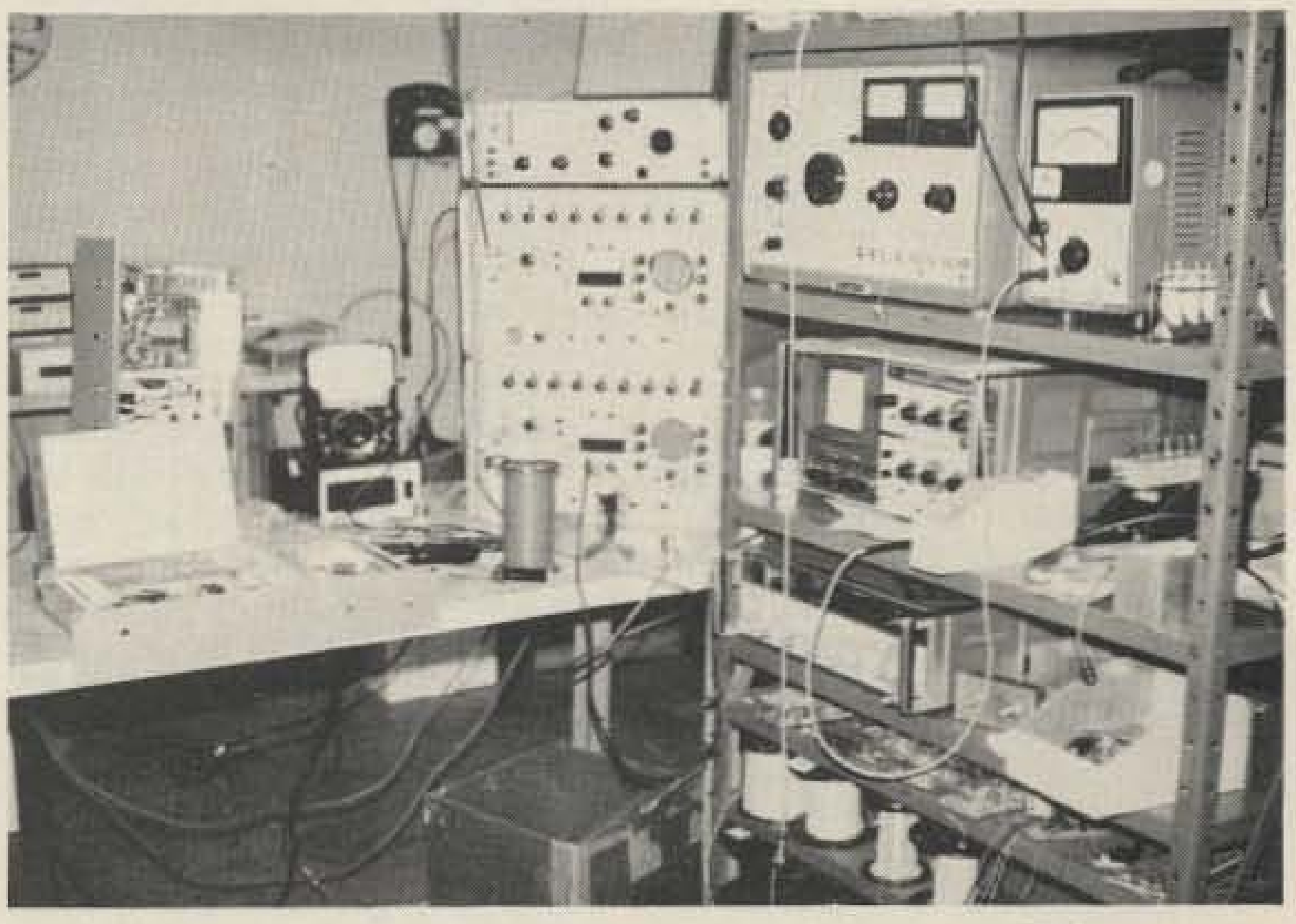
Not that two meters is the only interest of Ed Clegg and his company. Two meters in many places is getting really crowded. With an eye to the future, about five years ago Clegg was the first on the market with a 220 MHz radio designed and priced for the

Continued on page 55

Photos by Larry Levy WA2INM

Ed Clegg — servicing what he sells.

WA6ITF eyes the world's largest collection of FM-DXs, all ready for delivery.



One of the complete service facilities at Clegg's Lancaster PA factory.

Looking West

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

The news about 21033 first reached this area at about 7:30 pm on the evening of September 23, in the form of a telephone call from Jay O'Brien W6GO to Jim Hendershot WA6VQP, current SCRA chairman. It took everyone quite by surprise.

THE BIG CHANGE IS ON TWO

Probably of most significance to the average ham is the deregulation of a second subband on two meters for relay communication. This does not mean that repeaters *must* be placed in the segment from 144.5 to 145.5 MHz. Rather, it gives us the *option* to do so if we wish. In deregulating this new subband, the FCC has alarmed many of the amateurs who specialize in other aspects of VHF, such as SSB, EME experimentation, and local AM rag chewing. Needless to say, these people have been less than enthusiastic about this change, and in some areas organized non-FM groups have already declared "war" on any attempt to channelize this portion of two meters and assign repeaters to it. While no FM group wants such a confrontation to develop, it is likely to happen in some places.

Coordinators probably face their biggest challenge yet. Not only must they deal with the needs of those amateurs involved in relay communication, but they also will have to come to terms with non-relay-oriented groups. Remember, during the early days of coordination, councils were dealing for the most part with spectrum that was usually vacant and unused.

Groups of amateurs involved in non-relay communication have banded together over recent years in an effort to preserve their special interests and help foster the growth of such interests. A well-known and successful Texas organization of this kind is Sidewinders-On-Two. Here in Southern California, we now have a local chapter of SWOT, and this organization has been growing. To do well, the coordinator of today must deal with the needs of the non-relay-oriented amateurs on a basis equal to that of those involved in FM relay communication.

TWO METER BAND PLANS

In the five days since the deregulation, several potential band plans have been proposed. There is the right-side-up 20 kHz plan with built-in protection for non-FM interests, already adopted by the Northern Amateur Relay Council at a meeting on 9/25/77, at least two 30 kHz plans following the system used between 146 to 148 MHz (with the only difference between the two being which way the 15 kHz splits will go), and, finally, the proposal that 100 kHz translators, rather than repeaters, should be coordinated within that spectrum so as to be compatible with existing and future activity. Only the NARC 20 kHz plan and the translator idea take any great pains to protect the interest of already existing activity. The other plans seem to look out mainly for the welfare of those involved in repeaters.

As outlined by Jay O'Brien W6GO, here is the NARC plan, along with their reasons for adopting it: There would be twenty repeater channels with 600 kHz input-output spacing. 144.9 through 145.1 MHz would be left open for direct (simplex) communication of any kind. Repeater inputs would be 144.51 through 144.89 MHz. Repeater outputs would be 145.11 through 145.49 MHz. Channel spacing would be 20 kHz.

Rationale: 1) since the FCC did not allow the Technician SSB activity to relocate to 144.0 MHz, the present activity at 145.0 MHz is respected by the provision of the 200 kHz non-FM band; 2) channel spacing was selected to provide 20 completely usable channels spaced 20 kHz, instead of 26 unsatisfactory channels spaced 15 kHz – they were persuaded not to repeat the 15 kHz spacing error made in the 146 to 148 MHz band; 3) input low was chosen to place possible intermodulation products in the repeater band rather than in the 144.0 to 144.5 or 145.5 to 146 MHz segments.

As far as "band plans" go, this is the first to be adopted by any coordination group. It's a good one technologically-speaking, and tries to serve the needs of the non-FMer. To date, it's the only one that has met with any degree of acceptance from the non-FM amateur community.

While NARC went out of its way to give protection to non-FM interests, not everyone has. For instance, a plan similar to the NARC plan calls for the same 20 repeaters, the same 200 kHz in/out separation, and the same 20 kHz spacing between systems – but it also specifically channelizes 144.9 to 145.1 again on a 20-kHz-between-channels basis for FM point-to-point communication *only*. This is a selfish attitude, and one that any sane coordinator must avoid like the plague. Adoption of channelized FM operation in the 144.9 to 145.1 spectrum would lead to wars.

There has been but one good 30 kHz plan to date. It calls for 30 kHz between systems, 600 kHz between input and output, inverted 15 kHz channels for additional repeaters, and a non-FM simplex band between inputs and outputs. The major problem with this is twofold. First, while yielding a total of 26 possible additional repeater pairs, past experience has proven that 15 kHz splits, even when inverted, are marginal at best. The 15 kHz split was born out of necessity in the 146 to 148 MHz spectrum, when we ran out of 30 kHz pairs. The east coast went right-side-up, placing the selectivity burden on the user's receiver, while out west we went inverted, feeling that it was easier for repeaters to solve these problems than for thousands of users. Time has proven us right, and even the ARRL now endorses the inverted plan. However, since we have a chance to do it right this time, why not do it right? 30 kHz with 15 kHz splits gives quantity, but wouldn't we do better with 20 quality systems?

THE LINEAR TRANSLATOR ISSUE

Do we really need more 2m FM repeaters? Here in Southern California, and in some Texas circles as well, consideration is being given to the implementation of coordinated 100 kHz linear translators compatible with any and all modes of operation that any amateur might want to use. Unlike with channelized repeater operation, translators permit an amateur to "roam free," VFO-controlled, to locate the person or persons he may choose to QSO with.

In essence, a translator is a wide band repeater that has the ability to "repeat" individual signals it hears in one given segment of spectrum, on an individual basis, to a specific point within another given segment of spectrum. A good example of this is the OSCAR satellites. These spacecraft contain translators which listen on 430 MHz or two meters and "repeat" *individual signals* heard back to Earth on either two meters or 10 meters, depending upon the mode in which the OSCAR is functioned.

Translators in the amateur service have previously been crossband, like OSCAR. Are in-band translators possible for a 600 kHz separation between input and output? Experts disagree. It would be a challenge worthy of amateur radio pioneers.

220: TWO METERS, YOU'RE NOT ALONE!

While this deregulation will not affect 220 in many places for a while, here in Southern California we are already into multiple coordinations in that band. For some time, the SCRA has been under pressure to start the coordination of repeaters below 222.30 MHz. There has also been an opposing pressure from non-repeater groups such as the Los Angeles 220 Association. So where do we put all the link and control channels wanted on 220? There is no room on 450 for them, and there is already a lot of money tied up in equipment. Southern California already has over 300 repeaters operational on 146 and 220. Just how many more systems are needed, anyhow? Every week, the SCRA gets at least a half dozen requests for repeater frequencies on 146 or 220. Most of these requests are for wide coverage systems rather than the local type (which are really what are needed). Where do you put them? What do you say to them? When will it end?

On 220, simplex is alive and well in the form of the 220 Rag and Tech Net. These chaps are determined to perpetrate the current SCRA band plan. They make no bones about it; they will not accept further relay operations, other than remote base stations which are compatible with simplex. At present, they are about equal in number to the repeater enthusiasts, and just as technologically competent. The SCRA and 220 simplexers have been getting along well with each other so far. This may be an area in which the translator concept might work. This problem is already in the hands of Tom Rutherford's SCRA 220 Technical Committee and the delegates of the 220 simplex group.

WHERE'S 450 IN ALL THIS?

With the emphasis on two meters and 220, the simultaneous deregulation of 420 to 450 MHz has been lost in all this. What about 450? What will happen there? The Southern California Repeater and Remote Base Association, which coordinates the 420 to 450 MHz spectrum, has issued no comment to date. The unofficial input indicates that little will change. UHF relay enthusiasts seem quite elated at the deregulation aspects of portable and mobile operation of auxiliary link stations, as this is important to successful remote base system operation. Otherwise, local UHF people involved in relay communication have been very silent on the entire issue.

GOODBYE WR

I can still remember the verbal abuse aimed at the FCC in the early '70s when we found out that we had to get a special WR call for our repeaters. We hated them at first . . . but . . . lo and behold . . . now that the time has come to place them to rest . . . what's this? . . . abuse again!

THE FINAL WRAPUP

Obviously, this has been written in great haste. It's been based upon personal contacts with amateurs around the nation as well as here in California. If it seems to dwell on what California faces and how it's meeting the new challenge that is inherent to this deregulation, it's only because California really typifies what is probably happening nationwide. Since I am part of it, it is easier to be accurate in writing about it. I am sure that in these pages, now and in coming months, you will be reading much about the feelings of others on all that has transpired.

If I seem down on repeater expansion, it's only because I really wonder just how many repeaters any one area needs to serve its amateur population.

Perhaps it's time that we amateurs take another step forward and do something truly constructive, something that amateurs generations from now will look back upon with pride. Whether it be translators or some other exotic device not dreamed of yet, the FCC has given the amateur of 1977 a chance to be again looked upon as the technological communication leader. It's in our hands.

FCC

DOCKET 21033

1. Repeater, auxiliary link and control stations eliminated.

— Immediate freeze on filing repeater, auxiliary link and control station license applications.

— Applications for new repeaters on file dismissed.

2. Portable and mobile operation of auxiliary links approved.

3. No more "WR" callsigns for stations in repeater operation.

4. Stations operating as repeaters have to identify with the word "repeater" on phone or the letters "RPT" on CW, in addition to the station callsign.

5. Stations operating as auxiliary links have to identify with the word "auxiliary" on phone or the letters "AUX" on CW, in addition to the station callsign.

6. ID interval increased from 5 to 10 minutes.

7. Transmissions from open-access automatically-controlled repeaters need no longer be monitored or recorded.

8. 144.5-145.5 MHz and all frequencies above 220 MHz made available for repeaters (except 435-438 MHz).

9. Technicians given privileges on 144.5-145.0 MHz.

10. No action on priority in frequency use, erp.

PART 97—AMATEUR RADIO SERVICE

Simplifying the Licensing and Operation of Complex Systems of Stations and Modifying Repeater Subbands in the Amateur Radio Service

AGENCY: Federal Communications Commission.

ACTION: Final rules.

SUMMARY: The FCC is revising its amateur radio rules to eliminate separate licenses for repeater, auxiliary link, and control stations. We are also allocating additional frequencies for amateur repeater operation, and we are making minor revisions of the rules concerning logging and identification for stations in repeater operation and remotely controlled stations. Adoption of these rules will afford amateur licensees greater flexibility in their operations.

SUPPLEMENTARY INFORMATION: In the matter of Deregulation of Part 97 of the Commission's Rules to simplify the licensing and operation of complex systems and stations and modify repeater subbands in the Amateur Radio Service (Docket 21033, RM-2664, RM-2780). Report and Order (Proceeding Terminated).

Adopted: September 21, 1977.

Released: September 27, 1977.

WHAT IS THE BACKGROUND OF THIS PROCEEDING?

1. In a Notice of Inquiry and Notice of Proposed Rule Making in Docket 21033 released January 6, 1977, 42 FR 2089 (1977), the Commission acted partially in response to rule making petitions RM-2664 and RM-2780, submitted by Mssrs. Gordon Schlesinger and William F. Kelsey and The Middle Atlantic FM and Repeater Council (T-MARC), respectively, and partially on its own motion. The Commission proposed substantial revisions to Part 97 of its Rules, 47 C.F.R. 97.1, et., seq., concerning the licensing and operation of repeater, auxiliary link, and control stations in the Amateur Radio Service. Other proposals concerned the licensing and operation of remotely controlled stations in the Amateur Service. Comments on our proposals were due no later than April 1, 1977. Reply comments were due no later than April 15, 1977. The deadline for the submission of reply comments was subsequently extended by the Chief of the Commission's Safety and Special Radio Services Bureau to April 29, 1977. We are now prepared to take action on our proposals in this proceeding.

WHAT WERE THE COMMISSION'S SPECIFIC PROPOSALS?

2. In our Notice of Inquiry and Notice of Proposed Rule Making in this proceeding, we made a number of proposals concerning the licensing and operation of complex systems of stations in the Amateur Service, which, if adopted in their entirety, would have had a significant impact on amateur licensing. Briefly summarized, our proposals in Docket 21033 were as follows:

a. We proposed to eliminate separate licenses for repeater, auxiliary link, and control stations. Operations now conducted by such stations would be permitted all remaining amateur stations without prior Commission approval under new forms of station operation to be known as "repeater operation" and "auxiliary operation".

b. We proposed no longer to require that an applicant wishing to operate a radio remotely controlled station obtain prior Commission authorization.

c. We proposed to permit portable and mobile operation by stations in auxiliary operation. (Auxiliary link stations are presently restricted to operation from a fixed location.)

d. We proposed to discontinue the issuance, in most instances, of call signs with "WR" prefixes to stations in repeater operation.

e. We proposed to require that stations in repeater and auxiliary operation transmit distinctive station identifications.

f. We proposed to increase the minimum interval at which stations in repeater operation must identify from five to ten minutes.

g. We proposed to delete the current requirement that transmissions from stations in repeater operation under automatic control either be recorded or monitored in real time by a duty control operator.

h. We proposed to require that the logs of all remotely controlled stations contain a list of all authorized control operators.

i. We proposed to require that a photocopy of the remotely controlled station license and a list of authorized control operators be posted conspicuously at the remotely controlled transmitter site and the station location of each control operator and be carried by each control operator operating a remotely controlled station from a portable or mobile control point.

j. We proposed to require that the antenna or mast associated with a remotely controlled transmitter bear a durable tag, marked with the remotely controlled station call sign, and the names of the station licensee and all authorized control operators.

k. We proposed to make all authorized amateur frequencies, except 435 to 438 MHz, available for repeater and auxiliary operation.

l. We proposed a new rule stating that a station occupying a frequency has priority in its use over other stations, and that all frequencies in the Amateur Service must be shared.

m. Finally, we requested comments concerning present and future anticipated interference patterns, the adequacy of current techniques for keeping interference to a minimum, and the adequacy of present voluntary spectrum management systems. We also asked for comments concerning the utility of the limitations on the effective radiated power (ERP) of stations in repeater operation contained in Section 97.67 of the Rules.

WHY DID WE MAKE THESE PROPOSALS?

3. Our purpose in issuing the Notice of Proposed Rule Making in this proceeding was to continue the relaxation of amateur regulations governing the licensing and operation of complex systems of stations. We stated in our Notice that since adoption in 1972 of regulations governing the licensing and operation of repeater and associated stations, (Report and Order, Docket 18803, 37 FCC 2d 225 (1972)), we have become increasingly convinced that amateur licensees could develop and operate complex systems of stations with a minimum of Commission regulation. Accoringly, in 1974 we began reducing the unnecessary burdens imposed on licensees of repeater and associated stations. In a series of rulemaking proceedings, we deleted the requirements that certain technical data be submitted with applications for repeater and remotely controlled stations and relaxed the rules to permit the linking, automatic control, and crossband operation of repeater stations. This proceeding is, in part, an attempt to provide amateur operators even greater flexibility in their operations and to create a more favorable regulatory atmosphere for the Amateur Radio Service.

WHO COMMENTED ON OUR PROPOSALS?

4. We received 86 timely comments in response to our Notice of Proposed Rule Making. Of these, 24 were submitted by clubs or other organizations. We received two timely reply comments. Twenty-four comments and one reply comment were received too late to be considered in this proceeding.[1] A list of those submitting timely comments in response to our Notice is contained in Appendix I.

WHAT DID THOSE COMMENTING ON OUR PROPOSALS SAY?

5. The number of comments we received makes it impossible to discuss each comment individually. Each comment has been read and carefully evaluated by the Commission's staff, however. Most of the comments received supported some aspects of our proposals but opposed others. In general, opposition was greatest to the major proposals. The less significant proposals were generally favored. In capsule form, the comments on our proposals were along these lines—

a. Most respondents argued that separate licenses for repeater stations should be retained. To eliminate separate repeater station licenses would, it was alleged, encourage "pirate" or "fly-by-night" repeater stations, and, in the words of T-MARC, permit "any amateur to, on a moment's notice, decide [sic] to operate as a repeater." Comments, The Mid-Atlantic FM and Repeater Council at 1. Others stated that operation of a repeater station is a serious and often expensive matter, and that effective spectrum management planning and coordination require that an amateur be placed on notice, by means of a separate repeater station license application, that "something more than the grant of a simple application is required." Comments, American Radio Relay League, Incorporated (ARRL) at 15.[2] On the other hand, our proposal to delete separate licenses for auxiliary link and control stations and create another form of amateur operation known as "auxiliary operation" met with general approval. Few comments specifically addressed the proposed deletion of the requirement that authorization from the Commission be obtained before remote control operation is undertaken, but of those that did, most approved.

b. Our proposal to permit auxiliary operation from control points in portable and mobile operation was nearly unanimously accepted. Operators of remotely controlled base stations were particularly enthusiastic, because adoption of this proposal would permit them to operate their remotely controlled stations from portable and mobile locations, a practice not currently allowed.

c. Most of our respondents wished to retain distinctive call signs for stations in repeater operation and requested that the practice of issuing call signs prefixed by the letters "WR" to such stations be continued, whether or not such stations are actually licensed as repeater stations. The ARRL, among others, argued that a distinctive call sign for a station in repeater operation is necessary to let those monitoring know a station in repeater operation is on the frequency. Because most comments favored distinctive call signs for stations in repeater operation, they opposed any other form of special identification for stations in repeater operation, although there was some support for requiring a station in auxiliary operation to transmit a distinctive identification. Our proposal to increase from five to ten minutes the minimum inter-operation to transmit a distinctive identification must identify was widely supported in the comments.

d. The vast majority of our respondents urged the Commission to adopt the proposal to delete the requirement that transmissions from open access automatically controlled stations in repeater operation either be recorded or monitored in real time. Many of the comments went further, however, and offered a suggestion outside the scope of this proceeding, namely, that stations in repeater operation be exempted from the third party traffic logging requirements of Section 97.103(b)(2) of the Rules. Not to modify third party traffic logging requirements for open access automatically controlled stations in repeater operation would, in the words of the ARRL, "render the Commission's proposed relaxation * * * a nullity in terms of practical application * * *." Reply Comments, ARRL at 6.

e. Our proposals to modify slightly the logging requirements for remotely controlled stations, to require the posting of certain information at the remotely controlled transmitter site, and to require that a durable tag bearing certain data be attached to the remotely controlled transmitter antenna were relatively uncontroversial. Opposition was expressed to the durable tag proposal, however. The Northern Amateur Relay Council (NARC) of California, for example, stated that such tags are easily stolen or lost and that a requirement of this sort would be an unfair burden on licensees operating stations at truly "remote" locations.

f. Our proposal to make all amateur frequencies available for repeater and auxiliary operation was the subject of intense criticism by nearly all respondents. Although a few groups, such as NARC, welcomed the opportunity to experiment with the possibilities such a relaxation would have offered, the vast majority of the comments opposed such a radical change. Virtually all those commenting opposed any expansion of the repeater subbands below 28 MHz. They stated that there is no demonstrated need for repeater operation in the high frequency range, and that such an expansion would create many more problems than the increased flexibility in repeater operation would justify. Similarly, the majority of those submitting comments opposed making all very high frequency (VHF) and ultra high frequency (UHF) bands available for repeater operation. Concern was especially acute over opening all frequencies in the two meter band (144-148 MHz) to repeater operation. Respondents such as the Radio Amateur Satellite Corporation (AMSAT) stated that certain amateur activity in the two meter band must be provided protection from repeater operation. This activity, which typically involves the reception of weak signals, is said to be incompatible with channelized repeater operation. Many other respondents, such as T-MARC, agreed that weak signal work must be protected but argued that there is a definite need for additional two meter frequencies for repeater operation. The ARRL said that it may well be desirable to increase the allocation for repeater operation in the amateur two meter band but urged that any such expansion be the subject of a separate rule making proceeding.

g. Our proposed new rule concerning priority in usage of a frequency was overwhelmingly opposed. Most respondents said the proposed rule was inherently (if necessarily) vague and that its adoption would create more problems than it would solve. The general belief appeared to be that existing rules and practices are working reasonably well, and that, absent a compelling indication to the contrary, the Commission should take no action in this area at the present time.

h. In response to our inquiries concerning the adequacy of the current system of voluntary spectrum management and the necessity for the limitations on the effective radiated power of stations in repeater operation contained in Section 97.67 of the Rules, we received many informative and helpful responses. These comments indicated, generally, a widespread dissatisfaction with the ERP limitations on repeater operation, as well as a belief that the Amateur Service's voluntary spectrum management system functions with considerable effectiveness in most instances.

WHAT RULES ARE WE ADOPTING AND WHY?

6. After a careful analysis of our proposals and the comments submitted in response to our proposals, we have decided that the public interest will be best served by the following action—

a. We are eliminating separate re-

[1] The Commission's practice of informally accepting comments in rule making proceedings after the comment due date was recently held to be a violation of Section 1.415 of the Rules. *Home Box Office, Inc. v. Federal Communications Commission*, —— F.2d —— (D.C. Cir. 1977).

[2] The ARRL's Comments in this proceeding were filed late but were accompanied by a Motion to Accept Late Filed Comments. We are granting the ARRL's Motion.

peater, auxiliary link, and control station licenses, as proposed. Operations now conducted by such stations will be authorized other stations without prior Commission approval under new forms of amateur operation to be known as "repeater operation" and "auxiliary operation." We believe the contention that elimination of separate repeater station licenses will encourage "fly-by-night" repeater operation is frivolous. As the Iowa Repeater Council noted in its Comments, "[r]epeaters are expensive. They take a lot of hard work * * *." Comments, Iowa Repeater Council at 6. We doubt very much whether anyone willing to expend the time and effort necessary to place a station in repeater operation will do so on the spur of the moment. We simply do not believe that the incidence of so-called "ego-trip" repeaters will be any greater under the new rules than it is presently. The assertion made by T-MARC (and others) that elimination of separate licenses for stations in repeater operation will permit a licensee to decide "on a moment's notice" to engage in repeater operation is no more tenable now than it was before the adoption of rules for repeater stations in Docket 18803 in 1972. (Moreover, as NARC observed in its comments, absence of a repeater station license does not necessarily inhibit repeater operation under the existing rules. A licensee wishing to put a repeater station in operation need only find the licensee of an existing repeater station willing to share the responsibility of repeater operation from a portable location. The first licensee then operates a portable repeater station under the authority of the existing repeater station license.)

Further, processing and issuing repeater, auxiliary link, and control station licenses is much more complex than processing and issuing simple primary station licenses. Different data bases must be maintained, and FCC staff must be detailed to perform these specific functions. In sum, although repeater stations are relatively few, in comparison with the population of the Amateur Radio Service as a whole, their impact on the processing of other amateur licenses is far out of proportion to their number. Elimination of separate repeater, auxiliary link and control stations will enable us to provide the public with better service in other, more important areas, such as the processing of Novice Class and other classes of operator license applications.

Accordingly, beginning with the effective date of this Report and Order, no more licenses for repeater, auxiliary link, or control stations will be issued. Existing repeater, auxiliary link, and control stations may continue to be operated until expiration of their station licenses. Such licenses will not be renewed. Further, in order to continue the efficient processing of other amateur radio license applications, effective with the adoption of this Report and Order by the Commission we are imposing a "freeze" on the filing of applications for new, modified or renewed repeater, auxiliary link, and control station license applications. The freeze will continue until the date the regulations adopted in the Report and Order become effective.

We find that the public interest will be best served if the applications for new repeater station licenses presently on file are dismissed, and we hereby do so. Pending applications for renewed repeater station licenses or modified repeater station licenses will be processed, however.

b. *We are authorizing auxiliary operation from control points in portable and mobile operation.* This amendment, which was unopposed by the comments, will afford operators of remotely controlled stations much greater flexibility in their operations. It will permit operators of remotely controlled stations to operate their stations as they would locally controlled stations, without many of the previous restrictions placed on them.[3]

c. *We are discontinuing our practice of issuing call signs prefixed by the letters "WR" to stations in repeater operation.* We do not believe "WR"-prefixed call signs are a necessary aspect of repeater operation in the Amateur Service, any more now than they were before the regulations adopted in Docket 18803. We are aware, however, of the desire of many of those submitting comments in this proceeding, such as the ARRL, for rules ensuring that those monitoring a frequency know there is a station in repeater operation using that frequency. For this reason, we are adopting regulations as proposed requiring distinctive identification for stations in repeater and auxiliary operation. Stations in repeater operation will be required to transmit the letters "RPT" after the station call sign if identifying by telegraphy, or the word "repeater" if identifying by telephony. Stations in auxiliary operation will be required to transmit the letters "AUX" after the station call sign if identifying by telegraphy, or the word "auxiliary" if identifying by telephony. Finally, there was no opposition to our proposal to incease from five to ten minutes the minimum interval at which stations in repeater operation must identify, and we are adopting it as proposed.

d. *We are eliminating as proposed the requirement that transmissions from open access automatically controlled stations in repeater operation be either monitored in real time or recorded.* There was no opposition in the comments to our proposed relaxation. Our purpose in adopting this regulation originally was simply to ensure that licensees posses adequate means to determine whether their automatically controlled stations were being operated properly. Licensees of such stations continue to be responsible for the proper operation of their stations, but we believe we should provide amateurs with sufficient flexibility to enable them to determine compliance with our regulations in other ways. In addition, several respondents asked that the regulation be extended to exempt stations in repeater operation from third party traffic logging requirements entirely. Of course, our proposal to delete the monitoring/recording requirement had nothing whatsoever to do with third party traffic logging requirements, nor did we intend it to have. Although we do wish to relieve our licensees of unnecessary burdens, such as the monitoring/recording requirement, we do not believe at this time that stations in repeater operation should be exempt from third party traffic logging requirements. We recognize that as a practical matter many stations in repeater operation will continue to have to record their transmissions to ensure compliance with the third party traffic logging requirements. We also recognize these requirements may be a burden on certain stations in repeater operation, particularly those with telephone interconnection ("autopatch") capabilities. In our 1972 Report and Order in Docket 18803, however, amateur licensees were warned about use of autopatch equipment in violation of Section 97.114 of the rules, to facilitate the regular business affairs of any party. Since 1972, autopatch abuse has become, if anything, more widespread. The Amateur Radio Service is not now, and has never been, a common carrier, and third party traffic of all types must, under normal circumstances, constitute a very small part of amateur activity. We again warn the Amateur Service of unlawful use of telephone interconnection facilities and stress that unless voluntary compliance with our third party traffic regulations increases significantly, we may have to take action to curb the transmission of all third party traffic in the Amateur Radio Service. We are therefore eliminating the monitoring/recording requirement contained in Section 97.111(g)(2) of the rules but are retaining all existing third party traffic regulations.

e. *We are requiring that a photocopy of the remotely controlled station license be posted in a conspicuous place at the remotely controlled transmitter site and placed in the log of the station of each authorized control operator of the remotely controlled station.* We will also require that the name and telephone number of the station licensee and at least one control operator be posted in a conspicuous place at the remotely controlled transmitter location. We are aware that many licensees consider requirements of this sort to be unjustifiable burdens, but we believe it essential that there be adequate procedures to ensure that the Commission is able to contact the licensee or control operators of a remotely controlled station in the event of station malfunction. We agree with respondents, such as NARC, that in our proposal to require attachment of a durable tag containing certain information to the antenna or antenna feedline of a remotely controlled station would serve no useful purpose, and we decline to adopt it. Our proposal to require the log of a remotely controlled station to contain a list of authorized control operators was generally supported in the comments, and we are adopting it as proposed.

f. *We are making an additional one megahertz of spectrum available for repeater operation in the amateur two meter band.* It is clear from the comments that amateurs engage in a wide variety of activities and that repeater operation is but one of these activities. It is also clear that many amateurs believe their activities must be protected from possible encroachment by stations in repeater operation. For this reason, we will not adopt our proposal to make al amateur frequencies available for repeater and auxiliary operation. The pervasive opposition to our proposed relaxation convinces us that the Amateur Service is not fully prepared to assume responsibility for complete management of its own spectrum. We are therefore not allocating any additional frequencies for repeater operation or auxiliary operation below 144 MHz. Many comments, however, stated that there is a definite, immediate need for additional frequencies for repeater operation in the two meter band and above. At the suggestion of T-MARC, we are allocating an additional one megahertz of spectrum, 144.5 to 145.5 MHz, for repeater operation. We are also increasing Technician Class operator privileges to include 144.5–145.0 MHz, to permit Technician Class licensees to take advantage of the new allocation for repeater operation. We believe this additional allocation will meet the future need for frequencies in the two meter band for repeater operation, while providing adequate protection for weak signal and other activity in that frequency range. We do not agree with the ARRL that this allocation requires a new rule making proceeding. In our Notice of Proposed Rule Making in this proceeding we proposed to make the entire two meter band available for repeater operation. Our licensees were put on notice that we were actively considering additional frequencies for repeater operation in the two meter band. The claim that adequate notice has not been given that 144.5–145.5 MHz might be allocated for repeater operation cannot be supported. We are also making all amateur frequencies above 220 MHz, except 435–438 MHz, available for both repeater and auxiliary operation.[4] There was little, if any, opposition to an increase in the frequencies available for repeater operation above the two meter band, and we believe that in making all amateur frequencies above 220 MHz available for repeater and auxiliary operation we are providing amateur licensees with a great deal of flexibility while at the same time continuing to protect the "weak signal" two meter activity. We will continue to evaluate the spectrum requirements for repeater and auxiliary operation, however.

g. *We are taking no action at this time on our proposed new rule concerning priority in usage of amateur frequencies.* We may, however, take action at some time in the future if certain spectrum management problems within the amateur community are not settled by the amateurs themselves. As detailed in a recent Public Notice on this subject, we are increasingly concerned about malicious interference to, and from, certain amateur service 'monitoring nets'. If amateurs cannot solve these conflicts and others arising from competing demands for spectrum, then the Commission must consider additional regulations to resolve these matters. We are also not taking any action at this time on changing repeater ERP limits. Any action in this area will be done in a separate rulemaking proceeding.

7. Accordingly, *it is ordered*, pursuant to authority contained in Sections 4(i), 5(e), and 303 of the Communications Act of 1934, as amended, That Part 97 of the Commission's Rules is amended as set forth below effective November 4, 1977. *It is further ordered*, That all pending applications for new repeater station licenses in the Amateur Radio Service are dismissed. *It is further ordered*, That the Motion to Accept Late Filed Comments submitted by the American Radio Relay League, Incorporated is granted, and that the Motion to Accept Late Filed Reply Comments submitted by the Empire Radio Club is granted. *It is further ordered*, That to the extent RM-2664 and RM-2780 have not been granted herein, they are denied. *It is further ordered*, That this proceeding is terminated.

(Secs. 4, 5, 303, 48 Stat., as amended, 1066, 1068, 1082; 47 U.S.C. 154, 155, 303.)

FEDERAL COMMUNICATIONS COMMISSION,[5]
VINCENT J. MULLINS,
Secretary.

STATEMENT OF COMMISSIONER MARGITA E. WHITE CONCURRING IN PART AND DISSENTING IN PART

As a strong proponent of deregulation, I feel it is important that I explain why in this particular instance I find it necessary to disagree with the Commission's decision to no longer require separate licensing of repeater stations. It should be noted, however, that I do concur in the remainder of the Commission's proposals to deregulate Part 97 of the Commission's rules.

I was impressed, after reading the comments in this proceeding personally, that almost all the comments opposed the elimination of separate repeater station licenses. The Commission believes that the contentions of various repeater organizations including T-MARC, petitioner in RM-2780, that elimination of separate repeater station licenses will encourage more casual and haphazard operation are frivolous. I respectfully disagree. The elimination of separate repeater station licenses will make the voluntary coordination, frequency management, and voluntary enforcement of repeater operation much more difficult, thus increasing the probability of increasing interference—a probability recognized by several repeater associations as well as by the American Radio Relay League (ARRL).

The Commission is adopting the proposed rules to decrease the administrative burden associated with the processing and issuing of separate repeater station licenses. However, this burden which I do not view as substantial, since presently there are only approximately 3,000 authorized repeater stations and recently only about an average of two applications a day are received for repeater stations, must be weighed against the likelihood of increased Commission involvement in enforcement problems. It is quite likely that the potential enforcement problems will prove to be more costly than the savings to be gained by elimination of the separate processing of repeater station licenses. Moreover, I agree with the ARRL comment that by requiring a separate application for a repeater station license "the applicant is placed on notice that something more than the grant of a simple application is required." Comments, ARRL, p. 15. I also believe that repeater licensees have a special responsibility to serve the public interest and the requirement of a separate license places the licensee on notice and assists in keeping the licensee accountable.

Therefore, for the above reasons, I dissent.

[3] We do not believe separate regulations for so-called "remote base" stations are necessary or desirable at this time. As long as the auxiliary functions of such stations comply with the regulations for auxiliary operation, remote bases may be operated in the same manner as other amateur stations.

[4] Our decision to make the entire 420–450 MHz amateur band, except 435–438 MHz, available for repeater operation moots the "blanket" waiver granted by the Chief, Safety and Special Radio Services Bureau to permit fast-scan amateur television repeater operation in that band. That waiver is hereby terminated.

[5] By the Commission: Chairman Wiley concurring in the result; Commissioner Quello dissenting; Commissioner White concurring in part and dissenting in part and issuing a statement.

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AMSAT

LOCAL AMATEUR RADIO OPERATOR ELECTED ARRL SECTION COMMUNICATIONS MANAGER FOR LA COUNTY

Stan S. Brokl of Sunland, known to his amateur radio colleagues as K6YYQ, has just added another laurel to his crown. He was elected Section Communications Manager for Los Angeles County for the American Radio Relay League, the largest amateur radio enthusiasts' organization. The League acts as spokesman for a large segment of the nearly a third of a million FCC-licensed amateur radio operators in the United States.

Stan is a senior engineering assistant at the Jet Propulsion Laboratory in Pasadena. He has been an amateur operator for twenty-two years. Among his earlier laurels were his presidency of the JPL Amateur Radio Club during 1976 and his handling of the transmission of the JPL Viking Lander pictures of the surface of Mars to the amateur radio world via slow scan TV. In many parts of the world, these pictures were the only ones received from the surface of Mars. He is also the vice chairman of the Los Angeles Council of Amateur Radio Clubs.

The American Radio Relay League, in addition to its activity as spokesman for the amateur radio communications community, has a variety of activities in which amateurs participate. For some of these, awards are granted, such as for working all states, or working all continents. The ARRL is also involved in emergency communications when the need arises. The activity is called Amateur Radio Emergency Service (ARES), which handles communications in emergencies such as floods, earthquakes, or other catastrophic occurrences when normal communications media fail. Radio amateur operators are equipped to provide such communications with their battery-powered and mobile radios.

In an interview, Stan was asked what his job was as SCM. He told us, "The SCM is the only elected official in the ARRL *operating* program. That is, programs involving "on-the-air" activities. He fosters communication networks, makes appointments of qualified amateurs to various communications functions, and generally provides the leadership for the section."

One of Stan's plans is to expand the ARES activity to place it in readiness for any emergency that should arise. He pointed out that ARES differs from the Radio Amateur Civil Emergency Service (RACES) in that the latter is operated locally by the LA County Sheriff's Disaster Communications Service to maintain communications in the public service area where officialdom must be in communication with its headquarters and the emergency services. On the other hand, ARES provides what Stan called "people-to-people communications."

Stanley S. Brokl K6YYQ was recently elected SCM for the ARRL LA section. He is shown here examining an OSCAR display at the JPL library. The turntable shows the four interior panels of OSCAR 7.

DECEMBER FLIGHT TEST OF AMSAT/JAMSAT SATELLITE TRANSPONDER

The Radio Amateur Satellite Corporation (AMSAT) has obtained the cooperation of a number of amateur radio clubs up and down the state of California in flying the AMSAT-OSCAR D 2-meter-to-70-centimeter (146 to 345 MHz) amateur radio satellite transponder for a test to provide amateurs throughout the state an opportunity to test their gear and to familiarize themselves with the techniques and procedures to be used in operating the transponder during its orbital phase as AMSAT-OSCAR 8, mode J. The flight will take place December 3, 1977. An aircraft containing the transponder will fly a course starting from Van Nuys Airport near Los Angeles to San Diego, Santa Barbara, San Francisco, Stockton, Fresno, Bakersfield, and back to Van Nuys.

This will be the fourth flight test of an amateur radio communications satellite transponder since the AMSAT-OSCAR 6 2-meter-to-10-meter was flown on the east coast in May, 1971, by members of the AMSAT Washington group. In September, 1971, the Jet Propulsion Laboratory Amateur Radio Club ran a flight test similar to the one to be run in December on the 2-to-10-meter transponder. JPL ARC was also involved in a flight test of the 432.15 MHz to 145.95 MHz "Umsetzer" (built by AMSAT Deutschland) which became the mode B transponder of OSCAR 7. The latter flight test was run in September, 1973.

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A great many amateur operators participated in these earlier flight tests, learning the ropes, so to speak, about operating through an amateur satellite transponder under closely similar conditions to those which would occur in orbit.

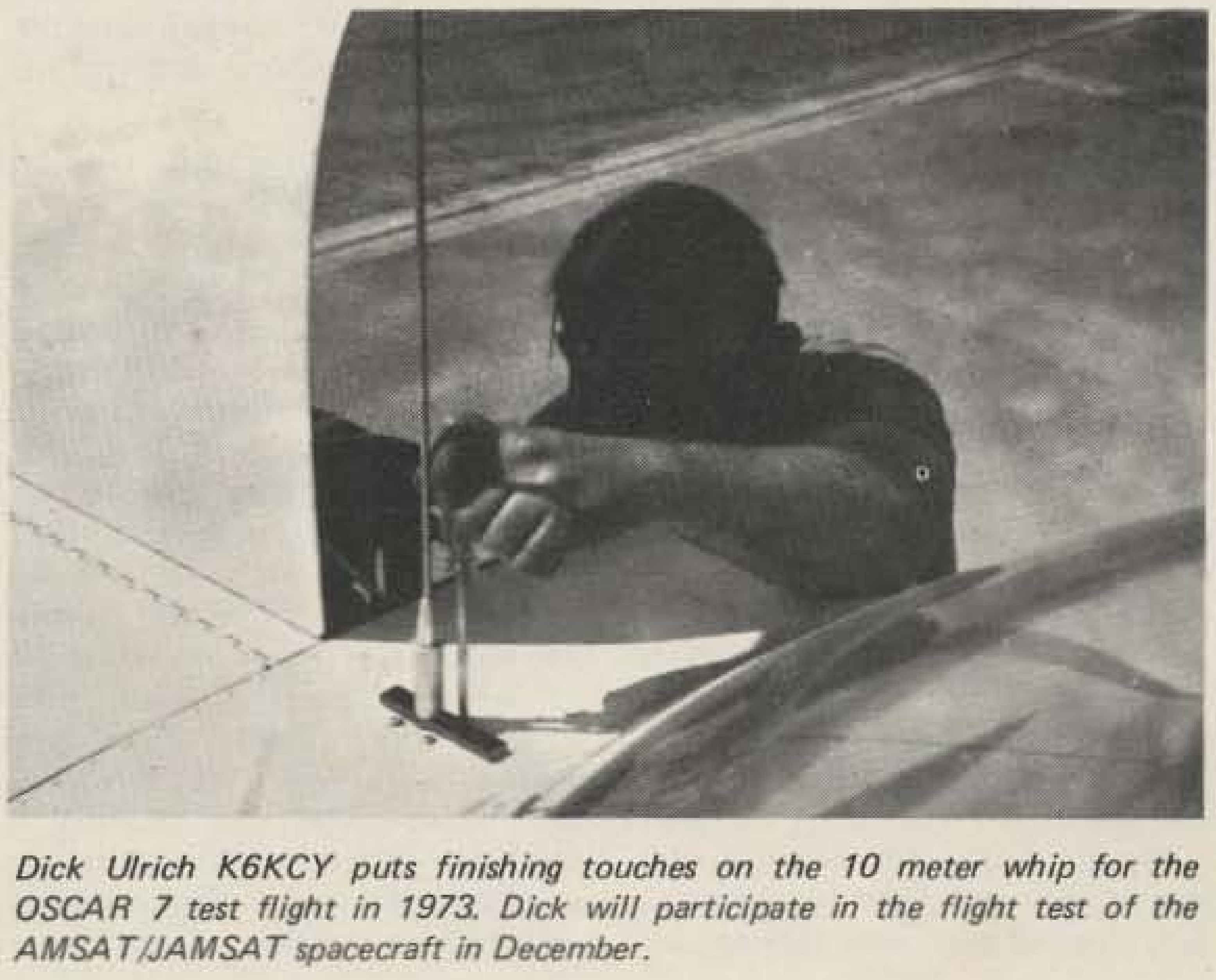
Activity through the transponder is encouraged during the December 3rd flight, and a commemorative QSL will be sent to all amateurs who send in a report of stations worked or heard. The aircraft call in flight will be WA3NDS.

During the flight, a liaison net will be maintained at about 7230 kHz, using the call W6VIO.

The test flight is cosponsored by the amateur radio clubs of Jet Propulsion Laboratory, Hughes, TRW, and Project OSCAR, as well as several other California amateur organizations.

One major purpose of the flight is to assist radio amateurs in adjusting their equipment for operation on the new amateur satellite frequencies above 435 MHz, the only available frequencies in the 420-450 MHz band open to satellite use under the ITU regulations. A secondary purpose is to determine the mutual interference potential between AMSAT-OSCAR D and amateur TV enthusiasts operating above 435 MHz. Launch of the AO-D amateur radio communications satellite is scheduled for February 17, 1978.

Reports should be sent to Skip Reymann W6PAJ, at Post Office Box 374, San Dimas, California 91773.



Dick Ulrich K6KCY puts finishing touches on the 10 meter whip for the OSCAR 7 test flight in 1973. Dick will participate in the flight test of the AMSAT/JAMSAT spacecraft in December.

LETTERS

from page 17

GE and various doctors would not give me any suggestions, I was lucky enough to get in touch with a man in the School of Aerospace Medicine, who told me of their extensive experiments with electromagnetic radiation and pacemakers, including 15 models of the GE, which proved them particularly susceptible. It is true that their experiments were not on a ham frequency, but their frequency was near enough the 20 meter band to be significant. It was here that I got suggestions for the grounded cage I built.

Possibly you may have occasion to pass along my experiences, or to improve upon them.

F. L. Wiltrout W9VFG
Elkhart IN

Technical Editor, *QST*
225 Main Street
Newington CT 06111

Dear Sir:

Some time ago, I wrote you that I had a General Electric pacemaker installed, and that when I attempted to make a transmission the radiation cut it out. I asked if you knew of any articles in ham publications or otherwise which might help me get on the air. Your reply was negative.

I have since read newspaper articles to the effect that CBers, using illegal amplifiers, were interfering not only with pacemakers, but also with hearing aids.

I solved the problem in a somewhat awkward manner, and I would like to pass along my experiences, thinking that they would be a basis for further refinement.

To begin with, I use a Drake TR-4 and a Heathkit SB230 linear, feeding an old Hy-Gain 20, 15, and 10 meter beam with coax. I have a switch arrangement to go from the beam to a Heathkit dummy load.

Using an inexpensive field strength meter, with the aid of my son (who is also a ham), I found that the field strength varied according to which way the beam was headed — that even on the ground forty feet from the beam, with the beam headed in my direction, the pacemaker acted up. I could tell when the rig was on transmit merely by feeling my pulse.

The next step was to take readings when the rig was on the dummy load. There was no reading whatsoever even when the meter was set on top of the rig. (Incidentally, the swr is down to one to one.)

My son and I then constructed a sort of cage, five feet high and three feet wide and deep, with both top and bottom, of perforated aluminum sheet, covered by a layer of copper wire. This was attached to a good outside ground. The microphone with switch was run into the cage, and I was back on the air! There was no field strength reading in the cage while transmitting. It is a little awkward reaching out the door to tune in stations, but you can't have everything. The rig itself can be tuned up on the dummy load.

So far I have tried only 20 and 40 meters, the latter on an inverted V, without the linear.

This is the old principle of the Faraday Cage, discovered in England many years ago, and hardly mentioned in the *Handbook*.

It occurs to me that the transceiver itself could be moved into the cage for greater operating convenience.

You can understand why I am reluctant to do too much experimenting personally when it might stop my heart.

Perhaps a more simple solution could be found, like putting some kind of shield on the roof underneath the beam, or on the ceiling of the shack.

Anyway, perhaps one of your bright young men might be willing to take my experiments and build on them. They are welcome to use my observations and experience.

F. L. Wiltrout W9VFG
216 West High Street
Elkhart IN 46514

SUPER PAT

Although in the past I've not been in entire agreement with most of your editorials, I will say this much — I've written several letters praising your study guides (which you've never printed). Well, here comes a super pat on your back with a request following.

On August 29, 1977, my employment required that I obtain a 2nd Class Radiotelegraph license. The first thought in my head was, "Oh-oh, a supervised code exam at 20 and 16 wpm," so I got out your 20+ tape — the one with all the weird characters — and listened to it for ½ hour every day for 17 days. (Keep in mind that I've been inactive for 3 years now.) Come the 29th in Detroit, the examiner put 20 wpm on and I really was shocked — it sounded like about 15 wpm! I swear I could have sharpened my pencil in between groups. No kidding! I even copied 35 wpm almost solid after listening to that tape — the same tape that, by the way, at first I spent 10 minutes of each half hour cursing. I now have a 2nd Class Radiotelephone, a 2nd Class Radiotelegraph, and an Advanced ham license, which I can say were duck soup to get after using your study guides and tapes. Now I will be going to Marquette to take the First Class Radiotelephone, the Extra Class, and the Radar Endorsement.

By the way, I'll be going for my 1st Class Radiotelegraph in a few months — do you have a 25+ wpm tape I can purchase?

Kenneth M. Cubilo, Jr. WB8DOI
Rogers City MI

Sure, $4.00. — Ed.

BE A LEGAL JAMMER

We would like to invite a couple of hams around the world for communication backup, and they can take all their equipment. We would give them 1/3 off the total cruise cost.

Captain Mike Burke
Windjammer Cruises
PO Box 120
Miami Beach FL 33139

FEATHER

Just wanted to drop you a note and put another feather in your cap. Last June, I purchased your 21+ wpm tape. When I received it, I played it for about five minutes. I then ignored the tape until the first of September. I practiced your tape an average of 45 minutes a day for 3 weeks. On September 21, I went to the FCC and took the exam. I aced the code test. I didn't have time to sleep in between characters, but I did copy comfortably the 20 wpm. I could copy your tape about 98% — let's face it, a code group like "kee ie" is something else. If you can't copy the group, it does teach you not to be flustered by missing a character or small group of characters.

Once again, thanks — and be proud of those feathers and cap. I will be forwarding my callsign change when I get my 2x2 call.

Kevin C. Potter WA6DNW
Arcadia CA

M.O.M.

With Christmas again rapidly approaching, we at Military Overseas Mail are concerned about the many thousands of our military personnel who will be away from their homes and families during the holiday season. For many of these young men and women, this will be the first Christmas away from home.

Readers of *73 Magazine* can help make this holiday season a little less lonely and a little more enjoyable for many of these young people by joining in the collection of Christmas mail sponsored by Military Overseas Mail. This is an ideal project for school classes, clubs, and other groups as well as individuals and families. For more information, please send an SASE to Military Overseas Mail, Box 4330, Arlington VA 22204, and mention that you read about M.O.M. in *73 Magazine*. Thank you.

Lee Spencer
Arlington VA

Tracking the Hamburglar

HIJACKED: Heathkit 2 meter transceiver HW-2036, series no. 03719, Heathkit Micoder HD-1982, series no. 00622, from my company car on October 10, 1977, at about 16:35 CDT, 1713 Webster St., Omaha, Nebraska. My ham call and social security no. 482-62-4198 are engraved in the chassis of the radio. A reward will be offered to the individual who returns the radio to me. Tom O. Mikkelsen WAØPOD, 902 Avenue G., Council Bluffs, Iowa 51501, (712) 323-8036; (office) Motorola Communications, 11045 I St., Omaha, Nebraska 68137, (402) 331-7709.

RIPPED OFF: Atlas 350XL with DDG-XL digital dial, s/n 877025, and ac power supply for the Atlas, s/n 877104 DS. Taken on October 1, 1977. Jay A. Leonard W5TSM, Rt. 1 Box 32A, Pottsville AR 72858.

RIPPED OFF: Regency HR-2B transceiver, 2 meter, 12 channel. Serial no. 49-04353. 1 — 94-94, 2 — 34-94 3 — 52-52, 4 — 13-73, 5 — 19-79, 6 — 96-36, 7 — 16-76, 8 — 04-64, 9 — 25-85, 10 — police, 11 — 46-46, 12 — sheriff. Carl R. Willis K8DKO, 464 Forest Street, Mansfield OH 44903, call collect (419) 524-2367.

TAKEN: Drake ML2, s/n 11546. Stoken from: Tom Fraser WAØQQT, Colorado Springs, Colorado. (303) 635-8911, ext. 3874. Frequencies installed: 34-94, 94-94, 16-76, 07-67, 22-82, 25-85.

Corrections

Please note a correction to my article, "Track OSCAR With Your SR-52" (November, p. 58). Lines 20-21, column 4, page 59, should read: "in register 13. Steps 018 to *038* solve equation 1 and".

Art Burke W6UIX
San Diego CA

Compare the Atlas 350-XL with other transceivers . . .

TYPE	ALL SOLID STATE			HYBRID (VACUUM TUBE P.A.)			
MODEL	ATLAS 350-XL	TEN TEC	YAESU FT-301	DRAKE TR4-CW	HY-GAIN 3750	KENWOOD TS-820	TEMPO 2020
INPUT POWER	350 WATTS	200	200	300	200	200	180
BANDS	10-160M	10-80M 160M OPT	10-160M	10-80M	10-160M	10-160M	10-80M

. . . and see why it's your best buy!

Above is a chart comparing leading HF Transceivers that fall in approximately the same price range as the Atlas 350-XL. The Drake TR4-CW is least expensive, while the HY-Gain 3750 is the highest. Rated power input (SSB) and bands covered are listed in the chart, but below is a discussion on a number of other interesting comparisons which will help you choose the right transceiver for your station.

1. STATE-OF-THE-ART, ALL SOLID STATE

The first 3 transceivers listed above are all solid state. The real designs of the future! Having manufactured and sold over 12,000 of our little 210x/215x's, we can attest to the high performance and reliability of all solid state design. Tubes for the driver and P.A., with their tuning circuits and high voltage power supplies are rapidly becoming obsolete. As a result their resale value will be declining.

2.POWER RATING.

The higher power rating on the 350-XL provides you with a comfortable edge over the others. Running barefoot you can easily ride over the competition. If you're driving a linear you don't have to strain for every bit of drive from the transceiver. It can loaf along with ease. The 350 watt input rating is really very conservative. Typical input power runs upwards of 400 to 450 watts without flat-topping. Considerably more than the others.

3. BAND COVERAGE

Not only does the 350-XL cover the 10 through 160 meter bands (including all of 10 meters in four 500 kHz segments), but one of its exclusive features is that you can install up to 10 auxiliary 500 kHz ranges anywhere from 2 to 5 MHz, and from 6 to 23 MHz. This gives you great flexibility for MARS operation and possible future amateur bands. Crystals for Auxiliary Ranges are installed internally. In addition, the 350-XL provides reception of WWV at 5, 10, and 15 MHz, without having to add any auxiliary range crystals.

4. DIGITAL FREQUENCY READOUT

On the 350-XL, the optional Digital Dial can be installed, and you still retain the conventional analog dial, with the option of switching the digital dial off if you wish. With the Ten-Tec or Yaesu 301, you lose the analog dial if you purchase the digital dial model, making you totally dependent on the digital dial.

5. FULL BREAK-IN CW

Only two rigs offer this feature; the Atlas 350-XL and the Ten-Tec ! The others are all "semi-break-in". And the Atlas includes CW sidetone with pitch and volume adjustments.

6. NARROW BAND CW FILTER

This is another standard feature in the Atlas, optional on the Ten-Tec , Yaesu, and Kenwood. Ours is an I.F. filter with 500 Hz bandwidth, and shape factor of better than 3 to 1.

7. A.F. NOTCH FILTER

This 350-XL standard feature permits nulling out heterodynes and other interference. The Yaesu, Hy-Gain and Kenwood include a similar feature.

8.SPEECH COMPRESSION

The standard Atlas ALC system provides up to 20 dB of R.F. compression which increases your talk power and at the same time reduces "flat-topping" and splatter. An optional speech processor to provide up to 20 dB additional A.F. compression will be available soon for installation in the AC supply. The Hy-Gain, Kenwood, and Yaesu also provide some form of speech processing.

9. AUXILIARY VFO

All of the rigs listed offer an optional second VFO for split frequency operation. But Atlas is the only one with an Auxiliary VFO that is not an add-on box. The Atlas Auxiliary VFO plugs right into a space provided in the upper right hand corner of the front panel. Although miniature in size it tunes the same 500 kHz as the primary VFO, and does it smoothly with coarse and fine controls that have 10:1 planetary drives. Green, yellow, and red LED's let you know which VFO you have set up for receiving and transmitting. Very neat, and all self-contained.

An option to the Model 305 Auxiliary VFO is the Model 311 crystal oscillator that provides up to 12 crystal controlled channels. It also plugs into the front panel just like the 305. Vernier controls provide fine tuning of the crystal frequency.

10. MOBILE/PORTABLE OPERATION

The Atlas, Ten-Tec , and Yaesu, being solid state, are unique in that they will operate mobile or portable directly from a 12-14 volt DC battery. Also, the solid state rigs are considerably smaller and lighter weight than the hybrid rigs. The Atlas is unique in having a very handy plug-in mobile bracket for the 350-XL that makes it a simple matter to plug-in and go mobile.

11. OTHER 350-XL STANDARD

FEATURES include R.I.T., VOX, Crystal Calibration, ANL, and Noise Blanker.

Compare the Atlas 350-XL SSB-CW Transceiver with the others, and we think you'll agrea the Atlas has everything you'll ever need in a transceiver. And it's made in America.

And let us not forget to mention Our Customer Service which is second to none. Just ask the ham who owns one.

Model 350-XL (less options) . . . $995.
Model DD6-XL Digital Dial . . . . $229.
Model 305 Auxiliary VFO . . . . . $155.

MADE IN AMERICA ★

We're very proud that every Atlas transceiver is made right here in America, (as are the Ten-Tec and Drake). We think the American worker, and our employees in particular, are the most talented, industrious people in the world. The quality and versatility of our transceivers are proof of this.

And by using this American quality workmanship, advanced value engineering in design and manufacture, and rigid quality control, the Atlas transceiver is not only competitively priced with the imports, but is actually a better value!

Merry Christmas and Holiday Greetings from all the gang at Atlas!

ATLAS RADIO INC.

417 Via Del Monte, Oceanside, CA 92054
Phone (714) 433-1983
Special Customer Service Direct Line
(714) 433-9591

A16

J. Tom Badgett K4MDK
1917 Washington Street
Bluefield WV 24701

Inside Ten-Tec

-- QRP innovators

It started with a telephone call in 1969. Al Kahn, former president of Electro-Voice, rang up Jack Burchfield, a design engineer for Bogan in New Jersey. Kahn had moved from Michigan to Sevierville, Tennessee, after he left Electro-Voice, and he wanted to get back into the mainstream.

Dick Frey K4XU/W1FCC is Ten-Tec's chief engineer. The Century 21 is his design, and he's obviously proud of it. "It works great on the bands," Dick beams, and says he's finally doing the job he's always wanted to do. That seems to be the spirit throughout the Ten-Tec operation.

"Hey, Jack, come on down, and let's do something," he suggested in that first telephone call. To hear Jack Burchfield tell it, a second request wasn't needed. He had so much confidence in the man he had worked with when he himself was at E-V, that Jack immediately packed up his family and moved south to Tennessee.

Both admit that Ten-Tec, Incorporated, a company now well-known for its solid state ham gear, wasn't formed in the conventional manner. Once they got together in Sevierville, the pair set about adding some kind of manufacturing business to their tool and die shop already under construction. Hi-fi gear came to mind first, since both had a number of years of experience in the field.

Al says they rejected that idea pretty quickly because, "We both were sort of tired of it. After the pioneering days were over, the fun went out of it." They agreed, instead, that they should pioneer some form of amateur radio equipment for the beginner. And the Power Mite line of solid state transmitter and receiver modules was born.

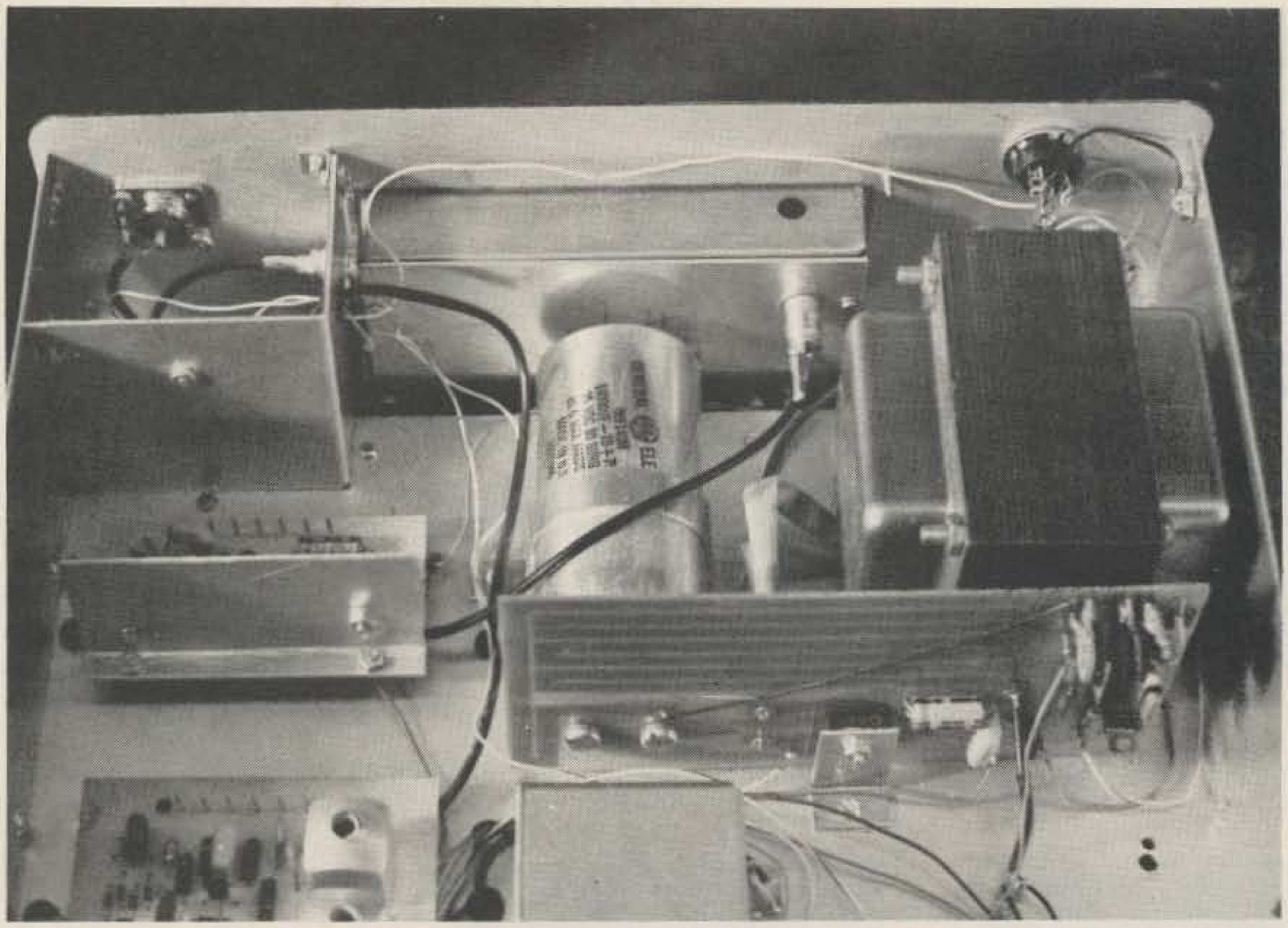
Low-power, low-priced solid state kits for the amateur market was an idea whose time just hadn't come, however. Ten-Tec sold fewer than five thousand of the units, and the ones they did sell went not to the beginner but to the guy with the S-line and the two letter call.

"If a Novice is going to work anybody with two Watts, he'd better have everything just about perfect," Jack said. "So most of the equipment went to the ham who wanted the challenge and to the QRP group."

Whatever the reason, sales volumes weren't high enough to support the young company, even though the multi-thousand square foot plant was paid for before production started. There were two founding principles they weren't ready to give up, though: low power and solid state design. The Argonaut was the next logical step, and acceptance was a little more general, even though it still ran only five Watts. This was in 1971. There were four more years of slim times before this guts-formed company became a force large enough to be reckoned with in the ham radio market.

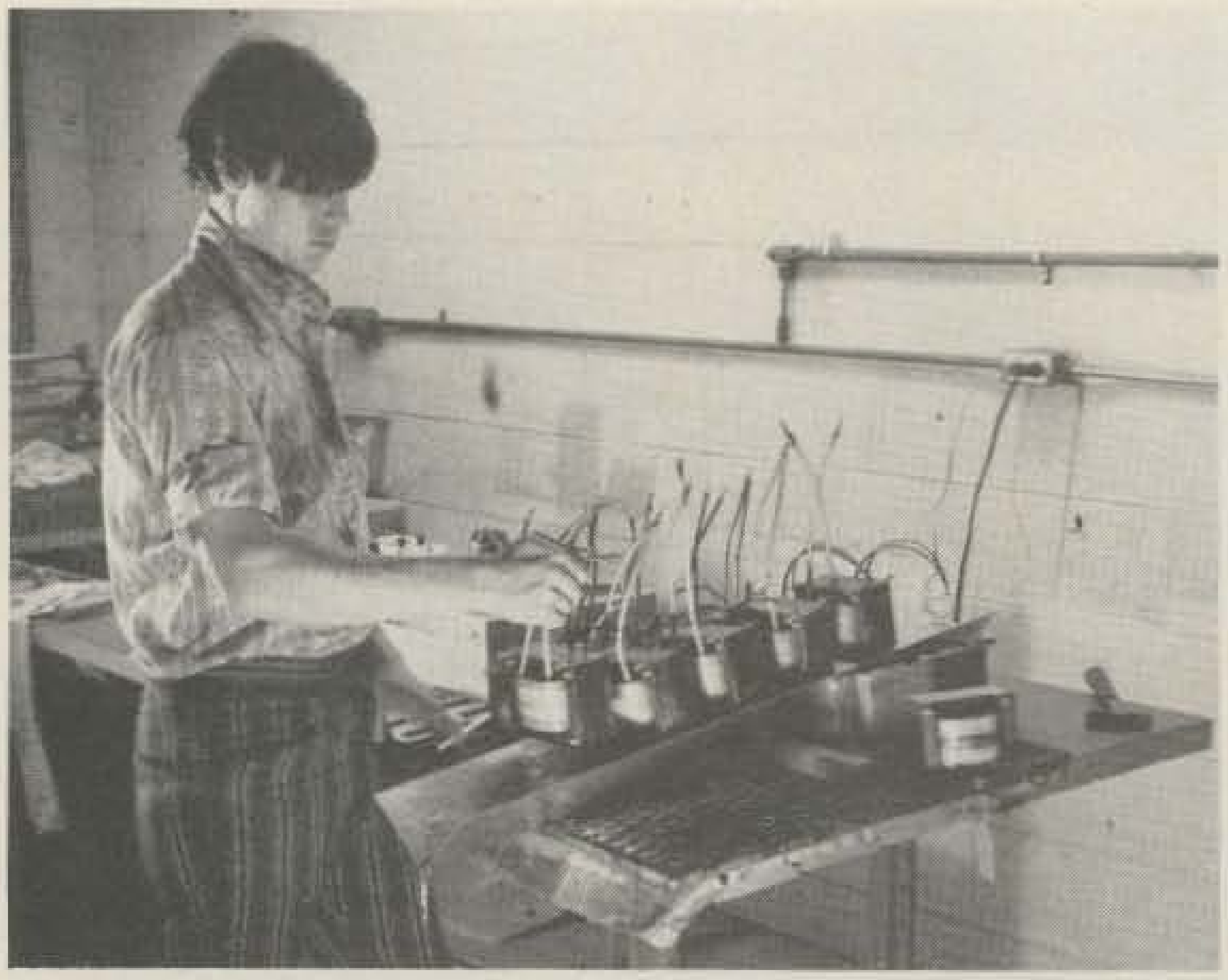
"We're making money now," board chairman Kahn says. "We turned the corner with the Triton."

One reason for the slow financial success may have been the company's strict dedication to treating the ham fairly. After the Triton came out, for example, it was decided that some design changes should be made. But before marketing the new unit, Ten-Tec made sure all the dealers knew a new design was on the way, and they instructed their dealers to tell Triton purchasers a new box was coming.



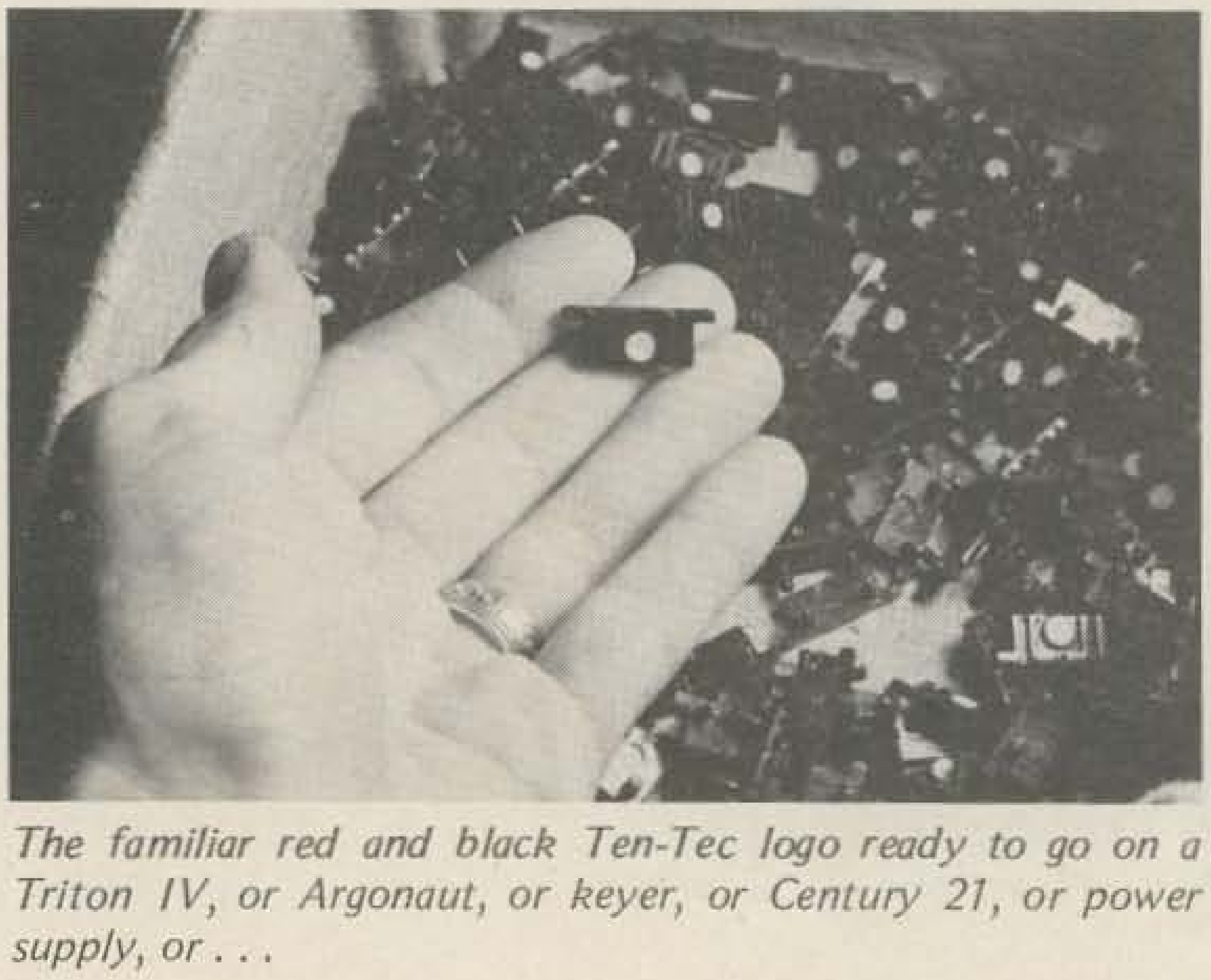
Reminiscent of Ten-Tec's earliest beginnings, this latest design – a solid state CW transceiver – began with a telephone call. Ten-Tec founder Al Kahn K4FW says he got three calls in quick succession from people wanting a reasonably priced station for large Novice classes. The Century 21 was the result – all solid state, broadband tuning, 70 Watts input, direct conversion receiver. Complete with built-in power supply, the unit is selling for $289.00. This is a prototype, but it's all there. Nothing is missing, even though there seems to be lots of room left over inside.

Ten-Tec President Jack Burchfield K5JU (left, standing) and Board Chairman Al Kahn K4FW (right, standing) watch as a technician gives one of the new digital Triton IVs an on-the-air check.



Even the power transformers for Ten-Tec equipment are wound at the Sevierville TN plant. A machine automatically inserts laminations in the transformer windings, then the whole affair is dipped in a sealant and put on a rack to harden.

This coil winder is a Ten-Tec innovation. The machine is attached to a digital turns-counter, which also is programmed to stop the winder after the proper number of turns has been applied to the form. It saves time and cuts down on errors.



The familiar red and black Ten-Tec logo ready to go on a Triton IV, or Argonaut, or keyer, or Century 21, or power supply, or . . .

"It probably cost us $25,000 to $30,000 to do it that way," Al says, "but we did it knowingly and it was the right move."

Design standards are strict, too. Until recently, Jack Burchfield was chief engineer as well as company president, and, with ten or fifteen years in the audio business, he naturally put some of that experience into the Triton – less than two per cent audio distortion, for example. Too, he says, computer predictions show a useful life on the solid state finals of 25 years. (In thousands of Tritons shipped, only 5 final transistors have failed.) Each vfo board is individually compensated for temperature stability after it is built. Toroids, coils, cabinets, chassis, circuit boards, dial mechanisms, transformers – they're all built under one roof in Sevierville, Tennessee.

What's the ham market like today? Challenging, Jack and Al agree, and changing. A ham doesn't have to be an engineer anymore to have functional equipment, and, Jack believes, more and more people are getting into ham radio "to talk to people, not to tinker." That's one reason Ten-Tec is offering sophisticated gear that's easy to operate – broadband tuning, for example, and instant break-in.

Supplying the ham market is a little like trying to please all the people all the time. It means keeping up with changing technology, but, moreover, staying abreast with what the buyer wants. To that end, a digital readout version of the Triton IV already is moving down the production line. Right behind it is a solid state, CW-only transceiver, which eventually will grow into a complete station package – keyer, tuner, antenna. A kilowatt solid state linear is on the back burner.

The Ten-Tec company presents an unusual dichotomy – state-of-the-art hardware and old-fashioned philosophy. Even though starting with all solid state equipment probably slowed the company's development, Al and Jack are adamant that whatever they design will use no tubes. They're putting those modern circuit designs in almost futuristic enclosures.

They work hard, on the other hand, to maintain a small-company, personal approach to the business as they grow. Even with $3 million in sales projected next year, there seems to be no worry about the company losing its personality.

"We did it at Electro-Voice," Al reflects. "It's just got to start at the top and go down."

Wherever it starts, the feeling is there. The people throughout the plant obviously take pride in their work. They're proud of the Ten-Tec equipment they're turning out. They seem to know a great deal about the work they perform, and there's a comradeship among all the staff that's heartening in these days when most people seem reticent in their relationships.

It's encouraging, too, to hear a ham equipment supplier promise to supply state-of-the-art gear based on a good engineering design, maintain a five-year warranty on the product, and answer every query and comment on the equipment.

Ham radio is growing and so are most companies supplying these new hobbyists. The hams at Ten-Tec have a move-carefully attitude – partly because they're not sure what direction ham radio may take in the future. But Al Kahn is sure of one thing: "Whatever you're doing, do it the best you can, and don't try to move into greener pastures until you can nail down your present job."

That idea pervades the Sevierville plant. It's as if everybody is walking around with a mouthful of nails and a big hammer. ■

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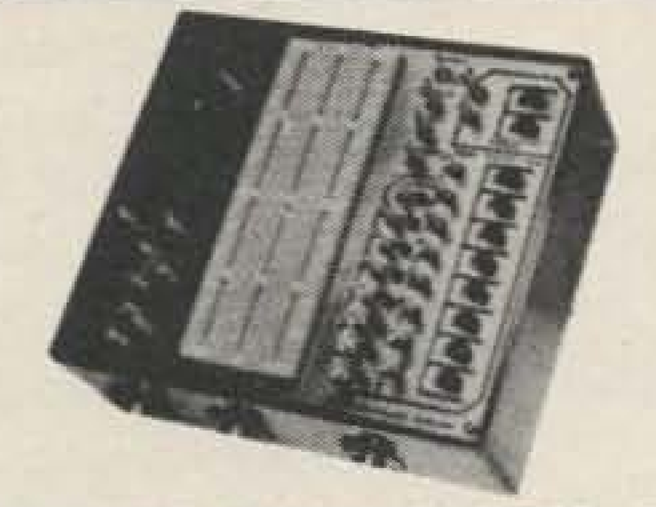

ANALOG-DIGILAB KIT $139.50

DESIGNED BY HAL-TRONIX AND MIKE GOLDEN OF R.E.T.S. ELECTRONICS SCHOOL OF DETROIT. FOR RUGGED CLASSROOM USE.

FOR THE RADIO AMATEUR, THE STUDENT, THE EXPERIMENTER OR DESIGNER

SPECIFICATIONS: OUTPUT VOLTAGES: +5V, +12V, −12V; USABLE CURRENT: 750mA; % Regulation at 500mA: 0.2%; Short-circuit limited at 1.0 amp; Thermal overload protected. Power requirements: 117VAC, 60HZ, 40 Watts.
Function Generator: Frequency range: 1HZ to 100 HZ in 5 bands. Amplitude adjustable from 0 to 10 VPP. DC offset adjustable from 0 to ± 10V. Waveforms: Sine, square, triangular and TTL Clock. TTL Clock 0 to +5V level, 200 ns rise and fall time, Frequency determined by Function Generator. Output impedance 1.2K ohm.
Most of all, it's easy to construct and service. PC boards are predrilled, plated thru and solder flowed. Over 1000 units sold to schools.

6-DIGIT CLOCK

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COMPLETE KIT CONSISTING OF 2 PC G10 PRE-DRILLED PC BOARDS, 1 CLOCK CHIP, 6 FND 359 READOUTS, 13 TRANSISTORS, 3 CAPS, 9 RESISTORS, 5 DIODES, 3 PUSH-BUTTON SWITCHES, MOLDED POWER TRANSFORMER CORD AND INSTRUCTIONS.
DON'T BE FOOLED BY PARTIAL KITS WHERE YOU HAVE TO BUY EVERYTHING EXTRA.
PRICED AT **$12.95**

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COMPLETE KIT CONSISTING OF 2 PC G10 PRE-DRILLED PC BOARDS, 1 CLOCK CHIP, 4 FND 503 READOUTS, ALL NECESSARY TRANSISTORS, CAPS AND RESISTORS INCLUDING 5 PUSH-BUTTON SWITCHES, MOLDED POWER TRANSFORMER CORD PLUS SPEAKER; COMES COMPLETE WITH INSTRUCTIONS.
PRICED AT **$16.95**

CLOCK CASE Available and will fit any one of the above clocks
Regular Price . . . $6.50 **But Only $4.50 when bought with clock**

60-HZ TIME BASE

CRYSTAL TIME BASE KIT, WILL ENABLE MOST ALL DIGITAL CLOCKS TO OPERATE FROM 12 VDC. LOW PROFILE UNIT, EASY 3-WIRE HOOKUP. ACC 2PPM, ADJUSTABLE.
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SS-2 #923252
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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.
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SEND SASE FOR FREE FLYER

H24

Eric Shalkhauser W9CI
527 Spring Creek Road
Washington IL 61571

The History of Ham Radio

-- part V

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

The first amateur radio get-together of any size was the St. Louis Midwest Convention in December of 1920, shortly after our licenses became available in 1919. No sooner had the enthusiasm at the St. Louis gathering died down, than the ARRL Board of Directors proposed a national convention.

In these early years after World War I, there was so much newness in everything connected with wireless, and there were so many original and worthwhile ideas to be aired, that no mere Morse code contact was sufficient. Voice communication had not as yet entered our amateur wireless channels. Amateurs were on the verge of many new developments. Major Armstrong had announced his "single" signal regenerative and then his superregenerative receiver designs. There were new circuits to be tested in the transmitter field, including the Colpitts, the Meissner, the Hartley, and the Heising, among others.

Amateurs wanted to be informed. They found themselves in new technical surroundings. So, for the first time, citizens of the United States and Canada, all interested in privately-owned and operated radio communication, decided to come together from far and near to a big first national convention.

The first gathering of the clan took place from August 30 to September 3, 1921, at the Edgewater Beach Hotel, located on the shore of Lake Michigan in Illinois. History relates that, following the success achieved at this first national convention, it was ordained that two succeeding ARRL national conventions were also to be held at the Edgewater Beach Hotel in Chicago at two year intervals – September 11 to 15, 1923, and August 18 to 23, 1925.

There was no telling what impact these get-togethers would have on the future destiny of amateur radio. Great effort and meticulous preparations were made for months in advance to insure success. Everyone connected with the preparations hoped that this first national meeting would find attendance coming from the far reaches of the States and Dominion, representing all districts.

The midwest location proved to be a most stragetic and advantageous choice. The Edgewater Beach Hotel was at the far north edge of Chicago, away from heavy traffic, with R.H.G. Mathews' 9ZN station located just to the north on the lake shore, spurting two tall station towers, a multiwire antenna, and up-to-date equipment in his spacious shack. All agreed that this was an ideal spot to congregate.

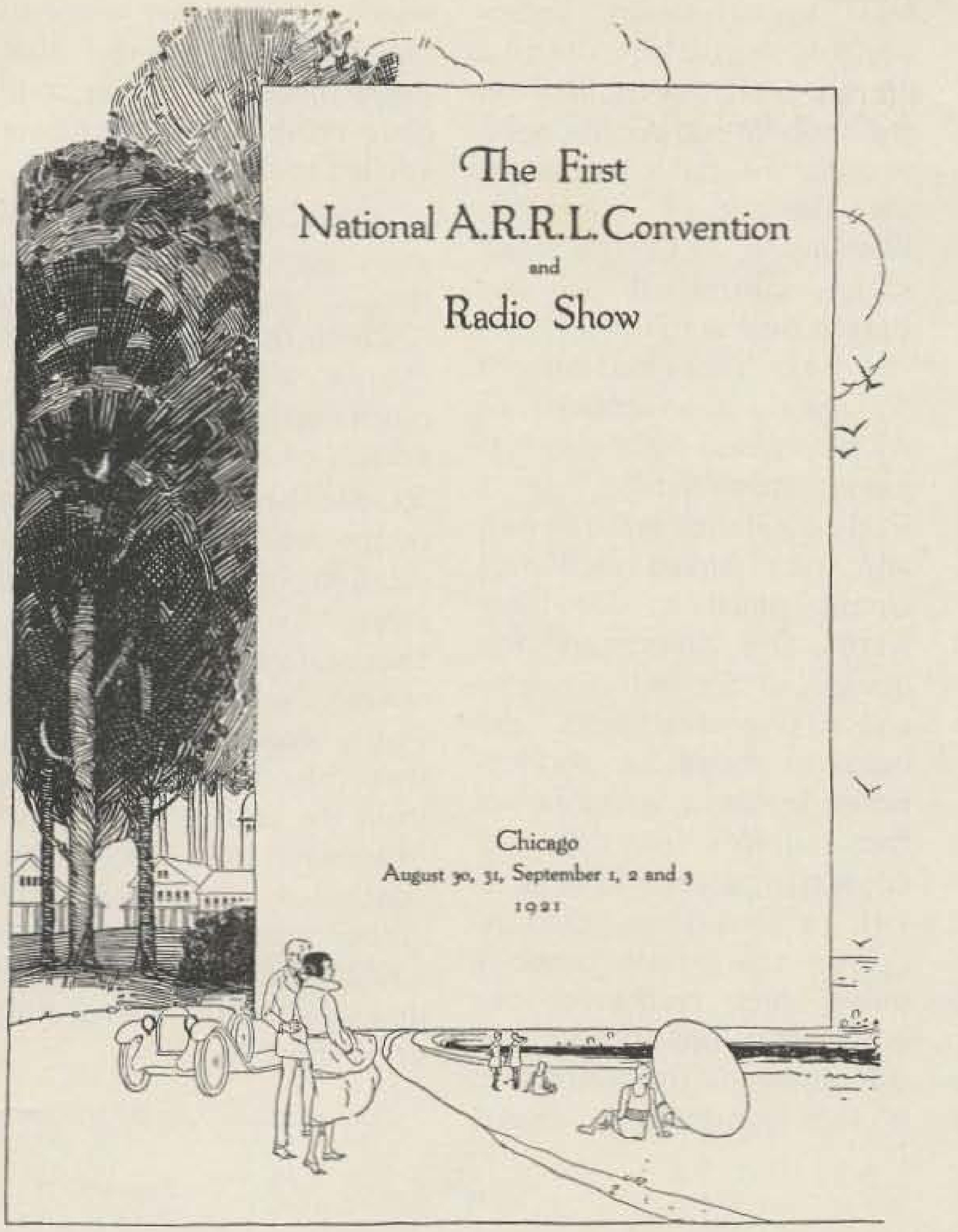
The convention committee had booked a large arena, the Chicago Broadway Armory, located within walking distance of the hotel. About fifty manufacturers and dealers in ham radio gear of all description displayed and demonstrated their products. For the first time, amateurs had an opportunity to talk shop with those people who had kept amateur radio alive through their advertising in *QST*, *Radio Amateur News*, *Wireless Age*, catalogues, and other literature. This was a ham's paradise!

The convention hall, where all the sessions took place, was a beehive of activity. There was no letup in making personal contacts, exchanging QSLs, and discussing many subjects slated on the agenda.

The First Day

The ARRL President, Hiram Percy Maxim, addressed the members with an inspiring talk concerning the aims and accomplishments which amateur radio had achieved in the relatively few years of the ARRL's organization. In his introductory remarks, the founder of the League had the following to say:

"As we meet and open this great convention, it is indeed



The Convention

THRU the many years of amateur radio there has developed an increasing desire to meet the other fellows that are, like yourself, interested in radio communication either as a pastime or business. And now comes a time when your wishes shall be gratified.

For, in Chicago on August 30, 31, September 1, 2 and 3, 1921, the American Radio Relay League will hold a First National Convention and Radio Show, which everyone is cordially invited to attend.

Chicago is itself a wonderful summer resort, offering every opportunity in any sport or diversion. You will never regret having spent part of your vacation here. The details of the convention are exceedingly comprehensive and every minute of the convention will be taken up with interesting and educational conference and lectures, being in all a most complete and co-ordinated program. Mornings, afternoons and evenings are fully arranged for, so that you will remember this convention as some of the most enjoyable days of your life.

There will be people that you know and many that you do not know that will be present from every district and city in this great United States. Probably the most important feature of the convention will be the huge banquet on the night of September 3rd, and there should be none failing to attend. Everybody from the Young Squirt up to President Harding will be there to pass you the sugar and tell you what a record station he or she is going to have this season.

The first day will be given over entirely to the arrival, registration and locating of the many delegates. The program will start promptly at ten A. M. August 31st, so you should arrange to be in Chicago some time during the previous day, August 30th.

We have arranged to accommodate you at the finest hotels in the city, very close to all activities, at rates from two dollars per day up.

From the moment that each delegate arrives, and they should not forget to bring the ladies, until their departure, the utmost of consideration will be devoted to their safety, comfort and pleasure.

Convention delegates will be admitted to the meetings, lectures, sportive expeditions and the Radio Show without any charge.

Banquet charges will be five dollars per plate, and reservations should be made immediately with convention reservation manager,

N. C. BOS
118 No. La Salle Street
Chicago, Illinois

(Make all remittances payable to Chicago Executive Radio Council)

The Radio Show

THE manufacturers and dealers' exhibit at the First National Radio Show, which is to be held in conjunction with the convention, will be the most spectacular conglomeration of modern radio equipment that has ever been put on display under one roof. This gorgeous and pompous affair will be well worth the trip itself.

The Broadway Armory, the most modern and largest exhibit and convention building in Chicago, will be used entirely for this great show.

Divided into model exhibit booths and beautifully decorated in one accord, it will equal in splendor any of the successful automobile shows. The magnitude of the affair is positively stupendous.

It will indeed be a great thing for the manufacturer and dealer, as it is held at a time that marks the opening of a new and more active radio season. Business conditions are rapidly improving and a very successful season is predicted.

In addition to publicity thru radio publications, circulars and placards, the daily newspapers with circulation over the million mark will be employed to advertise the show. This should result in a daily attendance of anywhere from three to eight thousand of interested people. The results to the advertisers, both direct and indirect, will be unprecedented.

This is not a money making proposition and the booths are being sold on approximately a pro-rata basis. The convention delegates will be admitted without charge, and the general public will pay an admission fee. Permanent passes will be issued to exhibitors. The show will open at the same time as the convention, ten A. M. August 31st, and everything must be in readiness the day before.

Here are some reasons why every manufacturer and dealer should be an exhibitor: It is the biggest affair that has ever been promoted in the age of radio. It comes at a time that marks the opening of the regular radio season. There will probably be over ten thousand people reviewing the apparatus. By personal contact with the field which he is selling he may gain good will. The exhibit cost is low and the results will be big.

Your competitor may have an exhibit and if you do not—well, think it over.

There will be every accommodation available for the exhibitor, delegates and the general public. The Armory is conveniently located near the three hotels at which the majority of the delegates will stop. There are also excellent amateur stations near by which will supply both spark and phone transmission for the reception of exhibitors.

It will be a long while before such opportunities as are here offered will again be presented.

a historic event . . . In years to come, much will be said about what we do here at this first convention. We are striking out into the unknown, and even the smaller actions which we take here during the next few days will weigh heavily in the future, for they will establish precedents and standards . . . Let us not forget that we are pioneers, blazing a way many are to follow. Our responsibility is great, and we must so regard it. It is one thing to repeat what has already been done, but it is another altogether different thing to do what has never been done before. What you see before you here today has never happened in the affairs of man. Not only is it a great pioneer effort in radio history, but it is a great pioneer effort in political history. We American and Canadian citizens assembled in this room represent pioneers in the development of something totally revolutionary in the art of communication. The like of what we are doing and proposing had never crossed the brain of man a short ten years ago. We already have a privately-owned, absolutely free continentwide means of instantaneous communication and no man may say we shall not make it worldwide." (What prophetic statements emerged from this gathering of dedicated and enthusiastic men!)

"It is no small distinction," our President went on to say, "to be one of those who make history."

General and Technical Sessions

There would be no point in listing the names of the high and low notables in attendance. They were all present. The program committee had topics scheduled for discussion pertaining to club organization, interference control, observations of laws, legislative matters, message handling, and many technical subjects.

Charles H. Steward, member of the ARRL legislative committee, reviewed pending legislation, a matter which required constant attention. Seven bills under debate in Congress at that particular time related to subjects concerning radio control, radio regulation, and enforcement. Observations made at this meeting were that: "If just two of these bills go through in their present form, the wavelengths, power, and decrement are then subject to control of the Commission, and they keep us champing around from one wavelength to another, increasing and decreasing the power available for amateurs. Constant vigilance is of vital importance to insure the amateur's place in the radio spectrum."

Probably the topic which drew top attention during the convention, and which was subject to heightened debate, proved to be the controversial question of power factor in ham transmitter circuits. As one reporter remarked afterward, "Without a doubt, this debate was the main attraction at the convention."

There were staunch supporters of the two main participants in the discussion, and it did not take long before sides were chosen. At the outset, Ellery W. Stone from the west and W. B. West 8AEZ were the antagonists in this struggle for definition and thoroughness of detail for presentation of facts.

Said Mr. Stone: "Power factor is unity in any ac circuit in which inductive and capacitive reactances cancel."

Said Mr. West (ignoring inductance and capacitance): "I confine my views in the matter to the relation of real Watts to apparent Watts."

This confrontation went on for hours, with other participants joining, until all agreed that it appeared that the confusion lay in the definition of power factor. There was no common understanding reached by the two parties. So it was decided, on the spot, to submit the question to the radio section of the Bureau of Standards, Washington, D.C. The statement submitted to the Bureau read as follows:

"For information of National Convention of ARRL, please wire our expense immediately: In a freely oscillating radio circuit, and in a forced oscillating circuit tuned to resonance with the impressed frequency, if the inductive and capacitive reactances are equal in magnitude and opposite in sense, is the power factor unity? One side contends that, according to present alternating current theory, the power factor is unity, and reactances are equal and opposite. Other side contends that resonance is that condition in circuit which causes power factor to automatically assume that degree necessary for the complete dissipation of the power applied to the circuit."

Within hours after the telegram was forwarded to the Bureau, the reply came back . . . with the answer which, in essence, left both sides very much up in the air. Supporters of both Mr. West and Mr. Stone hailed the outcome of the reply as complete vindication of their respective sides. Even a committee thereupon appointed to review the entire discussion finally ended up by stating that they are not reasoning from the same premise. Most of those in attendance finally concluded by these vague decisions that another subject could be more productive and down to earth and headed for other meetings.

Of great interest to ama-

January, 1920 QST -27

RADIO 9ZN

Radio 9ZN, the station of the Central Division Manager, is located at 5525 Sheridan Road, Chicago, Ill., on the shore of Lake Michigan.

The station consists of a two room, one story frame building situated midway between the two towers supporting the antenna. The building, towers and plane of the antenna are in a north-and-south line, at a distance of 60 feet from the edge of the lake. Because of this location, the station is clear of practically all high buildings and obstructions in all directions.

The aerial is 95 feet high, over all, the towers being of steel, 50 feet high, and the masts being also of steel, 45 feet in height. The towers are 150 feet apart, the ten wires composing the antenna being spaced equally within this distance, in the well-known vertical fan fashion. The aerial wires are 7 strand No. 22 tinned copper wire, the top cable being 7 strand No. 18 phosphor bronze, with three 10 ½ inch Electrose insulators at each end. The loose end wire attached to the tower sides of the insulators are to provide downhauls

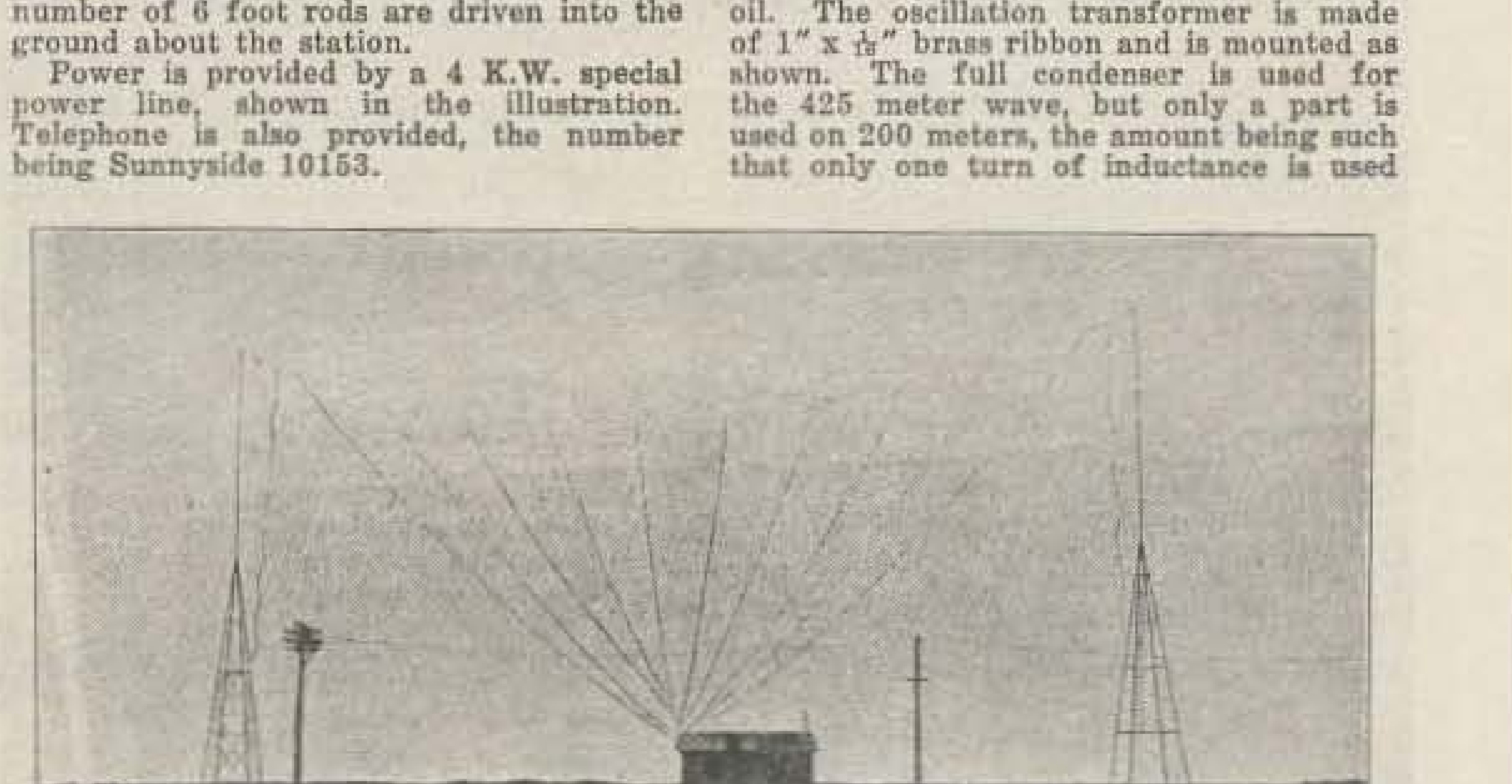
QST January, 1[illegible]

for the cable should the aerial give way.

The ground system of the station is perhaps one of the principal reasons for its success. It is composed of two banks of wires, one consisting of 20 wires (No. 14 bare copper) each 30 feet long, buried radially from the station, and the other consisting of 8 wires (7 strand No. 22 copper) each 150 feet long, buried similarly. In addition, two wires, each 100 feet long are submerged in the lake, and a number of 6 foot rods are driven into the ground about the station.

Power is provided by a 4 K.W. special power line, shown in the illustration. Telephone is also provided, the number being Sunnyside 10153.

Hy-Rad rotary gap. The rotary gap is contained within a double walled padded box, just behind the marble panel, on which are mounted the radiation ammeter, power variation switch, power ammeter and main switch, the transformer being directly beneath the gap box. The oil condenser is immediately to the right of the switchboard, and consists of 1200 square inches of tinfoil separated by ⅜ inch plate glass immersed in transformer oil. The oscillation transformer is made of 1″ x 1/16″ brass ribbon and is mounted as shown. The full condenser is used for the 425 meter wave, but only a part is used on 200 meters, the amount being such that only one turn of inductance is used



The receiver consists of a Chicago Radio Laboratory Paragon RA-6 short wave regenerative receiver and Amplifigon type AGN-2 audion control and two step amplifier. An Audiotron tube is used for detector, Western Electric VT-1's or Marconi VT's being used as amplifiers. With this receiver are used Baldwin Mica Diaphragm headphones. Practically all the long distance amateur stations are heard with the phones on the table on average nights; many, such as 2CS, 2ZS, 5AF, 8AA, 8ER, 9BT, 9BR, etc., being generally heard at distances up to 100 feet from the headphones. Six hundred meter stations are heard similarly. At present no set is provided for longer waves than 600 meters, but an undamped wave receiver is under construction.

The transmitter consists of a Marconi (United W.T.Co.,) open core 1 K.W. transformer, having a secondary voltage of 30,000, with an oil immersed plate glass condenser, and a Chicago Radio Laboratory in the primary on this wave.

Because of the high fundamental wave length of the aerial (300 meters) all 200 meter transmission and reception are done through series condensers, the transmitting series condenser consisting of 175 square inches of tin foil separated by ⅜″ plate glass and immersed in oil. This condenser is located just above the loader, which is used for 425 and 600 meter waves.

The radiation on 200 meters is 8¾ amperes, and on 425 meters is 9 amperes, the 425 being really better than would appear from a direct comparison of these readings, because of the elimination of the series condenser, and also because of the greater carrying ability of this wave.

The 200 meter wave is used ordinarily, with a shift to 425 to avoid interference or to work over greater than average distances. The answering wave of this station is invariably 200 meters, unless otherwise specified by the calling station.

(Concluded on page 35)

teurs who were still purchasing and installing spark gap transmitters was the subject of broadband interference. It was contended that spark gap units were doomed to fade out of ham stations, because the waves they transmitted on the air were not as sharp as a CW wave. It is true that they could be held better in reception and did not have tendencies to jam each other, like the CW signals did. Also, each spark on the band had an individual characteristic that identified it, and what distances could be covered (having 1000 Watts available)! The overall sensitivity and selectivity of circuits was a hindrance. The CW signals were difficult to tune and hold. Wave shifting was usually noticeable. Regenerative receivers had shortcomings, especially since they were asked to be equally effective in bringing in CW, ICW, and the broad spark signals. Receivers lacked adequate control to meet requirements. Being regenerative, they radiated energy and caused considerable interference, especially in more congested areas.

For most signal reception, the oversized loose couplers in station equipment were still serving their major purpose. Domestic and foreign longwave stations were very much on the air with news broadcasts, weather reports, time signals, and general information. Many stations served as sources of code signals for

RADIO STATION 9ZN, 5525 SHERIDAN ROAD.

Chicago, Ill.,.......19...

Your signals heard here........ Audibility.......

Characteristics.......... Note.......... Wave..........

Other informati...

Equipment at ... co...rises:—

Transmitti... 2 K. ... 500 cycle T...unken pa... ...che... set.

2 K. ... 60 cycle, ... synchrono... se...

... CW and ...iophone set.

Receiving—C. R. L. P...gon-Amp...on (2-step) ...mbi...

Aerial—10-wir... ...erti... fan, 90 ... ...igh, 150 ft. lo...

Wave lengths-...0, 2..., 375 me...

Hours of opera... ...0 P. M.— ... ...htly.

9ZN is the Central Division Distributing Station of the A. R. R. L. and will be very glad to handle any traffic you may have at any time. Please QSL.

QRK ?

....

Operator, 9ZN.

practice — NAA, 2,500 meters; POZ, 12,000 meters; PL, 10,000 meters; and MUU, 14,000 meters, continued on the air for years.

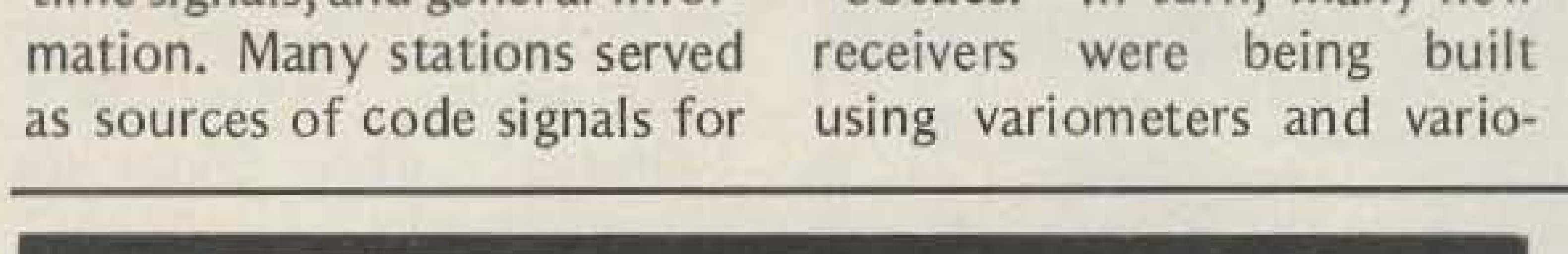
So loose couplers were in constant use by amateurs until, with the introduction of the honeycomb-coil design, units which occupied far less space but had equivalent inductance gradually replaced them. Amateurs also began to convert to shorter and shorter wavelengths with the move to CW and the application of available transmitting tubes. Amateur station layouts began to take on new and revitalized appearances. Power supplies had to be designed and built to accommodate larger tubes for that new requirement of "juice" for the "bottles." In turn, many new receivers were being built using variometers and variocouplers.

As is the case each year, with the coming of fall and colder weather, radio conditions improved, static tapered off, and interest in DX and relay activities increased. So the ARRL Board of Directors decided that a determined effort should be made to span the Atlantic via amateur radio. There had been an earlier try, not organized, that had failed. Undaunted, plans were laid by the ARRL traffic department announcing that all radio amateurs should enter into a series of transmitter tests. Selections would be made to find the best and most far-reaching transmitters to qualify for the proposed undertaking. The following form appeared in *QST*, September, 1921, page 12, directed to all hams:

"Traffic Manager, ARRL, 1045 Main Street, Hartford CT.: Please enter my station as a transmitter in the Transatlantic Sending Tests, Dec. 8th to 17th. I will be ready to transmit in the preliminary tests on Nov. 7th to 12th, and if I fail to cover the specified distance in the preliminary tests, I shall relinquish my rights to transmit in the final tests. Name . . . Call . . . St . . . City . . . State . . . Power of transmitter . . . type (CW or spark) . . . greatest distance heard (give three records) . . ."

The stated goal was: "We want the Atlantic Ocean spanned on schedule by an amateur station, and we want definite proof that it has been done." ■

To be continued.



EDITORIAL BY WAYNE GREEN

from page 16

vide amateur radio with growth and to offer a reasonable alternative to CB manufacturers to opening a Citizens Band in the amateur 220 MHz band. Now that history has eliminated the need for a Communicator license, will we be able to stop the FCC?

HAM GEAR FOR HAMS

Somewhere around 300,000 ham transceivers have crossed over into CB hands so far . . . where will it end? The manufacturers and importers of ham rigs estimate that about 75% or more of the new rigs end up in CB hands.

Sure, the use of these transceivers by CBers in their "HF" band, those channels in the 27.5 to 28.0 MHz band, is illegal. But, like the 55 mph speed limit, the enforcement is so slight that most CBers use the band with impunity. On those frequencies, up above the hurly-burly of the "bottom 40," sidebanders sit and make skip contacts with ease. Their ham transceivers and ham power amplifiers, aided by antenna installations which would make a dedicated DXer fidgety with envy, give them a very good taste of hamming.

Most of these chaps are much like the rest of us, a fact attested to by the large number of them who are getting their ham tickets. Recent estimates from a number of ham clubs indicate that almost 90% of the people in ham classes are CBers. Most ham classes have a dropout rate of around 40%, though this depends a lot on factors such as the instructors, the code tapes used, etc. The fact remains that very few of the HFers are among the dropouts. They seem to have a much higher degree of determination to succeed. The estimate is that at least 40% of the newly-licensed hams are now coming from the HF group.

When you figure how relatively small that group is, the number of HFers getting ham licenses is most remarkable. This also may explain why we have so far had only minor trouble with HFers bootlegging in the ham bands. The redneck crowd hasn't

Continued on page 190

R. J. Edmunds WB2BJH
48 Lakeside Trail
Kinnelon NJ 07405

Try BCB DX!

-- when you're tired of twenty

Many amateurs are familiar with DXing the foreign broadcast bands in the short waves, frequently from having DXed them in the process of aiming toward their licenses. There is, however, another area of DXing which offers a far greater challenge to the DXer, although he can no more "work" this DX than he can the international broadcast stations. This is the standard AM broadcast band, from 525-1605 kilohertz.

The hobby of listening on this band, like all other forms of radio listening which can be called DX, had its beginnings with amateurs. Before the advent of the commercial broadcasters on AM with which we are most familiar, amateurs pioneered here, too. Many of the oldest broadcast stations are outgrowths of amateur or other experimental operations. The first broadcast licenses were issued, indeed, for experimentation and development. Perhaps one of the most familiar of these is New York's WQXR, 1560 kHz, which was formerly W2XR.

In the old days, there were only a very few frequencies being licensed, due to the small numbers of stations and low powers involved. The present set of frequency allocations came into existence in 1934, when the old Federal Radio Commission became the familiar Federal Communications Commission. Actual commercial broadcasting, with commercial messages being broadcast as a means of revenue, began in 1924 over station WEAF (now WNBC) in New York, which broadcast spots for a Long Island realty company.

The author's shack. Left to right — clock timer with power selection panel; stereo tape recorder; speaker, audio input/output distribution panel, SB-620 spectrum analyzer; variable bandpass audio filter and HQ-150.

The amateur practices of sending reception reports and receiving QSL cards are also found in AM broadcast DX. Many stations will verify receptions with QSL cards or letters, although the practice is by no means as prevalent as it was in the 1920s and '30s. DX nights were common during that time, as most or all domestic stations would leave the air at local midnight on certain days, leaving the bands open for exotic international DX. Many old-time BCB DXers were able to hear and QSL stations in nearly every country which had them.

Today, however, with the over four thousand stations in the United States alone, many boasting extended schedules and higher powers, such a feat is impossible. It is, nonetheless, possible to log more than one hundred countries on the BCB. Country-counting is different from what it is on the amateur bands, and there are no DXpeditions to add to the totals, with the result that there are many fewer "BCB countries" than there are "ham countries."

But why should we DX BCB under these conditions? Perhaps the best answer is because it's there. We could well ask ourselves why we DX any band at all, and the answers would be somewhat similar. BCB offers several challenges to the DXer, including hearing stations which are not intended for long distance, international listeners, but rather for domestic ones; the challenge of beating the local QRM;

and the old familiar countries, state capitals, counties or what-have-you lists. Another aspect of particular importance to beginners and youngsters is the low cost and ready availability of equipment.

Equipment

All it really takes to hear BCB DX is a standard AM radio of medium to good quality, and, perhaps, a hunk of wire strung in the backyard. The best portable BCB DX equipment consists of a transistorized receiver, with a loopstick inside for an antenna, which retails for under $40.00 (the Radio Shack Long Distance TRF).

Of course, the DXer will likely wish to continuously upgrade his equipment, but a very fine setup can be assembled for less than it costs to equip a multiband ham shack with a good set of equipment. Communications receivers from the surplus market, including such makes as Hammarlund, National, Hallicrafters, Drake, or Collins, among others, are often ideal for BCB DX. Many enthusiasts consider the Hammarlund HQ-180 to be among the top receivers, while others opt for the Collins R-390A/URR. Any number of other receivers manufactured by the above companies, as well as military surplus units and current-production Radio Shack models, are also quite suitable.

Antennas are generally a home brew situation, with a four-foot air core altazimuth loop with FET rf amplifier being the ultimate of these. This is perhaps the most popular antenna in use today, although the old standby longwire and tuner is still quite prevalent. One commercially available antenna, developed by a DXer and former corporate engineer, is the Worcester Laboratories' Space Magnet series. This antenna is a ferrite-cored loop with amplifier, available in several models in the $50.00 range from Worcester Electronics Laboratories, Frankfort NY.

There are many other variations of BCB loop antennas available as construction projects, commercially available kits, or assembled units. Many DXers experiment to obtain new designs which combine high directivity, high "Q", and small space consumption to suit their individual needs.

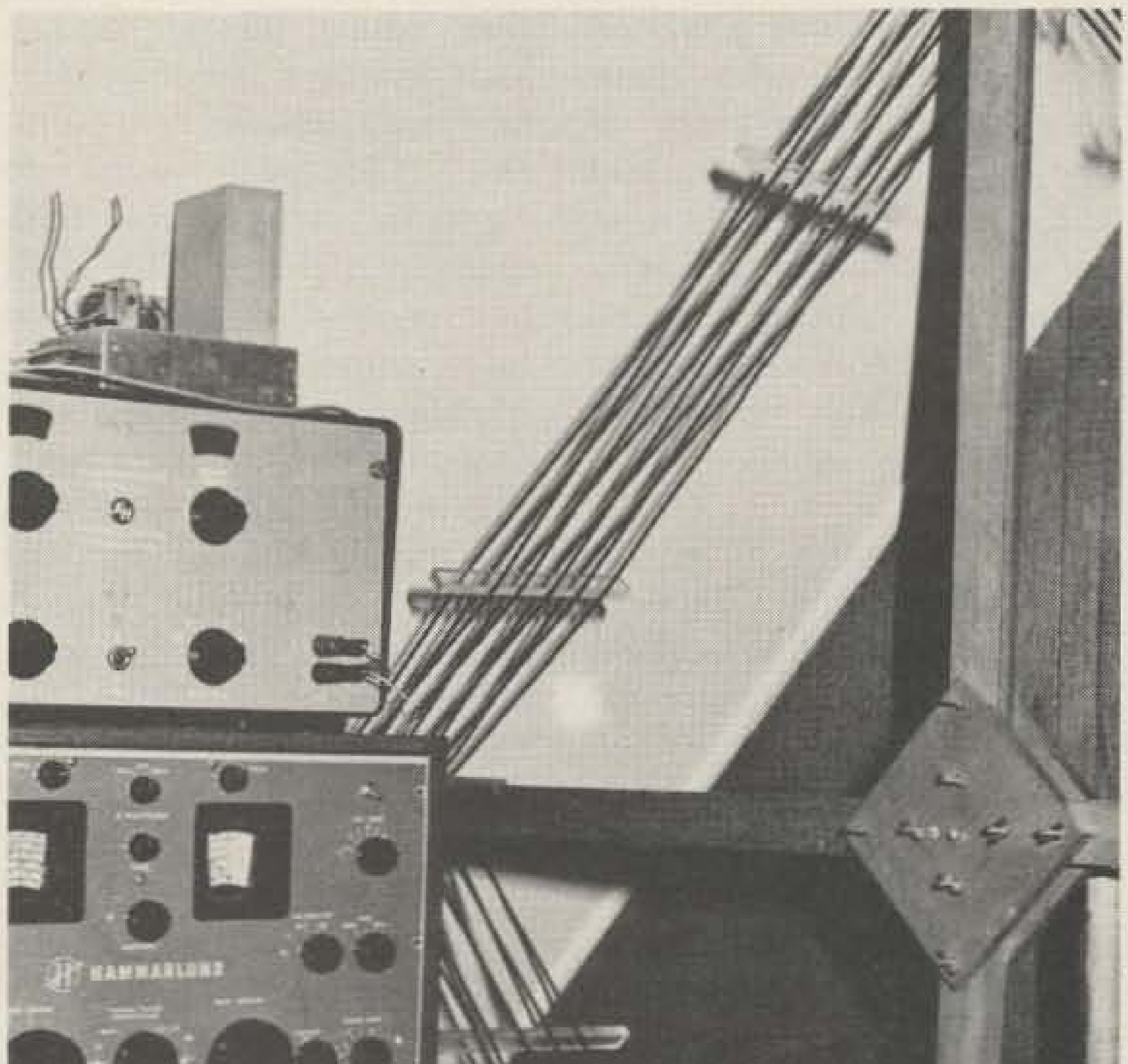
Among the most popular accessories are tape recorders, external Q-multipliers, audio filters, stereo headphones wired for mono, and oscilloscopes or spectrum analyzers. The latter are used primarily for observing signal traces and band scanning for additional signals not immediately audible, as well as for identifying interference and frequency measurement. Most of these, however, are really not necessary.

Getting Started

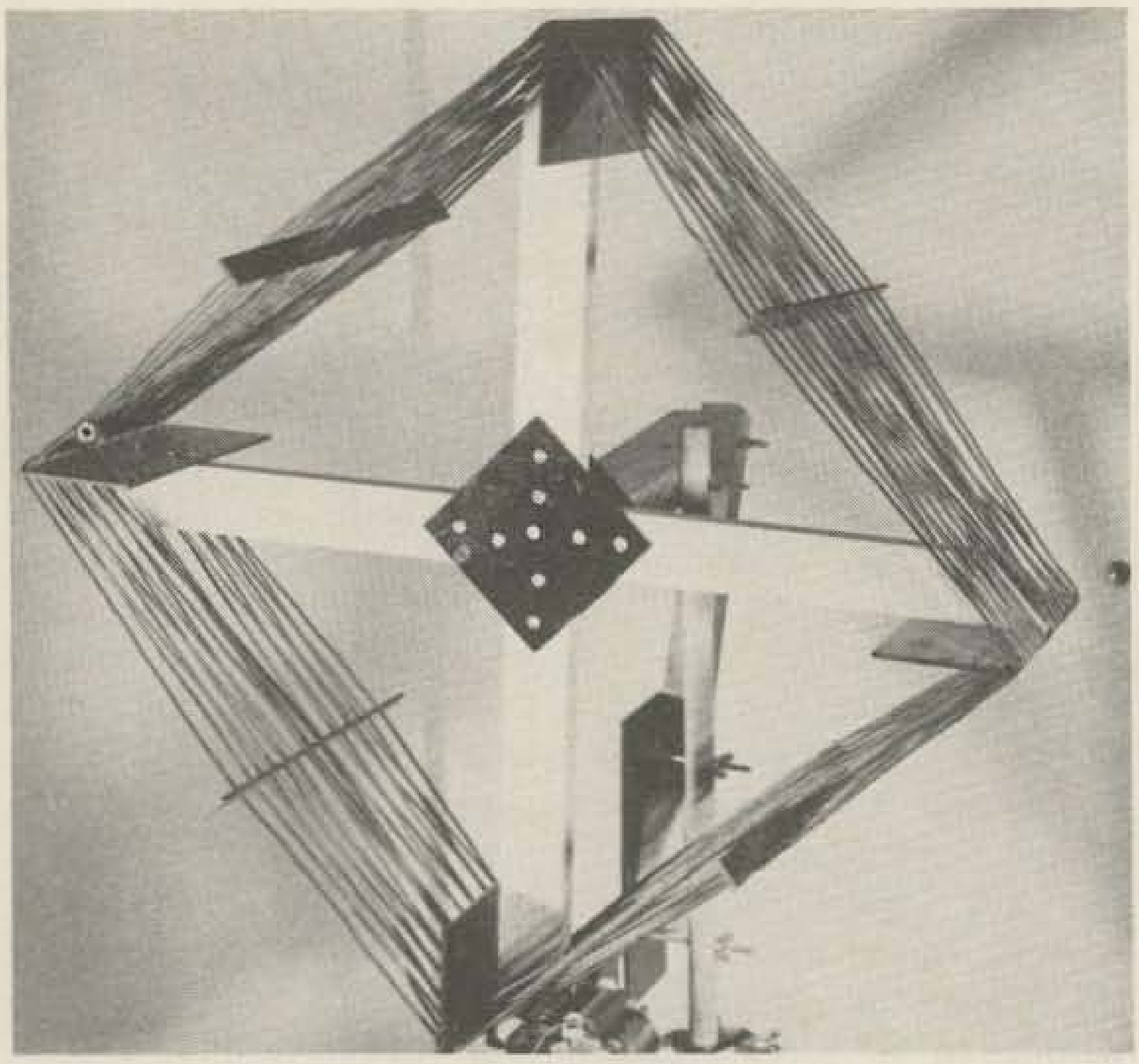
Any new hobby can be confusing to the beginner, and so it is with BCB DX. There are, however, a number of very useful publications to be had. Many of these are published by the two national BCB DX clubs – the National Radio Club, headquartered in Louisville KY, and the International Radio Club of America, in San Francisco. The two clubs were at one time one, but, as is often the case with amateur clubs, a split occurred in 1964, resulting in the two clubs. Both cover the whole continent and primarily the same segments of the hobby, although there are some differences in orientation. The NRC features more publications and a larger membership, as well as a somewhat more technically-oriented outlook.

Each of these clubs publishes a regular bulletin, which is weekly during the winter DX season, and less frequent during the summer. The NRC publishes *DX News*, which has appeared regularly since 1933. It also publishes a domestic station log, night directional antenna pattern book, receiver and antenna manuals, and a large list of article reprints. IRCA publishes a foreign log compiling all reported receptions on an annual basis, as well as a somewhat smaller list of reprints. Both publish introductory booklets. A copy of an explanatory publication and a publication list may be obtained from the NRC by writing to: NRC Membership Center, P.O. Box 118, Poquonock CT 06064. A sample bulletin may be had for 50¢, from the same address. Information on the IRCA may be obtained by writing to Richard Segalas, P.O. Box 26254, San Francisco CA 94126. Another valuable publication is the *World Radio/TV Handbook*, already known to many hams and SWLs.

Most newcomers to the BCB hobby start out with domestic DX (U.S. and Canada) and very little foreign DX. Even a casual listener will be aware that there are many stations throughout the U.S. and Canada which can be heard on even the poorest of equipment, and it naturally follows that the better the equipment and the more DX experience on the band, the more and rarer the DX will be. Much of the BCB DX hobby depends on knowing what to look for and when to look for it. For these reasons, one cannot take the publications too lightly, nor should the aspect of preplanning be



The author's shack. Variable audio filter, HQ-150, and part of 4' altazimuth FET loop. At the extreme top left is a simple fixed low pass audio filter. Not shown are mono-reel tape recorder, cassette recorder, and Nordmende Galaxy Mesa 6000 portable receiver.



A 2' altazimuth loop antenna for use with or without external rf amplifier, modified and built by the author from 4' antenna design.

ignored. Much time is wasted by beginners, who have passed the first plateau of hearing all of the regular and semi-regular stations, but have not yet learned that simply sitting and waiting for DX isn't good enough after that point.

Propagation

The optimum time for BCB DX listening is between midnight and local sunrise, when many stations are off the air, thus reducing interference and allowing DX stations through. In addition, many daytime-only stations test during this so-called "experimental period" and may, thus, be heard at far greater distances than they are normally heard during their regular broadcast schedules. Monday mornings (Sunday nights) generally yield the most silent periods from full-time stations and the most tests from daytimers, and are, therefore, the most worthwhile. Many stations conduct regularly scheduled tests during the experimental period, and lists of many of these are available from the BCB DX clubs.

Many DXers, however, find that listening during these hours conflicts with their normal lifestyle, and so such listening is confined to rare occasions. In this event, the DXer will want to capitalize on the other optimum period for BCB DX, namely the period around local sunset. At this time, propagation conditions are changing due to the sunset, and many daytime stations are leaving the air for that reason. These two factors combine to allow for more distant reception of these stations just before they do leave the air. The FCC has set out specified times for sign-offs and sign-ons of domestic stations, which correspond with their average monthly sunset and sunrise. The resulting pattern is an east to west sequence of sign-offs, thus allowing for stations to sign off leaving stations further west still on, and so on, until a full-timer becomes dominant. On some channels, a DXer may listen and hear one or two new stations signing off in every fifteen-minute sign-off period. Maps detailing the zones of monthly sign-offs (or in some cases, antenna pattern changes or power reductions for full-time stations), as well as the reciprocal times for sign-ons (and increases at sunrise), are also available through the clubs.

Propagation of domestic signals on BCB is generally accomplished by either ground wave, which follows the approximate line of sight, or by sky wave, which is reflected back to Earth in the ionosphere. Sky wave can be broken down into various levels of skip. In the daytime, the "D" and "E" layers of the ionosphere effectively prevent any significant long-distance skip on the medium waves. During the mid-winter period, receptions at distances of up to 1000 miles via ground wave are not uncommon, but, throughout the rest of the year, the average is much less.

At night, the "D" layer disappears, and the "E" layer weakens significantly, thus allowing many signals to travel on to the "F" layer, which really is composed of two layers, known as F1 and F2. During the daytime hours, these layers separate from each other to a greater distance than they are at night, but this fact is not immediately relevant to our discussion. Both "F" layers are capable, as is the "E" layer, under certain circumstances usually associated with geomagnetic disturbances known as "sporadic E," of reflecting signals back to Earth. To be technically correct, the process is really refraction, but the ultimate effect is sufficiently similar to reflection to be so called here. In general, most of the ionospheric reflection observed at BCB frequencies occurs in the F2 layer.

Normally, ground wave is reliable at night, up to a distance of approximately 125 miles. Sky wave is generally the predominant mode of propagation from about 160 miles on up. The area in between is an irregular combination of the two, with neither one dominant. It should be noted that some sky wave components will be present, but masked, at the lower distances, and that the reverse will be true at the lower range of the higher group of distances. A single hop reflection from the F2 layer can propagate a signal over a wide range of distances, up to nearly 2500 miles, depending upon the angle of radiation. A given transmitter will radiate at a multitude of angles, thus allowing it to reach the entire range of distances prescribed herein. Skyline blockage, such as mountains or large man-made structures, can prevent transmission at certain angles by blocking or absorbing the signal at either end of the path.

Long-distance (in excess of 2400 miles) propagation is primarily by multihop paths of F2 reflections. Occasionally, it may be possible for propagation by multimode paths, or other unusual modes, which are beyond the scope of this discussion. Included among these is reflection by nighttime sporadic E.

There are, however, other factors which materially affect BCB signal propagation. The most significant of these is that caused by auroral disturbances of the Earth's atmosphere. At such times, excessive absorption of sky wave signals by ionized particles in the ionosphere takes place and alters the character of reception in some areas. This alteration is geographically dependent, due to the nature of the Earth's magnetic field. It is most strongly noticed in the northeast, due to that area's proximity to the North Magnetic Pole. When this happens, absorption occurs, depending upon the severity of the disturbance, on signals arriving from the north, northeast, and northwest. In severe disturbances, or at higher latitudes, signals from the near southerly directions may also be absorbed.

This process leaves those signals which are ground wave, thus yielding signals from stations at an intermediate distance arriving solely by ground wave, as well as those sky wave signals arriving from such a distance and/or direction as to escape the absorptive layer. Thus, signals from the south, semi-local, and local signals will predominate. It may be seen, then, that the serious DXer on BCB will frequently be as hampered by an aurora as DXers at higher frequencies are aided by it.

Planning and Recordkeeping for the DXer

Perhaps the most important part of BCB DXing involves planning the DX sessions. As noted earlier, there comes a time when simply turning on the receiver and aimlessly looking about for new stations becomes nonproductive. At this point, the DXer should set about compiling realistic target station lists for each time block he plans to listen. Factors to be taken into account are interference, distance, season, and even month. The first two factors are obvious, but the latter two can use some explanation. In BCB DX, winter tends to be the primary time to listen, due to the shorter period the atmosphere is exposed to sunlight, thus allowing a lesser period of ionization to occur. Likewise, a case has been made for better propagation due to cold weather. Antenna radiation patterns are altered somewhat by a covering of snow around the antennas, and large fronts of snowy weather can often affect intermediate-range propagation by sky wave.

The month of the year is a direct factor in the sunrise and sunset times already discussed. Use of the maps of these times for domestic stations, as well as maps depicting actual sunrise and sunset times worldwide, can aid in planning the DX session by allowing you to determine when the signal path is in darkness, which predicts good propagation, or partly in sunlight, which does not. The domestic maps also allow the DXer to determine which stations lie closest to the borderline between one sign-off (or sign-on) block and another. At sunset, those stations closest to the previous block will be more likely to be heard than those closer to the following block, again due to the relative degree of darkness on the path. At sunrise, the reverse is true for sign-on DX. Even this difference of five or ten minutes in actual sunset or sunrise times among stations signing on or off simultaneously can make a significant difference.

Recordkeeping is a major part of planning, and it is also a part of "saving" your DX. Records of monthly sunrise-sunset maps for the most productive domestic frequencies may be reused year after year, as can lists of target stations. Identifying a station with marginal audio may require not only a knowledge of the rudiments, such as call letters, location, and network affiliation, but also a knowledge of programming type, special or local networks, telephone area codes, postal zip codes, sports programming, and program syndications. All of these can be used to shed light on the identity of a station for which you can pin down neither the call letters nor the location.

As noted at the outset, many DXers write for QSL cards, or "verifications of reception." This requires maintaining a log of what is heard, with an emphasis on items of local nature, advertisements, personalities, and phone numbers. This may be done via logging sheets for the long term, and by tape recordings, in order to put the data down on the logging sheets accurately. Tape recordings also allow you to play back partially-readable IDs or tentative IDs for analysis and ultimate identification. Many DXers maintain "ID tapes" which contain the station IDs recorded from DX sessions and rerecorded onto the master tapes. This creates a semi-permanent record of the individual's DX catches and provides a proof of reception as well, although not in the same way as verifications.

kHz	Call	Location
640	KFI	Los Angeles
650	WSM	Nashville
660	WNBC	New York
670	WMAQ	Chicago
680	KNBR	San Francisco
690	CBF	Montreal
700	WLW	Cincinnati
720	WGN	Chicago
740	CBL	Toronto
750	WSB	Atlanta
760	WJR	Detroit
770	WABC	New York
780	WBBM	Chicago
810	WGY	Schenectady, NY
820	WBAP	Fort Worth
830	WCCO	Minneapolis
840	WHAS	Louisville
850	KOA	Denver
860	CJBC	Toronto
870	WWL	New Orleans
880	WCBS	New York
890	WLS	Chicago
1020	KDKA	Pittsburgh
1040	WHO	Des Moines
1070	KNX	Los Angeles
1100	WWWE	Cleveland
1120	KMOX	St. Louis
1160	KSL	Salt Lake City
1180	WHAM	Rochester, NY
1200	WOAI	San Antonio, TX
1210	WCAU	Philadelphia

Table 1. Clear channel stations. All of the above stations broadcast on channels designated as "clear" channels by North American Radio Broadcasting Association agreements. All broadcast with 50,000 Watts and nondirectional antennas on a full-time basis.

What Can You Expect to Hear?

The beginning DXer might best start by trying to log as many stations on each channel as he can by day and by evening before settling down into the "DX prime time." This will weed out the regular stations from the nonregular and will give the DXer a familiarity with the band, so that he need not waste time trying to ID an unneeded station. Following that, one might try to hear all of the 50,000 Watt, class 1A "clear channel" stations, a list of which is shown in Table 1.

If foreign DX is more to the DXer's liking, or domestic DX has become boring, the beginner's goals should be toward Latin America initially, and ultimately, depending upon his geographical location, to transatlantic or transpacific DX. Here, the *World Radio/TV Handbook* is a must, in order to set up target stations, as well as to assist in identifying what is heard. Due to the fluid nature of many of these Latin American stations, as well as some differences caused by the listener's location, no list of widely heard stations will be presented. Such information, as well as information on transatlantic or transpacific DX, can best be obtained by joining one of the aforementioned BCB DX clubs.

By this time, you have either gotten interested in the concept of BCB DXing, or not. If you have, the best advice is to start out with some fairly easy targets, and to contact one or both of the two clubs mentioned. If you feel that you require still more information, again, you should contact one of the clubs, either for their descriptive material or to purchase a copy of their beginners' publications. In the meantime, good DX! ■

E. Doren WA6THG/KH6
58 Manaolana Place
Hilo HI 96720

Build An Engine Analyzer

-- use your scope!

If you are anything like me, you hate to pay someone else to do something you can do yourself, and that's the way it is with me and my automobile. It has occurred to me that I constantly find myself involved with electronics. Yet here I am, a self-professed expert, and I have no way of taking on the complexities of the common Kettering automobile ignition system. Or do I?

Recently, my daughter, Marie, gave me a beautiful automotive timing light. It's a real peach, with an extremely bright flash, and operates from the car battery system. "Hey neat ... just what I always wanted," and, with that, I ran out to the trusty, rusty Pinto and eagerly hooked up the light to the four-banger gas burner.

The instructions say to hook the red and black wires on the light to the positive and negative terminals of the car battery and then clamp the induction pickup around the number one spark plug wire. Elementary, so far. With the engine running, and being careful to watch that those dangling wires don't drop into the spinning fan blades, I gently squeeze the trigger on the gun and watch the light spring to life. I love gadgets, and this one had all the elements of being some real fun.

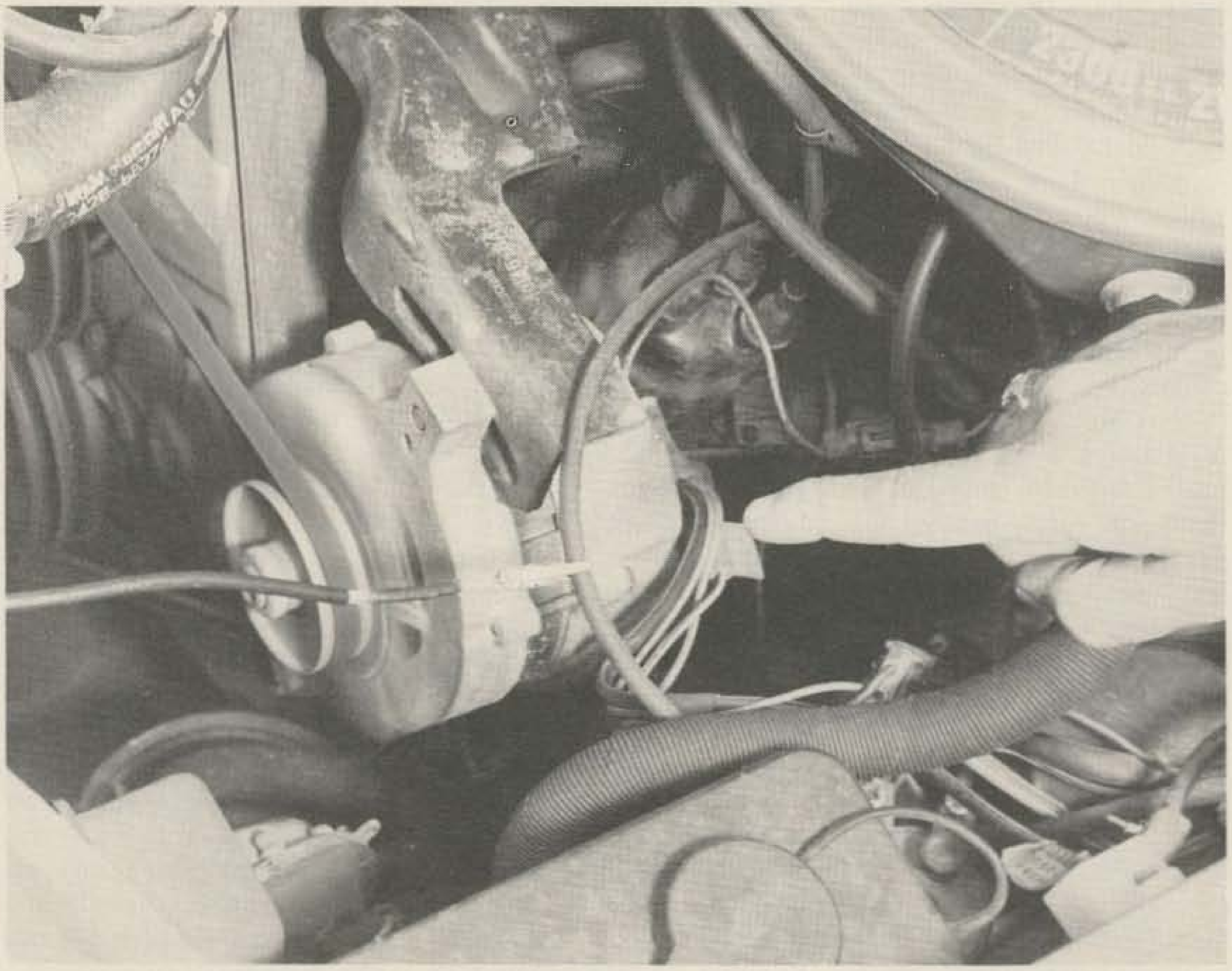


Photo A. This photo shows how the vertical input to the scope is coupled to the high tension lead from the distributor to the coil. Notice that it is only clipped to the insulation and does not make direct connection to the wire.

Now, I have fiddled around some with automotive problems and knew that the timing marks are found on the side of the front pulley. All that has to be done is to rub some chalk into those marks, so you can see them easily, and, with the timing light aimed at the spinning pulley, press the trigger and watch the strobing action, as the number one cylinder fires the timing light.

Somewhere back in my mind, I recalled that I had overlooked a few small details. Let's see ... yes, the books did tell me that the vacuum advance line to the distributor must be pulled and plugged (I used a 6/32 bolt from the junk box), but wait, what's this? ... "Timing must be adjusted with the engine running at manufacturer's specified rpm. If necessary, use a tachometer to set idle rpm."

Well, I don't have a tachometer. The first thought that went through my mind was to run out and buy one, but that didn't settle well with me. But I needed to figure how many revolutions per minute that little Pinto engine was turning over, and with a fair degree of accuracy.

We've all seen the modern, automotive electronics shops, with their big engine analyzer scopes all nicely calibrated, but who among us is going to rush out and buy one of those? What I do have is a pretty fair B and K model 1461, 10 MHz, triggered oscilloscope, with eighteen calibrated sweep ranges. It seemed to me that that should work, somehow.

The problem was interesting and one that took my thinking through many phases. I began by thinking in terms of how the combustion engine works. It takes a fuel/air mixture into the cylinder on a downstroke, compresses it on the upstroke, where it begins burning the mixture by sparking the plug somewhere before top dead center.

The resultant explosion gives us the power downstroke. Finally, the cylinder on the last upstroke exhausts the by-products of burning. Our problem is to fire the plug at just the correct time on the first upstroke before top dead center and do this timing with the engine running at a specified number of revolutions per minute. The timing light flashing on the timing marks will show us the answer to the first problem, but that rpm problem must still be figured out. Remember, that cylinder fires only once for every *two* engine revolutions.

What we must do is get a good, *stationary* display of all cylinders firing on our scope, so we can measure the duration of all cylinder firings in time. With an externally triggered scope, this is a cinch. Take a clip lead and loosely couple it around the number one spark plug wire. I just use an ordinary clip lead with an alligator clip on one end. Clipping this around the plug wire gives me plenty of induced pulses to easily trigger the scope (see Photo A). Switching to external trigger, the scope will now make one sweep, from left to right across the tube, for every firing of that number one cylinder. Then, by coupling the vertical input of the scope to the high tension lead coming out of the center of the distributor in the same manner (see Photo B), your display will show the firings of all cylinders in exactly the sequence they actually are firing. In the case of the Pinto, it will be, first, number one cylinder, followed by three, four, and finally, number two. It's a simple matter to immediately see if all plugs are firing, and also to see the relative amplitude of the spark voltage to each cylinder. The vertical gain control, along with the vertical positioning control, can be used to bring the voltage peaks of all firings onto the scope face. Just remember, we are only looking at *induced* voltage through the insulation of the spark plug wire. We have not connected our scope directly to any bare wire, as the plug wires can carry well over 10,000 volts of ac. In some cases, it may help to put a 2200 Ohm resistor and .05 capacitor across the input of your scope, to dampen out much of the high frequency information we are not interested in. Some experimentation is called for with the exact values. Nothing is very critical in this department.

Years ago, I learned a remarkable thing that turned out to be a gem of knowledge, and, after having spoken to other people in electronics, was very surprised to learn how few understood this fact. Very simply stated: "Time in seconds is the reciprocal of frequency in Hertz, and frequency in Hertz is the reciprocal of time in seconds." Those of you who knew all along can smile, but those of you who didn't should read and reread that until you understand its exact meaning, because, with this little nugget of knowledge, many mysteries of the oscilloscope become child's play.

Remember, we want to measure engine revolutions in time – specifically, revolutions per minute. Because, as stated above, frequency in Hertz is the reciprocal of time in seconds. All we must do is measure, with the scope, the time for all cylinders to fire, take the reciprocal of this time in seconds to get frequency in Hertz, and then multiply by 120, thereby getting revolutions per minute. (Remember, that cylinder fires once every other revolution; therefore we must multiply by 120 rather than 60.)

If we look at a calibrated sweep oscilloscope, we see that sweep time is usually measured in milliseconds or microseconds per division on the graticule over the face of the tube. All we must do is count the number of divisions, generally centimeters, multiply by the indicated number of milliseconds or microseconds per division of the sweep time scale of the scope, and take the reciprocal to find frequency. At this point, a small calculator is an immense help, unless you like to do long division with a pencil.

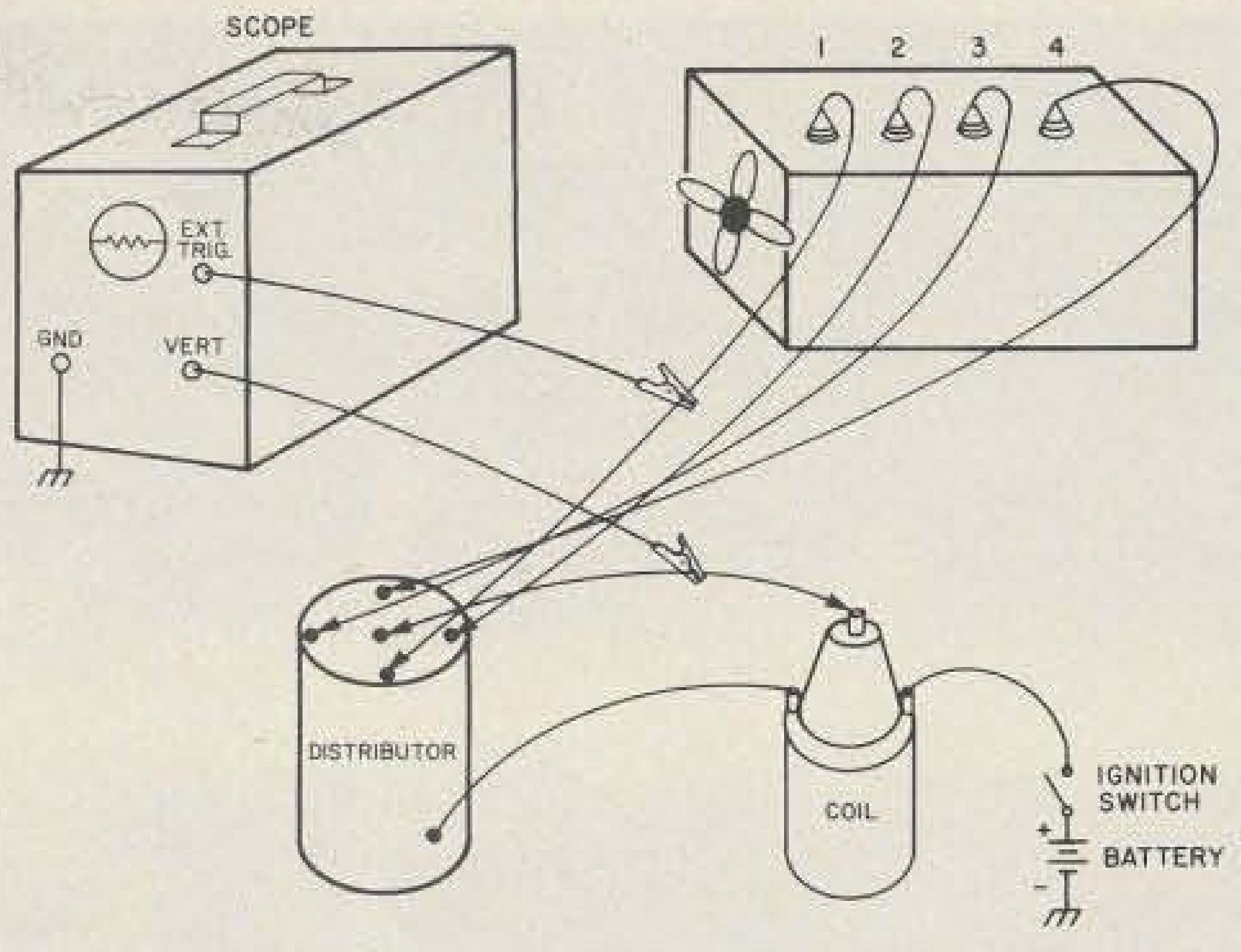


Fig. 1.

As an example, suppose we have connected our scope up as shown in Fig. 1, and we are driving a four-banger. Our sweep time is set for 5 milliseconds per centimeter. As seen in Photo C, the time between firings is 6.6 centimeters. Multiplying this by our sweep time of 5 milliseconds per centimeter, we find that time between firings is 33 milliseconds, or 132 milliseconds for four cylinders. Taking the reciprocal of 132 milliseconds and multiplying by 120 reveals our engine revolutions to be 909 revolutions per minute. For those of you who hate

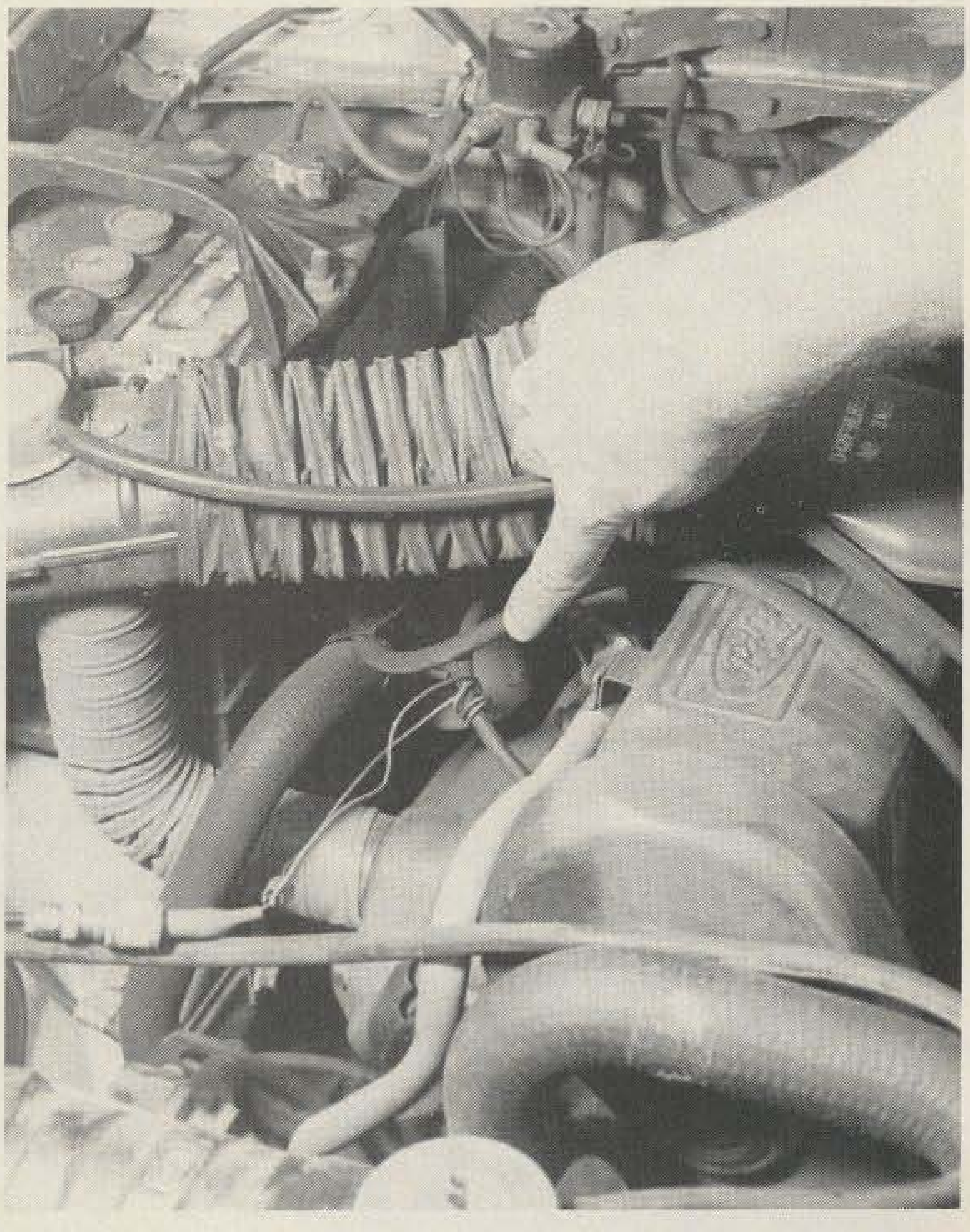


Photo B. This shows the method of obtaining the external trigger pulse from the number one cylinder. Notice that the wire is only loosely coupled around the plug wire and does not make direct connection.

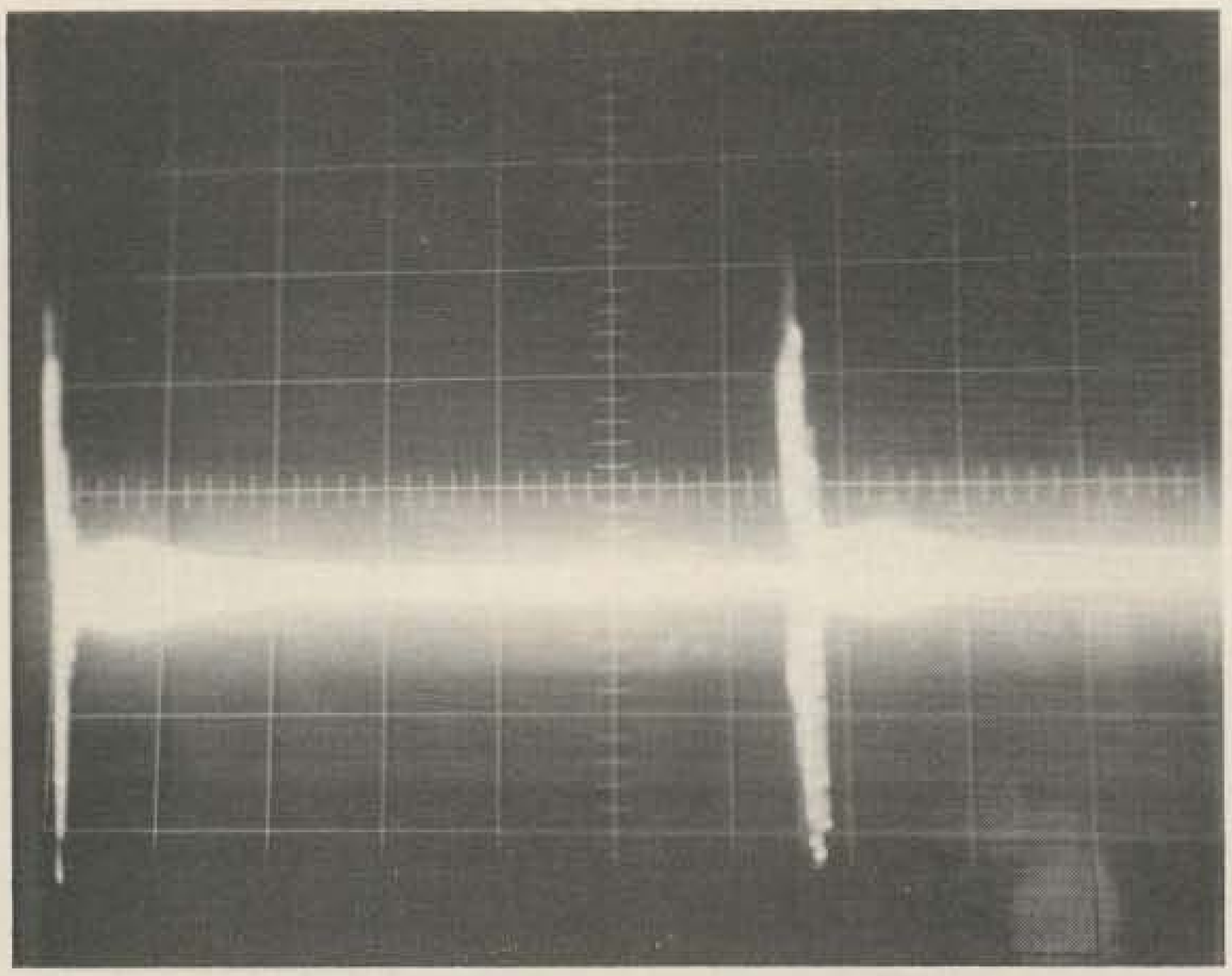


Photo C. With the sweep time of the scope set to 5 ms per centimeter, we see the time duration between two firings to be 33 milliseconds. This represents 909 rpm on a four-cylinder engine.

Engine rpm	Time for all cylinder firings in milliseconds
400	300 ms
450	266 ms
500	240 ms
550	218 ms
600	200 ms
650	185 ms
700	171 ms
750	160 ms
800	150 ms
850	141 ms
900	133 ms
950	126 ms
1000	120 ms
1050	115 ms
1100	109 ms
1150	104 ms
1200	100 ms

Fig. 2.

this kind of math, refer to Fig. 2, where I have figured out all firing times and converted them to rpm for you.

Although the scope could have been set up for a display of all four cylinder firings, I personally feel a little more accuracy is possible by using an expanded sweep and measuring the time for one cylinder firing, rather than by multiplying by the total number of cylinders. There probably isn't much difference, so it will boil down to what each individual feels most comfortable with.

To set the curb idle speed of your car, it is always best to refer to the manufacturer's specs, either in the owner's manual or in a local library, in a good automotive manual. I like *Chilton's Motor Manual* myself, and find it very complete. Generally, it's a matter of adjusting the correct screw on the carburetor. Curb idle speeds will vary, and the specs may call out different rpm for such cases as cars equipped with or without air conditioning, etc. Once the idle speed has been properly set, the timing can be adjusted with the light. This involves loosening the lock nut under the distributor and gently turning the distributor, while watching the timing marks on the front pulley in the strobing flash of the timing light. Timing will also increase or decrease the engine rpm, so you may find yourself going back and tweaking the curb idle adjust again.

A word of caution is called for here. Adjustment of engine timing and curb idle speed will affect the emissions of your car. Go slowly the first time, consult your manuals, and set your car up by the book. Don't forget to reconnect the vacuum line back onto the distributor when you are finished.

It is beyond the scope or intent of this article to go completely into electronic engine analysis and tune-up procedures. Others before me have done this with more success. All I have attempted is to introduce to you the elements of using commonly available test equipment, rather than buying specialized equipment. I have found that, with a basic single-trace, triggered scope, using calibrated sweep and a good VOM, almost any problem in the ham shack or shop can be solved with a little thinking and some understanding.

At today's prices for automotive analysis and tune-up, it won't take long before my simple equipment will pay for itself. Even if it doesn't, the satisfactions of doing it yourself, saving, and learning in the process, are the real long-term payoffs. ■

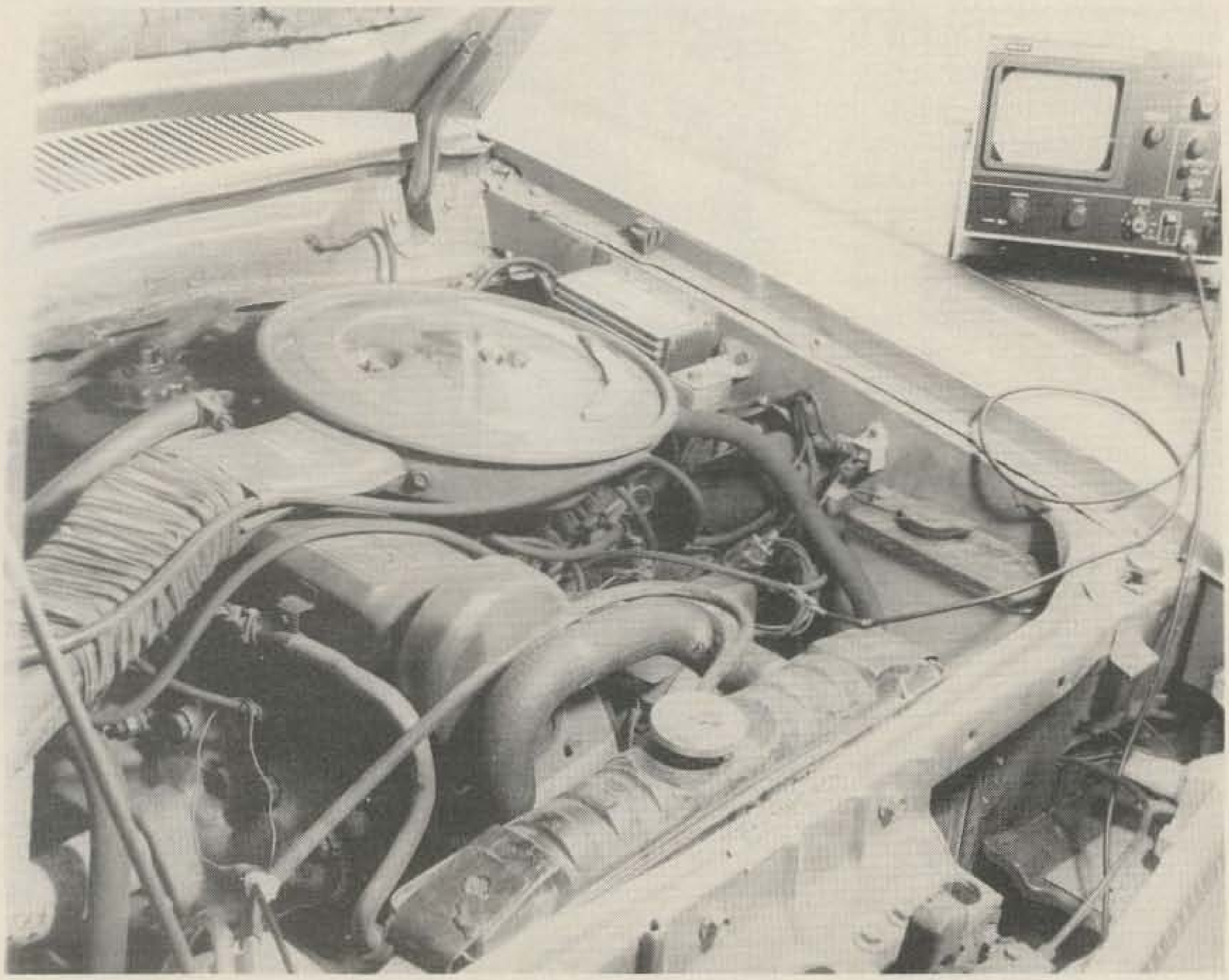


Photo D. Overall test setup used to determine the rpm of the Pinto. The ground connection of the scope is made to the bumper.

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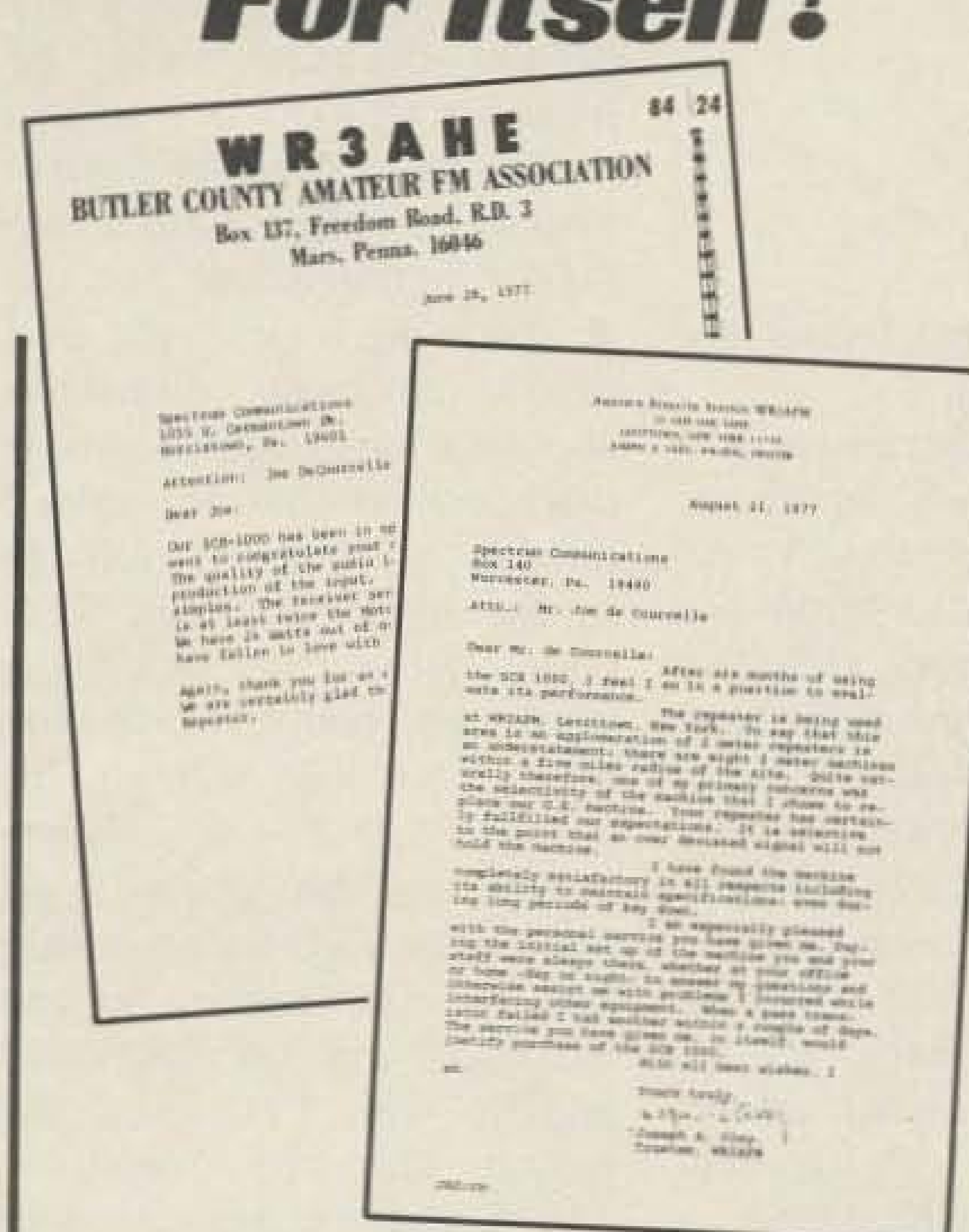

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More Repeater Control Devices

-- control unit/audio interface

Over the period of the last two or three years, I have designed, built, and installed a fairly complex control system for a system of five repeaters. Three of those repeaters are local or co-located with the primary control system, while two are remote, located from 20 to 50 miles from the primary site. Since the system is now fairly well finalized, I decided to publish it. None of what is to follow was consciously copied from any other source, but, with a project of this magnitude, there are bound to be some out there who can say, "Hey, that's my circuit." To them I offer my apologies.

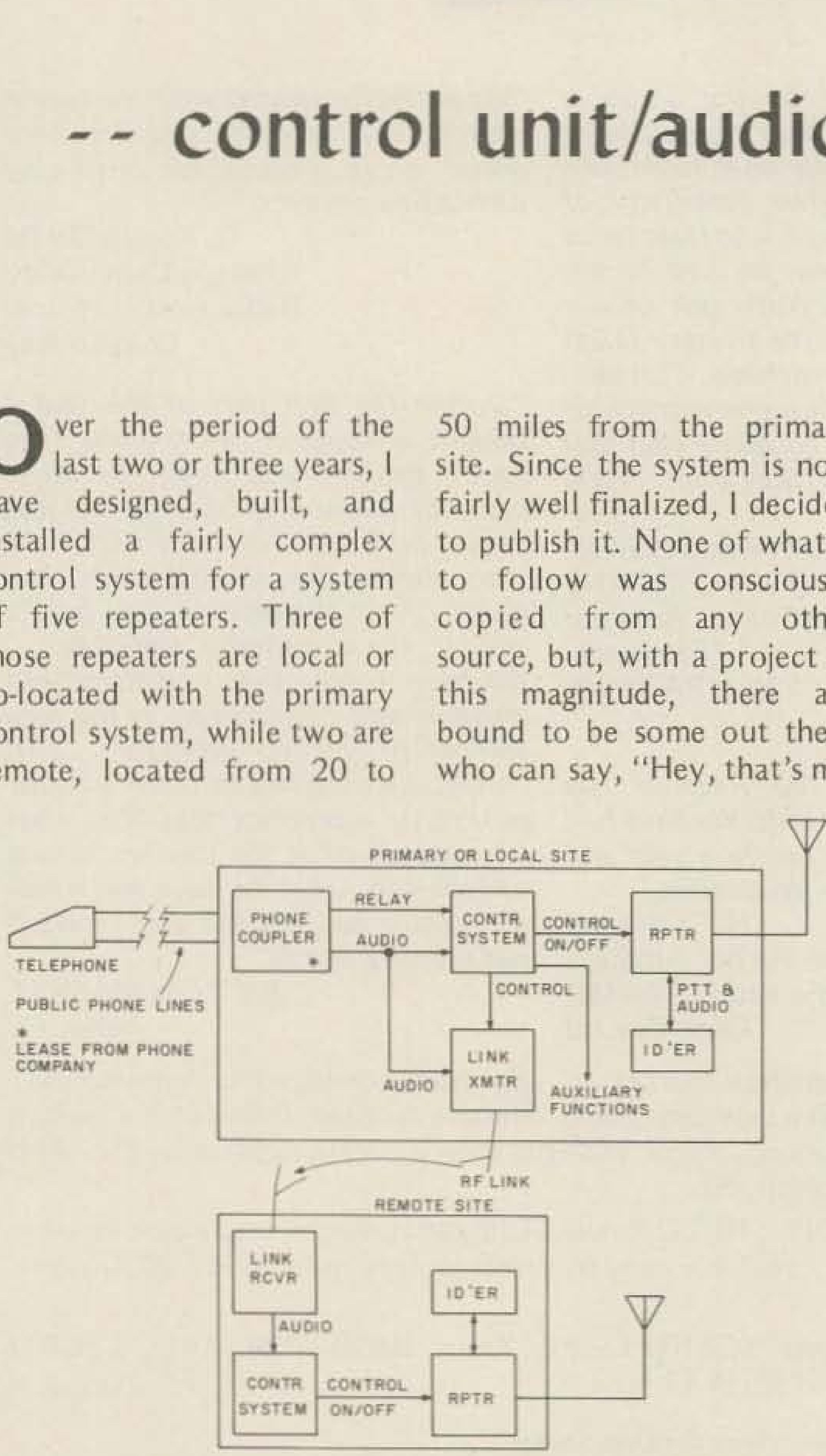

Fig. 1. Control system block diagram. Entry is via public telephone using a Ma Bell coupler. The control system then either controls the local repeater(s) directly or activates a link transmitter to relay control tones to a remote site.

The total repeater control system is shown in block diagram form in Fig. 1. All primary control functions are carried out via tone codes on public telephone lines. There is a control phone termination with a Ma Bell coupler on it. The coupler answers the line and connects the audio into the control system. It also hangs up the phone after a certain period of time. After the control phone number is dialed, a two digit control sequence is sent with touchtones™. The present equipment at the phone site has the capability of about 30 functions, but that can be changed to fit system needs.

In order to control the remote sites through the same system, one of the local control codes will turn on a 450 link transmitter and couple the telephone audio to the transmitter. Activating that code also inhibits all of the other functions at the local site while the remote is being functioned. Each of the remote sites has its own complete decoder system and its own set of control codes. The sites have a 450 receiver coupled into the control system. Under our present system, each of the remote sites has the capability of about 15 different functions, but here again, that is expandable to fit different conditions.

In addition to the control functions at each site, each has an audio interface board for the control decoder and an identifier. The identifier is a CMOS version of my original identifier circuit which appeared in the September, 1976, issue of *73*. As of this writing, the audio interface board design is not completed. I expect to complete the design in the near future. The basic theory and block diagram will be included later in this article.

The entire repeater control system is built around a two digit function code. The use of two digits was the end result of much discussion about various code lengths. It was decided that the added number of functions available or the added security afforded by more than two digits were not really worth the increase in logic complexity or cost.

The system started out entirely in TTL for economic reasons. The control at the local site was the first built and is still TTL, but the remote site equipment is CMOS and any expansion to the system will use CMOS. Only the CMOS circuitry will be discussed in this article.

Basic Control Function

The basic control function is shown in block form in Fig. 2. It consists of a tone decoder/clock generator and a function decoder. The way the system is laid out, each function decoder provides one primary function and up to four auxiliary functions. The way it works is that each function decoder module accepts a unique primary digit (i.e., a 1) and then a second digit (i.e., 2) to complete a given function. The primary function has separate two digit ON and OFF codes having the same first digit (i.e., 1-2 ON, 1-3 OFF). The auxiliary functions all have separate ON codes, but all share a common OFF code (i.e., 1-4, 1-5, 1-6, etc., ON, 1-0 all OFF). It is possible to wire the function board to provide more than one primary function, but I didn't do it that way because it used up more of the available codes. Also, although it is feasible with this scheme, I steered clear of repeating digit coding such as 1-1.

Notice, also, that I show the digit going to the function decoder module(s). The * is a master reset which shuts off all functions at a site simultaneously. The # is used as a reset function for the initial logic states simply to eliminate possible functioning of an undesired code if doing two in sequence. For example, a sequence of 1-2 - # would turn on a function and then reset the initial stages of the decode logic. An automatic reset function is also provided which performs the same function about 10 seconds after the last tone is sent. The # and automatic reset are ORed on the decoder module, and both appear on the reset line.

Due to the many different control requirements and the low drive capability of CMOS circuits, I also provided an interface module which can provide either relay or transistor outputs or both.

Audio Interface Module

The as yet unfinished audio interface module is shown in block diagram form in Fig. 3. The module will provide the wide range agc action which is so vital to proper 567 tone decoder operation plus high group/low group tone filtering, which, while not strictly a necessity, will provide for more stable, false-free decoding. At the present time, I do have agc amplifiers on all of the decoders, but I am unhappy with the sensitivity of the circuit to the parts used. I (hopefully) will have a new design done in the near future. Also, since I'm not happy with the present circuit, I haven't designed a printed circuit board as yet.

Tone Decoder Module

The tone decoder module consists of a set of 567 tone decoders, a clock generator, and a reset generator. The basic 567 tone decoder circuit is almost right out of the *Signetics Data Book*, with only a couple of component values changed. The block diagram of the module is shown in Fig. 4, and the complete schematic in Fig. 5. NE567 tone decoders have been discussed by me (*73*, April, 1976) and many other authors, so I will forego any detailed circuit description in this article. It should be remembered, however, that the 567 output goes low with the tone present and that the NOR gates on the outputs are actually functioning as AND gates.

A look at Figs. 4 and 5 will show some circuitry not included in most decoder circuitry, but which is most necessary to allow sequential decoding. Those circuits are a clock generator and a reset generator. Gate U11 forms a circuit which will provide an output whenever any column tone is present. The output of this circuit is used to drive the clock and reset pulse generators.

As you look at the clock and reset circuits, you may well ask, "Why the gates instead of monostable multivibrators (74121, 74123, 14528)?" Well, the TTL version I mentioned earlier uses 74121s, and they gave me fits with false and double triggering. The CMOS version wasn't readily available to me.

While experimenting one night, I stumbled on the cir-

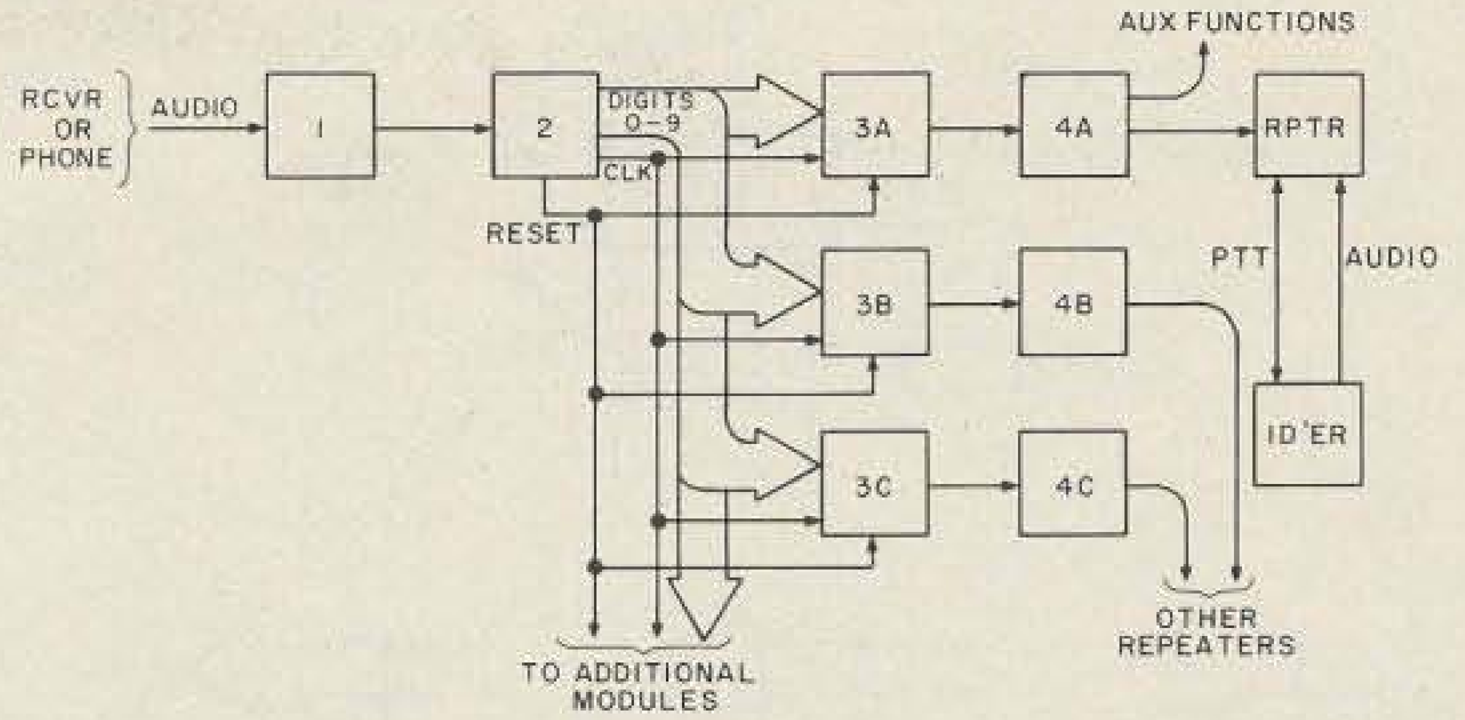

*Fig. 2. Basic control decoder block diagram. The numbers in the blocks are separate modules (1: audio interface; 2: tone decoder; 3: function decoder; 4: interface). The outputs of the tone decoder module are TTL logic levels. There is one output for each digit plus * and #. In addition, there are clock and reset pulse generator outputs. These outputs drive the function decoder module(s). The function decoder outputs, via appropriate interface module(s), control the repeater(s) and auxiliary function(s). The identifier module is a separate, independent module requiring audio and PTT to the repeater.*

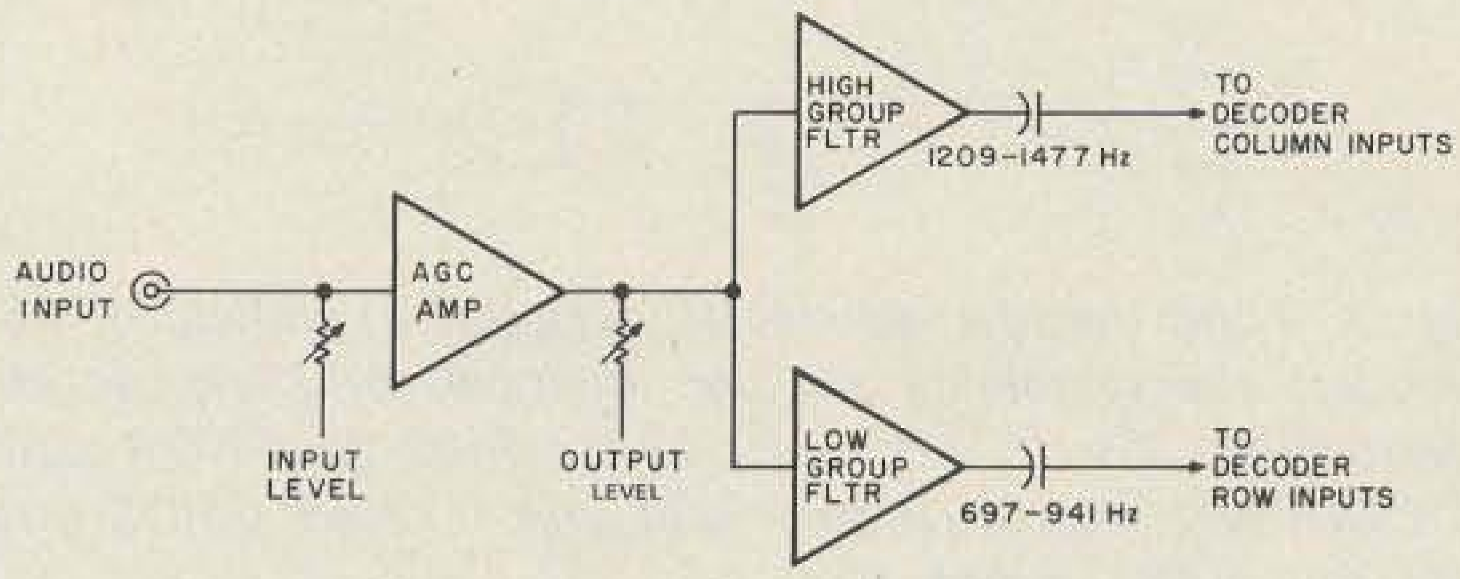

Fig. 3. Audio interface block diagram. Incoming audio passes through an agc amplifier which provides a constant output for inputs varying from about 50 mV to over 1 volt rms. The audio is then filtered into high and low tone group ranges for input to the tone decoder module.

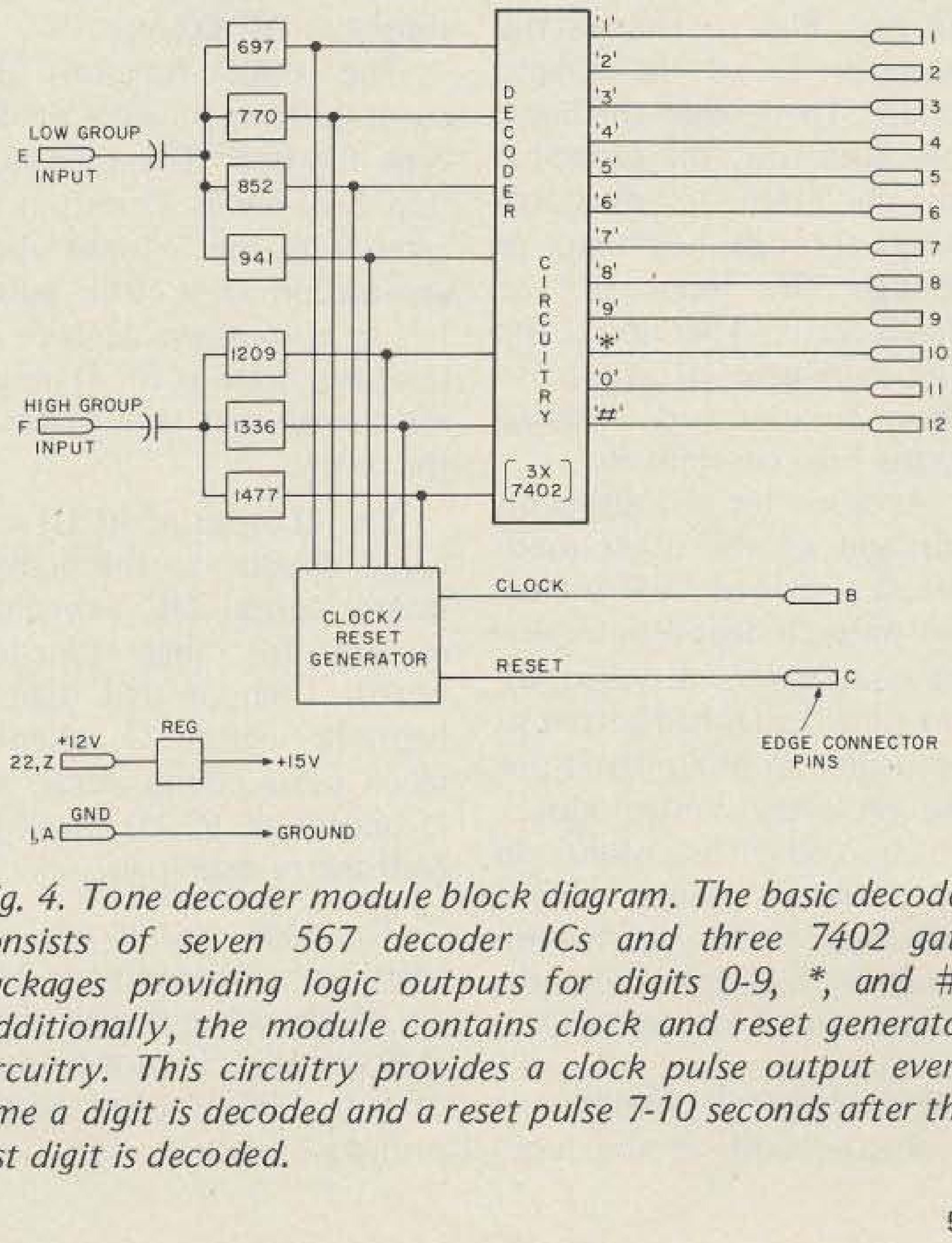

*Fig. 4. Tone decoder module block diagram. The basic decoder consists of seven 567 decoder ICs and three 7402 gate packages providing logic outputs for digits 0-9, *, and #. Additionally, the module contains clock and reset generator circuitry. This circuitry provides a clock pulse output every time a digit is decoded and a reset pulse 7-10 seconds after the last digit is decoded.*

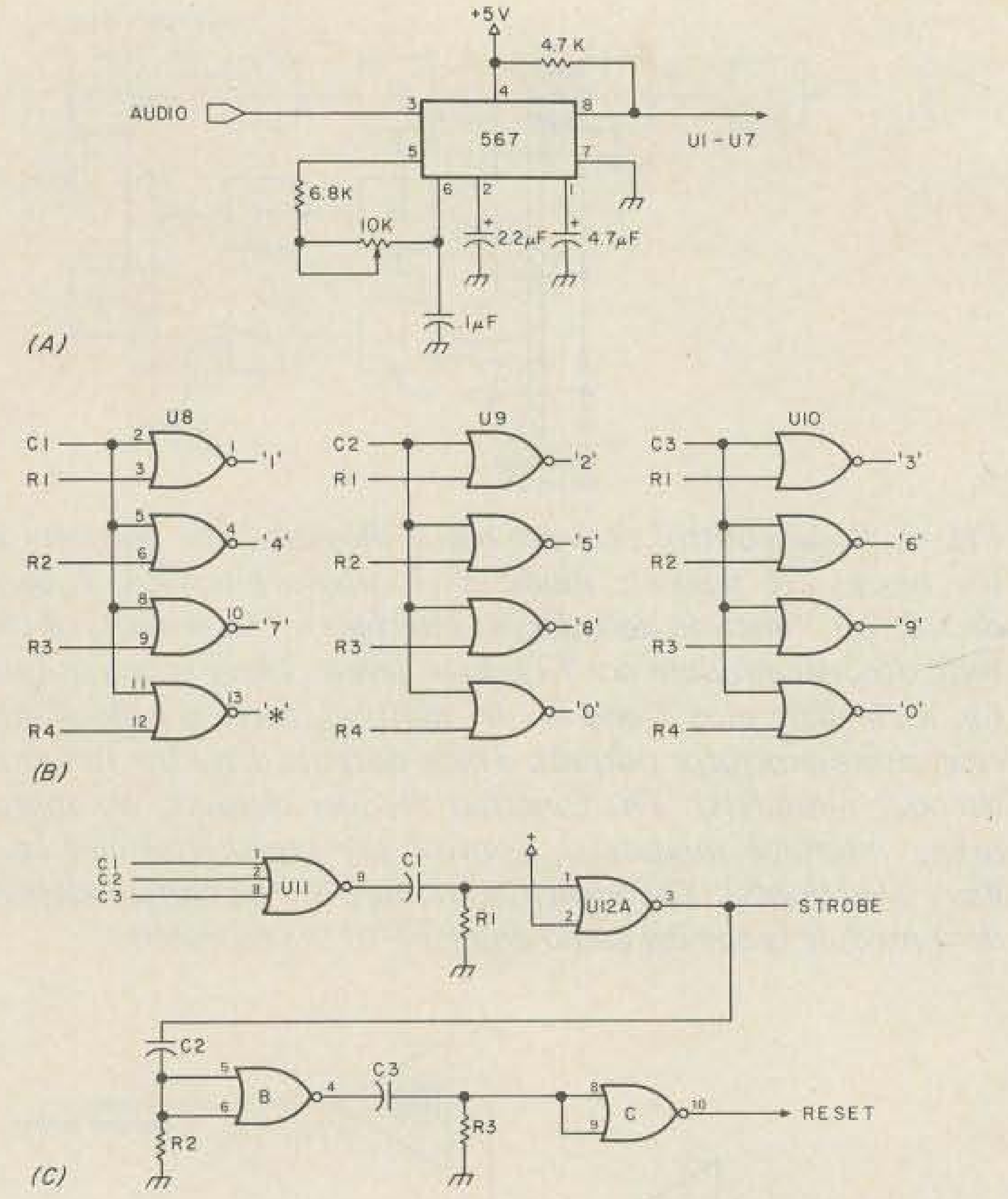

Fig. 5. Tone decoder schematic diagram. a) Individual 567 decoder; the remaining six are identical. b) Digit decoder connections. ICs U8, U9, and U10 are 7402 quad NOR gates. c) Clock and reset generator. U11 and U12 are CMOS gates 4025 and 4001, respectively.

cuit of Fig. 6, and it worked so simply and reliably that I replaced all my monostables in the CMOS designs with the gate circuit. It works in a very simple manner. When the input goes high, it charges the capacitor C to the supply voltage. Then, when the input goes back low, the capacitor has no place to discharge except through the resistor or through the input of the CMOS gate. Therefore, the output of gate U1 is a pulse whose duration is determined by the time constant RC.

As a matter of routine on this and all the other modules, I provided LED indicators on each digit output plus the reset and clock pulses. By this time, LEDs had gotten so reasonable in price that I put one on every control signal, which could be useful in determining proper circuit operation. The LEDs are driven by high gain transistor switches such as MPS6521s.

Function Decoder Module

A schematic of the function decoder module is shown in Fig. 7. Since each user would have different coding and different modules within a given system configuration, I have indicated the digits simply as D1, D2, etc.

The basic function decoder building block is the D-type flip-flop. This type flip-flop changes its Q output to agree with the D input upon application of a clock pulse. If the output was already in the same state as the D input, no change will take place in the output.

The D input of IC U1A is wired directly to the desired master digit (as explained earlier) for that function board. Then, if that digit is high (a logical 1) when a clock pulse comes along, the Q output of IC U1A will go high and remain high.

The high output of U1A then simultaneously enables all of the second digit gates (U8 and U9). The other input of gate U8C is wired to the primary function ON digit.

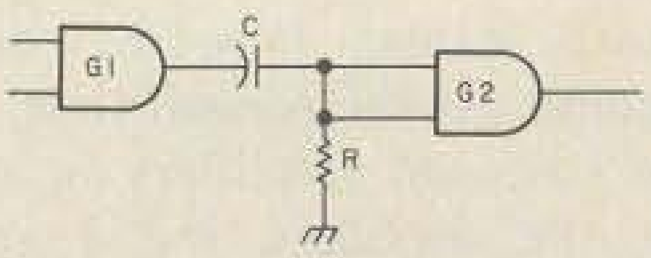

Fig. 6. Basic CMOS pulse generator. This circuit can be implemented with gates or with buffers. The one shown is a 4071 gate.

Now, assuming the master digit was sent and the ON digit is now sent, the output of U8 will go high and place a high on the D input of U1B while awaiting a clock pulse. When the clock pulse arrives, it will set the output of U1B high, thus turning on the desired function via flip-flop U2. The same clock pulse will simultaneously reset the first or master flip-flop since its D input was low during the clock pulse. About seven seconds after the last digit, a reset pulse will come along and reset U1B to a low state. This will not affect the output state.

Flip-flops U2, U3, U4, U5, and U6 are wired as set-reset flip-flops and, wired as such, provide a latching function. This function could also have been provided with cross-connected NOR or NAND gates as desired. When the high from the output of U1B is applied to the SET input of U2B, its output goes high, in turn energizing a function via the interface module. The reset input of U2B is ORed with the master reset (*) and the output of U2A which responds to the unique two digit OFF code. As a result, the function is turned off either by a two digit code or by a master reset.

The remaining auxiliary functions all activate in the same manner as the primary function and with the same first digit. The difference is in the OFF function. All of the auxiliary latch stage's resets are tied together and go to the output of U10A. They are also ORed with the master reset (*) input. With this arrangement there is one two digit code which resets all auxiliary functions at the same time, and they are also

Function	ON	OFF
Primary	6-1	6-2
Auxiliary 1	6-3	6-0
Auxiliary 2	6-4	6-0
Auxiliary 3	6-5	6-0
Auxiliary 4	6-7	6-0

Table 1. Typical function coding.

reset with the master reset. In all of the cases that I have built so far, I have used X-0 (X is the primary digit) as the auxiliary function OFF code. To make the picture a little bit more clear, refer to Table 1, which shows typical codes for a single function decoder module.

The user could alter this scheme to add more separate OFF codes, but it would be at the expense of total number of functions. For example, the F3 ON code could be wired to reset the second function instead of the common reset line.

In most cases where I have to bring a signal such as the clock onto a board and drive several devices, I have used a gate to buffer the signal before using it on the module. Also, to be on the safe side, I added buffers to each function output for more drive to the interface module. I also, as mentioned earlier, put an LED and driver on the output of each function. This proves to be an invaluable aid to both checkout and normal use. As with all the boards in this system, I provided an on-card regulator. Also, although not shown on the schematics, I put .01 uF capacitors directly across the supply pins of each device.

Interface Module

It is necessary to provide an interface between the somewhat fragile CMOS outputs and the real world of repeater controls. The circuit to be controlled might range from a Darlington transistor, requiring only microamps to operate, to a large power relay, requiring tens or hundreds of milliamps and (most probably) capable of producing a large reverse voltage spike on release. Additionally, the output might require a switch to ground, or it might require dry (floating) relay contacts.

To take care of these diverse requirements, I have used two standard interface circuits, one transistor and one relay. The schematics are shown in Fig. 8. The transistors used are power Darlingtons requiring little drive and capable of sinking six Amps. I provided a reverse diode to clamp out any reverse spikes which might appear on the line from controlling an inductive device. In the case of the transistor outputs, they are switching to ground, and I used common phone jacks for control outputs. I mounted the jacks on a small metal panel on the front of the circuit card.

The relay output uses 12 volt PC card mount relays having contacts rated at least to 2 Amps. The relays are driven by a high gain transistor such as the MPS6521 or equivalent. I used a small barrier strip to bring out the relay contacts to the front edge of the module. If multiple relay contacts are desired from one module, they will have to be brought out to the rear edge connector.

Identifier

The identifier module is an offshoot of my original TTL design which appeared in the September, 1976, issue of *73*. The main drawback of the TTL version was the current consumption — almost one Amp.

The second problem was complexity. Most of the complexity was a result of an attempt to automatically identify about three minutes after the identifier was originally keyed, without restarting the timing circuitry.

I did some research into the memories I was using and found that I could drive the address inputs with the output of a CMOS device without destroying the device. With that in mind, I redesigned the identifier using CMOS devices for the counters and data selectors, but retaining the TTL memory and 555/556-type clock. The revised circuit with all the reidentify circuitry removed is shown in Fig. 9. The programming for the memory is shown in Table 2. The basic IDer function is the same as described in my earlier article, so I won't go into much detail here.

Briefly, operation is as follows. One half of the 556 functions as a clock which is turned on and off by the action of the start-stop flip-flop made up of U4A and U4B. The output of the clock drives counter U2, which sequences data selector U3 through each of the eight memory outputs, advances the word address by one, and then repeats the output scanning operation. This sequence is repeated until 256 bits are decoded. If different length IDs are desired, a gate could be installed to decode the outputs of the counter at the desired stopping point.

Construction

I built all of my present system on 4½ by 6½ general purpose circuit cards with 44-pin edge connectors. The cards then go in a standard rack for logic cards. This type of construction makes for easy changes and lots of versatility.

As I mentioned earlier, I put metal brackets on the front edge of the cards, with jacks and controls installed

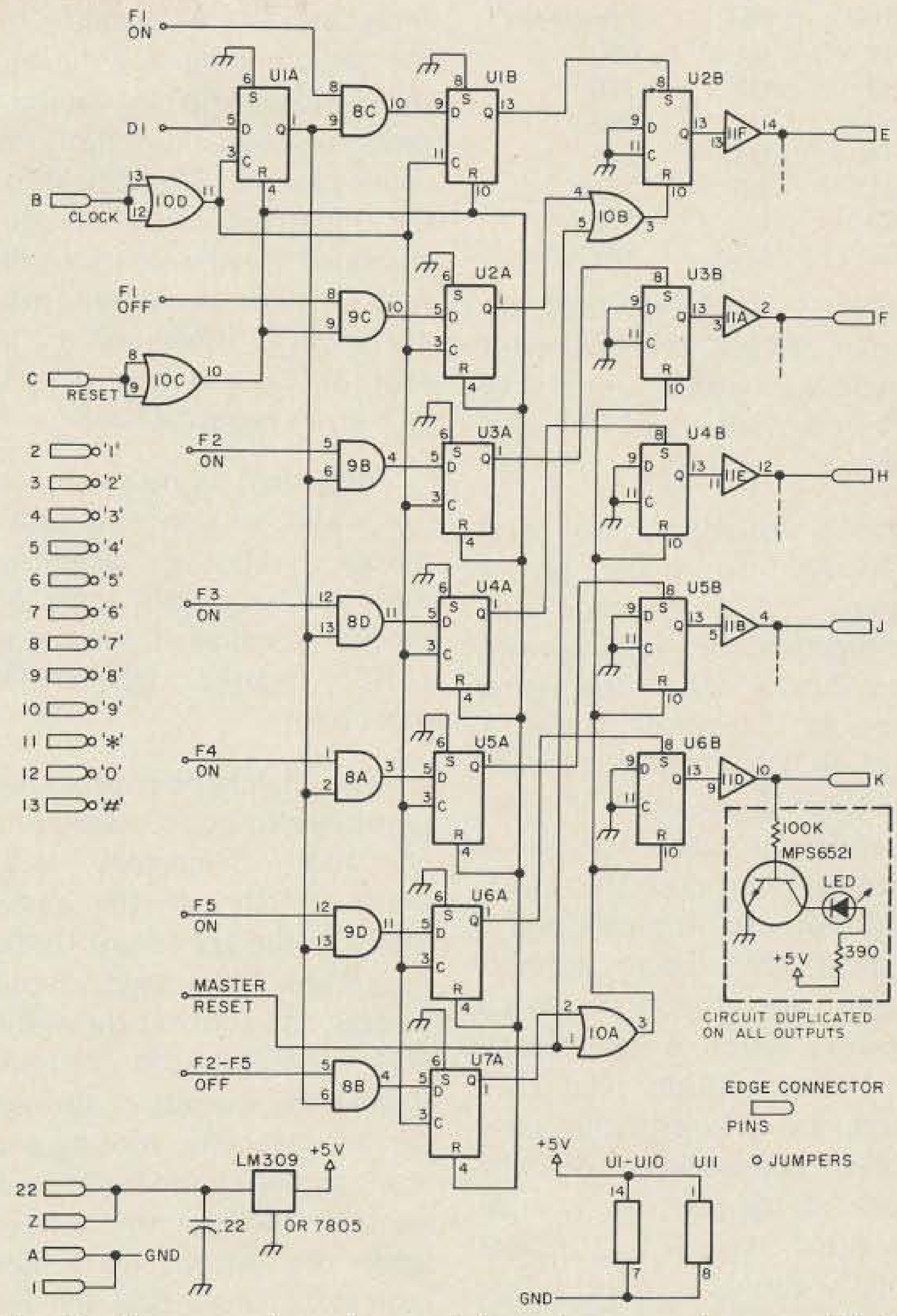

Fig. 7. Function decoder module schematic diagram. U1-U7 are 4013 CMOS dual D type flip-flops, U8 and U9 are 4071 AND gates, U10 is a 4081 OR gate, and U11 is a 4050 hex buffer. The circles on the schematic represent locations for on-board jumpers. The jumpers are for function coding.

on the brackets.

At the time of this writing, I have started printed circuit layouts on two of the system boards, and I expect to have some of the modules available by the time the article gets into print. For information on availability and pricing write to CONTACT Electronic Research and Development, 35 W. Fairmont Dr., Tempe AZ 85281.

Interconnection and operation of a set of modules as a system is greatly aided by use of a logic card rack of some kind. I tried to make the PC cards' connections such that wiring of the logic

	B0	B1	B2	B3	B4	B5	B6	B7	
01									
02	X	X	X		X		X		D
03			X						E
04		X		X	X	X		X	W
05	X	X				X		X	R
06	X	X		X				X	7
07	X	X		X	X	X		X	
08		X		X				X	A
09		X	X	X				X	
10		X		X		X			H
11		X	X	X		X		X	B
12	X								
13									
14									

Table 2. Programming sample for the CMOS identifier. Shown is the program for DE WR7AHB where an X indicates a "1" programmed in a bit position. The blanks in the first address provide start-up time for the identifier and transmitter.

R/C	567	Frequency
R1	U1	697
R2	U2	770
R3	U3	852
R4	U4	941
C1	U5	1209
C2	U6	1336
C3	U7	1477

Table 3. Table of tone decoder settings. Attach your frequency counter to pin 5 of the 567s to read the frequency.

rack wouldn't be too difficult. To make power busing easy, I made the connections on both sides of the board serve the same purpose. Terminals 1 and A are GROUND, while terminals 22 and Z are +12 V. The decoder outputs are on pins 2 through 13, and the clock and reset are on pins B and C respectively. These connections are then paralleled down a series of connectors.

Unless multiple relay contacts are desired, the only other connections on the back of the rack are a small terminal strip for power supply connection and a fuse block. I also added a 2000 uF capacitor across the supply input to the rack since the actual power source was some distance away.

Setup and Alignment

The first stage of system setup consists of deciding on the digit coding desired and then wiring the appropriate gates on each function decoder module. The PROM for the identifier must be programmed for the desired callsign. I have presented programming information in other articles, as have others, so I won't repeat it here.

Alignment is necessary on the audio and tone decoder modules. The agc amplifier input/output levels must be properly adjusted and the tone decoder frequencies must be set.

Agc alignment is easy, but requires a source of audio and an audio frequency voltmeter. First, set the audio input to the agc circuit to the maximum expected input voltage and connect the audio voltmeter to the output. Adjust the output of the agc for a convenient reading and start increasing the input level control. Increase the control until the output no longer increases. Now adjust the agc output level for the desired input to the decoder (about 150 mV rms). Now, you should be able to decrease the input from the audio source by at least one order of magnitude without the output varying.

Adjustment of the tone decoders consists of setting each 567 to its proper frequency. To be done properly, this requires a frequency counter, but it can be done with a tone pad. Power up the tone decoder module, put your counter on pin 5 of U1, and adjust the pot for a frequency of 697 Hz. In a similar manner, adjust the remaining decoders for their proper frequency. I have shown the IC numbers and frequencies in tabular form in Table 3.

Now connect the audio module and the tone decoder module together either in the logic rack or on the workbench. Here an extender board (also available from CONTACT) is a great help. Hook a touchtone generator to the audio input of the audio module and apply power to the system. Start depressing the digits on the pad. As each digit is activated, its proper LED on the tone decoder module should light, the clock LED should flash once, and, about 5-7 seconds later, the reset LED should flash.

If all of the above has progressed to a satisfactory conclusion, you are ready to plug in a function decoder module and continue testing. Once everything is connected together, sending the correct ON digits should cause the LED for that function to light, and the OFF digit should cause it to turn off.

Interface module checkout is simply a matter of seeing if the proper transistor or relay is activated when the correct function code is sent, and the proper LED on the function board is illuminated. Identifier module checkout requires either an audio amplifier or connection to your transmitter and a method of monitoring the transmitter audio. I have provided an identifier test button in the design. Every time this is pressed, the IDer will send the programmed identification and should keep the transmitter keyed through the keying transistor. The only adjustments that have to be made are the ID speed, pitch, and timeout delay.

Conclusion

A typical system configuration would consist of the following modules: audio, tone decoder, function

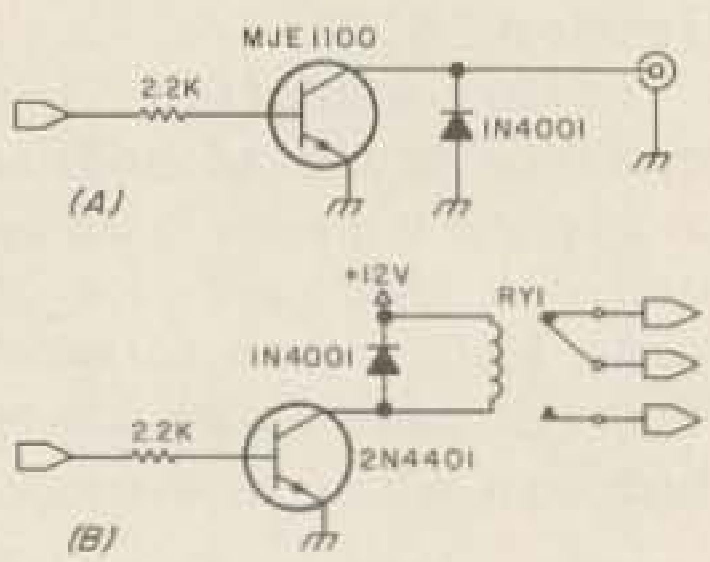

Fig. 8. Interface module schematics. a) Transistor switch. The transistor used should be a high gain one. In my case, I used MJE1100s. b) Relay output circuit. The relay driver must be a fairly high gain transistor. I normally use an MPS6521 for this type of application. The relays are PC mount with at least 2 Amp contacts. The module provides the option of using either 5 or 12 volt relays by either installing or bypassing a five volt regulator.

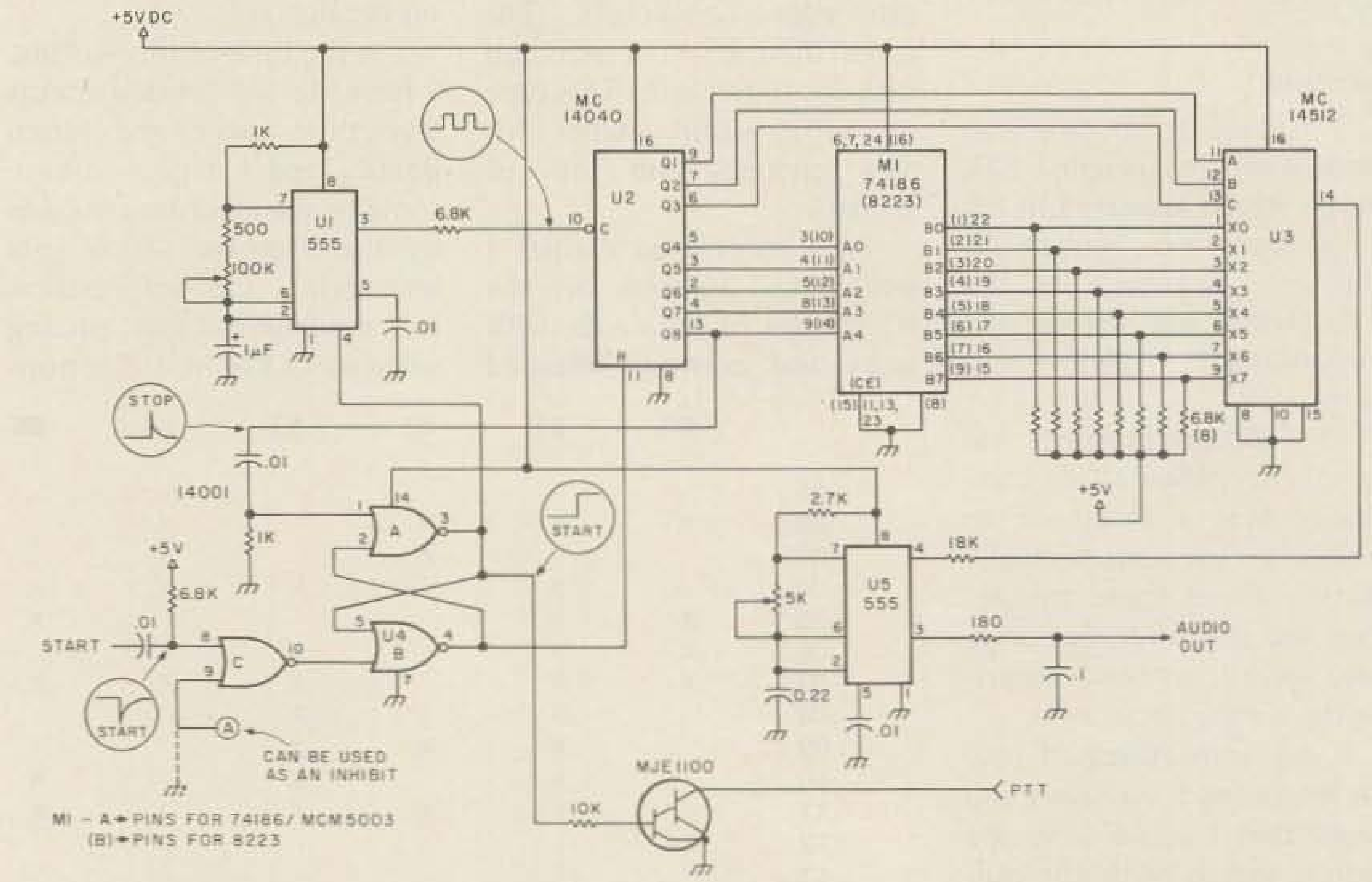

Fig. 9. CMOS identifier module schematic. The circuit is the same as my earlier article, but now in CMOS and without the automatic reidentify feature. M1 is an 8223 programmable read only memory. If more than one message or a longer one is desired, a 74186 memory could be used with appropriate wiring changes.

decoder (2), interface (2), and identifier. Addition of a COR/timer module such as laid out in my article in the January, 1977, issue of *73* would make a complete repeater control system.

I have had very good luck with this system. The only problems I have encountered were mostly my own fault. Don't use ceramic-type capacitors for the tone determining capacitors on the tone decoder module. I found out the hard way that they drift badly with temperature. I had some initial trouble with clock timing when I first went to CMOS on the function decoders, but the delay I mentioned earlier appears to have solved that problem. I got completely wiped out on a remote site once by lightning causing a surge on the power line and wiping out a lot of devices. I have since added various kinds of lightning protection on all of the sites, but I don't really know if it will be effective.

Use of this system requires a method of sending tone signals down the phone line after the line is connected at the receiving end. In some instances we have controlled our repeaters with an acoustically-coupled tone encoder, but it was not completely satisfactory. A touchtone phone is the key, but there is even a problem there. In many exchanges, Ma Bell reverses the phone line polarity when the answering connection is made, and this shuts off the tone pad in your phone so you can't send tones down the line. The answer to this problem is a little gadget the phone company will install on your phone called "polarity guard." There is no charge for the gadget itself as far as I know, but naturally it will cost you a service charge to have the thing installed.

Again, I am trying to make a complete system of module circuit boards available, but it is a slow process. If you are interested, write to CONTACT as mentioned earlier. If you decide to put one of these systems together and have any trouble, please feel free to contact me. The only thing I ask is that you include an SASE. ■

Parts List

Tone Decoder

U1-U7	NE567	7 — 2.2 uF/15 V electrolytic
U8, 9, 10	7402	7 — 4.7 uF/15 V
U11	7410	7 — .1 uF mylar
U12	4001	7 — 4.7k ¼ W
	1 - 7805	7 — 6.8k ¼ W
		7 — 10k pot

Function Decoder

U1-U7	4013	5 — MPS6521 or equiv.
U8, U9	4081	5 — LED
U10	4071	5 — 100k ¼ W
U11	4050	1 — .22 uF

Interface Boards

One of the following per controlled circuit:
MJE1100 or 2N4401
1N4001
2.2k ¼ W
12 volt relay

Identifier

U1	555 timer	1 — MJE1100	1 — 500 ¼ W
U2	4040	2 — 1k ¼ W	1 — 100k pot
U3	4512	10 — 6.8k ¼ W	1 — 5k pot
U4	4001	1 — 2.7k ¼ W	4 — .01 uF
U5	555	1 — 18k ¼ W	1 — .22 uF
M1	8223/82S23	1 — 180 ¼ W	1 — .1 uF

New Products

from page 25

amateur. It was called the FM-21, originally marketed as a six-channel radio that had twelve-channel expandability and the rather novel feature of requiring but one crystal per channel. The FM-21 has since given way to a "kissin'-country-cousin" of the two meter MK-3, the 220 MHz FM-76. Other than coverage and power output, the two radios appear to be twins. I can personally vouch for the FM-76, since one is mounted in my car and is in use daily. For better than six months, it has performed without a flaw, and, due to my life-style, I really give any mobile installation a real workout.

The FM-76 has something else going for it. As most of you are aware, the selection of 220 MHz amateur equipment is still quite limited, and if you are going to build a repeater, you have but two choices. Either you build it from scratch or you start with a good radio and build from there. Nobody has a tally, but there are many successful 220 MHz repeaters out there that got started as an FM-76. I know of at least one remote-base using an FM-76 as a 220 downlink as well. Repeater and remote-base service take a lot from any radio, and in that department, the FM-76 seems to excel.

There is more to this story, though, than radios. Very important is what does an amateur do when his radio decides to do things it's not supposed to do? Fact is, not every amateur is an rf or digital expert. When a radio decides to "go west," where do you turn? If you are lucky enough to own a Clegg radio, you simply mail it back (or drive over if you are not too far away) to Clegg Communications, and, in a few days, it's back in your hands working properly. In fact, when we drove out to Lancaster to do this story, we took with us Lou Belsky K2VMR's FM-27B. Three days later, Lou had his radio back in his car and on the air. This includes the time it spent going UPS back to Queens NY. Clegg believes that product support after sale is important and strives to supply the best in the shortest possible time. No matter where you live, if you have a way of getting your radio to Clegg, Clegg will make it play, doing so at a price that won't bankrupt you.

Clegg sells only "factory direct," and this has been the key to holding the price to where we, the amateur consumer, can afford his goodies. His current facility in Lancaster is well stocked for quick delivery and good, fast after-sale product support and service. Also available are accessories such as power supplies for base station use, antennas, and many other items we amateurs need. Soon, possibly before you read this, Ed hopes to be moving into even larger quarters that will enable him to expand his ability to meet our needs.

By listening to his peers in the amateur community, by looking ahead and being willing to "take a chance," by having something available for every VHF-interested amateur in every price range, Edward T. Clegg has become almost a legend in his own time. He's a ham who cares about amateur radio, an active amateur who keeps in tune with the needs that we have and endeavors to fill them. Moreover, as I can personally attest, he is a human being who cares a lot about his fellow man. Those of you who know him, know of what I speak; those who have never met Ed have missed something special. I sincerely hope that one of these days you have the chance I have had.

Ed Clegg pioneered VHF at a time when such was not really fashionable; he was there when it started and is still here today. There are many of us who hope that the "Man and his Radios" will be here for many years to come. Yes, I'm sold on Clegg equipment. Why not? I've owned a lot of it over the years and never once have I been dissatisfied. And I know many others who feel the same way.

Bill Pasternak WA6ITF
Newhall CA

Ham Help

I need information and a schematic on converting the Motorola T43A series of VHF transceivers. Keep up the good work on a fine magazine.

Billy L. Nielsen WB4APC
Rt. 2, Box 253E
Radcliff KY 40160

Help! To get on CW, I need a schematic and alignment info on a Gonset G-76 AM-CW transceiver.

Don Patterson WA1FXK/2
Box 123, 773 RADS
Montauk AFS NY 11954

Do you know of any persons or clubs that are into classroom instructions in my area? I would like to get some help and get my license.

Medardo Cruz
4911 Ave. I
Brooklyn NY 11234

I wonder if any of your readers can tell me where I might purchase DC4 silicone grease?

Neil Johnson W2OLU
74 Pine Tree Lane
Tappan NY 10983

Alexander MacLean WA2SUT/NNN0ZVB
18 Indian Spring Trail
Denville NJ 07834

How Do You Use ICs?

-- part VIII

Recently I was asked to try to unscramble a little circuit that appeared in another magazine.[1]

I didn't have all the parts needed to make the circuit, but I was able to come up with some suggestions for the correspondent, and immediately sent for the materials to build the circuit – just to make sure.

It struck me that this simple little circuit is a good demonstration of circuit function and analysis.

The circuit is an LED blinky circuit. All it does is turn two LEDs on and off alternately at a slow rate that can be seen by the eye. However, within that simple operation is the ability to show the operation of digital circuitry visually.

As a secondary benefit, you finally get to sit down and build a real live IC project, although perhaps it's not the most spectacular.

Let's take it from the beginning, the circuit analysis leading to the fault in the original circuit.

Fig. 1 is the circuit as it originally appeared.[2] You can read the circuit the way it is drawn – it is simple enough – but it will be easier if the circuit is redrawn so that the IC sections are shown individually.

This is shown in Fig. 2. The circuit uses the SN7400 IC, which has been described in a previous part of this series.

This is a four section IC. The redrawn circuit shows that two sections are not even in the circuit. They are grounded out.

That's one way to simplify a circuit. Now, for the problem. When the circuit was built as it was shown, it did not work. This was because the circuit is not correct. It is a simple defect, but let's go over the circuit closely.

The basic technical description in the original article described the circuit as a multivibrator. This is a switching oscillator. The LEDs show this operation visually. Obviously, if you build the circuit and the lights don't blink, it means the circuit doesn't work. The object in this case is to make the lights blink. That's why you built it in the first place.

However, the lights blinking is the result of circuit operation. We have eliminated two sections of the IC which are not even part of the circuit – let's cut out a bit more.

The blinky part of the IC circuit is the two remaining IC sections and the LEDs. We can see that the LEDs don't blink; what we want to know is why.

The circuit can be further divided into three main functions, any one of which could cause the malfunction.

In order to work properly, the circuit must get the correct voltage, the oscillator circuit must function, and the LED indicating circuit must function.

No work, no blinky. Now comes the easy part. You have to start troubleshooting. How do you go about it?

The voltage to an IC circuit is easy to check. In an unknown circuit, the first thing to check is the pin connections. If the Vcc and the ground pin are correctly drawn and wired, then you measure the source voltage.

If the voltage to the device terminals is within the correct range, you can eliminate it as a possible cause in a simple circuit like this. There are circuits where pulses on the voltage bus can cause mind-boggling troubles, but they won't cut off a simple circuit.

That leaves two elements. The oscillator supplies the signal that lights the LEDs, but the only function the LEDs have is as indicators. They are not part of the oscillator circuit.

In this circuit the voltage is correct, so we are left with two possible troubles. Either the LED indicator circuitry is not correct, or the oscillator is not correct.

There is not much choice, really. The first thing you have to know is if the oscillator is working. Then you can worry about the LEDs.

Now then, if the LEDs aren't going to tell you if the circuit works, what is? Let's look at the circuit again to see exactly what we are playing with.

The oscillator circuit has been redrawn in Fig. 3 without the extra section and the LEDs. We are left with the basic multivibrator.

This we have seen before. In the article dealing with the crystal oscillators, it was pointed out that they were actually not an oscillator at

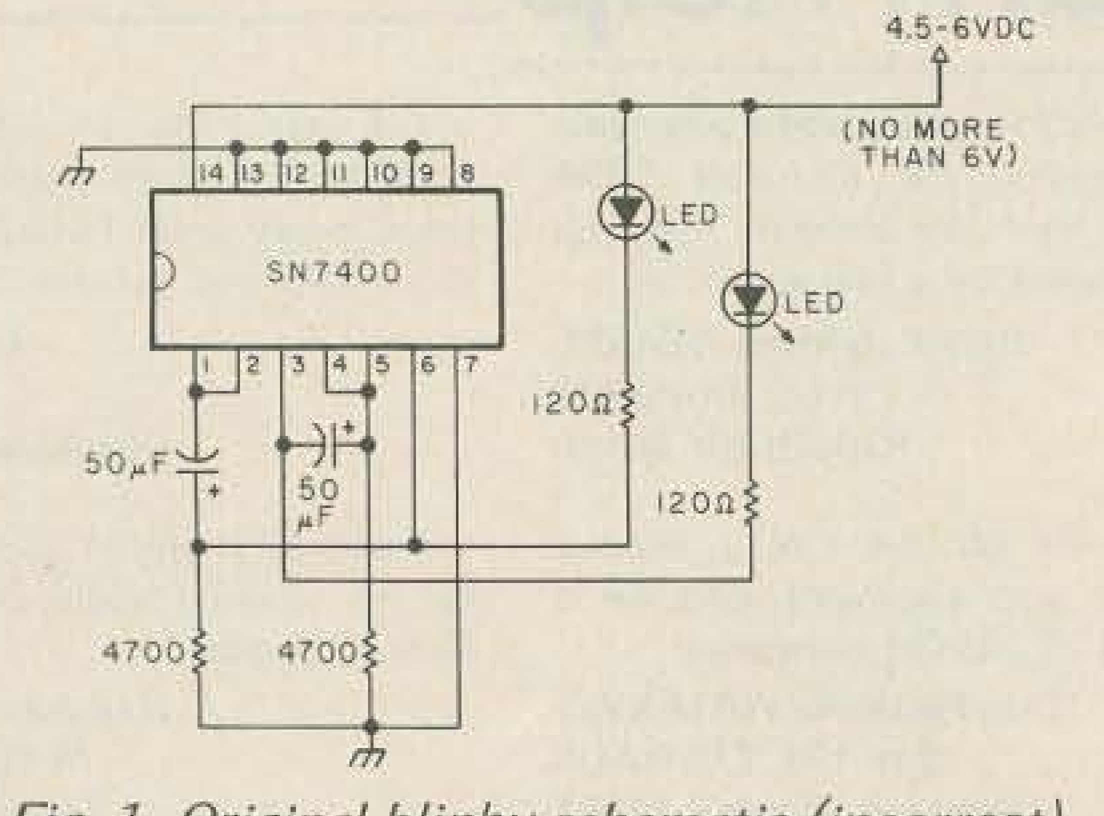

Fig. 1. Original blinky schematic (incorrect).

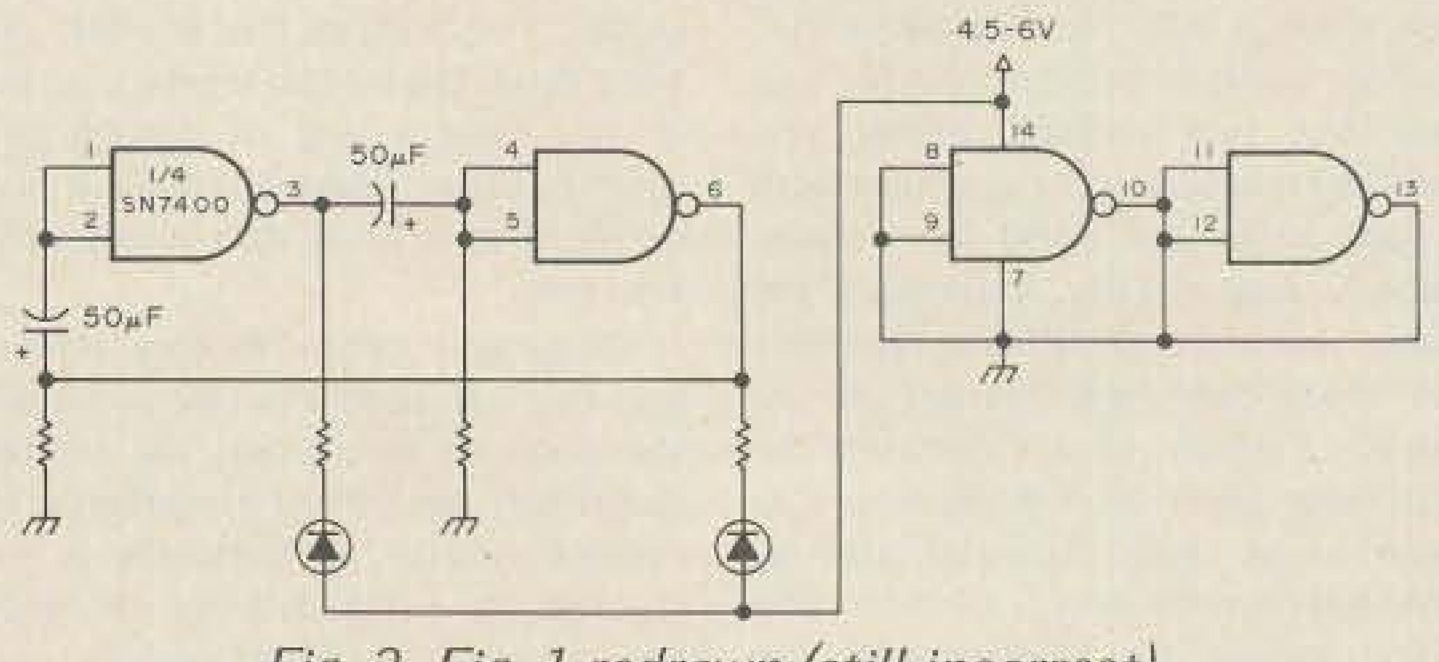

Fig. 2. Fig. 1 redrawn (still incorrect).

all, but a form of IC multivibrator circuit whose frequency of operation was determined by the crystal.

This circuit is an old friend. If you remember the basic configuration of the other circuits, the problem with this one should stand out from the page as you look at it now.

You have three basic fault choices. The IC could be defective, the parts values could be wrong or they could be defective, or the circuit could be wrong.

One of the first things that comes to mind when looking at an IC multivibrator is that normally both sections are symmetrical. Does that look symmetrical to you? That was the trouble. The circuit was incorrect. It didn't work, but how do you test it?

You test it with another indicating device. The thing to keep in mind is what it is indicating. A digital IC is a switch. It's on or it's off. In this case, it is supposed to be on and off consecutively.

As this is an oscillator, it must have a frequency. The frequency determines the test equipment to show its operation.

Here we have an awkward situation. It is supposed to flip-flop slowly enough for your eye to see the blinks. This might be a bit fast for a meter and a bit slow for a scope to really show the waveform.

When I built the test circuit (Fig. 4), I changed the values of the circuit constants. I used 2200 Ohm resistors and 0.1 uF capacitors. This raised the frequency high enough for the scope to really show the waveform.

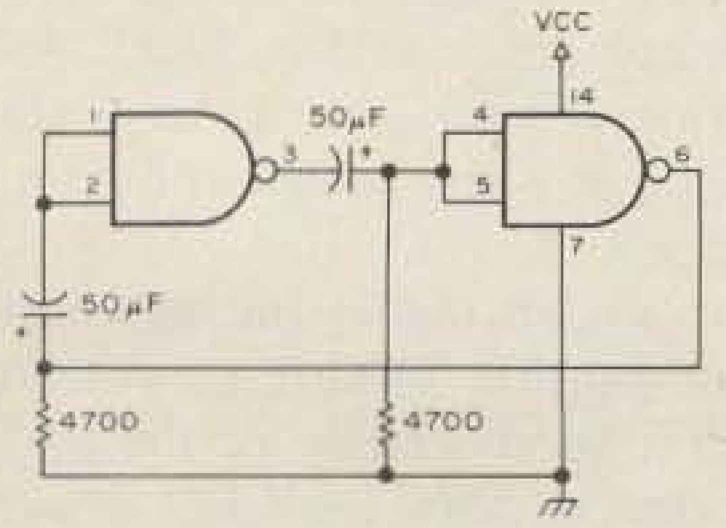

Fig. 3. Simplified circuit (Fig. 1).

Once the circuit was hooked up right, it took off the first time. Then other values were tried while it was on the scope.

It also worked with 0.01 uF caps in the circuit. This raised the frequency even higher. Now, the basic multivibrator is a symmetrical circuit. Electronically, both pulses are identical in shape and duration. It is possible to vary that to an extent.

Just to see what it looked like, one of the capacitors was made 0.1 uF and the other was made 0.01 uF. This resulted in a nonsymmetrical waveshape. One of the pulses was most definitely a different width than the other.

There is a limit to how far you can bend the circuit before it stops working, but if you have a scope, try a few different combinations to see what it looks like once you get the basic circuit working.

These values result in a switching circuit which is great for a scope but far too fast to see visually. To get back to the original idea, much larger values are used to get a lower frequency.

It is the combination of the resistor and the capacitor in each leg of the circuit which determines the frequency. Within reasonable limits, there is a wide range of combinations that can be used.

The original article suggested that no higher than 4700 Ohms be used, because it would affect the bias too much. 2200 Ohms was the highest on hand, and the 50 uF capacitors called for gave a frequency that blinked too fast. The LEDs looked like they were on continuously. The 100 uF caps slowed it down so that the blinking showed fairly clearly.

Now then, without the LEDs, how do you tell if the circuit works? First of all, it showed on the scope, but instead of seeing the familiar square wave, you got the trace being deflected at a slow rate.

What if you don't have a scope? That's simple, too. Stay with the switch action. There is a dc voltage at the output of each IC section of the multivibrator. Here the trick is making the meter show it.

In this case, you don't want a fast frequency, so start with the slow speed constants. If you have to substitute, you may come up with an inconveniently high frequency, but you still want to know if the circuit works.

If you do have a nice low frequency, you can prove circuit operation with the dc scale of your VOM or VTVM. The meter may not read correctly, but you will see the needle fluctuate up and down as the circuit switches on and off.

If you can get that, you know the circuit works. Make this test carefully. The needle may not follow the variations well, and if the frequency is too high, it will just quiver. It still tells you the circuit works, but it's really not too good for the meter – so keep an eye on it and get off fast.

If you can actually see a back and forth meter pulse rather than a fast quiver, it is a good indication that you have a nice blinking rate.

Of course, this would be the ideal situation in which to use a logic probe if you happen to have one. It will tell you immediately if the circuit is switching, and you won't have to fuss about frequency at first.

When the circuit works, you can add the indicator. In the original circuit, the LEDs went between the output and the Vcc pin. That's a bit redundant. You only need one source to light the LED. That way, it was relying on reverse biasing to turn the LED on and off.

When the test circuit was made, the LED was put between the IC stage output and ground. Thus, it was switched on when the IC section was in its high or "on" state.

Schematic symbols are nice, but if you really want to know which way is up on the LED, take one and its resistor and connect it between the Vcc pin and circuit ground. If it lights, you're OK; if not, reverse the diode. If it still doesn't light, it may be defective – try another LED.

Don't forget those resistors. As with the LED readouts, they are current-limiting resistors and just as necessary to prevent damage to the single LED. The value isn't too critical. 150 Ohms would be the smallest you would want to use; I prefer 220 or higher. If you want to be fancy, measure the actual current drawn to get the value you want.

Don't forget what you have here. The IC multivibrator is the operative part of the circuit. The LEDs merely indicate the operation visually.

The circuit constants are chosen to have a speed of operation that the eye can follow. It should be slow enough that you can easily see each LED go on and off alternately. When one looks on, the other should look off. At the least, it should show

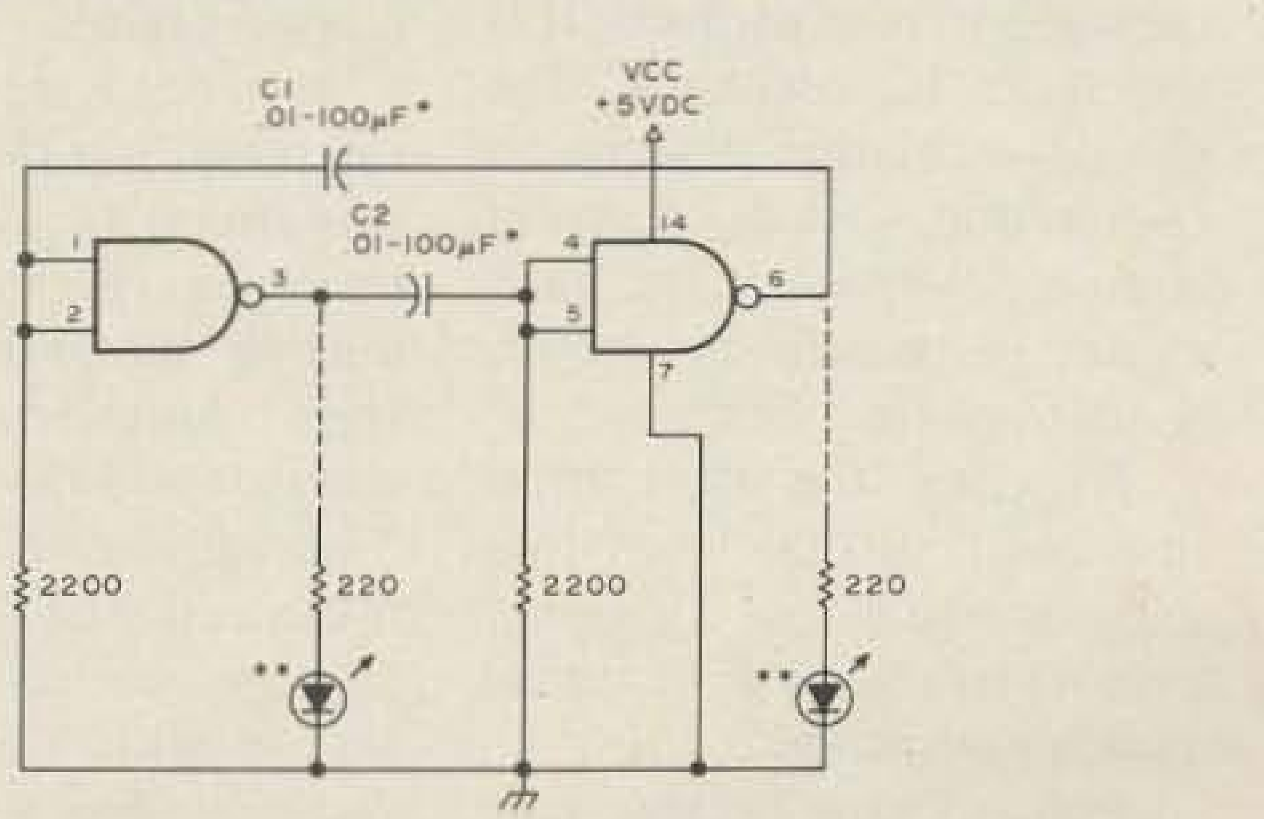

*Fig. 4. Correct multivibrator configuration test circuit. *C1, C2: both of same value. **Optional LED low speed indicators.*

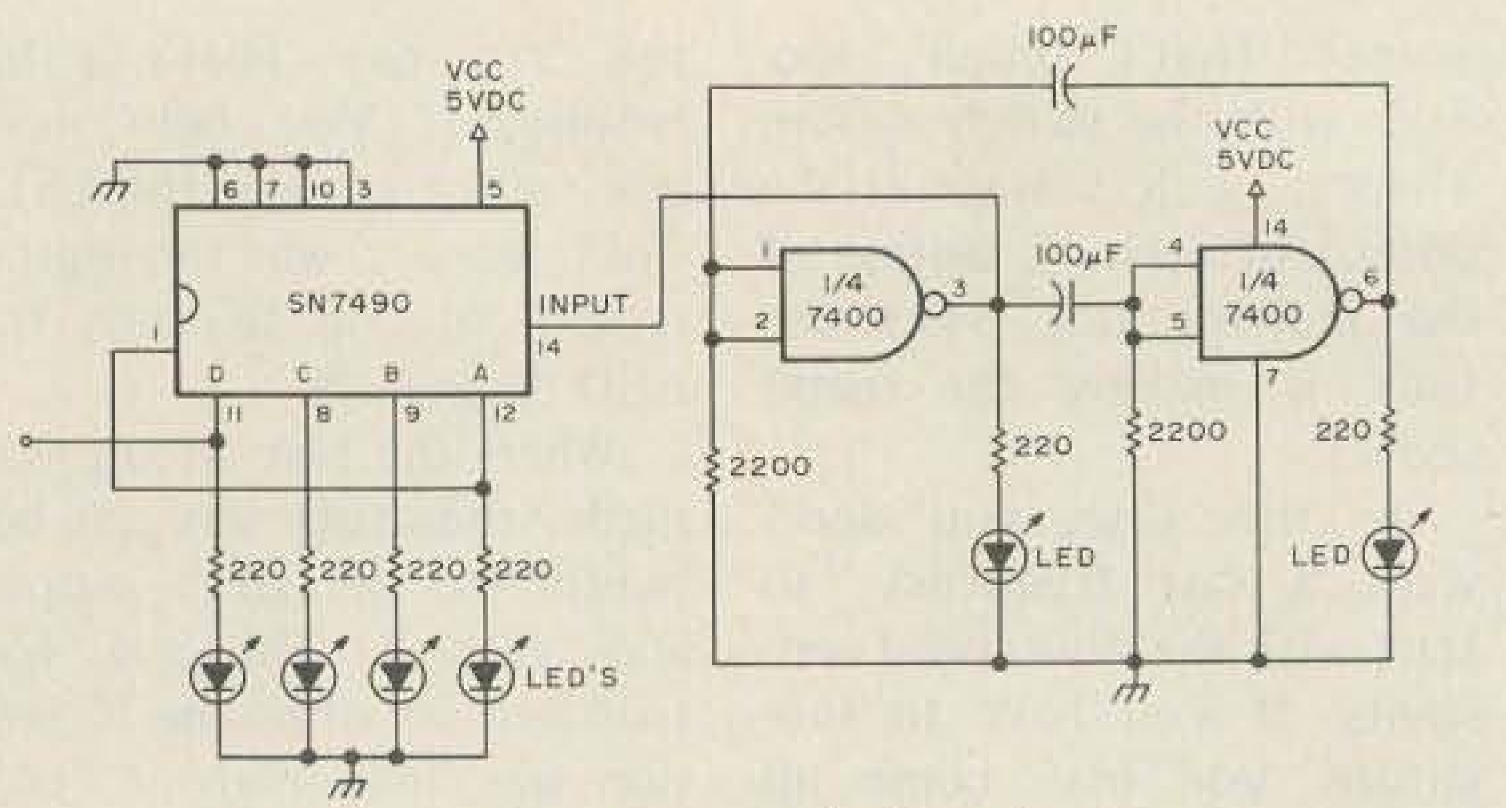

Fig. 5. Basic binary display circuit.

to show.

One other thing should be mentioned. These ICs are negative edge triggered. It can be confusing at first to see that when the LED lights up at the input to the 7490, nothing happens. It doesn't pulse until the LED goes out on the negative part of the pulse.

Your eye will get used to it in a while, particularly if you understand or explain the circuit timing and what the pulses are doing.

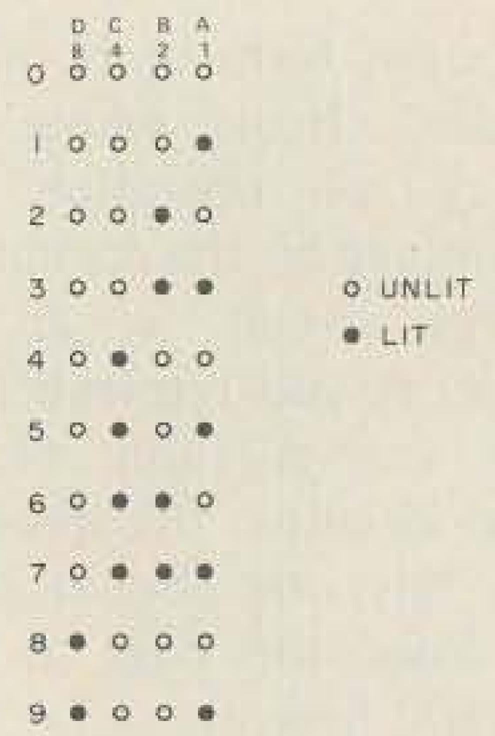

Fig. 6. Binary chart.

an alternating action, blinking back and forth.

There is another, most interesting, way of looking at what we have here. This little blinky circuit is showing us the high and low state of each section of the working part of the IC.

Since that is all that a digital IC is supposed to do — switch between two states — we can see all that it does right before our eyes.

To carry this a little further, if the speed of the switching operation is set at a speed that the eye is capable of following, much of the electronic operation of any digital circuit can be presented visually.

Even with a more complex circuit, it permits a visual understanding of the actual workings of a digital circuit that would be unobtainable easily by any other means.

This opens up a rather wide range of circuit possibilities that can be used to further your own understanding of circuit operation or as a teaching aid to demonstrate IC basics to others.

For example, the IC multivibrator circuit is quite common in ham projects. It is the basic IC oscillator. The choice of circuitry determines its function, such as crystal or audio or whatever. The basic circuit is much the same, apart from frequency.

Probably the next most important digital functions are frequency dividing/counting and circuit switching (gating).

One of the hottest ham projects going is the frequency counter. These IC functions are the main meat of the IC counter.

Fig. 5 shows a beginning application of the test demonstrator. Starting with our original blinky, which should be slow enough to see, we add an SN7490 decade counter IC. This is the basic counter circuit hooked up to show the counting action by displaying the outputs.

The second IC is hooked up to show its binary outputs. This is the whole key to the IC's ability to provide a coded output that can be translated into numbers.

This should be slow enough that the viewer can actually see the binary numbers in lights, and watch the combinations change visually with each pulse. With the explanation of the binary number system and perhaps a chart, a viewer will soon get a feel for the numbers as they change.

There you have two basic IC functions: the initial switching action and the counting action.

There are a few other points about this circuit. It may still be a bit fast when you are watching the binary numbers blink.

It is not hard to get a feel for them, but if you are using this circuit for demonstration purposes, you might consider putting in another 7490 IC stage between the multivibrator and the LED display. That will slow it down so that it can easily be followed.

You can have both 7490s set up with LEDs to give a fast/slow display. There are a lot of possible options, depending upon what you want to show.

Fig. 6 is a chart of how the LEDs will display the binary coded numbers. It takes only a short while to master it, and then it should be easy to "read" it.

Remember that it reads from right to left, each position adding to the next. There are four positions used, corresponding to 8, 4, 2, and 1. The lit positions are added together to get the total, which is the number that is counted.

Now you see what a handy little gadget the decoder/driver IC really is. It does all the work of translating the binary data to a form that can be displayed as an immediately recognizable number by the LED readout IC.

So far we can flip-flop and we can count. We can also time. Many operations in IC equipment involve the ability to switch or pulse a circuit at a specific point in the sequence.

It is a timing pulse in the counter that gates the counting circuit. This is what changes it from an event counter to a frequency counter — the ability to tie the count to a known time period.

This is usually no more than an IC gate or two. The hard part is knowing where and when to do it.

We are concerned with two specific problems: the timing of the pulse and the polarity. Both of these can be demonstrated with the addition of a few more 7400 gate sections.

You can use the unused sections of the blinky IC, but I found it easier to use a separate IC on another part of the IC board where it was less crowded.

Fig. 7 shows the basic takeoff circuit from one of the binary outputs. This is also the basic IC inverter circuit, so let's go into a little more detail about what's happening here.

The 7490 is being keyed by a negative pulse. This means that its input LED (at the blinky) is out of phase with the actual pulse action.

If you watch the other LED of the blinky IC circuit, it will be pulsing with the correct phase for the circuit. When it is on, it is high, which means that the other IC half is low and pulsing the 7490.

For this hookup, the takeoff was from the 1 binary output at pin 12. Now watch the relationships between the LEDs as they blink.

The blinky circuit LED to watch is the one that is *not* the input LED to the 7490. This, in effect, is the visual indication of the pulse that keys the 7490.

Notice that the blinky LED pulses twice for every blink of the LED at pin 12 of the counter IC. In effect, that part of the counter is acting as a divide-by-two circuit.

Now notice the pin 12 LED in relation to the indicator LED of the 7400 section fed by pin 12. They are out of phase. When one is on, the other is off.

Fig. 8 shows the addition of another 7400 IC section to reverse the phase of the first section. Now the LED at pin 12 and the indicator LED are in phase and blinking together.

The easiest way to demonstrate a timing pulse controlling a circuit is to use the 7490 counter's own reset circuit.

Fig. 9 shows a test circuit for this. Notice that the basic change is the connection of the 7400 switch sections to the reset pin of the 7490. Also, the switch is connected to the binary eight output and will reset the circuit to zero when the count reaches eight.

For correct counting action, at least one of the 7490's zero reset pins must be at low logic. To interrupt the counting sequence, it is only necessary to pulse the reset pin(s) to high logic.

As the pulse count changes from seven to the next pulse, it produces a high output at the binary eight pin. This same pulse appears at the reset pin of the counter IC.

When this happens, the counter automatically displays the binary zero output code: all outputs low. This happens so quickly that there is no visual binary eight output. The count goes from binary seven to binary zero, and picks up with binary one on the next count.

Thus, in effect, the eighth count is zero, which is displayed instead of an eight output code.

The counter reset can be hooked up to other binary outputs besides the eight. The four output will give you a visual count of one, two, three, and zero. The same principle holds for the two output.

While this is a simple concept to apply, there are a few pitfalls. In a counter circuit the reset action is usually keyed to the gating pulse. This is to keep them working in harmony.

You want the signal gate open for the correct time period for the count, and you want the reset action to take place when the gate is closed and be completed before the gate is open for the next count.

Otherwise, you might have the situation where the gate is open and a reset pulse appears during the count.

This means that the circuit will reset itself during the actual count, which will give you an inaccurate count. Things like this are why digital designers spend so much time making graphs and charts of circuit timing – to find these glitches on paper before they have to try and find them in their equipment.

It may seem odd to see that the output for the next counter stage is taken from the D output, which is the binary eight output.

This will take a little explaining. The problem is how to get a ten pulse out of an eight output.

The answer is to follow the actual outputs and how they affect the next stage. To do this we will pick up the count at the end of the seventh count.

Up to the end of the seventh count, there has been a low output at the binary eight output and at the input to the next stage which is fed by that output.

As the next negative pulse hits the first counter stage, it causes a high output at the binary eight output and at the input to the next counter stage.

This does nothing to the next stage. The counter is negative edge triggered. A high output means nothing to it yet, except to prepare it for the next negative pulse.

At the end of the eight count, the binary eight output of the first IC remains high. This is important. It stays on the whole cycle.

The ninth count adds a high output at the binary one output, and does nothing to the eight output, which is still on. All this while, there has been no change to the next IC stage.

At the tenth count, all of the binary outputs go to low (which is the binary for zero). At that point, the low logic is also fed to the next stage.

Since this stage is looking

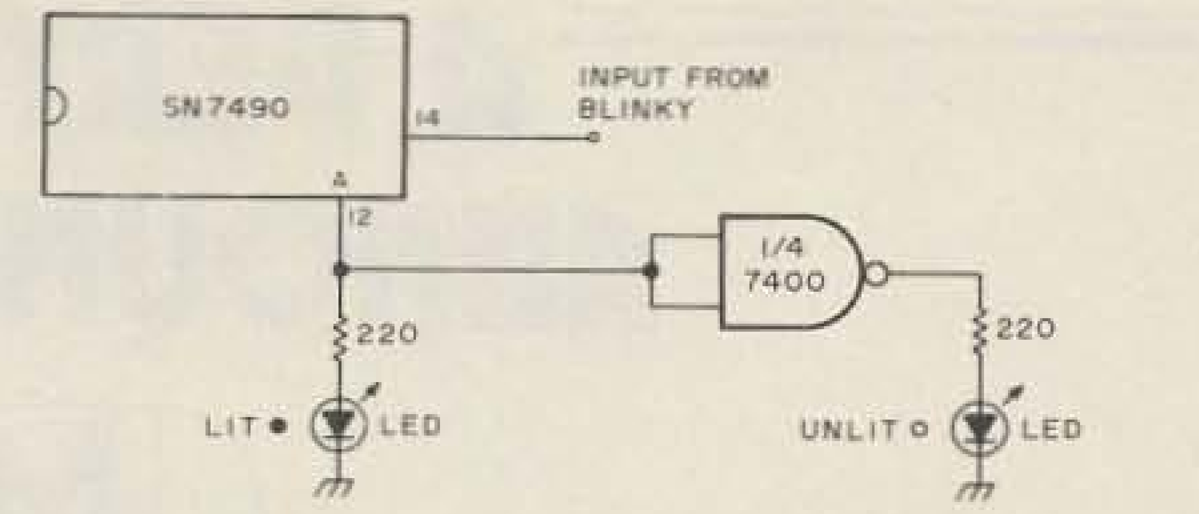

Fig. 7. Inverted output indicator or switch section.

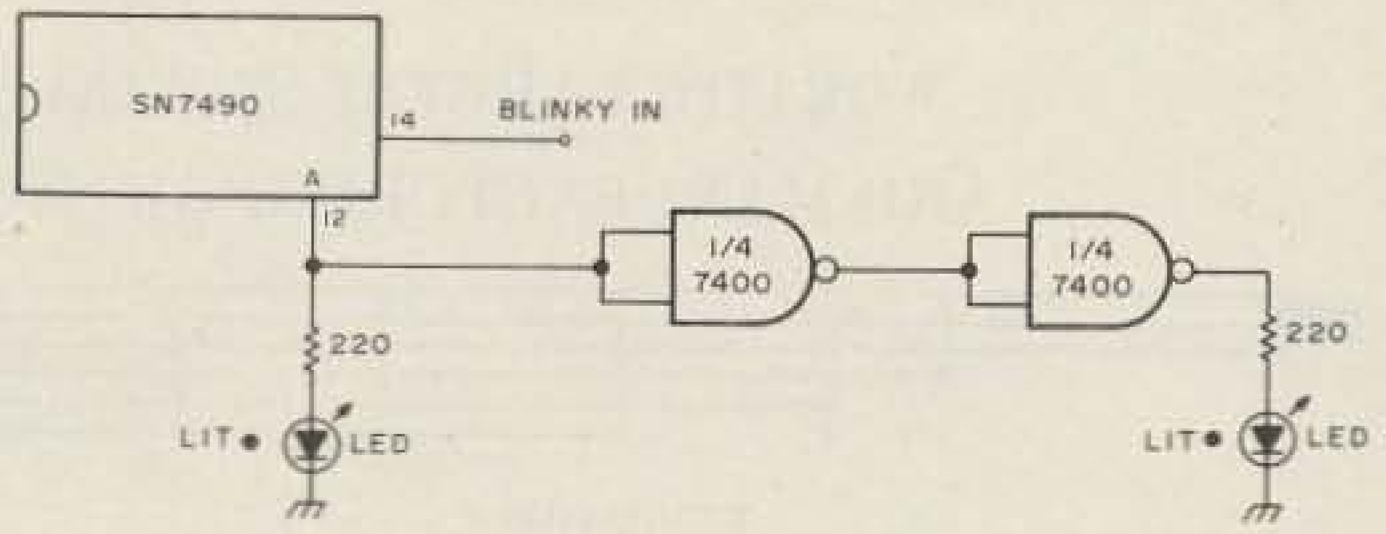

Fig. 8. Non-inverted output indicator or switch.

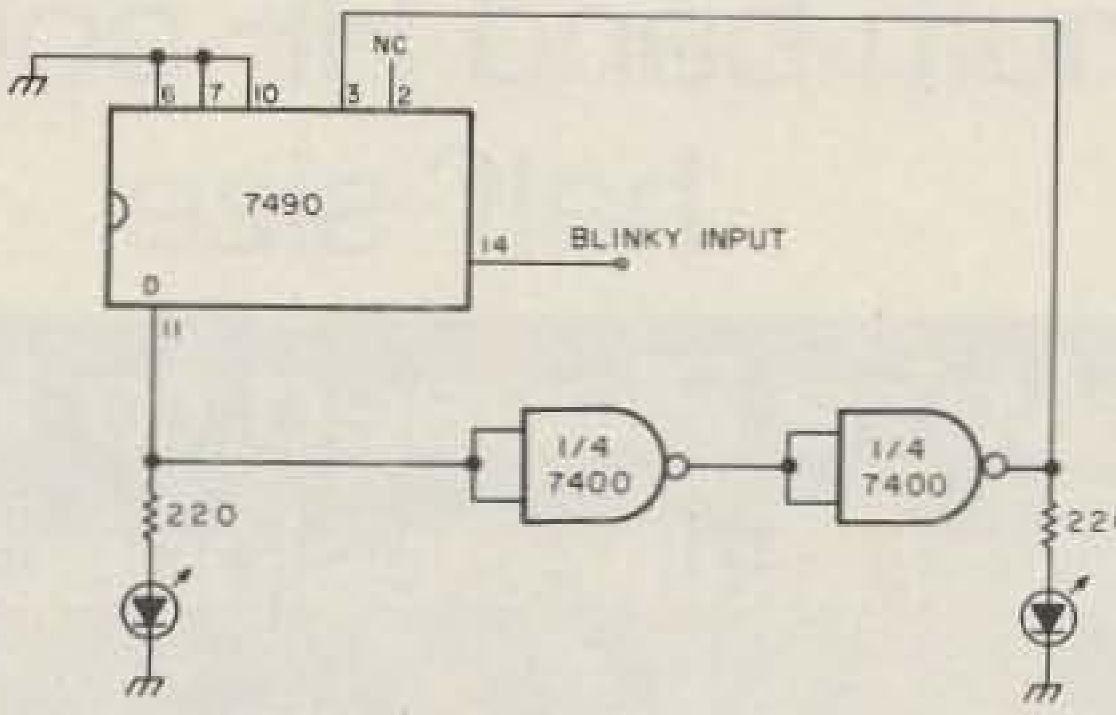

Fig. 9. Non-inverting switch used to reset counter (at 8 count).

for a low logic input, it registers its first count of one. Thus, even though the output of the binary eight output only registers as eight, its logic results in the needed pulse at ten for the next stage to begin counting.

There is one obvious thing about this test circuit. Since the output pulse and the pulse from the IC train which resets the counter are the same phase, the logical question would be, "Why not use the pulse from the IC itself to reset, instead of adding another circuit?"

In this circuit, you can do just that. It works just as well. The circuit counts to seven, and on the eighth pulse resets to zero and begins the counting sequence again.

However, that would not show the IC used as a switch. In many circuits you will not have the option of letting the IC switch itself. You will need separate switching action that can be controlled as you need it.

It is probable that there are many other circuits that can be coupled to LED indicators for a visual demonstration of circuit operation, but you will have to be careful.

Not all IC outputs will drive an LED, and you may cause damage trying. I shot a handful of 7490s trying to couple to the divide-by-two, -five and -ten hookup. They still work as counters, but not as dividers.

You may also have problems because of the phase of the TTL logic (most of which appears to be negative edge triggered). That means that the LEDs may not be on when you want them.

Still, for a few dollars worth of parts, there are a variety of IC operations which can help you become familiar with digital IC operation through hands-on practice. ■

References

1. Thanks to Ralph A. Schlegel ex-9HR, ex-W2ICX, 10 Grandview Ave., Pawling NY 12564.

2. *Electronics Hobbyist*, Fall-Winter, 1976.

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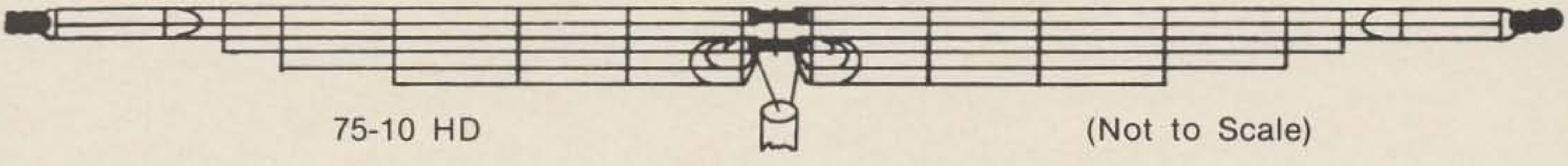

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75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
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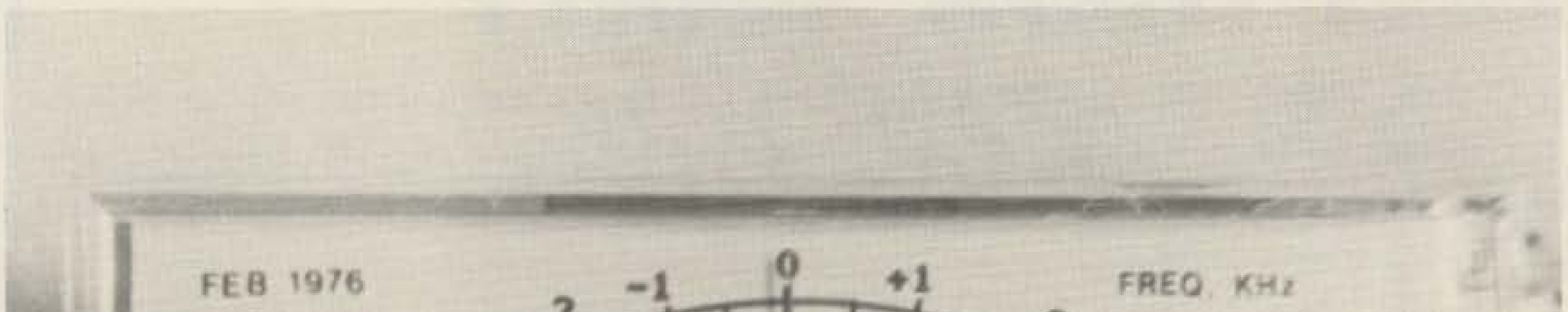


The prototype discriminator meter, the particular one used and described in the design process.

The do-it-yourself amateur can easily improve the FM station by the addition of a simple discriminator meter. The meter can be calibrated to read directly the difference between the transmitting frequency being received and the frequency to which the receiver is tuned. Receiver crystals can be trimmed precisely to local repeater frequencies. You can help other amateurs align their transmit crystals to the same frequency, which is a big help in getting everybody on the correct input frequency to your local repeater.

This article describes the design process used and the results obtained in building a discriminator meter for an Ultracom 25 2 meter transceiver. Although the particular design presented here was based on components in my possession, the procedure is described so that custom designs can be made with the particular equipment and components the builder may already have. Assumptions are made in the analyses to keep the mathematics to the simplicity of Ohm's Law.

Discriminator Characteristics

First, the characteristics of the discriminator must be determined. The discriminator alignment procedure for the builder's receiver will be of assistance in locating the discriminator signal input point and the discriminator output point. An accurate means of determining the discriminator input frequency must be available. A signal generator and digital counter are preferred. Fig. 1 shows the arrangement used to determine the discriminator output voltage as a function of the input frequency. Fig. 2 shows the results obtained for the Ultracom 25. The discriminator provides approximately .2 volts change for each kHz frequency change, at frequencies near its 455 kHz center frequency. This characteristic is reasonably linear up to about 460 kHz, but is highly nonlinear as the frequency decreases below about 450 kHz. (The audio characteristics of the discriminator are quite different than the dc characteristics of interest here – don't worry about nonlinearity in the audio responses.) A reasonable frequency range for most needs is about ±5 kHz. Examination of Fig. 2 shows that a voltmeter covering +1.0 volts to -0.8 volts could be used, if properly calibrated, to read directly frequencies ±5 kHz from the discriminator center frequency.

A surplus 1 mA 4-inch meter was available. Upon careful disassembly, it was found that this meter could be converted to a 500-0-500 uA meter by repositioning the friction-mounted return springs. The meter internal resistance was about 200 Ohms, much too low to be connected directly to the high impedance discriminator output. If a very sensitive meter, say 50-0-50 uA or better, is available, it may be

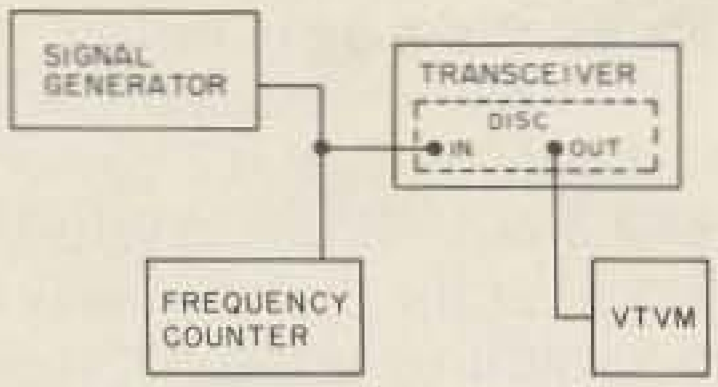


Fig. 1. Test setup for measuring discriminator characteristics.

practical to simply add the proper series resistor and connect it directly without unduly loading the discriminator output. It is worth a try.

Circuit Design

The problem for the less sensitive meter was to design a high input impedance dc circuit that would accept inputs both above and below system ground without applying bias voltage to the discriminator. The circuit must operate from a single-ended power supply (12 volts from the transceiver) for convenience and must provide both plus and minus 0.5 mA to the 200 Ohm meter. The high

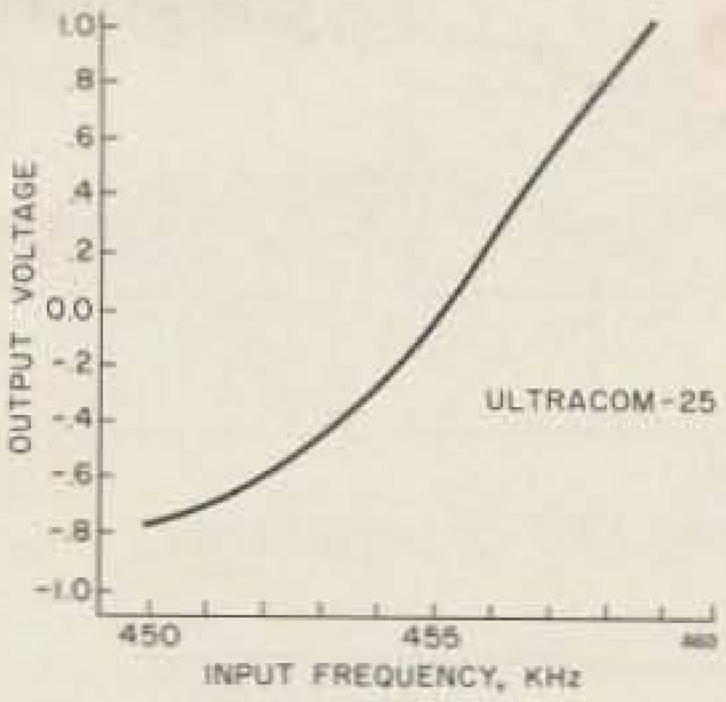


Fig. 2. Ultracom 25 discriminator dc characteristics.

input impedance and zero volts dc bias can be obtained with a self-biased junction FET. The +1 volt to -0.8 volt input signal suggests an FET with a pinch-off voltage of around 2 volts. Driving the meter with plus and minus 0.5 mA suggests a bridge circuit with each bridge leg drawing about 5 mA, i.e., about 10 times the meter full scale current.

The circuit then begins to take the form shown in Fig. 3. Since the meter current is not significant (< 10% of the current), the value of R4 +

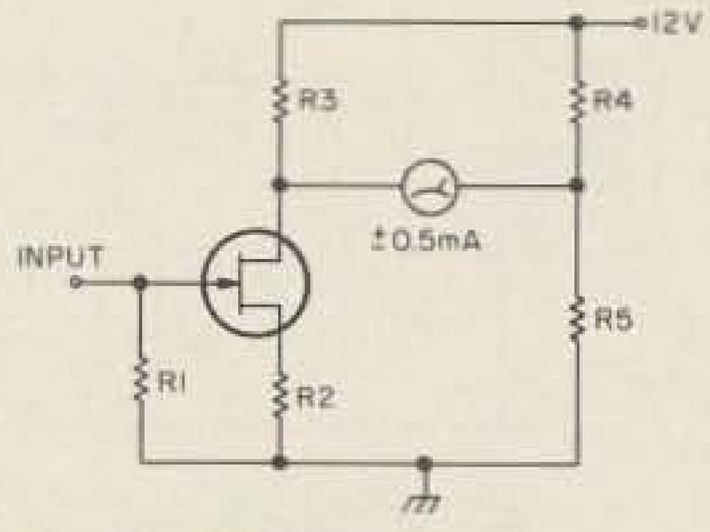


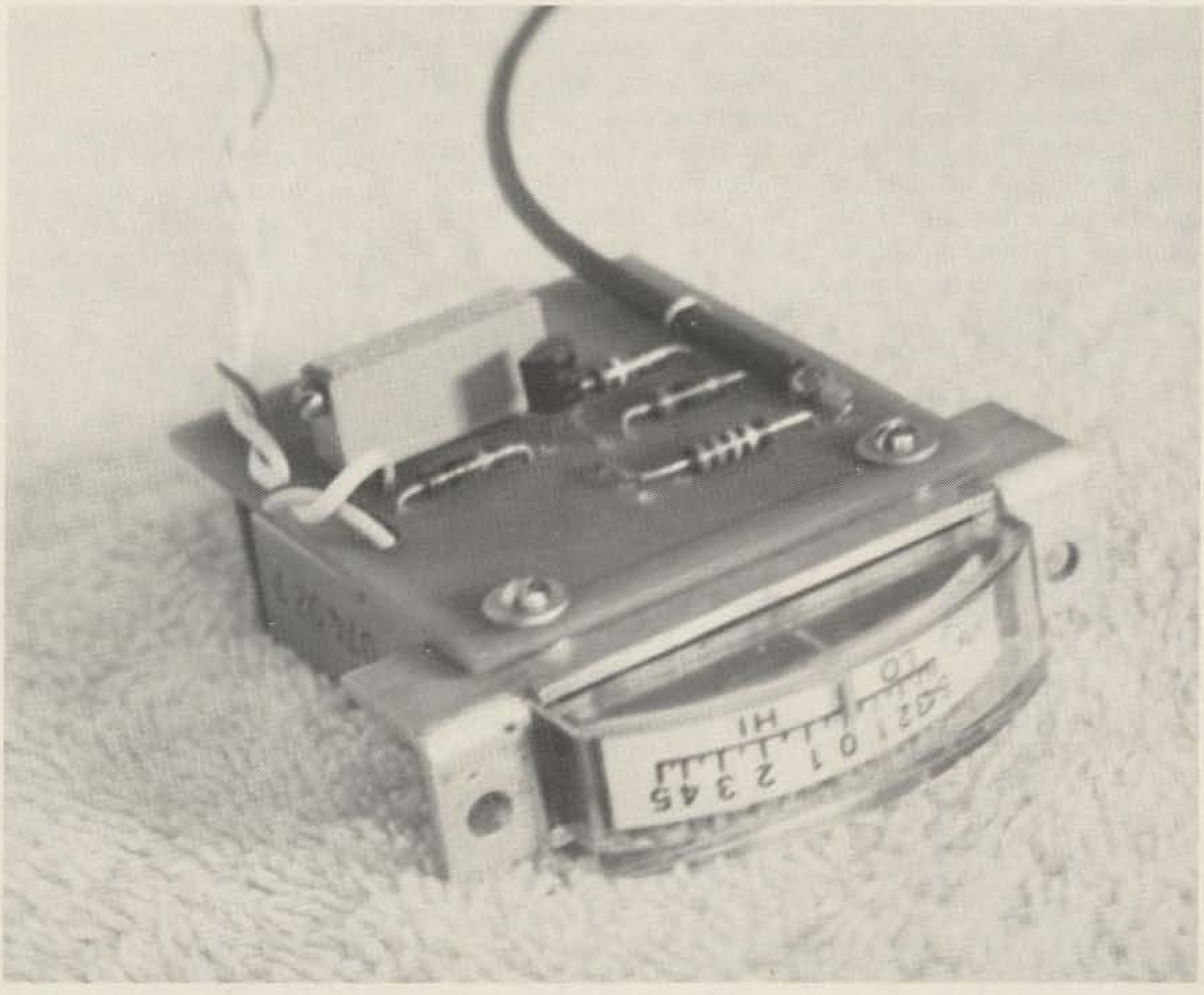
Fig. 3. Basic circuit configuration.

R5 is readily computed.

$$R4+R5 = \frac{12\ V}{.005} = 2.4k$$

Using a 2.5k pot for R4 + R5 allows for easy zeroing of the meter and accommodating variations in components of the other leg of the bridge. My circuit employed a surplus 5k ten-turn trimpot allowing easy trimming to zero.

In order to design the active leg of the bridge, it is necessary to know the characteristics of the FET to be used. The test setup shown in Fig. 4 can be used to find the FET characteristics if they are not available.



A second discriminator meter showing circuit board mounted to a small edge reading meter. This one is ready to be installed in the box housing a home brew synthesizer. The FET is a 2N3819 available from Radio Shack as RS 2035. The input pot has been replaced with a fixed resistor.

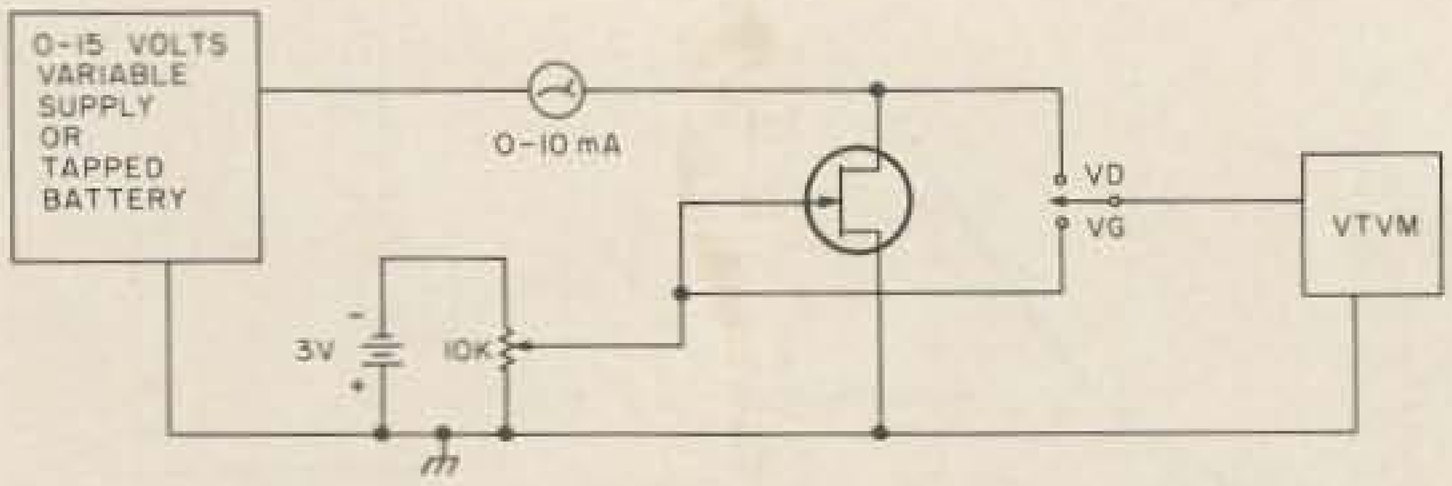


Fig. 4. Test setup for finding FET characteristics.

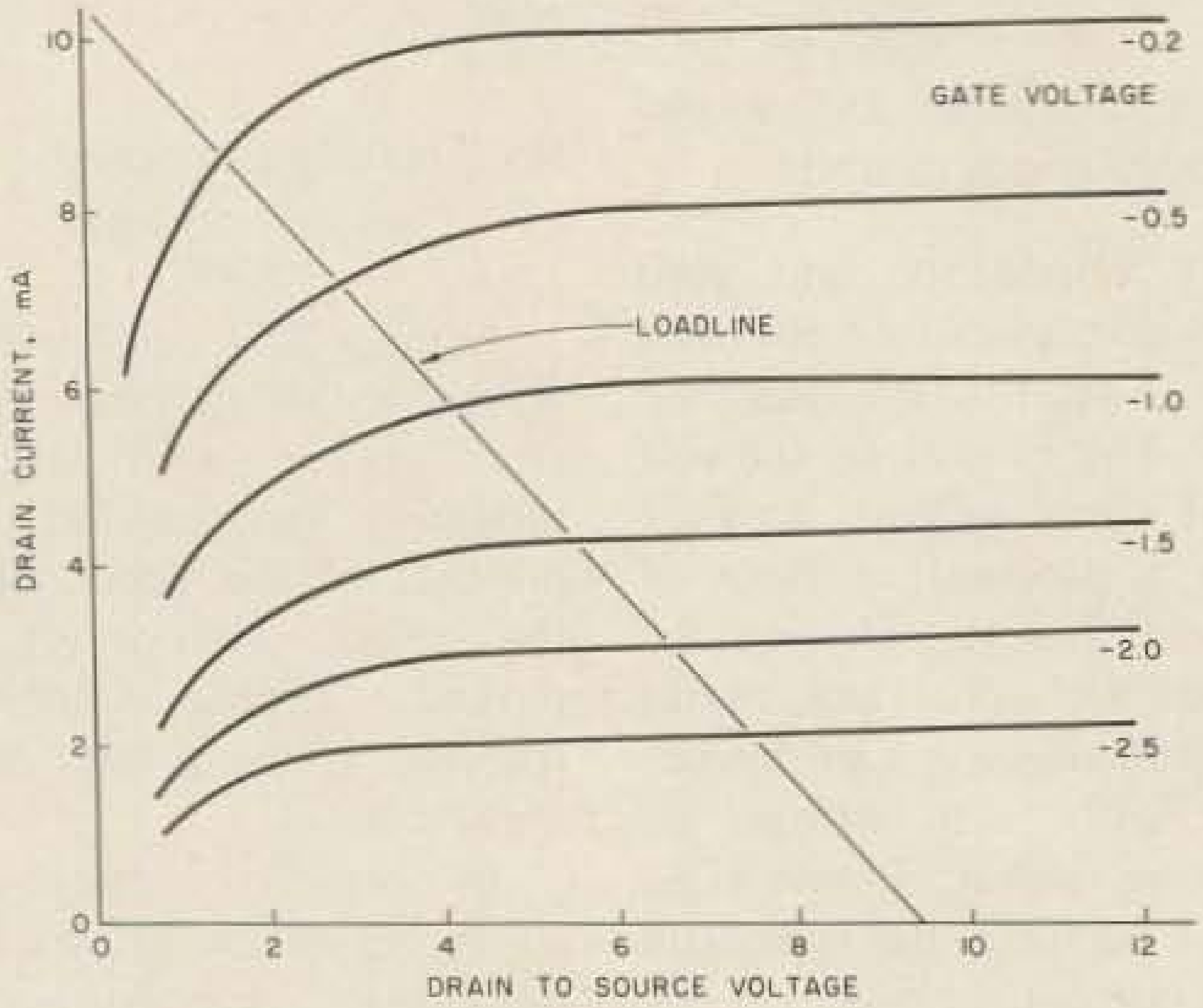


Fig. 5. FET characteristics as measured.

Several FETs from the junk box were examined and a Radio Shack N-channel FET (one of the P-channel, N-channel pair in a package) was found to have the desired characteristics. Fig. 5 shows the characteristics measured.

Once the FET characteristics are known, a bias and operating point must be determined. In general, a drain voltage of near ½ the supply voltage is desired to allow the maximum voltage gain. That is, the drain voltage can theoretically vary +½ to -½ the supply voltage if the FET drain is biased at the supply voltage midpoint. For the case in point, this ideally should occur with an FET current of about 5 mA, simultaneously with a gate self-bias of around -1.0 volt. If a gate bias of -1.5 volts is selected, a ±1.0 input swing can be tolerated without driving the FET into its pinch-off region. Examination of Fig. 5

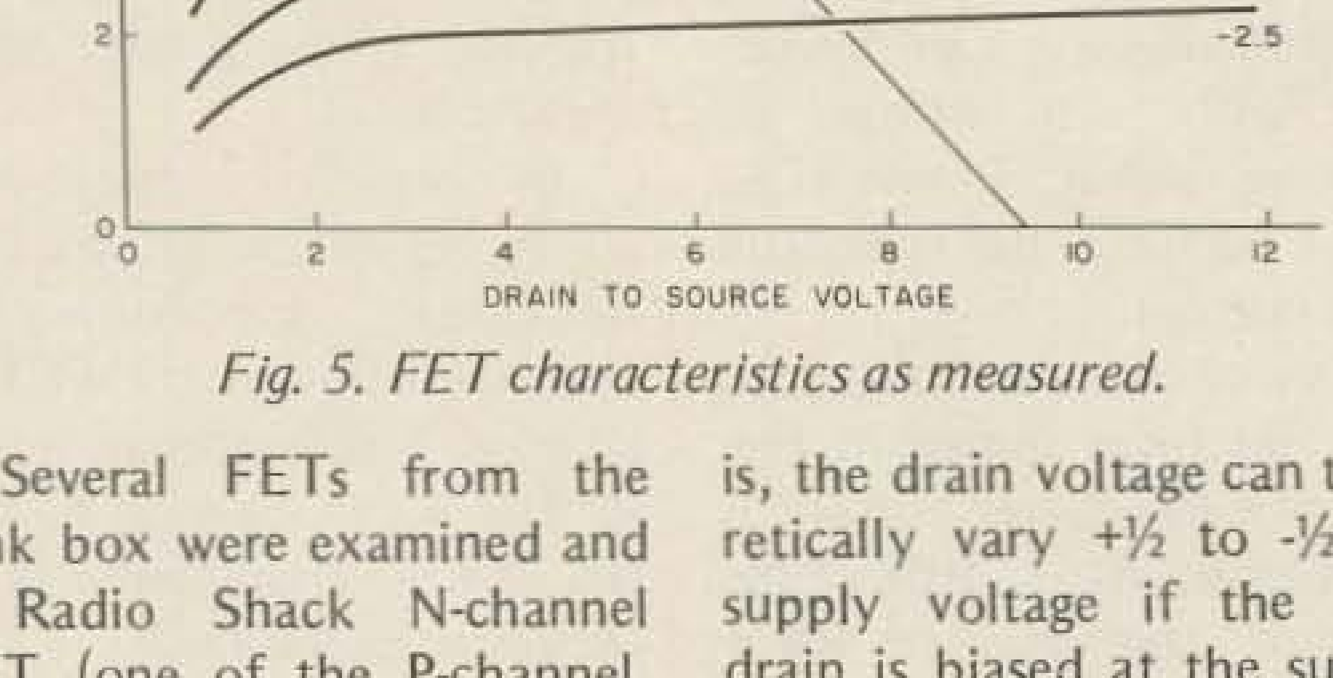


Fig. 6. Equivalent circuits when the FET is "pinched off."

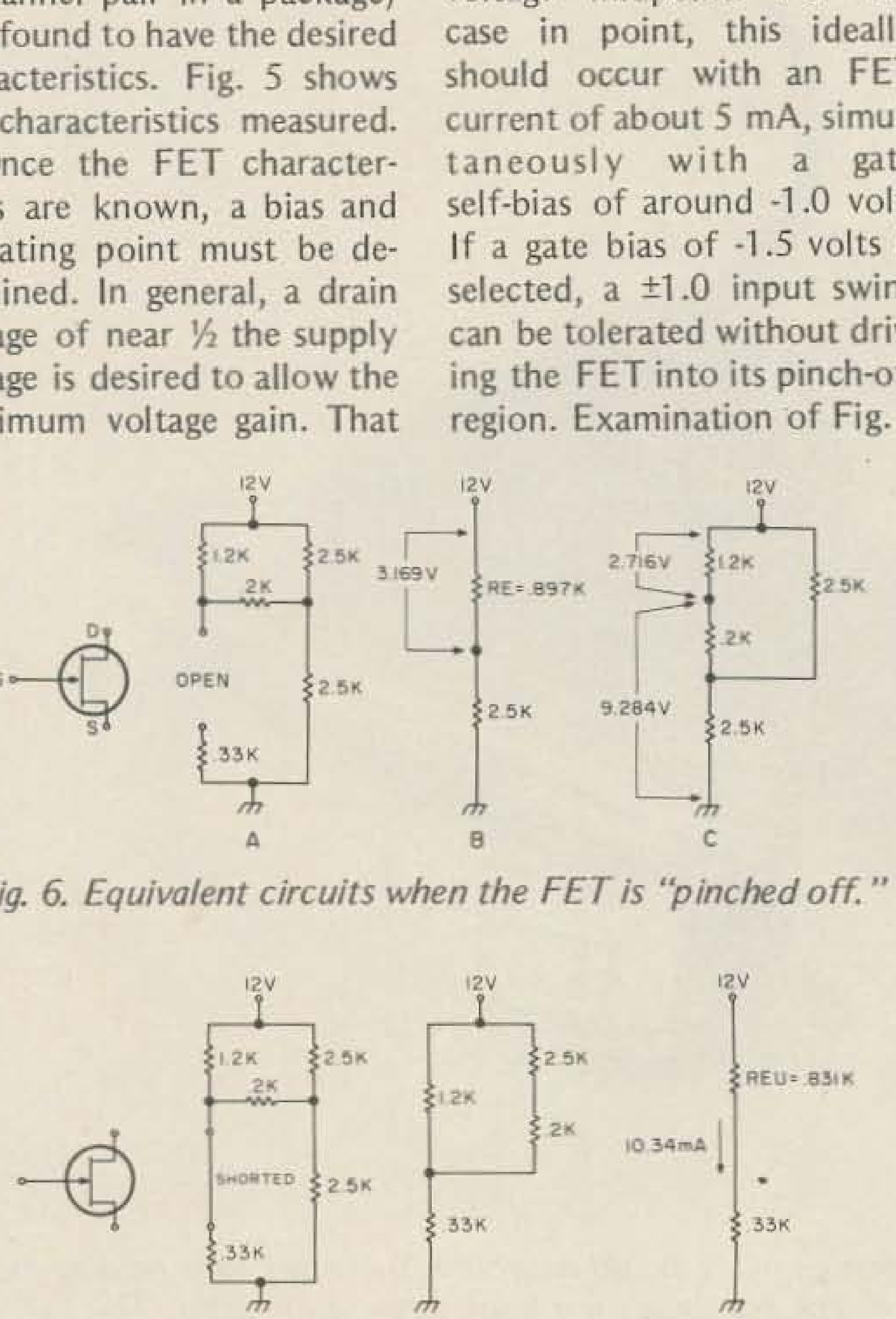


Fig. 7. Equivalent circuits when the FET is fully conducting.

shows that a drain voltage of 5 volts can be obtained with a -1.5 gate voltage at a current of 4.3 mA. Six and ½ volts (5 + 1.5) at the drain requires a 5.5 volt drop across R3 when the current is 4.3 mA. Note that when the bridge is balanced, no current flows through the meter and therefore all FET current flows through R3.

$$R3 = \frac{V_{CC} - V_D}{I_D} = \frac{5.5}{.0043} = 1.28k$$

A value of 1.2k can then be used for R3.

The value of R2 can be computed from the desired gate bias (equal to the negative source voltage) and FET current.

$$R2 = \frac{1.5}{.0043} = 349$$

A 330 Ohm standard value resistor can then be used for R2.

The load line should now be drawn on the FET characteristic curves and the circuit characteristic determined. The load line can be found by considering two conditions of the FET: (1) an open circuit, and (2) a short circuit.

Consider the condition when the FET is completely "pinched off," that is, it presents an open circuit to the bridge as shown in Fig. 6(a). Equivalent circuits are shown in Figs. 6(b) and 6(c), where:

$$Re = \frac{(1.2 + .2)\ (2.5)}{(1.2 + .2) + (2.5)} = .897k$$

The voltage across Re is:

$$V_{Re} = \frac{(12)\ (.897)}{(.897) + (2.5)} = 3.196 \text{ volts}$$

and the voltage across the 1.2k resistor is:

$$V_{1.2} = \frac{(3.169)\ (1.2)}{(1.2) + (.2)} = 2.716 \text{ volts}$$

Since no current is flowing through the 330 Ohm resistor, both ends of it are at ground potential. That means that the FET source is at zero volts and its drain voltage is:

$$Vd = 12.0 - 2.716 = 9.284 \text{ volts}$$

The FET drain to source voltage is 9.284 volts when its current is zero.

When the FET is driven completely on, that is, it acts like a short circuit, the equivalent circuit is as shown in Fig. 7(a). Since the lower 2.5k resistor is large compared to the 330 Ohm resistor and the 200 Ohm meter, its effect on the circuit is small. The equivalent circuits are shown in Figs. 7(b) and 7(c). The effective resistance of the upper portion of the circuit is:

$$Reu = \frac{(1.2)\ (2.5+.2)}{1.2+2.5+0.2} = .831k$$

and the total current is then:

$$I = \frac{12}{.831 + .33} = 10.34 \text{ mA}$$

The load line can be plotted on the FET characteristic curves by locating the two points, zero volts at 10.34 mA, and 9.284 volts at zero mA. A line drawn between these two points represents the load seen by the FET.

$$R_{load} = 9.284/10.34 = .898k$$

The FET operating point, or its bias conditions with no input signal, can be found by an iterative process. First, guess a gate to source voltage, say -1.25 volts, and find from the characteristic curves the FET current and drain to source voltage at the point where the -1.25 volt gate curve intersects the load line. Fig. 5 gives values of 4.7 volts and 5.1 mA. The 5.1 mA of current through the 330 Ohm resistor produces a gate self-bias of -1.68 volts. The computed voltage and the guessed voltage should be averaged and the process repeated, using the average value as the new guess, until the computed and guessed values are equal. The operating point for the characteristic curves and load line of Fig. 5 were found to be:

-1.48 volts gate to source self-bias
5.30 volts drain to source
4.48 mA FET current

The circuit response to input signals can be determined by examining the voltages and currents along the load line. If an input signal drives the gate to source voltage from its -1.48 volt operating point to -1.00 volts, the drain to source voltage is 4.05 and the current is 5.88 mA. The input signal required is equal

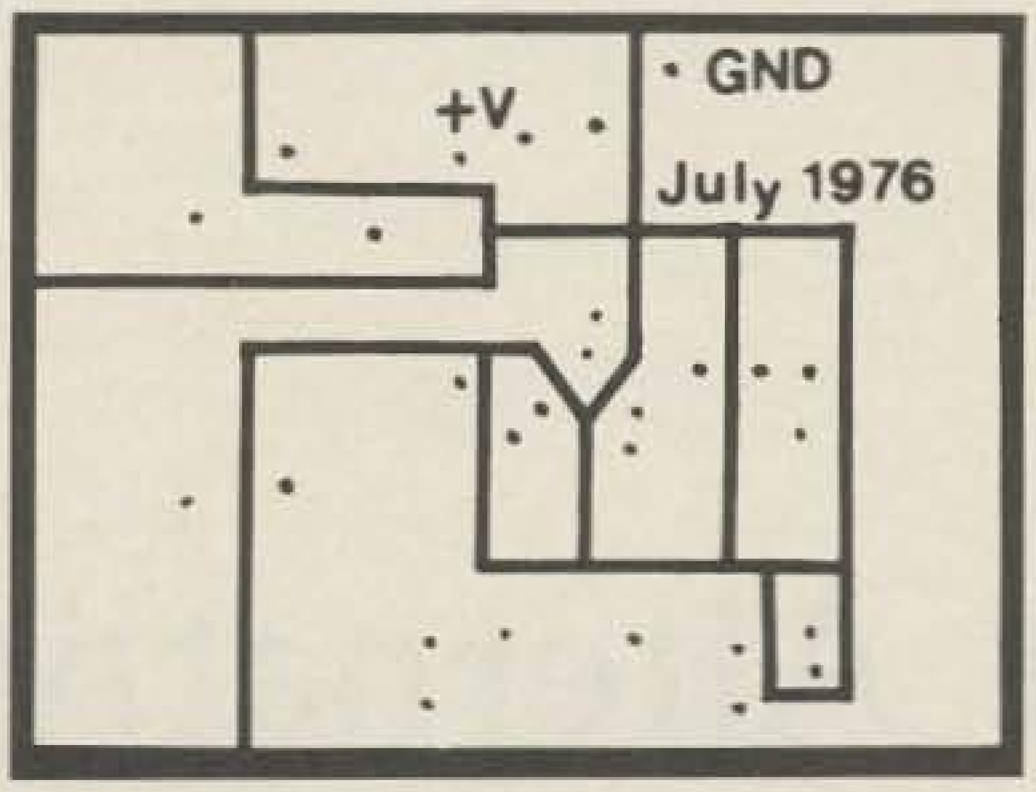


Fig. 8. Printed circuit board layout.

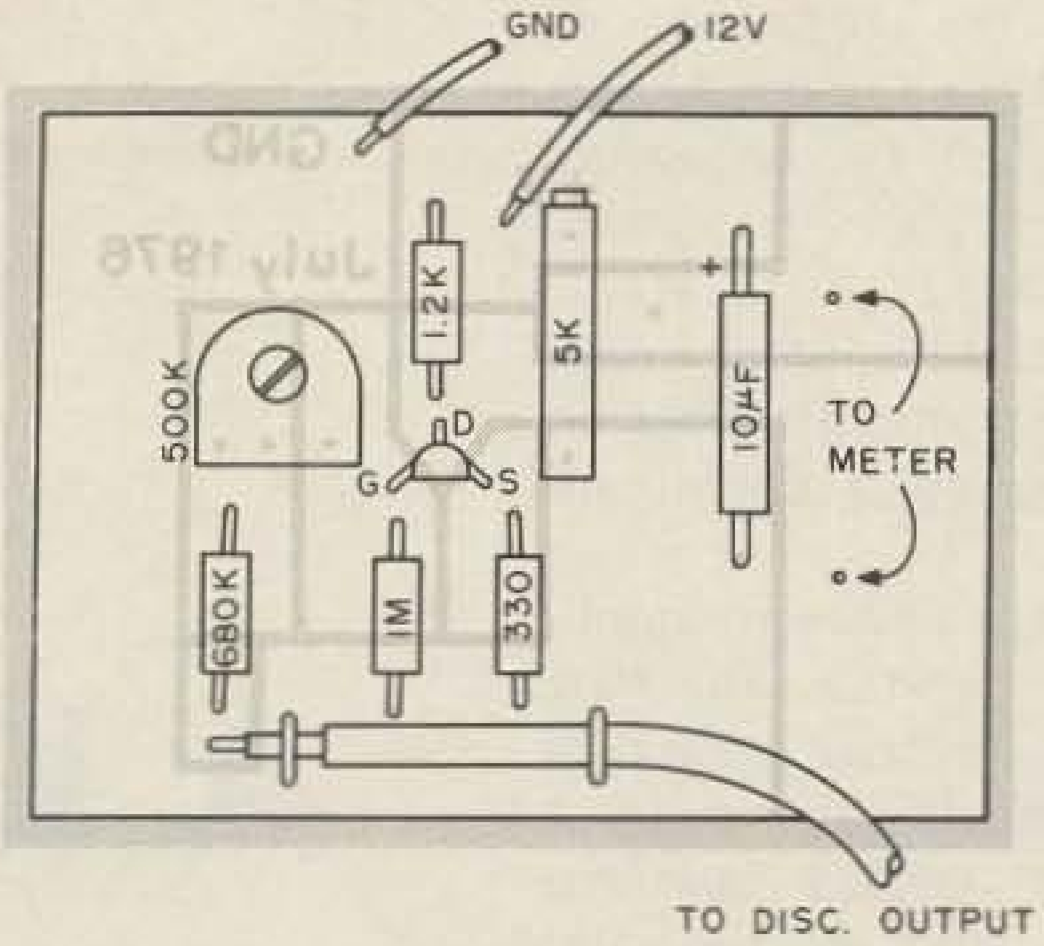


Fig. 9. Component placement.

to the -1.00 gate to source voltage plus the voltage across the 330 Ohm resistor.

$V_{in} = -1.00 + (5.88)(.33) = +0.94$ volts

Given the voltage at the FET drain,

$V_d = 4.05 + (5.88)(.33) = 5.99$ volts

the voltage across the 1.2k resistor and its current can be found.

$$I_{1.2} = \frac{12.0 - 5.99}{1.2} = 5.01 \text{ mA}$$

The load line indicates that 5.88 mA flow through the FET, so the additional current must flow through the meter.

$I_m = 5.88 - 5.01 = 0.87$ mA or 870 uA

The circuit response in terms of meter current for an input voltage can then be found.

Resp = 870/0.94 = 926 uA/volt

Since the meter to be used is ±500 uA full scale, and the signal from the discriminator is about 1 volt, a voltage divider of about 2 to 1 will be required at the FET input. The circuit input impedance is determined by the 1 meg resistor between the FET gate and ground. A 680k fixed resistor in series with a 500k pot was used with the 1 meg resistor to form a divider that could be easily adjusted.

Notice the expected discriminator output voltages of +1.0 and -0.8 do not drive the circuit into regions where it cannot operate. That is, the circuit is not driven too close to zero mA current, nor is it driven to a positive gate voltage which would lower its input impedance. The circuit is also not driven near its maximum current limit. All three of these conditions should always be checked to assure proper circuit operation.

Construction

A printed circuit board layout is shown in Fig. 8. This layout fits the parts that I had, but will fit most parts by drilling holes in the correct location. The board is easy to copy with an etch resist marking pen. My assembled board was mounted by bolting directly to the meter terminals. Fig. 9 shows the parts placement.

The bridge balancing pot, R4 + R5, must be adjusted before connecting the meter to the circuit. After assembling the circuit board, apply power from the source to ultimately be used. A well-regulated power source must be used. Adjust the balancing pot for exactly zero volts across the terminals that are to be connected to the meter. Now the meter can be connected without fear of damage.

A direct reading frequency scale can be added to the meter to make it easy to use. Most military surplus meters have scales on a thin aluminum plate. This plate can usually be unscrewed and reversed, thus providing an attractive blank scale that just fits the meter. The plastic meters with permanent scales can be modified by the addition of a piece of heavy bond paper. In either case, a temporarily attached blank scale is to be calibrated. The test setup of Fig. 1 is used to accurately provide known frequencies to the discriminator. Apply power to the meter circuit and connect it to the discriminator output. Adjust the signal generator in 1 kHz steps and carefully mark the blank scale accordingly. The accuracy of the meter is determined by the precision of this calibration. Do it carefully! India ink and rub-on lettering can be used to make an attractive scale. Protect it with a light coat of clear plastic spray paint.

Using The Instrument

The meter described measures how far the discriminator input frequency is from its center frequency. The absolute accuracy with which a received signal can be measured is then dependent upon the accuracy of the receiver local oscillator ahead of the discriminator. Keep this in mind when reporting other amateurs' transmit frequencies! The discriminator meter can be used to align two transmitters to the same frequency. If a meter with a large scale is used, frequency differences of less than 100 Hz can easily be read. One hundred Hertz out of 146 MHz ain't half bad! Your receive crystals can be trimmed to frequency by listening to local repeaters and adjusting crystal trimmers until the discriminator reads zero. You will be able to measure receiver crystal warm-up frequency drift. Some of my crystals appear to drift 200 to 400 Hz. After you observe for a few months, you may suspect that some repeater output frequencies vary a few hundred Hertz from time to time. The warm-up drift of a home brew synthesizer was measured by comparing its transmit frequency with a local repeater. The transceiver receiver crystal was trimmed to the repeater frequency. A spot switch was added to the synthesizer to allow it to switch to the repeater transmit frequency while the receiver was still receiving via the crystal. An extension of this technique with several different repeaters can be a big help in getting a synthesizer on frequency without need of a frequency counter. You may find that all repeaters are not quite on their advertised frequency and that a compromise on the synthesizer frequency may have to be made to get as close as possible to all of the repeater frequencies. Readers will undoubtedly find additional uses for the discriminator meter.

Concluding Remarks

The discriminator meter was easy to design and build. It worked as expected on the first try. It was a fun project that can be duplicated in a week by just about anyone. All in all, it is a worthwhile piece of test equipment to add to the FM station. ■

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A Kilowatt Alternative

-- try a gain antenna

Since the beginning of amateur radio, hams have worked on improving the efficiency of their signals. And many, not wanting to spend the time, would buy a linear amplifier, instead of putting up a decent antenna.

Although a kilowatt amplifier may boost a 200 Watt signal 6 dB, the power is often wasted by using a dipole or vertical antenna. After all, you are generally trying to communicate with one person in a distinct portion of the world at a time. Why, then, should you send your signal to all parts of the Earth? A beam or antenna array would solve this problem by directing your signal in a distinct direction. At the same time, a certain amount of gain would be realized, and QRM from many stations would be minimized.

The variety of beam antennas in use today is astounding. Each has a distinct pattern, gain, and front-to-back ratio (the difference, in dB, between a signal transmitted off the front and off the back of the antenna).

Although it is possible to buy a beam antenna, money can be saved by "rolling your own." Books are available on how to build your own beam antenna, so the remainder of this article will deal with the choosing of a beam antenna, not the construction of one.

The Yagi

The yagi is a parasitic beam antenna. This means that the reflector and director elements are not connected to the feedline.

The main element consists of a simple dipole. The reflector is slightly longer than ½ wavelength, and the directors are slightly shorter than ½ wavelength. A two-element beam, consisting of a dipole and a parasitic element, when properly adjusted, will exhibit a reasonable amount of gain. (See Fig. 1.)

All minor back lobes cannot be completely eliminated, but a gain of 5 dB is to be expected when using a two-element yagi. When another parasitic element is added, to make a three-element beam, a practical gain of 7.0 to 8.5 dB is to be expected. In general, doubling the number of parasitic elements will increase the antenna gain by 3 dB. (See Table 1.)

Yagis can be constructed out of tubing and wire. Wire yagis are identical to their pipe counterparts in operation. For best operation, a yagi should be elevated at least 30 feet off the ground.

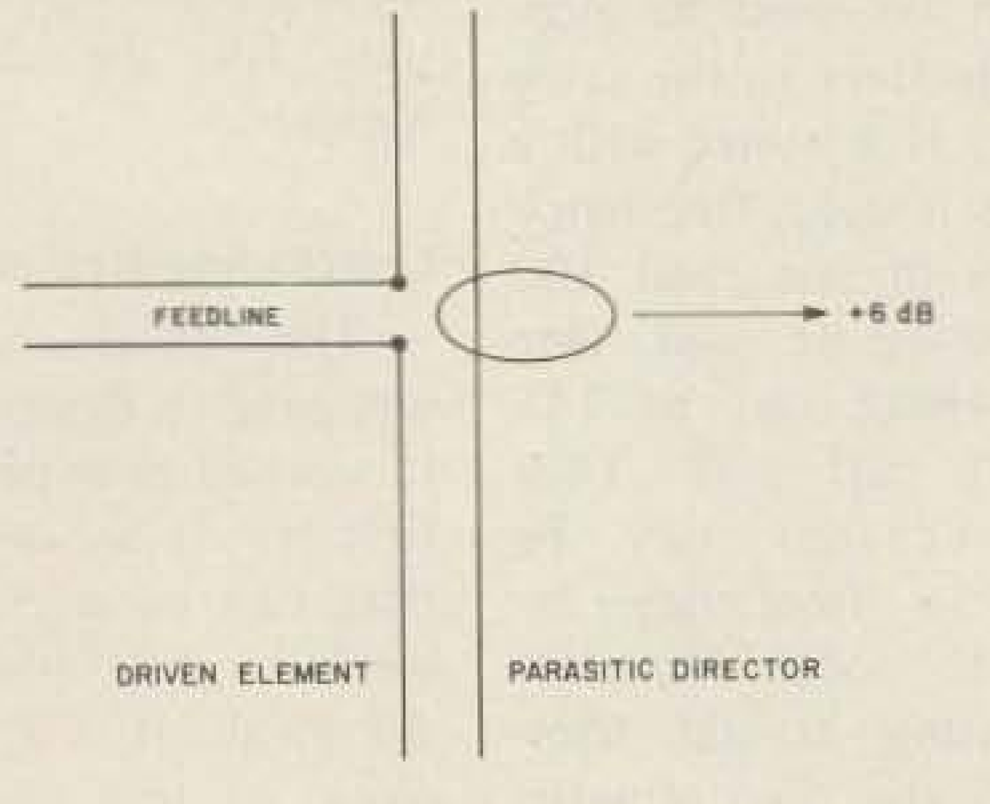

Fig. 1.

Vertical Beams

Because a single ¼ wavelength vertical antenna does not exhibit any gain over a dipole, many hams pass by this low-angle radiator without realizing that two or more vertical antennas can be used to form specific patterns. The vertical radiates rf at a low angle, making DX much easier to work. Shown in Fig. 2 is a two-element, phased, vertical system.

Coax is used as a delay line in this system. One vertical receives rf ¼ cycle before the other one does. This way, two verticals can become an end-fire array. Note: The coaxial phasing harness lengths mentioned in Fig. 2 are electrical, not physical, lengths.

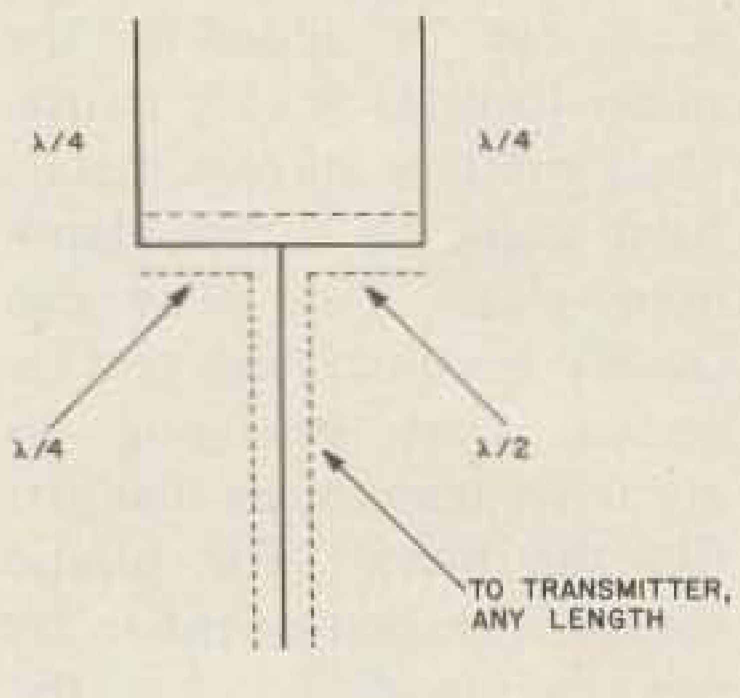

Fig. 2.

Cubical Quads

A cubical quad is an efficient, low-cost DX antenna. It is light and has a small turning radius. A quad is effective even when mounted close to the ground.

The quad consists of a simple loop, with reflector and director loops. Although the quad may be more difficult to build and erect than a yagi, the gain compares very favorably to that of a yagi. More details can be found in William Orr's book, *All About Cubical Quad Antennas*.

Long Wires

Single long wires, vee beams, and rhombics are very effective DX antennas. They have a high amount of gain. I am not going to go into the details of any of these antennas, however, for most hams would not have the amount of land necessary for them. For those who are interested in long wire antennas, the *ARRL Antenna Book* should prove quite useful. ■

4 elements (3 parasitics)	9 dB*
7 elements	12 dB*
19 elements	15 dB*
56 elements	18 dB*
933 elements	27 dB*

*Table 1. *Gain will be slightly less, in actual practice, by about 1 dB.*

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All About Transceivers

-- Novices, take note!

Many radio amateurs are searching for their dream transceiver or their dream station and are finding the search and selection difficult. Selection, unfortunately, is most frequently based upon cost rather than performance characteristics.

Dream stations have been described many times over the years – the best in spark gap and audions, a Collins station, all solid state, all mode (AM, FM, SSB, FSK, ATV, SSTV, EME, etc.) stations, and computer controlled or "the lazy man's station." Every amateur has visions of his dream station, and as the years progress, these visions change.

What you may set as criteria for that dream rig (size, power, all mode, sensitivity, selectivity, stability, frequency coverage, etc.) are not the same as some I must also consider: Does its appearance please the XYL? Does it fit the shack decor? Does it have pretty lights? "You have to sell your other stuff before you can buy anything new!", etc.

Since my XYL (WB5TNI) finally got her license after 27 years, I am at the stage of converting my tube-type, patchwork station into some type of unified, solid state station which we can both use. First we must consider the heart of the station, a separate transmitter and receiver or a transceiver. We chose to go for a transceiver to which we hope to add a remote vfo to give split frequency capability.

Most rigs have much in common as far as basic characteristics are concerned – they cost more than I can afford, they do not cover all the frequencies I wish to operate (how am I going to cover MARS frequencies?), they do not function in all modes I wish to use, they have insufficient power at a critical moment in the QSO, and they are not quite sensitive enough to pull that station out of the DX muck. I am sure that you can think of other basic characteristics.

A dream transceiver, or dream station, must fulfill your needs. How do you like to operate in amateur radio – CW, SSB, RTTY, SSTV, ATV, VHF, EME, satellites, rag chew, Technician, Novice, General, Advanced, or Extra? Many factors must be considered when we get down to actual hardware.

A station for the professional Novice would seem fairly simple to dream up as the maximum parameters have been established by the FCC – 250 Watts, vfo, CW only, and limited frequencies. One still has to choose between solid state versus tubes, kits versus factory-built equipment, and new versus old (used). However, most Novices look forward to advancing to higher class licenses. These Novices must consider most of the same criteria as the General or higher class licensee if they wish to grow into their rig. Many of the characteristics looked for by the Novice would also be good for more advanced licenses.

The vfo must be stable, and there should be provision for offset tuning. As a Novice, one needs only CW, but the transmitter should key cleanly (without chirps) and have a fast break-in mechanism. Almost all current new equipment will meet these criteria. Equipment designed for a specific small number of frequencies can be better designed than that for a larger range. A CW filter with 400 cycles or less passband is a must for CW enthusiasts. Selectivity, the ability to separate one signal from another, should also be good. Sensitivity, to dig signals from the muck, ideally should be 0.5 uV or less on all bands. Although most transceivers have a very narrow output impedance (50-70) Ohms), the ability to tune the output over a wider range would be helpful.

The Technician's requirements on the high frequency bands are the same as the Novice's. However, he has a range of choices in the VHF bands. We will not discuss VHF in this article.

We really come to a wide range of choice with the General, Advanced, or Extra class licensee. A good method of making a choice among the many currently available transceivers is to listen to the discussions of amateurs on the air. Amateurs are fairly free with their comments concerning the good and bad characteristics of the various rigs. Another method is to listen to the quality of the rigs you hear on the air.

In our area, the popular transceivers seem to be the Heath SB series, Kenwood TS-520, Yaesu, and Drake. The Swan transceivers have never been popular here. We are also noting a decrease in popularity of the Drake TR-4C and the Yaesu FT-101. The Kenwood and Atlas transceivers seem to be increasing in popularity. Five years ago, the Drake, Heath, and Yaesu were the most popular units. I personally have a Swan-350 which is one continuous headache, and a borrowed Drake TR-4. The TR-4, in the experience of hams in this area, is a better rig than the TR-4C. In our area, there are probably more Kenwood TS-520s (with Heath being second) than any other rig. (In our charts, the Tempo "one" is added for consideration as some amateurs still prefer tube-type units. Collins is not considered, due particularly to cost, the fact that other transceivers can outperform the KWM-2, and because the KWM-2 has not been modernized for many years.)

If I were to buy a new rig today, I would have great difficulty deciding just what I would choose. Even after the research I have done for this article, I still find choice confusing. I like some features on one unit, and others I don't like. So it goes with all available units. My dream transceiver has yet to be designed and built. However, each of us has our own requirements, and we must compromise with what is available.

What would I like for my dream transceiver? Cost should be below $500 (but that is impossible in the current market); built-in ac and dc power supply; variable power – 100 to 150 Watts PEP output, with capabilities of going to 300 Watts PEP output when the going gets rough; full coverage of all HF amateur bands, plus enough extra on the ends to cover MARS frequencies; capabilities built-in for CW, SSB, FSK and AFSK, and adaptable to SSTV; digital dial backed by an accurate frequency counter; WWV monitoring capability on 10 and 15 MHz; VOX and push-to-talk; all solid state; separate vfo to use split frequencies for DX; sensitivity on all bands of 0.25 uV, or less, for 10 dB S+N/N; carrier suppression of 60 dB or better, unwanted sideband suppression of 60 dB or better, and spurious and harmonics down by at least 60 dB; and selectivity of 2.1 kHz at -6 dB on SSB, and not much greater than that at -100 dB. On CW I would like a filter or selectivity of about 150 Hz. And, of course, I would like a noise blanker and a sidetone monitor.

Transceiver	TR4-C	FT-101E	FT-301	SB-104	HW-104	HW-101	TS-520	TS-820	3750	2020	'One'	210X	Triton IV
Characteristic:													
Mode: CW	+	+	+	+	+	+	+	+	+	+	+	+	+
AM	+	+	+	-	-	-	-	-	-	+	+	-	-
LSB/USB	+	+	+	+	+	+	+	+	+	+	+	+	+
FSK	-	-	+	-	-	-	-	+	-	-	-	-	-
Frequency:													
160 meters	-	+	+	-	-	-	-	+	+	-	-	-	OPT
28-28.5 MHz	OPT	+	+	+	+	+	+	+	+	+	?	OPT	+
29-29.5 MHz	OPT	+	+	+	OPT	+	+	+	+	+	?	OPT	OPT
29.5-30 MHz	-	+	+	?	?	-	?	+	+	+	?	OPT	+
WWV	-	+	+	+	+	-	+	+	+	+	-	OPT	+
Aux. Bands	-	1	-	OPT	-	-	-	1	-	-	-	OPT	OPT
Crystal Cali.	+	+	+	-	+	+	+	+	-	+	?	+	+
Suppression (-dB)													
Carrier	60	50	40	55	55	45	40	40	50	50	40	50	60
Unwanted SB	60	50	40	55	55	45	40	50	50	50	50	60	60
Spurious	?	40	40	50	50	55	?	60	40	50	30	40	45
Harmonics	?	?	40	45	45	45	40	40	40	40	30	35	45
Sensitivity													
(uV)	.5	.3	.25	.6	.6	.35	.5	.25	.25	.3	.5	.3	.3
Selectivity													
SSB													
Selectivity													
SSB	2.1	2.4	2.4	2.1	2.1	2.1	2.4	2.4	2.4	2.4	2.3	2.7	2.3
CW	-	OPT	OPT	OPT	OPT	OPT	OPT	OPT	400	600	400	-	OPT
Noise Blander	OPT	+	+	OPT	OPT	+	+	+	+	+	?	OPT	OPT
Power Supply:													
Internal ac	-	+	-	-	-	-	+	+	+	+	-	-	-
Internal dc	-	+	+	+	+	-	+	-	-	+	-	+	+
Power, final													
Input, W PEP	300	250	200	?	?	180	160	200	200	180	300	200	200
Output, PEP	?	?	?	100	100	?	?	?	?	?	?	100	?
Sidetone													
Oscillator	+	+	+	+	+	+	+	+	+	+	?	-	+

Fig. 2. Transceiver basic characteristics. + = present in transceiver, - = not present, OPT = optional accessory.

The Tempo 2020 and Hy-Gain 3750 are still rather unknown quantities, although the specs look good. We are beginning to see more and more Japanese-built rigs that seem to be the same basic unit with only the name plate, front panel, and a few options difference.

Although there are many ways to broadly divide transceivers into groups, the following are usually the first considered:

Cost: Below $500, $500-1000, $1000-2000, and over $2000. New versus used equipment.

Construction: Kits versus factory-assembled. Solid state, tubes, hybrid.

Modes: CW only; CW/SSB; CW/AM/SSB; CW/SSB/AM/FSK.

Frequency: Single band versus allband, or multiband; vfo, crystal, synthesizer.

New equipment and new models of present equipment are coming out at all times, so what is said in this article may be superseded shortly. Heathkit is featuring the SB-104 which has superseded other units in the SB series. Although the Heathkit HW-101 is still advertised, it appears the HW-104 is destined to replace the HW-101. Kenwood brought out the TS-520, and shortly thereafter the TS-820 appeared on the market. Yaesu is also bringing out new models – first the FT-101, then the FT-101B, the FT-101E and EE, and now the FT-301D. With every new model the price seems to go up. There are now very few, if any, transceivers selling new for under $500 if one considers the total cost of putting the transceiver on the air.

The question of new versus used is faced by both the newcomer and the established amateur. New units have a much better warranty than used units, but if repairs are needed, how long would it take to get the unit repaired under warranty? Where does one have to send the transceiver for warranty repairs? There are different types of warranties – factory and dealer. A few dealers also offer warranties in addition to the factory warranty.

TRANS-CEIVER	Drake TR-4C	Yaesu FT-101E	Yaesu FT-301	Heath SB-104	Heath HW-104	Heath HW-101	Kenwood TS-520	Kenwood TS-820	Hy-Gain 3750	Tempo 2020	Tempo 'One'	Atlas 210X	Triton IV
Basic New	599.95	749.00	769.00	N/A	N/A	N/A	629.00	830.00	1895.00	759.00	399.00	679.00	699.00
Basic Used	469.00	425.00	?	595.00	449.00	249.00	529.00	?	?	?	319.00	519.00	?
Kit	N/A	N/A	N/A	669.95	489.95	339.95	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ac power	120.00	X	125.00	89.95	89.95	57.95	X	X	X	X	99.00	195.00	129.00
Crystal Calibrator	X	X	?	-	X	X	X	X	-	X	?	X	X
Speaker	24.95	X	19.00	29.95	19.95	19.95	X	X	59.95	X	19.00	**	X
Microphone	39.95	X	X	39.95	39.95	39.95	39.95	39.95	39.95	X	39.95	39.95	29.50
SUB-TOTAL	784.85	749.00	913.00	829.80	638.80	457.80	668.95	869.95	1994.90	759.00	556.95	913.95	827.50
dc Power	135.00	X	X	X	X	84.95	X	N/A	N/A	X	120.00	X	X
Noise Blanker	100.00	X	X	26.95	26.95	?	X	X	X	X	?	40.00	29.00
CW Filter	?	45.00	45.00	39.95	39.95	29.95	45.00	45.00	X	X	X	N/A	25.00
29-29.5 MHz	7.95	X	X	X	16.95	X	X	X	X	X	?	*	5.00
28-28.5 MHz	7.95	X	X	X	X	X	X	X	X	X	?	*	X
160 meters	N/A	X	X	N/A	N/A	N/A	N/A	X	X	N/A	N/A	N/A	97.00
Dig. Dial	N/A	N/A	X	X	N/A	N/A	N/A	170.00	X	Hybrid	***	*299	N/A
TOTAL	1035.75	794.00	958.00	896.70	723.65	572.70	713.95	1084.95	1994.90	759.00	676.95	1252.95	983.50

*Fig. 1. Cost comparison. X = Built into the transceiver, N/A = Not available,? = not known. Available options are listed with cost. *Auxiliary vfo Model 206 (digital dial) provides complete coverage of 3-5, 6-8, 8-10, 14-16, 20-22, and 28-30 MHz. (206 also functions independently as a 100 Hz-40 MHz frequency counter. Price $299.) **Built into ac power supply console. ***Available as an option at one time, no longer listed.*

Questions to ask are where the repair work will be done — factory or local dealer — and how long it will take for repairs.

When buying used equipment, you may be buying someone else's troubles. If you buy either new or used equipment, you should buy from a reputable firm or person. In the charts we list new and used prices as published in amateur journals by reputable firms. Used prices from individuals can vary greatly, as can equipment condition. Locally, the maximum used price is at least 15-20% less than east coast or west coast prices. Used prices from individuals are usually less than used prices from retail stores.

If you do not know which are reliable companies, then ask your friends who may have had dealings with the firms or listen to the comments made on the air by other amateurs.

Buying used equipment from individuals can be very hazardous, particularly if you do not know how to judge used equipment. It is best to take a friend with you who can judge used equipment. If possible, take a friend who owns a unit like the unit you are considering or has had some experience operating such a unit.

Several points should be kept in mind when buying used equipment. First comes visual inspection, externally and internally. Is the unit clean or beat-up? Have modifications been made on the unit? Is there evidence of rewiring or soldering not of factory manufacture or not equal to factory quality soldering? Are there any additional holes in the cabinet or chassis that were not there when the unit came from the factory? Also determine if repair parts are still available. Some of the older units are sold as is because repair parts are difficult to obtain. Other units are difficult to repair because the manufacturer has gone out of business, or has gone out of the amateur radio business.

Second, you should check the receive characteristics. Attach the transceiver to an antenna and check the receive characteristics on all bands. Is it noisy? Does it separate the signals well? Does the S-meter work? Compare sensitivity, or ability to pick up weak signals, with a unit you know works properly. Is there distortion or a broken cone in the speaker? Do you get ringing on SSB or when the CW filter is used? Does it cover the frequencies you wish to work? Does the crystal calibrator work?

If the receive section seems to work well, then check the transmit section. If possible, make on-the-air contacts, and get reports. Terminate the output of the transmitter through a wattmeter into a dummy load to measure output power. Can you load it to full rated power on each band? Are the final tubes soft? Does the transmitter cover the frequencies which you would like to work? Do you get maximum output at the point where you get the maximum dip on the plate-current meter? If not, you may find the transmitter is improperly neutralized.

Fig. 1 is a cost comparison chart. The most important figure is the *total*, which is what it would cost to put a new unit on the air (exclusive of the antenna system) at the level to include options that may be standard on other units. For example, some units have noise blankers as standard equipment, whereas this may be optional with others. The cost of such options is included in the total. We also include both ac and dc power supply cost in the total. Under microphone, we list the cost of factory recommendations, but it is realized that cheaper microphones are available. Some units have built-in speakers, but an external speaker is usually to be preferred. Three of the listed transceivers have digital readouts based upon frequency counters, and one has a hybrid readout combining a digital readout for megahertz and kilohertz and a dial for hundreds of cycles. Most of the units have frequency readouts resettable within ±1-2 kHz and a drift of less than 100 Hz after warm-up.

The FCC requires that the amateur licensee have some method of measuring transmitter frequency independent of the frequency-determining device of the transmitter itself. Most amateurs meet this requirement by using a calibrated receiver with a 100 kHz and/or 25 kHz crystal calibrator which has been zero beat with one of the primary frequencies of WWV. Some transceivers have WWV receive capability, others do not. A few can receive WWV on both 10 MHz and 15 MHz. The capability to receive WWV is a desirable feature on a transceiver. In the chart, *crystal calibrator* refers to one with 100 kHz calibration points. A few units also have 25 kHz calibration points, and WWV also means that the transceiver has receive capability for WWV.

All transceivers considered in the comparison did cover the full 80-40-20 and 15 meter bands and 28.5 to 29.0 MHz of the 10 meter band. In the chart, we list additional coverage by the transceivers that is in excess of these basic bands. A few units also have provision for auxiliary bands which may be determined by the user.

During years of low sunspot activity, there is considerable activity on the 160 meter band, even though there are frequency and power restrictions in certain geographic areas for use of this band. I personally would not pay extra for the 160 meter band. However, it is important to me that a transceiver be able to cover at least to 29.5 MHz for OSCAR activity and that it cover sufficiently beyond the band edges for MARS frequencies. It is important to consider the total coverage of the transceiver – if you don't want the extra coverage now, you may want it in the future.

Some transceivers have selectable sideband on all frequencies, others have only lower sideband on 80 and 40 meters and only upper sideband on 20-15-10 meters. In our chart, an X in the LSB/USB column means the unit has selectable sideband. The lack of selectable sideband is not a serious detraction, as most amateurs use only the lower sideband on 80 and 40 and only upper sideband on 20, 15, and 10 meters.

Final amplifier input power is limited to a maximum of 250 Watts for Novices and Technicians, and other classes of licensees have a maximum input of 1,000 Watts for CW and AM, and 2,000 Watts PEP for sideband. FCC regulations state that an amateur should use the minimum amount of power necessary to maintain communications. For each 3 dB increase, one must double the power. Assuming 100 Watts output as the baseline, one must go to 200 Watts to bring about a noticeable difference in reception over 100 Watts, to 400 Watts for 3 dB increase over 200 Watts, and 800 Watts output from 400 for another 3 dB increase. Generally, one can figure about 100 Watts output from 160-180 Watts input to the final. Most of the transceivers reviewed had an input of about 200 Watts and generally can produce satisfactory communications.

Many amateur radio magazines – *Ham Radio, QST, 73* – carry articles evaluating in depth new equipment as it is marketed. These are usually good sources of unbiased technical evaluations, and usually indicate how the particular unit under test compared with the manufacturer's published specifications. We are using the manufacturer's published specifications in our comparison charts.

Sensitivity is the ability of a receiver to pull in weak signals and is rated in microvolts (uV) for 10 dB S+N/N. The 1977 *Handbook* defines sensitivity as "the signal at the input of the receiver required to give a signal plus noise output some stated ratio (generally 10 dB) above the noise output of the receiver." Sensitivity can be increased through the use of a solid state, low-noise preamplifier, as much noise is generated by thermionic emission from tubes. The amount of thermionic noise in tubes can be decreased by running them at a lower voltage – e.g., 100 V instead of 180 V – in the early stages of the receiver where the most noise is generated before the signal is adequately amplified. An all solid state receiver has a lower noise level, and usually better sensitivity than does a tube type receiver. The newer transceivers are all of the solid state variety in the receiver section. Exceptions to this statement in the comparison chart are the TR-4C and HW-101, which are predominantly tube types.

Selectivity is a measure of the ability of a receiver to separate adjacent signals. Selectivity is a measure of the width of the bandpass at a point 6 dB down (-6 dB) from the peak of the bandpass curve. For a receiver with 2.4 kHz selectivity, the bandpass is 2.4 kHz wide at -6 dB. For SSB, a selectivity of 2.1 to 2.4 kHz is good, as an SSB signal is usually no broader than 2.4 kHz. On CW, since theoretically it is a single frequency signal, the bandpass can be much narrower. Most receivers with CW filters have a 400 cycle bandpass, but some have only 150 cycle bandpass. In newer types of receivers, a crystal filter is used to provide bandpass attenuation.

The selectivity bandpass at 6 dB down must be sufficient to pass the necessary signal information (single sideband, double sidebands, or carrier plus sidebands) without undesired attenuation. An AM signal requires about twice the bandpass of an SSB signal. A CW signal, as stated previously, requires even less bandpass frequency.

If your transmitter has a sidetone oscillator, you can hear yourself as you send CW. The ability to hear yourself with a sidetone oscillator in the transmitter, or on the keyer, helps in sending better formed CW. Without being able to hear yourself send, you can have difficulty with proper spacing and formation of characters.

Other characteristics of transceivers are also important and are used as selling points in advertising. We have listed in the charts only what we consider to be the basic characteristics of importance in a good transceiver. ■

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German Amateur Procedures

-- and repeater information

This article has two purposes. The first is to inform anyone who talks to a German ham on the HF bands, because he may be interested in knowing more about the other man's hobby environment. The second is to help anyone anticipating a trip or work assignment in Germany, who may well wish to do some hamming while in the country. For these reasons, this article will explain the ham license structure and hobby activities available in Germany.

Like most hams all over the world, the German ham you talk to has had to pass a series of exams. They are given by the Deutsche Bundespost. The minimum age at which one can become a ham is 16 years. There are two main divisions of licenses, the class A/B and the class C. Holders of a class A or B can operate all permissible amateur bands on all modes, with the only difference between them being the transmitter power authorized. If you've worked a German ham on the HF bands, he had either a class A or B license, because the class C license is the equivalent of the American Technician class and allows only operation above 144 MHz.

If you will refer to Table 1 for a summary of the bands and modes for each license, you will note that, unlike the American Technician class, the German class C ham may not operate CW on any band. He has not been required to pass a CW exam to get his license. This is the only difference between the class C and class A/B ham, because all hams take the same written exam on technical, regulatory, and operational subjects. The code test is at 60 characters per minute and requires a solid minute's copy each of, first, five-letter groups, then German language text, and then English language text. A maximum of three errors is permissible. If a ham has a class C license, he need only pass the code test to upgrade to a class A license.

If the exam is failed, the applicant may take it again. If the second attempt is failed, a mandatory waiting period of one year must be observed before trying again. If the third attempt is failed, a period of three years must be waited out before trying again.

License fees are paid by the month at 3 Deutsche Marks (DM) ($1.25), plus 3 DM for the issuance of a new or duplicate license. The exam costs 15 DM ($6.25) the first time and 5 DM for a repeat.

A ham must operate as a class A operator for a year's probationary period before he may upgrade his license to class B status, if his record is good. A class A station is allowed a maximum of 50 Watts final power amplifier dissipation, a class B station 150 Watts, and a class C station 50 Watts. While this system is different from the American use of power input, you can readily compare them if you refer to the normal efficiencies of SSB and FM amplifiers.

Just as in the U.S.A., you can tell something about a German ham from his callsign. Old-timers with class B licenses are assigned a DL, DK, or DJ prefix, and newer operators have a DF prefix. Class C stations are DC or DD prefixed. If the ham is not a citizen of Germany, but of another country, he receives a a DJØ class A/B prefix or a DCØFA to JZ class C call. American military stationed in Germany receive a DA1 or DA2 prefix for a class B or a DA4 prefix for a class C license, depending on the class of their U.S. license.

To operate in Germany as an American, there are two basic systems in use. If you are a tourist, you can obtain a temporary reciprocal license commensurate with your U.S.A. license class, and you will use your U.S.A. call with a /DL. The ARRL has an information package available for your use in applying in advance for the license. Or, if you're in a hurry or already in Germany, write the German equivalent to the ARRL, the Deutscher Amateur Radio Club (DARC), at Postfach 1153, 3507 Baunatal 1, West Germany. Ask in your letter for a tourist license valid for three months, and include the following information in the format shown:

1. Family name, Christian name, nationality
2. Birthday
3. Place of birth
4. U.S.A. address
5. U.S.A. callsign
6. ARRL membership status
7. Copy of U.S.A. license
8. Dates of 3-month period desired
9. Mail address in Germany

10. Actual address in Germany

11. 15 DM international check or money order, or wire to the DARC bank account, Postscheckamt Essen 5613-430, with a note (showing your U.S.A. callsign) that it is for a tourist license.

You should expect up to six weeks processing time for your license to go through the DARC to the German authorities and back to you. If you are to be stationed in Germany with the U.S. military under the Status of Forces Act, you must go through the U.S. Army liaison office to apply for a license. Write for application forms to the Commander, 5th Signal Command, Attn: CCE-OP-T-ML, APO NY 09056. This license will be issued for a year at a time, at an annual cost of 39 DM ($16.50), by the FTZ division of the Deutsche Bundespost (DBP). It will be a class B license for all classes except Technician and Novice. Technicians receive a class C license, and Novices are not eligible for a DA call license. However, a Novice can obtain a three-month tourist license to hold him over until he can upgrade at the FCC examinations given twice a year at Ramstein Air Base, Germany.

Now that we've discussed the license and privilege structure, it's time to talk about what can be done on the air with the license. The HF bands, you will note, are smaller than in the U.S.A., but are not legally divided into modes of emission or subbands. However, "gentlemen's agreements" exist, much the same as in the U.S.A. German hams like working DX and rag chewing as much as any ham, and the usual blend of home brew and commercial equipment can be found, made by German, Japanese, and American manufacturers. Customs and taxes really elevate the prices on gear, however. Can you imagine paying $1000 for a new Drake R4B receiver or $800 for a Yaesu FT-221? "Discount" is a word not readily found in a German ham dealer's vocabulary. However, in the usual ham spirit of "keeping the rig new while forgetting to buy shoes for the family," hams manage to stay on the air. Hams here also find themselves interested in CW, SSB, SSTV, and RTTY, with, of course, the usual local and international blend of contests available to jam the weekend bands into an aspirin bottle.

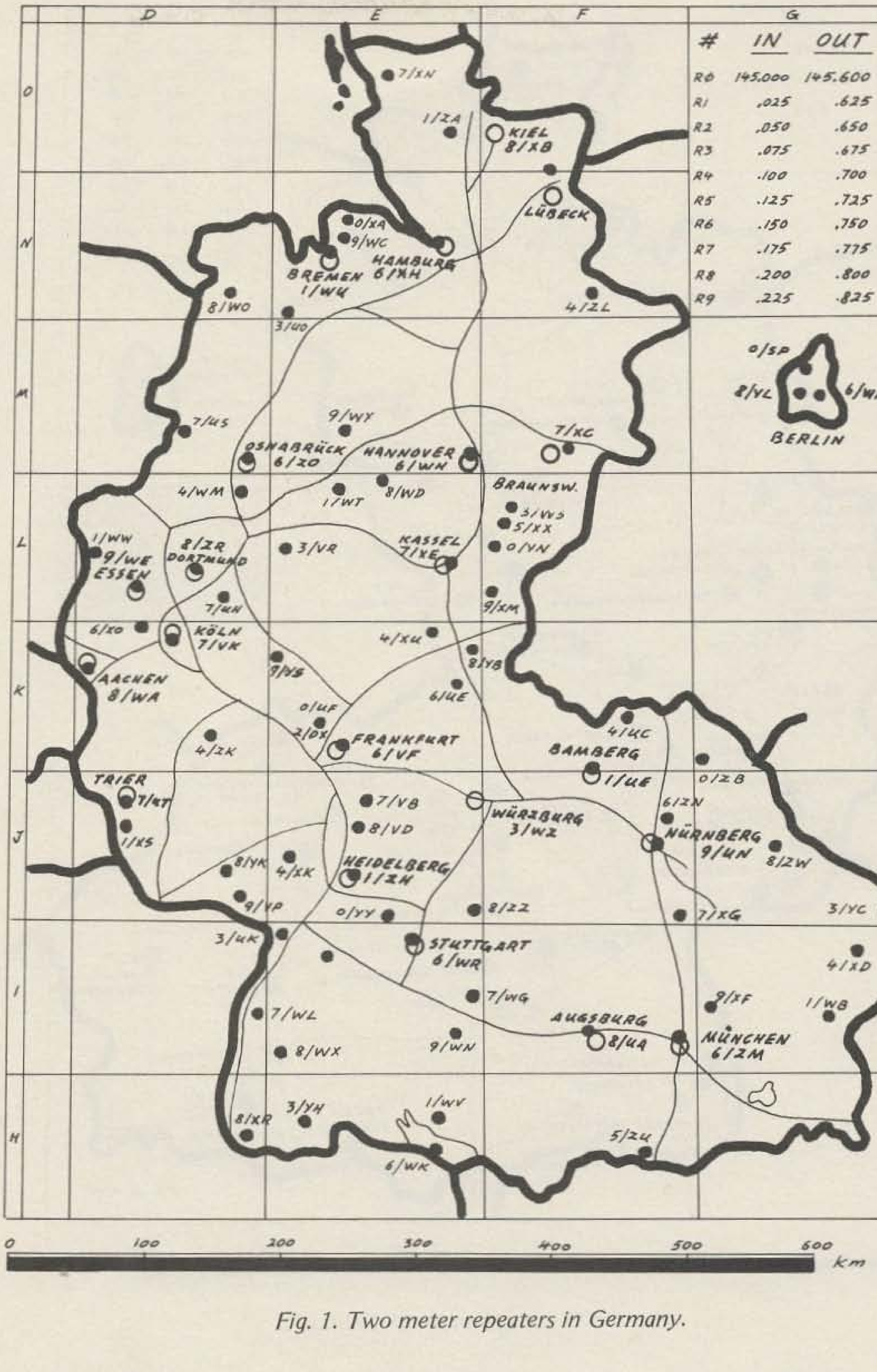


Fig. 1. Two meter repeaters in Germany.

Of the over 25,000 German hams, many, either because of their class C license or a genuine interest and desire for the open spaces of radio, find their interests directed towards VHF/UHF operation. It is in this area that the German hams really excel. Technical proficiency is, on the average, very high, and these bands lend themselves to home brew and antenna projects readily. As can be seen from Table 1, there are no 50 MHz or 220 MHz bands in Germany. As a result, most activity is on the 144 and 430 MHz bands, and even these bands are smaller than in the U.S.A.

There is a high degree of activity on FM using both simplex and repeaters. The main two meter and 70 cm frequencies are given in Tables 2 and 3, from which you can see that the Germans use the standard two meter 600 kHz offset, and a 7.6 MHz offset on 70 cm. There

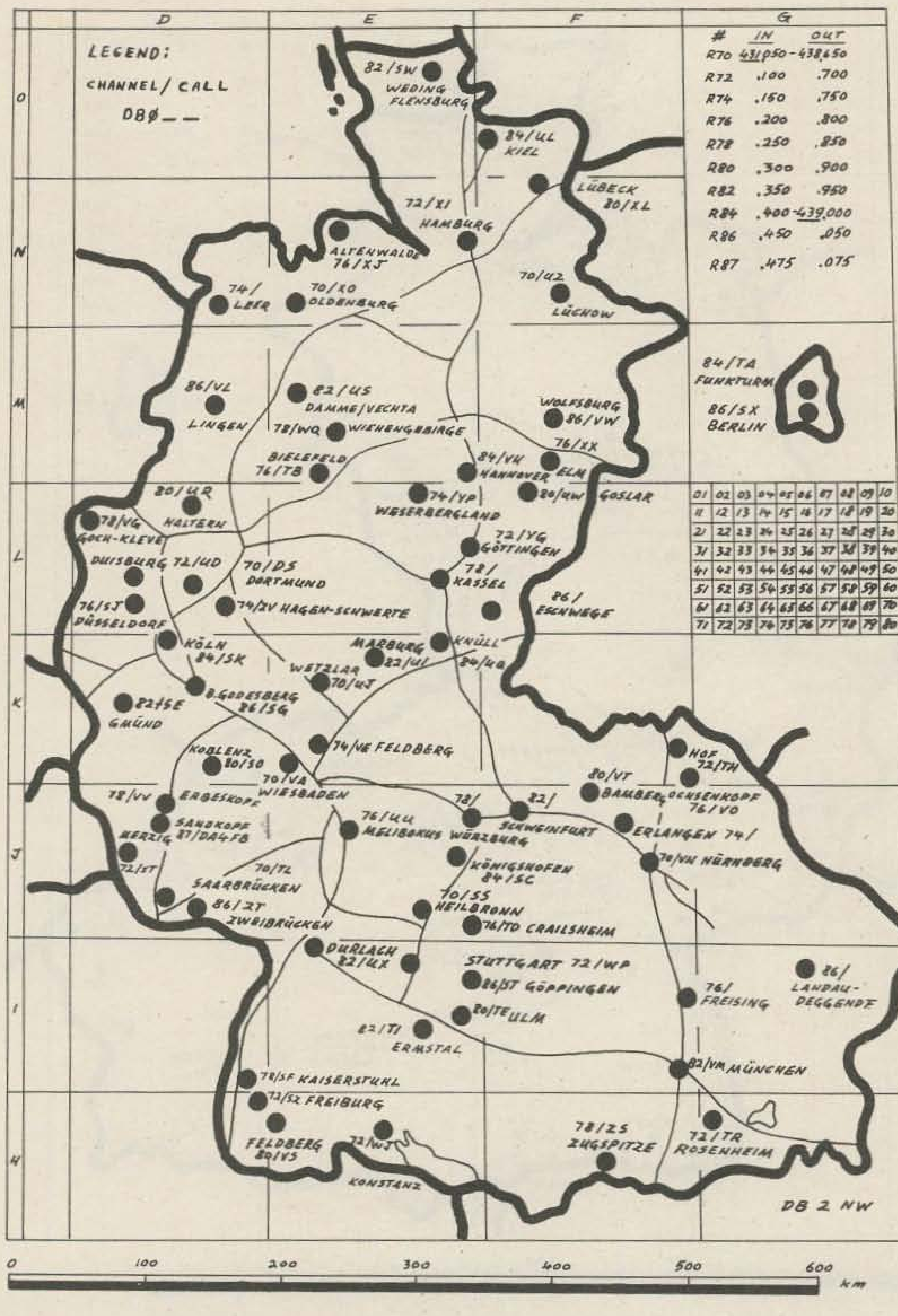


Fig. 2. 70 cm repeaters in Germany.

are ten two meter repeater channels allocated to about 77 active machines on a 25 kHz spacing, and with no oddball or reverse splits. Fig. 1 is a map of two meter FM repeaters in Germany. The 70 cm repeaters number 45 at present, and, although provision is made for the eventual use of 25 kHz spacing, present spacing is mainly 50 kHz. Fig. 2 shows the German 70 cm repeaters. All German repeaters operate on a dual entry of carrier squelch plus a 1750 Hz tone burst. No other entry tone burst frequency is allowed, and many commercial transceivers sold in the U.S. have a special German "G" version, which includes a tone burst circuit for this purpose. The DARC coordinates all repeater locations and frequencies, and the DBP will not process a license application for a repeater that has not been approved by the DARC. Some DARC standards for repeaters include a 4-5 second delay on transmitter turnoff, a 1-2 minute time-out on individual transmissions, and a 1-1.5 second delay between squelch off and time-out timer (TOT) reset, at which time a short audio beep called a "roger beep" is sounded to tell the repeater users that the TOT has reset. This last feature works wonders in discouraging tailgaters from excluding breakers and emergency traffic. In addition to FM repeaters, there are a few repeaters available for ATV and RTTY, plus some linear transponders. All German two meter repeaters are extremely busy. Unless he has an adequate command of the German language, the American ham in Germany will usually avoid the repeaters and operate on the simplex channels, with 145.550 MHz being the standard frequency adapted by the DA stations.

So far it would seem that the VHF/UHF scene is exclusively FM, but this is far from true. There is heavy use of two meter SSB, and it is not unusual to work Austria, Switzerland, Belgium, France, Luxembourg, Holland, or England on good days. Nor is it unusual to talk to a two meter station using a 15 Watt transceiver and a 40 to 88 element yagi array! Also, the Germans are heavily active on OSCAR and, in fact, operate a branch of AMSAT, AMSAT-DL, which furnished the mode "B" 70 cm to two meter transponder now in operation in OSCAR 7. In fact, there are more active mode B users in Europe than in the whole U.S.A.

There are some FM repeaters appearing on the 23 cm band now, and several groups are working with such high frequencies as 10.5 GHz microwave. But this is relatively specialized and beyond the scope of this article.

Those hams who aren't on the air talking may well be at their benches building a home brew project. Home brewing is very popular, especially at VHF and above, and there is a whole subgroup of hams devoted to this aspect. There is even a magazine, called *VHF Communications*, which is published in both German and English language versions four times a year and is devoted to home brew projects. The nice thing about this particular publication is that it offers as a service the complete availability of critical parts and printed circuit boards to duplicate any project that has been published. German home brew equipment generally reflects a high standard of technical sophistication and construction technique excellence.

If you have a radio frequency interference problem, don't despair. The Bundespost has a large fleet of specially equipped radio test vans and friendly, helpful, proficient technicians who can come to you and evaluate your station and transmitted signal. If you are "clean," German law requires the owner of the TV, stereo, antenna preamplifier, etc., to fix his equipment by shielding, grounding, and filtering. Of course, if you are at fault, you can be required to install your own station low pass filters, grounding, etc., as may be required, plus obey license restrictions until you are clean, just as in the U.S.A.

If you like to meet your ham friends, look at the latest commercial equipment, or buy some parts or kits, have a dinner with music and a live dance band, you can do it all at a German hamfest. Just as in the U.S.A., these popular occasions come in all sizes, from large to small, ranging from national to local in scope. Not only are the German fests categorized by size, but they are also sometimes devoted to a particular interest group. Can you imagine a Dayton Hamfest devoted to exclusively VHF/UHF interests? In Germany, one such event that draws national attendance of VHF/UHF enthusiasts is held every autumn at Weinheim, and is quite a feast for those who like VHF/UHF FM, SSB, commercial and home brew equipment and antennas.

The national radio club, the DARC, boasts a membership of over 90% of Germany's 25,000 hams and offers a wide variety of services. The club's national magazine, *CQ-DL*, is published monthly with 80 pages and 30,000 copies. The club is organized into 19 districts, each of which can have up to 50 local clubs. The club magazine offers operating and legal news on the international, national, and local fronts, technical articles, etc., just like any ham magazine. If you think the new equipment reviews written by the American hams in American magazines are worthwhile, you should see the articles written by the DARC engineering staff after a checkout in the club's lab. One commercial Japanese all-mode two meter transceiver that got a one page review by an American magazine received an eleven page thoroughly technical review by the DARC!

Another service of the DARC is an international and national QSL bureau, which handles cards sent and received. Cards are processed from the club and its allied national QSL bureaus to the individual district clubs. One more service is a third party insurance policy for hams to cover damages; for example, it might cover damages caused by an antenna blowing down or falling onto a neighbor or his roof.

As mentioned earlier in the article, the DARC works extremely closely with the German government. What does all this cost? At first, the annual dues of 65 DM ($27) seem like a lot, but when you consider all the services available, as only partly mentioned above, it becomes much more reasonable.

Incidentally, U.S. hams stationed in Germany with the military are generously afforded reciprocity by the DARC as a courtesy, which means that the ham can defer receiving the German language *CQ-DL Magazine* and the insurance policy, and still use the full QSL bureau services through a local DARC club for only 11 DM ($4.60) a year. All it takes is 40 or more QSL cards sent out by U.S. postage rates to make the fixed charge look good, and it looks even better when you discover that, while in the U.S. a first class letter costs 13¢, in Germany a first class letter within the country costs 21¢, and international European mail from Germany costs 50¢ or more. Nonetheless, many American hams do pay the full dues and enjoy the full privileges of the DARC. You'd be surprised how well you can understand the German language ham magazine, even if you don't "spricht Deutsch," by looking at the pictures and catching key words in the text; after all, a dB or kHz in English is the same in German!

Speaking of clubs, the largest and most organized American club in Germany is the Wiesbaden Amateur Radio Club. This club is headquartered in Wiesbaden, Germany, has an international cast of members, but is heavily composed of Americans working in Germany. This ARRL affiliated club is associated with its DARC counterpart local club, and enjoys outstanding cooperation and rapport with the local German club and the DARC. Members come from over an hour's drive away to attend the monthly club meetings, and the club's activities include the only "Americanized" hamfest, held once each May in Germany, as a regular event. The hamfest is an excellent meeting place for hundreds of German and American hams, as well as those of several other nationalities. It's a real sight to see the German hams eating the club's food concession's barbecued hamburgers, while the American hams eat wurst and brotchen. The hamfest has a technical booth, where FM transceivers are checked for frequency, power, and deviation. Other fest features enjoyed by all

Frequency	Class A/B modes	Class C modes
3.5-3.8	A1, A2, A3, A3J, F1, F3	none
7.0-7.1	A1, A2, A3, A3J, F1, F3	none
14.0-14.35	A1, A2, A3, A3J, F1, F3	none
21.0-21.45	A1, A2, A3, A3J, F1, F3	none
28.0-29.7	A1, A2, A3, A3J, F1, F3	none
144-146	A1, A2, A3, A3J, F1, F3	A3, A3J, F3
430-440	A1, A2, A3, A3J, F1, F3	A3, A3J, F3

Table 1. Higher frequency bands are deleted.

Simplex: calling/working frequencies
145.500 / 145.525 / 145.550 / 145.575

Repeaters:

Channel	Input	Output
0	145.000	145.600
1	145.025	145.625
2	145.050	145.650
3	145.075	145.675
4.	145.100	145.700
5	145.125	145.725
6	145.150	145.750
7	145.175	145.775
8	145.200	145.800
9	145.225	145.825

Table 2. Two meter FM band plan.

Simplex: 435.0

Repeaters:

Channel	Input	Output
70	431.050	438.650
72	431.100	438.700
74	431.150	438.750
76	431.200	438.800
78	431.250	438.850
80	431.300	438.900
82	431.350	438.950
84	431.400	439.000
86	431.450	439.050
87	431.475	439.075

Table 3. 70 cm FM band plan.

are the flea market, door prize raffle, and end-of-the-day flea market auction, with the latter being especially novel and enjoyed by the German hams.

Also, of course, the club offers code and theory classes during the year. Since elimination of the mail exams, it has become harder to get new hams or upgrade licenses, but the FCC has been very helpful by working with the authorities to allow an examiner to come to Germany twice a year to give commercial and amateur exams. If you want to talk to a club member, you'll find him on 145.550 MHz FM or on the club's repeater, DA4FB. This open repeater is the only one in Germany that has a license granted to an American-backed club, and operates on channel 87, as per Table 3. So, by all means, bring along your two meter and 70 cm FM rigs when you come to Germany.

As you can see, hamming in Germany has a lot to offer. Perhaps this article will allow you to have a more meaningful and interesting rag chew with the next "D" prefix station you talk to, or, if you are coming to Germany to visit or work, you will be better prepared to enjoy your hobby more fully. The hams in Germany and Europe are very friendly and helpful, and you are sure to enjoy your next QSO or visit.

I've had the pleasure of living and hamming in Germany for three years, and would like to take this opportunity to express my deep appreciation to all the hams in Germany, the DARC, and the Wiesbaden ARC, for making it so much fun and for helping me to see another aspect of my hobby. A special thanks to Jean Binet DCØHO/FØAOB and to Herb Brasington DA1KD/WB4EWX for their help and encouragement in the writing of this article. Auf Wiedersehen! ■

Herb Brasington WB4EWX/DA1KD
301 Gemini Drive
Satellite Beach FL 32935

The DA4FB Story

-- American repeater in Germany

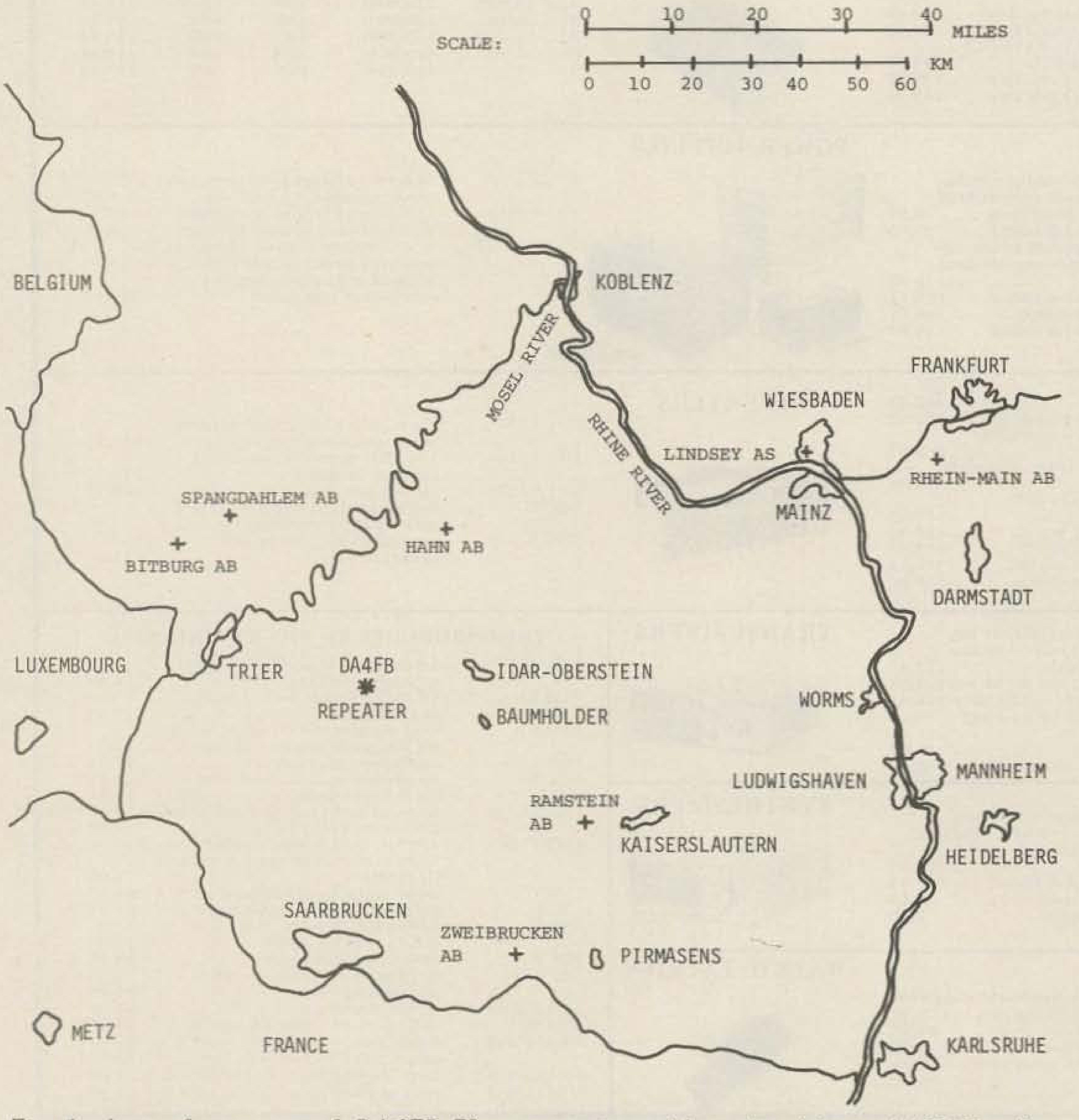


Fig. 1. Area of coverage of DA4FB 70 cm repeater, with major cities and USAF military installations indicated. The antenna is at a height of 800 meters (2624 feet), and has a cardioid pattern oriented toward Frankfurt.

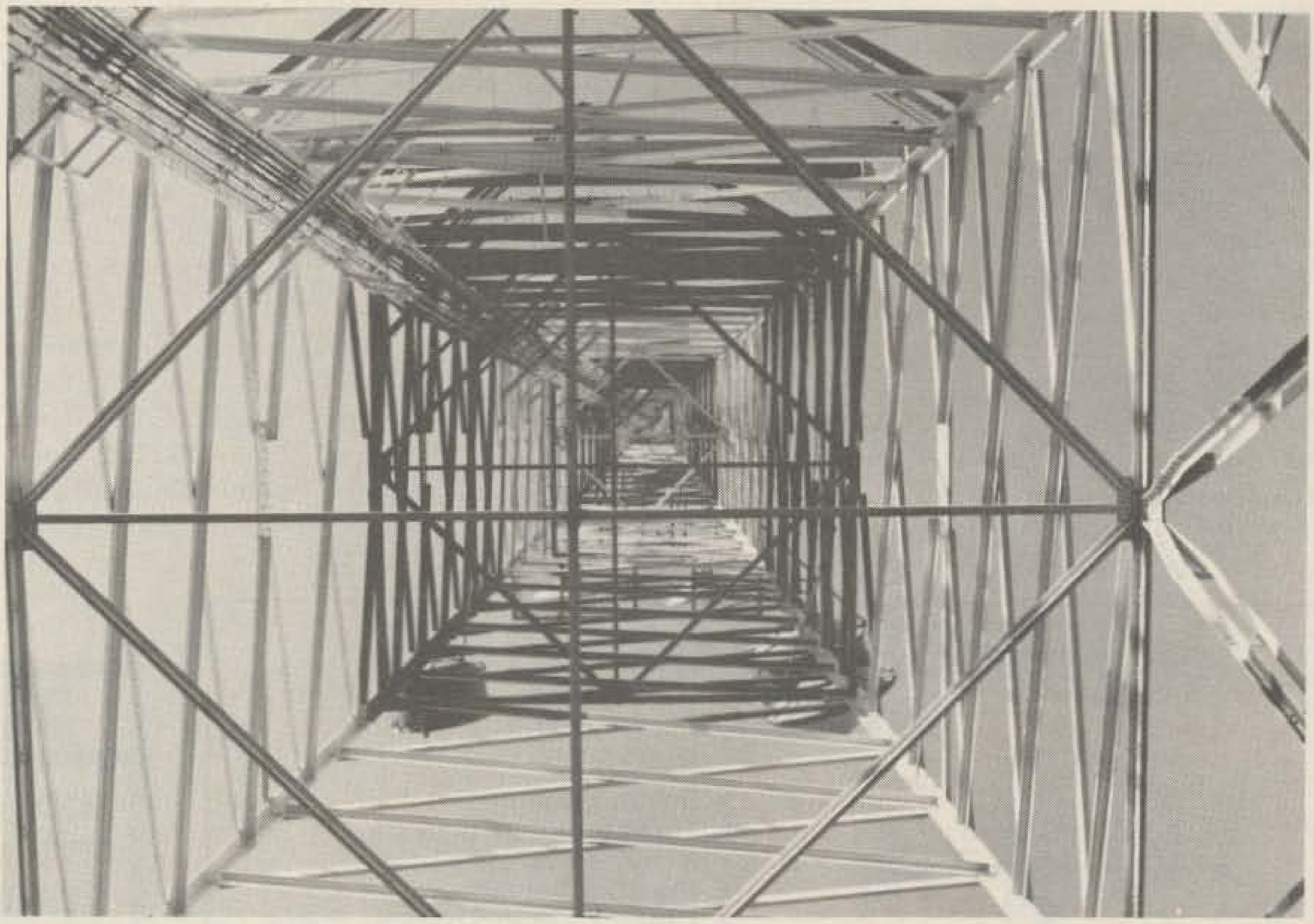
How do you draw together amateurs who are spread over a large geographical area (4700 square miles) and provide for reliable communications among them? One obvious solution to this problem is the installation of an FM repeater. But, when you consider that the geographical area of concern is in the Federal Republic of Germany, and that the majority of the amateurs are Americans, the solution to the problem is a little more complex.

Members of the US Wiesbaden Amateur Radio Club (USWARC), a large group of amateurs composed heavily of Americans living and working in West Germany, began discussing this problem in May, 1976. A repeater committee was formed, and various members of the club and committee were tasked to begin to look for a suitable site, secure equipment, and apply for the station license.

The area of desired coverage was so large that a central location for the repeater was necessary. The terrain consists mainly of rolling hills, and is divided almost in half by a range of mountains that runs northeast/southwest through the area. Jerry Stewart K5CFQ/DA1HZ was able to secure permission to install the proposed repeater at a military communications site near the center of the area. The site is on a 2300-foot mountain, has a 300-foot microwave tower, is manned 24 hours a day, and has emergency backup generators. What more could be asked for?

Preliminary negotiations were initiated with Deutschland Amateur Radio Club (DARC) officials for the authority to install and operate a repeater. The FTZ division of the Deutsche Bundespost (DBP, the German equivalent of the FCC) will issue a license for a repeater only if the license application has been coordinated with the DARC. The DARC analyzes the application and insures sufficient separation between repeaters (both in frequency and distance) before giving the OK to the FTZ to issue the license. The DARC makes the frequency assignments and tells the FTZ what frequency pair is to be on the license. As you can see, the DARC is a very powerful organization. But their power is well directed, and repeater wars are almost nonexistent in Germany.

DARC officials indicated that the 2 meter band was extremely crowded and that they could only agree to a repeater in operation on the 70 centimeter band (430-440 MHz). The USWARC discussed this proposal and agreed that a 70 cm repeater was acceptable.



The search for equipment then began in earnest. About the only rig available at first was the VHF Engineering 70 cm repeater. The projected cost of the repeater, coax, antenna, control logic, duplexer and miscellaneous parts soon grew to over $1000, and the repeater committee started looking for fundraising projects.

Some of the USWARC members are associated with Motorola GmbH, and high level corporate management was informed of the club's repeater project. Soon, a rebuilt 70 cm MOTRAC repeater, complete with control logic, duplexer, and 350 feet of 7/8" foam coax, was donated to the club by the corporation!

By this time, eight months had passed since first discussion of the project, and the committee was ready to install the repeater antenna. A CushCraft 4-pole phased array was purchased, and it was decided that the cardioid pattern should be directed toward Frankfurt (as that city was the farthest distance from the site in the area of desired coverage). Installation was planned for the first weekend in December. (Why do all complex antenna projects have to be accomplished in the winter?) The weather cooperated, and the weekend turned out to be clear and cold. Normally, German winter weather would prevent anyone from seeing the top of the tower from ground level. The job was time-consuming, with the installation of the heavy coax being the major back-breaker. The antenna was placed about 5 feet below the top of the tower, a definitely impressive location with a commanding view of the countryside.

The repeater was installed in a new upright cabinet, and work began on the control logic to conform with DARC standards. At about the same time, the repeater frequency pair was changed by the DARC due to complaints to the DBP by a repeater group who had previously operated a machine on the frequency pair assigned to the USWARC in the same general location as the club's repeater site. A new pair on standard channel R87 was assigned to the club, with input on 431.475 MHz and output on 439.075 MHz. This provided 25 kHz separation from the next adjacent channel (R86) and is the first such channel assignment in Germany. New frequency elements were purchased for the machine, and work continued.

Finally, all the modifications were complete and the repeater was tuned and adjusted for proper operation. The only remaining items were the repeater license and correct programming of the ID unit, which is a little tough without the correct callsign. The wait for the license seemed eternal, and was due to slight confusion over what the correct licensing office was, since the club, trustee, and repeater were in different DBP administrative areas. This was cleared up, and in the third week of March, 1977, the license was issued with the callsign DA4FB. This is another "first," as all other repeater callsigns in Germany have DBØ prefixes. The DA prefix simply reflects the American club's operation under the German-American reciprocal licensing agreement.

The ID unit was programmed, and the machine went into test operation for a week before being transported to the site. On April 9, 1977, the repeater was installed on-site, and DA4FB became the first American-sponsored repeater to be licensed and in operation in the Federal Republic of Germany.

The repeater system was designed to give base station to base station coverage over most of the area depicted in Fig. 1. It was soon found that coverage was better than that planned for. Solid mobile operations are possible within about 30-40 miles of the repeater site. A five Watt base station with an eleven element beam is able to fully quiet the repeater receiver from Rhein-Main Air Base near Frankfurt, a distance of 72 miles from the site. A mobile station using a ten Watt transceiver and a 5 dB gain mobile antenna has copied the repeater signal with full quieting in the city of Heidelberg, a distance of 75 miles. Occasionally, a QSO will be conducted with a station outside of the depicted area. One station, DC5NB, located in Aschaffenburg, is a regular on the repeater. He is 97 miles from the site, and uses two 91-element yagis: one for transmit and one for receive. (The Europeans are big on VHF, UHF, and microwave work.)

Many American hams reside in the coverage area, but not too many are active on the 70 cm band. Many US Army installations and all major USAF installations in Germany are within range of the repeater. Kaiserslautern boasts the largest American community outside the US, with over 50,000 Americans. *All* hams are invited to use the open repeater and also join in the activities of the USWARC. If any further information is needed about the club or the repeater, contact the club vice president at the following address: Jean Binet DCØHO/FØOAB, In den Haferwiesen #30, 6506 Nackenheim, West Germany.

Many of the club members participated in this project and, without everyone working together, the job would have taken much longer and probably would not have enjoyed such success. The following is a list of the hams who devoted their time and energy to the USWARC repeater project: Mike Baker W8CM/DA1BM, Carl Beckenbach WA1LHW/DA1TT, Tex Bell WD8BGA/DA1BO, Jean Binet FØOAB/DCØHO, Herb Brasington WB4EWX/DA1KD, Jerry Cole WA7YMR/DA1JC, Chuck Elquist W6JIF/DA1BZ, Ed Goldsby W3JKL/DA1UC, Terry Huston WA8RYC/DA1TH, Gerhardt Pless DC8CX, Joe Roman WB7CCK/DJØNA, Jerry Stewart K5CFQ/DA1HZ, John Stohel WB7CVU/DA1AY.

Special thanks are due to Mike Baker, who was the design engineer, mastermind, and driving force for the whole project. Without the multi-linguistic talents of Jean Binet and Carl Beckenbach, the liaison work with the DARC and the DBP would have been difficult indeed. The USWARC would also like to express its unfailing gratitude to Motorola GmbH for its complete support of the repeater project. ■

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30W	130W	130A30	$189
2W	80W	80A02	$169
10W	80W	80A10	$149
30W	80W	80A30	$159

UHF (400 to 512 MHz)

Drive Power	Output	Model No.	Price
2W	70W	70D02	$270
10W	70W	70D10	$250
30W	70W	70D30	$210
2W	40W	40D02	$180
10W	40W	40D10	$145
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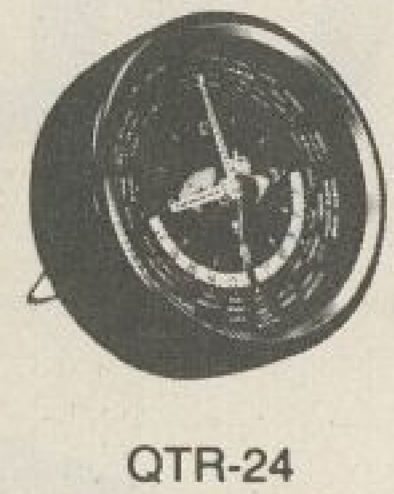
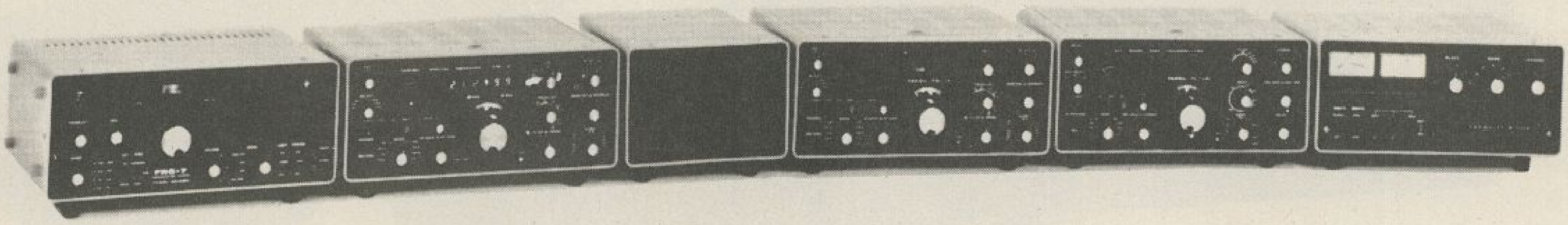
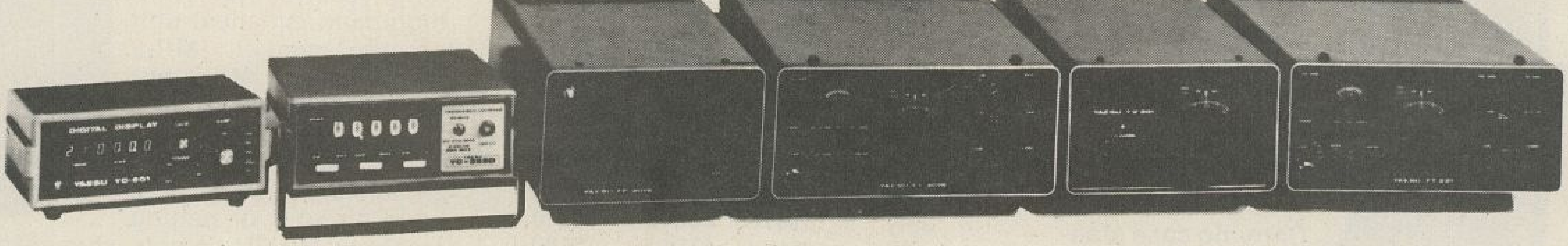


QTR-24
World Clock



Left to right – FRG-7, Solid State Synthesized Communications Receiver • FR-101 Digital. Solid State Receiver • SP-101B, Speaker • FR-101, Digital Solid State Receiver • FL-101, 100 W Transmitter • FL-2100B. 1200 W PEP Input Linear Amplifier

Left to right – FT-620B, 6 Meter Transceiver • YP-150, Dummy Load Wattmeter • YO-100, Monitor Scope • FTV-250, 2 Meter Transverter • FTV-650, 6 Meter Transverter • FV-101B, External VFO • FT-101E 160-10 M Transceiver



Left to right – YC-601, Digital Frequency Display • YC-355D, Frequency Counter • FP-301, AC Power Supply • FT-301S Digital, All Solid State Transceiver • FV-301, External VFO • FT-221, 144-148 All Solid State All Mode Transceiver

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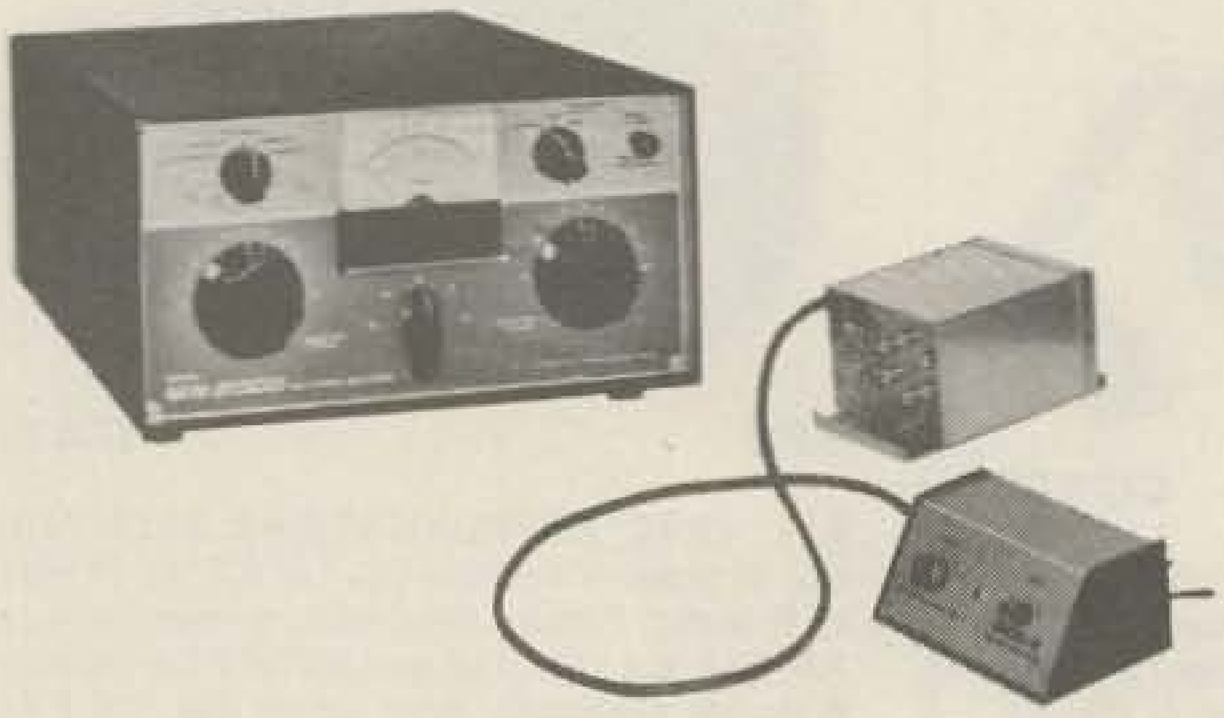

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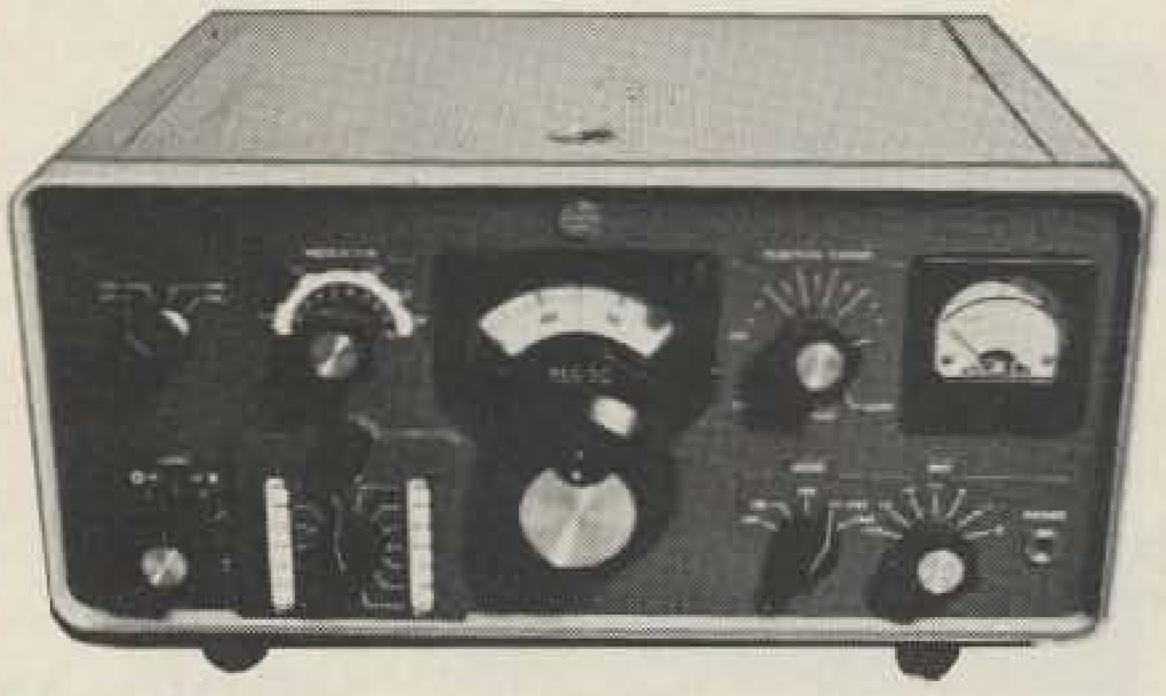

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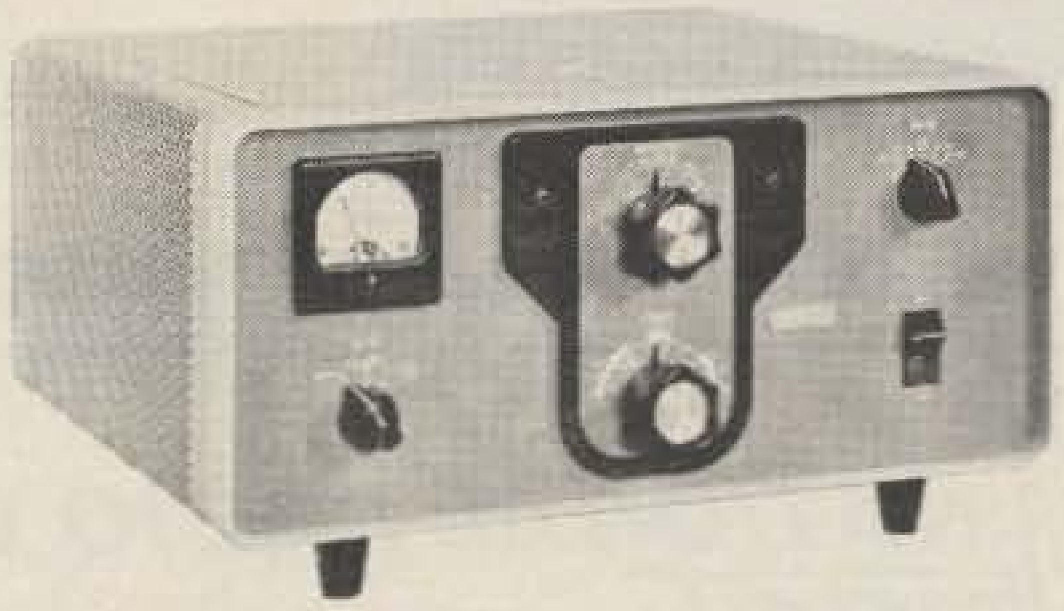

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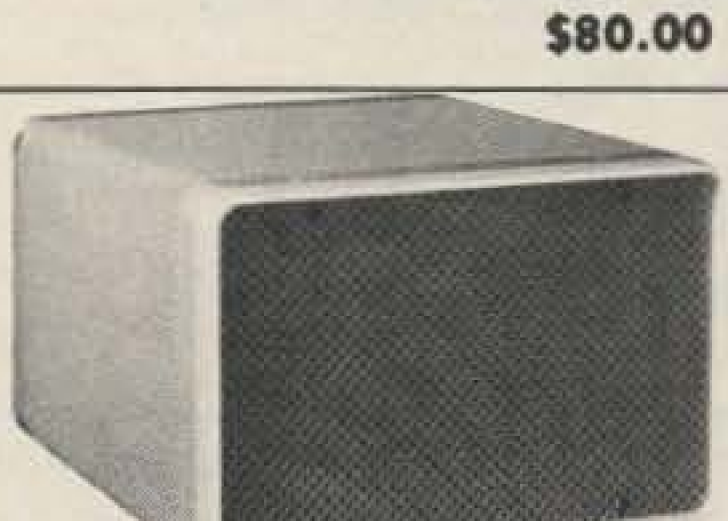

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5 watts	—	5A	5B	5C	5D	5E
10 watts	—	10A	10B	10C	10D	10E
25 watts	—	25A	25B	25C	25D	25E
50 watts	50H	50A	50B	50C	50D	50E
100 watts	100H	100A	100B	100C	100D	100E
250 watts	250H	250A	250B	250C	250D	250E
500 watts	500H	500A	500B	500C	500D	500E
1000 watts	1000H	1000A	1000B	1000C	1000D	1000E
2500 watts	2500H					
5000 watts	5000H					

Table 2
LOW-POWER ELEMENTS

1 watt	Cat. No.	2.5 watts	Cat. No.
60-80 MHz	060-1	60-80 MHz	060-2
80-95 MHz	080-1	80-95 MHz	080-2
95-125 MHz	095-1	95-150 MHz	095-2
110-160 MHz	110-1	150-250 MHz	150-2
150-250 MHz	150-1	200-300 MHz	200-2
200-300 MHz	200-1	250-450 MHz	250-2
275-450 MHz	275-1	400-850 MHz	400-2
425-850 MHz	425-1	800-950 MHz	800-2
800-950 MHz	800-1		

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OMK	Deluxe Mtg. Kit for 210X & 215X	48.00
220CS	AC Console for 210X & 215X	149.00
350-XL	Transceiver. SSB. Solid State. 10-160M. 350W.	995.00
DD6-XL	Digital Dial Readout for 350-XL	195.00
305	Plug-In Auxiliary VFO. For 350-XL	155.00
311	Plug-In Auxiliary Crystal Oscillator for 350-XL	135.00
350-PS	AC Pwr Supply w/Spkr & Phone Jack for 350-XL	195.00
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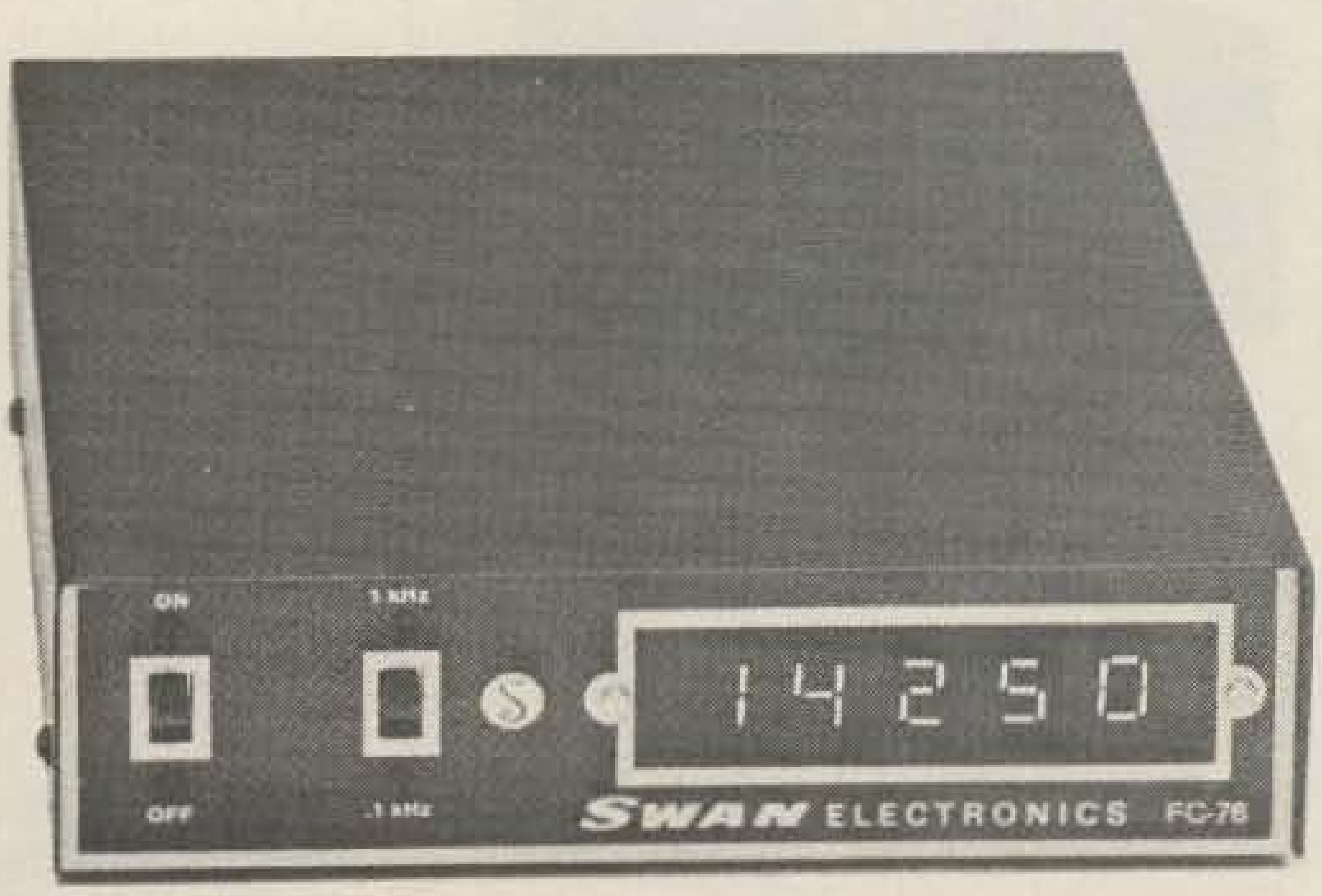
1200 X	Portable Linear Amplifier. 1200W PEP. SSB. 700W, Ch. 300W, AM. 80-10M.	349.95
FP-1	Hybrid Telephone Patch. Connect Rcvr/Xmitter to Phone lines	64.95



FC-76	Frequency Counter. 5 Digit LED	169.95
WM6200	In-Line Presicion Wattmater for 2M. 2 Scales to 200W. Reads SWR.	59.95
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SWR-1A	Relative Power Meter & SWR Bridge	25.95
W2000	In-Line Wattmeter. 3 Scales to 2000W. 3.5 to 30 MHz	59.95
WM-3000	Peak/RMS Wattmeter. Tells The Truth About SSB	79.95
FS-1	Pocket Field Strength Meter	10.95
WM1500	In-Line Wattmeter. 4 Scales to 1500W. 2 to 50 MHz	74.95
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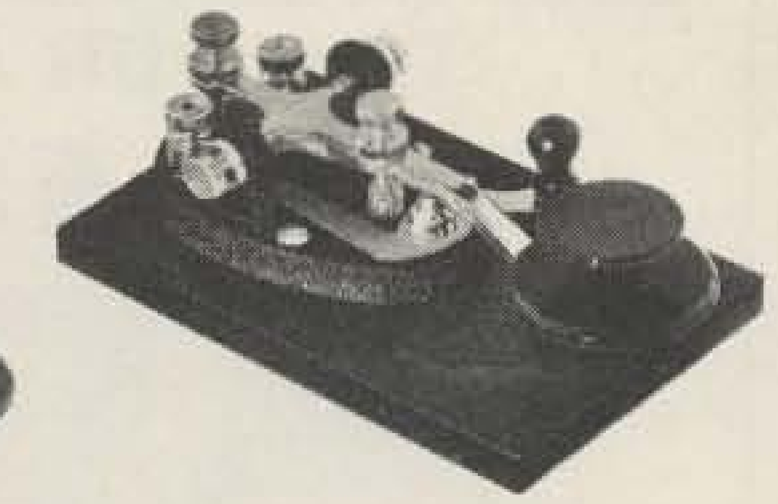

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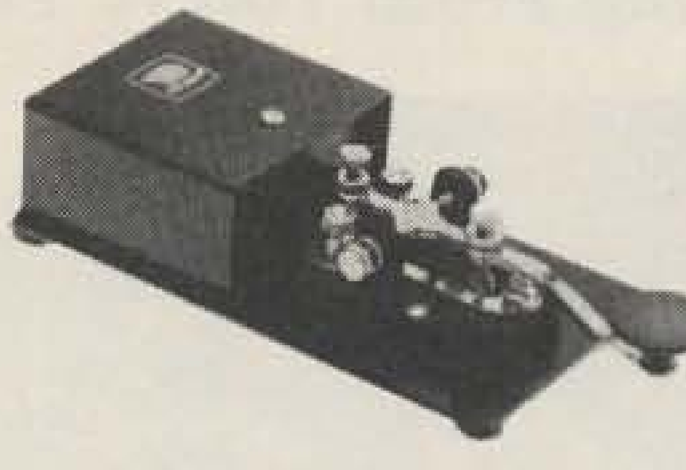

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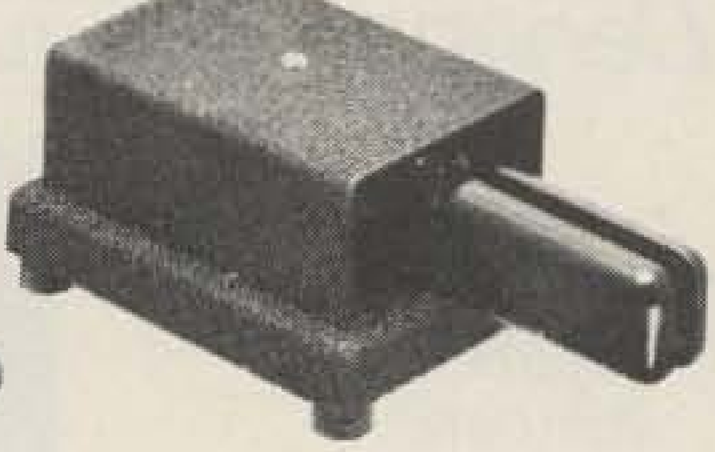

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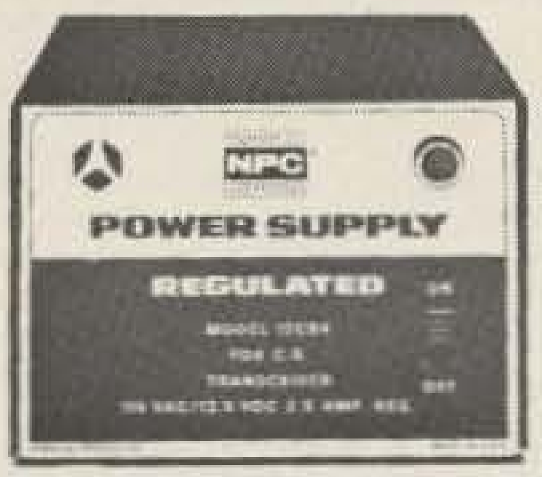
NPC

2.5 AMP



12CB4 29.95

4 AMP

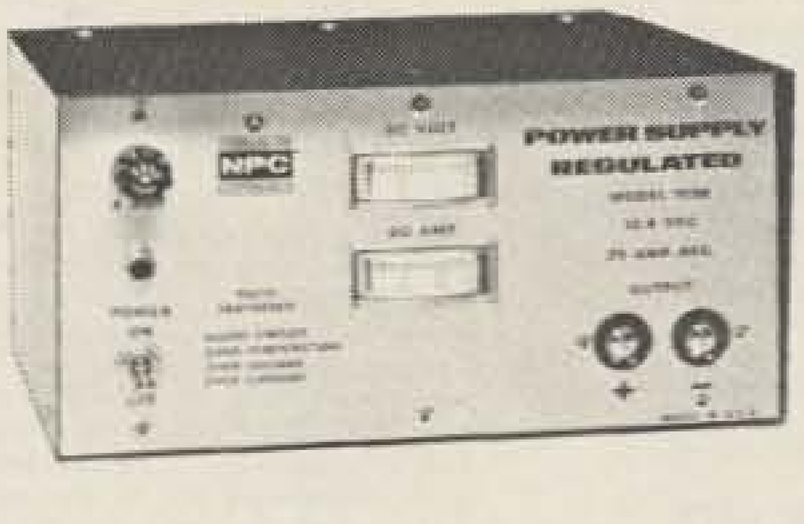
103R 39.95

6 AMP

104R 49.95

12 AMP

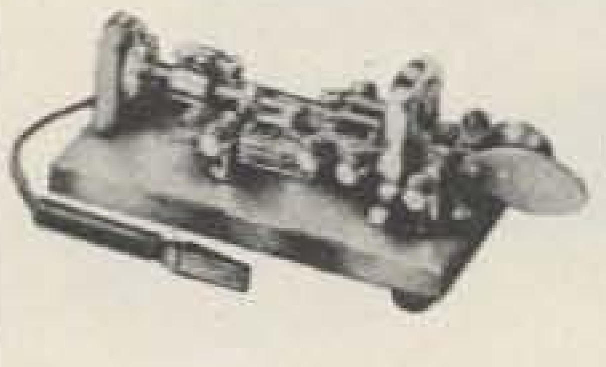
108 RM
99.95



25 AMP

109R 149.95

VIBROPLEX



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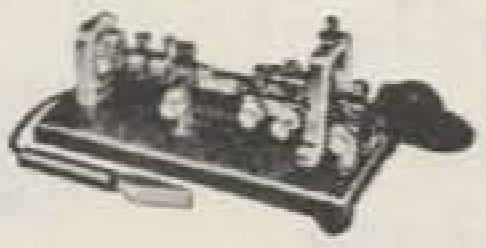

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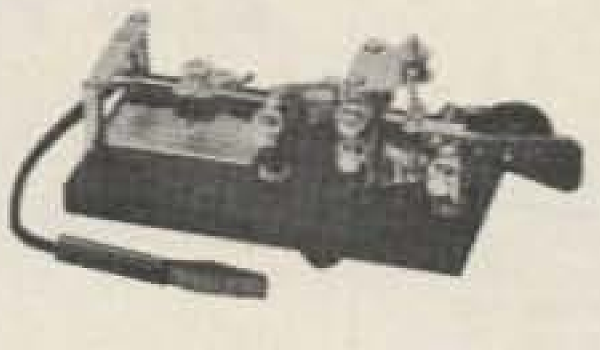
49.95



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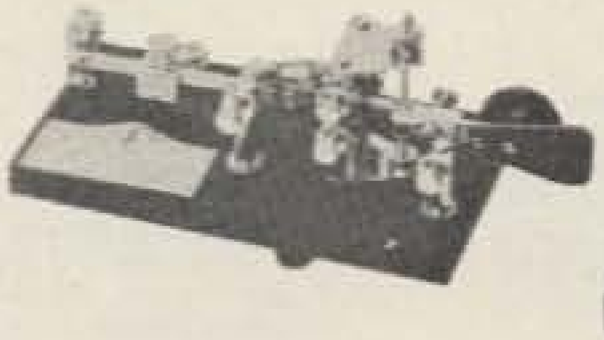

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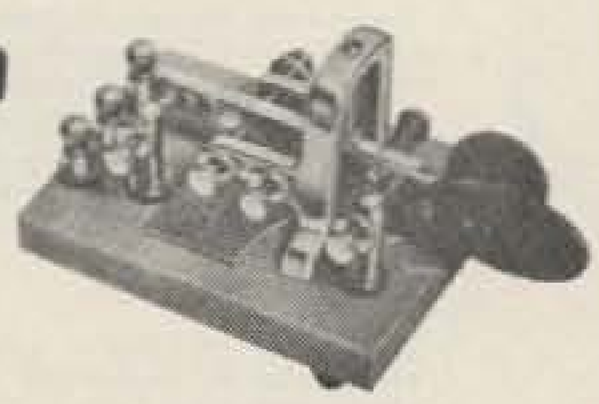
46.50



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80	200
40	entire band

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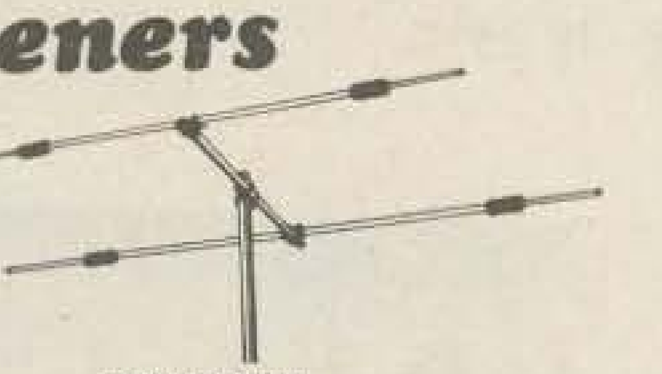

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The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantsatic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

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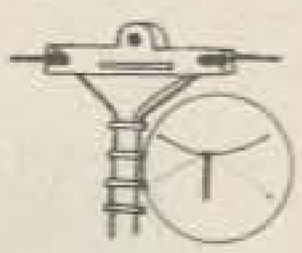

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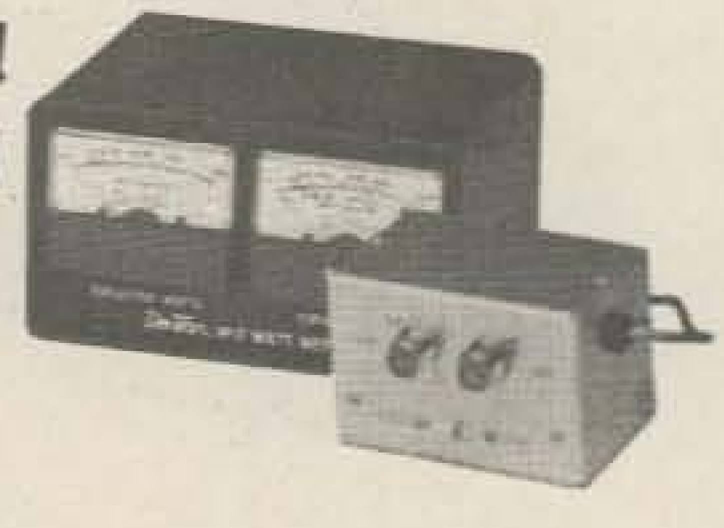

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Decode Morse

-- with an 8080

Why should you want to read another article on Morse decoding? I could tell you that this was the ultimate program (which it isn't), or that I have invented a new technique (I haven't). In fact, there is nothing tremendously novel about the material presented in this article. However, you will read about a completely general decoder algorithm which can be implemented on any microcomputer system. For those of you with an 8080-based system, a full program listing of the algorithm is included as an example.

My fascination with automatic decoding was fostered by the introduction of the first microprocessors. Up until then, I had considered the project too inflexible, from a hardware point of view. The microcomputer concept was appealing because of the easy way in which changes in the system could be implemented. I must admit that, from the very beginning, the problem of computer-generated Morse code was not as interesting a project, since it is relatively straightforward. Hence, this article will not be concerned with that aspect of a system.

The concepts used in this decoder are from many sources, including my own work. The magazine articles which I have studied are listed at the end of this article. Most authors start their presentation with a list of features and a description of the method for distinguishing dots from dashes. This is a good approach, so I will do likewise.

Decoder Features

My idea of desirable features are those that minimize the external hardware requirements for normal operation. There will always be special cases, which need advanced hardware for error-free operation.

Here is the list of features incorporated in my algorithm:

1. All program timing is done with software delays.
2. A sidetone is generated for monitoring the operation of the decoder.
3. An automatic carriage return/line feed (CRLF) sequence is generated.
4. The code input is debounced for reliable performance from a variety of sources.
5. The speed range is from at least 5 wpm to about 50 wpm.
6. The I/O routines that must be supplied by the user easily patch into the program.

The method used for interpreting dots, dashes, letters, and spaces is adapted from Petit's original article. Briefly, the rules are as follows:

1. If the key-down interval is ⩾ DD (the last dot-dash time, explained later), then the present element is a dash; otherwise, it is a dot.
2. If the key-up interval is ⩾ LS (the last letter-space time), then a character has been completely received and should be processed.
3. If the key-up interval is ⩾ 2LS, then a word has been completed.

Assuming a dot has been received, by rule 1, then DD is set to twice the duration of this dot. For dashes, a more complicated set of calculations is performed. In hand-sent code, which is most difficult for the computer, a tendency for variations in dash duration is common. This usually occurs at the end of words and often precedes a long pause during which the operator collects his thoughts. Therefore, I decided to average the received dash interval with the last received element. The averaging is accomplished by dividing the duration of the present dash by two and, then, adding the last value of DD. This is the LS value referred to in the above rules. By dividing by two once more, the new DD value is calculated. Two features result from this set of manipulations: (1) The letter-space decisions are heavily weighted by the duration of dashes, and (2) the effect of excessively long dash intervals is reduced. These seem like desirable traits, and yet do not add much complexity to the algorithm.

Software

The algorithm which has been partially discussed is presented in flowchart form in Figs. 1 and 2. A generalized symbolic approach, similar to BASIC statement

Variable	Description
TIME	Elapsed time counter (14 bits). If overflow occurs(>14 bits), time is set to large value.
DD	Dot-dash time(≈15 bits). Value is calculated in Dot and Dash routine.
LS	Letter-space time(≈15 bits).
STAT	Main status register: Bit 7 Key status = 1 if key down 6 DD Flag = 1 if TIME DD 5 LS Flag = 1 if TIME LS 4 Sidetone 3 --- 2, 1, 0 } Debounce counter
STAT2	Secondary status register Bits 5-0 are the CRLF counter
CODE	Code register, used for storage of incoming dots and dashes. For dots CODE = CODE * 2, for dashes CODE = (CODE * 2) + 1. Bits 5-0 are used.
CPTR	Column pointer, used for automatic CRLF function. Six bits or more may be required for storage.

Table 1. Description of variable storage requirements.

structure, is used, except for the status subroutine. This routine will be discussed in detail, since it is the cornerstone of the decoder.

The main routine is presented in Fig. 1. All the operations necessary for translating the received code into text form can be easily identified. Starting from the top and working down, the first step is program initialization, followed by a routine for printing a space.

After the space is printed, a key-down input causes the program to go to the Down routine. When the key returns to the up state, a branch to the Dot or Dash routine occurs. Within each routine, calculations for updating DD and LS, along with storage of the received elements, are made.

While the input continues in the key-up condition, the elapsed time is measured in the Wait routine. If an end of character is detected before the next down state, a transition to the Decode and Print routine is made. After printing the character, another wait loop is entered. If it times out, then a word has been received. Before printing a space, a check as to whether or not the algorithm should stop is performed. Usually the program will continue by printing a space.

Looking at the program subroutines presented in Fig. 2 will illustrate further details of the software. Four internal subroutines are called by the main program routines. These are (1) Status, (2) Print, (3) Decode, and (4) Delay. The Delay subroutine times out after 1 ms has elapsed. Obviously, this function will require different initialization, depending on the microcomputer used. The Decode subroutine performs the actual conversion from the dots and dashes, stored as a unique digital pattern, to the ASCII character representation.

In this algorithm, an automatic carriage return and line feed sequence is initiated by the first space character occurring after the 55th column. This is handled in the first section of the Print subroutine. Normally, the character is printed by calling a user-defined subroutine. However, if the CRLF sequence must be printed, the CR is immediately output, and a counter is set up for delaying the printout of a line feed.

The Status subroutine is the most complicated portion of software in the decoder. Note that all the timing in the main routine is determined by this subroutine. A call to the Delay routine, which returns after 1 ms, is the first action taken. Then the possibility that a line feed must be printed is tested and appropriate actions taken. Next, the key input (or receiver) is sampled for an up or down state. If a new state is detected, the debounce counter is decremented. A zero debounce count signifies that, in fact, the key has changed state and causes the key status to be updated. Otherwise, the debounce count is stored and the routine continues. Now the user-written routine for outputting the sidetone value is called, and, then, the elapsed time counter is incremented (checking for overflow). Lastly, the LS and DD flags, which indicate whether the time is ≥ LS or DD, are stored. These flags are easily checked in the main routine's decision-making process.

Details, Details . . .

Many flags, counters, pointers, and registers have been mentioned in the algorithm description. These are summarized in Table 1. In the 8080 listing presented, they occupy ten bytes of memory. Further explanation of the characteristics of these variables will complete the description of the algorithm.

The TIME counter is incremented as each pass through the Status subroutine is completed. An overflow condition is checked, and the variable is set to a large value, if

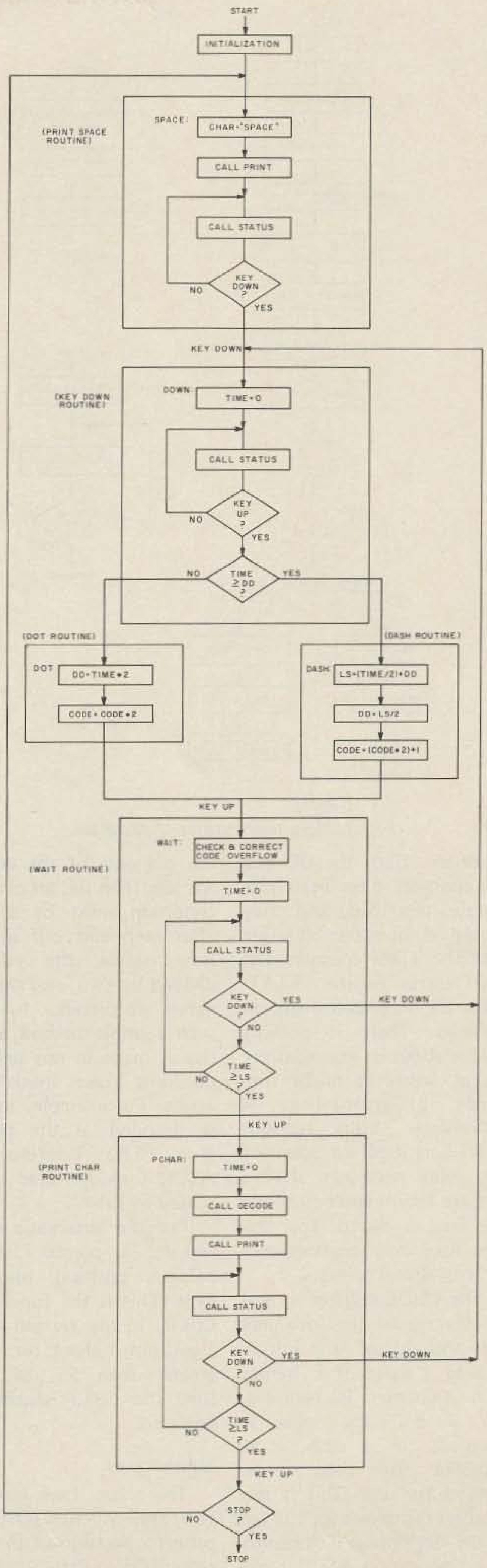

Fig. 1. Main decoder algorithm.

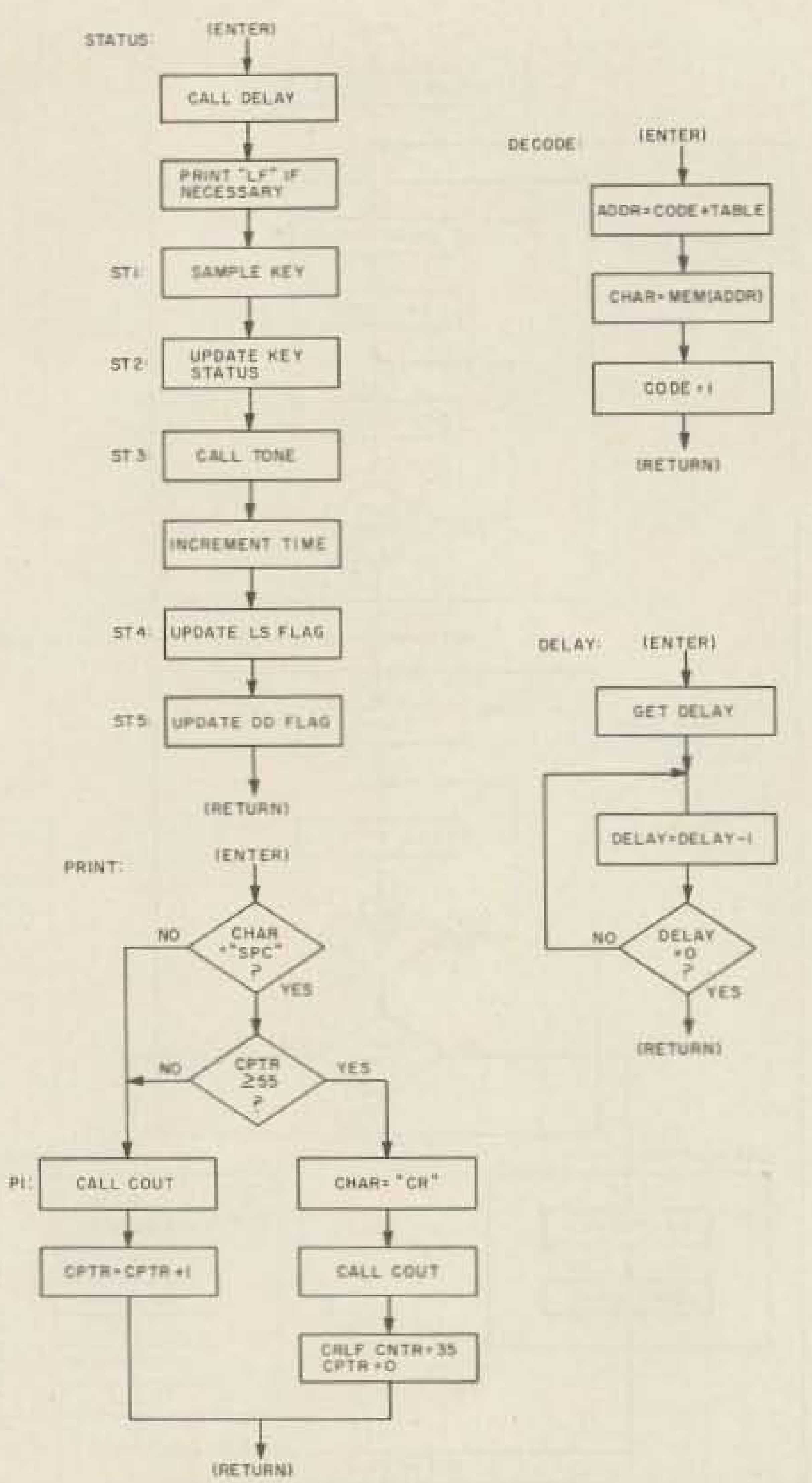

Fig. 2. Main subroutines of program.

00		20	5, and error
01		21	4
02	E	22	# ($\overline{SK}$)
03	T	23	3
04	I	24	
05	A	25	
06	N	26	?
07	M	27	2
08	S	28	= ($\overline{AS}$)
09	U	29	
0A	R	2A	.
0B	W	2B	
0C	D	2C	
0D	K	2D	
0E	G	2E	
0F	O	2F	1
10	H	30	6
11	V	31	& ($\overline{BT}$)
12	F	32	/
13		33	
14	L	34	
15		35	:
16	P	36	+ ($\overline{KN}$)
17	J	37	
18	B	38	7
19	X	39	,
1A	C	3A	
1B	Y	3B	
1C	Z	3C	8
1D	Q	3D	
1E		3E	9
1F		3F	0

Table 2. ASCII look-up table for character decoding. The hex number corresponds to the value of the code counter.

necessary. Both the DD and LS counters have been previously described, and they should be about one bit larger than the TIME counter. The main status register, STAT, holds the flags and single bit variables. There is nothing unique about its organization, except where it might simplify programming. A secondary status register, STAT2, is used for counting the delay necessary after a carriage return and before the line feed is issued. This feature may only be necessary for mechanical printers.

The CODE register is used for storage of the incoming dots and dashes. It is initialized to a value of 1 before each character is received. For a dot, the value is doubled; for a dash, it is doubled and then incremented by one. This is the simplest technique for storage of the elements, which results in a 64-location ASCII look-up table. To make sure that the contents of the counter are less than 64, an overflow condition must be checked after each entry. If an overflow occurs, the value is divided by two, and the algorithm continues. In using such a simple method, a sacrifice is made in not uniquely decoding a few special characters. For example, an error is decoded as the number five. The corresponding ASCII look-up table is presented in Table 2.

For the automatic CRLF feature, a pointer for the column position must be kept. This is the function of CPTR. In my version of the algorithm, I check for a value greater than 55, at which time the CRLF sequence is initiated.

Subroutines

There are two kinds of subroutines necessary for proper operation of the algorithm. The first kind, the main program subroutines, are well-defined for any microprocessor chosen for implementation of the decoder. The second type, user-supplied subroutines, will vary from one particular equipment setup to another. A few more comments concerning the first type will be made before attention is focused on the user-supplied subroutines.

There are several subtle aspects concerning the Status subroutine. In Fig. 1, the subroutine is called repeatedly while in the down state. The rate at which this loop is executed defines the frequency of the sidetone output. If all the possible paths through the Status subroutine are not matched for execution time, an instability in the sidetone output will result. A difference of only a few machine instructions can be detected by the ear. This problem can be handled by whatever method is easiest for the microcomputer used. In the 8080 example program, 13 bytes of extra jump instructions are used for the timing equalization.

The second point worth mentioning is the comparison of the TIME counter with LS and DD. Since these are 16-bit unsigned values, you will have to be careful if it is necessary to break it up into 8-bit comparisons. Beware of your microcomputer's 2's complement arithmetic!

The user-supplied I/O subroutine requirements are summarized in Table 3. There are four routines, which are concerned with printing a character, sampling the key input, generating the sidetone, and stopping execution of the program. All these functions require interfacing with your particular computer configuration.

As examples, the subroutines that I used in my 8080 program will be described. First, notice that they are linked to the main routines through an I/O patch table, which follows the Delay subroutine. This makes it possible to call the user subroutines from one section of code. There is no need to hunt through the listing for the subroutine calls when supplying your customized I/O. The Cout subroutine sends the ASCII character to the UART or display device, after checking if the device is ready. For sampling the key

COUT	Called by the Print subroutine. A character is passed, the UART status is checked, and the character is sent to the display device.
SKEY	An input line is tested for the key up or down state. The appropriate result is returned to the status subroutine.
CONT	The main program can be stopped by an appropriate hardware input which is checked by this routine.
TONE	Called by the status subroutine. If the key is down, toggle the sidetone output line and save value in STAT register. If key is up do nothing.

Table 3. User I/O subroutine specifications.

input, the Skey subroutine reads an input line and then returns with an appropriate flag. The Cont subroutine reads a status line and then either returns to the main program or stops execution. (Instead of stopping execution, a branch to another program would be possible.) A sidetone is generated by the Tone subroutine. The key state is checked, and, if the key is up, a return to Status occurs. Otherwise, the last sidetone value is toggled, output, and saved for the next iteration. This generates a square wave with a period equal to two passes through the Status subroutine.

User Modifications

Perhaps one of the most interesting aspects of playing with computer programs is making changes which reflect how you feel the program should have been written. Since I suspect many of you are already considering changes to this program, let me suggest a few first.

One possible modification would be to calculate a smaller value for LS (but not for DD). When copying the 18 wpm code bulletins from W1AW, I set LS = DD = [(TIME/2) + DD]/2, which is a simple change. Since the original LS value calculated in the algorithm is approximately equal to the average dash, this would suggest that Petit's rule, of using 3/4 of the dash, might be a good compromise.

Other possible changes include timing modifications and altering the line length for your particular terminal. Timing changes would be possible in the CRLF sequence (i.e., change CRDLY) or in the 1 ms Delay subroutine. By changing the duration of the delay, the sampling rate and sidetone frequency would be affected. If your display device doesn't accommodate at least 55 characters per line, this value could be changed (in the Print subroutine).

The four user-supplied subroutines are obvious places where you may require different code than in my examples. This could be as simple as changing port assignments.

Hardware

Simple hardware interfaces were built for the initial testing of the decoder. These are illustrated in Fig. 3 and consist of output and input circuitry.

The sidetone output is a square wave, which can easily drive a speaker using an emitter follower. The NPN transistor can be any power transistor out of your junk box. The interface for driving your display device is probably available from other projects, so I won't make any comments concerning this subject.

For receiving code, two simple circuits will get you going. Initially, I would suggest hooking up your favorite key or keyer to the code input line; a 1k pull-up resistor may be necessary. After the operation of the algorithm has been checked, it is time to connect a receiver to the computer.

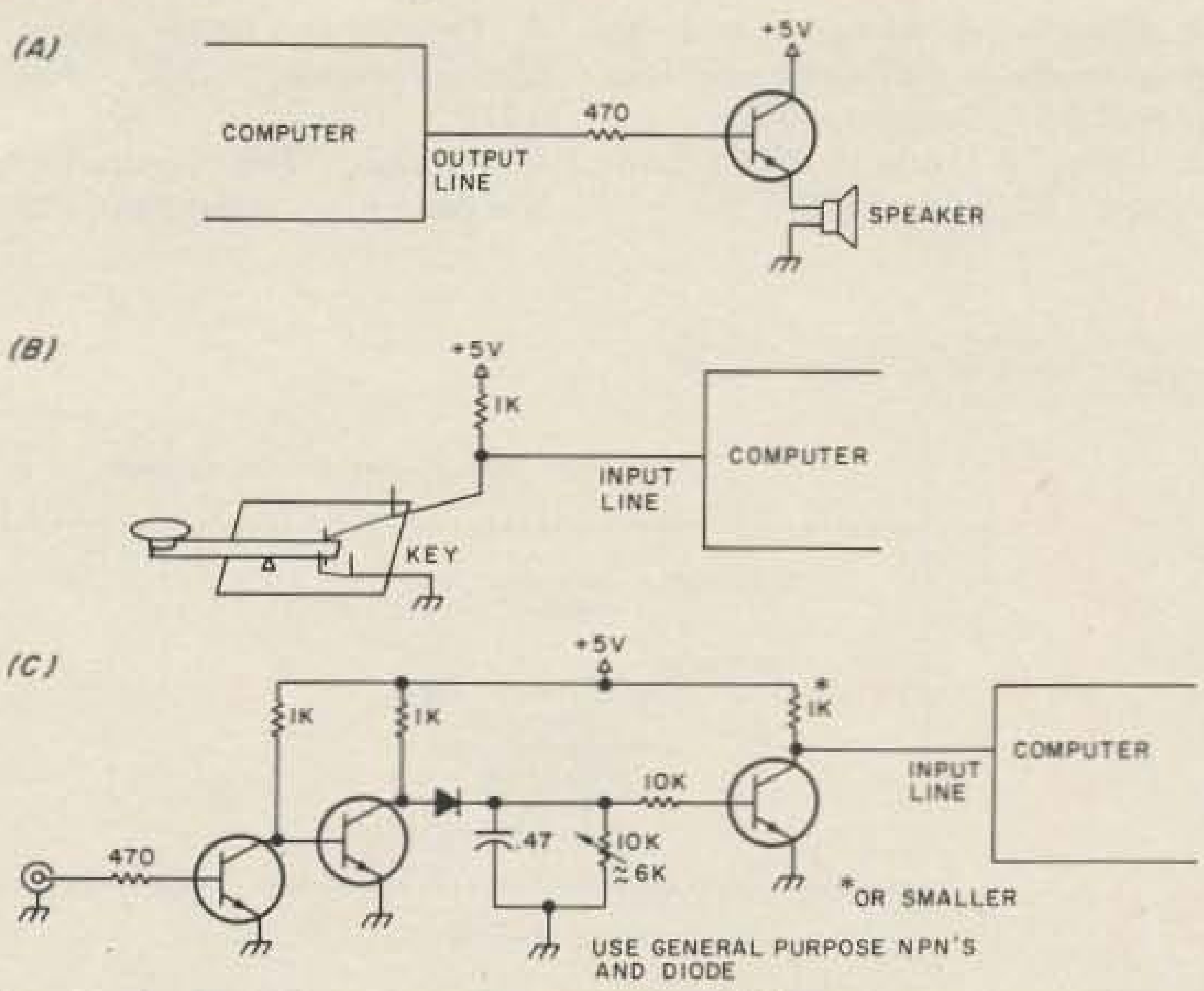

Fig. 3. Simple hardware interfaces. (a) Speaker connections; (b) key input; (c) receiver audio adapter.

I know of no easily constructed optimum interface between a receiver and a computer. Many ideas have been proposed, including narrow pass band filters and phase locked loops. These approaches are not appropriate for the goal of minimizing external hardware under normal conditions. Instead, I will assume you have a good receiver with an adequate CW filter. Connecting the circuit of Fig. 3(c) will provide satisfactory operation in most cases. The audio input is amplified (only about 2 V p-p input is required) and then applied to a peak detector, which follows the envelope of the received signal. The variable resistor can be used for adjusting the decay time constant, or a fixed value can be substituted. The output stage operates as a switch for driving the computer. By monitoring the sidetone output, the input level can be easily adjusted for any signal.

The Next Step Is Yours

With the information presented in this article, you should be able to program a computer for Morse code reception. If nothing else, this is an impressive demonstration for your friends. I hope you will not restrict your efforts solely to the ideas presented here, but will continue with further experimentation on your own.

Possible areas of experimentation include a different LS calculation, a BASIC program implementation, or matched filtering for the receiver interface. With a fast BASIC interpreter, most of the algorithm could be written directly from the flowcharts. However, the Status subroutine would be best left as a machine language program. Using some of the newly-available tapped analog delay lines (such as the Reticon TAD-32), an adaptive matched filter for optimum detection may be possible.

As a final challenge, consider how it might be possible to implement the decoder using one of the new single-chip microprocessors. The 8080 listing which follows is less than 512 bytes!

Thanks

I would like to thank the authors for writing the articles which are listed under references. A special thanks goes to Steve Belter WB9SGP, for his suggestions and support.

I will be happy to correspond directly with anyone on this subject; please include an SASE. ■

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```
8080 MDS MACRO ASSEMBLER, V2.2
WB9KPT MORSE CODE DECODER  6/77

                  ;
                          TITLE   'WB9KPT MORSE CODE DECODER  6/77
                  ;
                  ;********************************************************
                  ;
                  ;       8080 MORSE CODE DECODER
                  ;               W. THOMAS  WB9KPT  6/77
                  ;
                  ;       FEATURES:
                  ;               1)SOFTWARE TIMER
                  ;               2)SIDETONE
                  ;               3)AUTOMATIC CRLF
                  ;               4)DEBOUNCED INPUT
                  ;               5)5-50 WPM
                  ;               6)EASY I/O PATCHING
                  ;
                  ;********************************************************
                  ;
                  ;       USER ASSIGNED CONSTANTS:
                  ;
03FF                      MEMTOP  EQU     1023    ; TOP OF MEMORY
0084                      DLY     EQU     132     ; 1 MSEC DELAY
0023                      CRDLY   EQU     35      ; CRLF DELAY COUNT
0004                      DBNCE   EQU     4       ; DEBOUNCE VALUE
0000                      STOP    EQU     0       ; STOP ADDRESS
000A                      LF      EQU     0AH     ; LINE FEED
000D                      CR      EQU     0DH     ; CARRIAGE RETURN
0020                      SPC     EQU     20H     ; SPACE
                  ;
                  ;       VARIABLES ARE STORED HERE:
                  ;
0010                      ORG     10H
0010                      TIME:   DS      2       ;ELAPSED TIME
0012                      DD:     DS      2       ;DOT-DASH TIME
0014                      LS:     DS      2       ;LETTER-SPACE TIME
0016                      STAT:   DS      1       ;MAIN STATUS REGISTER
0017                      STAT2:  DS      1       ;2ND STATUS REGISTER
0018                      CODE:   DS      1       ;CODE COUNTER
0019                      CPTR:   DS      1       ;COLUMN POINTER
                  ;
                  ;********************************************************
                  ;
                  ;       MAIN PROGRAM    (START EXECUTION AT 60H)
                  ;
                  ;********************************************************
                  ;
0020                      ORG     20H     ;PROGRAM STARTS HERE
0020 20204554     TABLE:  DB      '  ETIANMSURWDKGO'  ;ASCII TABLE
0024 49414E4D
0028 53555257
002C 444B474F
0030 48564620             DB      'HVF L PJBXCYZQ  '
0034 4C20504A
0038 42584359
003C 5A512020
0040 35342333             DB      '54#3  ?2= .    1'
0044 20203F32
0048 3D202E20
004C 20202031
0050 36262F20             DB      '6&/  ;+ 7, 8 90'
0054 203B2B20
0058 372C2020
005C 38203930
0060 31FF03       START:  LXI     SP,MEMTOP ;SET STACK POINTER
0063 3E00                 MVI     A,0     ;INITIALIZE VARIABLES
0065 321900               STA     CPTR
0068 321600               STA     STAT
006B 321700               STA     STAT2
006E 3C                   INR     A
006F 321800               STA     CODE
0072 210000               LXI     H,0
0075 221000               SHLD    TIME
0078 21A000               LXI     H,160   ;10 WPM
007B 221200               SHLD    DD
007E 21F000               LXI     H,240
0081 221400               SHLD    LS
                  ;
                  ;       PRINT SPACE ROUTINE
                  ;
0084 3E20         SPACE:  MVI     A,SPC   ;CHAR="SPACE"
0086 CDA501               CALL    PRINT
0089 CD2701        S1:    CALL    STATUS
008C 3A1600               LDA     STAT    ;KEY DOWN?
008F E680                 ANI     80H
0091 CA8900               JZ      S1      ;LOOP IF KEY UP
                  ;
                  ;       DOWN ROUTINE
                  ;
0094 210000       DOWN:   LXI     H,0
0097 221000               SHLD    TIME    ;TIME=0
009A CD2701        DW1:   CALL    STATUS
009D 3A1600               LDA     STAT    ;KEY UP?
00A0 E680                 ANI     80H
00A2 C29A00               JNZ     DW1     ;IF NOT, LOOP
00A5 3A1600               LDA     STAT    ;TIME >OR= DD?
00A8 E640                 ANI     40H
00AA C2BB00               JNZ     DASH    ;IF YES, GO TO DASH
                  ;
                  ;       DOT ROUTINE
                  ;
00AD 2A1000               LHLD    TIME    ;GET TIME
00B0 29                   DAD     H
00B1 221200               SHLD    DD      ;DD=TIME*2
00B4 3A1800               LDA     CODE    ;GET CODE COUNTER
00B7 87                   ADD     A       ;CODE=CODE*2
00B8 C3DF00               JMP     WAIT    ;GO TO WAIT
                  ;
                  ;       DASH ROUTINE
                  ;
00BB 2A1000       DASH:   LHLD    TIME    ;GET TIME
00BE CDD700               CALL    HL2     ;TIME/2  (PART OF DASH)
00C1 EB                   XCHG            ;MOVE TO DE REGISTERS
00C2 2A1200               LHLD    DD      ;GET DD TIME
00C5 19                   DAD     D       ;(TIME/2)+DD
00C6 221400               SHLD    LS      ;LS=(TIME/2)+DD
00C9 CDD700               CALL    HL2     ;LS/2
00CC 221200               SHLD    DD      ;DD=LS/2
00CF 3A1800               LDA     CODE    ;GET CODE COUNTER
00D2 87                   ADD     A
00D3 3C                   INR     A       ;CODE=(CODE*2)+1
00D4 C3DF00               JMP     WAIT    ;GO TO WAIT
00D7 7C           HL2:    MOV     A,H     ;DIVIDE HL BY 2
00D8 B7                   ORA     A       ;SET CARRY=0
00D9 1F                   RAR
00DA 67                   MOV     H,A     ;H=H/2
00DB 7D                   MOV     A,L
00DC 1F                   RAR
00DD 6F                   MOV     L,A     ;L=L/2
00DE C9                   RET
                  ;
                  ;       WAIT ROUTINE
                  ;
00DF FE40         WAIT:   CPI     64      ;CODE OVERFLOW?
00E1 FAE600               JM      W1      ;IF NOT, GO TO STORE CODE
00E4 B7                   ORA     A       ;SET CARRY=0
00E5 1F                   RAR
00E6 321800        W1:    STA     CODE    ;STORE NEW CODE
00E9 210000               LXI     H,0
00EC 221000               SHLD    TIME    ;TIME=0
00EF CD2701        W2:    CALL    STATUS
00F2 3A1600               LDA     STAT    ;KEY DOWN?
00F5 E680                 ANI     80H
00F7 C29400               JNZ     DOWN    ;IF YES,GO TO DOWN
00FA 3A1600               LDA     STAT    ;TIME >OR= LS?
00FD E620                 ANI     20H
00FF CAEF00               JZ      W2      ;IF NOT, WAIT
                  ;
                  ;       PRINT CHARACTER ROUTINE
                  ;
0102 210000       PCHAR:  LXI     H,0
0105 221000               SHLD    TIME    ;TIME=0
0108 CDD501               CALL    DECODE  ;DECODE CHARACTER
010B CDA501               CALL    PRINT   ;PRINT CHARACTER
010E CD2701        PC1:   CALL    STATUS
0111 3A1600               LDA     STAT    ;KEY DOWN?
0114 E680                 ANI     80H
0116 C29400               JNZ     DOWN    ;IF YES, GO TO DOWN
0119 3A1600               LDA     STAT
011C E620                 ANI     20H     ;TIME >OR= LS?
011E CA0E01               JZ      PC1     ;IF NOT, LOOP
                  ;
                  ;       CONTINUE ROUTINE
                  ;
0121 CDE901               CALL    @CONT   ;STOP?
0124 C38400               JMP     SPACE   ;IF NOT, PRINT SPACE
                  ;
                  ;********************************************************
                  ;
                  ;       MAIN PROGRAM SUBROUTINES
                  ;
                  ;********************************************************
                  ;
                  ;       STATUS SUBROUTINE
                  ;         TEMPORARY STORAGE:
                  ;               B REG= STAT
                  ;               C REG= KEY SAMPLE
                  ;               DE REG= TIME
                  ;
0127 2684         STATUS: MVI     H,DLY   ;LOAD DELAY VALUE
0129 CDE301               CALL    DELAY
012C 3A1700               LDA     STAT2   ;GET CRLF COUNTER
012F E63F                 ANI     3FH     ;MASK CRLF COUNT
0131 CA4001               JZ      ST1     ;IF =0,GO TO SAMPLE KEY
0134 3D                   DCR     A       ;DECREMENT CRLF COUNT
0135 321700               STA     STAT2   ;STORE STAT2
0138 C24001               JNZ     ST1     ;IF NOT =0,GO TO SAMPLE KEY
013B 3E0A                 MVI     A,LF    ;CHAR="LF"
013D CDA501               CALL    PRINT   ;PRINT LINE FEED
0140 CDED01        ST1:   CALL    @SKEY   ;SAMPLE KEY INPUT
0143 3A1600               LDA     STAT    ;GET STAT
0146 E69F                 ANI     9FH     ;RESET TIME FLAGS: LS=DD=0
0148 47                   MOV     B,A     ;SAVE STAT
0149 E680                 ANI     80H     ;MASK KEY STATUS
014B B9                   CMP     C       ;KEY=SAMPLE?
014C CA5001               JZ      ST2     ;IF YES,GO TO UPDATE KEY STATUS
014F 04                   INR     B       ;DEBOUNCE=DEBOUNCE+1
0150 78            ST2:   MOV     A,B     ;UPDATE KEY STATUS
0151 E607                 ANI     07H     ;MASK DEBOUNCE
0153 FE04                 CPI     DBNCE   ;NEW KEY STATE?
0155 C25D01               JNZ     ST3     ;IF NOT,GO TO CALL TONE
0158 78                   MOV     A,B     ;GET STAT
0159 E670                 ANI     70H     ;RESET STAT: KEY=DEBOUNCE=0
015B 81                   ADD     C       ;NEW KEY STATUS
015C 47                   MOV     B,A     ;SAVE STAT
015D CDF101        ST3:   CALL    @TONE   ;SERVICE SIDETONE
0160 2A1000               LHLD    TIME    ;GET TIME
0163 23                   INX     H       ;TIME=TIME+1
0164 7C                   MOV     A,H     ;CHECK FOR OVERFLOW
0165 E6C0                 ANI     0C0H
0167 CA6F01               JZ      ST4A    ;IF NOT,STORE TIME+1
016A 263F                 MVI     H,3FH   ;IF YES,STORE LARGE TIME
016C 221000        ST4:   SHLD    TIME    ;STORE TIME
016F EB                   XCHG            ;MOVE TIME TO DE REGISTERS
0170 2A1400               LHLD    LS      ;GET LS TIME
0173 CD9C01               CALL    CMPS    ;TIME >OR= LS?
0176 D29201               JNC     ST5A    ;IF NOT,GO TO DD TEST
0179 78                   MOV     A,B     ;GET STAT
017A F620                 ORI     20H     ;SET LS FLAG=1
017C 47                   MOV     B,A     ;SAVE STAT
017D 2A1200        ST5:   LHLD    DD      ;GET DD TIME
0180 CD9C01               CALL    CMPS    ;TIME >OR= DD?
0183 D29701               JNC     ST6A    ;IF NOT,GO TO STORE STAT
0186 78                   MOV     A,B     ;GET STAT
0187 F640                 ORI     40H     ;SET DD FLAG=1
0189 47                   MOV     B,A     ;SAVE STAT
018A 78            ST6:   MOV     A,B     ;GET STAT
018B 321600               STA     STAT    ;STORE STAT
018E C9                   RET
```

```
                ; TIMING EQUALIZATION FOR SIDETONE PURITY
019F C36C01      ST4A:  JMP     ST4     ;GO TO STORE TIME
0192 F600        ST5A:  ORI     0       ;DO NOTHING
0194 C37D01             JMP     ST5     ;GO TO DD TEST
0197 F600        ST6A:  ORI     0       ;DO NOTHING
0199 C38A01             JMP     ST6     ;GO TO STORE STAT
                ; COMPARE SUBROUTINE (IF DE >OR= HL THEN CARRY=1)
019C 7C          CMPS:  MOV     A,H     ;HL=2'S COMPLEMENT OF HL
019D 2F                 CMA
019E 67                 MOV     H,A
019F 7D                 MOV     A,L
01A0 2F                 CMA
01A1 6F                 MOV     L,A
01A2 23                 INX     H
01A3 19                 DAD     D       ;IF DE >OR= HL THEN CARRY=1
01A4 C9                 RET
                ;
                ;       PRINT SUBROUTINE
                ;               CHARACTER IS IN "A" REGISTER
                ;
01A5 C5         PRINT:  PUSH    B       ;SAVE BC REGISTERS
01A6 FE20               CPI     SPC     ;IS CHAR="SPACE"?
01A8 C2C901             JNZ     P1      ;IF NOT, PRINT CHAR
01AB 3A1900             LDA     CPTR    ;GET COLUMN POINTER
01AE FE37               CPI     55      ;CP >OR= 55?
01B0 3E20               MVI     A,SPC   ;RESTORE CHAR="SPACE"
01B2 FAC901             JM      P1      ;IF NOT, PRINT CHAR
01B5 3E0D               MVI     A,CR    ;CHAR="CR"
01B7 CDF501             CALL    @COUT   ;PRINT CARRIAGE RETURN
01BA 97                 SUB     A       ;SET A=0
01BB 321900             STA     CPTR    ;CP=0
01BE 3A1700             LDA     STAT2   ;GET STAT2
01C1 F623               ORI     CRDLY   ;SET CRLF COUNT
01C3 321700             STA     STAT2   ;STORE STAT2
01C6 C3D301             JMP     P2      ;GO TO RESTORE BC
01C9 CDF501      P1:    CALL    @COUT   ;PRINT CHAR
01CC 3A1900             LDA     CPTR    ;GET COLUMN POINTER
01CF 3C                 INR     A       ;CP+1
01D0 321900             STA     CPTR    ;CP=CP+1
01D3 C1          P2:    POP     B       ;RESTORE BC REGISTERS
01D4 C9                 RET
                ;
                ;       DECODE SUBROUTINE
                ;
01D5 3A1800     DECODE: LDA     CODE    ;GET CODE COUNTER
01D8 C620               ADI     TABLE   ;CALCULATE ADDRESS
01DA 6F                 MOV     L,A     ;SET L=ADDRESS
01DB 97                 SUB     A       ;SET A=0
01DC 67                 MOV     H,A     ;SET H=0
01DD 3C                 INR     A
01DE 321800             STA     CODE    ;STORE CODE=1
01E1 7E                 MOV     A,M     ;CHAR=TABLE(ADDRESS)
01E2 C9                 RET
                ;
                ;       DELAY SUBROUTINE
                ;         ASSUMES 2MHZ CLOCK,NO WAIT STATES
                ;           DELAY=(DLY*7.5)+7.5 USEC
                ;
01E3 7C         DELAY:  MOV     A,H     ;GET DLY VALUE
01E4 3D          DLY1:  DCR     A
01E5 C2E401             JNZ     DLY1
01E8 C9                 RET
                ;
                ;       I/O PATCH TABLE
                ;         ALLOWS EASY I/O DRIVER ASSIGNMENTS
                ;         FOR USER SUPPLIED SUBROUTINES
                ;
01E9 CD1102     @CONT:  CALL    CONT    ;CALL CONT SUBROUTINE
01EC C9                 RET
01ED CD0402     @SKEY:  CALL    SKEY    ;CALL SKEY SUBROUTINE
01F0 C9                 RET
01F1 CD1902     @TONE:  CALL    TONE    ;CALL TONE SUBROUTINE
01F4 C9                 RET
01F5 CDF901     @COUT:  CALL    COUT    ;CALL COUT SUBROUTINE
01F8 C9                 RET
                ;
                ;*****************************************************
                ;
                ;       USER DEFINED SUBROUTINES  (EXAMPLES FOLLOW)
                ;
                ;*****************************************************
                ;
                ;       COUT SUBROUTINE
                ;         SENDS CHAR IN "A" REG TO UART
                ;
01F9 47         COUT:   MOV     B,A     ;SAVE CHAR
01FA DBF7        CH1:   IN      0F7H    ;XMIT READY?  (BIT 0)
01FC 1F                 RAR
01FD D2FA01             JNC     CH1     ;IF NOT, LOOP
0200 78                 MOV     A,B     ;PRINT CHARACTER
0201 D3F6               OUT     0F6H    ;UART XMIT PORT
0203 C9                 RET
                ;
                ;       SKEY SUBROUTINE
                ;               RESULT RETURNED IN "C" REG
                ;                 IF DOWN THEN C=80H
                ;
0204 DB10       SKEY:   IN      10H     ;READ KEY INPUT PORT
0206 E601               ANI     1       ;KEY DOWN?  (BIT 0)
0208 C20E02             JNZ     SK1     ;JUMP IF DOWN
020B 0E00               MVI     C,0     ;KEY UP
020D C9                 RET
020E 0E80        SK1:   MVI     C,80H   ;KEY DOWN
0210 C9                 RET
                ;
                ;       CONT SUBROUTINE
                ;         CHECK FOR RCVR READY
                ;           RETURN IF CONTINUE
                ;
0211 DBF7       CONT:   IN      0F7H    ;GET RCVR READY  (BIT 1)
0213 E602               ANI     02H
0215 C8                 RZ              ;IF ZERO, CONTINUE
0216 C30000             JMP     STOP    ;OTHERWISE... STOP!
                ;
                ;       TONE SUBROUTINE
                ;         IF KEY DOWN THEN CHANGE SIDETONE
                ;           STATUS IN "B" REG
                ;
0219 78         TONE:   MOV     A,B     ;GET STAT
021A 17                 RAL             ;KEY UP?
021B D0                 RNC             ;IF KEY UP RETURN
021C 1F                 RAR             ;RESTORE STAT
021D EE10               XRI     10H     ;TOGGLE SIDETONE
021F 47                 MOV     B,A     ;SAVE STAT
0220 1F                 RAR             ;OUTPUT SIDETONE
0221 1F                 RAR
0222 1F                 RAR
0223 1F                 RAR
0224 D310               OUT     10H
0226 C9                 RET
                ;
0000                    END

@CONT  01E9     @COUT  01F5     @SKEY  01ED     @TONE  01F1
CH1    01FA     CMPS   019C     CODE   0018     CONT   0211
COUT   01F9     CPTR   0019     CR     000D     CRDLY  0023
DASH   00BB     DANCE  0004     DD     0012     DECOD  01D5
DELAY  01E3     DLY    0084     DLY1   01E4     DOWN   0094
DW1    009A     HL2    00D7     LF     000A     LS     0014
MEMTO  03FF     P1     01C9     P2     01D3     PC1    010E
PCHAR  0102     PRINT  01A5     S1     0089     SK1    020E
SKEY   0204     SPACE  0084     SPC    0020     ST1    0140
ST2    0150     ST3    015D     ST4    016C     ST4A   018F
ST5    017D     ST5A   0192     ST6    018A     ST6A   0197
START  0060     STAT   0016     STAT2  0017     STATU  0127
STOP   0000     TABLE  0020     TIME   0010     TONE   0219
W1     00E6     W2     00FF     WAIT   00DF
```

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HEX PROGRAM DUMP:
  (INCLUDING EXAMPLE USER DEFINED SUBROUTINES)

D20,226
0020 20 20 45 54 49 41 4E 4D 53 55 52 57 44 4B 47 4F
0030 48 56 46 20 4C 20 50 4A 42 58 43 59 5A 51 20 20
0040 35 34 23 33 20 20 3F 32 3D 20 2E 20 20 20 20 31
0050 36 26 2F 20 20 3B 2B 20 37 2C 20 20 38 20 39 30
0060 31 FF 03 3E 00 32 19 00 32 16 00 32 17 00 3C 32
0070 18 00 21 00 00 22 10 00 21 90 00 22 12 00 21 F0
0080 00 22 14 00 3E 20 CD A5 01 CD 27 01 3A 16 00 E6
0090 80 CA 89 00 21 00 00 22 10 00 CD 27 01 3A 16 00
00A0 E6 80 C2 9A 00 3A 16 00 E6 40 C2 BB 00 2A 10 00
00B0 29 22 12 00 3A 18 00 87 C3 DF 00 2A 10 00 CD D7
00C0 00 EB 2A 12 00 19 22 14 00 CD D7 00 22 12 00 3A
00D0 18 00 87 3C C3 DF 00 7C B7 1F 67 7D 1F 6F C9 FE
00E0 40 FA E6 00 B7 1F 32 18 00 21 00 00 22 10 00 CD
00F0 27 01 3A 16 00 E6 80 C2 94 00 3A 16 00 E6 20 CA
0100 EF 00 21 00 00 22 10 00 CD D5 01 CD A5 01 CD 27
0110 01 3A 16 00 E6 80 C2 94 00 3A 16 00 E6 20 CA 0E
0120 01 CD E9 01 C3 84 00 26 84 CD E3 01 3A 17 00 E6
0130 3F CA 40 01 3D 32 17 00 C2 40 01 3E 0A CD A5 01
0140 CD ED 01 3A 16 00 E6 9F 47 E6 80 B9 CA 50 01 04
0150 78 E6 07 FE 04 C2 5D 01 78 E6 70 81 47 CD F1 01
0160 2A 10 00 23 7C E6 C0 CA 8F 01 26 3F 22 10 00 EB
0170 2A 14 00 CD 9C 01 D2 92 01 78 F6 20 47 2A 12 00
0180 CD 9C 01 D2 97 01 78 F6 40 47 78 32 16 00 C9 C3
0190 6C 01 F6 00 C3 7D 01 F6 00 C3 8A 01 7C 2F 67 7D
01A0 2F 6F 23 19 C9 C5 FE 20 C2 C9 01 3A 19 00 FE 37
01B0 3E 20 FA C9 01 3E 0D CD F5 01 97 32 19 00 3A 17
01C0 00 F6 23 32 17 00 C3 D3 01 CD F5 01 3A 19 00 3C
01D0 32 19 00 C1 C9 3A 18 00 C6 20 6F 97 67 3C 32 18
01E0 00 7E C9 7C 3D C2 E4 01 C9 CD 11 02 C9 CD 04 02
01F0 C9 CD 19 02 C9 CD F9 01 C9 47 DB F7 1F D2 FA 01
0200 78 D3 F6 C9 DB 10 E6 01 C2 0E 02 0E 00 C9 0E 80
0210 C9 DB F7 E6 02 C8 C3 00 00 78 17 D0 1F EE 10 47
0220 1F 1F 1F 1F D3 10 C9
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Frank J. Derfler K9KIC
99-1440 Aiea Hts. Dr. #51
Aiea HI 96701

Futureshot

-- just around the corner

Fred Thompson hurried through the shopping mall. His watch showed him that it was 8:57, and he knew that Harry closed the doors promptly at 9 pm. Harry's Computer Store was the largest in the city, and Fred was sure Harry would have the integrated circuit he needed.

"Whoa," Fred said, "got time for a paying customer, don't you?"

"Sure," Harry backed away from the door he was about to close and chuckled, "glad to take your money. What do you need?"

"Program chip." Fred answered. "Got a French language course?"

"Check the wall unit over there. We don't get too much call for those, so it's probably down in the bottom cabinets someplace."

Fred keyed "French language" into the wall mini-terminal. The liquid crystal display listed two brand names.

"Hey, you've got two kinds in stock."

"Better check," Harry advised, "one might use two chips."

Fred asked the computer for a compare and contrast. Sure enough, one program, which gave complete branching and learning reinforcement, used two chips. One chip was the program and a file. The other was just a vocabulary file of four megabits. The price differential was only about 30%. Fred touched the listing for the two-chip version to indicate his choice. A green LED came on over the handle of the bottom drawer. He opened the drawer and took out one of the bags from the cubbyhole indicated by a photoluminescent panel.

"What, no servomechanism to drop it in front of the point of sale terminal?" Fred chided.

"I told you we don't get much call for that program," Harry responded. "Gotta save the gadgets for the big sellers — private secretary and the like."

"Been selling a lot of the private secretary?"

"Oh yeah, been selling a lot of the vocal interfaces, too, both male and female voices."

"I didn't buy the talk feature. I think it's great telling the machine what to do without any backtalk."

"Yeah, they say the darnedest things. Don't know what some of those programmers are thinking of sometimes. Well, anything else? We called up a back file of 'Star Trek' on the TV tonight, and I want to get home to make sure it gets recorded okay."

"Captain Kirk still chasing Klingons, eh? How much do I owe you?"

"With state and federal sales tax, twenty dollars and forty cents. Want to use my terminal or have you got your remote toy with you? Last ham radio operator I had in here insisted on using his homemade handi-term. Took him three tries, and he wound up crediting me with a hundred dollars too much."

"Never fear, mine works!" Fred said. He pulled back his shirt sleeve to reveal what appeared to be an odd-shaped calculator, with a rubber stick attached. "I don't mind an exterior antenna. Gives me great coverage through the local repeater," he said. As he talked, he composed a digital message that consisted of his amateur radio callsign, Harry's account number, his account number, the date (November 2, 1985), and the amount. He pressed the transmit button, and Harry's counter terminal registered the correct transfer on its readout. "Hah, see!" he said proudly.

"How long do you figure till everybody has one of those?" Harry asked.

"Probably never, except for a few kinds of salesmen. It's just a toy, like you said. Well, thanks a lot."

"Thank you. We've got Spanish, Russian, any kind of language course you want."

"This is for my daughter's French class. A few of the kids don't have access to a microcomputer at home yet, so I thought I'd let her take a CPU to school in her book bag and use the school's peripherals."

"If I can help, let me know. Night, Fred."

"End," Fred responded in BASIC.

Fred got back to his car and saw that the parking meter had almost run out. "Boy, a dollar sure doesn't buy much time anymore," he thought.

On the way home, the message indicator on his amateur radio rig was blank, so he put out an "available" or CQ message. Almost immediately the display showed a response and the callsign K9KIC. Fred knew that this was the call of a young man named John, who lived nearby. They had never met, but they had shared many interesting conversations over the radio. At the next stop sign, Fred saw that John wanted to switch over to voice transmission. He picked up a pencil-thin microphone which was connected to the radio by a piece of slender plastic line. "Hey, John, what brings you on this band now? Did the amateur radio satellite fall out of synchronous orbit?"

"No," came the voice through the solid state speaker, "Murphy has struck, and I need some technical help."

"Well, tell me what you've got, and I'll make one of my educated guesses," Fred responded.

"You were with me when I bought that old Z-80 CPU at the swap meet. I've got it up and running on an antenna-aiming program for the Russian amateur radio satellites. Everything goes fine until I actually hook up the azimuth and elevation rotators. The first time it changes the azimuth, everything stops. Whaddya think?"

"Well, my young lad, my educated guess is spikes."

"Spikes! But there are lots of capacitors everywhere, and the power supply just has tons of farads hanging on it."

"The power supply, yes, but you are about to learn one of the main reasons why computer designers, radio designers, and almost everyone who pushes an electron has gone to fiber optics for signal circuits. These program chips that I just bought are a good example — two power connectors and ten optical signal ports each. Sure makes it nice."

"Okay, Fred, I can see I'm going to have to listen to one of your lectures, if I want to get my antenna pointed. Go ahead."

"You are aware that wires used to be used for carrying things other than power?"

"They still carry rf, Fred."

"Hrumph. That's power, too. Anyway, all the signal leads in computers, radios, phonographs, and everything else once were metallic. The time and money we used to spend eliminating hum, rf interference, and all the other kinds of unwanted signals were amazing. Bypass capacitors by the bushel, special circuit board and cabinet designs, tons of sheet metal. Then, about '79, the use of fiber optics for carrying signals really came of age. Practical microcomputers were only a few years older, so the marriage was a natural. Their use in radios and TVs was spurred along by federal legislation aimed at reducing TV interference, so you just don't find many of the metallic signal bus systems anymore."

"Well, I did."

"Right, and now we have to reinvent a few old tricks. I think that every time the relay in that old antenna rotator control unit of yours clicks, a big spike is sent back to the computer over the control wires. That spike drives the microprocessor crazy. Do you have any old discrete optoisolators in your junk box?"

"I'm not really sure what they are."

"Nowadays they are just a part of many chips, but basically, they relay a control signal, via light, to get rid of any spikes that might be introduced. You come on over tomorrow, and I'll see if I can find a reference that tells us how to use them. Here, I've keyed up my address. Come over about 10 am."

"Okay! Thanks a bunch, Fred. See you then."

As he signed off from his contact, Fred pulled into his carport. He put the tires of his car into the wide grooves in the composite floor and stopped when a light glowed on the dashboard. Beneath the car, twin spring contacts were already recharging the car's battery. He opened the front door of the house by punching a four digit sequence on the lock.

"Hi, anybody home?" he asked.

"We're downstairs," a female voice answered.

He went down into the main portion of the house, which was below the level of the surrounding ground. This arrangement gave both superb insulation and a nice landscape. The family room was dark, with the skylight in the clear mode to give an undistorted view of the night sky.

"Did you just get off work, dear?" he asked. His eyes were still adjusting to the darkened room.

"Yes, we had another one of those late conferences — more decisions and options," his wife replied.

"I'm glad you're home, Daddy," his daughter Jeanne interjected. "This is one of the first tries for our class project. Mother may understand stocks and bonds, but laser communications are too much for her."

"Oh great," Fred said, "I had forgotten it was tonight. We must not have entered it into the secretary. Where is the target?"

"The computer says that Orbiting Base I is due to pass over in about 15 minutes. We are going to try hitting it with a laser from the roof of the school. We want to use the communications mirror on the Orbiting Base to bounce a signal. I've got this laser detector set up here, and Sue and Billy each have one, too. It's not very precise, but we can show the principles involved."

"That would be a pretty fair accomplishment," Fred replied. "The military and some hams have been using the satellite mirror incremented light element system for some time, but if you kids can bounce off the Orbiting Base, you can get some good communications and good tracking data at the same time." Fred walked over to the small computer terminal hanging on the wall of the family room. He touched a sensitive square on the top of the visual display and said, "Print time; Print Orbiting Base time; Print difference; Run."

Immediately the solid state display showed:

2137:20
2143:33
6:13

"You going to work through the skylight?" he asked his daughter.

"Yes, I don't think we'll lose very much, since it's in the clear mode."

"If you two will excuse me," his wife said, "I'm going to take a bath. Secretary," she said, touching the computer terminal. The screen printed "READY" above the time numerals still on its face. This indicated that the secretary program was ready for use. "Bath; Hot; Full; Run," she said. "Isn't science wonderful!?" she chided, after taking her hand off the computer's touch spot. "Let me know when you talk to the woman in the moon."

"Ouch," Fred said, "give 'em females on the Orbiting Base, and they want the whole moon."

"Just our fair share, Daddy," Jeanne laughed.

The minutes and seconds displayed on the computer terminal went by swiftly. The Orbiting Base passed overhead. The laser detector was operating at its highest gain, but nothing was heard. Ten minutes after the direct overhead pass, the phone buzzed and Jeanne hurried to answer it.

"No, Billy, we didn't hear anything. What? You did. I know I had everything set up right. OK, we'll have to check it out tomorrow."

"They heard the bounced signal?"

"Yes, but without all three results, we can't get any accurate position data to write up. It isn't just enough to receive a signal; we have to be able to show good tracking data, too, if we are going to get a good grade on the project."

"Boy, high school science projects sure have changed," Fred mused. "Let's see if there is anything wrong with your receiver that an old technician can recognize."

Fred placed the equipment in self-test and made all of the checks with no discrepancies apparent. Opening the small cabinet revealed only two lumps coated with protective material. One was the entire detector and amplifier, and the other was the power supply. "Not an adjustment anyplace; besides, everything checks out okay."

"Thanks anyway, Daddy. At least I know I had it turned on and pointed the right way. The Orbiting Base will be over again tomorrow night. Maybe we can get a new receiver by then."

Later, as the house quieted down for the night, Fred addressed the computer again. "House; Status; Run." A floor plan of the house appeared. All doors and windows were shown in green, indicating they were locked. Below the diagram, a row of numbers began to appear on the screen. They showed the temperature of the water in the solar heaters, the output of the wind generator, and the amount of power that had been drawn from the commercial mains to supplement the wind generator over the past 24 hours. The temperature in the various rooms and other factors, such as circulating air flow, were also shown. Security systems, fire detection, and environmental control were all under the control of the home computer system while the family slept.

The next morning found Fred hard at "work." Actually, he went into the office less and less each year. The marriage of cheap data processing with high quality communications interconnections allowed many people to do a great deal of their work at home. As a lead design engineer, Fred had ties, via telephone lines, to the five design engineers in his group. They were able to exchange ideas, diagrams, and comments through their computer terminals at home. They could confer individually, or as a group.

The "smart" terminals they were using contained powerful microprocessors and were actually stand-alone computers. They could work individually, in concert with other smart terminals, or as an extension of the central "big memory" operated by Fred's company. The savings in real estate and overhead more than paid for the cost of the additional communications circuits. Many businesses still required the personal touch. But those that could were encouraging their people to work at home. Fred's wife was at "work" in another part of the house. Their breaks were frequent, and their family life was quite strong.

At a little before 10 am, the secretarial program in Fred's computer printed out "K9KIC COMING TO VISIT AT 10 AM."

A few minutes later, the doorbell rang. The young man he admitted was quite different from the bookish boy Fred had expected to see. John was tall and athletic. He held out his hand and said, "Hi, I'm K9KIC."

"Come in," Fred said. "I've got an optoisolator on my desk."

They discussed optoelectronics, the good old days of ham radio, and several other topics. Fred was just about to relate how he had changed over his old receiver to fiber optic elements, when his daughter walked in.

"Hi, Dad, can you help me for a minute?" She was weighted down with various pieces of her laser project. "Oh, I'm sorry. I didn't know you had company."

"Jeanne, this is John, one of my ham radio buddies. John, my daughter Jeanne."

"Say, isn't that a laser detector?" John asked.

"Yes, I just brought it back from a complete checkout. Everything seems to be fine, but it wouldn't work on a beam we bounced off the Orbiting Base last night."

"Maybe your bandpass was too narrow," John said, helping her with her load.

"I checked . . ." Fred tried to say.

"Or maybe you were getting a frequency shift."

"That could . . ." Fred tried again.

"Oh, do you think so?" Jeanne asked wide-eyed. "I just don't know much about these things," the winner of the local science fair for the last three years said innocently.

"Maybe we can try it on the ridge outside of town tonight . . ." were the last words Fred heard as they disappeared out the door.

He chuckled. "Bubble memories, laser mirrors, and electric cars, but some things never change!" ■

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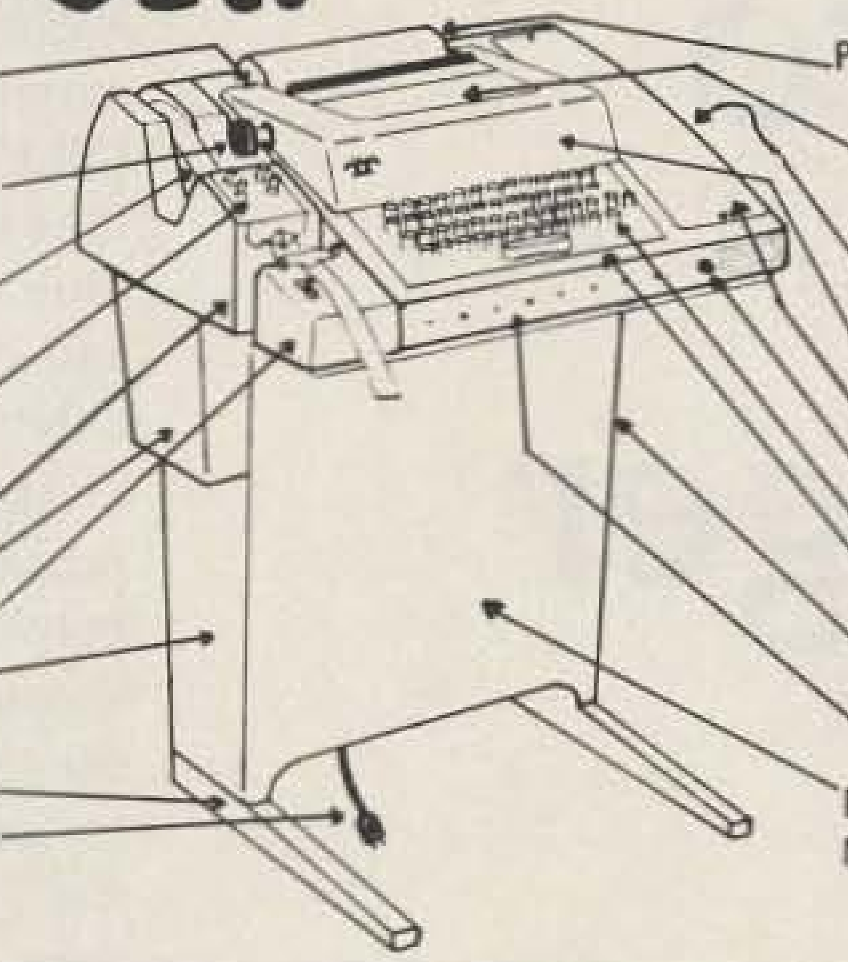

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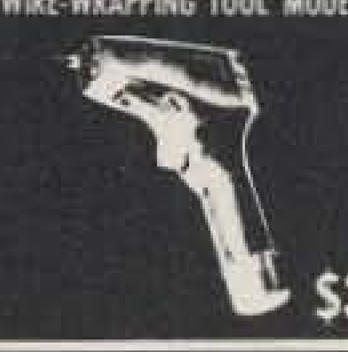

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Try A Micro Contest Logger

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Any contester will tell you that the removal of duplicate contacts from a contest log is absolutely necessary but can be an arduous and time-consuming chore, particularly when a large number of contacts are involved. For example, say 2000 QSOs are made on one band. Each callsign must be compared against all other callsigns on that log, in order to determine if a duplicate exists. When done manually, with pencil and paper, this operation can take nearly as long as the actual on-the-air operation, and, needless to say, it's nowhere near the fun.

Naturally, since I do operate in all the major contests, the first function I wanted to perform with my new micro, once it was up and running, was the removal of duplicate contacts from a contest log. The program presented here does just that. It reduces the operation to merely entering each callsign from the log into the processor via the control keyboard. Duplicate contacts are identified with both an audible and a visual indication.

The ultimate contest program, of course, would be used during the actual operation of the contest and would identify duplicates before they were logged. It would maintain the log for you, printing it out on hard copy for submission to the sponsor. Such a program would be beyond the memory capacity of my system, and I have no hard copy device. I, therefore, designed this program to be used after the contest. Callsigns are taken from the completed logsheets, and the duplicate contacts identified must be marked on the logsheets as such.

This program is written for the SWTPC 6800, with the CT-1024 control terminal and AC-30 cassette interface. The AC-30 is necessary only in the generation of the audible alarm described below. As suggested by SWTPC, memory locations 0000 through 0020 are unused. The program requires $478_{(10)}$ bytes of memory, leaving all remaining memory for the workspace. Each callsign is assigned six bytes, plus one for the end-of-callsign control character (a period).

It is possible to process 1100 callsigns in 8K of memory, while 500 may be handled by 4K. As you will notice in the assembly listing, maximum use is made of the INEEE and OUTEEE routines contained in the Motorola Mikbug firmware, and direct addressing is used extensively.

Upon execution of the program from its starting point, location 002F, the home-up and erase to end of file functions are performed to produce a clean screen, and then the "Enter Callsigns" screen message appears on the control monitor. Callsigns of variable length are entered from the keyboard, each followed by a period. They appear on the monitor in column format at the left margin. In the event of a typing error, a slant bar is entered (anytime before the period) and the erroneous callsign may be entered correctly. A line feed, carriage return, and erase to end of file string follow each callsign entered, to produce the column format and to cause a clean screen on page changes. The compare routine is bypassed for the first callsign entered. After that, as each callsign is entered, it is compared to all others already in the workspace. Upon detection of a duplicate entry, the screen message "Duplicate – Type A Space" appears following the callsign, and the audible alarm alerts the operator. The alarm is extinguished when the space (actually any character will do) is typed.

This audible alarm feature was included only as a convenience, so if your system does not include the AC-30, don't worry; the program will still function as written. You will, however, have to glance

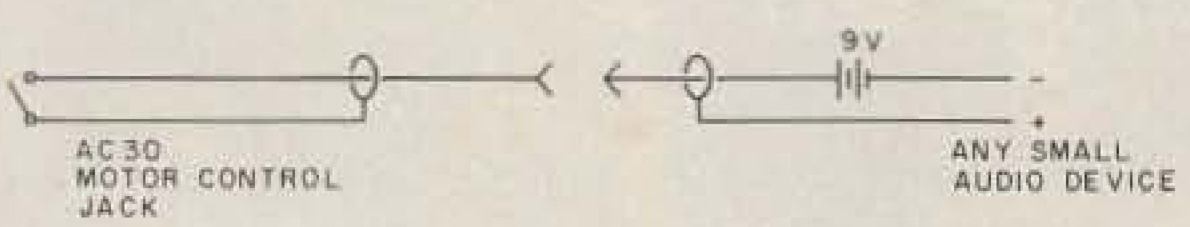

Fig. 1.

up at the screen after each entry to check for the visual indication of a duplicate on the monitor screen. Any audio device may be used for the audible alarm. Simply place the auto/manual switch of the AC-30 in the auto position, engage input A as a reader, and use the motor control jack A as a switch to turn on the audio device. (See Fig. 1.) The "Duplicate" and "Memory Full" screen message strings contain reader-on commands, and a reader-off is generated after keyboard input. I merely plug in a cassette recorder locked in the play mode and containing a program tape. Crude as it may be, the Kansas City Standard tones never fail to get my attention when the recorder is activated by the remote switch.

After the last callsign to be processed, key in a dollar sign, which terminates the entry and compare function and begins a "Print" function. Should the end of your memory be reached before you have come to the last callsign, the "Memory Full" screen message is displayed along with the audible alarm. The dollar sign must then be entered to begin the "Print" function.

The "Print" function actually serves no purpose, except to allow a simple recheck to insure all duplicates have been properly marked on the log. The callsigns are displayed at the left margin in column format. Printing continues rapidly until an identified duplicate contact is reached. The callsign is followed by a "Duplicate" screen message, and you are instructed to type a space to continue. After the last callsign is displayed, a screen message instructs that you type a "P" to print again or a "C" to clear. If the "P" is selected, the print operation cycles through again, while a "C" clears the memory workspace and prepares for the entry of a new series of callsigns, perhaps the processing of another band.

Included in the program are two constants, which are dependent on the memory capacity of your system. Location 0023 contains the highest memory address, while 007F contains the address of the highest callsign starting point in memory. I have used 1FFF and 1FF9, respectively, for an 8K memory. If you are using 4K, simply change to 0FFF and 0FF3.

This program should prove to be a most valuable addition to your program library. You can process your log in a minimum of time and still have complete confidence that you are submitting a clean log. ■

Fig. 2.

```
                        NAM    SUPERDUPER
      E1D1      OUTEEE  EQU    $E1D1     MIKBUG FIRMWARE
      E07E      PDATA1  EQU    $E07E     MIKBUG FIRMWARE
      E1AC      INEEE   EQU    $E1AC     MIKBUG FIRMWARE
                *
0021  01DE              FDB    $01DE     Constant start of workspace
0023  1FFF              FDB    $1FFF     Constant high memory address
0025  0000              RMB    $0000     Initialize with zeros
0027  0002              RMB    2         Reserve for temp storage
0029  0002              RMB    2         Reserve for temp storage
002B  0002              RMB    2         Reserve for temp storage
002D  0002              RMB    2         Reserve for temp storage
                        ORG    $002F
                *       STARTING LOCATION
002F  DE 21     START   LDX    $0021     Start of workspace
0031  86 20             LDA A #$20       Put a space in A
0033  A7 00     NEXT    STA A 0,X        Load the space in memory
0035  9C 23             CPX    $0023     Reach end of memory yet?
0037  27 03             BEQ    ENTER     Yes, to enter
0039  08                INX              No, go to next mem loc
003A  20 F7             BRA    NEXT      To NEXT
                *       BEGIN ENTERING CALLSIGNS
003C  BD 014B ENTER     JSR    STG4      Display MSG4
003F  DE 21     ENTER2  LDX    $0021     Start of workspace
0041  C6 20     LOADB   LDA B #$20       Put a space in B
0043  A6 00             LDA A 0,X        Load A from memory
0045  11                CBA              Is it a space?
0046  26 2C             BNE    LDCTR     No, to LDCTR
0048  DF 27             STX    $0027     Yes, store X temp
004A  BD E1AC ENCHAR    JSR    INEEE     MIKBUG
004D  A7 00             STA A 0,X        Store char in memory
004F  C6 24             LDA B #$24       Put $ in B
0051  11                CBA              Is it a $?
0052  26 03             BNE    SLNT?     No, to SLNT?
0054  7E 00EA           JMP    END       Yes, to END
                *       ERROR?
0057  C6 2F     SLNT?   LDA B #$2F       Put a / in B
0059  11                CBA              Is it a /?
005A  26 04             BNE    PD?       No, to PD?
005C  DE 27             LDX    $0027     Yes, restore X
005E  20 EA             BRA    ENCHAR    To ENCHAR
                *       PERIOD?
0060  C6 2E     PD?     LDA B #$2E       Put a . in B
0062  11                CBA              Is it a .?
0063  27 03             BEQ    FIRST     Yes, to FIRST
0065  08                INX              No, get another char
0066  20 E2             BRA    ENCHAR    To ENCHAR
                *       FIRST CALLSIGN?
0068  CE 0000 FIRST?    LDX    $0000     If this is the first
006B  9C 25             CPX    $0025        entry, don't search
006D  26 27             BNE    SEARCH    To SEARCH
006F  BD 0146           JSR    STG3      Display MSG3
0072  20 CB             BRA    ENTER2    To ENTER2
                *       CHECK THE COUNTER
0074  C6 07     LDCTR   LDA B #$07       Load the counter with 07
0076  08        LOOP    INX              Increment X
0077  5A                DEC B            Decrement the counter
0078  2F 02             BLE    FULL?     If zero, to FULL?
007A  20 FA             BRA    LOOP      Else to LOOP
                *       IS THE MEMORY FULL?
007C  DF 25     FULL?   STX    $0025     Store X temp
007E  8C 1FF9           CPX   #$1FF9     See if reached end
0081  27 02             BEQ    MEMFUL    Yes, to MEMFUL
0083  20 BC             BRA    LOADB     No, to LOADB
                *       MEMORY IS FULL
0085  BD 013C MEMFUL    JSR    STG1      Display MSG1
0088  BD E1AC           JSR    INEEE     MIKBUG
008B  C6 24             LDA B #$24       Put a $ in B
008D  11                CBA              Is it a $?
008E  26 F5             BNE    MEMFUL    No, to MEMFUL
0090  DE 25             LDX    $0025     Yes, store X temp
0092  A7 00             STA A 0,X        Load the $ in memory
0094  20 54             BRA    END       To END
                *       SEARCH ROUTINE
0096  DE 21     SEARCH  LDX    $0021     Load X from temp
0098  DF 2B     AGN     STX    $002B     Store X in temp
009A  DF 2D             STX    $002D     Store X in temp
009C  DE 27             LDX    $0027     Load X from temp
009E  DF 29             STX    $0029     Store X in temp
00A0  C6 07             LDA B #$07       Load the counter with 07
00A2  8D 14             BSR    CPRMEM    To CPRMEM
00A4  27 23             BEQ    DUPE      It is a dupe, to DUPE
00A6  DE 2D             LDX    $002D     No, then load the location
00A8  08                INX                 of this callsign in X
00A9  08                INX                 and increment 7 times
00AA  08                INX                 to begin looking at
00AB  08                INX                 the next callsign
00AC  08                INX
00AD  08                INX
00AE  08                INX
00AF  9C 27             CPX    $0027     Is it this callsign?
00B1  26 E5             BNE    AGN       No, to AGN
00B3  20 2F             BRA    ISLAND    Yes, to ISLAND
                *       COMPARE SUBROUTINE
00B5  08        CPRCON  INX              Increment X
00B6  DF 2B             STX    $002B     Store X temp
00B8  DE 29             LDX    $0029     Load X from temp
00BA  A6 00             LDA A 0,X        Load A from memory
00BC  08                INX              Increment X
00BD  DF 29             STX    $0029     Store X temp
00BF  DE 2B             LDX    $002B     Load X from temp
00C1  A1 00             CMP A 0,X        Compare A and X
00C3  26 03             BNE    CPRET     Not equal, to CPRET
00C5  5A                DEC B            Decrement counter
00C6  26 ED             BNE    CPRCON    Counter not zero, to CPRCON
00C8  39                RTS              Counter zero,return w/flag cond
                *       DUPLICATE CALLSIGN FOUND
00C9  86 11     DUPE    LDA A #$11       Put $11 in A
00CB  BD E1D1           JSR    OUTEEE    MIKBUG (turns on alarm)
00CE  BD 0141           JSR    STG2      Display MSG2
00D1  DE 27             LDX    $0027     Load X from temp
00D3  C6 2E             LDA B #$2E       Put a . in B
00D5  A6 00     LOADA   LDA A 0,X        Put memory char in A
00D7  11                CBA              Is it a . ?
00D8  27 03             BEQ    PDFND     Yes, to PDFND
00DA  08                INX              no, look next char
00DB  20 F8             BRA    LOADA     To LOADA
                *       REPLACE PERIOD WITH ASTERISK
00DD  C6 2A     PDFND   LDA B #$2A       Put an * in B
00DF  E7 00             STA B 0,X        Put the * in memory
00E1  BD E1AC           JSR    INEEE     MIKBUG
00E4  BD 0146 ISLAND    JSR    STG3      Display MSG3
00E7  7E 003F           JMP    ENTER2    To ENTER2
                *       END OF MEMORY
00EA  BD 0150 END       JSR    STG5      Display MSG5
00ED  DE 21             LDX    $0021     Start of workspace
00EF  A6 00     END2    LDA A 0,X        Put char fm memory in A
00F1  C6 24             LDA B #$24       Put $ in B
00F3  11                CBA              Is it a $?
00F4  27 07             BEQ    DECIDE    Yes, to DECIDE
00F6  C6 2A             LDA B #$2A       No, put an * in B
00F8  11                CBA              Is it an *?
00F9  26 1B             BNE    PRCHAR    No, to PRCHAR
00FB  20 30             BRA    DUPRNT    Yes, to DUPRNT
                *       DECIDE
00FD  BD 0155 DECIDE    JSR    STG6      Display MSG6
0100  BD E1AC           JSR    INEEE     MIKBUG
0103  C6 50             LDA B #$50       Put ASCII P in B
0105  11                CBA              Is it a P?
0106  27 E2             BEQ    END       Yes, to END
0108  C6 43             LDA B #$43       No, put ASCII C in B
010A  11                CBA              Is it a C?
010B  26 F0             BNE    DECIDE    No, invalid reply,ask again
010D  7F 0025           CLR    $0025     Reset storage loc to zero
0110  7F 0026           CLR    $0026     Reset storage loc to zero
0113  7E 002F           JMP    START     To START
                *       PRINT THE CHARACTER
0116  C6 20     PRCHAR  LDA B #$20       Put a space in B
0118  11                CBA              Is it a space?
0119  27 08             BEQ    INCX      Yes, to INCX
```

```
011B  C6 2E               LDA B #$2E    No, put an * in B
011D  11                  CBA           Is it an *?
011E  27 06               BEQ   PRCRLF  Yes, to PRCRLF
0120  BD E1D1             JSR   OUTEEE  No, MIKBUT
0123  08          INCX    INX           To get next char
0124  20 C9               BRA   END2    To END2
                  *       PRINT CR AND LF
0126  DF 25       PRCRLF  STX   $0025   Store X temp
0128  BD 0146             JSR   STG3    Display MSG3
012B  20 0B               BRA   LDX     To LDX
                  *       PRINT DUPLICATE
012D  DF 25       DUPRNT  STX   $0025   Store X temp
012F  BD 0141             JSR   STG2    Display MSG2
0132  BD E1AC             JSR   INEEE   MIKBUG
0135  BD 0146             JSR   STG3    Display MSG3
0138  DE 25       LDX     LDX   $0025   Load X from temp
013A  20 E7               BRA   INCX    To INCX
                  *       DISPLAY MESSAGE SUBROUTINES
013C  CE 015C STG1        LDX   MSG1    Load X start of MSG1
013F  20 17               BRA   PRINTO  To PRINTO
0141  CE 017B STG2        LDX   MSG2    Load X start of MSG2
0144  20 12               BRA   PRINTO  To PRINTO
0146  CE 019A STG3        LDX   MSG3    Load X start of MSG3
0149  20 0D               BRA   PRINTO  To PRINTO
014B  CE 019F STG4        LDX   MSG4    Load X start of MSG4
014E  20 08               BRA   PRINTO  To PRINTO
0150  CE 01BD STG5        LDX   MSG5    Load X start of MSG5
0153  20 03               BRA   PRINTO  To PRINTO
0155  CE 01C1 STG6        LDX   MSG6    Load X start of MSG6
0158  BD E07E PRINTO      JSR   PDATA1  MIKBUG
015B  39                  RTS           Return from subroutine
                  *       ASCII MESSAGE DISPLAY STRINGS
015C        114D MSG1     FCC   /Reader On followed by screen
            454D                 message (MEMORY FULL...TYPE $
            4F52                 TO PRINT)
            5920
            4655
            4C4C
            2E2E
            2E54
            5950
            4520
            2420
            544F
            2050
            5249
            4E54
017A        04            FCB   End of Message
017B        0D0D MSG2     FCC   /Reader on, carriage return, six
            1717                 spaces followed by screen message
            1717                 (...DUPE...TYPE A SPACE)
            1717
            2E2E
            2E44
            5550
            452E
            2E2E
            5459
            5045
            2053
            5041
            4345
0199        04            FCB   End of Message
019A        130A MSG3     FCC   /Reader off, line feed, carriage
            0D16                 return, erase to end of file
019E        04            FCB   End of Message
019F        1016 MSG4     FCC   /Home up, erase to end of file,
            2020                 four spaces, followed by screen
            2020                 message (...ENTER CALLSIGNS...)
            2E2E                 followed by line feed, carriage
            2E45                 return
            4E54
            4552
            2043
            414C
            4C53
            4947
            4E53
            2E2E
            2E0A
            0D
01BC        04            FCB   End of Message
01BD        1310 MSG5     FCC   /Reader off, home up, erase to
            16                   end of file
01C0        04            FCB   End of Message
01C1        1016 MSG6     FCC   /Home up, erase to end of file,
            2020                 three spaces followed by screen
            2050                 message (P TO PRINT   C TO CLEAR)
            2054
            4F20
            5052
            494E
            5420
            2020
            4320
            544F
            2043
            4C45
            4152
01DD        04            FCB   End of Message
                  *       Beginning with 01DE, all remaining memory
                  *       comprises the workspace
                          END

START   002F NEXT    0033 ENTER   003C ENTER2  003F LOADB   0041
ENCHAR  004A SLNT?   0057 PD?     0060 FIRST?  0068 LDCTR   0074
LOOP    0076 FULL?   007C MEMFUL  0085 SEARCH  0096 AGN     0098
CPRCON  00B5 CPRMEM  00B8 CPRET   00C8 DUPE    00C9 LOADA   00D5
PDFND   00DD ISLAND  00E4 END     00EA END2    00EF DECIDE  00FD
PRCHAR  0116 INCX    0123 PRCRLF  0126 DUPRNT  012D LDX     0138
STG1    013C STG2    0141 STG3    0146 STG4    014B STG5    0150
STG6    0155 PRINTO  0158 MSG1    015C MSG2    017B MSG3    019A
MSG4    019F MSG5    01BD MSG6    01C1
```

Computerized Global Calculations

-- finding the best way to Pago Pago

Carl Wagar VE3EKR
PO Box 911
Waterloo, Ontario
Canada N2J 4C3

```
10 PRINT "THIS IS GLOBAL"
20 PRINT " "
30 REM      INPUT DATA FOR MY LOCATION
40 PRINT "MY LOCATION IS"
50 PRINT "LATITUDE(DEG,MIN, 1 FOR NORTH- 0 FOR SOUTH)"
60 INPUT L2,M2,Y
70 PRINT "LONGITUDE(DEG,MIN, 1 FOR EAST- 0 FOR WEST)"
80 INPUT L1,M1,Z
90 PRINT " "
100 REM     CALCULATE CONSTANTS FOR MY LOCATION
110 L1=(L1+(M1/60))*3.14159/180
120 L2=(L2+(M2/60))*3.14159/180
130 K1=SIN(L2)
140 K2=COS(L2)
150 IF Z=0 THEN 170
160 L1=-L1
170 IF Y=1 THEN 190
180 K1=-K1
190 PRINT " "
200 REM INPUT DATA FOR HIS LOCATION
210 PRINT "HIS LOCATION IS"
220 PRINT "LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)"
230 INPUT L4,M4,B
240 PRINT "LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)"
250 INPUT L3,M3,A
260 PRINT " "
270 REM CALCULATE CONSTANTS FOR HIS LOCATION
280 L3=(L3+(M3/60))*3.14159/180
290 L4=(L4+(M4/60))*3.14159/180
300 IF A=1 THEN 330
310 C1=ABS(L1-L3)
320 GOTO 340
330 C1=ABS(L1+13)
340 IF C1<3.14159 THEN 360
350 C1=(2*3.14159)-C1
360 IF B=1 THEN 390
370 K1=-K1
380 REM  CALCULATE DISTANCE
390 A1=(K1*(SIN(L4))+(K2*(COS(L4))*(COS(C1)))
400 D=(3.14159/2)-(ATN(A1/(SQR(1-A1↑2))))
410 D=69.15*180*D/3.14159
420 PRINT " "
430 REM    OUTPUT
440 PRINT "DISTANCE IN MILES",D
450 D1=1.6093*D
460 PRINT "DISTANCE IN KILOMETRES",D1
470 STOP
480 END
```

Fig. 1. Program listing for GLOBAL.

How many of you DXers now keep a hand calculator next to your rig? After Frank Kelly described "Global Calculations for the DXer" in the August, 1976, issue of *73 Magazine*, no doubt some of you have tried it. The article showed how to calculate the distance between two places anywhere in the world.

When you're working that rare DX in Timbuktu, it's always nice to drop a tidbit of information like, "I calculate that our QSO spans a distance of 8346 kilometers, QSL?" Pretty impressive-sounding information, no doubt, and it's a novel topic for conversation.

After a while, though, you can become tired of doing all of that number-crunching every time. No doubt some of you have let the bit bug bite. Either you have picked up some type of microcomputer or are at least interested in them. If so, let the number-crunching bother you no more. Let the computer do it!

This article describes a computer program that calculates the shortest distance between any two points on the globe. All you need to do is type in the latitude and longitude of any two locations on Earth, and it prints out the distance in miles and kilometers.

I call the program GLOBAL, for obvious reasons, and it is written in the programming language BASIC. GLOBAL is listed in Fig. 1. It is very straightforward and takes very little time to run. In Fig. 1, statement numbers 40 through 90 have the computer ask you to input information about your location or the location of the first station. (If you are holding a three-way QSO, you could tell the other fellows how far apart they are.) Statements 100 through 180 calculate the parameters for the first station. Unlike Kelly's method, your station can be located anywhere in the world. So, if you're not in North America, you can still use the program. Statements 200 through 250 ask you questions about the second station's location, and statements 280 through 370 calculate the parameters for his location. The actual calculation of distance is carried out from statement 390 through 410, and then the distance is output in both miles and kilometers.

The language BASIC that I used may be slightly different from the one that you're using, but I've attempted to make it so that the program will work on most machines. Notice that when inputting latitude, you must type 1 for north or 0 — zero for south latitudes. If your machine will accept what they call string variables (mine won't), then you could change the program to accept the letters "N" or "S", or the words "North" or "South." The same applies for longitude. You will need to alter the IF statements: 150, 170, 300, and 360. For instance, 150 would become: 150 IF Z$="W" then 170. Also, all of the variables, A, B, Y, and Z, would need to be changed to A$, B$, Y$, and Z$, since these usually denote string variables.

One other important point

```
RUN
THIS IS GLOBAL

MY LOCATION IS
LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)
?40,52,1
LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)
?73,19,0


HIS LOCATION IS
LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)
?48.52,0,1
LONGITUDE(DEG,MIN,1 FOR EAST-0 FOR WEST)
?2.2,0,1

DISTANCE IN MILES                3596.772218
DISTANCE IN KILOMETRES           5788.28553
```

```
RUN
THIS IS GLOBAL

MY LOCATION IS
LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)
?40,52,1
LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)
?73,19,0


HIS LOCATION IS
LATITUDE(DEG,MIN 1 FOR NORTH-0 FOR SOUTH)
?22.54,0,0
LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)
?43.15,0,0

DISTANCE IN MILES                4793.847786
DISTANCE IN KILOMETRES           7714.739241
```

Fig. 2. Two runs for GLOBAL. The first calculates the distance between Huntington, Long Island, NY and Paris, France. The second calculates the distance between Huntington and Rio de Janeiro, Brazil.

is that GLOBAL converts degrees to radians before calculating. Make sure that your version of BASIC uses radians for angle calculations. If your BASIC needs degrees, then you'll have to eliminate the conversion factors (3.14159/180) from statements 110, 120, 280, 290, and 410, and you'll have to change pi (3.14159) to the value 180 in statements 340, 350, and 400. One last thing you should know is that part of statement number 400 reads like this: SQR(1-A1↑2). The A1↑2 means A1 to the exponent 2, or A1 squared. Some machines may need that written A1**2, or, if all else fails, just multiply A1 by itself (A1*A1). So with these hints in mind, you should be able to get GLOBAL to perform for you, no matter what kind of BASIC your machine eats.

Fig. 2 shows the output for two different runs of the program. These two runs are identical with the examples that Frank Kelly gave in his article. The first run calculates the distance between Huntington, Long Island, NY (40°52'N., 73°19'W.) and Paris, France (48.52°N. 2.2°E.) as a total of 3596 miles, which is the same as Kelly's figure. The second run calculates the distance between Huntington and Rio de Janeiro, Brazil (22.54°S., 43.15°W.) as 4794 miles, again the same as in Kelly's calculations.

If you get tired of typing in your own location, you can always calculate L1, L2, K1, and K2 from your location and assign these in the first statements of your program. You could then eliminate statements 40 through 180. By the way, GLOBAL takes up very little space in memory, less than 1K, and the above measure would reduce it even more. ■

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Micro Meets JANET

-- meteor scatter, anyone?

The idea of utilizing meteor scatter propagation for data transfer first occurred to W5HK and WB9WXM during one of their long, frequent bull sessions on FM this past April. Bob had just received his first computer, an 8080, and Steve was nearly through reading *Hobby Computers Are Here.* Both were looking for a way to genuinely show the computer's value in VHF communications. It was not long before the pulse data characteristics of data transfer encouraged them to look at an old mode that has been almost forgotten – meteor scatter. This mode has never been highly popular, either commercially or with the amateur, because it requires either high speed CW or a very quick mouth on SSB to communicate. Information transfer is tedious and requires more patience than most of us have. But wouldn't this mode be ideal for the microprocessor and the transfer of data in quick bursts?

A look through a nearby technical library showed an interesting fact: Most information on meteor scatter was written in the 1950s, and there appeared to be considerable interest in it until satellites attracted the interest and backing of government and industry. Almost an entire issue of the *Proceedings of the IRE* was devoted to the mode in late 1957. In it were described the successful commercial experiments conducted between 1953 and 1956 using meteor scatter. The JANET principle refers to the technique first suggested in 1950 by McKinley and proven commercially in a long term RTTY link over a 950 km path in Canada between 1954 and 1956. JANET utilizes a duplex system of two stations and a continuously transmitting carrier. When A is transmitting, B is listening for the signal to appear from a trail. These ionization trails appear in the upper atmosphere and vary in length from 15 to 40 km. They have a thickness on the order of 1 meter.[1] When the detector registers a predetermined signal level, it will begin storing data. JANET, as the IRE article states, was named after Janus, the Roman god of the doorway who looked both ways at once.[2]

Meteor scatter itself is a result of the continuous, although sporadic, bombardment of the Earth by meteorites. Approximately 10^{10} particles, representing a mass of approximately 1 ton, hit the Earth each day.[3] The important point is that a fiery spectacle is not required to produce a usable trail; grains of sand that are invisible when entering will suffice. The meteoric particles enter the ionosphere at a height of 80-120 km. "Although a single observer may see only two or three visible meteors per hour, hundreds of trails can be detected in the same period by sensitive radio equipment."[4]

The average number of trails varies from season to season, for reasons best left to further reading, and meteor showers can greatly enhance the duty cycle of communications. For purposes of reliable year-round communications, we are interested in the fact that trails are always present and that their occurrence is always frequent enough to ensure a reasonable information rate (60 wpm at a continuous RTTY speed of 1300 wpm, for example, in tests conducted in the 1950s).

The characteristics of the trails are such that fading is a problem because high altitude winds can shift the ionized gas trail slightly; trails that are either underdense or overdense can introduce distortion of the signal. A small number of trails appearing at the optimum angle between two points become the vehicle for the communications link. An effective system would endeavor to use a single trail at a time in order to minimize fading and multipath distortion. Thus, the practical duty cycle would be decreased, to less than .05.[5] Because of the critical angle of entry for meteors to form usable trails between points A and B, the optimum path is not a great circle route, but, rather, a few degrees to either side. An effective antenna for 50 MHz would be a non-highly directional yagi. Great success was achieved with JANET, using two five-element yagis aimed 8° either side of the great circle path and 8° above the horizon. Because of the Earth's rotation, more trails will appear on one side of the direct path in the morning and the other in the evening. This antenna permits both propagation paths to be utilized.

At the time the JANET principle was published and advocated as a commercial viability, the error rate had been reduced to less than 0.1 percent, and average information rates from 30 to 60 wpm were achieved. The major

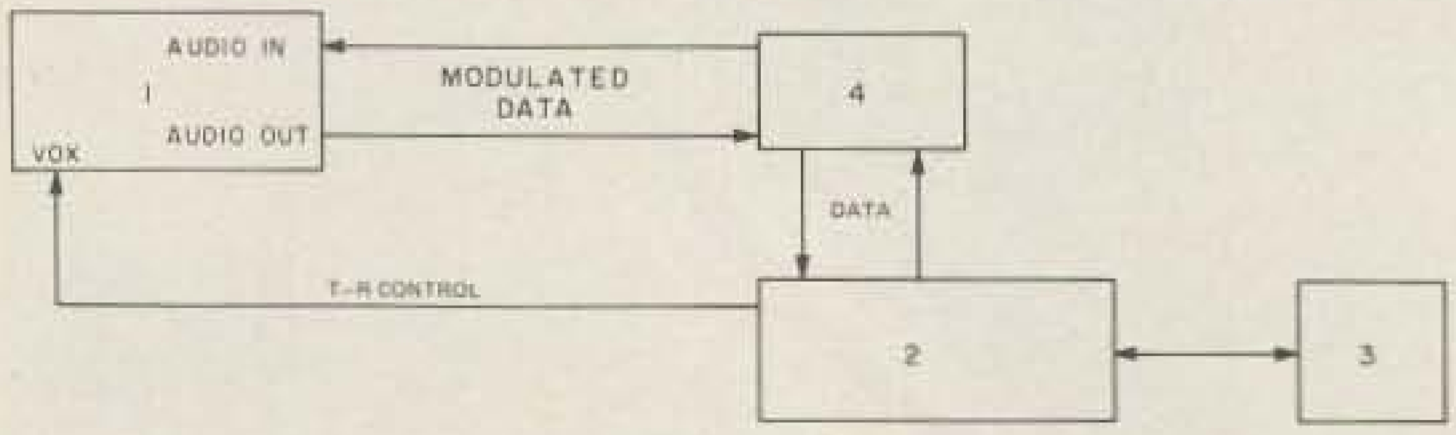

Fig. 1.

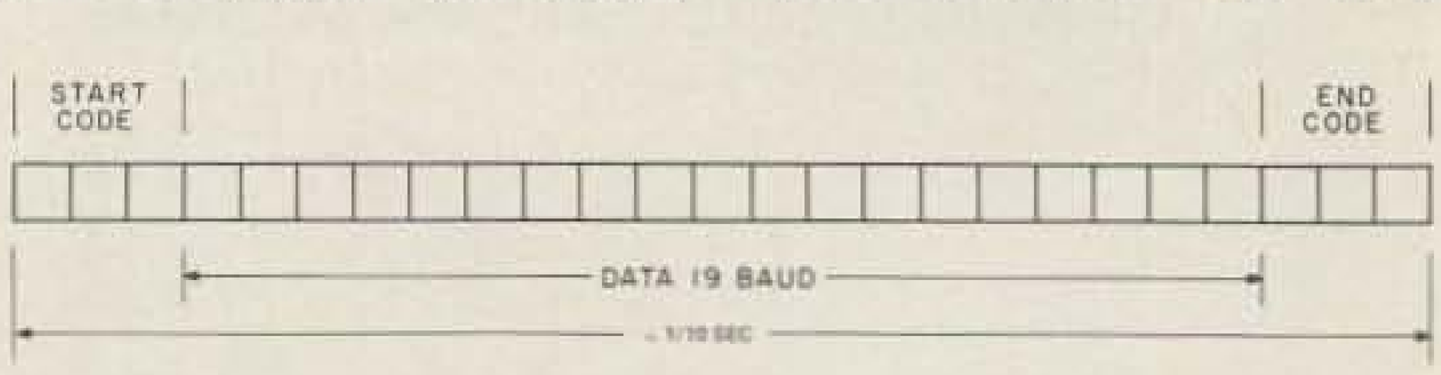

Fig. 2.

problem, as was to be expected, was to develop effective gating equipment to determine when the signal from the distant station was at a usable threshold.

Since most of the work on the meteor scatter mode has been done in the 30-50 MHz range, it is difficult to predict exactly what the relative values for error rate and duty cycle would be on 144 MHz. From discussions with other amateurs, we learned that meteor scatter commonly provides 3-6 second trails on six meters, 1-2 second trails on two meters, and possible occasional trails on 432 MHz. From our attempts to find articles and to locate other individuals who were familiar with the mode, we learned several things that were disappointing. Very little was done with the mode commercially after the satellite became a reality, very few VHF amateurs had ever worked the mode or knew anything of it, and a great deal remained to be done at 144 MHz and above to determine its characteristics.

From our investigation of the mode, we became convinced that meteor trail scatter, although practically forgotten, had very considerable potential for data transfer and that experimentation on two meters would be essential to find the answers. In summing up the mode's disadvantages (from a data viewpoint), there are few. The path appears to be limited to 2000 km, is not as fast as satellite or other continuous modes, and would require well-aimed antennas and precision tuning between amateur stations to effectively utilize the short burst time with a minimum of "search and setup" time. These disadvantages are *vastly* overshadowed by the advantages:

1. Reliable communications, regardless of sunspot or solar conditions;
2. 24 hour a day usability, unlike the amateur satellites;
3. A reasonably low error rate, due to the inherently stable condition of the path for the short time it is there;
4. A degree of security and privacy not achievable on HF or satellite repeaters — the critical angle of usable trails between points A and B precludes usable signals being detected beyond several hundred kilometers around each station;
5. Spectrum efficiency and reuse as a result of 4 above — indeed, the authors of the 1957 article on JANET believe stations could operate on the same frequency if they are operating from moderately right angles to one another's paths;
6. Above all, this mode is uniquely suited to the sporadic, parcel nature of data communications; the birth of hobby computers makes meteor trails viable as they never have been before, making possible an inexpensive and reliable way for nationwide contacts using the home computer.

Station A Send	/ / /WB9WXM (S) BOB (S) IL (R) +++
Station B Receive	WB9WXM BOB IL
Station B Send	/ / /WB9WXM (S) W5HK (S) STEVE (R) +++
Station A Receive	WB9WXM W5HK STEVE
Station A Send	/ / /TS700 (S) 100W (S) 4L (S) YG (R) +++
Station B Receive	TS700 100W 4L YG
Station B Send	/ / /TX (S) YS221 (S) 50W (S) 5L (S) YG (R) +++
Station A Receive	TX YS221 50W 5L YG
Station A Send	/ / /PLS (S) QSL (S) TNX (S) 4 (S) QSO (R) +++
Station B Receive	PLS QSL TNX 4 QSO
Station B Send	/ / /73 (S) BOB (S) OK (S) QSL (R) +++
Station A Receive	73 BOB OK QSL
Station A Send	/ / /73 (S) WB9WXM (S) QRX (R) +++
Station B Receive	73 WB9WXM QRX
Station B Send	/ / /W5HK (S) QRX (R) +++

This is how a typical QSO might appear. Total QSO time — 8 minutes. A new state was worked on two meters, direct and with meteor burst data transmission. (S) = space, (R) = return, / / / = start code, and +++ = end code.

At this point, we decided to develop a working system built around the 8080 uP. First, we had to decide what basic system configuration could best utilize the meteor burst mode in a relatively economical fashion.

Meteor Burst Modes

Several possibilities exist for the automatic transfer of data via meteor burst. In decreasing order of complexity:

1. Full duplex — A duplication of the JANET system provides a station with the ability to utilize the greatest number of trails, thus increasing usable transmission rates. For the exchange of large amounts of data, it is probably the only viable technique. For the amateur, it has several pitfalls. The narrow spacing that would have to be used on two meters (if the repeater segment were to be avoided) would require an expensive duplexer and cavities. Critical retuning would have to be performed every time the frequency was changed. A much simpler duplex system, available to any amateur, would involve crossband operation between 2 and 1¼ meters or 2 and 6 meters. This alternative should be considered in the future.

2. Modified full duplex — In theory, a commercial base station, amateur repeater, or television station could be monitored by a distant meteor burst station. The reception of the monitored signal from point A at point B could be used to gate the amateur transmitter to release data. If both points A and B utilized this gating method, higher transmission rates could be achieved.

3. Simplex — This requires selection of defined transmission periods that are long enough to have a high probability of hitting one usable trail. Much less information could be exchanged than with 1 or 2, but for the VHF amateur using a 300 baud per second rate with a microprocessor, 30 baud, or approximately six words, could be transferred in a 1/10 second burst. This is more than adequate for DXing or short messages. It is the suggested technique because of its relative cost. One minute transmissions would result in a high probability of completed QSOs in less than ten minutes, with none of the tedium associated with conventional meteor burst operation. Experimentation would determine the best transmission length and data parcel size. After this technique was developed, transmission bursts might effectively be decreased to rapidly transfer data. Of course, an individual interested in high volume traffic would then find considerable merit for constructing a station based on duplex or crossband operation. For most amateur operation, simplex operation would be fully adequate. It is this system we are developing and to which we are encouraging interest be directed.

Simplex Version

Having determined that we would utilize a simplex system, we decided that we would need the following basic components:

1. 2 meter FM transceiver with 100 Watts and 4-7 element yagi;
2. Microcomputer;
3. TTY or video terminal;
4. Modulator and demodulator.

A block diagram using the simplex version is shown in Fig. 1. The data format is shown in Fig. 2.

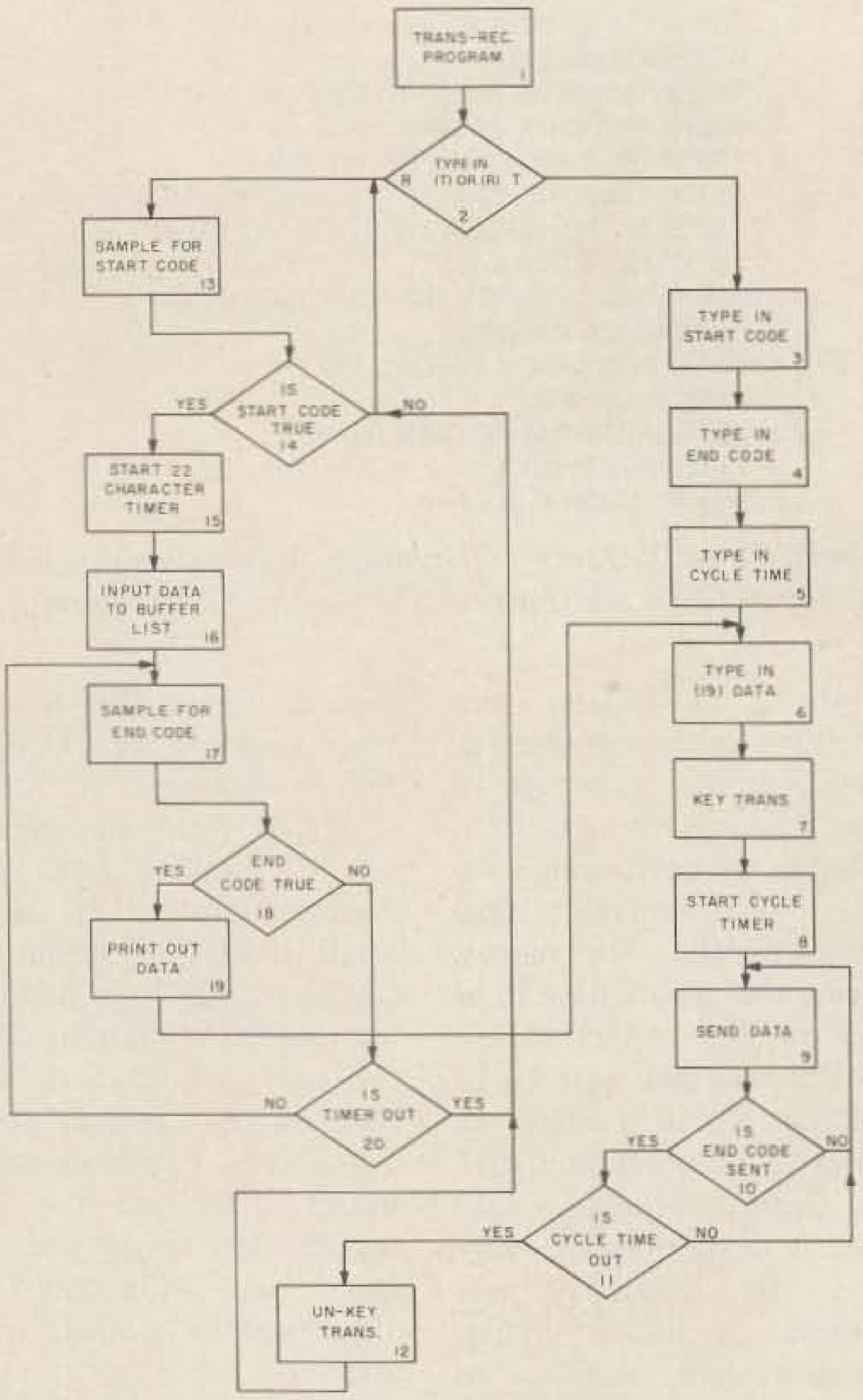

Fig. 3. Flowchart of the program that will be used in the first system.

1. Initial program waits for a command.
2. Decision block: If a (T) is typed in or an (R), will either jump to block #3 or #12.
3. Start Code block: Type in the Start Code to be sent and to be sampled when in the receive program.
4. End Code block: Type in the End Code to be sent and to be sampled when in the receive program.
5. Type in the cycle time desired; ½, 1, 2 min. etc. This is the total time the data message will be cycled.
6. Type in the message to be sent, up to 19 characters. The last character of the message has to be a carriage return.
7. Because of carriage return being typed, the system keys the transmitter.
8. The cycle timer is activated (this is a software timer).
9. The total data is sent – Start Code, message data, End Code.
10. Decision block detects if the End Code is sent, if (no) is generated the program loops back to #9 until a yes is generated in #10. Once this happens the program jumps to #11.
11. Decision block to determine if the cycle time is reset: If (no) the system continues to send the data until the cycle timer is reset. Once this is true, the program jumps to the receive block #12.
12. Un-keys transmitter for receive portion of program.
13. Sample for Start Code.
14. Decision: If Start Code is false, then continues sampling. If true, jumps to #15.
15. Start a timer whose length is equal to the maximum number of remaining characters, which is 22.
16. Load data to buffer register.
17. Sample data for End Code.
18. Decision block for End Code: If true, go to #19, if false, go to #20.
19. If End Code was detected, then the data between Start Code and End Code is printed out.
20. If End Code was not detected, this decision block is used to determine if the 22 character timer #15 has timed out. If no, jump back to #17. If yes, return to #13. Begin Start Code sampling.

Fig. 4.

Mode of transmission will be narrow band FM with deviation between 2.5 and 5 kHz. Experimentation will begin at 5 kHz. The modulator and demodulator are based on the Audio Cassette Standard described in the article entitled "A Nifty Cassette-Computer System" in *Hobby Computers Are Here*. Since this standard has been adopted by the industry for the audio transfer of digital information, it provides the most economical and effective means of transferring data, at the reasonably fast rate of 300 baud per second.* Secondly, although the original JANET system utilized double sideband AM with audio frequency shift keying, narrow band FM provides advantages in terms of signal to noise ratio and noncriticalness of tuning. Those who have operated FSK on HF will appreciate the criticalness of exact tuning. FSK is not tolerable with a short burst meteor mode. With FM, a signal tuned in reasonably close will provide a usable signal, and, unlike FSK, the frequency of the audio tone is automatically in tune. As a further bonus, this provides the multitude of VHF FMers with the ability to use existing FM gear, if they couple it with an inexpensive microprocessor-based data system. Of course, further experiments can use SSB, FSK, or other more exotic modes, such as decimal frequency shift keying. The goal here is to provide the largest number of amateurs with an inexpensive yet effective way of using this mode.

*In this article, the tones of 2400 cycles for mark and 1200 cycles for space are suggested. These tones are relatively inexpensive to generate; a stable 4800 Hz can be divided by 2 for mark, and divided by 4 for space.

Now let's return to the data format and give it a closer look. Total transmission was chosen to be 25 baud in 1/10th of a second or less, repeated for 1 minute. The repetition is to insure that a complete data transmission will be received. The first 3 baud are the recognition code, thus allowing the receiving station to know if a transmission is starting. The next 19 baud are information such as call, QTH, handle, etc. Last, the remaining 3 baud are the ending code to tell the receiving microprocessor that the message is completed. Total transmission time is ≤ 1/10th second; repeating for 1 minute will cycle this 600 times. Only experimentation will determine if this time is sufficient. When the receiving station has decoded an ending code, it will print out the message, and the receiving station can then send a reply by the same format. When sending data, the microprocessor will key the transmitter by using the VOX circuit; this will enable the transceiver to be either receiving or transmitting as determined by the microprocessor program.

That's the total system in operation, but one of the most important things is the microprocessor program. Since both W5HK/9 and WB9WXM are not the most proficient programmers of microprocessors (we are both learning), we brought in a third party to write the program. (See Figs. 3 and 4.) Gary Chaffin is a non-amateur who has a great love for the microprocessor and programming; he is also one of the sharpest people we know in that field. The microcomputer we are using is the IASIS Computer in a Book. Besides being a learning tool, it is also a powerful microcomputer using the 8080A.

Conclusion

At this point in time, we are actively constructing a system based on the principles described in this article. The reason for writing this article now, rather than after a system is fully operational, is quite simple; we need the assistance of other interested VHFers outside of this area to prove the system. Whereas an EME enthusiast can test his system by listening for his echo, the narrow propagation angles and short time for reflection from a meteor trail only 100 km in altitude make it impossible to use the same technique.

We believe this technique has considerable potential and feel it is an effective marriage of the microcomputer and the meteor burst mode. It has the potential for contacts that are not limited in duration as are present OSCAR QSOs, or distance as is the case with conventional VHF propagation. From the Chicago area we should be able to work most of the country on meteor burst. We welcome those with computers and interest to join us on 145.180 this winter. We could all be pleasantly surprised with what can be done when JANET is refurbished and utilized in an environment where she best functions — the short data bursts of the modern microprocessor. ■

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TC 22 | 4 IN | 923705 | 11.56
TC 24 | 5/6 IN | 923714 | 13.85
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The fifteen-year-old girl was placed in the starting blocks. A silence fell over the stadium. Everyone was tense, straining. The starter raised his pistol and called, "Runners on your mark, ready!"

"BANG!" The report of the starter's pistol pierced the silence and tenseness of the stadium. Sheila leaped from the blocks like a coiled spring, and, for the next 14.2 seconds, the only sound to be heard was the pounding of her feet on the cinder track, along with the almost-monotone of my voice speaking into a microphone telling the blind Sheila, "Left – left – right – looking real good – half way – now, you're there – real good – that's all, you're done now."

Coach Jim Blasingame aims Sheila Holzworth in the starting blocks.

I laid the microphone down and turned the transmitter off, as there was no longer any need for it. Her teammates had met her and were now walking her back to the stands. Sheila was very dejected with her time. The 14.2 was not very good for the one-hundred-yard dash. She had been very nervous on this run, as she had gotten into the fence on an earlier practice run that day. She had had only about a dozen practice sessions with the radio equipment she was using.

14.2 seconds for the one-hundred-yard dash may not be a good time for your average runner, but Sheila changed that the following week with a 13.2 time. The second time she was not as nervous and had had a few more practice sessions. Sheila is now within three-tenths of a second of the rest of her team, which is not bad for a girl who, only five years ago, lost both of her eyes. It was a freak accident in which the orthodontic headgear she was wearing broke and flew into her eyes. Her father, being a doctor, had given her immediate first aid, and she started to recover. But a secondary infection set in, and it became necessary to remove both of her eyes.

Now, five years later, she wants to do, and does do, everything that other fifteen-year-old girls do – skateboarding, roller skating, riding horses, bicycling (tandem) – and she planned to participate in the bicycle ride across Iowa this year. She also begs to be allowed to drive a car. Prior to the accident, she was very active in track and athletics, but the accident slowed her down a bit. She used to run with her coach in front of her, but in the high school meets this can't be done.

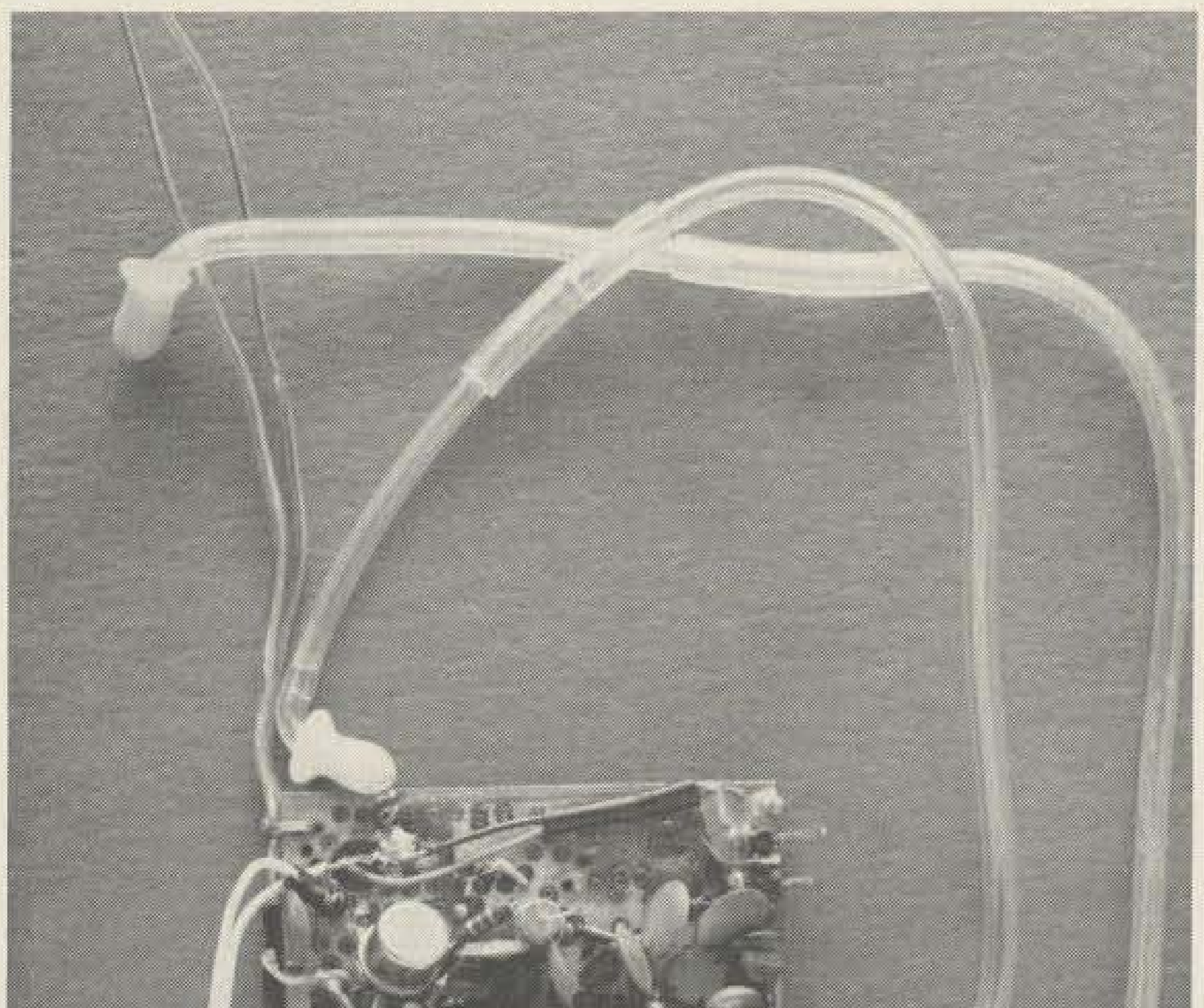
A friend of mine, who also knows Sheila's family, asked me one day, "Ed, you're a ham and know about radio; is there any way that we can wire Sheila for sound, so she could run in track?"

My response was, "Let me see what I can scrounge up and what is available." I was thinking of two meters and a pocket scanner, on a little used frequency, with earphones. It sounded like a good idea, if a bit bulky. But, at least, it could be made to work, and this kid really wanted to compete with the other kids on their level.

A quick call to another ham, Ron Kinton WBØMBZ (who knows a lot more about radio than I and has a bigger junk box), revealed that it might take time to get crystals for an odd frequency and that the plain bulk of the pocket scanner might not be good. He said he would get back to me the next day. Sure enough, he did, with a model airplane receiver donated by another ham, Tom Taylor KØHHE. It was already on six meters, so Ron proceeded to modify it by removing all the heavy digital circuits and adding one stage of audio amplification. This proved to be sufficient to drive a high impedance earphone. To get the receiver down to the lower part of six meters, a surplus crystal from an old Collins aircraft transmitter was found. These components combined to give us the magic number of 50.4 MHz for a receiver frequency.

Ron gave me the receiver and told me to tune it up and make it work. He even donated his ancient Gonset Communicator III for the cause. But he didn't have a 50.4 rock. His vfo for the Gonset didn't work either. I had a Heath sixer and a 50.4 rock, which I soon found out was no good either. But the Heath HW-16 I used for a CW station had a vfo that worked on six meters. It was pressed into service to provide the proper signal to tune the receiver with. The HW-16 and vfo combined with a counter enabled me to tune the receiver down to the proper frequency, and, in the meantime, I was able to locate another 50.4 crystal. After a few hours of tweaking i-fs and coils, it became apparent that I needed to get further away from the transmitter. I then called yet another ham, Ken Freberg WBØIFE. Good old Ken, he never questions the crazy stuff I do, just helps out any way he can. We took the Novice course together and got consecutive calls, and I have had him over for several projects. Ken took over the duties of operator, and I became a "Sheila" and proceeded to walk up and down the street at night, in a light rain, muttering to myself, while trying to fine tune that tiny receiver, which we now had down to just about one ounce of weight, including the earphone.

After satisfying myself that this just might work, I contacted Sheila's family, and we made arrangements for a few tests. This proved to be very encouraging. I presented to Sheila the tiny receiver and the large, seven ounce carbon battery that we had for practice. Now was the time for the first of many trips for Sheila, with my voice in her ear. She held the receiver and battery in her hand, while holding the earphone in her ear — it wouldn't stay in her ear, so she had to hold it. A walk down her long, broad driveway was an outstanding success for both of us. I was even able to guide her up to and around several parked



Receiver module showing the high impedance earphone with medical IV tubing and Y junction. The splice between the IV tubing and the Plantronics earphones is medical catheter tubing.

Sheila with her headband. The object on this side is a nicad battery. One antenna is worn in front, the other in back, both under her shirt.

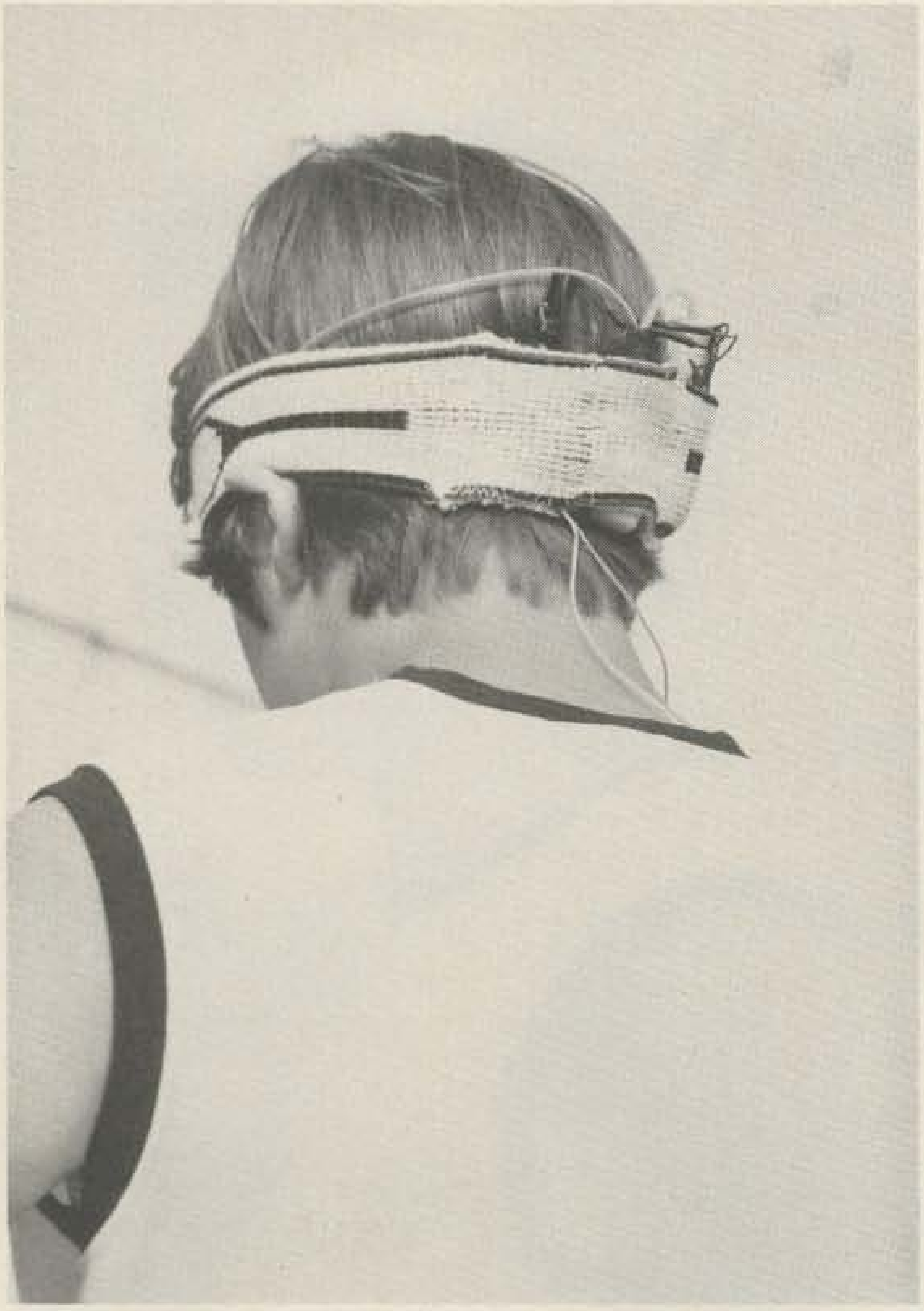
cars. It is difficult to say who was more excited over the promises this held for Sheila, but it was decided right away that she should try to run with the radio. A belt was brought out to tape the heavy battery to. Some surgical tape was used to hold the earphone in place and also to wrap the receiver with, so it could be pinned to her shirt. Her coach, who lived nearby, showed up, and we proceeded to let Sheila run. In her very own tunnel, in the absolutely black abyss world of the blind, with only the voice of the person who held the microphone to guide her, she ran.

Her best friend, Kim Novak, was asked to try as a controller for her. Because of their long friendship, we thought she would be good, but Kim got too excited and was unable to tell Sheila what she had to know. Her coach then took over the microphone for the rest of the test that day. It soon became apparent that we had a real winner on our hands. This girl and her abilities are fantastic.

I returned to my home and proceeded to rework all the external hookups, so the receiver could be placed in a sweatband. My wife made a pocket in the headband for the receiver. Another pocket was added later for a nicad battery, which was added for the competition runs. The placement of 2 antennas was necessary, as her body would null the signal when she was between the transmitter and receiving antennas. With the system pretty well completed and refined, I met with Sheila nearly every day for practice. Because of our practice schedule, I have become Sheila's controller. True, it takes time, but what better way to develop a hobby into something positive?

This girl was so eager and trying so hard that she developed shin splints, which were extremely painful, but she kept on trying. We finally had to quit for a few days, so Sheila could recover. I found that if I asked her if she hurt, the answer was always "no," but if I watched her very closely, I could tell when she hurt. I had to watch her constantly, until she finally realized that she couldn't perform when her legs were sore.

It is still a real problem to keep her in the narrow space that is allowed on a track, but I am sure that the day will come when Sheila will keep in her lane, and she will come out in one of the first three places. The amazing thing is the faith and trust this girl has to run down a track with no more than someone telling her which way to go! We have all tried it at one time or another, and the results of seeing another ham walking down the track blindfolded, with the radio for a guide, can sometimes be quite funny. When Sheila does it, running faster than any of us old men can, it is nothing short of amazing. She makes mistakes, but don't we all? They don't make her feel very good, but, with practice, I am sure that she can do the things that she wants. I don't think I can ever take this girl and her efforts as commonplace or for granted. I constantly marvel at her abilities, and I will be forever grateful for the opportunity I have had to work so closely with her. The fact that amateur radio has had a hand in this project just makes my hobby that much better. ■



Rear view of the headband showing the pocket holding the receiver and battery and the placement of the audio tubes. The two wires coming down are the antennas.

Ron Kinton WBØMBZ making some adjustments on the Gonset Communicator III during a practice session, with Sheila standing next to him. The antenna is a 5/8 wave on 2m extended to ¼ plane on 6m using aluminum foil for a ground plane. Works FB, 1:1 swr.

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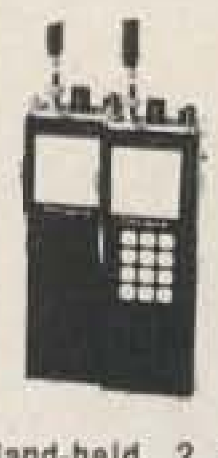

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CB to 10

-- part VI: antenna suggestions

Tom M. Murphy K5UKH
Rt. 1, Box 301A
Ethel MS 39067

One of the better things to happen to amateur radio lately is the availability of lots and lots of low cost communications equipment – new and used Citizen's Band transceivers. These range from old tube types to modern solid state units.

Want to be cheap? Just do as I did – find an old tube radio, get it into operating shape, and convert it to 10 meters. I was given a Johnson Messenger 1 tube radio by a "good buddy" who was all hung up on his latest 40-channel play-pretty. Well, sort of "given" . . . it cost me three beers and a quick radio repair job. A couple of tubes later (which I scrounged), I had it going great on CB channel 11. The radio was putting out 10 Watts AM into a wattmeter and dummy load.

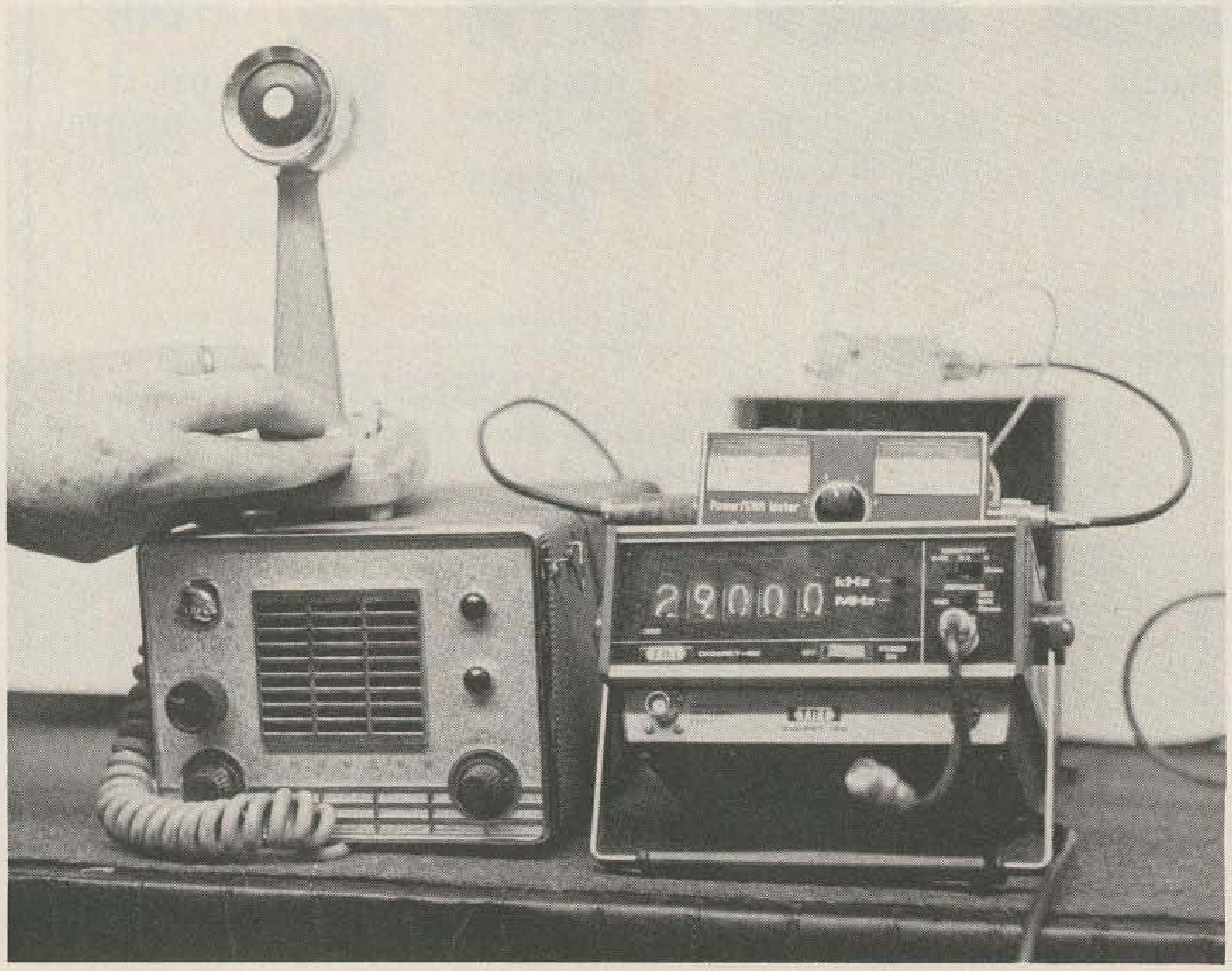
That's one of the reasons most of the tube types were (and still are) so popular. They could be "tweaked" for more output very easily. In this area, 29.000 MHz is coming into use for channel 1, since there is really no established band plan for this equipment. Let the CW boys use 28 to 28.5, of course; SSB has 28.5 to 29; and let the AM activity start at 29.000 through 29.290. That gives everyone a lot of room.

The 2 meter band is getting more and more crowded. Onward and upward is the cry, but the cry I hear right now is my pocketbook. So, let's fall back and regroup and have a whole bunch of fun in the process. The Johnson has a 5-channel capacity, a built-in ac power supply, and puts out 10 Watts with no problems. The conversion was about as simple as sticking a couple of crystals in. You just have to tweak on the rf stages, both receive and transmit, for optimum performance at 29 instead of 27 MHz.

Checking with a number of good buddies in the area reveals a huge quantity of tube type radios. These are just ideal for conversion to 10 meters. I have a solid state rig converted to 10 in my truck, and it works like a champ. Having solid state for mobile and a cheap tube set for base use is the way to go. The people I want to talk to can now get me on 10 meters instead of 2. Because it's sparsely populated, there's no problem like on 2. It was hard to work SSB on HF without the 2 meter radio sounding off. So, this way, if DX is around, I can get a call or give one to alert the "good guys."

What about antennas? Well, there is a lot of "scrap"

Photos by James Clegg



10 Watts at 29.000 MHz.

lying around. This scrap is good stuff, and it can usually be obtained for the asking. I've seen many antennas whose only problems were that the fellows using them couldn't make them work, shorted PL-259, cut coax too short, etc. The latter may be just fine for this use because that's what you have to do to go up in frequency, of course — generally cut off about 2 inches for 29 MHz.

The antennas for mobile use are of many types, ranging from cheapos to the expensive, high quality items. With base-loaded coils, I just snip a couple of inches off the whip, rather than worrying about getting into the coil. Then there are the center-loaded types; again, take a couple inches off. On my truck I use a 4-foot, fiberglass, top-loaded antenna (Radio Shack, new $9.95 with $4.95 mirror mount), which I got for no cost when one of the fellows was getting the swr down and trimmed it off too short. It started going up on him, and that was it; he had to scrap it and get a new antenna. That was fine with me; it's going in my direction anyhow. There's a rubber tip over the end; remove it, and you will see the end of a wire. Carefully take your pocketknife, fish the wire out, and trim. Of course, all the trimming is done while using the 10 meter radio in conjunction with an swr meter.

Then there's the full length "whip," 102 inches long, plus a 4-inch spring and ball mount. If you like it "whipping" around, trim a couple and get talking. As you go down the street, you will come to know the height of tree branches above the street.

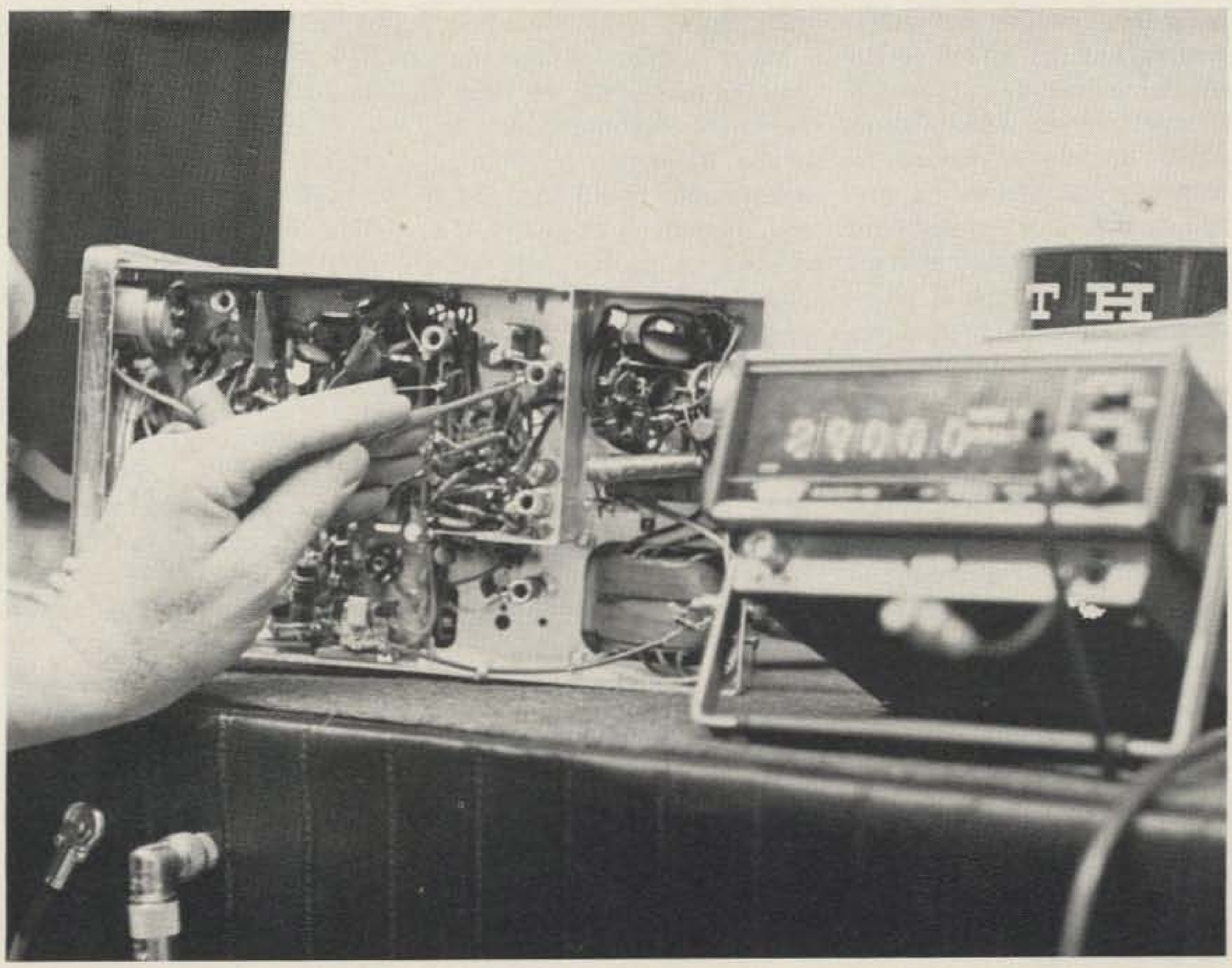
Seriously, there's a world of CB antennas out there just for the seeking, so put the old ham spirit to work and scrounge! Base station antennas are equally as easy to convert. Just a little trimming is all it takes. They range from the cheapies that have no gain (actually a loss compared to dipole reference), to quarter wave, to the big, long ones, more than 19 feet, that have several dB of gain. Again, I have a preference as to type. I just don't like the big, long ones; they're hard to handle and sure do catch the wind. However, if it's cheap, the price is sure hard to beat, so that could be the way to go. I use a compact antenna called the "Starduster." I believe it sells new for about $45.00. I spent a couple of hours helping with an antenna erection and inquired, "What are you going to do with that old antenna?" I got it free or, at least, as a reward for my help.

The advantage of a compact antenna is that it can be easily mounted on top of the HF or whatever beam without a lot of trouble, whereas the long ones would be just about impossible. Of course, the trimming takes place closer to the ground. I just put the antenna on a 20-foot mast to make adjustments, and it changes very little when I finally put it way up there.

Beam antennas? Well, there are uses, of course. Say there's one specific direction you want; you could convert and side mount the beam. The average CB beams are just too big and unwieldy to be practical for our use, unless they're on top of a tower, and the chances are you already have a good HF beam. I have a TH-6DXX, and 4 working elements on 10 meters, which are enough for me. If it is difficult to make contact on the vertical polarized ground plane, then we just switch to horizontal on the existing HF beam. Also, the ground plane works very well in the omnidirectional pattern, to catch calls from mobiles that may be in any direction, and, of course, band openings. With the ground plane, I can hear stations that I would otherwise miss if I was using the beam and did not have it turned in their direction. The ground plane is up 85 feet, and the distances worked are amazing — base to base, and base to mobile. If I want to talk to my good buddy 60 miles away, I just ring his number (channel 1, 29.000 MHz), and away we go.

There are all sorts of goodies to be found. I honestly believe that those fellows must buy PL-259s by the bushel. Just scrounge, and you can come up with all sorts of radios, antennas, swr meters, coax, plugs, connectors, microphones, power supplies, external speakers, coax switches, and a whole raft of stuff.

I'm looking forward to conversions of HTs to 10 meters. They sure can do everything a 2 meter unit can (using direct frequencies), and they're a whole bunch cheaper. It should be lots of fun for hidden transmitter hunts, and, when the band opens, I think it would be a real kick to talk from here to California on an HT! SSB CB radios have come down a lot in price for the 23-channel models, but are still fairly high. I believe they'll come down some more. How about a conversion to 29 MHz for 23 channels of AM, with switching to drop it to the 28.5 MHz region for SSB? It's sure going to be fun. So, start scrounging! ■



Heavy-duty rf section.

Paul Hurm WB8CLF
Box 173
Seven Mile OH 45062

CB to 10

-- part VII: convert a TRC-11

A lot of hams have been talking about converting CB rigs for 10 meter use. I've even seen band plans for use with converted synthesized rigs which retain the same spacing as the CB channels. If you would like to avoid the work needed to convert a synthesized rig, but still want to join the group on 10 AM, try Radio Shack's Realistic TRC-11. It is a six-channel rig, which requires very little effort to be put on 10.

Like most of us who have to watch our pennies, I like to be able to justify buying a new rig. The justification I needed grew out of the results of our first Red Cross simulated emergency test of 1977. Our drill went well, but, during the debriefing, it became apparent that, in a real emergency, our dependence on 2 meter FM simplex channels might lead to problems. We sent three field teams out. Each team used a separate simplex frequency, either 46, 52, or 94, for their own communications. The field control stations also used our 146.37/97 repeater for relay to Red Cross headquarters.

Our later discussions pointed out that we should avoid 94, because it is a repeater frequency and mutual interference could arise. 52 is a nationally recognized frequency and could be crowded. 46 is set aside by the Ohio Area Repeater Council for statewide emergency use. All the frequencies we used had a potential for severe interference in the case of a real emergency, so we talked about possible alternate frequencies. 10 meter AM with a converted CB rig seemed like a natural.

Crystals

The TRC-11 is a crystal-controlled rig and uses separate crystals for transmit and receive. The transmitter uses fundamental frequency crystals. To transmit on 29.3 MHz, get one cut for 29.3.

The receiver is single conversion with a 455 kHz intermediate frequency. The receive crystal frequency is 455 kHz less than the frequency to be received. To receive on 29.3 MHz, get a crystal cut for 28.845 MHz.

I ordered my set of crystals from International Crystal Mfg. Co., 10 N. Lee, Oklahoma City, Oklahoma 73102. They cost $7.90 each. It may be possible to get them for less elsewhere, but, in two separately mailed orders, the crystals have been received within two weeks, so the service was worth any extra cost. Their catalog number for transmit crystals for the TRC-11 is 820308. For receive it is 8203097. Specify catalog number and crystal frequency when ordering. I suggest sending a check when you order – it will save time on processing your order, and International pays the shipping if you do.

Adjusting the Crystal Oscillators

Don't! That's right, you don't need to do a thing to the oscillator circuits. They are broadband enough that they take off with no problems at 10 meters. Before I received my crystals, I wanted to see if I would need to work on the oscillators. The only crystal I had was a spare for my Heathkit SB-301 heterodyning chain, and it was at 29.895, which is above the 10 meter band. I did want to check it out, so I jumpered the crystal into the circuit and tried it into a dummy antenna. It worked with no trouble, so I was sure it would work in the band as well.

Tuning for Output Power

Tuning up for maximum output power on 10 meters is very simple. Before I retuned for 10, I wanted to check how much I was getting on CB channel 9, which comes with the rig. Before retuning, channel 9 had 3 Watts, and 29.3 MHz had about a quarter of a Watt. After retuning for 29.3 MHz, I had 3 Watts there and 1.5 on channel 9.

To peak the TRC-11 for 10 meters, simply adjust the settings of coils L5 and L6 for maximum output, as measured on a wattmeter. All coils are plainly marked on the printed circuit board. L5 and L6 are very near the coaxial connector, towards the left rear side of the unit.

That's all the work you need to do to get the TRC-11 going on 10 meters. Simple, isn't it? Although I have not tried it, I believe the Realistic TRC-9A should convert just as easily as the TRC-11. The TRC-9A is listed as the three-channel, economy version of the TRC-11. It uses the same crystals, and the schematics are nearly identical.

Antennas

As I mentioned earlier, my major use for this rig is as an alternate frequency for emergency use. I did not want to put a permanent antenna on my car, so I tried Radio Shack's magnetic mount CB antenna, model 21-940, and found that it, too, is very simple to convert for 10 meter use.

The swr is adjusted by decreasing the length of the whip, using the cut-and-try method. I physically shortened the length of the whip to about 73 cm. On my unit, minimum swr was obtained with 66.3 cm of the whip extending above the top of the collar where the setscrew is located. I was able to get the swr down to 1.2/1.

Results

During our second Red Cross drill, Ted White WA8WQC and I tried identical mobile setups using the TRC-11 and model 21-940 antenna. Our results indicated nearly 100 percent usability over a 5-mile path with several hills and numerous buildings. Line-of-sight paths yielded good results at nearly double this distance.

The only problem we encountered was caused by the fact that I have a rather soft microphone voice. Using my usual voice gave poor results, because I was not driving the modulator circuit hard enough. With a little self-control, I find it is easy enough to speak a little louder and closer to the mike to overcome this problem.

If you are looking for a CB rig that is easy to convert for use on 10 meters, and don't want or need to convert a 23-channel synthesized rig, I suggest trying the Realistic TRC-11.

No matter what type of rig you convert to 10, the model 21-940 magnetic antenna from Radio Shack is easily converted to fill your need for an antenna.

With such an easy way of getting on 10 meters AM with a converted CB rig available to you, you no longer have an excuse to miss the action. See you on 10! ■

Battery Backup for Digital Clocks

-- don't miss a second

Joseph W. Long WA2EJT
2406 Maria Blvd.
Binghamton NY 13903

With the addition of a crystal timebase to my digital clock, it began to keep time very accurately — to about a second a month. Unfortunately, my house seems to have more than its share of short power interruptions and blown fuses. An accurate clock is of no great use if it must be reset every few days. Power line independence is a necessity for electronic digital clocks.

None of the ideas on battery power for clocks could be adapted to mine without cutting the foil on the printed circuit board in at least a couple of spots. Since I seem always to manage to slit my thumb along with the circuit board, I like to avoid this approach if at all possible.

The circuit in Fig. 1 should work for just about all clocks, without *any* modification to their circuitry. It amounts to connecting a battery in series with a resistor across the output of the clock supply.

R1 serves two purposes. First, it limits the charging current supplied to the battery while the clock is plugged in. Second, when power fails, it limits the discharge current to about 5 mA. This causes the clock LEDs to extinguish, and the clock runs with no readout, consuming very little power.

Depending on the clock, a different value for R1 may be needed. A little experimentation will determine an appropriate value. Closing S1 will allow the readouts to function on battery power, but the battery won't last long this way, so I used a momentary contact push-button.

Battery life seems to be very long in this circuit. After several months of "field testing," the battery tests as good as new. The trickle charge current it draws seems to do no harm.

Upon power failure, my timebase slows down from 3579545 Hz to 3579515 Hz. This is a change of about 10 parts per million and is equivalent to about 5 minutes per year, or less than one second per day. Most failures last a few minutes or a few hours at most, so this drift is not really any problem. Regulating the voltage at the timebase could eliminate even this drift.

This kind of project is my favorite — it uses only three parts, total cost could not exceed two dollars, it requires no "mods" to existing equipment, it gives real improvement, and it can't fail to work! There is something awfully nice about pulling the plug on your digital clock, plugging it in again and seeing it still displaying the correct time. ■

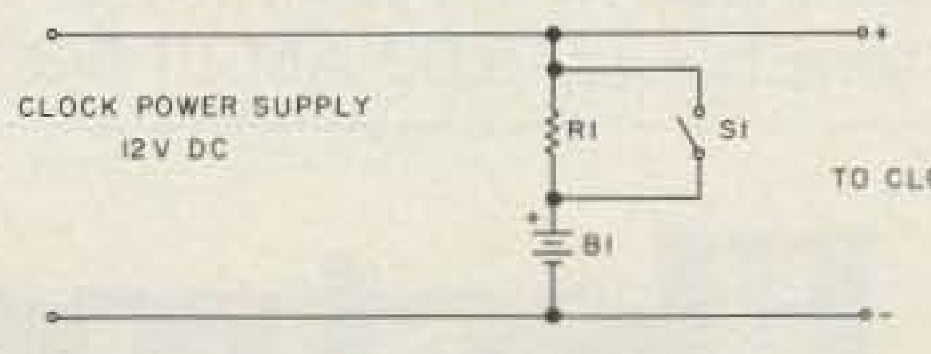
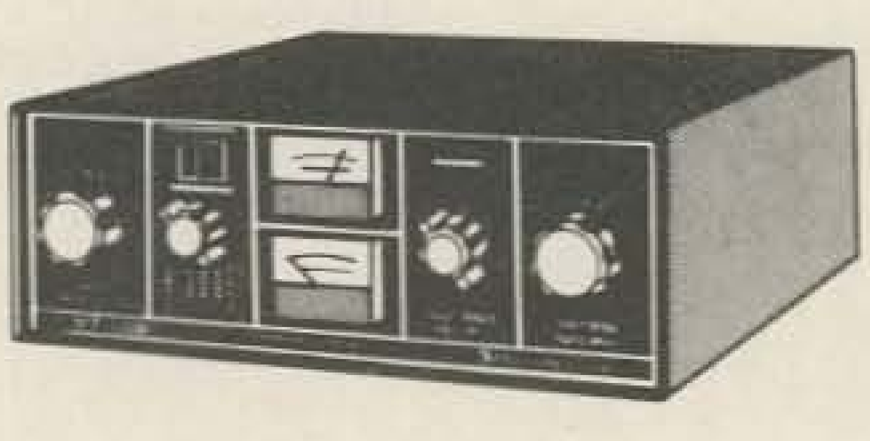


Fig. 1. R1 — 2k Ohm, see text; B1 — small 9 V battery; S1 — momentary contact switch.

Call Toll Free 1-800-633-3410 for antenna tuners



DENTRON MT-3000A antenna tuner

The MT-3000A is Dentron's "ultimate tuner". Tunes 3 coax, random wire and balanced feed system, just select the one. Handles in excess of 3KW PEP. Built-in 50 ohm - 250W dummy load. Dual watt meters. 3 core heavy-duty Balun.

349.50 list price. Call for quote.

DENTRON 160-10AT super tuner

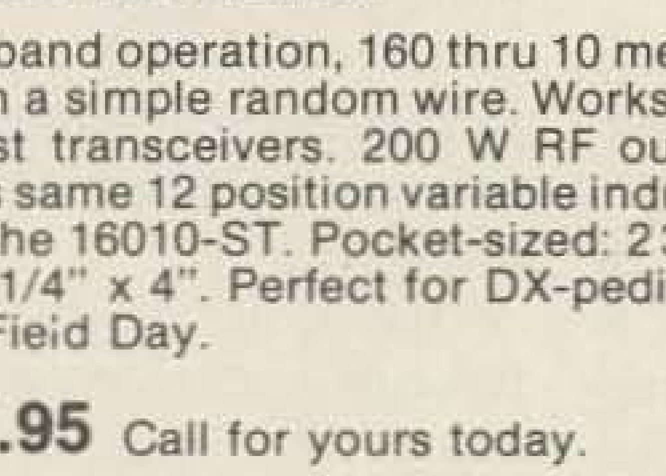
The only tuner for 160-10 meters that accepts all feed lines at 500 W DC - 1 KW PEP. Has extra heavy-duty ceramic inductor switch. Continuous tuning: 1.8 to 30 MHz. Tunes unballanced coax, random wire, or balanced feeders.

129.50 list price. Call for quote.

MFJ 16010-ST antenna tuner

Matches everything from 160 thru 10 meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, and coax lines. Up to 200 watts RF output. Built-in balun. A wide range, 12 position variable inductor is the 16010-ST's secret.

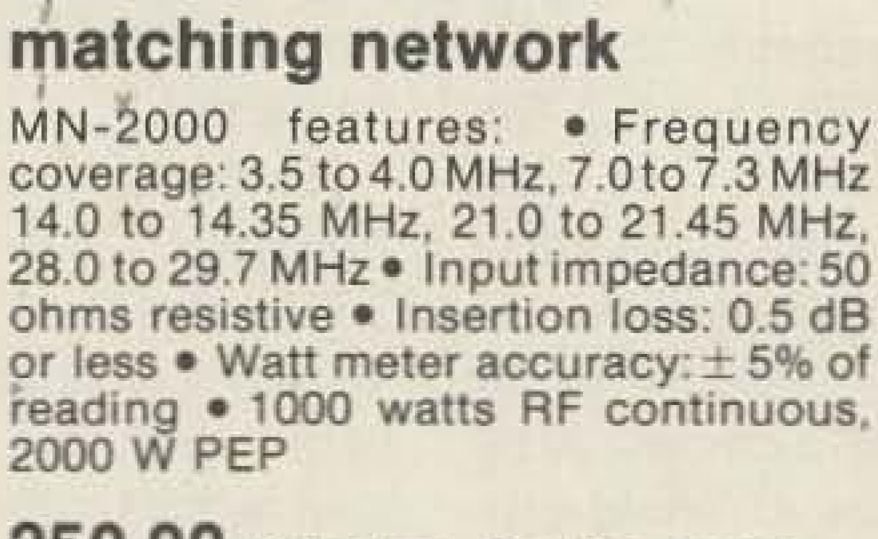
69.95 Call for yours today.



MFJ 16010 antenna tuner

All band operation, 160 thru 10 meters, with a simple random wire. Works with most transceivers. 200 W RF output. Has same 12 position variable inductor as the 16010-ST. Pocket-sized: 2 3/16" x 3 1/4" x 4". Perfect for DX-peditions or Field Day.

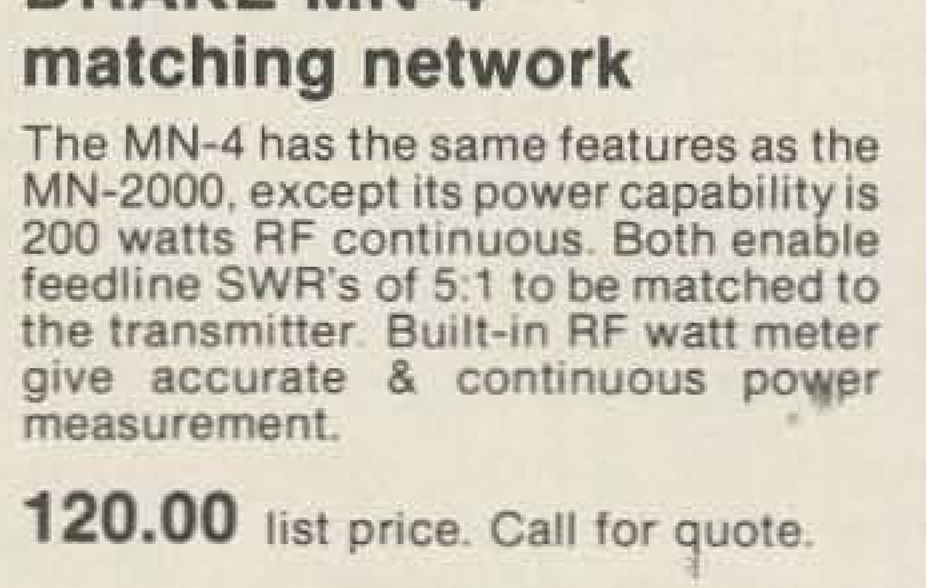
39.95 Call for yours today.



DRAKE MN-2000 matching network

MN-2000 features: • Frequency coverage: 3.5 to 4.0 MHz, 7.0 to 7.3 MHz 14.0 to 14.35 MHz, 21.0 to 21.45 MHz, 28.0 to 29.7 MHz • Input impedance: 50 ohms resistive • Insertion loss: 0.5 dB or less • Watt meter accuracy: ± 5% of reading • 1000 watts RF continuous, 2000 W PEP

250.00 list price. Call for quote.



DRAKE MN-4 matching network

The MN-4 has the same features as the MN-2000, except its power capability is 200 watts RF continuous. Both enable feedline SWR's of 5:1 to be matched to the transmitter. Built-in RF watt meter give accurate & continuous power measurement.

120.00 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. Store hours: 9:00 AM til 5:30 PM, Monday thru Friday.

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Call Toll Free 1-800-633-3410 for keyers

MFJ 8043 IC deluxe keyer

8043 IC features: • 4-way sending: iambic, automatic, semi-auto, & manual • Iambic squeeze key operation • Semi-auto "bug" operation provides auto dots & manual dashes • Dot memory: self-completing dots & dashes • Totally RF proof • Solid-state keying • Weight & tone control • Optional squeeze key shown: only 29.95

69.96 Call for yours today.

MFJ 8043 CMOS keyer

Features: • Built-in key w/adjustable contact travel • Dot memory • Iambic operation w/external squeeze key • Jam proof spacing • Variable weight control • 8 to 50 WPM • Sidetone & speaker w/adjustable volume & tone • Ultra reliable solid-state keying.

54.95 Call for yours today.

TEN-TEC KR-50 electronic keyer

KR-50 specs: • Speed range: 6-50 WPM • Weighting ratio range: 50% to 150% of classic dit length • Memories: Dit & dah with individual defeat switches • Paddle actuation force: 5 to 50 grams • Power source: 117 VAC • Side-tone: 500 Hz tone

110.00 list price. Call for quote.

TEN-TEC KR-20A electronic keyer

KR-20A: • 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 • Character generation: self completing dits & dahs • Weighting: Dit length increased approx. 10% at 20 WPM

67.50 Call for yours today.

TEN-TEC KR-5A electronic keyer

Similar to KR-20A but without sidetone oscillator or AC power supply. Ideal for portable, mobile, or fixed station. Housed in an attractive case with aluminum front, with black textured top & sides. 6 to 14 VDC operation.

38.50 Call for yours today.

NYE VIKING SSK-1-K keyer

Features: • Long, form-fitting paddles w/adjustable spring tension and contact spacing • Extra-large gold plated silver contacts • Audio oscillator & speaker • On-Off vol. switch • Speed control • Polarity switch allows instant change from positive to negative keying.

98.00 list price. Call for quote.

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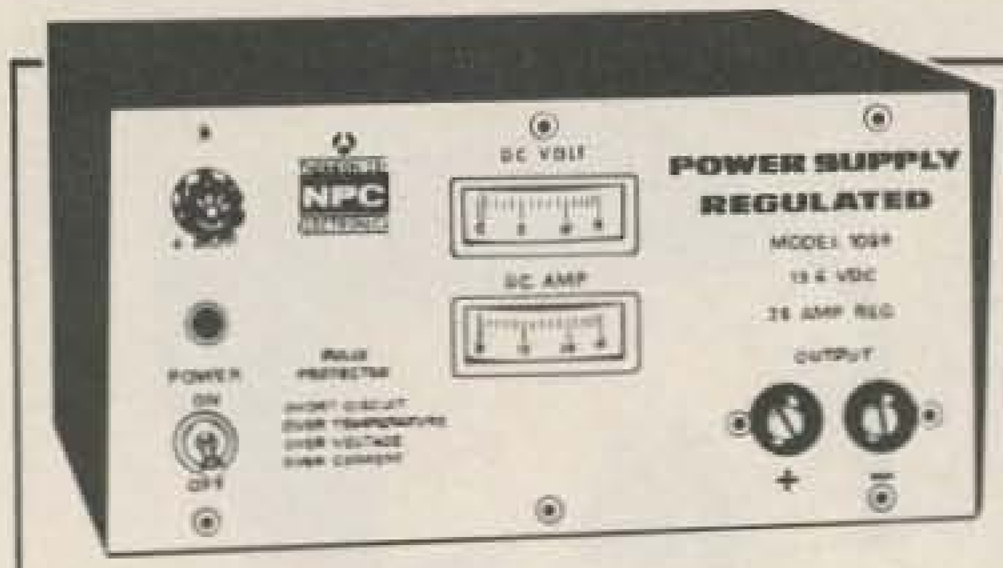
Call Toll Free 1-800-633-3410 for power supplies



NPC 109R power supply

The 109R is 25 amp regulated, 4-way protected. Other features: • Output voltage and current meters • All solid-state • Output voltage: 13.6 ±.2 VDC, typical to 13.6 ±.3 VDC, max. • Line/load reg.: 50mV, typical to 100mV, max. • Ripple/noise: 5mV RMS to 10mV RMS.

149.95 list price. Call for quote.

NPC 108RM power supply

The 108RM is 12 amp regulated, 3-way protected. Also: • All solid-state • Current meter • Output voltage: 13.6 ±.2 VDC, typical to 13.6 ±.3 VDC, max. • Line/load reg.: 20mV, typical to 50mV, max. • Ripple/noise: 2mV RMS to 5mV RMS.

99.95 list price. Call for quote.

NPC 104R power supply

104R is 6 amp regulated, dual overload protected. Features: • Output voltage: 13.6 ±.2 VDC, typical to 13.6 ±.3 VDC, max. • Line/load reg.: 20mV, typical to 50mV, max. • Ripple/noise: 2mV RMS to 5mV RMS • Excellent DC stability • Trickle-charge 12V auto batteries.

49.95 Call for yours today.

ESI POS-1220Z power supply

This one really works! • 13.8 VDC regulated power supply • Current rating: 20 amps continuous, 30 amps surge • Fuse protected • LED power indicator • ON/OFF switch on front panel. This unit will power a TR-7400A AND a KLM 160 watt 2m amplifier!

69.96 Call for yours today.

DRAKE AC-4 power supply

The AC-4 power supply works with all Drake 4-line transceivers and transmitters. Fits inside the MS-4 speaker cabinet. • Input: 120 or 240 VAC • Output: 650 VDC at 300 mA average, 500 mA peak, also: 12.6 VAC at 5.5 amps. Just what you need to complete your Drake station!

150.00 list price. Call for quote.

TEN-TEC 252G power supply

The 252G power supply is fully voltage regulated and solid-state to provide highly stable, pure DC from commercial mains. Instantaneous overload protection circuit prevents damage caused by excessive current drain. Reset by momentary turn-off.

99.00 list price. Call for quote.

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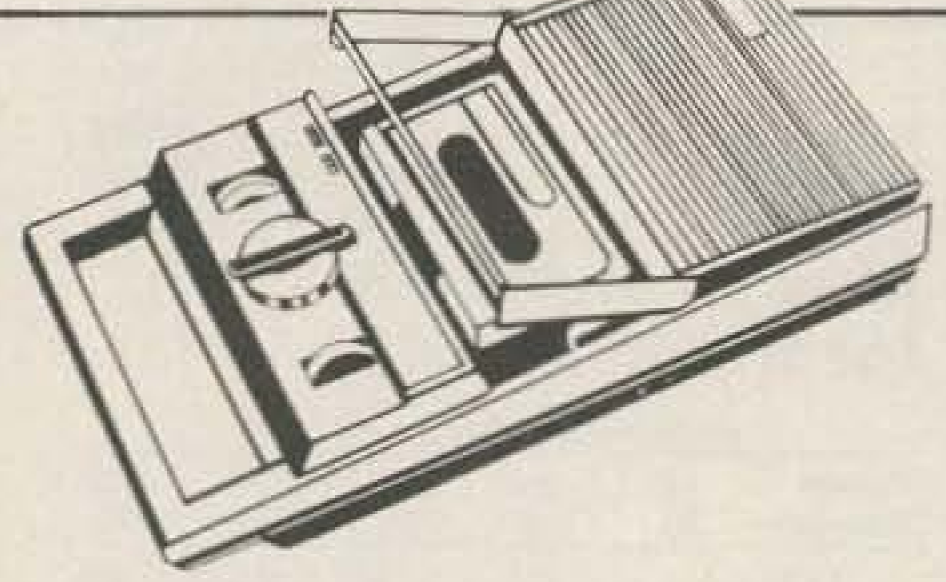
Call Toll Free 1-800-633-3410 for training aids



TEMPEST LCT-905 AC/DC cassette player

The perfect machine for the Ham who wants to improve his code speed. Just put in a code tape (see listings on this page) and listen. • 100% solid-state • Rotary knob operation • Complete with batteries, earphone, and AC cord • 6 VDC jack.

24.95 Call for yours today.

PANASONIC RQ-312S recorder, VC-12 album, & 10 C-60 cassettes

This package is just what you need for code practice or making station recordings. The RQ-312S is a full feature AC/DC recorder complete with batteries, built-in mike, and AC cord. The VC-12 album will store up to 12 cassettes. We give you 10 C-60 cassettes as a starter. All this for the recorder's price alone!

49.95 Call for yours today.

TUNE IN THE WORLD WITH HAM RADIO

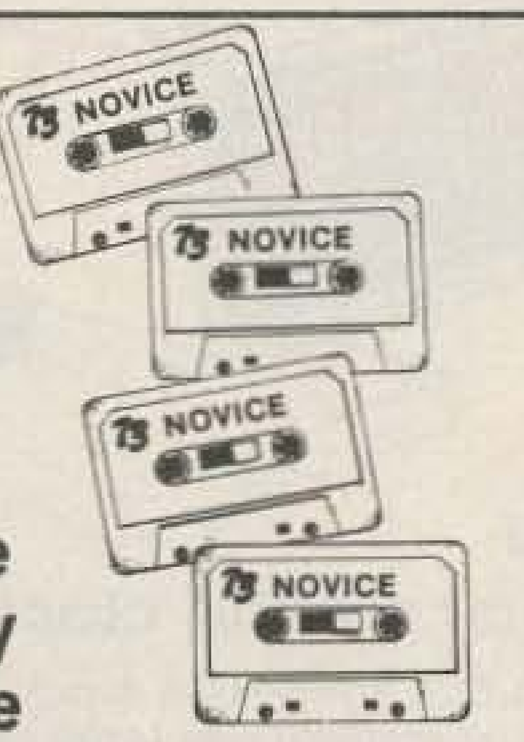
This nifty package will completely introduce you to Ham Radio. The book will show you how to pass your Novice exam and set up your first station. The code tape provides the necessary instruction in Morse Code. All considered, a great introduction to Ham Radio.

7.00 Call for yours today.

ARRL CODE KIT

Good practice for increasing your code speed. Booklet and two C-60 cassettes with 30 min. each of 5, 7½, 10 & 13 WPM.

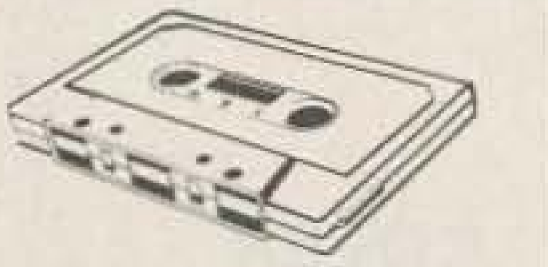
8.00 Call for yours today.



73's Novice Theory Course

You'll be amazed how easy it is to learn the theory when you listen to these tapes. Three tapes cover all Novice Theory and one has questions and answers from the latest Novice exams. You can listen in your spare time and breeze thru the exam.

15.95 Call for yours today.



73 and AMECO code practice tapes

73's "Blitz" code practice tapes will more than prepare you for any FCC exam. Available in four speeds: 5, 6, 13, & 20 WPM. One tape for each speed, one hour each.

4.95 each, all four: 15.95.

AMECO's code practice tapes: Junior Code Course, 0 to 8 WPM; Advanced Code Course, 8½ to 18 WPM; Extra Class Code Course, 13 to 22 WPM. Instruction booklet included with each course.

4.95 each. Call for yours today.

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Terry Weatherley G3WDI
16 Beverley Court
Carlton Colville
Lowestoft, Suffolk
England

Roll Your Own QSL Cards

-- originality for rare ones!

The QSL card is as old as amateur radio itself, and cards are as varied as the operators and the gear they use. This article describes a method of photographically home brewing cards that stand out from the pack and are very suitable for that special contact. They also might winkle out that card from the rare DX station.

The technique is simple. Ordinary darkroom equipment is all that you need. The process is based on "lith" and

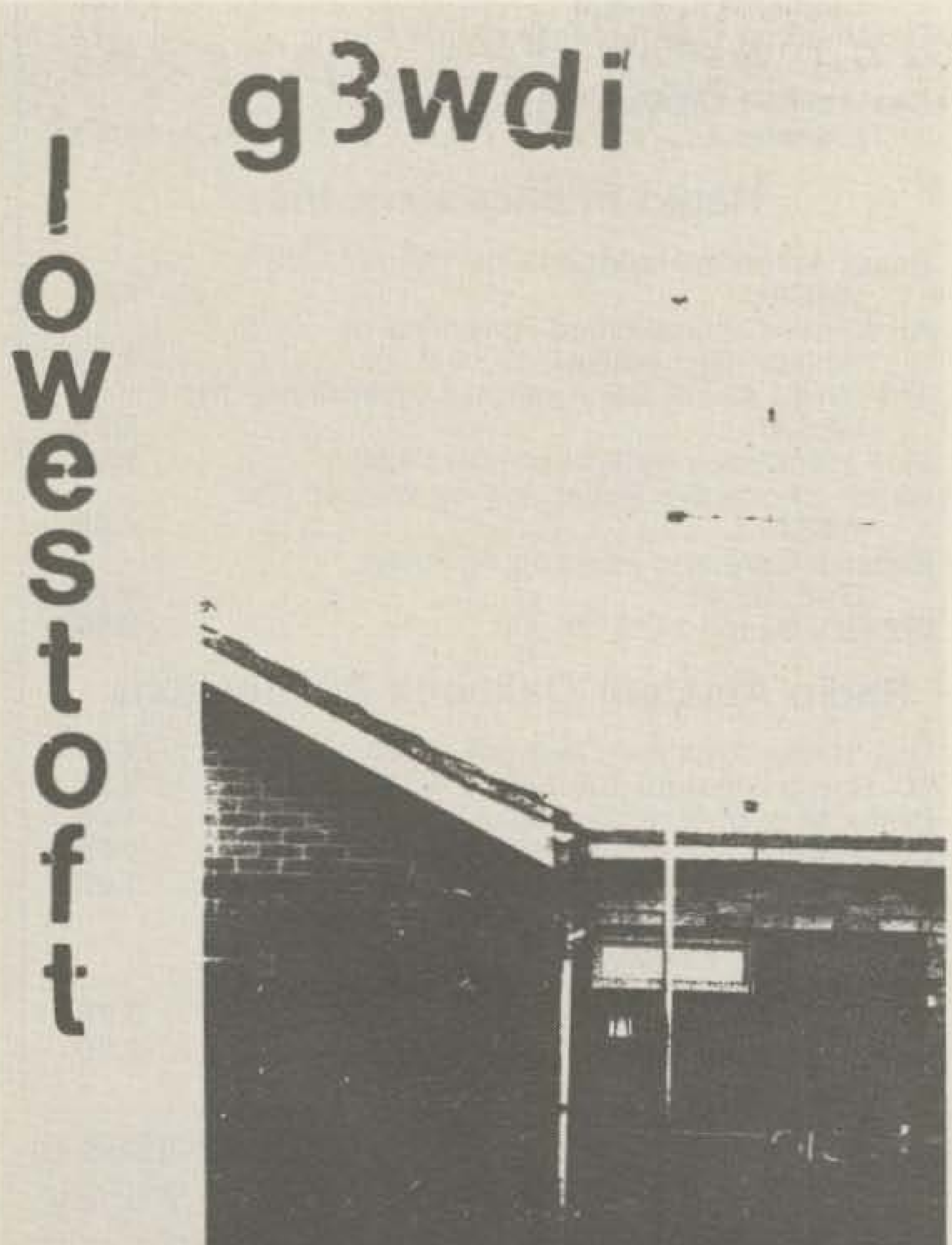


Photo 1.

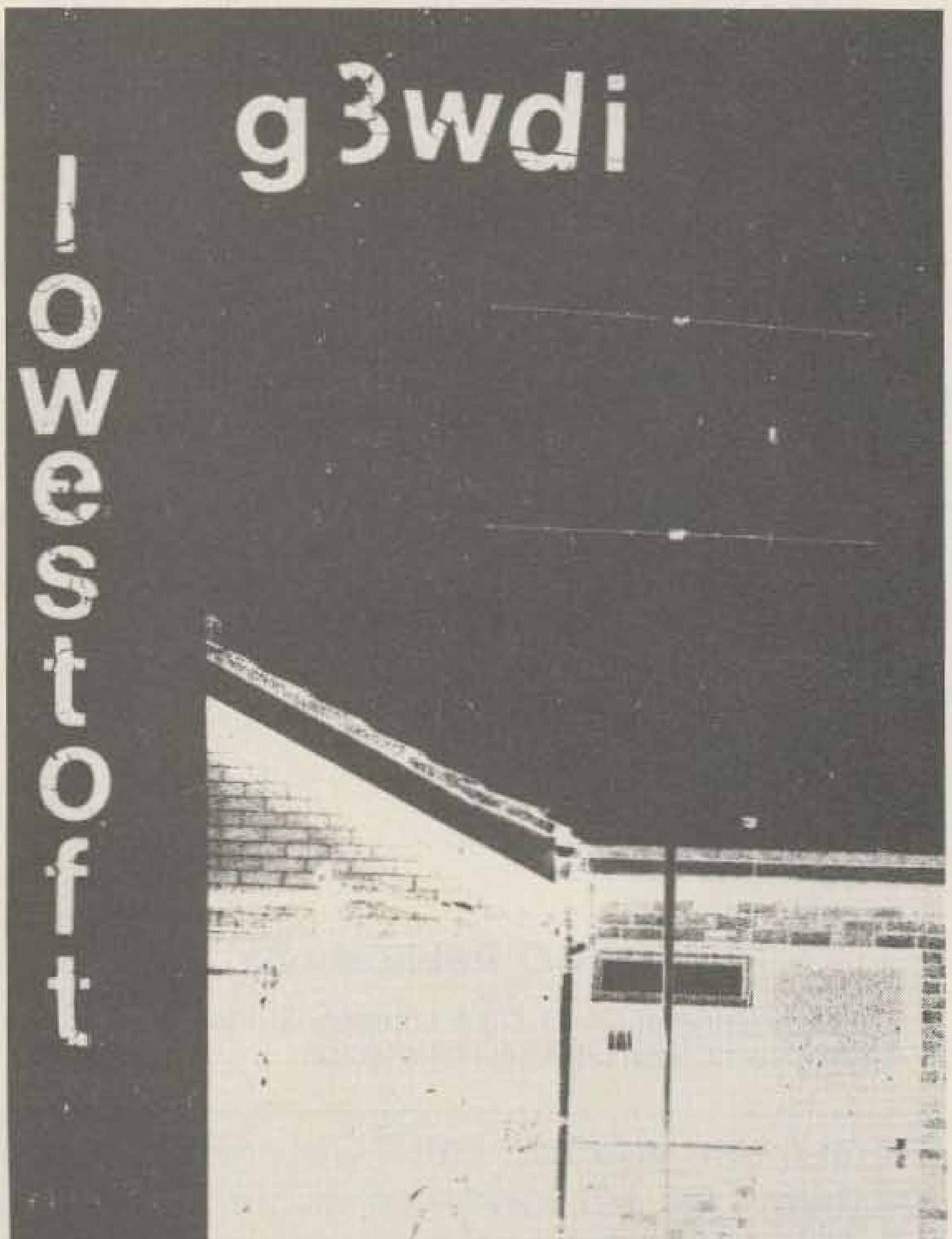


Photo 2.

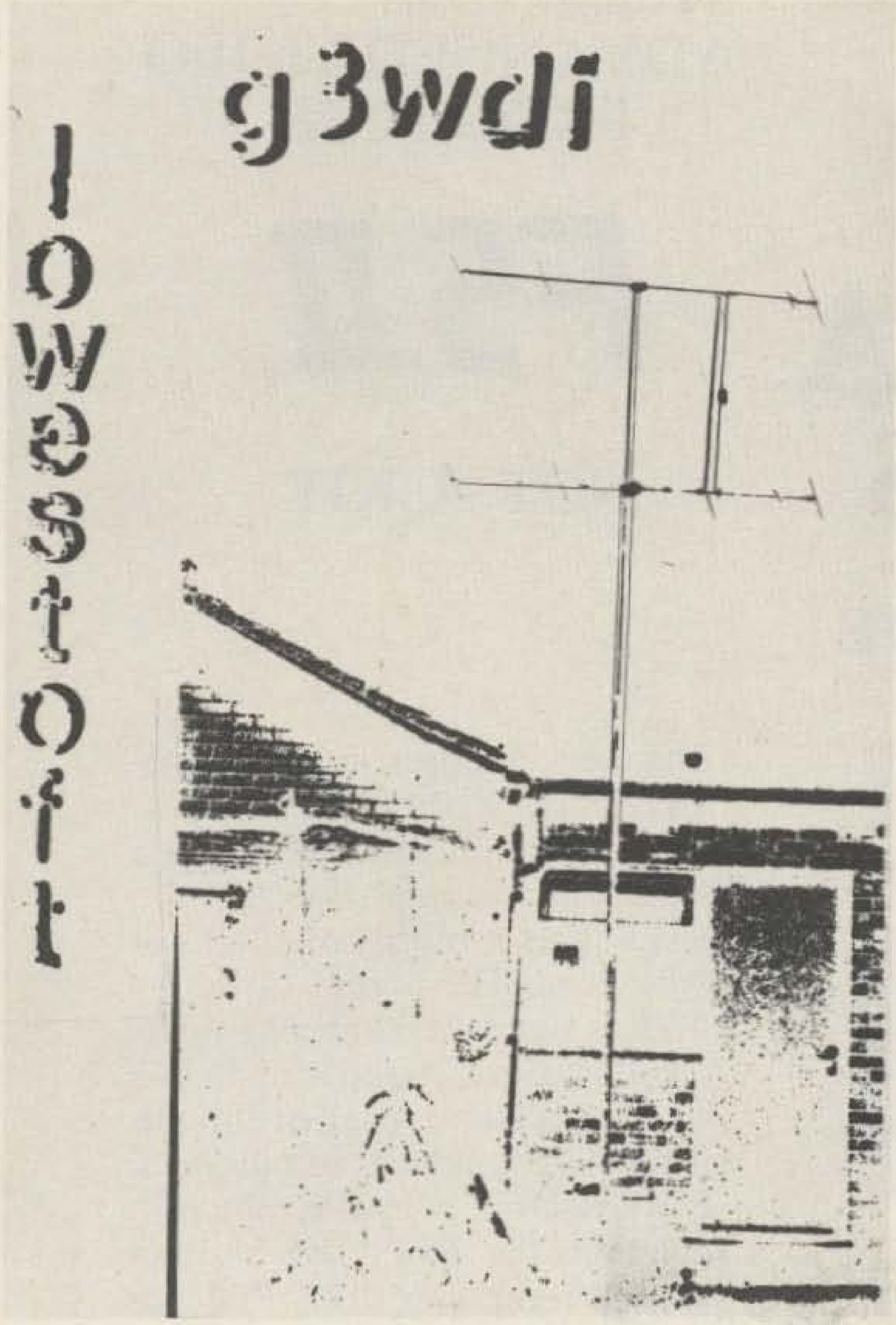


Photo 3.

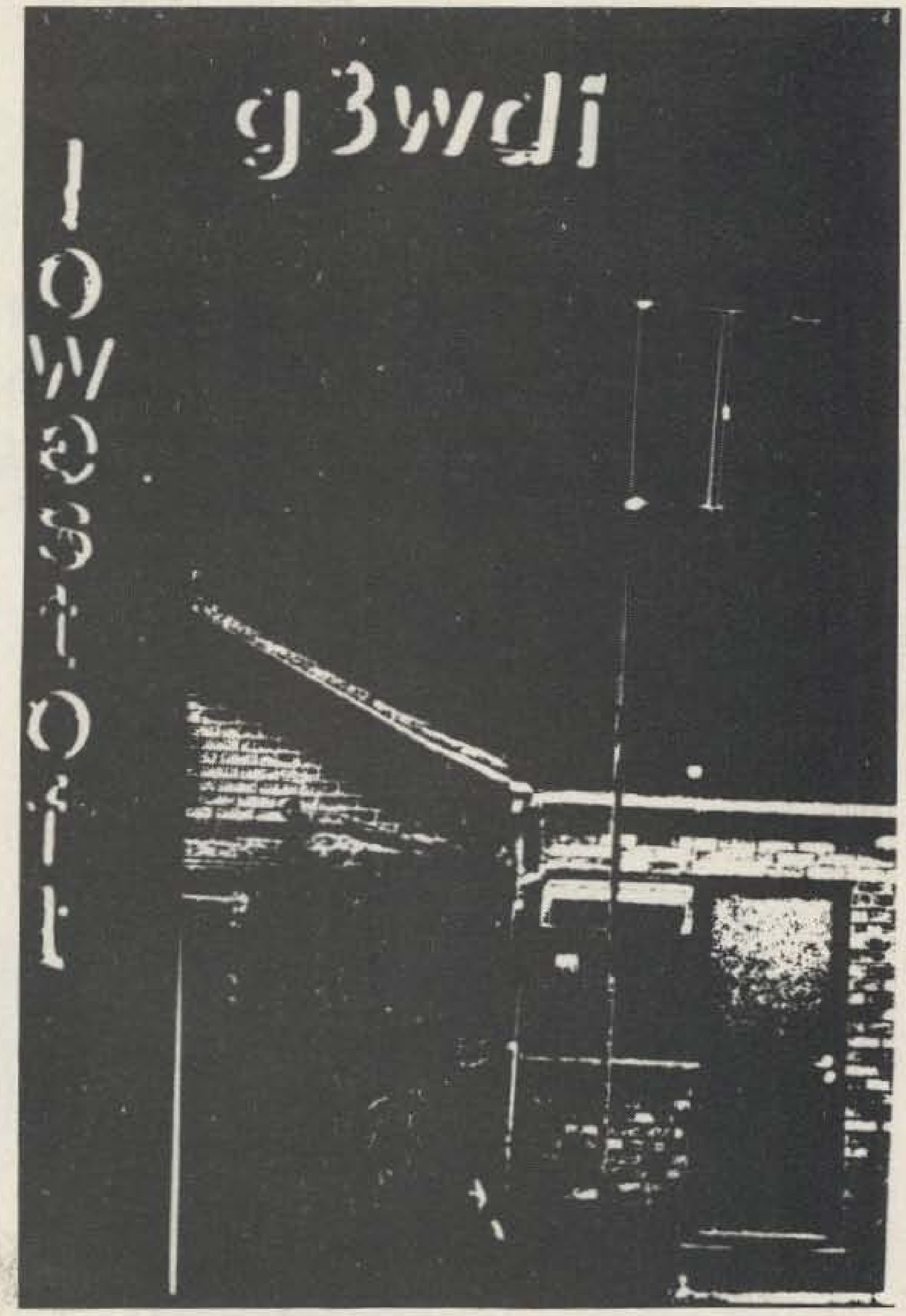


Photo 4.

"line" film, together with lith developer. Advertisements in the photographic press should provide the names of suitable suppliers of these materials.

Lith film is very contrasty and produces pictures in two tones – black and white. Greys on the original picture are thus rendered black or white, according to their density.

A suitable photograph for a QSL card is taken or selected from the negative file. In my case, a photo showing my shack and "antenna farm" was selected. As a normal print this had been less than successful, and it was in the reject file. However, it was most suitable to experiment with. A print of suitable size for a QSL card was made from this negative on a sheet of lith film. The result, after processing and drying (careful use of a hair dryer speeds up the drying), was a large black and white transparency (Photo 1). Using self-adhesive letters, the callsign and other details were added to the picture. In my case, a strip had been masked on the left-hand side for this purpose. A contact negative was then produced on a sheet of line film, and the result is shown in Photo 2.

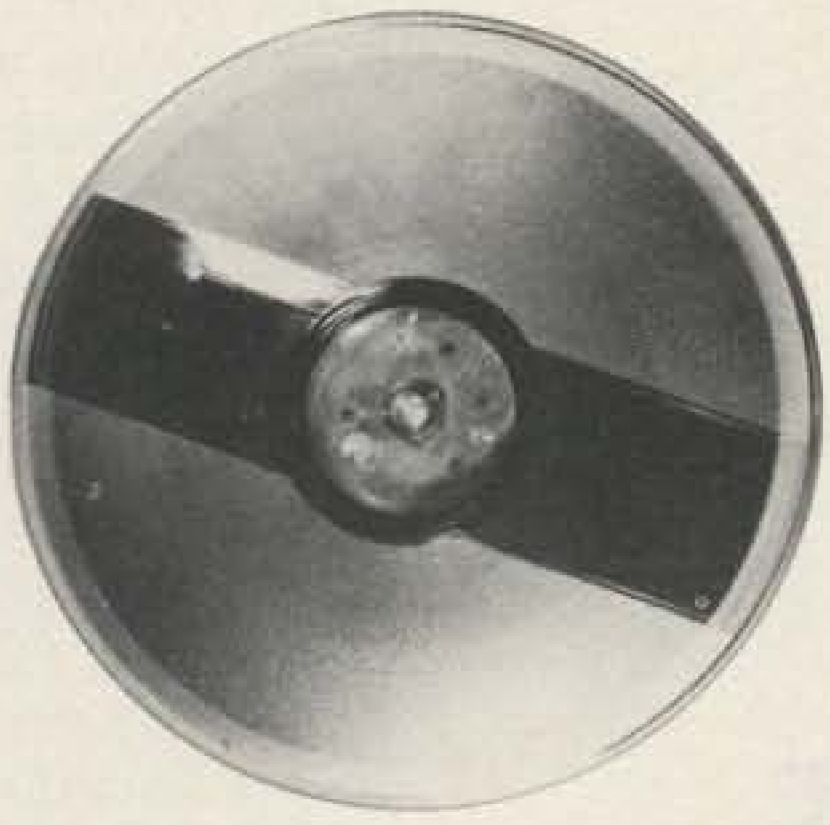
The negative and positive transparencies are now taped together, slightly out of register, and printed onto a sheet of lith film. The result is shown in Photo 3.

A negative is then produced from this print. Using either the positive or negative, prints are now made onto normal photographic paper for use as QSL cards (Photo 4). In my case, the prints were stuck onto a card, and QSL information was written on the back, since writing directly on the back of photographs is difficult.

Some control over the finished picture can be exercised during the processing – unwanted detail can be blacked out or scratched in. The six over six in my picture was scratched in with a pin, when it disappeared into the sky during processing.

This process of tone separation can be used with filters and colored paper to produce exotic, if expensive, QSLs. At G3WDI these cards will be reserved for special contacts. My first 2m contact with the USA will certainly receive one, while G8HRF in the next block may not! I will watch my incoming QSLs with interest. ■

VIDEO ACCESSORIES ADVANCED VIDEO PRODUCTS



Magnetic Tape	Memorex	Our Brand	Used Tape
½ × 1200' on 7" reels	$18.00	$10.00	$4.00
½ × 2400' on 7" reels	$27.00	$18.00	$7.00

For Cartrivision VTR	Memorex	OEM Brand	Used Tape
60 minute	$22.00	$17.00	$10.00
100 minute	$31.00	$22.00	$13.00

Roll Your Own and Save

Cartrivision casettes for reloading: ----------------- $6.00 each
7" reels for reel to reel VTR's: -------------------- $2.00 each
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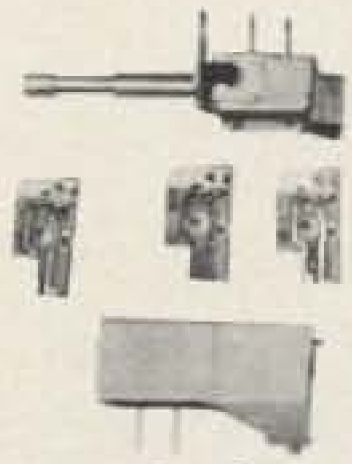

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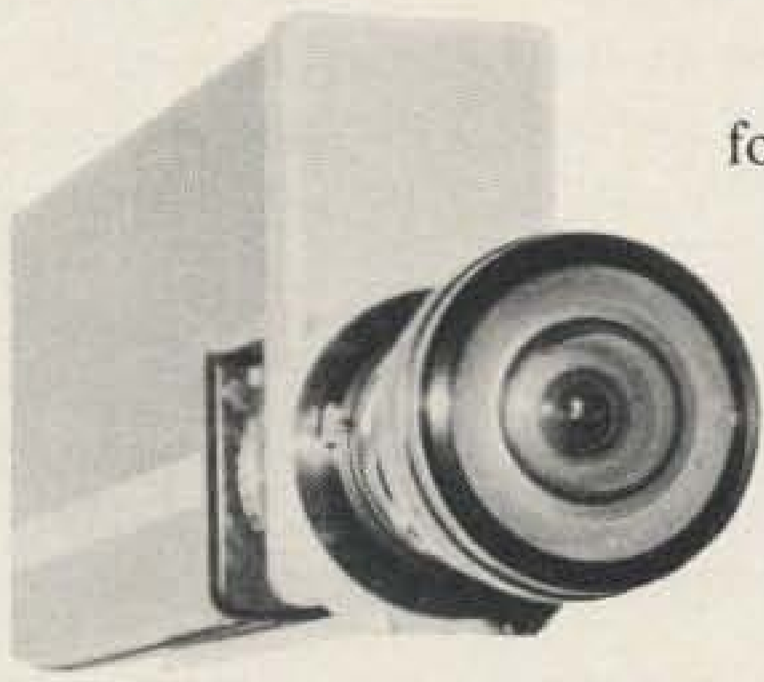

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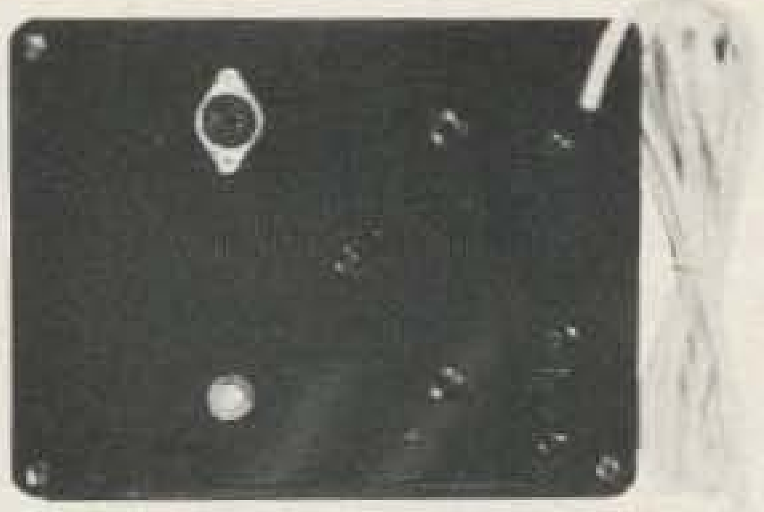

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Glide On Six

-- radio control primer

Radio-controlled model sailplanes and the six meter band were made for each other. We all know how quiet the activity has been on six since the dip in the sunspot cycle has chased all the good DX away. Well, when your twelve-foot-span sailplane is just a dot on the distant horizon, and the rf link that will guide it back home is only 750 milliwatts into a crude rod type antenna, you can appreciate all that peace and quiet. While other types of flying models use radio control guidance, none test the range of the equipment and the vision of the pilot like sailplanes. These planes depend on the rising air currents which drift downwind to sustain them, and they must follow these currents to gain altitude. This results in flights that roam all over the sky in search of lift and gently circling climbs to heights of several thousand feet before a landing in the grass at the pilot's feet.

A modified Windrifter sailplane with transparent yellow plastic covering to show off internal craftsmanship. Span is 99 inches.

In addition to pleasant Sunday afternoons at the local meadow flying for fun and practice, the coming of summer brings the contest season, with trips to places like Harris Hill near Elmira, New York, and the rolling fields of York, Pa. There, contestants numbering over 100 pilots and their planes gather to see who can stay aloft ten minutes precisely, and then land in a fifty-foot diameter circle for additional points. The majority of these planes are guided by four meter R/C rigs on 72 MHz, requiring a Class C CB license. But since there are only 7 channels authorized for R/C use, much time is wasted waiting for your particular channel to be clear. With 6 to 10 pilots on your channel, the wait can be a long one.

The equipment functions by digital pulse coding of the transmit carrier consisting of a clock pulse and additional data pulses, each of which controls a specific aircraft guidance function. The superhet receiver detects the pulse train and passes it to the decoder, which divides up the various data pulses and distributes them to the servomotors. A pulse width comparison circuit in each servo determines where the servo output arm is in relation to where the incoming pulse says the the pilot wants it to be. The error voltage is fed to a small dc motor which moves the output arm and a small potentiometer until the error disappears. There is one servo each to control the rudder, elevator, spoilers, and captive towhook on the aircraft. Power for operation is supplied by AA size nicads in both transmitter and airborne system, with a usable duration of three hours or so.

An interfering frequency has the effect of lengthening the data pulses fed to the servos, causing them to run to one end of the output arm and spiral the aircraft into the ground. Loss of radio contact generally has the same effect, in that the receiver agc cranks the i-f strip gains wide open and random noise triggers the servos, all of which used to occur with great regularity when the rigs were on 11 meter CB. Although the 5 frequencies there were not shared with "phone ops," the close proximity and large difference in power levels made those channels unusable.

The resulting crowding in the four meter band has resulted in pressure on the FCC to create a special code-free R/C controller's license class which would allow the pilots of planes, cars, and boats to pursue the hobby with reliable guidance systems. When one considers the damage or injury which could result from the crash of an aircraft weighing four to twelve pounds diving to earth at a hundred miles per hour, it's easy to see why modelers and R/C equipment manufacturers are pushing for space on six meters.

The majority of modelers are like most CBers, in that their interest is in using the rigs, not working on them. There are many, however, who would make fine

A "Hi-Pro" sailplane with molded fuselage and rudder. Wings have large movable flaps to change the airfoil and aircraft speed.

An all molded plastic and fiberglass model of a KA-6 sailplane. Span is 10½ feet, weight is nearly 12 pounds – ready to fly.

amateurs, given some encouragement from local hams. These Class C CBers already have a good record of compliance with FCC rules; indeed, pilots must show their licenses in order to fly in contests. These pilots would find that, in addition to reliable model control, there are some other, rather interesting things which the ticket offers. All they need is a little push in the right direction. And in case you think that big numbers are important, there are over 61,000 members of the Academy of Model Aeronautics, and 3 out of 4 of them fly Radio Control. It would make a significant increase to the amateur ranks if this resource could be tapped.

Which brings us back to that open field in the sunshine and the sailplane flirting with the puffy white clouds. The confidence that a ham rig gives to the sport of glider flying contributes in large part to the pleasure these birds have to give. To see your own creation so at home in the sky while it obeys the smallest movement of your hands makes all the code practice and radio theory sessions worthwhile. And at day's end, when it's time to key up the local repeater for some friendly rag chew, there is no end of ways to work models and flying and infinite descriptions of launches and landings into the conversation.

The next time you're driving down the road and see someone out in a field flying his plane, stop and say hello. He may be a four meter pilot who might like to be a ham or a ham who might give you some stick time on his latest creation. Either way, you can't lose! ■

Dave Gray of Elmira, the contest director, ready to launch his Hobie Hawk glider. This plane is sold through the Heathkit catalog.

Dave Lear WA2ERM throws his Pierce Paragon sailplane off the slope at Harris Hill. The horizon is over 8 miles away and the temperature that day was plus 16 degrees.

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More IC-22S

-- add a programming switch

I have found the following modification of the Icom 22S to perform in an entirely satisfactory manner, and to add considerably to the practical capabilities of this machine. As you who already own one know, all of the possible frequencies may be obtained by utilizing various combinations of diodes soldered into the programming board. It follows naturally that, if one could switch in various combinations at will, then all of the capabilities would be possible.

The first problem was where to put such a switch, so that it could be always available and wouldn't be dangling on a cable somewhere. You will see in Photo A where I chose to place this switch. I chose a small, 8-position SPST rocker switch made by AMP Special Industries. This switch plugs into a regular 16-pin IC socket. I bought two of the switches because, should a switch fail with use, I might not be able to find an exact duplicate later.

Photo B shows a detail of the switch in place, plugged into a 16-pin IC socket which is mounted on a small piece of 10 x 10 perfboard. The perfboard is supported on two arms, which extend from the small aluminum bracket plate. My aluminum bracket was cut from a junk box – extruded aluminum T-section. A bracket made from any piece of metal would serve just as well.

A look at Photo C shows the bottom of the transceiver with the 8 hookup wires soldered into position 13, in my case. However, you can use any channel or switch position you choose.

There is a ninth wire required, which is attached to the common channel position you may choose, and which goes down to the new switch common bus.

In Photo D, the hookup cables have been pushed aside to expose the underside of the bracket, perfboard, socket, and switch combination. Here you will note that

Photos by Dale Andrews

Photo A.

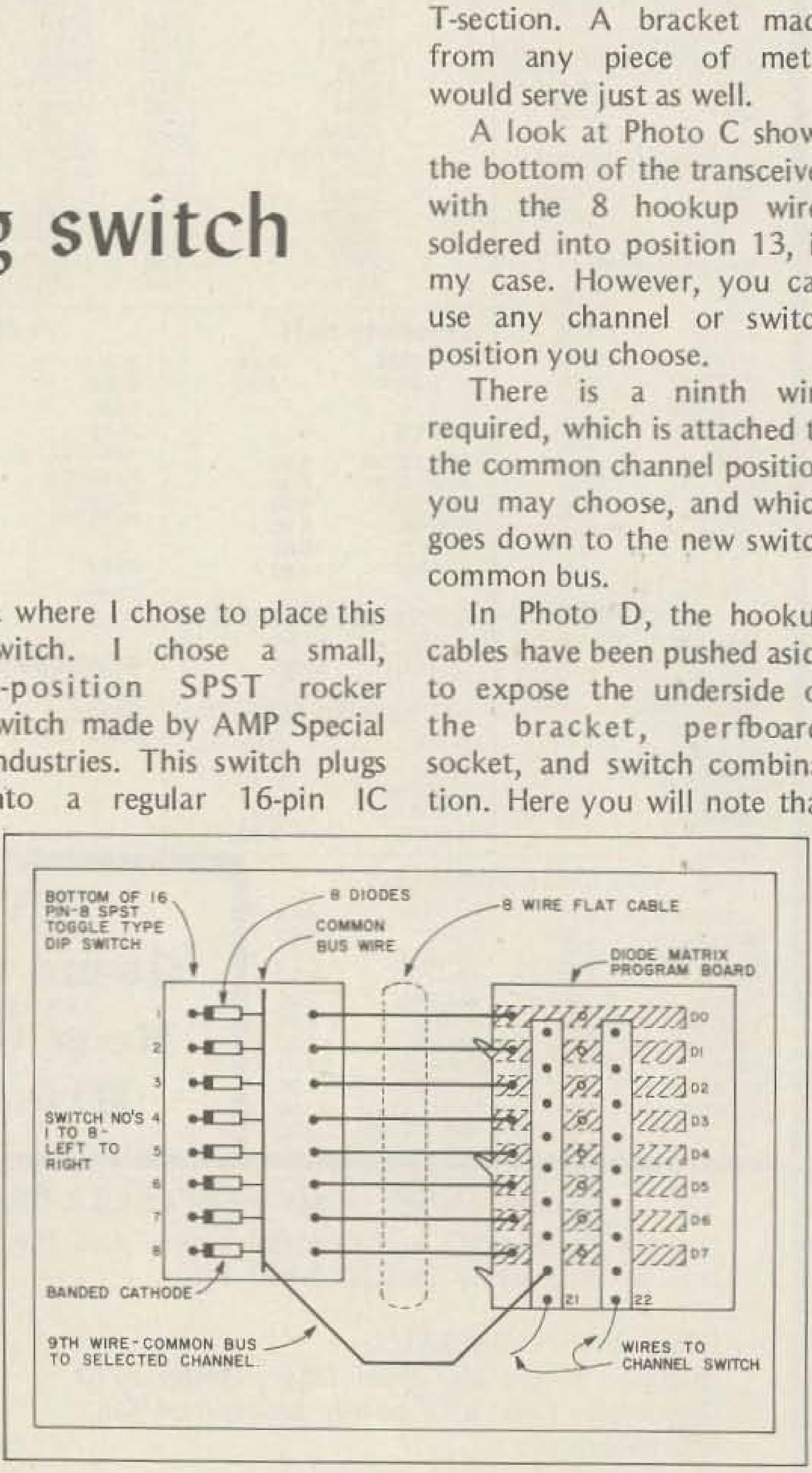

Fig. 1. A portion of the diode matrix program board. The 8-wire cable is attached to channel 21, with the ninth wire connecting the new switch assembly common bus to the program board channel 21 common bus. Note that your dip switches will probably be numbered from 1 to 8. Thus, no. 1 switch will attach to no. D0 program board hole, no. 2 switch to no. D1 program board hole, etc. Thus, when setting up frequency, you must remember to call no. 1 switch D0, no. 2 switch D1, etc. As you can see, this arrangement allows you to switch in any combination of diodes on your selected channel.

a common bare wire was bent and installed between the two rows of socket pins. The bent-down ends of this wire were epoxied to the perfboard. Eight diodes were installed, with the cathode (banded) ends going to each of the eight socket positions on the right, the anode ends going to the common bus wire, and, you can also see, the ninth wire, mentioned above, attached to the common bus. The eight wires going to the program board are attached, one to each socket pin in the left-hand run. Be sure to identify the wire for installation in the proper holes of the programming board.

Construction Hints

The bracket, IC socket, switch, bus bar, diodes, and wiring were all constructed outside the cabinet. The switches, diodes, and wires were all tested for continuity before installation.

The entire bracket assembly was then installed and epoxied to the circuit board and transformer can, as shown in Photo B. Note that this assembly was positioned far enough to the left of the machine, or towards the top of Photo B, to allow access to the meter pilot light. The perfboard is also epoxied to the bracket arms. The socket itself is held by the solder on its pins below.

The bracket must be so sized as to position the top of the body of the switch level with the underside of the transceiver cover plate, allowing the rockers to extend into the opening. After the switch was in place, with careful measuring, a rectangularly-shaped hole was cut in the cover plate. This hole was filed to size, and, as you see in Photo A, I touched up the raw metal edges with paint and used bright red tape to set it off.

I hope, with the above description and accompanying photos, that you will be able to install a similar improvement on your Icom 22S and will enjoy using it as much as I have. Of course, I recommend installing diodes permanently for those channels you use frequently, but this little gadget will get you into all the others when you want to. ■

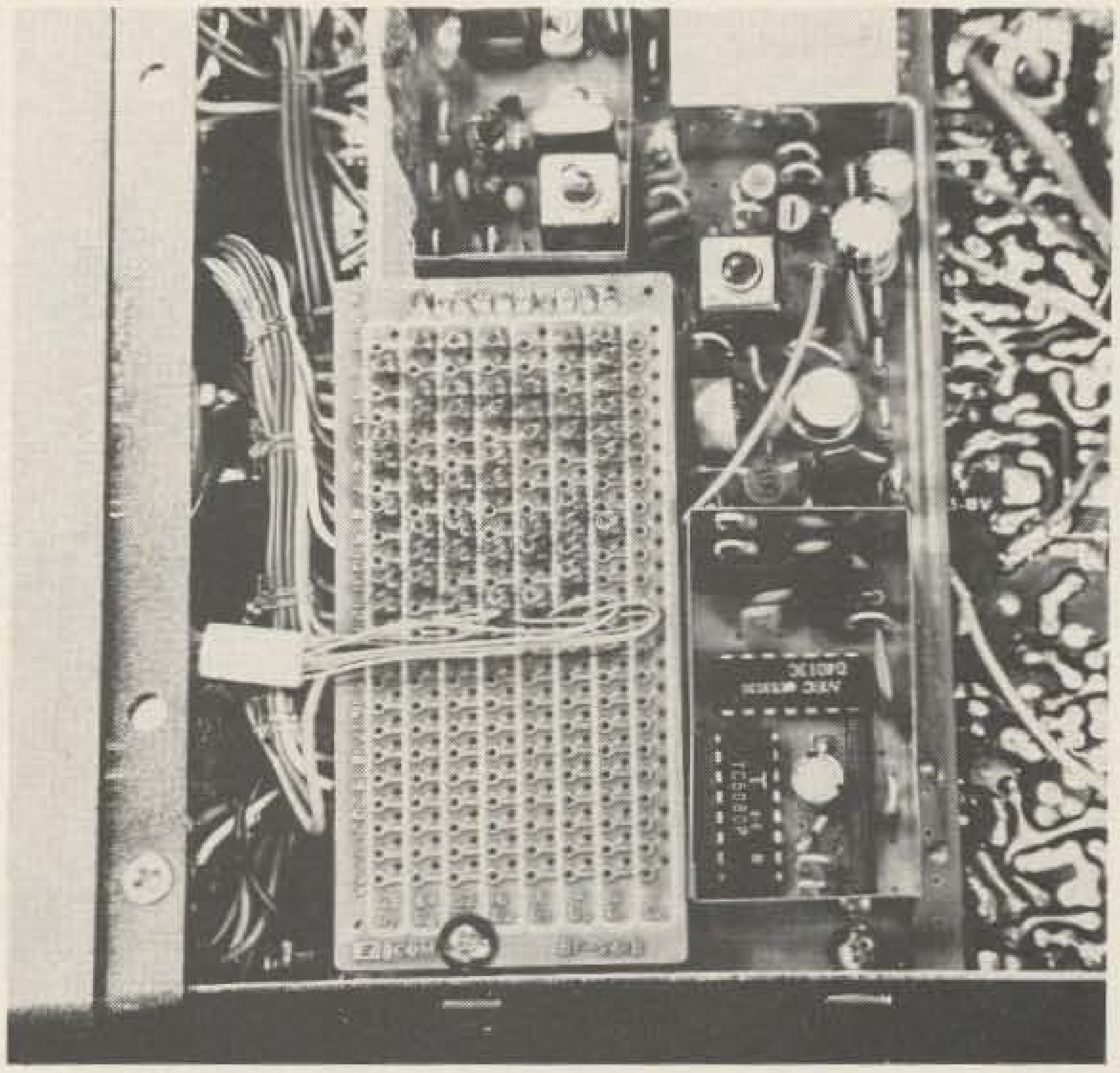

Photo C.

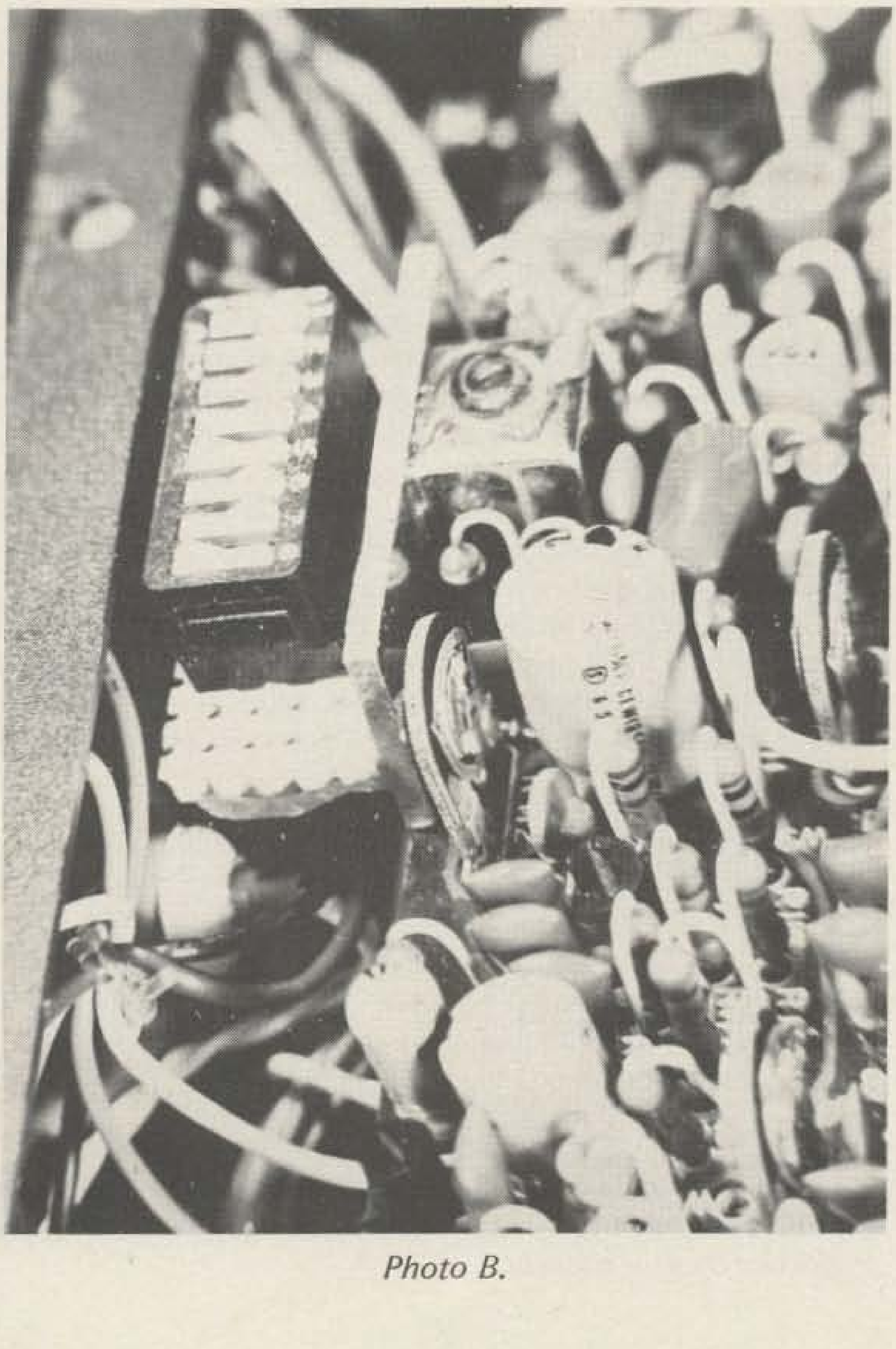

Photo B.

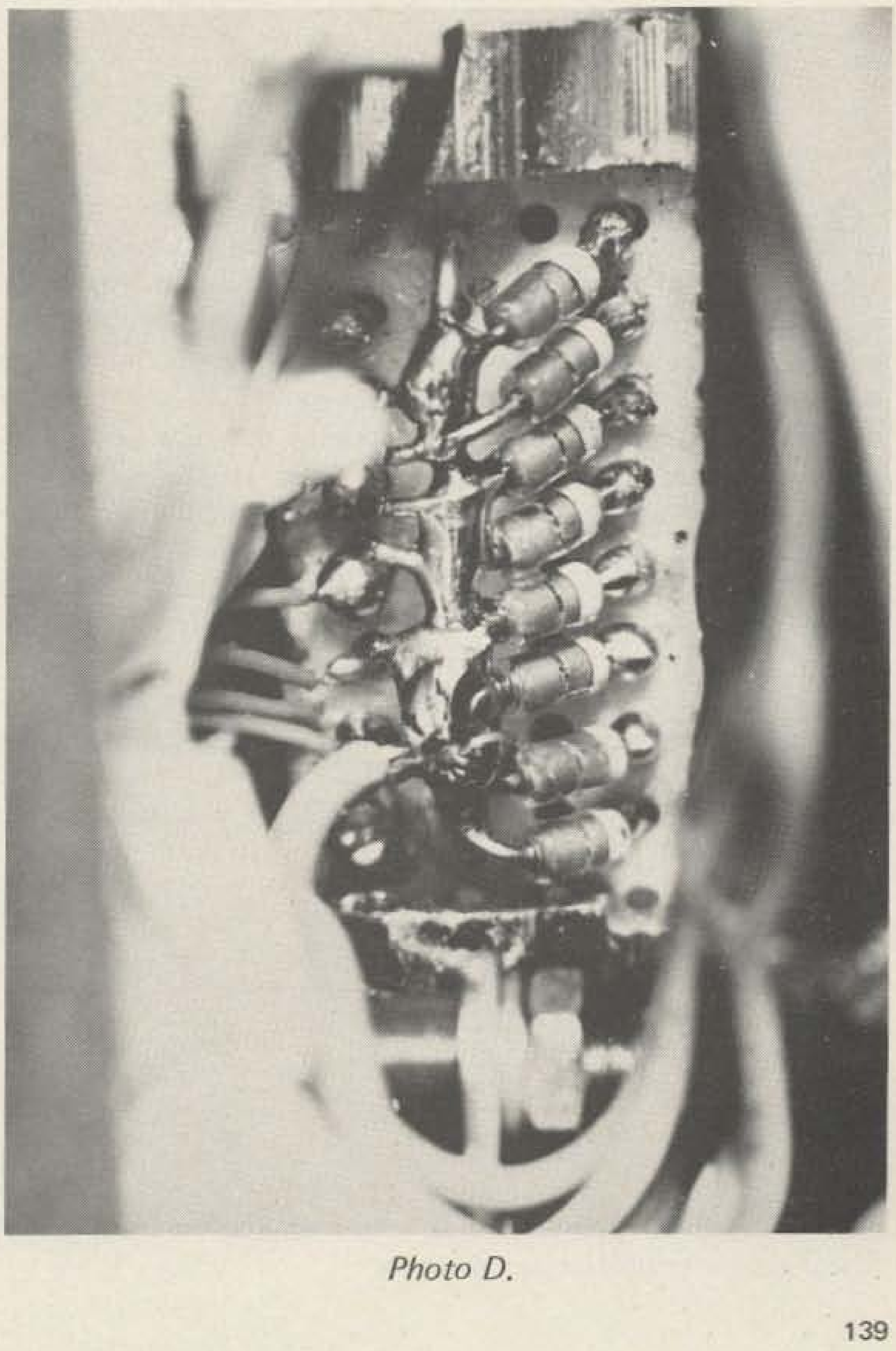

Photo D.

73 Magazine *Staff*

Amplitude vs. Frequency

-- poor man's spectrum analyzer

Anyone who has used a spectrum analyzer for checking the frequency response of audio or rf filters quickly appreciates its great convenience. Filter values can be changed, and you note instantly the effect upon the selectivity, the change in cutoff frequencies, etc. But, even when using a $12,000 professional instrument, you often find it desirable to switch it into a manual scan mode. In this mode, you turn a single knob, which varies the frequency being fed into a filter under test and simultaneously moves the spectrum analyzer display along its horizontal (frequency) axis. So, as you manually turn the knob, you can note, at any given frequency, the displayed amplitude, or, conversely, you can look for changes in amplitude and note at what frequency they occur.

The manual scan feature on professional instruments was the idea responsible for the simple adapter described in this article. This adapter uses a signal generator and oscilloscope combination. It will not turn them into anything near the equal of a $12,000 instrument, but it does provide an extremely useful method to develop a simplified amplitude versus frequency display on an oscilloscope.

The idea is to turn off the horizontal sweep on the oscilloscope and use an external voltage to move the trace horizontally, at the *same* time that the frequency being fed into the circuit under test is varied. Fig. 1 presents the main idea. If you can simultaneously use one hand to rotate the frequency control knob on the signal generator, and the other hand to rotate the potentiometer connected to the battery, an amplitude versus frequency display is created. Stopping at any given point, you can temporarily use paper tape on the oscilloscope face to mark down the frequency, and thus calibrate the horizontal frequency line on the oscilloscope.

In practice, you need to add a feature to the signal generator so it provides the horizontal control voltage – in order to make the scheme a practical reality, as only one knob is rotated. The practical details for accomplishing this depend upon the equipment being used.

For instance, one setup on which this scheme was tried utilized a 3" scope and a Southwest Technical Products function generator. The horizontal sweep was switched to "external," and the horizontal position control used to move the dot on the oscilloscope screen to the extreme left. Then, by applying a variable dc voltage to the external horizontal input terminals, it was determined that the voltage had to vary from 1 to 9 volts to move the dot completely across the screen. The function generator uses a single

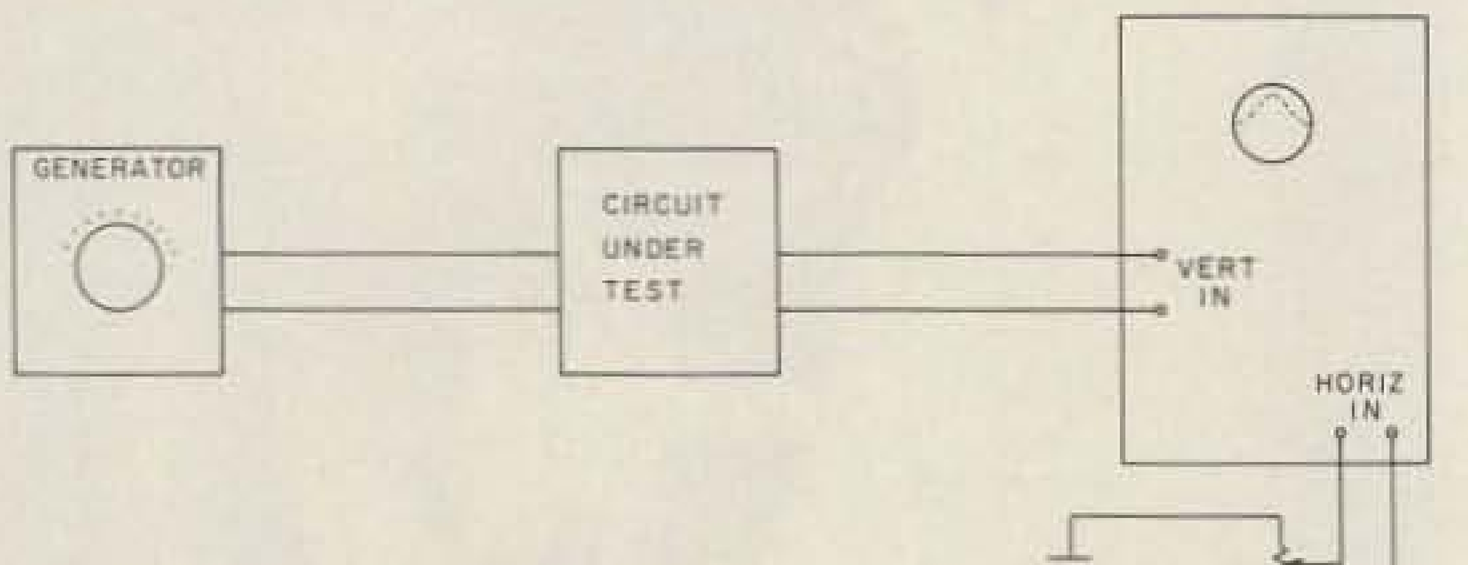

Fig. 1. Basic idea for setting up a manual scan system with a signal generator and an oscilloscope.

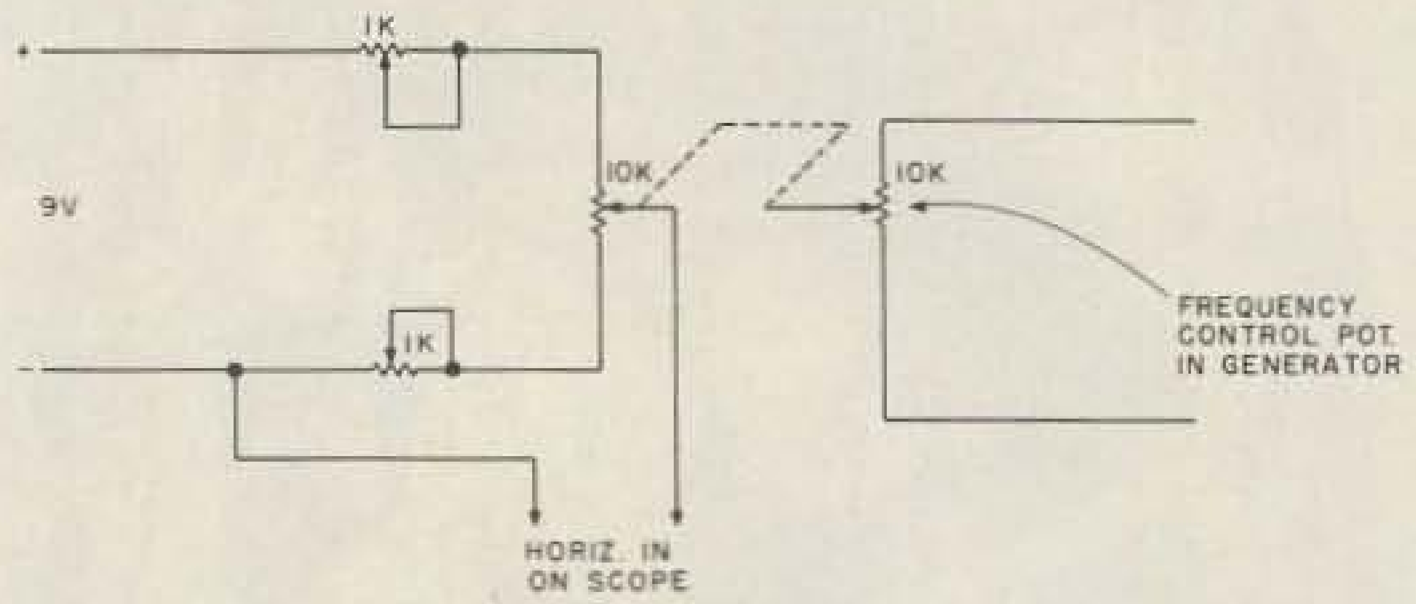

Fig. 2. This simple adapter circuit can be added to an audio-type generator which uses a potentiometer for its frequency control element.

10k potentiometer as a frequency control. This potentiometer was replaced by a dual 10k unit, as shown in Fig. 2. The two 1k PC potentiometers simply allow trimming up of the voltage range covered by the 10k potentiometer, so the dot on the oscilloscope screen moves exactly from extreme left to extreme right, as the generator is turned through one frequency range.

A similar scheme can be applied to other generators, even those using a variable capacitor as a frequency control element. The only problem which must be solved in each individual case is the mechanical coupling of a potentiometer to the shaft of the frequency control element in the generator.

You could add further refinements to the basic idea, depending upon need and the specific equipment involved. For instance, it might be desired to scan across the oscilloscope screen, as the signal generator is only tuned across a narrow part of its frequency coverage on a given band. A higher dc voltage to the control potentiometer will allow the potentiometer to sweep across the required voltage range over less of its rotational range. A better solution is to make the control potentiometer part of a resistive Wheatstone bridge. The bridge can be balanced at any given point, as the control potentiometer is rotated, and the scan across the oscilloscope screen is started at that point. A typical circuit is shown in Fig. 3. Furthermore, by making the dc voltage to the bridge variable, you could expand or constrict the width of the scan. An ultimate embellishment might be to add a variable gain, dc voltage amplifier to the output of the bridge circuit. The display, which you see on the screen as a circuit is tested, will be a vertical line, changing in amplitude both above and below the center line on the oscilloscope as it moves across the oscilloscope screen. You can adjust the vertical position control on the oscilloscope, so only the top "half" of the display shows. This does get a bit closer to a real spectrum analyzer display. But, depending upon the circuit under test, it may hide negative peak clipping taking place in a circuit.

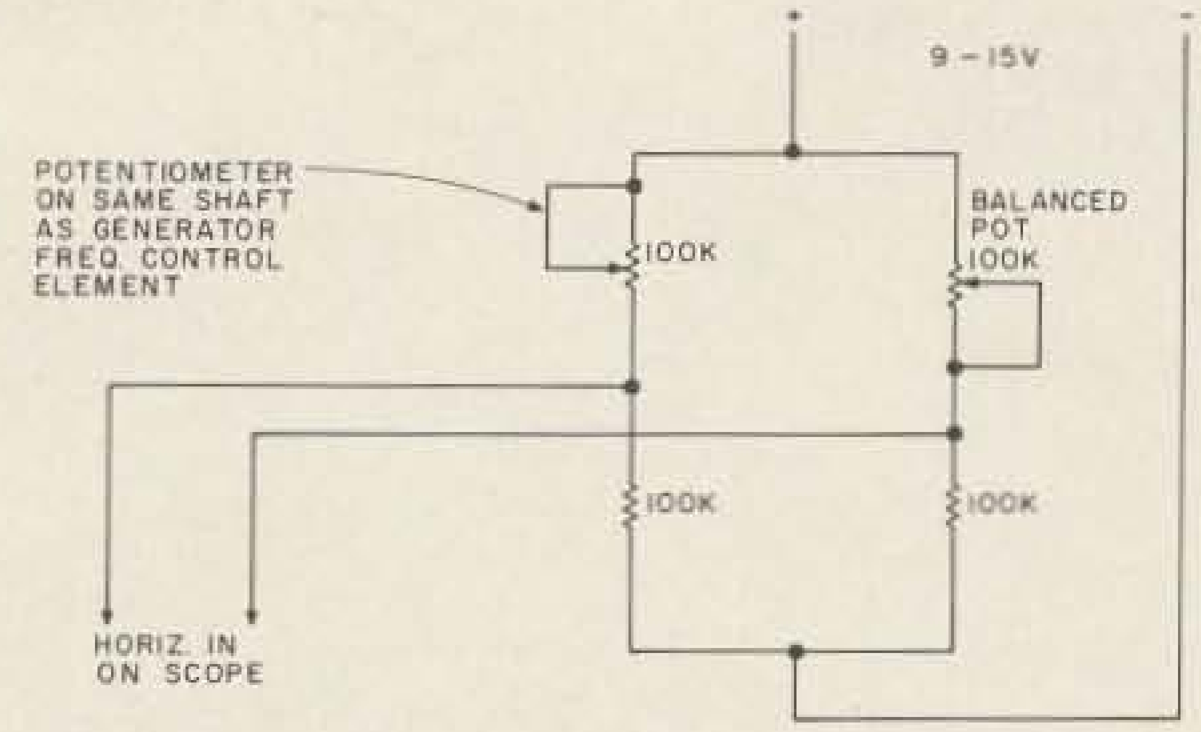

Fig. 3. Bridge circuit to allow better control over setting point on signal generator scale where scanning starts across oscilloscope.

You should neither overestimate nor underestimate the usefulness of this adapter. It displays only a simple plot of amplitude versus frequency for a circuit under test. Many other things, such as phase shifts, might be taking place in the circuit which you would not be aware of. Nevertheless, for someone who likes to experiment or needs to adjust simple tuned circuits or filters, this simple adapter will give you a little and very useful hint of what life would be like with a $12,000 Hewlett-Packard spectrum analyzer on your bench. ■

Dexter S. French, Jr. K4TSY
142 Stoney Ridge Dr.
Longwood FL 32750

How About An Auto CQ?

-- generate some 10m activity!

How many times have you tuned across 10 meters and wondered if it was really dead? I used to sit down and call CQ for a while, until I got tired of it or else got hoarse. Wouldn't it be nice if I could call CQ automatically? Then I could spend the time more constructively, and I just might beat a hole in the band!

I could use a tape and operate VOX[1], but this would be plagued by nuisance tripping as I shuffled papers or stumbled around the shack. No — I must have a more sophisticated solution! And so was born the tone-actuated, tape-driven auto CQer described below.

Certain requirements for this magic machine were immediately set forth:

1. The device must be immune to ambient noise.
2. Any tone used must not be transmitted.
3. The circuitry must include capability to make the control tape.
4. The automatic operation must be easy to cancel.

To make all this happen, the block diagram shown in Fig. 1 shows briefly how the auto CQer works. A tone on the tape is detected and clocks a flip-flop. The flip-flop, in turn, drives a relay to activate the PTT line in the transmitter. A 4 kHz tone was chosen because it falls about an octave above the bandpass of SSB transceivers available today and, thus, is not transmitted. The tone from the tape on playback is first applied to an active filter, A1, whose narrow bandpass is centered on 4 kHz. The output of this filter is rectified by CR1 and averaged by C2. The resulting dc voltage is fed to comparator A2, whose output clocks the 948 flip-flop for on-off control of the PTT line.

The result of this is that the state of the 948 is changed only when a tone is detected. The transmitter is thus protected from nuisance tripping.

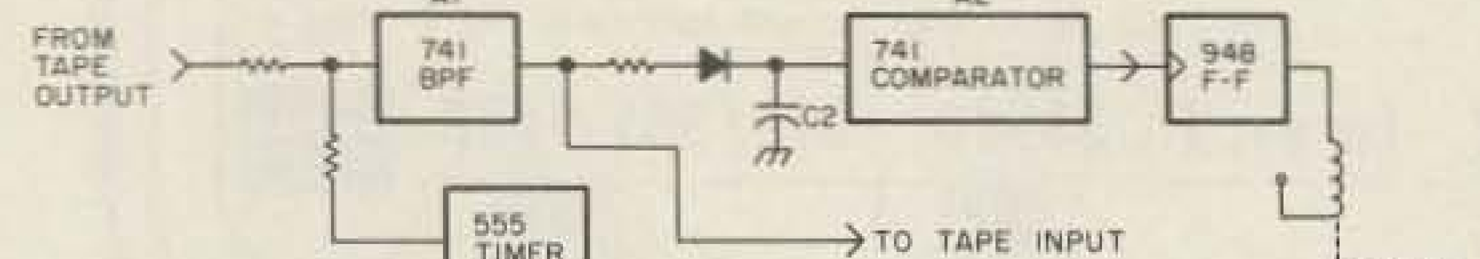

Fig. 1.

Basics

The circuit shown in Fig. 2 has two modes of operation. The first develops the tone and mixes it with the microphone audio to be recorded. The second mode, playback, detects the tone from the playback audio, as outlined above, and activates a flip-flop to control the transmitter.

In the record mode, the 555 tone generator develops a 4 kHz square wave. This is keyed by unshorting the timing capacitor, C1, with S1. The square wave is fed to an active filter A1. This 4 kHz active bandpass filter provides a clean sinusoid to mix with the voice audio for the recording.

In the playback mode, the audio from the recorder is fed into the active filter, and the tone is separated and detected. The rectifier/filter on the output of A1 also integrates or sums the tone. This means that the tone must be detected and remain so for a certain minimum time. After about a second or so (depending upon the playback amplitude of the tone), the reference threshold of the second 741 (A2) is reached, and, acting as a comparator, it flips from a high (+) to a low (≈0) output voltage. This voltage clocks the flip-flop to its opposite state. The output of the 948 drives the transistor, which in turn activates a small relay to key the transmitter PTT line.

To prevent audio feedthrough to the transceiver speaker, the audio to the mike jack is shorted to ground by C3 when Q2 conducts during receive. This short is released in transmit to pass audio on to the mike jack on the transmitter. The normally open side of S1 serves to reset the 948 flip-flop, just in case the PTT line gets stuck in transmit. S2 shifts audio control from the auto CQer to the station microphone. Just remember to operate S2 when you answer someone!

Building It

I built the circuit on

vectorboard, and the layout is not critical at all. However, I have found that if the part locations follow the way the schematic is drawn, it is a lot easier to troubleshoot later on. In addition, inputs and outputs fall to the edges of the board more readily.

A word about parts: The 741 operational amplifier was chosen for its ease of use and procurement. The 948 flip-flop, though an old DTL device, is hard to beat at 20¢ from James Electronics.

Care and Feeding

My audio input is from a compressor which puts out .25 volts p-p. The mixing resistors are set to divide this audio down to the proper level for the recorder input. The same goes for the tone level. It may be necessary to adjust R2 so as not to overdrive the tape recorder. The speaker output of the tape recorder feeds the audio to A1. The audio level at the output of A1 determines if, or at what time delay, the comparator, A2, switches. A little experimentation may be necessary here to determine the required audio output level for a one or two second delay. This delay provides further noise immunity. If a scope is available, 2.5 V p-p at A1 is sufficient. Any more output volume than that may well overload and distort the voice audio into the transmitter.

Set the tone frequency by measuring the dc voltage on C2. Use a VTVM or other high impedance voltmeter, and adjust the value of R1 for maximum deflection. The response is slow, so wait for the voltage to stabilize. The voltage should be greater than about 0.4 volts dc for the comparator to operate.

The comparator has positive feedback around it to provide a noise margin of 90 mV, which results from the hysteresis. This means that with a threshold of, say, 0.4 volts, the input voltage must get to 0.445 V (0.4 + .09/2) before the output changes state. The reverse is also true. If the input starts above 0.445 volts, it must fall below 0.355 volts (0.4 − .09/2) for the output to change.

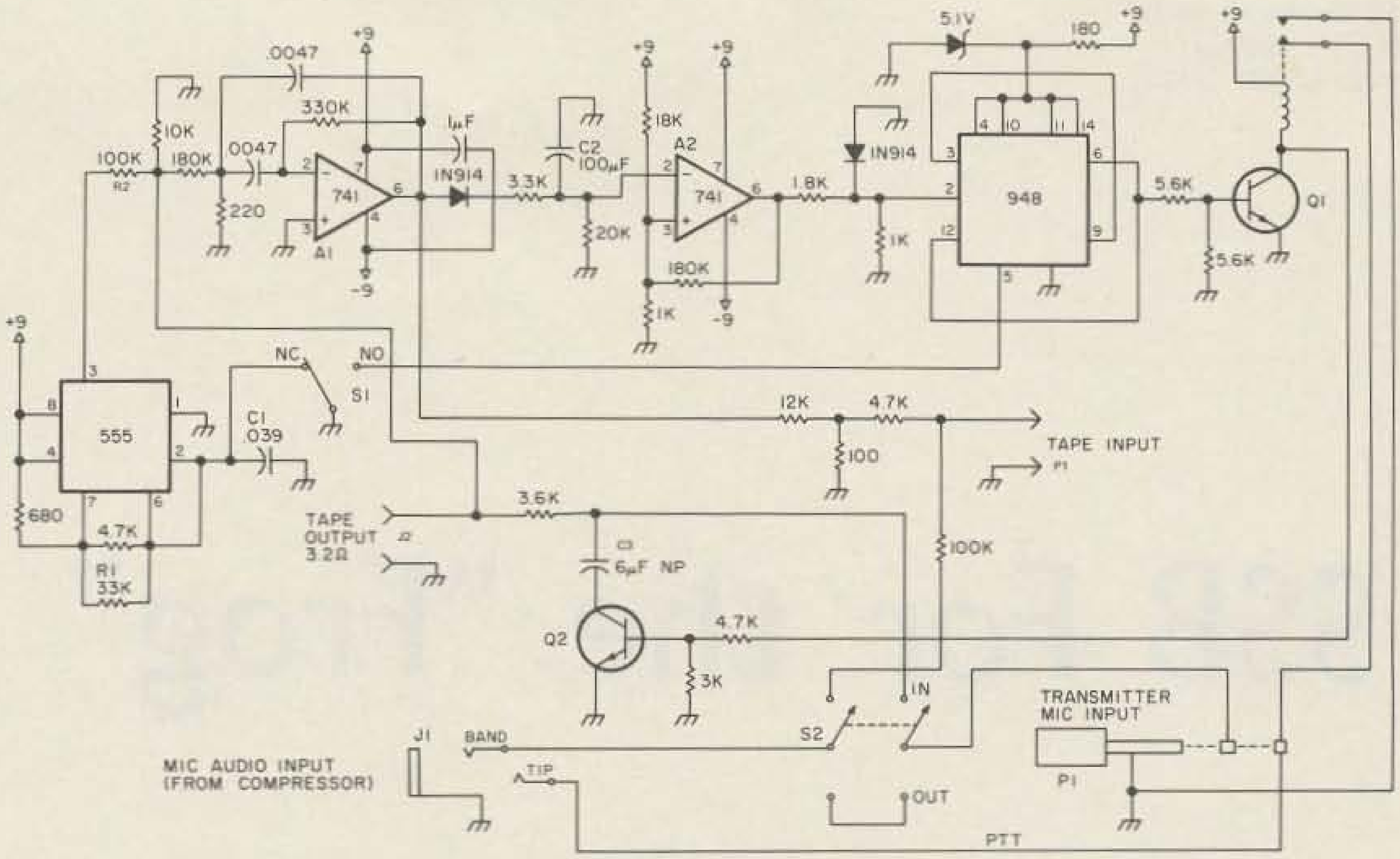

Fig. 2.

A word of caution in substituting parts: The 948 flip-flop clocks at a threshold voltage and is, therefore, not dependent on the rise and fall times of its clock signal. A JK TTL flip-flop like the 7473 should be clocked with a fall time of, at most, 30 ns. The output slue rate of the 741 is much too slow at 30 μs. The transistors, on the other hand, can be any common NPN. The 2N2222 is a good choice because of its price and availability.

My intent is not to limit substitutions, but rather to provide a starting place for the experimenter. A little thought given to certain substitutions will save a corresponding amount of grief later on.

The simple power supply is shown in Fig. 3.

How To Use It

The first step to using the auto CQer on the air is to make the tape. Plug the tape input, P1, into the mike input of the tape recorder and a microphone into the audio input on the CQer. Now you're set to record the tape.

You will need about 3 seconds of tone (just to be safe) to activate the flip-flop, so plan accordingly. I made my tape on a 30-second CQ, 30-second listen program, but this is offered only as a starting point. Just remember to give the tone at the beginning *and* at the end of the CQ.

To use the CQer is even easier. Plug the transmitter mike input, P1, into the transmitter and the station mike into J1. The tape recorder speaker output plugs into the tape output jack, J2. Set the playback volume to trip the PTT in about 1 to 2 seconds, but not so high as to overmodulate. If the recorded audio of tone and CQ are of the same relative level, it will be possible to achieve the right balance of playback volume and mike gain on the transmitter.

On the air, set S2, punch up playback and sit back and relax. Even though the band may be dead, at least all you're doing is wearing out the tape and not your vocal cords!

To answer a call, just switch S2, shut off the recorder (you might do this with another position on S2, if your recorder is equipped with a remote jack), and operate your rig normally.

The reliability of this machine has been excellent. After about 18 months of use on the air, the only problem has been when the recorder batteries run low, and the tone frequency shifts and goes undetected. It is for this reason that the reset switch, S1, was included, just in case the transmitter gets stuck.

Since I've built this device, I can't imagine not having it. It actually is my way of having a beacon on 10 meters, to which I am so devoted. You can hear what is being transmitted, and so can catch it if anything goes haywire. I hope that the utility of this machine will provide you with more time to really enjoy this great hobby of ours. ■

Reference

[1] Fischer, "Bring a Dead Band to Life," *73 Magazine*, December, 1976, p. 125.

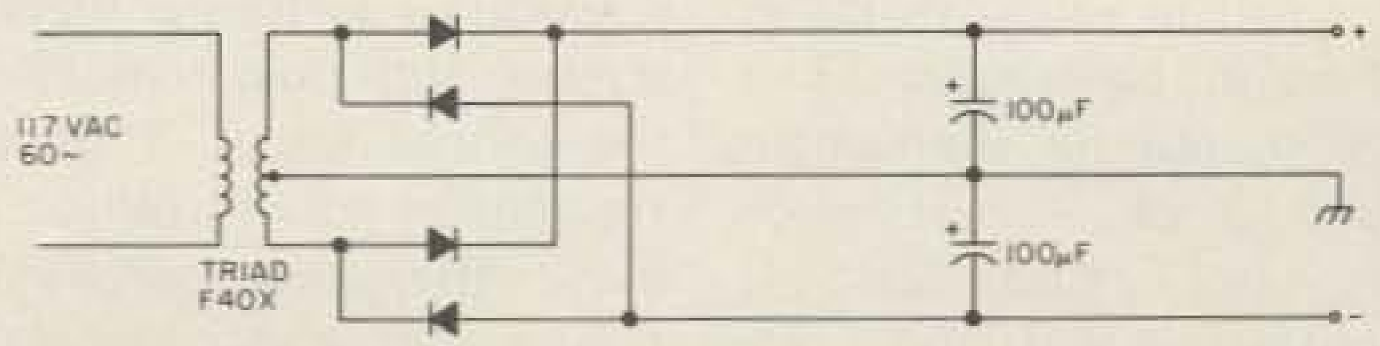

Fig. 3.

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SSB For the "Frog"

-- tame the croak

The Yaesu FRG-7 is a remarkably good receiver for "all-wave" reception of AM or radio telegraphy. It falls short, however, of being good for SSB reception, unless you have one of the new models featuring a fine tuning control. This article is addressed to the owners of FRG-7s having serial numbers between 502001 to 505999 or between 060001 to 072000. If you have one, read on.

For $7.25 you can buy a modification kit from Yaesu. I did. You shouldn't. Why? Except for matching knobs, you can buy the needed parts (if you can't find them in your junk box) for a small fraction of the cost of the modification kit.

You need just two items. One is a small variable capacitor, small in physical size as well as in capacitance. The latter should be somewhere around 5 pF – not much more, not much less. It should have a shaft about one inch long (2.5 mm) and must be of the single-hole mount type. The other item is a knob to fit the shaft of the variable capacitor. If you have a choice, get one with a dot or other type of position indicator. If you're a purist, buy a replacement for the volume control of your FRG-7. It's a bit large, but it'll match.

Now you're ready to dissect your FRG-7. You'll need a Phillips, or Reed Prince, type screwdriver and a ¼-inch nutdriver. With the latter, take out the two screws along the bottom rear lip of the cabinet. With the former, remove the six small screws around the front edge of the cabinet and the one small screw at the top of the rear edge. Now, slip the chassis forward out of the cabinet.

Use a small, blade-type screwdriver to loosen the setscrews, and then remove all the control knobs. Then use the Phillips screwdriver to remove the three screws retaining the escutcheon plate.

With the slimmest soldering iron you can find, unsolder the two wires leading to the "Lock" lamp. Then remove the nut from the "Mode" switch. Next, take out the four screws that hold the external front panel to the inner one. Slip off the panel, and prepare to do some precise measuring.

If you have a metric rule, as everyone should, use the following figures. Otherwise convert them to inches.

From the right-hand edge of the front panel, measure in 14.4 cm. Then, from the bottom edge, measure up 6.2 cm. Mark the intersection, and drill a very small hole, barely through the panel. Pause there, turn the panel over, and carefully cut out the padding around the hole you just drilled, removing enough to leave a clear spot about 18 mm in diameter, centered on the hole in the panel.

Put the outer panel back on the receiver, and run the drill through the hole just far enough to clearly mark the spot to drill through the inner panel. Remove the outer panel, and drill the inner one. Make a hole just large enough to mount the variable capacitor. The one I got from Yaesu required a 7.5 mm (about 5/16 inch) hole. Note that you'll need a semicircular bushing between the capacitor and the panel; the speaker mount intrudes into the space needed for the capacitor. This is easily made.

While you're drilling, enlarge the hole through the front panel to 14 mm (about 9/16 inch).

After you've mounted the variable capacitor and screwed tight its retaining nut, replace the front panel and also the escutcheon plate. Don't forget to reattach the two wires to the "Lock" lamp or to replace the nut on the "Mode" switch! Very carefully set the plates of the variable capacitor to half mesh. Then attach the control knob, having the dot or pointer straight up. Replace all control knobs.

If you bought the Yaesu modification kit, *do not* install the 33 pF capacitor in place of the 51 pF capacitor C-458.

Note the printed circuit board just behind and a bit to the right of the variable capacitor you just installed. All the parts you'll be concerned with are located close together on the corner of the board that's next to the variable capacitor. The parts identification numbers are marked on the board, but you must look closely to see them. Locate T-403, a transformer in a tiny square can. Then spot TC-403, an adjustable capacitor just to the left of T-403 and a bit behind it. Look a bit behind TC-403, and spot the two terminals to which are attached wires running down under the chassis to the main variable tuning capacitor. The rearmost of these two terminals is the "ground" one. The foremost one is "hot."

Now run wires from the

variable capacitor you installed over to these two terminal posts, being careful, of course, to hook the rotor to the rearmost and the stator to the foremost!

If you bought Yaesu's kit, now you're ready to file the provided instruction sheet very carefully in the wastebasket, and get out the instruction manual that came with your FRG-7. Turn to page 12 of your manual. Look under the heading "Main Tuning Dial, T-403, TC-4D3." I quote:

"The following alignment should be done after warm-up of the receiver.

"Set the dial hairline to the center of the dial window. When the main tuning dial is rotated until it stops over the 1000° scale mark, the delta mark should be within 5 mm of the hairline.

"Set the Mode switch to lsb and the MHz dial to 0°. Set the main tuning dial to 1000°; a beat tone *may* be heard. Adjust T-403 until the beat is heard and is brought to zero beat. Set the main tuning dial to 0°, and adjust TC-403 for zero beat. Repeat these two procedures until zero beat is obtained at both 0° and 1000°."

The procedure in the manual works quite well. The one contained in the instruction sheet is utterly worthless!

The addition of the fine-tuning control makes the FRG-7 quite easy to use for SSB reception. More selectivity might be desired. Should you feel you need that extra selectivity, read the article by Ron Risher VK3OM in the March, 1977, issue of *Amateur Radio*. He describes a nonbutchering operation, one using a spare deck on an existing switch to select an alternate filter, consisting of four cascaded SFD-455-B solid state filters linked by small coupling capacitors. I haven't tried it, but it sounds intriguing! ■

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Beat the Books

-- study hall special

There comes a time in every kid's life when he wants more out of study hall than just studying. My time came about two weeks ago, and being a ham, I naturally wanted to do something with radio. I knew from the start that it would be hard, for Ma (as we had nicknamed our teacher) had an eagle's eye that could weed out a well-hidden game of solitaire in a class of 55. Anyway, I began to think of ways to outwit Ma and still have fun. A code practice oscillator was out, as I had already bored myself to tears tapping out English assignments on the desk with my pencil. Of course, the ultimate goal would be a QSO with a portable transceiver, but it seemed a little far-fetched at the time. But the more I thought of it, the more feasible it sounded. The walls of the study hall were made of wood and plaster, easily penetrated by radio waves.

I began my search for a suitable battery-powered QRP transmitter. This proved easy, for the second magazine I looked at was the January, 1977, issue of *73*, which contained a dandy little portable transistor QRP transmitter, easy to construct, and, from the description by the author, pretty potent at getting those waves into the sky.

Having decided on a transmitter, I was then faced by the dilemma of what to house the thing in. It must be inconspicuous, but large enough to handle the transceiver and batteries, which amounted to quite a load. I decided on a card filing box, for these were a fairly common sight at school.

For a receiver, I decided on a converter for a broadcast band radio with an earphone attachment. I wasn't taking any chances with Ma, who had the ears (and the temperment) of a wildcat. The pocket radio conveniently fit inside the lid of the card file box with a bit of double-sided foam tape.

I then constructed an aluminum chassis to fit the box, and on this I mounted the transmitter, which consisted of a transistor oscillator and a tuned circuit tuned to 40 meters, the chosen band. The BC converter was a bit tougher, as a bfo had to be constructed to take in the signals without the tones sounding like pure ac.

But eventually everything was straightened out and ready for initial testing. I plugged in a 40 meter crystal, plugged in a dipole, and flipped her on. A little tuning later, and the receiver began hauling in all sorts of signals, and with my station receiver, I roughly calibrated the dial. The transmitter really blared away on my station transceiver. Finally, after a grueling two hour slop-together job, all was ready. The next day, after breakfast, I tucked away a tiny earphone, grabbed my 98¢ "Junior" code key (I wonder how many old-timers still use those things), snatched a long wire antenna with a phone plug at one end and an alligator clip at the other, and smuggled the whole mess out the door past my mother.

When I got into study hall that day, I sat in the back row where there was a radiator for a grounding, and connected the transceiver. I didn't have the slightest idea about where to connect the antenna, and glanced around for a support. I ended up connecting it to a vacant desk three seats to the right. I ran the earphone up my shirt. Even Ma doesn't have x-ray vision. I turned everything on, and immediately zeroed in on WB9—— calling CQ, S9. I answered him, hoping the key clicks (audio, not rf) wouldn't be noticed. To my great joy, he came back TNX, OM. UR RST IS 369. NAME IS. . . Immediately my mind soared. Mini rotary beams! DX! SSB! Maybe later, that W8 is really giving me QRM. I might lose my first study hall QSO! ■

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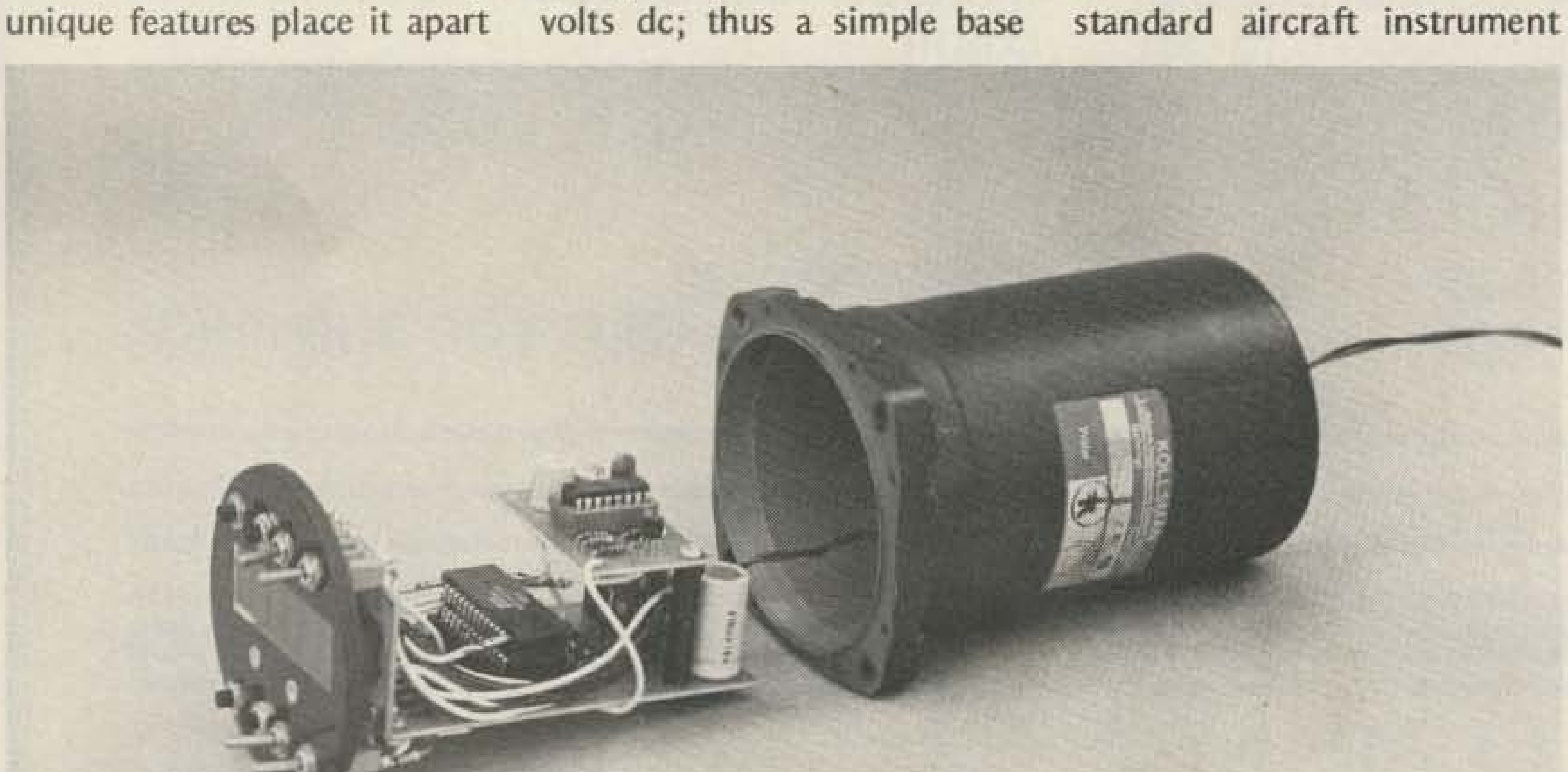
Clocking Those Clock Kits

-- check out the MK-03!

The current plethora of digital readout clock kits makes it very difficult for the potential buyer to decide which is the one best suited for his needs. One of the many that are presently available, and which has not been advertised to any great extent by its suppliers, is the MK-03 Aircraft Clock-Timer kit. Bullet Electronics, the kit maker, may be underestimating the potential popularity of this kit. Its many unique features place it apart from others that are available.

Although this clock may have its primary application in cars, boats, and planes (FAA certification may be required), its compactness and features have a number of good applications in the ham or CB shack. OSCAR buffs will find it ideal for alerting them to the next pass, as the quick-setting alarm feature enhances this type of use. Power supply voltage requirement is 9 to 18 volts dc; thus a simple base station power supply is all that is required for fixed use. A power supply for this purpose is available from the kit supplier.

The kit, as received from Bullet, contains all parts, except switches and a case, to make a working clock-timer. The lack of case and switches allows you to design the enclosure and panel to suit your exact needs. In my case, the objective was to place the entire assembled unit inside a standard aircraft instrument case for use in a sailplane (glider). This was an old altimeter case, as shown in the photo. Doing this required a fair amount of ingenuity, but the result was very satisfactory. Others may wish to use a larger, less difficult package, and, if panel space is available, as at a fixed station installation, larger switches and layout would be more convenient.



Bullet MK-03 Clock-Timer completed and ready for installation in aircraft instrument case. Digital readout board is attached to plastic escutcheon.

The printed circuit boards for this kit include a six-digit readout board (allowing the FND-70 0.5-inch readouts to be directly soldered to the board), a main clock-timer board, and a timebase board. The latter uses a ceramic resonator as its standard, and a CD4060 CMOS as a 14-stage binary counter/oscillator. The oscillator frequency is divided by 2^{13} to produce the output frequency (50 Hz in this instance). My scope showed the output of this oscillator to be an excellent 4.9 volts square wave. Bullet advertises this oscillator kit as being available as a separate item, incidentally.

The main clock-timer board is standard, as far as digit drivers are concerned. However, the board uses two 50252 28-pin ICs, stacked in parallel, to accomplish the separate clock and timer functions.

The clock chip (bottom) operates as a normal 24-hour six-digit display clock. The timer chip (upper) operates as a 24-hour six-digit display elapsed time indicator. As received, the two chips are piggy-backed together, with the pins, which are paralleled in operation, already soldered together by the kit supplier. No soldering to the pins is required, as the dual IC is eventually installed in a DIP socket, which the user has previously soldered to the board. Connections to the top chip which are required are made with slip-on connectors (not supplied).

Components in the kit appear to be of good quality, and, for the most part, are "house-numbered" items, indicating that they were probably not to the manufacturer's standard, but are quite satisfactory for general use. Two of the FND-70s, as received with the kit, had one open segment. Otherwise, all parts were excellent. All resistors for board mounting were precut and bent to radius, and all diodes and transistors were cut to length for mounting and soldering. Material was provided to assemble a toroid choke, in the event that the unit is to be powered by an ignition-type engine power source. In addition, an input protection diode is provided to prevent an incorrect polarity connection from damaging the unit.

Circuit board solder plating tended to have a dull appearance, and occasionally some difficulty was encountered in preparing satisfactorily soldered connections. This was particularly noticeable when working on the readout board, which has rather closely spaced traces that compounded the problem. Manufacturers would be wise to increase the cost of a board by a few pennies to provide good traces and well-plated boards, in order to insure customer satisfaction and trouble-free operation.

The many switches required for full operation of the clock-timer increase the complexity of the wiring external to the board, but they do not create any problems, if care is taken in routing the leads.

Instructions and diagrams supplied with this kit are quite complete, with ten pages of information. Nevertheless, they must be read thoroughly prior to constructing the kit, in order not to overlook some item of importance, not necessarily mentioned where you think it might be in the text. There was a schematic error in my instructions, which may be corrected now, as this has been brought to the attention of Bullet.

Upon completion of the entire assembly, I used a 9 volt transistor radio battery to test the clock-timer (this is not recommended for other than testing because of a .085 A current drain). The unit operated immediately, with no difficulties whatsoever, and it was fun to be able to run through the interesting list of functions that this clock is capable of performing.

The fact that the timing and clock functions perform independently of each other permits using the features of one without interfering with the ongoing action of the other. For instance, the elapsed time function, which displays hours, minutes, and seconds, may be started, held, restarted, or reset to zero while the "real-time" clock continues its normal operation, undisplayed.

The switches may be connected to perform the following listed functions. The display switch may be switched either to the off position (in which case all functions continue, but are not visible), or to display either the timer action or real-time clocking.

Real-time clock — Hours set, 10-minute set, minutes set, alarm enable, and clock display mode (shows either real time or what the alarm set time is).

Timer — Start, hold, and reset.

An additional feature may be used, but was not necessary for my application. This is a photo intensity input to the clock chip, which will reduce or increase the display intensity, dependent upon the ambient lighting.

As a full-function device in the shack, or mobile anywhere, this clock-timer appears to have all the requirements, for a modest $26.95. Bullet Electronics, P.O. Box 19442, Dallas, Texas 75219, is the supplier. ■

Arvid G. Evans K7HKL
5128 S 3600 W
Kearns UT 84118

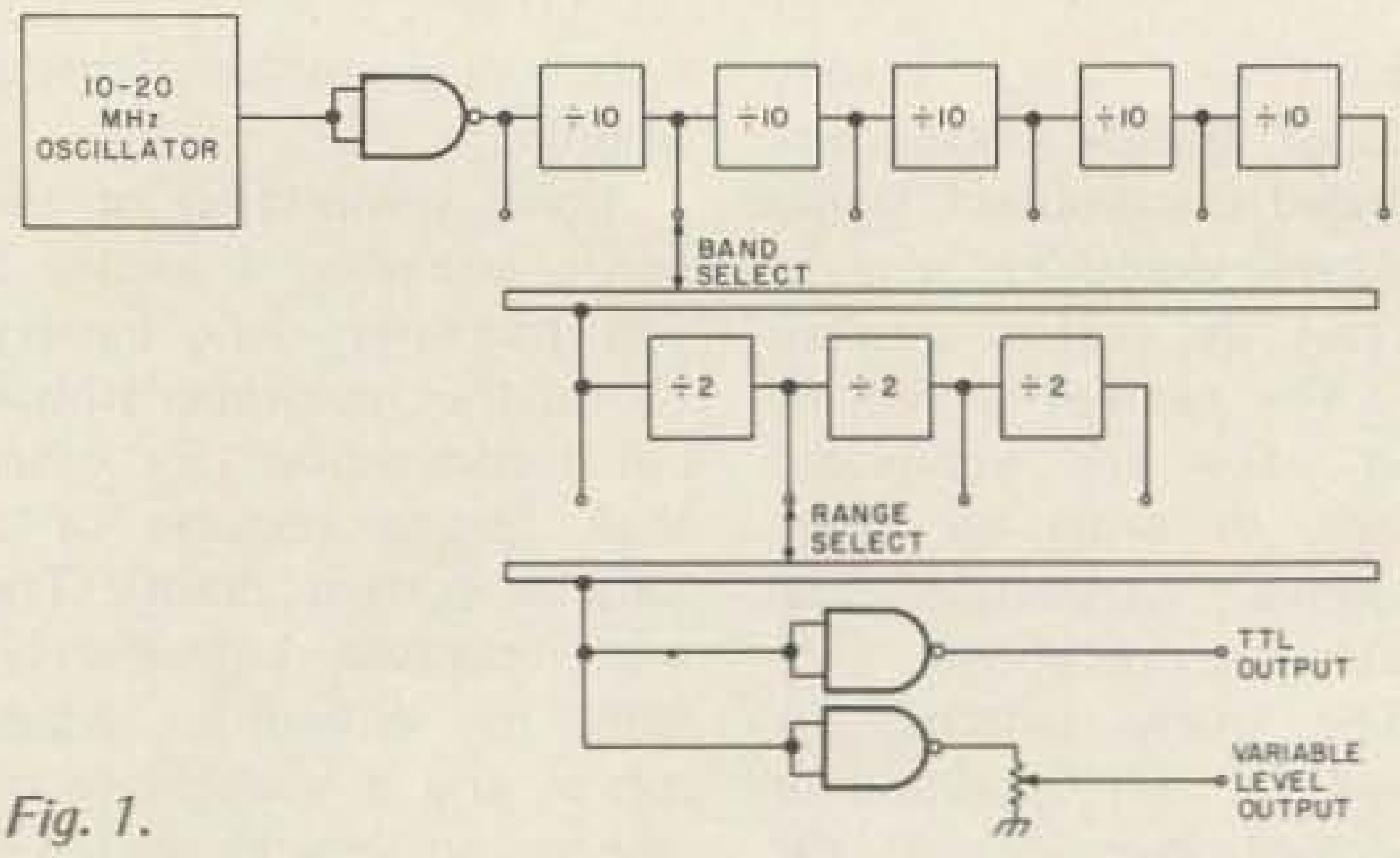


Fig. 1.

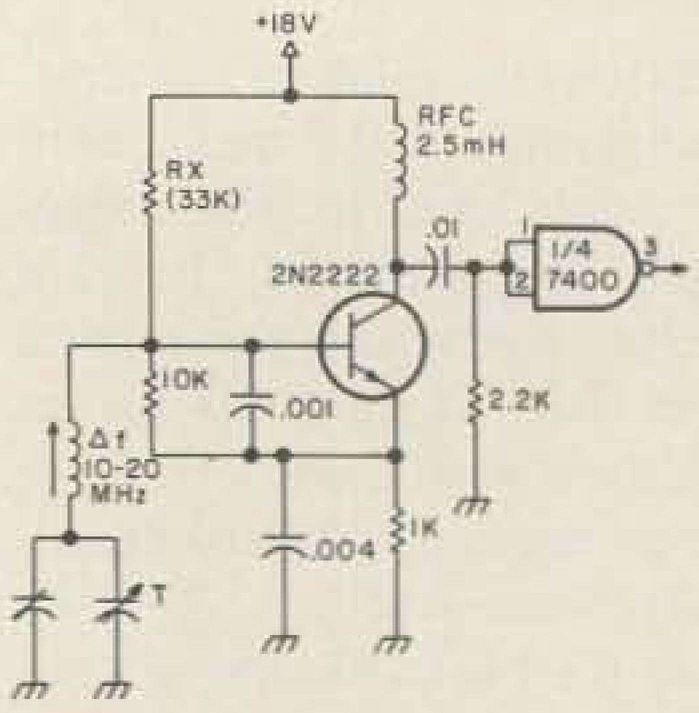


Fig. 2.

Digital Signal Source

-- TTL signals for counters, micros

In playing with logic circuits over the past few years, I repeatedly encountered the lack of a suitable signal source. Several things were tried, including squaring circuits on the wide-range rf generator and several pulse/function generation units, with only marginal success. Recently, while working on a frequency synthesizer, an idea occurred that after breadboard construction seems to be the answer. Development of this idea as outlined below will result in a square wave signal source covering from 20 MHz down to subaudio in fully tunable decade steps. For my purpose, it has proven to be an ideal unit for experimenting with amateur radio applications of TTL and CMOS logic.

Theory

The basic idea as presented in Fig. 1 is for a tunable oscillator in the 10 to 20 MHz range with switchable decade dividers for the range selection and switchable binary dividers for band selection. The resulting frequencies and time constants are listed in Fig. 5.

Construction

Fig. 2 is the oscillator which I used – others would do as well. Try your favorite ... just be sure the output is adequate to drive the digital buffer. Drive requirements to the first TTL stage can be cut down by biasing that stage into its linear (?) range with a 2.2k resistor to ground as indicated in Fig. 2.

Fig. 3 represents the power supply circuitry and is self-explanatory. Fig. 4 includes the dividers and output circuit. Construction is straightforward with few precautions. It would be wise to keep all divider-to-switch wires separated from each other slightly (just don't bundle them all together in a cable harness). Run a separate power and ground lead for each IC. That way you need only one bypass capacitor on the common +5 volt and ground point.

My final version has a calibrated dial and tunes with a 20:1 VFO drive. However, I find it more convenient to cable the output to my digital counter for direct frequency readout.

I wired the VFO portion using point-to-point technique on insulated standoffs. The divider is on perfboard and wired with wire-wrap pencil.

Summary

While my unit is just the basic generator, hindsight has indicated many additions which might enhance its operation. Some of the possible

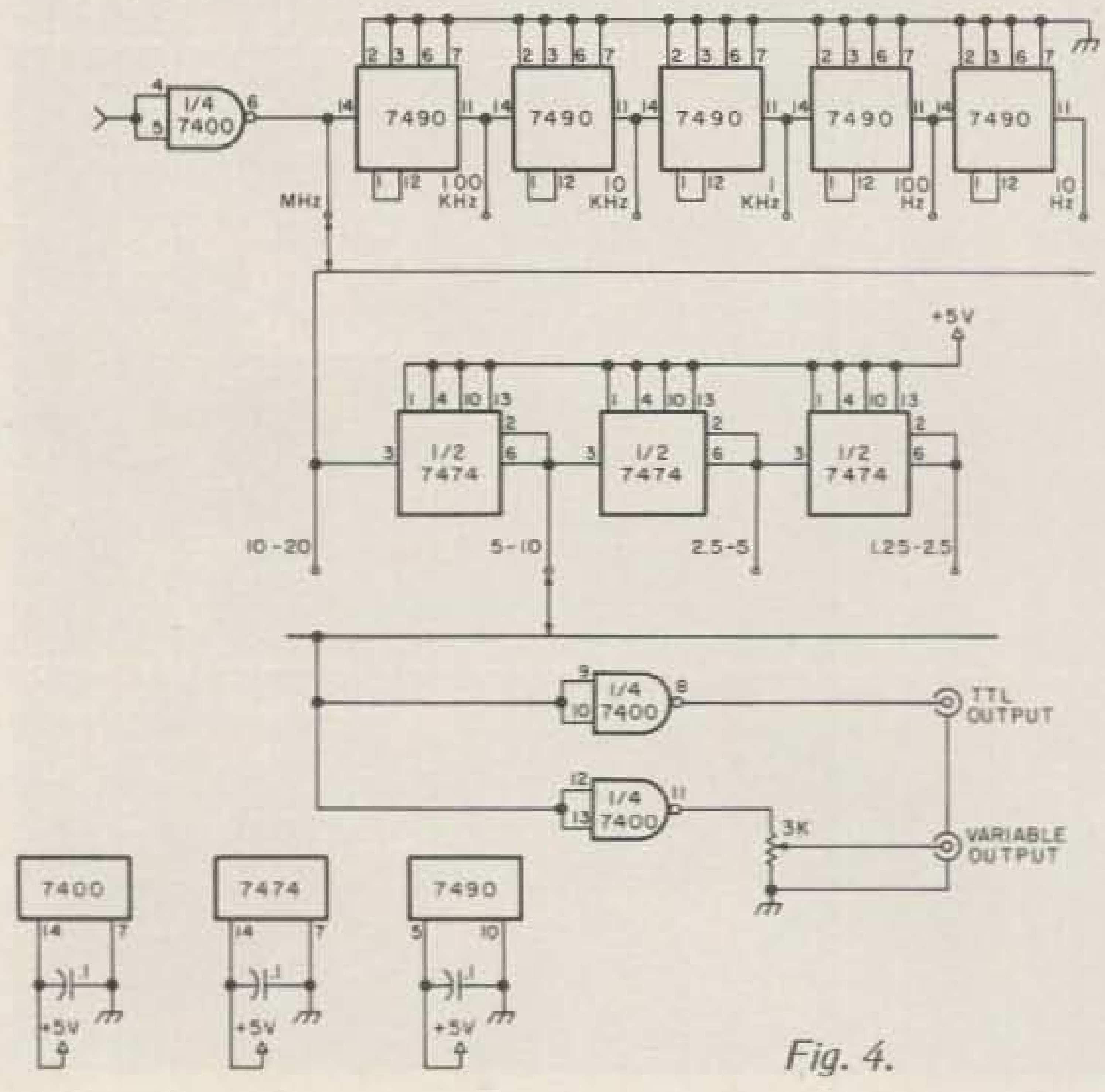


Fig. 4.

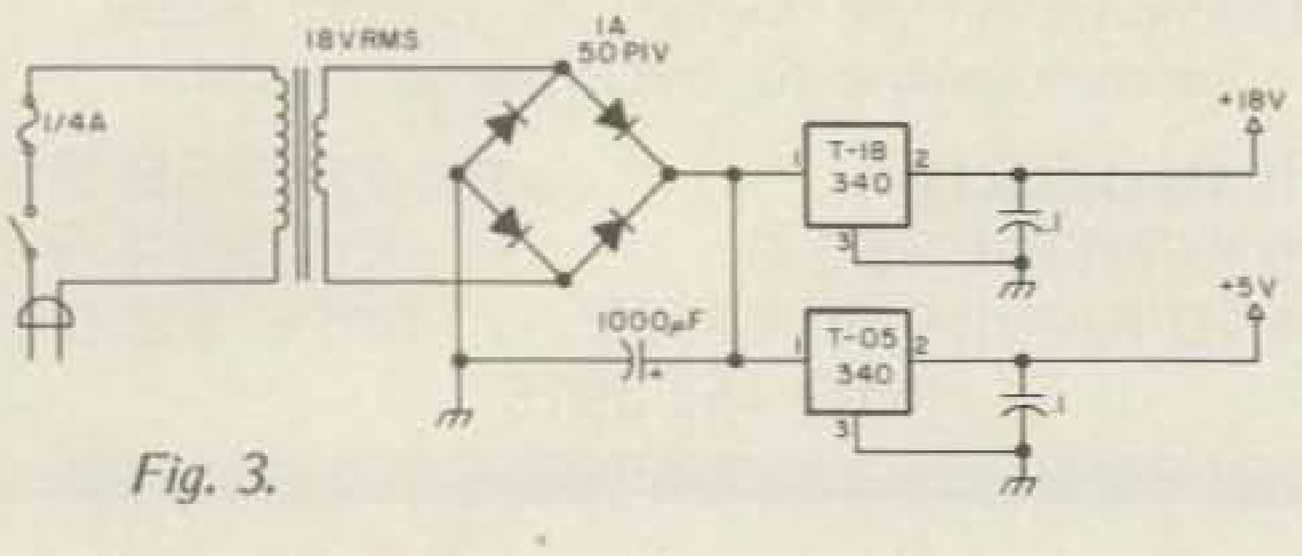


Fig. 3.

additions and their applications are listed below:

1. FM the VFO with an audio oscillator and voltage variable capacitor for working with FM receivers, phase detectors, or PLL circuits.

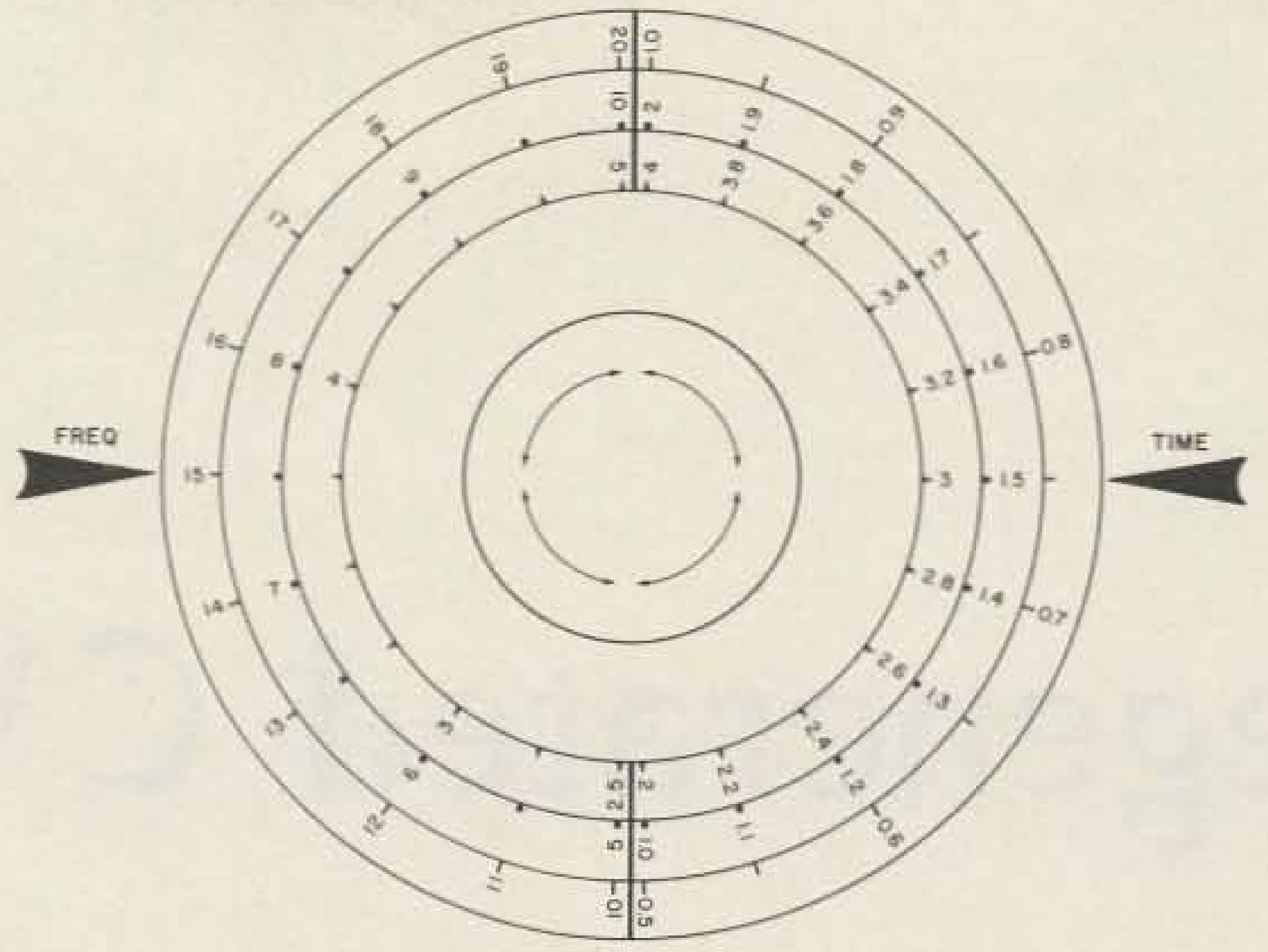
2. Switch the divider chain from the internal VFO to an external input jack. This would allow signals from external sources to be divided.

3. Switch the divider chain input between the internal VFO and a crystal oscillator to generate harmonically-related standard frequencies.

4. Add a second buffer and output circuit for opposing polarity outputs.

5. Run the output through a one-shot multivibrator for thin-line pulse generation.

In case you use this as an rf generator for general purpose work, you might be interested to know that the square wave output generates strong harmonics beyond 2 meters! ■



Frequency	Time (⎍)	Frequency	Time (⎍)
10-20 MHz	0.1-0.05 uS	10-20 kHz	100-50 uS
5-10 MHz	0.2-0.1 uS	5-10 kHz	200-100 uS
2.5-5 MHz	0.4-0.2 uS	2.5-5 kHz	400-200 uS
1.25-2.5 MHz	0.8-0.4 uS	1.25-2.5 kHz	800-400 uS
1-2 MHz	1-0.5 uS	1-2 kHz	.001-.0005 Sec
0.5-1 MHz	2-1 uS	0.5-1.0 kHz	.002-.001 Sec
0.25-0.5 MHz	4-2 uS	0.25-0.5 kHz	.004-.002 Sec
0.125-0.25 MHz	8-4 uS	0.125-0.25 kHz	.008-.004 Sec
100-200 kHz	10-5 uS	100-200 Hz	.01-.005 Sec
50-100 kHz	20-10 uS	50-100 Hz	.02-.01 Sec
25-50 kHz	40-20 uS	25-50 Hz	.04-.02 Sec
12.5-25 kHz	80-40 uS	12.5-25 Hz	.08-.04 Sec

Fig. 5. Suggested dial layout.

73 Magazine *Staff*

Regenerated CW

- - CW: as you like it

One of the useful accessories to a receiver for CW operation is a device that will key an audio oscillator in accordance with an incoming CW signal. Then one doesn't have to listen to the original CW signal with its background noise and QRM, but can listen to a clean, locally generated audio signal. This sort of device also provides a bonus feature useful with transceivers having no tunable bfo and where one must listen to a CW note determined by i-f filter characteristics and the crystal-controlled frequency of a product detector. Usually, these transceivers are set up to produce CW notes of from 600 to 900 Hz. But not everyone enjoys listening to a constant pitch CW note for extended periods. However, if the incoming CW keys a local audio oscillator, one can vary the pitch of the tone actually being listened to without affecting the correct tuning of the transceiver.

Such local oscillator keying devices for CW reception are not new. Many designs were built in tube-type days and worked quite well. The problem was that such a device got to be rather elaborate and costly with tubes. Such devices usually consisted of a sharply tuned audio filter followed by some audio amplification. Then the audio signal was rectified and used to operate a sensitive relay. The relay simply keyed a local, variable frequency sine wave oscillator which one then listened to as it was keyed instead of the original signal.

Using solid state devices one can, of course, duplicate the original circuit idea. Sharp, single frequency audio filters can be built using the commonly available 88 mH toroid coils. The filtered signal can be amplified by an audio IC stage, rectified, and the dc signal used to control a reed relay. Any desired local oscillator can then be keyed by the relay.

This article presents a similar but slightly different approach by taking advantage of some of the new phase locked loop ICs on the market. Basically, a phase locked loop is used to serve as a tunable audio filter and LED switch driver. The LED switch in turn activates a variable frequency tone oscillator. The circuit is compact and inexpensive. Its only disadvantage is that it must be more carefully tuned than a circuit configuration using a passive input filter. But this is mostly a matter of becoming used to the adjustments involved, and it is not a tedious affair. Only parts of the basic circuit can be used if one further wants to simplify the device. For instance, the PLL tunable audio filter can be replaced by a passive LC filter. This eliminates any tuning but takes away from the versatility of the unit since the receiver tuning controls then have to be adjusted so the CW beat note falls in the filter passband. Still another alternative, if one has a receiver with already good i-f or audio signal selectivity but gets tired of listening to the hollow ringing sound of such a receiver, is to use only the LED and audio oscillator portions of the circuit. The LED is driven by rectified af and activates the audio oscillator. Each of these application variations is discussed in the following paragraphs.

Fig. 1 shows the diagram of the 567 PLL tunable audio filter. The 10k potentiometer by pin 5 serves as the frequency tuning control, and the 10k potentiometer in the

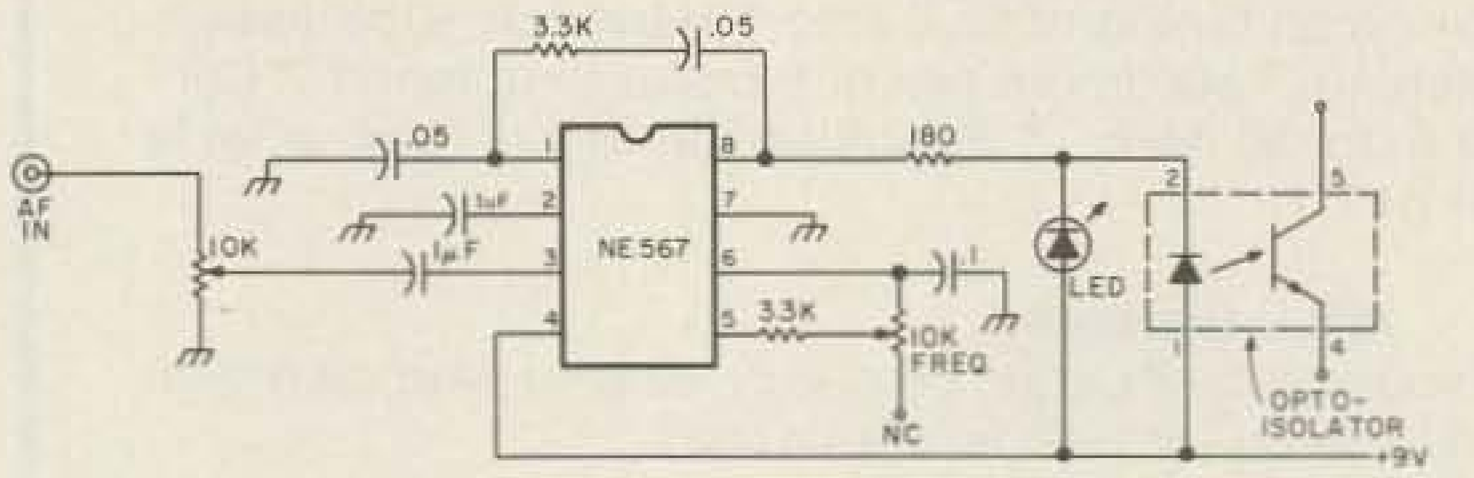


Fig. 1. Tunable audio filter uses a 567 PLL IC. The optoisolator can be a Sprague ED702 (many other surplus units at lower cost will also suffice). A multi-turn potentiometer for the 10k frequency adjustment control will facilitate adjustment, but a regular potentiometer with a large knob will also work.

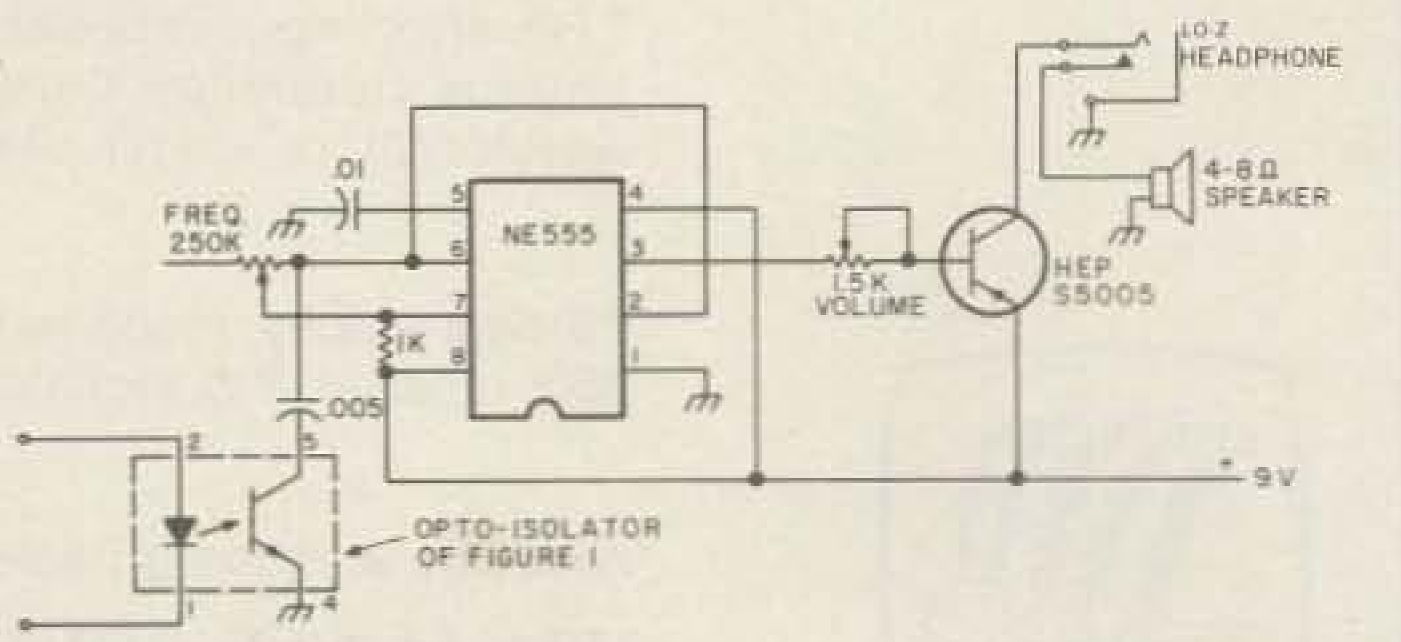


Fig. 2. NE555 audio oscillator/amplifier which can be driven by the PLL tone filter of Fig. 1. Note the simple but effective S5005 amplifier stage for the square wave output of the 555.

input lead is used to adjust the input level. This extra control is provided since one will usually initially monitor the receiver's audio output aurally until the filter locks into place on the incoming signal. The af input level (from a headphone jack, for instance) that provides good aural level may overload the PLL. Hence, the 10k input potentiometer is necessary. The bandpass of the filter varies with the input voltage level, and careful adjustment of the frequency and input level controls is needed. It is best to practice first with steady tone input signals rather than a keyed signal. The output of the PLL drives a regular LED and an LED optoisolator. The regular LED simply serves as a visual tuning aid to indicate the PLL is locked on to the incoming signal. Of course, it will lock on to any input frequency to which it is tuned (or even harmonics of the input signal if it is overdriven). However, by providing a switch to go back and forth between the audio input and the output of the keyed audio oscillator stage, confusion will be eliminated. The optoisolator LED is used as a switch to key an audio oscillator stage. It can be used to key any desired oscillator. Some operators prefer a sine wave signal, while others find a harmonic-rich square wave more interesting to copy.

Fig. 2 shows an NE555 oscillator/amplifier which can be keyed by the circuit of Fig. 1. The circuit is straightforward and provides both variable frequency and volume control. It will drive directly a small loudspeaker or low impedance headphones.

Fig. 3 shows some additional circuits which can be used with the circuit of Fig. 2. Fig. 3(a) shows a passive 900 Hz audio filter and rectifier which can be used to drive the LED optoisolator to key the NE555 oscillator. The PLL stage of Fig. 1 is not used and the 900 Hz filter is driven directly from the speaker output of the receiver being used. Fig. 3(b) shows just a rectifier circuit driving the LED optoisolator. This ultrasimple circuit can be used when the receiver has adequate selectivity and it is only desired to key the NE555 oscillator. The optoisolator approach in the foregoing circuits may seem a bit elaborate for a simple switching function. However, they allow versatility in keying various oscillator circuits and if purchased in untested lots can be very economical. The pin arrangement of most types is as shown in Fig. 1. One can locate the basic elements with a VOM and use a 1.5 V battery with a series 47Ω resistor to see that switching action takes place when the LED is activated. ■

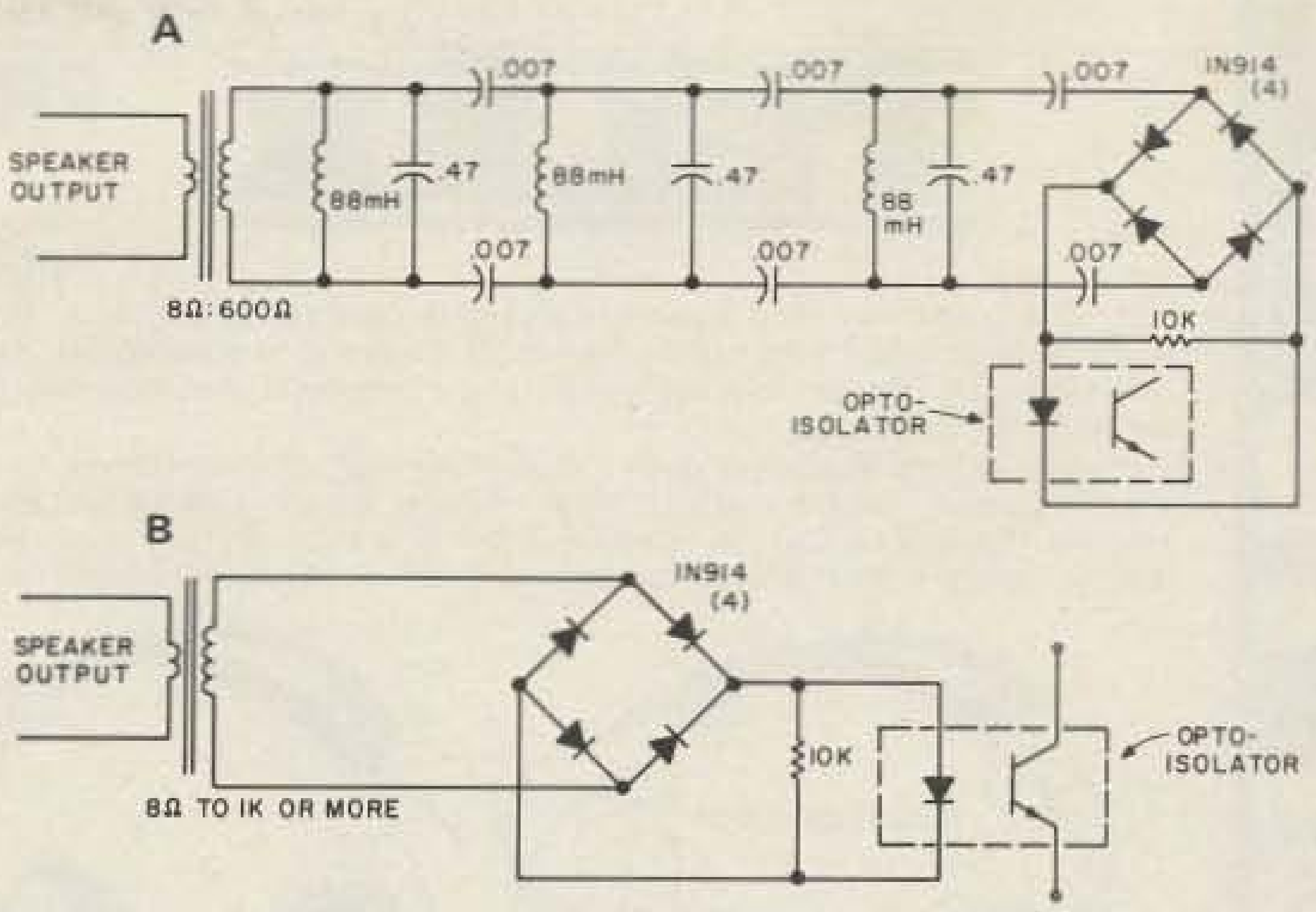


Fig. 3. Two other circuits that can be used to key the NE555 oscillator without using the PLL circuit of Fig. 1. Mylar capacitors should be used in (a). The .007 capacitors are paralleled .005 and .002 mF units.

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: $9.95

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

SST T-1 RANDOM WIRE ANTENNA TUNER

All band operation (160-10 meters) with most any random length wire. 200 Watt power capability. Ideal for portable or home operation. A must for Field Day. Size: 2 x 4-1/4 x 2-3/8. Built-in neon tune-up indicator. Guaranteed for 90 days. Compact — easy to use. Only $29.95.

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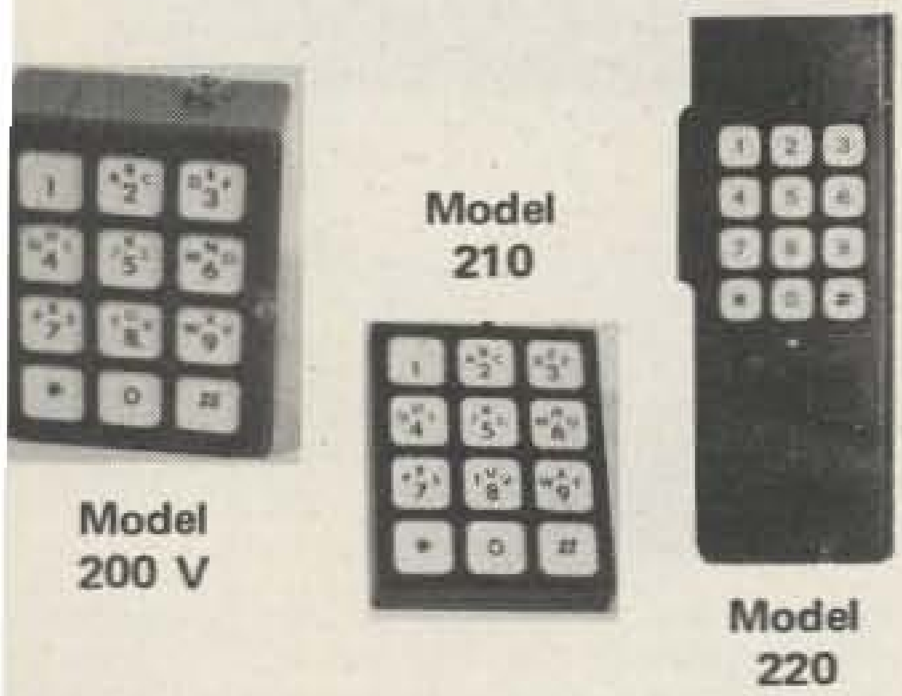
SILVER EAGLE — $69.95

T-UG8-D104, transistorized $48.60
T-UG9-D104, "Golden Eagle," transistorized $95.40
T-UG9-D104, "Silver Eagle," transistorized . $69.95
UG-D104, ceramic or crystal $42.60



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Model 200 V — acoustic coupling. $49.95

Model 210 — for mounting on walkies or hand-helds. $39.95

Model 220 — CES can now offer you a TOUCH TONE back for Standard Communications hand-held radios. This is the complete back assembly with the TOUCH TONE encoder mounted and ready to plug into the private channel connector. Also included is a LED tone generator indicator and an external tone deviation adjustment. $59.95

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Model	Input	Output	Typical	Frequency	Price
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702B	1-4W	60-80W	1 in/70 out	143-149 MHz	$169.00

Now get TPL COMMUNICATIONS quality and reliability at an economy price. The new Econo-Line gives you everything that you've come to expect from TPL at a real cost reduction. The latest mechanical and electronic construction techniques combine to make the Econo-Line your best amplifier value. Unique broad-band circuitry requires no tuning throughout the entire 2-meter band and adjacent MARS channels. See these great new additions to the TPL COMMUNICATIONS product line at your favorite amateur radio dealer.

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New Slinky® dipole* with helical loading radiates a good signal at 1/10 wavelength long!

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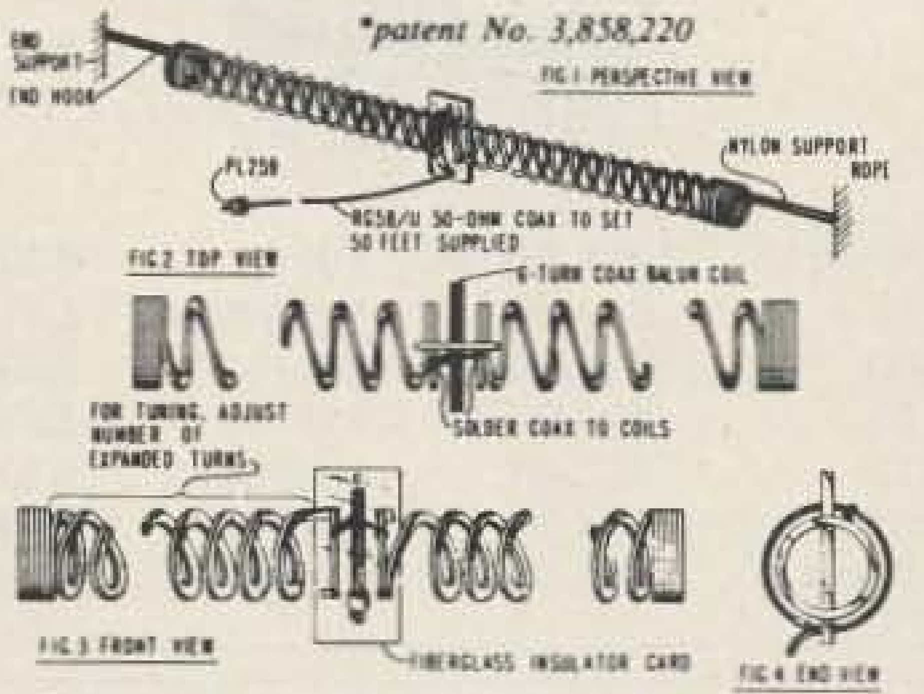

• This electrically small 80/75, 40, & 20 meter antenna operates at any length from 24 to 70 feet • no extra balun or transmatch needed • portable—erects & stores in minutes • small enough to fit in attic or apartment • full legal power • low SWR over complete 80/75, 40, & 20 meter bands • much lower 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 • now in use by US Dept. of State, US Army, radio schools, plus thousands of hams the world over

YAESU

FT-301D

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FP 301	AC Power Supply	125
FP 301 CID	AC P.S. w/Clock and CW ID	209
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QTR-24	Yaesu World Clock	30
FT-101-E 160-10M	XCVR W/Processor	729
FT-101EE 160-10M	XCVR W/O Processor	649
FT-101EX 160-10M	XCVR W/O Processor AC Only, Less Mike	589
FL-2100B	Linear Amplifier	399
FTV-650B	6M Transverter	199
FTV-250	2M Transverter	199
FV-101B	External VFO	109
SP-101B	Speaker	22
SP-101PB	Speaker/Patch	59
YO-100	Monitor Scope	199
YD-844	Dynamic Base Mike	29
FA-9	Cooling Fan	15
MMB-1	Mobile Mount	19
RFP-102	RF Speech Processor	79
XF-30C	600 Hz CW Filter	40
FR-101S SOLID STATE	160-2M/SW RCVR	489
FR 101 DIG SOLID STATE	160-2M/SW RCVR	599
FT 301S	160-10M 40WPEP	559
FT 301S	160-10M 40WPEP Digital	765

Accessories:		
FC-6	6M Converter	24
FC-2	2M Converter	25
FM-1	FM Detector	20
-	Aux/SW Crystals	5
XF-30B	AM-Wide Filter	40
XF-30C	600 Hz CW Filter	40
XF-30D	FM Filter	49
SP-101B	Speaker	22
FL-101 SOLID STATE TRANSMITTER	160-10M	525
Accessories:		
RFP-101	RF Speech Processor	79
MONITOR/TEST EQUIPMENT		
YC 500 J	500 MHz (10 PPM) Counter	249
YC 500 S	500 MHz (1 PPM) Counter	399
YC 500 E	500 MHz (0.02 PPM) Counter	537
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YP-150	Dummy Load/Watt Meter	69
YC-601	Digital Readout (101/401 series)	169
VHF FM & SSB TRANSCEIVERS		
FT-620B	6M AM/CW/SSB	365
FT-221	2M AM/FM/CW/SSB	629
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MMB-4	Mobile Mount (FT-620B, FT-221)	19

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MODEL	NET PRICE		
12V4	$19.95	103R	$39.95
600	$20.50	*13 HM 4	$41.95
102	$24.95	104R	$49.95
612	$27.95	12/115	$69.95
107	$28.95	108RA	$79.95
12 HM 4	$29.95	108RM	$99.95
		109R	$149.95

MODEL 12HM4

NPC 2.5 Amp Regulated Power Supply. Solid State. Short Circuit Protected.

Low cost regulated power supply quietly converts 115 volts AC to 13.5 volts DC ±200 millivolts. 1.5 amps continuous, 2.5 amps reg. Ideally suited for operating mobile CB transceivers in your home or office base station.

ALSO! Available as 13 HM 4 with built-in loudspeaker.

	TYPICAL	MAXIMUM
Output Voltage	13.5 ±.5VDC	14VDC
Continuous Current	1.5 Amp	
Regulation	2.5 Amp	
Ripple/Noise	5 mV RMS	10 mV RMS

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 103

NPC 4 Amp Regulat[ed] Power Supply. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles amps continuous and 4 amps max. Ideally suited for applicati[ons] where no hum and DC stability are important such as CB transmissi[on], small Ham radio transmitter, and high quality eight-track car stere[os]. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 V
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

MODEL 107

NPC 4 Amp Power Supply, 6 Amp Max. Solid State. Overload Protected

Functions silently in converting 115 volts AC to 12 volts DC. 4 amps continuous, 6 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office.

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	.5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 5 lbs.

MODEL 109R

NPC 25 Amp Regulated Power Supply. 4-Way Protected. Output Voltage and Current Meters.

Extra heavy-duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 10 amps continuous, 25 amps max. All solid state. Features dual current overload, overvoltage and thermal protection. Ideally suited for operating mobile Ham radio and linear amplifier in your home or office. Excellent bench power supply for testing and servicing of mobile communications equipment.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	50 mV	100 mV
Ripple Noise	5 mV RMS	10 mV RMS
Transient Response	20 uSec	
Current Continuous	10 Amp	
Current Limit	26 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180°F	

Case: 4¾" (H) x 9" (W) x 8½" (D). Shipping Weight: 15 lbs.

MODEL 12V4

NPC 1.75 Amp Power Supply. 3 Amp Max.

Functions silently in converting 115 volts AC to 12 volts DC. Ideally suited for most applications including 8-track stereo, burglar alarm, car radio a[nd] cassette tape player within power rating.

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.4 V RMS
Short Circuit Protection	Thermal Break[er]

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 108RM

NPC 12 Amp Regulated Power Supply. Solid State. 3-Way Protected. Current Meter.

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 8 amps continuous, 12 amps max. All solid state. Features dual current overload and overvoltage protection. Ideally suited for operating mobile Ham radio 2 meter AM-FM-SSB transceivers in your home or office. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	8 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case: 4¼" (H) x 7½" (W) x 5½" (D). Shipping Weight: 9.5 lbs.

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

MODEL 104R

NPC 6 Amp Power Supply Regulated. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 4 amps continuous and 6 amps max. Ideally suited for applications where excellent DC stability is important, such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can be used to trickle-charge 12 volt car batteries.

	MAXIMUM	TYPICAL
Output Voltage	13.6 ±2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case: 3½" (H) x 5½" (W) x 6½" (D). Shipping Weight: 6 lbs.

MODEL 102

NPC 2.5 Amp Power Supply. 4 Amp Max. Solid Sta[te]. Overload Protected.

Functions silently in conver[ting] 115 volts AC to 12 vol[ts] DC. 2.5 amps continuous, 4 amps max. Enables anyone to enjoy C[B] radio, car 8-track cartridge, cassette tape player or car radio in a hom[e] or office.

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.6 V RMS
Short Circuit Protection	Thermal Breake[r]

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

- General Multi-purpose V-O-Ms
- Drop Resistant
- Hand Size
- Model 310 V-O-M
- Type 3

1. Drop-resistant, hand-size V-O-M with high-impact thermoplastic case.
2. 20,000 Ohms per volt DC and 5,000 Ohms per volt AC; diode overload protection with fused Rx1 Ohms range.
3. Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.

RANGES

DC Volts: 0-3-12-60-300,1,200 (20,000 Ohms per Volt).
AC Volts: 0-3-12-60-300-1,200 (5,000 Ohms per Volt).
Ohms: 0-20k-200k-2M Ω-20M Ω (200 Ohm center scale on low range).
DC Microamperes: 0-600 at 250 mV.
DC Milliamperes: 0-6-60-600 at 250 mV.
Accuracy: ±3% DC; ±4% AC; (full scale).
Scale Length: 2-1/8".
Meter: Self-shielded; diode overload protected; spring backed jewels.
Case: Molded, black, high impact thermoplastic with slide latch cover for access to batteries and fuse, 2-3/4" w x 1-5/16" d x 4-1/4" h.
Batteries: NEDA 15V 220 (1), 1½V 910F (1): Complete with 42" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 2 lbs.

Model 310 Cat. No. 3018 .... $53.00

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AMPLIFIER #405

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ARGONAUT, MODEL 509

Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter. SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509 ..... $359.00
Linear Amplifier, Model 405 . 159.00
Power Supply, Model 251
(Will power both units) 85.00
Power Supply, Model 210
(Will power Argonaut only) .. 30.00

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes.

For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age.

But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air.

The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as *full* CW break-in, pre-selectable ALC, off-set tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW wave form, built-in SWR bridge and on and on.

For new standards of SSB and CW communication, write for full details or talk it over with your TEN-TEC dealer. We'd like to tell you why "They Don't Make 'Em Like They Used To" makes Ham Radio even more fun.

TRITON IV $699.00

ACCESSORIES:
Model 240 One-Sixty Converter....$ 97.00
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Model 245 CW Filter $25.00
Model 249 Noise Blanker 29.00
Model 252G Power Supply 109.00
Model 262G Power Supply/VOX .. 139.00

TEN-TEC

TRITON IV
Digital Model 544
$869.00

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. Price $69.50

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. Price $39.50

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. Price $35.00

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. Price $17.00

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weithting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortless. The jambie (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

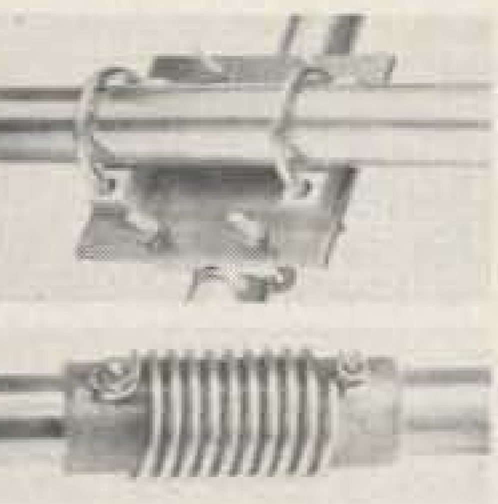
Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing. Price $110.00

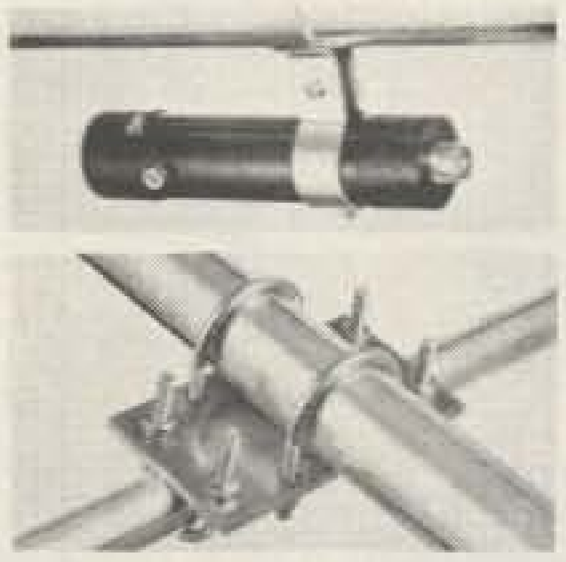
SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms.
Power Source: 117VAC, 50-60 Hz, 6-14 VDC.
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¼"
Weight: 1¾ lbs.

TEN-TEC

KR50





cushcraft **4 ELEMENT BEAM • 10-15-20 METERS** Price : $239.95

From one package you receive every component to quickly and easily assemble your beam. ATB-34's rugged construction, full power handling capability, broad band coverage, and four active elements will give you superior performance on all three bands. Our new coaxial traps are very high Q, resulting in extremely low ohmic losses and longer full performance elements. They are rated for 2KW power handling. Feed is direct 52 ohm through the 1-1 balun, supplied at no extra cost.

SPECIFICATIONS

FREQUENCY COVERAGE	14.00-14.35 MHz	NOMINAL INPUT IMPEDANCE	50 OHMS TAKES PL-259	ASSEMBLED WEIGHT	42 Lbs. (19.05 kg)
Three Active Elements on Each Band	21.00-21.45 MHz	BOOM DIA/LENGTH	18' (5.48 m) x 2-1/8" (5.4 cm) – 2" (5.1 cm)	SHIPPING WEIGHT	49 Lbs. (22.23 kg)
	28.00-29.00 MHz	ELEMENT DIA/MAX LENGTH	32'8" (9.96 m) x 1¼" (3.2 cm)	EST WIND SURVIVAL	90 MPH (144 KPH)
FORWARD GAIN	7.5 dBd ALL BANDS		tapered 5/8" (1.6 cm)	ELEMENT/BOOM MATERIAL	6063-T832 HARD DRAWN,
FRONT TO BACK RATIO	30 dB OPTIMUM	TURNING RADIUS	18'9" (5.71 m)		BRIGHT FINISH ALUMINUM
V.S.W.R.	1.5 to 1 OR LESS AT RESONANCE	MAXIMUM SUPPORT MAST DIA.	2½" (6.41 cm)		TUBING
POWER HANDLING	2000 WATTS PEP	WIND SURFACE AREA	5.4 Sq. Ft. (0.50 m²)	BALUN	#12 WIRE, FERRITE CORE

Now You Can Receive The Weak Signals With The ALL NEW AMECO PREAMPLIFIER

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one.

- Improves sensitivity and signal-to-noise ratio.
- Boosts signals up to 26 db.
- For AM or SSB.
- Bypasses itself automatically when the transceiver is transmitting.
- FET amplifier gives superior cross modulation protection.
- Advanced solid-state circuitry.
- Simple to install.
- Improves immunity to transceiver front-end overload by use of its built-in attenuator.
- Provides master power control for station equipment.

MODEL PT-2

$69.95

BIRD

The indispensable BIRD model 43 THRULINE® Wattmeter

Read RF Watts Directly.

0.45-2300 MHz, 1-10,000 watts ±5%, Low Insertion VSWR—1.05.

Unequalled economy and flexibility: Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

Dealer Programs NOW Available

Table 1 STANDARD ELEMENTS (CATALOG NUMBERS)

Power Range	Frequency Bands (MHz) 2-30	25-60	100-250	200-500	400-1000
5 watts	—	5A	5C	5D	5E
10 watts	—	10A	10C	10D	10E
25 watts	—	25A	25C	25D	25E
50 watts	50H	50A	50C	50D	50E
100 watts	100H	100A	100C	100D	100E
250 watts	250H	250A	250C	250D	250E
500 watts	500H	500A	500C	500D	500E
1000 watts	1000H	1000A	1000C	1000D	1000E
2500 watts	2500H				
5000 watts	5000H				

MODEL	PRICE
43	$120
Elements (Table 1) 2-30 MHz	42
Elements (Table 1) 25-1000 MHz	36
Carrying case for Model 43 & 6 elements	26
Carrying case for 12 elements	16

(Specify Type N or SO239 connectors)

BOMAR Crystal Company

Novice Crystals (Specify Band Only)

TWO METERS

CRYSTALS IN STOCK

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.

THE BIG SIGNAL $12.95 "W2AU" BALUN

THE APPROVED LEADING HAM AND COMMERCIAL BALUN IN THE WORLD TODAY.

THE PROVEN BALUN

IT'S WHAT'S INSIDE THAT COUNTS!

1. **HANDLES FULL 2 KW PEP AND THEN SOME.** Broad-Banded 3 to 40 Mc.
2. **HELPS TVI PROBLEMS** By Reducing Coax Line Radiation
3. **NOW ALL STAINLESS STEEL HARDWARE.** SO239 Double Silver Plated
4. **IMPROVES F/B RATIO** By Reducing Coax Line Pick-Up
5. **REPLACES CENTER INSULATOR.** Withstands Antenna Pull of Over 600 Lbs.
6. **BUILT-IN LIGHTNING ARRESTER.** Helps Protect Balun—Could Also Save Your Valuable Gear
7. **BUILT-IN HANG-UP HOOK.** Ideal For Inverted Vees, Multi-Band Antennas, Dipoles, Beam and Quads

NOW BEING USED BY ALL BRANCHES OF THE U.S. ARMED FORCES, FAA, RCA, CIA, CANADIAN DEFENSE DEPT. PLUS THOUSANDS OF HAMS THE WORLD OVER

THEY'RE BUILT TO LAST...

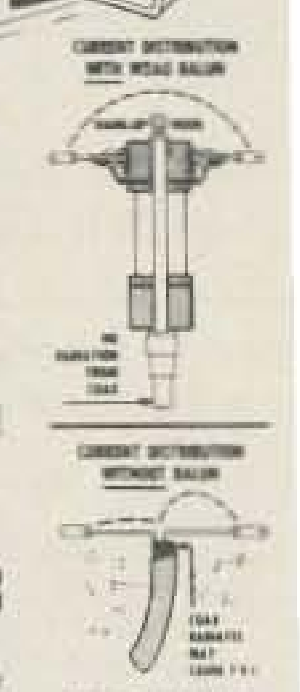
BIG SIGNALS DON'T JUST HAPPEN— GIVE YOUR ANTENNA A BREAK

Comes in 2 models. 1:1 matches 50 or 75 ohm unbalanced (coax line) to 50 or 75 ohm balanced load. 4:1 model matches 50 or 75 ohm unbalanced (coax line) to 200 or 300 ohm balanced load.

AVAILABLE AT ALL LEADING DEALERS. IF NOT, ORDER DIRECT

The big signal W2AU Balun reflects the type of quality that has kept our product out front and number 1 in Baluns the world over for the past 10 years.

The originator of the Balun with a built-in lightning arrester and hang up hook.



We'll GUARANTEE no other balun, at any price, has all these features.

SERIES 31 — BNC CONNECTORS

Amphenol's BNC connectors are small, lightweight, weatherproof connectors with bayonet action for quick disconnect applifications.

Shells, coupling rings and male contacts are accurately machined from brass. Springs are made of beryllium copper. All parts in turn are ASTRO-plated® to give you connectors that can take constant handling, high temperatures and resist abrasion.

BNC BULKHEAD RECEPTACLE 31-221-385 UG-1094 Mates with any BNC plug. Receptacle can be mounted into panels up to 104" thick. $1.25

BNC (M) TO UHF (F) ADAPTER 309-2900-385 UG 255 Adapts any BNC jack to any UHF plug. $3.63

DOUBLE MATE ADAPTER 83-877-385 Both coupling rings are free turning. Connects 2 female components. $2.72

JACK ADPATER $1.95 575-102-385 Adapts 83-1SP-385 to Motorola type auto antenna jack or pin jack.

PANEL RECEPTACLE 83-1R-385 SO239 Mounts with 4 fasteners in 21/32" diameter hole. $1.17

PANEL RECEPTACLE 83-878-385 SO239SH Mounts in single 21/32" diameter hole. Knurled lock nuts prevent turning. $1.59

BNC ANGLE ADAPTER 31-009-385 UG-306 Adapts any BNC plug for right angle use. $4.23

BNC TEE ADAPTER 31-008-385 UG-274 Adapts 2 BNC plugs to 31-003-385 or other female BNC type receptable. $4.56

UG-273

UG-1094

575-102-385

BNC(F) TO UHF (M) ADAPTER 31-028-385 UG-273 Adapts any BNC plug to any UHF jack. $2.39

PUSH-ON 83-5SP-385 Features an unthreaded, springy shell to push fit on female connectors. $2.27

LIGHTNING ARRESTOR 575-105-385 Eliminates static build-up from antenna. Protects your valuable equipment against lightning damage. $4.80

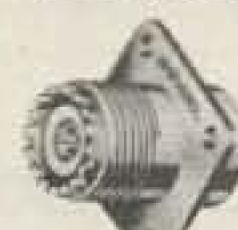
BNC PLUG 31-002-385 UG-88 Commonly used for communications antenna lead cables. For RG 55/U & RG 58/U cables. $1.59

BNC STRAIGHT ADAPTER 31-219-385 UG-914 1 9/32" long, allows length of cables to be joined. Mates with BNC plugs. $2.12

BNC PANEL RECEPTACLE 31-003-385 UG-290 Mounts with 4 fasteners in 29/64" diameter hole. $1.74

83-877-385

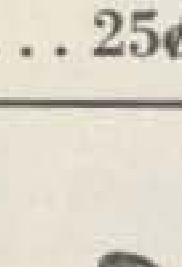
PL-259 . . . 90¢
UG-175 (Adapter for RG 58U) . . . 25¢



SO239

SO239SH

UG-290



UG-274

83-5SP-385

UG-306

575-105-385

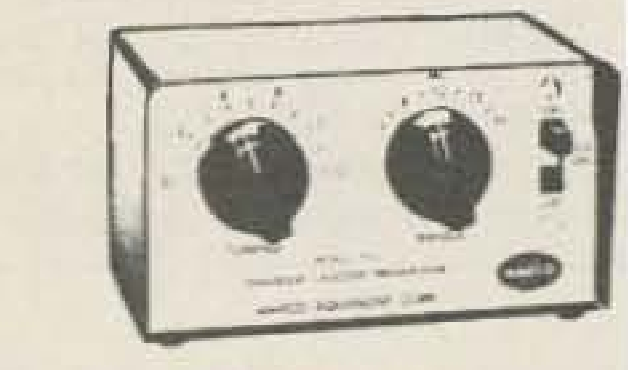
UG-255

UG-88

UG-914

AMECO

ALL BAND PREAMPLIFIER



- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp. Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

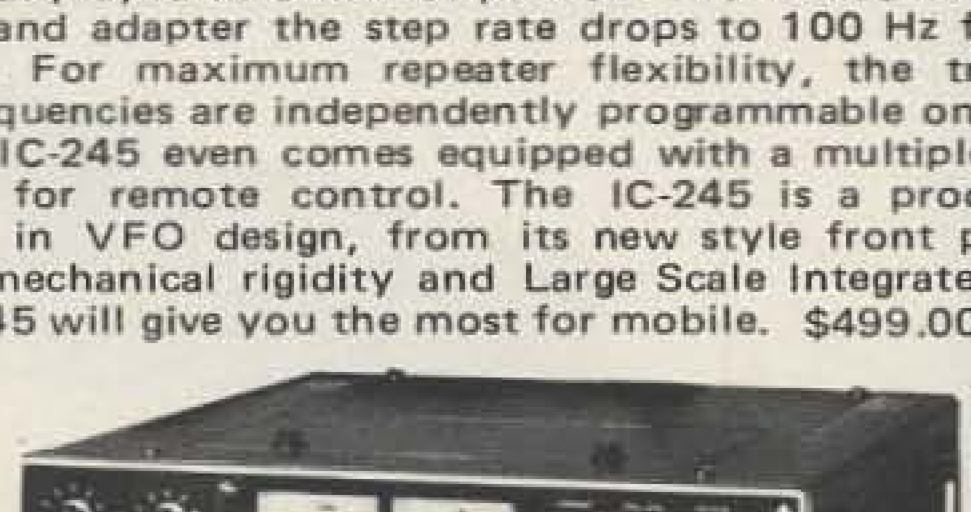
Model PCLP Uses nuvistor $44.00

Now It's Crystal Clear

Yes, now ICOM helps you steer clear of all the hassles of channel crystals. The new **IC-22S** is the same surprising radio you've come to know and love as the **IC-22A**, except that it is totally crystal independent. **Zero crystals.** Solid state engineering enables you to program 23 channels of your choice without waiting. Now the ICOM performance you've demanded comes with the convenience you've wanted, with your new **IC-22S**. *Price: $299.00*

IC-245 Transceiver

The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The IC-245 offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the IC-245 puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 kHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100 Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programmable on any separation. The IC-245 even comes equipped with a multiple pin Molex connector for remote control. The IC-245 is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your IC-245 will give you the most for mobile. $499.00



THE NEW ICOM 4 MEG, MULTI-MODE, 2 METER RADIO — IC 211

ICOM introduces the first of a great new wave of amateur radios, with new styling, new versatility, new integration of functions. You've never before laid eyes on a radio like the IC-211, but you'll recognize what you've got when you first turn the single-knob frequency control on this compact new model. The IC-211 is fully synthesized in 100 Hz or 5 kHz steps, with dual tracking, optically coupled VFOs displayed by seven-segment LED readouts, providing any aplit. The IC-211 rolls through 4 megahertz as easily as a breaker through the surf. With its unique ICOM developed LSI synthesizer, the IC-211 is now the best "do everything" radio for 2 meters, with FM, USB, LSB and CW operation. $749.00

Hold it!

Take hold of SSB with these two low cost twins. ICOM'S new portable **IC-202** and **IC-502** put it within your reach wherever you are. You can take it with you to the hill top, the highways, or the beach. Three portable watts PEP on two meters or six!

Hello, DX! The ICOM quality and excellent receiver characteristics of this pair make bulky converters and low band rigs unnecessary for getting started in SSB-VHF. You just add your linear amp, if you wish, connect to the antenna, and DX! With the **202** you may talk through OSCAR VI and VII! Even transceive with an "up" receiving converter! The **IC-502**, similarly, makes use of six meters in ways that you would have always liked but could never have before. In fact, there are so many things to try, it's like opening a new band.

Take hold of Single Side Band. Take hold of some excitement. Take two.

IC-202
2 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 200KHz
VXO Tuning • 144.0, 144.2 + 2 More! • RIT!
Price: $259.00

IC-502
6 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 800KHz
VFO • RIT!
Price: $249.00

Now ICOM Introduces 15 Channels of FM to Go!

The New IC-215: the FM Grabber

This is ICOM's first FM portable, and it puts good times on the go. Change vehicles, walk through the park, climb a hill, and ICOM quality FM communications go right along with you. Long lasting internal batteries make portable FM really portable, while accessible features make conversion to external power and antenna fast and easy.

Grab for flexibility with the new **IC-215** FM portable.

- Front mounted controls and top mounted antenna
- Narrow filter (15KHz — compatible spacing)
- 15 channels (12 on dial / 3 priority)
- Fully collapsible antenna
- Compatible mount feature for flexible antenna
- Dual power (3 watts high / 400 mw low, nominal)
- External power and antenna easily accessible
- Lighted dial and meter

Price: $229.00

Your new **IC-215** comes supplied with: 5 popular channels; handheld mic. with protective case; shoulder strap; connectors for external power and speaker; 9 long-life C batteries.

ICOM

TUFTS RADIO CATALOG TUFTS RADIO

model 333 dummy load wattmeter

Favorite Lightweight Portable—250 WATT RATING—Air Cooled

Ideal field service unit for mobile 2-way radio—CB, marine, business band. Best for QRP amateur use, CB, with zero to 5 watts full scale low power range.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	250 watts intermittent
Wattmeter Ranges	0–5, 0–50, 0–125, 0–250
Connector	SO-239
Size	4" x 7" x 8"
Shipping Weight	2 lbs.
Price	$98.50

model 374 dummy load wattmeter

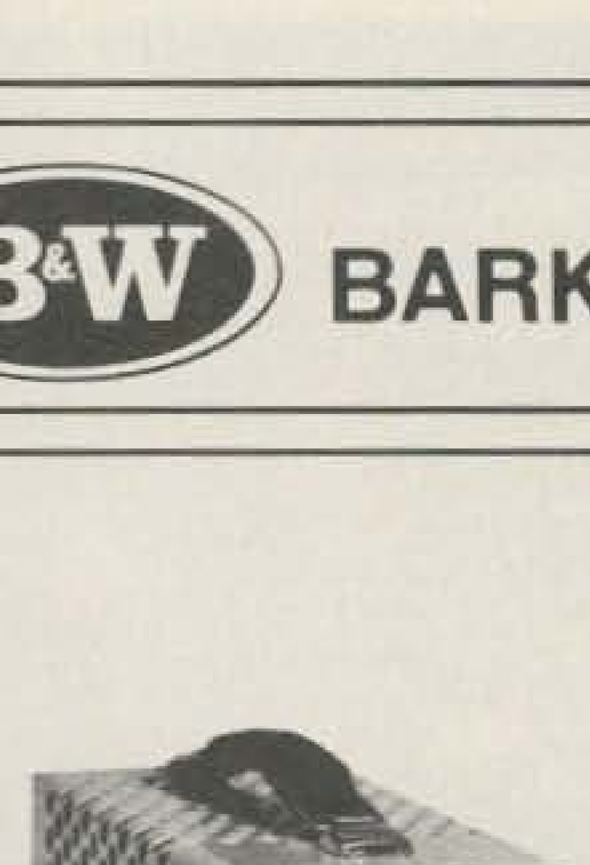
Top of the Line—1500 WATT RATING—Oil Cooled

Our highest power combination unit. Rated to 1500 watts input (intermittent). Meter ranges are individually calibrated for highest accuracy.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts DC intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0–15, 0–50, 0–300, 0–1500
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$215.00

B&W BARKER & WILLIAMSON, INC.



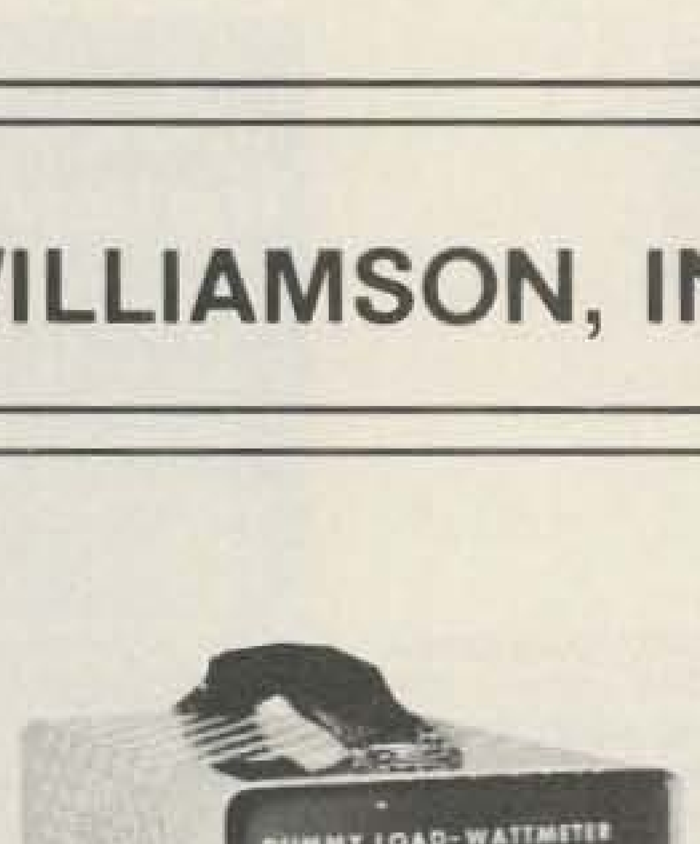
Economy High Power Load—1500 WATT RATING—Oil Cooled

model 384 dummy load

For high power when all you need is the load.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts intermittent. Warning light* signals maximum heat limit.
Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/2"
Shipping Weight	12 lbs.
Price	$94.50



High Power—1000 WATT RATING—Oil Cooled

model 334A dummy load wattmeter.

Our most popular combination unit. Handles full amateur power. Meter ranges individually calibrated. Can be panel mounted.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1000 watts CW intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0–10, 0–100, 0–300, 0–1000
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$174.00

LITTLE DIPPER

model 331A

transistor dip meter

Portable RF single generator, signal monitor, or absorpti wavemeter. Lightweight (1 pound, 6 ounces with all coi battery-powered unit is ideal for field use in test transceivers, tuning antennas, etc. Can also be used measure capacity, inductance, circuit Q, and other factc Indispensable for experimenters, it is easily the m versatile instrument in the shop. Continuous coverage fr 2 MHz to 230 MHz in seven ranges.

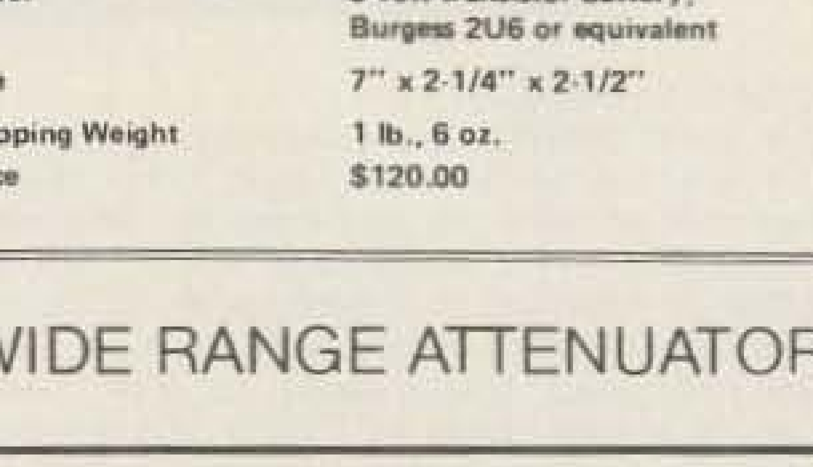
Unit consists of a transistorized RF dip oscillator a 100-microampere meter circuit. Meter circuit uses single-transistor DC amplifier with a potentiometer in t emitter circuit to control meter sensitivity. A 3-positi slide switch connects the meter circuit to the oscillator f dip measurements, to a diode for absorption waveme peak measurements, or provides audio modulation of t RF signal.

Frequency dial has a calibrated reference point for Q ar bandwidth measurements. Each coil has its own frequen dial. there's no confusion with multiple markings or sma hard-to-read scales near the center of the dial.

▪ specifications

Frequency Coverage	2 MHz to 230 MHz in 7 overlapping ranges by plug-in coil assemblies: 2 MHz–4 MHz, 4 MHz–8 MHz, 8 MHz–16 MHz, 16 MHz–32 MHz, 32 MHz–64 MHz, 50 MHz–110 MH 110 MHz–230 MHz
Accuracy	±3%
Modulation	1000 Hz, 25% to 40%
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	7" x 2-1/4" x 2-1/2"
Shipping Weight	1 lb., 6 oz.
Price	$120.00

WIDE RANGE ATTENUATOR



Model 371-1

Protect your receiver or converter from overload, or pro vide step attenuation of low-level RF signals from signa generators, preamplifiers, or converters. Seven rocke switches provide attenuation from 1 dB to 61 dB in 1-dl steps. Switches are marked in dB, 1-2-3-5-10-20-20. Sum o actuated switches (IN position) gives attenuation. With a switches in OUT position, there is NO insertion los Attenuator installs in coaxial line using UHF connectors.

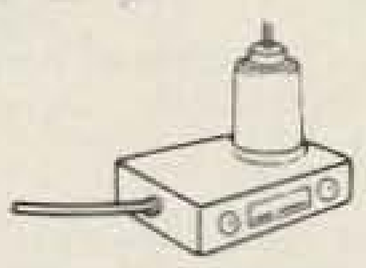
▪ specifications

Power Capacity	1/4 watt
VSWR	1.3:1 maximum, DC to 225 MHz
Impedance	50 ohms
Accuracy	1 dB/dB, DC to 60 MHZ 0.1 dB/dB ±0.5 dB, DC to 160 MHz 0.1 dB/dB ±1.0 dB, DC to 225 MHz
Size	8-1/2" x 2-1/2" x 2-1/4"
Shipping Weight	1-1/2 lbs.
Price	$49.50

• Handle full 200 watts • low-low V.S.W.R. • Deliver 3 dB gain and more! • Pick the one that best fits your needs:

Larsen Kūlrod® Antennas

MAGNETIC MOUNT



stays put even at 100 mph!

MM-JM-150 for 144 MHz use
MM-JM-220 for 220 MHz use
MM-JM-440 for 440 MHz use

Only $38.50 complete

TRUNK LID MOUNT

No holes and low silhouette too!

TLM-JM-150 for 144 MHz use
TLM-JM-220 for 220 MHz use
TLM-JM-440 for 440 MHz use

Only $38.50 complete

And 1/4 wave antenna for trunk and magnetic mount – $18.50

ROOF or FENDER MOUNT

Goes on quick and easy in 3/8" or 3/4" with fewest parts.

JM-150-K for 144 MHz use
JM-220-K for 220 MHz use
JM-440-K for 440 MHz use

Only $31.50 complete

And 1/4 wave antenna for roof and fender mounts $11.50

Above antennas all complete with mounting hardware, coax, connector plug, allen wrench and complete instructions.

Model 372 – $27.50

model 372 CLIPREAMP

Get maximum legal modulation without danger of splatter. Solid-state speech preamplifier and clipper for transmitters, public-address systems, and tape recorders needs no external power.

• specifications

Input Impedance	100,000 ohms
Input Levels	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Ouput Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	7 oz.
Connectors	Terminal strip

COAXIAL ANTENNA CHANGEOVER RELAY

model 377

Model 377 – $17.95

Economical and reliable. Can be operated from VOX circuit for completely automatic operation or from PTT or manual T/R switch. Receiver input is automatically grounded when the relay is in the Transmit position. Wide AC operating voltage range and low operating current.

• specifications

Power Rating	1000 watts CW (2000 watts SSB)
VSWR	Less than 1.15:1, DC to 150 MHz
Power Requirements	0.015 Ampere, 48 to 130 volts AC
Connectors	UHF Type SO-239
Dimensions	3-1/2" x 1-1/2"
Shipping Weight	1 lb.

UNIVERSAL HYBRID COUPLER II PHONE PATCH

model 3002W and model 3001W

Connect your station to the telephone lines. Five switch-selectable modes give complete flexibility for patching the station to the line and for tape recording and playback to or from the line or the station. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in *Compreamp* speech preamplifier/limiter (in Model 3002W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The *Compreamp* also functions as a preamplifier/limiter with the station microphone, if desired.)

• specifications

Inputs from:		
	Line	600 ohms
	Receiver	4 ohms
	Microphone	High impedance (50,000 ohms) crystal or dynamic
	Tape Recorder	4 ohms
Outputs to:		
	Transmitter	50,000 ohms
	Receiver Speaker	4 ohms
	Tape Recorder	0.5 megohm
Size		6-1/2" x 7-1/2" x 3"
Shipping Weight		3-1/2 lbs.
Power		9-volt battery, Burgess 2U6 or equivalent
Connectors		Phono

Model 300 2W with *Compreamp* – $125.00

Model 300 1W without *Compreamp* – $85.00

B&W

BARKER & WILLIAMSON, INC.

Model 359 – $37.50

Dealer Programs NOW Available

Increase your transmitter's effective speech power up to four times. Or use it with your tape recorder or public address system for improved performance. This two-stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters. Powered by a long-lasting dry-cell battery—no external power needed. Installs without any wiring changes in your transmitter. Just connect the *Compreamp* between your microphone (50,000-ohm dynamic or high-impedance ceramic) and your transmitter's microphone input connector. Front-panel rocker switch lets you bypass the *Compreamp* when you want to. Compression level is adjustable, too.

• specifications

Input Impedance	100,000 ohms
Input Level	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	6-1/2 oz.
Connectors	Terminal strip

COAXIAL SWITCHES AND ACCESSORIES

for antenna selection and RF switching

These high-quality switches have set the standard for the industry for years. Ceramic switches with silver-alloy contacts and silver-plated conductors give unmatched performance and reliability from audio frequencies to 150 MHz.

B&W coaxial switches are designed for use with 52- to 75-ohm non-reactive loads, and are power rated at 1000 watts AM, 2000 watts SSB. Connectors are UHF type. Insertion loss is negligible, and VSWR is less than 1.2:1 up to 150 MHz.

Crosstalk (measured at 30 MHz) is -45 dB between adjacent outlets and -60 dB between alternate outlets.

Models are available for desk, wall, or panel mounting, and with or without protective grounding of inactive outputs. Radial (side-mounted) connector models can be either wall or panel mounted, axial (backplate-mounted) connector models are for panel mounting only, save panel space.

Use the selector chart below to choose the models you need.

Model 550A

Model 590

Model 590G

Model 551A

Model 592

Model 595

COAXIAL SWITCH SELECTOR CHART

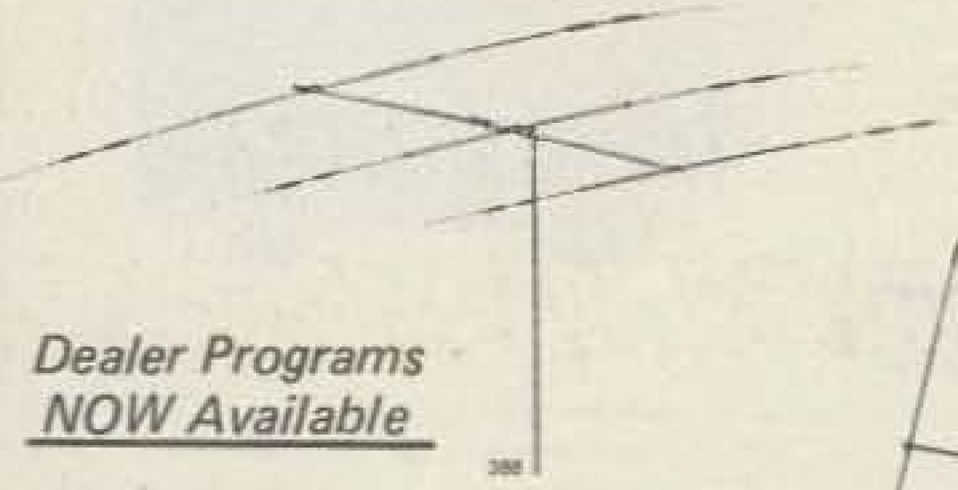
Model	PRICE	Outputs	Connector Placement	Mounting			Automatic Grounding	Dial Plate	Remarks
				Panel	Wall	Desk			
375	18.95	6	Axial	x			x	Supplied	PROTAX switch. Grounds all except selected output circuit.
376	18.95	5	Radial	x	x		x	Supplied	PROTAX switch. Grounds all except selected output circuit. Sixth switch position grounds *all* outputs.
550A	14.00	5	Radial	x	x			DP-5	
550A-2	12.50	2	Radial	x	x			DP-2	
551A	17.50	2	Radial	x	x			DP-2	Special 2-pole, 2-position switch used to switch any RF device in or out of series connection in a coaxial line. See figure (over).
556	.95	–	–		x			–	Bracket only, for wall mounting of radial connector switches.
590	17.95	5	Axial	x				DP-5	
590G	17.95	5	Axial	x			x	Supplied	Grounds all except selected output circuit.
592	16.50	2	Axial	x				DP-2	
595	18.50	6	In-line		x	x	x		Grounds all except selected output circuit.

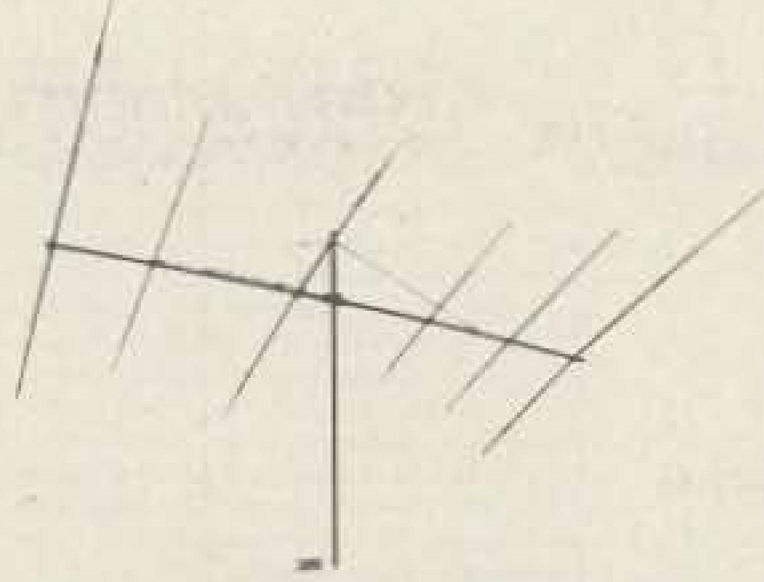
Model 376

Model 375

Model 550A-2

Dealer Programs
NOW Available





Super
3-Element Thunderbird
for 10, 15 and 20 Meters
Model TH3Mk3 — $199.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

	TH6DXX	TH3Mk3
Electrical		
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 lbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.

6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6 DXX $249.95 Separate HY-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and readjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

HY-GAIN'S INCOMPARABLE HY-TOWER FOR 80 THRU 10 METERS

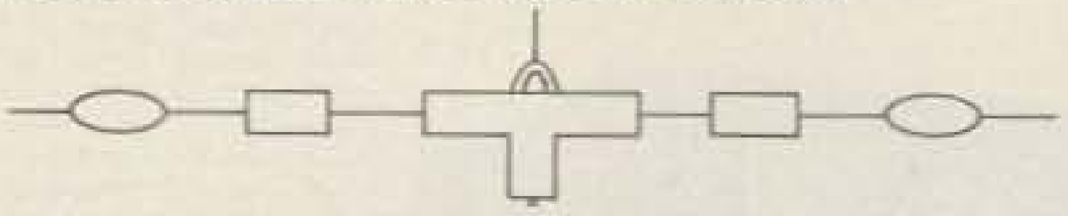
Model 18HT
- Outstanding Omni-Directional Performance
- Automatic Band Switching
- Installs on 4 sq. ft. of real estate
- Completely Self-Supporting

By any standard of measurement, the Hy-Tower is unquestionably the finest multi-band vertical antenna system on the market today. Virtually indestructible, the Model 18HT features automatic band selection on 80 thru 10 meters through the use of a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical ¼ wavelength (or odd multiple of a ¼ wavelength) exists on all bands. Fed with 52 ohm coax, it takes maximum legal power ... delivers outstanding performance on all bands. With the addition of a base loading coil, it also delivers outstanding performance on 160 meters. Structurally, the Model 18HT is built to last a lifetime. Rugged hot-dipped galvanized 24 ft. tower requires no guyed supports. Top mast, which extends to a height of 50 Ft., is 6061ST6 tapers aluminum. All hardware is iridite treated to MIL specs. If you're looking for the epitome in vertical antenna systems, you'll want Hy-Tower, Shpg. Wt., 96.7 lbs. Order No. 182, Price: $279.95

NEW Special hinged base assembly on Model 18HT allows complete assembly of antenna at ground level ... permits easy raising and lowering of the antenna.

BROAD BAND DOUBLET BALUN
for 10 thru 80 meters
Model BN-86
$15.95

The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95 Shpg. Wt. 1 lb. Order No. 242



MULTI-BAND HY-Q TRAP DOUBLETS
Hy-Q Traps

- Install Horizontally or as Inverted V
- Super-Strength Aluminum Clad Wire
- Weatherproof Center and End Insulators

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke ... will not stretch ... withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cyolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

MODEL 2BDQ for 40 and 80 meters. 100' 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs $49.95 Order No. 380

MODEL 5BDQ for 10, 15, 20, 40 and 80 meters. 94' overall. Takes maximum power. Shpg. Wt., 12.2 lbs. $79.95 Order No. 383

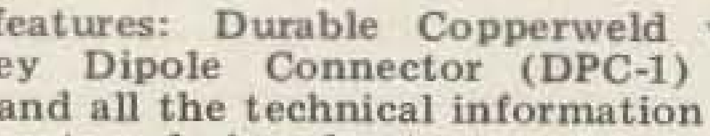
CENTER INSULATOR for Multi-Band Doublets Model CI

Strong lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ¾" coaxial. Shpg. Wt., 0.6 lbs. $5.95 Order No. 155

MULTI-BAND ANTENNA
Dipole Antenna — Model DIV-80
$13.95
For 10 thru 80 meters — choice of one band

A dipole antenna for the individuals who prefer the "do-it-yourself" flexibility of custom-designing an antenna for your specific needs. (Work the frequencies you wish in the 10 through 80 meters bands).

The DIV-80 features: Durable Copperweld wire for greater strength, Mosley Dipole Connector (DPC-1) for RG-8/U or RG-58/U coax and all the technical information you will need to construct your custom-designed antenna.



END INSULATORS for Doublets Model EI

Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs. $3.95 Order No. 156

WIDE BAND VERTICAL for 80-10 Meters Hy-Gain's 18 AVT/WB

Take the wide band, omni-directional performance of Hy-Gain's famous 14AVQ/WB, add 80 meter capability plus extra-heavy duty construction – and you have the unrivalled new 18AVT/WB. In other words, you have quite an antenna.

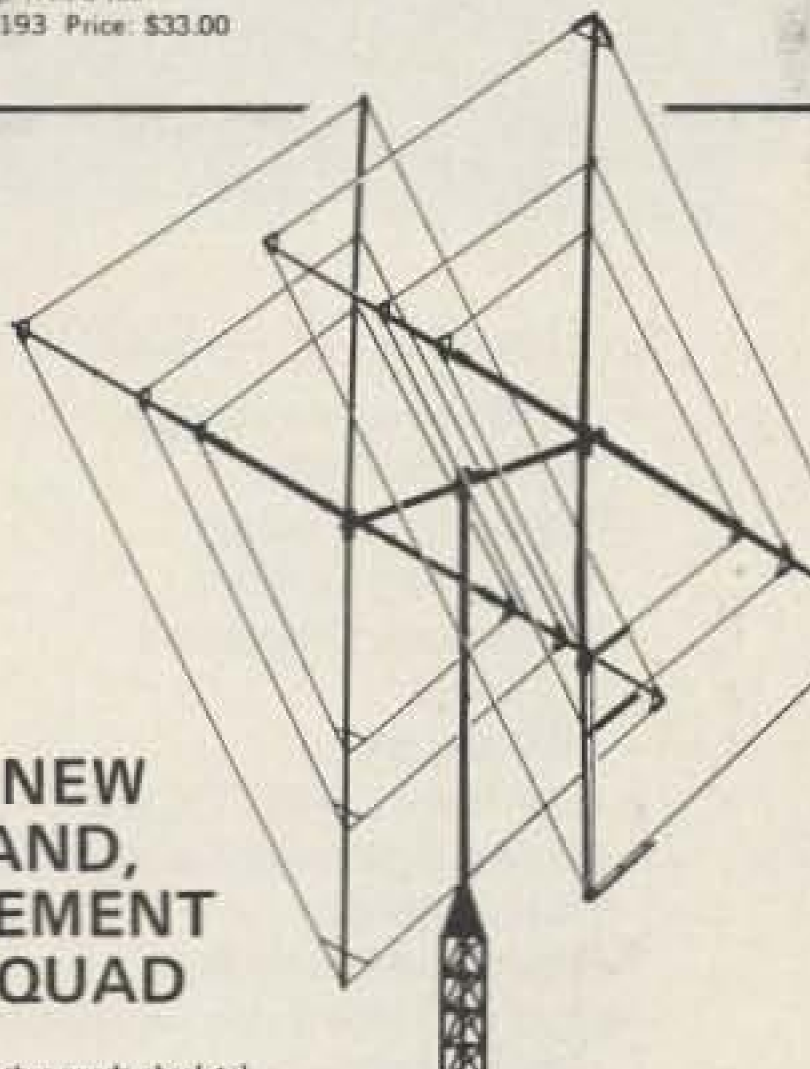
- Automatic switching, five band capability is accomplished through the use of three beefed-up Hy-Q traps (featuring large diameter coils that develop an exceptionally favorable L/C ratio).
- Top loading coil.
- Across-the-band performance with just one furnished setting for each band (10 through 40).
- True 1/4 wave resonance on all bands.
- SWR of 2:1 or less at band edges.
- Radiation pattern has an outstandingly low angle whether roof top or ground mounted.

CONSTRUCTION . . . of extra-heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at slotted tubing joints . . . is so rugged and rigid that, although the antenna is 25' in height, it can be mounted without guy wires, using a 12" double grip mast bracket, with recessed coax connecter.

Order No. 386 Price: $97.00

The Versatile Model 18V for 80 thru 10 Meters

The Model 18V is a low-cost, highly efficient vertical antenna that can be tuned to any band 80 thru 10 meters by a simple adjustment of the feed point on the matching base inductor. Fed with 52 ohm coax, this 18 ft. radiator is amazingly efficient for DX or local contact. Constructed of heavy gauge aluminum tubing, theModel 18V may be installed on a short 1¾ inch mast driven into the ground. It is also adaptable to roof or tower mounting. Highly portable, the Model 18V can be quickly knocked down to an overall length of 5 ft. and easily re-assembled for field days and camping trips. Shpg. Wt., 5 lbs.
Order No. 193 Price: $33.00



ALL NEW 3–BAND, 2 ELEMENT HY–QUAD

- Makes all other quads obsolete!
- Complete – nothing else to buy
- High strength, low wind load

The Hy-Quad from Hy-Gain makes all other quads obsolete! Here's why:
First, it's the only quad that is complete. There is nothing more to shop for or buy.
Secondly, it is uniquely designed so that it overcomes all of the previously undesirable features inherent in quads.
The all aluminum structure stays up! The single feed line and diamond shape simplifies feed line routing.
Hy-Gain's all new Hy-Quad will outdo all other quads because it's engineered to do just that. The Hy-Quad is new, it's superior, it's complete. It's the first quad to have everything: spreaders are broken up at strategic electrical points with Cycolac insulators / tri-band 2 element construction with individually resonated elements with no interaction / Hy-Quad requires only one feed line for all three bands / individually tuned gamma matches on each band with Hy-Gain exclusive vertex feed / full wave element loops require no tuning stubs, traps, loading coils or baluns / heavy duty mechanical construction of strong swaged aluminum tubing and die formed spreader-to-boom clamps / extra heavy duty universal boom-to-mast clamp that tilts and mounts on any mast 1¼" to 2½" in diameter / aluminum stranded wire. You can open and close the bands with this antenna. You'll experience the thrill of real DX.

Order No. 244 Price: $219.95

SPECIFICATIONS

Overall length of spreaders	25'5"	Forward gain	8.5 db
Turning radius	13'6"	Input impedance	52 ohms
Weight	42 lbs.	VSWR	1.2:1 or better at resonance on all bands
Boom diameter	2"		
Boom length	8'	Power	Maximum legal
Mast diameter	1¼" to 2½"		
Wind survival	100 mph	Front-to-back ratio	25-35 db depending upon electrical height
Surface area	6.4 sq. ft.		
Wind load at 100 mph	256.0 lbs.	Polarization	Horizontal

hy-gain

For 10, 15, and 20 Meters New Hy-Gain Model 12 AVQ

Completely self-supporting, the Model 12AVQ features Hy-Q traps...12" double-grip mast bracket...taper swaged seamless aluminum construction with full circumference compression clamps at tubing joints. It delivers outstanding low angle radiation. SWR is 2:1 or less on all bands. Overall height is 13'6". Shipping weight 7.2 lbs. Price: $47.00

Order No. 384

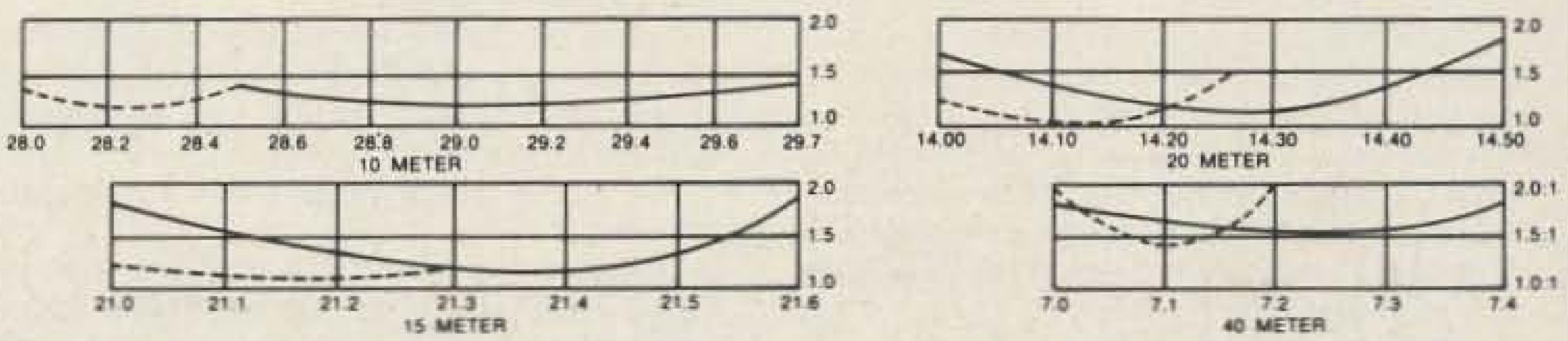
New, improved successor to the world's most popular vertical!
Hy-Gain Model 14 AVQ/WB for 40-10 Meters.

- **Wide band performance with one setting (optimum settings for top performance furnished)**
- **New Hy-Q Traps • New 12" Double-Grip Mast Bracket • Taper Swagged Seamless Aluminum Construction**

The Model 14AVQ/WB, new improved successor to the world famous Model 14AVQ, is a self-supporting, automatic band switching vertical that delivers omni-directional performance on 40 through 10 meters. Three separate Hy-Q traps featuring large diameter coils that develop an exceptionally favorable L/C ratio and a very high Q, provide peak performance by effectively isolating sections of the antenna so that a true 1/4 wave resonance exists on all bands. Outstandingly low angle radiation pattern makes DX and other long haul contacts easy. Superior mechanical features include solid aluminum housing for traps using air dielectric capacitor...heavy gauge taper swaged seamless aluminum radiator...full circumference compression clamps at tubing joints that are resistant to corrosion and wear...and a 12" double-grip mast bracket that insures maximum rigidity whether roof-top or ground mounted. The Model 14AVQ/WB also delivers excellent performance on 80 meters using Hy-Gain Model LC-80Q Loading Coil. Overall height is 18 feet. Shipping weight 9.2 lbs. Unsurpassed portability...outstanding for permanent installations. Price: $67.00

Order No. 385

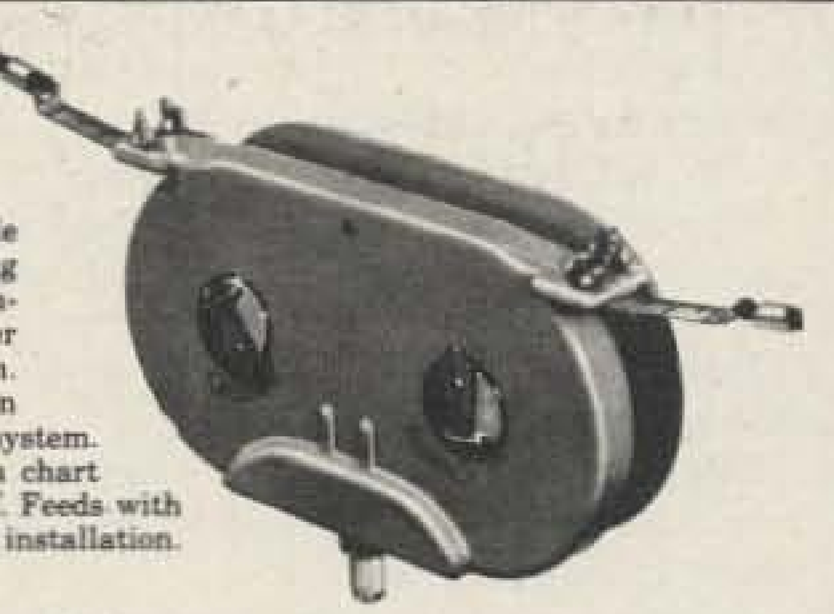
TYPICAL 14AVQ/WB VSWR CURVES



ROOF MOUNTING KIT – Model 14RMQ provides rugged support for Model 14AVQ/WB.
Order No. 184. Price: $28.95

Hy-Gain REEL TAPE PORTABLE DIPOLE for 10 thru 80 Meters Model 18TD

The most portable high performance dipole ever...



The Model 18TD is unquestionably the most foolproof high performance portable doublet antenna system ever developed. It has proven invaluable in providing reliable communications in vital military and commercial-applications throughout the world. Two stainless steel tapes, calibrated in meters, extend from either side of the main housing up to a total distance of 132 feet for 3.5 mc operation. 25 ft. lengths of polypropylene rope attached to each tape permits installation to poles, trees, buildings...whatever is available for forming a doublet antenna system. Integrated in the high impact housing is a frequency to length conversion chart calibrated to meter measurements on the tapes...makes installation foolproof. Feeds with 52 ohm coax. Delivers outstanding performance as a portable or permanent installation. Measures 10x5½x2 inches retracted. Wt., 4.1 lbs.
Order No. 228 Price: $94.95

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.

Pipo Communications TROUBLE FREE TOUCH-TONE ENCODER

PP-1

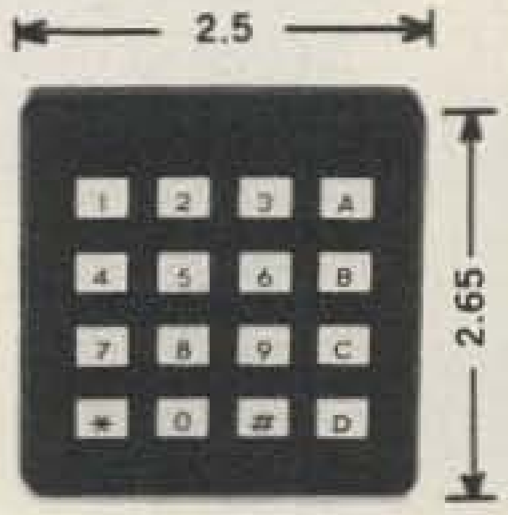
POSITIVE TOUCH (KEYS DEPRESS) • MOBILE • HANDHELD
DESK MOUNT • NO POTTED PARTS (SERVICEABLE)
MIL. SPEC. COMPONENTS • NO RFI • SELF CONTAINED
XTAL CONTROLLED • LEVEL ADJUSTABLE FROM FRONT
Pat. Pend.

M series is for mounting to surfaces inaccessable from the rear; walls - mobiles - systems interface - panels - test equipment, etc.

K series is self contained with a relay inside the encoder. When Keys are pressed contact closer occurs with a 2 sec. delay, (adjustable). Contacts are rated at 110ma @ 28 Volts switched, 500ma carry. PP-2K contains delay exclusion for the forth column. However, by jumpering D-5, 4th column delay is restored.

Pipo Communications has developed a trouble free reliable instrument to be free of any defects for years. Unit is constructed with the best components available, without compromise in quality. Unit is operable from 4.5 - 60 Volts at temperatures from below 0 to + 140°F. Output level will drive any transmitter or system. Adjustable output level is controlled with an extremely stable multiturn trimpot, with access from the front of the encoder (not behind), saving time for level setting, which amounts to hours when involved with a system.

PP-1	$55	12 Keys	PP-2	$58	16 Keys	PP-1A	$68 For Standard Comm. Hand Held
PP-1m	$55	Lettering Optional	PP-2m	$58	Lettering Optional		
PP-1K	$66	Add $1.00	PP-2K	$69	Add $1.00		



PP-2

TUFTS RADIO CATALOG TUFTS RADIO

-C – LINE AMATEUR EQUIPMENT DRAKE — COMMUNICATIONS RECEIVERS–

Drake R-4C

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. In addition to the ham bands, tunes any fifteen 500 kHz ranges between 1.5 and 30 MHz, 5.0 to 6.0 MHz not recommended. Can be used for MARS, WWV, CB, Marine and Shortwave broadcasts.

Superior selectivity: 2.4 kHz 8-pole filter provided in ssb positions. 8.0 kHz, 6 pole selectivity for a-m. Optional 8-pole filters of .25, .5, 1.5 and 6.0 kHz bandwidths available.

Tunable notch filter attenuates carriers within passband.

Smooth and precise passband tuning.

Transceive capability; may be used to transceive with the T-4X, T-4XB or T-4XC Transmitters. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Agc with fast attack and two release times for ssb and a-m or fast release for break-in cw. Agc also may be switched off.

New high efficiency accessory noise blanker that operates in all modes.

Crystal lattice filter in first i-f prevents cross-modulation and desensitization due to strong adjacent channel signals.

Excellent overload and intermodulation characteristics.

25 kHz Calibrator permits working closer to band edges and segments.

Scratch resistant epoxy paint finish.

Price: $699.00

Drake T-4XC

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. Four 500 kHz ranges in addition to the ham bands plus one fixed-frequency range can be switch-selected from the front panel.

Two 8-pole crystal lattice filters for sideband selection.

Transceives with the R-4, R-4A, R-4B, R-4C and SPR-4 Receivers. Switch on the T-4XC selects frequency control by receiver or transmitter PTO or independently. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Controlled-carrier modulation for a-m is compatible with ssb linear amplifiers.

Automatic transmit-receive switching. Separate VOX time-delay adjustments for phone and cw. VOX gain is independent of microphone gain.

Choice of VOX or PTT. VOX can be disabled by front panel switch.

Adjustable pi network output.

Transmitting agc prevents flat-topping.

Meter reads relative output or plate current with switch on load control.

Built-in cw sidetone.

Spotting function for easy zero-beating.

Easily adaptable to RTTY, either fsk or afsk.

Compact size; rugged construction. Scratch resistant epoxy paint finish.

Price: $699.00

Drake SPR-4 – $699.00

- **Programmable to meet specific requirements: SWL, Amateur, Laboratory, Broadcast, Marine Radio, etc.**
- **Direct frequency dialing: 150-500 kHz plus any 23 500 kHz ranges, 0.5 to 30 MHz**
- **FET circuitry, all solid state**
- **Linear dial, 1 kHz readout**
- **Band-widths for cw, ssb, a-m with built-in LC filter**
- **Crystals supplied for LW, seven SW, and bc bands**
- **Notch filter**
- **Built-in speaker**

Drake DSR-2 – $3200.00

- **Continuous Coverage 10 kHz to 30 MHz**
- **Digital Synthesizer Frequency Control**
- **Frequency Displayed to 100 Hz**
- **All Solid State**
- **A-m, Ssb, Cw, RTTY, lsb**
- **Series Balanced Gate Noise Blanker**
- **Front End Protection**
- **Optional Features Available on Special Order**

Power Supplies

Power Supplies for T-4, T-4X, T-4XB or T-4XC (The AC-4 can be housed in an MS-4 speaker cabinet).

Model No. 1501 Drake AC-4 $120.00
Model No. 1505 Drake DC-4 $135.00

Drake MS-4

Drake MS-4 Matching Speaker for use with R-4, R-4A, R-4B and R-4C Receivers. (Has space to house AC-3 and AC-4 Power Supplies)

Price: $33.00

Accessories

DRAKE MICROPHONES

Wired for use with Drake transmitters and transceivers, for either push-to-talk or VOX. Type of operation is determined by the VOX control setting of the transmitter.

Desk Type Model No. 7075

• **Type:** Heavy Duty Ceramic Desk Top • **Cable:** Four Foot, 3-Conductor, One Shield • **Output Level:** Minus 54 dB (0 dB = 1 volt/microbar) • **Frequency Response:** 80-7000 Hz • **Switching:** Adapts to either push-to-talk or VOX. **Price: $39.00**

Hand-Held Type Model No. 7072

• **Type:** Ceramic, hand held • **Cable:** 11" Retracted, 5' extended, PVC 3 Cord, 1 shielded, Coil Cord • **Case:** Cycolac • **Finish:** Grey • **Output Level:** Minus 65 dB (0 dB = 1 volt/microbar) • **Frequency Response:** 300-3000 Hz • **Switching:** Adapts to either push-to-talk or VOX.

Price: $19.00

Drake FS-4 Digital Synthesizer – $300.00

The new solid state Drake FS-4 Synthesizer opens the door to a new world of continuous-tuning short wave! Combines synthesized general coverage flexibility with the selectivity, stability, frequency readout and reliability of the Drake R-4C or SPR-4 Receivers.

• Interfaces with all R-4 series receivers and T-4X series transmitters: (R-4, R-4A, R-4B, R-4C, SPR-4, T-4, T-4X, T-4XB and T-4XC), without modification. • MHz range is set on FS-4, with kHz readout taken from receiver dial. • Complete general coverage—no range crystals to buy. • T-4/T-4X series transmitters transceive on any FS-4 frequency, when used with R-4 series receivers. • Readout 1 kHz with Drake PTO.

Price: $250.00

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.

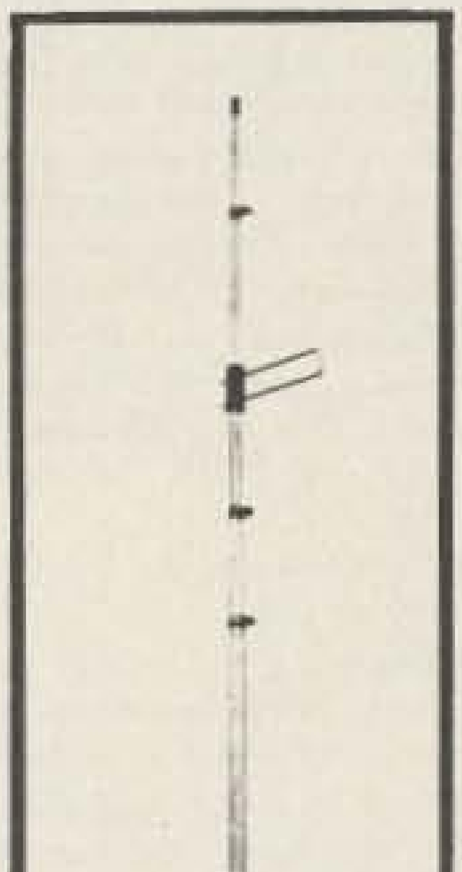
Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable 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.

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

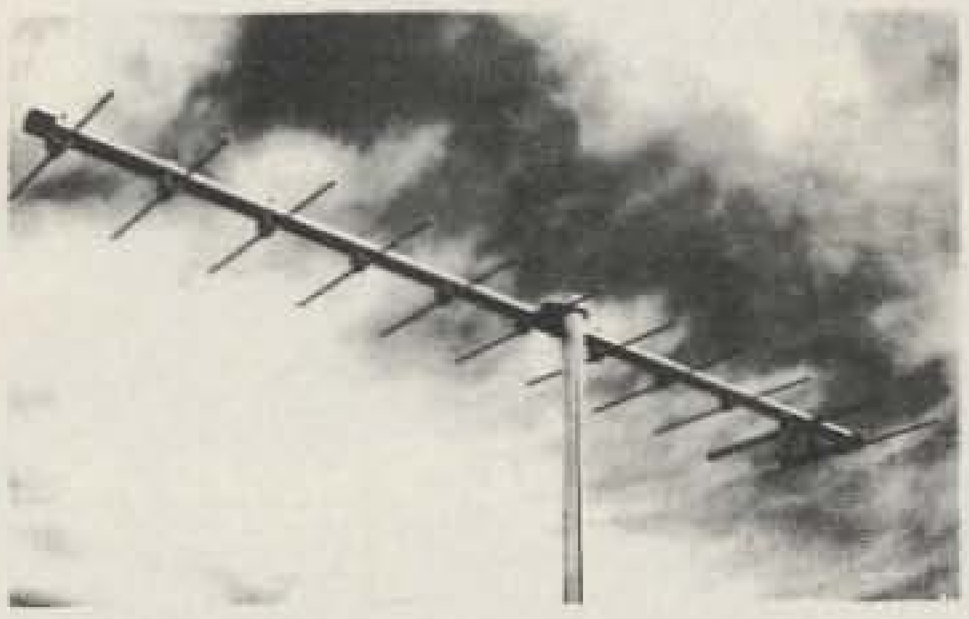
E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

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



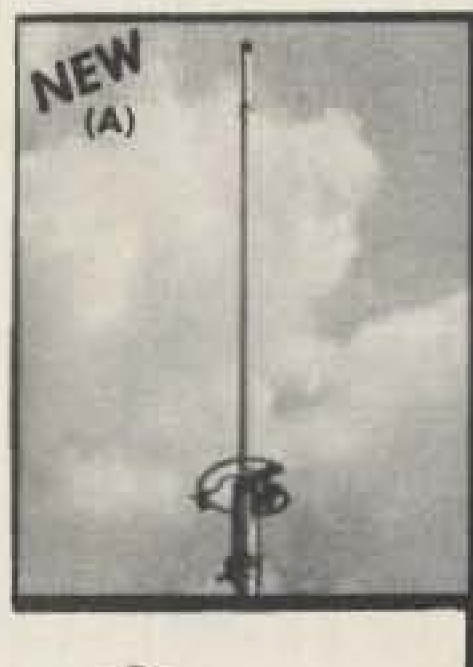
3/4, 1-1/4, 2 METER BEAMS

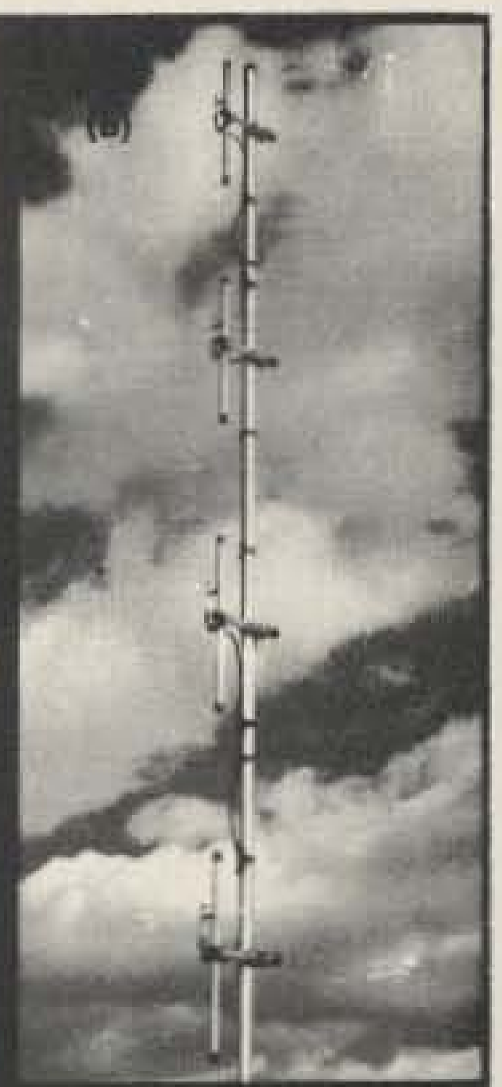
The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

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.

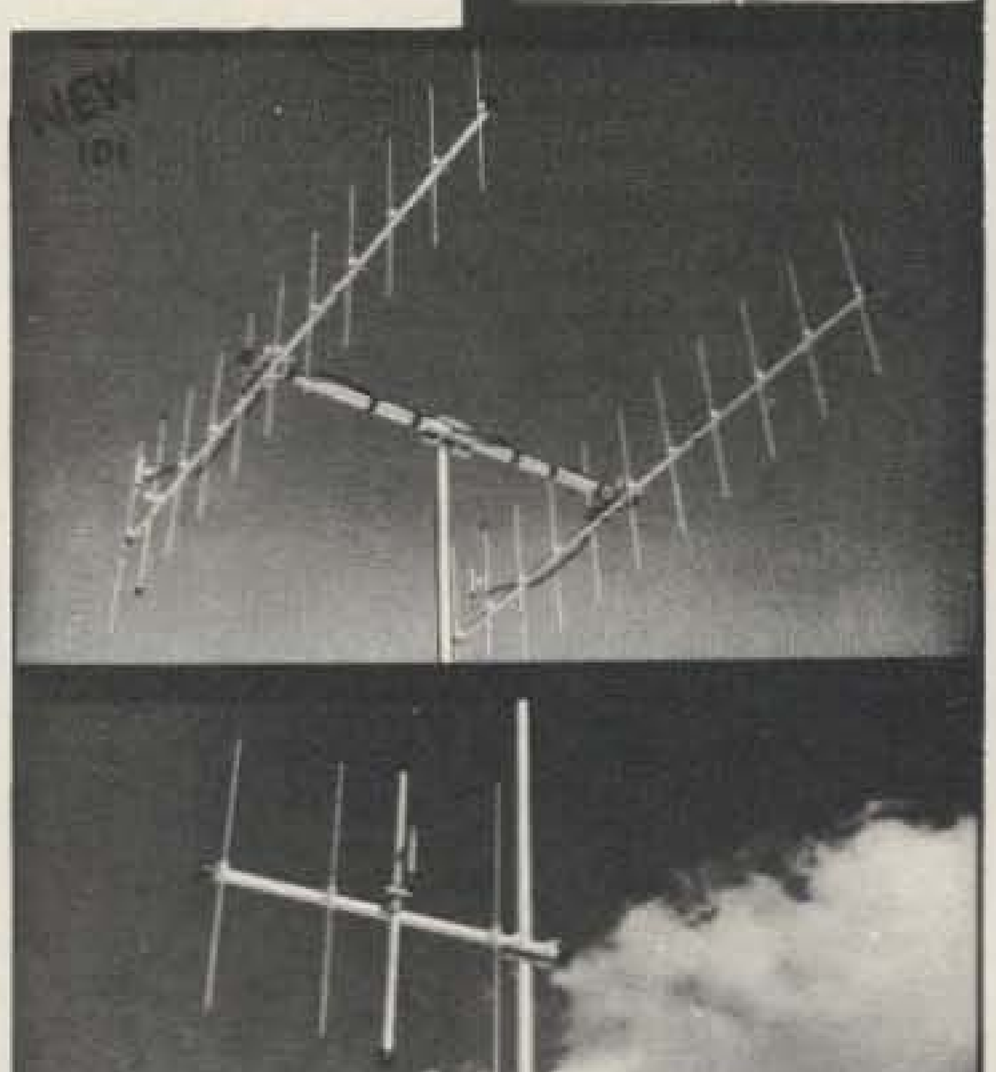
New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

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

Description:	144 MHz. Model:	Price:	220 MHz. Model:	Price:	432 MHz. 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

why waste watts?

(SWR-1A $25.95)

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.

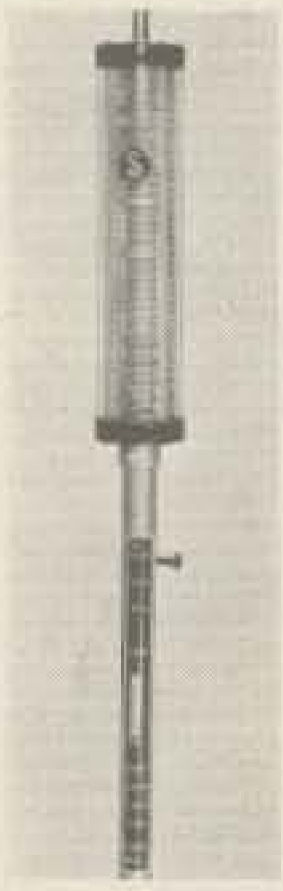
Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

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.

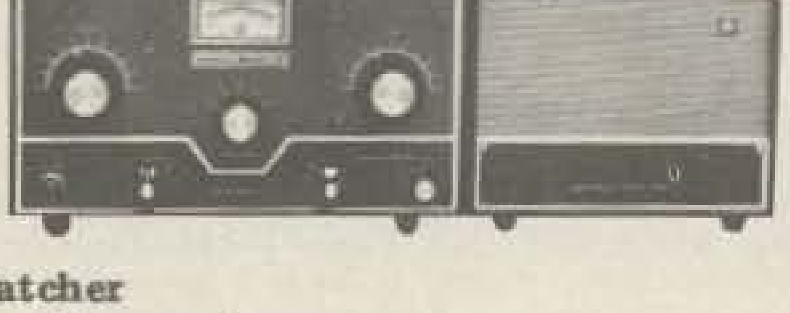
WM2000 In-Line Wattmeter With Muscle. Scales to 2000 watts. New flat-response directional coupler for maximum accuracy. $59.95

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. $79.95

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. $849.95



NEW Swan MMBX Mobile Impedance Matcher

It keeps your transmitter and your speaking terms for a song. Price: $23.9

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. $349.95

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

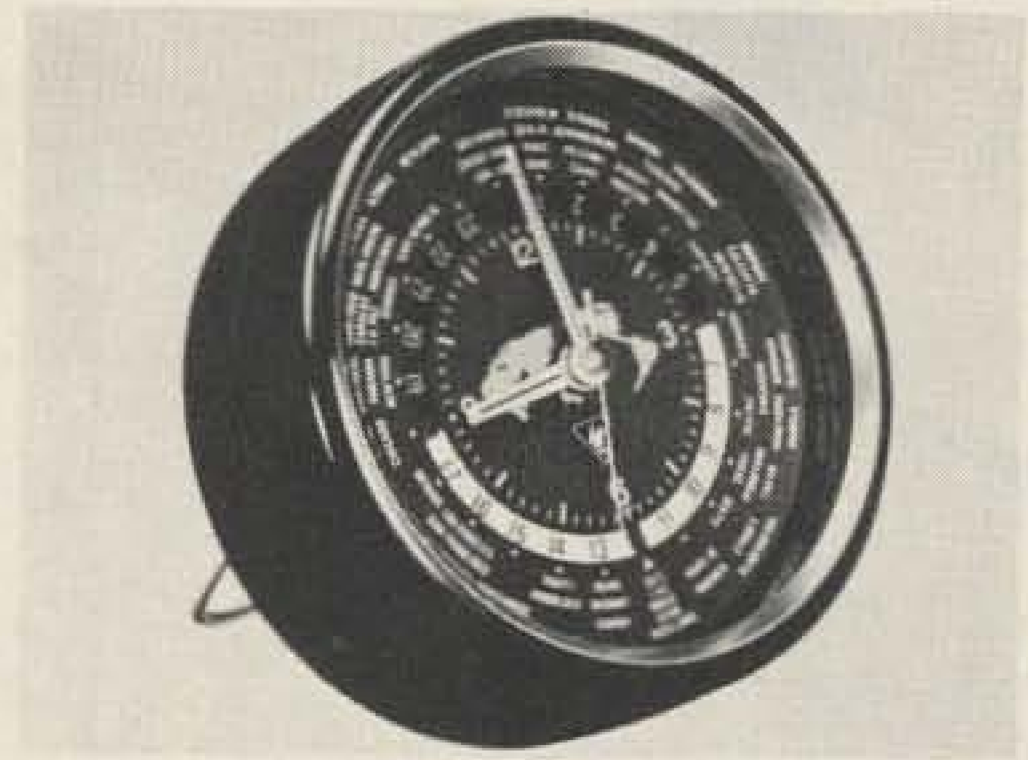
Earphone impedance and type:	8 ohms, dynamic
Microphone type:	Electret capacitor
Microphone frequency response:	200–6000 Hz
Amplifier type:	FET transistor, variable gain
Amplifier battery power:	7-volt Mallory TR-175
Switching:	Relay or electronic

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 •

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.



NYE VIKING CODE PRACTICE SET

No. 114-404-002

Get the RIGHT START!

With a NYE VIKING Code Practice Set you get a sure, smooth, Speed-X model 310-001 transmitting key, a 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). Units can be connected in parallel so that two or more operators can practice sending and receiving to each other. List price, $18.50.

MORGAIN

Manufactured & Guaranteed by
MOR-GAIN
2200T South 4th Street
Leavenworth, Kansas 66048
(913) 682-3142

Fully Air Tested – Thousands Already in Use

#16 40% Copper Weld wire annealed to it handles like soft Copper wire – Rated for better than full legal power AM/CW or SSB-Coaxial or Balanced 50 to 75 ohm feedline – VSWR under 1.5 to 1 at most heights – Stainless Steel hardware – Drop Proof Insulators – Terrific Performance – No coils or traps to break down or change under weather conditions – Completely Assembled ready to put up – Guaranteed 1 year – ONE DESIGN DOES IT ALL.

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/.73	36/10.9
40-10 HD	40/20/15/10	59.50	36/1.01	36/10.9
80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

NO TRAPS – NO COILS – NO STUBS – NO CAPACITORS

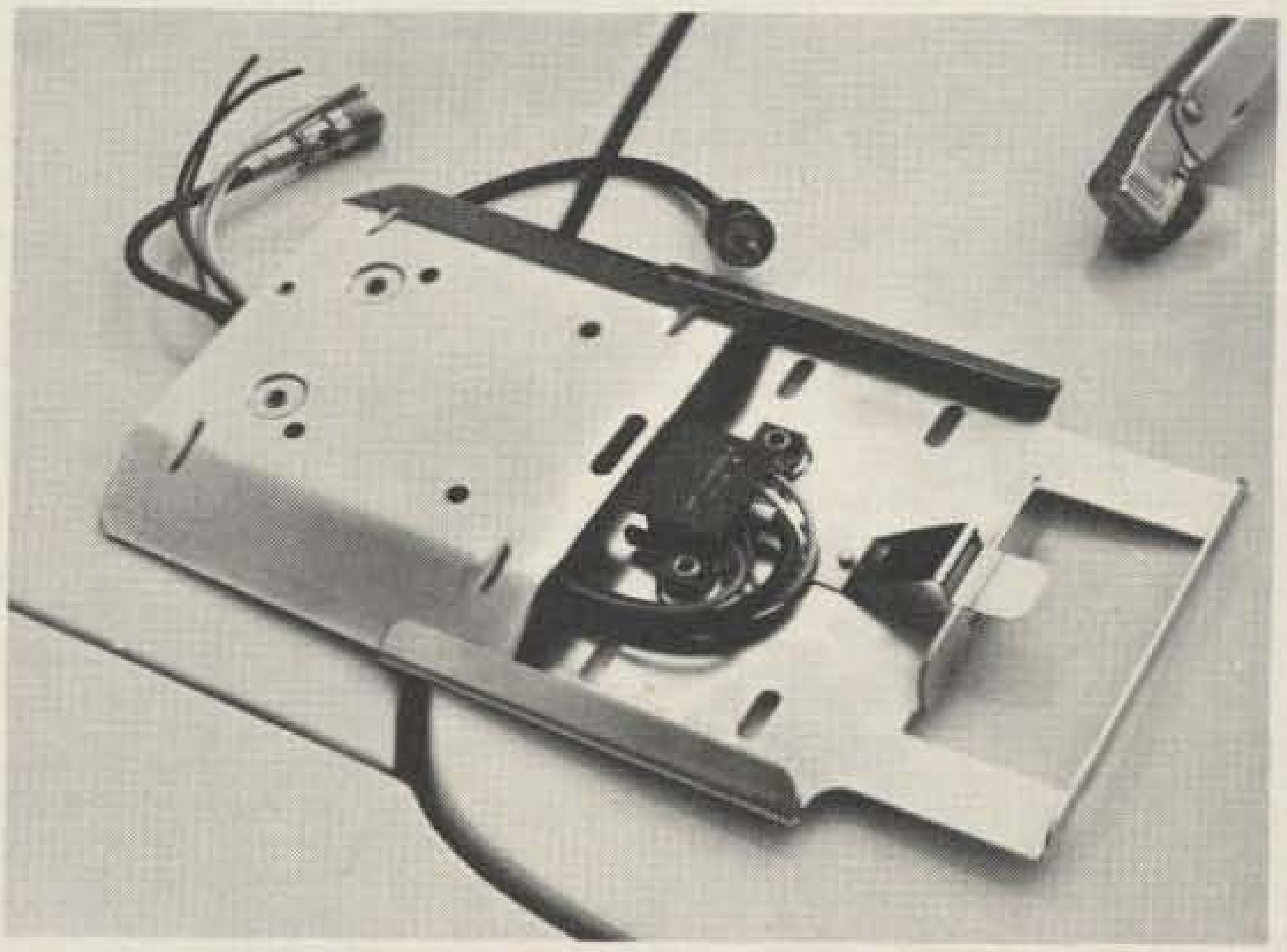
MOR-GAIN HD DIPOLES . . . • One half the length of conventional half-wave dipoles. • Multi-band, Multi-frequency. • Maximum efficiency – no traps, loading coils, or stubs. • Fully assembled and pre-tuned – no measuring, no cutting. • All weather rated – 1 KW AM, 2.5 KW CW or PEP SSB. • Proven performance – more than 15,000 have been delivered. • Permit use of the full capabilities of today's 5-band xcvrs. • One feedline for operation on all bands. • Lowest cost/benefit antenna on the market today. • Fast QSY – no feedline switching. • Highest performance for the Novice as well as the Extra-Class Op.

EXCLUSIVE 66 FOOT, 75 THRU 10 METER DIPOLES

NOTES

- All models above are furnished with crimp/solder lugs.
- All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
- 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3650 kHz. See VSWR curves for other resonance data.

STOP A THIEF! SAVE YOUR RADIO!



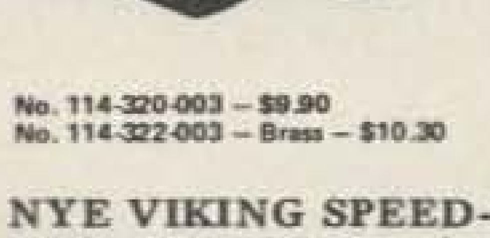
DESIGNED FOR COMMERCIAL USE UP TO 1000 MHZ.

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.

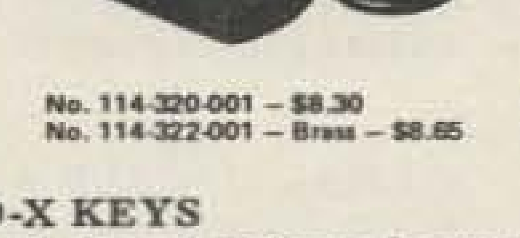
The connector system has a special coaxial cable connector which will provide you with a lossless connection right up to 1000 MHz! No loss! In addition to the quick coax connector there are also four power and accessory connections which are made automatically when the rig is slid into its bracket . . . 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



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

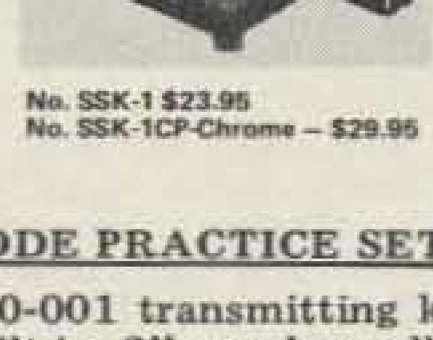
No. 114-310-003 – $8.25
No. 114-312-003 – Brass – $8.65

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.

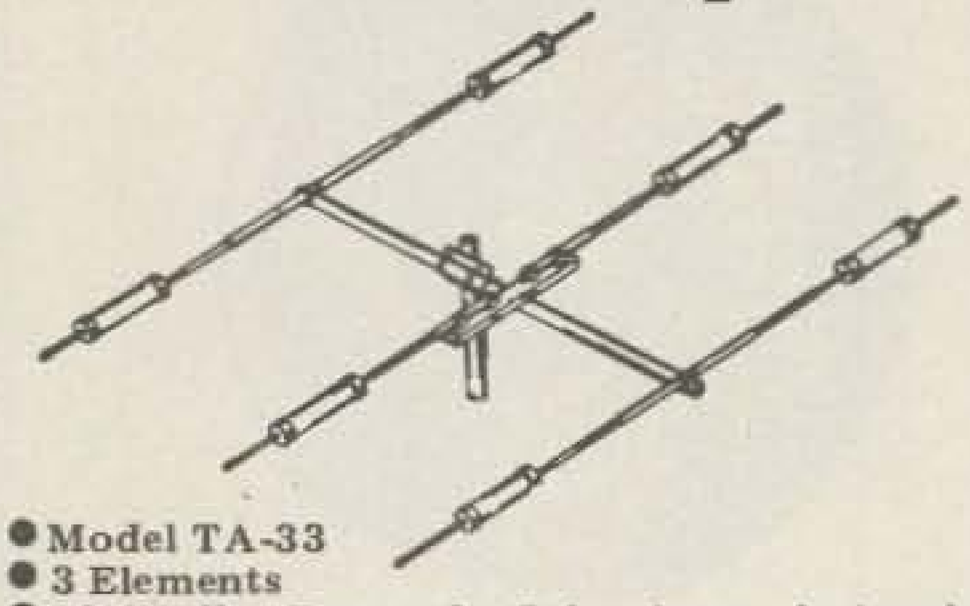
CODE PRACTICE SET

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 CATALOG TUFTS RADIO

Mosley



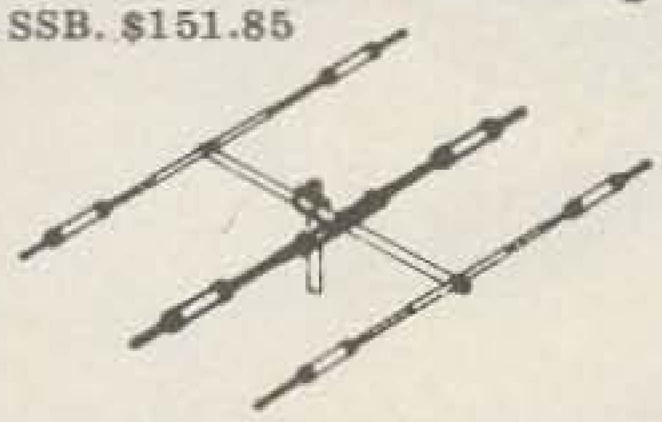
- Model TA-33
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

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

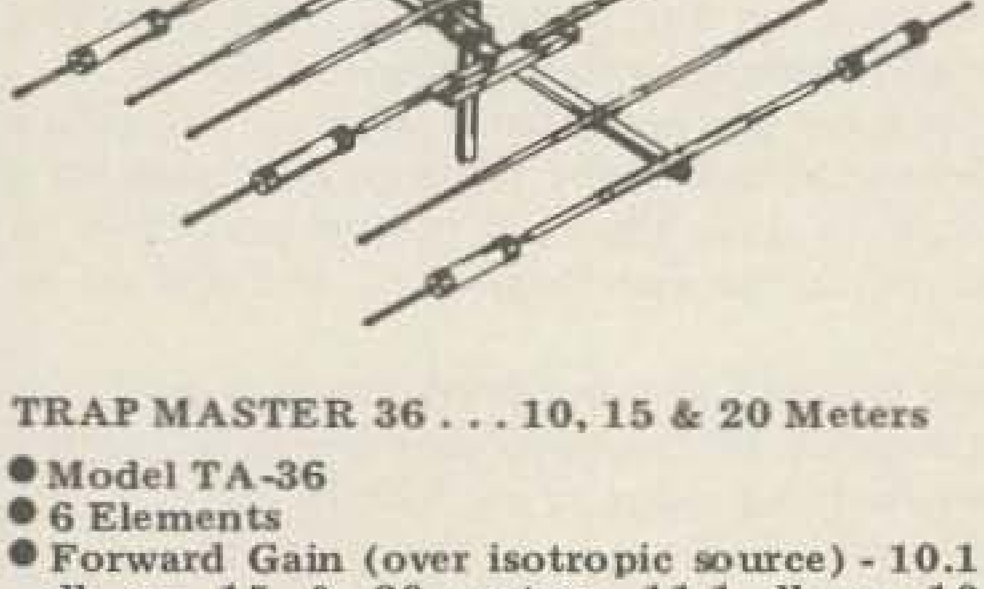
- Model TA-33Jr.
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

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

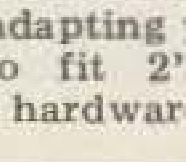
Owners of the Mosley Trap-Master TA-33Jr. may obtain higher power without buying an entirely new antenna. The addition of the MPK-3 (power conversion kit) converts the TA-33Jr. into essentially a new antenna with 750 watts AM/CW and 2000 watts P.E.P. SSB. $52.25



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

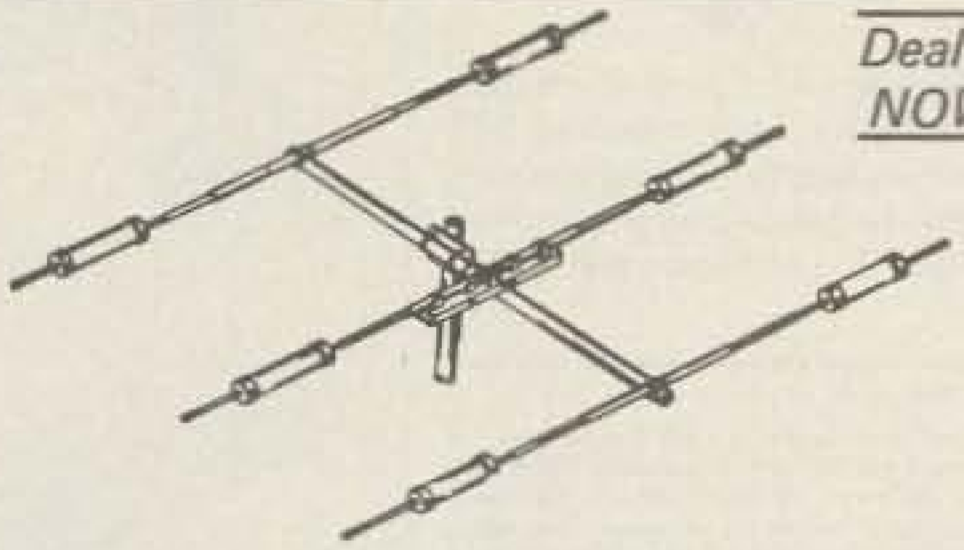
★ Synthesizer and VFO.
★ All modes: NBFM, WBFM, AM, SSB w/USB/LSB and CW.
- Frequency synthesizer (PLL) 3 Knob, 600 channels, 10 kHz steps.
- VXO, plus or minus 7 kHz.

★ 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).

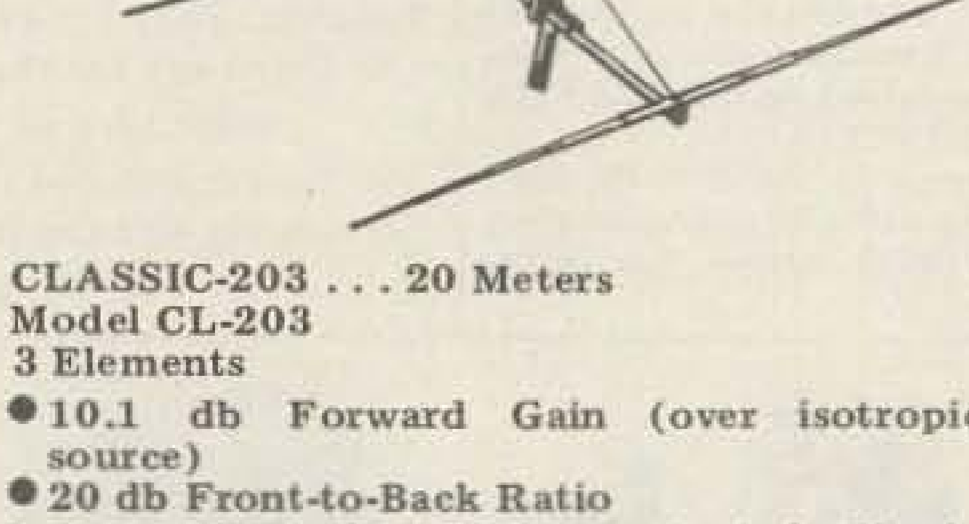
Dealer Programs NOW Available



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.

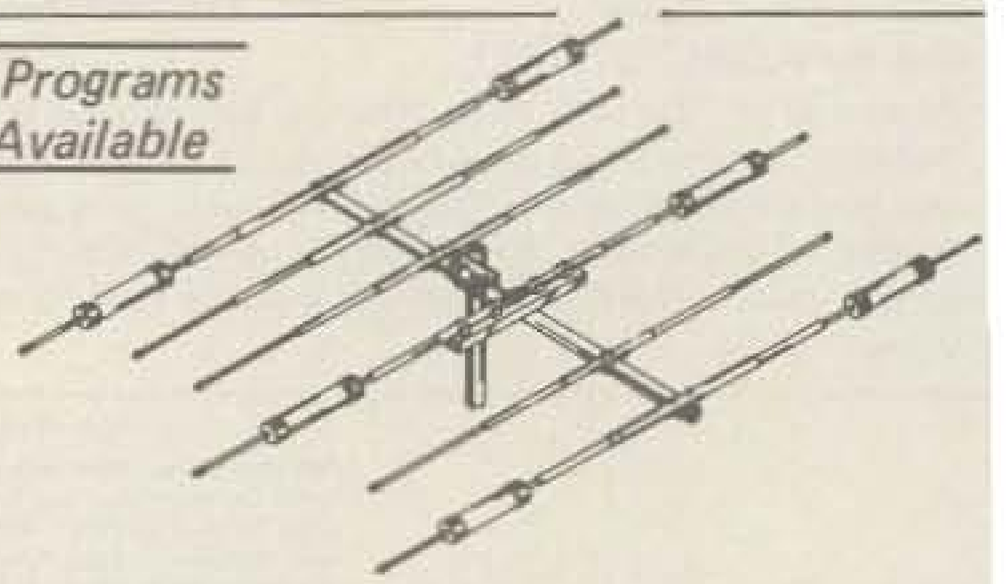
BRIDGING THE GAP . . . The Classic 33, combines the best of two Mosley systems. Incorporating Mosley Classic Feed System for a "Balanced Capacitive Matching" system with a feed point impedance of 52 ohms at resonance, and the Famous Mosley Trap-Master Traps for "weather-proof" traps with resonant frequency 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

- *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, 14⅜"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	(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)

DRAKE

- Synthesized • General Coverage
- Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands
- Excellent Performance

SSR-1 COMMUNICATIONS RECEIVER

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

TR-4CW SIDEBAND TRANSCEIVER

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.

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

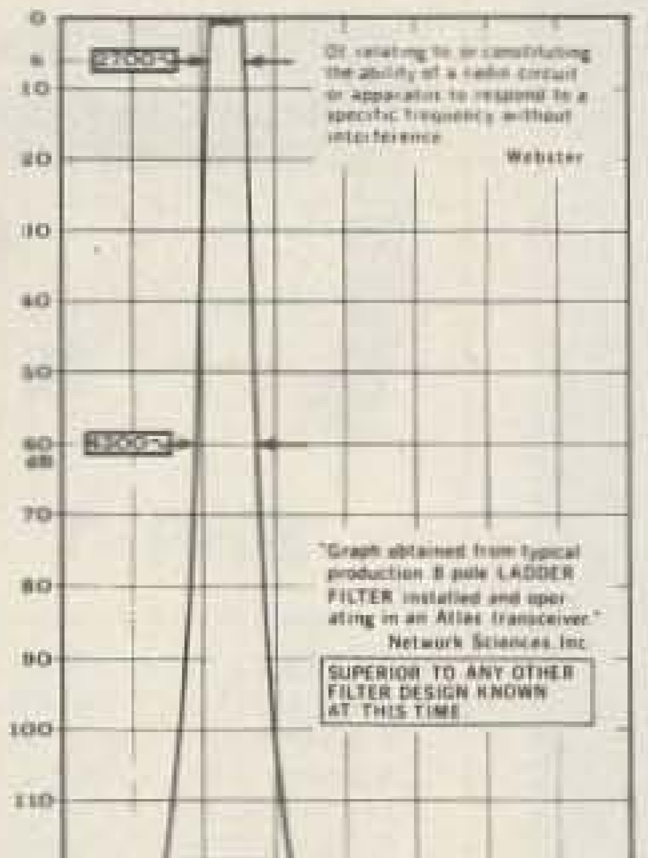
Push Button Encoding Mike

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.

For all you hams with little cars ...

We've got the perfect mobile rig for you.



The Atlas 210x or 215x measures only 9½" wide x 9½" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

200 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

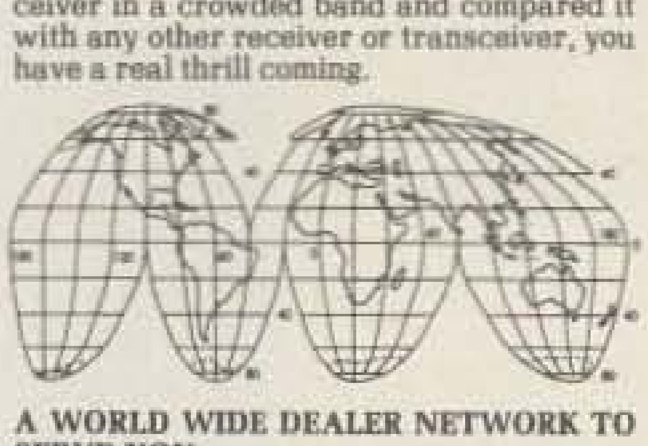
NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.

PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.



A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

Atlas 210x or 215x	$675.00
W/Noise Blanker	719.00
ACCESSORIES:	
AC Console 110/220 V	$147.00
Portable AC supply 110/220 V	100.00
Plug-in Mobile Kit	48.00
10x Osc. less crystals	59.00
Digital Dial DD-6B	229.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS RADIO INC.

HUSTLER®

"the home of originals"

AMATEUR ANTENNAS

STANDARD GAIN MOBILES

Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL BBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $33.75

MODEL BBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ¾" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $31.65

HUSTLER "BUCK-BUSTER"

MODEL SF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included).
Price: $9.00

DELUXE MOBILE MOUNTS

For medium length, light weight antennas with ⅜" — 24 base.

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached.
Price: $14.85

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. Price: $17.20

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. Price: $9.00

MODEL MM-1
Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors.
Price: $7.50

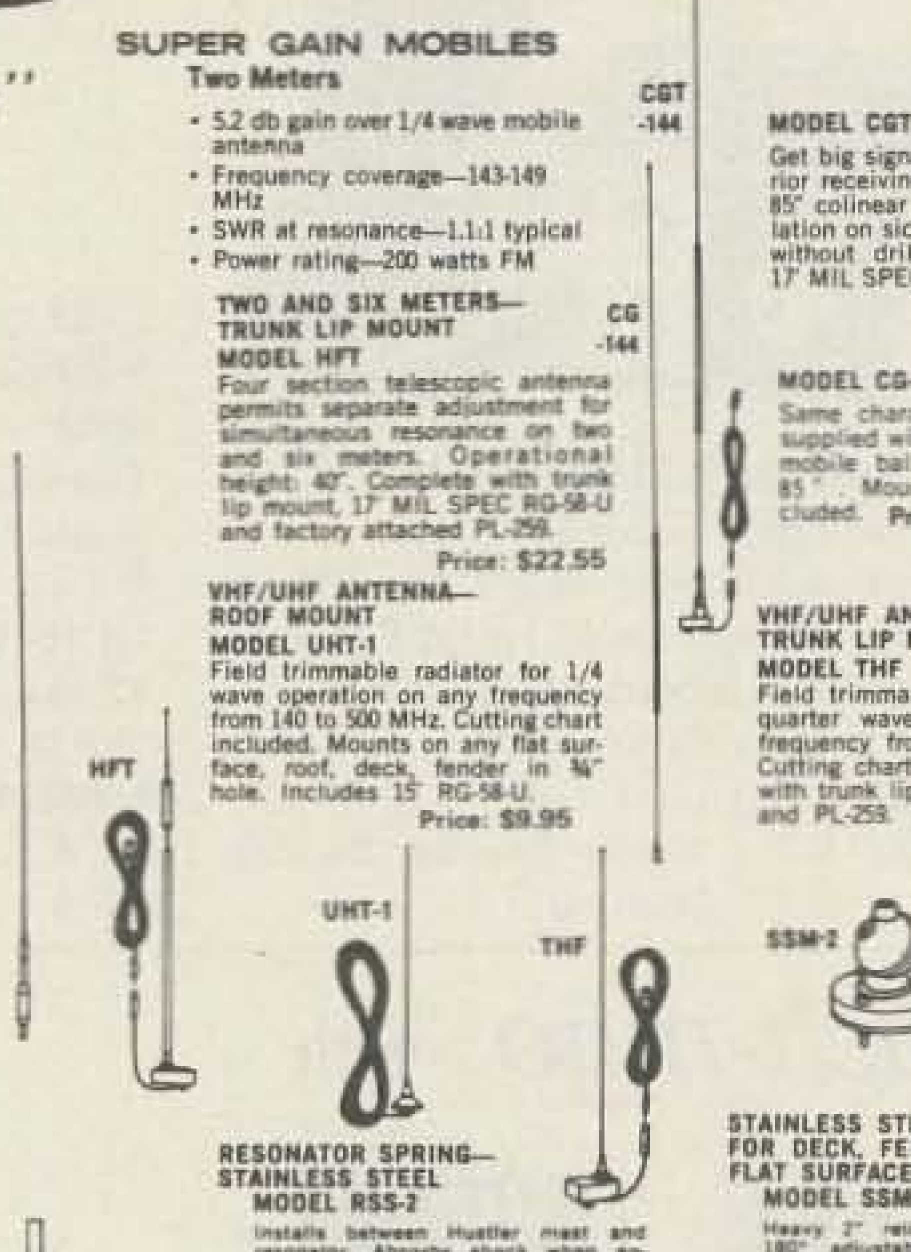
MODEL TGM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. Price: $8.00

MODEL C-32
Ball mount complete with mounting hardware.
Price: $8.20

SUPER GAIN MOBILES

Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM



TWO AND SIX METERS— TRUNK LIP MOUNT
MODEL HFT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259.
Price: $22.55

VHF/UHF ANTENNA— ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ¾" hole. Includes 15' RG-58-U.
Price: $9.95

RESONATOR SPRING— STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation .... $ 5.95

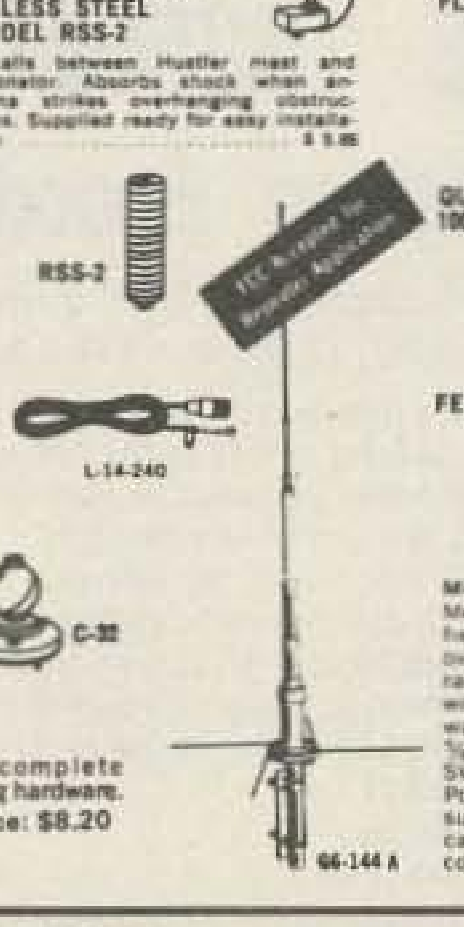
MODEL CGT-144
Get big signal performance, superior receiving capability with this 85" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259.
Price: $41.30

MODEL CG-144
Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included. Price: $25.50

VHF/UHF ANTENNA— TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. Price: $16.55

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL SSM-2
Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cycolac base, steel back-up plate and mounting hardware.
Price: $19.20

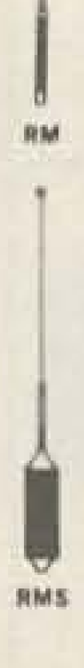
QUICK DISCONNECT— 100% STAINLESS STEEL
MODEL QD-1
Remove antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. ⅜"-24 threads—female one end, male the other.
Price: $16.95



FEED LINE MODEL L-14-240
Get known performance, maximum shielding for minimum noise pick-up in this MIL SPEC 20' length of RG-58-U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver.
Price: $6.55

MODEL G6-144A — Deluxe, Two-Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ⅝ wave lower section, ¼ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1¼" O.D. SO-239 coax connector. Price: $67.55

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.



STANDARD HUSTLER RESONATORS

Power Rating: 400 Watts SSB

Model	Band	Price
RM-10	10 meters	$ 6.50
RM-15	15 meters	6.95
RM-20	20 meters	7.30
RM-40	40 meters	13.20
RM-75	75 meters	15.50
RM-80	80 meters	15.95

SUPER HUSTLER RESONATORS

Power Rating: Legal Limit SSB
Supers have widest bandwidth

Model	Band	Price
RM-10S	10 meters	$11.30
RM-15S	15 meters	12.65
RM-20S	20 meters	13.00
RM-40S	40 meters	15.50
RM-75S	75 meters	30.00
RM-80S	80 meters	30.40

For 6-10-15-20-40-75-80 Meters

HUSTLER MASTS

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

The Majority Choice of Amateurs Throughout the World!

MODEL MO-2
For bumper mounting—Fold is at roof line 27" above base. Price: $22.00

MODEL MO-1
For deck or fender mounting—Fold is at roof line 15" above base. Price: $22.00

Covers 10 - 15 - 20 - 40 Meters
Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-BTV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers "Spritz" extruded to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss — high strength insulators. Mounting hardware included.
- All sections 1¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5"
MODEL 4-BTV

Weight: 15 lbs.
Price: $99.95

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**

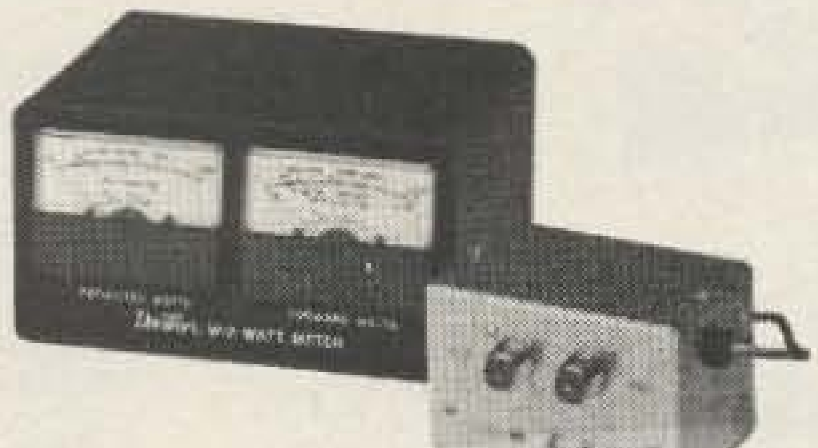
The 80-10 Skymatcher

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

Read forward and reflected watts at the same time



Tired of constant switching and guesswork?

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter.

$99.50

The Sky Openers

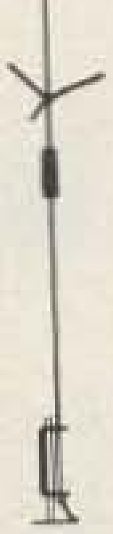
SKYMASTER

A fully developed and tested 27 foot vertical antenna covers entire 10, 15, 20, and 40 meter bands using only one cleverly applied wave trap. A full 1/4 wave antenna on 20 meters. Constructed of heavy seamless aluminum with a factory tuned and sealed HQ Trap, SKYMASTER is weatherproof and withstands winds up to 80 mph. Handles 2 KW power level and is for ground, roof or tower mounting. Radials included in our low price of

$84.50

Also 80 m resonator for top mounting on SKYMASTER.

$29.50



SKYCLAW

A tunable monoband high performance vertical antenna, designed for 40, 80, 160 meter operation. SKYCLAW gives you the following spectrum coverage:

BAND (Meters)	BANDWIDTH (kHz)
160	50
80	200
40	entire band

Tuning is easy and reliable. Rugged construction assures that this self-supporting unit is weatherproof and survives nicely in 100 mph winds.. Handles full legal power limit.

$79.50

EX-1

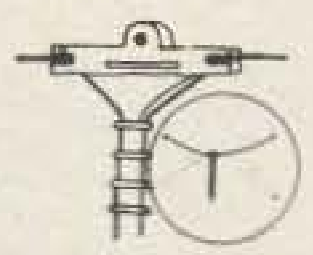
The DenTron EX-1 Vertical Antenna is designed for the performance minded antenna experimenter. The EX-1 is a full 40 meter, ¼ wave, 33', self-supporting vertical. The EX-1 is the ideal vertical for phasing.

$59.50

TRIM-TENNA

The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantsatic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

$129.50



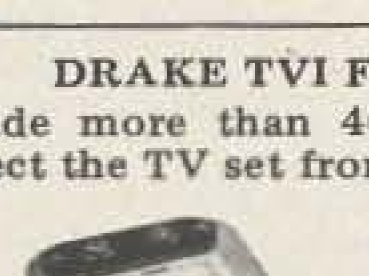
ALL BAND DOUBLET

This All Band Doublet or inverted Type Antenna covers 160 thru 10 meters. Has total length of 130 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 450 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

$24.50

DenTron

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.

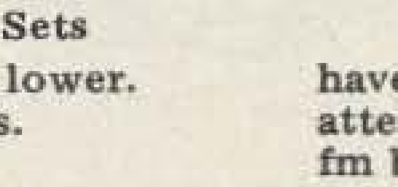


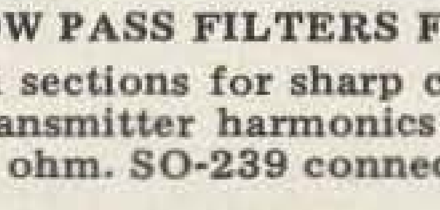
Drake TV-300-HP
Model No. 1603
For 300 ohm twin lead
Price: $10.60

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

TUFTS RADIO CATALOG TUFTS RADIO

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

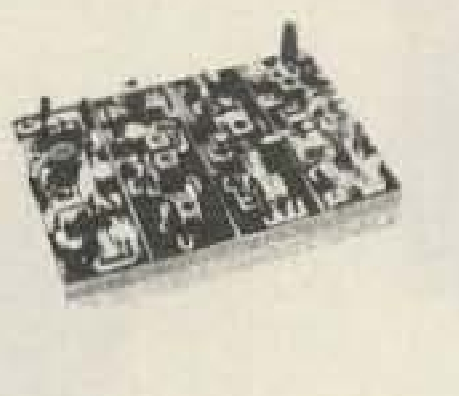
WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

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!

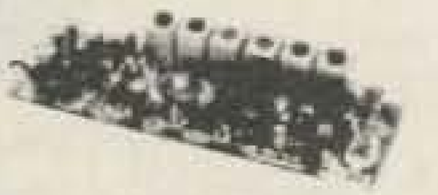
RECEIVERS



RX28C . . . . . 28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter . . . . $ 59.95
RX28C W/T . . same as above–wired & tested . . 104.95
RX50C Kit . . 30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter 59.95
RX50C W/T . same as above–wired & tested . . 104.95
RX144C Kit . 140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter 69.95
RX144C W/T . same as above–wired & tested . . 114.95
RX220C Kit. . 210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter 69.95
RX220C W/T . same as above–wired & tested . . 114.95
RX432C Kit. . 432 MHz rcvr w/2 pole 10.7 MHz crystal filter 79.95
RX432C W/T . same as above–wired & tested . . 124.95

RXCF . . . . . accessory filter for above receiver kits gives 70 dB adjacent channel rejection 8.50
RF28 Kit . . . 10 mtr RF front end 10.7 MHz out 12.50
RF50 Kit . . . 6 mtr RF front end 10.7 MHz out 12.50
RF144D Kit. . 2 mtr RF front end 10.7 MHz out 17.50
RF220D Kit. . 220 MHz RF front end 10.7 MHz out 17.50
RF432 Kit. . . 432 MHz RF front end 10.7 MHz out 27.50
IF 10.7F Kit . 10.7 MHz IF module includes 2 pole crystal filter 27.50
FM455 Kit. . . 455 KHz IF stage plus FM detector 17.50
AS2 Kit . . . . audio and squelch board 15.00

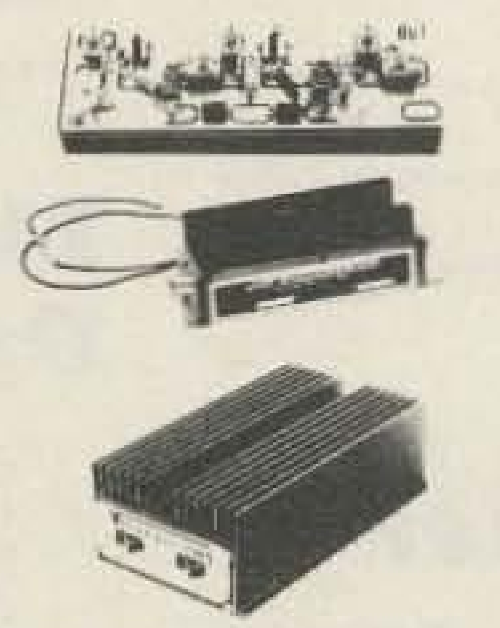
TRANSMITTERS



TX50 . . . . . transmitter exciter, 1 watt, 6 mtr. 39.95
TX50 W/T. . . same as above–wired & tested . . 59.95
TX144B Kit . . transmitter exciter–1 watt–2 mtrs 29.95
TX144B W/T . same as above–wired & tested. . . 49.95
TX220B Kit . . transmitter exciter–1watt–220 MHz 29.95

TX220B W/T . same as above–wired & tested . . 49.95
TX432B Kit . . transmitter exciter 432 MHz . . . 39.95
TX432B W/T . same as above–wired & tested . . 59.95
TX150 Kit . . . 300 milliwatt, 2 mtr transmitter . 19.95
TX150 W/T . . same as above–wired & tested . . 29.95

POWER AMPLIFIERS

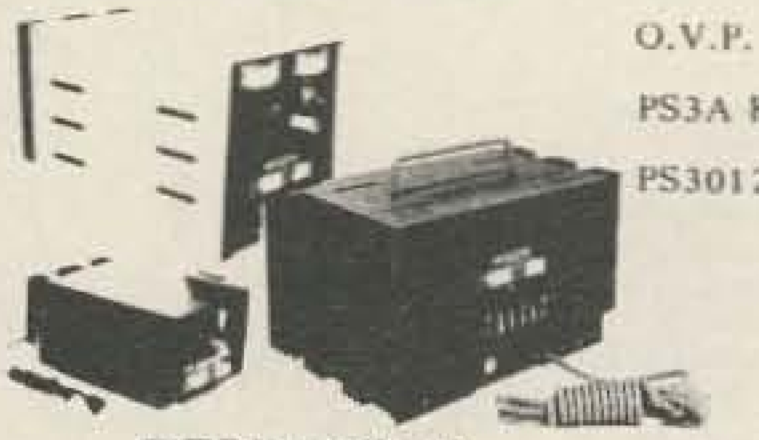


PA2501H Kit . 2 mtr power amp–kit 1w in–25w out with solid state switching, case, connectors 59.95
PA2501H W/T. same as above–wired & tested . . 74.95
PA4010H Kit . 2 mtr power amp–10w in–40w out–relay switching 59.95
PA4010H W/T. same as above–wired & tested . . 74.95
PA50/25 Kit . 6 mtr power amp, 1w in, 25w out, less case, connectors & switching . 49.95
PA50/25 W/T . same as above, wired & tested. . . 69.95
PA144/15 Kit. 2 mtr power amp–1w in–15w out–less case, connectors and switching 39.95
PA144/25 Kit . same as PA144/15 kit but 25w . . 49.95
PA220/15 Kit . similar to PA144/15 for 220 MHz 39.95
PA432/10 Kit . power amp–similar to PA144/15 except 10w and 432 MHz 49.95
PA140/10 W/T 10w in–140w out–2 mtr amp . . 179.95
PA140/30 W/T 30w in–140w out–2 mtr amp . . 159.95

Blue Line . . . RF power amp, wired & tested, emission–CW-FM-SSB/AM

Model	Frequency	Power Input	Power Output	
BLB 3/150	45- 55MHz	3W	150W	TBA
BLC 10/70	140-160MHz	10W	70W	139.95
BLC 2/70	140-160MHz	2W	70W	159.95
BLC 10/150	140-160MHz	10W	150W	259.95
BLC 30/150	140-160MHz	30W	150W	239.95
BLD 2/60	220-230MHz	2W	60W	159.95
BLD 10/60	220-230MHz	10W	60W	139.95
BLD 10/120	220-230MHz	10W	120W	259.95
BLE 10/40	420-470MHz	10W	40W	139.95
BLE 2/40	420-470MHz	2W	40W	159.95
BLE 30/80	420-470MHz	30W	80W	259.95
BLE 10/80	420-470MHz	10W	80W	289.95

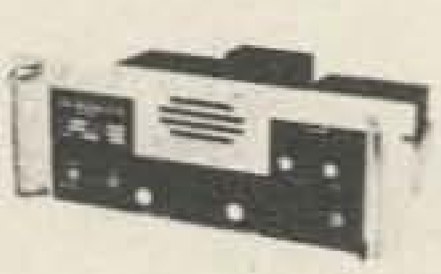
POWER SUPPLIES



PS15C Kit . . . 15 amp–12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection . . . 79.95
PS15C W/T . . same as above–wired & tested . . 94.95
PS25C Kit . . . 25 amp–12 volt regulated power supply w/case, w/fold-back current limiting and ovp 129.95
PS25C W/T . . same as above–wired & tested . . 149.95
PS25M Kit. . . same as PS25C with meters 149.95
PS25M W/T . . same as above–wired & tested . . 169.95

O.V.P. . . . . . adds over voltage protection to your power supplies, 15 VDC max. . . 9.95
PS3A Kit . . . 12 volt–power supply regulator card with fold-back current limiting . . 8.95
PS3012 W/T . new commercial duty 30 amp 12 VDC regulated power supply w/case, w/fold-back current limiting and overvoltage protection 239.95

REPEATERS



RPT50 Kit. . . repeater–6 meter. 465.95
RPT50 . . . . . repeater–6 meter, wired & tested 695.95
RPT144 Kit . . repeater–2 mtr–15w–complete (less crystals) 465.95
RPT220 Kit . . repeater–220 MHz–15w–complete (less crystals) 465.95
RPT432 Kit . . repeater–10 watt–432 MHz (less crystals) 515.95
RPT144 W/T . repeater–15 watt–2 mtr. 695.95
RPT220 W/T . repeater–15 watt–220 MHz. . . . 695.95
RPT432 W/T . repeater–10 watt–432 MHz. . . . 749.95
DPLA50 . . . . 6 mtr close spaced duplexer 575.00

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

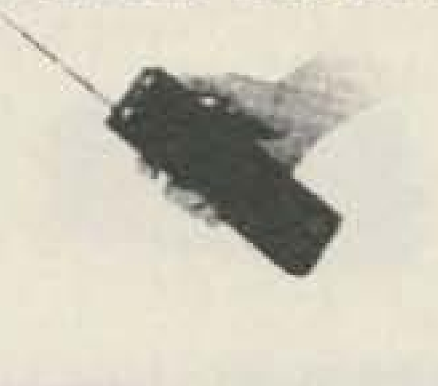
TRANSCEIVERS

TRX50 Kit . . Complete 6 mtr FM transceiver kit, 20w out, 10 channel scan with case (less mike and crystals). 249.95
TRX144 Kit . same as above, but 2 mtr & 15w out 219.95
TRX220 Kit . same as above except for 220 MHz 219.95
TRX432 Kit . same as above except 10 watt and 432MHz 254.95
TRC-1 . . . . . transceiver case only 19.95
TRC-2 . . . . . transceiver case and accessories . . 39.95

SYNTHESIZERS

SYN II Kit. . . 2 mtr synthesizer, transmitt offsets programmable from 100 KHz–10 MHz, (Mars offsets with optional adapters) 169.95
SYN II W/T . . same as above–wired & tested . . 239.95
MO-1 Kit. . . . Mars/cap offset optional 2.50
TO-1 Kit . . . . 18 MHz optional tripler 2.50

WALKIE-TALKIES



HT 144B Kit . 2 mtr, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex . 129.95
NICAD. . . . . battery pack, 12 VDC, ½ amp. . . 29.95
BC12 . . . . . battery charger for above 5.95
Rubber Duck . 2 mtr, with male BNC connector . 8.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit . . . . 10 channel receive xtal deck w/diode switching. . . . . $ 6.95
CD2 Kit . . . . 10 channel xmit deck w/switch and trimmers 14.95
CD3 Kit . . . . UHF version of CD1 deck, needed for 432 multi-channel operation 12.95
COR2 Kit . . . carrier operated relay. 19.95
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 29.95
TD3 W/T . . . same as above–wired & tested . 39.95
HL144 W/T . . 4 pole helical resonator, wired & tested, swept tuned to 144 MHz ban . . 24.95
HL220 W/T . . same as above tuned to 220 MHz ban 24.95
HL432 W/T . . same as above tuned to 432 MHz ban 24.95

vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

Dealer Programs NOW Available

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

KLM RF Power Amplifiers

- A simple, add-on-immediately RF amplifier.
- Merely coax-connect amplifier between antenna and transceiver.
- No tuning! Efficient strip-line broad band design.
- Automatic! Internal RF-sensor-controlled relay connects amplifier whenever transmitter is switched on. Manual, remote-position switching is optional.
- Models for 6,2,1¼ meters, 70CM amateur bands plus MARS coverage.
- Two types: **Class C** for FM/CW. **Linear** for SSB/AM/FM/CW.
- Negligible insertion loss on receive.
- American made by KLM.

Highest quality, American-made "brand" transistors are fully protected for VSWR, short and overload, reverse polarity. Highly effective heat sinking assures long life, reliable performance. Black anodized containers...exclusive KLM extrusions, **have seven, full length fins on both sides!**

FREQ. (MHz)	MODEL NUMBER	PWR INP. (watts)	NOM. PWR OUT.(watts)	NOM. CUR. (amps.)†	SIZE	PRICE
50-54	PA4-80AL	4	80	10A	C*	164.95
144-148	PA2-12B	1-4	12	2	A	59.95
"	PA2-70B	1-4	70	10	C*	159.95
"	PA2-70BL◇	1-4	70	10	C*	169.95
"	PA2-140B	1-4	140	20	D	229.95
"	PA10-40B	5-15	40	5	B	83.95
"	PA10-40BL◇	5-15	40	5	B*	94.95
"	PA10-70B	5-15	70	8	C*	139.95
"	PA10-70BL◇	5-15	70	8	C*	149.95

FREQ. (MHz)	MODEL NUMBER	PWR INP. (watts)	NOM. PWR OUT (watts)	NOM. CUR. (amps.)†	SIZE	PRICE
144-148	PA10-80BL◇	5-15	80	10	C*	159.95
"	PA10-140B	5-15	140	18	D*	199.95
"	PA10-140BL◇	5-15	140	18	D*	215.95
"	PA10-160BL◇	5-15	160	22	D*	229.95
"	PA30-140B	15-45	140	15	D*	179.95
"	PA30-140BL◇	15-45	140	15	D*	189.95
219-226	PA2-70BC	1-4	70	10	C*	169.95
"	PA10-60BC	5-15	60	8	C	149.95
"	PA30-120BC	15-45	120	15	D*	189.95

FREQ. (MHz)	MODEL NUMBER	PWR INP. (watts)	NOM. PWR OUT.(watts)	NOM. CUR. (amps.)†	SIZE	PRICE
400-470	PA2-40C	1-4	40	7	C*	149.95
"	PA10-35C	5-15	35	6	B*	119.95
"	PA10-35CL◇	5-15	35	6	B*	139.95
"	PA10-70C	5-15	70	13	D*	229.95
"	PA10-70CL◇	5-15	70	18	D*	249.95

SIZES: Inches: *A. 2.25×5×2 *B. 6.5×5×2 *C. 6.5×7.5×2 *D. 6.5×10×2
MM: 57×127×50.8 165×127×50.8 165×190×50.8 165×254×50.8
◇**LINEAR AMPLIFIER** †**At 13.5VDC.**

TEMPO

Dealer Programs NOW Available

THE TEMPO 2020

- Phase lock-loop (PLL) oscillator circuit minimizes unwanted spurious responses.
- Hybrid Digital Frequency Presentation.
- Advanced Solid-state design...only 3 tubes.
- Built-in AC and 12 VDC power supplies.
- CW filter standard equipment...not an accessory.
- Rugged 6146-B final amplifier tubes.
- Cooling fan standard equipment...not an accessory.
- High performance noise-blanker is standard equipment...not an accessory.
- Built-in VOX and semi-break in CW keying.
- Crystal Calibrator and WWV receiving capability.
- Microphone provided.
- Dual RIT control allows both broad and narrow tuning.
- All band 80 through 10 meter coverage.
- Multi-mode USB, LSB, CW and AM operation.
- Extraordinary receiver sensitivity (.3u S/N 10 db) and oscillator stability (100 Hz 30 min. after warm-up)
- Fixed channel crystal control on two available positions.
- RF Attenuator.
- Adjustable ALC action.
- Phone patch in and out jacks.
- Separate PTT jack for foot switch.
- Built-in speaker.
- The TEMPO 2020...$759.00.
- Model 8120 external speaker...$29.95. Model 8010 remote VFO...$139.00.

ATLAS 350-XL

- ALL SOLID STATE
- SSB TRANSCEIVER
- 350 WATTS P.E.P. OR CW INPUT
- 10 THROUGH 160 METER COVERAGE

Illustrated with optional AC supply, Auxiliary VFO, and Digital Dial.

The all new Atlas 350-XL has all the exciting new features you want, plus superior performance and selectivity control never before possible. Price: $995.00

• 10-160 METERS

Full coverage of all six amateur bands in 500 kHz segments. Primary frequency control provides highly stable operation. Also included is provision for adding up to 10 additional 500 kHz segments between 2 to 22 MHz by plugging in auxiliary crystals.

• 350 WATTS

P.E.P. and CW input. Enough power to work the world barefoot!

IDEAL FOR DESKTOP OR MOBILE OPERATION

Measuring just 5 in. high x 12 in. wide x 12½ in. deep, and weighing only 13 pounds, the Atlas 350-XL offers more features, performance and value than any other transceiver, regardless of size, on the market today!

- 350-PS matching AC supply — $195.00
- DD-6XL plug-in digital dial readout $195.00
- 305 plug-in auxiliary VFO — $155.00
- 311 plug-in crystal oscillator — $135.00
- DMK-XL plug-in mobile mounting kit — $65.00

TEMPO VHF/ONE PLUS

The Tempo/ONE PLUS offers full 25 watt output or a selectable 3 to 15 watt low power output, remote tuning on the microphone, sideband operation with the SSB/ONE adapter, MARS operation capability, 5 KHz numerical LED, and all at a lower price than its time tested predecessor... the Tempo VHF ONE.

The Tempo VHF/One Plus is a VHF/FM transceiver for dependable communication on the 2 meter amateur band • Full 2 meter coverage, 144 to 148 MHz for both transmit and receive • Full phase lock synthesized (PLL) • Automatic repeater split — selectable up or down • Two built-in programmable channels • All solid state • 800 selectable receive frequencies with simplex and +600 kHz transmit frequencies for each receive channel. Price: $399.00

TEMPO ONE HF Transceiver. 80-10M. USB, CW & AM — $399.00
AC/ONE Power supply for TEMPO ONE — $99.00
VF/ONE External VFO for TEMPO ONE — $199.00

TEMPO SSB/ONE

SSB adapter for the Tempo VHF/One

• Selectable upper or lower sideband. • Plugs directly into the VHF/One with no modification. • Noise blanker built-in. • RIT and VXO for full frequency coverage. • $225.00

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

Dealer Programs NOW Available

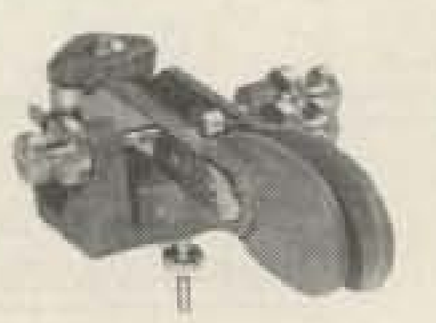
THE HAM-KEY
NOW 5 MODELS

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

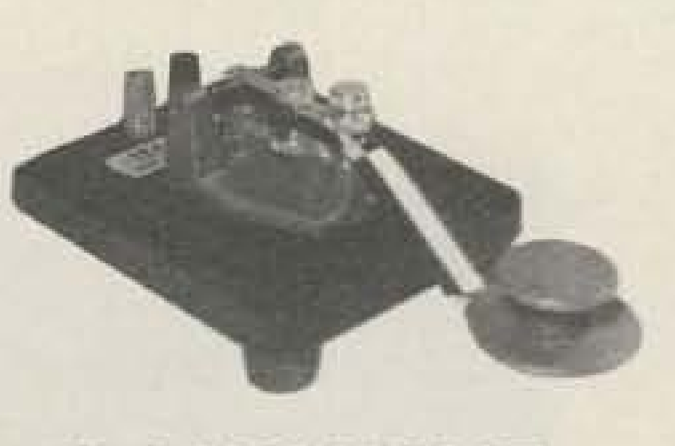
- Dual lever squeeze paddle.
- Use with HK-5 or any electronic keyer.
- Heavy base with non-slip rubber feet.
- Paddles reversible for wide or close finger spacing.



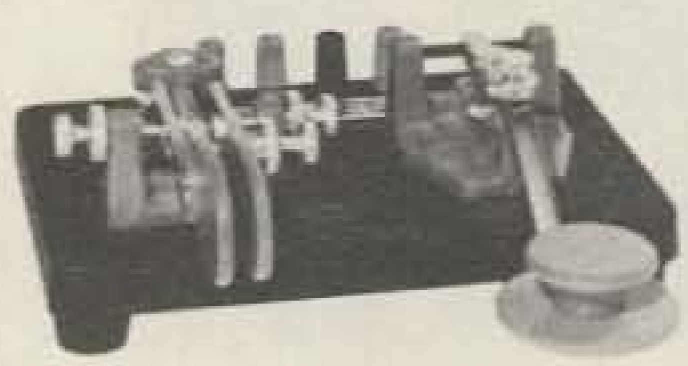
Model HK-2 $19.95

- 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

$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.

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."

$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 fatique 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

TUFTS SELECTED TITLES OF POPULAR SAMS PUBLICATIONS

RADIO HANDBOOK (20th Edition)

by William I. Orr, W6SAI. A completely updated 20th edition of the famous communications handbook that is the electronics industry standard for engineers, technicians, and advanced amateurs. Explains in authoritative detail how to design and build all types of radiocommunications equipment. Contains greatly enlarged section on semiconductor and IC circuit design. Includes ssb design and equipment; rtty circuits; linear amplifiers, both solid-state and tube types; vhf and uhf transmitters and converters; as well as special-purpose and logic circuitry, plus completely revised chapter on electronics mathematics. 1080 pages; 6½ x 9¼; hardbound.

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HAM AND CB ANTENNA DIMENSION CHARTS

by Edward M. Noll, W3FQJ. Tabulates dimension information in feet and inches for all the popular antenna configurations. Gives data for dipole antennas, quarter-wave verticals, two-element beams, quads, triangles, inverted dipoles, and inverted vees. Includes information for cutting transmission lines to a preferred wavelength, dimensioning phasing lines, cutting a matching stub, and spacing antenna elements. 64 pages; 6 x 9; softbound.

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by Edward M. Noll. Prepares the reader to take the examinations for the various grades of radiotelephone licenses. Emphasizes those subjects that are most important or most likely to be misunderstood. The questions are representative of those used in the FCC examinations. 304 pages; 6 x 9; softbound.

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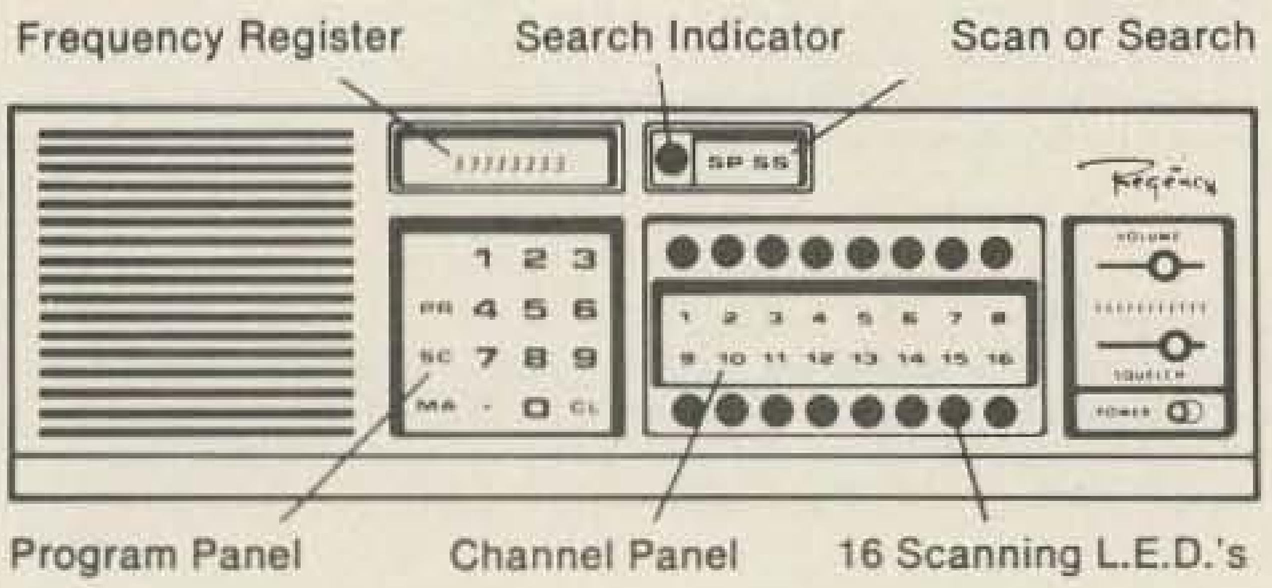

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High-Band Your KDK

-- monitor the other half!

It sounds almost blasphemous to talk about modifying a beautiful, synthesized rig, doesn't it? Well, it can be done, and it can be done by anyone who knows how to solder two pieces of wire. That's the whole modification. I can add two pieces of wire to the KDK and double its versatility.

Why To

The KDK, as it was designed, covers 144 to 148.995 MHz, and the receiver sensitivity leaves nothing to be desired, with the front end being tuned along with the synthesizer. The frequency coverage is so close to the public service band that it would be nice to have such a sensitive receiver, with a nice sharp i-f and precise frequency readout, to see how the other half lives. No sooner said than attempted.

How To

1. Take the cover off the rig (the two nuts on the back).
2. Lay it upside down with the front panel facing you.
3. Move the red wire on the on-off switch over to the terminal that already has the two white wires with violet tracers.
4. Solder a 1/2-inch piece of bare wire to the rear terminal of the other side of this same switch (the three terminals closest to you).
5. Find the top terminals of the aircraft-type frequency selector switch that have a jumper going from the front wafer to the rear wafer.
6. Solder a 6-inch piece of wire to this point (the rear wafer makes a neater job).
7. Solder the other end of this wire to the center terminal of the top bank of the on-off switch (see Fig. 1).
8. Find the frequency selector terminals on the shielded enclosure directly behind the front panel controls. The terminal you want is the one to the far right as you look at the rig. It has 2 white-with-red tracer wires connected to it.
9. Solder the wire from step 4 to this terminal (the one in step 8). Be very careful that some strands of the wires do not short to ground. I have done this many times, and this is not conducive to receiving.

How To Use It

With the on-off switch turned on, the rig works the same as it always did (if not, see step 9). With the switch off, the rig will stay on. It's very easy to add an external power switch, and I didn't want to drill any holes in the rig. However, you will see some very strange-looking megacycles on the readout. This is because you are feeding values in excess of 9 to the seven-segment decoder. It doesn't hurt anything, just makes it hard to read. If you add 8 to the frequency shown on the MHz switch, you will have the frequency that the rig is really receiving. The KDK now tunes 152 to 155 MHz. With the switch on 148 MHz, the modification doesn't do anything, and the rig still receives (and transmits) 148 MHz. It is possible, with additional switching, to extend the range from 140 to 155 MHz, inclusive, but what do you want for 2¢ and five minutes?

Possible Problem (Only One)

You may find that, when the rig is switched to 152 to 155 MHz, the unlock indicator does not go out (some do, some don't). This is due to the fact that the vco is just out of range. Adjust the vco tuning capacitor *very slightly* and *very slowly*, and you will find a point very near where it was that causes the unlock light to go out. If you are receiving a signal, again tune the vco capacitor for maximum S-meter reading on the signal.

The receiver, when properly tuned up, shows .2 uV sensitivity for 20 dB quieting on 2 meters and about .3 uV on high band. Not bad!

Theory

The terminals on the front of the shielded enclosure determine the division ratio of three 74192s. If the first one (the one on the right, looking at the rig from the bottom) divides by 4, we are on 144 MHz. If it divides by 8, we are on 148 MHz. (Aha! It determines the third digit in the megahertz number.) We simply placed +5 volts on the 8 terminal, so we added 8 to that number. On 148 MHz, there is already +5 volts on that terminal, so . . .

Enough theory, already. Try it; you'll have fun! ■

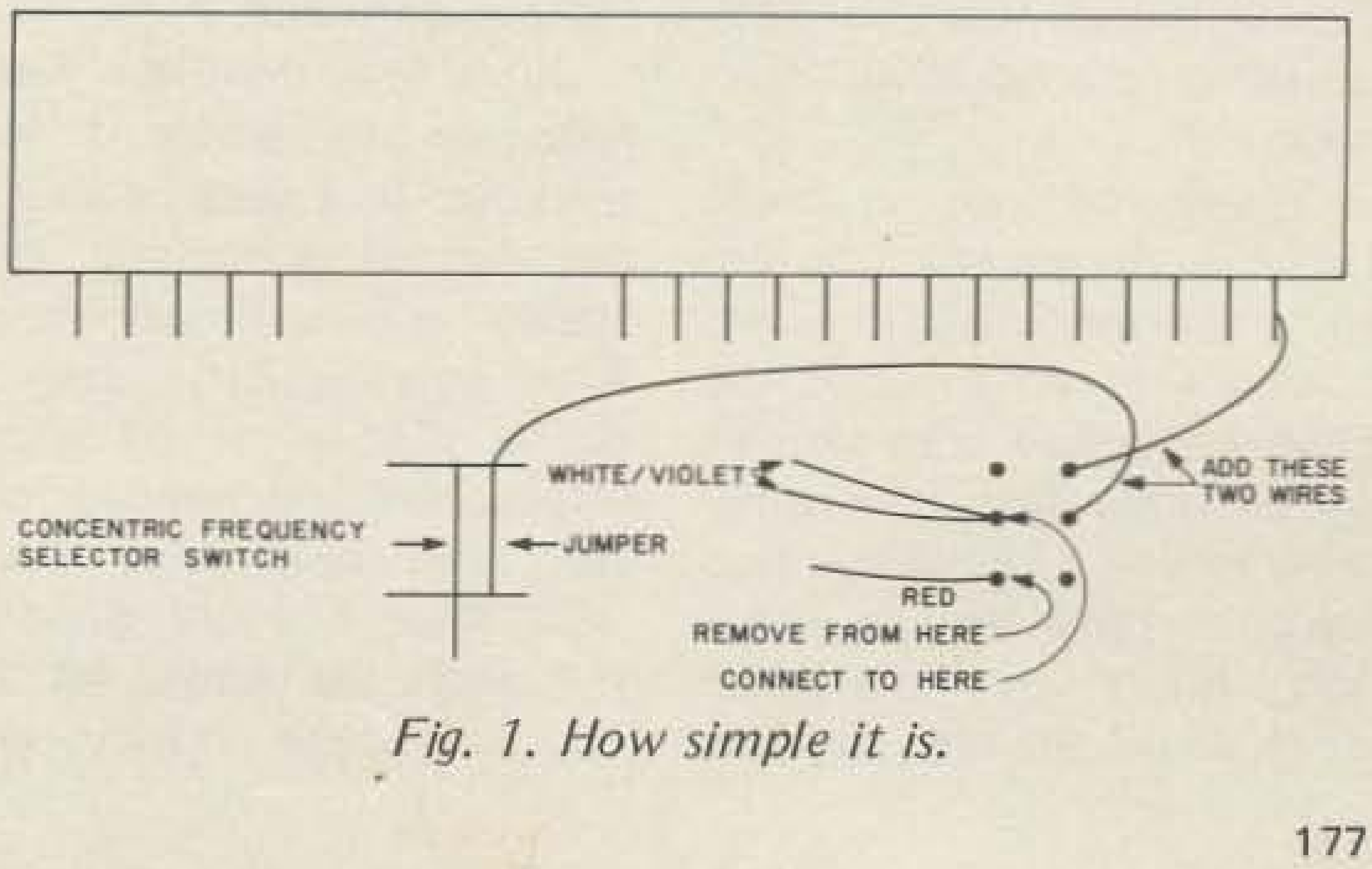

Fig. 1. How simple it is.

J. George Taylorson, Jr. WA6LJL
2924 Clarmeya Lane
Pasadena CA 91107

The Rescue

-- real-life drama

The temperature was about 82°, a perfect-day for exploring the back country of Fish Creek. Now, if you're not familiar with the whereabouts of Fish Creek, it's about 50 miles east of Jackson Hole, Wyoming, about one mile from the Continental Divide.

On this beautiful August 21, 1976, two young girls and a male friend decided to take the horses out for a ride in the back country. Nancy, 17, Patty, 19, and John, 17, saddled up the horses that they had been assigned to and started out on what was supposed to be a beautiful afternoon ride.

When you run a ranch, there is always much to do, so I set out with my two cowboys to do some of the chores that had been waiting to be done for some time. Now I think I should mention that the ranch is one and a half hours by four-wheel drive from the nearest telephone. A person could set out from the ranch in any direction and never see another living person for 30 miles. The only electricity is a small, four-cylinder engine generator. Many have said it is one of few ranches left that reflect the way the old west was in the early 1900s.

About 4:30 pm, while I was working in the pasture, I looked down the path to the east and saw a rider heading for the ranch at a full run. One of the rules of the ranch is to never run your horse, so I immediately knew that there was trouble.

In a few minutes, Patty rode up to where I was working. In a state of shock, she started screaming that Nancy was seriously hurt. After quieting Patty down, I got a description of where Nancy was and jumped into the four-wheel drive truck with Mike, another guest at the ranch. We headed for the canyon where Nancy and John were. The road was no more than a cow path, so the traveling was slow and bumpy. Once at the canyon, called Deer Creek, Mike and I started a one-mile hike looking for the injured girl and John. After about twenty minutes of rough hiking, we came upon them in a little clearing.

Nancy was lying on the grass in a state of shock, with blood flowing from her mouth. There was a lump on her head where she had hit the ground, and her left elbow was completely distorted. It was decided that Nancy could not be moved.

Grabbing one of the horses, I headed down the canyon as fast as the horse could go to where the truck was parked. I headed back to the ranch, where I hoped and prayed that the old generator would start. Once at the ranch, I was able to get the generator going, and I headed for my new Atlas 210, which I had just purchased a month earlier. The antenna was a 20 meter dipole on the roof oriented in a northwest and southeast direction. I wasted no time in finding a clear frequency and started calling "Mayday, mayday, mayday; WA6LJL/7 near Jackson, Wyoming, calling mayday. Someone come in, please."

I called several times and got no response. I didn't know what to do, as a girl was lying seriously injured, and this was the only means of help or communication with the outside world. I kept calling, and, then, like music to the ears, I heard "WA6LJL/7 this is K5TZK Bob in Houston, Texas. Do you copy?" Thank God someone heard me! It didn't take long for me to tell Bob the problem. Shortly after I made contact, Ernie W7JRW in Las Vegas and Jim WB5NRX were involved keeping the surrounding frequencies clear, so I could communicate with Bob K5TZK.

Bob immediately got the long-distance operator and explained the situation to her. She then connected the sheriff's department in Jackson, Wyoming, and the U.S. Forest Service Department with Bob in Houston. After about 15 minutes of my giving directions to Bob, the sheriff's department dispatched a helicopter and a registered nurse to our location. We were instructed to start some smoke fires so we could be spotted. For 30 minutes more I gave directions to Bob to relay to the sheriff's department, which in turn relayed them to the chopper.

As the drama continued, there was not a bit of QRM on the frequency, thanks to Jim, Ernie, and, I am sure, others, who helped keep the frequency clear.

It seemed like hours before I heard the low hum of the helicopter as it started to come into view over the mountains. Seeing our signal fires, it wasted no time getting to us and making a landing. I told the hams on the frequency that it was here, and, all of a sudden, there was a chorus of "Hoorays," making the prettiest QRM that I had ever heard. I signed quickly and headed for the chopper. I boarded, and we took off to the location of the injured girl.

About five minutes later, we spotted the trio and made an unbelievable landing within 30' of where Nancy lay. By this time, she was unconscious. The nurse said she looked bad, so we wasted no time getting her on a stretcher and airborne. We all gave a sigh of relief as the helicopter headed for the hospital.

The next day I drove into town to the hospital to find out how Nancy was. I found her doctor and asked him how she was doing. "Doing well," he replied, "but if she had gotten here 2 hours later, we would have had to amputate her left arm, as the circulation had been cut off and the tissue was dying." Had we tried to take Nancy out by truck, it would have taken us 4 hours to get her to the hospital.

Today, many months later, Nancy is a beautiful young girl living in Palos Verdes, owing her life and healthiness to the many hams who helped. Without this help, she might not be alive today.

So let everyone know that there is no greater service fraternity anywhere in the world today than the hams, who would rather be of service to their fellow man than anything else.

Oh yes, I'll be back there again, and, again, I'll have my trusty little Atlas 210 with me! So, if you hear "WA6 Lovely Japanese Ladies portable 7," give a call and be sure to say hello, as you're the only commmunication we have with society. ■

Tom N. Todd WA5TSJ
1300 S.W. 62
Oklahoma City OK 73159

Welding Rod Special Antenna

-- for seamless contacts

Most two meter mobile antennas manufactured today are easily mistaken for Citizens Band antennas, especially by CBers and, more importantly, a faction which, of late, has greatly proliferated – the CB rip-off artists.

Many articles have appeared concerning the use of burglar alarms and other devices to protect your rig, but few solutions have been offered concerning the most vulnerable part of your mobile system – the antenna.

The solutions seem to boil down to two things:

1. Take your antenna off when not using it, which is a hassle, even if you use a magnetic mount.
2. Let them take the antenna.

The second solution can be a viable one, providing the antenna is cheap, easily replaced, and doesn't look so great, so not many people bother to steal it anyway.

The antenna described here will adapt readily to the popular Antenna Specialists 5/8 wave roof or trunk mounts, as well as many CB mounts. If you don't have one of these, the roof or trunk mount, less antenna, can be purchased at your local Radio Shack (roof mount – part no. 21-914; trunk mount – part no. 21-913).

The antenna itself is easy to construct. The only materials required are a PL-259 coax connector and a 20-inch piece of welding rod, coat hanger, large copper weld wire, or what have you, and some silicone rubber sealant. Use a hacksaw or a large pair of diagonal pliers to cut about half of the pin off of the PL-259. Take the 20-inch piece of rod, clean the end, and solder it to the center conductor of the PL-259, trying to get a smooth, round bead of solder on the tip of the PL-259 to make good connection with the mount. Fill in the back of the plug with the silicone sealer, in order to keep moisture out.

The PL-259 sleeve is brought down over the rod and screwed over the connector in the usual fashion. The entire assembly may now be screwed down securely on the antenna mount. A 20" piece of rod is used, to allow for about 19" measured from the back end of the connector to the end of the rod, which is a good ball park figure for two meters. An swr bridge may be used to prune the antenna, by careful snipping with wire cutters, but I've never even measured my swr and haven't had any problems.

The antenna has been used on my car for about 8 months and works quite well. No one has yet bothered to steal it, but, if they do, I haven't lost much. I still keep my 5/8 wave in the trunk in case I go out of town and want that "extra 3dB." ■

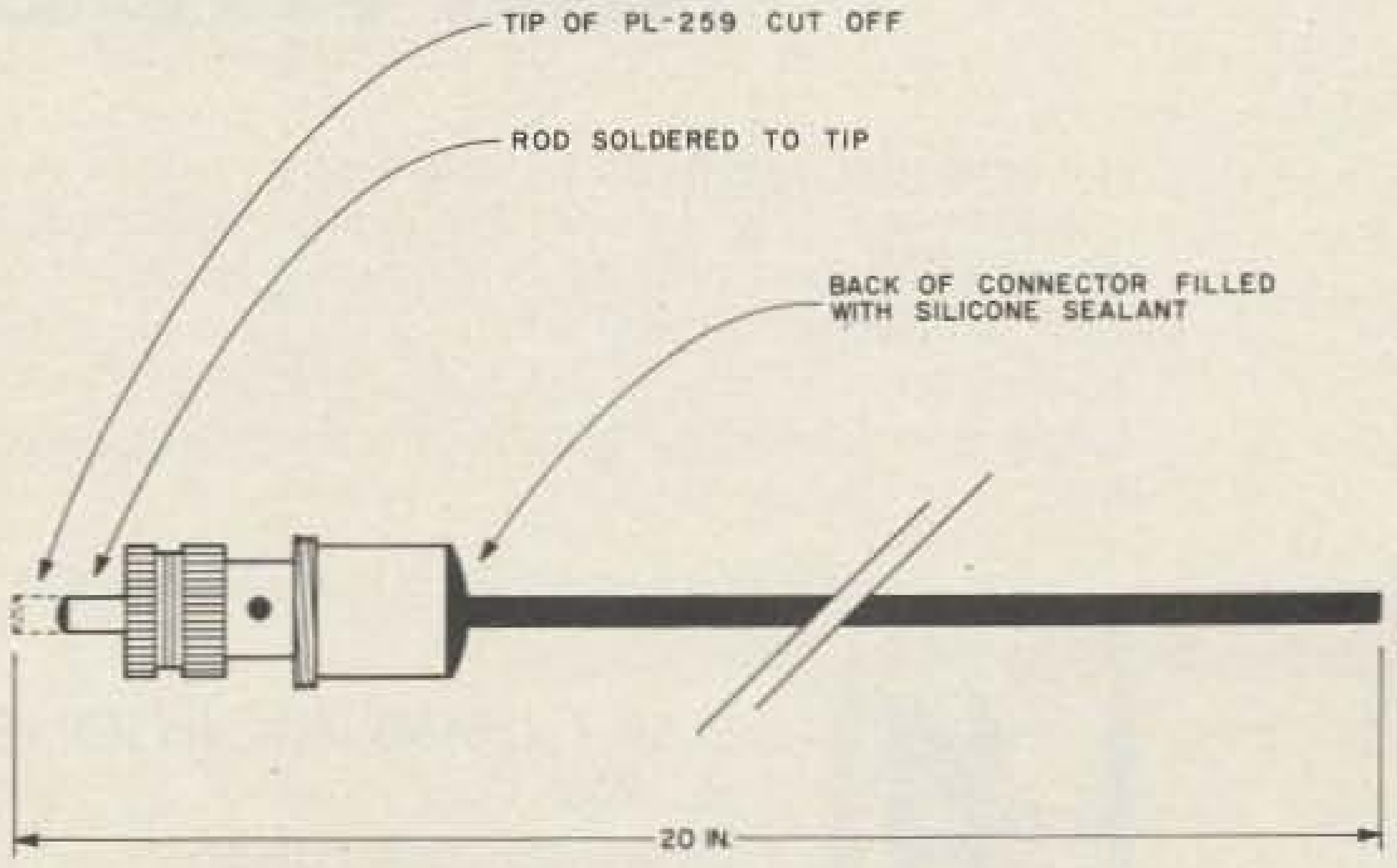

Fig. 1:

RTTY Can Be Easy!

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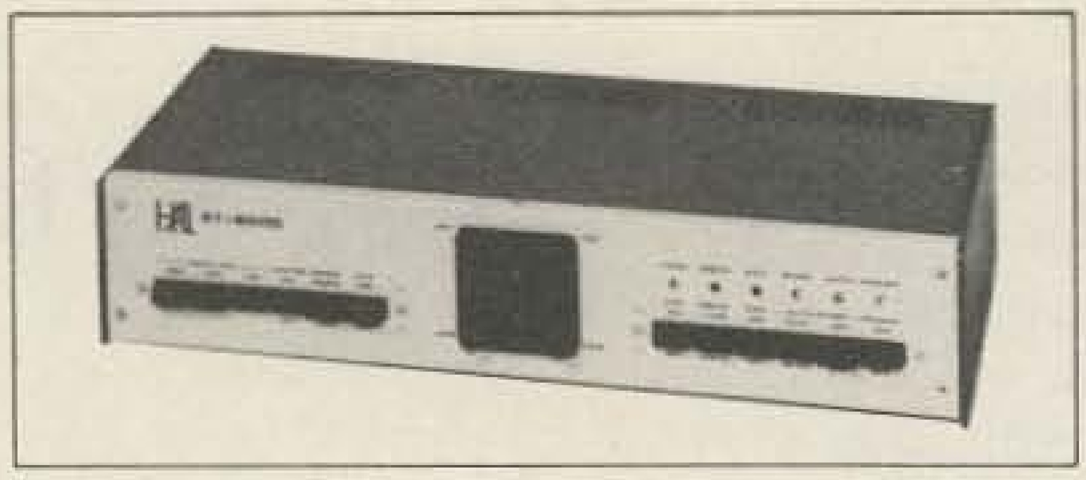
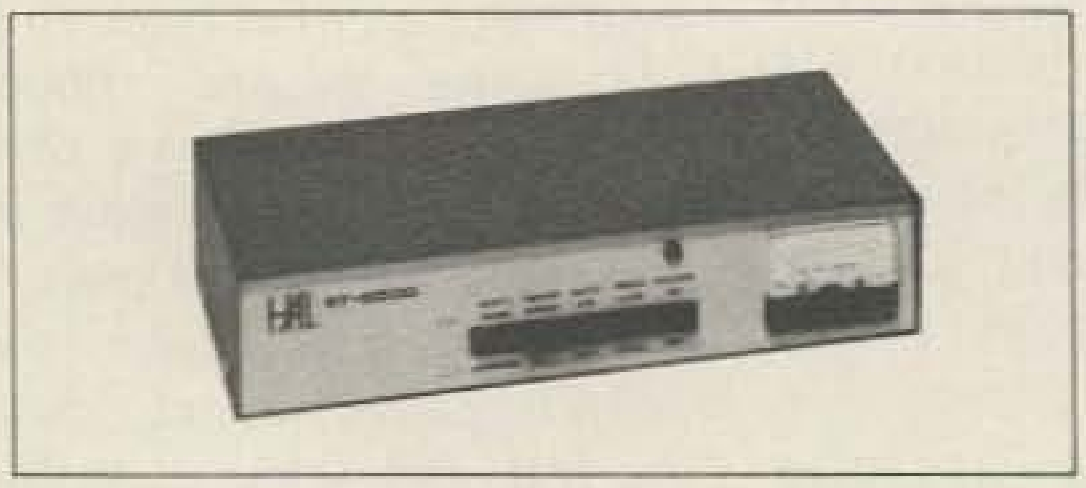
About Finding Out but Didn't Know Who to Ask?





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Tanks A Lot!

-- inductor calculation program

If you don't own a programmable pocket calculator, chances are you will before too long. A 100-step programmable calculator is already on the market for less than a scientific-type pocket calculator cost two years ago. They're just too nice a toy to be overlooked by hams for long.

Now suppose you pull a variable capacitor out of the junk box and you want it to resonate with an inductor at a specified frequency. What's the value of L?

$$L_{\mu H} = \frac{10^{12}}{4\pi^2 (C_{pF})(f^2{}_{kHz})}$$

Not too bad. But now how do you wind the inductor to get this value of inductance? Well,

$$\text{turns} = \sqrt{\frac{L(9a + 10b)}{a^2}}$$

where a is the inductor radius and b is the inductor length. Now this gets a little messy. Squaring, dividing, and taking square roots is not a whole lot of fun. But there is another problem. Assuming we settle upon a value for the inductor radius, we still have to contend with the proper value for the length. How do we find b? Well, we know that turns per inch (tpi) times length equals turns. So if we vary the length b, carry out the above calculation to get turns, then multiply that same length by tpi and compare the result with turns, we can see how close we are. We want the difference between the two to be zero. So we change b just a bit and do the whole thing again and again until the difference is zero or very near zero. But that's a lot of work! You bet, but it's not for a computer.

The program shown here carries out the above procedure starting b at .05 and incrementing it by .05 units after each calculation and comparison until the difference between tpi times length and turns changes sign, that is, crosses zero. Then it decrements b by .001 units and continues in the same fashion until the sign changes again, whereupon it stops and displays the number of turns. The result is, for all practical purposes, excellent. One must initiate the program by putting the various parameters in the memory registers, all ten of which are used with my SR-56.

As an added feature, I thought it would be interesting to know how many times the subroutine

Location	Key
0	0
1	STO
2	0
3	STO
4	6
5	RCL
6	1
7	x^2
8	×
9	RCL
10	9
11	×
12	RCL
13	2
14	=
15	1/X
16	×
17	1
18	EE
19	1
20	2
21	=
22	STO
23	5
24	R/S
25	CLR
26	.
27	0
28	5
29	SUM
30	6
31	Subr
32	8
33	8
34	Subr
35	6
36	1
37	$X \geq t$
38	2
39	5
40	CLR
41	.
42	NOP
43	0
44	0
45	1
46	Inv
47	SUM
48	6
49	Subr
50	8
51	8
52	Subr
53	6
54	1
55	Inv
56	$X \geq t$
57	4
58	0
59	R/S
60	RST
61	(
62	1
63	SUM
64	0
65	RCL
66	4
67	×
68	9
69	+
70	1
71	0
72	×
73	RCL
74	6
75	=
76	÷
77	RCL
78	7
79	×
80	RCL
81	5
82	=
83	$\sqrt{X}$
84	STO
85	8
86	)
87	Rtn
88	(
89	RCL
90	3
91	×
92	RCL
93	6
94	=
95	$X \gtreqless t$
96	)
97	Rtn

Fig. 1.

was called upon to carry out the searching calculation. In one problem that I devised, over 700 passes were undertaken. This bit of information is stored in register zero.

So how do you run it? Select your variable capacitor and, for example, its center position capacitance. Store this value in pF in file 2. Store the frequency in kilohertz in file 1, the number of turns/inch or less, from the closewound value in the wire tables, in file 3, and the radius you've selected in file 4. You can't have more turns/inch than the closewound value. Square the radius and store in file 7. Finally square pi and multiply by 4 and store in file 9. Now you're ready. Punch R/S. The calculator will display the inductance in microhenrys needed to resonate with pF at the specified frequency in an instant. Punch R/S again, and the calculator will continue computing until it stops and displays the number of turns you need to wind at your selected tpi and radius. Any of the memory registers can now be recalled. The computed length can be recalled from file 6. This length times tpi should be very close to the computed turns. Punch reset, and the program is ready to begin again.

Memory Registers

0	Subr Calls
1	kHz
2	pF
3	tpi
4	radius
5	uH
6	length
7	$(radius)^2$
8	turns
9	$4 Pi^2$

Fig. 2.

Ah, you say, I can get the same stuff from the ARRL Lightning Calculator. True, but you can't get any information on an inductor 3 feet or 0.1 inch in diameter, and it doesn't have all those flashing lights. ■

Build the El Sapo Tester

-- for hams with spare time

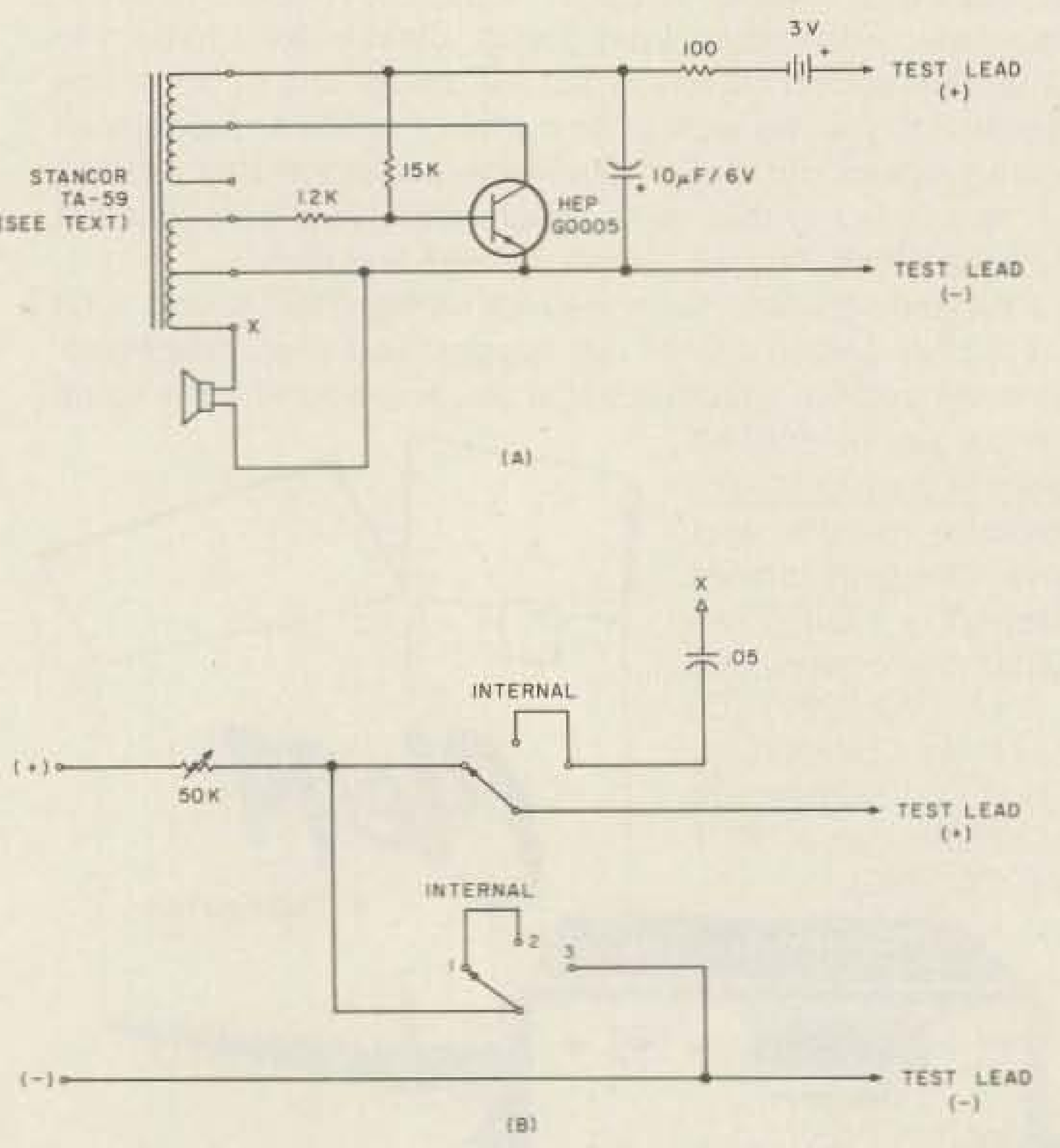

Fig. 1. Basic circuit of tester (a) and switching add-on for more versatility (b). See text for description of components not marked.

73 Magazine *Staff*

The little test instrument described in this article is something for the amateur who has nothing and something for the amateur who has everything. In the former case, it provides, very inexpensively, an instrument that can function as a continuity tester, transistor tester, diode tester, signal injection source, code practice oscillator, CW monitor, substitution microphone, and substitution loudspeaker. In the latter case, it provides a very handy addition to a tool box, for quick continuity and relative resistance checks, without having to look at a meter.

The instrument is nothing more than an audio oscillator using a one transistor circuit. But the components are carefully chosen. A switching scheme is utilized so that a low current is passed through the circuit under test. The volume and/or pitch varies with the resistance placed across its test terminals, and maximum utilization is made of the circuit and its components for several modes of operation. Such basic testers, but without all the versatility of the one described, have been available commercially for years. They are popular with many service technicians, since one can visually concentrate on the circuit being tested or traced out without having to glance away to read a meter. This feature is particularly helpful when doing work on a detailed PC board, since one can lose one's place on the board in the time it takes to glance at a meter.

The circuit of the unit is shown in Fig. 1(a). The oscillator circuit utilizes a transistor transformer, which has one or two center-tapped windings to form the equivalent of a transformer with three windings. One winding is used in the base circuit of the transistor, another as a feedback winding in the collector circuit, and another as an output-coupling winding. Many of the usual miniature transistor transformers will work, aside from the TA-59 unit mentioned, such as the usual 10k Ohm to 2k Ohm CT or 1k Ohm CT to 8 Ohm units. One must be prepared to do a bit of experimenting to get the windings phased correctly and to get the output pitch desired. To achieve the latter with some transformers, it may be necessary to experiment with a small capacitor (.001 to .1 mF) across the base winding. The output "loudspeaker" should ideally be a unit such as a 600 Ohm telephone receiver. But anything, from high impedance, miniature loudspeakers to cheap, dynamic-type microphones, can be used. Power is supplied by two 1½ volt batteries in series. No on/off switch is required, since no current can flow unless some resistance is placed across the test terminals.

The unit, as shown in Fig. 1(a), can be used by itself, if desired. If the test leads are marked for polarity, one can test diodes and transistors and determine the direction of the junction involved. Resistance values, from a short to about 100k Ohms, can be detected with the upper limit, depending on the specific oscillator components used. As the resistance value increases, the volume will decrease, but the pitch will tend to rise. This is a very handy feature, since, after a period of usage, one is not so aware of the volume changes as one is aware of associating higher pitch with higher resistance. With usage, one can become familiar with the sound of at least the major steps in the output pitch, such as for resistance values of 1k and 50k.

By adding a few more components to the basic circuit, as shown in Fig. 1(b), more versatility can be gained from the unit. The addition of a series 50k potentiometer allows one to control the volume and also to limit the short circuit output current to less than 60 uA. The latter is useful as a safety feature, when testing some semiconductor devices, when one is unsure of the terminal markings. In the center position of the switch shown, the battery line is left floating, and the positive test lead is connected to the speaker over a .05 mF capacitor. The speaker can then function as a replacement test speaker or as a dynamic microphone replacement. The reproduction quality is good enough to at least determine whether or not the speaker or microphone substituted for is basically defective. In the right-hand position of the switch, the battery circuit is completed to ground, and the internal speaker output remains connected to the positive test lead. In this mode, the circuit functions as an injection oscillator, the level of which can be controlled by the 50k potentiometer and monitored on the internal speaker. The output is quite harmonically rich, and it can be used to check amplifiers all the way from the audio range to the HF range.

The switch used in the unit I constructed was a special miniature DPDT toggle switch with a center position. But, in the center position, instead of the usual "off" position, the poles still remain connected to opposite side terminals of the switch. The switch is available for $1 from Tri-Tek, 6522 North 43rd Ave., Glendale AZ 85301. The switch can, of course, be replaced by a regular 2P3T rotary switch, but, then, this requires a larger enclosure. Using the miniature toggle, and with the basic circuit wired on perfboard, the unit was assembled in a 3-1/4 x 2-1/8 x 1-5/8 Bakelite box, complete with batteries.

Probably some more uses can be found for the circuit, with a bit of imagination and a modified switching scheme. For instance, it would seem possible to rearrange things so that the circuit could also function as either a preamplifier or a low level audio amplifier complete with speaker. All in all, it is hard to find a more handy unit for general circuit or equipment checking, before one resorts to proper instruments for specific checks.

The name of the instrument comes from the sound the unit makes. When you test for continuity and encounter a very low resistance, the unit sounds off with a hoarse tone, sounding somewhat like that produced by El Sapo — the frog. ■

Finally!

A Simple PROM Burner!

-- for the 8223 and 82S23

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As a result of my various articles using TTL programmable read only memories, I have received many letters and phone calls for help from people who cannot get devices they have purchased to accept a program. In almost all cases I discovered that they had been sent 82S23s, assuming that 82S23s were the same as 8223s. While the devices do the same job with the same pin connections, they are quite different when it comes to programming. The 82S23 will not program with the same inputs as an 8223.

After doing some research into the device data books and getting some help from a friend, the following circuit was developed which will program either the 8223 or the 82S23.

Circuit

The circuit is shown in Fig. 1. To those of you who have either read my earlier articles or used the Signetics data book, the circuit should appear quite familiar except for the additional power supply input and the FET-zener circuitry.

It turns out that the 82S23 requires 19 volts current regulated to about 65 milliamps in order to program right. The circuit shown in Fig. 2 will perform that quite nicely. The only limitation is in the selection of JFETs. The JFET must have an IDSS of greater than 65 mA. Of course the 19 volt zener must be able to handle the full 65 mA, which means that it should be rated at least 5 Watts.

The remainder of the circuit in Fig. 1 is fairly straightforward. For S1 and S2, I used thumbwheel switches which select the word address in octal. These could be replaced with cheap toggle switches, but the saving in time and effort is well worth the slight extra cost of the BCD coded thumbwheel switches. S3 selects the output bit to be programmed or verified. S4 is a push-button switch used to do the programming once a word and bit are selected, and S5 is used to verify that the bit was actually programmed. S6 was added to switch the programmer from the 8223 devices to the 82S23 devices. S7 simply puts a 12 volt zener across the 19 volt zener for current calibration purposes. The 21 to 19 volt supply is the same as shown in detail in Fig. 2 except for the addition of a meter for current calibration. For the best stability, the zener and FET should be mounted on heat sinks. One last circuit

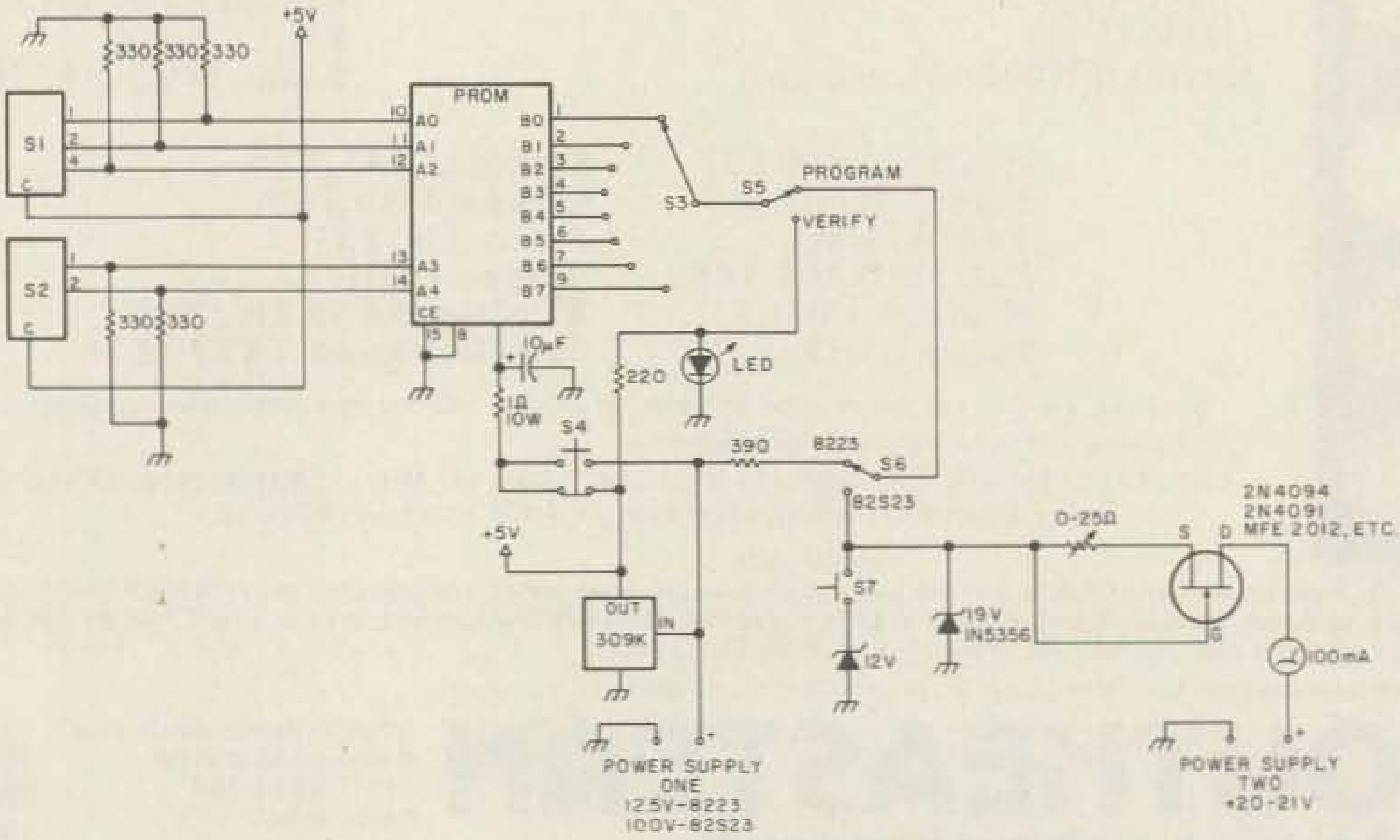

Fig. 1. PROM programmer schematic diagram. Power supplies one and two can be bench supplies or built up specially for this use. Regulation is not critical.

comment: If additional contacts were available on push-button switch S4, I would break the line from S6 to S5 and put it through the extra contacts.

Programming

If programming an 8223, set S6 to 8223 position and adjust power supply one for 12.5 volts. Power supply two need not be on.

If programming an 82S23, set S6 to 82S23. Adjust power supply one to 10.0 volts and power supply two to 21 volts. Now momentarily depress S7 and adjust Ra for a current of 65 ±3 mA. Turn power supply one off, insert device to be programmed, and set S1, S2 to desired octal address. At each address select, one by one, the bits to be programmed with S3. Then momentarily push S4. Now, pushing S5 to the verify position should cause the LED to light if the programming was successful. When all desired bits of one word have been programmed, switch S1, S2 to the next address and repeat the operation.

Conclusion

I have two words of warning for programming either type of device. Monitor the device case temperature with your finger. Any time you can't keep your finger on the device it is time to stop for a few moments to let the device cool down. The other warning is that, once programmed, a TTL PROM is forever programmed whether right or wrong, so it takes time and care to do the job right without destroying a device. I hope this article will help those of you who have had problems or been frustrated by these devices. ■

Fig. 2. Constant current supply and current regulator schematic.

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Try A Topical CQ

-- for special interest groups

When I became interested in personal computers, I developed an intense desire to talk to someone – anyone – who shared my enthusiasm for this new and fascinating hobby.

Don't let the term "computer" turn you off. This article is about amateur radio, not about computers. Bear with me for a few moments, and you'll see. I mentioned my interest in discussing computers as a prelude to disclosing a practical solution to the problem of locating someone who shares your interests, whatever they may be.

Since my home town is comfortably small, I wasn't too surprised to discover that I was the only one here who was active in tinkering with a personal computer system. Therefore, when I had questions about computer hardware or computer programming (and believe me, I had many), I became frustrated. I had no one to whom I could turn for enlightenment.

One day, as I was sitting at my bench busily creating an ulcer because I couldn't understand the instructions that some engineer had prepared to help me, I chanced to glance over at my rig. It had been neglected, shamefully, since I had become interested in computers.

Suddenly the thought struck me – surely, someone out there in the ham radio community knows how to interpret this jargon that I've been trying, unsuccessfully, to understand. As I turned on the rig and began tuning it up on 20 meters, I gave no conscious thought to the means I'd use to reach someone who might answer my questions.

"CQ computers, CQ computers," I called into the mike. "Calling anyone who can help me interpret some microcomputer buzzwords." The plea came out as naturally as if I had used the special topic CQ all of my (considerable) amateur radio life.

I wish I could report that an electronics and computer programming expert who had built and operated the exact make and model of my computer had responded. No such luck. But I did get calls from several fellows who were able to clarify the instructions that I had been misinterpreting.

In fact, three QSOs, which lasted several hours, resulted from that topical CQ. I had an opportunity to discuss and learn a great deal about hobby computers that day. It's a gross understatement to report that I enjoyed that experience immensely.

The frustration that drove me to call "CQ computers" may have had a significance for the enjoyment of amateur radio that I never before considered.

What's wrong with calling a topical CQ? Why not call "CQ color photography," "CQ Windom antennas," "CQ linears," "CQ bass fishing," or "CQ recreational vehicles"?

I realize that such CQs sound strange. But perhaps that's just because we haven't heard topical CQs before.

We are all familiar with "CQ DX," "CQ New York for a phone patch," "CQ contest," "CQ for a test," and "CQ for a short QSO." Those calls certainly don't sound strange anymore.

The beauty of the topical CQ lies in its promise of bringing together two (or more) hams for the sole purpose of discussing an announced topic in which both (all) are interested.

The rag chews that used to take place on 75 phone just after World War II were fascinating, in part, because they involved discussions of transmitter, receiver, test equipment, and antenna projects that were in various stages of construction. Most ham gear was of the home brew variety, and almost everyone was engaged in a building project he wanted to discuss. That commonality of interest was what contributed most to the satisfaction one gained from a QSO. If you doubt it, ask a ham who owns a two-letter callsign how often he stayed up until three or four in the morning chewing over construction projects he enjoyed discussing with others.

It's the search for that elusive common interest topic that occupies most of our time at church socials, PTA meetings, cocktail parties, bus stops, or most other gatherings. What we refer to as "small talk" is really this exploratory probing for a subject that interests us. Often, we start with the weather. Then we switch to the old home town, mutual friends, television, children, traffic problems, disasters, politics, etc., to keep the conversation going while we continue our search for a common interest.

Then, without warning, we pick up a chance remark that leads to the exciting moment when we discover that someone else shares our interest in something. From that moment on, our conversation comes alive, as we share our views and experiences with someone who seems to hang on our every word. A topic of mutual interest has been discovered. The evening is a success; a new friend has been found.

A similar phenomenon occurs repeatedly on the amateur radio bands. In fact, many hams resign themselves to the expectation of a casual conversation. You hear them call "CQ for a short QSO," meaning: "Let's get together to exchange handles, signal reports, QTHs, weather reports, and descriptions of our rigs."

Fortunately, on occasion the "short QSO" can stretch into hours, if some remark made discloses that both hams have a common interest in some topic.

Back to the topical CQ.

As I see it, calling a CQ that announces your interest in discussing a specific topic comes close to insuring that you and one or more other hams are likely to have an enjoyable QSO, QRM permitting. There's no guarantee of a stimulating exchange, of course, because the expertise of all participants as well as the level of interest in the topic by participants play a significant part. But the topical call certainly holds far more promise of satisfaction than does the general CQ with which we are all familiar.

As an added incentive to use the topical CQ, think of the prospect of some ham having a rare DX call responding to your call because he is tired of hit-and-run QSOs and is anxious to discuss your favorite subject with you. It could happen.

There is no good reason why the topical CQ couldn't be extended to seeking help with some project in which you've become involved. My initial call was a plea for help in understanding computer terms, despite the fact that I was thinking of the call at the time as merely an attempt to discuss computers. There is no doubt in my mind now that I was looking for someone who might add to my limited fund of knowledge, i.e., someone to help me.

Over the years, I have listened in on QSOs during which hams have instructed one another on how to tune an antenna, adjust a discriminator circuit, rebuild a VW carburetor, remove the flywheel from a lawn mower engine, prime a water pump, repair a sailboat centerboard, and locate a locksmith on a Sunday afternoon. I have even heard a physician offering medical advice to one of his longtime net buddies, but that's carrying too far the help requests I'm advocating here.

Hams, generally speaking, are people who are unusually alert and have wide diversities of interests and talents. Few will deny that hams are responsive to one another's calls for assistance. Each of us has knowledge and experience that we are willing to share, if only we are made aware of the need.

A topical CQ can announce that need for assistance or can merely signal a desire to contact someone for the purpose of exchanging views about a subject that is of special interest to the person initiating the call.

So, how about it? If you want to talk about my current special interest, personal computers, I'll be listening on 20 meters for your topical "CQ computers" call. ■

George Young WB6JYK
Sierra High School
Tollhouse CA 93667

Call Letter Gouger

-- adds class to any shack

High school wood shop instructors are always looking for simple, educational, inexpensive projects for those students who need to be kept busy until such time that they come up with their own projects.

Keep in mind that this project must have educational value for the instructor to justify putting a student on it, and the process of education is a slow one. You will actually be doing the instructor a favor with your request, since he is always looking for just this kind of project. Shown is a piece of cedar, stained first, then routed in about 20 minutes by one of my students while he was waiting for his own project to dry before applying the next coat of sanding sealer. I'm sure WB6TJV will be pleased with the results. ■

RECIPE

Take accompanying photo to local high school wood shop instructor.
Supply him with your call letters.
Furnish $1.00 to $1.50 in U.S. funds.
Wait suitable time for educational process.
Completed callsign will be returned so you can hang it out front of the shack.

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 41

for the most part gotten into HFing.

The move by the ARRL to force dealers to sell ham gear only to hams by refusing to let them advertise in *QST* if they don't promise to be good is about what I would expect from the ARRL. There is something about the bureaucratic temperament which seems to always think in terms of punishment as a way to force people to do their bidding rather than using rewards for behavior mod. Their forcing the FCC into "incentive licensing" was typical . . . forcing hams to get a higher license by taking away bands unless they did. The bureaucratic system of making ever more laws to force people to do what the bureaucrats think is right has not been noticeably successful.

A handful of ham dealers have been making a killing for several years by selling ham rigs to CB dealers for resale to HFers. All they have to do is change a wire or two, add a couple of crystals, tune it up, and move it along for a very nice profit. The dealers, such as Tufts Electronics, which refuse to sell ham rigs to CB dealers or directly to CBers, are at a disadvantage. This loss of sales volume can mean higher prices for some equipment and slower delivery.

Traffic in ham rigs to HFers will slow down when it becomes unprofitable for the ham dealer to indulge in it. There are ham dealers out there who will sell to anyone waving money and even sue the manufacturers if they refuse to ship to them for this trade. While the entire industry looks with disgust on these "sewers," they still have to do business with them or else spend a lot of money on lawyers, with the courts eventually backing up the sewers.

Other than making ham gear in short supply for hams, what problems are HFers causing us? Oddly enough, not all that many. The added volume of sales they represent helps keep ham rig prices down and encourages the development of new equipment. The amplifiers the HFers buy are generally the higher-powered ham amplifiers and thus are relatively free from spurious emissions. Even the FCC admits that the HFers aren't seriously bothering any other service. Perhaps this explains why, though the FCC people at HQ in Washington are bent out of shape over HF operation, little is being done in the field to discourage it . . . even when ham groups get together and supply detailed information about HFer names, locations, equipment, etc.

Will an edict from the ARRL/*QST* change the ways of business when the FCC doesn't seem to really care and when the people involved are not causing any serious damage? It seems unlikely to me that this is anything more than a grandstand play. We'll see.

Ham dealers who sell gear to CBers are quite aware of what they are doing. Chuck Martin WA1KPS of Tufts Electronics comments on the ARRL demand that customers show a ham license to buy a rig, "Are you kidding? We can tell a CBer the minute he walks into the store. We don't waste time asking for ham licenses . . . it's too easy for anyone to borrow one for a purchase. One or two questions and we know who is a ham and who isn't. We sell ham rigs *only* to hams."

The FCC is terribly upset over the TVI and other interference complaints caused by the many illegal power amplifiers being sold to add on to the 4 Watt AM rigs. Since the FCC put the ethical manufacturers out of the business, they've opened the floodgates for the unethical manufacturers . . . who have no reason at all to worry about spurious responses. The result has been hundreds of thousands of incredibly dirty power amplifiers being sold and a resulting tremendous increase in interference.

The manufacturers of legal ham amplifiers have been trying to point out to the FCC that a further restriction on making clean amplifiers will obviously result in the production and sale of dirty amplifiers. Laws further prohibiting amplifiers will result in exactly the opposite desired end. There has been no sign of anyone listening at the FCC. I do think that further prohibitions of linear amplifiers would be about the worst thing the FCC could do. They'll probably do it.

COMPUTERIZED QSLS?

The RTTY chaps have been sending their QSLs by radio for many years; however, I doubt if these confirmations are considered adequate by the organizations issuing certificates.

With more and more microcomputers in the hands of hobbyists, it is probably just a matter of days before a system will be devised to allow the access of one computer by another via the telephone system for either leaving a message or picking one up. Indeed, I'd like to publish the details on the interface boards for accomplishing this, complete with details of the standards and protocols developed to accomplish a confirmed automatic message transfer.

With the phone rates going as low as 19¢ per minute at some hours, this offers a reasonable and fast system as an alternate to the U.S. mails. Even the daytime 40¢ per minute charges aren't bad for a priority message, delivered within a minute or so instead of having to wait until night.

In the past, some organizations have been very sticky about accepting QSL cards which have neither a canceled postage stamp on them nor the stamp of a QSL bureau. I can understand the situation, for one of the early aspirants for one of the *73 Magazine* operating awards sent in some QSL cards which looked perfectly okay, but were fakes. They lacked the QSL bureau stamp or postage to indicate mailing. Fortunately, the fakes included cards from some rare DX stations which I had worked, and I quickly recognized the bogus cards submitted. Tsk.

As more operators use microcomputers, we may be able to have cassette tapes of the logs submitted by DX stations and do away with QSL cards. In the meanwhile, put on your thinking cap and see if you can come up with an interim solution.

The high (and going higher) postage plus slow (and getting slower) deliveries of our postal system are going to help encourage the use of computer-to-computer messages. The Postal Service has its own problems, and it is going to be a long time before they will be permitted to tackle most of the more serious ones . . . so there is no immediate hope of lower postage or much better service.

One of the big miseries of the Postal Service is the political constraints. There are over 12,000 post offices in small towns which could be closed, saving over $100 million annually. These are kept open as a matter of town prestige, not of function. Another big lump could be saved if more rural mail could be delivered to clumps of post boxes instead of free delivery to each customer at his home. When I was young, our post box was almost a half mile away, and I didn't think anything of walking down to it . . . at least not on warm days. Of course, our farm was out a ways . . . we didn't even have electricity (it still doesn't) . . . or running water (still doesn't).

When the Postal Service is permitted to be run more like a business and less like an arm of the government, I think we'll get better and cheaper service. In the meanwhile, the pressure for faster and cheaper service may quickly force the development of computer communications. As pioneers in communications, perhaps hams will be in there with the first systems and help develop the standards which will stick with us.

CATCH 22 FOR HAMS

Early experimenters with RTTY found that they were severely limited in their possibilities by the FCC. Even though the amateur service is chartered by the FCC rules to provide inventions and pioneering, the FCC has constantly gone counter to their regulations by prohibiting any experimentation which would produce signals which the FCC monitors could not copy. So how are hams going to invent something new if anything new is prohibited? Catch 22.

One of the questions I've asked at FCC formal and informal hearings is why . . . why . . . the FCC monitors have to be able to copy ham transmissions using new techniques? If what is being transmitted is so difficult to copy that even the FCC monitoring stations can't hack it, what do they care about what is being transmitted?

Perhaps there was, long ago, the fear that hams would go berserk and send naughty words over the air if they thought the FCC monitors couldn't copy them. Well, I've a secret . . . this is probably one of the first things hams will do. So what? That gets boring very quickly and the pioneers will be on to more interesting matters. There hasn't been any proof that words will do much long-range damage, so let the child in the ham come out and get over the excitement of being able to secretly pass naughty words. Big deal. The important thing is for ham experimenters to have the freedom to try new ideas, new types of communications, new techniques. And they should be able to give these things a try without a seven-year wait from the FCC for permission.

The current FCC ban on amateurs using ASCII is, unfortunately, well precedented by earlier refusals to allow amateurs to do other just as innocuous things. Here we are being held back for years, while the FCC blunders through its molasses-slow procedures to permit what should have been automatically permitted at first request.

FCC HEADACHES

The FCC Amateur Division made the papers recently over the call letter business where one of the FCC employees was accepting cash in return for choice calls. I wish I'd heard before it got stopped.

For years I've been interested in getting W1NSD, but the FCC has put me off, saying they couldn't do it. The call has been open for about 25 years. At one time, I even put in a petition to make it possible to get counterpart calls such as this. The League liked the idea, too, and they also put in a petition asking for the same thing. These petitions, after yellowing for about eight years in the FCC files, were recently thrown out, with no reasonable explanation.

It was my own fault. I could have gotten the call if I had not goofed off. When I moved down south, I was able to get W4NSD. Later, when I moved to Ohio, I got W8NSD. That was back in the '40s and '50s. As a matter of fact, in the Sweepstakes contest of 1951, if you have an old issue of *QST* around, you'll find that I operated the first weekend of the contest as W2NSD/8 (and did quite well). The second weekend of the contest I ran as W8NSD/2 (my new call had arrived just as I was going to New York for a few days).

By 1962, when I moved to New Hampshire, the FCC had stopped giving counterpart calls. There was no rule change; they just decided not to do it any more . . . too much trouble. Having lived in New Hampshire off

Continued on page 199

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UHF .... 0.6 μ V

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Dec 1977

73 Magazine *Staff*

Adjustable Bench Supply

-- would you believe 1.2-37 volts?

How about constructing an adjustable voltage power supply that can have up to 1.5 Amperes output with good load voltage regulation and full overload protection at minimal cost? Admittedly, a $5.00 estimate depends a lot on what parts are available from one's junk box, but for just a few dollars spent on a new IC, one can have the "heart" of a very versatile power supply.

The new IC is the LM317 by National Semiconductor. This IC promises to be as famous as the LM309, which is so universally used in power supplies for digital circuitry.

The new LM317 is an adjustable, three-terminal positive voltage regulator. Its simple external connections rather belie the complexity and performance features of the unit. As shown in Fig. 1, it has only simple in/out connections and a minimum of three simple external components are required. The output voltage is set by the ratio of two resistors, R1 and R2. By making R2 variable, one can adjust the output voltage to be any value from a few volts less than the dc input voltage to the regulator down to a minimum of about 1.2 volts output. Thus, if the input dc voltage were 40 volts, the output voltage can be continuously varied from about 37 volts down to 1.2 volts.

Although the output voltage is determined only by a resistor setting, the output voltage is regulated at *any* given setting. The regulation will be about 0.1% going from no load to full load (1.5 Amperes, assuming the transformer/rectifier used for the dc input voltage handles this current). The LM317 is also overload and thermally protected. If the current limit is exceeded, such as by a short circuit, the LM317 will simply "shut down." If the regulator gets too hot, either because of excessive load current and/or inadequate heat dissipation, it will also protect itself. Although one can destroy the LM317 like any other IC, it is pretty hard to do with any sort of reasonable care.

The manufacturer suggests two additional capacitors (C2 and C3) be used, which may prove useful in some applications. C2 is used to bypass the adjustment terminal to ground to improve ripple rejection. This bypass prevents ripple from being amplified as the output voltage is increased. About 60 dB ripple rejection is achieved without this capacitor, but it can be improved to about 80 dB by adding it. A 10 mF or greater unit can be used, but values over 10 mF do not offer any significant advantage in further ripple improvement. The manufacturer particularly recommends the use of a solid tantalum capacitor type since they have low impedance even at high frequencies. An alternative is the use of the more readily available and inexpensive aluminum electrolytic, but it takes about 25 mF of the latter type to equal 1 mF of the tantalum type for good high frequency bypassing! C3 is added to prevent instability when the output load presents a load capacitance of between 500 and 5000 pF. By using a 1 mF bypass at the output (solid tantalum again or aluminum electrolytic equivalent), any load capacitance in the 500 to 5000 pF range is swamped and stability is ensured. Both C2 and C3 will not be required for many applications where the LM317 is being used with a specific load circuit. But if the LM317 is used as the heart of a general purpose bench type power supply, they should be included.

Fig. 2 shows a PC board layout and component placement diagram. This layout has been suggested by the manufacturer, but there is no need to follow it exactly as

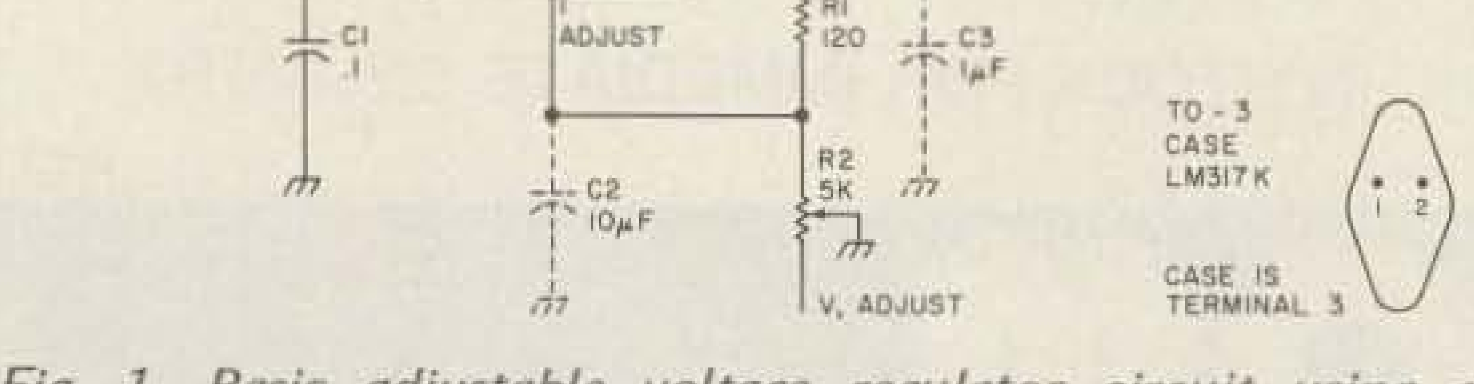


Fig. 1. Basic adjustable voltage regulator circuit using an LM317. Normally only three external components are needed, but C2 and C3 may be useful in certain situations as explained in the text.

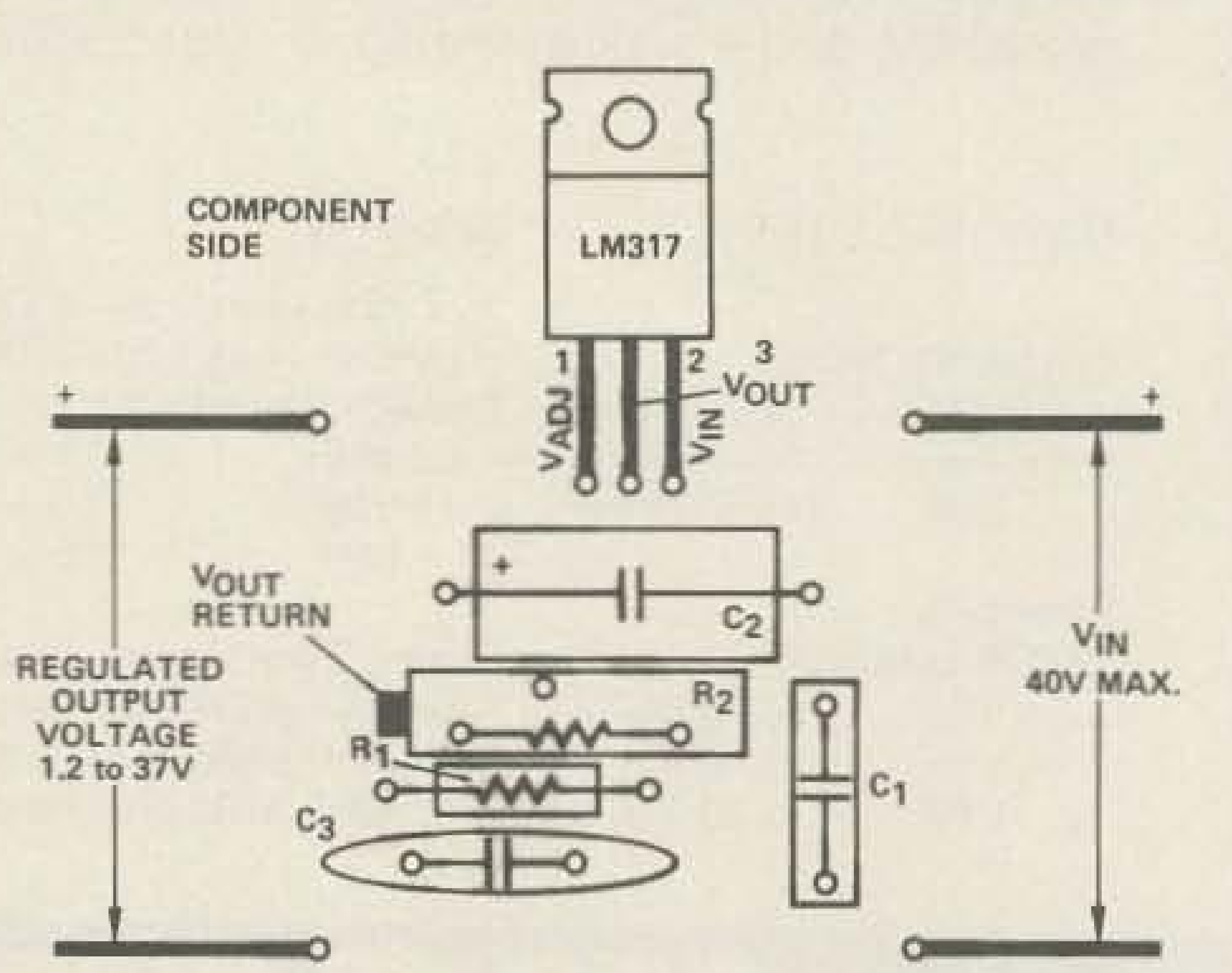


Fig. 2. This is a PC board layout for the regulator suggested by the manufacturer. R2 is shown as a multi-turn pot for ease of adjustment. The figure also shows the pin connections for an LM317 if it is obtained in the TO-220 plastic case.

long as all of the external components are grouped around the regulator with solid short leads. The diagram shows the LM317 in a TO-220 plastic case which is designated the LM317T. Most amateurs will probably prefer to buy the LM317 in the familiar TO-3 metal case and, in this case, it is the LM317K. But, when using the unit, note an important difference as compared to the old LM309K. The case on the LM309K was ground so one could simply bolt the thing down on a chassis for heat sinking. The case on the LM317K is the output terminal, so it must be properly insulated from a chassis.

Various power supply ideas and considerations can suggest themselves for the LM317. For instance, R2, instead of being a variable resistor, can be replaced by switchable fixed resistors to obtain some of the commonly used supply voltages such as 6, 9, 12, 15 volts, etc. This idea, plus a continuously variable output voltage position, is featured in the practical realization of a power supply using the LM317 as shown in Fig. 3. This supply will deliver fixed output voltages of 6, 9, 12, and 15 volts (depending upon how the trim potentiometers are set), plus a continuously variable output of 1.2 to about 24 volts. All outputs can deliver at least 1.5 Amperes with the components specified. The supply is simple to build in any size metal enclosure suitable for the components used. The only precautions to observe are to firmly heat sink the LM317 to one side of the metal enclosure and to keep the 0.1 mF capacitor going from pin 3 to ground, the 10 mF capacitor going from pin 1 to ground, and the 120 Ohm resistor going between pins 2 and 1, *all* connected directly at the LM317 terminals. The other components may be mounted wherever it it convenient to do so.

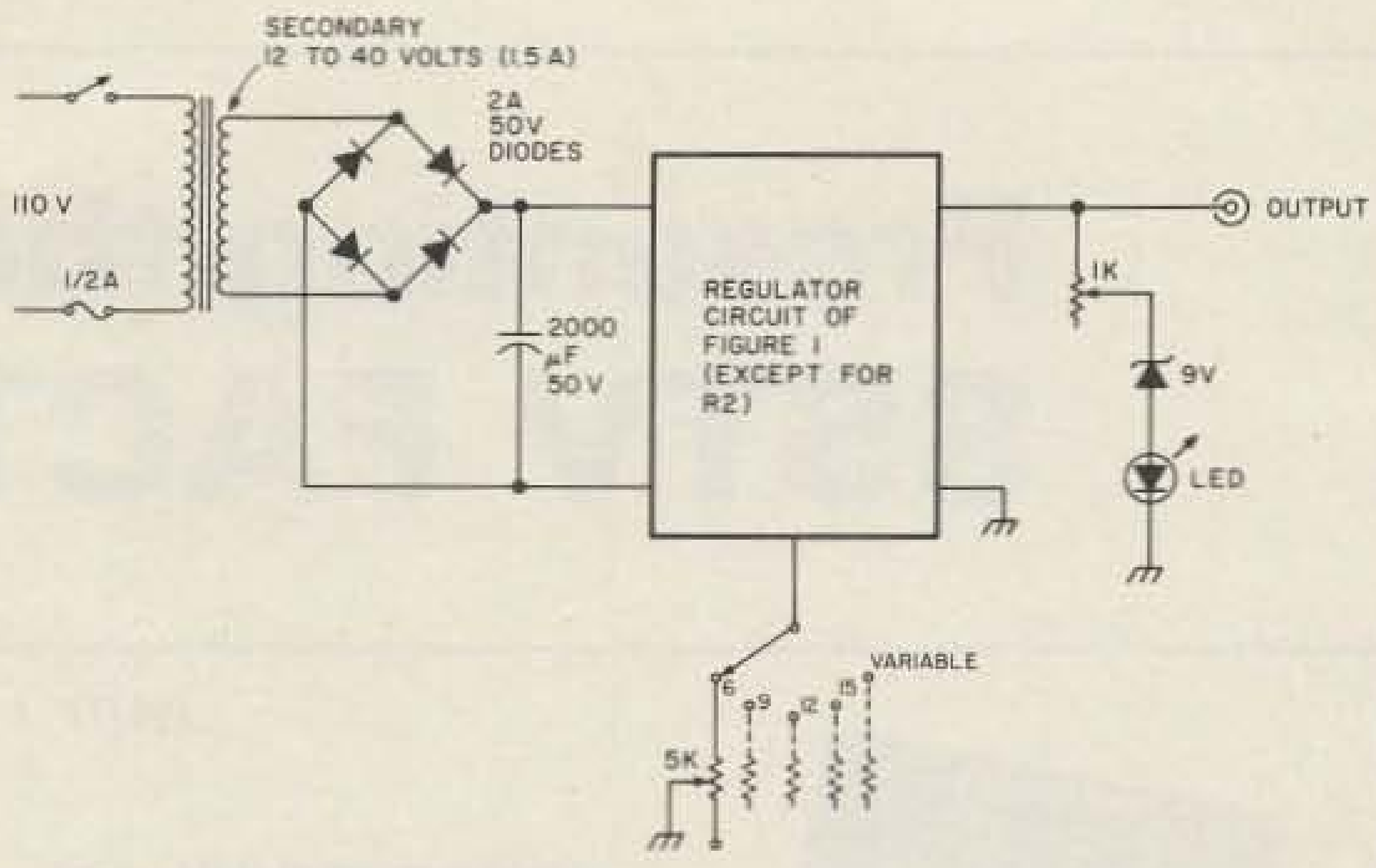


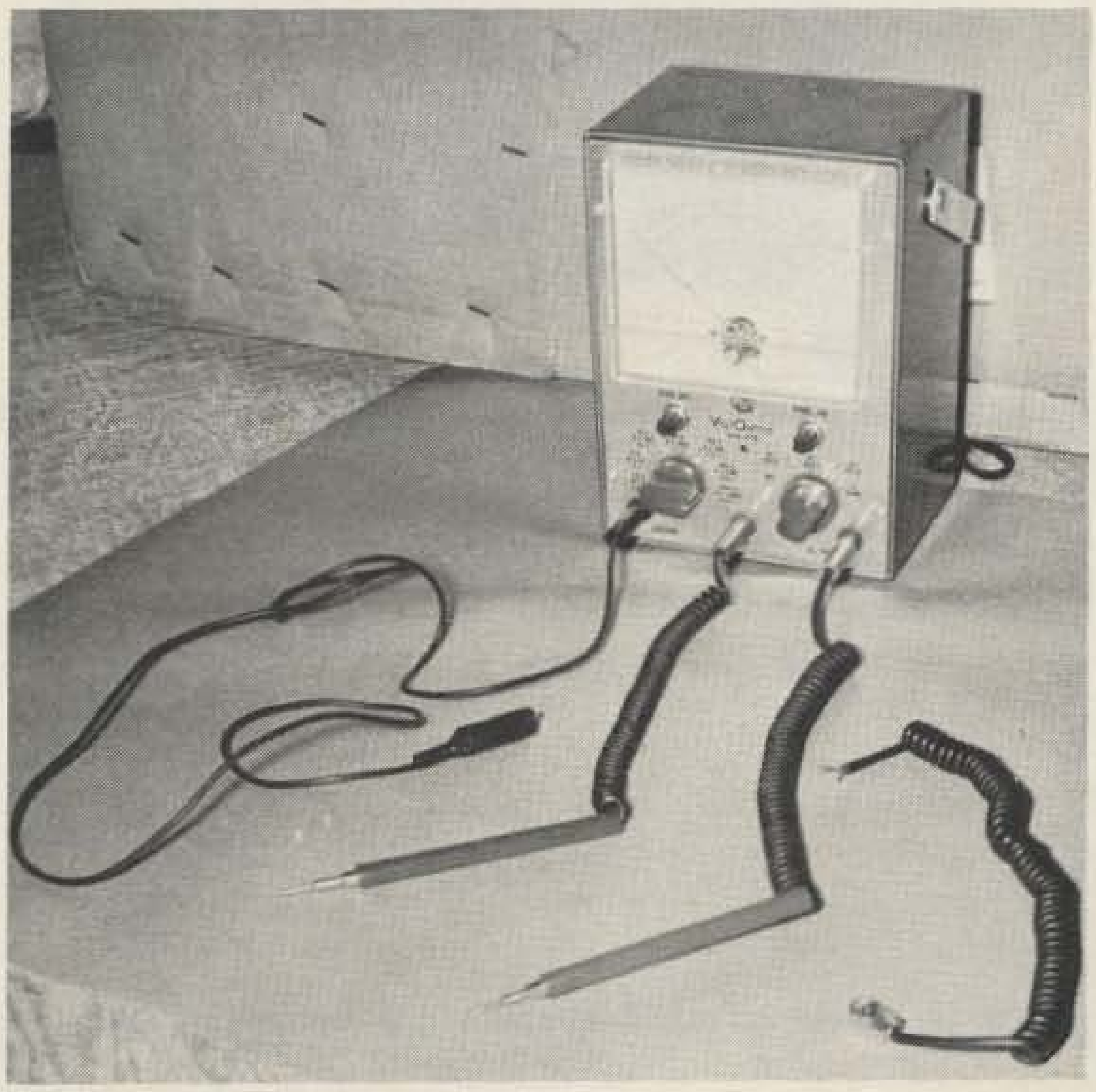
Fig. 3. A complete power supply using the LM317. The switch simply selects different 5k Ohm pots which are set for 6, 9, 12, 15, and a variable voltage output. The latter 5k pot is front panel mounted. The function of the LED is described in the text.

The zener diode/resistor/LED combination at the output of the supply serves as a crude but useful voltage output indicator without having to build a regular voltmeter in the supply. The LED just starts to glow when the output voltage is about 9-10 volts (depending on the tolerances of the components used). The 1k resistor is adjusted so the LED just glows fully when the *maximum* output voltage is reached. So by using the fixed output voltage positions (which are adjusted using a good VOM) and watching the LED, one can obtain a fairly good estimate of what the variable output voltage is set for. ■

Test Instrument Saver

-- an old phone is required

Harry J. Miller
991 42nd St.
Sarasota FL 33580



Delicate, costly test instruments may suffer severe damage when their conventional, too long leads snag on tools or on components spread out on the workbench and are inadvertently yanked off it to the floor.

A partial cure for this hazard is to replace the long leads with the much shorter coiled leads commonly used on cameras and flash units.

The coiled leads can be stretched out to where needed. When let go they retract out of harm's way. Should they lose their recoil power, rewinding the coils in the opposite direction helps restore their springiness.

Since each lead has two wires, their extra continuity gives them longer life. ■

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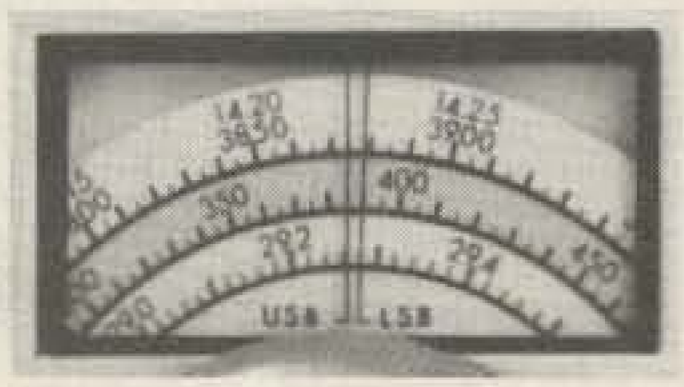

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Photoelectric Bench Accessory

-- when you need an extra "eye"

Combine the leftover power supply from an experiment that failed with some twelve for a dollar CdS photocells purchased from S.D. Sales. Mix well with a lull in regular ham activities and the result is an interesting unit with many uses.

The diagram in Fig. 1 shows the basic unit. The photocell is in series with a pot. There is a voltage applied across this series combination to ground. The op amp is used as nothing more than a high impedance driver for the one mil meter used as an indicator of *relative* light flux impinging on the cell. The word "relative" is important to note, as the meter is not calibrated in any special units. Its reading is comparative only and its function is to tell you that light has either increased or decreased at any specific moment. The pot is used to control sensitivity. The higher the resistance, the greater the sensitivity of the unit. The photocell is mounted on two back to back lids from 35 mm film containers of the plastic variety. One film can makes up the body of the probe. This has a hole cut in the side to allow the cell leads to exit. Exiting the leads from the side rather than through the bottom allows the probe to be firmly positioned relative to a light source. A second container has its bottom cut off and is used for a stray light shield around the cell. These details are apparent in the photograph.

Notice that there are two outputs: One is dc coupled through an isolating resistor and the other is ac coupled through a 3.3 uF capacitor.

With the values indicated, here is an idea of sensitivity for general use. An LED energized from an audio oscillator and held next to the cell will give about ½ volt of audio at the exciting frequency when the unit is at maximum sensitivity. This makes a handy bench coupler into your counter. A sixty Watt bulb in a white glass shade will pin the meter from a distance of about nine feet as will an ordinary two cell flashlight.

If you play around with QRP rf levels and are addicted to using pilot lamps as power indicators for tune-up, this unit will allow you to convert the light into a meter reading that seems much more sensitive to slight changes than the eye. When you are fighting for each milliwatt, this is very helpful.

The unit puts out a nice dc pulse with a flash of light hitting the cell. Thus the dc output can be used for triggering an SCR or used to bias the base of a transistor used as a switch or some form

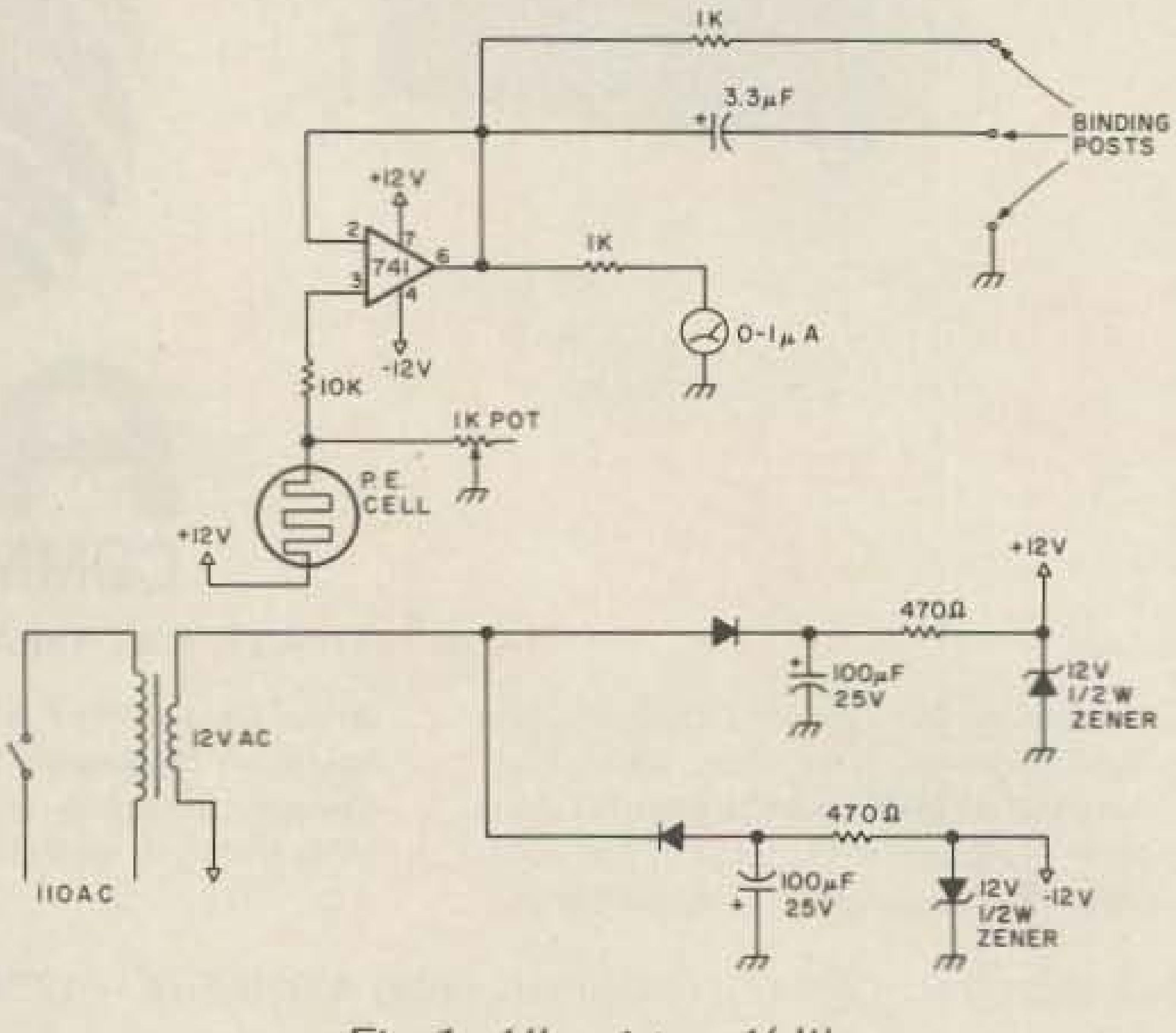

Fig. 1. All resistors ½ W.

of dc amplifier for control purposes.

If you wish to raise the overall sensitivity of the unit, merely increase the value of the pot to 5k or 10k. This will greatly raise the sensitivity but may create stray light problems. For general use, the indicated values work very well.

There is nothing magic about the voltages shown for the op amp; I used an existing supply, but six volts or so would work as well.

Note that there is no need to use shielded cable for the cell leads.

As with most projects, just about the time you get the last screw in place, there is that little voice whispering in your ear, saying, "I wonder what would happen if . . . ?" Well, this project was no exception. Fig. 2 shows what happens when you listen to little voices.

The ac power supply has disappeared, replaced by two C cells in series. The op amp has vanished because a more sensitive (50 microamp) meter has been used. The diode in series with the meter is used to provide a holdoff threshold effect so a small steady meter reading is cancelled. Either unit does about the same job of providing your bench with a photocell dimension that will find many uses. ■

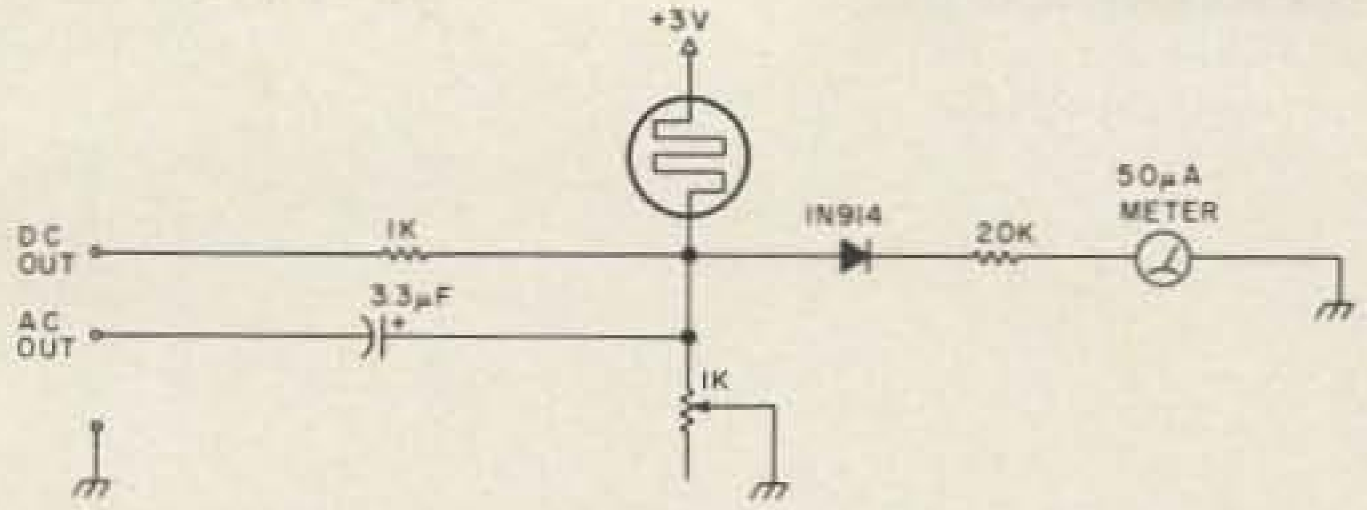

Fig. 2.

Eugene Doren WA6THG
6218 Calle Empinade
San Diego CA 92120

Inside the SR-52

-- calculator doubles as micro

If you are anything like me, this business of math formulas as used in electronics today is enough to scare you half to death.

Being a basically lazy but inquisitive sort, the need for mathematical answers when designing some pet project kept rearing its ugly head. About a year and a half ago I broke down and bought my first scientific calculator, a Texas Instruments SR-50. I loved this instrument, and its ease of use made those formulas I had hated in the past child's play. But the SR-50 had a nagging problem which took some of the edge off the fun. Its problem, simply stated, was only one memory. This fact made me resort to the pencil more times than I cared. Something had to be done.

Then one day, something was done. The first programmable calculator with multiple memory came upon the market. I fell in love instantly and dreamed of the day when I, too, could carry the wisdom of Solomon in my back pocket. But the early introduction price of almost $400.00 made me hesitate. Wisdom was fine, but for $400.00 I found that I could push an awful lot of pencils.

Gradually, as time wore on, I watched the prices drop until one day it broke the magic $200.00 figure, and I rushed with sweatstained, crumpled bills to my local calculator emporium to buy my first programmable calculator . . . no, not calculator but, rather, mini pocket computer . . . the magnificent SR-52.

Oh joy of joys, oh thrill of thrills, for the next two days I sat mesmerized by the winking, blinking, flashing numbers. At last the drudgery of math was truly defeated.

The programmable pocket computer is a very powerful tool, and, whether you write your own programs or use those of someone else, it is a constant joy. For those of you who have recently bought your first instrument but have not mastered the knack of programming, here is a simple program to calculate Xc, capacitive reactance.

Simply stated, the formula for capacitive reactance says: Xc in Ohms is equal to the reciprocal of frequency in Hertz times capacitance in farads times the quantity 2 pi. What a drag to wade through that humbug. But with the accompanying formual keyed into your favorite SR-52 or SR-56, it suddenly all becomes child's play.

Turn on your machine, press LRN and up pops 000 00. The first three zeros indicate the step number, and the last two zeros indicate the key to be pressed in teaching the calculator its smarts. An extremely well written set of books comes with each and every machine, and in the back of the small book with the SR-52 is a chart detailing each key as to its identification number.

Now, let's key into the machine the program in Table 1.

The formula turns out to be somewhat an unwieldy one to use, as who of us uses capacitance values in farads. In step 008 the machine is told to convert farads to microfarads by going automatically into scientific notation when "EE" is pressed, and then in step 009 and 010 we enter into the program, the minus 6th power of ten. This allows us, when entering the problem's values, to enter capacitance values in microfarads and let the machine convert it to farads. Further into the program we round off our answer to two places beyond the decimal point. This is done in step 033 where we fix the number of places after the decimal point to two in step 034. If we feel that we really don't need any portion of an Ohm in the final answer, step 034 could be keyed Ø instead and the machine will then round off the answer to no places to the right of the decimal. Later, in steps 040 and 041, we tell the machine to go back to its original 10 digit display and clear all memories for a complete new set of values. Isn't that beautiful?

Let's do a sample problem and watch this wondrous little gem go through its tricks. Let's suppose that we have discovered that upon

000	46	*LBL
001	11	A
002	42	STO
003	00	Ø
004	01	1
005	81	hlt
006	46	*LBL
007	12	B
008	52	EE
009	94	+/-
010	06	6
011	42	STO
012	00	Ø
013	02	2
014	81	HLT
015	46	*LBL
016	13	C
017	53	(
018	59	π
019	65	x
020	02	2
021	65	x
022	43	RCL
023	00	Ø
024	01	1
025	65	x
026	43	RCL
027	00	Ø
028	02	2
029	54	)
030	20	1/x
031	22	inv
032	52	EE
033	57	fix
034	02	2
035	81	HLT
036	46	LBL
037	15	E
038	25	CLR
039	47	*cms
040	22	inv
041	57	*fix
042	81	HLT

end of program

Table 1.

attempting to pipe a touchtone™ pad into our phase modulator and bypass all the mic stages, we still can't key up that autopatch down the road.

Hmmmm ... the lowest frequency used in the touchtone pad is 697 Hz, but the guys on the frequency all seem to agree that the high frequency tone is there, but the low frequency tone is very low in amplitude. Upon examination of the schematic we find that the coupling capacitor out of the interstage transformer in the mic circuit feeding the phase modulator is only an .02 uF.

Well, let's see ... picking up our trusty SR-52 and loading up the program, we enter the audio frequency value 697 into "A" and the coupling capacitor value .02 uF into "B". Depressing "C" tells us that the capacitive reactance of that .02 uF coupling capacitor is 11417.14 Ohms.

Gee, no wonder those guys on the autopatch can't hear the low frequency tone. Suppose we increase the capacitor value to .05 uF. What's the Xc value then? Returning to our miracle of miracles, we enter into "B" the new value .05 and once again press "C". Out spits 4566.86. Well, that's better, but not really good enough for the autopatch operation, so we try another capacitor value of .33 uF into the computer and out spits 691.95. I'll bet that works. Suddenly, after changing the capacitor to the new value of .33 uF, we find the autopatch swallowing our signal and keying up the dial tone.

If you have followed me through this exercise, you will now begin to appreciate this beautiful little handful of plastic and electrons. Loading some of the other programs that come with the instrument will truly open your eyes to the reason I, for one, will never be without my wondrous mental crutch. ■

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 190

and on for much of my life, it wouldn't have been much trouble to get a W1NSD call back when the getting was good. Goofed.

The current frenzy over two letter calls is fun. When I suggested to the FCC that they offer special calls as an incentive to get an Extra class license (in 1963), they said that hams identified with their calls and would never go for it. Instead, they opted to punish hams for not upgrading their licenses rather than offering an incentive such as a special call. They called it "incentive licensing."

At any rate, while most of us were tied to our calls, a few found ways around the red tape. The ones involved in the conviction of the FCC chap were K8MM, K8KD, K8RS, and K8RZ, all of which now appear to have been withdrawn. All Ohio boys ... odd, since the last I heard, Ohio wasn't yet officially one the United States. They really should be issuing their own calls out there and stop voting in our elections. But that's another story, and an interesting one. It seems the Ohio legislature never actually got around to ratifying the joining of the Union, and by the time this was discovered, everyone felt it was better to shut up and not make waves.

Getting back to those licenses ... I have noticed others have managed to get counterpart calls, while I'm still living out the remainder of my existence as W2NSD instead of W1NSD.

The newspaper article made a big deal out of one of the FCC officials getting his own initials for his call. Big deal. The FCC's answer to that was that they tried to make officials more visible when they operated. That's not a bad answer. Perhaps something even more visible ... like W3A ... would have been even more satisfactory. Those one letter calls do stand out!

THE NEW "REPEATER" BAND

Apparently there are a few amateurs who have noticed that while the FCC deregulated the 144.5-145.5 MHz band so repeaters could be used there, the FCC made no mention that repeaters *had* to be used there.

With only a small percentage of the currently operational repeaters being used much, it seems counterproductive (dumb?) to start allocating a whole new bunch of channels for repeaters. Yes, I know that every red-blooded ham will not be happy until he has found out how difficult it is to set up and run a repeater of his own. Yes, I know that few of us are able to learn from the experiences of others and that most of us prefer to make our own mistakes, no matter the expense in time and money.

As the past setter-upper and maintainer of some repeaters, I can testify as to the trouble and expense. As a matter of fact, I suppose I should write up some of the adventures in repeatering as a humor article for *73* – the wading through four feet of snow to get to a locked-up repeater – the two snowmobiles in the barn just to get to the repeater site – all so a small group of misfits who had been chased off every other repeater in New England would have a place to spend the remaining days of their unproductive lives.

Should I mention the purchase of the duplexer? It seems that when you use a duplexer there is a little problem which gets kind of glossed over in the literature ... temperature. Temperature is something of which there is a great lack on top of a New Hampshire mountain during the winter. So this chap (a *73* staffer), who shall have to go unnamed, figured out a fix for that problem ... he set up a heater near the duplexer and I just about had heart failure when the electric bill came the next spring ... $350 to heat that damned duplexer. Let me know if you want to buy a duplexer cheap ... very cheap. I gave away the repeater.

So, do we need a whole new raft of unused repeaters in the newly deregulated MHz, complete with the usual wars between SSBers, CW DXers, AMers, and all the groups who have already announced that they are ready and willing to go to war? Why is it that the very first reaction to any change is to threaten war? I get the feeling that a lot of hams are excited over the prospects of getting back to war ... it's more fun. Cooperation has led to very dull repeaters and a big loss of interest. Now, a good hot war ... ?

Well, you do what you like. I really don't care if the repeater fans (and I'm one) have terrible battles over whether to go 20 kHz splits, or 30 kHz with 15 kHz unusable splinters (who *ever* learns from experience?). And I'll cheer on the sidewinders and their forays against the terrible repeater groups ... and the AMers leaping out to do battle with any repeater which dares to set foot inside the new band ... etc.

If people want to be foolish and waste their time and energy fighting instead of inventing and pioneering and trying to move things ahead, I'll do what I can to ignore them. It's a pity ... just think of all the new things we could develop if we would spend our time in a positive manner. We could develop some fantastic repeater systems – with automatic calling and message handling – with microcomputer interface – perhaps as an adjunct to burglar, fire, water, etc., alarm systems in hams' houses – tied in with ELT for locating planes which are down ... etc.

Just why the FCC didn't open the rest of two meters to Techs is one of those mysteries. Frankly, I think that was dumb. If the lack of a full MHz hasn't forced Techs to get a General license in all these years, why will the lack of a half meg do it?

WARC PROPOSALS

A reader sent along a copy of some of the foreign proposals for band changes which might interest you ... particularly if you have been worrying about whether to buy a new rig now or wait for one which will include those promised new ham bands which we will be getting after the ITU meeting in 1979.

The BBC proposals (remember, that is the British government) are to resolve the sharing of the 7100-7300 kHz broadcast band with amateurs by re-allocation (moving out the amateurs). They further point out that it is necessary to at least double each of the shortwave broadcasting bands below 20 MHz. Guess whose bands would be affected?

The BBC also wants to use up most of the ham 220 MHz band with added television allocations ... up to at least 223 MHz. Whoops, there goes 220!

The BBC will not have things all their own way with this TV plan, for the C.E.P.T. (Central Europe governments) wants to allocate 174-235 MHz for mobile service. They also are proposing 41-68 MHz for mobile (there goes six meters!) and a mobile service in the 430-432 and 438-440 MHz bands, replacing amateur use of those bands. These decisions were reached at a meeting in Puerto de la Cruz in 1974 and revised at Malaga-Torremolinos in 1975. They will probably stick.

Obviously we may lose more than just our low bands at WARC.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of publication, 73 Magazine. 2. Date of filing, 28 Sept 1977. 3. Frequency of issue, Monthly. A. No. of issues published annually, 12. B. Annual subscription price, $15.00. 4. Location of known office of publication (Street, City, County, State and ZIP Code) (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 5. Location of the headquarters or general business offices of the publishers (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 6. Names and complete addresses of publisher, editor, and managing editor. Publisher (Name and Address) Wayne Green, Peterborough, N.H. 03458. Editor (Name and Address) Wayne Green, Peterborough, N.H. 03458. Managing Editor (Name and Address) Jack Burnett, Peterborough, N.H. 03458. 7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.) Name, 73 Inc., Peterborough, N.H. 03458. Wayne Green, Peterborough, N.H. 03458. 8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (If there are none, so state) Name, none. 9. For completion by nonprofit organizations authorized to mail at special rates (Section 132.122, PSM) The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one) Not applicable. 10. Extent and nature of circulation. (X) Average No. copies each issue during preceding 12 months. (Y) Actual No. copies of single issue published nearest to filing date. A. Total No. copies printed (Net Press Run) (X) 100,416 (Y) 102,341. B. Paid circulation 1. Sales through dealers and carriers, street vendors and counter sales, none. 2. Mail subscriptions (X) 93,880 (Y) 95,744. C. Total paid circulation (Sum of 10B1 and 10B2) (X) 93,880 (Y) 95,744. D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies (X) 1,786 (Y) 1,860. E. Total distribution (Sum of C and D) (X) 95,666 (Y) 97,604. F. Copies not distributed 1. Office use, left over, unaccounted, spoiled after printing (X) 4,300 (Y) 4,737. 2. Return from news agents (X) 450 (Y) 0. G. Total (Sum of E, F1 and 2 – should equal net press run shown in A) (X) 100,416 (Y) 102,341. 11. I certify that the statements made by me above are correct and complete. Signature and title of editor, publisher, business manager, or owner. Sherry Smythe, Business Manager.

Boost Your TR22!

-- with a mini rock crusher

Larry Levy WA2INM
1114 E. 18th St.
Brooklyn NY 11230

My TR22 is a very nice rig, but it is a little short on the power output side to reach some of the more distant repeaters full quieting. There have been several modifications published that would increase the power output of this rig, but they all have common drawbacks: 1) There is barely enough drive for the final that is in there now, so the drivers have to be reworked to give more power. 2) The increased power means increased battery drain for the times that I want to use it on battery power. And, 3) the increased power doesn't help my other HT, when I want to use that at the QTH or mobile.

The easiest and most flexible solution is to build an outboard power amp, which will connect to either HT and can be used in the car as well as the house. (Actually, given the price and effort to build these, you could build an extra and leave it in the car.) The cost for construction is under $15, and it takes less than an hour to build.

Depending upon the transistor used and the rig driving it, you will get 9 or 10 Watts out with a 2N5590. If you have a higher-powered HT or base rig, you could substitute a 2N6081 (1.5-2 W drive, 15 W out), a 2N6082 (3-5 W drive, 25 W out), or a 2N6083 (30 W out), or, if you have 7-10 W available, you might try a 2N6084 (40 W out) or 2N6097 (40 W).

These would all use the same basic amplifier circuit. The 2N5590 and most of the others listed are available from CeCo Communications, 2115 Avenue X, Brooklyn NY 11235 (a *73* advertiser), and are reasonably priced (the 2N5590 is about $6, the 2N6081 is about $7, currently, and the others are comparably priced).

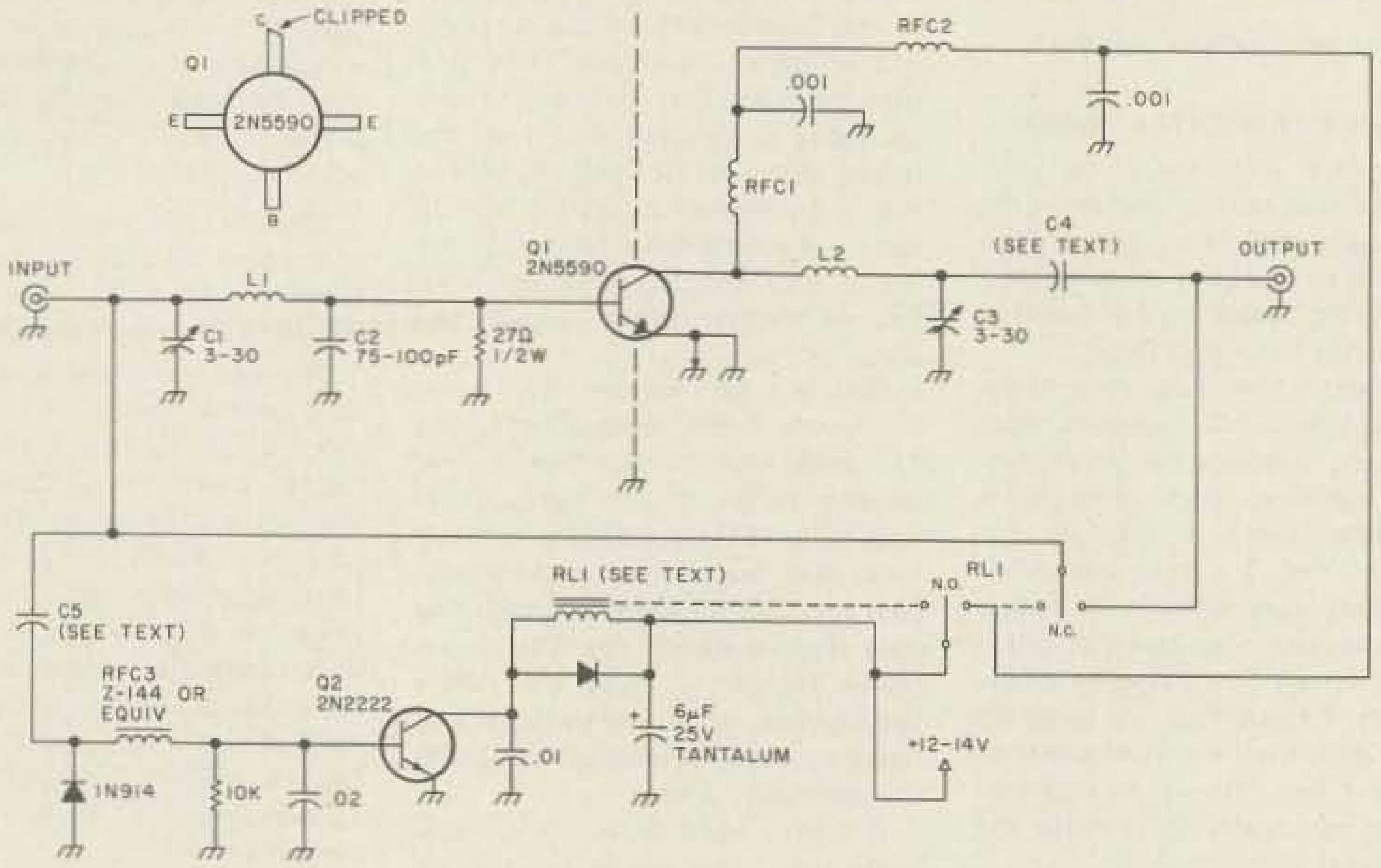

Fig. 1.

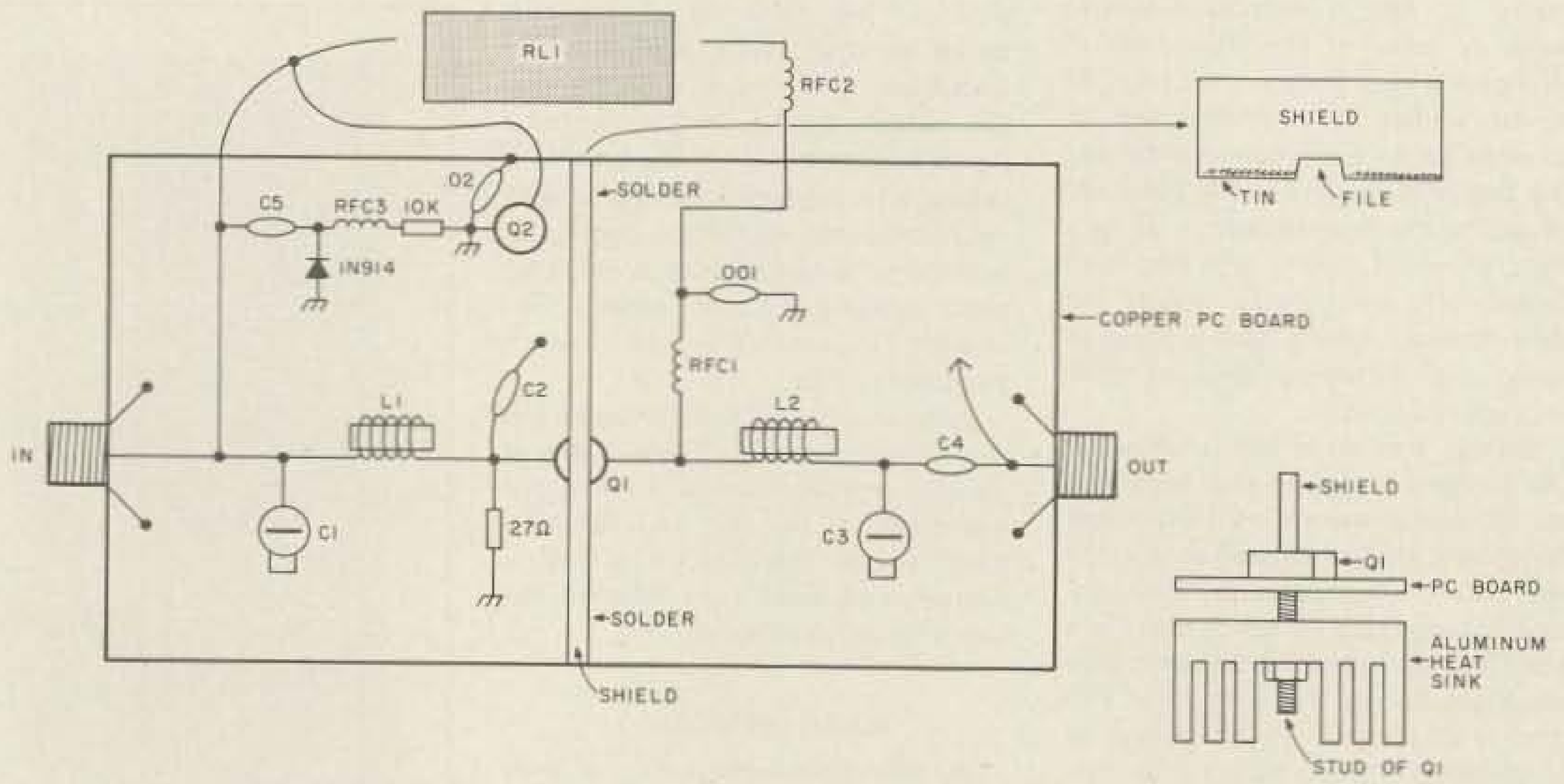

Fig. 2. L1 — 2½ turns #22 solid wire; L2 — same as L1, ¼" diameter spaced ¾"; RFC1-2 — approximately 6 turns #22 solid wire (insulated), ¼" diameter close spaced.

Construction

The amplifier is constructed on a piece of copper PC board, mounted on a finned aluminum heat sink. The stud of Q1 is used to mount the board to the heat sink. A scrap piece of PC board is filed to clear the case of Q1, and soldered to the main board after the transistor is mounted and the emitter tabs are soldered to the main board. This acts as a shield between the input and output circuits. Layout is simple (see Fig. 2) straight-line construction. RL1 is a DPDT 12 V relay, with 25-50 mA coil current. (A relay with a higher coil current could be used, but the 2N2222 type transistor should be replaced with one having a higher current rating. The cheap plastic TO-220 type audio transistors should work fine for this application.) Radio Shack stocks a relay with the right current, available for a few dollars.

L1 and L2 should be dipped, with a few feet of coax connected. C4 can be a disc ceramic, about 40 pF. If really fine tuning is desired, it could be replaced with a 50 or 60 pF trimmer. C5 is a 1.5-7 pF trimmer. It could be replaced with a fixed value cap, if desired. 2-3 pF should work for a small hand-held HT or TR22 (1-2 W range), or a gimmick could be used for the higher power rigs (when used with the higher power transistors). In either case, the minimum capacitance that will give reliable keying should be used.

Tune-up/Operation

Connect the amplifier to a power source, and connect a wattmeter to the output with a dummy load. Tune C1 and C3 (also C4, if variable) for maximum output. Now back down C5 until the relay drops out, and increase it slightly until it keys reliably.

You might now connect the wattmeter to the input and check swr. C2 may be varied to get the lowest swr (with retuning C1), if the swr is high. Connect the wattmeter to the output, connect an antenna, and repeak for maximum. This completes the tune-up. A switch may be added in the power lead, so the booster may be shut off if not needed. ■

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QRM on the Moon?

-- yep, on all bands

A while back, I had occasion to do some design work to determine the best frequency to be used by an explorer using a handie-talkie on the moon's surface. In that work, I had to calculate the signal levels arriving on the moon from all known Earth transmitters, to determine which frequencies were so QRMed that they would be a bad choice. The results were quite interesting in that they showed that most frequencies are already "occupied" on the moon by Earth QRM.

It may surprise you kilowatters to learn that your idle chatter bombards the moon with readable signal levels. If there had been moon people, they would have had little problem knowing all about Earthlings, since they could have merely turned on their radios and TV sets to monitor just about any station in the world broadcasting on frequencies above the broadcast band. Many persons will kind of suspect that TV signals with their 1 megawatt effective radiated power (ERP) might reach the moon, but few hams whom I have talked to even suspected that their QSOs regularly reached the moon.

Ham signals above 80 meters frequently reach the moon at enough strength to be quite readable, if a receiver up there using a decent antenna was tuned to the frequency. Most moderately powered transmitters that use dipoles, which radiate appreciable power straight up, reach the moon when it is high in the sky, providing the ionospheric critical frequency is low enough relative to the transmitting frequency to permit the signals to punch through at high radiation angles.

For those hams that may be rusty on their critical frequencies, Fig. 1 gives a typical summer and winter curve showing how these vary versus local time. In using this chart, remember that 12:00 local time is high noon by the sun, regardless of what your clock may indicate. Study of Fig. 1 reveals that the 40 meter signals punch through all the time except for a couple of hours each noon in the winter. Eighty meters punches through only late at night through early morning, and bands above 40 punch through always.

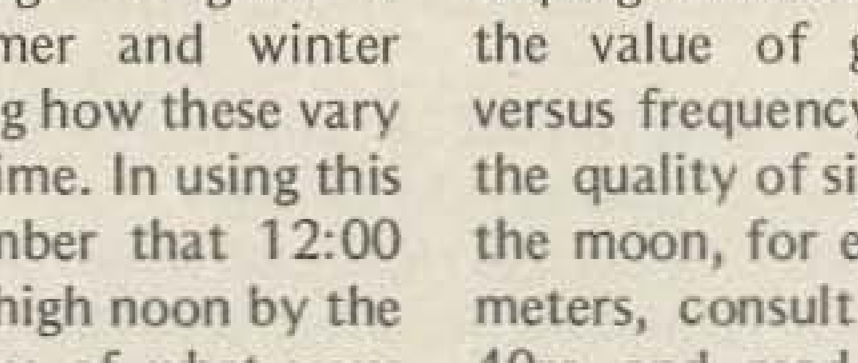

Fig. 1. Typical critical frequencies.

To show the signal levels arriving on the moon, Fig. 2 presents their level when the transmitter is 1 kW, and both the Earth transmitter and the moon receiver use ordinary dipole antennas. Notice that even on the moon one cannot escape static completely, since the galactic noise still prevails much stronger than pure receiver noise. The lower sloping curve on Fig. 2 shows the value of galactic noise versus frequency. To estimate the quality of signals reaching the moon, for example on 40 meters, consult the chart at 40m and read the received signal level as being -97 dB below a milliwatt (dBm). The galactic noise at 40m is about -107 dBm, so the signal to noise ratio will be about 10 dB in a 2 kHz SSB bandwidth, which is the bandwidth the chart is designed for. This 10 dB is not a very hot signal, but it is readable.

If antennas with vertical gain were being used instead of free space dipoles, such as, for instance, ordinary dipoles within a quarter wave of ground, a larger signal would prevail. For example, if a Super Gain[1] antenna was used on each end of the link, 14 dB more gain would result, giving a 24 dB signal to noise ratio, which is quite readable indeed. CW fans may rejoice in the fact that CW truly booms into the moon. This is because the human ear is equivalent to a 50 Hz effective pre-detection bandwidth, when using a receiver with a product detector. Therefore, CW has a bandwidth compression factor of 2000/50, or about 40 times, which amounts to 16 dB more signal to noise ratio over SSB voice. Thus, even a 100 Watt rig is very readable on the moon if CW is used.

Of course, there will still be the usual QRM from other hams on the same frequency, even on the moon. However, since beams and vertical antennas put very little signal straight up, those with such antennas will not QRM the moon, and the net result will be much less congestion on the moon.

The above values of signal levels are given in dBm, which are very familiar to all who do serious work in communications, but dBm may be unfamiliar to many hams whose usual jargon references signals in the notorious S meter system. I cannot convert to S values, since each receiver is different in its indication of S level, and gross differences even exist between similar units on a production run. However, the value of -97 dBm represents

[1] See *73*, Oct., 1970, pg. 8 for description.

3.8 uV in a 50 Ohm line. You will have to calibrate your receiver to determine what that would be in S units on your rig. Anyhow, this is a piddling signal for anyone who would try to communicate on Earth. Earth static and QRM are severe, and would completely mask such a weak signal. However, on the moon, such a signal, small though it is, would be above the noise and static far enough for useful communications.

So, you guys on the UFO net, be advised that the moon is listening, and one would be unwise to bad-mouth saucers, for this might offend some compulsive young saucer captain who may use his laser to ionize a conducting path between the nearest ripe thunderhead and your antenna, thereby delivering a bolt directly into the shack creating much smoke, reverence, and no doubt setting some record for the shortest though loudest digital message ever sent. Also, those who would like a temporary respite from our unresolvable terrestrial problems may want to contemplate what callsign the first moon DX expedition should have. ■

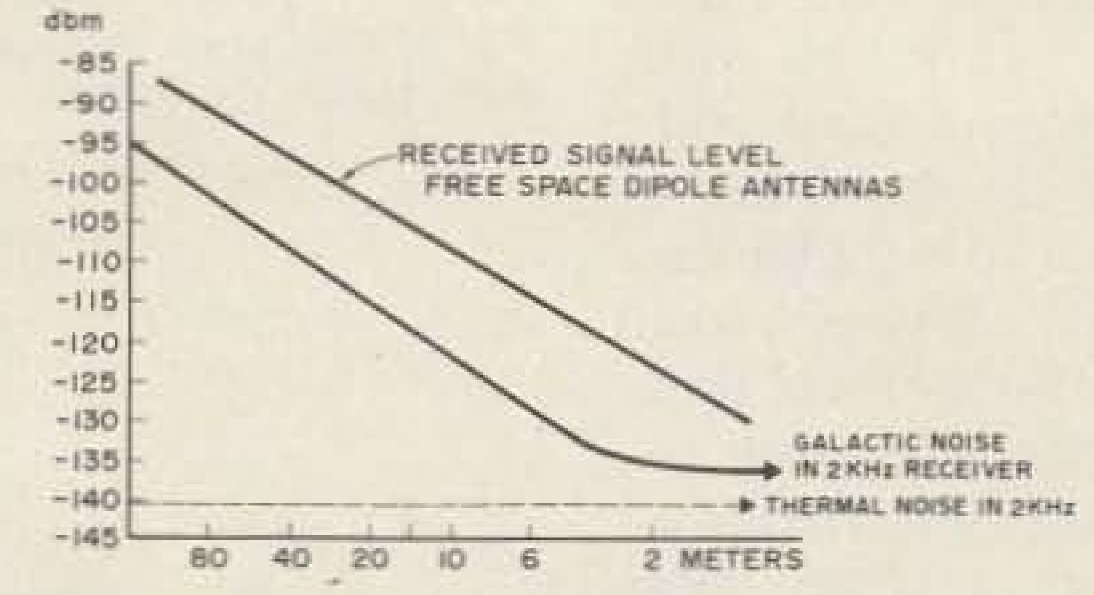

Fig. 2. Received signal levels on the moon in typical SSB receiver.

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Filcher Foiler Car Alarm

- - car door operated

I have been a VHF enthusiast from the time I first knew of the 2m band, and I prefer mobile work most of all. This was to my advantage while in the Navy, as I could take my QTH with me wherever I might be stationed.

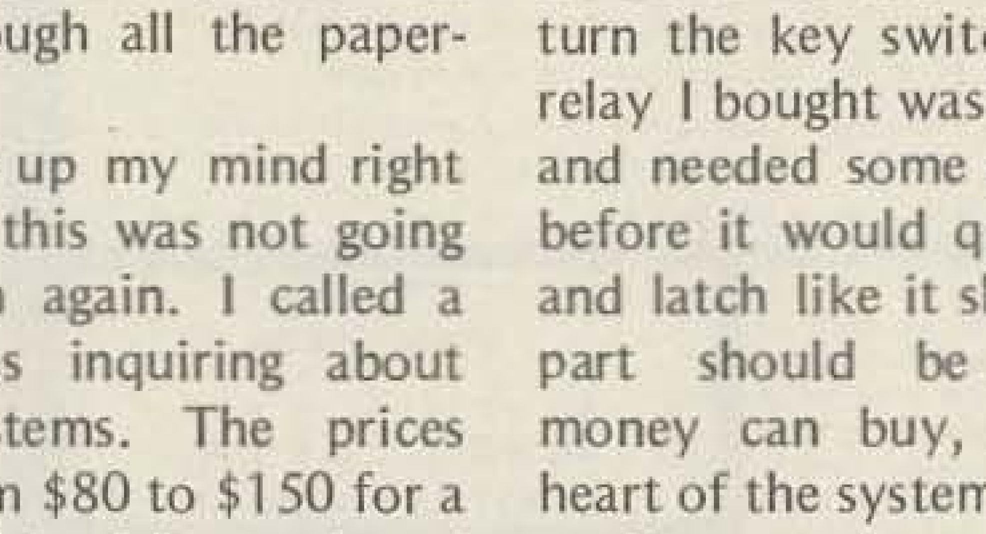
Now that I am a civilian, I decided to become more active and help save some of our frequencies. In Montana we had a great group on "two" but nowhere else in the VHF range. So, joined by another ham, I decided to do some work on 450 MHz. Since I own an IC-230, I fell in love with the IC-30a when I saw it. We both bought a unit at a great savings through the local dealer to help get our 450 effort off to a good start.

Since I owned a Pinto, I didn't really have the room for both rigs or two antennas, so I was always with one rig or the other. I soon tired of this ordeal (and decided to help the economy too) and bought myself a new Dodge van. Now this was big enough to hold my IC-230, IC-30a and my scanner, with enough roof to make the thing look like a porcupine. After weighing many options, I decided to make a shelf above the sun visors, since none of the rigs were more than two inches thick. I spent one whole weekend drilling holes, filing, sawing and having a great time. I then stood back and was pleased with what I saw. From left to right, the shelf was occupied by the IC-30a, the IC-230, the discriminator meter and, finally, the scanner. I still had plenty of room for a 6 meter or 220 rig in the future. I used the mounting hardware that came with the Icom gear. I put wood screws through the two holes in the clamps and affixed them to the shelf. I thought this way they were solid, but could be taken out if they ever failed (my first mistake).

Having never had any ham gear stolen, even in California, I didn't think about it. But I did always lock all the doors when I was away. Then I came out Saturday morning (one week later) to find my van raped and my IC-30a savagely ripped away from the shelf. The power and speaker cords were cut, but not the antenna, which had a slip on fitting since the SO-239 was metric. Once I got over the shock, I put out a QST (*A general call to hams, not a magazine. — Ed.*) on 2 meters to let them know what happened. In a daze, I then called the police and went through all the paperwork.

I made up my mind right then that this was not going to happen again. I called a few places inquiring about alarm systems. The prices varied from \$80 to \$150 for a complete job. I then gathered up my ham pride and decided I could build one for less money. After about ten minutes of head scratching, I came up with the circuit in Fig. 1. It is very simple and the total cost of parts came to about \$25 to \$30. All parts can be bought at Radio Shack except the door switches. They are the "dome light" type and must be bought at an auto parts store for about 79¢ each. If any door is opened the relay energizes and latches, putting plus battery to the noise maker. The only way to turn it off is to come to the vehicle and turn the key switch off. The relay I bought wasn't the best and needed some adjustment before it would quit buzzing and latch like it should. This part should be the best money can buy, as it's the heart of the system.

Since my van was new, it was a simple matter to install the door jam switches. Run all the wires to a common switch bus terminal, wire up the relay and mount the key switch. A mercury switch could be added so that if the vehicle is even bumped the alarm will go off. I now had a system ready to let me know if anyone got in. But how could I slow them down if they did get in?



The best way to come up with a solution is to think like a thief and figure out what would make it hard to take something. First, the nice mounting for the Icom gear had to go. I took the radio apart and found I had a lot of room inside near the front. So, I bought some "stove bolts" and drilled holes through the shelf and the bottom panel of the IC-230 case. With this bolted to the shelf, I put the radio back together around this bottom panel. This way, the thief would have to take the time to take the radio apart and, if he wanted the bottom panel, he would have to unbolt it. To do this, he would have to take the shelf down from the six flat iron brackets that hold it in place, with three screws through each of those. I did the same with my discriminator meter, but my scanner was another problem. There wasn't any room for stove bolts, so I put four wood screws through the bottom panel into the shelf with huge washers (2 inches across) under the countersunk screw head. I then put the scanner back together around this bottom panel.

It took me a half an hour to assemble the radios onto the shelf and put the shelf back into the van. I am sure that if they want them badly enough there is a way, but my arrangement should certainly slow them down.

As someone once said, "an ounce of prevention is better than a pound of cure," so naturally I had the van insured for everything. I found out that I should get all but the $25 deductible back from my insurance company. I had had the IC-230 individually insured but hadn't yet done so for the IC-30a. If so, I would be getting the total value back. I found out from my agent that, with the measures I had taken, there was no question about insuring against theft with a blanket policy "covering everything that's in the van at the time." This is at about the same cost as the single policy I now have on the IC-230.

Since there are a few of us who would rather run these "rice box rigs" instead of commercial gear, and since the rigs look a lot like CB rigs, we must do what we can to keep these nice rigs from being borrowed by our "break in" brothers. I hope what I have done might help at least one fellow ham hold onto what he has saved for years to buy and enjoy. ■

Be sure to include a mercury switch attached to the hood if your vehicle's battery is accessible without entering the passenger compartment. Thieves have been known to clip battery leads to disable alarm systems. — Ed.

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Quick Deviation Meter

-- for the IC-22A

Sooner or later a 2m FMer will find a need for a fairly reliable deviation meter. As is the case with most test gear, the cost of a commercially-prepared deviation meter doesn't make it a justifiable expense for the casual user.

However, being strong on need, yet weak in resources, an inexpensive deviation meter became a must for me. Going on the philosophy that a deviation meter is nothing more than a stable FM receiver with a visual readout, I took my trusty IC-22A and a VTVM and experimented. As a result, here's a quick and easy modification to an IC-22A which will allow for deviation measurement of other 2m FM transmitters.

Connect one end of a 9-inch length of #22 insulated wire to the junction of D2 and R43, located in the ratio detector circuit. Connect the other end of the wire to any open terminal on the accessory plug (Fig. 1).

Obtain, through any legitimate means, a VTVM with a 1 volt range and an rf probe (I used a Hewlett-Packard 410B and had excellent results). Attach the common lead to any ground point on the IC-22A. Plug the tip of the rf probe into the slot in the accessory plug which matches to the terminal now connected to the D2/R43 junction (Fig. 2). Turn on the IC-22A, and tune to any reasonably active frequency. Engage the squelch, so no noise is heard when no signal is present.

Now, turn on your VTVM, let it warm up, and set it for ac, 3 volt range. You'll notice that, when no signal is present, a fairly stable voltage of approximately 1.2 volts will be present. When an unmodulated signal is received, the voltage dips to roughly 0.8 volts. As modulation is applied to the signal, the voltage may then vary from approximately 0.8 to 1.0 volts.

In order to observe the variable voltage better, change the VTVM range control to its 1 volt position. Now, during a period of unmodulated signal input, adjust the meter setting to "0" or "center," whichever suits you best. As a result, when modulation is applied to the input signal, a meter movement following the pattern of the modulation will be observed. The observed modulation pattern will conform to the deviation of the input signal.

It is now necessary to compare meter readings to known deviations. I have found that on my IC-22A, utilizing a regulated 13.6 V dc supply, a peak deviation of 5 kHz will cause a peak voltage reading of 0.2 volts from my adjusted "0" setting. However, this may vary slightly on different IC-22As, depending on power supply stability, component accuracy, etc.

When using this quickie deviation meter, make sure that the input signal is not strong enough to desense the IC-22A. Also, be sure to measure deviation on a simplex frequency, not through a repeater. ■

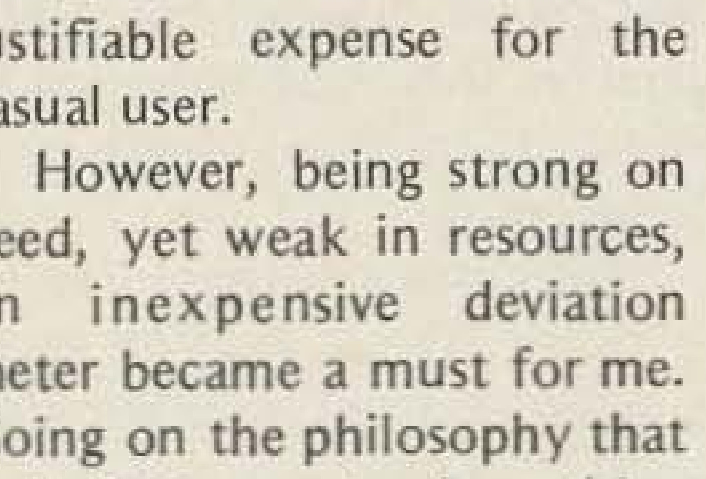

Fig. 1.

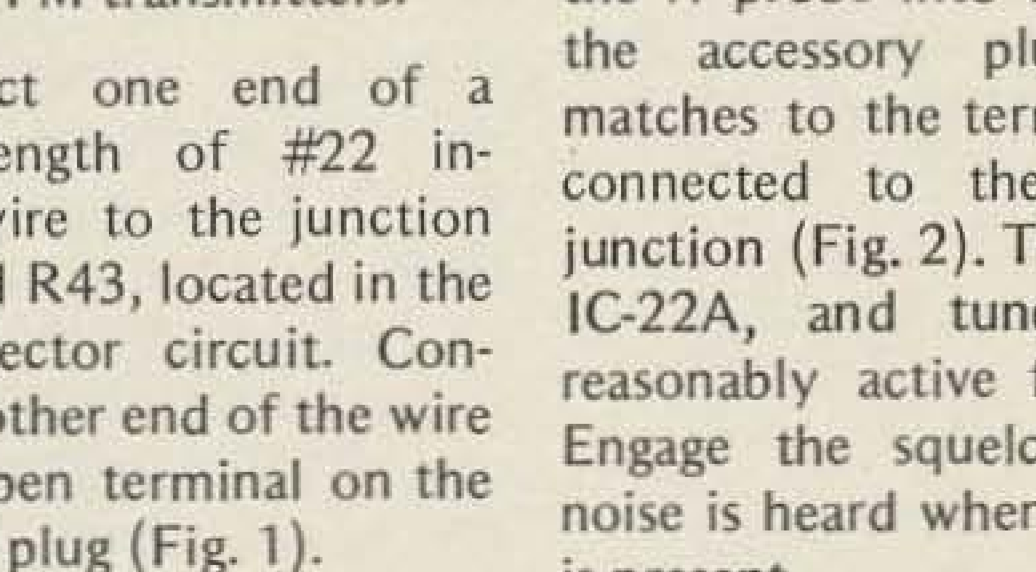

Fig. 2.

Build a Noise-free Power Supply

- - avoid spikes with sine waves

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I've been doing a lot of experimenting with miniature solid state receivers the last few years and in most cases have stuck with single 12 volt power supplies just in case I should want to use batteries at some time. Most of the ICs I use are designed for nominal 12 volt operation, and when a few op amps are sprinkled into the circuit, I generally offset the output to 6 volts by biasing the non-inverting input with a couple of resistors and ac coupling everything. This is common practice and in most cases quite satisfactory.

Then I became intrigued with the idea of using a PLL in one of my designs, but the NE561 needed at least 13 volts for satisfactory operation. Besides the PLL, I had several 741 op amps in the audio and agc circuits whose performance could be improved by the use of dual polarity supplies. An ac supply capable of providing 3 voltages was no problem, but battery operation would call for a converter of some kind.

In the past I've built my share of dc to dc converters using saturating cores and switching transistors, but it seemed I always had a terrible time taming these beasts. Tremendous spikes would show up on the output and cause all kinds of problems in the equipment being powered by this pulse generator. This time I decided to cut out the problem rather than try to cure it. Instead of the customary square waves, I thought I'd start with a pure sine wave and use an audio amplifier to build up the level to a value suitable for feeding into a power transformer.

The idea worked quite nicely and a schematic for the converter is shown in Fig. 1. The majority of the receiver circuits operated from 12 volts and were fed directly from the battery. The NE561 was run off the +15 output and the op amps from both outputs. My circuit drew about 5 mA from each output, but as much as 10 mA should be possible.

All kinds of chokes and transformers were tried in the oscillator tank circuit, but eventually it was found that a hand wound pot core inductor worked best. The pot cores I used were obsolete Ferroxcube parts, but similar units should work as well. Mine are about 3/8" in diameter and 5/16" thick with both halves assembled. Material is Ferroxcube 3C. The bobbin was wound with 800 turns of #44 magnet wire. On a homemade bridge, the inductance checked out around 700 millihenries. In the power supply the oscillator frequency is around 900 Hz.

An LM380N audio amplifier IC is used to drive the voice coil side of a standard 500 Ohm to 3.2 Ohm output transformer. I used Radio Shack #273-1379. The bridge rectifier is one of the small plastic units about the size of a T0-5 transistor case. The transformer center tap is grounded and the dual polarity voltages taken from either side of the bridge. Output level is set by the 5k vertical trimmer which controls drive to the LM380. This control should be set with the load connected. All decimal value capacitors are 50 volt discs and the rest are electrolytics. Resistors are ¼ Watt carbon. The silicon diode may be a 1N914 or any other type used for switching or general purposes. Other JFETs will work in most cases as the oscillator transistor. Just make sure you get the right pins in the right holes since not all packages have the same pinouts.

Tests made with ±15 volts out and 10 mA load on each supply showed a maximum ripple of 15 mV peak to peak. At 5 mA loads, the ripple dropped to 8 mV peak to peak. Input current from the 12 volt source was 85 mA and 55 mA respectively. This is not particularly good efficiency, but at these low levels it was of no great consequence. The 900 Hz hum was just about audible with the receiver quiet but normally was lost under background noise.

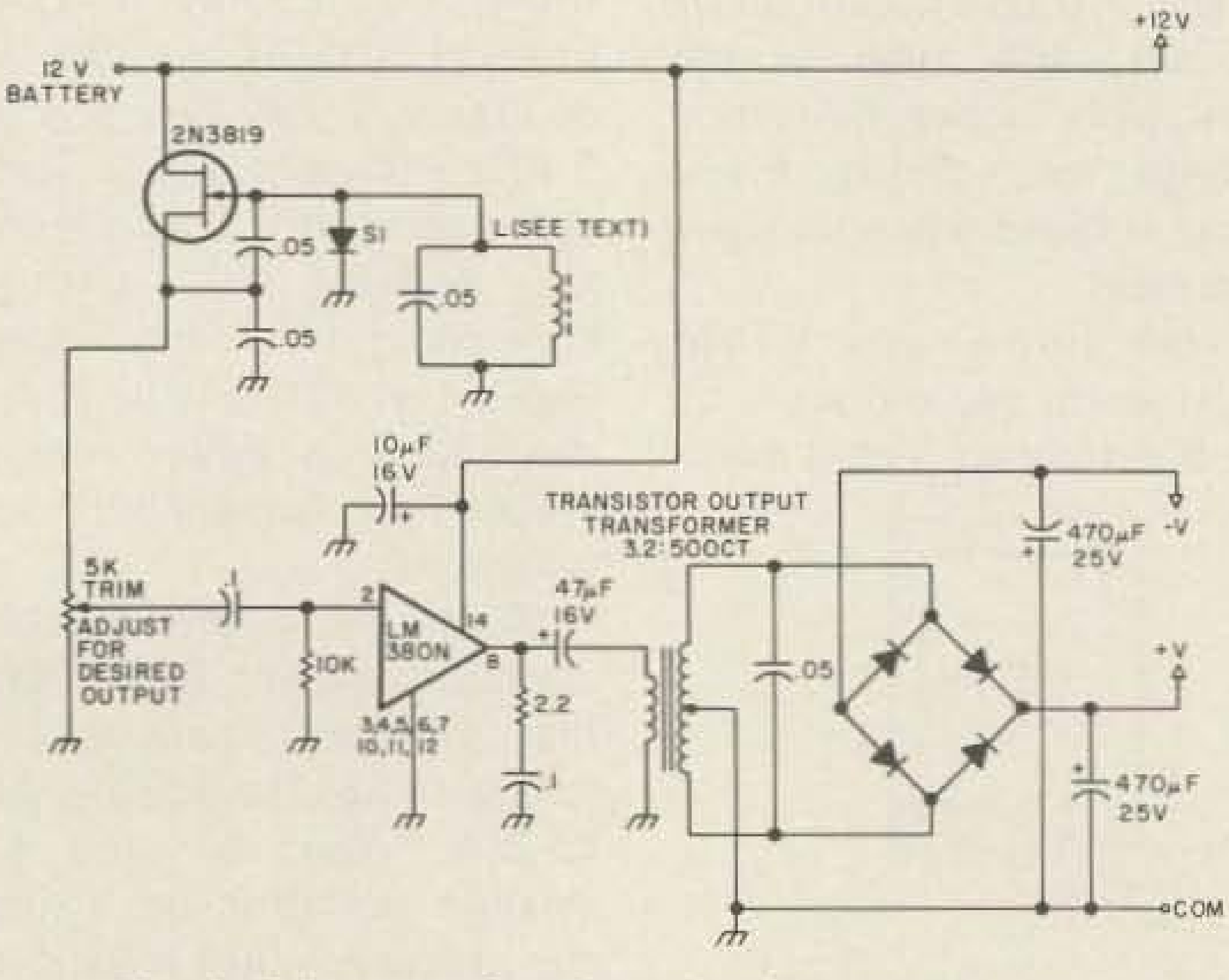
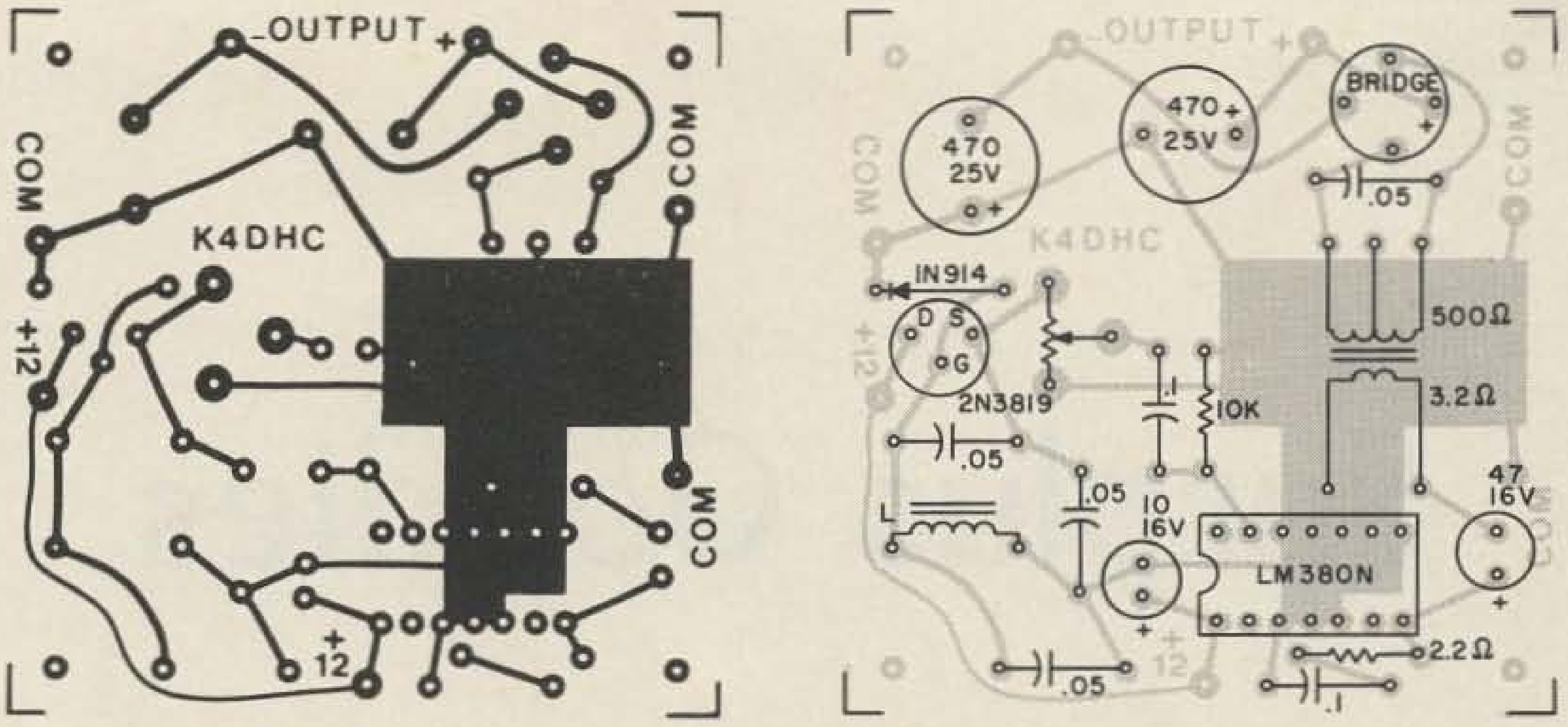


Fig. 1. Schematic for the spike-free power supply.

Fig. 2. PC board layout and parts location as viewed from copper side.



The PC board layout and parts placement are shown in Fig. 2. The board is 2.3" square. The pot core inductor was potted in a cylindrical form after winding and provided with 2 radial leads for insertion into the PC board. A finished inductor and undrilled board are available from me for $5 including postage. ■

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Surplus Goodies

- - are they really for you?

The question of whether or not government surplus is for the Novice deserves a simple answer, but an unqualified answer cannot be given. It resembles the question, "Should you build or buy?" The answer depends on the ability of the Novice. Generally, the surplus market is not for the Novice. The best advice is to look, but don't buy. It sounds easy, but surplus is sometimes difficult to leave alone. Many of the new units can't be utilized in their present forms, but they look so pretty that it is normally assumed a useful conversion is possible.

Leave it alone. Especially if you do not have the loot to play with. If you are lucky enough to become a Novice already possessing the knowledge and skills of an electronic technician, the value of the surplus will be apparent.

Another deterrent to buying government surplus is the new Novice regulations governing power and frequency control. Two hundred fifty Watts is unusual in military equipment. Most units are rated much lower in their outputs and are seldom worth the money if any thought is given to upgrading your license in the future. Yet the outlay of several hundred dollars to obtain one of the late model transceivers is not the wisest of moves if you consider the possibility of losing interest in amateur radio before advancing to a higher stage in the license process.

Assuming the interest is there but the money isn't, at least one surplus buy may be in order: a receiver. Check the bank account and see if you have ten or fifteen dollars that can be used for a trip to the nearest surplus or junk dealer that has government surplus materials in stock. Do not be influenced by the prices advertised by the many mail-order houses that dwell on the misinformed nontechnical Novice. Keep in mind that you can spend a bunch of green for a great receiver that will provide features you won't find anyplace else. I would recommend that you do so if it's affordable. There are many available at any price you would like to pay.

One of the most important steps to take before visiting the local surplus house or yard is to familiarize yourself with surplus equipment that has been used in amateur service during the past thirty years. Careful scanning of the catalogs issued by several of the surplus mail-order houses and, if they are available, old copies of various ham magazines can supply a great deal of information. There are a few units still available from World War II that require very little, if any, conversion.

A recent trip to the local surplus dealer to buy a piece of angle iron for a certain project turned up something more and is a common occurrence. Digging through towering piles of so-called junk left out in the weather, I found several old BC 342 receivers and ARR 7 receivers. The covers were in bad shape . . . paint flaking, mildew, and other indignations that had been thrust upon them by the years of bad weather and the rough handling that is apparent in a junk yard. Producing one of the small screwdrivers that I normally carry on my salvage trips, I had one of the receivers open in a flash. Everything was intact and spotless on the inside. The junker wanted ten bucks for the four receivers, two BC 342s and two ARR 7s. I offered him five and he settled on six if I took them all. I did.

The BC 342 is a big piece of reliable iron with tubes. It lacks many refinements but it will get you to 18 MHz, just short of 15 meters. It is better used as a general coverage radio, although many have been used in amateur service. It is one of the few that will operate unconverted.

The ARR 7 is a military version of the old Hallicrafters SX-28 modified to conform with most aircraft equipment of World War II. All the controls were moved to the end of the chassis so that the radio could be inserted lengthwise into the aircraft. The addition of an audio output transformer, a power supply, and a couple of wiring changes can provide an excellent and inexpensive way to listen in on all the activity from the broadcast band to above ten meters (.55-42 MHz). There have been later models but, as with most equipment, the price goes up along with the later release date. And sometimes it isn't as good in quality.

These are just two examples of what you can find if you do a little digging.

If you are like most who develop an interest in amateur radio, one of the first events that takes place is making friends with that guy down the street who has the wires hanging all over his house. If he is a do-it-yourselfer, you will learn something from him and he can give you a big assist in buying, building, or modifying existing equipment.

Besides a telegraph key, you can pick up a low power surplus transmitter that will perform satisfactorily. Contrary to the "power mongers" that are graduating from the CB ranks (if the shoe fits), it really isn't necessary for Novice operators to have a large transmitter output. The increase from a maximum 75 to 250 Watts input was apparently an attempt at appeasing manufacturers of equipment under the guise of providing an "extra" for the Novice. If the main interest is learning and increasing code speed, power isn't going to help. Fifty Watts more or less will do the job. There are many used commercial models selling for twenty or thirty dollars. Some for less. Most of these are crystal-controlled, which is the biggest drawback. A VFO (variable frequency oscillator) which allows the operator to dial the transmitting frequency is probably the one late improvement that nullifies the increase in power. If your signal is covered by a stronger station, a simple twist of the wrist and you can transmit somewhere else on the band.

With the addition of a transmitter, the one item that remains is an antenna. Several things will determine what your antenna requirements will be. The length of an eighty meter dipole in most cases makes it a difficult antenna to install. Since the main objective is to keep the cost down, the most logical is a dipole. Not only will this be less expensive, but also the results that are obtained are more satisfying. The problems involved are mainly with the area needed to install a piece of wire in the length required. If you intend to operate at night only, then you can eliminate the possibility of ten and fifteen meters and concentrate on putting up a little over sixty feet of wire. I personally preferred fifteen meters due to lack of noise, less crowds, and less room needed for the antenna. Regardless of which band you choose, you still have to have the antenna.

A unit that has been on the surplus market for years and is now obsolete contains the ingredients plus quite a few little odds and ends that you can have fun with. The old CRT-3 (Gibson Girl) survival radio transmitter can be found in almost any junk yard. If you don't know what one looks like, and you missed seeing Robert Taylor use one in the World War II movie, "Bataan," I shall try to describe one. In kit form it comes in a canvas bag with a lot of accessories: balloons, kite, hydrogen generators, telegrapher's key, parachute material, and antennas. Usually the transmitter is found without the accessories, and can be bought as scrap metal. It has a kidney shape with a folded handcrank. There is a door on the front case that contains a fully prepared reel of stranded copper wire. If it is a junk unit, the reel is easily removed. It may cost you two or three dollars at the most.

Any other "buys" of surplus gear would be a waste of money. Many of the items carried by the surplus dealers are truly bargains, but not for the Novice. Some test equipment and other units can save you a bunch of money at a later time when knowledge and experience overtake the desire to proceed to higher goals in amateur radio. This not only applies to the Novice, but also to the older group that is presently migrating into amateur radio.

With the equipment listed or other government surplus units, you can get on the air inexpensively and find out if amateur radio is really for you. There are many ways to equip the Novice station. This has been but one. There are other pieces of surplus that can be utilized without conversion, but the price eliminates the equipment from the bargain category.

The simplest method is to avoid surplus as a Novice. It will save you time and money. ■

Author's note: The December, 1962, issue of *73* featured a conversion article by James M. Stueber W5UOZ. It's one of the most complete ARR 7 conversions available.

Don Keith N4KC
462 Ridgewood Ave.
Fairfield AL 35064

Try A New Mode!

-- don't let boredom strike

I know exactly how it was. You snatched that Gettysburg-postmarked envelope out of the postman's hand, not even giving him a chance to give you the bills and junk mail, lit a streak down the basement steps, and had the filaments warming up while you tore into the thing. And there it was – your own amateur license, complete with totally unpronounceable call letters, indecipherable signature, and of a size so it wouldn't fit your wallet, no matter how you folded it. In short, it was beautiful!

Then you made that first contact, hand jerking spasmodically on the key, sweat dripping off the end of your nose onto the logbook. And from there, you fell deeper and deeper into the euphoria of amateur radio.

It could be now, though, that you've cooled down a bit. Call it the sophomore slump, the child-and-his-new-toy syndrome, or whatever, but you've reached a point where you don't really want to talk about the weather with that guy in California or get another 579 from New Jersey. You find "Starsky and Hutch" more interesting than a dead fifteen meter band. And when the ice storm gets your dipole, you keep forgetting to put it back up.

Recognize your symptoms?

There are two ways you can go now. Sit there, molting, and let your hobby, rig, and license go down the tubes. Or use a little imagination, inject some excitement back into amateur radio, and have the time of your life – even more fun than when you tore into that envelope from Gettysburg.

I'll bet we've all heard about the fellows who dropped out, letting their licenses lapse, blaming it on "twenty meters went to the dogs," or "I couldn't get my code up for the General," or "I was just so busy down at the office." With lame excuses like that, no wonder they couldn't muster up any imaginative ways to get some life back into their hobby.

If you will just stop to think about it, you can probably come up with many ways to perk up your enthusiasm, and most of them can be accomplished sitting right there in front of the rig. Can't think of any? Read on!

Have you ever checked into a traffic net or relayed a message from a homesick serviceman back home to his folks? One of the biggest thrills you can have is to hear a tearful mother's voice on the telephone thanking you for letting her know her son or daughter has survived an earthquake. I know from personal experience what satisfaction it is to allow a missionary in a remote South American jungle speak with his family back home. The day-to-day handling of formal messages on the ham bands involves hundreds of amateurs in a valuable public service activity.

You can find the nets in your area by listening or by sending a self-addressed, stamped envelope, 6" x 9" or larger, to the American Radio Relay League, requesting the net directory. The procedures used can be quickly learned by listening or by reading several ARRL publications which are available. There are also many slow speed or Novice nets, which offer a great introduction to traffic handling (and some super code practice, too).

Phone patching requires listening and volunteering when appropriate (and, of course, a patch!). The Military Affiliate Radio System (MARS) offers many a chance to perform a public service.

There are also plenty of special interest nets and round tables. Some specialize in assisting mobile operators, relaying traffic to missionary personnel or to ships at sea. Some are for physicians to assist in medical problems in remote areas. Whether you're interested in politics, religion, parapsychology, ecology, or a technical discussion, you can find somebody with similar interests, either by simply listening, or by watching for blurbs in the radio magazines. You might even send one in yourself. There are even professional group nets, such as attorneys, post office employees, and the like, who get on the air, not to just talk shop, but to share similar interests and experiences.

Like to play a little chess? There are many games and activities which lend themselves well to amateur radio. It may be a simple game of checkers or the complexity of "Diplomacy." You may practice your stamp collecting or discuss computer science. Practically any other hobby you enjoy can be combined with amateur radio, with the enjoyment multiplied.

Have you thought about experimenting with other modes? RTTY, slow scan or fast scan television, OSCAR, or even CW – all exotic life forms for engineers? Hardly! They are proving to be loads of fun for thousands of us who once thought we could never get the hang of such way-out weirdness. Expensive? Not necessarily. Build, find used gear, scrounge around – getting there is half the fun. And wait until you see that first SSTV picture from the Middle East or good teletype copy from a station in Japan. There are plenty of books available for the beginner in each of these specialized modes, and you will find that most people already involved like nothing better than to talk about their interests and will be glad to help a newcomer.

And though you probably worked pretty hard to get away from that 5 Watt limitation on the Citizens Band, you are missing a lot of challenging fun if you don't give QRP a try. Several QRP rigs have been featured in the various magazines, and more are available commercially. Sure, it can be frustrating fighting the full gallons with flea power, but when that fellow in Germany gives you a 589 and refuses to believe your 3 Watts input, then you'll know true happiness. QRP is sneaky, too, in that it makes you a better, smarter operator and forces you to learn a little about antennas and propagation.

There are a lot of things you can do off the air to get the fun back into your hobby.

You say you haven't built anything since the code practice oscillator when you were working on 5 words per minute? There are plenty of projects that are not only fun to build, but also are so useful you'll wonder how you ever did without them. Parts are as reasonable now as I can ever remember, with a friendly electronics store on practically every corner. There is no better way to get a firm grasp on the modern technology than to hook some of those funny little things together and see what happens. Even if you only thought a soldering iron was good for burning holes in the carpet, there are kits available that you can put together, get a good idea of how it all works, and have a good piece of gear when you're finished. I have a friend who tries to start a new project every week. He has never finished one, but he has a ball.

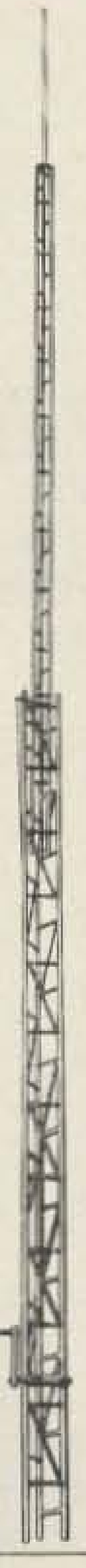
You may get out of the house and join a local club. Very few hams bite, and most are friendly sorts. And your club most likely has interesting programs and speakers, worthwhile fun projects, and maybe even coffee and doughnuts. There is also great satisfaction in participating in club projects, like public service activities, helping plan a hamfest, or presenting a program yourself.

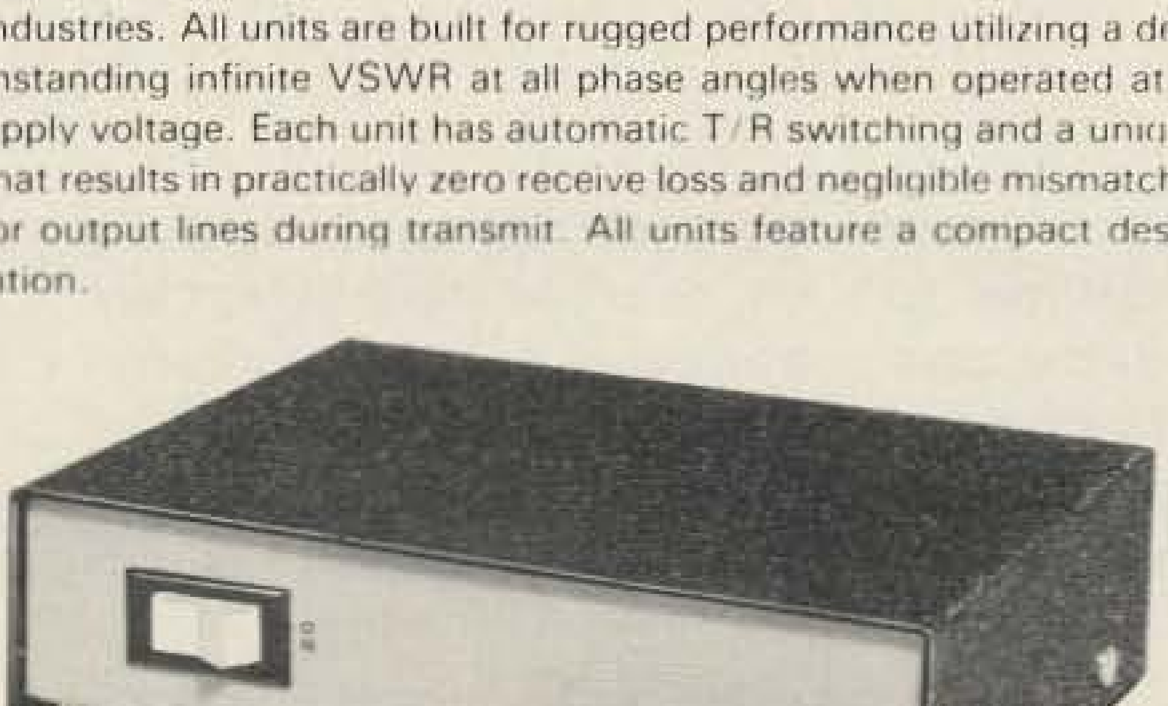
I don't know how you got started, but a lot of us attended formal classes. And classes like that need instructors. You? Sure, you can teach! Or maybe set up chairs in the classroom, work on publicizing the classes, or just help passing out books. Or you could do something on a smaller scale, like helping an interested prospect in the neighborhood or teaching a scout troop.

As long as you're volunteering, raise your hand for the work party at the repeater site. It's a great way to get to know the locals, learn a little about VHF by doing it, and do a little toward keeping the machine going. And you could also take part in the next disaster drill, too, or maybe help with communications for the motorcycle races, or man the information booth at the shopping center, or accept an operating assignment for Field Day, or demonstrate the rig for a school science class. You get the idea.

Then, you could even sit down and write an article about some of your projects for *73 Magazine*.

And then, if you can possibly find the time, you could sit down at the rig and have a good old-fashioned rag chew. ■





73 Magazine Staff

Build A Useful HF Receiver

-- Novice special

It is interesting to note how events sometimes go around full circle in the amateur radio field. Many years ago, the only way to have an amateur band receiver was to build one yourself. Then later on, as commercial equipment appeared, most amateurs regarded those who "rolled" their own receivers as a group of technical geniuses. Building a transmitter wasn't too difficult, but building a good receiver was another matter. A crude, crystal-controlled transmitter with plug-in coils could be built with a minimum of electrical/mechanical workshop facilities. But to build a good receiver required good test gear and practically machine shop facilities.

Today, with solid state components and PC layout technique, almost any amateur can build a receiver with performance matching commercial units. For those who would like to start to try their hand at receiver building, this article presents a simple HF utility type receiver. It can be used to monitor WWV, to check specific frequencies in the HF bands, or to monitor station transmissions.

As presented, it is crystal-controlled, although one could add a vfo for continuous tuning of its entire range or of just specific bands. With the addition of an audio-type CW filter, it would make an excellent little receiver for portable QRP operation.

The receiver is a single conversion, superheterodyne type, with an FET front end, and is crystal-controlled. No bandswitching is required when it is used over the 6-15 MHz range. Coil usage has been held to a minimum to simplify construction. Construction is also facilitated by the use of a single IC for all audio amplification and the use of a commercial i-f amplifier module.

The schematic for the receiver is shown in Fig. 1, as it would be used for WWV reception. Note that the only switching which has to be done to receive WWV on different frequencies is that necessary to select the appropriate local oscillator crystals. The frequency coverage can be extended below 6 MHz and above 15 MHz, by using a different coil between the MPF 102 (HEP 802) rf amplifier and mixer stages. Or, in the case of just extending coverage below 6 MHz, a 100-200 pF padding capacitor, across the 210 pF variable capacitor shown,

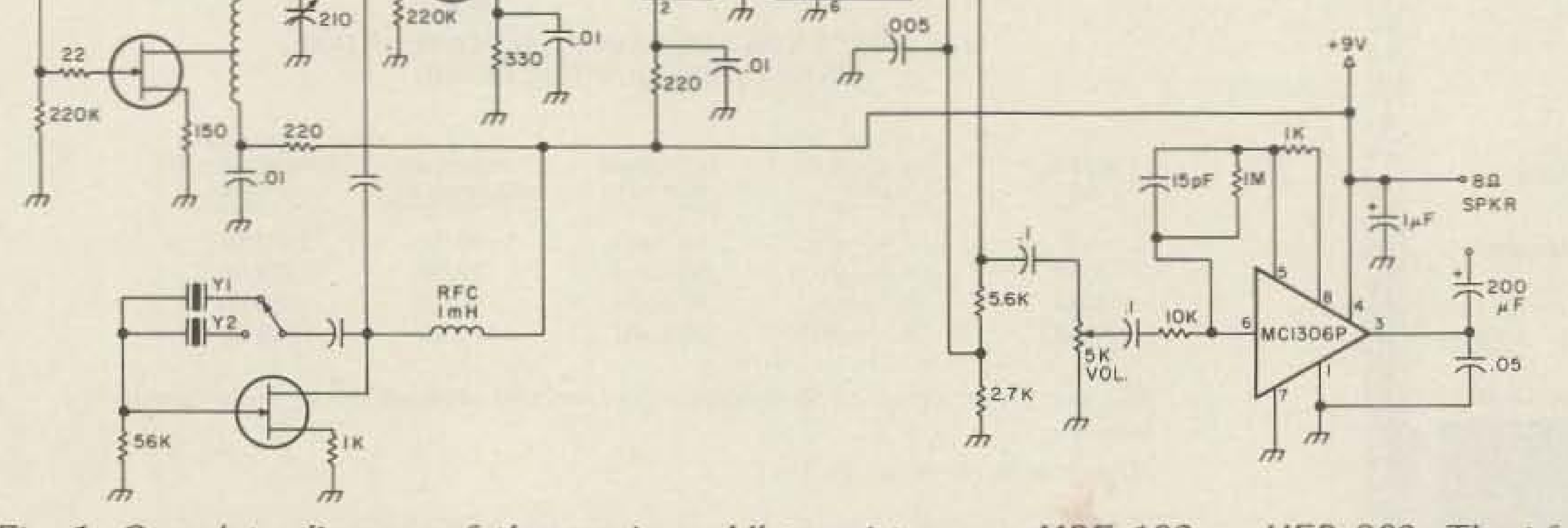


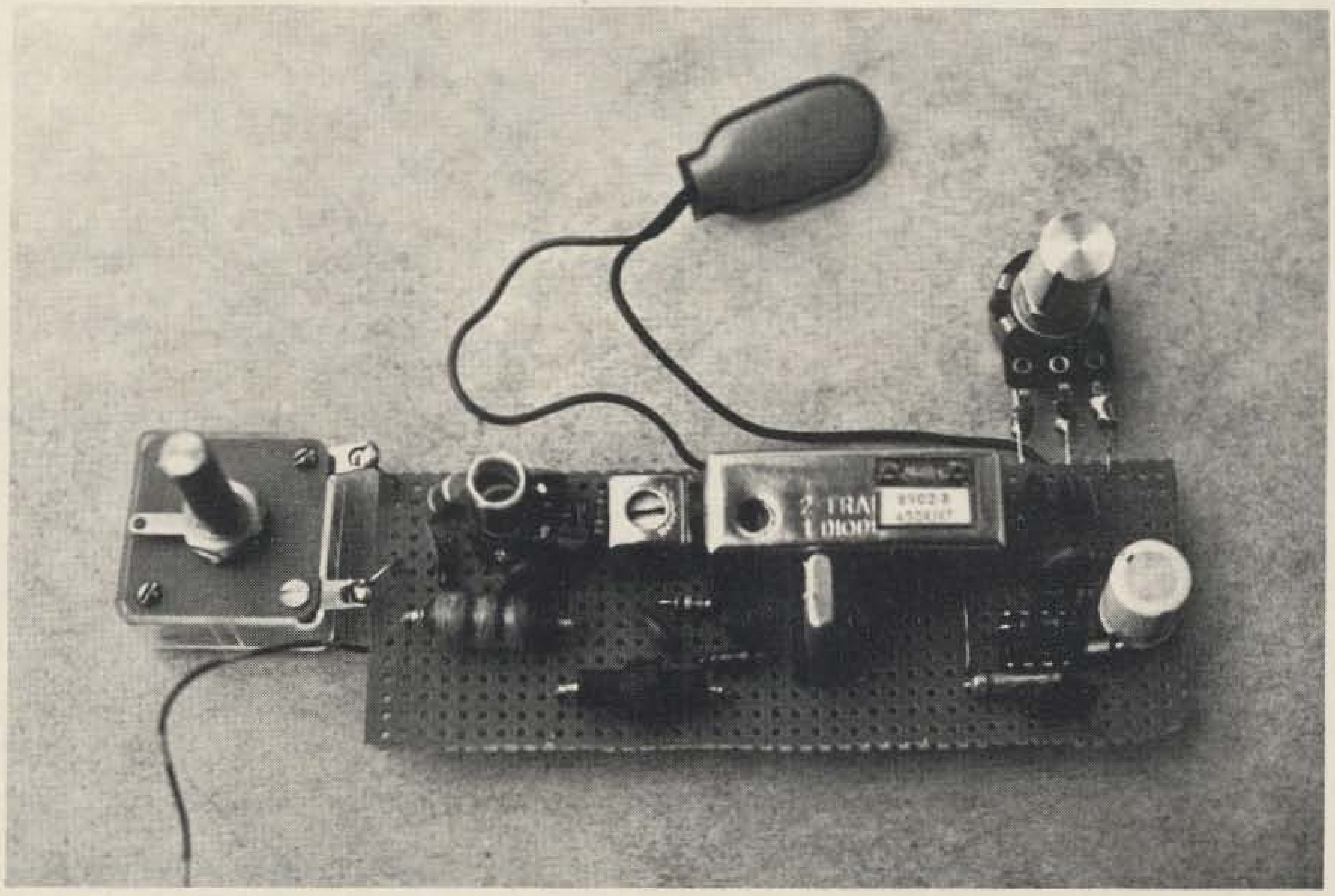
Fig. 1. Complete diagram of the receiver. All transistors are MPF 102 or HEP 802. The i-f transformer comes as part of the J. W. Miller i-f module. L = 26 turns #26 on ¼" form. Tap at 13 turns (for 6-15 MHz). Y1 = 9,545 kHz (10 MHz WWV). Y2 = 14,545 kHz (15 MHz WWV).

should extend coverage down to the 80 meter band.

The MPF 102 rf amplifier stage is untuned at its input. Its main purpose is to keep the antenna from loading down the tuned circuits between the rf amplifier and mixer stages. This single tuned circuit is sufficient to provide reasonable image rejection. The MPF 102 mixer stage and MPF 102 crystal oscillator stage are conventional. The oscillator stage is untuned. This has proven satisfactory for general reception, using regular miniature HC6/U type. crystals. With some sluggish crystals, the rfc shown in this stage may have to be replaced with a tuned circuit.

The i-f amplifier module is a J.W. Miller type 8902-B. This module is just a two-stage i-f amplifier, complete with all necessary i-f transformers, and it also includes an AM diode detector. Its use greatly simplifies construction. If one can't find it readily available, a simple substitute is to cannibalize the i-f section from a small transistor portable radio. But, use an i-f section which has at least two stages. The really cheap $5 portables often use only a single i-f stage, and this will not provide sufficient gain for any sort of reasonably sensitive reception.

The audio amplifier IC is a Motorola MC1306P. This is a neat, inexpensive ($1) IC, which combines a preamplifier and ½ Watt output amplifier in one package. A minimum of external components are needed to make it function. If you did "borrow" the i-f strip from a cheap AM portable to build this receiver, *don't* be tempted to "borrow" the audio section of the AM portable, also. Generally, the quality of such audio sections is horrible, when compared with the clean sound of the MC1306P used with any small, but decent, 8 Ohm speaker.



This is the complete receiver, as assembled on an approximately 4" x 2" piece of perforated board stock.

The photo shows how the receiver was initially laid out on a piece of perforated board stock. Simple point-to-point wiring was used. The layout wasn't planned, but, rather, construction started on a slightly larger piece of board stock. Starting with the rf amplifier stage, the components were simply grouped together as closely as possible, as I worked from left to right. The rf and mixer stages were grouped around the interstage coil. The crystal oscillator stage is below the i-f amplifier module, and the af amplifier IC is just to the left of the electrolytic capacitor, shown at the extreme right middle side of the board. When the receiver had been assembled, the oversize perforated board was carefully cut down to its final size.

The tuning capacitor used is a regular BC type and is temporarily shown attached at the left side of the board. The receiver should be mounted in a metal enclosure, and the ground leads used in the receiver should be carefully grounded to the enclosure at several points. Although the receiver did work fine wired as shown in the photo, it probably would be safer, from the viewpoint of avoiding possible spurious oscillations, to utilize an isolated pad type of component mounting/soldering technique. The relatively new Stamp-It, Etch-It kit, sold by Rainbow Electronics (see *73* ads), is a pretty handy way of developing an easy do-it-yourself PC layout for the receiver, if you like to take a bit more time but end up with a more professional-looking PC board.

To use the receiver to monitor SSB transmissions, a product detector and bfo have to be added. The circuit for a suitable product detector/bfo is shown in Fig. 2. It is relatively simple and inexpensive. If the product detector circuit is added to the receiver using the J.W. Miller i-f module, you have to remove the shield can from the module and take the i-f signal off the first 1N67A, *before* the diode detector is built into the module. This operation is fairly simple and obvious, if one uses the module, since a diagram comes with it, illustrating the modification. The diode AM detector need not be disconnected, however. So, one can, if desired, add a switch at the volume control to choose either the output of the product detector or the output of the AM diode detector.

With a mixture of some parts from one's junk box and newly-bought main components, the receiver can be constructed for about $20. This represents a rather modest cost for a utility-type HF receiver, for which one can find many applications around the shack or in portable use. ■

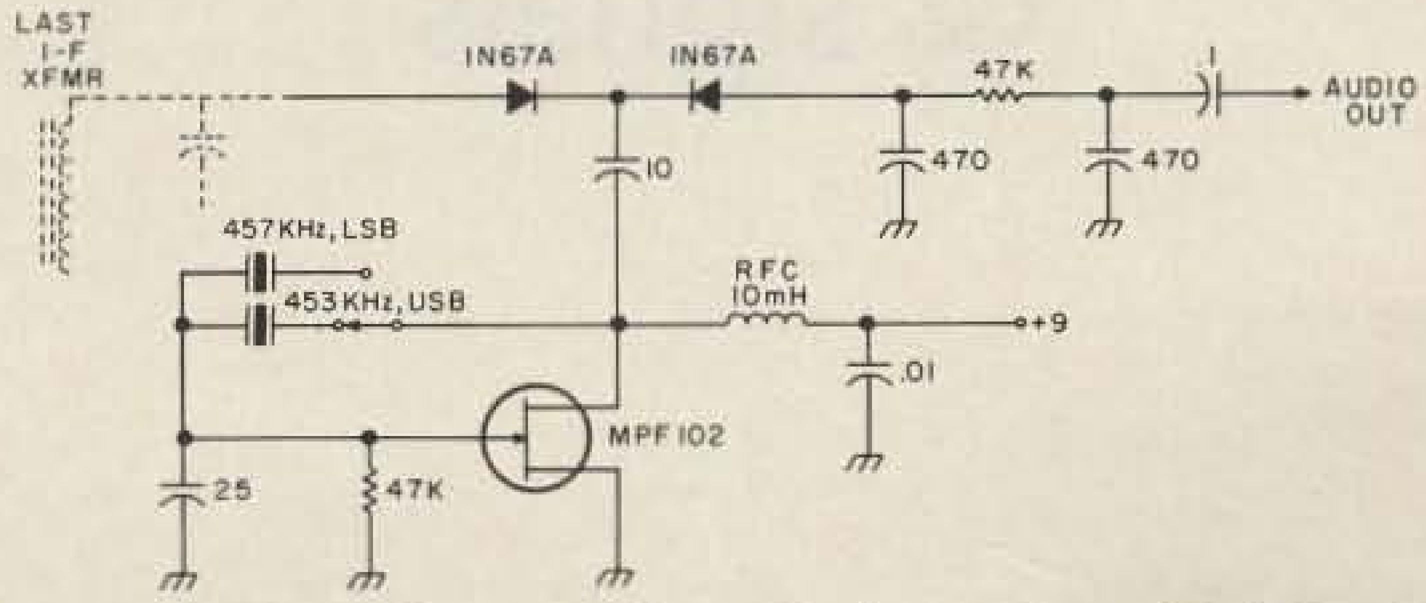


Fig. 2. Product detector/bfo, which can be added for SSB reception.

Wake Up A Dead Repeater!

- - with these new Q signals

Guy Slaughter K9AZG
753 W. Elizabeth Dr.
Crown Point IN 46307

Because the sophistication of state-of-the-art radio gear hasn't been matched by improved ham operating practices, it is often essential for an amateur to vent his spleen over the air in one or another of a patterned program of careful comments.

And no such comments, despite the need for their frequent repetition and the necessity of avoiding actual profanity, are the subjects of any of the "Q" signals on the traditional list.

I have developed, therefore, a suggested list of updated state-of-the-operating-art "Q" signals intended to lower the blood pressure and restore tranquillity without violating the FCC "no obscenities" regulation.

There undoubtedly will be others recommended by other hams.

My suggested list, therefore, is open to amendments, revisions, additions and modifications by fellow hams also frustrated by the shortcomings of other operators and the traditional list of "Q" signals.

Welcome to recommend such amendments or revisions are all who have within the past year sat in for even a few minutes on a DX contest, a sweepstakes, or a band opening to a rare call area.

Because the purpose of the proposed list is to help vent the emotions sure to be seething in the modern ham handicapped by others' operating techniques, most of the suggested "Q" signals are assertions, not the bland and polite question-and-response types of the outmoded traditional list.

They are most useful when delivered as commands or comments, with feeling. ■

QXA	Hey, dolt, tune up someplace else.
QXB	Drop dead, oaf, my dummy load is busted.
QXC	Quit calling through his comeback, jerky.
QXD	I gotta call long, because I'm running low power to a poor antenna with a lousy fist.
QXE	He's listening up two, but you'd better go down five.
QXF	Buzz off, buster. I got here first.
QXG	Slow down, finkie. Your dits sound like ignition noise.
QXH	Speed it up, nipsie. Code practice is over and the band is going out.
QXI	You're working the wrong street, friend. They only use AM on 27 now.
QXJ	Sign, for goodness sakes. I've been waiting 20 minutes to put your call in the log.
QXK	Quit calling through his comeback, dummies.
QXL	Don't expect a card, OM. I don't keep a log.
QXM	Don't gimme that exotic call from Illinois, Mac. I could care less about your state fair station.
QXN	Boy, you gotta lousy fist.
QXO	I worked him before, anyway.
QXP	That ain't hum on me. I'm just blocking your receiver.
QXQ	(Expletive deleted – this is the biggy, the quick tension releaser. It's bad, nasty and very helpful in a crisis. But it should be saved for true crises.)
QXR	I told you before, dang it – quit calling through the rare cat's comeback.
QXS	I copied you solid, 100 per cent, OM, but I can't remember what you said.
QXT	I'm not working for my Extra, cuz I don't believe in that incentive jazz.
QXU	All solid state here. Someday I'm gonna lift the lid and see what's inside.
QXV	I wish to QXQ you QXQers would quit calling through the rare guy's comeback.
QXW	Nil copy, cuz them QXQers keep calling through your comeback.
QXX	I'm reporting you blind, cuz them QXQers keep calling through your comeback.
QXY	I distinctly heard a "G," so I'm gonna put you in the log – even though them QXQers keep calling through your comeback.
QXZ	Where'd everybody go?

Social Events

HAZEL PARK MI
DEC 4

The Hazel Park Amateur Radio Club is holding their 12th annual Swap & Shop on December 4, 1977, at the Hazel Park High School. Admission is $1.00 at the door. Main prize tickets are available from Robert Numerick WB8ZPN, 23737 Couzens, Hazel Park MI 48030. Reserve table space is available from WB8ZPN.

NORTH POLE
DEC 6-17

The Calgary Amateur Radio Association is pleased to announce "Operation Santa Claus" will be activated again this year. Commencing December 6 until December 17 inclusive. CARA will be operating between 0200Z and 0300Z on 3790 kHz and between 0300Z and 0400Z on 3910 kHz. These frequencies are plus or minus QRM. At that time there will be two stations on frequency, a net control station and a Santa Claus station. All calls, from amateur stations with children wishing to speak to Saint Nick at the North Pole, will be accepted. Merry Christmas.

ROYAL OAK MI
JAN 8

The Oak Park Amateur Radio Club's Ninth Annual Swap n' Shop will be Sunday, January 8, 1978, at the Frost Junior High School in Oak Park (north of Nine Mile on Scotia). Talk-in on 52/52. Admission is $2 — ample table space. Hours are from 8 am to 3 pm. Prizes and refreshments. For further into, write to: Lee Ricelli WA8RNB, 118 South Pleasant, Royal Oak MI 48067.

SOUTH BEND IN
JAN 8

A Swap & Shop will be held January 8, 1978, at the New Century Center in downtown South Bend by river on U.S. 31 Oneway North across from St. Joseph Bank Building. Half acre in one large room at ground level of entrances and loading dock. Four lane highways to door from all directions. Talk in on 52-52 and area repeaters.

RICHMOND VA
JAN 15

The Richmond, Virginia, Winterfest will be held on January 15, 1978, at the Bon Air Community Center, sponsored by the Richmond Amateur Telecommunications Society. ARRL coordinated. Technical symposium, drawing, home brewers contest — 2 divisions, over 18 and under — with framed certificate to winners with Most Original Idea, Best Mechanical and Best Electrical Construction. FCC exams will be administered, starting at 10 am — to take exam, mail Form 610 at least five days prior to Fest to address below. Send SASE if you need Form 610. Commercial exhibits, indoor flea market, $2.00 (table included), outdoor frostbite tailgate flea market, $1.00. Admission $2, children under 12 free. RATS members excluded from contest and drawing. Talk-in on 28-88 and 52 simplex. Richmond Amateur Telecommunications Society, PO Box 1070, Richmond VA 23208.

FORT WAYNE IN
JAN 22

The annual Fort Wayne Winter Hamfest will be held on January 22 at Shiloh Hall, north of Fort Wayne, from 8 am until 4 pm local time. Early parking is available and 28/88 and 52/52 will be monitored. This yearly event is sponsored by the Allen County Amateur Radio Technical Society (AC/ARTS). Admission is $2.00 at the door. Table space is available at $1.50 per half table (about 4 feet).

ST JOSEPH MO
JAN 31-MAR 7

The Missouri Western State College Center for Continuing Education is offering a Novice amateur radio class on Monday evenings, 7 to 9 pm, January 31 through March 7, at the Engineering Tech. Bldg. 110. 6 meetings $5.

DAVENPORT IA
FEB 26

The Davenport Radio Amateur Club hamfest will be held on February 26, 1978, at the Masonic Temple in Davenport, Iowa. Admission is $2.00 advance, $2.50 at door. Talk-in will be on 28/88 and 52 simplex. Tables will be available at $2.00 each. For info and tickets, write: Dick Lane WAØGXC, 116 Park Avenue So., Eldridge IA 52748.

Ham Help

I'm asking the help of anyone who can help me get started on SSTV. Any help, information, and/or tips will be greatly appreciated.

Steve Ketler WA1WFA
85 Columbus Avenue
West Bridgewater MA 02379

I recently purchased a theater projection television system. The problem is that I need a picture tube and service information. The set is built by RCA, model PT-100. The picture tube is a 7NP4 or 7WP4. Neither the tube nor manual are available.

I realize that your magazine is mostly amateur radio, and while I am not yet a ham, I do have a 1st phone and repair commercial equipment for a living. I also service amateur gear as well. This TV system is not the small home-type that was popular years ago and is making a comeback. It is a huge commercial projection set that is often used to present fights and races in movie theaters. This unit is quite old, so there are no parts or info available today. It's a very impressive piece of gear, and I would love to make it work again. I never plan to use it commercially. I feel that some reader of your magazine might be able to help me get this monster going.

Bruce Gentry
624 Plymouth Ave.
Mattydale NY 13211

I am a reader of *73*, am not a ham (yet), but need help. The help I need is the answer to this question: Where can I buy a good, used "pan adapter" — that is, an oscilloscope device which visually displays all signals on a 300-500 kHz band? I would consider a new one, if it wouldn't cost the moon. My receiver is a National HRO 600. Any ideas?

Lawrence J. Gutter
President
Chicagoland Broadcasters, Inc.
2622 W. Peterson Ave.
Chicago IL 60659

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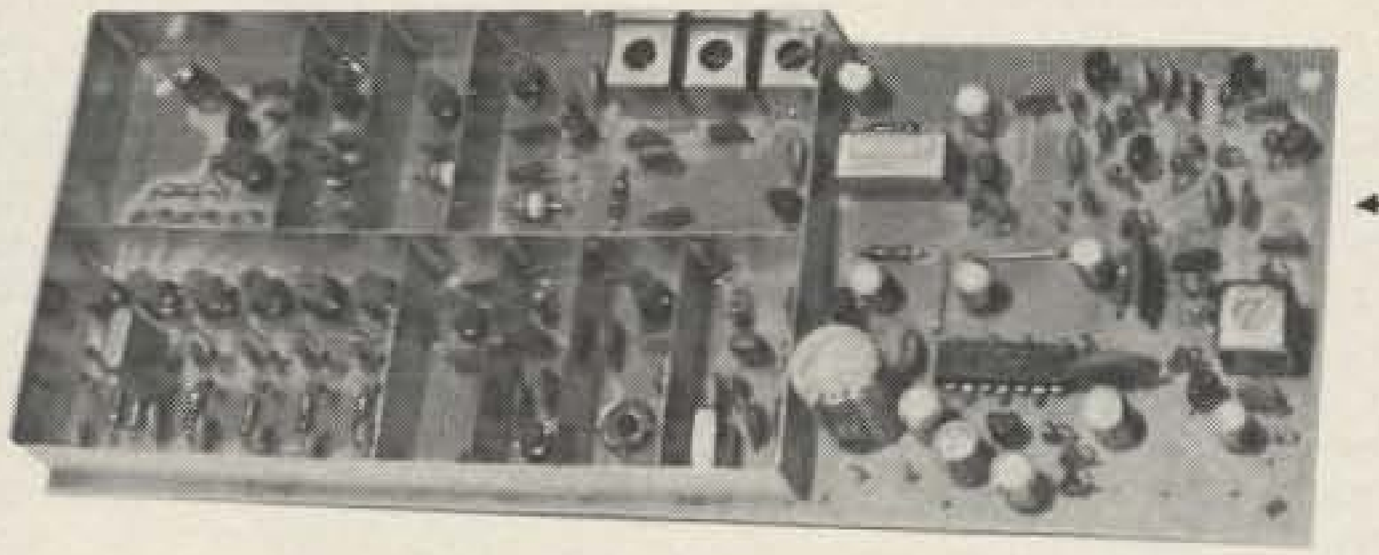

VHF MODEL R70 $69.95
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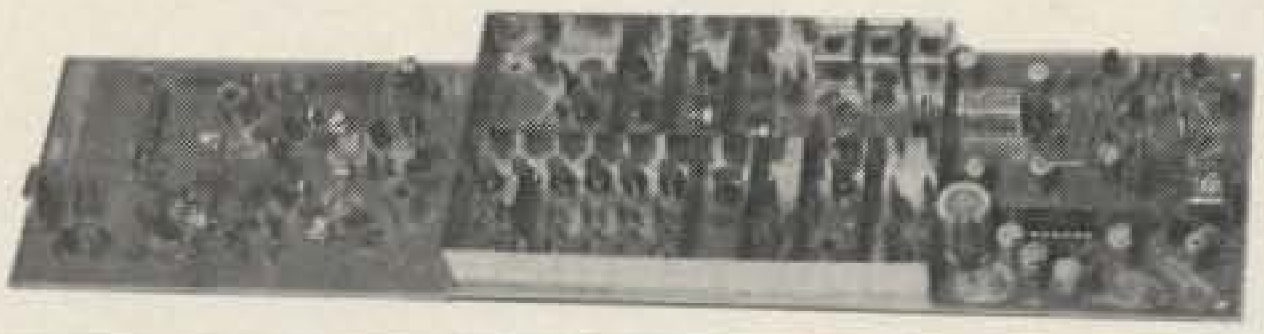

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MODEL	RANGE
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MODEL	RANGE
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C144	144-146	28-30
C145	145-147	28-30
C146	146-148	28-30
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Special	Other rf & i-f ranges are available on special request	

MODEL	RF RANGE (MHZ)	IF RANGE
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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.

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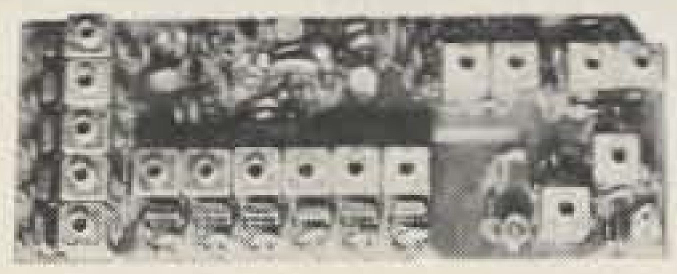
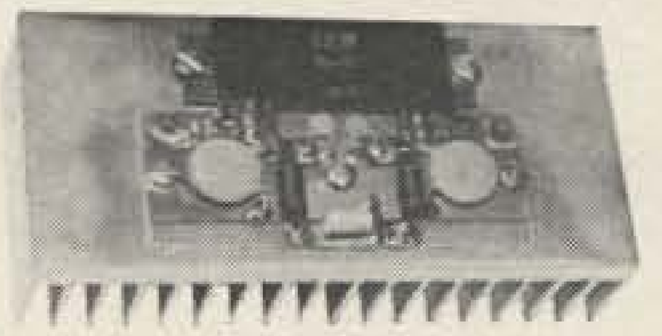


200 MW EXCITER MODULE KITS

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



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T80-450, 430-470 MHz, 13-15W....... $79.95

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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

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1977 Index

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NON-LINEAR SYSTEMS, INC.

60 MHz FREQUENCY COUNTER
Model FM-7

LOW COST, completely portable, battery operated, rugged seven digit counter featuring LSI construction and overload protection for field or lab use. Small enough to be hand held. Frequency Range can be extended to 512 MHz using Model SC-5 Prescaler.

Includes 4-AA rechargeable Nicad batteries and charger, for battery or AC operation, and test leads. Also available are optional leather carrying case, handle and tilt-stand or panel mount flange.

DISPLAY: 7-digit LED, 0.33" high
FREQUENCY RANGE: 10 Hz-60 MHz in 2 ranges; expandable to 512 MHz using SC-5 Prescaler
ACCURACY: ±(1 count ± time base accuracy)
TIME BASE: Internal Crystal 2.097152 MHz; Stability < 10 ppm/year (aging), ±10 ppm (temperature 0° to +40°C), ±2 ppm (battery voltage +4.5 to +6.5V)
SENSITIVITY: 30 mV (50 Hz-30 MHz), 100 mV (10-50 Hz; 30-60 MHz)
RESOLUTION: 1 Hz (10 MHz range); 10 Hz (60 MHz range)
INPUT IMPEDANCE: 1 MΩ
MAX. INPUT VOLTAGE: ±100 VDC; 250V RMS (10 Hz-500 kHz) to 5V RMS (25-60 MHz)
SIZE: 2.7 x 1.9 x 4" deep; WEIGHT: 9.2 ounces

Model FM-7	Counter	$195.00
Model FM-7/LH	Counter with Tilt Stand	198.50
Model FM-7/PH	Counter with Panel Mount Flange	199.00
Part #39-439	Leather Case	16.00
Part #39-452-2	Tilt Stand Case	5.00
Part #39-454-2	Panel-Mount Flange Case	6.00

512 MHz PRESCALER
Model SC-5

LOW COST, portable battery operated prescaler extends the frequency range of the FM-7 Frequency Meter (or any 50 MHz frequency meter with 50 Ω Input) to 512 MHz.

Includes 4-AA rechargeable Nicad batteries and charger for battery or AC operation, and interface and input cables. Available accessories are: Tilt-Stand, Leather Carrying Case and Panel Mount Flange.

FREQUENCY RANGE: 20 MHz-512 MHz
SENSITIVITY: 30 mV RMS
MAX. INPUT: 4V RMS
OUTPUT: 2 MHz-51.2 MHz, 100 mV RMS
INPUT IMPEDANCE: 50Ω
SIZE: 2.7 x 1.9 x 4" deep

Model SC-5 Prescaler	$89.00
Model SC-5/LH Prescaler with Tilt Stand	92.50
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15 MHZ OSCILLOSCOPE • MODEL MS-15

COMPACT, completely portable, BATTERY operated 15 MHz mini-oscilloscope providing BIG, BIG Performance at a LOW, LOW Price. Features improved circuitry for field or lab use.

Includes rechargeable batteries, charger for battery or AC operation and input probe. Also available are 10MΩ, 10:1 probe and leather carrying case.

BANDWIDTH: 15 MHz
VERTICAL GAIN: 10mV-50V/div. ±3%
TIME BASE: 0.1uS-0.5S/div. ±3%
INPUT SENSITIVITY: Vertical 10mV; Horizontal 1V; Internal Trigger < 1 div.; External Trigger < 1V
VIEWING AREA: 1.35"W x 1.1"H (graticle 0.25" divisions)
SIZE: 6.4"W x 2.7"H x 7.5"D;
WEIGHT: 3 lbs.

ACCESSORIES

41-140 Leather Carrying Case	$30.00
41-141 10MΩ, 10:1 Probe	24.50

Compact DIGITAL MULTIMETERS

LOW COST, rugged digital multimeters small enough to fit in the palm of your hand

FEATURES: 17 Ranges; Automatic Polarity; Automatic Zero; Automatic Overload Indication; No F.S. Ohms Adjust; 0.33" high LED Display; MOS/LSI Construction; Drop-proof; 1-YEAR Factory Warranty

INCLUDES test leads, rechargeable Nicad batteries and charger for battery or AC operation. Optional leather carrying case is available; permits carrying meter on belt or around neck for hands free operation. Also available are Tilt Stand, Panel Mount Flange, H.V. Probe (to 45 KV)

DISPLAY: 0.33" high
RANGE SELECTION: Manual
POLARITY SELECTION: Automatic
DECIMAL: Positioned by range switch
SIZE: 2.7 x 1.9 x 4" deep
WEIGHT: 9.2 ounces

MODEL	LM-3A (3 digits)		LM-3.5A (3½ digits)		LM-4A (4 digits)		LM-40A (4 digits)	
RANGE*	INDICATION	ACCURACY	INDICATION	ACCURACY	INDICATION	ACCURACY	INDICATION	ACCURACY
1VDC 10VDC 100VDC 1000VDC	.999 9.99 99.9 999	±(1% rdg ±2 digits)	1.999 19.99 199.9 1999	±(0.5% rdg ±2 digits)	.9999 9.999 99.99 999.9	±(.03% rdg ±2 digits)	.9999 9.999 99.99 999.9	±(0.1% rdg ±2 digits)
1VAC 10VAC 100VAC 1000VAC	.999 9.99 99.9 999	±(1% rdg ±2 digits) 50-400Hz	1.999 19.99 199.9 1999	±(0.7% rdg ±2 digits) 50-400Hz	.9999 9.999 99.99 999.9	±(0.2% rdg ±2 digits) 50-400Hz	.9999 9.999 99.99 999.9	±(0.3% rdg ±2 digits) 50-400Hz
1KΩ 10KΩ 100KΩ 1000KΩ 1MΩ	.999 9.99 99.9 999 .999	±(1% rdg ±2 digits)	1.999 19.99 199.9 1999 1.999	±(0.5% rdg ±2 digits)	.9999 9.999 99.99 999.9 .9999	±(0.1% rdg ±2 digits)	.9999 9.999 99.99 999.9 .9999	±(0.2% rdg ±2 digits)
1mA 10mA 100mA 1000mA	.999 9.99 99.9 999	±(2% rdg ±2 digits)	1.999 19.99 199.9 1999	±(2% rdg ±2 digits)	.9999 9.999 99.99 999.9	±(2% rdg ±2 digits)	.9999 9.999 99.99 999.9	±(2% rdg ±2 digits)

* - 1000V AC or DC max. input any range

PLAIN CASE	Model LM-3A $125.00	Model LM-3.5A $147.00	Model LM-4A $227.00	Model LM-40A $190.00
TILT STAND	Model LM-3A/LH $128.50	Model LM-3.5A/LH $150.50	Model LM-4A/LH $230.50	Model LM-40A/LH $193.50

ACCESSORIES

39-439	Leather Case & Strap	$16.00	39-454-2	Panel Mount Flange Case	$ 6.00
39-452-2	Tilt Stand Case	$ 5.00	39-525-2	High Voltage Probe, 45KV	$38.00

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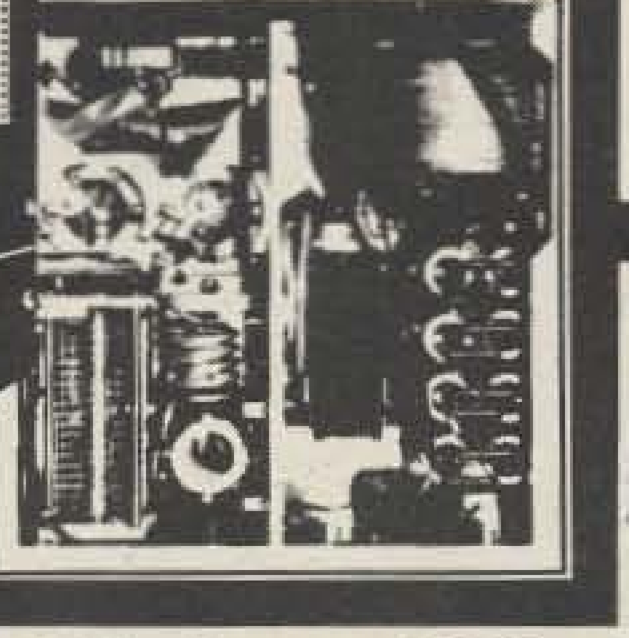

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New! Sigma Model AF250L Deviation/Modulation Meter

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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.

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SIGMA RF-2000 SWR & POWER METER

$29
Introductory Price

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).

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FOR KENWOOD TR-7400A

14 Channel Programmable
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7400 Scanner II Reg $189-$119

FMSC-1 Scanner for KDK FM 144 and 7400 Scanner II for Trio-Kenwood TR-7400A. ● Full scan 146 and 147 MHz consecutively or 1 MHz, or any MHz range ● Scan rate: 1 MHz/2 seconds (adjustable) ● Controls: Scan/Hold, Latch/Delay, 600 KHz offset (off, up, down), program 1 MHz ● Simple installation.

KDK SPECIAL SALE
FM 144 Accessories

- FMTP-1 Touch Tone Pad $59
- FMTP-2 Touch Tone Pad with 10 Number Programmable Memory $99
- FMTD-1 Private Call Decoder for use with and Programmed by Any Touch Tone Pad $75
- SC-12A Audible Tone Encoder Decoder $65
- FMSC-1 Scanner-Random Any Range . $99
- MARS-CAP Option Kit - Any Frequency, Any Split $12
- FMOF-1 Offset Option Kit - 2 Extra Positions, Crystals Required .. $10
- FMOF-2 1 MHz Offset Option Kit (No Crystals to Buy) $10
- FMTE-1 Sub Audible Tone (100 Hz-Adjustable 67-203 Hz) $15
- Owners Manual (Extra) $5

FM 2015R Accessories:

- FMPS-4R Regulated AC PS.......... $49
- FMMC-1 Microphone with Built-in Touch Tone Pad $49
- MARS-CAP* Option Kit - Any Frequency, Any Split $6
- FMAT-1 ½ Wave Portable Antenna for Hotel, Motel or Apartment ..$7.95
- Extra DC Cord & Plug $3.50
- Service Manual $2.00
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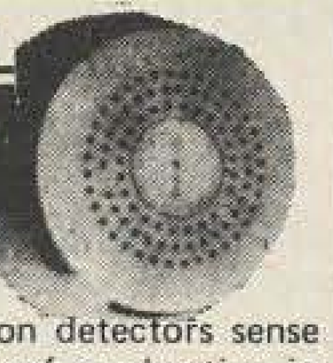
E12

12" Video Monitor

This solid state monitor will display 80 characters x 16 lines for a total of 1,280 characters. These are ready to attach to your computer or CCTV. Operates on 115VAC, video input to 75 ohm, SO-239 co-ax connector. Qty. Ltd. Used and guarenteed. Sh. Wt. 35 Lbs.
7HU70398 . . . . $68.88 each

HONEYWELL SMOKE ALARMS



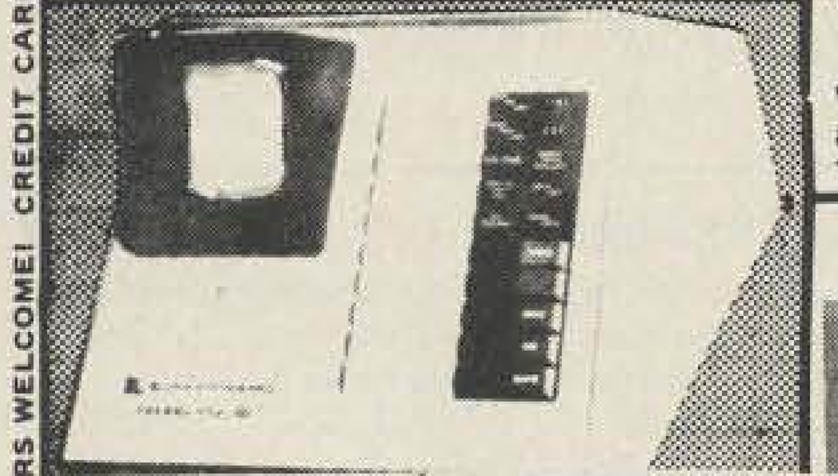
Dual chamber ionization detectors sense tiny air-borne particles of combustion in a fire's earliest stage - even before there's smoke. Operates on 115VAC, UL listed. Sh. Wt. 3 Lbs. . . 7MI70349 . . . $24.88

0 to 20 DC AMMETER

Large 2-3/8" square see-thru plastic covered meters. External resistor req. Super! Sh. Wt. 8 oz. . . .7W70343. . . $2.00 ea.

TV-COMPUTER INTERFACE KIT

Converts any standard TV into a computer monitor. This self-contained RF oscillator & modulator allows easy interface of any video output device to a standard TV set. This kit was part of a video game, and contains its own power supply. With instructions & data.
Sh. Wt. 3 Lbs. . . . 7ZU70213. . . $7.88
7 for $48.00. . . 7ZU70213 . . $48.00/7



DESK-TOP I/O TERMINAL

At one time these data terminals were used by stock brokers for keeping track of stock quotations. They tied in to a central system which has now been updated, leaving these surplus units behind.

Use this unit as a basis for building your own computer input/output station or to build a compact scope . . . or simply take it apart for the components within.

Sold complete or in parts, prices and descriptions listed below:

- † **3" CRT, with Hi-volt. supply** (+3315 vdc; −1730 vdc), and low-volt. supply +440V; +225V; +125V; +28V; +1.2V; +0.6V; 6.3VDC; 6.3VAC. Also - **ramp generator card** & some drive circuits (15 Lbs.) $17.50
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- † **Plus:** 3 wire line cord, brown, 7'lg for $1.00; 14 wire connector cable for $2.50.
- † **COMPLETE UNIT** Sh. Wt. 35 Lbs. **6NB60336** $29.95
- † Also available is a **complete tech. manual** covering operating procedure, theory disassembly (& reassembly), trouble-shooting techniques and schematics. With complete unit - **$1.00** or sold separately for **$3.50** each. Sh. Wt. 8 oz.

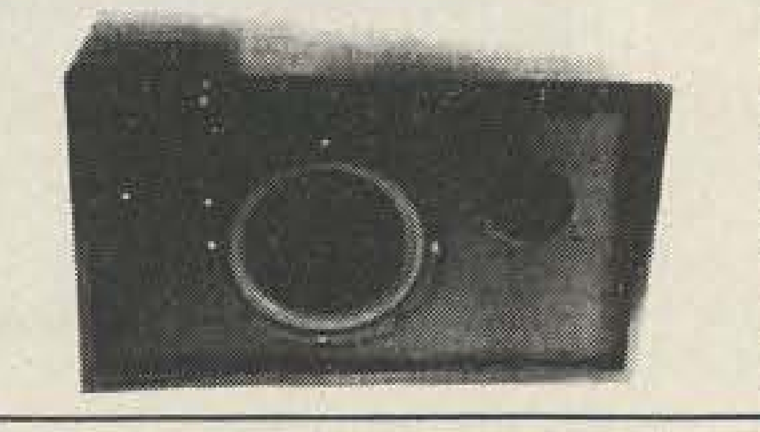
WHEN ORDERING:
Specify part, use order no. 6NB60336

SPEAKER KITS

SUPER SURPLUS SAVINGS!

Build your own and save! These kits are made up of quality components intended for use by a big-name mfr. (who we can't mention). Over $2-million in inventories were closed out! His loss your gain! Kits are 1st quality, all U.S. made. Cabinets are vinyl-clad with pre-cut holes, grill cloth is included. Perfect for those do-it-yourself-ers! Two types of kits available:

SPEAKER SYSTEMS KIT No. 1 Our deluxe model . . .



Super cabinets, size 21x12x8". Includes 8" woofers w/whizzer; 4" dome tweeters; crossovers; damping; hardware & instructions. Systems sells for $198 if bought ready-to-go, B&F kit price only $69.95 per pair. Quality need not be costly!
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7OB70197 . . . .$25.00/pair

SPEAKER SYSTEMS KIT No. 2

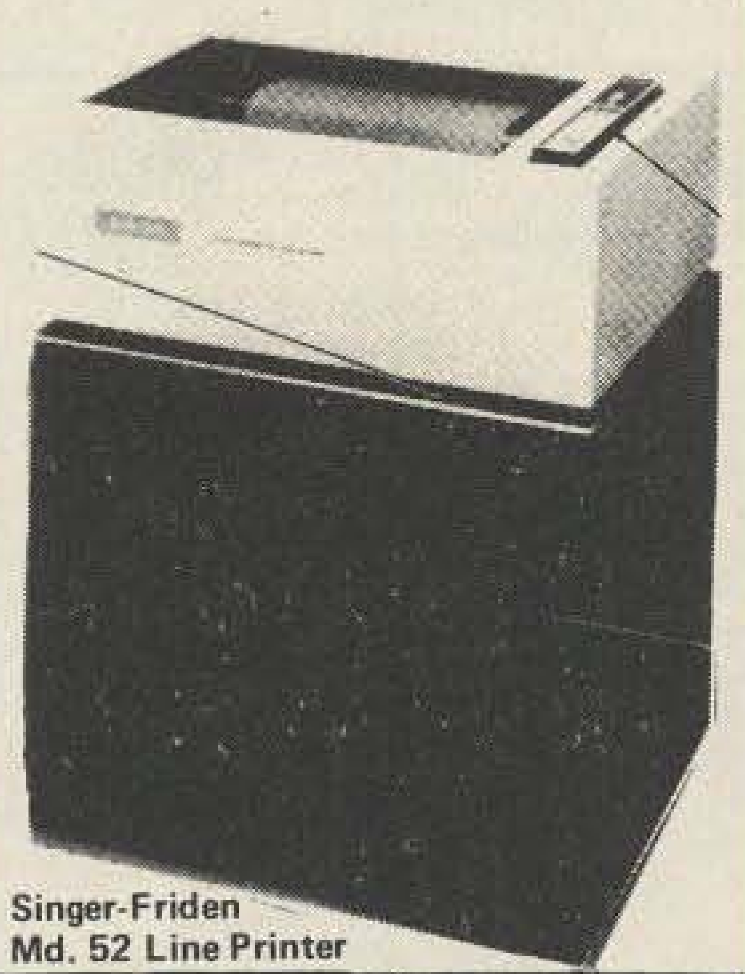
Fantastic cabinets designed for direct dispersion of high frequency sounds and wide dispersion of bass tones. Size: 17x 10½x9½". Sold with 8" woofers, 4" dome tweeters, crossovers & instructions.
7ZU70242 . . . (35 Lbs.) . . . $49.50/pair
Kit No. 2/**CABINETS Only** (25 Lbs.)
7OB70200 . . . . $25.00/pair

More SPEAKERS & COMPONENTS
. . . are available through our catalog!

Line Printer

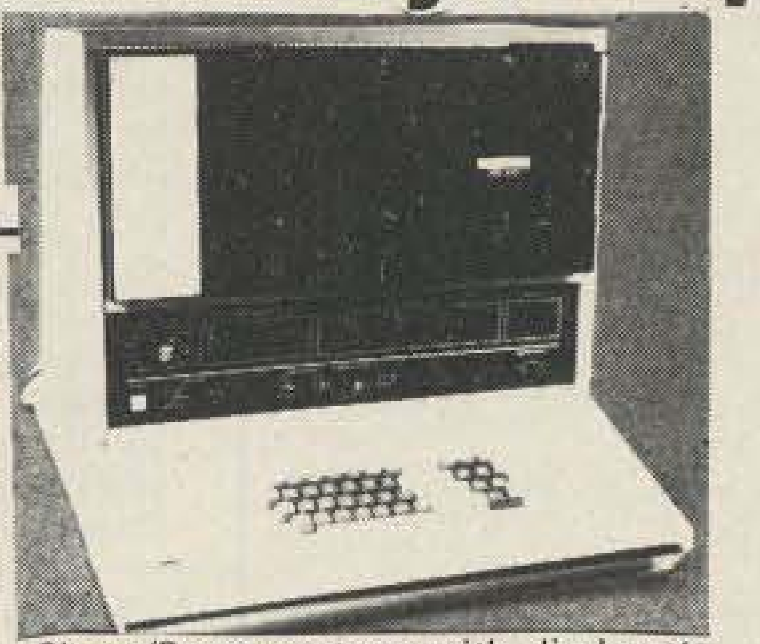
Computer surplus close-out on Singer-Friden Md. 52 line printer. 100 lines per minute with 132 characters per line max. The printer is connected to a system computer through an input/output channel and may be located up to 2,000 wire-feet from computer using a 2-wire line. Uses standard continuous paper forms, with up to 5 copies and 1 original. Power: 115V, 60 Hz; 6 amps. Size: 30"W x 27"Dp x 38"H.

These units were working & going units when taken out of service. Shipped only on an "AS IS" basis. You should be able to put these on line with a minimum of work, and then you have a $3,600 line printer working for you at less than 1/5 the cost. Shipped via truck freight collect to you, F.O.B. Peabody, Ma. 01960.
7SF70298 . . . . $650.00
DATA MANUALS, while they last . . .
7SF70298-M $45.00
****Also available** are a few damaged units, which have broken glass covers. Damage appears to be cosmetics only. Save $100.
7SF70299 . . . . $550.00



Singer-Friden Md. 52 Line Printer

Key-to-Tape Recorder



Singer/Pertec systems with display station, keyboard, 7 track magnetic data recorder, controller, etc. Singer closes out its computer products division and these unit become surplus! Their loss ($460x10⁶) is your gain . . . you can buy this super recorder for pennies on a dollar. They are late design models of recent mfg., and are still being serviced with backup. Unit has internal memory/buffer for 80 or 200 character storage. Units show character, character no., and record no. Read back circuits allows search on record key, editing, duplicating, etc. Units were working when taken out of service and are complete & ready-to-go, but may require minor adjustments. Sold on an "AS IS" basis only. Manuals not supplied with unit, available separately. Size: 19"H x 21¼"W x 19½"D. Tape not supplied.

We have 2 types available:

Md. 4301-7 7-track Data Recorder, our catalog no. 7SF70296 . . . . **$218.88**
Complete Manual .7SF70296-M . $28.50
Md. 4311-7 7-track Data Recorder with remote data communication channel, our catalog no. 7SF70297 . . . . **$248.88**
Complete Manual .7SF70297-M . $28.50
(Manuals weigh 3 Lbs.)

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Unique 12" strip, self-stick backing, ¾" high. Use whole or cut into smaller parts to give up to 24 - ½"cable clips. Handy! Sh. Wt. 8 oz. . **7K70354 . $1.25/2 strips**

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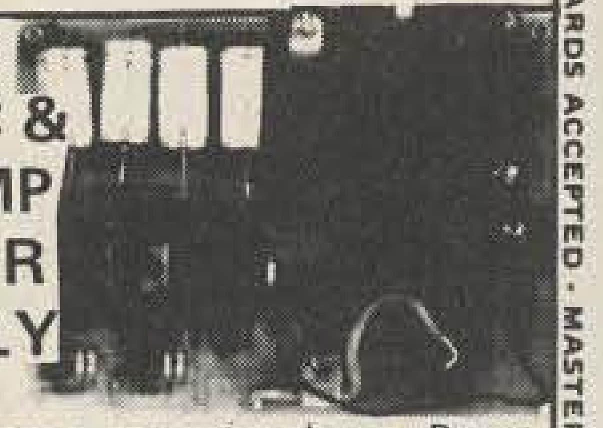
B&F

AM/FM stereo

TUNER/AMP CHASSIS
only $18.88!

New surplus stereo tuner & amp, 4 watts RMS per channel. Super-slim unit measures only 2¼"H x 12½"L x 8"D. Controls include bal., tone, vol.-on/off, AM/ FM/FM stereo AFC/Aux. selector and tuning. Dial has red needle and black face with no markings. Sh. Wt. 6 Lbs.
7HU70397 . . . . **$18.88 each**

LOGIC & OP AMP POWER SUPPLY



Surplus from a computer phone. Power supply is regulated, input of 115V 60Hz., outputs of ±12V @ .125A, +5V @ .75A. Uses (3) 723 voltage regulator IC's for regulation. Open frame type, Qty. Ltd. Size: 7.2"L x 5.6"W x 2"H. New.
Sh. Wt. 5 Lbs. . . 7MI70353 . . . $13.50
3 for $38.88. . . 7MI70353 . . . $38.88/3

10 to 24 VDC, 2 Amp POWER SUPPLY KIT

GREAT FOR CB's!

A complete kit which puts out 10 to 24 VDC at 2 amps, regulated, 115 VAC in. Can be wired for contant 13.8VDC, ideal & compact for C.B. Kit includes PC card, components and instructions . . . just add your own case. Super as a bench supply!
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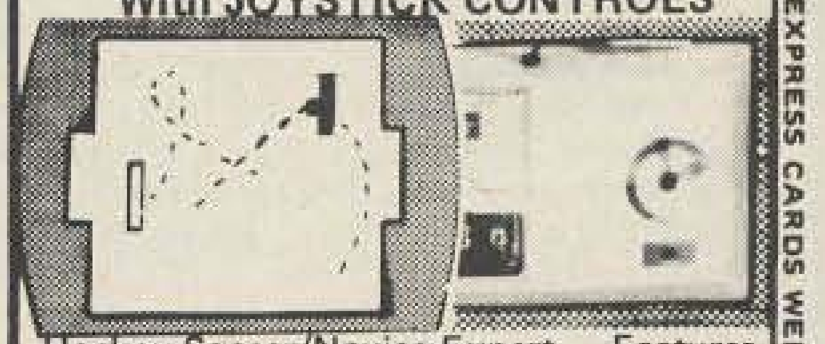

Hockey-Soccer/Novice-Expert. Features a hockey mode in which players skate up, down and accross the ice using the joystick, with the ability to "catch" the puck and "shoot" for goals with another control. A real challenge for all players. LED readouts show score, operates on 115V 60Hz. Never at this low price!
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Joystick: Four 100K Pot's; by ALPS
The best controls on the market. . . 8 oz.
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This radiosonde is used by meteorologists for upper atmosphere studies of pressure, temperature & humidity. Package has temp. sensor, hygistor, barograph, etc. Tinkerer's delight - lots of gadgets!
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B4

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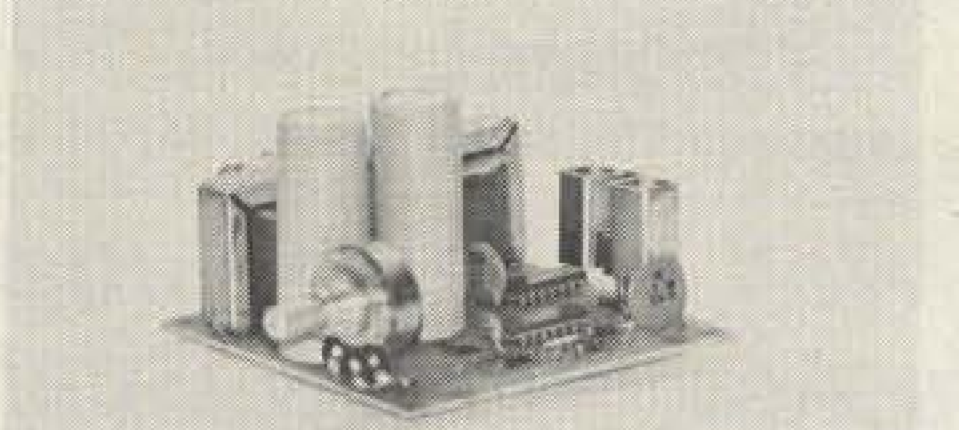

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KIT $11.95

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- Continuously Variable from 2V to over 15V
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2N3906	PNP Amp/Sw β100	6/$1	CA3086	5 Trans Array DIP	.62
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RF391 RF Power Amp Transistor 10-25W @ 3-30MHz TO-3	$5.00
555X Timer 1μs-1hr Different pinout from 555 (w/data)	3/$1
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8038 Waveform Generator ∿⊓∧ Wave With Circuits & Data	$3.75

SPECIALS — THIS MONTH ONLY

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2N3904	NPN Amp/Switch β100 40V 200mA	8/$1
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2N4869E	N-Channel Audio FET Super Low-Noise	2/$1
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A24

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30 MHZ LOW COST FREQUENCY COUNTER KIT

Features:

* Frequency Range—100Hz to 30Hz min., resolution 100 Hz
* All TTL Circuitry—No tears in the eyes when replacing ICs
* FET Input Stage—Offers high input impedance
* High Sensitivity—15mV typical
* Xytal Time Base—10MHz for better accuracy
* On Board Regulator—No external power supply needed
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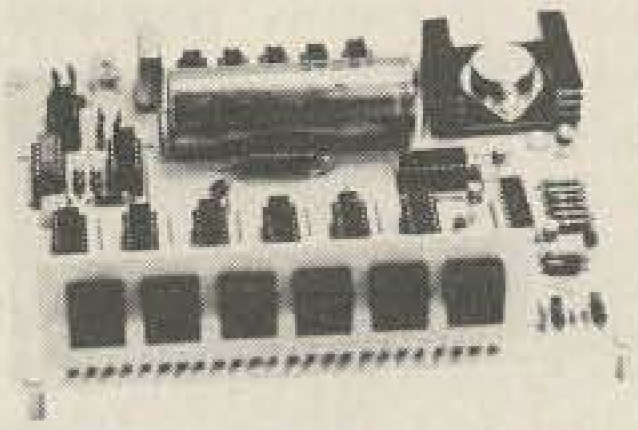


COMPARE and SAVE!

$54.95

KIT # T-250-30A

KIT INCLUDES: Detailed Instructions (22 pages). All parts including transformer (case not available).

PUT YOUR HAM GEAR OR CB IN YOUR HOUSE WITH THIS SPECIALLY DESIGNED POWER SUPPLY KIT!

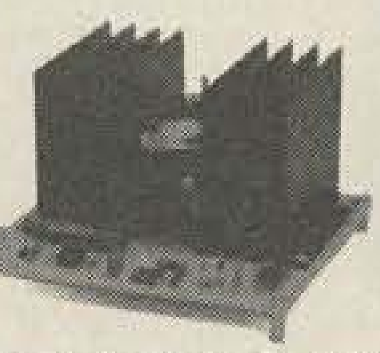
A lot of companies offered you this kind of power supply with very poor quality. Either the ripple is too high or the output voltage is not stable. Some of them even made their power supply with a zener diode and a resistor! Nobody has ever considered the safety of your equipment. With our kit, you can be sure of high quality and your equipment is protected against any failure of your power supply by a built in OVP circuit.

KIT INCLUDES: Transformer, PC Board, Large heat sink, Large filtering capacitor and all the parts with detailed instruction.

ONLY $16.95 KIT # T-700

WOW! LOOK AT THIS!

5V 10A Power Supply Kit for your TTL Circuits!



Kit Includes: Extra Large Heat Sink, Power Tr., IC Regulator, P.C. Board, with OVP Circuitry. KIT # T-500 **$11.95**

With Optional ~~X'former~~, Rectifiers and Filtering Capacitor. **$14.95** (X'former not available)

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6-DIGIT AUTO CLOCK KIT WITH ALARM

Features:

A. Fairchild 0.5" FND 500 Series Display
B. Display Board may be remote
C. X'tal time base
D. P.C. Boards, speaker, IC's and all parts.
E. Detailed Instructions

$19.95 KIT # T-1302

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Features:

A. Fairchild 0.8" FSC8000 Display Array
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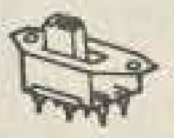
D. Detailed Instructions

THIS IS A BIG ONE!

$19.50

MINIATURE SLIDE SWITCH



DPDT .20 each
10 for $1.75
100 for $15.00

PUSH BUTTON SWITCH

Red, White, green and yellow 30¢ ea. 4/$1.00

PANEL METERS

2¼" X 2¼"

50mA	$3.00	150mA	$3.00
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3" GIANT SOLAR CELLS

The largest, most powerful solar cells available. 0.9amp @ 0.45V. Can be ganged for higher voltage or current.

Special for just **$7.95 ea.**
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PNP-General Purpose 30V	10/$1.00
2N2222-Switching	10/$1.50
2N3055-150W Power	10/$6.75
2N6059-Darlington Power, 20A HFE 1k Typical	$3.25 ea.

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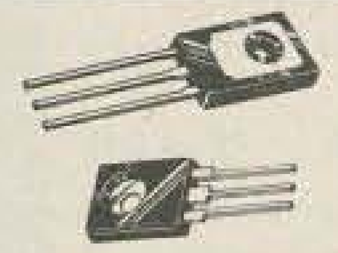
Hobby Wrap - 30	$5.45
Hobby Wrap—Model BW-630 Battery Op. (less batt.)	$30.95

OPEN FRAME POWER SUPPLY

5V @ 3A with OVP 115V AC input $17.50

POWER TRANSISTORS



MATCHED PAIR
MOTOROLA MJE2955 PNP
MJE3055 NPN
10 AMP 60 VOLT 90 WATTS
$2.25 PER PAIR

PLASTIC PUSH BUTTON SWITCH

J-188-1 Push On — Push Off
J-188-3 Normally Closed
J-188-2 Normally Open
45¢ or 10/$4.00

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0.5"	FND507 C.A.			$1.00
0.8"	FSC8000 C.C.			$5.00

MULTI-COLOR LED INDICATOR

Red—Green Colors in one LED with Plastic Housing
99¢ Ea.
Voltage 2V 20 MA per LED

CPU 8080A
ONLY $16.95
Special from TI
2716 — 16K EROM
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6,000 μF	75V	4.50
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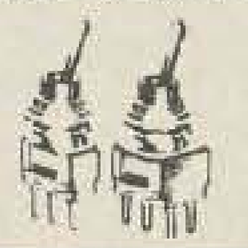
27,000 μF	50V	4.50
30,000 μF	15V	3.50
36,000 μF	30V	4.00
63,000 μF	15V	3.95
100,000 μF	5V	2.00

MINIATURE TOGGLE SWITCH



SPDT On-Off $1.30 ea.
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Mini-Size Rocker Type also available at the same price

INTER—COM BOARD

Fully assembled.
Works on 9~15V D.C.
2 speakers make it work.
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T21

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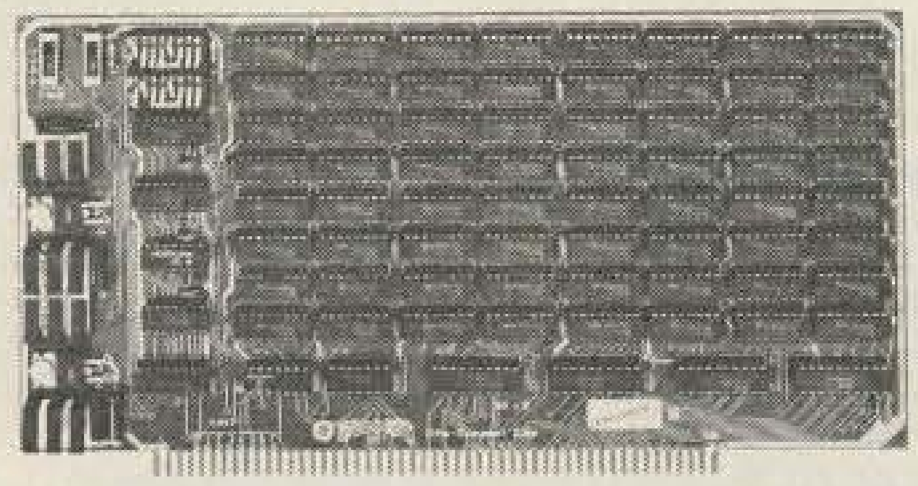

Those who know memory recognize the Godbout board as not just an exceptional value (it's no secret we know how to keep costs down), but as an example of how to pack extra options into a basic memory board. Extras like a vector interrupt provision if you try to write into protected memory. Configuration as **two** independent 4K blocks (both protectable separately). A selectable write strobe for either PWR or MWRITE. An all static design. The ability to handle DMA devices. Guaranteed speed under 450 ns (with on-board wait state logic for use with 4 MHz Z-80) and guaranteed current under 1.5A (1250 mA typ). And of course...sockets for all ICs, legended board with solder mask, one year warranty on parts...**we've got it all.**

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12A at 50% duty cycle. .05V regulation, current limiting, crowbar overvoltage protection. Easy to build, compact kit. Excellent for powering ham, CB, and automotive equipment from the AC line. Please include sufficient postage; case & hardware not included.

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MORE COMPUTER KITS

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RF POWER TRANSISTORS

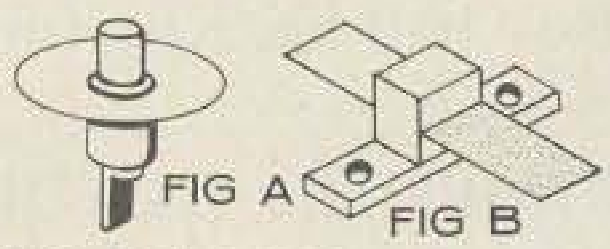


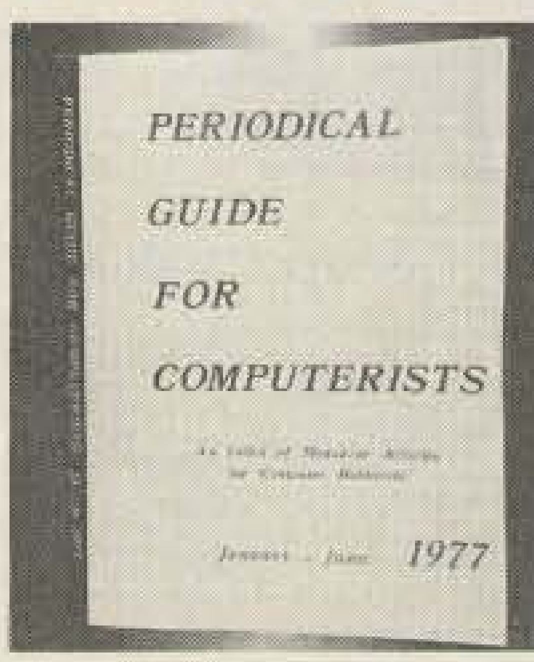
FIG A FIG B

2NRF-1 ($4.95) 2 GHz RF POWER TRANSISTOR. Pd max @ 25OC 3.5W, Pout minimum @ 2 GHz 1.0W, Pin 310 mW, efficiency @ 2 GHz 30%. A package. Sim RCA 2N5470

2NRF-2 ($5.95) 2 GHz RF POWER TRANSISTOR. Pd max 8.7W, Pout 2.5W, Pin 300 mW, efficiency 33%. B package. Similar to RCA TA8407.

2NRF-3 ($6.95) 2 GHz RF POWER TRANSISTOR. Pd 21W, Pout 5.5W, Pin 1.25W, efficiency 33%, B package. Similar to RCA 2N6269.

2NRF-4 ($7.95) 2 GHz RF POWER TRANSISTOR. Pd 29W. Pout 7.5W, Pin 1.5W, efficiency 33%, B package. Factory selected prime 2N6269.



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MAN 7Y	Common Anode-yellow	.270	1.95	MAN 6730	Common Anode-red ±1	.560	1.25
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MAN 71	Common Anode-red	.300	1.25	MAN 6750	Common Cathode-red ±1	.560	1.25
MAN 72	Common Anode-red	.300	1.25	MAN 6760	Common Anode-red	.560	1.25
MAN 74	Common Cathode-red	.300	1.50	MAN 6780	Common Cathode-red	.560	1.25
MAN 81	Common Anode-yellow	.300	1.00	DL701	Common Anode-red ±1	.300	1.00
MAN 82	Common Anode-yellow	.300	1.00	DL702	Common Cathode-red	.300	1.25
MAN 84	Common Cathode-yellow	.300	1.00	DL704	Common Cathode-red	.300	1.50
MAN 3620	Common Anode-orange	.300	1.00	DL707	Common Anode-red	.300	1.50
MAN 3630	Common Anode-orange ±1	.300	1.00	DL741	Common Anode-red	.600	1.95
MAN 3640	Common Cathode-orange	.300	1.75	DL746	Common Anode-red ±1	.630	1.95
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MAN 4740	Common Cathode-red	.400	1.00	FND70	Common Cathode (FND359)	.250	.75
MAN 4810	Common Anode-yellow	.400	1.00	FND503	Common Cathode (FND500)	.500	1.29
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	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.

		10 OHM	12 OHM	15 OHM	18 OHM	22 OHM	
ASST. 1	5 ea.	27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5% = 50 PCS.
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5% = 50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K	
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K	1/4 WATT 5% = 50 PCS.
		3.3K	3.9K	4.7K	5.6K	6.8K	
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K	1/4 WATT 5% = 50 PCS.
		22K	27K	33K	39K	47K	
ASST. 5	5 ea.	56K	68K	82K	100K	120K	1/4 WATT 5% = 50 PCS.
		150K	180K	220K	270K	330K	
ASST. 6	5 ea.	390K	470K	560K	680K	820K	1/4 WATT 5% = 50 PCS.
		1M	1.2M	1.5M	1.8M	2.2M	
ASST. 7	5 ea.	2.7M	3.3M	3.9M	4.7M	5.6M	1/4 WATT 5% = 50PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

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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.

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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

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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.**

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			10 or more
• ⅛" ht. • Common Cathode Red	2 Digit	$ .79	.69
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• Dip Package	5 Digit	1.19	.99

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	400mm	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
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MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
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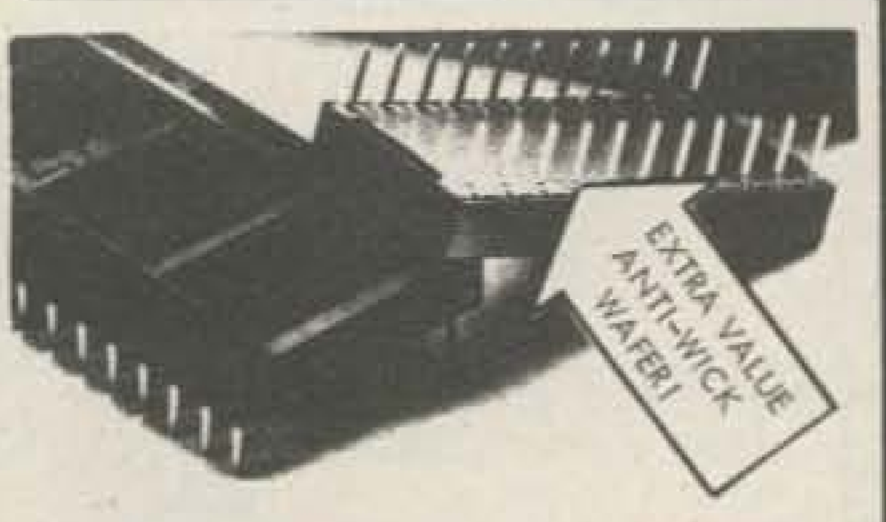
MPS A05	5/$1.00	2N3638	5/$1.00	PN4250	4/$1.00
MPS A06	5/$1.00	2N3702	5/$1.00	2N4400	4/$1.00
2N918	4/$1.00	2N3704	5/$1.00	2N4401	4/$1.00
2N2219A	3/$1.00	2N3705	5/$1.00	2N4402	4/$1.00
2N2221	4/$1.00	2N3706	5/$1.00	2N4403	4/$1.00
2N2222A	5/$1.00	2N3707	5/$1.00	2N4409	5/$1.00
2N2369	5/$1.00	2N3711	5/$1.00	2N5086	4/$1.00
2N2369A	4/$1.00	2N3724	$ .65	2N5087	4/$1.00
2N2484	4/$1.00	2N3725	$1.00	2N5088	4/$1.00
2N2906A	4/$1.00	2N3772	$2.25	2N5089	4/$1.00
2N2907A	5/$1.00	2N3903	5/$1.00	2N5129	5/$1.00
2N2925	5/$1.00	2N3904	4/$1.00	2N5138	5/$1.00
2N3035	2/$1.00	2N3905	4/$1.00	2N5139	5/$1.00
2N3055	$ .89	2N3906	4/$1.00	2N5209	5/$1.00
MJE2955	$1.25	2N4013	3/$1.00	2N5210	5/$1.00
MJE3055	$1.00	2N4014	3/$1.00	2N5432	$2.00
2N3392	5/$1.00	2N4123	6/$1.00	2N5449	3/$1.00
2N3398	5/$1.00	PN4249	4/$1.00	2N5951	5/$1.00
PN3567	3/$1.00			C106B1SCR	2/$1.00
PN3568	4/$1.00			40409	$1.75
PN3569	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



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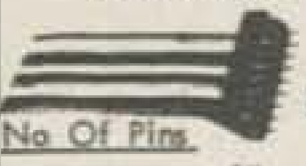
End /Side stackable on .100" centers

	1-9	10-24	25-100
SKT-0802 8 pin	.15	.15	.14
1402 14pin	.18	.17	.16
1602 16pin	.20	.19	.18
1802 18pin	.27	.26	.25
2002 20pin	.29	.28	.27
2202 22pin	.35	.34	.33
2402 24pin	.36	.35	.34
2802 28pin	.42	.41	.40
4002 40pin	.60	.57	.53

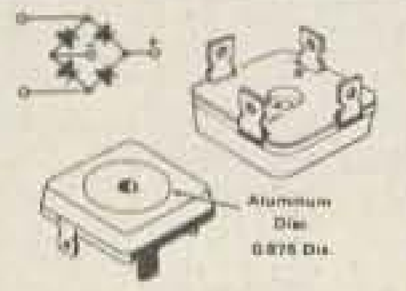
3 Level Wire Wrap Gold

	1-9	10-24	25-10C
SKT-1400	.38	.37	.36
1600	.42	.41	.40
1800	.73	.65	.59
2400	1.00	.91	.83
4000	1.69	1.51	1.37

RIBBON CABLE IC INTERCONNECTS




No Of Pins	6"	12"	18"	24"	36"	48"
SINGLE END						
14P	1.51	1.62	1.72	1.83	2.05	2.26
16P	1.64	1.76	1.87	1.99	2.21	2.44
24P	2.49	2.69	2.88	3.08	3.48	3.87
DOUBLE END						
14P	2.76	2.87	2.97	3.08	3.30	3.51
16P	3.01	3.13	3.24	3.36	3.58	3.81
24P	4.55	4.75	4.94	5.14	5.54	5.93



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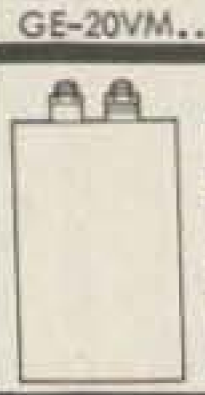
Hi current bridge in rectangular case. Has integral heat transfer disc for best cooling. An overstock at a large equipment manufacturer brings you a bargain from a famous Semi-Conductor manufacturer.........
BRR-2230M..................................$2.00

Latching Reed Relay
Miniature reed relay with 2 coils and latching reed. Use one coil to set, other to reset or reverse current in one coil for opposite functions. Single pole-single throw capsule. P.C. Mounting. Rated at 13.5V but works great on 12V.
RYL-1201C.............$2.45

G.E. PANEL METER
Attractive rectangular meter from G.E.'s HORIZONTAL LINE. Model 50-157011, 0 to 20V scale. 2½" across face. 2 hole mount. Catalogs for more than $20. Brand new in boxes with hardware.
GE-20VM.......................... $12.75



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1.2V cells in transparent rectangular plastic case. Removed from equipment but O.K. Just add distilled water and charge. Two sizes to chose from.
1.5 Amp Hour $2.20
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.....designed primarily for use in single sideband linear amplifier output applications in citizens band and other communications equipment operating to 30 MHz.

- Characterized for Single Sideband and Large-Signal Amplifier Signal Amplifier
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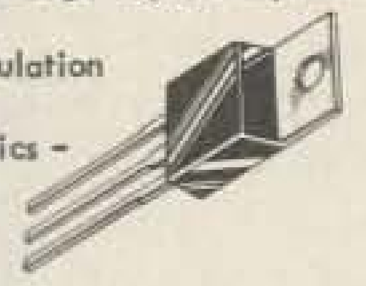
- Specified 13.6 V, 30MHz Characteristics -
  Output Power = 12 W (PEP)
  Minimum Efficiency = 40% (SSB)
  Output Power = 4.0 W (CW)
  Minimum Efficiency = 50% (CW)
  Minimum Power Gain = 10 dB (PEP & CW)



Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	18	Vdc
Collector-Base Voltage	V_{CBO}	48	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	4.0	Adc
Total Device Dissipation @ T_C = 50°C Derate above 50°C	P_D	10 0.1	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150	°C

Direct replacement for 2SC1969 for imported radios.
MRF-475..$4.82

2N5301 Super Tranny
200W 40V 30A NPN silicon transistor in TO-3. Perfect for Power Supply pass element. Made by Motorola for giant computer company who over stocked them - your gain.
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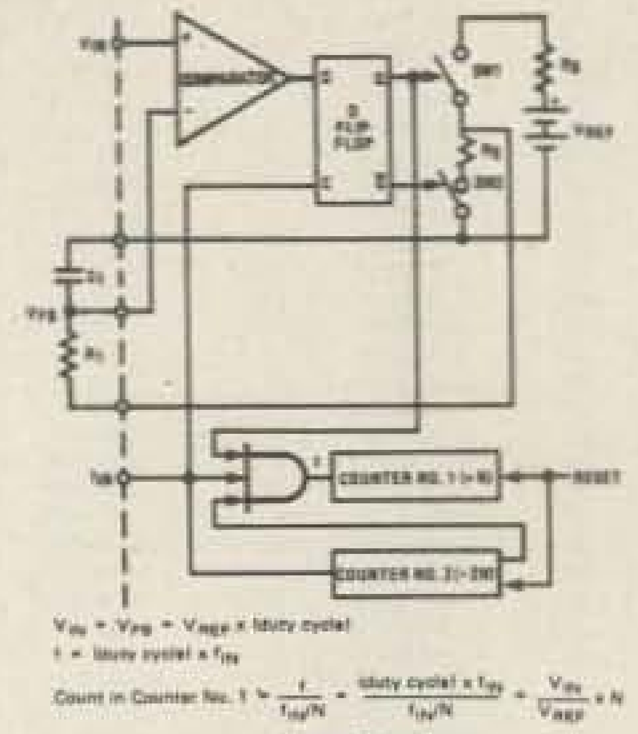
Hi Voltage Hi Power NPN
G.E. D56W1 is a 1400V, 5A NPN transistor in TO-3 case. Used in Horizontal deflection driver for color T.V. or any hi voltage hi pulse energy applications.
D56W1...$2.55

MM74C935-1
3½ digit DVM with multiplexed 7-segment output



Analog Loop Schematic
Pulse Modulation A/D Converter

The MM74C935 Monolithic DVM circuit is manufactured using standard complementary MOS(CMOS) technology. A pulse modulation analog-to-digital conversion technique is used and requires no external precision components. In addition, this technique allows the use of a reference voltage that is the same polarity as the input voltage.

One 5V(TTL) power supply is required. Operating with an isolated supply allows the conversion of positive as well as negative voltages. The sign of the input voltage is automatically determined and output on the sign pin. If the power supply is not isolated, only one polarity of voltage may be converted.

The conversion rate is set by an internal oscillator. The frequency of the oscillator can be set by an external RC network or the oscillator can be driven from an external frequency source. When using the external RC network, a square wave output is available. It is important to note that great care has been taken to synchronize digit multiplexing with the A/D conversion timing to eliminate noise due to power supply transients.

The MM74C935 has been designed to drive 7-segment multiplexed LED displays directly with the aid of external digit buffers and segment resistors. Under condition of overrange, the overflow output will go high and the display will read +OFL or -OFL, depending on whether the input voltage is positive or negative. In addition to this, the most significant digit is blanked when zero.

A start conversion input and a conversion complete output are included

FEATURES:
- Opeates from single 5V supply
- Converts 0V to ±1.999V
- Multiplexed 7-segment
- Drives segments directly
- No external precision component necessary
- Medium speed - 200ms/conversion
- All inputs and outputs TTL compatible
- Internal clock set with RC network or driven externally
- No offset adjust required
- Overrange indicated by +OFL or -OFL display reading and OFLO output
- Analog inputs in applications shown can withstand ±200 Volts

APPLICATIONS:
- Low cost digital power supply readouts
- Low cost digital multimeters
- Low cost digital panel meters
- Eliminate analog multiplexing by using remote A/D converters
- Convert analog transducers (temperature, pressure, displacement, etc.) to digital transducers

MM74C935N-1......with specs............$16.98
Specs only for 74C935.......................$.90

LM336Z Reference diode
Precision 2V reference to be used with MM74C935-1 DVM chip.
LM336Z......................................$2.40

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National MA1003

Actual Size – 1.75" x 3.05"

BRIGHT .3 FLUORESCENT DISPLAY

Same unit supplied as original equipment in many new automobiles • 12 volt DC • Xtal timebase • 12 hour format • completely assembled unit • dims to comfortable viewing when car lights are on • low standby power consumption.

LIMITED SPECIAL **All for ONLY ~~$24.95~~ $19.95**

PLUS – FREE

3 push switches and choice of green, blue or amber filter.

also good for marine and aircraft

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

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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 $1.00 each

Positive	Negative
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
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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

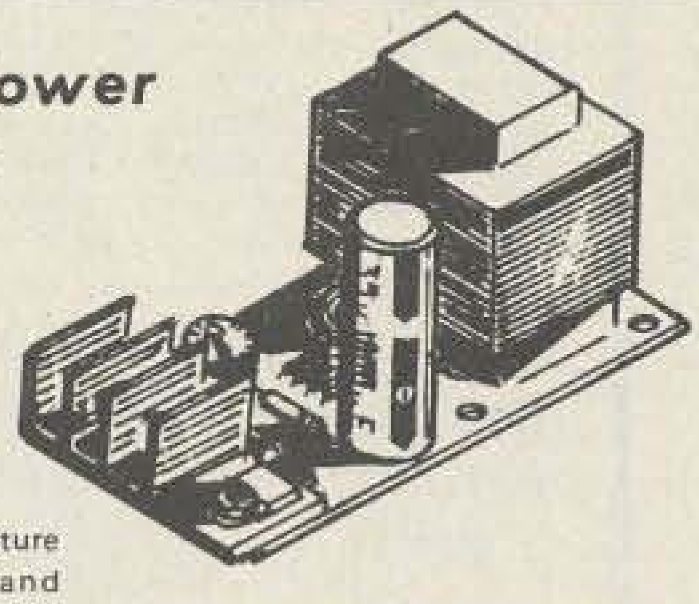
NOW!

2 Dual Digital 12-24 hour clock kits

MODEL ALD5:
Six big .5 display LEDs in an attractive black plastic cabinet with a red front filter. Great for a ham or broadcast station. Set one clock to GMT the other to local time. Or have a 24 hour format on one clock and 12 hour on the other. Freeze feature lets the clock be set to the second. Each clock is controlled separately. Cabinet measures 2¼" x 4¼" x 9¼". Complete Kit $44.95.

MODEL ALD7:
Four bright .3 nixie tube display. Cabinet is an attractive deep blue including front filter. Will display seconds at the push of a button. An asset to any station. Cabinet size is 2¼" x 3" x 9¼". Complete Kit $34.95.

Variable Power Supply Kit



Specify:
5 to 15 Volt
or
12 to 28 Volt
unit

-500 mA regulators feature current limiting and thermal protection.

only $6.95 plus $1.00 shipping

NEW

Ham TV Converter

use on regular TV set

Covers 420 MHz amateur band. Works on unused TV channel.

Kit $39.95
Assembled 49.95

Aldelco presents a NEW battery operated Frequency Counter & digital clock kit in one cabinet

Frequency Counter
Typical 100 Hz to 40 MHz
Accuracy .00005%

Using a 0.4 Display this unit is switchable from Clock to Counter while continuously keeping time. The clock can be wired either 4 or 6 digits and either 12 or 24 hour time. Small size makes this an attractive unit for Auto or Boat use. It operates on 12 VDC or from 8 AA Nicad batteries (not supplied) with a built-in battery charger. Optional Plug-In power supply allows charging and an operating source form 110 Volts AC.

Comes complete with Cabinet, Instructions and all parts.

Kit $99.95
Assembled 139.95
110 Volt AC Power Supply 5.95
8 General Electric or Gould AA Nicad Batteries 17.95
Frequency Counter with Memory in place of Clock same pricing.

ALDELCO

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516-378-4555

A2

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NOW-THE ULTIMATE RAM BOARD

MEMORY CAPACITY
MEMORY ADDRESSING
MEMORY WRITE PROTECTION

8K, 16K, 24K, 32K using Mostek MK4115 with 8K boundaries and protection. Utilizes DIP switches. PC board comes with sockets for 32K operation. Orders now being accepted allow 6 to 8 weeks for delivery.

Available the 1st quarter of 1978: 16K, 32K, 48K, 64K using Mostek 4116 with 16K boundaries and protection.

32K FOR $475.00

Buy an S100 compatible 8K Ram Board and upgrade the same board to a maximum of 32K in steps of 8K at your option by merely purchasing more ram chips from S.D. Sales! At a guaranteed price – Look at the features we have built into the board.

PRICES START AT $151. FOR 8K RAM KIT
Add $108.00 for each additional 8K Ram

Board fully assembed and tested for $50. extra.

8K FOR $151.00

INTERFACE CAPABILITY
Control, data and address inputs utilizes low power Schottky devices.

POWER REQUIREMENTS
+8VDC 400MA DC
+18VDC 400MA DC
–18VDC 30MA DC
on board regulation is provided.
On board (invisible)refresh is provided with no wait states or cycle stealing required.

MEMORY ACCESS TIME
IS 375ns.
Memory Cycle Time is 500ns.

8K LOW POWER RAM - $159.95

Fully assembled and tested. Not a kit.

Imsai –Altair – S-100 Buss compatible, uses low power static 21L02-500ns fully buffered on board regulated, quality plated through PC board, including solder mask. 8 pos. dip switches for address select.

4K LOW POWER RAM KIT

Fully Buffered – on board regulated – reduced power consumtpion utilizing low power 21L02 – 1 500ns RAMS – Sockets provided for all IC's. Quality plated through PC board. *Add $10. for 250ns RAM operation

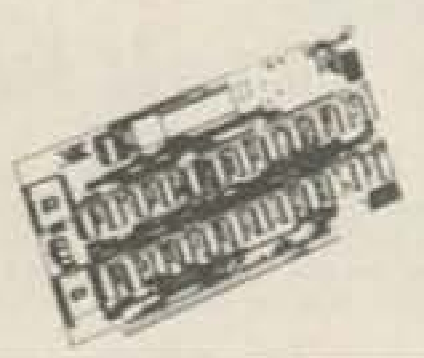
The Whole Works-$79.95

MUSICAL HORN

One tune supplied with each kit. Additional tunes – $6.95 each. Special tunes available. Standard tunes now available: –Dixie – Eyes of Texas – On Wisconsin – Yankee Doodle Dandy – Notre Dame – Pink Panther – Aggie War Song – Anchors Away – Never on Sunday – Yellow Rose of Texas – Deep in the Heart of Texas – Boomer Sooner – Bridge over River Kwai

Special Design Case $3.50

CAR & BOAT KIT **$34.95** HOME KIT **$26.90**



Z-80 CPU BOARD KIT - Complete Kit $139.

CHECK THE ADVANCED FEATURES OF OUR Z–80 CPU BOARD: Expanded set of 158 instructions, 8080A software capability, operation from a single 5VDC power supply; always stops on an M1 state, true sync generated on card (a real plus feature!), dynamic refresh and NMI available, either 2MHZ or 4MHZ operation, quality double sided plated through PC board; parts plus sockets priced for all IC's. *Add $10. extra for Z–80A chip which allows 4MHZ operation. Z–80 chip with Manual – $39.95

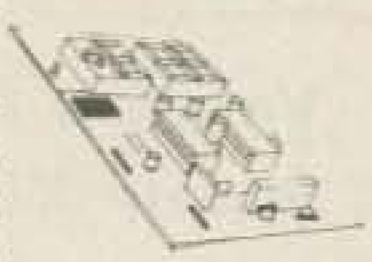
Jumbo LED Car Clock Kit

FEATURES:
A. Bowmar Jumbo .5 inch LED array.
B. MOSTEK – 50250 – Super clock chip.
C. On board precision crystal time base.
D. 12 or 24 hour Real Time format.
E. Perfect for cars, boats, vans, etc.
F. PC board and all parts (less case) inc.
Alarm option – $1.50
AC XFMR – $1.50

$16.95

DIGITAL LED READOUT THERMOMETER - $29.95

Features: Litronix dual 1/2" displays. Uses Silicoaix LD131 single chip CMOS A/D converter. Kit includes all necessary parts (except case); AC line cord and power supply included. 0-149° F



6 DIGIT ALARM CLOCK KIT

Features: Litronix dual 1/2" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). Xfmr optional. Eliminate the hassle – avoid the 5314! Do not confuse the Non – Alarm kits sold by our competition!
AC XFMR – $1.50 Case $3.50 **$12.95/kit**

Bowmar 4 Digit LED Readout Array

4 JUMBO .50" DIGITS ON ONE STICK! WITH COLONS & AM/PM INDICATOR
$3.95

5 Digit Countdown Utility– Darkroom Timer Kit - $44.95

Features: Large LED ½" displays, crystal controlled Mostek 50397 counter display driver, set timer at 0.1 second precision from 0.1 second to 59 minute 59.9 second, 5A-115V relay included to control photographic enlarger, sun lamp, appliances, TV, or other equipment, operates on 115V AC, displays can be turned off for total darkness applications, simple push button operation, use in kitchen, school, office or laboratory. All necessary parts included. Special design case $3.75

6 Digit General Purpose or Computer Timer Kit - $29.95

Features: Large LED ½" displays, Mostek 50397 counter display/driver, counts up to 59 minutes, 59.99 seconds with crystal controlled 1/100 second accuracy, operates on 115V AC or 12V DC supply. Use it to time telephone calls, athletic events, practice time, school and laboratory demonstrations, experiements, chess games, etc. Time computer functions in real time such as run times on programs, sub routines and other computer controlled events. Requires two output channels for start/stop and clear controls. All necessary parts included. Special design case $3.75

Full ½" Litronix Jumbo Dual Digit LED Displays

DL 722 - C.C.	DL 728 - C.C.
DL 721 - C.A.	DL 727 - C.A.
99c	$1.29

RAM'S·CPU'S·PROM'S

21L02 - 500NS	8/11.50
21L02 - 250NS	8/15.95
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1101A – 256	8/$4.00
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74S 200 - 256	3.95
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Z–80A includes manual	34.95
8080A CPU 8 BIT	11.95
8008 CPU 8 BIT	6.95
1702A - 1K - 1.5us	3.95 or 10/35.
2708 - 8K Intel - 450ns	14.95
5204 - 4K	7.95
82S129 – 1K	2.50
2708S - 8K signetics 650ns	9.95

Low Cost Cassette Interface Kit

$14.95

Features: K.C. standrad 2400/1200 Hz, 300 Baud, TTL, I/O compatible, phase lock loop, 22 pin connector. Feeds serial data via microprocessors I/O ports and from cassette tape recorder. $14.95

DISC CAP * ASSORTMENT
PC leads. At least 10 different values. Includes .001., .01, .05 + other standard values 60/$1.00

39 MFD * 16V Mallory Electrolytic 15/$1.00

* 1000 MFD FILTER CAPS
Rated 35 WVDC. Upright style with PC leads. Many popular values. 4/$1.

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4–100K POTS
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P.C. LEAD * DIODES
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25W by CLAROSTAT
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TR1602B Uart	3.95

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MK50250 Alarm clock	4.99
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MK50396 6 digit up/down counter	12.95
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MK5021 - Cal. chip sq. root	2.50

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It's a little giant in sound quality. Metal encased with built-in FET circuit, omni-directional, freq. resp. 20-12,000Hz. Less tie pin or lapel clip. 600 ohm impedance, 1.5VDC. No. 12A3178 **4.95**

7/16" x 7/8" long

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Rechargeable! Perfect for back-up power for computers, alarms, and more. Sealed, spill-proof, leak-proof. Better than NI-CADS, recharges to 100% capacity. Compact, only 4" x 1" x 2", stack 'em in series or parallel. Lead or lead/antimony gel (sorry, no choosing). Wt. 16 ozs. No. 12A4088 □ **$4.95**

6 V 1000 MILS

AM-FM-MPX TUNER AMP

- 4D Matrix for 2 & 4 speaker systems • Wall/Console
- Contemporary design black and chrome front panel

The Philharmonic

SPECIFICATIONS: AMP: Pwr. our 5W x 2 RMS, both chan into 8 ohms, 40-20000 Hz. THD 0.9%. Freq. resp. 15-20,000±2db. S/N ratio 55db. FM: Sens 2.7 uV for 20 db S/N. Requires 115-VAC 60 Hz. Size: 8½ x 13½ x 3½". Wt. 7 lbs.

Solid state circuitry. 4D MATRIX simulates quad sound from stereo FM, tapes, and records. Gives feel of a live performance. Slide controls for VOLUME, BASS, TREBLE and BALANCE. Selector for PHONO, TAPE, AM, FM, FM-MPX. Rocker switches for POWER ON/OFF, AFC, STEREO/4D MATRIX. Also features stereo headphone jack, FM stereo indicator.

Cat. No. 12A4007 □ **$69.95**

In 5-12-15 volts! 1-AMP REGULATED POWER SUPPLY

New! Easy to assemble! Uses LM340K positive voltage regulator. Reverse leads for a negative supply. Buy 2 for a ± power supply! With transformer, regulator, PC board & all components. Complete kit, nothing else to buy. Wt. 4 lbs.

Cat. No.	Volts
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□ 12A3857	12
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2 for $15.95

□ Your choice

KIT **$8.88** □

100 KHz* MARKER CRYSTALS

Build your own marker generator at 100, 200, 300 KHz etc. Calibrate receivers, ham rigs and more. Accuracy 0.001%, size 1½ x ½". With instructions for building marker generator. *100 KHz after trimming. Wt. 1 oz.

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RCA "POCKET" VOM

- 1000 ohms per volt

Model WV-539A. Features 1% precision, movements diode protected against burnout. Measures DC volts 0-15-150-1000; AC volts 0-15-150-1000; DC current 0-150ma; resistance X1000. Sensitivity 1000 ohms/volt AC-DC. Uses penlite cell, not included. Size 2⅝ x 3½ x 1⅝". Wt. 5 ozs. Cat. No. 12A3921

$8.88 □

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TRANSISTOR CHECKER DYNAMIC

Tests NPN, PNP, Powers and unknown semi's. Simple to use, both in-or-out of circuit. Automatically identifies polarity. Tests leakage, matches similar transistors. Use with VOM to test noise, dynamic leakage and more. Built-in quick test socket. Requires 1½V "D" cell. With instructions. 2½ x 2 x 5". Wt. 16 ozs.

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69¢ EACH 6 for $2.50 SPECTROL "SKINNY-TRIMS"

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*Available in all types **Available in Cat. No. 12A3863 only.

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Ideal for CB's, Ham rigs, tape decks & more! Modern cabinet, 5 x 4½ x 2¼". With on/off switch, built-in circuit breaker, LED lamp. 115 VAC 60 Hz, Wt. 5 lbs. Cat. No. 12A3452

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□ SN7404	.17	□ SN7465	.14	□ SN74153	.63
□ SN7405	.18	□ SN7470	.28	□ SN74154	.99
□ SN7406	.19	□ SN7471	.69	□ SN74155	.78
□ SN4707	.24	□ SN7472	.26	□ SN74156	.68
□ SN7410	.14	□ SN7473	.31	□ SN74157	.64
□ SN7411	.19	□ SN7474	.31	□ SN74160	.89
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□ SN7427	.26	□ SN7485	.88	□ SN74174	.93
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□ SN7438	.24	□ SN7491	.63	□ SN74180	.69
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□ SN7447	.69	□ SN74107	.29	□ SN74194	.83
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□ SN7454	.14	□ SN74121	.31	□ SN74200	5.50
□ SN7455	.14	□ SN74123	.49	□ SN74251	1.39
		□ SN74125	.39	□ SN74284	4.25
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BARREL KIT #188 400 PARTS $1.98 — Includes resistors, caps, diodes, IC's, for PC work, some on PC boards. Dumped into barrels by factories, 100% material. Wt. 12 ozs. Cat. No. 12A3401

BARREL KIT #184 ¼-WATT METAL FILM 150 for $1.98 — 100% metal film resistors. Long leads. 12A3413

BARREL KIT #182 JUMBO RED LEDS 15 for $1.98 — 100% material, user cancellation from factory dumps, 3V 10 mils. For 100's of projects, red lens. Cat. No. 12A3369

BARREL KIT #163 MINI TRIM POTS 30 for $1.98 1 oz. — Asst. values 100 to 1 meg What a buy. Single turn. ¼ W. Wt. 6 oz. 12A3345

BARREL KIT #160 HOBBY VOLTAGE REGULATORS 10 for $1.98 — LM-309K TO-3 barreled, bot by the pound, but who wants to check 'em? Your gain. Wt. 20 ozs. 12A3330

BARREL KIT #138 PANEL SWITCHES 30 for $1.98 9 ozs. — Did you hear of OAK? Another eqpt maker barrelled all types of rotaries, electric, slides, etc. 12A3268

BARREL KIT #128 MINI-DIP IC'S 100 for $1.98 — 741's, LM380, 703, 567, 555, who knows? Factory mixed, you test. Untested and hobby. Wt. 1 lb. Cat. No. 12A3245

BARREL KIT #127 AXIAL ELECTROS 40 for $1.98 — Asst. capacities and voltages. Cat. No. 12A3227

BARREL KIT #126 UPRIGHT ELECTROS 40 for $1.98 — 1mf to 300mf in mixture of voltages. 100% marked 'n good. 12A3226

BARREL KIT #115 MOLEX SOCKETS 100% good 150 for $1.98 Cat. No. 12A3144 — Calculator maker dump! We gut a zillion of 'em.

BARREL KIT #109 TERMINAL STRIPS 100 for $1.98 — Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat. No 12A3136

BARREL KIT #104 SLIDE VOLUME CONTROLS 10 for $1.98 — Cat. No. 12A3057

BARREL KIT #101 RESISTOR SPECIAL 200 for $1.98 — Includes: ⅛, ¼, ½, 1, 2-watters, carbon. 8 oz. 100% good. 12A3054

BARREL KIT #99 PHOTO ELECTRIC CELLS 10 for $1.98 — Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat. No. 12A3052

BARREL KIT #93 HALF WATTERS 200 for $1.98 — Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value is there. 4 oz. 12A3046 Untested

BARREL KIT #87 NAT. IC BONANZA! 100 for $1.98 — Hobby and untested, factory mixed in barrels. Linears, 7400's, ROMS, DTL'S, registers, clock and calculator chips and more. Wt. 12 ozs. Cat. No. 12A2860

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BARREL KIT #83 LM-340T VOLTAGE REGULATORS 15 for $1.98 — Factory rejects, hobby, cosmetic rejects May include 5, 6, 12, 15, 18 or 24 volts, TO-220 power tab. Wt. 4 ozs. Cat. 12A2635

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BARREL KIT #61 POLYSTYRENE CAPS 100 for $1.98 — Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat. No. 12A2729

BARREL KIT #58 SLIDE SWITCHES 30 for $1.98 — All shapes, sizes, spst, dpdt, momentaries, etc. Tremendous shop pak for 100's of switching projects. Cat. No. 12A2726 100% good

BARREL KIT #39 HOBBY NPN POWER TRANSISTORS 15 for $1.98 — Factory fallouts and "off spec" TO-3 powers. 100% hobby, no opens, no shorts. Wt. 1 lb. Cat. No. 12A2617

BARREL KIT #31 METALLIC RESISTORS 100 for $1.98 — Made mostly by Corning, the finest resistor made. Mostly ½ watters, 1% to 5% tol. & a barrel of values. Cat. No. 12A2609

BARREL KIT #30 PREFORMED RESISTORS 200 for $1.98 — We got barrels of ¼ and ½" watters for pc use. 100: ¼, 100 ½" watters. No. 12A2608 100% good

BARREL KIT #27 PREFORMED DISCS 150 for $1.98 — Hi-Fi mfr's shelf inventory but he dumped 'em in barrels. Preformed, for PC use, Mixed values too! 12A2605

BARREL KIT #26 PLASTIC TRANSISTORS 100 for $1.98 — Untested and hobby transistors, TO-92 (TO-18), asst. 2N numbers, asst. manufacturers. Wt. 8 ozs. 12A2604

BARREL KIT #20 LONG LEAD DISCS 100 for $1.98 — "auction sale". Prime, marked only. Long leads Cat. 12A2598 100% good

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BARREL KIT #7 VOLUME CONTROL 30 for $1.98 100% good — Singles, duals, variety of values, styles, big ones — small ones. Cat. 12A2421

BARREL KIT #3 1N4148/914 SWITCHING DIODES 100 for $1.98 — Imagine famous switching diodes at these prices! Cat. No. 12A2418 Untested.

BARREL KIT #1 SN7400 DIP IC'S 75 for $1.98 — Marked 14 and 16 pin dips, may include gates, flip-flops, registers, counters, who knows? Untested, hobby. Wt. 14 ozs. 12A2415

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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: DMQ-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, solid state troubleshooting, IC freq counter (many errors & omissions), "cv" transformers, space comm odyssey, pulsar info, thin-wire ants, 40M transistor cw tx/rx, BC-348M double conversion, multifunction tester, copper wire specs, thermistor applications, hi-voltage transistor list, ham club tips (Part 5).

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 summy 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 II), 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, meggering 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).

SOLD OUT

APR 71. Intro to fm, noise ... ker, repeater problems, Motorola HT ... icrowave repeater linking, di... ...neable 2M fm rx/tx, rep... fm marketplace, meter ev... ...ctor modulator, simple sig gen, touc... hookup, hf preselector, 10M 12W tx.

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 heatsinking, 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 gndplane, 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 are 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.

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FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, acti... ...r, time freq measurement (part 2) ... ...ing control, SSTV circuits ... converter using modules, ...netering, FET biasing, freq cou... ...up, TR22 hi-power mod, transistor ...ower amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info.

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-Strain your Ham—M, An Automatic Dialer for the Deluxe Mob[illegible] ...ing Dead Nicads to Life, The Computer QSO Mach[illegible] ...wered Counter, Save Money on Coax, How[illegible], Using a Bargain Surplus Keyboard, Impr[illegible] with the FRAMER, and more. The first *73* in new lar[illegible]! (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 — T[illegible] Receiver Strips, Surplus Circuit Board[illegible] Space Age Junque, A PC Board Bonar[illegible] Is It All Gone?, Stereo — A New Type o[illegible]ter, Build This Exciting New TVT, The Smart Power Supply, How to Use Surplus Pots. SOLD OUT

APR 76. Special FM Issue — A Programm[illegible], Put That AM Rig on FM, A COR for your Recei[illegible] Amplifier, Build a 220 MHz Repeater [illegible] Your Regency, Long Distance C[illegible] New TT Decoder, One IC Tone Burster, Th[illegible]aveler, A Versatile TTY Generator, The PLL — Expo[illegible], TR-22 Tips, Computers Are Ridiculously Simple. SOLD OUT

MAY 76. Special Antenna Issue — The Magnificent Sevens 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-Mite 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 Junque 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?

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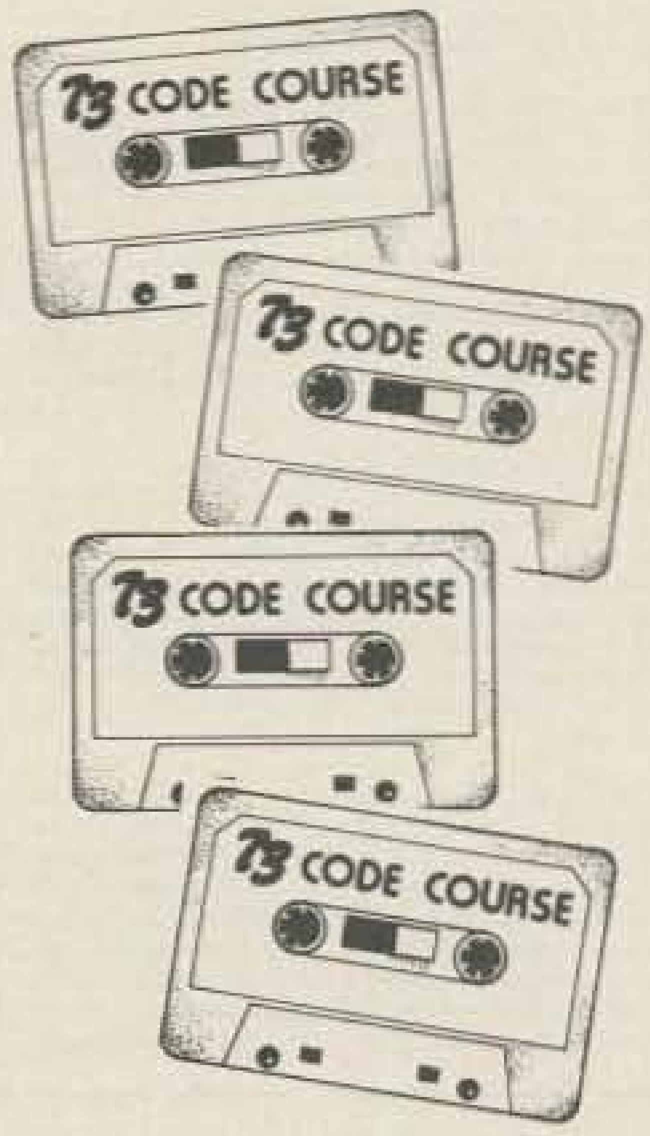

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13+ WPM Code groups again, at a brisk 13 per so you will be at ease when you sit down in front of the steely eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is 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.

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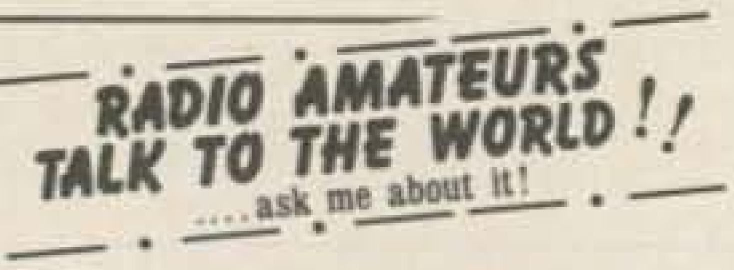

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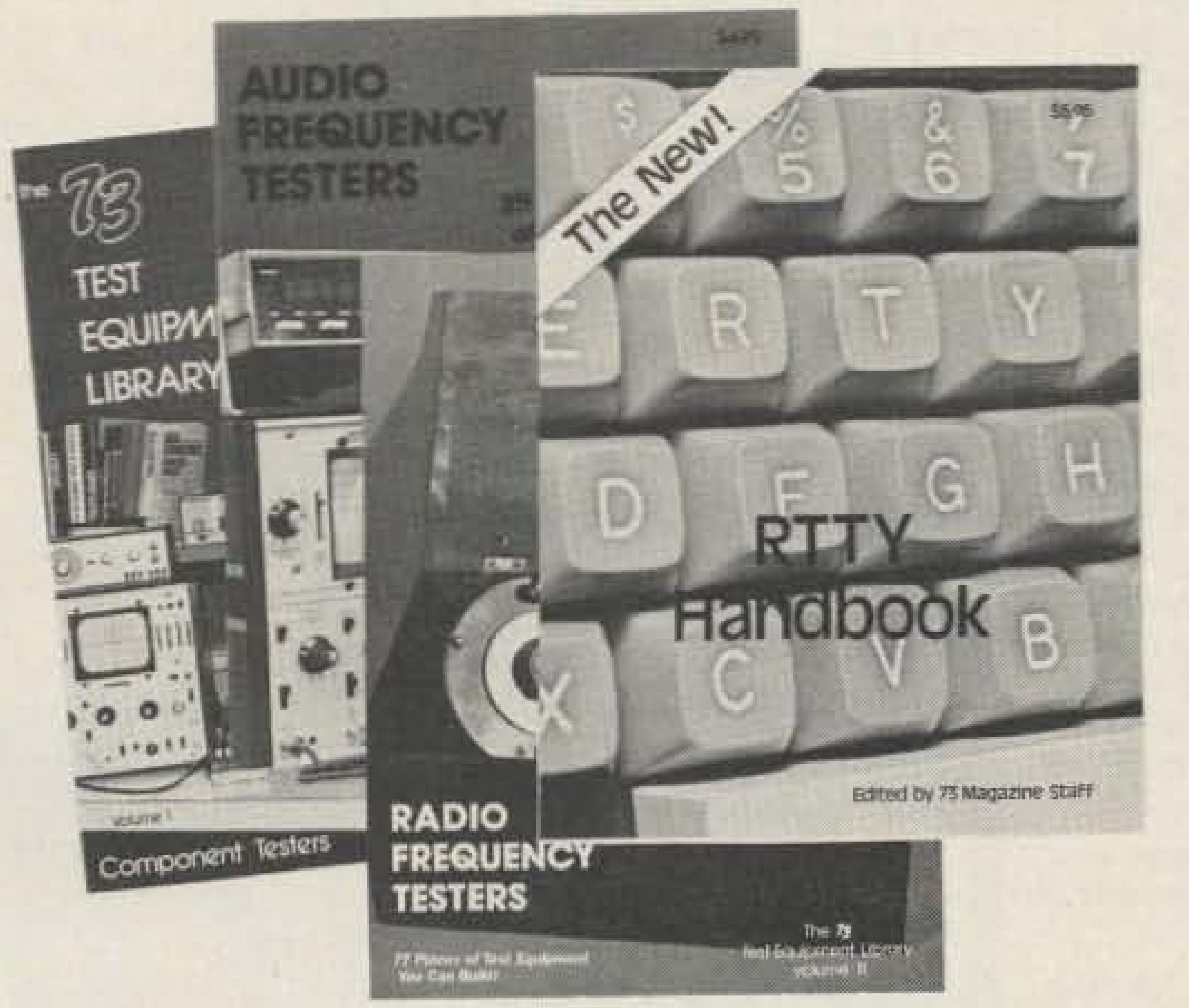

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• AN INTRODUCTION TO MICROCOMPUTERS, VOLS. 1 AND 2 At last! Someone has finally written a book containing hardware details about most of the popular micro chips available to computerists. *An Introduction to Microcomputers*, Volumes 1 and 2, by Adam 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.

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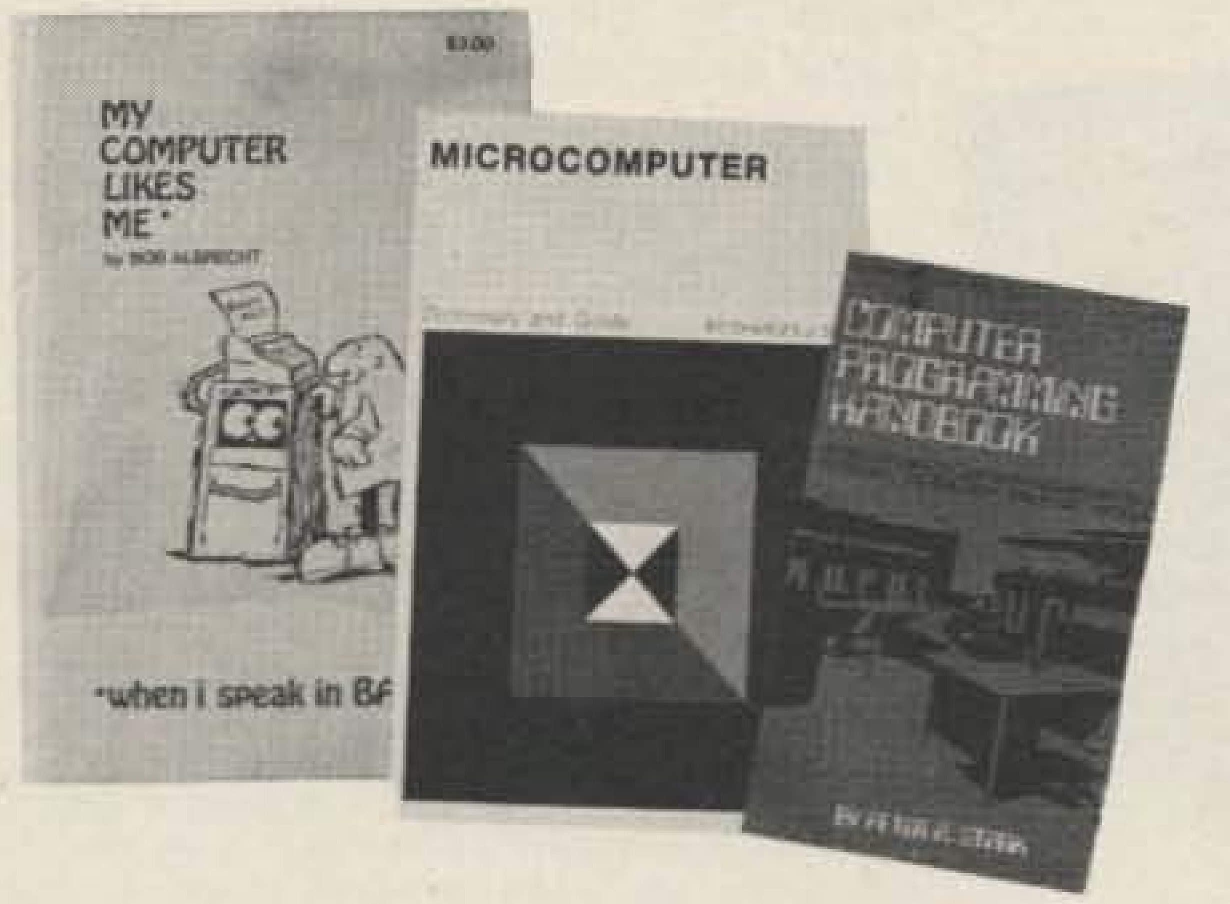

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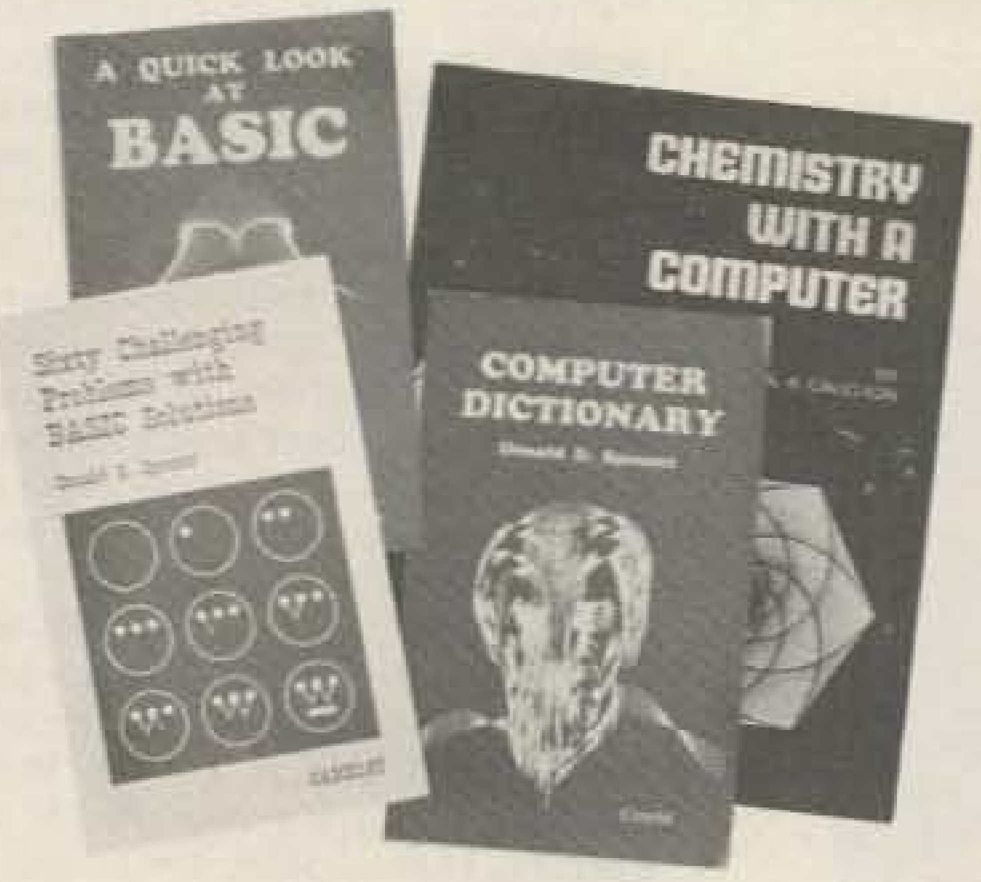

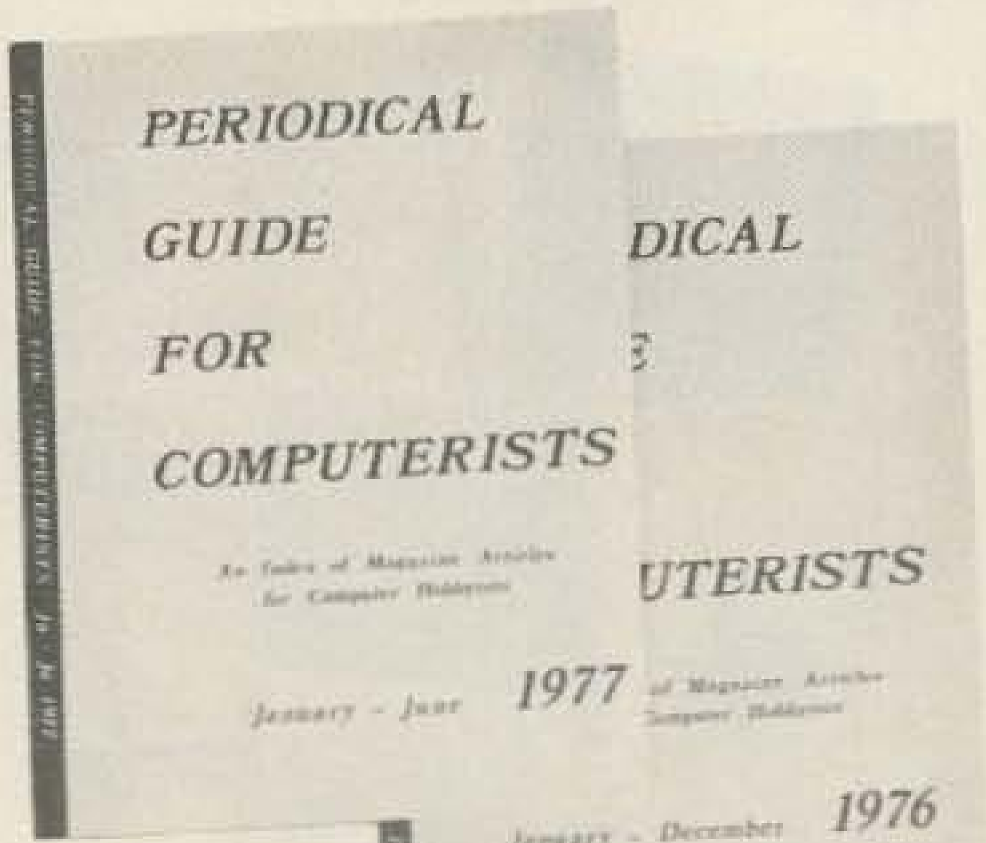

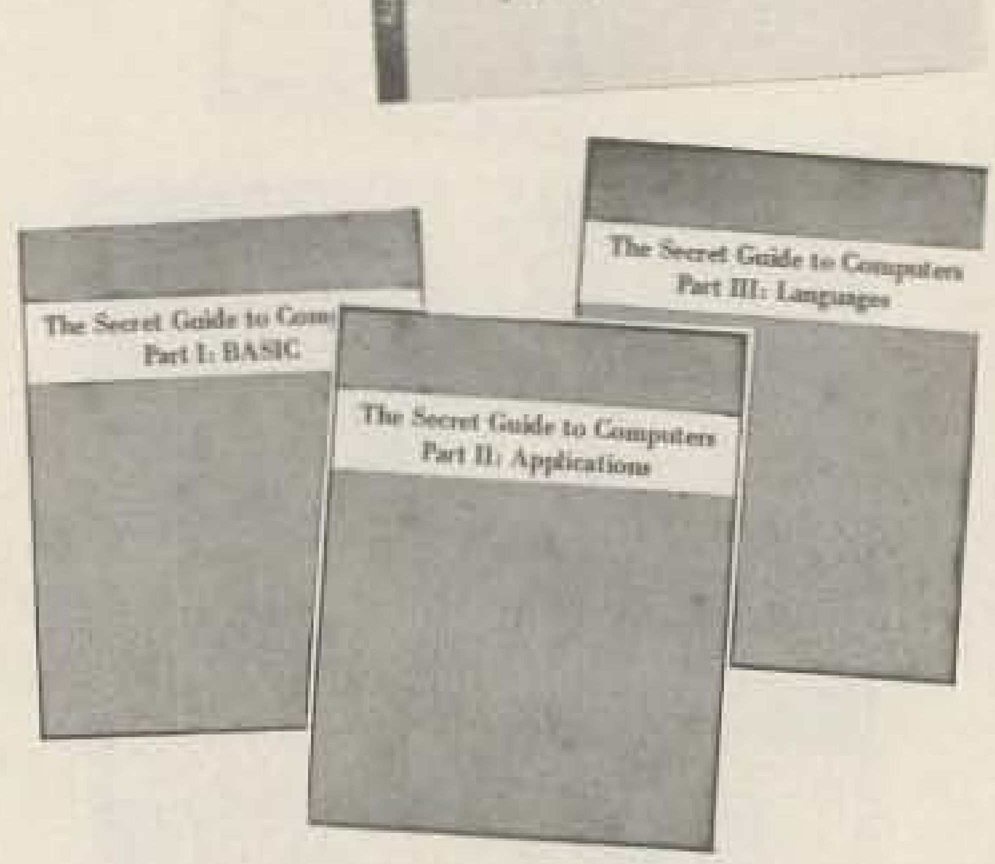

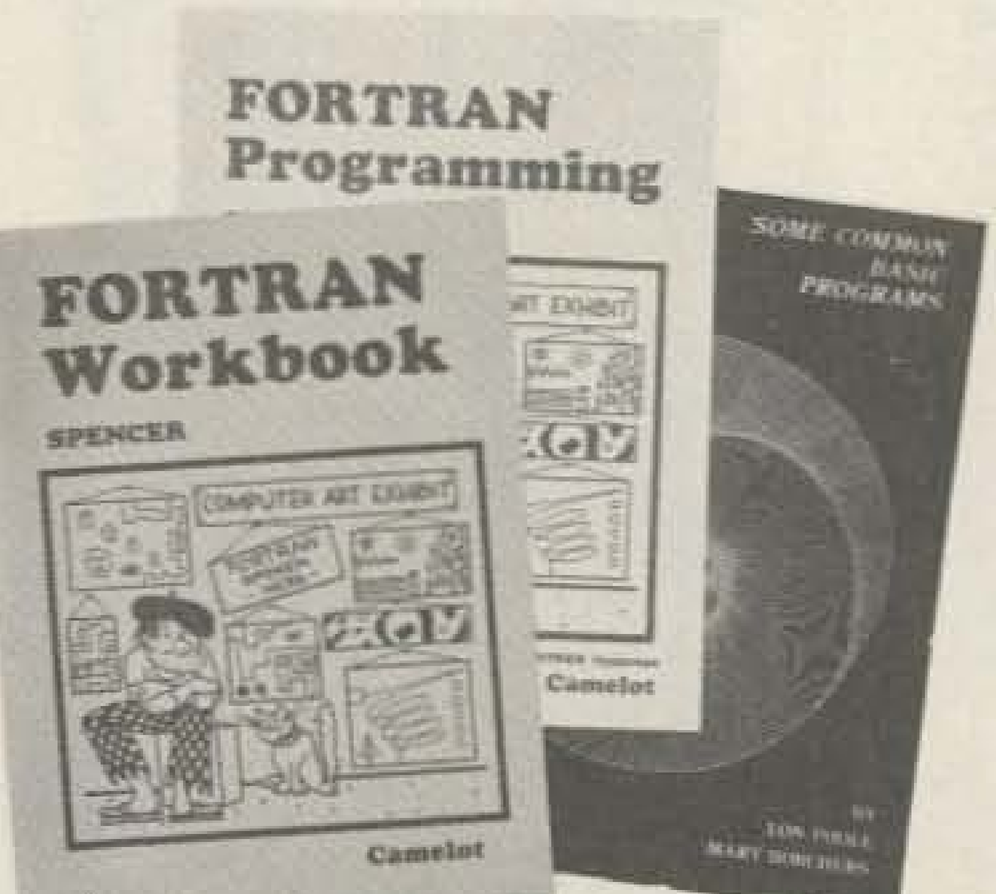

• SIXTY CHALLENGING PROBLEMS WITH BASIC SOLUTIONS Donald Spencer. This book provides the serious student of BASIC programming with sixty interesting problems and their solutions. None of the problems require a knowledge of math above algebra and should interest the casual user of BASIC on hobby machines. A number of game programs are also provided, as well as programs for financial interest, conversions and numeric manipulations. Price: $6.95

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A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
FG = Fair to Good
P = Poor

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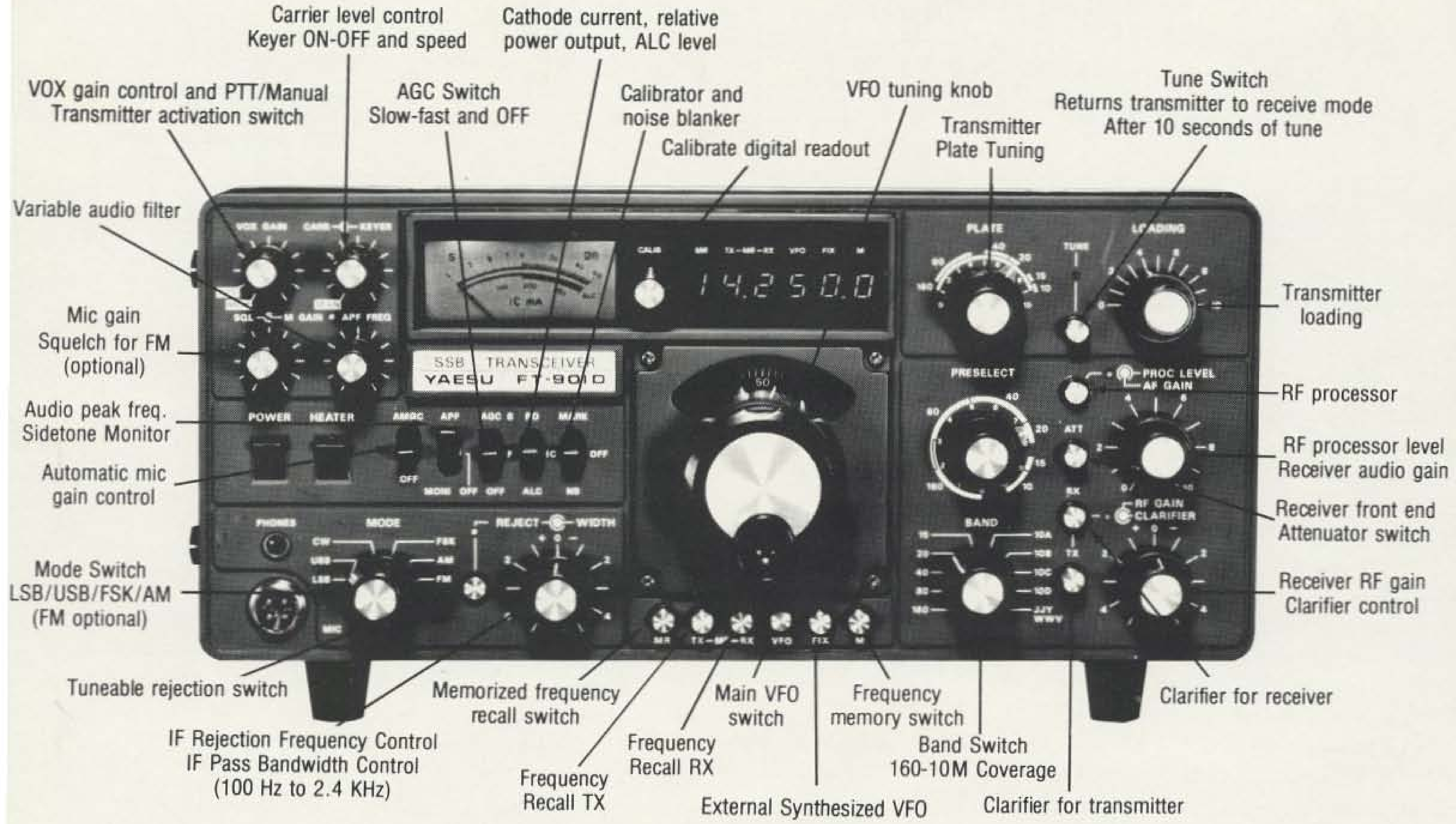

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