73

FM ANNUAL

APRIL 1975
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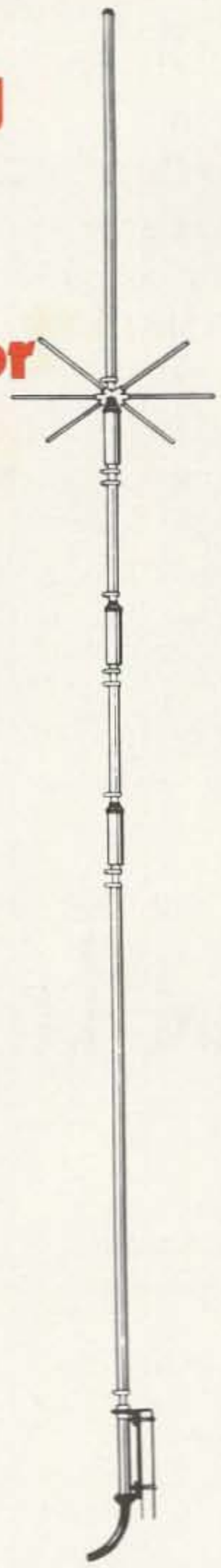

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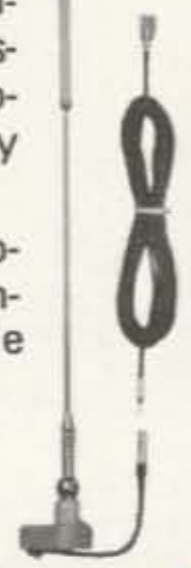

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73 amateur radio

#175 APRIL 1975

COVER: Photo of Judi Light, AKA Judi Repeater, courtesy of Charles Webb KØBWR.

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73 staff

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

I think it is about time we stopped insisting on exams and spent a little more time trying to interest amateurs in learning about new things because they are fun.

Docket 20282 is just another attempt by the FCC to get incentive licensing to work. There was no legitimate excuse for proposing or putting through the incentive licensing rules and I see none for this docket either.

The whole idea of forcing amateurs to go down to the FCC and take exams to get higher classes of license serves no useful purpose. It wastes a lot of time for the amateurs who have to study the theory and code required for these tests and it wastes the license fees involved. Passing a test proves very little — it certainly doesn't make better operators — it doesn't make more hams — it doesn't develop experimenters — it just wastes time and effort.

Not one amateur in a hundred is prepared at any moment to pass an FCC exam — every one of us has to get out the books and study for a while before we are up on the material in the tests — and this is because there is no way for the tests to be consistent with real life. Passing a test is passing a test — it does little to help an amateur as an amateur.

The fact is that amateurs who are interested in CW get to be good at it. Those interested in RTTY learn about that — and no amount of questions on an exam about RTTY will aid the learning process. I think it is about time we stopped insisting on exams and spent a little more time trying to interest amateurs in learning about new things because they are fun.

A few years back we had just two classes of ham ticket — the beginner or Class B, and the Advanced or Class A. Oh, yes, there was a Conditional, Class C, for those over 75 miles from an FCC office. That was the same as the Class B. The fact was that practical experience in those days showed us rather clearly that there was little to be gained from the Class A exams and we could have done just as well with one single class of license. Many of the Class A amateurs wore their ticket as a badge of honor and were absolutely insufferable about it.

So here we are today with six classes of license and the prospect of two more being added to the list. For what? **One look at the FCC regulations tells us that this whole intricate construction is absolutely against the most basic rules** — the very foundations set out in 97.1 — the basis and purpose of amateur radio. Unfortunately not one amateur in a thousand has read over the rules.

So here we are about to set up a new license class — a Communicator Class. Do we have any evidence at all that a code-free ticket will accomplish anything beneficial? What is it that the FCC wants to accomplish with this new license? The language is vague, but apparently one rationalization is that this will magically bring in thousands of new amateurs. Another is that the restructuring will repair the faults in the incentive licensing regulations which have failed so miserably.

We've been publishing the FCC figures on license exams in Hotline for the last year and they show very clearly that about 80% of those who flunk the ham test drop out over the written exam, not the code. The fact is that code has been a negligible deterrent for those trying for ham licenses — so what is there to gain by getting rid of it? Not much, it would seem.

But what about Japan where a no-code ticket has resulted in over 300,000 amateurs? Surely that is proof that a no-code license will drag 'em in by the tens of thousands? Sorry, but the main reason they have so many amateurs in Japan is because the clubs are organized and give classes in amateur radio, complete with licenses for those graduating. There is no indication that the success of amateur radio in Japan has any connection with the no-code aspect. If every ham club in the U.S. had classes for beginners and the members were

out beating the bushes for newcomers, we'd have tens of thousands of new amateurs over here too.

Unfortunately, only a small fraction of our clubs have classes for newcomers and a great many clubs actively discourage youngsters from coming to meetings. If the clubs I've visited in New England are any criterion, very few clubs are making any effort to attract high school kids — **and it is the 14 and 15 year olds which are our major source of new hams.**

> **If every ham club in the U.S. had classes for beginners and the members were out beating the bushes for newcomers, we'd have tens of thousands of new amateurs over here too.**

If the clubs would get out there and train new amateurs we would have no problem with dropping numbers — no need for any no-code license — no fear of CB — no worry about all those virtually empty ham bands that we know we are going to lose for lack of use — no panic over the vacant 220 MHz band — the almost inactive 10m band — the vast silences on six meters — the quiet which has descended over the bottom two MHz of the two meter band — and so forth.

Against the Rules

Let's take a close look at the rules — in particular 97.1, the basis and purpose of the regulations. Just one part of 97.1 has to do with the regulations and only the regulations — that is 97.1c and, as the only rule having to do with the purpose of the rules, it should have constitutional power for the FCC.

This section says that the rules should provide for advancing skills in both the communications and technical phases of the art. How does that square up with docket 20282? The docket is a clear miss on this and as such should be considered as unconstitutional and should be thrown out.

> **Taking 2/3 of the hams off of experimental modes of transmission is hardly advancing skills in the technical phases of the art.**

Taking away the franchise for Techs, Conditionals and Generals to operate on ATV, SSTV, RTTY, Touchtone, Fax, and all the other innovative types of modulation is flatly against the whole concept of the rules. Remember that this affects about 2/3 of the licensed amateurs, not just a small part. Remember also that a good part of the experimentation on some of these modes has been done by the Techs. Taking 2/3 of the hams off of experimental modes of transmission is hardly advancing skills in the technical phases of the art.

No Code?

Letters coming in from happy users of the 73 code cassettes indicate that most amateurs are able to learn the code from scratch and get to where they can pass the five word per minute test in a matter of three or four hours — with one hour being par for learning the letters and numbers. Data is still coming in on the time it takes for 13 per, but apparently is is quite short using the new blitz techniques of the code cassettes — running about 10 hours of practice.

Considering the uses of the code, perhaps the advocates of no-code should rethink. Our CW bands are still quite active — most of the satellite contacts are via code — we use code for identification on RTTY and repeaters — code is used for most DXing on VHFs and moonbouncing. Code is not yet dead.

When I set up the amateur radio structure for Jordan I set it up with a five word per minute code exam — but none beyond that. I figured that those who like CW would develop their skills and that they would get far more interested in CW if it was not made a big ogre. Time has proven me right on this.

Though it might be traumatic for a lot of old timers, I'd like to see one single class of license in the U.S. I'd like to see one with a 5 wpm code test and a theory exam about like that for General. Beyond that those interested in RTTY will learn about it — those into SSTV will ditto . . . etc. Learning is fun and studying for exams is a pain in the lower back.

Let's throw out docket 20282.

We don't need classes of license to keep amateurs out of our bands — this just puts off the day when QRM forces us to invent and pioneer new techniques which will be of value to the world. We pioneered SSB and NFM, the two of today's most used communications modes, and we can pioneer new and better systems if we are permitted to experiment.

The proliferation of repeater councils and frequency coordinating committees for repeaters proves to me that we can run amateur radio ourselves without any help from the FCC

Continued on page 140

HOTLINE HEADLINES

FCC proposes automatic indentification of transmitters using ASCII code (docket 20351). It would apply to just about all services other than amateur (including CB).

Call letter change docket, companion to 20282 restructuring docket, held up by FCC staff losses.

North Carolina/Tennessee repeater feud (16/76) could seriously affect repeater regulations for whole country.

Immigrants and visitors may now take FCC ham exams as a result of a new law (93-505).

New CA3130 op amp mosfet/cmos chip detailed — also LM1808N ditto chip.

Over 5000 VHF Engineering transmitter strips sold to date — plus over 800 of the walkie-talkie kits.

CB advertised on TV in prime time to build up CB market — gets free ads as public service — so where are amateur radio ads?

Police oppose CB patrols as possible vigilante groups.

Ladder hassle on towers resolved in favor of amateurs.

Canadian Amateur Radio Federation (CARF) recognized by Canada DOC — ARRL loses another battle to keep tight control of Canada in U.S. hands.

Get a receipt! Amateurs in NY indicted for receiving stolen rigs bought at hamfests.

FCC strikes at CBers — cites 75 in Little Rock, 104 in Cleveland.

QST super blooper — virtually direct copy of old 73 article is QST feature for January and February.

Chronex watch — a computer on the wrist — invented by ham.

Amsat reports 87 countries using Oscar 6 so far — 18 WAS certificates awarded — almost 3000 contacts reported to them. Oscar 7 much better than 6 and certain to give program a big boost.

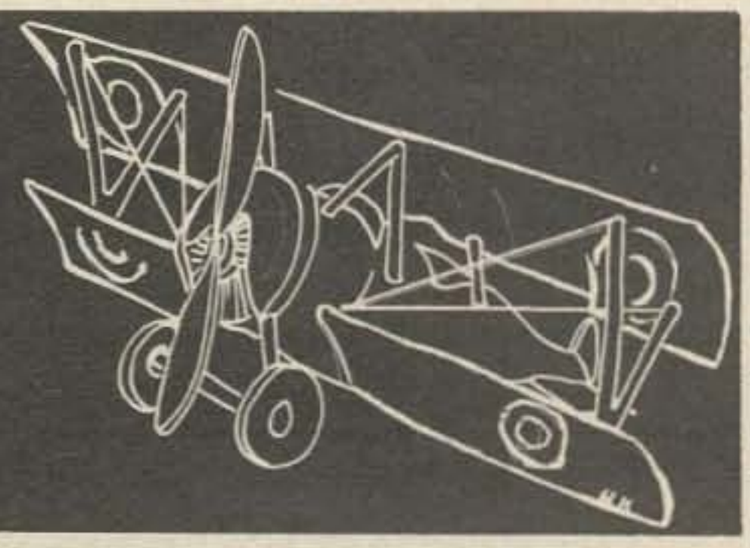
Ham movie available from PARC — the adventures and misadventures of the club during Field Day 1971.

Dealers report ham biz holding well — sales only held back by delays from manufacturers.

ITC Multi-2000 being tested at 73 HQ — considerable enthusiasm generated over this $700 CW/SSB/FM synthesized rig.

Autobiography of an Ancient Aviator

W. Sanger Green
1379 E. 15 Street
Brooklyn NY 11230



Thanks to the bootleggers, low flying on maneuvers sometimes led to high flying on Saturday nights . . .

WILD BLUE YONDER

CARLSTROM FIELD, ARCADIA, FLORIDA, 0800 15 NOVEMBER 1922.

This morning flying instruction started. Each Cadet was assigned to a flying instructor and not one failed to draw the best instructor on the field. I drew Lt. Tommy Claude. He was a tall, affable fellow who used the "follow me" method of instruction. His idea was that if a student became proficient in air work, and had a good feel of the ship, take-offs and landings would come more easily.

The planes used for primary instruction were Curtiss JN6H (Jennies) with 180 HP Wright Hispano-Suiza engines. These planes were used for training during WW1 equipped with 90 HP Curtiss OX5 engines. They had two open cockpits, front for instructor and rear for student. The Hisso Jennies were very easy to fly and had practically no bad habits. Of course, like any other airplane, if they "ran out of air" (stalled) they came right down.

While I was busy practicing wingovers, figure 8s, rolls, loops, side slips and other air work, Lt. Claude would watch for any cars crossing the prairie. If they stopped and hid a package under a mesquite bush he would mark the spot on a map. A few times we were lucky enough to spot a bootlegger caching some of his liquor load near a place where we could land. The Claudes lived in the same apartment house we did so the next Saturday evening we would give a party, inviting guests to come and bring the food.

About the sixth or seventh morning of my instruction, Lt. Claude told me to go to the hangar supply room and get two shot guns, ammunition and hip boots. He said that the lesson this morning would be duck hunting. The prairie north of Carlstrom was dotted with small ponds that were quite shallow and surrounded by high roads. They provided excellent cover for migrating ducks. He landed near one of them but the meadow was too soft so the ship stuck its nose in the ground and the propeller went the way of all nose-over props. Claude said not to worry, that soon someone would spot the tail of our ship in the air. Sure enough it was only about 15 minutes before Lt. Hez McClelland came over low. We pulled the tail of our ship down and pointed to the broken wooden propeller. He left and was back again in about half an hour and landed on some nearby higher ground with a new propeller and installation tools. In the meantime Claude and I had each bagged a couple of ducks from the pond. It took us about 45 minutes to remove the old prop hub and install the new propeller. The Claude taxied the ship to firmer ground, I got in and we were back at Carlstrom in time for lunch. Lt. Claude got the officer's mess cookee to pluck and dress the ducks so the Claudes and Greens had wild ducks for dinner that evening.

In spite of all the extracurricular activities, Claude soloed me after about eight hours dual and hunting instruction. I must have been a trifle overconfident because at about my tenth solo landing I leveled off a bit high and ended up with my nose in the ground, tail in the air and a broken propeller. This made necessary another hour of dual time with a new instructor — Lt. Umpstead. Lt. Claude was not available as he was in the hospital as a result of a slight miscalculation of his own.

It seems that Lt. Claude had flown a DH4B (DeHaviland with Liberty engine) to Fort Myers, about 40 miles south, to pick up two majors who had cracked up there earlier in the day and bring them back to Carlstrom. His crew chief went with him. They got a late start back, the two majors squeezed into the rear cockpit, with the crew chief out on a wing straddling a strut. In those days field lighting for night landings consisted of a few lights on the hangars that dimly lit the field a short distance in front of them. By the time Claude got back to Carlstrom it was dark and he evidently didn't allow for the extra load he had aboard, for his wheels hit a drainage ditch at the edge of the field. That put the DH over on its back tossing out Claude and the two majors and killing the crew chief. Claude sustained a broken leg and numerous cuts and bruises while the two majors were only bruised and shaken.

The rest of the primary flight training was uneventful as far as accidents were concerned. I practiced landing to a mark (180s and 360s) acrobatics and other air work, formation flying, cross country trips and night flying with periodic instruction and checks to make sure I was not developing any bad flying habits.

Ground school terminated on February 18th and from then until my departure for Post Field on May 15th my only duties consisted of flying. I passed all the numerous check flights and was glad to be checked out to fly DH4Bs. I also got a small amount of time in some WW1 single seater fighter planes such as Nieuports, Spads, SE5s and Thomas-Morse Scouts. The Nieuports were different from the other planes I had flown in that they had a rotary engine (the entire engine revolved). These engines had only two speeds — on (full speed) and off. There was a coupe button on the top of the control stick that, when pressed, cut off the ignition. When you were coming in to land you had to keep giving the engine spurts of power in order to keep it from quitting altogether. Same thing when you were taxiing. My total flying time at Carlstrom Field was only 68 hours.

When we got ready to go to Post Field about the middle of May, Cleo and I found that we had around 250 cans of food I had brought home from Carlstrom during my eight months of duty there (2/3 of my ration allowance). We couldn't take them with us so we sold them to our landlord for $25.

Special Orders #73, HQ Carlstrom Field dated 13 May 1922 sent Cadets Fredericks and Conerton along with us to Post Field, Fort Sill, Oklahoma by train.

Next month I'll tell you about several Carlstrom Field incidents that were worth remembering such as: The time I caught a whooping crane, the time Art Smith managed to total 5 Jennies at one time, the way one

lieutenant followed orders to quit drinking, and others, including our method of getting frogs' legs for dinner. Also, in one word or less I'll cover the enriching experience of a train trip from Arcadia, Florida to Lawton, Oklahoma.

FCC NEWS

220 MHz CB COMMENT OF IMPORTANCE

The following comment on docket 19759, written by the immediate predecessor of Walker, is of immense importance and a copy of this letter should be sent to your Congressman and your Senators just to back up the comments that have appeared in 73 to the same purpose: Someone appears to have been bought — is that reason enough for a new service to be instituted? And the proposed Class E CB is a whole new service.

Dear Chairman Wiley:

I wish to point out to you that the Commission will commit a very serious error if it adopts the course proposed in Docket 19759 and as urged by the Office of Telecommunications Policy in Acting Director Eger's December 27, 1974 letter to you.

In case you are not familiar with my qualifications to make such a statement, I was the Acting Chief of the Commission's Amateur and Citizens Division at the time of my retirement in 1971, after working 20 years in that area of regulatory activity. Prior to that, I was in the allocations Branch of the Commission's Frequency Allocation and Treaty Division and engaged in monitoring, inspection and intelligence activities in the first years subsequent to my employment by the Commission as a Radio Inspector in 1940.

Former Commissioner E. K. Jett's dream of cheap two-way radio communication for people in all walks of life seemed likely to become a reality when the Citizens (Class D) Service grew so rapidly in the sixties when it was established on the 27 MHz frequencies taken from the Amateur Radio Service. However, the Bureau Chiefs responsible failed to heed staff warnings that this Citizens band would soon become an unmanageable mess if not adequately policed. As a result of the Commission's neglect, the Citizens Service Class D operation has become a shameful disgrace. While the Commission's recent sampling experience with its three field "CB" enforcement teams indicates a potential answer to the establishment of the discipline necessary for a useful Class D service, only the actual application of an all-out effort will prove the Commission can, *and is willing* to do it!

In the face of the foregoing, the Commission's Docket 19759 proposes a new Class E Citizens Service again, as for Class D, taking frequencies away from the amateurs. Even though a potential of several million licensees is estimated by the Electronic Industries Association, no concrete, proven means of maintaining discipline is assured or promised and the Notice vaguely refers only to "...examining a number of various proposals..." (for reducing Class D violations) and to the intent that "...abuses of its Class D rules, and associated enforcement problems, shall [not] be extended to this new service."

It appears that your Chief Engineer is in a big hurry to create a new monster by amending Part 2 of the Rules to allocate frequencies for "it" before he knows how "it" will be put together or how to control it! WHY? Are you and your fellow Commissioners willing and able to commit the funds the Chief of the Field Bureau would need to maintain the disciplined radio service Mr. Eger hopes it would be? If so, why does your Safety and Special Radio Services Chief propose in Docket 20120 to expand the Class D 27 MHz frequency space through rule amendments which are expected to "...enhance the potential of the Citizens Radio Service to provide adequate and efficient radio Communications provided licensees comply, *on a voluntary basis,* with our Rules"? (italics added for emphasis) At least, in this latter proceeding, the Commission and *some* of its staff appear to believe it advisable to re-examine "...the Commission's ability to regulate the Citizens Radio Service in the public interest, the Commission's ability to adequately enforce its regulations, and the ability of licensees and others involved with the Citizens Radio Service to use the Service in a mature, responsible manner."

Mr. Eger's letter observes that "Estimates of the industrial activity contribution of such a service suggest a market size approaching half a billion dollars per year..." and that "...a larger public need for radio justifies the foregoing reallocation." How, when and where has such a need been demonstrated to O.T.P. or to the Commission? Comments by prospective users on the Docket 19759 proposed Class E Service is so light as to be insignificant. In the absence of any demonstration of need, it would appear that the sole benefit to result from Class E would be to the electronic industry which hopes for a new market for equipment. Currently, tens of thousands of newcomers to Citizens Radio operation find their purchase of equipment is wasted because the chaos which prevails on Class D Channels prevents their operation for legitimate purposes. Is it in the public interest to further prime the electronic industries' economic pump from money obtained by holding out a false promise of useful communications to the general public via the proposed Class E Service? In the face of this, it seems strange that some staff members in O.T.P., D.O.D. and F.C.C. are pushing so hard for this Class E proposal.

Mr. Chairman, I urge you and your fellow Commissioners to weigh this matter *very* carefully and consider *all* pertinent information before you decide the Commission's course.

Sincerely,
William S. Grenfell

Before the Federal Communications Commission, Washington, D.C. 20554.

In the Matter of

Implementation of the National Environmental Policy Act of 1969

Docket No. 19555

ORDER
Adopted: January 22, 1975
Released: January 24, 1975
By the Commission:

1. The Commission has before it four petitions for stay of the effective date of its rules implementing the National Environmental Policy Act (FCC 74-1042, 39 F.R. 43834, December 19, 1974). The petitions were filed on January 14, 1975 by the American Radio Relay League and on

January 15, 1975 by Communications Properties, Inc., Midwestern Relay Company, and Teleprompter Corporation. The effective date of the rules is January 20, 1975.

2. The Relay League asks that the rules be stayed until the amateur license application form (FCC FORM 610) has been revised or supplemented to reflect the requirement of submitting an environmental report with certain applications and until the new form has been made widely available to amateur applicants. The League states that information concerning the size and precise location of amateur antennas and supporting structures is not required by the present form and expresses concern that some 8000 amateur applications received monthly by the Commission will be rejected or not acted on for want of a statement that the facilities to be operated by the amateur applicant under his license are "minor" within the meaning of the environment rules. As the League states and as we are fully aware, it would be rare, indeed, for an amateur operator to construct an antenna tower which is 300 feet in height or which would for any other reason be a "major" action within the meaning of the environmental rules. In this respect, we note that structures of 200 feet in height require aviation hazard clearance, where information concerning the height and location of the structure is required, and the need for clearance is made known to the Commission, and that amateur structures in this category are also rare. It should therefore be apparent that we do not intend to reject or hold up amateur applications for want of a statement that the facilities in question are "minor" facilities. The petition for stay submitted by the American Radio Relay League is therefore denied.

3. The three other petitions for stay are essentially identical as to substance and can be dealt with as one. The petitioners request a stay pending action on their petitions for reconsideration. Their principal complaint on reconsideration is that the rules require that an environmental report be submitted with applications for the construction of microwave towers of 100 feet in height and that similar reports are required for other towers in most cases only if they are 300 feet in height. We agree that this disparity is one which should be given further consideration by the Commission. We do not, however, consider that it is a valid ground for stay of the rules. If construction of a particular antenna tower carries with it consequences which are significant for the environment, the public interest will be served by preparation and Commission consideration of an environmental report, and the burden on the applicant is only that which is appropriate under NEPA. If construction of a particular tower does not carry with it consequences of significance, on the other hand, the burden of preparing the report is very slight and processing of the application will not be delayed. The submission of reports concerning towers of varying types and heights during the period in which the environmental rules are being reconsidered, moreover, will provide an improved factual basis for considering which of the many projects authorized by the Commission should ultimately be subjected to routine environmental processing. The petitions for stay submitted by Communications Properties, Inc., Midwestern Relay Company, and Teleprompter Corporation are therefore denied.

Federal Communications Commission
Vincent J. Mullins Secretary

FCC EXAMS AT ROCHESTER

The FCC will conduct amateur radio examinations at the Western New York Hamfest, in Rochester, N.Y., on Saturday, May 31st for General and higher class licenses. Examinations requiring a code test (13 or 20 wpm) will begin at 10 am. Those not requiring a code test (advanced class) will begin at 1 pm. Applications should be submitted with the $4.00 filing fee no later than May 23rd to the FCC, Room 1005 Customhouse, Second and Chestnut Sts. Philadelphia, Pa., 19106. Applications should be marked "For examination at the WNY Hamfest."

A complete Hamfest informational mailing along with a copy of the program will be sent to all on the mailing list around April first. To be included on the list, just send a card to WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

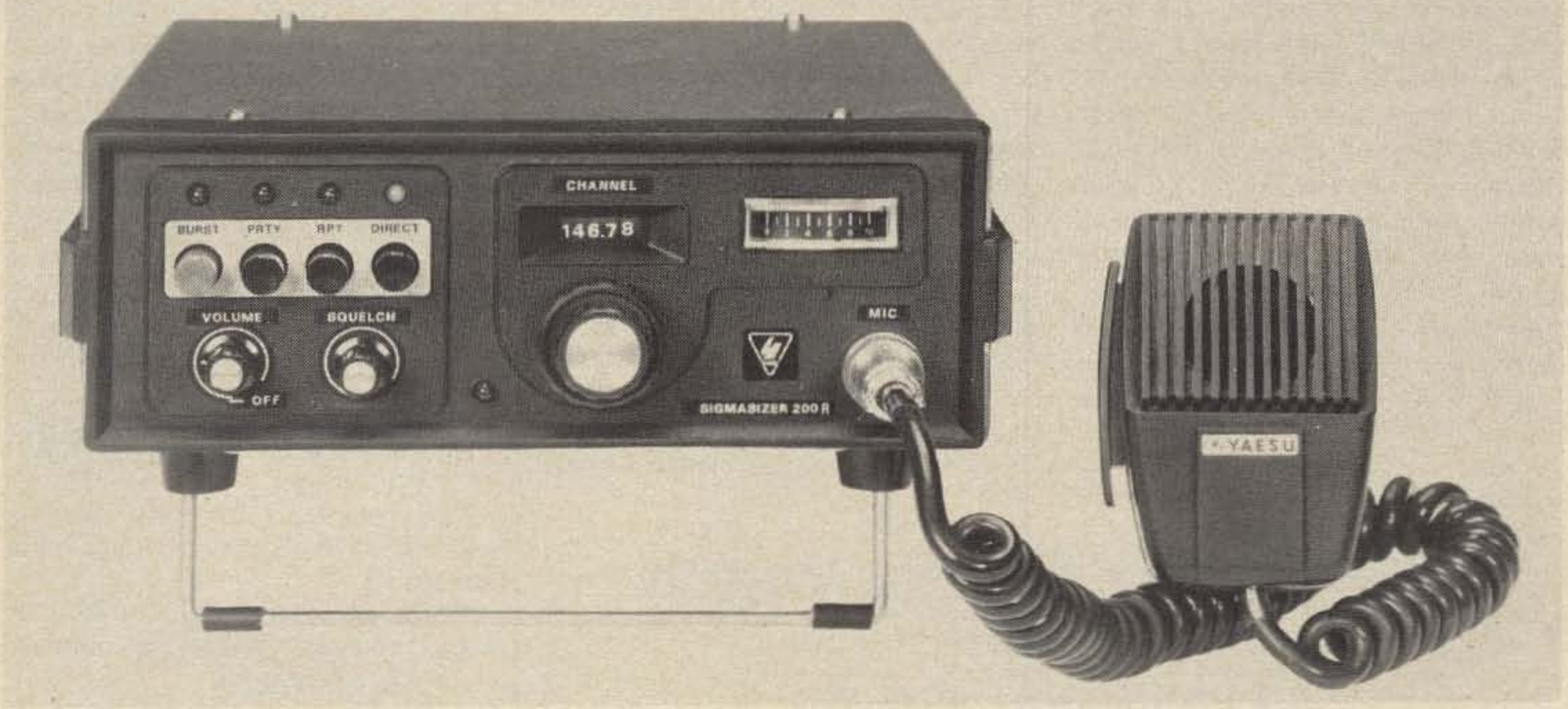
Satellite Orbiting Data

Oscar 6 Orbital Information

Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W
11237	1	0104.2	66.0
11249	2	0004.2	50.9
11262	3	0059.1	64.7
11275	4	0154.0	78.4
11287	5	0054.0	63.4
11300	6	0148.9	77.1
11312	7	0048.8	62.1
11325	8	0143.8	75.9
11337	9	0043.7	60.9
11350	10	0138.6	74.6
11362	11	0038.6	59.6
11375	12	0133.5	73.3
11387	13	0033.4	58.3
11400	14	0128.4	72.0
11412	15	0028.3	57.0
11425	16	0123.2	70.8
11437	17	0023.2	55.8
11450	18	0118.1	69.5
11462	19	0018.0	54.5
11475	20	0112.9	68.2
11487	21	0012.9	53.2
11500	22	0107.8	66.9
11512	23	0007.7	51.9
11525	24	0102.7	65.7
11537	25	0002.6	50.7
11550	26	0057.5	64.4
11563	27	0152.5	78.1
11575	28	0052.4	63.1
11588	29	0147.3	76.9
11600	30	0047.3	61.8

Oscar 7 Orbital Information

Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W
A1708	1	0026.9	56.6
X1721	2	0121.2	70.2
A1733	3	0020.5	55.0
D1746	4	0114.8	68.6
A1758	5	0014.1	53.4
B1771	6	0108.4	67.0
A1783	7	0007.7	51.8
B1796	8	0102.0	65.4
X1808	9	0001.4	50.3
B1821	10	0055.6	63.8
A1834	11	0149.9	77.4
B1846	12	0049.3	62.2
A1859	13	0143.5	75.8
B1871	14	0042.9	60.6
A1884	15	4137.2	74.2
X1896	16	0036.5	59.0
A1909	17	0130.8	72.6
B1921	18	0030.1	57.4
A1934	19	0124.4	71.0
B1946	20	0023.7	55.8
A1959	21	0118.0	69.4
B1971	22	0017.4	54.3
X1984	23	0111.6	67.8
B1996	24	0011.0	52.7
A2009	25	0105.3	66.2
B2021	26	0004.6	51.1
A2034	27	0058.9	64.6
B2047	28	0153.2	78.2
A2059	29	0052.5	63.0
X2072	30	0146.8	76.6



Charles Anzman WB2PVH
2159 Seneca Dr. E.
Merrick NY 11566

The Remarkable Yaesu Sigmasizer

You want to go synthesizer-FM. The reality that buying 12 sets of crystals could have bought you two synthesizers has finally sunk in. Now, a new problem . . . which synthesizer? You could get a Clegg Crystiplexer or one of the newer external synthesizers like the GLB or RP. To add to the growing confusion, Yaesu has just announced their new synthesized transceiver — The Sigmasizer.

The Sig, as we'll call it, is about half the height of your common Clegg and about one inch wider. It has an output of 10 Watts and one Watt in low power. Like the Clegg, it uses some crystals (included) for synthesization (say that three times fast!). The Sig covers 146-147.99 MHz in ten kHz steps, with a five kHz mod in the not too distant future. Both the frequency readout and quote 'S' meter are illuminated. No tuning is required. You just set the dial to your desired channel and you're on. From there, you can operate Simplex (direct) on the dialed frequency or activate the RPT button which will automatically offset your transmitter 600 kHz down in the 146 range or 600 kHz up in the 147 segment. The Sig has a priority position into which you can put crystals for your favorite repeater making QSY to that channel quick and easy. Just push the PRTY button. LEDs are provided to tell you if the rig is operating SMPLX, RPT or PRTY and if the unit is transmitting low power. Additionally, another LED lets you know when you're transmitting. The 200R has a built-in tone burst oscillator with variable time delay, frequency, and amplitude, making it useful for PL and other applications. The unit comes ready to go with molded cigarette lighter plug and microphone. No worry about alternator whine, as the Sig incorporates a built-in toroidal alternator whine filter. Antenna troubles? Don't fret. The Sig has an swr protection circuit which disables the transmitter at higher than a 1.8:1 vswr. Unlike other protection circuits, the disable mode is made obvious to the operator by the transmit LED shutting off one second after pushing the PTT button.

Setting frequency is simple. Two concentric knobs do all the work. The inner knob sets the MHz and 100 kHz digit, and the outer knob sets the 10 kHz increment. The frequency is then displayed on the illuminated dial. No worry about the readouts burning out because it's mechanical. Of course, common features like external speaker jack and plug-in mike have not been forgotten.

Time to get technical. The specifications provided with my prototype were, believe it or not, in Japanese, so I took a few of my own. Sensitivity measured an unbelievable .13 uV for 20 dB quieting. Intermodulation products were down compared to other transceivers we have tested. This might be attributed to the Sig's dual-

filter design with filters in both the high and low i-fs. A Murata 'E' filter keeps things tight but is easily changeable to an 'F' if much splinter operating will be done. The Sig's speaker is bolted to the bottom cover for minimum vibration at low frequencies. Receive quality was good and the unit's audio amp provided plenty of push in the noisy mobile.

The transmitter put out 10.1 Watts at 13.8 volts. It dropped only to 8 Watts at 11 volts and put out 13 Watts when subjected to 15 volts. Audio was good with the provided 600 Ohm dynamic mike (which is directly interchangeable with the FT-101B mike).

It looks like Yaesu's done it again. A synthesized transceiver for the serious FMer.

Construction-wise, the Sigmasizer is excellent. Opening the lid, you see three separately shielded subassemblies. The rf compartment is also separately shielded making TVI virtually non-existent. Operating the Sig right on top of my Sylvania color set resulted in slight bars on channel two. When subjected to the same test, my TR22 (one tenth the power) wiped out the picture.

Temperature changes barely fazed our Sig. When subjected to my mobile environment, which varies from 20 degrees F to about 75 with the heater on, the Sig never wandered more than 300 Hz.

Summing up, the Sig is quite a little box — versatile, easy to operate, and offering many features that more expensive rigs don't. Don't pass it up when it comes your turn to get sick of buying crystals. The price tag? How about 449 bucks, about what you'd expect to pay for a fully crystalled rice box.

Many thanks to Harrison Radio, Farmingdale, for providing our test Sigmasizer.

. . .WB2PVH

N. Tenhulzen
120 S. Jupiter
Garland TX 75042

The Quartz Digital Watch

an electronic marvel

How many times have you missed a MARS net check-in or an important sked with that W6 across the country? In several cases it was probably because your $19.95 drug store special thought there were 63 minutes in an hour instead of 60. I have had this problem on more than one occasion and I think I have found a cure for it. It's called a quartz digital electronic watch. These electronic marvels boast the amazing accuracy of better than five seconds a month. My particular model, an LED type, lights up when a command button is pushed and displays the time in hours, minutes, seconds and also tells me the day and the month (very useful during those long weekends contests).

Operating Principles

Most of the quartz digital watches on the market today operate with the same basic principles. Divide the output from a crystal oscillator down to a one Hz signal to be used to control several types of displays. In most cases, the crystal oscillates between 30 and 1000 kHz (in this particular case, 32,768 Hz). This 32.768 kHz signal is then applied to a divider chain which divides 32 kHz down to 1 Hz. This 1 Hz signal is applied to control logic that routes this 1 Hz pulse to other divide circuits or counters. These counters divide the 1 Hz signal into minutes, hours, days and months (that's a lot of dividing). The outputs from these counters are then applied to decoders. These decoders take the information that once was a 32.768 kHz signal and transform it into signals usable in a seven segment display. All this oscillating, dividing, controlling and decoding is done on a single integrated circuit chip about 150 mils square, and drawing only about 8 microamps.

Most of the work is done by a single CMOS integrated circuit containing over 1500 transistors (another amazing feat). There is even a built-in provision for increasing the brightness of the display when the ambient light level is high. During high light levels, PC1, a photocell, lowers its resistance causing the integrated circuit to increase the duty cycle of the multiplexed seven segment display outputs. The only other parts in the watch are the crystal oscillator circuit components, two 1.5 volt silver oxide batteries, two command switches, the display driver transistors and, of course, the four digit seven segment display itself.

Put all this together and you indeed have an electronic marvel, guaranteed to tell you time and date with 5 seconds per month accuracy, and to run for a year on one set of batteries. Now it looks as though I will have to find a new excuse for missing my next net check in.

. . .TENHULZEN

Ham Help

This column is for those needing help in obtaining their amateur radio license.

If you are interested, send *73* your name, address and phone number.

Eugene Neigoff
1120 Algonquin, Apt. 2H
Schaumburg, Ill 60172

Johnnie David Twine
T-44 4ATAF
APO New York 09131

Mr. William Prago
2240 Center Avenue
Fort Lee NJ 07024
(201 944-2860)

SPECIAL THANK YOU TO MY ANONYMOUS BENEFACTOR

I cannot tell you how deeply I appreciate your concern for me, as evidenced by the trouble you went to by placing an ad for me in the "Ham Help" column of 73 Magazine.

I hate to disillusion you but I am presently Vice President of Engineering of WSNL-TV here in Central Islip, operating on UHF Channel 67, with a power of 5,000,000 Watts e.r.p. I am a member of SMPTE (Society of Motion Picture and Television Engineers), AES (Audio Engineering Society), and a member of the Board of Directors of the SBE (Society of Broadcast Engineers), and have been engaged in Broadcast Engineering for a mere 18 years! I have been a licensed ham since 1956, first as KN2VGD, and now with Advanced call letters of K2VGD (since 1957).

I don't mean to sound ungrateful, but your concern is not only unnecessary . . . but . . . unwanted.

P.S. I am very willing to render any assistance to any person who is interested in obtaining a license.

. . . Edwin T. Karl K2VGD

73 MAGAZINE STAFF

73 Inspects Spec Comm

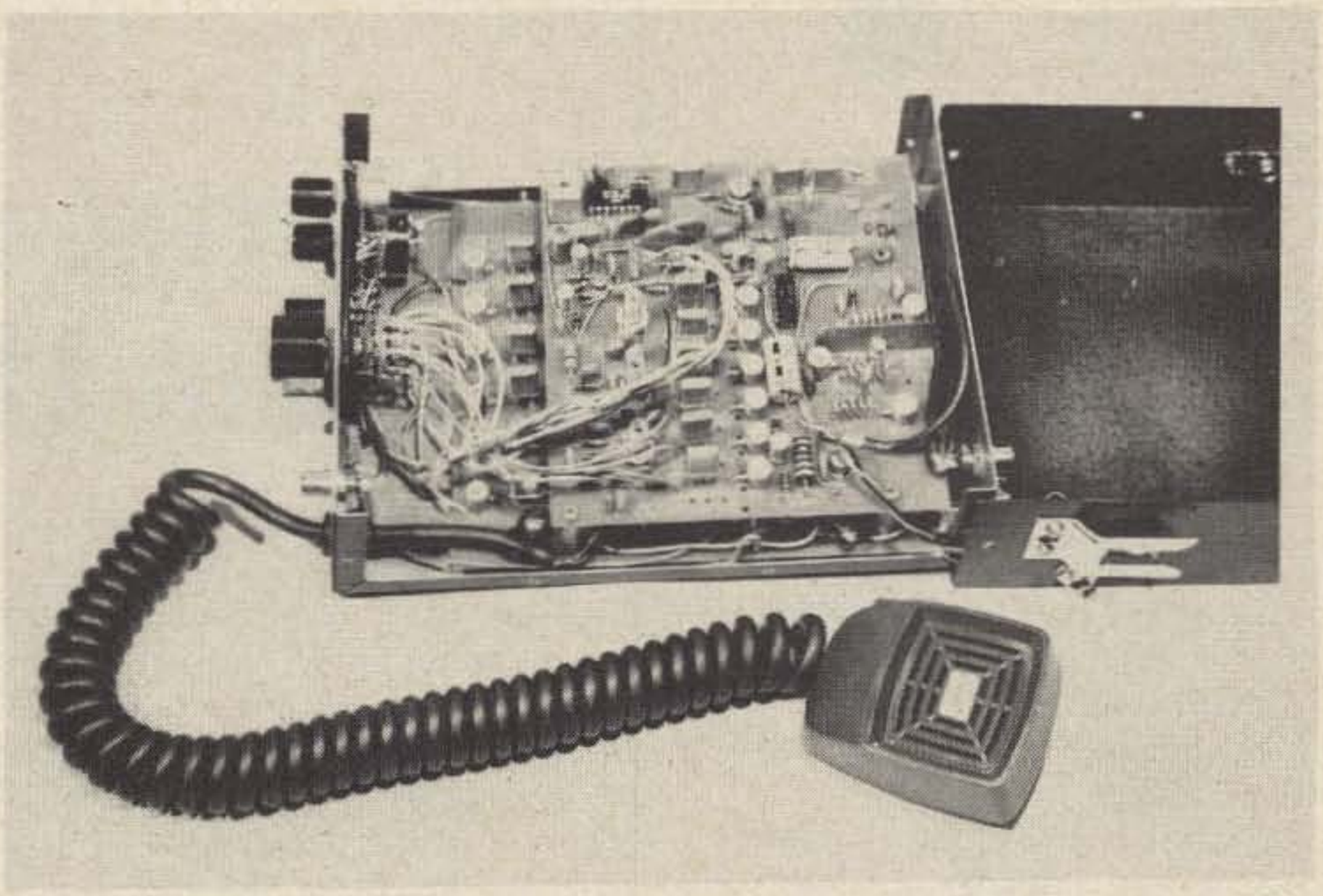
Readers of the ads in 73 may have been wondering about the new two meter FM rigs announced by Spectrum Communications in Worcester, Pa. At that price can they be any good?

We've checked it out at 73 HQ and we want to report that the rig is not just good, it is amazing. The engineers at Spec Comm have applied the latest and hottest IC chips to FM and the result is one of the simplest and most effective rigs on the market.

The receiver centers on the i-f IC which has a four pole crystal filter on the input and a two pole on the output – the result being sharp skirts without all the extra images and other troubles which come with going to a double i-f chain. The mosfet preamplifier and Shottky hot carrier diode mixer go a long way toward eliminating intermod and adjacent carrier interference.

Most of the transmitter is contained in two ICs, including an extremely effective speech clipper/filter which really makes the voice fill out the signal, but without the usual muffled distortion. It sounds beautiful.

There are a lot of details which add up to a remarkable package – such as all solid state switching (no relay to defunct or get dirty), a 3" speaker (which sounds a lot better than the usual 2" jobs), the use of TR-22 crystals (which are available everywhere), a choice of six or twelve channel models (depending on how many repeaters you have around), antenna connections on both front and back of the rig (very handy at times – it also allows clip-on accessories to automatically plug into the antenna input), and one of the best acting squelches we've seen yet.



The accessories help to round out the system – items such as an ac supply which simply clips on the back of the rig ($45) for home use (the antenna jack feeds through so you can still plug in the antenna on the front or rear of the rig). The power supply uses one of the newest silicon-steel transformers (keeps very cool).

There is a nicad battery pack which also clips on the back of the rig, making it a great five Watt walkie-talkie to sling over the shoulder. The nicads are hefty and designed to run the five Watt rig – not your usual penlight size cells which poop out in a couple of hours.

A 25 Watt amplifier clip-on module is also available ($90) which both boosts the power output of the rig and provides a low-noise preamplifier for the receiver.

There is a battery status indicator on the front panel that indicates when it is time to stop talking and service the nicads. Anyone who has overtalked nicads will appreciate the value of this gadget. The indicator is needed because the voltage regulator circuit is so good that the receiver never indicates when the voltage is starting to run low. Hooking up the rig backwards won't blow it either, due to a reverse voltage protector. The final is well protected from shorts or open circuits.

The rig is built on two large circuit boards so everything is right out there easy to check and service – quite a difference from some of the rigs which take a deformed midget to get into.

By virtue of the 1975 type of circuit and direct sale from the factory, the Spec Comm boys are able to make the 560 (five Watts six channel) available for $180. The twelve channel model 512 is $200. There aren't many bargains like that any more.

BE MY GUEST

Visiting views from around the globe.

I HAVE MET THE ENEMY– AND HE IS US

WA8OGS has asked me to write about my patent application. I applied for a patent on a system of Stereo for the Standard Broadcast Band on June 27th of 1968. In the course of the following seven years, I've traversed all the courts.

From the patent office I went to the Appeals Tribunal, after my application was rejected on a simple technicality. One of my claims was not in a one-sentence structure!! This is a no-no. While in the Appeals Court, I had to write my own brief and submit the required number of copies. I had sent my new claims in a registered letter which was signed for. But for some strange reason it was not before the Court when they deliberated in closed session (in camera). I did not know about this until 18 months had elapsed. I became angry and tons of letters were written back and forth.

I decided to fight on. I had a choice of taking civil action against the United States or of going to the U.S. Court of Customs. The latter won out, and I thereby waived my right forever of taking civil action. This is a rule spelled out in USC 145. I lost again after writing and printing 40 copies of a brief. The date was March 21, 1974. I immediately asked for a review. The review was denied May 28, 1974.

It looked like the end of the road for me. I decided I would fight on. I wrote the Clerk of the Supreme Court at 1 First Avenue for an example of a petition. They sent me a petition to use as a format. It was done on 8½ by 13 inch paper and double spaced. I followed this scrupulously. I sent the filing fee too. Three days later it came back with the stamp of the Supreme Court on it. They rejected it and sent me a new rule book. The printing must be done as spelled out in rule 39. Print shall not be less than 11-point type and adequately leaded, and the lines shall not be more than 4-1/6 by 0-1/6 inches. The paper must be of a certain color and it shall be bound.

JOSEPH M. RICE
vs.
THE UNITED STATES

The front cover told the story under the general heading of "Joseph M. Rice versus The United States of America". The argument was now between me and the Attorney General and The Justice Department. The second petition was rejected because I had neglected to show why the Supreme Court had jurisdiction in this case. My answer was that I had exhausted all the Federal Courts below. They accepted this, and I again wrote 40 copies of a new petition with different rules and supplied the Justice Department with three copies as "proof of service". The case was docketed as 74-152.

On November 25, 1974 the Supreme Court denied the Writ of Certiorari. I have now lost in every court in the land. Hopeless? Yes. But somehow I picked up the pieces and found a technicality. The Justice Department had not filed their brief in opposition to my petition in time. They are allowed 30 days plus an additional 20 because it involves the United States. They had gone overtime by almost a month.

I am presently protesting to the Chief Justice, Mr. Warren Burger, and to the head of the Justice Department. I pointed out that even though I am not an attorney I do know the difference between a statute and common law. I am arguing that I had to abide by stringent rules and the Justice Department must do so also. I've had numerous telephone conversations and our language is getting salty! Like I said in the beginning, I've met the enemy and he is US!

. . . W4RHZ

Reprinted from *Feedline*, Northern Kentucky Amateur Radio Club, February, 1975; submitted by Joe Burke WA8OGS.

Nuts to You, Alpha Bravo Charlie!

We are hum-drum, dull and in a rut! I don't know – perhaps things are just different today from when I got my ham ticket (more sophisticated?), but it seems to me some action is in order. What I'm referring to is callsign phonetics.

Way back when (circa '54) everyone truly went to great lengths to put together clever, or odd, or ridiculous phonetics for his (or her) call so it would be remembered. Long after you forgot the QSO and the person, the phonetics would remain – and if you heard them again you would instantly recall. As a matter of fact, almost every QSL card you got contained the phonetics used – something I rarely

see today. For instance, I remember vividly a clergyman I worked on 40 meters about 20 years ago whose call, W8JAP, I never forgot, and, who signed as "Just A Parson." Fritz, back when he used to be W3MCH, was the Most Cheerful Ham, a set of phonetics I dubbed him with and which stuck. Lois W8MHF from Cincinnati was the Mighty Homely Female and Bill, my blind friend from Etna, Pa (W3TOC) was the Tired Old Cowboy. You could forget TOC, but could you forget Tired Old Cowboy?

Today, with some notable exceptions (Little Queer Vampire, Young Girl Chaser, Only In America, Charlie Sends Kisses), we seem to be afraid to budge one inch from Government Suggests We Use.

It is high time the chains of verbal bondage are smashed.

Undoubtedly, with very little thought, you can do much better than what follows. However, for your consideration, I offer these random possibilities: Hot Rotten Nasty, Tired Used Nash; Some Kinda Queer; Uncle Sam's Cousin; Uncle Tom's Cabin; Poor Yellow Fig, American Car Tester; South Eastern Yankee; Hippy Yo Yo; Mighty Shota Whiskey; and on and on. Used for instance as: This is W3HYY, the Hippy Yo Yo.

Some calls are impossible to do much with and some merely lend themselves to such ribald thoughts as to be better left alone. If my call was W3GFY I probably would have long ago been thrown off the air. Then there are those calls with X's in them which are really deadend streets right away. Beyond Never Xray Unicorns, where can you go?

The FCC insists that you use your call with phonetics only if conditions warrant. I say nonsense. (With all the stations we have on the repeater nobody can be remembered anymore with help.) Believe me, it is much easier to know that Fritz is the Cold Blooded Vampire or the Chocolate Bagel Vendor . . .

So let's get our imaginations working and get some life into those hackneyed letters. And maybe someone will come up with a better one than the best one I ever heard — probably 15 years ago — mobile in N.Y., where a fellow let it all hang out and K2HMJ became Keeper to Her Majesty's Jewels. See — I never forgot!

. . .Jules W3YZE
3 Yaks, Zebras & Elephants

Reprinted from *The Modulator*, Baltimore Amateur Radio Club, Inc., January, 1975.

Guest Editorial: Counterpoint

FM vs. AM

Response to VE3DNR

(73 Magazine, February, 1975)

Hey — Wait a minute! Let's forget about comparing 40 Watt FM transmitters against 10 Watt AM transmitters, claims of different antenna gains for the two modes, and loaded statistics that scream "foul". Let us look at the receiver, and its bandwidth.

Looking at my copy of "Amateur Single Sideband", Collins Radio Company, 1962, First Edition, I find a chart comparing FM and SSB on page 11, figure 1-5. Unfortunately, the signal to noise ratio at the crossover point is not given. We must use a small amount of simple math to approximate the signal levels at which the performance is equal. Please note that the FM bandwidth is given as 12 kc, the current commercial two-way radio bandwidth, and that for most modern amateur repeaters, not 30 kc as remarked on by VE3DNR.

The chart on page 7, figure 1-3, compares AM and SSB using sine wave modulation. Let us make a few notes and additions to the chart, in the portion identified as block "E", or, "noise voltage, arbitrary noise power per kc of bandwidth." Remember, we speak of equal noise *power* per kc of bandwidth, but we measure *voltage.* The figure given for 3 kc bandwidth is .07 Volt, and for 6 kc bandwidth, the figure is .1 Volt. By simple calculation, the figure for 12 kc bandwidth is .14 Volt. If it seems that rabbits are starting to come out of the hat, keep in mind that twice the reference voltage also means twice the reference current, therefore a power ratio of 4 to 1, or 6 dB. For a 3 dB increase in power, a ratio of 2 to 1, the voltage increase would be the square root of the power ratio, or 1.4 (approximately).

In a modern FM receiver with good capture ratio, an incoming carrier 3 dB above the noise in the FM i-f strip will quiet the noise as heard in the loudspeaker approximately 20 dB. For various reasons, an FM carrier is not ordinarily modulated the full 12 kc bandwidth of the receiver, but is usually limited to about two thirds of the allotted bandwidth. This in turn means the signal to noise ratio at the loudspeaker is considerably less than 20 dB, but is on the order of 10 or 12 dB. Looking at the i-f voltage level, this means an input signal of .2 Volts at the FM receiver i-f strip. (3 dB above the noise voltage of .14 Volts.)

In the comparison AM receiver i-f strip, .2 Volts input, with .1 Volt noise equals 2 to 1 voltage ratio, 4 to 1 power ratio, or a signal to noise ratio of 6 dB. By VE3DNR's figures, this is about the usable limit. Calculating the SSB signal to noise ratio, we come up with .2 Volt signal, .07 Volt noise, or a 3 to 1 voltage ratio or 9 to one power ratio, very close to 9 dB signal to noise ratio. No surprise here, as we already knew SSB has a built-in 3 dB advantage over AM.

Extrapolating to zero is a dangerous business, but dropping the signal levels 2 dB would drop the AM signal to 4 dB signal to noise ratio, and by VE3DNR's own reckoning, this is the level of unusability. Not having any accurate figures on the FM threshold effect, I will assume that a 2 dB drop in input signal will reduce the FM receiver recovered signal to noise ratio to 5 or 6 dB, or barely usable. Of course, proper speech processing can be applied to all three modes, and will help all, but I feel that I have shown that the FM signal, on its own, without any concessions, is at least the equal, and in some ways the superior of AM. In practice, full bandwidth use in FM (using the full 12 kc receiver bandwidth) would far surpass AM, and approach the performance of SSB at the 3 or 4 dB signal to noise ratio. I myself am lazy enough to want at

least a 10 dB signal to noise ratio from the loudspeaker, and at this level, FM clearly surpasses both AM and SSB. As for VE3DNR's statement that SSB or CW is the only way to work truly weak signals, I would like to mention FSK RTTY. It is a form of FM, and will outperform both SSB and CW. My reasons for writing this included his unfair claim of a 64 to 1 "stacked deck" situation in the FM vs. AM conflict. I submit that the FM mode is superior in usability, defined as a 10 dB or better signal to noise ratio at the loudspeaker.

Much could be said about BCI (SSB isn't BCI-free, it's just unintelligible to the non-ham) and power output efficiencies, but I rest my case.

. . . WØDKU

Again QRZ . . . QRZ . . . at Hattingspruit

The weather report on the evening of the 13th of June, 1974, forecast rain for the area. Mr. I. McCallum, an engineering draughtsman of Hattingspruit, got up at 5 a.m. the next morning, glanced out of the bedroom window, expecting to see the rainy conditions that had been promised. Instead of a cloudy sky he saw the stars shining brightly and an intense bright white light coming, it appeared, from an object in the sky. Calling his wife to see this unusual light they both went outside to have a better look. Mr. McCallum said:

"I looked in the direction of this bright light through my 10-50 binoculars and saw a cylindrical object. It was about the size of a Boeing 737, but without wings or tail-fins. I could not see the ends because of the intense brightness of the light. I could also see a row of square portholes in the centre and strong white light beams were shining from these towards the ground. During the first hour of observation the UFO zig-zagged along at a leisurely pace with the lights coming from the portholes shining towards the ground almost as if it was looking for something! It was cold and clear, there was no sound at all and it was at a low altitude and quite near till about 6 a.m. After 6 a.m. the craft started ascending and just before sunrise the light from the object was as strong as the morning star. The ascent of the UFO was rather strange, while seeing it on end view I could see red lights flashing upwards from the body. It ascended in the direction of these reddish lights each time a flash was emitted, and so it ascended zigzagging upwards. At approximately 6 a.m. the UFO switched off most of the side lights from the portholes and after sunrise the craft could still be seen with one light shining and the sunrays reflecting off the body. From 6 to 9 a.m. it was still visible in the sunlight if one was shown the position but then it was too high to be photographed; earlier no photograph was taken as I had no camera or telelens available, but there are three other witnesses besides my wife and myself who saw the UFO. My wife looked at the intense brightness of the UFO during the first hour or so, mostly without binoculars and she ended up with 'arc eyes' due to the intensity and brightness of the light."

This is another one of these strange phenomena. In this case the craft was close enough for the square portholes to be seen. The question arises, where does it come from and what is it doing here? For an answer to this enigma we must look to the experts and see what they have to say. Professor Carl Sagan of New York's Cornell University said in a recent report that a growing number of scientists believe there may be life on other planets and that we may receive their message in our radio telescopes any day.

The mindbending Uri Geller, who is causing shock waves in the world of science with his remarkable feats, has said that a contact with extra-terrestrials could take place on a large scale in about three years time.

We can but wonder at all this. In the meantime sightings like the one above continue to take place all over the world! You could help in the investigation of this problem by reporting any unusual happenings such as the above in the sky, or on the air (such as LVE, see Radio ZS July 74, P 8) by writing to me: ZS5GZ, P.O. Box 15, Wandsbeck, Westville 3631, Natal. Who knows, you may be coming up with the missing parts of the puzzle. These reports would be sent to MUFON, the Mutual UFO Network in USA where a panel of experts are evaluating all these data from all over the world.

. . . ZS5GZ

Reprinted from *Radio ZS*, Official Organ of the SA Radio League, November, 1974.

73 in the works

Fantastic 2m Converter from K1CLL – plus more on the 432er

Solid State Burglar Alarm System

W2AOO's Fat Nixie Clock

Slow Scan Hard Copy Machine

More K2OAW digital stuff

Postage Stamp IC Squelch

Simple Approach to Satellite Communications

ID Timer

Mini-repeater

TT-63A Regenerative Repeater

Rock Solid Tone Encoder . . . simplified

Mother's Day Special: LED Violet Checker

UP COMING

Big Auction Near Boston

Saturday April 12th is the day – Eagles Hall, Litchfield Street off Route 12, South Leominster, near the Leominster Motor Inn – 1pm. Bring lots of gear and lots of money – take the reverse home. 10% of sales goes to the MARC. Flea market space available. This has been a big auction, growing every year. Dig into your pile of unused gear and get it into eager hands. Come and get some fantastic bargains. You'll find the spillover from a hundred electronic plants here . . . plus plenty of ham gear.

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FROM
TECO

$79.95

61R ADVANCED SLIDE RULE ELECTRONIC CALCULATOR

The Rockwell 61R Advanced Slide Rule can handle trigonometric, inverse trigonometric, logarithmic and inverse logarithmic functions. But that's not all. This easy-to-operate electronic calculator computes roots, powers, reciprocals, squares, sum of the squares and more. All this plus a full accumulating memory.

$99.95

NOVUS 4520 SCIENTIST

8-digit plus 2-digit exponent LED display slide rule with scientific notation. Arithmetic, trigonometric and logarithmic functions. RPN logic with rollable 4-level stack, floating decimal, separate storage memory, Pi, square root, reciprocal, exchange and change sign keys, low battery indicator.

RESIDENTS OF TEXAS AND NEW JERSEY ADD 5%. RESIDENTS OF CALIFORNIA ADD 6%. RESIDENTS OF ILLINOIS ADD 4%.

SEND CHECK, MONEY ORDER, BANK AMERICARD NUMBER, MASTERCHARGE NUMBER, OR AMERICAN EXPRESS NUMBER TO:

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A SUBSIDIARY OF TUCKER ELECTRONICS CO.

P. O. BOX 1050
GARLAND, TEXAS 75040

FOR RUSH ORDERS CALL TOLL-FREE 800-527-4642 (IN TEXAS CALL 214-348-8800)

Caveat Emptor?

PRICE – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order. Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue. For $1 extra we can maintain a reply box for you.

VERY INTERESTING! Next 5 big issues $1. "THE HAM TRADER," Sycamore, IL 60178. (Information about our "HAM EQUIPMENT BUYERS GUIDE" covering equipment 1945-75 included. Nostalgia! Helpful!)

MOTOROLA PAGEBOY, carrier squelch on 147.72, .3 mV for 20 dB charger, Batt $135. Jim Maloney, 2670 Tierra Cir., Winter Park FL 32789. Ph 305-678-0244.

RTTY FOR SALE: Model 15-19 friction-feed conversion it, $13.00, Model 28 style table-stand, $25.00, Model 15-19 printer bases, $7.00, Model 28ASR motors, $25.00. Model 28 printers, gearshifts, cabinets, parts, accessories. SASE for complete list. Motorola T53GKT, Mint, $225.00. Antique tubes. Lawrence R. Pfleger, P.O. Box 21956, Milwaukee WI 53221.

"FM BASH", DAYTON, OHIO While at Hamvention, come relax with us at Imperial House North, 9PM til?, Friday, April 25. Prize drawing at 11PM featuring ICom 230 and much more. Free admission, snacks, COD bar, entertainment, tables for ladies. Miami Valley FM Ass'n., K8SNJ, 725 Parkview, Dayton, Ohio 45403.

CRYSTAL PACKAGES with the purchase of any 2 meter FM radio. Write for our deal on the rig of your choice. Factory authorized dealers for Collins, Regency, Drake, Icom, Atlas, Alpha, Kenwood, Tempo, Ten-Tec, Swan, Clegg, Genave, Standard, SBE Midland, Hy-Gain, CushCraft, Mosley, Hustler, plus accessories. For the best deal around on HF or VHF gear, see us first or see us last, but see us before you buy. Write or call us today for our low quote and become one of the many happy and satisfied customers of Hoosier Electronics, R.R. #25, Box 403, Terre Haute, Indiana 47802. (812) 894-2397.

STATION Identification collectors, swap cassettes of local PBS, 2 mtr rptrs, and BCB. Arnold Timm, 3207 4th St. N. Mpls., Mn 55412 (SASE Mpls, list).

FOR SALE Collins 32S-1 $300.00 Call after 6PM Eugene Rhodes WB4JCV, 227 Edison Drive, Pensacola FL 32505. (904) 453-3844.

FOR SALE. Antique radio collection. Includes, Grebe Synchrophase, Philco 511, Kilster 6-D, Several A-K models. Contact Ernest Prince, Rt 2 Fairwood, Union, SC 29379.

$75 PLUS U.P.S. buys a Deltron No. 1980 dc power supply – variable 0-15 V dc, 0 to 10 Amps with voltmeter and ammeter. Well regulated. Martin Shapiro, 1138 Boxwood Rd, Jenkintown PA WA3IFQ.

TECH MANUALS – $6.50 each: R-220/URR, URM-25D, USM-159, USM-16, PRC-10. Thousands more available. Send 50¢ (coin) for large list. W3IHD, 7218 Roanne Drive, Washington DC 20021.

WANTED – Catalog sheet 1971-72, Sears, Ward, Admiral, etc. Color television and recorder; also cartrivision cassettes and matching Sears TV cheap. W4API, Box 4095, Arlington VA 22204.

LOGIC PROBE KIT!...Now a digital Logic Probe Kit at a realistic price. Red, green and yellow light emitting diodes signal the presence of logic levels encountered in TTL digital circuitry. Utilization of transistor and integrated circuit switching techniques permit the Digapeake-A to indicate logic 1, logic 0 and pulsing circuit conditions. Complete kit including easy instructions is available now from Cheasapeake Digital Devices Inc., Dept F, P.O. Box 341, Havre de Grace, Md., 21078. Satisfaction guaranteed. Order yours today. $14.95 plus shipping. Maryland residents add tax please.

PUSH-BUTTON TELEPHONE to step dialing IC $10.00, TCA430 Quad tone generator $3.00, Memory plane 20k bits $12.00, Wire – 18-2 $15.00, 18-3 $21.00, 20-2 shielded jacketed 1300 ft. $29.00. All above stranded, twisted #26 solid $10.00M, #30 solid $10.00M. PC Board. Some pieces discolored. All G10. 4¼" x 24" x 3/32" one sided 2/$2.00. 7½" x 16" x 3/32" $1.50. Following 1/16" two sided 6" x 18" $3.00, 8" x 18" $3.50, 9" x 18" 2/$6.00. Large SASE for list. Interested in quantities of some Mos and special chips. Nothing prepaid. Doug Craton, 5625 Balfrey Drive, West Palm Beach FL 33406.

SLOW SCAN TV Monitor Kits, Venus Scientific Model SS2K $235.00 each while they last. 73 Magazine.

FOR SALE – HT220 – 2 frequency, 2 Watt, slim line, 2 new batteries, charger, case, built-in mini-touch tone pad. Working on 2 meters. $350.00 or best offer. 305-678-0244. Jim Maloney, 2670 Tierra Circle, Winter Park, Florida 32789.

NEW YORK CITY Second Annual Hall of Science Radio Club Auction Flea Market Saturday, June 7, at Worlds Fair Grounds, Flushing L.I. No sellers commission but 10% fee on auctioned items. Admission $2.00. Zoo, boating, childrens farm, art and science museums adjacent. Field Day goodies galore. Box 1032, Flushing, 11352.

PHILLIPS CODE, complete copy of 62 pages. $10 postpaid via insured parcel post. Dr. Hess W6CK, P.O. Box 19-M, Pasadena CA 91102.

SWAN 270 AC/DC $350. Swan 250C and 117XC $350. Kenwood R599, matching speaker, 2 and 6 meter converters installed, $300. Gonset G50 $70. Clegg 22er $125. Drake 2nt $80. Hammarlund HC-10 sideband adaptor $75. More. 212 641-2559, Colella WA2HQD, 105 18 131 Street, Richmond Hill NY 11419.

WANTED License Plates. Ham, motorcycle, personalized. U.S., Canada, Foreign, describe, Pay 1-5 dollars each. "Automobile License Plate Collectors Association," Member No. 1560, 5015 Albertly, Parma OH 44134.

NORTHWESTERN Pennsylvania Swapfest, May 3. Crawford County Fairgrounds, Meadville. Flea market begins 10 am. ($1 to display) Free admission, hourly door prizes, refreshments available. Commercial displays welcome. Indoors if rain. Talk-in 146.94, 146.04-.64 and 29.0 MHz. Map and details: RAE, Box 844, Erie PA 16512.

HAMFEST! Indiana Friendliest and Largest Spring Hamfest. Wabash County ARC's 7th Annual Hamfest will be held Sunday, May 18, 1975, rain or shine at the 4-H Fairgrounds in Wabash, Indiana. Large flea market, technical sessions, Bingo for XYLs, free overnight camping, plenty of parking. Lots of good food at reasonable prices. Admission is still only $1 for advance tickets, $1.50 at the gate. For more information write: Bob Mitting, 663 Spring St., Wabash IN 46992.

WANTED: ARRL Handbook T-9er, 6 band CW transmitter or any parts needed for construction of same. K7BD, 103 E. Bartlett, Selah WA 98942.

FOR SALE: General Radio Time and Frequency Standard, including 1101B Oscillator, 1102A Multivibrator, 1102A Power supply, 1103A Syncronometer, and 1107A Interpolation Oscillator. All operating with Tech Data, rack mounted. Will deliver in S. Cal. Best offer. D. Blackmer WA6UNK, Rt 1, Willow Rd, Nipomo, CA 93444.

FREE MANUAL with purchase of classic old General Radio 650-A impedance bridge (with 650-P1 oscillator/amplifier). Operation and calibration guaranteed. Appearance good or better. $90 FOB Modesto (45 lb.) or $80 for any unsold after June 1st. Write for specs: Massingill's Mechanigraphs, 2500 Young Rd., Modesto CA 95351.

SELL: Atlas 180 transceiver. Absolutely mint condition, used only few hours. Latest production model with 8 pole filter and new ALC control. $350. Schultz, c/o RLC, 30 East 42nd St, NYC 10017. Call 212-867-5200.

FM-YOUR KNIGHT TR-108 Complete kit. Use xtal-vfo. $19.95 ppd. Check or M.O. Calif. res. 6%. Revilo Color, 4725 W. Washington BL., Los Angeles, CA 90016.

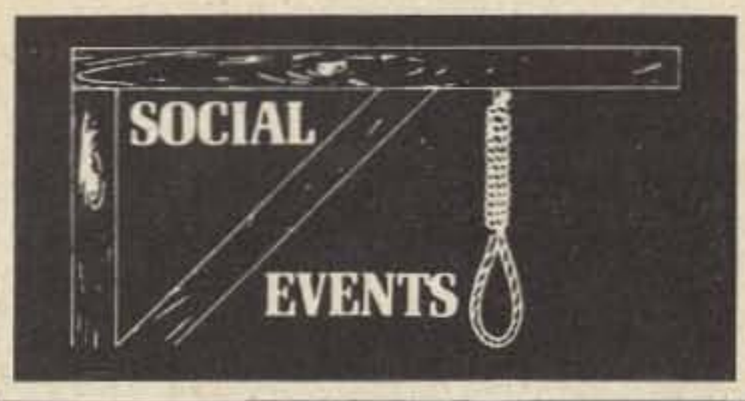
COMPLETE QSL Catalog! Hundreds of cuts, stock and ink samples. Ten sample QSLs 25¢. Corneilson's Quality QSLs, 321 Warren Street, N. Babylon NY 11704.

SELL MANY OLD ham and radioserviceman type magazines, handbooks, callbooks, texts, etc. SASE for list. Henry Shaw, 508 Alexander Ave., Cape May Point NJ 08212.

ANTIQUE RADIO BUFFS. Do you need a schematic for your radio? For information send SASE showing make and model number. Joseph C. Crockett K3KUL, 762 S. Gulph Road, King of Prussia PA 19406.

STANDARD, SR-C-145 Handy-talkie, 19/79, 25/85, 28/88, 78/18 xtals supplied; one spare with Nicads and ten-tec 1 amp supply/charger. $200.00 W1MBX, 21 Nancy Mae Ave, Prospect CT 06712. (203) 758-5858.

FOR SALE: Hewlett-Packard HP-45 calculator in excellent condition with nicads, charger, handbook, etc., $295.00. Write David Bonham WB4HKY, 36 Hilltop Road, Canton NC 28716.



DAYTON OH
APRIL 25-27

Dayton is the big one – with about 10,000 expected this year. It has the biggest in manufacturers' displays – the biggest flea market – the biggest program. If you only get to one convention a year, this is it.

While the major action is on Saturday, there is so much happening that day that you'll do well to pull in on Friday and spend that day visiting the commercial exhibits. Manufacturers and engineers will have more time to talk with you then – and on Saturday you may have a tough time even getting close to the booths. You just might miss some of the fantastic bargains out in the enormous flea market, too. Bring money.

The crooks know you're coming, so be sure to take your rig out of your car at night – a lot of rigs got stolen last year from the motel parking lots. Bolting it in better is not the answer – one gal had her dashboard chopped out, complete with 2m rig.

Say hello to the 73 staff.

BROOKLYN NY
MAR 29-APRIL 6

The Radio Society of Greater Brooklyn will hold its first annual Worked All States Week Contest March 29 0001G to 2359G April 6. Winner will be the one to work all states in the shortest period of time. Anyone who works all states within the period will receive a certificate. Special certificate to the Novice who works the most states and operator working most states under most unusual conditions. Number of states only counts, not number of QSOs. Logs must include description of your station and the time, date, call and state of all stations worked. Any legal band, mode or power. Send logs to F. Grossman WB2BXO, 9519 Ave. M, Brooklyn, NY 11236.

WESTLAKE OH
APRIL 4

Westpark Radiops W8VM auction April 4 at 8 pm at Clague Park Cabin-Clague & Hilliard Roads in Westlake. Magazines, surplus gear, used & new equipment, components, Ollie Rathburn, Auctioneer. All items can be viewed before sale, coffee & donuts following.

TOWSON MD
APRIL 6, 1975

The Greater Baltimore Hamboree will be held at Calvert Hall College, Putty Hill and Goucher Boulevard, Towson, Maryland (one mile south of Exit 28 of Beltway-Interstate 695), on Sunday, April 6, 1975 at 9 am. Food Service, Flea Market, Contests, Prizes. Registration: $2.00. Complete table set-ups indoors. INFO: Joe Lochte, 5400 Roland Avenue, Baltimore MD 21210 or Brother Gerald Malseed, 8102 La Salle Road, Towson MD 21204. (301) 825-4266.

DETROIT MI
APRIL 6

The Seventeenth Annual SEMARA Swap 'N' Shop will be held on April 6, 1975, from 8:30 am EST to 3:30 pm EST. It will be held on the east side of Detroit, Michigan at Cannon Recreational Center on East Warren and Cadieux Avenue.

JOHNSON CITY NY
APRIL 19, 1975

The Sixteenth Annual Hamfest, sponsored by the Southern Tier Amateur Radio Clubs, is scheduled for 10 am, April 19, 1975, at St. John's Ukrainian Hall, Johnson City, New York. Admission to lectures and flea market only, $1.00 for adults. Total admission, including awards and excellent dinner, $6.50. For tickets or further information, write to: STARC, P.O. Box 11, Endicott NY 13760.

COLUMBUS GEORGIA
APRIL 19-20

The Columbus Georgia Hamfest sponsored by the Columbus Amateur Radio Club will be held April 19-20, 1975.

Activities will begin with the flea market at 1 pm Eastern time on Saturday and finishing with the main prize drawing at 2 pm Sunday.

For information and reservations contact Gary L. Kindred, 293 Nightingale Drive, Columbus, Georgia 31906. Phone 404 689-4494.

RALEIGH NC
APRIL 20, 1975

Third Annual Raleigh Amateur Radio Society Hamfest will take place all day Sunday, April 20, 1975, at Crabtree Valley Mall, Hwy 70-W, just

... continued on page 16

SOCIAL EVENTS from page 15

west of the city. A covered flea market, bigger than ever; many great prizes; group meetings will be featured. General admission $2.50 ea. Food at reasonable cost. For flea market reservation and other info write: George Richards WA4EKJ, Chairman, RARS Hamfest, P.O. Box 17124, Raleigh NC 27609.

GRAND RAPIDS MI
APRIL 24-26

Grand Rapids Annual Communication Show and Swap 'n Shop. On the Mall exhibits April 24-26, 1975. Ham and Electronic Swap 'n Shop April 26, 1975. At Eastbrook Mall on East 28th Street (N.E. corner of M11 and M44). Contact Bob WN8PTM, P.O. Box 2402, Grand Rapids, Michigan.

DAYTON OHIO
APRIL 25

"FM BASH", an annual affair will again be held on the Friday night of Hamvention, April 25, at the Imperial House North. Sponsored by the Miami Valley FM Ass'n., it will run from 9 PM til?, and will include a prize drawing at 11 PM, featuring an IC-230 transceiver. Admission to this social event is free, with snacks and a COD bar, entertainment, ladies' tables and more. Contact K8SNJ, 725 Parkview, Dayton, Ohio 45403.

LA MESA NM
APRIL 26-27

The 11th Annual "Whitey's Bean Feed" will be held at La Mesa, NM near Las Cruces, from noon, Sat., April 26 through Sunday the 27th. Sponsored by Mesilla Valley Radio Club with "Whitey" K5ECQ as chef. Swapfest, chili bean feed, beverages, prizes and "eye-ball" QSOs, free camper parking on grounds Sat. night. Adults $3.50, kids $1.50. Talk-in on 16-76, 52 and 3940 kHz. For info contact K5HZH, 1020 Circle Dr., Las Cruces NM 88001.

AMBOY IL
APRIL 27, 1975

Rock River Radio Club Hamfest, Sunday, April 27, 1975. Same location as in past year's at the Lee County 4-H Club Center, Amboy, Illinois. 1 mile East of Junction Rt52 & Rt 30, South of Dixon, Illinois. Advanced Tickets $1.50. Gate $2.00. Special to April 1, 1975 4 tickets for $5.00. Rain or shine, indoor facilities, etc. Camping area. Limit 1 table free per party. Additional tables $5 each or bring your own. Talk-in frequency will be 146.94 mc.

SAN DIEGO CA
MAY 2-4

This year's West Coast VHF Conference will be held at the Sheriden Inn on Harbor Island in San Diego on May 2-4, 1975. Tech talks are sked for Sat. 3rd, from about 9 am to 5 pm; prize drawing; Noise Figure contest Sat evening; Antenna measuring contest Sun am. Pre-reg is $2.50, hotel accomos are $21 single, $27 dbl. More info will be sent later to those on our mailing list. Those who don't get one should drop a line for info sheet, etc, to Louis N. Anciaux WB6NMT, Spec Comm Sys, 4519 Narragansett Ave, San Diego CA 92107.

CONNECTICUT
QSO PARTY
MAY 3 to MAY 5

Contest period 2100 GMT May 3 to 0200 GMT May 5. Certificates to highest scorer in each ARRL section or Province and each Connecticut county. Special — Worked All Connecticut Counties certificate. Trophy to highest scoring club entry. For info write Candlewood Amateur Radio Assn., c/o Donald Crosby W1EJM, 10 Royal Rd., Danbury, Conn. 06810.

CADILLAC MI
MAY 3

The Wexsaukee Radio Club announces their 15th annual Swap-Shop and Eye-Ball that will be held May 3rd in the National Guard Armory in Cadillac, Michigan starting at 9 am. This Swap-Shop is open to all radio amateurs, CBers and anyone interested in radio communications. Lunches will be available at noon and there is lots of free parking. Tickets available at the door. All are invited.

ST PETERSBURG FL
MAY 4

The St. Petersburg, Florida, Amateur Radio Club (SPARC) will hold their annual Hamfest at Lake Maggiore Park, Sunday, May 4, 1975. Tables will be available for sales or trading of used and Home brew equipment as well as home-made Arts and Crafts items.

GEORGIA QSO PARTY
MAY 10-12

Starts: 2000 GMT, Saturday, May 10, 1975

Ends: 0200 GMT, Monday, May 12, 1975

The 14th annual Georgia QSO Party is sponsored by the Columbus Amateur Radio Club, Inc. There are no time or power restrictions and contacts may be made once on phone and once on c.w. on each band with each station.

For further info contact John T. Laney, III, K4BAI, P.O. Box 421, Columbus GA 31902.

WEST LIBERTY OH
MAY 18

The Champaign Logan Amateur Radio Club will hold their annual flea market and auction May 18, 1975 at 12 pm at the West Liberty Lions Park, West Liberty OH. Talk-in on 146.52 and 146.13/73.

Making PC Boards Easily

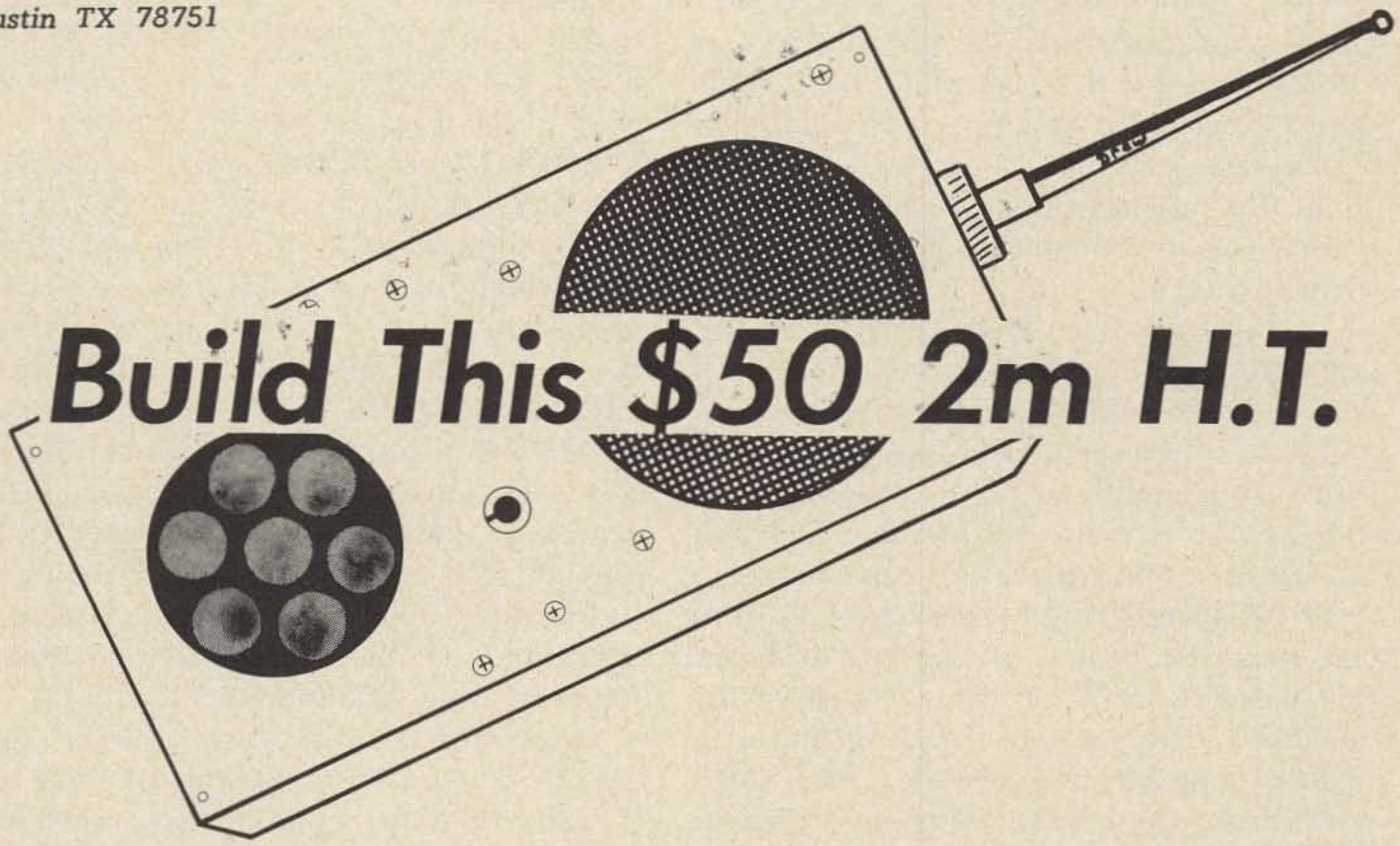
A new kit for the stamping and etching of printed circuit boards is being successfully marketed by M Tech Engineering Corporation of Springfield, Virginia. Probably the biggest stumbling block and the principal reason for the oft-declared (but certainly not proven) decline in home brewing has been a complete lack of the simple, inexpensive and flexible equipment required for making PC boards.

The number of articles appearing in the past year not requiring PC boards has been minimal. This system consists of a series of stamps, a stamp pad with special resist-ink, and a resist-ink fiber tip pen. It is so simple and fool proof that the world's worst klutz can make high quality professional boards. One of the more experimental individuals we know built a digital clock, 3 QRP transmitters, a new front end for a frequency counter and a prototype VFO — and still has two thirds of the bottle of stamp resist-ink left.

Like any system, this one appears at least as fool proof as the fool using it. One word of caution: Don't put too much force on the stamp when printing or it will blob. TLT (tender loving touch) should be the rule.

The 73 staff was quite favorably impressed with this product and found no real need for any additional stamps other than supplied with the kit.

J. R. Johnson WA5RON
4558 Avenue A #205
Austin TX 78751



Build This $50 2m H.T.

Why should two meter portable rigs be so expensive or difficult to build? Believing that they should be neither, I set out to construct a 1 watt walkie-talkie that other hams can duplicate in a couple of evenings' work and at an expenditure of less than $50.

How can that be? Simple and cheap pre-fab receiver and transmitter modules offered by various 73 advertisers can be used. Most of the design work is done for you, but you will have to find (or build) a case, position controls, and perform the human engineering that will result in a custom hand-held that you can proudly claim as homebrewed.

The Transmitter

The transmitter for this project is the TX-144 kit from VHF Engineering. (1) The kit goes together in four or five hours, and is a real pleasure to build and tune up. The transmitter as it comes has only one crystal socket, but you can add an outboard switch and more sockets, if desired, for multi-channel capability. You should order some xtals from your favorite quartz grindery when you send for the transmitter. Crystals are the 12 MHz type, HC-25/U ground at 20 pf. Using a multiple of 12, base frequency for 146.94 is 12.245, and 146.34 is 12.195.

In the prototype unit, the transmitter strip is attached to the case front by four copper brackets, 1cm wide and about 5cm long. These were soldered to the circuit board corners at one end, and the other end bent out about 1cm and drilled for a 4-40 mounting screw.

A dynamic mike is needed to drive the transmitter, and I found that the surplus HA1 (earphone) element from a field-phone handset gives excellent audio quality when epoxied in behind a 1-3/8 inch hole in the case front. If pocket-size compactness is desired, the receiver speaker could double as a mike, but this may require additional switch complexity and a mike preamp. Separate speaker and mike were employed in the prototype unit.

The Receiver

Olson Electronics (2) sells a Windsor Weather Radio model 2094 which is a small, oval, desk-top FM receiver tuned for the U.S. Weather Service VHF broadcasts on or about 162.55. Some other stores sell similar VHF monitors at a higher price, and if you already own one of these, perhaps the simple conversion for the Windsor set will apply.

Disassembly of the receiver will yield a

speaker, knobs, sturdy 19 inch telescoping antenna, and a compact oval-shaped receiver board. You might save the nice plastic case for building an intercom station or something. Check the receiver for operation before you start modifying it. Don't worry about the modest audio output, that will improve when you increase the input voltage from 9 to 12 V.

Tracing back from the antenna connector you will find a 9 pF capacitor. Replace it with a 47 pF or larger. Following that is a 3-turn rf input coil. A second rf coil (3 turns) paralleled by a 30 pF capacitor is the tuned circuit for the preamplifier. Melt out the beeswax and replace this capacitor with a 39 pF silvered mica. Another three turn coil near the center of the circuit board (paralleled by a 20 pF cap.) is part of the oscillator. The receiver local oscillator is slightly tuneable and operates 10.7 MHz down from the receive frequency. Replace the 20 pF with that 30 you took from the preamp.

Examination of the tiny schematic packed with the receiver shows the 9 volt input line running directly to the audio amplifier, but separated from the rf stages by a dropping resistor. The audio section seems to work quite happily at 12 volts, but the other stages should be held below 9 volts by the addition of a zener diode (SK3060 or equivalent). This will fit on the board in a small space just beside the audio interstage transformer, between it and the oscillator components.

On the underside of the circuit board you should find a jumper wire between two ground strips. The jumper jumps over a third strip that is the negative lead to the rf stages in the receiver. Drill a tiny hole (no.60) in this strip about 3cm from the tuning capacitor shaft. Drill another hole in the ground strip that goes to the volume pot shaft, 3.2cm from the center of that pot shaft.

Mount the zener on the component side with the cathode to ground (positive ground). This will allow the use of 9-12 volts input without damaging sensitive components.

At this point you may wish to consider the switching arrangement of your transceiver. I chose to replace the 5k volume control pot with one containing a SPST switch (Olson VC-302B). While you are there, you might also improve upon the work of the original Chinese assembler.

Of the several units I have examined, each had electrolytic capacitors sticking up on 5mm of excess lead, long loops of jumper wire, component leads bent over instead of being clipped off, etc. Dress up the wiring a bit, and your receiver will not only squeeze into a tighter space, but may also last longer.

A word of warning: the tuning capacitor is easily damaged by heat. At the close approach of a soldering pencil, that polyethylene spacer between the plates will shrivel up. You would do well to place an appropriate sized washer over the capacitor to protect it during these modifications.

Now, with a small screwdriver or pick, dig out the wax from around the three turn rf coils. With a soldering iron, melt out sufficient wax to allow easy spreading or squeezing of the coils with a plastic tool (save the wax and melt it back into the coils when you are finished tuning).

Start with the oscillator coil, nearest the center of the board. Spread or squeeze to bring the oscillator to 135.8 MHz with the fine-tune control set half way. You can tune by following the oscillator output on a tuneable VHF receiver (aircraft-police mon-

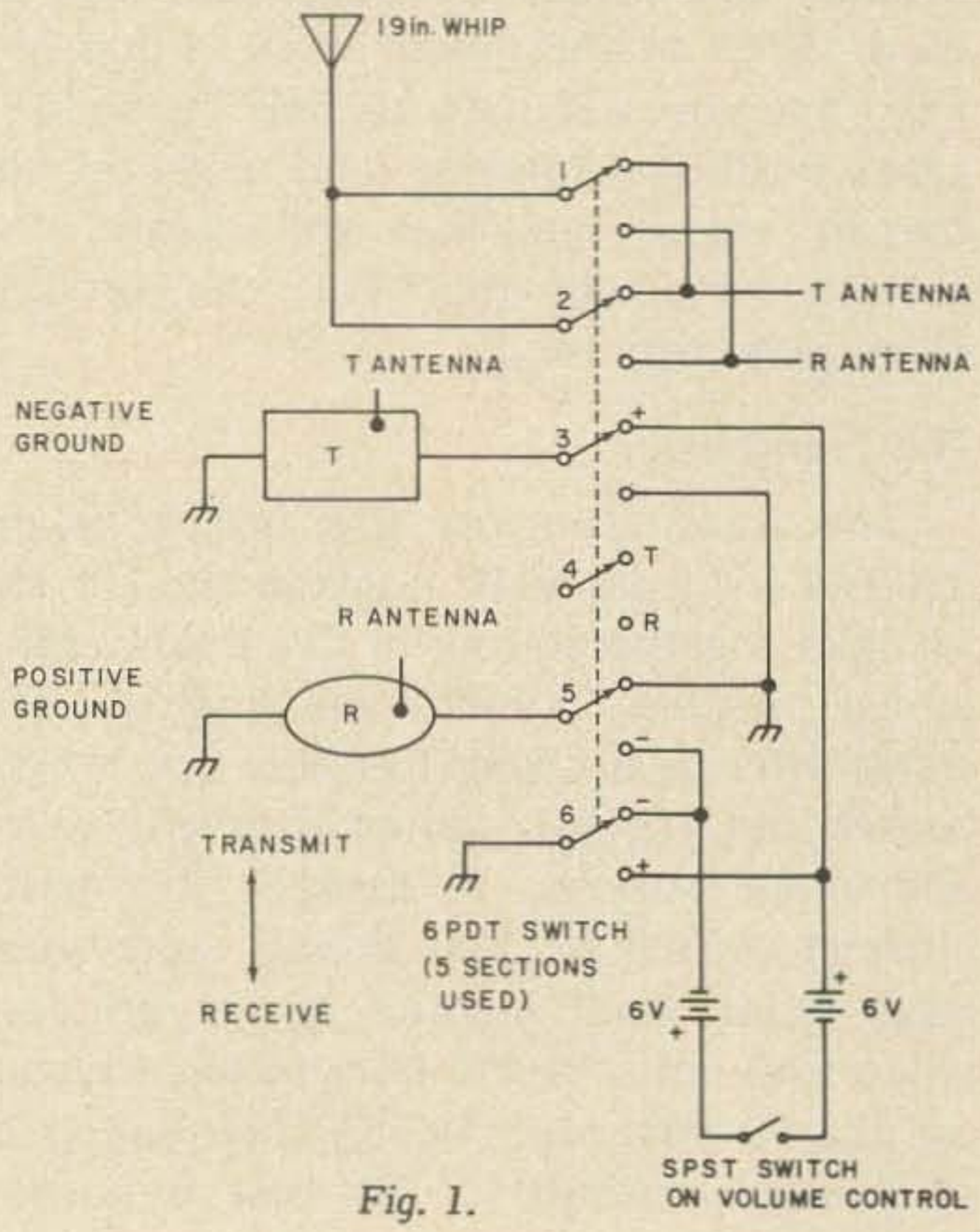


Fig. 1.

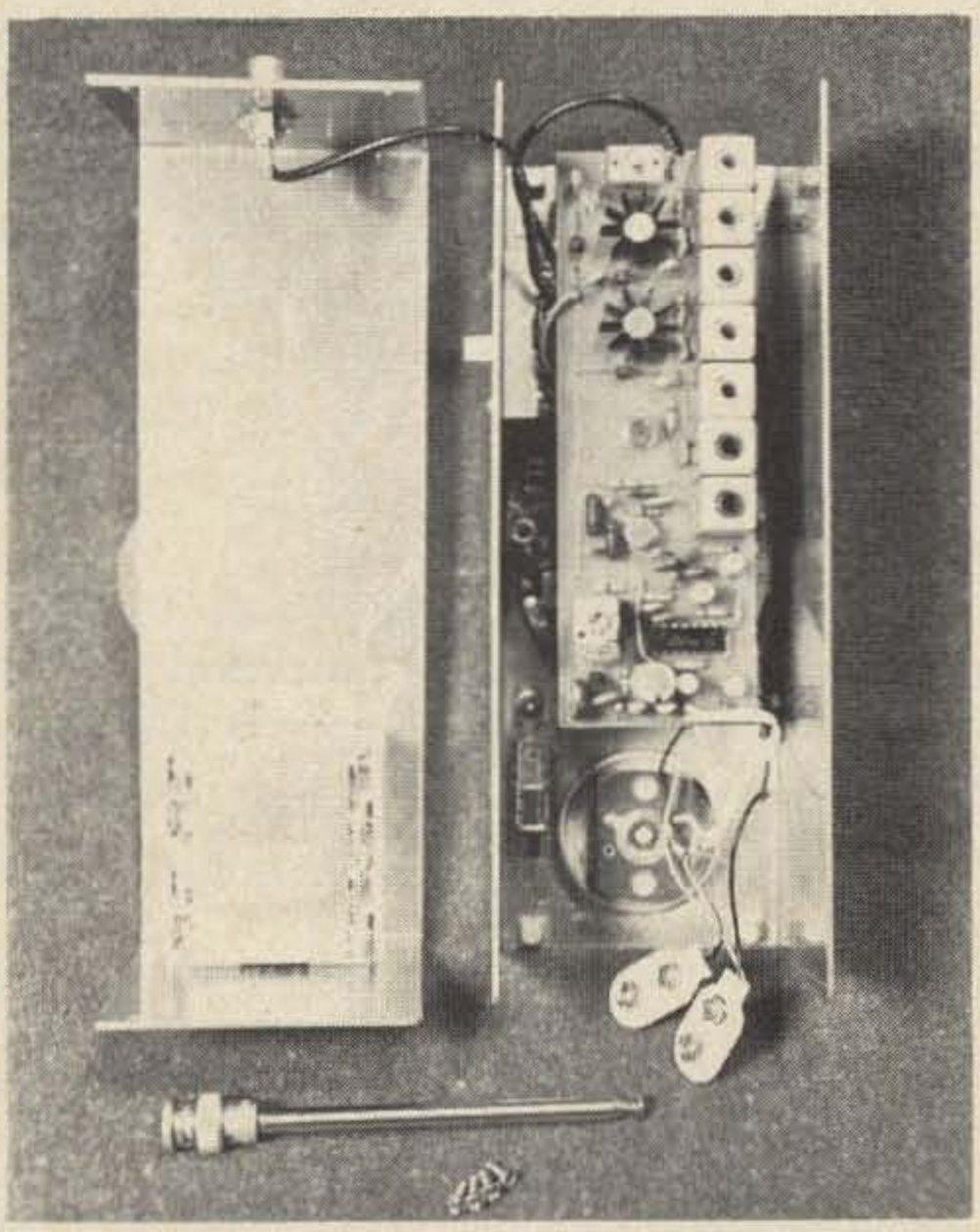
itor) or just by listening for signals on the two meter band.

If the oscillator will not go low enough with the coil squeezed tight, then solder that 9 pF capacitor you removed earlier across the coil on the circuit side of the board. This was necessary for one of the three receivers I tuned up on 2 meters.

When you are hearing signals from amateur QSOs or from a signal generator at 146.5, adjust the antenna and rf amplifier coils for maximum sensitivity. The i-f and detector settings should not be changed. Filling the coils back up with beeswax will reduce the microphonic speaker-vibration feedback problem common to cheapie VHF receivers.

An additional stage of rf amplification using a low-noise FET has been successfully used by the author on the front end of such receivers, but was not added in this hand unit. Good circuits for FET preamps can be found in 73 Magazine (3).

When the receiver is mounted in a metal case, the ground circuit should be connected by a short lead to the case in three or four places about the receiver board. Using threaded metal standoffs and solder lugs allows for both good mechanical and good electrical mounting. One rig built exhibited self-oscillation before it was grounded to the case in this fashion.



Inside view of transceiver. Visible are transmitter (above), receiver (below), dynamic microphone, T-R switch on side of case, batteries in plastic holders, and removable telescoping antenna.

Once tuned up and mounted in a metal box, the receiver is stable and unaffected by hand capacitance. Its characteristic of low hiss noise with no signal input eliminates the need for a squelch. Its small size and low price ($11) make it an excellent find for the VHF builder and experimenter.

Assembly

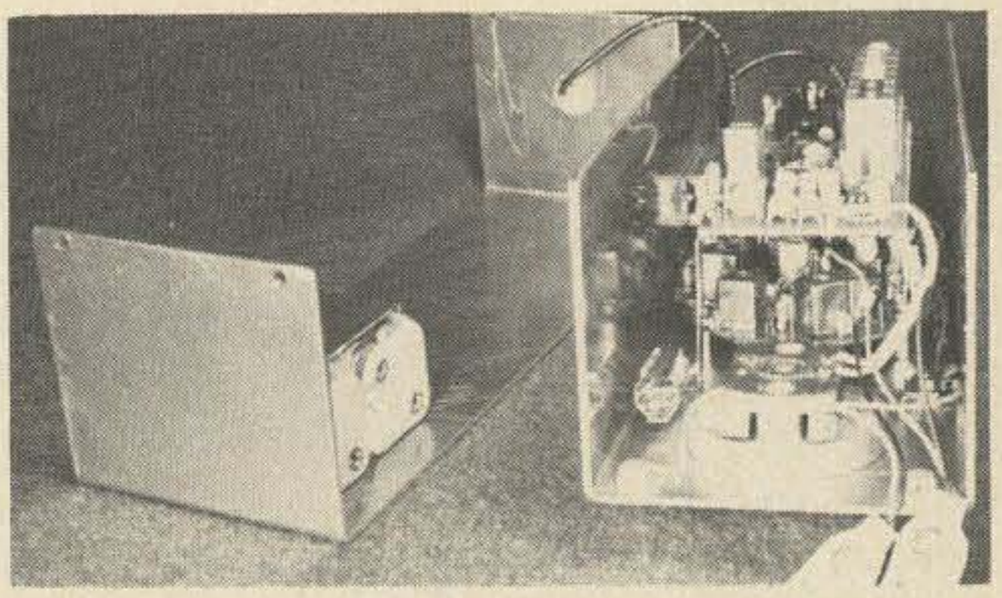
A simple, sturdy case for the transceiver was made by folding 1/16" aluminum into two "U" shaped pieces that fit together as shown. Everything except the antenna and battery clips is mounted in the front half of the case. The case shown measures 22.5 x 8 x 7 centimeters, but as you can see there is still a bit of room left inside.

A more compact design with perhaps a different battery arrangement might yield a more pocketable transceiver. You might have an old CB type talkie gathering dust somewhere from which you could steal a case. Be sure to disguise it so it won't look CB.

A nice stainless steel appearing finish can be had on aluminum by rubbing it in long, straight strokes with steel wool. The steel wool wears out (and so does your arm), so stop occasionally and rub in some light oil. The resulting finish is well worth the hard work. Deep scratches in aluminum are difficult if not impossible to rub out. Protect the new metal surface before bending and drilling by spraying on several coats of enamel.

Acetone will quickly remove the paint after it has served its purpose.

T-R switching is complicated somewhat by the different polarity of ground in the transmitter and receiver. A six pole double throw switch was employed, with two sections paralleled for antenna switching. The antenna that comes with the receiver is just the right length for two meters. Solder it to the center pin of a BNC connector and stand it perfectly upright in your oven. Mix and pour epoxy cement into the BNC and leave it overnight at 150-200F (this is the ONLY way I've been able to make those dime-store epoxys set).



End view showing how receiver and transmitter are stacked.

The speaker, perforated metal grille, and a thick sheet of polyethylene were sandwiched together and epoxied to the case behind an appropriately sized punch-hole. Epoxy, when applied to clean, roughened surfaces and hardened at an elevated temperature is sufficiently strong for construction of this sort. It eliminated a number of screws and clamps that would otherwise have been needed to mount the mike and speaker, detracting from the appearance of the finished rig.

Speaking of helpful hints, you can prevent the wires from breaking off inside those snap-type battery clips by squirting vinyl cement into them and letting that harden up. Eight zinc-carbon AA cells in two standard holders are used with my transceiver. If you want to buy nicads or alkaline cells, then you should plan on using 10 due to their lower voltage under load. Carbon cells are most economical and last through six or seven rechargings. The assymetric ac charger described in 73 (4) has been used around this shack for charging all kinds of batteries with excellent results.

The walkie-talkie works well too, and makes for a quick and easy portable for the OT repeater-blipper, or an inexpensive introduction to Fun Mode for the newcomer.

. . . WA5RON

References

(1)VHF Engineering 320 Water St. PO Box 1921, Binghamton, NY 13902.

(2) Olson Electronics 260 S. Forge St., Akron, OH 44327.

(3) Articles concerning two meter receiver preamplifiers have appeared in 73 Magazine in the following issues: (Month Year Page) JUL 67, 48; OCT 68, 112; JUN 69, 76; MAY 70, 74; FEB 72, 97; MAR 72, 112; NOV 72, 120; DEC 72, 23; DEC 72, 134; APR 73, 27; APR 73, 93.

(4) Reverse-Current Charging (K8YUC in 73, March 1970, page 20).

John W. Kuivinen WB6IQS/AL6IQS
3426 Duke Avenue
Claremont CA 91711

Proof of the Extraterrestrial Repeater

Throughout the history of electronics amateur radio has helped to explain and understand the phenomenon of radio. Hertz, Marconi, and Lee De Forest were all pioneers in radio communications and were in many ways true examples of amateur radio operators exploring the unknown. Now, amateur radio has shown that intelligent extraterrestrial life has visited the vicinity of earth.

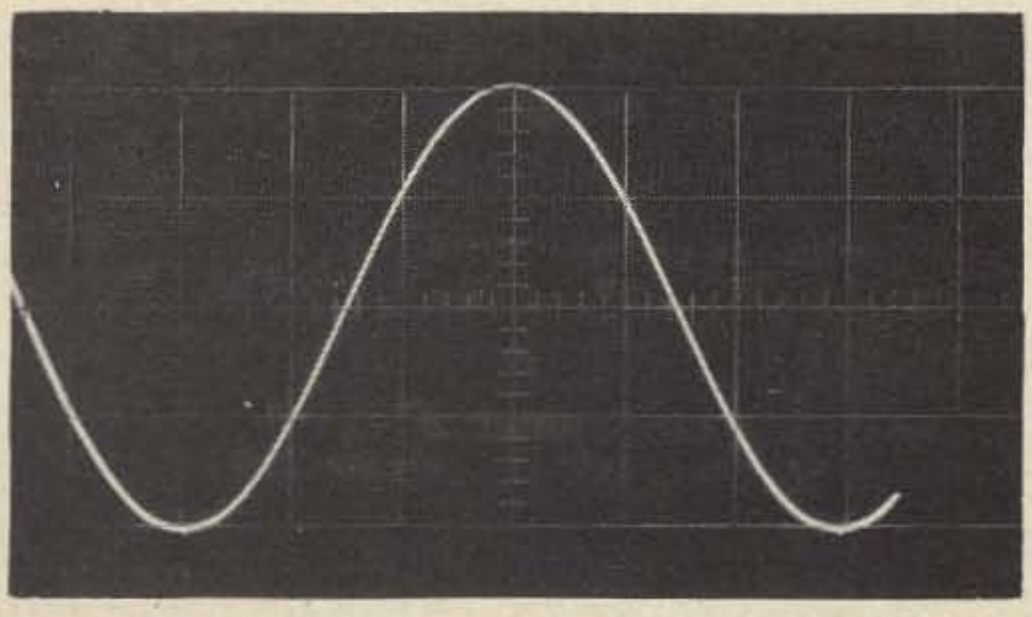
In experiments conducted over a period of years, it has been demonstrated that natural causes are not the only reflector of radio waves over the earth. A system of alien repeater satellites relays radio signals around the earth and to a distant planet in the constellation Bootes (Balfour, Malcolm, "Scientists Attempting Contact With Alien Space Probe Believed to be Orbiting Earth," *National Enquirer*, Vol. 47, No. 29, March 18, 1973, p. 26).

These satellites derive their power from the sun's energy and especially the higher forms of energy present during periods of high sunspot activity. These repeaters work continuously but are much more active during peaks of the eleven year sunspot cycle, thus making it appear that all skip activity is natural in origin.

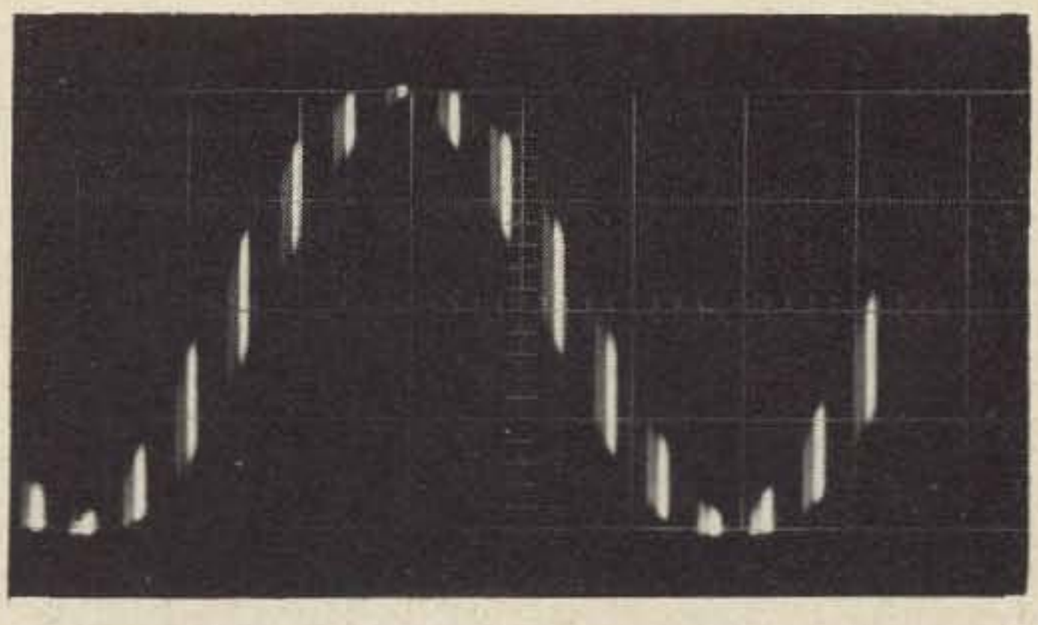
The proof was determined after careful research into pulse and multiplex transmission methods. Close experimental observation of the received waveform on 40 meter signals showed that many of them were segmented. Many CW signals would appear to be noisy on the oscilloscope, but after close inspection the signal was actually being pulsed on and off very rapidly. The pulses were so rapid that the ear could not hear them and after detection and audio amplification no distortion was present in the speaker output.

My Heathkit IO-103 scope has a maximum response to ten megahertz so all observations were done on 40 and 80 meters initially. Later a series of low noise very low distortion converters were built for the higher bands and all bands showed signs of the segmented signals.

As can be clearly seen from the example, the DX stations signal was being turned on and off very rapidly. At first it was a puzzle to understand what could cause such a signal, but later it was easily explained. The only answer that could fit all the available facts is the idea of a phantom repeater in outer space. The repeater would receive the original signal, store it in a temporary memory device, retransmit it an instant later on the same frequency, and then go back to



Normal 7 MHz sine wave as received without the phantom repeater operating.



A signal that has been retransmitted through the phantom repeater.

the receive mode to pick up the next segment. It works very much like break-in CW but much faster.

This effect can be only seen before any mixing is done in the receiver. The output waveform of the signal must be seen just after the first radio frequency amplifier stage, and, if it was possible, directly out of the antenna would be best. The scope was attached to the plate output of the first rf amplifier of my transceiver and a high gain wide band preamplifier was added to increase the sensitivity of the scope.

It can be seen that the change from receive to transmit is nearly instantaneous and very many repeater cycles can be seen on each Hertz of received signal. After the first mixer stage very poor results are obtained because of distortion and non-linear amplification in these stages; also the capacitors and inductors used as LC circuit elements tend to average out the individual repeater cycles due to their charging effect.

This discovery offers many answers to numerous and as yet unexplainable radio observations. The most obvious is the much publicized L.D.E. (Long Delayed Echo). (Villard, O.G. Jr., "Long-Delayed Echoes – Radio's 'Flying Saucer' Effect," *QST*, Vol. LIII, No. 5, May, 1969, pp. 38-43.) These L.D.E.s occur very infrequently and only under very special circumstances (Villard, O.G. Jr., "A Long-Delayed Echo $\overline{AR}$," *QST*, Vol. LIV, No. 2, February, 1970, p. 33). It is easy now to explain them as a simple malfunction in the alien repeater or perhaps replays of some special signal that the central control wanted to hear again.

If a careful analysis of the pattern to the L.D.E.s can be made it may even be possible to communicate directly with the alien central control by knowing what conditions they watch for when asking for a replay of a transmission.

It is also probable that more than one system of satellites are listening to earth. The short term L.D.E. (two or three seconds) is probably caused by a second relay system in the orbit of the moon. This short term L.D.E. is most common on 80 meters and is presently being actively investigated (Villard, O.G. Jr., "A Long-Delayed Echo $\overline{AR}$," *QST*, Vol. LIV, No. 2, February, 1970, p. 33). The time delay from the earth to the moon round trip is about three seconds. This time delay would be about correct for the secondary repeater system.

This initial satellite system is a near earth Stationary Orbital System (SOS). It consists of three or four satellites that relay all types of radio transmissions to other parts of the earth and to the alien central control in the star system of Bootes. The Lunar Orbital Satellite System (LOSS) was installed later and probably works in the three or four MHz frequency spectrum exclusively.

A system such as SOS can explain much of the abnormal DX activity that goes on in the amateur bands. How many times have amateurs heard signals on the air that just should not be there? Japan and Europe can come in well at the same time and at a time when the charts say that it is impossible to hear either one. It is easy to understand this abnormal activity now that the SOS and LOSS systems have been discovered.

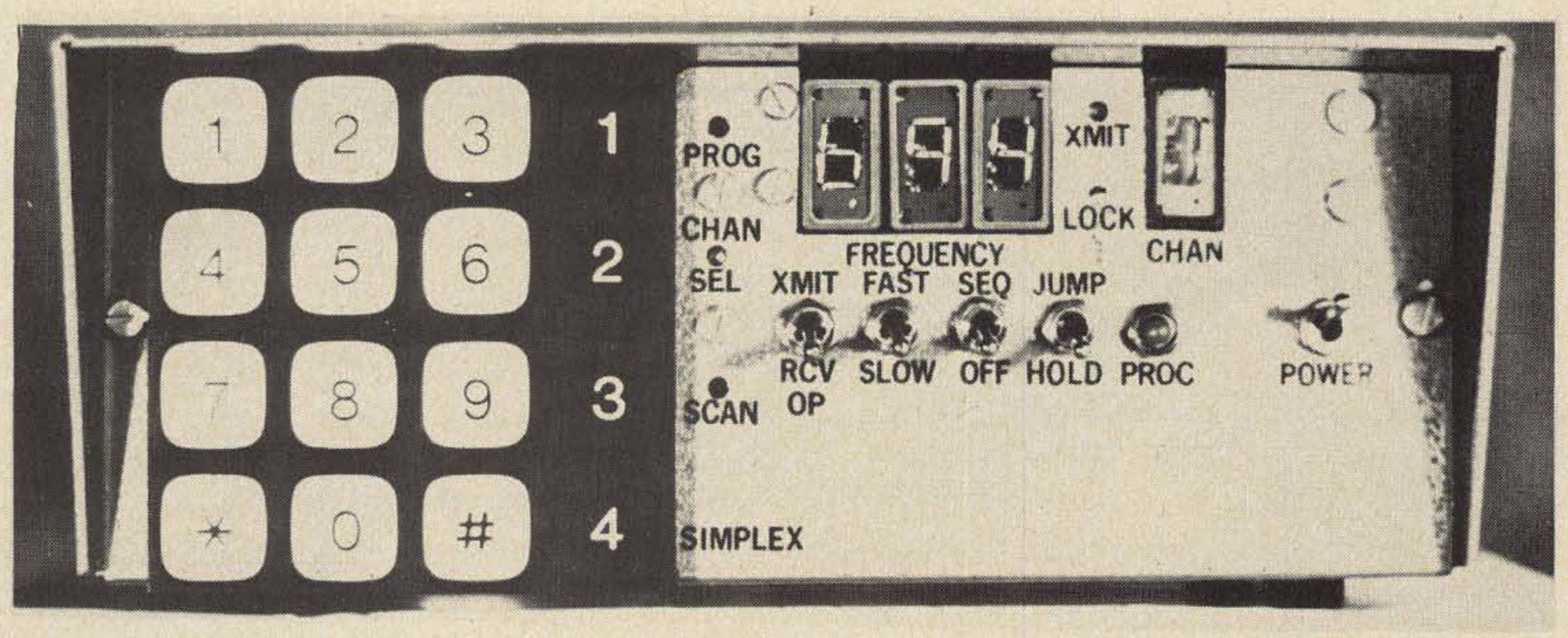
The most pressing issue is what we as amateurs can do about these super "Watergaters" in the sky. First, all transmissions derogatory to aliens must be banned. We do not know what they may look like so all talk of little green men or bug-eyed monsters should halt. Second, an attempt should be made to analyze these relay satellites. Find out from the earth what makes their control system work and perhaps take control of their functions. It would be then possible to concentrate their energy in smaller segments of frequency and have good DX all year long.

Of course the deflector shields and anti-jamming equipment must be overcome first. Possible defensive weapons such as photon torpedoes and phaser rays may deter NASA from looking at these satellites too closely, but with telescopes it may be possible, once the space shuttle starts regular operations, to see them from outer space directly.

The use of the SOS and LOSS system may be the next great advancement for radio since the discovery of short waves. If reliable worldwide communications without fading at all times could be achieved, it would be the greatest discovery in recent history for the radio amateur.

...WB6IQS

John Gearhart WAØAQO
Sunset Trailer Court
Columbia MO 65201



Front panel view of the scanner showing Channel 1 containing the frequency 6.94 (146.94). Channel select mode is indicated by one LED and the lock indicator LED is also visible. Photographs by K4CHS/Ø.

Scanning With a Synthesizer

When first getting on 2m, in a somewhat typical fashion with a commercial crystalled transceiver, I began thinking of a possible next step in upgrading the station. At this point I seemed to hit a dividing point: I could either buy or build a scanning receiver so I could keep up with activity on the different frequencies — thereby being bound to the crystal market — or I could go the synthesizer route. The synthesizer seemed the more versatile way, so I incorporated a GLB 400B Channelizer in my station. Since, however, I would lose the benefits of scanning, it seemed logical to combine the advantages of both, hence, a scanning synthesizer.

To allow for easy reprogramming, I chose a Random Access Memory (RAM) as the basis for the scanner. The net result is a scanner which stores eight pairs (transmit and receive) of frequencies, and of these eight pairs, selected receive frequencies can be scanned. Provision is also made for one of the eight pairs to automatically be incremented in 10kHz steps over a one MHz segment to effectively sweep a selected MHz. The frequencies are entered into the RAM from a touch pad. Three digits of 7-segment readouts display the receive and transmit frequency appropriately, and a single 7-segment display shows the channel number. The scanner can also recall a specific frequency at a touch of a single button. A feature to make operation convenient permits the transceiver's PTT button to stop the scan, and, in addition, a jump option provides a pseudo-priority type operation.

As for the important statistics, the

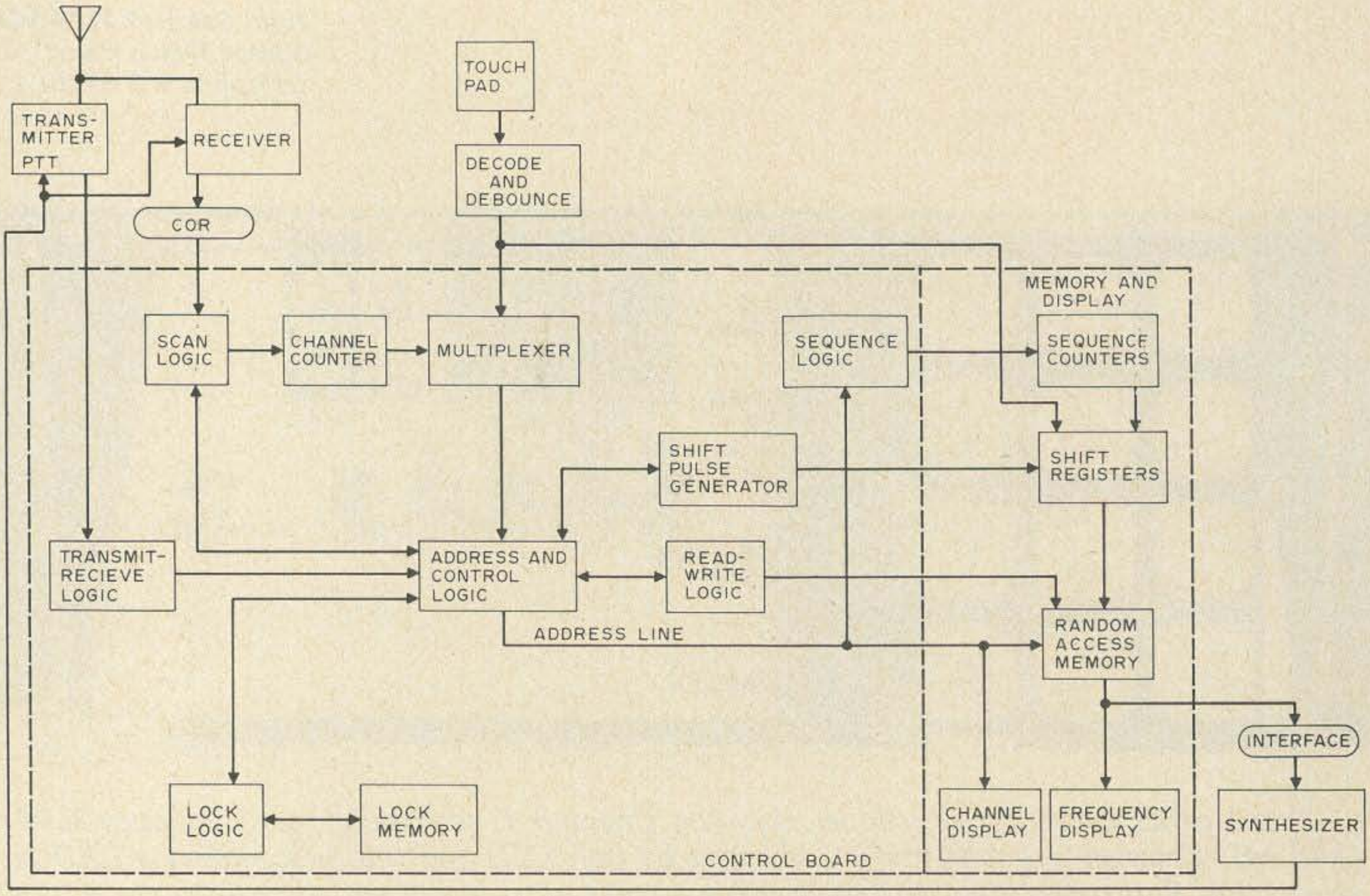


Fig. 1. Block diagram of the scanner in a two-meter station.

scanner uses approximately $40 worth of ICs. The touch pad and four 7-segment displays are the only other parts that hurt the pocketbook and are not as likely to be in the standard junkbox. The touch pad costs about $8. The entire circuit operates on 5V, but a power supply of two LM309K regulators makes it easily used with 12V.

Theory of Operation

Although the overall schematics are somewhat foreboding with 41 ICs, the functions can actually be separated into 17 blocks and built on four boards. The scanner is represented in the block diagram, Fig. 1. The key elements of the scanner are the shift register and memory blocks. The remaining circuitry effects control of those blocks or accomplishes special functions. Before reading the theory of operation, I would recommend reviewing the section on operation.

Memory and Display Board

Let's start with the memory and display circuitry which is represented on the block diagram enclosed in a dashed line. ICs16, 17, 18, Fig. 2, are 4 bit, parallel-in, parallel-out shift registers which allow for data manipulation and entry from both keyboard and sequence counter (ICs14, 15). The sequence counter is a Binary Coded Decimal (BCD) divide-by-ten counter that counts from 00-99. If the sequence circuit is on, each time channel 7 is scanned, the counters are incremented, and their outputs are gated into the shift registers (ICs16, 17) by a pulse called Sequence Pulse (SP). A Read Enable Low-digit pulse (REL) transfers the count from the shift registers to the memory (ICs11, 12). The shift function of the shift registers is used for a touch pad entry. When programming the memory, the touch pad BCD digit is gated into the MHz digit shift register (IC18) with the New Word Pulse (NWP). After the NWP, the control logic on the control board supplies a shift-register Mode Control pulse (MC) and a series of four shift pulses called Clock 1 Pulses (C1P). The result is a rotation of four bits (or one BCD character) in the shift registers (ICs16, 17, 18). This causes the BCD character just entered in the MHz position to appear in the 10kHz position and moves the contents of the 10kHz to the 100kHz position, etc.

Therefore, as each character is keyed in,

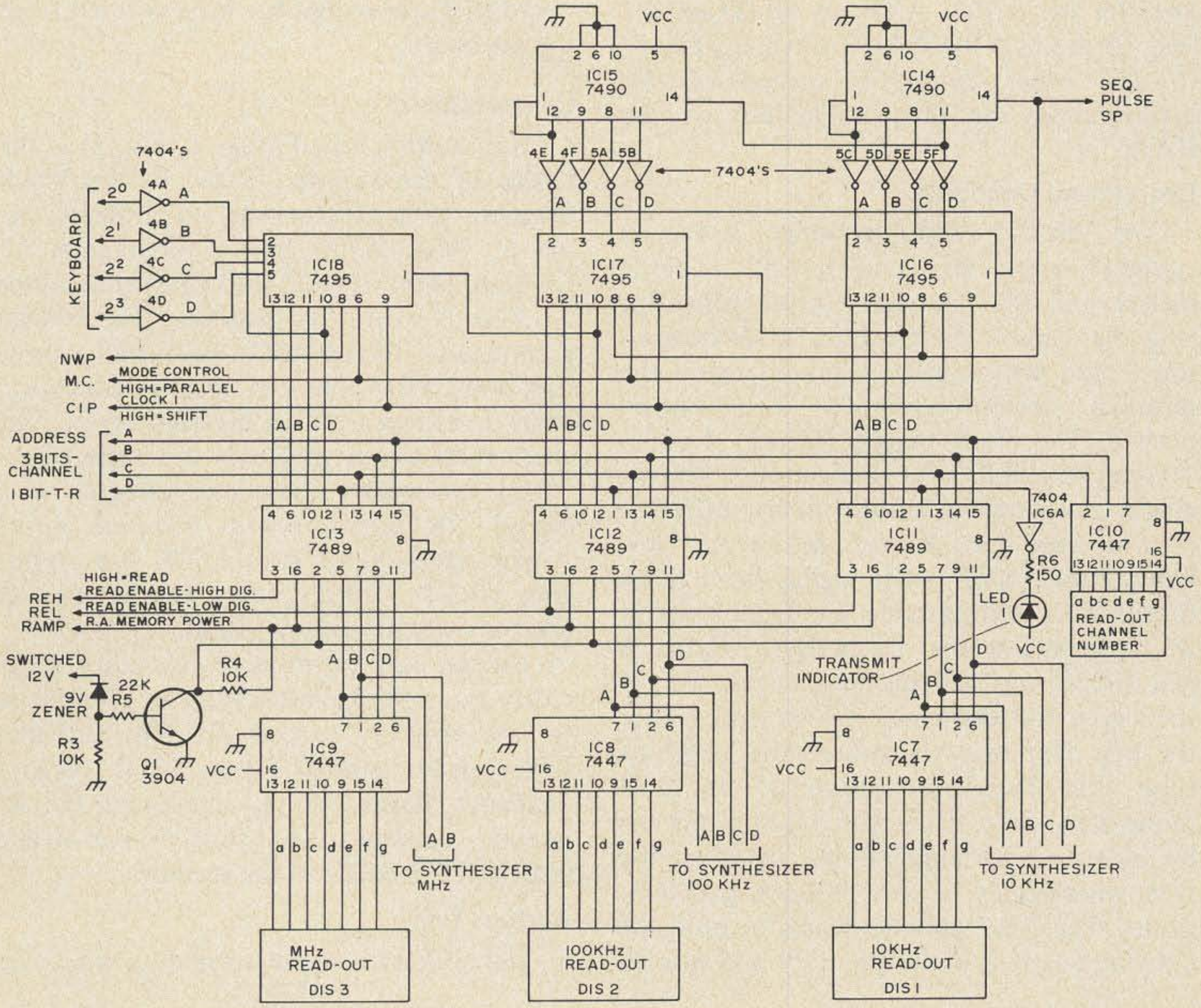


Fig. 2. Schematic of the memory and display board.

it appears on the right; old characters move to the left. For example, if the frequency display reads "069" and a "4" is keyed in, the BCD representation of 4 (0100) enters the MHz position shift register (IC18), and 4 pulses rotate the contents of the shift register by four bits. The frequency display now reads "694."

After the data are rotated in the shift register, they are stored in the Random Access Memory (RAM-ICs11, 12, 13) by the read enable pulses (REL, REH). Each RAM stores 64 bits, which makes it convenient to store 16 BCD characters, or eight transmit-receive pairs. The address in the RAMs is four bits. Of these three bits are the channel number in binary (000-111); which is decoded by IC10 and displayed as the channel number. The other bit of the address is low for receive and high for transmit and is supplied by the transmit-receive section of the control logic. A Light Emitting Diode (LED 1) is driven by an inverter IC6A and serves as the transmit indicator, i.e., displays the status of the fourth address bit.

Memory output in BCD sets the synthesizer frequency and drives the 7-segment decoders (IC7, 8, 9) for frequency readout. Therefore, what the displays show and what goes to the synthesizer is always identical. What you see is what you get. Reviewing the address for each RAM (address lines ABCD, Fig. 2) is four binary bits; three bits are the channel number in BCD (0-7) and one bit is the transmit-receive status.

If power to the RAMs is lost, the information stored will be lost. Rather than have the entire unit on all the time, I used a separate unswitched power supply for the RAMs. However, when the rest of the circuit is switched, transients occur in the control

lines for the RAMs. A circuit of ZD and Q1 (Fig. 2) disables the RAMS when the power to the other circuit is turned off by ungrounding the chip-enable pin of the RAMs.

Decode and Debounce

The decode and debounce board is straightforward and consists of a diode matrix and the new word pulse generator (Fig. 4). This is designed for a Chromerics touch pad which gives a low state on the terminal corresponding to the button pushed. The diode matrix (D1-15) decodes 10 lines to 4 BCD keyboard outputs. When a character is entered, a pulse on any BCD line or from the zero button initiates a New Word Pulse (NWP). The signal from IC2A fires a dual retriggerable monostable (IC3) which generates the actual NWP signal. A gate (IC2B) permits this pulse to pass only if the key is still depressed, which insures that the key depressed for at least the length of time that the first section of the dual monostable fires. The capacitance of C1 can be increased to lengthen the delay of the first monostable if any bounce problems occur. The NWP communicates to both the control board and the memory and display board that a new digit has been entered from the keyboard.

Control Board

The control board (Fig. 1, Fig. 3) is the brains of the scanner. Refer to the block diagram (Fig. 1) for the component elements. First, a few general comments: All gates are 7400 series NAND gates with either 2, 3 or 4 inputs or inverters. The NAND gates can be thought of as performing three functions. First, they can operate in a logical AND function with an inverted output (as when both inputs go HIGH the output goes LOW). Secondly, they can operate as a logical OR function with inverted inputs (when either input goes LOW, the output goes HIGH). Thirdly, they can be used as inverters whenever convenient.

The primary purpose of the control circuitry is simply to provide a four bit address to the memory circuit. It also provides shift-register control pulses (C1P, MC), a Sequence Pulse (SP) to increment the sequence counter, and finally read-enable pulses (REH, REL) to the memory.

Address Logic

The address is made up of four bits. One

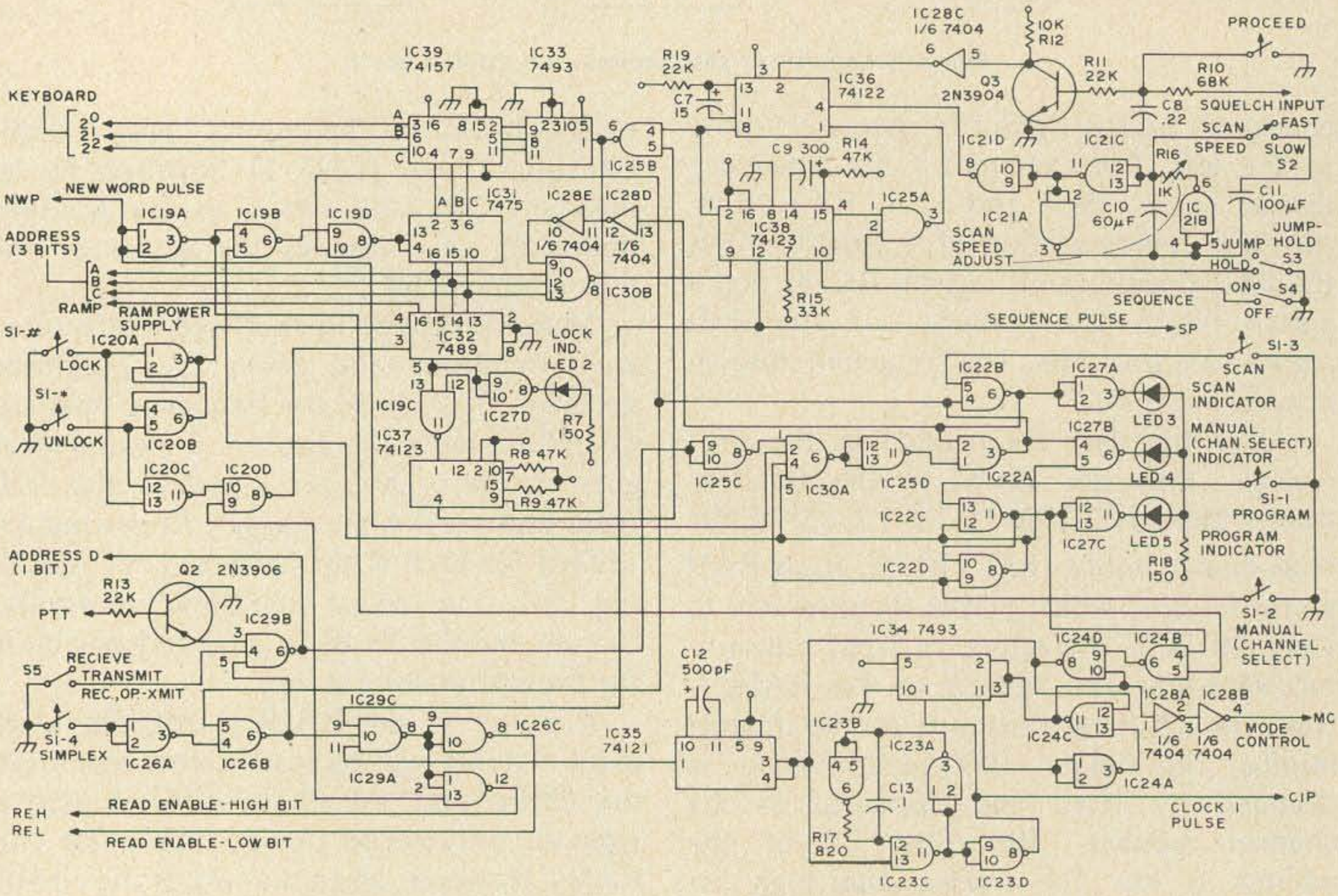


Fig. 3. Schematic of the control logic board.

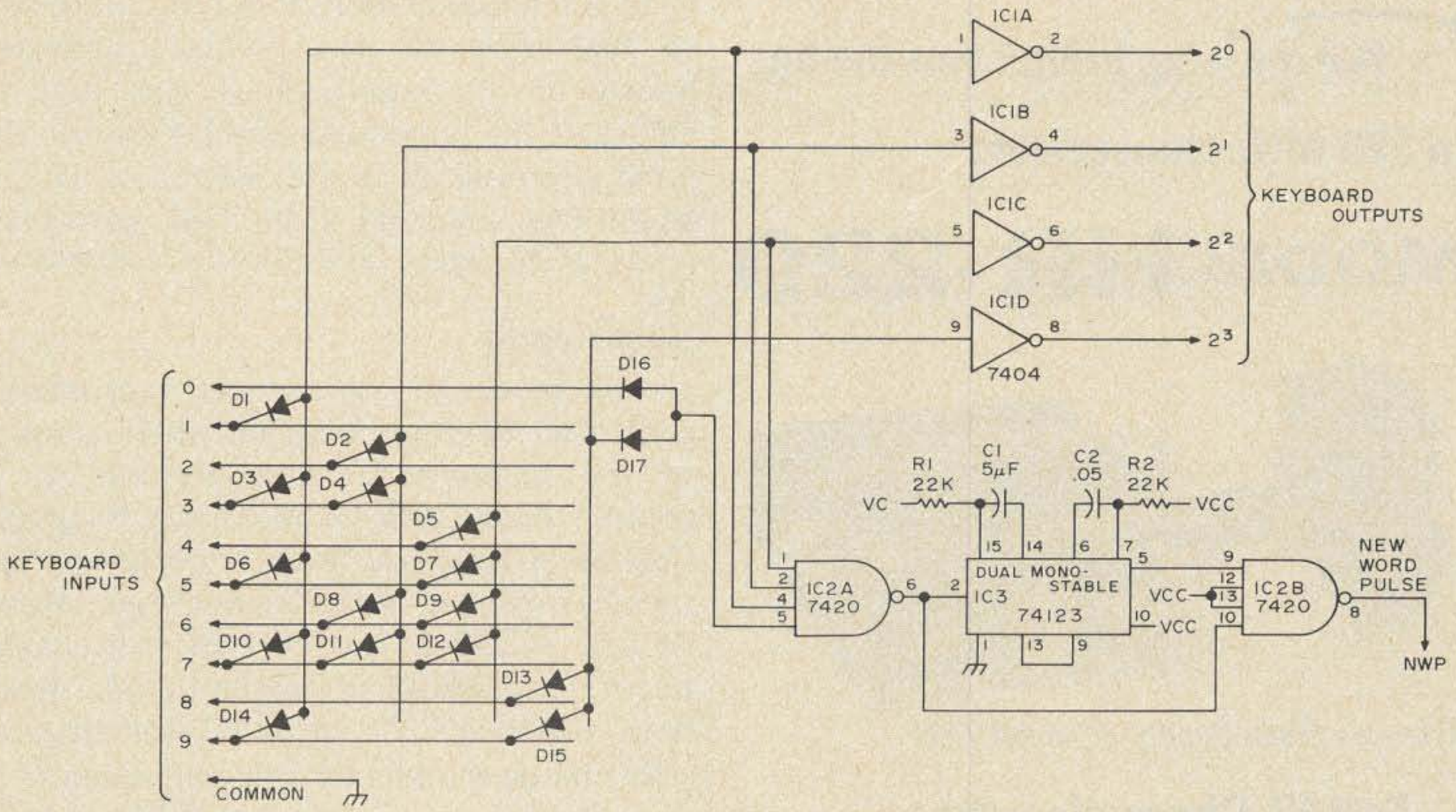


Fig. 4. Schematic of the decode and debounce board.

bit is the transmit-receive status; three bits make the channel number (0-7) in binary (000-111). The three bits of address information come from one of two sources, the keyboard or the channel counter (IC33), and go to IC39 which is a multiplexer. The multiplexer can be considered as a three-pole double-throw switch connecting its outputs – pins 4, 7, 9 – to either set of inputs as controlled by the level on pin 1; HIGH indicates channel-select mode (keyboard input) and, LOW, scan mode (channel counter input). The output of IC39 goes to IC31, which is a latch. The latch stores data when the input control (pins 4, 13) is LOW, and it transfers data on input control HIGH. When in the scan mode, no storage is necessary, so IC19D holds pins 4, 13 HIGH in scan mode since IC 19D-10 is LOW in scan mode, forcing its output HIGH. However, when a keyboard entry is made in channel select mode, storage of that information is required and accomplished by using the NWP to gate the data into the latch. When a keyboard entry is made, the NWP is inverted by IC19A. IC19B gates the inverted NWP through when in channel select mode. Hence, the NWP can serve as the clock pulse for the latch to store the keyboard entry. IC19B inhibits in program mode; therefore, the latch stores or transfers the appropriate channel information which is three binary bits of the four bit address used for the RAMs.

Scan Logic

The scan logic includes the channel counter (IC33, Fig. 3) which is used as a ÷8 counter and generates the channel number when scanning. The scanning rate is determined by the oscillator consisting of IC21, C10, C11 and R16. The slow scan switch adds extra capacitance to slow down the oscillator. Capacitors C10, C11 can be changed to suit the builder. Pulses from the oscillator trigger a monostable (IC36). The monostable generates a relatively wide pulse of about 100ms when it is not inhibited by the signal from the receiver squelch. The input from the receiver squelch is filtered by R10, R11 and C8 and buffered by Q3 so that IC28C-6 is HIGH for signal, LOW for no signal. If a TTL compatible squelch circuit is used, the filter and buffer can be eliminated. The output of monostable IC36 is gated by IC25B advancing the channel counter (IC33).

Jump-Hold Logic

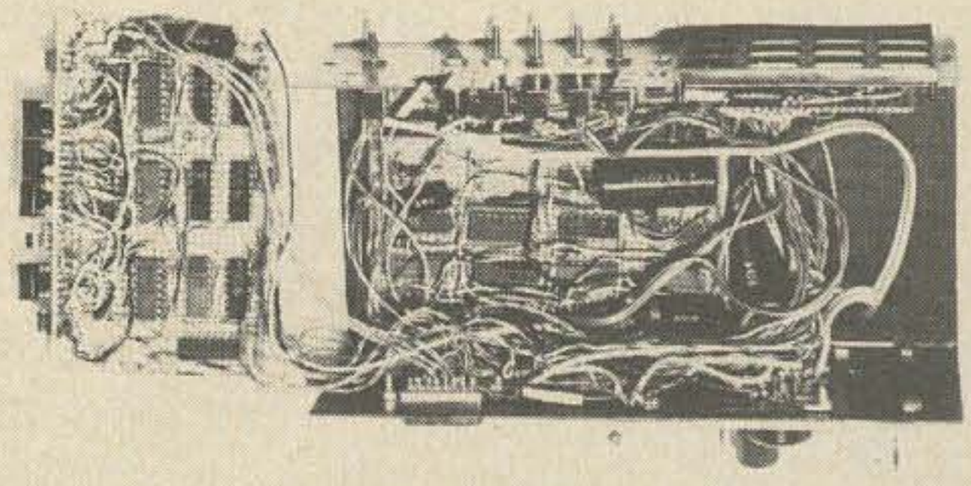
One half of IC38 is another monostable and is kept retriggered by the scan pulses from IC36-8. If, however, the squelch opens,

IC36 is inhibited and IC38 is not retriggered, so that after its time constant (approximately 5s) its output, pin 4, goes back to HIGH. If the jump-hold switch (S3) is in the jump position, then the output of IC25A goes LOW, enabling IC36. This, of course, resets IC38 again and the cycle starts all over.

Mode Control

The mode of the scanner is primarily controlled by three switches which are part of the touch pad. These are the fourth column digits ①, ②, ③, which are Program, Channel Select, and Scan, respectively. The switches control the two set-reset latches (IC22). IC22B-6 is HIGH in scan mode. IC22C-11 is HIGH in program mode. When both aforesaid lines are LOW, the channel-select mode is achieved. The output states of these latches are displayed by LEDs 3, 4, 5. Note that only one current-limiting resistor, R18, is needed, since the latches are interlocked.

While three of the four inputs to the latches are switch contacts, the reset to the scan latch (IC22A-1) includes a four input gate IC30A. This performs a logical OR function allowing any of the four signals to reset the latch. Pin 1 is low in transmit to stop the scan when the Push to Talk (PTT) is activated. Pin 2 is low during a NWP, so if a touch pad channel is keyed in, the scanner will revert to channel select mode. Pin 4 is the channel select switch (S1-②). Pin 5 is LOW in program mode to form the interlock between the latches. Several other lines go from the output of these latches to the remainder of the circuitry and accomplish mode control.



Cover off view of the scanner with the memory and display board removed to show the control board below.

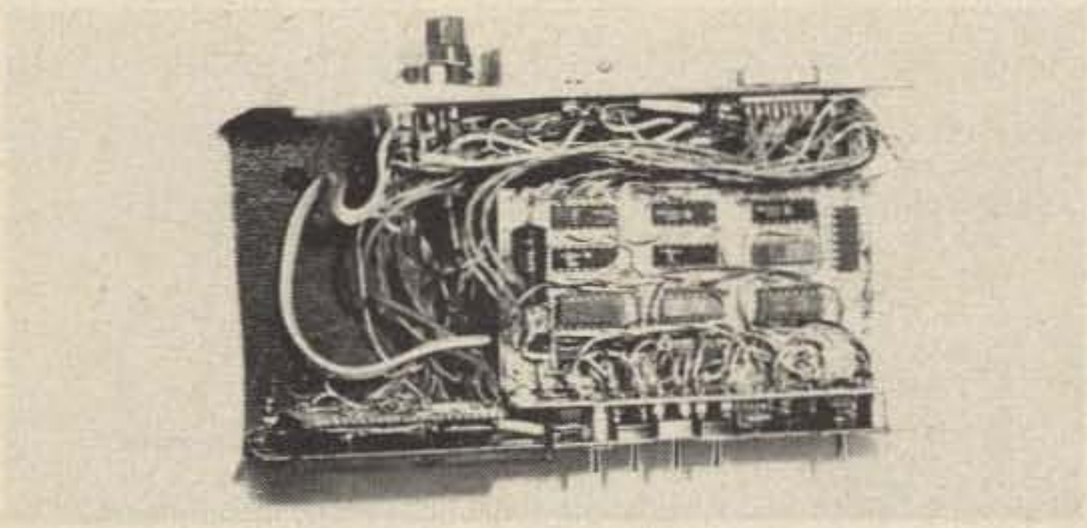
Shift Pulse Generator

The block shown as shift pulse generator on the block diagram (Fig. 1) is IC23 (Fig. 3) which is controlled by IC24 and IC34. IC23 forms an oscillator which runs when IC23C-13 is HIGH. It is necessary to remember that the shift registers need four pulses to shift the digit one place when a digit is entered in program mode. If a keyboard entry is made in program mode, IC24B gates the inverted NWP to IC24D. This sets a latch (IC24C, 24D). As this latch is set, it resets IC34 which is used as a divide by four counter and also starts the oscillator (IC23). The oscillator output is the Clock 1 Pulse train (C1P) and is counted by IC34. When the counter reaches "4," pin 11 goes HIGH, which, by way of IC24A, resets the latch and stops the oscillator. The net result produces a pulse train of four pulses which is called C1P.

An output from the latch also controls the mode of the shift registers, since they can operate in either parallel or series. To prevent a timing problem a pair of inverters (IC28A, 28B) provides a delay before changing the Mode Control (MC) line (HIGH to LOW) from parallel to series. After the pulse train is completed and the latch resets, the monostable (IC35) fires, giving a short pulse to the read-write logic and the new digit is written into the memory.

Transmit-Receive Logic

The PTT signal (LOW for transmit) enters through R13 to Q2 which serves as a buffer to the TTL logic. IC29B generates the transmit-receive status bit which makes up one bit of the memory address (LOW for



Cover off view of the scanner with all boards in place. Note the top edge of the decode and debounce board is visible behind the touch pad. This is attached directly to the pad with Molex pins.

receive and high for transmit). The three inputs into the gate (IC29B) allow three signals to force the bit HIGH for transmit. Pin 3 from the PTT line, pin 4 from the receive and operate--transmit switch (S5), and the simplex signal from IC26B-6 will force the address bit high.

The simplex function (S1-④) copies the information that was entered in receive into the transmit memory. When (S1-④) is pressed, it activates two functions: First, it changes the receive-transmit status, to transmit, and secondly, it gives the read-wire logic a signal (IC29C). IC26B is used to inhibit simplex operation in scan mode to prevent overwriting the memory by accidently hitting the simplex button.

Read-Write Logic

The read-write control is made of three gates (ICs29C, 29A, 26C). The first, IC29C, logically ORs the three conditions that require the memory to be put in the write mode. These are: the write pulse for the sequencer operation that goes to pin 9, the write signal for simplex operation from IC26B, and the write pulse for a new entry from monostable IC35. For both simplex and a new entry, each of the memories needs a write pulse, but from the sequencer only the lower order two memories are changed, so IC29A inhibits the write pulse for the high order (MHz) digit memory in scan mode. Although I speak of write pulses, the RAMs are controlled by read-enable lines. These write pulses are LOW to write and HIGH to enable the memories to read. The line to the HIGH order (MHz) digit is called Read Enable HIGH (REH) and the line to the LOW order two RAMs is called Read Enable LOW (REL).

The Sequencer

The sequencer utilizes IC30B, IC28E, IC28D, and one half of IC38. This circuit generates a Sequence Pulse (SP) to increment the sequence counters (IC14, 15) and to give the low order two memories a write pulse. When the sequencer is on (S4), monostable IC38 is enabled. IC30B detects the channel number "7" by looking for all HIGH levels on the address lines. This then fires the monostable IC38. IC30B is enabled only in the scan mode through the pair of inverters IC29D and IC28E. This pair of inverters is required for the special case when the scanner is in channel-select mode and on channel 7 and then is switched to scan mode. Without the delay, a sequence pulse would be generated and take place after the address is changed.

Lock Logic and Lock Memory

The last blocks are the lock logic and memory. The lock data are entered from switches S1-# and S1-*. These signals set and reset the latch made from gates IC20A and IC20B. IC20C logically ORs both switch inputs to create a write pulse for the lock memory. IC20D inhibits the write pulse during scan operation. The output of the latch provides the data for the memory and the output of IC20D generates the write pulse. The lock memory (IC32) gets its address from the three channel number bits, as do the other RAMs, but the receive-transmit bit is not needed, since only 8 bits of data are stored. The output of the RAM, pin 5, basically does two things: First, it supplies the signal for IC27D which drives LED 2 and indicates the lock status of the channel. Secondly data also are gated through IC19C to fire one half of monostable IC37. This pulse is only about 300 ns wide and through gate IC25B advances the channel counter (IC33). Hence, a locked channel is rapidly skipped. However, if two locked channels in a row occur, the monostable would not give an additional pulse, so a second monostable (the other one half of IC37) is fired by the first and interrupts the data from the memory with gate IC19C. This allows multiple locked channels to be skipped in less than one microsecond per channel. Well, that's it! Simple enough?

Construction

The builder can have much flexibility in layout and construction of this project. At this time, printed circuit boards are not available, so I will make some general comments about the methods I found useful.

Layout is noncritical. Adequate bypassing of the ICs is essential. I can't emphasize this

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point too much. Each monostable and counter should have its own .01μF capacitor across its power leads. These are not shown in the schematics. I also put an electrolytic on each board, something in the 100-300 μF range. With these precautions, I experienced no difficulties with transients. There are many fast pulses in close proximity, so do use the .01μF capacitors very liberally.

I used microvector board wiring on both sides, but wirewrap would also be a good method if the equipment is available.

Decode and Debounce

I divided the circuit into four major boards. The decode and debounce board is small, 5.72cmW x 6.03cmH (2-1/4"W x 2-3/8"H), by using Molex pins on the board. It plugs directly onto the Chormeric pad, thereby eliminating interconnections. The pad is a 4 x 4 touch pad with 16 output lines plus a common and can be purchased from B&F Enterprises as well as other sources. The dimensions are 7.62cm x 7.62cm (3" x 3") Refer to Fig. 5, for the pin diagram. On

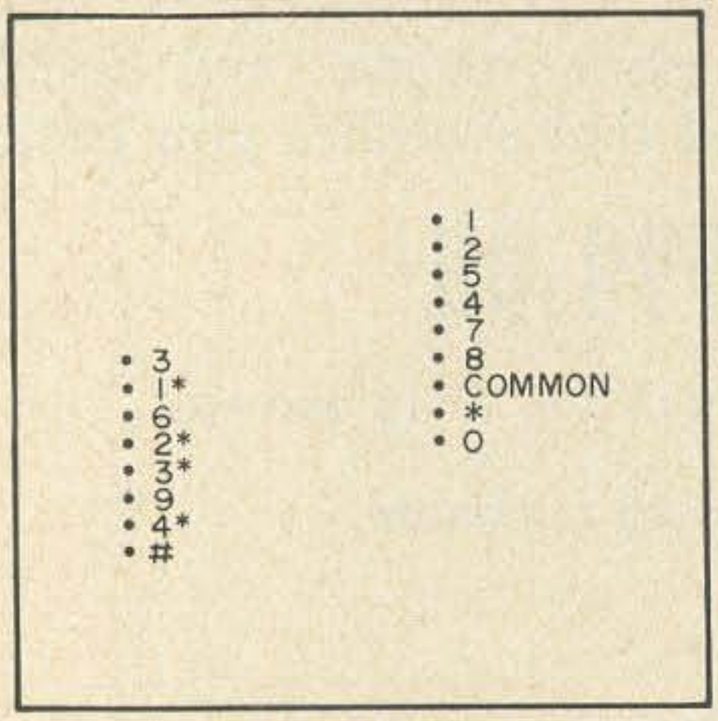

Fig. 5. Diagram of the pin connections of the Chromerics touch pad.

an earlier prototype I employed a standard Touch-Tone keyboard using the switch contacts only, but a different decoder has to be used to convert its 3 x 4 matrix output to Binary Coded Decimal (BCD), and four additional push buttons are needed to replace the extra four buttons on the 4 x 4 Chromerics pad.

Memory and Display

The second major board, the memory and display board, is straightforward. Again, don't forget to bypass. I recommend bypassing all the chips on this board. The layout is primarily just BCD lines in parallel for the data and address information as in the schematic. When making this, lay out the board in such a way that the 7-segment readouts can be mounted on the panel. I used a 11.43cm wide by 6.03cm deep (4-1/2" by 2-3/8") microvector board with a 11.43cm by 2.54cm (4-1/2" by 1") board placed at a right angle to mount the 7-segment displays. Put a 500 μF capacitor on the memory power supply (RAMP) line to decrease transients associated with turn-on.

Control Logic

The control logic fits on a 4.43cm wide by 9.84cm deep (4-1/2" by 3-7/8") board. There are no major considerations except to again bypass the ICs. When laying this out, allow for the larger capacitors used with the monostables, IC38, and with the oscillator IC21. Throughout, it may be easier to build segments of the circuit and test them before assembling the entire unit. Observe that the fourth column buttons of the touch pad are denoted as S1 followed by circled numerals indicating the row.

Interface Board

The final board is the interface board (Fig. 6). This is very small and can be mounted inside the synthesizer with S7 mounted on the panel. I mounted a 15 pin connector on the synthesizer so it could be easily disconnected and used alone.

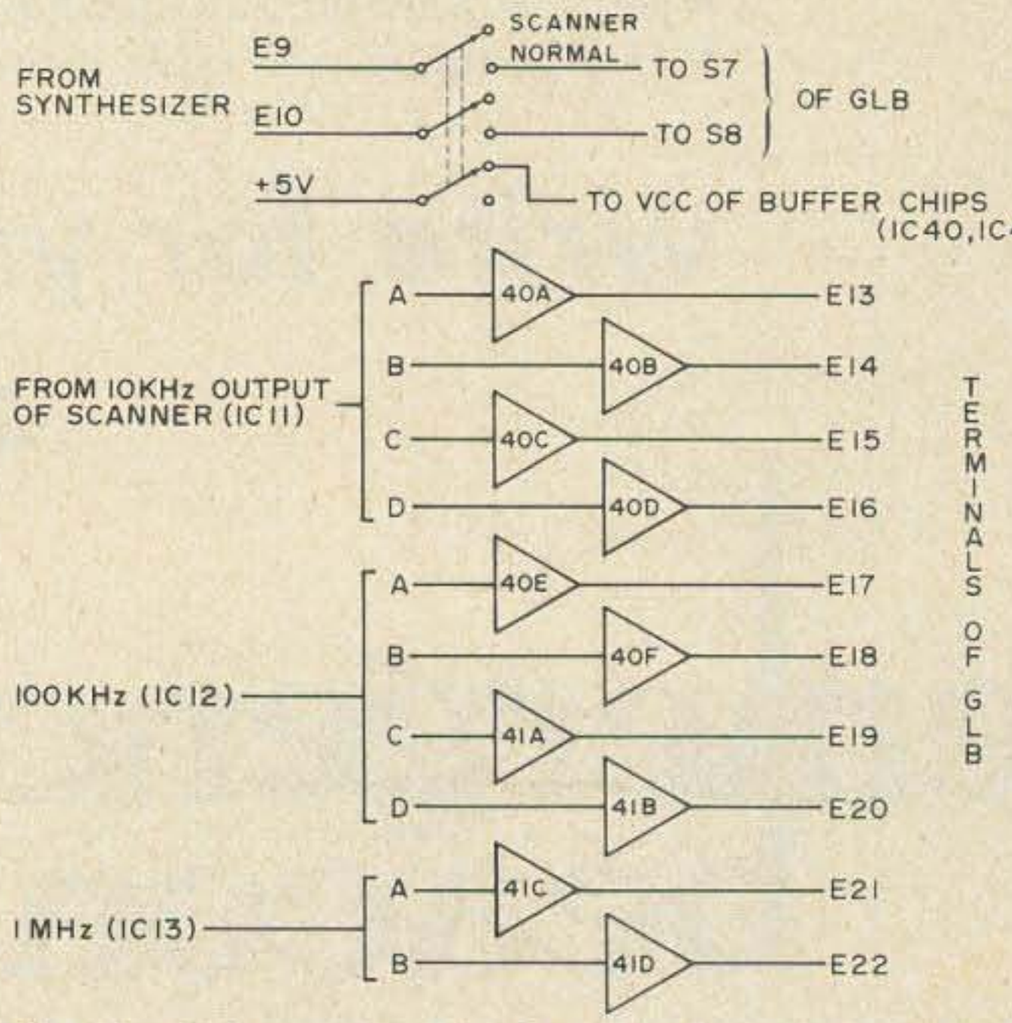

Fig. 6. Schematic of the interface between the scanner and a GLB 400B Channelizer.

Power Supply

The power supply (Fig. 7) is just two 309K 5V regulators. One is switched from the panel (S6), and the other is unswitched to supply the memory chips which will lose

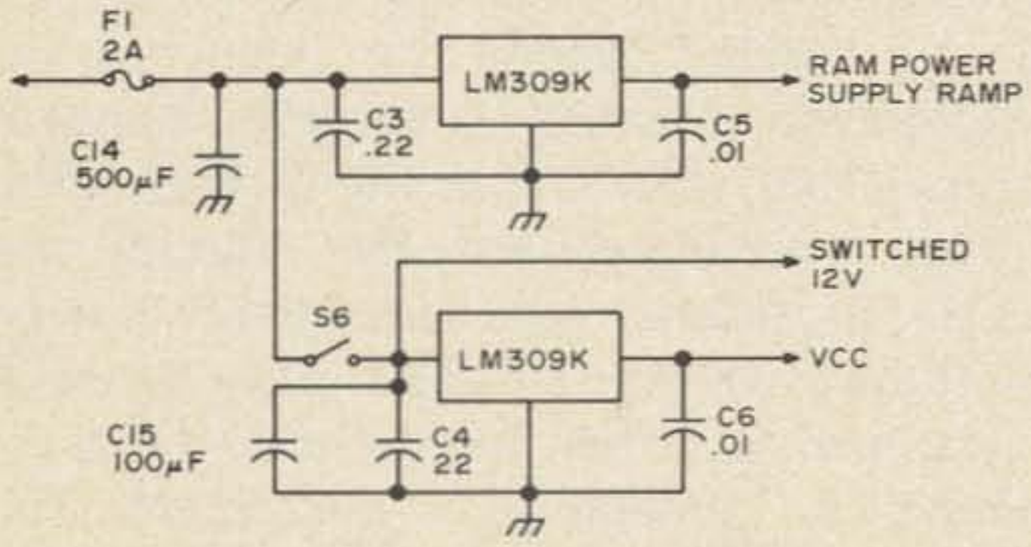

Fig. 7. Schematic of the 5V power supply.

their data if power is interrupted. Don't omit C15, Fig. 7, as this is necessary for the memory protect circuit.

The entire unit fits into a 7.62cm x 20.32cm x 12.7cm (3" x 8" x 5") cowled minibox if not too much room is wasted. A 15 pin connector is good to allow for interconnections with the synthesizer. In making interconnections between boards, be sure to allow for slack to lift out each board.

Interface

The scanner was designed to interface with the GLB 400B Channelizer. Since the scanner basically replaces the frequency-select switches of the synthesizer and these work at digital logic levels, there is no problem with the interface. Hex buffers are used as shown in Fig. 6. In addition to providing a buffering action, these serve as diodes to isolate the scanner from the synthesizer's own switches when the hex buffers are turned off. Therefore, the synthesizer can be controlled with its front panel switches independently of the scanner.

Though I have not used it with any other synthesizer, a similar interface could be devised, if switches are digital, with either buffers or inverters to obtain the proper BCD levels; if a 10 line switch is used, 4-10 line decoders could replace the buffers. The primary limitation would be the lockup time of the synthesizer. The GLB is rated at 10-20 ms typical, 100 ms maximum lockup time. The scan rate would have to be decreased with slower lockup times of some other synthesizers.

I will say least about the receiver interface as this will vary much with different transceivers. If used with some commercial ones, the auxiliary squelch line may work directly. The scanner requires a high level when there is no carrier and ground when carrier is present. The scanner has a transistor buffer, so the signal from the squelch does not need to be TTL compatible. Many COR-type circuits have been published and will be satisfactory for the squelch input.

Operation

There are three basic independent modes of operation: (1) Program (2) Channel Select (3) Scan. These modes are selected by switches on the pad, and their status indicated by the adjacent LED indicators.

In program mode, the touch pad functions as a means of entering data into the RAM memory. As a number is keyed in, the new number appears on the display in the right-hand position. The numbers that were there previously appear to shift to the left; therefore, if a mistake is made upon entering, the correct number can be re-keyed in and stored. If a simplex pair of frequencies is desired, it is necessary to key the number into the receive frequency; then touching the simplex key will store the number in the transmit location. If a duplex pair, however, is to be programmed, then the transmit-receive and operate switch is moved to transmit position, and the transmit frequency is entered in a similar manner. This switch is left in the receive and operate position except when programming a transmit frequency, or if it is desired to view the transmit frequency without actually keying the transmitter. The channel remains unchanged in the program mode.

The channel-select mode allows the touch pad to select the channel, which is associated with a paired frequency. The channels are designated by channel numbers 0-7 and displayed on the panel as Channel, with a 7-segment readout. If the operator desires to monitor or use a pre-programmed frequency, he need touch only the proper channel number on the pad and the already-stored

frequency will be displayed.

The final mode is the scan mode. In this, the scanner advances through the selected channels; as a carrier is detected, the scan will stop on that frequency for either a 5 second period of time (if the jump-hold switch is in the jump position) or will remain until the carrier is dropped (if that switch is in the hold position). The advantage of the jump position is that, if you desire to listen for a station on another frequency which may not be the common-call frequency, a long-talking station won't keep you from missing the other call. If the transmitter is keyed in scan mode, the channel remains unchanged, and the mode is automatically returned to channel select – thereby preventing it from continuing to scan when the carrier is dropped. This makes answering a call on any active frequency as simple as briefly keying the transmitter, assuming you have programmed in the proper associated transmit frequency. To return to scan mode, just press the scan key. Also, if you wish to go to a specific channel, just press the touch key of the channel number and the scanner will automatically revert to the channel select mode and display the keyed-in channel and corresponding frequency. A fast and slow scan switch allows the rate to be reduced to a speed the eye can follow to inspect the frequencies being scanned. A proceed button enables the operator to continue the scan if it is stopped on a channel. When used with the GLB 400B Channelizer, I have found that a scan rate of about 10 channels per second can be achieved, so if, for example, 5 of the 8 channels are selected to be scanned, each channel is checked two times a second.

Other features include the ability to "lockout" a channel. This is the method that allows only selected channels to be scanned. When a channel is locked out, it will be skipped when scanning. The lock indicator LED lights when a channel is locked. For example, if channels 1, 4 5 and 7 are locked out, the scan will look at channels 0, 2, 3 and 6. To lock out a channel, the "lock" touch key (the #) is pressed when in either program or channel-select mode, and the lock indicator LED will light; to unlock a channel, similarly, the unlock button is keyed (the *). When no channels are locked out, all eight channels are scanned, and up to 7 channels can be locked out – a useful situation when using the sequencer.

What is the sequencer? Well, this is the function that will sweep in 10kHz steps, a selected MHz. When the sequencer is switched on, Channel 7 becomes a special channel. Only the data in the MHz position remains unchanged, and the 100kHz and 10kHz positions are sequentially incremented by 10kHz each time that Channel 7 is scanned. In other words, each time the channel is "looked at," the receive frequency is increased by 10kHz. If all the channels except this one are locked out, then it is repeatedly scanned. At 10 channels per second, if only Channel 7 is being scanned, you can check a 1MHz segment for activity in about 10 seconds; if all 8 channels are being scanned, the 1MHz is covered about every 80 seconds. When the sequencer is switched off, Channel 7 behaves the same as all the other channels and can be scanned without its contents being changed.

Although on first reading this may seem very complex, the important point in operation is that of the three modes of operation – Program, Channel Select and Scan – it can be in only one mode at a time. To put frequencies in the memory, put it in program mode and the touch pad enters frequencies. In channel select mode the touch pad serves to enter the channel number. To scan, push the scan button and it will check all the channels for activity that are not locked. The lock and unlock buttons (the # and *) allow you to lock and unlock channels.

Comments

This has been an enjoyable project for me. Please feel free to write or call me when questions arise and include a SASE if you write. Many modifications, deletions or additions are possible. Touch Tone could be added easily with the hybrid tone chip, for example. A modification to add 5kHz spacing is also possible. But whatever you devise I hope it improves your hamming.

My thanks to the many hams who aided and abetted the cause and contributed their time and skills. I am particularly indebted to

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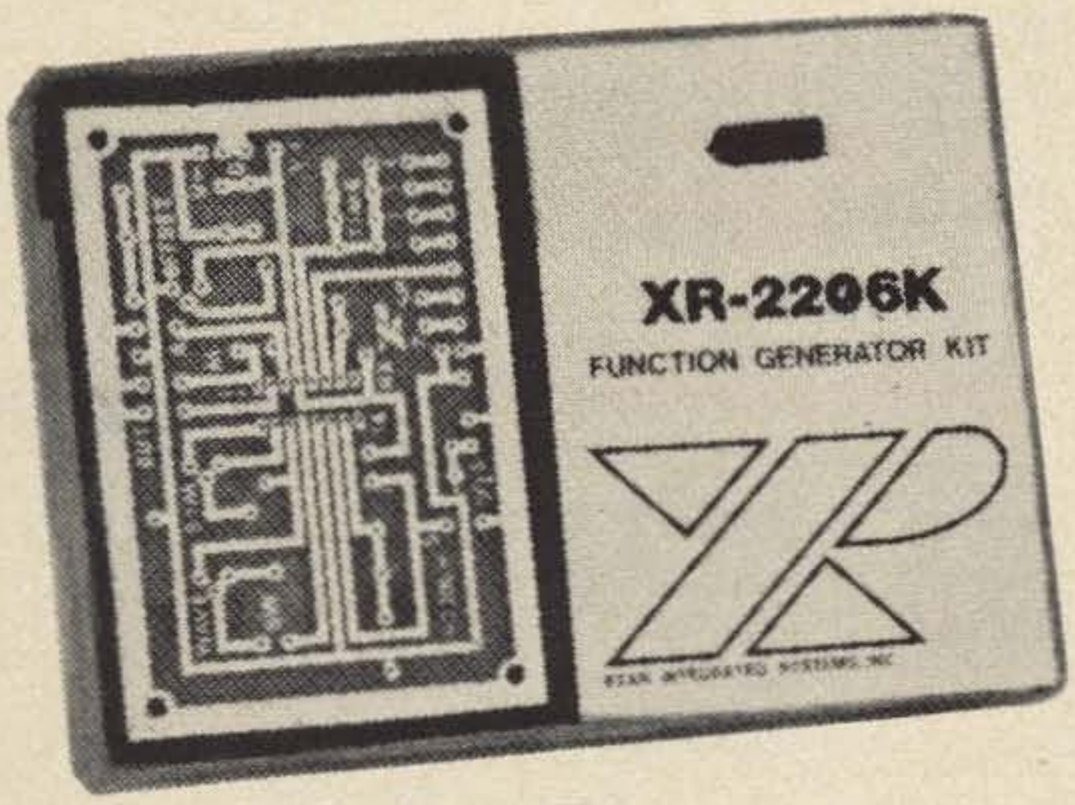

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Don KØTVO, for much information and advice and to Bob WØKGJ, for building another prototype.

A possibly unique feature of my prototype is that when powering it up, the frequency display usually reads ' 73."

PARTS LIST

Power Supply

C3, C4 – 0.22 μF, 50VDC
C5, C6 – 0.01 μF, disk
C14 500 μF, 25 VDC, electrolytic
C15 – 100 μF, 25 VDC, electrolytic
F1 – 2 A fuse
S6 – SPST miniature toggle switch
Regulators – LM309K 5V 1A regulators

Decode and Debounce

C1 5 μF, 25 VDC electrolytic
C2 0.05 μF disk
D1-D17 – general purpose diodes
IC 1 – 7404
IC 2 – 7420
IC 3 – 74123
R1, R2 – 22K, ¼W
S1 – Touch Pad, 16 key, Chromerics (see text)

Memory and Display

DIS 1-DIS 4 7-segment minitron display or 7-segment LED*
IC4-IC6 – 7404
IC7-IC10 7447
IC11-IC13 – 7489 or 8225 which is equivalent.
IC14, IC15 – 7490
IC16-IC18 – 7495
LED 1 – MLED500 LED or your choice
Q1 – 2N3904 transistor or other NPN switching transistor
R3, R4 – 10K, ¼W
R5 – 22K, ¼W
R6 – 150Ω, ¼W
ZD – 9V zener, 400mW

*If LED displays are used add limiting resistors to parts list and schematic for each segment.

Control Board

C7 – 15 μF, 25VDC electrolytic
C8 – 0.22 μF
C9 – 300 μF, 25VDC electrolytic
C10 – 60 μF, 25VDC electrolytic
C11 – 100 μF, 25VDC electrolytic
C12 – 500 μF, disk
C13 – 0.1 μF, disk
IC19-IC27 – 7400
IC28 – 7404
IC29 – 7410
IC30 – 7420
IC31 – 7475
IC32 – 7489 or 8225 which is equivalent.
IC33, IC34 – 7493
IC35 – 74121
IC36 – 74122
IC37, IC38 – 74123
IC39 – 74157
LED2-LED5 – MLED500 LED or your choice.
Q2 – 2N3906 transistor or other PNP switching transistor.
Q3 – 2N3904 transistor or other NPN switching transistor.
R7, R18 – 150Ω, ¼ watt
R8, R9, R14 47K, ¼ watt
R10 – 68K, ¼ watt
R11, R13 – 22K, ¼ watt
R12 – 10K, ¼ watt R15 – 33K, ¼ watt
R16 – 1K miniature potentiometer
R17 – 820Ω, ¼ watt
R19 – 22K, ¼ watt
S2-S5 – SPST miniature toggle switches.

Interface

IC40, IC41 – 7407 or 7417
S7 – 3PDT Miniature toggle switch.

. . . WAØAQO

James C. Nordgren WB9BNF
1100 N. LaSalle, Apt. 1106
Chicago IL 60610

Poor Man's BFO

The rain splashed hard against my office window driven by the well-known Chicago wind. Meanwhile, back in my apartment lay the latest issue of 73 Magazine and my raincoat. However, on my office desk sat a short-wave receiver, without BFO, and a $2 transistor broadcast-band receiver. The happy thought occurred to me to use a harmonic of the broadcast receiver's oscillator to beat with code stations' carriers and provide a carrier for single sideband reception. I brought the broadcast receiver, turned on with volume low, close to the short-wave receiver, which was tuned to a CW station, and tuned the broadcast receiver until a pleasing audio tone was heard from the short-wave receiver. I found this method successful with CW and sideband stations on the 80, 40 and 20 meter amateur bands. Injection level was adjusted by changing the spacing between receivers. I had so much fun that I hardly noticed when the rain finally stopped.

. . .WB9BNF

Robert L. Harding
RD #2
Midlbury Center PA 16935

The Torrid Toroid

An in-depth look at the 88 MHz toroid.

The 88 MHz loading coil is some toroid. Not only is it ubiquitous and inexpensive but it can be bought for about 25¢ almost everywhere. Data on it is not so ubiquitous, although most ham constructors seem to have and use these coils in precision audio filters and oscillators. Presumably everyone is thoroughly familiar with them; hence, I recently had to refer way back to the RTTY column in CQ March 1961 to remind myself that, for series connection, the center tap is formed by joining the two wires directly across either barrier.

Even if this article repeats previously published or easily discoverable information, the ready reference may assist in more effective usage of this standard component. It is tedious to strip and count turns, measure, calculate, and get the decimal point in the right place. On the last one I stripped, I got the following results:

368 turns #30 wire in each 22 MHz section
736 turns total for 88 MHz. Wire diameter mikes out at 12.6 mils, including enamel.
Core dimensions (with fantastic accuracy based on my X-ray vision):

od: 1"
id: 9/16" to 19/32"
A: 3/16 x 3/8 = 0.07 $in.^2$ (cross section area)
WA: 0.235 x 10^6 circ mils (window area)

P: $13\pi/16$ = 2.55" (mean magnetic path length)

Even if the value A is physically correct, the effective core area will be somewhat less, depending on the ratio of magnetic material to empty space within the core structure.

Once this information is known, stripping the windings from these coils is the wrong way to go. Better, we can remove or add turns to make a precision inductor with any value of inductance, possibly up to 400 MHz. This task is made easier if we first predict the total turns required, halve this number to work on each section independently, and account for the 368 original turns. If adding turns, we simply splice a #30 wire of the appropriate length, including slack for final trimming, onto the outside end of each winding. Incidentally, 100 turns stripped from my coils measured 9 feet long; progressively more wire should be allowed as the winding deepens. A popsickle stick notched at both ends makes a fairly good shuttle onto which the appropriate length of wire is first wound before passing it through the toroid window.

Total turns required can be estimated from the empirical equation: $L = 3.2N^2 \mu A/10^8 P$ where P = in., A = $in.^2$, L = Henrys and μ is permeability. At first, this seems to tell us very little, because μ, A and P all depend on unknown core material and geometry. However, using the data that 736 turns yields 88 MHz and rearranging the equation to solve for $\mu A/P$ (treated as one constant) we obtain:

$$\mu A/P = \frac{(10^8)\ (.088)}{(3.2)\ (736)\ (736)} = 5.08$$

Using my values for P and A, we then get a value of $\mu = 185$. This looks surprisingly low, but suggests that the core has ferrite composition rather than helically wound steel laminates. I didn't crack mine open to find out.

The real purpose of this article is to print the following equation (derived by combining all constants and solving for N in terms of L):

$N = 2482 \sqrt{L}$, L = Henrys.

Now we can choose our L and calculate N, the total turns. The reader may verify that the equation works for the 88 MHz coils and each 22 MHz section. Now it is clear why series inductances don't just add when they are wound on the same core. In other words, to get the most inductance for your money, wrap all your wire on one core.

Of course, this equation doesn't guarantee that a certain N will produce a certain L in every circuit. That magic number 2482 still involves permeability μ which varies considerably according to the flux induced by current in the windings. Likewise, the original coils have 88 MHz inductance only under the conditions they are designed for.

Someone out there with access to lab equipment could do us a great service by publishing B/H hysteresis curves on these cores.

Personally, for just an 88 MHz inductor, I prefer the potted type. Once upon a time when my scope was working, I figured out the color-coded leads. To connect in series, connect either yellow and orange together or white and blue together, this junction forming the center-tap.

...HARDING

Voltmeter Switch Quiz

Below are illustrated three possible ways of wiring a voltmeter selector switch One has a serious handicap, a second would wind the meter needle into a hairspring, while the third would work nicely. The internal resistance of the meter is 50Ω in each case. Can you separate the sheep from the goats?

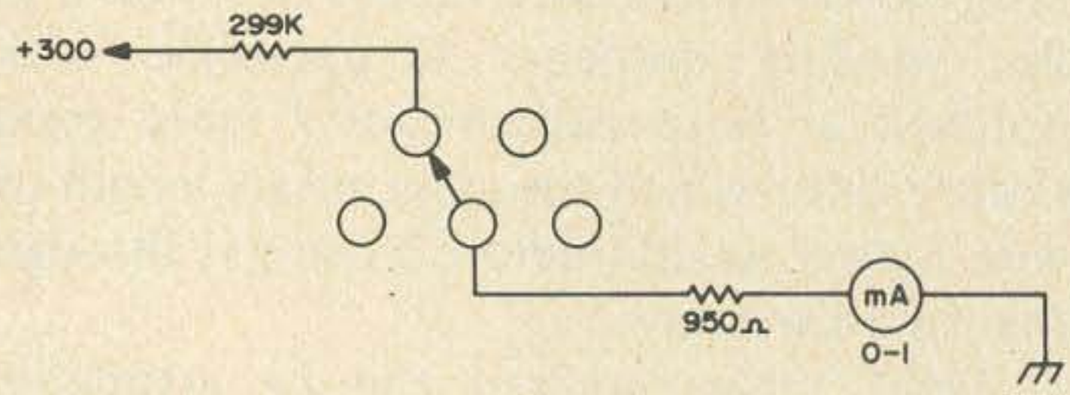

Fig. 1.

In Fig. 1, due to lack of current flow, the switch end of the resistor is at full supply voltage and 300V dc would be applied to a 1V dc meter. This will not contribute to the life of the meter.

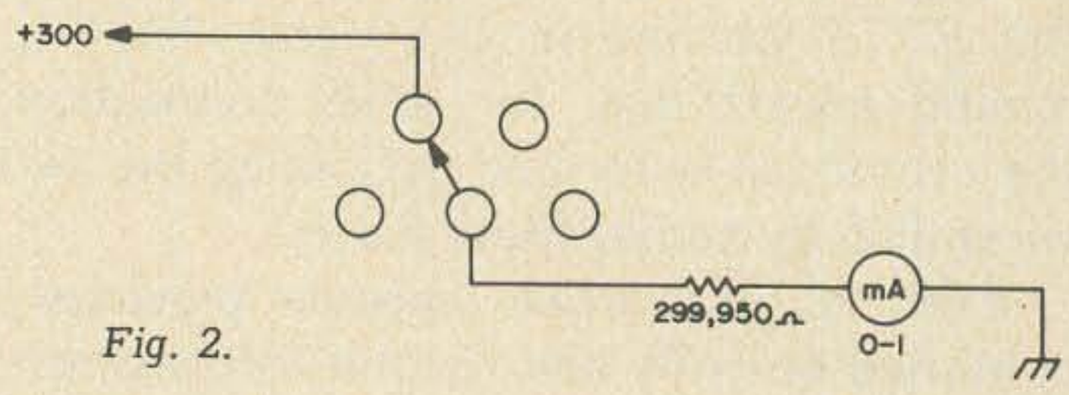

Fig. 2.

In Fig. 2, 300V would be applied to a 300V meter. This would work but all inputs to the meter switch would have to be read on a 300V or higher scale.

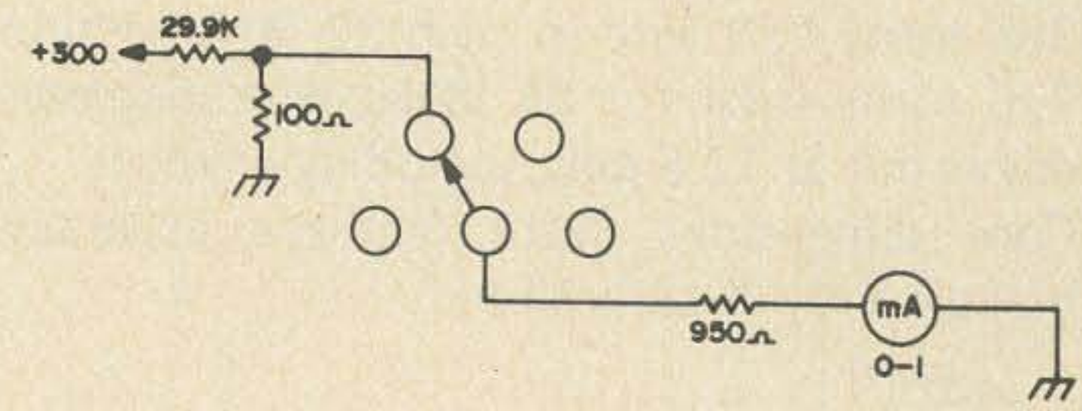

Fig. 3.

Figure 3 protects the meter and at the same time maintains high sensitivity for other ranges and functions.

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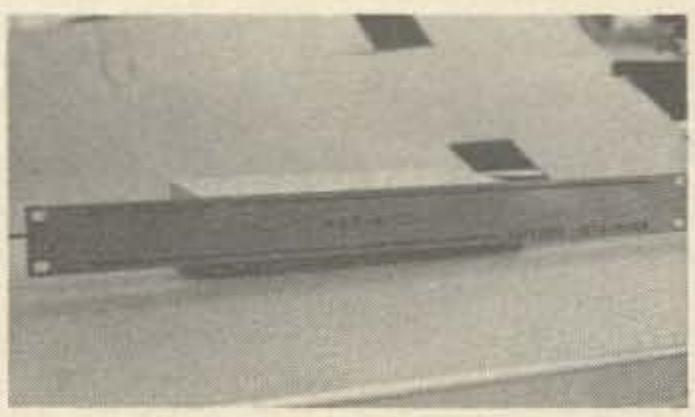

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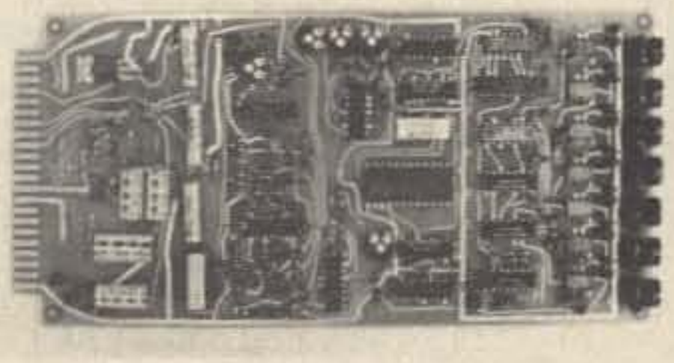

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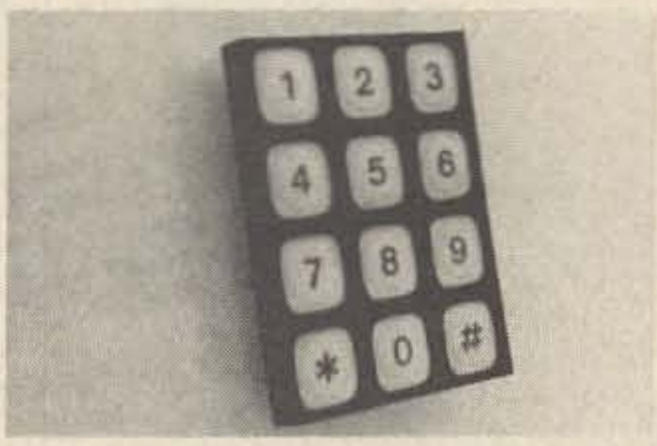

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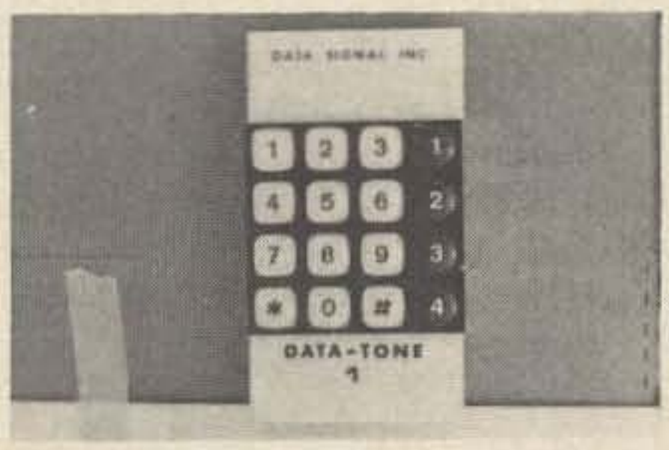

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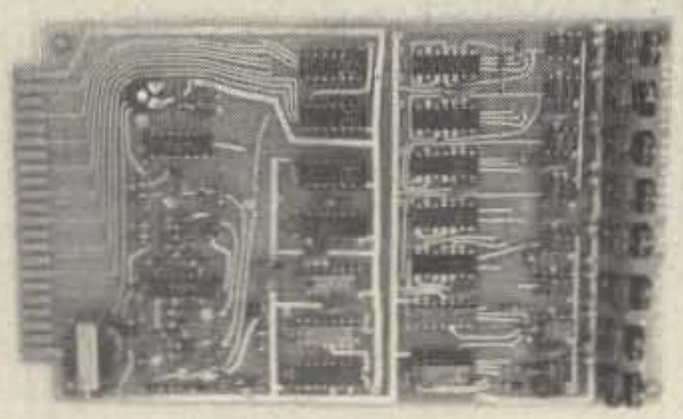

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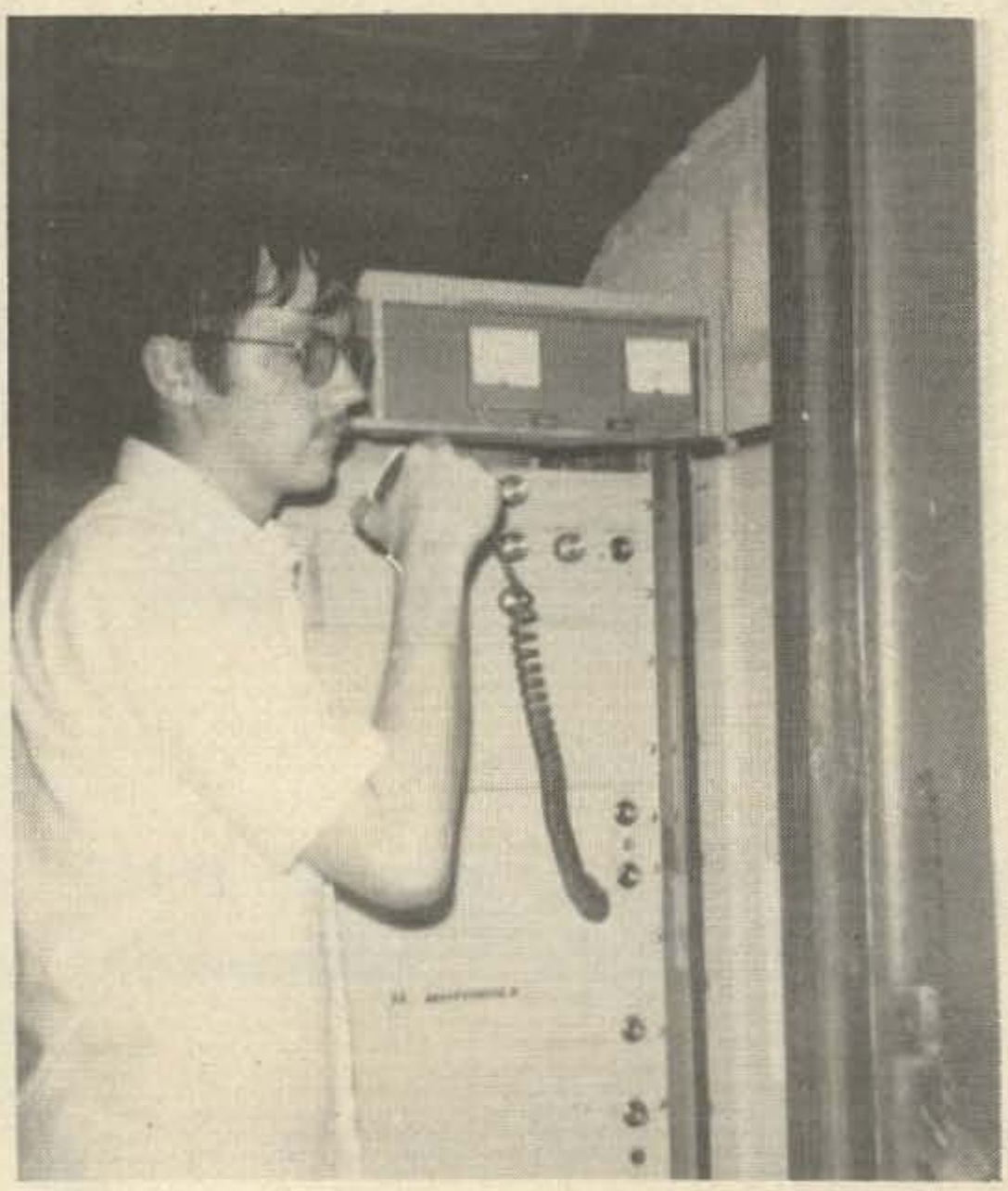
The Inside Story

Repeaters are made not born. Their inception, development, activation and continued operation take a lot of work, money, time and plain old guts on the part of the relative few who maintain them. I say "few" because in the final analysis there are only a few who are technically competent to "stick" their fingers inside a repeater and make it tick; competent enough to organize an association that has high standards of operation, provides public service support to local government, keeps its user/members happy and motivated and has control stations capable of providing constructive criticism without alienating the feeling of the user. The Green Mountain Repeater Association Inc., is such an organization serving the Washington D.C. and surrounding Virginia/Maryland areas and is the largest Repeater Association in Maryland. A title that took hard work. Here is its story.



Dan Addis WA3TUF, past president of the GMRA, Inc.

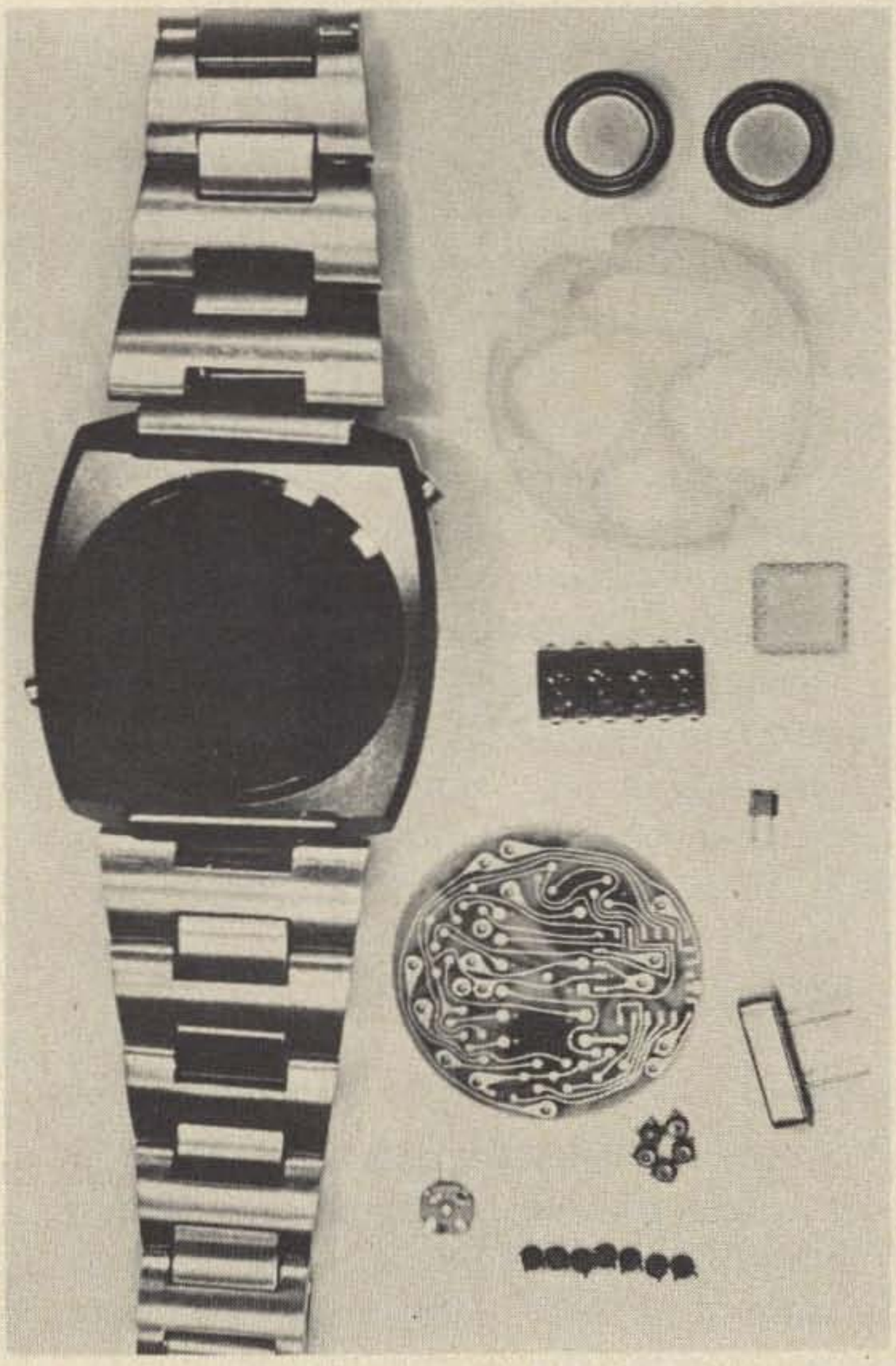
Inception

The GMRA was first conceived in October 1971 at the York PA annual ham-fest. It was here that 5 local Marylanders decided to put a 2m autopatch repeater on the air to service the Washington D.C. area. All had many years of experience in amateur radio and their own personal expertise in organization, technical ability, legal affairs, public relations and operation. Collectively they had "all the makins" to form a first rate repeater association.

Development

A site was soon selected overlooking Washington D.C. yet high enough to spread a strong signal into surrounding northern Virginia and Maryland. The frequencies

digital electronic QUARTZ watches



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146.01/146.61 were finally chosen with the help of the area frequency coordinator. This saved much time and consternation and helped ward off possible infringement upon an already operating or planned repeater system. A 60W Motorola base station was procured together with a vertical fiberglass antenna, a 4 cavity duplexer and an 80 foot Rohn tower. We had all the hardware, now all we had to do was put it all together into an operating system. No easy chore. While the technicians were putting the parts together including control and autopatch circuits, a license was requested and approved. The call sign WA3KWG was initially assigned (followed later by WR3ABC). Finally, after 500 man-hours of installation, testing, debugging, invention, frustration and more testing, Maryland's first 2m autopatch and The Green Mountain Repeater Association Inc., were activated.

Growth

From the 5 original founders, user participation increased by leaps and bounds. Within 6 months from the repeater activation the association had over 100 members. The repeater saturated the Washington D.C. area and news spread rapidly throughout the FM community that the 01/61 repeater was operational with autopatch facilities.

Public Service

Because of the repeater's very valuable public service potential, it was decided to make the repeater available to the local government's Civil Defense Agency. This was a "no holds" "no bar" proposition. The repeater was dedicated to public service exclusively if needed during an emergency. At the strike of an agreement pen, the local Civil Defense Agency increased its communication potential by over 100 mobile units each having direct access to autopatch facilities. The Civil Defense Director was "damned impressed."

Second Repeater

Well sir, as the membership/user population continued to increase (150 ten months later) the Board of Directors (fancy name for the original founders) started to think about a second repeater. After all, the first repeater was primarily for autopatch and public service support. Why tie it up with "rag chews," short as they may be, especially in view of the projected user growth? It was agreed a second repeater would be planned using the frequencies 28/88 with the blessing of the area frequency coordinator. It didn't take long since these guys work fast. In the summer of 72, less than one year later, the 28/88 repeater was activated. The call sign WA3SFG was assigned, soon to be changed to WR3ABB under the new repeater rules. The 28/88 machine also tied to a 4 cavity duplexer and fiberglass vertical. Talk about growth. Membership jumped over the 200 mark by the winter of 73. That's over 200 users in a little over 14 months.

Movie

To further publicize the association and in particular show people how a repeater is put together, a 15 minute movie with associated dubbed in sound was made by the Board of Directors. The film was such a success that it was shown at the summer of 73 ARRL Roanoke Division Convention at Reston VA. I'm sure many of you readers enjoyed the amateur but professional quality of the movie. It's something that can be shown again and again at Hamfests, club meetings and who knows maybe television. All you need is a good camera and someone who has writing ability, imagination and a little bit of Cecil B. De Mille in him.

Finis

When the smoke all cleared almost 2½ years later, the association had over 250 members, provided primary communications to local Civil Defense government, 2 active repeaters, AUTOPATCH facilities, affiliation with local FM repeater councils and had a color/sound movie of its efforts to boot. Good enough reasons for the Green Mountain Repeater Association Inc., to be called Maryland's Largest Repeater Association.

. . . K3BEQ

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John S. Hollar Jr. W3JJU
5012 Sunset Drive
Harrisburg PA 17112

EIGHT FUNCTION REPEATER CONTROLLER

When recounting construction articles appearing through the pages of 73 Magazine in recent years, it is evident that most of the smaller scale projects could be strung together on one piece or several pieces of copper clad board. With a little imagination and some preplanning I decided to standardize a construction format for my station for ease of construction, circuit design, testing, up-dating and reduced cost.

What started my thinking along these lines was WA4YND's fine article in the *73 Repeater Handbook* entitled, "A Repeater Controller." The "plug-in" approach is universal today except for the fact that few, if any, amateurs give thought to the card's environment until after the completion of the project. Items such as plugs, guide rails, chassis, power and indicators are usually afterthoughts which cost more and require more fabrication time than the card itself.

In the September 1970 issue of 73, Roger Taylor K9ALD proposed to the amateur world the modular approach to construction with his article, "A New Approach to Communications Equipment." In this article, K9ALD suggests the 24-pin edge connector as the standard, predesignating pins and proposing card size and housings. Unless anything but the most ambitious project is attempted, most home construction projects would use far less space than that proposed by K9ALD. Fewer than 24-pin connections are also suggested. In developing my own standard, I selected the 15-pin one sided connector used by W. B. Kincaid WA4YND because it readily expands to 30-pins by using a double-sided board. This feature gives plenty of extra pins when necessary but keeps basic projects simple.

The method is most easily employed by creating to your own preference a template or worksheet which is preprinted and used in planning and preparing all projects. The method we used was to merely draw, as accurately as possible, on graph paper, the card outline and pins, edges and similar connecting points, such as a hole for a card puller. By duplicating several hundred of these sheets, circuits may be pasted up on the worksheet, or collected until the project is ready for fabrication. WA4YND's basic card was used because it seemed to be the correct basic size for most chassis and the edge connectors (Amphenol 15-pin type 143-015-04 or Cinch 250-15-30 170) are abundantly available from surplus at very low prices.

Fig. 1 shows the work sheet without circuitry. It will surprise you to find how many of these sheets will be used in planning, grouping and setting up projects. Circuits pulled from magazine articles are then literally pasted on the worksheet in layout form, interconnecting various points and pins using dark ink felt-tip pens. The finished product is a camera-ready-copy for production of the lithographic negative required for printed circuit production.

Complicated circuits, one of a kind circuits, or experimental circuits, may be constructed in a similar format with these additional methods:

a) An "experimental breadboarding card," consisting of a large number of soldering pads, socket pads and copper runs may be made on the basic card, or:

b) Perforated card stock with stick-on soldering pads and edge connectors will produce very fast results ready for mounting and wiring. At a later date, when the card is

perfected, a more permanent card can be produced and inserted into the works replacing the temporary card.

In order to prove that experimental circuits could be constructed in this manner, the WA4YND "Inexpensive IC CW Ider" was constructed using perforated board as suggested but in the card format. The number of specific soldering connections would have made a single sided PC Board very difficult to construct. However, by weaving barewires in and out of the holes on the perforated board and connecting each wire to its corresponding scan generator in the circuit, this new layout enables the identifyer to be reprogrammed.

A case should therefore be made to begin to think about the method, which should be called the Taylor Construction Method (TCM) for its originator, for radio amateur projects for the following reasons:

1. Materials and supplies come cheaper when ordered in larger quantities, use predictable amounts of reactant, and can be cut to size with a minimum of waste. (Two cards may be constructed from a single 7" x 10" piece of PC Stock.)

2. Most every circuit for which a layout has been included can be superimposed on the standard card.

3. Cards may be replaced, improved, bypassed, or traded (mailed) with ease and the "if only I had included" syndrome is all but eliminated in construction projects.

4. Test sets may be constructed serving a large number of projects and can be used again and again, resulting in improved diagnostic analysis, and more importantly, more thorough experimentation.

5. Extension cables, or extender cards may be used to bring an operating card down to the table for close scrutiny while still in the circuit.

6. Basic card "frames" may be constructed and serve as an excellent way to try out new cards, or improved circuits. Also, many amateurs duplicate projects entirely with some modifications and improvements, thus providing interchangeability of circuits. circuits.

Using the above self-imposed standard, the Multi-Function Control Card consisting of "proven circuits" performs a wide variety of functions of general station value to the amateur or for repeater control of systems audio, remote control operations and what I call last minute "fudging," which is always a part of interfacing two or more dissimilar pieces of equipment.

The Card contains the following: A VOX with adjustable delay; speech compressor; a

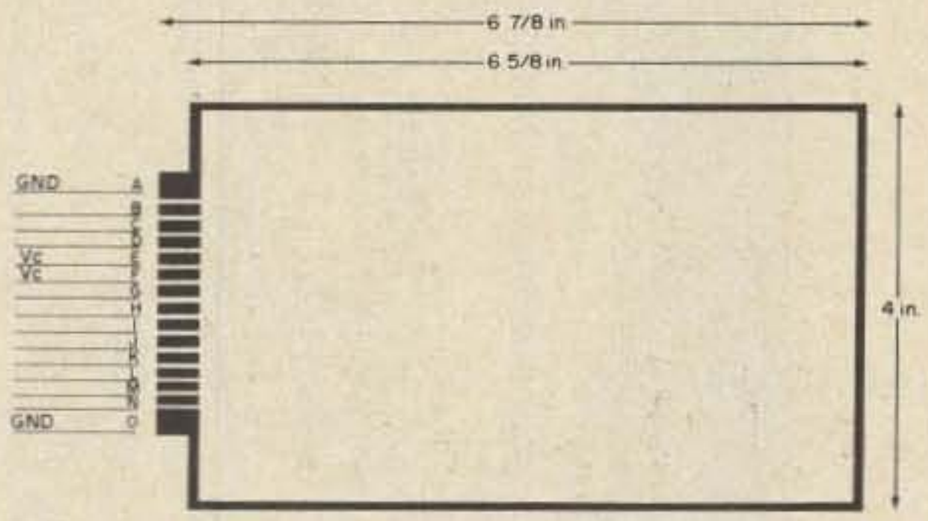

Fig. 1.

line amplifier for driving telephone lines at 600 Ohms (from small signals); an audio amplifier for driving an 8 Ohm speaker to 1W; a small signal audio impedance matcher (hi Z to 600 Ohms or low Z to hi Z); a COR is also possible; a squelch circuit; a medium gain preamp for yielding a flat response for microphone to line or encoder to line or discriminator to line without roll off.

All these functions seem a bit ambitious for a single card but the necessary circuitry is all inclusive (except for the relay) and the circuitboard will receive a wide variety of components and junk box parts. Finally, the card matches WA4YND's Repeater Controller size.

The Circuits

Line amplification has always been a function of sufficient audio and proper match from a telephone line (or remote pair) to a speaker free of hum, and loud enough to handle most listening conditions but using the least amount of power. The usual method of matching is to just add on transformers in order to drive the various necessary inputs. Phase distortion and dropping audio levels usually result. Pins B & C of the MFC-1 provide a 600 Ohm unloaded input for an unbalanced (one side grounded) audio preamplified drive to the LM370, AGC Squelch Amplifier. If an audio level for driving a transmitter is all that is desired, pin 1 of the LM 370 may be

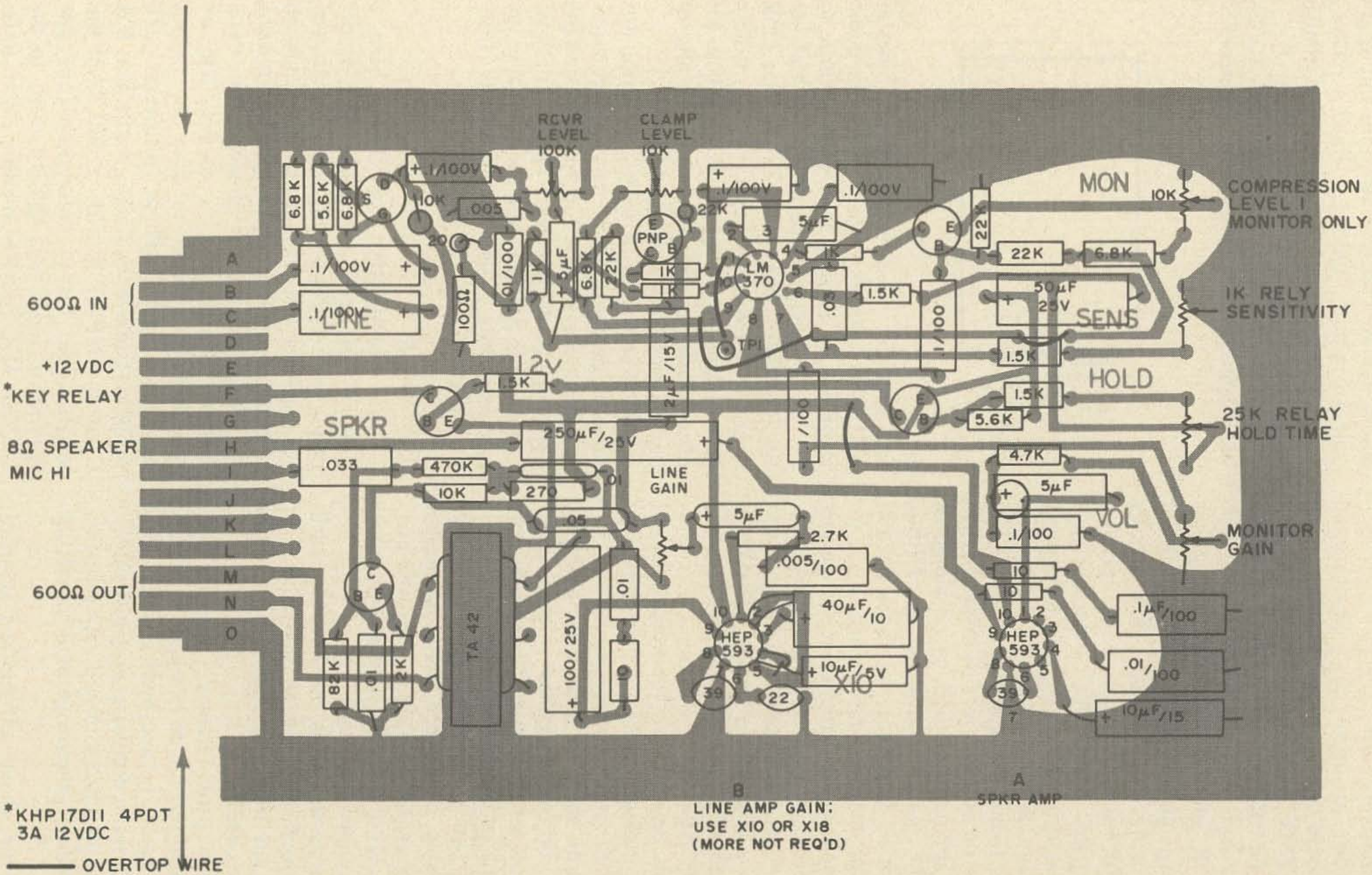
RCVR LEVEL 100K
CLAMP LEVEL 10K
MON
10K
COMPRESSION LEVEL I MONITOR ONLY
600Ω IN
LINE
IK RELY SENSITIVITY
SENS
+12 VDC
*KEY RELAY
12V
HOLD
SPKR
25K RELAY HOLD TIME
8Ω SPEAKER
MIC HI
LINE GAIN
VOL
MONITOR GAIN
600Ω OUT
LM 370
TP1
PNP
HEP 593
TA 42
X10
A
SPKR AMP
B
LINE AMP GAIN:
USE X10 OR X18
(MORE NOT REQ'D)
*KHP17D11 4PDT
3A 12VDC
OVERTOP WIRE

Fig. 2.

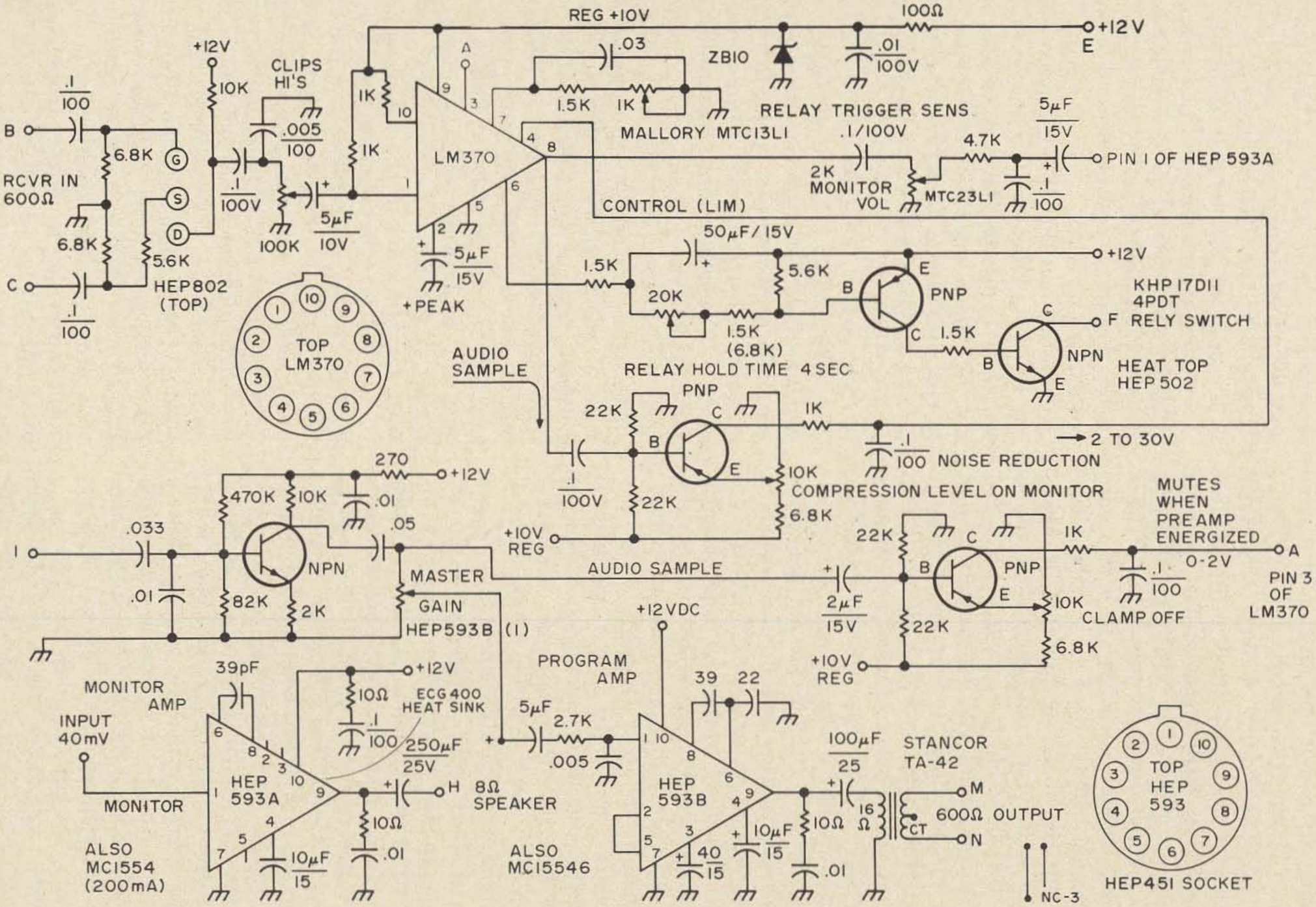
REG +10V
100Ω
+12V
E
.03
ZB10
.01
100V
1.5K
1K
MALLORY MTC13LI
RELAY TRIGGER SENS
.1/100V
5μF
15V
4.7K
PIN 1 OF HEP 593A
2K
MONITOR
VOL
MTC23LI
.1
100
CONTROL (LIM)
+12V
.1
100
10K
CLIPS
HI'S
.005
100
1K
1K
LM370
.1
100V
100K
5μF
10V
5μF
15V
+PEAK
RCVR IN
600Ω
6.8K
6.8K
5.6K
HEP802
(TOP)
B
C
G
S
D
TOP
LM370
50μF/15V
1.5K
20K
1.5K
(6.8K)
5.6K
PNP
1.5K
NPN
KHP17D11
4PDT
F RELY SWITCH
HEAT TOP
HEP 502
RELAY HOLD TIME 4 SEC
AUDIO
SAMPLE
PNP
22K
1K
.1
100
NOISE REDUCTION
2 TO 30V
.1
100V
22K
10K
COMPRESSION LEVEL ON MONITOR
6.8K
+10V
REG
MUTES
WHEN
PREAMP
ENERGIZED
0-2V
A
PIN 3
OF
LM370
.1
100
CLAMP OFF
22K
IK
10K
6.8K
+10V
REG
270
+12V
470K
10K
.01
.05
.033
.01
82K
2K
NPN
MASTER
GAIN
HEP593B (1)
I
AUDIO SAMPLE
2μF
15V
22K
PNP
+12VDC
PROGRAM
AMP
39
22
5μF
2.7K
.005
100μF
25
STANCOR
TA-42
M
600Ω OUTPUT
N
10μF
15
40
15
10Ω
16
Ω
CT
.01
ALSO
MC1554
(200mA)
ALSO
MC1546
NC-3
39pF
+12V
MONITOR
AMP
INPUT
40mV
10Ω
ECG400
HEAT SINK
.1
100
250μF
25V
HEP
593A
MONITOR
H
8Ω
SPEAKER
10Ω
10μF
15
.01
TOP
HEP
593
HEP451 SOCKET

Fig. 3.

brought directly out of the card at pin D on the edge connector for later reconnection. The bridge from pin 1 to the LM 370 may be retained as it is unloaded, or it may be broken if adding another input.

AGC/Squelch Amp in the VOX or COR mode. The smoothed output of the LM 370 is applied through a gain control (monitor volume) to pin 1 of the HEP 593 (MC1554) as an audio amplifier driving an 8 Ohm speaker directly from pin H of the edge connector without need for a transformer. The purpose of the AGC on the line amp is to insure that its output, which also could be brought out to pin D as above, from almost any telephone line used will provide uniform gain to the output and to the speaker. It may seem strange to drive a speaker from a compressor amp but this will be explained later when other parts of the card and their inter-relationships have been described. From pin 6 of the LM 370 are the adjustments of the delay time (hold down) and a driver transistor for an external VOX or COR relay. Pin F of the edge connector may be connected to any relay and positive supply provided that the voltage and current limitations of the transistor are not exceeded. Thus, when a signal appears at B & C, the relay driver will engage an external relay (a KHP 17D11 was used) and hold it down for a selected period of time (varied by the "delay" control) after the audio at a selected level (relay sensitivity) disappears.

Microphone Preamp/line drivers. A discriminator or medium impedance microphone may be connected to edge-connector pin 1, the output of which can be made to drive a second Hep 593 which, in turn, drives the remote 600 Ohm line at pins M & N. Voltage for transmitter control may likewise be inserted at the center tap of T-1 for simplex (phantom ground) line control. It was noted that the AGC amplifier drives a speaker instead of a line amplifier; the dynamic range of the LM 370 is so great that edge connector pins B & M and C & N can actually be tied together to serve as a relayless half-duplex two-way wire with dispatch audio control. This is made possible by taking advantage of an auxiliary mute input to the LM 370. The IC can be made to shut down partially or completely (within a range of approximately 2V dc) during microphone input. This feature presents many audio-control possibilities when using wireline remote control or rented lines. Further, any telephone hybrid can be placed at the repeater site, and the telephone line inserted at the dispatch point (rather than the control point) as a totally matched and controlled system. Several of these methods are not common in the amateur service but are used extensively in commercial service where cost is a greater factor.

A word about the HEP 593 audio amplifier IC's is in order because this device can do several interesting things. Gain selections can be "hard wired" into the board by placing capacitors at different pins and cutting the board where necessary; for a gain of 10x, leave pin 2&4 open and ac ground pin 5 through a 10μF capacitor; for a gain of 18x, leave pin 2&5 open and ac ground pin 4 with the 10 μF capacitor (Fig. 2); and finally for a gain of 36x, connect pin 2 to 5 and ac ground pin 4 through the 10 μF capacitor (Fig. 3). It should be noted that feedback at this high gain level could be a problem. I encountered some very high frequency instability at 36x which was corrected by using a "stiffer" power supply. At first the instability was not noted because of the very high frequency (in the order of 40k) but output was very low and power consumption was high for no visible reason. A check with an oscilloscope quickly found the nature of the output which was corrected with a modifcation to the supply voltage.

The Multi-function Control Card can be used as a total system, inter-connected, or as separate units for separate reasons. Several other cards of a similar layout have been constructed using this format and also work in a multi-function mode, including a 2805 pulse decoder, "tone-cosmetics for the station (a card which generates a busy-tone, dial tone, ringing tone, and beep tones so that all that "dead air" can be put to use) and several repeater controllers for auto-patch and mobile to mobile. If these cards prove interesting we will be sure to send them along to 73 for consideration in the months ahead.

...W3JJU

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Studio City CA 91604

Nicads - a Shocking Exposé

Nicad batteries are used almost universally in small hand-held and portable transceivers. They have a number of advantages over other rechargeable batteries in that they are relatively cheap, don't leak (much) and if respected a little, last a good long time.

First, let's compare them to ordinary flashlight batteries (carbon-zinc). Carbon-zinc types have two electrical problems: they have a relatively high internal resistance (making it difficult to extract high transmit currents without a significant voltage drop) and they gradually drop their voltage as they are used up. Also, they cannot be recharged, in spite of what some charging manufacturers say. Nicad type batteries have about the same capacity (amp-hrs) for a given size but do not suffer from the two above problems. The internal resistance is very low which means that you can extract several amps from an AA size cell, making them nearly ideal for transceiver applications. The voltage remains nearly constant (1.2 V fully charged; 1.0 V at discharge) over the life of the charge. This makes for proper, consistent and uniform transceiver operation during the duration of the charge. Note that the cell voltage for nicads is lower than carbon-zinc. (1.5 V when "fresh") so it usually requires 10 nicads or 8 carbon-zincs to make 12 V.

Manganese or "alkaline" cells are another common chemical type that have characteristics of carbon-zinc cells but are rechargeable. *All* alkaline cells are rechargeable (even if they are not so marked), but two problems exist. First, the impurities in the chemistry will degrade the battery capacity so it is only practical to recharge them 3 to 10 times and secondly the overcharge (continued charging after the battery is charged) will cause the chemistry to generate an internal gas pressure. If the charging current is relatively high (200 mA or more for AA size) this gas pressure could cause the thing to explode (actually it just cracks and oozes caustic soda all over your expensive electronics). The alkalines that are marked "rechargeable" have vents to prevent this mess.

Note that during the constructive charge period, the chemistry doesn't liberate gas, only during the "overcharge" condition. So if you're careful about how you go about it, even the unvented types can be recharged many times. It is best if the alkalines are only discharged to about half their capacity before recharging as the degradation is much less and the total life can be maximized.

Mercury batteries are about 75% the cost of the average nicad, have 1.4 V of good constant voltage and for a given size have about 7 times the amp/hour capacity of nicads. They are not rechargeable but for an extended period of use where there are no facilities for recharge, they are ideal.

So much for all those things and back to your already-bought nicads. Although they come from the factory mostly discharged we will first try to confuse you by discussing discharging (or using) the things. With their very low internal impedance, it is possible to extract huge amounts of current from nicads (but not for huge amounts of time). If you happen to short your battery pack for 20-30 seconds with, say a screwdriver, the current flow will heat the little terminal springs red hot and melt the plastic case, causing you to utter all sorts of noises, particularly if you

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Santa Barbara Amateur Radio Club
P.O. Box 3232
Santa Barbara CA 93105

were holding the case on your lap at the time. This tends to ruin the springs, which by this time have turned to very rugged solder, the plastic case, the batteries, and your lap.

The arch enemy of nicads is excessive temperature. Not the leaving-it-in-the-sun or hot trunk kind of excessive temperature but the over 300 degree type of internal temperature caused by the rapid discharge of a short circuit. The internal impedance is low but not zero. All that current can I^2R the poor battery into a rotten pumpkin. You can safely discharge AA size nicads at rates of 5 amps without damage. This means that those little things in your handheld can power your 25 W base station (albeit, not for long; how about 5 minutes?). Now, if you want to be more practical and use them in your 146 or TR22 you can talk for about an hour and a half OR YOU CAN LISTEN FOR ABOUT *TEN* HOURS, (does that give you any ideas?).

Now that we have discharged our batteries by all that talking, we have our first real peculiarity of nicads. Us ham types usually string up 10 or so nicads to come up with 12 V. If one of the cells discharges before the other 9, the voltage out of the string will only drop to 10.8 V (you'd keep right on talking) but the current (450 MHz for the 2 W radios) would be busy trying to charge this kaput cell in the wrong direction. If this condition continues for only a few minutes, no harm will be done. However, if this condition persists, the cell chemistry will change and that cell will not accept a normal charge and will look like a short circuit in both directions. This brings up some interesting suggestions. Always buy your nicads at the same time, don't mix cells of different ages or brands. Try to match their discharge time so some don't discharge before the others. Fully discharging nicads does not hurt them except when they are unequally charged as we discussed above. Always fully charge new cells before discharging so that an equal initial charge is assured. If a series of nicads are to be used together, charge them together to keep their state of charge equalized.

... WB6JPI

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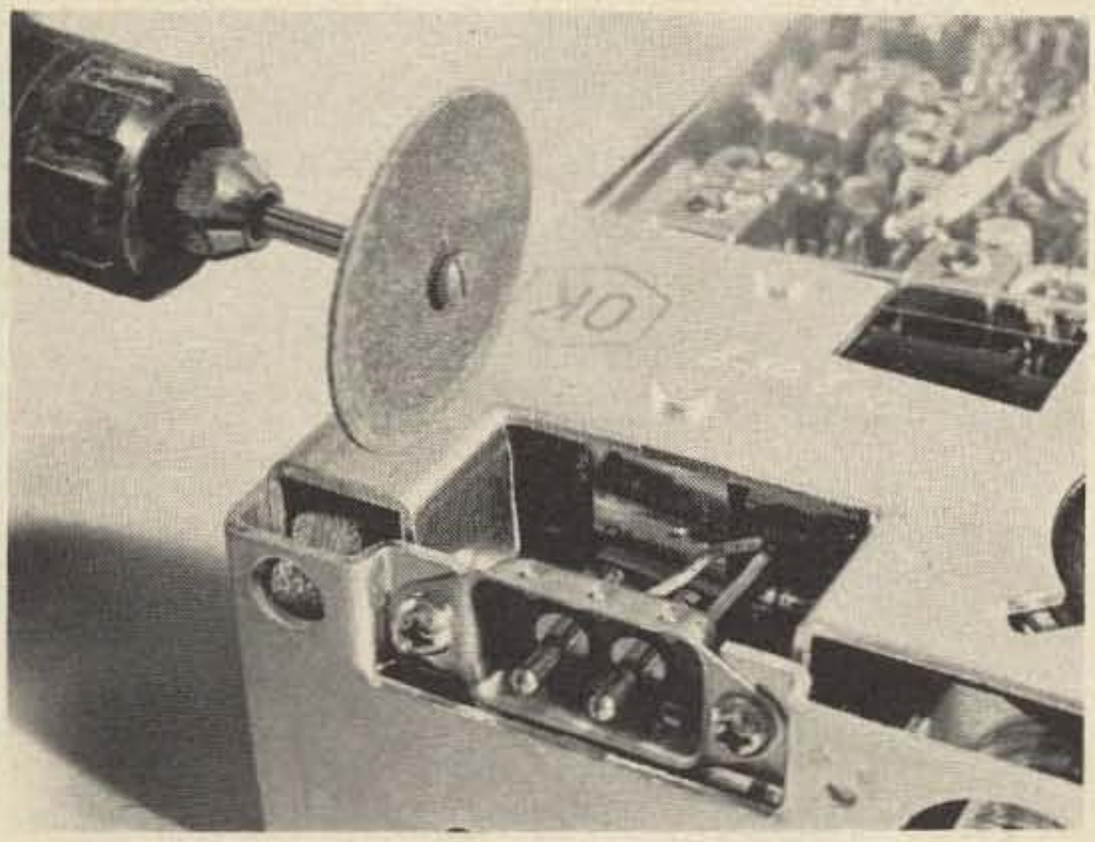
PREAMP FOR THE TR22C

The problem was space.

If you take a look into the guts of a TR22C Drake two meters transceiver you will arrive at the conclusion that every square centimeter has been used, and there is no room for any major modification.

I don't want to insinuate that the TR22C needs modification or change. It is a nice little rig, well engineered, compact and good looking. The TR22C is made in Japan, but under very rigid specifications set by the Drake designers.

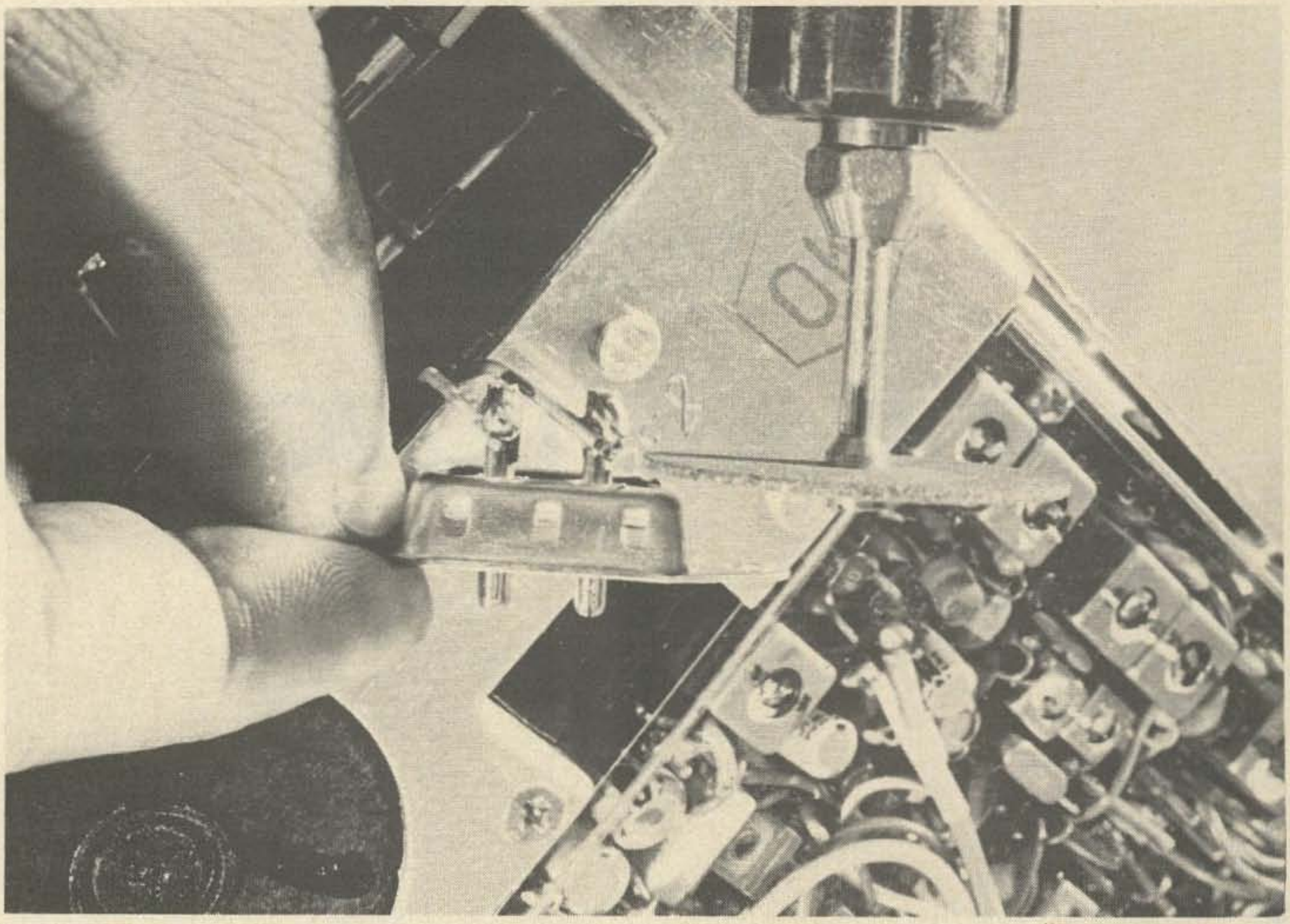


With an abrasive disc on the Roto-tool, cut off the aluminum flaps. Notice the battery spring holder where the ground edge of the board will be soldered.

However, I am the kind of cat who likes to change things around, even if they are already in the proper place. Every piece of electronic equipment I own has been modified in one way or another. The TR22C "ain't" going to be the exception, so I decided to install a preamplifier into this cute little rig. But where? I took the cover off and started looking for the space for my preamp. I decided to build a preamp I saw in the Handbook – only one FET, two inductors and two ceramic trimmer capacitors, a few capacitors and resistors, etc. I etched a board 3 by 5 centimeters and crammed all the components onto the epoxy glass board. After a lot of thinking and looking I decided that the only available space was under the battery compartment, behind the ac outlet.

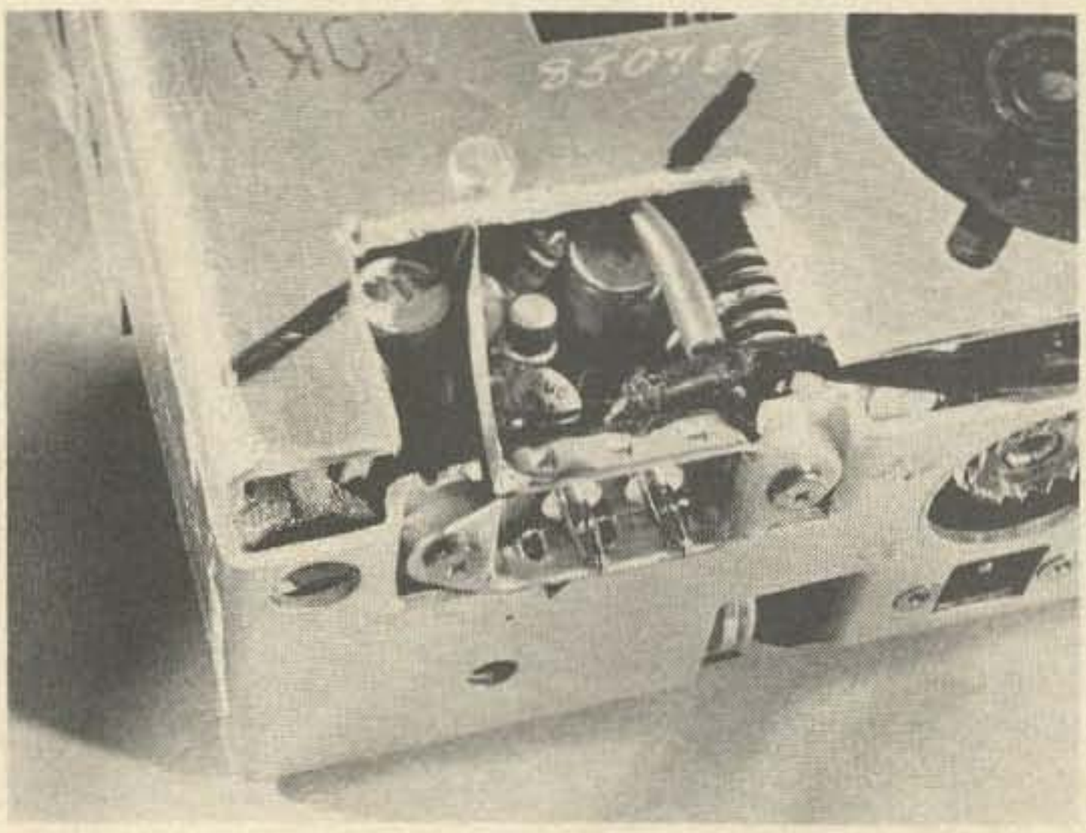
I had to cut out with my Roto-tool two metal flaps (see photograph), cut short the ac prongs, and insulate the connectors with rubber cement and a piece of thick plastic tape.

I'm the kind of cat who likes to change things around . . .



With the Roto-tool cut the back prongs of the ac connectors, and then resolder the wires and insulate with thick tape and rubber cement.

The ground edge of the board was soldered to the spring holding the battery, and a piece of window sealing foam (very handy around the shack) insulated the bottom of the board and the sides to avoid short circuits.



The preamp already installed behind the battery and the ac outlet. Note the shield to prevent interaction between input and output.

The hookup was made with some thin coax (RG174/u) between the receiver input and the antenna relay by breaking the input to Ls1 (called RA on the circuit diagram). This is on the input of the first rf amplifier Qs1 and is simple to change. The plus voltage (the preamp uses 12 volts dc) was tapped on the receiver board.

With this modification the reception of the TR22C was improved close to 20 dB and some intermodulation I was experiencing in certain areas of Miami was quieted to almost nothing.

Of course, these changes void the warranty on my rig, so I recommend waiting until the warranty is over, in order to avoid any trouble. Hi.

. . .WB4SNC

IT'S TIME TO SWITCH TO ALPHA

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J. K. Bach WB2PAP
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Walden NY 12586

Ma Bell vs. Foreign Attachments

Joe Blow is flying his light plane mostly on the fumes from the fuel that used to be in his tank, and the weather has closed in. He contacts the tower by radio, and the tower clears him to land immediately. It turns him over to ground control approach. A couple of turns to identify his radar blip, and GCA gets him headed for the runway. He is about 150 feet up, and in the proper glide-path, near the edge of the airport where all the water towers and high lines are. And now the controller's voice disappears!

Joe's abdominal muscles are already as tight as they can go. He can't see anything but his instruments; he is trying desperately to hold his air speed so that he doesn't dive into the high lines or stall out and spin in. After ten long agonizing seconds, however, Joe heard the controller's calm voice correcting his heading and glide path. He landed OK.

What happened? The leased line, or "pair" between the radar location and the remote airport transmitter had developed trouble. While the latter was only about two air line miles away, the actual route was over six miles in length. The pair must follow the right of way for obvious reasons. It may have to follow a circuitous route to pick up a repeater, say, or for other reasons. And it may be grouped with a variety of other pairs in a cable, or several different cables. The other circuits may be toll or local, government or private line, broadcast station loops, anything. It is impossible to segregate any given pair. The only thing to do is to treat each facility as if it were of the first importance.

Let me be clear at the outset: I am not privy to legal and political and financial considerations that pertain to leased wires and customer relations – these all lie well outside my interests and abilities. I wouldn't speak for Ma Bell even if I could. Moreover, no one man could speak for so many different companies except as their agent.

Nevertheless I know, sometimes better than I would like to know, the technical considerations that determine some of these policies. To draw a parallel, the patrolman on the beat could not discuss department policies with the authority of the police commissioner, but he has first-hand knowledge of the crime conditions that make them necessary. The technical picture is the one I intend to draw. The business office of your local telephone company (TELCO) can answer any question not answered here.

The man on the street, and sometimes even the well-informed ham thinks that there is only one telephone company and won't even listen to explanations to the contrary. He knows that his phone goes somewhere; mostly he doesn't care why or how, so long as it does.

Besides Ma Bell and her brood, there is the General Telephone axis, and myriad smaller companies scattered all over the country. Every last one of these is franchised, and this for public convenience and necessity. You don't know what inconvenience is until you live in a town with two telephone companies. You have to subscribe to both, or be out of touch with half the town, always the wrong half. Years ago states learned to franchise only one company for a given area, and to set up a Public Service Commission to control the companies and take the place of free competition, which is not practical in the case of a

public service.

Franchised companies must answer to their state Public Service Commission. And if they do interstate business (long distance) they must answer most particularly to the FCC just as radio stations and radio operators do. This covers technical matters and financial, also. If they gave you that extension jack for free, they'd have to explain why in detail and in triplicate to all the higher authorities. So you get no freebies.

Nearly all hams believe implicitly that the reason their Telco doesn't want them to phone-patch is because Telco might lose the revenue of a toll call. Now, while it is perfectly true that stock dividends are not paid in lost revenues, this is not the first consideration – it's the last. I've worked for AT&T over forty years; I've discussed this very point with local company men – installers, test-desk men, Telco engineers (several) also AT&T engineers, supervisors, craftsmen, chiefs, etc. The lot of them agree without any reservation or hesitation whatever that revenue is not the prime reason. Protection of service is. It is the only thing on earth they all do agree on.

Now suppose the ham – no, he doesn't even have to be a ham – suppose the subscriber has picked up a subset (telephone instrument) from any of several surplus outfits and wants to install an "unofficial" extension. Ever look into one of the modern subsets? Incredible! He manages to get one side of his line grounded – it's easy – which makes a heavy hum on the line. His line happens to be in the same cable as the pair from the airport, which also picks up the hum by induction. Theorists might point out that this does not necessarily happen. I agree, but non-interference requires a simple set of operating conditions. You can run stop signs all day without getting hurt so long as you are the only one in the intersection. Now there are many conditions that can make that line hum a serious matter, to other circuits as well as the airport line. Suppose Joe's circuit happens to be connected to a repeater and that repeater howls?

Anyhow, Joe couldn't hear the controller and was in deep trouble. The subscriber, finding that the new set didn't work for some reason, disconnected it. Now, suppose he had gone to the kitchen for a beer first, Joe would have spun in. There are any number of troubles that might have cut Joe off – the example given is a perfectly possible one.

The Telco calls anything hooked onto a telephone line that it doesn't furnish a "foreign attachment" and since in this story I am trying to show the Telco point of view, I also call phone patches "foreign attachments," since this is what they actually are.

For many years Telco has answered all phone patch requests with a firm NO until the Carterfone case came along. (FCC68-922 20284). The Carterfone is a device used to connect a mobile radio circuit with the Telco plant. The FCC thought this was a good idea, and ruled that Telco had to permit this, subject to plant protection and privacy considerations. This means that the subscriber was responsible for levels used and the introduction of any frequencies that might get into other services and cause trouble. Privacy of communications is, of course, an old story to any ham.

So Foreign Attachments became CPE, customer provided equipment, and Telco designed what they call "couplers" to serve as the interface as between Telco Facilities and the subscriber's equipment, to protect Telco's plant. (Couplers are not expected to do anything else.) If you want to connect directly to any telephone line, you must go through the Telco business office and get a coupler. They will install it for a nice round sum, but the monthly charge is nominal. It has an ordinary jack in it – the device provides dc isolation, peak limiting, and frequency limiting – and you plug in your equipment as you would plug a headset into your receiver. Your telephone is left in place for dialing, ringing and call-registration control.

The voice coupler is connected through your telephone, and the exclusion switch is made a part of the hook-switch assembly. One of the buttons in the handset-cradle is made to pull up and snap into position, which cuts out the subset and connects directly through to the voice coupler and whatever you have connected to it. When you are through using the special voice

equipment, just hang up the handset which automatically depresses the exclusion switch as well as the hook switch and your phone is ready for normal service – you can call or be called, and the voice coupler is now out of service, and will not interfere with normal telephone operation.

What if you want to use the voice coupler without the phone? You can't do this. You couldn't tell if you were being signalled, you couldn't dial out, and toll calls coundn't be automatically registered to you for billing. No go.

All right, suppose you got a surplus subset from any of several outlets and installed it yourself? No go.

A telephone network is unimaginably vast and complex. The FCC recognizes this and backs up Telco in the company's reservation of signalling rights. The reason – compatability. Your dial or touchtone or key-pulsing or whatever has to operate anything in the country – Bell System, General Tel, or Skunk Hollow Telephone & Grocery Co, Bait & Boats rented. It has to work this way. True, you can buy surplus sets guaranteed to work from any number of suppliers. But what does the guarantee mean? What does surplus mean? Means somebody didn't need it. Maybe it is brand new Kellogg, Stromberg, Ericson or whatever equipment. Maybe it was pulled out of "working equipment" for the very reason that they wanted to keep it working. I must admit that I have heard of Telcos who have tested such instruments owned by subscribers and given permission for attachment for its connection. But the FCC says no, the PSC says no, Telco says no, and I believe that the practical solution is to go around and not through.

So why not use acoustic coupling – just pretend that your ham station is just a person, with the loud speaker a mouth and the microphone an ear. How about that!

Before you get carried away, permit me to point out that the FCC, the PSC and Telco all have regulations about this, which they all feel most strongly about. The idea, which I personally favor, is not useful for evading regulations; it does put you on your own, however, and with a little intelligent planning, will provide the workable solution you're after.

The idea that regulations applied may be a shock, but it shouldn't have been. You know that there is no excuse for profane or indecent language on the land lines as well as on radio circuits and channels. The secrecy of communications idea applies also, and the FCC enforces both of these as you well know.

Later on in this article, you will find a quotation from FCC material, reproduced with their permission, giving level and frequency data pertaining to acoustic coupling, where no physical or electrical attachment exists. A little study will show that these data pertain only to protection of plant, and are binding on every subscriber.

A normal user does not have to worry about levels and frequencies – he can only yell so loud, and he's no lyric soprano either. But hook a radio circuit even acoustically to Telco and problems arise.

The first of these is level. A bunch of plain old cable pairs must all have about the same level, or else the high one will crosstalk (QRM) with all the others. This is just a problem of electrostatic and e-m fields, nothing more. If non-linear devices are present, then you get over-modulation, and the production of new frequencies that may go anywhere and do anything – interfere, put pigeons on your TV screen, or shut off the power upstate by false operation of a telemetry circuit.

The second is frequency. The higher frequencies, especially, get into carrier channels they shouldn't and various kinds of hell break loose.

On the FCC list, #6 is interesting also. Here, the FCC is talking about Telco signalling. This is very often a kind of voice-frequency telegraph system, with a signal tone being amplified, detected and used to operate a relay which operates the local signalling circuits. So you receive a heterodyne of about 2700 Hz, at not very high a level, hardly annoying to your talkers and – blip! – the receiver operates the relay which dumps the circuit as it is programmed to do when the call is over.

This point is always overlooked since it never happens on local calls, and few know Telco plants that well. But it will pay you to include some kind of notch filter, or what-

ever, to get rid of that 2700 Hz tone. It needn't degrade speech quality much. And a filter to pass communications frequencies may turn out to be quite cheap – sometimes you can buy them in surplus for less than a dollar, or you could build your own.

So far as notifying the FCC or Telco about your acoustic coupler, I'm convinced that they couldn't possibly care less, so long as you hold up your end. But since your log has "the force of a sworn statement" to the FCC, it would be an excellent idea to describe your phone-patch somewhere therein, together with diagram and working levels. It might save you a deal of cheap conversation, some day.

Overseas telephone has its own variety of phone patch. They have hybrids and privacy equipment and TOLAs and LREs and VOGADs (Volume Operated Gain Adjusting Device, a very sophisticated level control) VODAS (AT&T VOX) and all manner of other junk – a whole bagful per circuit. They do not attempt to operate both directions at once, though this is theoretically possible.

Perhaps I should mention that TOLA is a tone operated loss adjuster, LRE is a limited range expander (a super squelch) and the VODAS is a voice operated device anti-sing, the switching device. Mostly it works just with normal conversation and the parties don't realize it is there. But if they both attempt to talk at once, or one gets to crying, or one end has a noisy line, the device locks up and nobody talks. The technical operator then takes over and switches by hand and gets the subs started talking again. Voice control has its limitations.

Now, the actual phone patch. I'd start with an auxiliary cradle for the handset, so it wouldn't roll off. It would stay in the phone patch cradle under its own weight. Under the phone transmitter would be a small loudspeaker to drive the handset mike, and under the receiver, your microphone. This latter would need some thought – some people can really blast a phone receiver, so maybe an acoustic diaphragm that could slide between, or maybe a lever that would drop the mike away from the receiver? You can't put a volume control on a telephone, and mikes do blast. You don't need much between mike and transmitter except the usual amplifiers. The transmitter should turn on the instant the antenna is connected and the receiver disabled.

This should be under the operator's control, using a single button or switch for change-over. The receiving side is more critical – it needs an audio band-pass filter to cut out the higher frequencies, and perhaps a notch-filter set at 2700 Hz would be a good idea. Doesn't have to be awfully deep – every little bit helps. But if toll connections get dumped on you, better look into this notch business and make it a little deeper. Then you need a good – and I mean good – limiting amplifier to keep the level within bounds, unless you're greased lightning on a volume control. A couple of pilot lights to indicate the position of the switch would help. And you need some means for listening to both sides of the conversation so that you can switch intelligently.

That much is enough to keep a sharp ham busy for quite a while. First he has to set up a good radio circuit because without it, the best patch is no good.

Recording? Sure – good idea, but by FCC Regulations you need a beeper to let both ends know they're being recorded. Build one? One of the magazines had full directions not long ago. Because the FCC says this must be furnished by Telco, the man told me that this regulation was being interpreted rather loosely! So now you know.

Obviously, there are problems, several of them, but nothing that would prevent or even slow down a good ham from whipping up something suitable, once he knows what's what.

Appendix D, FCC 68-1234, 24346

Technical criteria for all terminals and systems connected by acoustic or inductive means (Effective January 1, 1970).

(I) The power of the signal at the output of the network control signalling unit (#1) shall not exceed 9 dB below one milliwatt (#2) when averaged over any three second interval, and such signal at such output point shall be controlled so that:

(1) The power in the band from 3,995 Hz

to 4,005 Hz shall be at least 18 dB below the power of the signal as specified in (I) above.

(2) The power in the band from 4,000 Hz to 10,000 Hz shall not exceed 16 dB below one milliwatt.

(3) The power in the band from 10,000 Hz to 25,000 Hz shall not exceed 24 dB below one milliwatt.

(4) The power in the band from 25,000 Hz to 40,000 Hz shall not exceed 36 dB below one milliwatt.

(5) The power in the band above 40,000 Hz shall not exceed 50 dB below one milliwatt.

(6) The signal shall at no time have energy solely in the 2450 to 2750 Hz band (#3) and any signal power in such band shall not exceed the power present at the same time in the 800 to 2450 Hz band.

Author's personal interpretation: (#1) The telephone subset. (#2) Could be much lower. Average level in Central Office is negative 23 dBm or 1/200 of a milliwatt! (#3) Obviously protecting the 2600 Hz Telco uses for signalling.

. . . WB2PAP

73's Guide to 2m Hand Transceivers

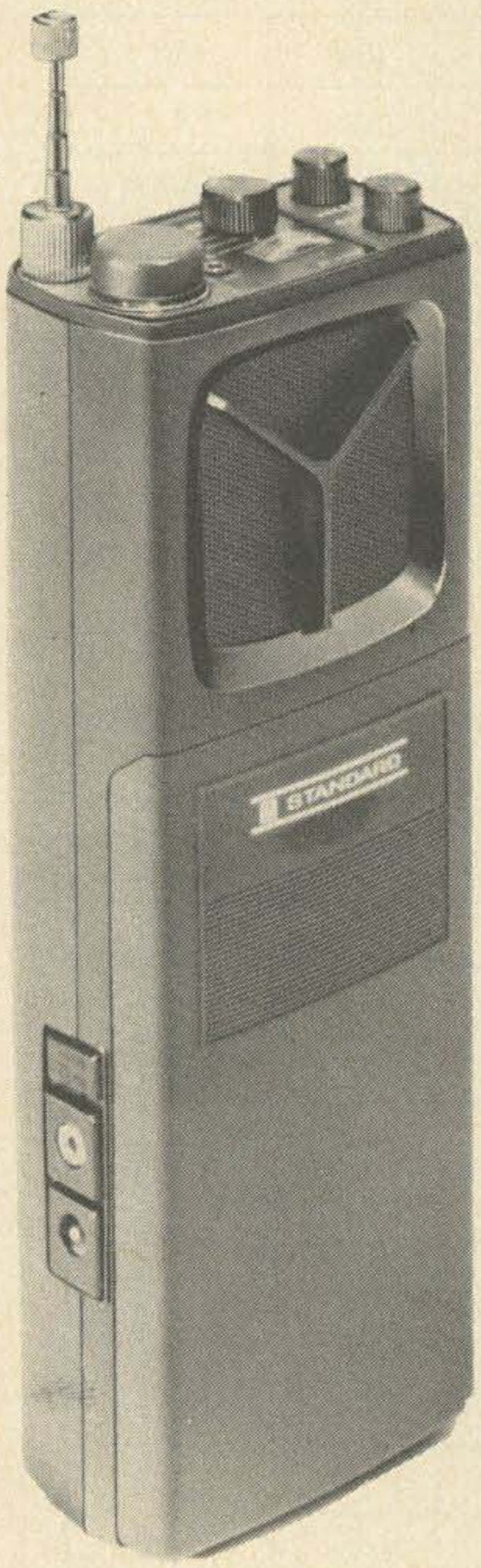
	Clegg	Regency	Standard	Tempo	VHF Eng.	Wilson
Model	HT 146	HRT 2	SR-C 146A	FMH	HT 144	1402SM
Price – less batteries	$217.00	$179.00	$298.00	$199.00	kit $154.95	$239.95
Channels	5	5	5	6	4	6
Size – height (inches)	8.5	9.8	9.0	8.5	9.3	9.0
width (inches)	3.2	3.3	3.0	2.9	2.5	2.9
depth (inches)	2.3	1.9	1.6	2.0	1.5	2.0
Weight with batteries (oz.)	26	40	32	27	25	30
without batteries (oz.)	18	32	24	17	15	20
Power – Transmit current	.250	.600	.620	.500	.500	.410
Receive w/squelch	.005	.030	.015	.020	.015	.015
Receive – Peak	.130	.100	.100	.150	.100	.150
Transmitter – power – watts	2.0	2.0/1.0	2.0	2.0	2.0	2.5
Battery used	Nicad or Merc. pack	MA-50	10-AA	10-AA	10-AA	10-AA
Price of battery supplied	6682 $24.95	14.4V 50 mah $70.	$43.00 SC-UBP-1	None Supplied	BP-12 Nicad pack $29.95	Nicad $14.00
Receiver Sensitivity uV dB	12 dB .35	.70	.40	.50	.35	.30
First IF	10.7	10.7	11.7	10.7	10.7	10.7
Second IF	455	455	455	455	455	455
net cap Rx Crystals divide by	3	3	9	9	3	9
Rx Crystals Formula	WA	35Ω Ser. (-600 Hz)	NA	Anti-R 78 pF	Par 20 pF	81 pF
Xmt Crystals Divide by	8	12	18	12	8	12
Xmt Crystals Formula pF series or parallel	Par 20 pF	30Ω 32 pF	Par 24 pF	Anti-R 78 pF	Par 20 pF	NA
Mike & Speaker Separate	No	No	No	No	No	Yes
Antenna Connector type	BNC	NA	Motorola	F-type	BNC	TV
S-Meter & Battery Indicator	No	No	Yes	Yes	No	Yes
Remote mike & speaker	No	Yes	Yes	No	No	Yes
Rubber Duckie Ant. (price)	$5.95	$13.00	$6.00	$9.95	$12.95	incl.
Remote Antenna Jack	Yes	Yes	Yes	No	Yes	No
Earphone Jack	Yes	Yes	Yes	Yes	Yes	No
Power Jack	Yes	Yes	Yes	No	Yes	Yes
Crystals included No. of chans.	1	1	2	1	1	3
Speaker-Mike cost	$9.95	$9.95	$36.50	N/A	None	$24.00
Charger – cost	$54.95	$29.95	$28.00	$29.00	$4.95	$29.95
Case – cost	$11.95	$16.00	$8.50	$10.00	$8.00	inclu. $12.00

SR-C146A 2 WATT HAND-HELD

SR-C146A, 2 WATT HAND-HELD — now in its 4th year of popularity, still continues to be one of the smallest Hand-Held Transceivers on the market today, giving over 2 watts of output power with 5 channels available coming with 2 channels. Additionally, the Waller Touchtone can easily be added to the front of this unit to give you touchtone flexibility, as well as internal sub-audible tone that plugs directly into the inside of the unit for PL access repeaters. A full complement of accessories, ranging from a rubber duckie antenna to a base station charger adapter, is available. A review of the accessories on the Specification Sheet will show you that *this* Transceiver leaves the other ones behind with the amount of accessories that can be added.

DESCRIPTION

THE STANDARD COMMUNICATIONS CORP. Model 146A VHF/FM Amateur Handheld Transceiver provides up to five channel operation within a 2 MHz portion of the 143 to 149 MHz frequency range. However, should operation be desired on frequencies outside of this bandwidth (i.e., for "MARS" operation) it may be possible without retuning, although a drop in sensitivity and/or output may occur. The Model 146A is completely solid-state and is designed to operate from a 12-volt DC power source (nominally an internal rechargeable 12-volt Ni-Cad battery) with an rf power output of two watts. Provision is included to install the optional TN3 Private Channel for activation of continuous tone coded squelched systems (CTCSS).



SPECIFICATIONS

All performance specifications are nominal unless otherwise specified.

General

Frequency range:	143 to 149 MHz
Number of channels:	5
Channel spread:	2 MHz max.
Input voltage (negative ground):	12.5V dc ±20%
Circuitry:	All solid state
Current drain:	15ma squelched max., 100ma receive max. 0.62A transmit max.
Microphone:	Internal dynamic type
Dimensions:	9"h x 3"w x 1-5/8"d
Weight:	32 oz. max. (including batteries)
Supplied with 2 channels:	146.94Tx/Rx (national calling channel) 146.34Tx/146.94 Rx (repeater channel)
Speaker:	Internal 2" dynamic

Transmitter

Power output (into 50 ohms):	2 watts
Spurious and harmonics attenuation:	50 dB min.
Hum and noise level attenuation:	40 dB Min.
Audio response:	Meets EIA specifications
Audio distortion:	6% Max.
Frequency stability:	0.001% (-10° to + 50°C)
Modulation:	16F3 ±5 kHz

Receiver

Sensitivity (20 dB quieting):	0.4uV
Squelch sensitivity (threshold):	0.2uV
Squelch type:	Carrier
Modulation acceptance bandwidth:	±8 kHz Min.
Selectivity (20 dB quieting 30 kHz ch):	60 dB Min.
Spurious and image attenuation:	55 dB Min.
Audio power output:	0.3 Watts at 10% max. dist.
Audio response:	Meets EIA specifications
Frequency stability:	0.001% (-10° to +50°C)
Intermodulation spurious attenuation:	40 dB Min.

Optional TN-3 Private Channel

Tone Deviation	700 Hz Min (using 77 Hz reed)
Tone sensitivity:	-3 dB Max. (using 77 Hz reed, 300 Hz deviation)

Standard Communications Corp.

213 / 775-6284 · 639 North Marine Avenue, Wilmington, California 90744

The TEMPO/fmh

GENERAL DESCRIPTION

The Tempo/fmh is a hand held VHF/FM transceiver for operation between 144 and 148 MHz (any two MHz spread without retuning) with an output power of 2 watts. The transceiver is designed specially for hand held operation. It is compact, ruggedly constructed, and uses completely solid state circuitry. The transceiver can be used with 8 AA non-rechargeable batteries or with 10 rechargeable AA nickel cadmium batteries.

The Tempo/fmh has capabilities for 6 channels and is provided with two channels of operation, and the collapsible antenna can be carried in the antenna case which comes with every transceiver. The transceiver uses a built-in speaker and a separate built-in microphone for top audio quality. Each FMH has provisions for use with an external accessory battery charger.

The front panel meter indicates relative signal strength in receive and the battery level during transmit. The unit also contains a squelch circuit as well as trimmers on all receive and transmit crystals for netting.

- 6 Channel Capability
- 2 Watts Output
- All Solid State, 12 VDC
- 146 to 148 MHz
- Supplied with two pair of crystals.
- Built-in charging terminals for ni-cad cells.
- S-Meter and Battery Level Meter
- Telescoping Whip Antenna
- Built-in Speaker and Built-in Microphone
- 8.5" long x 2.9" wide x 2.0" deep
- 1.7 pounds with batteries (batteries extra).
- 3.0 pounds shipping weight.
- Price: $199.00

So much for so little! This small 2 watt VHF/FM hand held transceiver offers high quality performance and features usually found on more expensive units. Features such as 6 channels for operation, completely hand held design, and 2 watts of output are standard.

Each transceiver includes a collapsible antenna, an antenna connector, and two dummy batteries for operation off of 8 AA carbon batteries. Tempo also offers a full line of accessories to meet every need.

The FMH delivers reliable, low cost operation on the two meter amateur band. The 2 watt output is more than adequate for most uses and is also perfect for driving the Tempo solid state amplifiers for output power up to 130 watts.

Tempo products and accessories are available from dealers all over the United States and in other countries. Please write or call Henry Radio for information on all their products or for the name of their nearest dealer.

GENERAL SPECIFICATIONS

Frequency Range: 144-148 MHz (any 2 MHz without retuning)
Channel Spacing: 25 kHz.
Number of Channels: 6 Channel Capability.
Power Requirements: 12 VDC nominal.

Receive Stand-by	**.02 amp**
Receive (Full Audio)	**.15 amp**
Transmit	**.50 amp**

Polarity of Supply Voltage: Negative Ground.
Channels Supplied: Two pair of transmit and receive crystals — 146.94 simplex and 146.34/146.94.
Dimensions: 8.5" long x 2.9" wide x 2.0" deep.
Weight: 1.7 lbs with batteries (3.0 shipping)
Frequency Stability: ±0.003%.

TRANSMITTER SPECIFICATIONS

RF Power Output: 2 watts.
Audio Sensitivity: 0.15 volts ±3 db for 70% deviation at 1000 Hz.
Output Impedance: 50 ohms unbalanced.
Deviation: Internally adjustable ±15%.
Spurious and Harmonic Radiation: 60 dB nominal below the carrier power level.
FM Noise: —40 dB below 70% deviation at 1000 Hz.
Type of Modulation: Phase.
Transmitter Crystal Frequency: $f_o/12$.
f_o = Operating Frequency (in MHz)

RECEIVER SPECIFICATIONS

Type of Receiver: Dual conversion superheterodyne.
Sensitivity: 0.5 uv nominal for 20 dB quieting.
Squelch Threshold: .2 uv nominal.
Audio Output: 1.0 watt to 8 ohm load at less than 10% distortion.
Audio Response (at 1000 Hz): ±6 dB at 300 Hz;—8 dB at 3000 Hz.
Input Impedance: 50 ohms unbalanced.
Selectivity (for 20 dB quieting): —6 dB at ±6 kHz;—70 dB at ±15 kHz.
Spurious Rejection: More than 60 dB.
Receiver Crystal Frequency: $(f_o-10.7)/9$
f_o = Operating Frequency (in MHz).

Henry Radio

11240 W. Olympic Blvd.
Los Angeles, Calif. 90064
213/477-6701

HRT-2

NEW 5 CHANNEL 2 METER NARROW BAND FM HAND-HELD TRANSCEIVER

Size: 3 5/16 x 1 15/16 x 9 3/4

With a power output of 2 watts (min.), this little hand-held transceiver is the portable and convenient answer to two-way radio needs. A double-conversion, super-heterodyne receiver design employs two ceramic filters for optimum performance in areas where numerous channels are closely grouped together. The transmitter and receiver sections both employ band-pass circuitry so that effective transmitter power and receiver sensitivity are maintained across the entire band (144-148 MHz). Three integrated circuits provide for compactness and circuit reliability. Complete operation from 3 simple controls: on/off/volume, squelch, and channel selector. High-Low power switch. Removable telescoping, internal antenna can be easily replaced with a short, flexible type antenna. Extra provisions have been made for external mike, external power supply, external earphone, and external antenna. Case is made of high-impact ABS plastic. American Made quality with Regency reliability.

BASIC PACKAGE

$179.00

Amateur Net

includes factory installed transmit and receive crystals for 146.94 MHz.
Shipping weight: 1 ¾ lbs.

INTERMEDIATE PKG.

$229.00

Amateur Net

includes MA-50 Nicad battery and factory installed transmit and receive crystals for 146.94 MHz.
Shipping weight: 2 ½ lbs.

DELUXE PACKAGE

$295.00

Amateur Net

includes MA-50 Nicad battery, BC-101 Battery Charger, MA-30 Flexible Antenna with adapter, MA-58 External Mike, MA-54 Leather Carry-Case, MA-52 Earphone, MA-29 DC Power Cord with cigarette plug, and factory installed transmit and receive crystals for 146.94 MHz.
Shipping weight: 4 ¼ lbs.

SPECIFICATIONS

RECEIVER

Antenna (external) impedance	50 Ohms
Frequency Range	144-148 MHz
Channels	5; Crystal Controlled
Crystal Installed	146.94 MHz
Sensitivity	0.7μv, 20 DB Quieting
Selectivity	±7 KHz, 6 DB down ±20 KHz, 50 DB down
Spurious Rejections (excluding primary image)	60 DB
IF Frequencies	10.7 MHz; 455 KHz
IF Filters	2; ceramic
Squelch System	"Noise" Operated
Modulation Acceptance	±7 KHz
Audio Output (32Ω Speaker)	0.5 Watts, Maximum
FCC Certified	Part 15, Subpart C.

TRANSMITTER

Antenna (external) Impedance	50 Ohms
Frequency Range	144-148 MHz
Channels	5; Crystal Controlled with Individual Netting Capacitors
Crystal Installed	146.94 MHz
Crystal Multiplication	12
Power Output—Hi Position	2 Watts (min) @ 14.4V DC
Lo Position	1 Watt (max) @ 14.4V DC
Modulation	Frequency Modulation with Automatic Deviation Limiting
Deviation	0-7 KHz; Factory Adjusted to 5 KHz (approx.)
Microphone (internal)	32Ω Speaker
Microphone (external)	300Ω, dynamic type

POWER

Voltage Requirements	11-16V DC
Current Requirements	@ 14.4V DC
Receive—Squelched	30 MA. (typ.)
Receive—Max. Audio Output	100 MA. (typ.)
Transmit—HI Power	600 MA. (max.)
Transmit—LO Power	350 MA. (max.)

SEMICONDUCTORS

Integrated Circuits	3
Silicon Transistors (Total)	22
Field Effect Transistor	1
Balanced Emitter Transistor (RF Power)	1
Diodes (Total)	6
Zener Diodes	2
Varactor Diode	1
Signal Diodes	3

Regency ELECTRONICS, INC.
the first name in solid state

7707 Records Street, Indianapolis, Indiana 46226

the HT-146 hand-held transceiver

SPECIFICATIONS

GENERAL

Frequency Range	*144-148 MHz*
Number of Channels	*5*
Dimensions	*1-9/16 x 3-1/16 x 8-5/16*
Weight	*18 oz. (w/o battery)*
Antenna Impedance	*50 ohms (nominal)*

TRANSMITTER

Power Output	*1.5 watts (min)*
Frequency Stability	*±.005% from -20° C to +50° C*
Modulation	*16F3, ±5KHz deviation*
Audio Response	*6db per octave preemphasis from 300 to 3000 Hz*
Max. Channel Separation	*2 MHz*
Spurious Output Levels	*44db (min) below carrier*

RECEIVER – Certified under Part 15

Sensitivity	*.4 uv (max) for 12db SINAD*
	.25 uv (max) for Squelch Threshold
Selectivity	*13 KHz at 6db*
	45db adjacent channel rejection
Modulation Acceptance	*7 KHz deviation*
Frequency Stability	*±.001% from -20° to +50° C*
Image Rejection	*40db (min)*
Audio Response	*6db per octave deemphasis from 300 to 3000 Hz*
Audio Output	*500mw at 10% THD*

CRYSTAL REQUIREMENTS

Crystal holders: HC-25/U

Receiver Crystal –

a) Frequency: $\frac{\text{Desired Signal (in KHz) - 10,700}}{3}$ **KHz**

b) Series Resonant, 3rd overtone

c) .001% Calibration Tolerance

d) .001% Temperature Characteristics, -20° to +50° C

Transmit Crystal –

a) Frequency: Desired Output Freq. ÷8

b) Fundamental Mode Parallel resonant with 20 pt load

c) .001% Calibration Tolerance

d) .001% Temperature Characteristic, -20° to +50° C

GENERAL DESCRIPTION

The HT-146 is a self-contained, solid-state, VHF, hand-held transceiver designed to provide high quality two way FM communication in the Amateur 2 Meter band. The HT-146 features recent technical innovations such as single conversion receiver design employing 10.7 MHz monolithic crystal filters and multifunction integrated circuits. The unit includes provisions for five crystal-controlled channels and is designed to operate with several available battery packs. A unique feature of the HT-146 is the battery saver technique employed to provide substantial increase in battery life.

The antenna connection is accomplished with a standard BNC receptacle permitting instant and versatile adaptation to any antenna or booster amplifier arrangement. A flexible "rubber duckie" monopole antenna with BNC plug, ISC Part No. 801-178, is recommended for use with the HT-146.

Further versatility is provided by accessory jacks and interconnect provisions for external microphone, earphones, speakers and battery charging.

Clegg DIVISION
3050 Hempland Road, Lancaster PA 17601

HT-144B HAND TRANSCEIVER

THE HT-144 "HAND TRANSCEIVER" is a complete 2 meter; 4 channel; crystal controlled; battery operated; transceiver. The main circuit board and the four channel crystal deck are both G-10 epoxy. Extremely low standby current is achieved by operating several stages in D.C. series.

*Anodized aluminum case 1½ x 2½ x 9¼
*All tunable coils are prewound
*Transceiver is on one G-10 predrilled board
*Parts layout silk-screened on boards for easy construction
*Crystal deck is separate predrilled board
*Weight less batteries — approximately 15 oz.
*Battery case is AA size — accepts alkaline or nicad
*External battery charging/power supply jack furnished
*1 dual gate mosfet 2 ICs 15 transistors 7 diodes
*Antenna — collapsible 17" ship
*Can be tuned to any 2 MHz segment between 140 and 170 MHz
*Plenty of room in case of add ons (PL and tone)

HT-144 TRANSMITTER SPECIFICATIONS: Output 2 watts minimum. 3 dB bandwidth 2 MHz typical. Stability .002 typical (depends on crystal). Spurious outputs down 30 dB or better. Modulation true FM with varactor in crystal circuit. Netting separate trimmers for each channel. Deviation adjustable to 5 kHz. Audio limiter and active low pass filter. Microphone speaker type. Crystal 18 MHz parallel at 20 pF. Multiplication factor frequency times 8. Current drain 500 mA typical.

HT-144 RECEIVER SPECIFICATIONS: Sensitivity better than .35 uV for 20 dB quieting. Squelch threshold better than .25 uV. Stability .002 typical (depends on crystal). Adjacent channel rejection 60 dB. Spurious responses down 70 dB. First i-f 10.7 MHz second i-f 455 kHz. Filter 4 pole monolithic 10.7 MHz crystal. Discriminator pretuned ceramic 455 kHz. Bandwidth 15 kHz at 3 dB points. Crystal 45 MHz parallel at 20 pF. Crystal formula receive frequency minus 10.7 divided by 3. Audio output .5w typical. Current drain 15 mA squelched, 100 mA on voice peaks.

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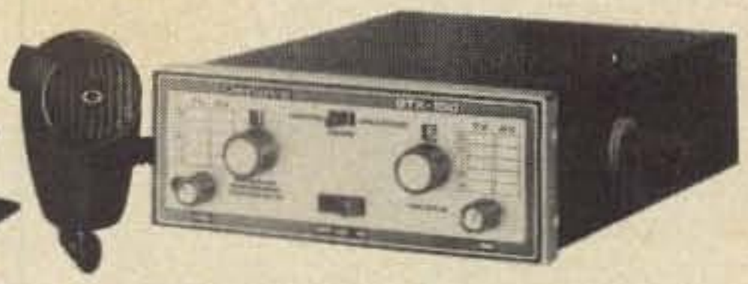

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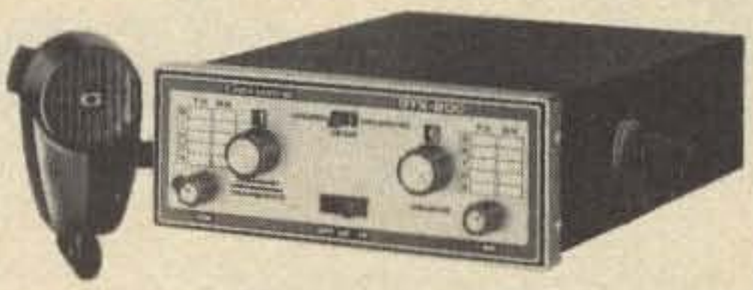

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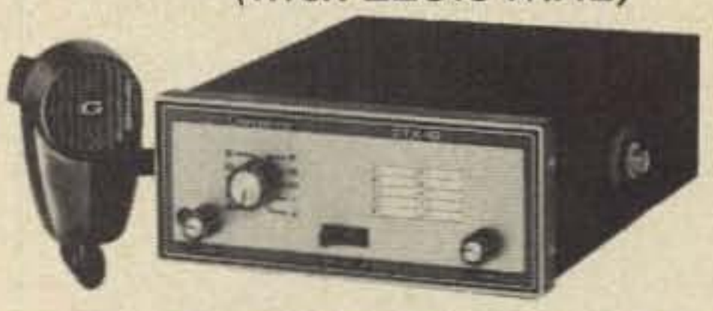

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Wilson's handie talkie has six channels and an output power of 2.5 watts making it more than adequate to handle any two way radio needs you might have. Features such as its built in battery and S meter are standard. A remote mike and rugged case are also available from Wilson for a relatively low cost. Write to Wilson Electronics for a complete price list. Here are some of the prices they sent us:

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Weight – 1 lb. 4 oz. (less batteries)
Output Power – 2.5 watt nominal 12 vdc
Receiver Bandwidth – ±6 kHz at 6 dB
Receiver Sensitivity – 0.3 uV 20 dB quieting
Type of Batteries – AA cells
Transmitter Crystal Formula – Freq. ÷ 12
Receiver Crystal Formula – Freq. -10.7/9
Type of Microphone – Magnetic
I-f Frequencies – 10.7 MHz & 455 kc
I-f Filter Used – 455 kc Ceramic Filter
Voltage & Current – Receive 14 mA on Standby, Transmit 400 mA

Charger	**$ 29.95**
Case	**12.00**
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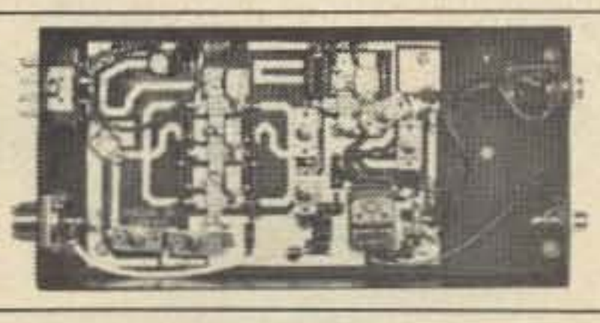

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Whether you are a newcomer to 2 meters, an old-timer rediscovering the band, or a regular repeater user, you must admit that its wide open spaces are great fun. With virtually no QRM and small-size antennas, the band is a joy to operate.

Many hams, however, have made the mistake of sinking all their money into equipment and then, with little or no money left, find that they are seriously limiting their operating range by using dipoles or whips because they can't afford to buy a beam. The solution to this problem is simple. Build one. Construction of a beam for 2 meters is easy and cheap. Take a look at the antenna described below. It can be built for just a couple of bucks. You might even find that you have all the "makings" lying around the house.

Now that you know that a 2 meter beam is cheap and easy to build, you're probably

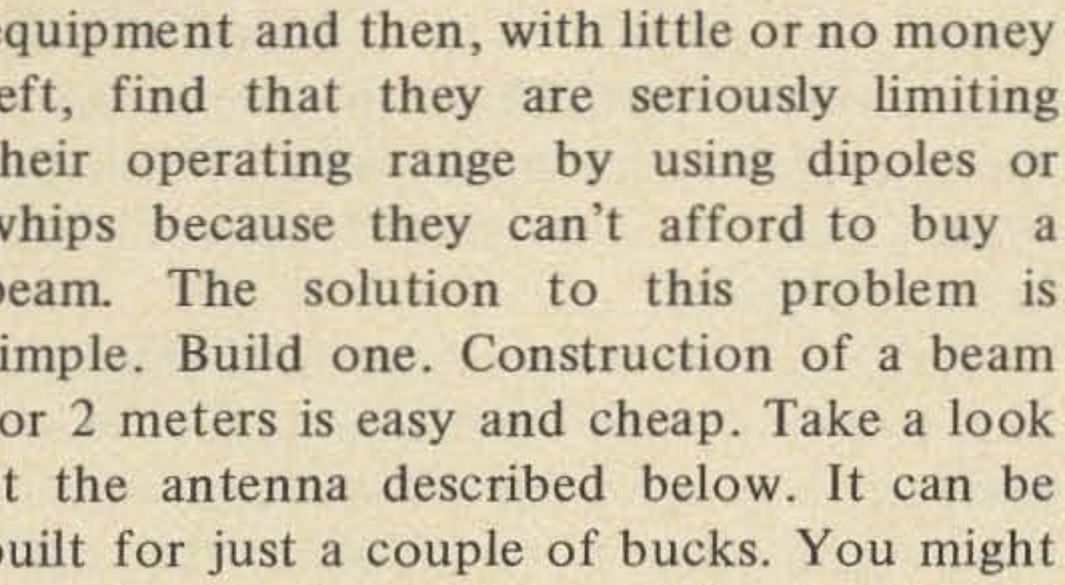

Fig. 1. Top view of 7 element beam.

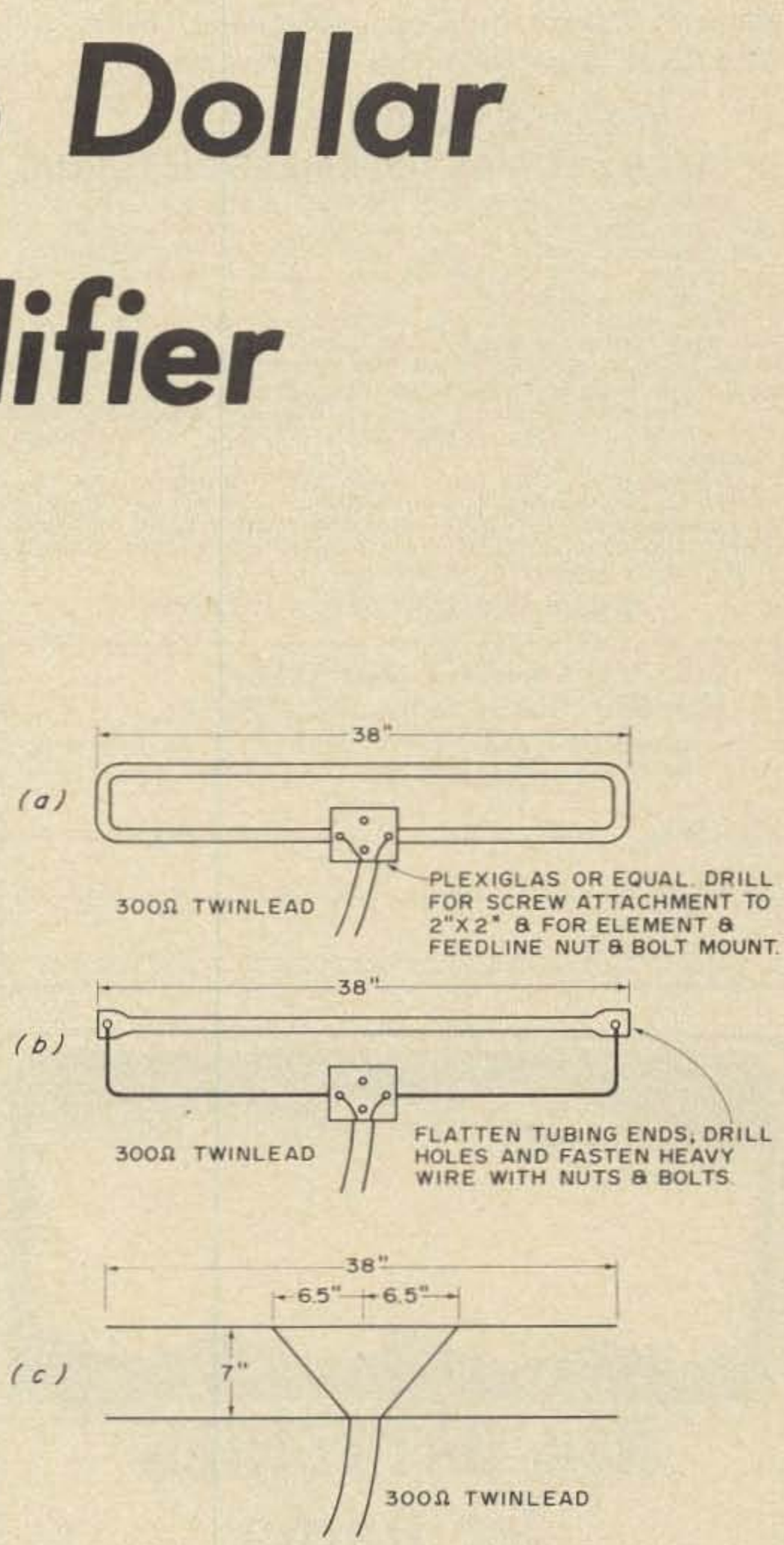

Fig. 2. Driven element details.

wondering if it will work. Well, you should get about 6 to 8 dB of forward gain out of this antenna. This is roughly equivalent to raising your power about 4 times! Let's quit talking and begin to build. Your beam will be finished in a couple of hours.

You can begin with the boom. Try a piece of 1" x 2" if you like, but you will find 2" x 2" to be rigid, light, and not at all unwieldy. If you like, put a couple coats of shellac on the boom. Draw a pencil line longways through the center of the entire boom. Now measure the boom for the

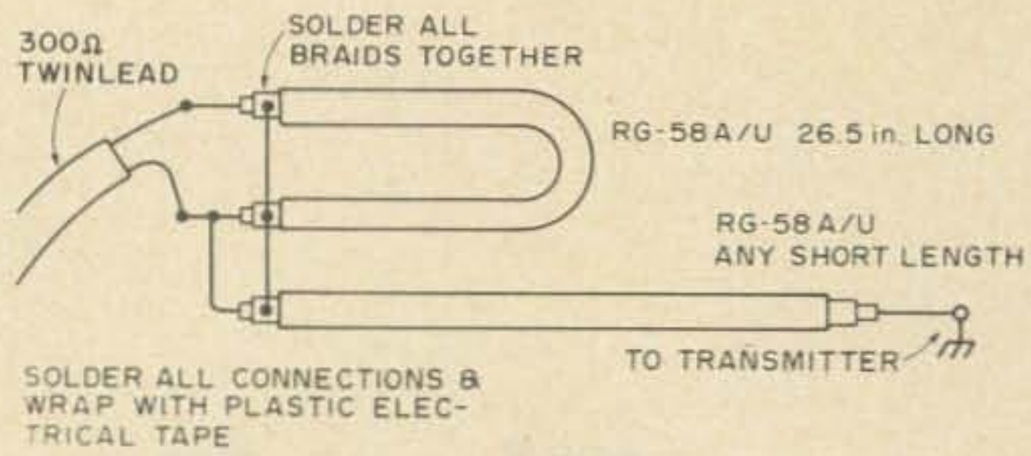

Fig. 3.

placement of elements by drawing a line across the boom at each point an element will be attached as shown in Fig. 1.

Next, prepare the driven element. Three methods are shown in Fig. 2. Figure 2a is a folded dipole made of one continuous piece of copper or aluminum tubing (auto gas line is suitable, but a bit heavy). In Fig. 2b, the folded dipole is constructed by attaching heavy wire to a piece of aluminum tubing, while Fig. 2c shows still another feed method which may require a little experimentation with the taps.

Now cut the reflector and 4 directors from a piece of aluminum clothes line. If you want to be real fussy about straightening them, roll them between two boards. After the elements are cut, and straightened, put a pencil mark at the mid-point of each element. Match these pencil marks with the center line on the boom, so that the elements will be centered on the boom. Fasten the elements to the boom with "U" shaped brads. Dab on some epoxy glue and the beam is finished.

Perhaps, your transmitter or transceiver, like many that are available today, is not designed to work with a 300Ω transmission line. Again, this is no problem. Just make and use the simple balun shown in Fig. 3. However, you should use the best grade of 300Ω line that you can afford.

All that's left now is to get your beam up in the air as clear and as high as possible. You can mount it vertically or horizontally. If you have a rotator, by all means, use it.

With my beam mounted vertically on top of a twenty foot high two-by-four, I consistently work through a repeater that is forty miles away, and this is with only 10 watts input. Now, tune up your transmitter and enjoy the benefits of a really "cheep" beam.

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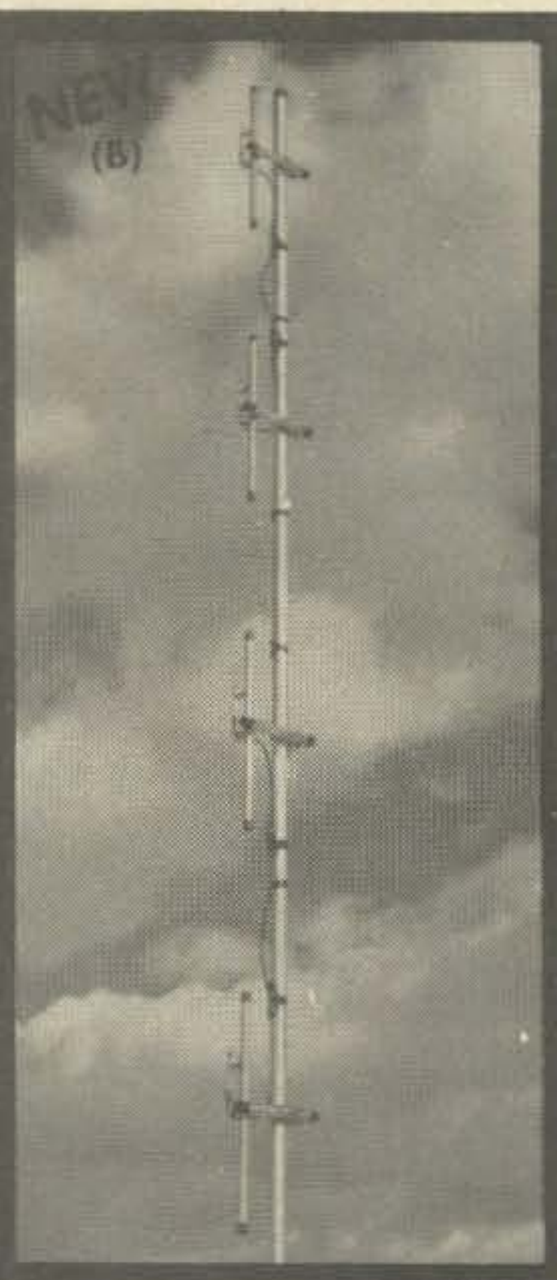

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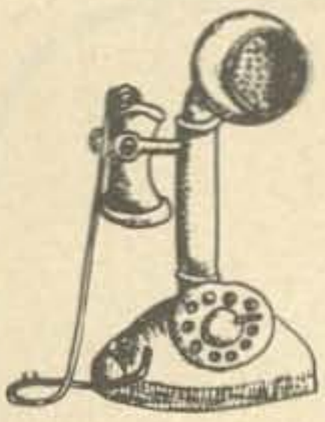

Basic Telephone Systems
Part One

Spenser Whipple, Jr.
c/o 73 Magazine
Peterborough NH 03458

Lifting Ma Bell's Cloak of Secrecy

Though telephones predate radio communications by many years, they aren't nearly as simple as they appear at first glance. In fact, some aspects of telephone systems are most interesting and quite ingenious. In this article we will describe some of these more interesting and perhaps less well-known areas of telephone systems.

But before going farther, let me explain and apologize for the fact that some of the information in this article may not be altogether complete, up to date, or even correct. I do not work for any phone company, and therefore do not have access to internal telephone company literature. Moreover, there is very little material available in books or magazines which describes how U.S. telephone systems work. Much of the information in this article has been obtained piece-meal from many different sources such as books, popular magazines, computer data communications journals, handbooks, and sometimes just plain hearsay. I have tried to correlate as much as possible all the little bits and pieces into a coherent picture which makes sense, but there is no easy way to be sure of all the little details. So think of this article as if it is a historical novel — generally accurate and, regardless of whether it is completely true or not, fascinating.

With this out of the way, let's go on. Fig. 1 shows a simple diagram which explains how your home telephone fits into the overall picture. You, as the customer, are generally referred to as the "subscriber." Your telephone connects to the Central Office through a two-wire cable which may be miles long, and which may have a resistance on the order of hundreds or even thousands of Ohms. This cable is essentially a balanced line with a characteristic impedance of around 900 Ohms, but this varies greatly with different cables, different weather conditions, and different calls. (This is why it is so hard to keep a hybrid phone-patch balanced.)

The main power in the central office comes from 48 volt storage batteries which are constantly kept trickle-charged. This battery is connected to your line through a subscriber relay and a balanced audio transformer. The relay is sensitive enough to detect even quite small currents through your line.

The buttons which stick up out of your telephone case when you lift the handset actuate the hook switch. The name probably dates back to the days when the handset (or even earlier, the earpiece) hung on the side of the phone from a hook. In any case, when your phone is hung up it is said to be on the hook, and when you lift the handset to make a call it is said to go off the hook. With the phone on hook, the line is connected only to the bell (called the ringer). Because

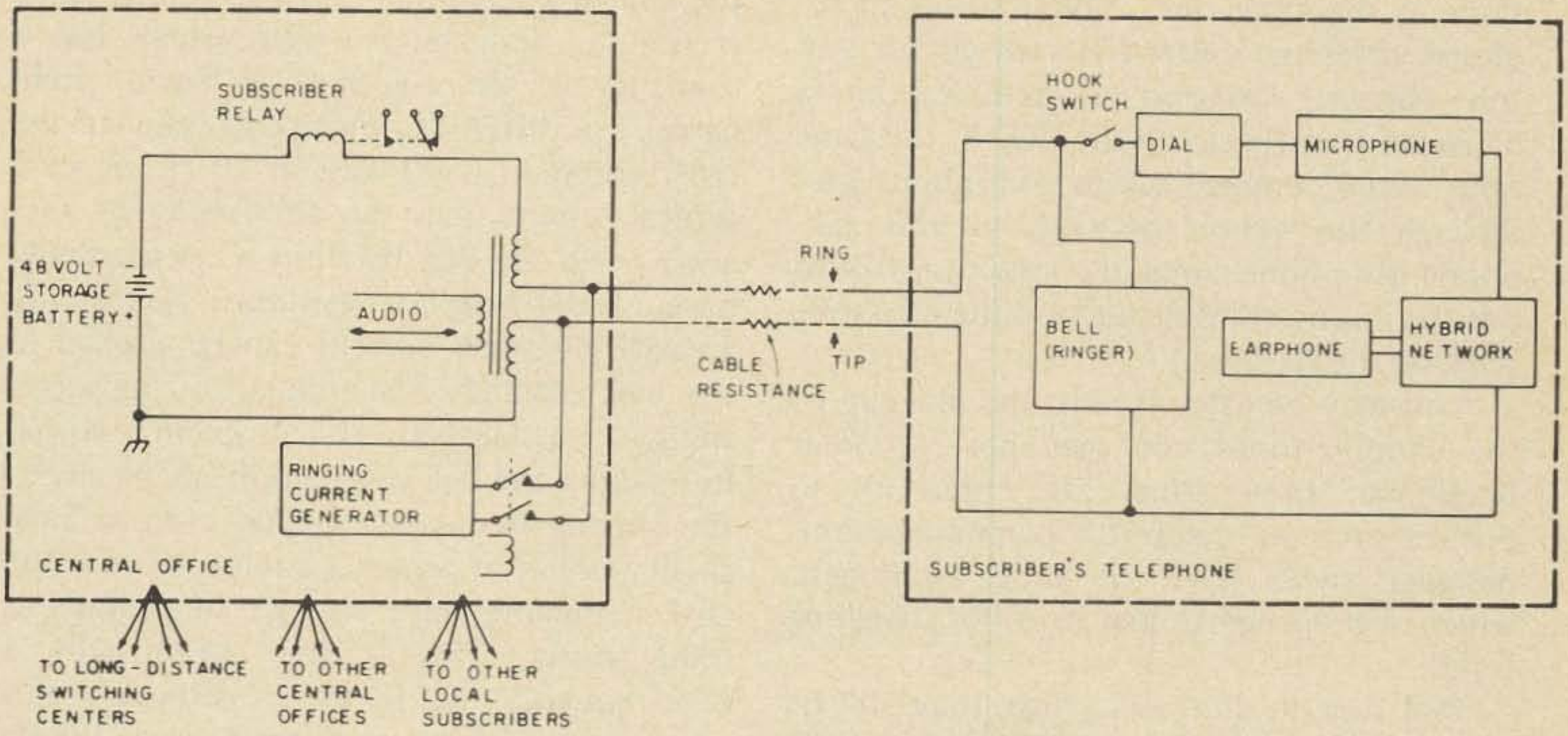

Fig. 1. Telephone block diagram.

the bell circuit has a capacitor in it, no dc current can flow through the phone. As a result, the subscriber relay back in the central office will be deenergized, indicating to the central office (let's abbreviate that as CO from now on) that your phone is hung up. Since there is no current through your line or phone, there is no voltage drop anywhere, and so if you measure the voltage across the phone line at your phone you will see the entire 48 volts (or even more if the CO batteries are well charged). The positive (grounded) lead is called the tip and negative lead is called the ring; these names correspond to the tip and ring of a three-circuit phone plug.

Now suppose you want to place a call. You pick up the handset, and the phone goes off the hook. This completes the dc circuit through the dial, microphone, and the hybrid network which is basically a complicated transformer circuit. At this point current starts to flow from the battery through your line and phone, and the subscriber relay back at the CO pulls in. The line voltage across your phone now drops to just a few volts because the line is loaded down by the low resistance of the phone. The CO now searches for some idle dialing circuits, and when it finds them, connects a dial tone back to your phone. When you hear this, you start dialing.

The dial shown in Fig. 1 is a rotary dial of the type which you turn with your finger (we will talk about Touchtone dials later). When you dial a number, the dial acts as a short circuit until you release the dial and let the built-in spring return it back to the resting position. As it is returning, it starts to open and close the circuit in sequence to indicate the number you dialed. If you dial a 1, it opens the circuit once; if you dial a 9 it opens the circuit nine times. As the dial is returning it causes the subscriber relay to open and close in step. This enables the CO to recognize the number you want. When you finish dialing, the dial becomes just a plain short circuit which passes current through the microphone and the hybrid network. Since the mike is a carbon unit, it needs this current to work.

When the CO receives the complete number, it starts to process your call. If you dialed another subscriber in the same area, it may connect you directly to that subscriber's line. Calls to phones a little further away may have to be routed through another CO, while long distance calls may go through one or more long distance switching centers (called tandems) and possibly many other CO's before arriving at the destination. At the completion of this process, you may get either a ringing signal, indicating that the phone at the other end is ringing, one of several types of busy signals, or possibly just silence, if something goes wrong somewhere.

When you talk to the person at the other end, the cable carries audio in both direc-

tions at the same time. Your carbon microphone varies the current in your circuit, and this current variation is detected by a balanced transformer in the CO. At the same time, audio coming back to your phone goes through the hybrid network to your earphone. (In phone company lingo they like to call the mike a transmitter, and the earphone is called the receiver.)

You may be interested in the makeup of the various tones you may hear on your telephone; these tones are important to people such as computer communications designers who have to build equipment which will recognize dial or other signalling tones:

Dial tone in older exchanges may still be a combination of 120 and 600 Hz, but the newer exchanges use a combination of 350 and 440 Hz. There is often a slight change in the dc line voltage at the beginning of dial tone, and this may also be detected.

Busy signal is a combination of 480 and 620 Hz which alternates for 1/2 second on and 1/2 second off (i.e., 60 interruptions per minute) when the party you are calling is busy. The same busy signal may be used for other conditions such as busy interoffice or long distance circuits, but would then be interrupted either 30 times a minute or 120 times per minute. This is a standard agreed on by an international telecommunications organization called CCITT (and I don't offhand remember the French words it stands for), but occasionally other frequencies up to 2 kHz are used. A siren-like sound varying between 200 and 400 Hz is often used for other error conditions.

The ringing tone, which you hear coming back to you when the phone rings on the other end of the connection, is nowadays mostly a combination of 440 and 480 Hz, but there is great variation between CO's. Very often a higher frequency such as 500 Hz is interrupted at 20 Hz, and other tones are used as well. The tone is usually on for 2 seconds and off for 4 seconds.

The ringing current, actually used to ring the bell in a telephone, is an ac voltage since it has to activate a ringer which has a capacitor in series with it. Different companies use different ringing currents, but the most common is 90 volts at 20 Hz. Since a typical phone may be thousands of feet away from the CO, the thin wires used may have a fairly high line resistance. Hence only a relatively small current can be applied to the bell, certainly not enough to ring something like a doorbell. This problem is solved by making the bell resonant mechanically at the ringing frequency so that even a fairly small amount of power is enough to start the striker moving hard enough to produce a loud sound. This is the reason why a low-frequency ac is used. Although this raises some problems in generating a 20 Hz signal at a high enough voltage, it has the advantage that a bell will respond to a ringing current only if the frequency is quite close to the bell's naturally resonant frequency. If you build two bells, one resonant at 20 Hz and the other resonant at 30 Hz, and connect them together to the same line, you can ring just one bell at a time by connecting a ringing current of the right frequency to the line; this has some useful applications in ringing just one phone on a party line.

Now let's look at some of the components of the phone itself. We will consider the most common new phone, a model 500 C/D manufactured by Western Electric and used by Bell System affiliated phone companies. This is the standard desk phone, having modern rounded lines and usually having a G1 or G3 handset. It was developed about 1950 and replaced the older 300-series phones which had the older F1 handset and had sharper corners and edges. (There was an inbetween phone, where they took an old 300-series phone and put a new case on it which resembled the 500-style case but had a straight up-and down back – the back of the case came straight down right behind the handset cradle, whereas the true 500-style telephone has what looks like a step sticking

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out behind the cradle). If you are still in doubt as to which phone you have, the bell loudness control is a wheel on the 500-type phone and a lever on the 300-type. If you live in the boondocks, you may still have the 200-type phone (sometimes called the oval-base) or maybe even the desk-stand type that looked like a candlestick, with the microphone mounted on the top and the earpiece hanging on the side from a hook. Neither of these phones had a built in bell, and so you probably have a bell box attached to your wall. (If you have a phone with a handle on the side which you crank to call the operator, the following does not apply to your phone!)

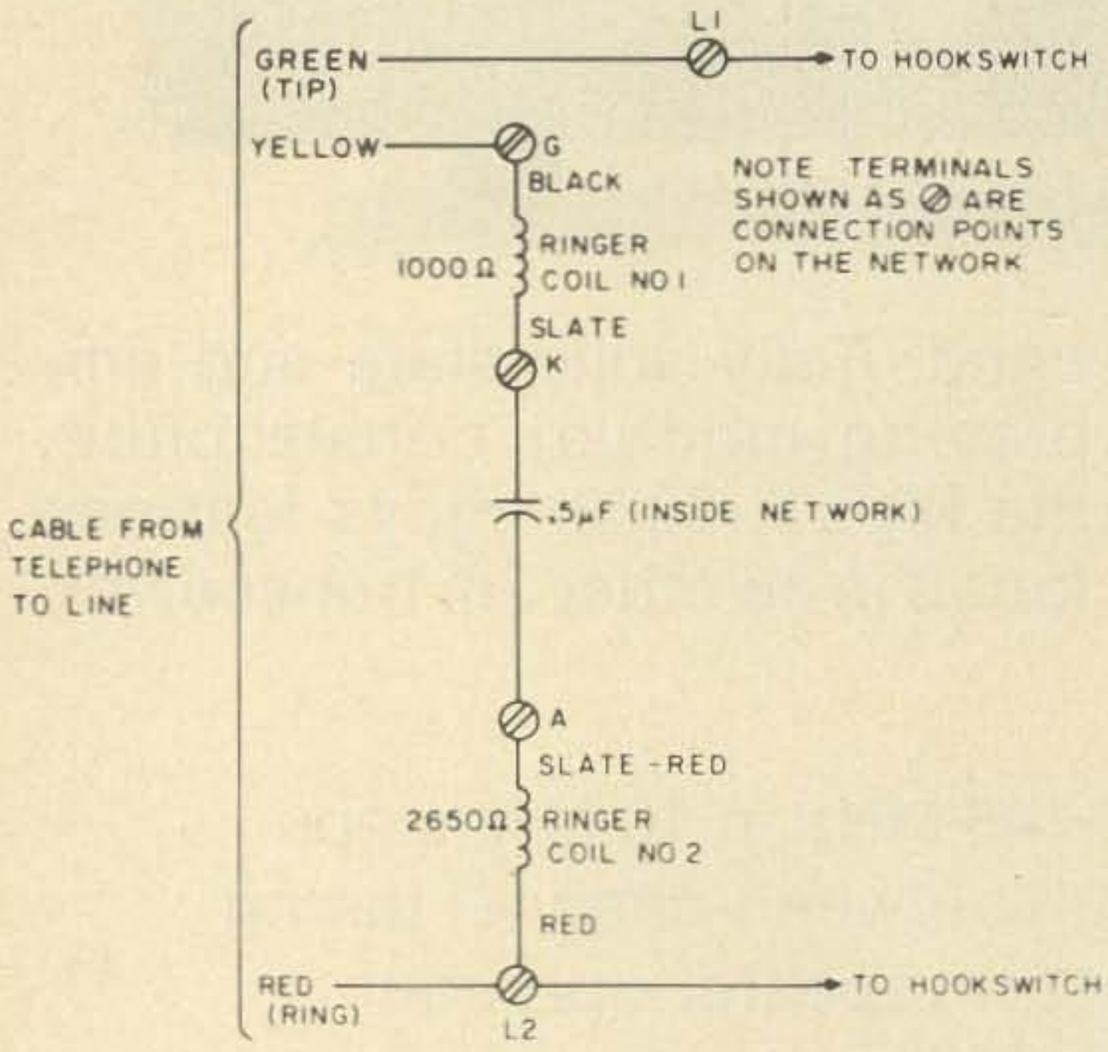


Fig. 2. Ringer connections inside 500 C/D telephone set.

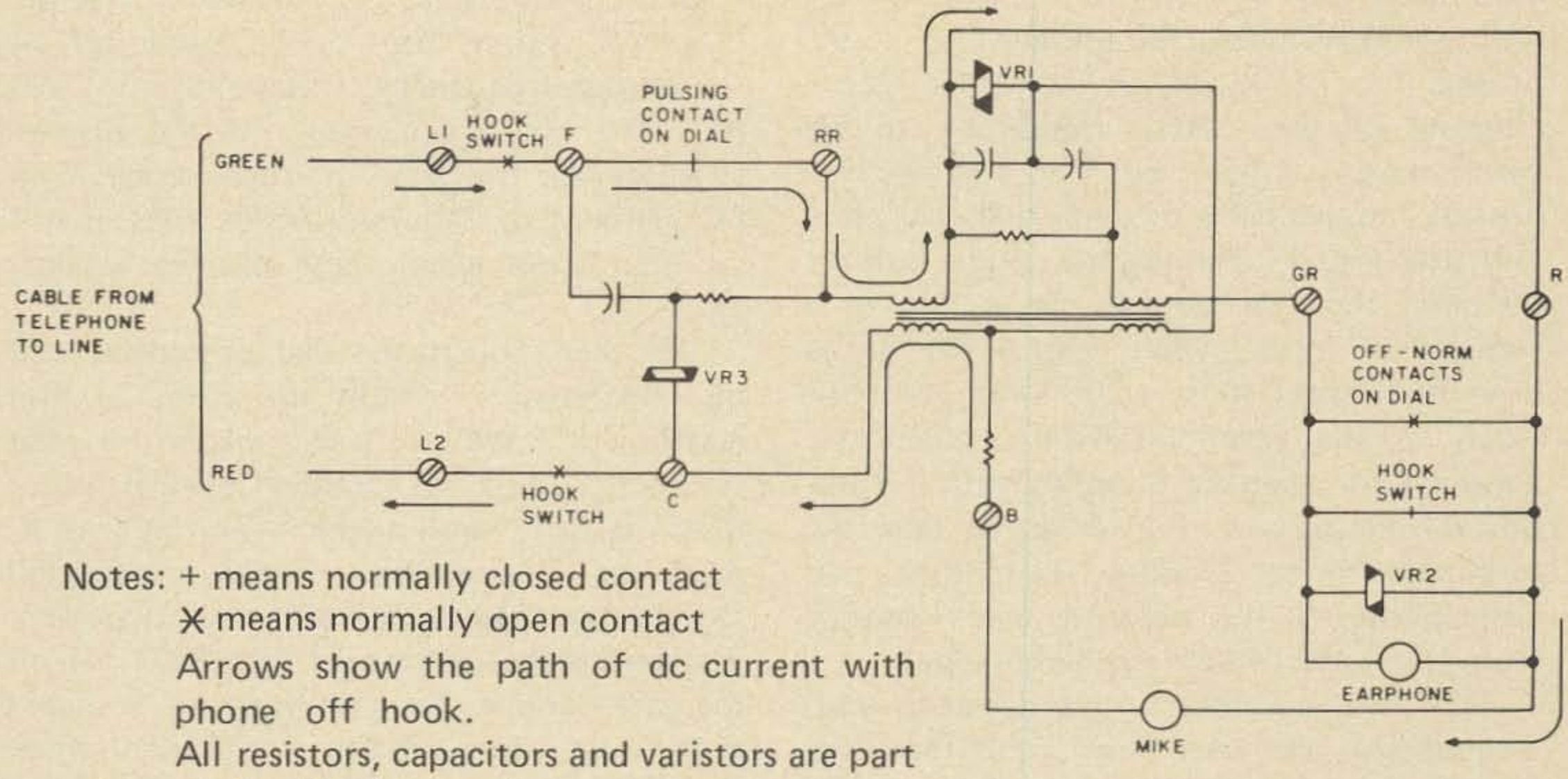
Fig. 2 shows the bell circuit, which consists of a two-coil ringer and a 0.5 uF capacitor. On Western Electric phones the capacitor is mounted inside the network assembly, which also has a large number of screws on top which act as connection points for almost everything inside the phone. (I have never been able to find out why the ringer has two coils of unequal resistance, but it apparently has something to do with determining which subscriber on a party line makes which call.) In most phones, the yellow and the green wires are connected together at the wall terminal block so that the bell is connected directly across the telephone line; disconnecting the yellow lead would turn off the bell (although sometimes the connection is made internally by connecting the black lead from the ringer directly to the L1 terminal, in which case the yellow lead is disconnected.

You may wonder why a yellow lead is needed at all when only two wires are normally used anyway. It is true that only two wires enter the house from the outside; one of. these is the tip and the other is the ring. In a non-party line the ringing current as well as all talk voltages are applied between the tip and the ring, and it doesn't actually matter which of the phone leads goes to the tip and which to the ring if you have a rotary dial phone. If you have a Touchtone dial, then you have to observe polarity so that the transistor circuit in the dial works, in which case you have to make sure that the green lead goes to the tip and the red lead goes to the ring.

The yellow lead is commonly used for party lines. On a two-party line ringing current from the CO is applied not between the two lines, but between one line and ground. In that case the yellow lead goes to ground while the other side of the ringer (the red lead) is connected to either the tip or the ring, depending on the party. In this way, it is possible to ring only one party's bell at a time.

The remaining connections inside the telephone are shown in Fig. 3. The components labeled VR are varistors: the phone companies must be the world's biggest users of these devices, which are variable resistors whose resistance drops as the voltage across them rises. Their function in the phone set is to short out parts of the set if the applied voltage gets too high. For instance, VR2 is connected directly across the earphone (receiver) and acts as a volume limiter to lower the volume if the applied voltage gets too high – a great way to protect your eardrums.

As you can see in Fig. 3 we use the standard phone company way of identifying normally open and normally closed switches – an X in a wire is a normally open contact of a switch or relay, while a short bar means a normally closed contact. The arrows in the drawing show the path of dc current through the phone when it was off the hook. Starting



Notes: + means normally closed contact
⋇ means normally open contact
Arrows show the path of dc current with phone off hook.
All resistors, capacitors and varistors are part of the 425E network.

Fig. 3. Interior connections of 500 C/D telephone set.

at the green wire, the current path goes through a set of contacts on the hook switch, then through the pulsing contacts on the dial, through part of the network, through the mike, back through a second winding on the network, and finally through a second contact on the hook switch and back out to the red wire.

The hook switch actually has three sets of contacts, two normally open (open, that is, when the hand set is on hook) which completes the dc circuit when you pick up the handset, and a normally closed contact which is wired directly across the earphone. This contact's function is to short the earphone during the time that the dc circuit is being opened or closed through the phone – this prevents you from being blasted by a loud click in the earphone.

The dial has two contacts. One of these is the pulsing contact, which is normally closed and only opens during dialing on the return path of the dial after you let go of it. The second contact, labelled the off-normal contact, shorts the earphone as soon as you start turning the dial, and releases the short only after the dial returns back to the normal position. In this way you do not hear the clicking of the dial in the phone as you dial.

Finally, the phone has the hybrid network which consists of a four-winding transformer and a whole collection of resistors, capacitors, and varistors. The main function of the network is to attenuate your own voice to lower its volume in your earphone. The simplest phone you could build would be just a series circuit consisting of a dial, a mike, and an earphone. But the signals coming back from the other party are so much weaker than your own signals, that an earphone sensitive enough to reproduce clearly and loudly the voice of the other person would then blast your eardrums with the sound of your own voice. The function of the network is to partially cancel out the signal produced by the local mike, while permitting all of the received signal to go to the earphone. This technique is similar to the use of a hybrid phone patch with a VOX circuit, where you want the voice of the party on the telephone to go to your transmitter, but want to keep the receiver signal out of the transmitter.

In addition to the parts needed for the hybrid, the network also contains a few other components (such as the RC network across the dial pulsing contacts) and screw-type connection points for the entire phone.

A Touchtone phone is similar to the dial phone shown here, except that the rotary dial is replaced by a Touchtone dial. In addition to its transistorized tone generator, the standard Touchtone pad has the same switch contacts to mute the earphone, except that instead of completely shorting the earphone, as the rotary dial does, the

Touchtone dial switches in a resistor which only partially mutes the phone. The circuit of the Touchtone dial is shown in recent editions of the ARRL Handbook so we won't reprint it here, but Fig. 4 shows two possible connections of such dials for amateur use. Fig. 4 (a) shows the connection for coupling the dial output electrically to a transmitter input, while Fig. 4 (b) shows how to connect it to a 500 Ohm earphone (such as the earphone from a telephone handset) for acoustic coupling into a transmitter microphone. Fig. 5 shows how the terminals on a Trimline Touchtone pad correspond to the colored wires coming from the standard desk-type phone pad.

It is fairly common knowledge as to what frequencies are used for Touchtone signalling, but a misprint in several recent ARRL publications gives the wrong frequency for one of the high tones, so here is a short table which repeats the correct numbers:

LOW TONE GROUP (HZ)	HIGH TONE GROUP (HZ)			
	1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

Each digit is composed of one frequency from the low group and one frequency from the high group; for instance, the digit 6 is generated by producing a low tone of 770 Hz and a high tone of 1477 Hz at the same time. The American Touchtone pads generate both of these tones with the same transistor, while European pads (yes, there are some) use two transistors, one for each tone. In addition to the first three high tones, a fourth tone of 1633 has been decided on for generating four more combinations, called A through D in the above table. These are not presently in use, although the standard phone Touchtone pad can easily be modified to produce this tone, since the required tap on the inductor used to generate the tone is already present and only an additional switch contact is needed to use it; information on this simple conversion is found in the 73 publication *Digital Control of Repeaters.*

What is not generally known is that the U.S. Air Force uses a different set of Touchtone frequencies, in the range of 1020 to 1980 Hz. Since many of the phones available for purchase in stores come from Department of Defense surplus sales, it will be interesting when these phones become available.

Another Touchtone dial presently used by amateurs is made up from a thin elastomeric switch pad made by the Chomerics Corp. (77 Dragon Court, Woburn, Mass. 01801) and a thick-film hybrid IC made by Microsystems International (800 Dorchester Boulevard, Montreal, Quebec). The pad is the Chomerics ER-20071, which measures about 2¼ inch wide by 3 inches high, and only about 3/16 inch thick (Chomerics also makes a smaller model ER21289, but it is very difficult to use and also apparently unreliable). Microsystems International makes several very similar ICs in the ME8900 series, which use different amounts of power and generate different amounts of audio. Some of these also contain protection diodes to avoid problems if you use the wrong polarity on the IC, and there are so many models to choose from that you should get the technical data from the manufacturer before ordering one. There are a number of US distributors, including Newark Electronics, Milgray and Arrow Electronics in New York. KA Electronics Sales advertised both the pad and the IC in the July 1974 issue of 73 Magazine. In single quantities, the pad goes for about $9 and the IC costs about $18, although it drops in price if you order larger quantities.

A simple circuit for the IC and pad is

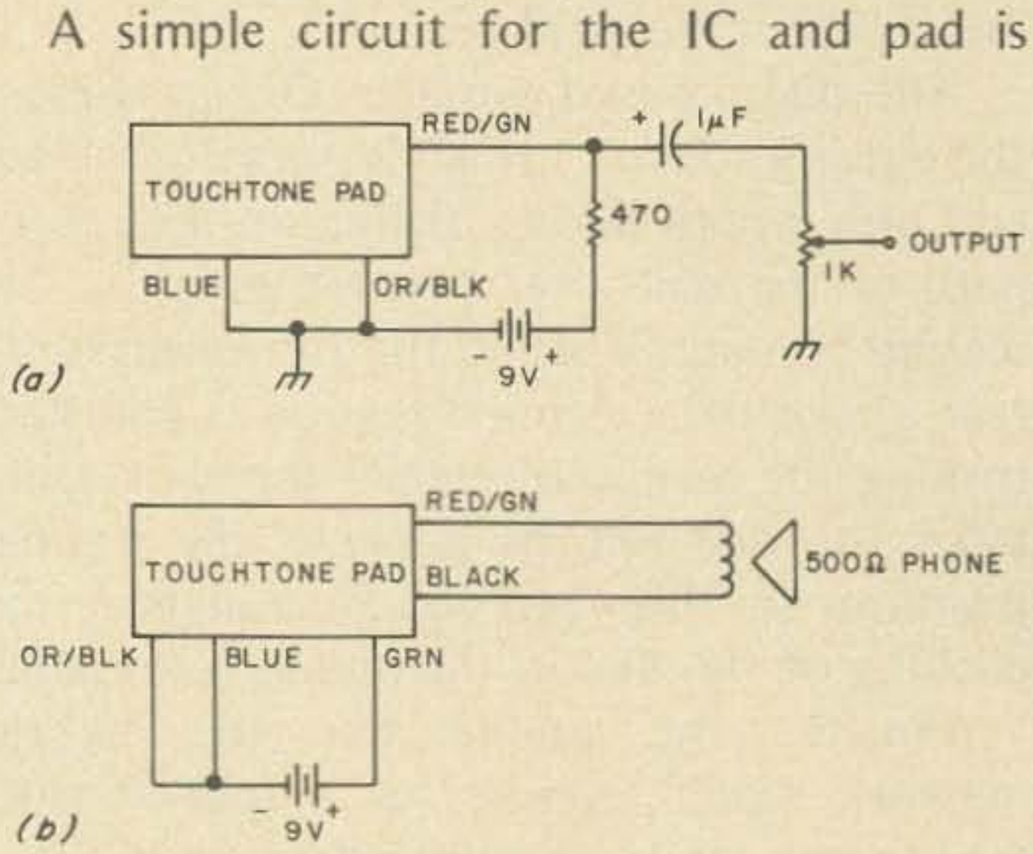


Fig. 4. Touchtone pad connections.

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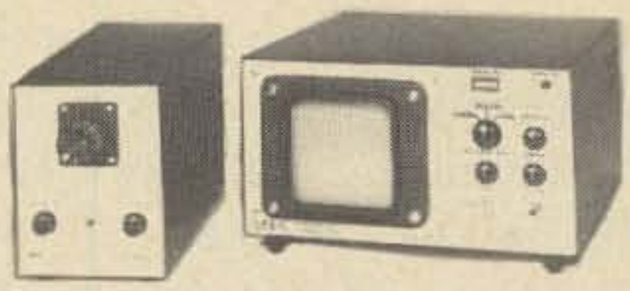

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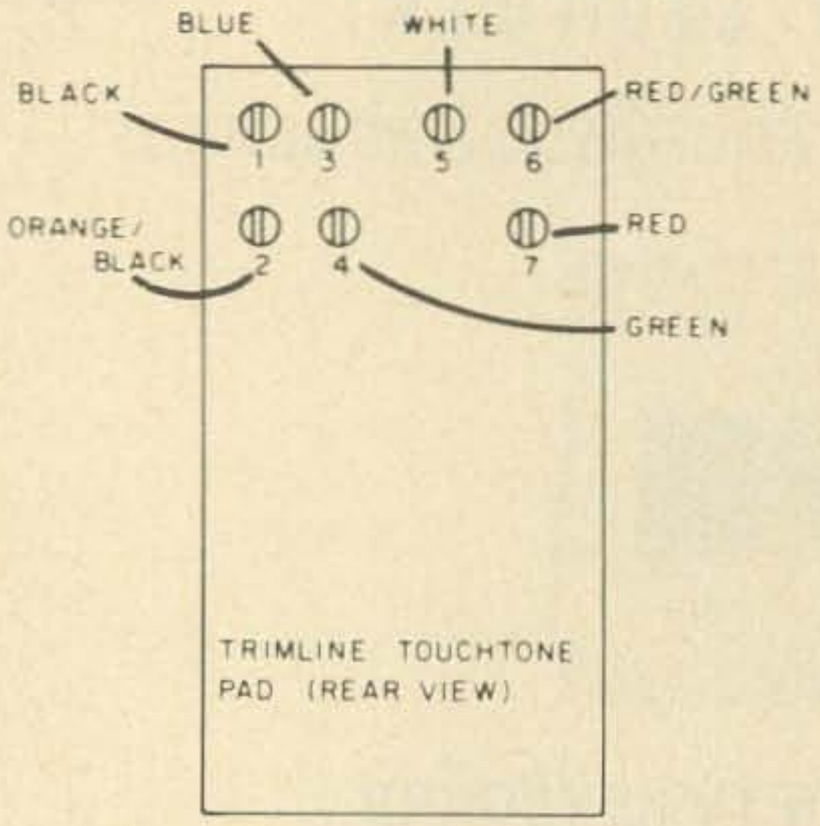

Fig. 5. Trimline Touchtone pad connections.

shown in the ARRL publication *FM and Repeaters for the Radio Amateur*. While this circuit is perfectly good, it does not work in the presence of strong rf. If you want to mount this pad and IC on a portable 2-meter rig, you will have to use bypass capacitors and chokes to keep the rf out of the IC. Bypass pins 8 and 16 of the IC to pin 13 with small discs of about 0.001 or 0.01 μF, right at the IC, using very short leads. Then put small 2 to 5 microhenry chokes in series with pins 8, 13 and 16 right at the IC. If needed, put more chokes at the other end of each lead. Ohmite Z-144 chokes are good but a little bulky; the small 1.8 microhenry chokes used in Motorola Handie-Talkies (Motorola type 24-82723HO1) are about the size of a 1/8-watt resistor and almost as good. It may seem a little funny to put chokes in the ground lead, as all hams are trained to use good rf grounds, but the object is to keep rf out of the IC at all costs and this accomplishes that by letting the IC float above ground if needed, but removing any rf voltage which might appear across the IC leads. It is also possible to generate the Touchtone tones with separate oscillators or with IC oscillators (such as the NE566), as is done in pads sold by Data Engineering. This system may not be as stable or accurate as other systems, though.

One of the problems with any current IC oscillator is that the frequency changes if rf gets near it. Many hams are having a hard time mounting such IC pads on their 2-meter Handie-Talkies. But a solution seems in sight – Mostek, a large IC company, is coming out with an IC Touchtone generator which has a cheap 3.58 MHz external crystal as reference, and then produces the tone frequencies by dividing the 3.58 MHz down with flip flops to get the required tone frequencies. This approach not only promises to be more reliable in the presence of rf, but should also be cheaper since it would not need the custom (and expensive) laser trimming of components that the Microsystems International IC needs to adjust the frequencies within tolerance.

At the other end of the telephone circuit, in the CO, various circuits are used to decode the digit you dial into the appropriate signals needed to perform the actual connection. In dial systems, this decoding is done by relay circuits, such as steppers. This circuitry is designed for dialing at the rate of 10 pulses per second, with a duty cycle of about 60% open, 40% closed. The minimum time between digits is about 600 milliseconds, although a slightly greater time between digits is safer since it avoids errors. In practice, many COs will accept dialing at substantially slower or faster rates, and often you will see a dial that has been speeded up by changing the mechanical governor to operate almost twice as fast; it depends on the type of CO equipment.

Touchtone decoding is usually done by filter circuits which separate out the Touchtone tones by filters and then use a transistor circuit to operate a relay. A common decoder is the 247B, which is designed for use in small dial switchboard systems of the type that would be installed on the premises of a business for local communication between extensions. It consists of a limiter amplifier, seven filters and relay drivers (one for each of the seven tones commonly used) and some timing and checking circuitry. Each of the seven relays has multiple contacts, which are then connected in various series/parallel combinations to provide a grounding of one of ten output contacts, when a digit is received. The standard 247B does not recognize the * and # digits, but can be modified easily enough if you have the unit diagram.

The 247B decoder is not very selective, and can easily be triggered by voice unless some additional timing circuits are connected at the output to require that the

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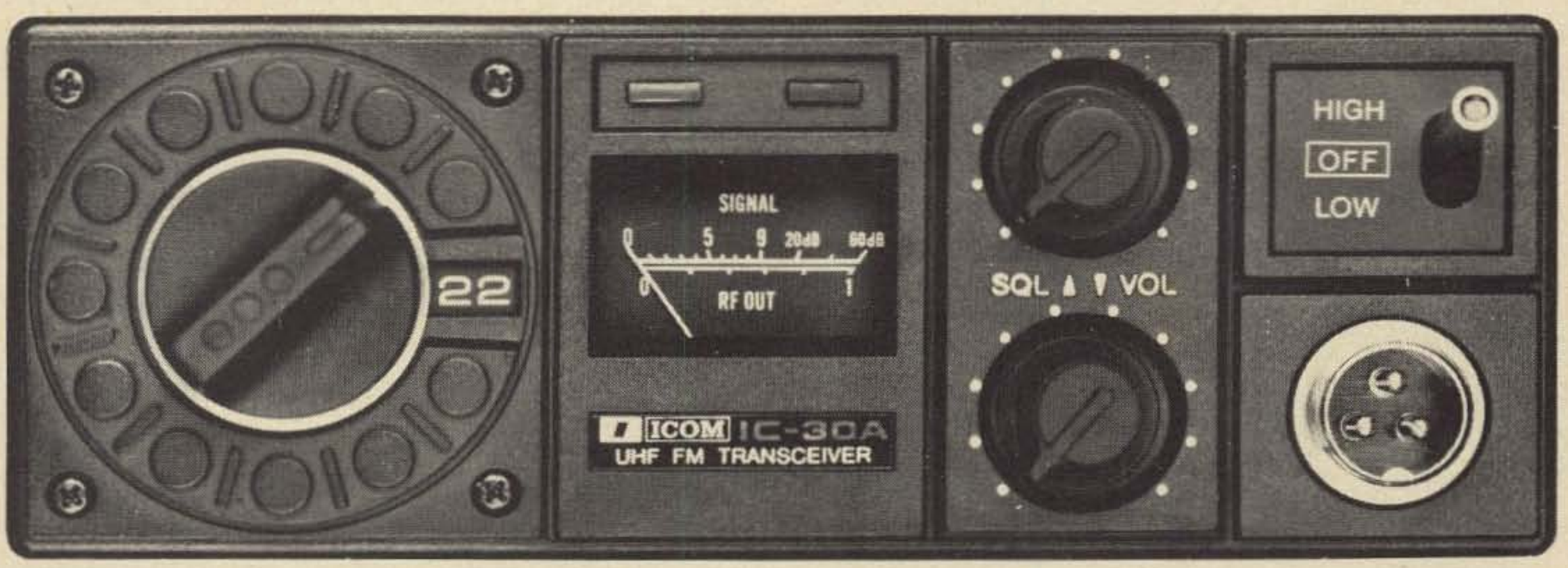

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relay closure exceed some minimum time interval before it is accepted. Slightly more complicated decoders which have the time delays built in are the A3-type and the C-type Touchtone Receivers. Both of these are used in customer-owned automatic switchboards when a caller from the outside (via the telephone company) wants to be able to dial directly into the private switchboard to call a specific extension. The C-type unit is similar to the 247B in that it has ten outputs one for each digit. The A3-type does not have output relays, but instead has seven voltage outputs, one for each of the seven basic tones, for activating external 48-volt relays. The A-3 unit is ideal for activating a Touchtone encoder, which can then be used to regenerate the touchtone digits if the original input is noisy. This might be very useful in a repeater autopatch, for cleaning up Touchtone digits before they are sent into the telephone system.

In addition to the above, there are probably other types of units specially designed for use in the CO, but information on these is not readily available. It is also fairly easy to build a Touchtone decoder from scratch. Though the standard telephone company decoders all use filter circuits, it is much easier (though perhaps not as reliable) to use NE567 phase-locked-loop integrated circuits.

An interesting sidelight to Touchtone operation is that it greatly speeds up the process of placing a call. With a Touchtone dial it is possible to dial a call perhaps 3 to 5 times faster than with a rotary dial. Since the CO equipment which receives and decodes the number is only needed on your line during the dialing time, this means that this equipment can be switched off your line sooner and can therefore handle more calls. In fact, the entire Touchtone system was invented so that CO operation would be streamlined and less equipment would be needed for handling calls. It is ironic that the customer should be charged extra for a service which not only costs the telephone company nothing, but even saves it money.

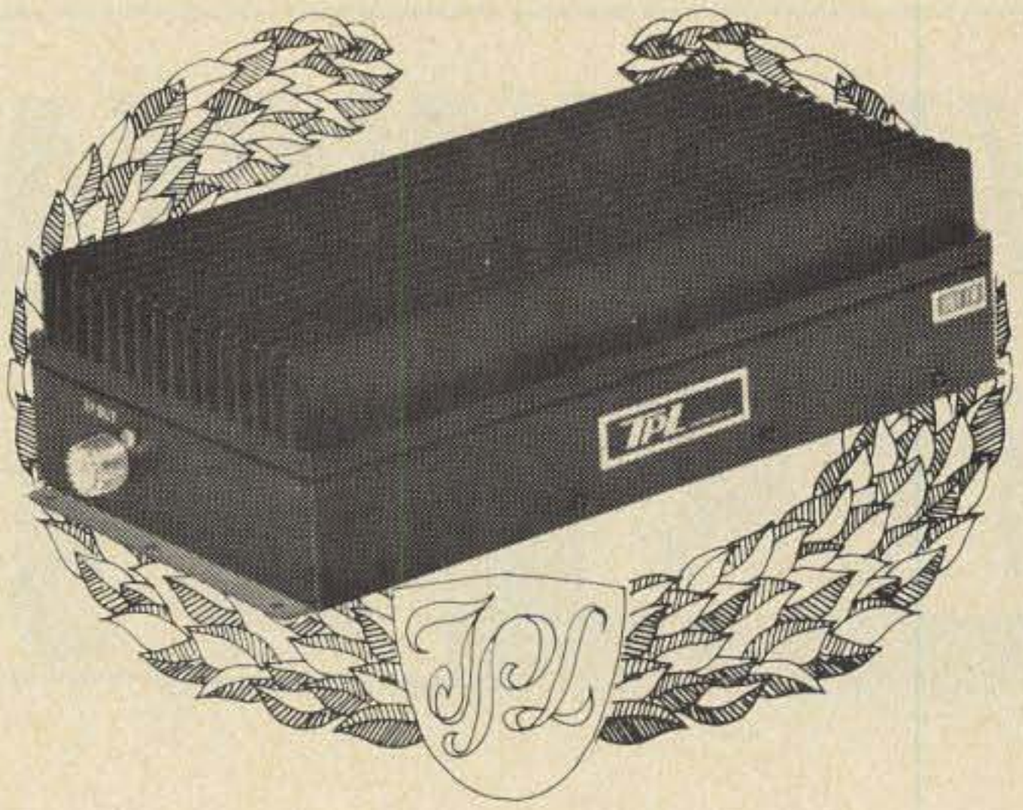
Another practice which may or may not cost the company money is the connection of privately-owned extension phones. You have probably seen these sold by mail order houses and local stores. The telephone companies claim that connecting these phones to their lines robs them of revenue and also may cause damage to their equipment. There are others, of course, who hold the opinion that the easy availability of extensions only causes people to make more calls since they are more convenient, and that the companies really benefit from such use. The question of damage to equipment is also not easily answered, since most of the extension phones are directly compatible, and in many cases the same type as the telephone company itself uses. Be that as it may, this may be a good time to discuss such use.

Prior to an FCC decision on telephone company interconnection in the Carterfone case in 1968, all telephone companies claimed that the connection of any equipment to their lines was illegal. This was a slight misstatement as no specific laws against such use were on the books. Instead, each local telephone company had to file a tariff with the public service commission in that state, and one of the provisions of that tariff was that no connection of any external equipment was allowed. By its approval of that tariff, the public service commission gave a sort of implicit legal status to the prohibition.

How strange that some companies allow interconnection of customer equipment without any hassle at all, while others make things quite difficult . . .

In the Carterfone case, however, the FCC ruled that the connection of outside equipment had to be allowed. The phone companies then relaxed their tariff wording such that connection of outside equipment was allowed if this connection was through a connecting arrangement *provided by the telephone company* for the purpose of protecting its equipment from damage. Although this result has been challenged in several states, that seems to be the present status. The strange thing is that some telephone companies allow interconnection of customer equipment without any hassle whatsoever, while others really make things difficult for the customer.

. . . WHIPPLE



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THE IDENTALERT

Not too long ago, the author decried the inability of the ham to home brew his equipment, particularly solid-state designs, due to the difficulty in obtaining small quantities of transistors and integrated circuits. Leave it to the hams though! Now it is not only possible to obtain these devices via mail order but the prices have dropped to a point where it makes it worthwhile to experiment with these devices.

The Identalert is the result of the author's desire to experiment with some TTL integrated circuits. (The "Century Digital Clock" used RTL IC's.) This remarkably accurate unit emits a beep every ten minutes and will do so as long as power is applied. No circuit that uses a unijunction transistor for timing long periods of time can attain the accuracy or repeatability of digitally derived timers.

Included in the unit is an option to switch to a lamp to annunciate the ident mark for use when rag chewing late at night to avoid disturbing others. The Identalert is all solid state (except for the lamp which will last two hundred times its rated life) therefore its accuracy will remain high indefinitely.

Hard wiring is used to interconnect circuitry; this is #24 solderable insulation wire (polyurethane insulation), available in parts stores such as Beldsol, Analac, Soldereze. For the home brewer it is completely practical to use punch board rather than go through the time and trouble to lay out, fabricate and drill a single PC board.

Circuit Description

Q2, Q3 divide the 60 Hz line frequency by 60 to give us an accurate 1 pulse per second. Q1 is a pulse stretching Schmitt trigger which shapes the attenuated line voltage to within the constraints of the IC's. Q4, Q5, Q6 count these pulses. We are looking for a count of 600 (seconds). In actuality, the signal starts its beep at 598 seconds and continues for two seconds; then the counters are reset to zero to start counting over again. The outputs from Q5, Q6 are in the form of a binary coded decimal which must be converted to the decimal system. This is accomplished in Q7, Q8. The desired outputs of Q7, Q8 are in the form of "zeroes" or low voltage. The chosen-time recognition gate, Q13, requires "ones" or high voltage (prox. 3.5V) therefore Q12, six inverters in one IC, is used for the transformation. Two of the inverters in Q12 are used as inverter-buffers to provide cleaned up pulses of proper polarity to operate the reset and timed annunciator circuitry. These pulses are obtained from Q12-12 and Q12-8. The decoded outputs of Q12 are connected

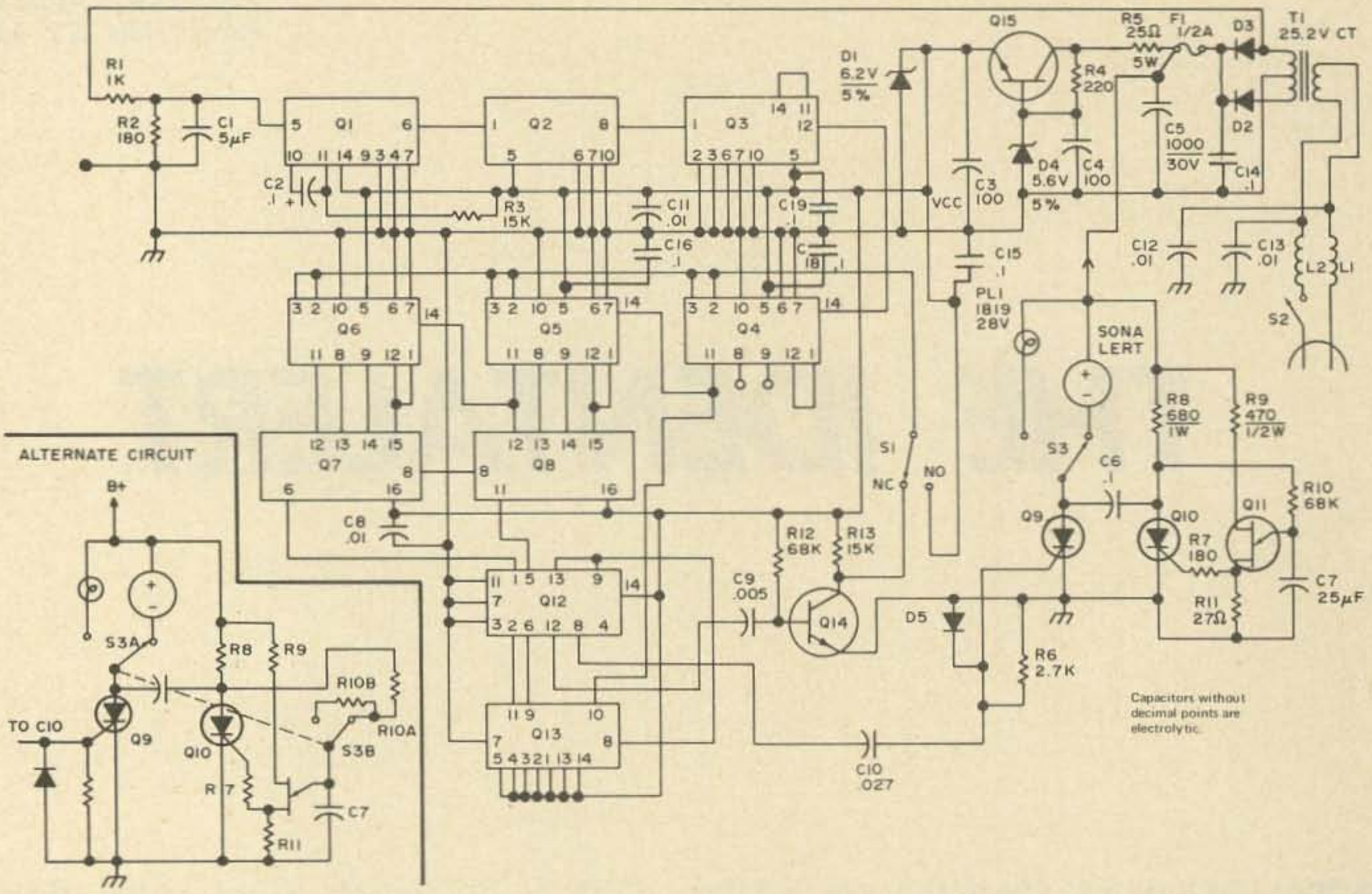

Fig. 1.

to Q13, one half of a dual triple-input NAND gate. You will note that the output of BCD 8 from Q4-11, the least significant digit, is connected directly to one of the inputs of the triple-input NAND gate because its desired output is in the form of a "one". When all the inputs to Q13 are "ones" or high – and only then – the output of that gate will go low (otherwise it remains a "one").

The timed annunciator circuit requires a positive going pulse to trigger Q9, a SCR which is in the off state. When Q12-8 goes from "zero" to "one" the charge across C10 follows it, causing Q9 to turn on and allows current to flow through the Sonalert. When a SCR turns on, the voltage at its anode goes to a low state. The charge across C6 follows this abrupt drop at the anode of Q9, resulting in a negative going voltage spike at the anode of Q10 which turns Q10 off. The voltage at the anode goes high (prox. 16V). This voltage is applied to the charging resistor R10 which generates a charging current into C7 which determines the length of time that the Sonalert will remain on. When the charging voltage across C7 reaches approximately 11 volts the unijunction fires and the resulting pulse across R11 is fed into the gate of Q10 via R7. This turns Q10 *on*. The voltage at the anode of Q10 drops abruptly to almost zero volts; charging voltage and current cease to be. The voltage across C6, which is called a commutating capacitor, follows the same sequence of events as before—except in reverse—turns off Q9. Therefore the Sonalert stops sounding.

As there is usually a great disparity between actual capacitance and the capacitance marked on the case of an electrolytic, you may have to use a different value of resistance for R10 than that noted in the parts list. With the particular electrolytic the author used and R10 as specified, the signal – both beep and light – remained on for two seconds which is optimum for the beep. When R10 was increased to 100K, the signal remained on for 6 seconds. An alternate circuit is shown for those of you that would like to have the lamp on for a longer time than the beeper. This may be advisable so that the visual signal is more obvious. You can leave out the lamp circuit altogether by connecting the minus terminal of the Sonalert directly to the anode of Q9.

Getting back to the main circuit, we must reset the counting circuits to zero at the end of our count period so that we can start over from the same point again and again. This is accomplished via Q14 which operates as an inverter-buffer. It is nothing more than a silicon NPN switching transistor that requires a negative pulse at its base to accomplish its task. C9 acts as a commutating capacitor in that there is a finite time that Q4-11 remains a logical one after triggering Q9 on. When Q4-11 goes in the negative direction it causes a negative pulse to appear at the base of Q14 via Q13 and Q12-12, turning it off. The collector of Q14 goes to about 5 volts which is fed to the reset gates of Q4, Q5, Q6 – making all the outputs of these ICs go to zero. We have completed the cycle!

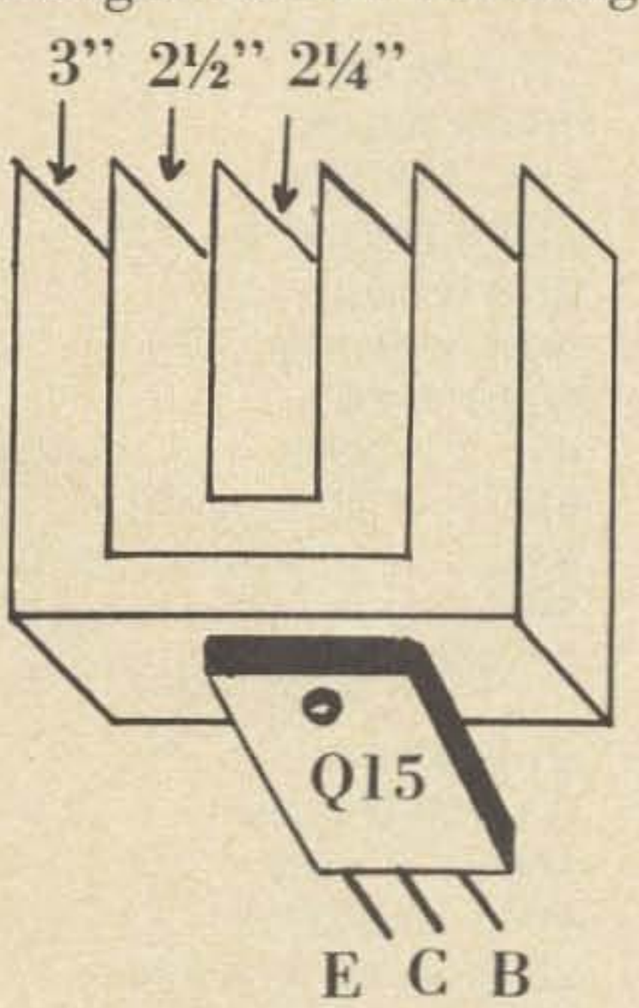

Fig. 2.

The simple but adequate power supply, with acceptable ripple and good regulation, provides all the voltages necessary to operate the unit. Zener diode, D1, acts as a simple overvoltage protection device. Don't leave it out! Should Q15 short, Vcc will become high enough to make the lives of the integrated circuits very short indeed. With D1 in the circuit, if the voltage rises above the zener breakdown point of the particular device installed, the fuse will blow before any damage can be done to the ICs.

Q15 must be attached to a heat sink. Either a commercial device can be used such as IERC PA2 or Thermalloy 6106; or the device can be properly mounted to the chassis using the mica washer and silicone grease; or you can fabricate a heat sink from strips of .062 aluminum 3/8" wide (Fig. 2). The strips can be bent in a vise or with pliers, drilled to clear a #4 screw and sprayed black. Spread a little silicone grease between each formed strip then attach the transistor to the assembly using the mica washer and the grease and tighten the whole assembly together firmly with a #4 screw and nut and the Belleville washer that comes with the transistor. Be sure that the voltage at the emitter of Q15 does not exceed 5.5 volts *before* you connect it to the Vcc buss. The IC circuitry draws 250 mA at 5 volts.

You may or may not require the low pass filter installed in the 117 vac line. Some of the appliances plugged into the same line as the Identalert caused inadvertent zeroing of Q4, Q5, Q6. In no case did any of the author's amateur radio equipment being turned on or off introduce transients into the Identalert.

Other than waiting for many 10 minute intervals to pass, which can be tedious, the fastest way to check out the Identalert is with an audio oscillator feeding directly in Q1-5. Unless you have a high power oscillator remove C1 and R2 from the signal path (lift ground end of these components temporarily). Under this condition all that is required is a signal of 1 v rms. To check short term (several hours) accuracy of the timer an electric clock is fine but I have found that the long term accuracy of several new and old electric clocks I have leaves something to be desired. The fact remains, though, that if your connections are correct as per schematic you must get the proper timing. There are no device or temperature limited parameters involved in this circuit.

Operating the unit is simplicity itself. Apply power to the unit via S2, press S1. When S1 is released the timing cycle starts. That's all there is to it; no warmup, no waiting for easily remembered time marks, no fuss!

IDENTALERT PARTS LIST

Q1	SN 74121 IC
Q2	SN 7492 IC
Q3, Q4, Q5, Q6	SN 7490 IC
Q7, Q8	SN 7442 IC
Q9, Q10	2N5060 SCR HEP R1001
Q11	2N4870 Unijunction HEP 310
Q12	SN 7404 IC
Q13	SN 7410 IC
Q14	2N706 Silicon switching transistor or equal HEP 50
Q15	MJE 520 HEP 245
D1	6.2 V 10% zener 1N5234A HEP ZO214
D2, D3	1N4001 silicon rectifier 50 PIV 1 A HEP 154
D4	1N5232B 5.6 V 5% zener HEP 603
D5	1N34 germanium diode or equal Sonarlert SC 628-Mallory
F1	½ A fuse
T1	Transformer 25.2 V C.T. Stancor P8180
R1	1K ¼ W 10%
R2, R7	180 ¼ W 10%
R3, R13	15K ¼ W 10%
R4	220 ¼ W 10%
R5	25 5 W 10%
R6	2.7K ¼ W 10%
R8	680 1 W 10%
R9	470 ½ W 10%
R10, R12	68K ¼ W 10%
R10A	68K ¼ W 10% for alternate
R10B	39K ¼ W 10% for alternate
R11	27 ¼ W 10%
C1	5 uF @ 10 V
C2, C6	0.1/100 V Mylar
C3, C4	100 uF @ 15 V
C5	1000 uF @ 25 V
C7	25 uF @ 15 V see text
C8, C11, C12, C13, C14, C15 C16, C17, C18, C19	discap 0.1
C9	0.005 mylar
C10	0.027 mylar
S1	SPDT push-button switch
S2	SPDT
S3	SPDT slide or toggle (use DPDT for alternate ckt)
PL1	Lamp 28 V @ 40 mA (CM22-02-05-11 or equal—Chicago Miniature) or 1819 lamp
L1, L2	2 uhy choke (25T #22 wire, ¼ in. I.D.

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Amateur mobile equipment, in keeping up with advancing technology (solid-state FM rigs for example), are no longer 50 pounds of trunk mounted transformer iron. Also, many transceivers are capable of operating either from a 120V ac source or the 12V mobile battery.

Therefore, when leaving your car, why not carry your rig with you. . .and eliminate the possibility of having it "ripped off?" One method of doing this, as shown in the photograph, is to bolt the equipment into an attache' case. (Most executives carry such a case only to impress their neighbors or inflate their own egos, while actually the contents consist of a ham sandwich and a Playboy magazine.) Power and antenna connections are made via appropriate plugs mounted on the bottom or end of the case. And. . .don't be afraid to drill holes in your nice expensive conveyance. After all, it is being put to yeomanly duty as attractive protection for many hundreds of dollars worth of equipment.

. . . W3WTO

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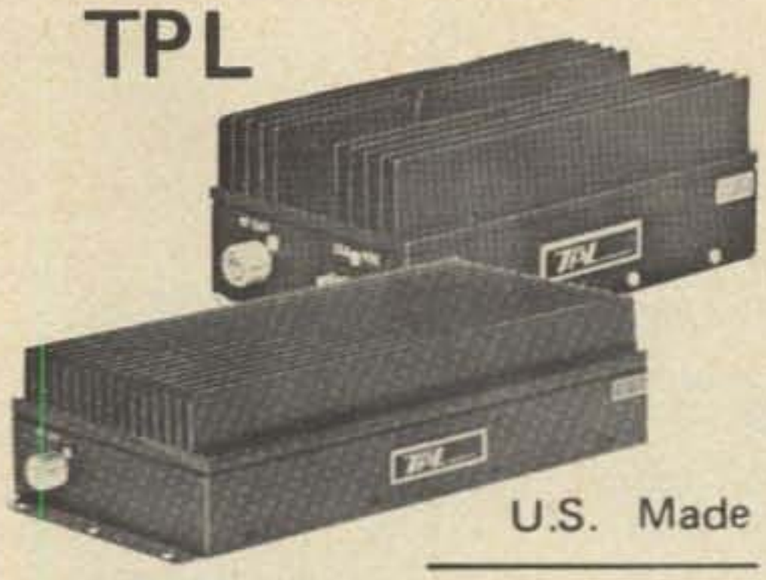

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TWO METERING A HUSTLER

It all started when I decided to increase my simplex channel 2 meter coverage as well as improve repeater performance in some of the marginal areas. The 19 inch quarter wave whip on top of the station wagon had to go, but what should replace it?

The problem was, the ¼λ whip just cleared the garage entrance and a 5/8λ antenna would have all kinds of problems in getting through. A midnight homecoming would hardly go unnoticed, as the whip clunks along the raised overhead garage door. The thoughts of unscrewing the 5/8λ antenna each morning and night to get the car into and out of the garage left me cold.

After several weeks of cogitation, the thought occurred: Why not devise a 2 meter antenna that folded over like the lower frequency 10 through 80 meter mobile antennas? Having a "low band" Hustler, I decided to see what could be done with it.

Folding over the low band Hustler to get the car into and out of the garage is no big deal, it takes about five seconds and I have been doing it for years.

The challenge, of course, was in figuring out how to adapt the Hustler for 2 meters and at the same time, have it available for low band operation. There are many of us who still like to operate the lower fre-

quencies, especially on long trips.

The solution that I arrived at was to convert the Hustler to a "J" match for 2 meters as shown in Fig. 1, and add a half wave radiator in place of the low frequency loading coil. The adaptation is simple and can be accomplished in several hours. The cost will vary from nothing if you have a good junk box, to under $10.00.

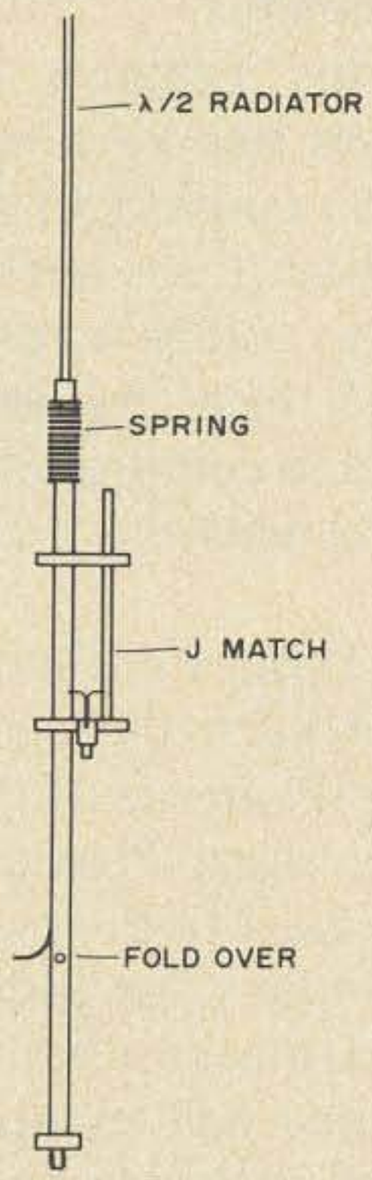

Fig. 1.

The coil spring is a good investment in any event. It is desirable for use with the 40 and 80 meter loading coils and essential for use on 2 meters. The length of these antennas is such that tree branches will occasionally be struck at high speeds and the impact can be destructive unless the coil spring is used.

The 2 meter antenna has been designed to be just a few inches shorter than the 80 meter radiator. The objective is to develop as much height as possible for the 2m antenna and a good place to stop is at a point equal to the longest low frequency antenna.

Also, moving the J match any higher could get it too close to the loading coil and affect low frequency operation. Any VHF addict recognizes that antenna height is a very important parameter, and this antenna is designed to achieve maximum height for mobile operation. If anyone objects, the antenna can be made any length shorter by sliding the J match down to a lower point on the Hustler mast and cutting the top section so that it is ½ wavelength (38") above the J matching section.

The top section is a 6, 10 or 11 meter whip cut down to 33½" and terminating in a 3/8-24 threaded stud. There is a slight problem in connecting it to the coil spring because it also terminates in a 3/8-24 threaded stud. A 1" long adapter with a 3/8-24 female thread provides the connection. The one in my junk box was purchased from a radio store several years ago but I haven't seen them listed lately.

In the worst case, any machine shop can easily make one for you out of 1" diameter aluminum stock or buy the drill and tap and do it yourself. The 19¼" J bar is 3/8" outer diameter aluminum obtained from an old TV antenna. The bottom of the J bar is grounded to the Hustler mast via the aluminum strip. A similar strip made out of plastic near the top of the J match is used to keep the J bar from vibrating. Clamps are fabricated out of 1/16" thick and 1/2" wide aluminum to fasten the J bars to the horizontal strips as shown in the detailed drawing Fig. 2.

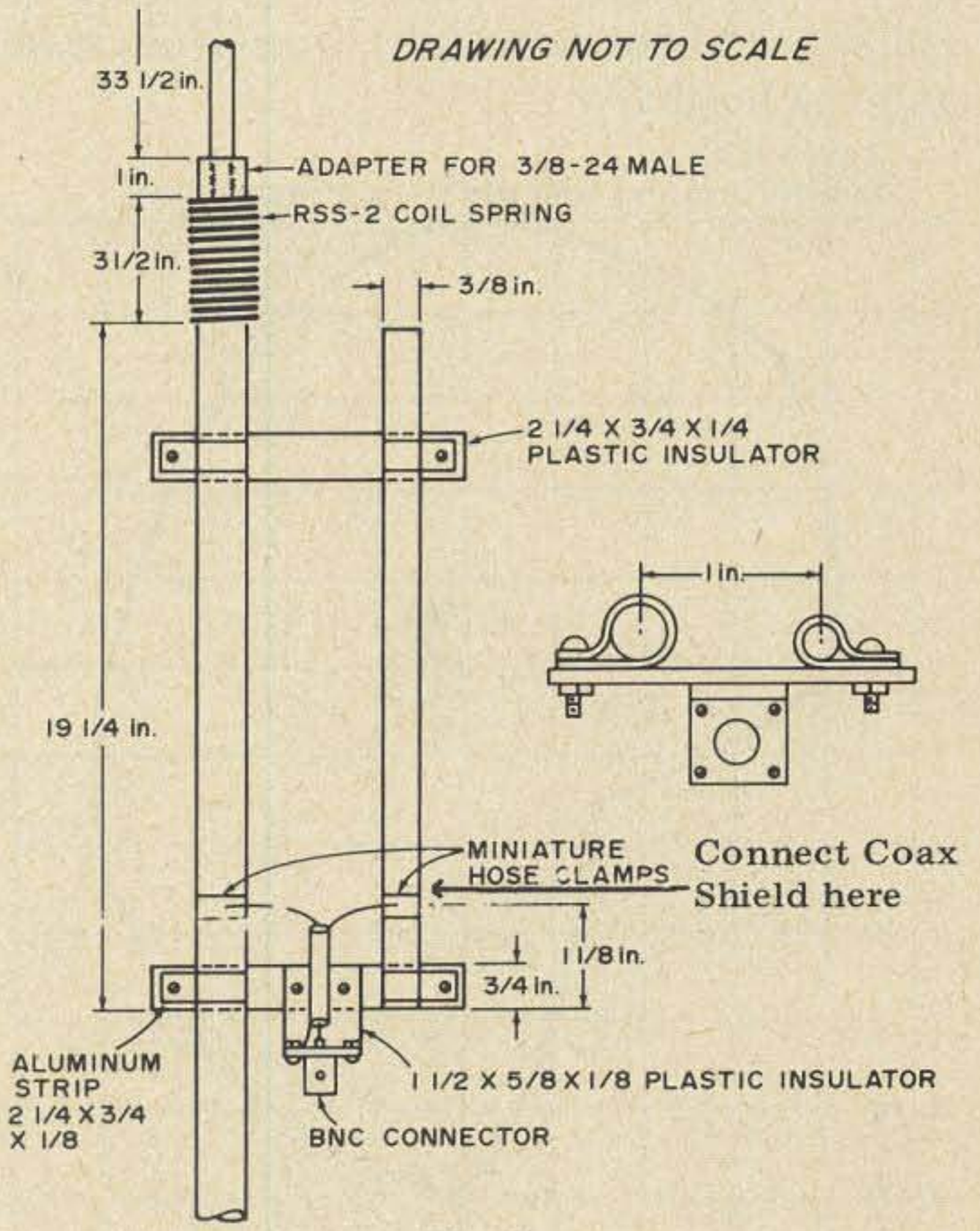

Fig. 2.

A quick disconnect BNC chassis mounting type connector has to be mounted on the shorting strip and insulated from it. This is accomplished with the 1¼" x 5/8" x 1/8" piece of plastic. A 3/4" x 3/4" piece of angle

aluminum holds the BNC connector on the plastic insulator. Be certain that the connector is not shorted to ground or you will have trouble getting the SWR below 1½ to 1.

RG58U interconnects the BNC to the tap points on the J match. Drilled holes and self-tapping screws could be used to attach the coax but I preferred using very small size hose clamps. The dimensions given should result in a low SWR. With some fine adjusting I have been able to bring my SWR down to 1.1 to 1.

All of the small hardware and coax connection points should be coated with RTV or similar material to prevent the inevitable corrosion that occurs with time and bad weather.

The gain of the antenna compared to the ¼λ whip is a significant 4 to 6 dB except at one point where it drops to 2 dB. The radiation pattern is shown in Fig. 3, and was taken by rotating the auto in an open field four miles away from the home base receiver. A precision attenuator was used to make the measurements. Two to 3 dB of the gain is derived from the ½λ versus the ¼λ radiator and the remainder from the greater antenna height.

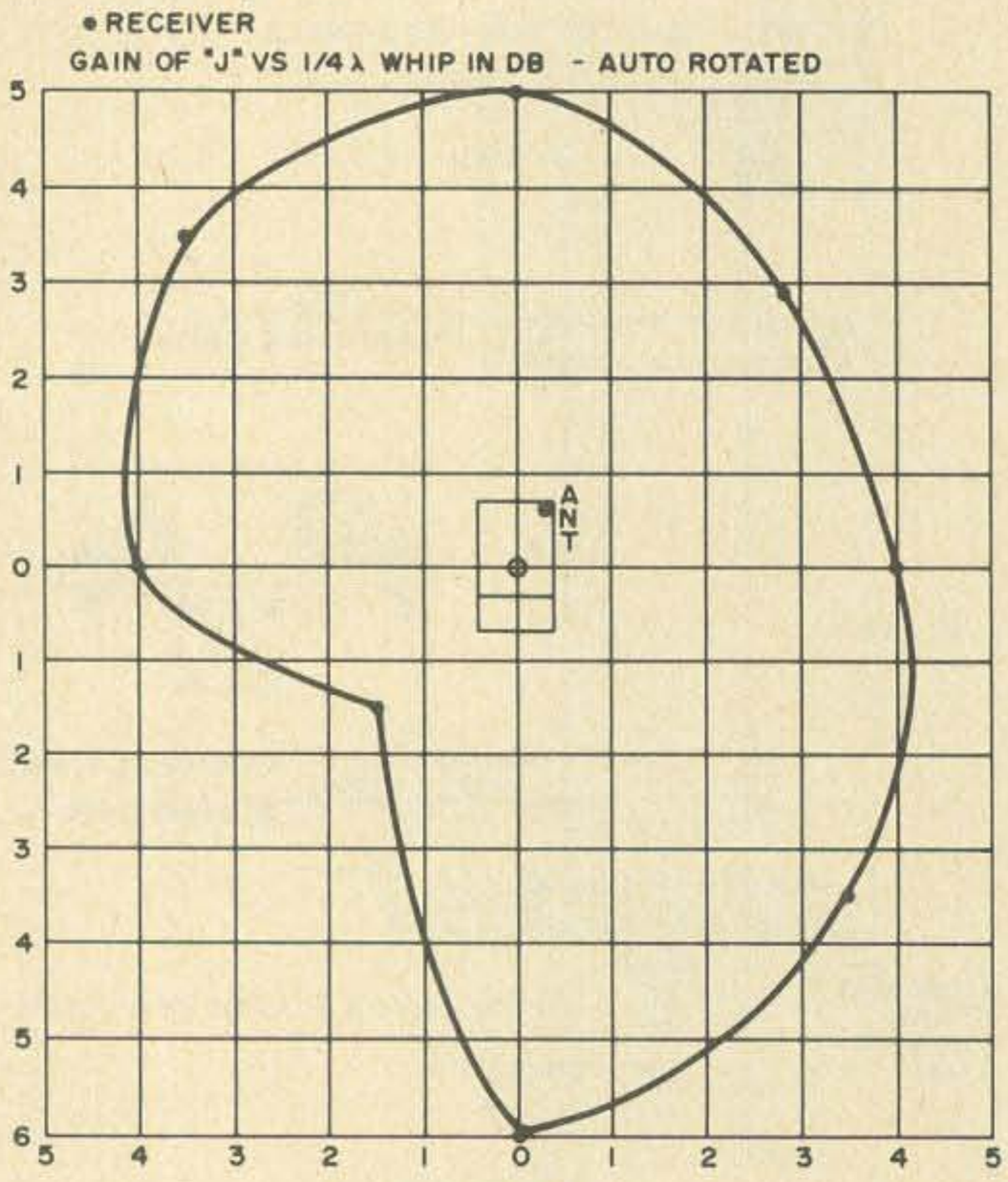

Fig. 3.

The unsymmetrical radiation pattern occurs because the Hustler is at the extreme end of the vehicle and because there is some radiation from the J match. Rotating the J match alone produces a 2 dB variation in signal. It should be possible to rotate the J match to produce a more symmetrical pattern but this was not tried.

For esthetic reasons and to keep the wind resistance down, the J match was oriented in line with the direction of motion of the car, thus the antenna appears as a single element when observed from the front or rear. When viewed from the side, it can generate some interesting comments.

There is one negative aspect to this antenna. It does require a separate RG58U coax feedline to connect to the J match for 2 meter operation. I was not able to think of a simple way to utilize a common coax for both low and high frequency operation without too much compromise. I'll leave this potential improvement as a challenge to the reader.

Meanwhile I run my 2 meter coax under the car, up between the car body and the bumper, along the inside of the tail light and up the Hustler mast. Plastic clips, or vinyl tape holds the coax to the mast. There is the option to run the coax inside the car and mount a BNC connector just an inch or two from the antenna ball mount. Then, just a shorter piece of coax will be visible running up the mast.

The switch from high to low frequency operation is quite simple and takes only ten seconds. Remove the 2 meter top section and replace it with the appropriate low frequency loading coil and radiator. Disconnect the 2 meter coax at the J match and move it away from the mast. Coil it out of the way. The J match is left untouched.

To go from low frequency operation to high, follow the procedure in reverse. Since you can't operate 2 transmitters simultaneously, 10 seconds is a small price to pay for having one convertible antenna and is little more effort than changing low frequency band operation.

The effects of leaving the J match in place for low frequency operation are immeasurable. The resonant frequencies and SWR's did not change by any measurable amount on an 80 and 20 meter test. This is readily understandable when you consider that on low frequencies, the 19" J bar is in parallel with the mast and sufficiently

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spaced from the loading coil to have no capacitive effect.

The results on 2 meters have been gratifying. My simplex channel buddy reports that he no longer loses me on the way to work in the morning. On weaker signals, flipping back and forth between the ¼λ whip and the J makes the difference between hearing them and not.

What is presented here is not original by any means. The J antenna has been around for many years. What is new is the adaptation to an existing product which many of us already own. The same concept could undoubtedly be applied to other manufacturers' low frequency mobile antennas. It's nice to be able to put out a solid signal and get the car into the garage too!

. . .W3HTF

Bill Pasternak WA6ITF
Associate Editor

Can Those Split-Split Channels Work?

It's needless to say that Two Meter FM is the hottest thing to hit the amateur radio world since the advent of SSB. In large urban areas, such as New York, Boston, San Francisco and Los Angeles, the growth pattern is easy to follow: Just listen to the number of new callsigns appearing daily on your local repeaters. Newcomers, Old-Timers and everyone in between are buying Two Meter radios and getting their share of the "Fun Mode." In some areas the overcrowding is getting to the point where the local Repeater Councils are being put into the position of reassessing the band-plan/activity amount ratio in order to find a way to sanction new repeater systems. One of the solutions being seriously considered is the split-split or 15 kHz separation repeater.

Before going any further, it may be best to explain what a split-split repeater is and where the term comes from. In the days before the national adoption of what is known as the Modified Texas Plan, areas that had some form of standardization used channels that were 60 kHz from one another with 600 kHz spacing between input and output. As the need for more channels grew, along with the need for some form of national standardization, the 60 kHz channels were "split" and we now had twice the number of available channels, separated by 30 kHz and still retaining the 600 kHz separation between input and output. For the past two years this has more than supplied the needs of most cities — even one as large as Los Angeles. However, it is apparent that no leveling off point for the number of amateurs coming to two is in sight, and as their numbers increase so do the demands for new repeaters. Again, the most logical approach you might think would be to again "split" from 30 kHz to 15 kHz separation between systems, and again double the number of channels. You do not need an electronic calculator to do the math on that one. But hold it! Is splitting again the best solution? While I do not claim to be an expert on the subject of split-split repeater systems, I suspect that I might be a bit more familiar with the pitfalls that may appear when such a system is being put on the air — since I had the dubious honor of being the first to try such (along with my good buddy Larry Levy and the rest of the Kings County Repeater Association). For better or worse this is the story of WA2ZWP, how it got started, why we wound up on a split-split channel and, most important, what we learned in the process.

WR2ACV, as it is now known in New York City FM circles, began about 2 am one cold January morning in 1970. Even the original members of the KCRA are probably not aware of that. Larry and I had been putting in some long hours in our TV service business and had stopped on our way home to grab a late-night snack before going forth to grab forty winks. We were both very active on the WA2SUR system (now WR2AAA) but with SUR's phenomenal growth it was getting hard to keep a QSO of any length going with ourselves or our friends. That evening Larry suggested that he and I put up our own repeater; we discussed the possibilities with regard to our available time, shrugged, and for the moment shelved the idea. Though we discussed the matter from time to time over the next eight months, it was not until Larry had interested a number of other amateurs and (through one of them) procured a site that the KCRA was officially formed and work begun on the machine. During that time the Northeast Repeater Association had been formed and by the time our group approached them for an allocation, all standard 30 kHz split channels had been assigned. We were left with the alternative of accepting a split-split channel pair or scrapping the whole project. We elected to go with what we could get, and that turned out to be 146.205 in, 146.805 out. In May '71, after a month of part-time on the air smoke testing (and that term is in no way used loosely) ZWP went into full operation and we started to learn a lot about the world of split-split systems — from both the owner and the user standpoint.

In regard to the latter, those of us using converted two-way commercial equipment found little or no problem using the system. About half of us were running mobile with various Motorola or RCA radios, and to us ZWP was like any other machine. On the other hand, the rest of ZWP's inhabitants, who were using the "made for amateur radio use" type transceiver, suffered severe co-channel interference from both .19-.79 and .22-.82. This held true for both American made as well as Japanese import transceivers. The cause of this problem was the lack of i-f selectivity exhibited by this equipment and, in a number of cases, changing the ceramic i-f filter and its associated components proved to be a cure. Radios using the Murata filters were the easiest to change since Murata has an office in New York and was able to supply direct replacement filters with steep selectivity curves. Changing from the factory supplied "B" filter to a series

"F" filter solved the problem in my IC-2F Base Radio. Since much of the equipment now available was not on the market during the time that ZWP operated .205-805, I cannot give any evaluation on other newer equipment. Suffice it to say that if you intend to operate on a split-split system be prepared for the possibility of extensive modification of your radio if it is of 1972 or earlier vintage. Simply said, you will need a receiver with very narrow i-f bandwidth, comparable to a Motorola "A" Strip using a Narrow-Band Permakay filter. That's about plus or minus 5 kHz deviation acceptance, 10 kHz overall! A "tight" front-end won't hurt matters either.

In this respect a word of caution. In many radios, especially the imports, making the necessary modifications may not be easy if you are not thoroughly acquainted with the art of working on a tightly packed circuit board chocked full of easily damaged miniature components. If you have never tried it before, I seriously suggest getting someone who has the proper experience to do it — or let the manufacturer's representative perform the work. You may have no idea how easy it is to create an expensive repair bill for yourself in that way. This is one time you should let the experts do it and pay whatever it costs. It will probably be cheaper that way. Not only is the new narrow filter needed, but modification to the audio and squelch circuits for proper audio recovery and squelch circuit action is also necessary.

So far we have discussed the split-split repeater in relation to its users. How about its effect on the rest of the FM community? Initially, it was a disaster, especially to the two systems on either side of us. Our deviation peaks were playing havoc with .19-.79 and .22-.82, even after careful checking with a deviation meter. As the newcomer, and in order to live in harmony with the rest of the systems, we finally dropped the average deviation level to 4 kHz and went directional in our antenna system. In turn, this limited our coverage area and many people complained that the repeater's audio seemed low. Well, it was — part of the price we had to pay for being on a 15 kHz channel.

Had we owned something like an Altec Audio AGC Amplifier-Processor we could have remedied the situation. Ah, but they cost the kind of money not found in amateur circles. This broadcasting industry device permits you to have a constant audio output amplitude level, regardless of the input level. I now have one of these gems sitting in the closet and I can assure you that it will be part of any future system I put up, regardless of band or split.

When we planned ZWP, we hoped it would become an alternate SUR, and to that end had installed a Super-Stationmaster as the receiving antenna with the intention of eventually purchasing a Duplexer for the system. When the co-channel interference problem became evident and forced us to go to a directional transmit pattern, that dream sort of ended for me. I think we were lucky in that the two other systems were to the west of us, and, using a final combination of a 3 element vertical beam and a 3 dB gain vertical fed through a co-phasing harness, we were able to create a bearable though not perfect compromise. Keeping the transmitter power at about 20 Watts out also helped, but frustrated many users in peripheral areas of our coverage. The machine could hear a lot more than it could talk to, but it had to be that way in order to survive at all. It also created some rather weird deadspots in our prime coverage area. In fact, it was possible to drive east along Atlantic Avenue, still have the Williamsburgh Bank Building in sight (the former home of the machine) and not be able to hear it — a fact that a number of users will attest to, myself included. Yet with all its problems it still managed to cover Brooklyn, Queens and part of Long Island's South Shore fairly well. Not the super-repeater of our dreams, but something better than nothing. If we proved anything in the year that ZWP was on .205-.805 it was that a split-split system could exist in even as densely repeaterized an area as New York City if we were willing to make a lot of sacrifices. That's where things stood in September '72 when I left New York and moved here to Los Angeles.

As a point of interest, ZWP (now WR2ACV) has found a better way to survive — thanks to a rather dedicated number of supporters who wouldn't give up. In November '73 the machine came back on the air after almost nine months of silence. In the interim a number of changes had taken place, in the form of a totally solid-state system, a new site in lower Manhattan and a shift to a one megacycle separation pair of 147.43 in, 146.43 out. This was quite an improvement over the system I had said goodbye to (as I recently found out on a trip to NYC). In this you have the final chapter of the original WA2ZWP, as far as I know the first "big-city" split-split repeater.

What did we learn from all this? First, anything is possible if you are willing to pay the price. In our case, the cost was both limited coverage and adjacent channel problems for many of our users. The split-split system will work if you are willing to hold to the limitations it entails. First, don't try to put a wide coverage system on such an allocation. If you need wide coverage then either make use of one of the established systems or, if you simply must own your own repeater, put it on 220 MHz. Heaven

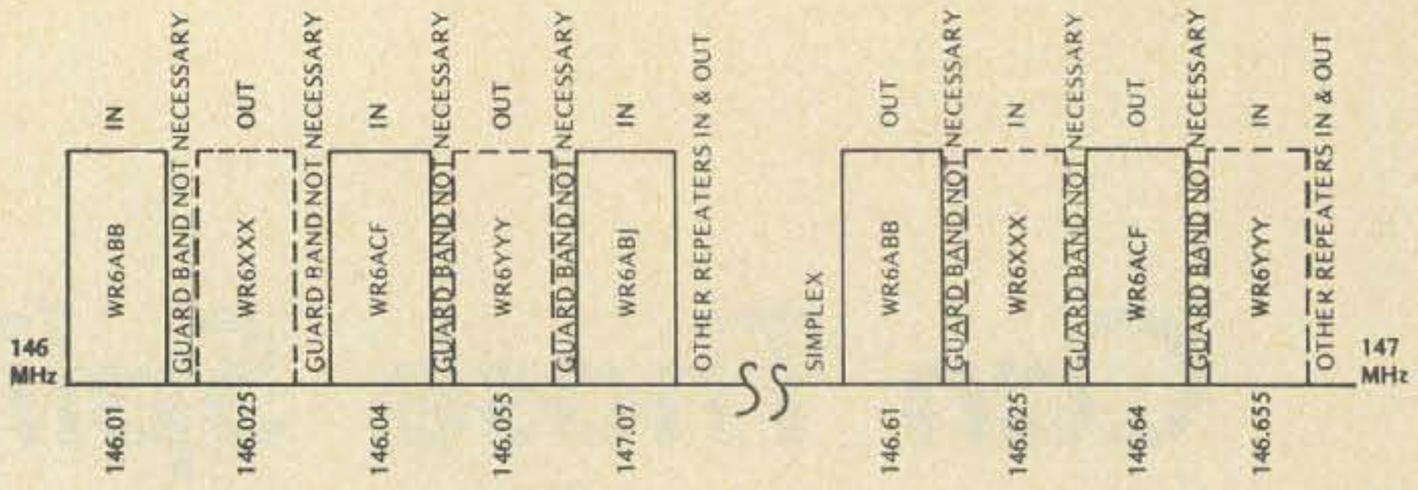

Fig. 2. The MWRA Inverted Split-Split plan using existing Southern California Repeaters. Note that the user's receiver sees a clear 30 kHz channel at all times unless close to a station on the input to an adjacent repeater. This plan has been adopted and implemented by SCRA for Southern California.

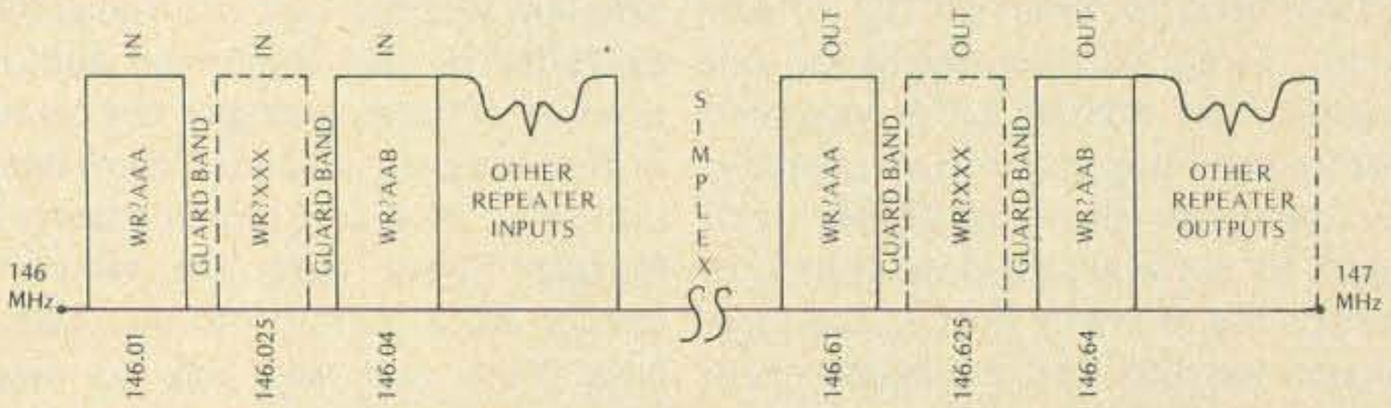

Fig. 1. The ARRL adopted Modified Texas Plan showing 15 kHz splits implemented and assuming 5 kHz deviation. Assuming nominal 20 kHz user receiver bandwidth, massive interference can result necessitating modification to user's radio.

knows we need as much activity up there as possible. However, if Two Meters is a must for you, then I can only suggest that all parameters be carefully considered before erection of such a system. Carefully analyze where all your prospective users will live and what areas they normally cover in their daily routine. Then choose a site that will afford the proper coverage while utilizing the minimum necessary power for good quality communication. In cities such as Los Angeles and San Francisco we have an advantage in terrain type which may prove to the benefit of this type of allocation: Mountains and valleys. Using .205 – .805 as an example, if I were to put such a system up to cover the San Fernando Valley where I live, I would put it on the tallest structure I could find at the base of the Valley – not on one of the surrounding mountains. It is doubtful that such a system sitting 100 feet above street level would bother .19 – .79 in Anaheim or .22 – .82 in Pomona, both about 50 miles away. Running nominal power, it could cover this area far better than simplex and yet the mountains would act as a natural shield, containing the transmitted signal to this area. On receive, they would have the same effect in relation to the two other systems, minimizing co-channel interference problems. Using a site atop one of the mountains would most likely play havoc with the other systems. Along the same line of thought, it will be necessary for repeater councils considering the sanction of such allocations to assign frequency pairs that are as geographically separated from established systems as possible. Also they must establish operating parameters before making such assignments, and enforce their decisions. In amateur radio, peer pressure is the best weapon.

From the foregoing, you might get the impression that using split-split channels in areas with heavy repeater density (areas where there are no more 30 kHz channels to be had) can lead to more problems than it can solve. Well, give hams what seems to be an insurmountable problem and someone always finds a solution. There had to be a way to utilize all those vacant 15 kHz channels and do so with a minimum of impact on those already on the air, both repeaters and users. This was the problem that faced Southern California and its repeater coordinating organization last January. The Southern California Repeater Association had a long list of applications for two meter channel assignments and no channels to give out. They had run out of available spectra two years earlier. A decision was made to issue the tertiary 15 kHz channels, but based on a suggestion made to the SCRA by Bob Thornburg WB6JPI, President of the Mt. Wilson Repeater Association (and after careful consideration by the SCRA Technical Committee), SCRA elected to issue the tertiaries on an inverted basis.

Under the MWRA* plan, the inputs of the tertiary allocations are put between the outputs of existing systems and the outputs of the tertiaries are between the inputs of existing systems. This means that the average user's receiver always sees a clear 30 kHz slot unless his next door neighbor happens to be transmitting on a repeater input 15 kHz away, and in that case it would take more than a narrow receiver to solve this problem. If some interference does occur between systems, then only the receiver of the repeater will require an up-grade in the selectivity department – or an adjustment to the repeater transmitter's deviation. In 99% of the cases, the user will be unaffected and will not have to go through the agony of tearing into his radio. Sounds nice you say, but can it really work?

Probably the busiest open repeater in the United States is the Mt. Wilson based WR6ABE system that boasts close to 600 users at present. Due to its location on Mt. Wilson's broadcasters' row, Burt Weiner K6OQK was forced to put ABE on a rather non-standard frequency pair in order for the system to function without interference to or from other electronic inhabitants of the mountain. ABE's input is 147.435 MHz, technically a split-split channel. (Its output is 146.40 MHz in case anyone is interested in using it on a visit to LA. All are welcome.) Not quite two years ago, another repeater, WR6AAB, came on the air utilizing 147.500 for an output. This put AAB's transmitter but 15 kHz from ABE's receive frequency. Initially, there was some minor interference to ABE, but Burt simply called Dave, the owner of AAB, and the two of them solved the problem in short order. This was because there was only one transmitter interfering with one receiver and the owner of each was competent in the fine points of two-way radio communication. It was two people working together which solved the problem, saving a couple hundred users from running out to get their radios modified as would have been the case had it been two repeater outputs interfering with one another.

While this is by far the best plan to date for utilization of the 15 kHz split-splits, and one that Burt and Bob deserve a lot of credit for coming up with, it is by no means a carte blanche cureall. What I said before about the responsibility of repeater councils to be judicious in geographic spacing still holds true, as it does for site location and keeping a careful eye on those deviation peaks. In fact, it puts the same burden for proper system maintenance on all existing systems as well as the new systems. Why? Well, when all the tertiary splits are assigned and operational, all repeaters will be split-splits (technically) in relation to one another. This will force the system that has been thinking of narrowing its receiver bandwidth to do so, as well as to keep a sharp eye on its transmitter's deviation. All systems, new and old, will be forced to follow the same parameters, but the inverted split-split plan negates the problem to the user. It puts all responsibility on the repeater owners. With tight receivers, you will find that your users will be wandering off frequency a lot less often. Perhaps an automatic on-channel ID tone similar to the one used on WR6ABN and described by Art Gentry W6MEP in QST Magazine will be a great aid in corralling your users on your channel. If I had ZWP to do over again, I would have gone .805 in, .205 out. Who knows, had we thought of it then, it might still be there now.

The SCRA has already implemented the inverted split-split system that we might here dub the MWRA/SCRA Plan, and at the outset it appears to be a success. It will take time to know for sure and I will do my best to keep you all informed through Looking West. By the time you read this, WR6ACK will have moved to .805 – .205, to clear their present channel for a wide coverage Baja California repeater, and another system is already in the works for 147.705 – .105.

If all this seems unfair to you, I agree, but it is a necessity if the split-split type allocation is to survive. You might ask yourself the question, "Why should our group be forced to

*For a free copy of the MWRA Plan, send a SASE to: Mt. Wilson Repeater Association, P.O. Box 10193, Glendale CA 91209.

live with restrictions that don't face others?" The answer is that you are late getting started in the game and you are being handed whatever is available. You are the newcomer and there are many ahead of you. Working within the known limitations is a heck of a lot better than not having a system at all. Don't try to cover the world with a split-split system, as it is easy to make enemies quickly that way. That's the last thing you need. Remember that you may be the first in your area to be assigned such an allocation, and everyone's eyes will be on you. Do things right and you may become famous for pioneering a new frontier in your city.

Are there alternatives to the split-split? The best one I know of is to foster interest in the development of 220 MHz systems. At this writing Southern California accounts for better than 50% of the 220 activity nationwide and has found it to be far superior to Two Meters. Also, if 450 MHz is not overpopulated, consider helping populate that band. (Forget it in California; we already need an additional 10 MHz up there to handle the existing activity!) 450 is even superior to 220 in what it will cover. And don't forget good old Six Meters. There is cheap equipment aplenty and that band in most areas is all but deserted. If we don't populate it soon, someone might get the idea that it would be a good place for another CB band.

Another alternative might be a total restructuring of the Two Meter FM Repeater sub-band as is being experimented with by WR2AAA and WR2ACV in New York City. Technically, a 1 MHz separation between input and output is far superior to the present 600 kHz, and you could put a repeater every 20 kHz without much chance of co-channel interference. You could get a few more repeaters in that way, especially if you shift all simplex below 146 MHz. On the other hand, the cost of implementing such an idea on a nationwide basis would be quite high in relation to the benefits derived. That is, if you could ever get the whole country to agree on the switch. How many years did it take us to agree on the present system? Oh yes, and what about all those synthesized radios designed around a 600 kHz offset? Well, many of them will require some modification anyhow, if split-splits proliferate.

Our final alternative is to petition the FCC to change the rules banning amateur repeaters below 146 MHz. That's not without its drawbacks, too. Just below 146 MHz is the part of Two Meters used for satellite communication and, unlike with a repeater, you cannot ride up to your favorite Amateur Communications Satellite to plug a new crystal into the receiver. Even if we could convince the FCC that we must expand down-band we must also remember that FM is not the only mode in use on Two Meters and we must respect the rights and interests of others. If you only operate FM on Two, you are missing a good part of the fun that band has to offer. There is a lot of interesting stuff between 144 and 146.

There might be other alternatives yet, but at this late hour I cannot think what they are. I suspect that the heavily populated areas will go the split-split route en masse and that they will do so soon. If you wind up with one of these allocations, I can only suggest that you strictly adhere to any parameters of operation set forth by your local Repeater Council and play it by the rule-book. In retrospect, I kind of wish there had been a rule-book back in January '70 when at some ungodly hour INM said, "Let's put up our own repeater." It's a heck of a lot easier to follow one than to help write one the hard way!

. . . WA6ITF

73 Magazine Staff

Saving the 15m Quad- By converting it to 20m

With the sunspot scene still on the decline and various scientific guesses about its low point ranging from mid '76 to mid '77, many OMs who enjoyed DX on 15 meters wish they had a good antenna setup on 20 meters. Although there doesn't appear to be much difference between antenna lengths on 15 and 20 meters, amateurs who have built cubical quad antennas will readily testify to the noted difference in structual size, rotator requirements, etc., between a 15 and 20 meter quad. For this reason, many amateurs choose to build a 15 meter quad while band conditions on 15 were still good for DX. Good DX openings on 15 are now becoming short in duration and more and more rare, and this situation will continue for several years.

The sunspot situation is not new, of course, but it brought to light again the methods amateurs used years ago to get their 10 and 15 meter antennas to operate efficiently on the lower frequency bands. One very interesting method was develòped by some European amateurs to do this with cubical quad antennas and that is the subject of this article. In contrast to the methods of inductive loading of cubical quads which have been presented in more recent years, no loading coils are involved and an absolute minimum of alteration to the cubical quad reflector and driven elements is necessary.

The basic idea behind the conversion scheme is shown in Fig. 1. Fig. 1(a) shows a single quad element as it normally appears. The total circumference is somewhat over a wave length at the operating frequency. One can think of the quad element, for a moment, as a folded dipole antenna where the two parallel wires have been pulled apart to form the diamond shape. As in the folded dipole antenna, the high impedance points appear at the end of the antenna or in the case of the quad, at the right and left corners as shown in the diagram. If the corners are tucked in, as shown in Fig. 1(b), the current flow is still in phase in each of the two parallel conductors. The resonant frequency of the antenna will therefore also remain approximately the same as when the two parallel conductors are replaced by a single conductor connected to the high impedance points on each side of the quad. The final form of the shortened quad is shown in Fig. 1(c). The idea is really not very new. Some amateurs may remember similar lengthening schemes being applied to folded dipoles when those antennas were the "latest" thing.

A practical application of the foregoing scheme is shown in Fig. 2 as applied to both the driven and reflector elements of a 15 meter quad that is to be converted for operation on 20 meters. An approximately 10 foot long piece of wire is run from each corner of the driven element and reflector along the plane of each element and then parallel to the boom. Where the wires run parallel to the boom, they are spaced about 15" or so apart. These wires have to be trimmed in the tune-up process so they should be initially connected together at the center of the boom as simply as possible by some insulating material. Plastic clothes line (the kind without a metal core) will suffice. Any of the usual tune-up methods for a quad can be used but a simple one involves only the use of a grid-dip meter. If a grid-dip

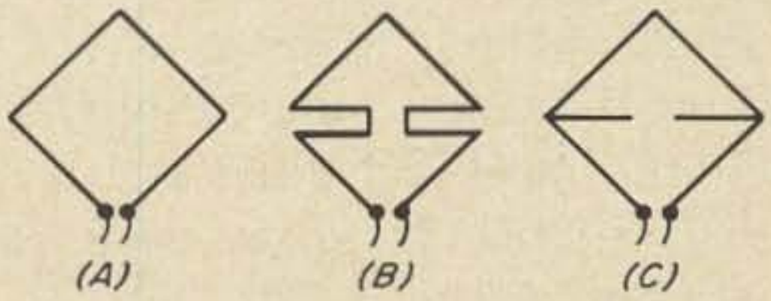

Fig. 1. Development of a folding technique for loading of a cubical quad element.

meter is used, check its frequency readings first on the station receiver. Some of the cheaper kit types easily can be off in calibration by a whole amateur band and that is not going to suffice for antenna tune-up purposes!

A grid-dip meter is connected directly in one of the antenna elements by winding a turn of the antenna wire around the coil of the grid-dip oscillator. The feeder line to the antenna is disconnected. First, the reflector element is tuned with the driven element terminals shorted. The two wires attached to the reflector are equally shortened until the grid-dip meter indicates resonance at a frequency about 5% *below* the desired operating frequency. The grid-dip meter is then used on the driven element and its loading wires trimmed to achieve resonance at the desired operating frequency. For those who are enjoying the outside weather while doing all this, a further refinement of the reflector tuning can be undertaken to achieve *either* maximum forward gain *or* maximum front to back ratio. They cannot both be simultaneously achieved. The 5% rule described above will suffice for practically all situations without further readjustment. The antenna may be fed as usual by coaxial cable either directly, or via a balun transformer. The bandwidth of the modified antenna will depend upon which segment of the 20 meter band the antenna was chosen to favor. If a typical quad is tuned up to the middle of the 20 meter band, the swr will rise to no more than 1.8 or 2.0 at the extreme band edges so the loading system has a minimal effect upon bandwidth. The typical 15 meter quad so modified can certainly be considered to have a usable bandwidth which encompasses the entire 20 meter band!

The results achieved with antennas modified in the above manner have all been reported to be very good. No exact measurement data is available, but it would appear that the forward gain of such a modified antenna is about 2-3 dB less than a full sized quad on 20 meters, which is a very reasonable figure. The only other difference noted between the modified quad and a full size one is somewhat increased side radiation from the modified quad. This is to be expected in view of the loading wires running parallel to the boom. The front to back ratio appears to be as good as that of a full-size quad. It should be noted that the converted 15 meter quad will automatically have an element spacing on 20 meters which is smaller in terms of wave length than that usually recommended for quad antennas. If the spacing was .125λ on 15 meters, it falls to .094λ on 20 meters. Although it would be unusual to have the possibility of extending the boom length on a modified 15 meter quad, if this could be done so that it measured .125λ on 20 meters even better results should be possible.

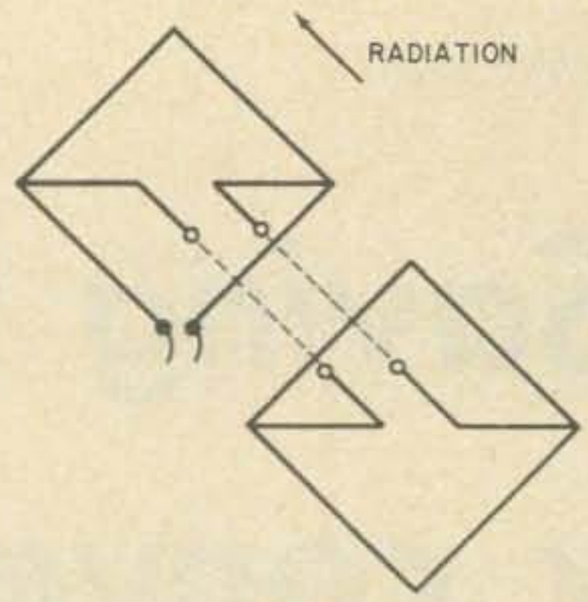

Fig. 2. Loading of the driven and reflector elements of a cubical antenna.

Two final questions may develop. How about a dual band quad by switching in and out the loading wires? And, can a 20 meter quad be converted in a similar manner for 40 meter operation? A dual band quad probably could be developed by some method of switching in and out the loading wires. Relay switching would be very difficult because the points of connection of the loading wires to the quad elements are both high impedance and thus high voltage points. Trap switching by means of 21 MHz traps at the connection points would seem to be the only possible solution. There is a greater jump in terms of wave lengths between 20 and 40 meters than there is between 15 and 20 meters. But, the loading scheme described should be just as applicable to the conversion of a 20 meter quad to 40 meters. Reduced bandwidth (relatively) and somewhat increased side radiation are to be expected in such a conversion but this may be an extremely small price to pay when one considers the enormous difference in dimensions between a 20 meter and 40 meter cubical quad.

. . .Staff

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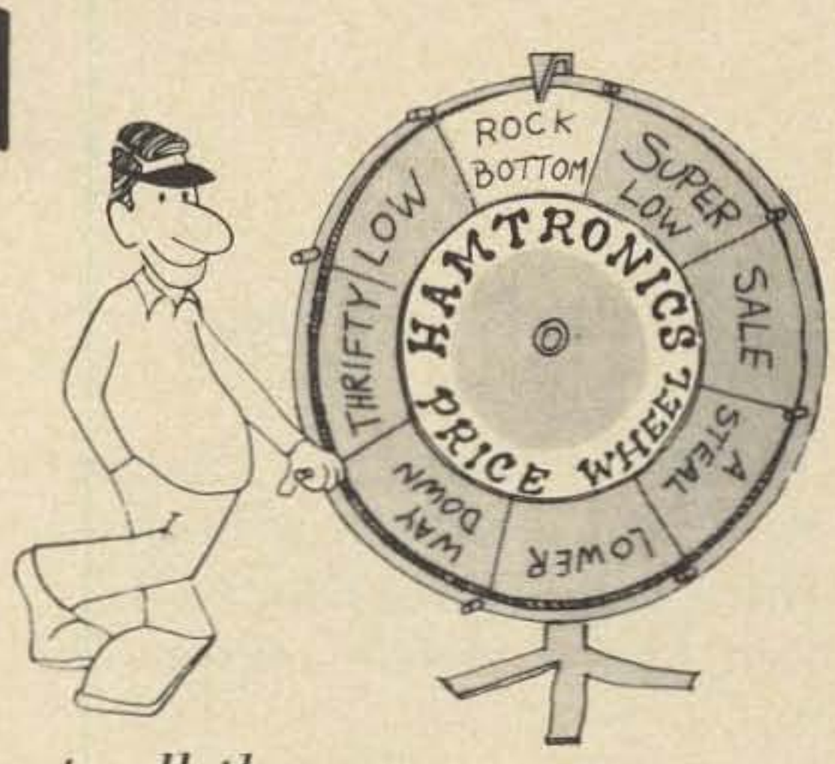

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The Rime Of The Ancient FMer

The Ancient FMer traveled to a hamfest with his mobile AM rig installed in his car.

1959

The tale of the ancient amateur
With rig covered o'er with grease
Who on his way to hamfest far
Said, "Lord, this din must cease."

"The QRM and QRN
For ears as old as mine
Cause headaches, gas pains, other ills,
Cured naught by dramamine.

"There must be sigs that crystal clear
Can enter ears so old,
Of such a mode that rings so true
I have ne'er been told.

"Methinks this mode called FM
Like taxis, police and fire,
It sounds so clear and trouble free
It may be what I desire."

So the FMer reviewed the magazines
And found a rig so true,
He pruned the coils and dutifully toiled
'Til finally said, " 'twill do."

The Preprogs and FMTRUs were examined until a workable unit was found.

1969

With crystals set on ninety-four
And squelch opened wide,
The ancient FMer set on his way
To travel the great Divide.

Having won a Sweepstakes ticket, the ancient one is freed from worldly tasks and starts a long vacation.

"Hello CQ," he cheery called.
But not a sig in sight.
"This rig be damned! This mode so grand?"
He turned the squelch down tight.

A tail burst through limiter stage,
"Oho!" he gladly cried.
Again and again it noisily sang, and
"We don't call CQ," the voice cried.

The ancient FMer makes his first QSO.

"I'll not offend my new-found friend,
But please, benevolent sir,
What are the rules, the hints, the tools,
Lest your wrath I incur?"

Like a stone the speaker sat dumb.
The FMer raged and cursed.
The speaker sat like a gnat,
As silent as at first.

The FMer learns the first rule of FM operation.

On he drove across the road
Into a town so bleak.
A QSO was in progress. He called . . .
Alas, his sig was weak.

"Try again," a voice came through,
"I can hear your signal clear.
Three-four transmit! Quick select it
And use the repeater."

A new aspect of FM is introduced to the lone driver.

"Repeater, what is this? It cannot exist!
A thing heard but not seen?"
"Yes, my friend," the voice did send,
"It is the great machine.

"Upon the hill it sits so still
'Til signal it doth detect.
Then retransmit it far and wide,
Giant antennas? No need to erect.

"Your 3-4 rock will hit the spot
Where receiver oven is tuned,
The greater range of your good rig
So greatly will mushroom."

The trick of using the repeater is revealed.

The ancient one looked in his rig
To find the crystal data,
And to the company sent a request
For a crystal to use the repeater.

The rocks arrived and put inside
The rig so grossly complex,

Another channel he installed
For repeater and simplex.

The FMer realizes the increasing sophistication of the hobby.

"Break!" he called and gave his call
As all on freq gave way.
"Emergency station, give your location
Give your traffic to save the day!"

"I only wanted to say halloo
As I passed your city location."
"Ne'er repeat your woeful deed
As 'Break' is for emergency stations."

The FMer learns his second lesson.

"QRZed" called the friend
On two meters as westward he rode.
"We don't use Q-Codes. We say 10-8."
And silence as the squelch closed.

Individual differences in operating become apparent in different locales.

The QRM it grew intense
In southern California
9-4 was a cacophony
Of stations with a mania.

Under each station was another
And yet there were still more.
The constant jabber, useless palaver;
Two meters became a bore.

Growing tired of so much talk was wearisome to his nerves.

"I must escape to a quieter place
With antenna farm up so clear
That I can escape from valley and cape
Yet still use machines far and near."

Age begins to tell on the old man.

1973

A magazine came on the scene
To tell of developments new,
And 'stead of surplus, commercial, junk box,
The imports were selling here too.

A new source of gear was revealed to the recluse.

"Smaller still than commercial swill,
And current drain so low.
This is the way to operate;
Multi-channel too? What ho!"

His interest revivifies itself upon reviewing the gadgets available.

To the city. . .What a pity,
The channels are so thick,
With intermod and other crud,
Clean signals one cannot pick.

Rice box, rice box, everywhere,
Everyone, foe and friend;
Rice box, rice box, everywhere?
Where will this mess all end?

Capture, capture, cried the box,
As signals weak were squashed;
Turn your antenna, this time we'll get ya . . .
"It's time my hands were washed."

He sold his rig and danced a jig
To a youngster with brand new call.
"220? 450? 1296?
I have done them all."

And so my friend, this is the end
Of an ancient FMer. No lie!
His timer has passed, and now, alas,
He's a control station at that machine
in the sky.

* * *

The OM contacts his final Repeater.

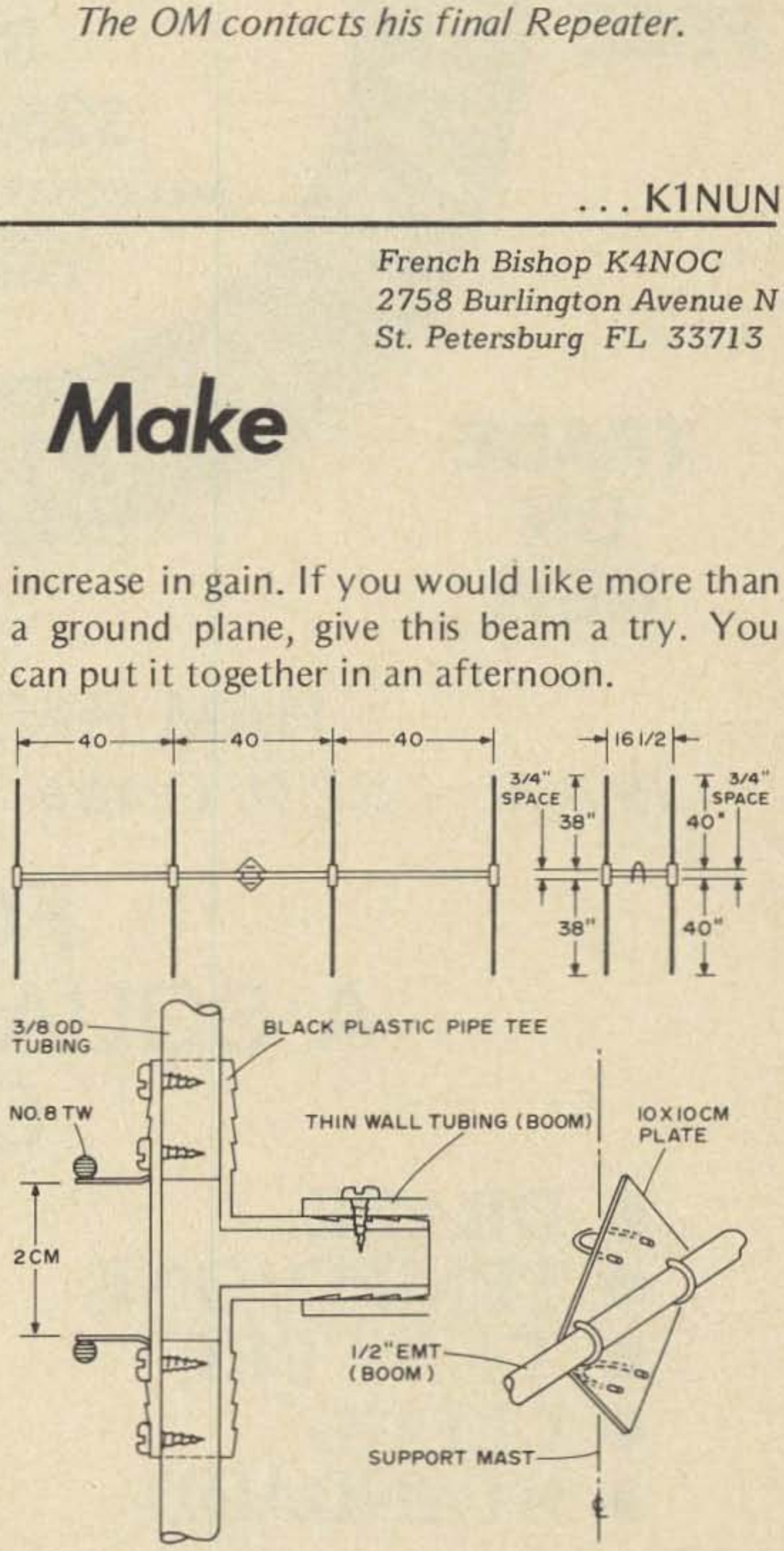
. . . K1NUN

A Two Meter Collinear You Can Make

French Bishop K4NOC
2758 Burlington Avenue N
St. Petersburg FL 33713

Here's a relatively easy to build 16 element collinear for 2m that will cost $10 or less, depending on your junk box and scrounging ability. The boom and supports are 1/2" EMT (thin wall conduit); the elements are .9cm x 1mm (3/8" x .040") wall standard aluminum tubing. Refer to the drawings for construction details. Dimensions are to center lines of tubing. I used #8 TW solid copper wire for the phasing lines. I stripped off the insulation and spaced them 2cm (3/4") apart. The balun is made of RG-8/U and its length is a little shorter than most figures in radio handbooks. I suggest starting an inch longer and trimming it for a good match. It takes a little time to achieve this but it's worth it.

I have one indication of antenna gain for the record. Dave Springer helped me by using an in-line variable attenuator on his receiver. We compared the collinear to a ¼ wave ground plane with both at the same height and both fed with RG-8/U. Dave is about six miles away and had to use 12 dB of attenuation to drop the collinear signal down to equal that of the ground plane. Though the numbers may not be perfectly accurate, they do indicate a substantial increase in gain. If you would like more than a ground plane, give this beam a try. You can put it together in an afternoon.



Parts List

1 – 1/2" x 10' conduit; 4 – 1/2" x 15" conduit; 8 – 3/8" x 40" aluminum tubing; 8 – 3/8" x 38" aluminum tubing; 8 – 1/2" black plastic pipe tee; 1 – 4" x 4" x 1/4" aluminum plate; 6 – 3/4" or 1" U-bolts; 2 – 1 1/4" or 1 1/2" U-bolts; 50 – #6 x 1/2" sheet metal screws.

. . .K4NOC

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Do You Know This Man?

"The handle here is Mike, old man, and I'm operating mobile on the outer expressway. So how copy? K4ABA, this is WB4UAN mobile four. Go ahead, OM.

"Okay, Mike . . . real fine . . . Yeeeaaahh. Lessee here . . . WB4ANE, I believe, and the group . . . this is W4ABA on the 34/94 repeater. You gotta real fine signal there, Mick . . . stronger than that last fellow that was on the machine. You must be closer to me than he was. A little noisy, though, at times. My handle is Bill. Brother . . . I . . . Love. . .Lucy. Yeah! Bill, as in short for William. So how you doin' this afternoon? WA4UNE in the mobile . . . this is K4ABA at the base.

"K4ABA this is WB4UAN mobile four. The call is Whiskey . . . Baker . . . Four . . . Uncle . . . American . . . Nancy . . . U . . . A . . . N . . . There Bill, and the handle is Mike, not Mick. I spell . . . Mary . . . Item . . . King . . . Easy . . . Mike. Okay on my signal. Thanks very much for the good report, but I believe the strong signal you are receiving is the repeater's, not mine, since the repeater is hearing my signal and retransmitting it. You're getting a good signal from the repeater, there, Bill. Go ahead.

"Right you are . . . WA4AUN this is K4 . . . Always . . . Be . . . Alert . . . Yeah, Mike, I know all about them machines, there, and I know a strong signal when I hear one, and you got one, ole buddy. I ain't never heard such a signal on two meters before. Ole Jack was a talkin' on here before you got on, and he wasn't a pinnin' my meter like that signal of yours. I guess it's sorta like addin' signals together. Yours and the repeater's to get a real strong signal. What? Oh. Yeah I did . . . I think I did. XYL here is remindin' me to give ya my handle there, Mick . . . guess it slipped my mind. It's Bill . . . Brother . . . I . . . Love . . . Lucy . . . Bill.

"And as you may know, that's short for William. Like in King William The Fourth or whatever they called that feller over in G-land. Haaa! You remember him from high school don't you, Mick, ole buddy? Back over to ya. Whiskey Four . . . Ahhhh . . . Nancy . . . American . . . Able, this is--oh yeah . . . in the mobile–this is kilowatt four always . . . be . . . alert . . or at least cautious . . . haaa! Go ahead there, Mick.

"K4ABA, this is WB4UAN mobile 4. Okay Bill . . . You still don't have the call right. If you've got a pencil handy, why don't you write it down this time. It's W-B-4-U-A-N, and I'm mobile four. Put it in the logbook, Bill, and write it on a QSL card, while you're at it. I'll be sending you mine. That's part of the hobby I like most. Well, Bill, I'm just about at the destination. It's been real nice talking with you. I'll turn it back over to you for your final transmission. K4ABA, this is WB4UAN mobile 4.

"Lessee here . . . Whiskey number four Uncle Alpha Michigan . . . That's a right nice call, there, Mick . . . This is kilowatt four ain't been asking . . . at least not lately . . . Haaa! Hee . . . Hee . . . Hey Mike, what kind radio you talkin' on anyway? You really gotta fine signal up here on the hill. 'Bout the strongest on two meters. Mine here is a Mallard 10-4, with a homebrew skyhook fed with open twinlead. Go ahead there, Mike, and tell me what kinda box you're usin' there. Break Break.

"It's a homebrew rig running about

twenty watts into a commercial whip with 3 dB gain mounted on the rear deck, Bill. I've really gotta sign with you this time, old man. I'm at my destination, and I'm late for an appointment. 73 and nice talking with you. K4ABA, this is WB4UAN. Good afternoon.

"Yeah, Marshall. Say, if you're gettin' them kinda results from a homespun rig, you must be pretty good at all that technical stuff. Personally, I had a hard time gettin' my technician ticket... and I still don't know beans about one of these here Mallard radios, which I'm a usin' to talk to you on. Say... I got an idea, Mac, how's about us gettin together sometime and you givin' me a few pointers on this electricity stuff, anyway. I'd be happy to supply some eats and brown 809's or whatever you fellers call it these days. How 'bout some Saturday morning? We could bring the XYL and Harmonics along and have a real good time. Maybe even make a field trip to a park out of it. You could bring along the theory books and maybe some test questions and answers, if you know what I mean, there, Mel. The XYL here... Lucy... says that would be mighty fine with her. Saaay... How's about this Saturday, Mick? WA4UAN mobile, but portable at the old destination, probably in the driveway, here is kilowatt four anything but asparagus. I don't like asparagus too well, there, Mick. Go ahead with your next transmission. Break Break.

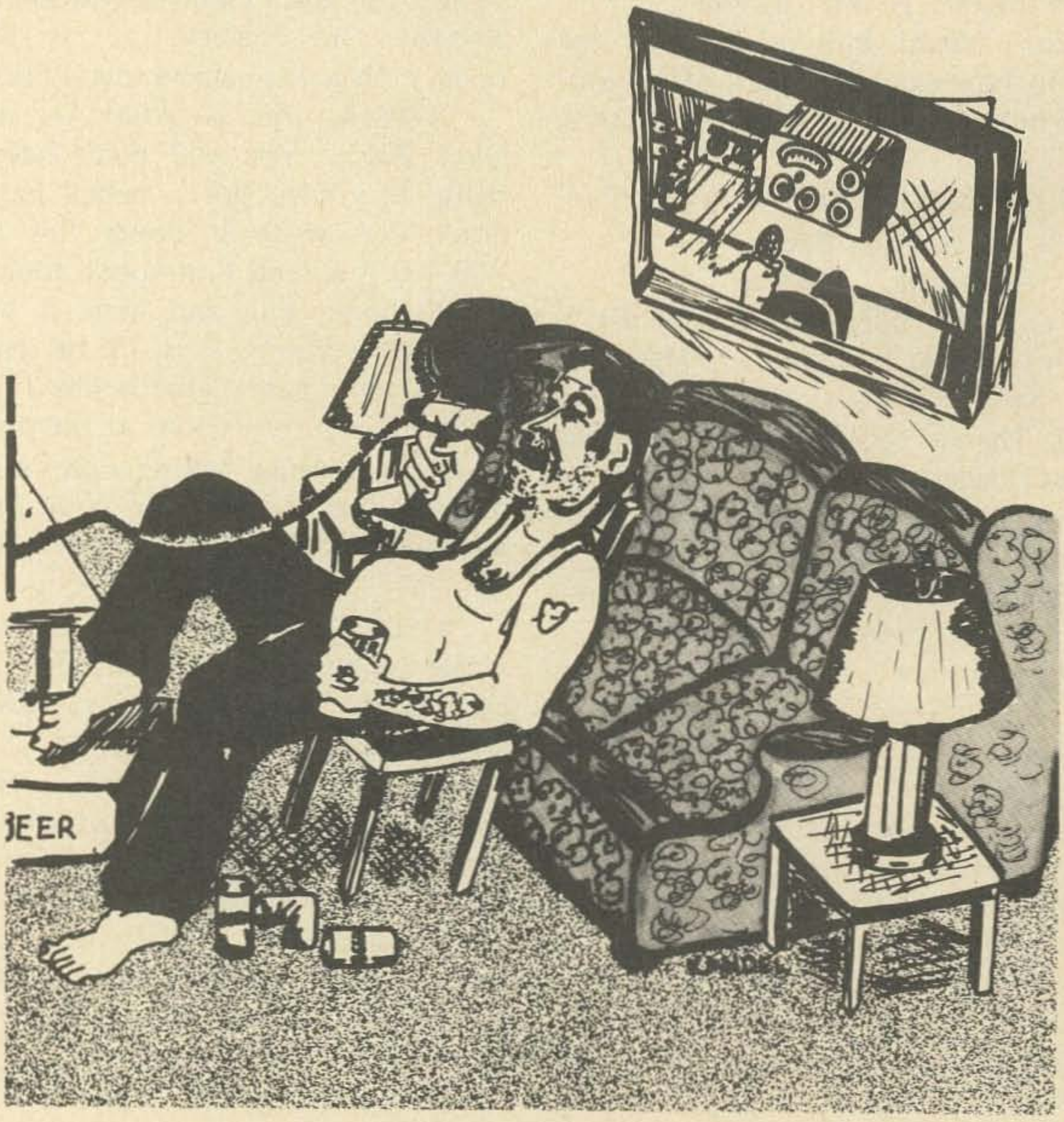
.....

"Hey Mick, you on there, ole buddy? Go ahead there, Mick. WB4AUN, takin' a short standby, here's K4ABA.

.....

"Well, that homebrew rig of his must not have been so hot after all... it didn't even last through the QSO. QRZed.. QRZed QRZed two meters... the 34/94 repeater... here's kilowatt four anybody before August... at the base... how copy? Break break."

...WB4UAN



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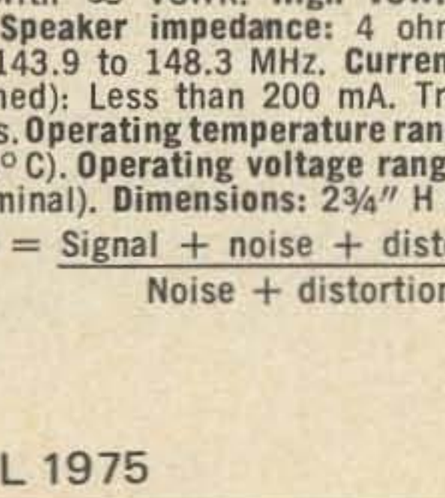

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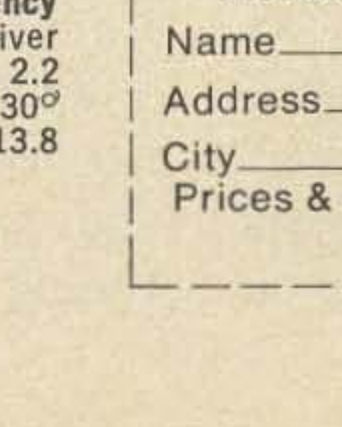

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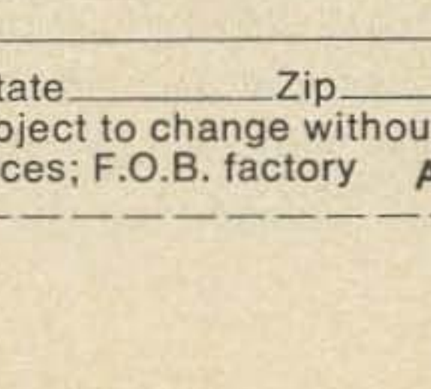

HW-202 SPECIFICATIONS — RECEIVER — Sensitivity: 12 dB SINAD* (or 15 dB of quieting) at .5 μV or less. **Squelch threshold:** 3 μV or less. **Audio output:** 2 W at less than 10% total harmonic distortion (THD). **Operating frequency stability:** Better than ±.0015%. **Image rejection:** Greater than 55 dB. **Spurious rejection:** Greater than 60 dB. **IF rejection:** Greater than 75 dB. **First IF frequency:** 10.7 MHz ±2 kHz. **Second IF frequency:** 455 kHz (adjustable). **Receiver bandwidth:** 22 kHz nominal. **De-emphasis:** −6 dB per octave from 300 to 3000 Hz nominal. **Modulation acceptance:** 7.5 kHz minimum. **TRANSMITTER — Power output:** 10 watts minimum. **Spurious output:** Below −45 dB from carrier. **Stability:** Better than ±.0015%. **Oscillator frequency:** 6 MHz, approximately. **Multiplier factor:** X 24. **Modulation:** Phase, adjustable 0-7.5 kHz, with instantaneous limiting. **Duty cycle:** 100% with ∞ VSWR. **High VSWR shutdown:** None. **GENERAL — Speaker impedance:** 4 ohms. **Operating frequency range:** 143.9 to 148.3 MHz. **Current consumption:** Receiver (squelched): Less than 200 mA. Transmitter: Less than 2.2 amperes. **Operating temperature range:** −10° to 122° F (−30° to +50° C). **Operating voltage range:** 12.6 to 16.0 VDC (13.8 VDC nominal). **Dimensions:** 2¾" H x 8¼" W x 9⅞" D.

*SINAD = $\frac{\text{Signal + noise + distortion}}{\text{Noise + distortion}}$

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A New Q5er - The R-11A

The civilian version of the BC-453 is on the surplus market. Although it is designed for remote control and has no dial, it can be placed in operation rather easily. A spin tuning knob or some other method of tuning the receiver through its 190–550 kHz range is needed. Fair Radio Sales and Meshna offer such knobs. Connect filament and plate power as shown in Fig. 1.

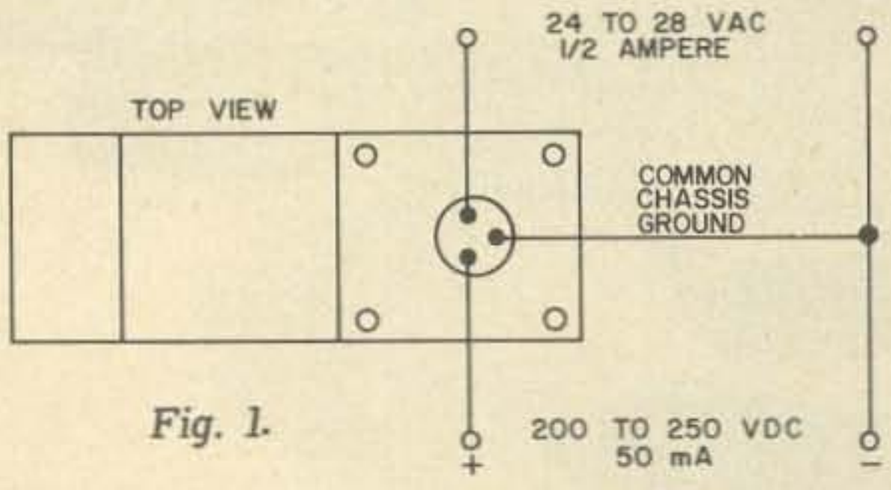


Fig. 1.

At the front panel, J-603, find the pin which has green wires coming to it from the cathodes of the 14A7 rf and i-f tubes. Connect resistors to this pin as shown in Fig. 2.

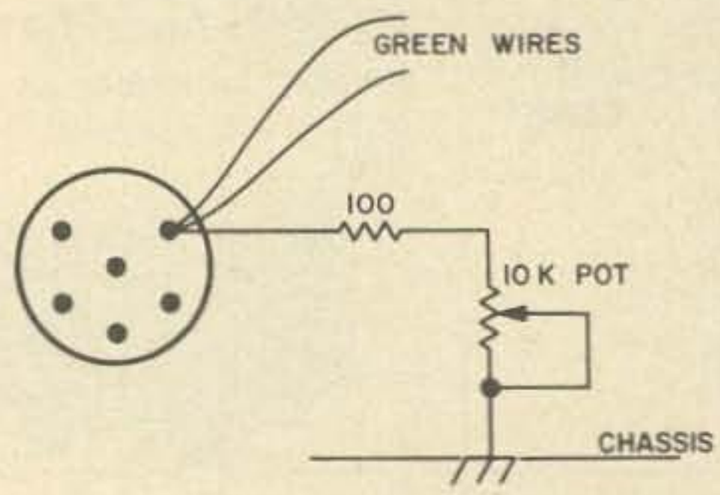
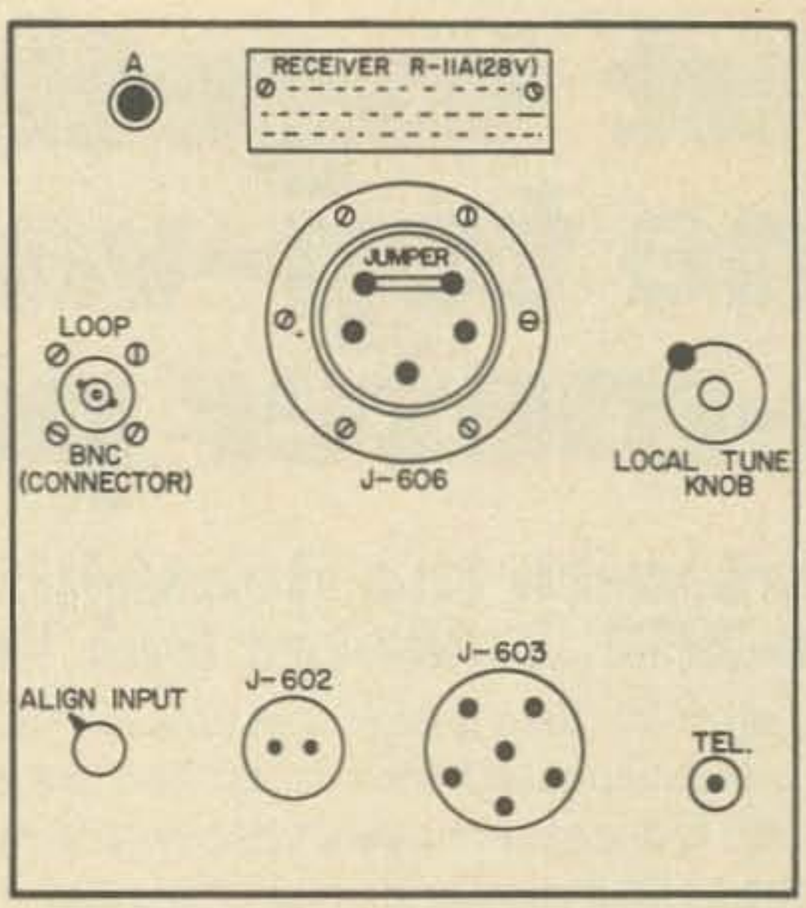


Fig. 2.

The R-11A is ready to operate. With antenna connected it will receive AM and MCW signals from weather station broadcasts in the low band. Its sensitivity is about 5 microvolts at the antenna post. When used as a Q5er in conjunction with the 455 kHz i-f signals from your station receiver, you can copy CW and SSB by turning on the main station receiver BFO. I added an 85 kHz external BFO by building a transistorized one which uses junk box coil. Others may have this same coil in their parts collection. Voltage for the FET can be taken



from the cathode of the 12A6 audio tube. Plus 12 volts is available there.

The front panel can be cleaned up and put to use. Both J-602 and J-603 power and control plugs can be removed and discarded. The loop antenna switching relay may also be removed. Just clip the wires from these parts and let them hang or shove them aside. Don't let the wires short out or touch the chassis. With those parts out of the way, the

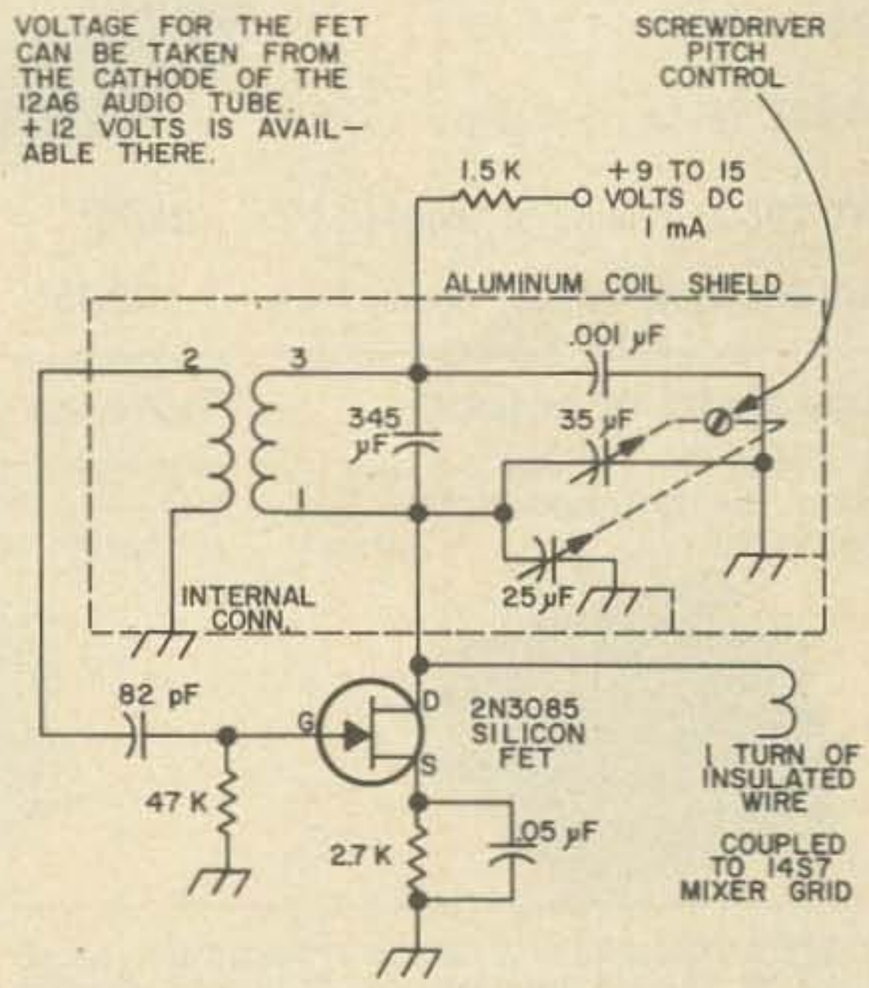


Fig. 3. All parts inside shield can are original values. The field effect transistor is from Poly-Paks.

front compartment can be used for the gain control potentiometer, an on-off switch, or whatever you wish. I swapped the antenna and loop input wires so that I could use the BNC connector to bring in shielded wire from the i-f of my station receiver.

Calibration is roughly 12 kHz per revolution of the spin tune knob. Therefore plus and minus 3 kHz is easily estimated when tuning SSB. . . . W5SOT

B. T. Ring K3VNR
6619 Powhatan St.
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Now — A 5/16 Wave Antenna?

Judging by the number of 5/8 wavelength antennas now being used for 2m operations, this is undoubtedly the most popular of all 2m antennas. This popularity seems to be well deserved, since the 5/8 wave antenna has about 3 dB gain over a 1/4 wave antenna and it is not excessively long. It would appear then that this is an ideal antenna for 2m mobile work and there should be little hesitation when it comes to selecting an antenna.

Faced with the task of mounting a 2m antenna on a subcompact station wagon, several problems had to be resolved. An antenna was needed that would be compatible with the size of the car and still approach the effectiveness of the 5/8 wave antenna. Although a 5/8 wave whip for 2m is not very long, when mounted on the roof of a subcompact it is almost as awkward looking as a 10m whip on the roof of a full sized car. The 1/4 wave antenna would be more suitable in size, but then it would not have the gain attributed to the 5/8 wave antenna. The cost factor also had to be considered since commercially made 5/8 wave antennas are rather costly. The higher cost for such an antenna is understandable because more is involved than just the antenna length. Contributing to the cost is the special base containing an impedance matching transformer which is needed to match a 50 Ohm line to the high impedance of the antenna.

A temporary compromise was reached by using a 69cm stainless steel broadcast type replacement antenna. This type of antenna is made to fit over the broken stub of the standard car antenna. Since this antenna is only slightly longer than 5/16 wave for 2m the higher impedance presented a reasonable match to the 50 Ohm coax. The inductive reactance introduced by the extra length of the antenna was tuned out with a series trimmer capacitor at the base of the antenna. With this antenna there was a noticeable improvement over a 1/4 wave mounted in the same position. Moreover, the size of the antenna was still in keeping with the size of the car.

This 69cm antenna was then used as the basis for a much improved antenna. By building out the electrical length of the antenna to 5/8 wavelength with a base loading coil and using a matching transformer to match the high impedance to a 50 Ohm line, it was possible to achieve an efficient antenna without greatly increasing the physical length.

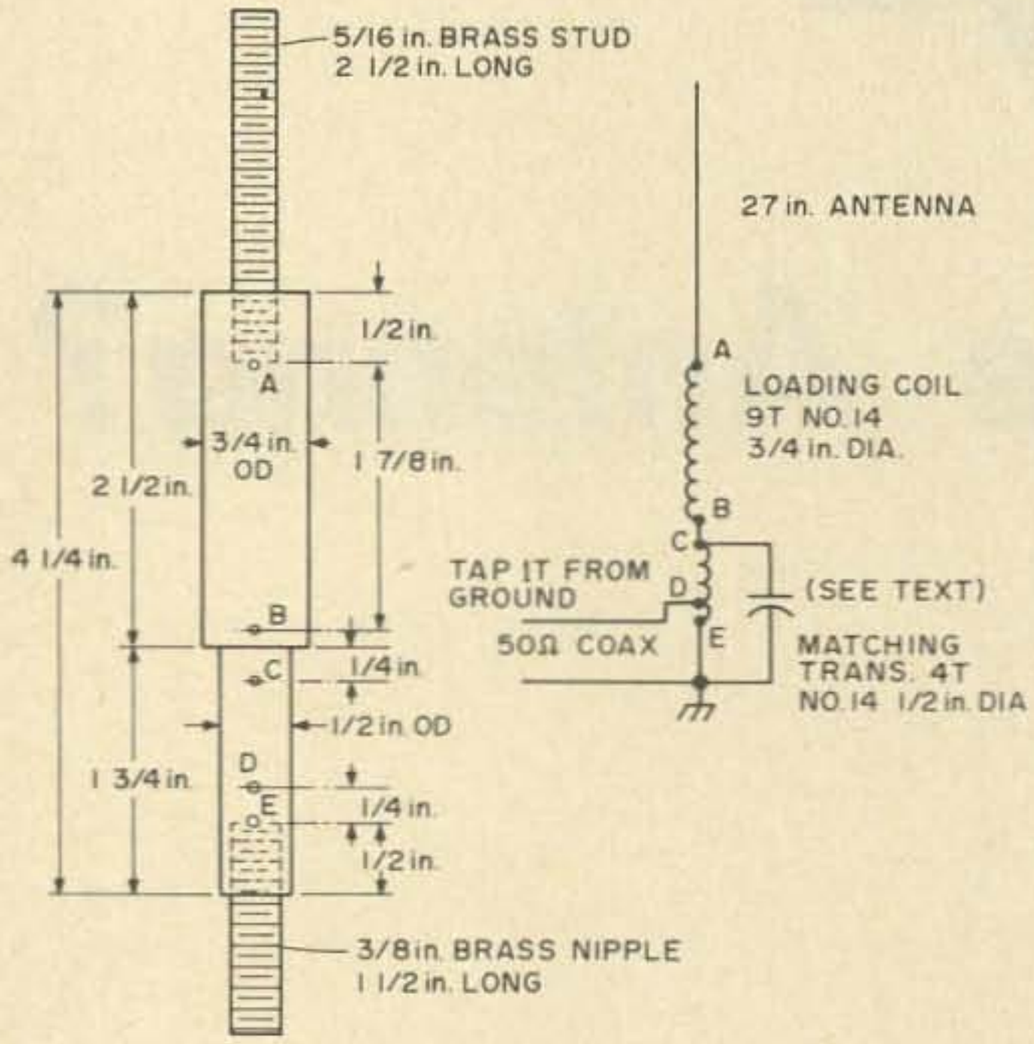

Fig. 1. Composite loading coil-matching transformer fabricated from telescopic tubing.

The unique feature about this antenna is that instead of a separate loading coil and matching transformer, these coils were wound as a composite coil on the same coil form. The complete coil assembly is protected from the weather by a housing made from PVC pipe enclosed at both ends by pipe caps. The stainless steel whip is attached to a 5/16 inch threaded brass stud at the top end of the housing, and a 5/8 inch threaded brass nipple is used at the lower end of the coil for mounting on the car. The 50 Ohm feedline passes through the nipple to the transformer, which is tuned for maximum output.

Two versions of the loading coil-matching transformer combination were made. Both performed equally well with the 69cm whip. The first version is almost 5.08cm shorter, but where the additional height is not objectionable the second version is easier to construct.

The first coil form was fabricated from telescopic polystyrene tubing having the following dimensions:

LENGTH (cm)	OUTSIDE DIAMETER (cm)	INSIDE DIAMETER (cm)
6.35	1.9	1.58
6.35	1.58	1.27
10.79	1.27	.95
2.54	.95	.63

The tubing is telescoped together, and holes large enough to pass #14 are drilled as shown in Fig. 1. All holes except D are drilled through both sides of the tubing. Hole D is for the coil tap (which is the feed point) and is drilled through one side only. Ream out the end of the smallest tubing a little to take the .80cm stud which will be heat fitted into the tubing.

The coils are wound from a 101.6cm length of #14 tinned wire. This is more than enough wire, but the extra length will facilitate handling. Bend the wire into a 1.27 cm wide hairpin with one side about 74.93 cm long and the other about 25.4 cm. Insert the long end through hole B and the short end through hole C on the side of the coil form which is opposite to hole D (both ends should protrude from the same side as hole D). Dress the loop of the wire down close to the coil form. Grip the end of the long wire in a vise and apply tension while winding 9 turns spaced over the length of the form to hole A. Pass the excess wire through hole A, but do not cut.

Place a .80cm X 6.34cm threaded brass stud into the opening at the top end of the form. This stud can be cut from threaded brass stock, or it can be a brass machine screw with the head removed. Hold the coil form in a vertical position so that the stud is facing down. Press the stud against the top of the work bench and apply heat to the stud with a soldering iron; at the same time apply pressure to the coil form to force the stud into the polystyrene tubing. Stop when the stud reaches the wire in hole A. Bend the end of the wire and loop it around the base of the stud. Cut off the excess wire and hold the loop in place with a brass nut over the stud. This completes the loading coil section.

The matching transformer consists of 4 turns on the 1.27cm section of the form

wound in the opposite direction from the loading coil. The feed point tap is one turn up from the ground end of the coil, so be sure not to cover hole D with the wire. After the coil wire end is passed through hole E use a short piece of flexible insulated wire to make the tap connection. Bare about 1.27cm of the wire and pass it inside the tubing and out through hole D and solder it to the coil. (Instead of the tap wire, the center conductor of the feedline could be soldered directly to the coil.)

Make a 1.27cm wide copper ring from 1.27cm copper pipe and slip it over the tap wire on to the coil form. This ring serves two purposes: it reinforces the polystyrene tubing and later it will also be used as part of the tuning capacitor. Insert a 1.58 X 3.81cm brass nipple (the type used in electrical fixtures) into the end of the tubing over the tap wire. Apply heat and pressure as with the stud at the other end until the nipple is seated against the coil wire in hole E. Bend the end of the coil wire over the copper ring and loop it around the nipple. Cut off the excess wire, and hold the loop in place with a lock nut over the brass nipple.

A combination fixed capacitor and adjustable gimmick wire are used to tune the matching transformer. The fixed capacitor is a small ceramic type with a value of about 3 to 5 pF. One capacitor lead is soldered to the copper ring along with the coil end wire. Solder the other capacitor lead and one end of a 15.24cm length of teflon covered hookup wire to the top end of the matching transformer (junction of the two coils). Use insulating sleeving on the capacitor leads to prevent shorting to the coil. Wrap the loose end of the gimmick wire around the copper ring but do not solder. Hold the gimmick wire in place with polystyrene coil dope. Tuning of the transformer will be done later.

The second version of the loading coil -matching transformer differs from the first one mainly in physical dimensions. Because of this, the number of turns on the loading coil is also different. The coils are wound on a single piece of 1.27cm diameter polystyrene tubing 15.24cm in length and having an inside diameter of 1.59cm. A 5.08cm piece of 3/8 OD 1/4 ID tubing is inserted at

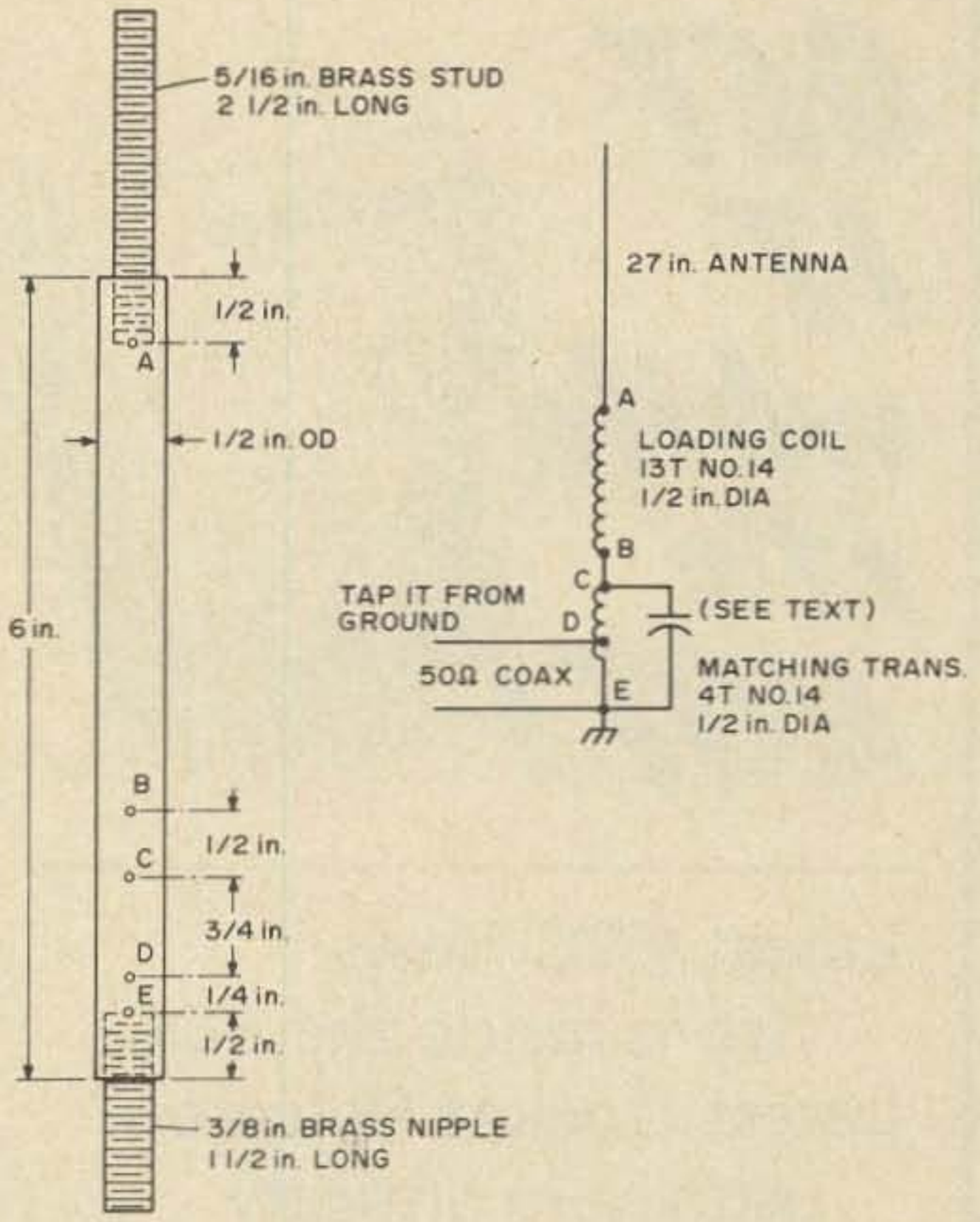

Fig. 2. Composite loading coil-matching transformer using single diameter tubing.

the top end to take the brass stud. Holes for the 14 gauge tinned wire are drilled in the coil form as shown in Fig. 2. Again, hole D is drilled on one side of the form only.

Before winding the coils three copper rings are prepared from 1.27cm copper pipe. Two rings are made 1.27cm wide; the other is 1cm wide. The 1cm ring is positioned on the coil form between holes B and C. The other rings will later be placed on both ends of the coil form.

Bend a 101.6cm length of wire as in the first composite coil. Insert the long side in hole B and the short side in hole C on the side of the form opposite to hole D. The wire should straddle the copper ring and come out on the same side as hole D. Wind 13 turns for the loading coil. Place a copper ring on the end of the tubing to prevent splitting when the .80cm brass stud is inserted with heat.

The matching transformer coil and tap are made the same as in the first version. The copper ring and brass nipple are also installed the same as before. The fixed capacitor and the gimmick wire are both soldered to the copper ring between the loading coil

and the matching transformer. The other capacitor lead goes to the end ring and the gimmick wire is wrapped around the end ring.

To protect the coils against the weather, they are enclosed in sections of PVC pipe. Cut the pipe about 1.27cm shorter than the coil forms to allow the end caps to be drawn up tight against the coil assembly. The first coil uses 2cm pipe, and the second coil uses 1.27cm pipe. Check to be sure that the inside of the pipe clears the coil assembly. The end caps are standard PVC pipe caps drilled to fit over the .80cm stud and 1.59cm nipple. The caps are held in place with additional brass nuts. After final tuning, the joints can be sealed with PVC cement, epoxy or RTV.

Tuning of the antenna coil assembly should be done with the complete antenna mounted on the vehicle. If the whip antenna has a coil spring base, shunt the spring with a flexible wire, or shielding braid, to assure a good connection when the spring flexes. With the PVC sleeve and the lower cap off temporarily mount the complete antenna assembly on the car and connect it to a transmitter through 50 Ohm coax. Prune the gimmick wire a small amount at a time while watching for maximum output as indicated on a field strength meter. When the signal strength just begins to drop push the end of the gimmick wire back against the copper ring and hold it in place with coil dope. The tuning is now completed and the coil assembly can be sealed in the PVC housing.

Comparison tests made against a 1/4 wave whip mounted in the same position on the car indicated that the two base loaded antennas had some gain over the 1/4 wave antenna. No measured comparison tests were made with full size 5/8 wave antennas, but signal reports received were encouraging, and indicated that the base loaded antennas were able to hold their own along with the long ones. In actual use, there was little if any difference in performance between the two base loaded antennas. The first model described perhaps had a slight edge; possibly due to the higher Q of the larger diameter coil.

. . . K3VNR

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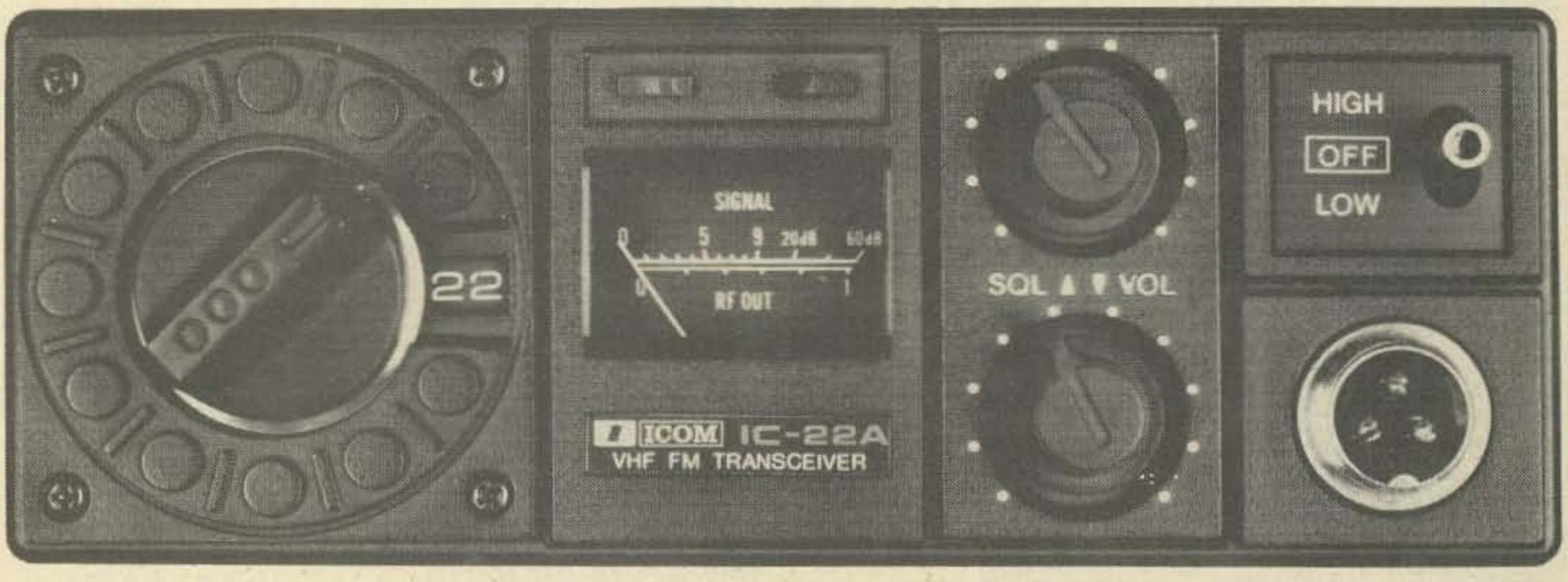

IC-22A

The front panel and control locations have been changed to make the IC-22A even better looking and easier to operate. The new design allows the use of larger channel numbers which may be viewed from the left side or right side by reversing the window position and installing a new dial. (optional at nominal cost)

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73 Magazine Staff

ICOM

THE NEW VHF GIANT

More and more hams in recent years have found Japanese gear to their liking; "Expo 70" undoubtedly contributed to this trend. Among the millions of visitors to Osaka and the Expo site were amateurs from all parts of the world. The Expo had an amateur station on the air throughout the fair (JA3XPO) and that further quickened ham interest. Finding wide varieties of portable, mobile, and base station transceivers blooming in the shops of Tokyo and Osaka, hams had a field day. Enormous amounts of gear not available up to that time on the European and American market were lovingly packed and carried home. VHF boomed, and wider interest in solid state along with it. Not far from the Exposition site is located one of the country's major VHF-UHF producers, ICOM – Inoue Communication Equipment Corporation.

This organization, begun in 1963 by Tokuzo Inoue, produces the only VHF transceivers capable of operating in the heavy rf fields found at the base of Tokyo Tower; actual tests were held, and ICOM emerged victorious. The success story of Toku, as his friends call him, beginning at age 25 in electrocardiograph design, graduating to Sharp as a design engineer, and finally founding his own company, would

Tokuzo Inoue, owner and founder of ICOM.

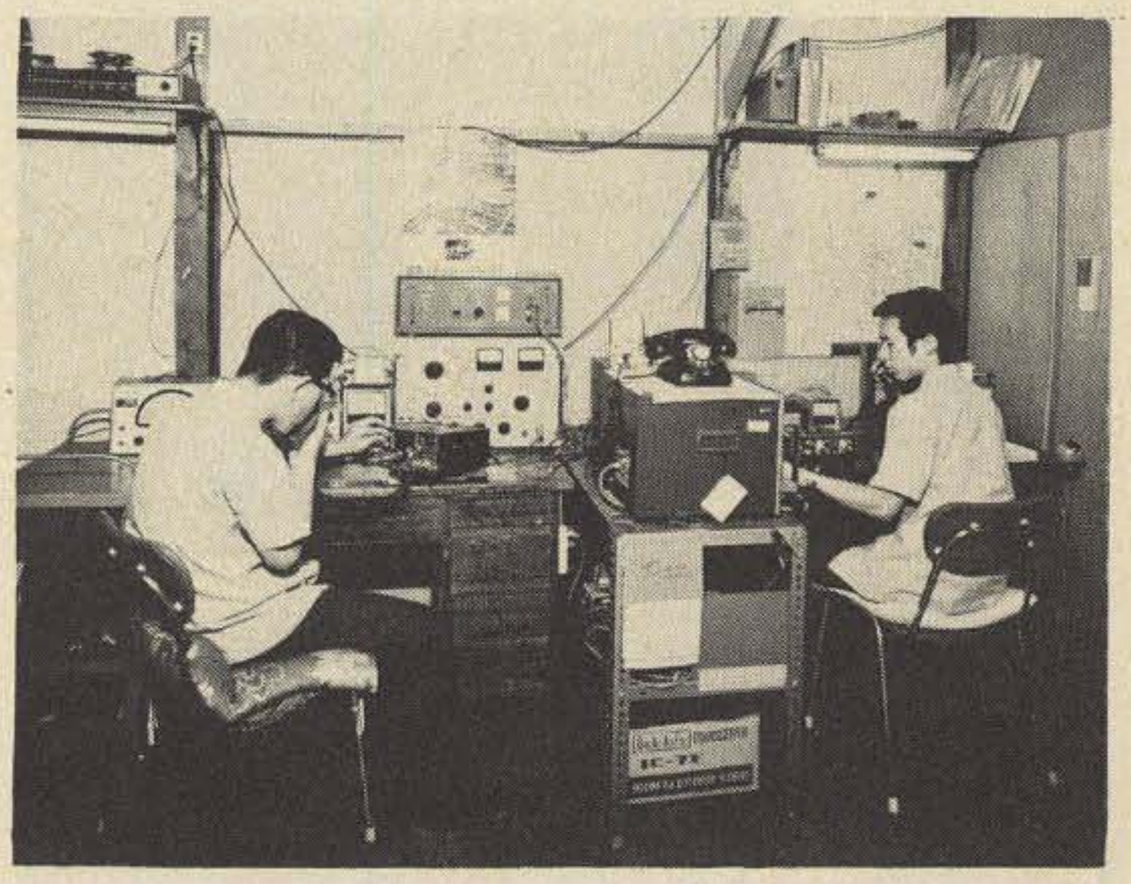
Main offices and assembly, located in Southeast Osaka.

Part of the second floor Testing and Assembly Section. The rf shielded booths are visible at the left.

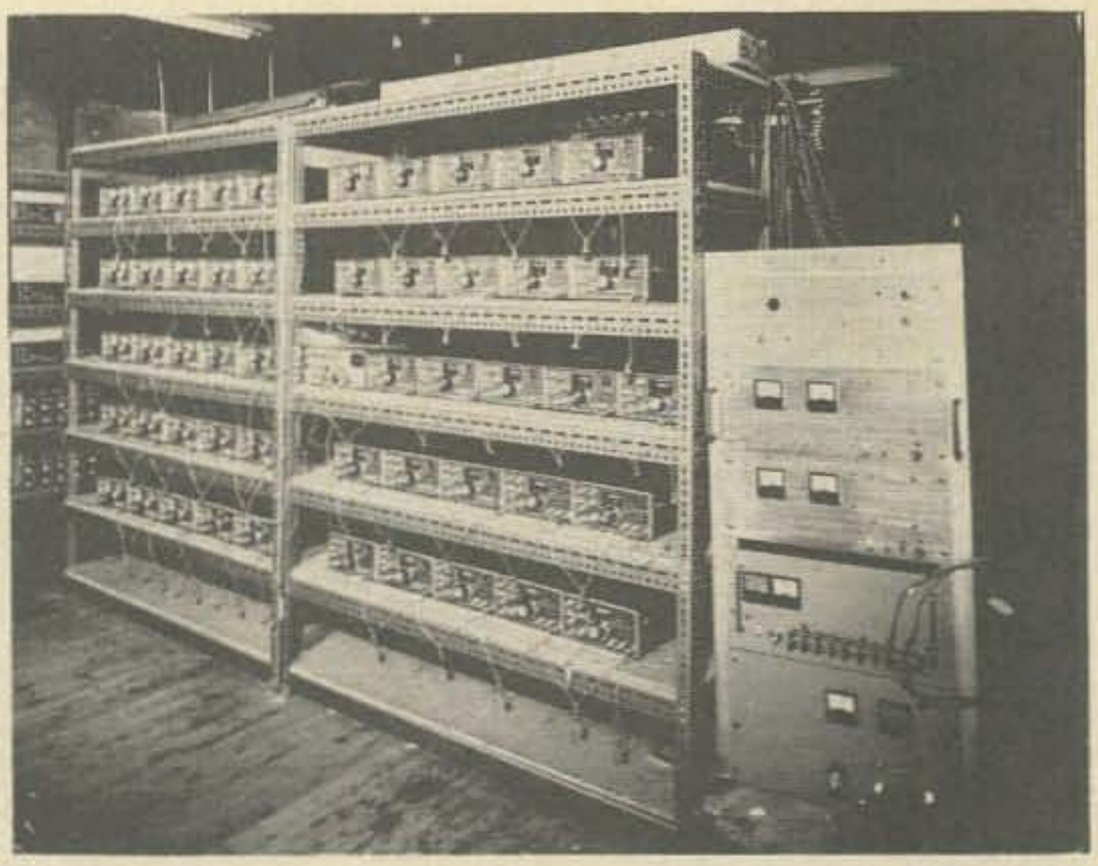
fill a book. This 42 year old engineer's versatility and imagination are reflected in the quality products his firm produces.

The original ten employees who began with the company, with not much more than a dream, are still members of the "family". A family it is, and the feeling is nurtured by twice-yearly trips to scenic areas, ranging all over Japan. All at company expense. Bowling clubs, outside activities of all varieties, and quality control meetings all add to this family feeling. The company's motto "ICOM where quality counts" is more than just a catch-phase, it is a way of life. Company pride and spirit can only be described as fierce.

The Research and Development Section is the envy of their competitors, and Toku's pride and joy. This is where he can be found night and day. Truly amazing things are done here, with an offhand, casual appearance, and an intense feeling of accomplishment. To enter this beehive of activity is bewildering. Test equipment fills the floor space, draftsmen produce drawings of equipment that seems fantastic – yet a short time later, there it sits on the bench, operational.



On-the-air testing: every set produced is tested on the air, the results retained for five years.



One of the burn-in racks, where all sets are run for a 24 hour period prior to shipment.

Here is where the quality starts, and no compromises are allowed. Such rigid specifications are set up, it seems they cannot be met. Yet met they are, and daily.

Hams worldwide are invited for an eyeball QSO. Visitors will find that true Japanese hospitality is extended, and ICOM proudly looks forward to a chance to show guests around.

...STAFF

Larry L. Essary WA5WWH
1568 Bar Harbor
Dallas TX 75232

Review of the IC-30A

The growth of amateur FM repeaters on 450, as a new field of endeavor and communications, has been boosted to a great extent by the availability of rigs once used in commercial services. Commercial equipment of many types has been in the foreground almost from the start of this growth. Many repeater sites are inhabited by machines built around units that once saw duty in commercial services.

Numerous mobile hams can trace their rigs to a similar lineage, but now 450 has come of age. If you have been in the market for a 450 transceiver, you are by now aware that there are few units on the market, but a new unit has been announced: the ICOM IC-30A!

The ICOM IC-30A could very well be the unit that will take the field! The transceiver is all solid state. It comes with five sets of crystals, and has 22 channel capability. It has a socket on the side where the mic, audio, push-to-talk and touchtone can be wired. It features a 10 Watt/1 Watt position power choice. With all these features it makes one wonder, "Where has 450 been all my life?"

The transceiver is modularly constructed. The receiver oscillator uses 24 MHz. There are Overtone crystals to provide output in the 433-435 MHz range. The signal is mixed with the incoming signal to provide an i-f output in the 10.69 MHz range. The 10.69 MHz is used deliberately to enable the IC-30A to be used in conjunction with two meter and other 10.7 MHz i-f rigs. The transmitter uses crystals in the 18 MHz range of the usual "AT" cut. The transceiver uses a T-R relay instead of diode switching. Reverse polarity protection is employed in the unit by means of a diode. If accidental reversal happens, the supply will see a short circuit, thus protecting the unit by blowing the fuse.

The IC-30A comes with crystals for 449.0, .1, and .2 high-in/low-out repeater or simplex on 446.0 or 446.5. The unit has individual trimmers for transmit and receive oscillators.

Typical of most low cost radios is the intermod caused by local ham repeaters and front-end overload by commercial frequencies. After finally getting up enough courage to drive through downtown Dallas during peak communication hours (not to mention the downtown drivers), I decided to see if the IC-30A would perform typically and be paralyzed by the rf field. Much to my surprise I carried on a QSO on a direct frequency, without a gurble of intermod or overload. The unit even has a transmit light and a COR light. Only two notes of dislike, but minor ones: The 9 pin socket only comes wired for discriminator (and you have a 5 minute job to search through the maze of wires to hook it up) and the IC-30A comes equipped with a metric thread, S0239, so it must be changed out.

In conclusion, I found the ICOM IC-30A to be a very pleasant and easy to operate unit. There are not too many knobs and switches to confuse you, and with 22 channel capability you will not be limited to 6 or a dozen channels. 450 is not like two meters was just a few years ago, when you had to scan the band looking for a QSO. 450 has come of age with the growth of UHF activity, and you will find it a new frontier to conquer. I'm sure you will enjoy every minute of it just as I have!

. . . WA5WWH

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□ **6 WPM** This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly — under pressure — faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five. Practice this one during lunch, while in the car, anywhere and you'll be more than prepared for the easy FCC exam.

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

□ **21 WPM** Code is what gets you when you go for the Extra Class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape. No one who can copy these tapes can possibly fail the FCC test. Remove all fear of the code forever with these tapes.

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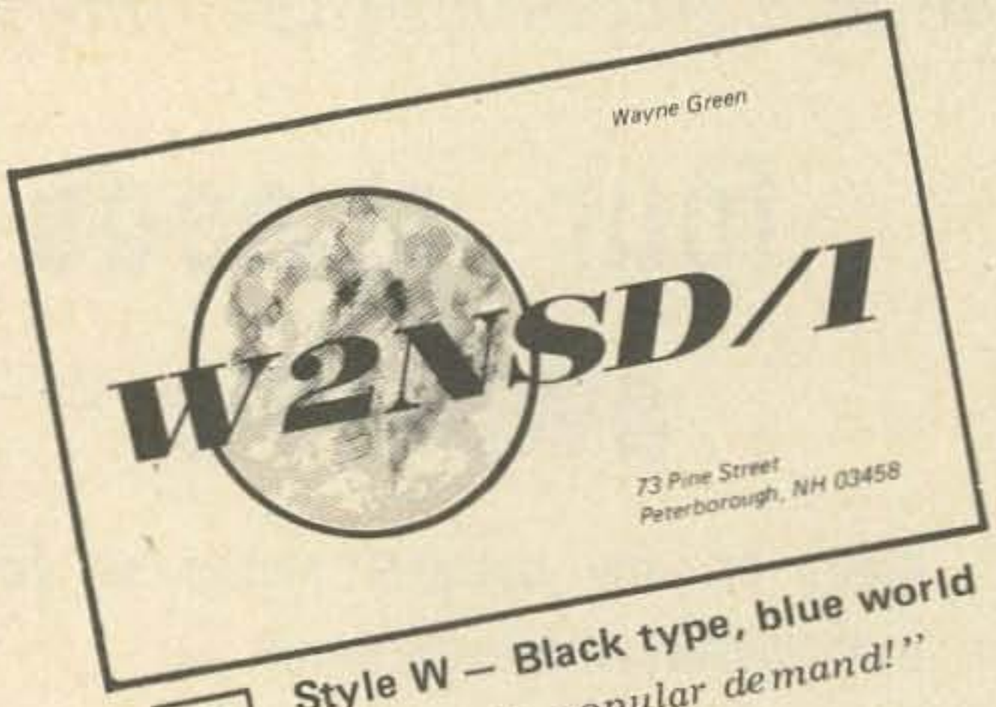

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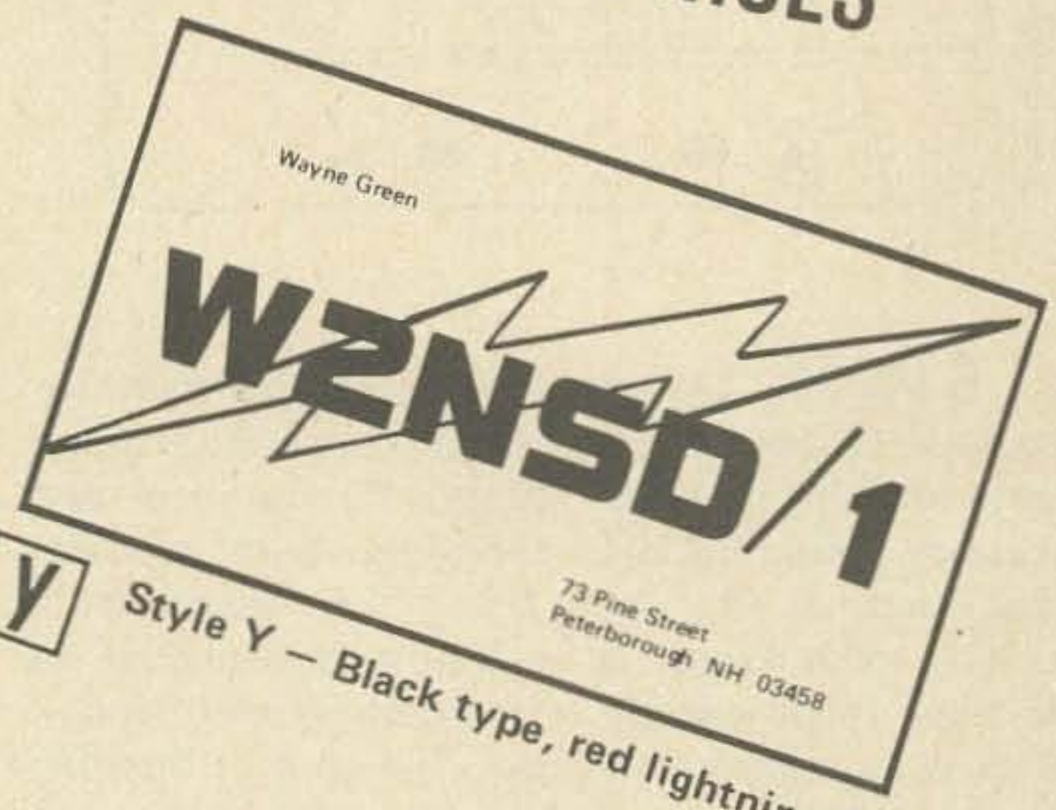

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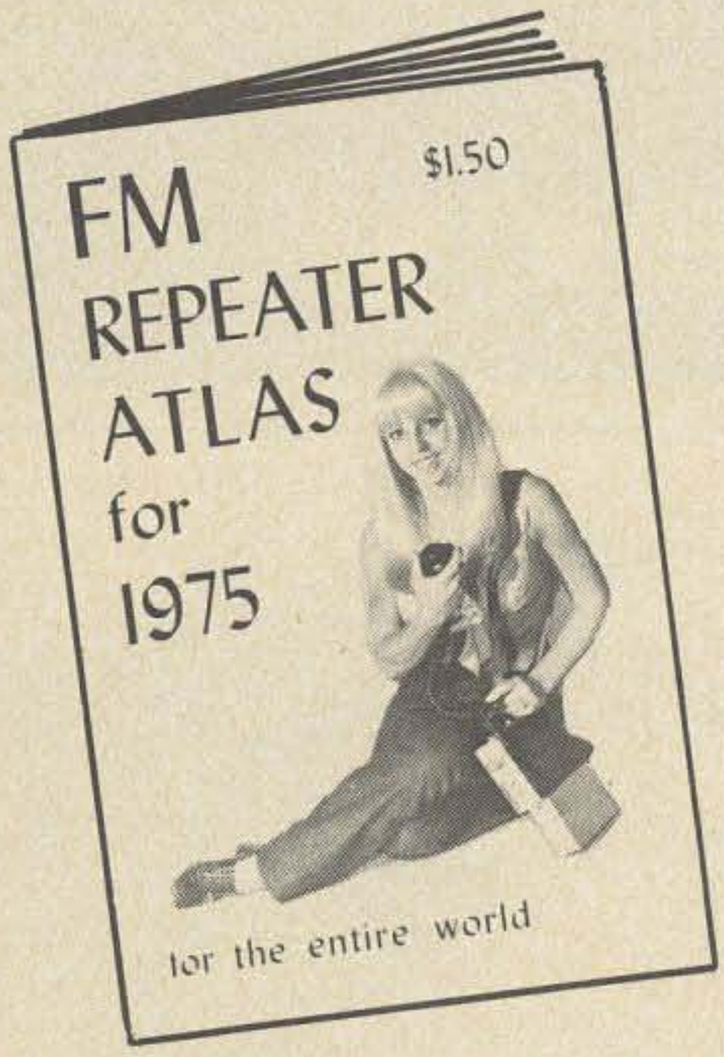

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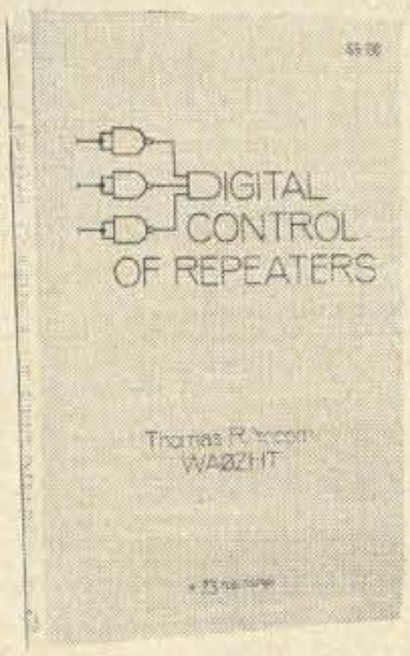

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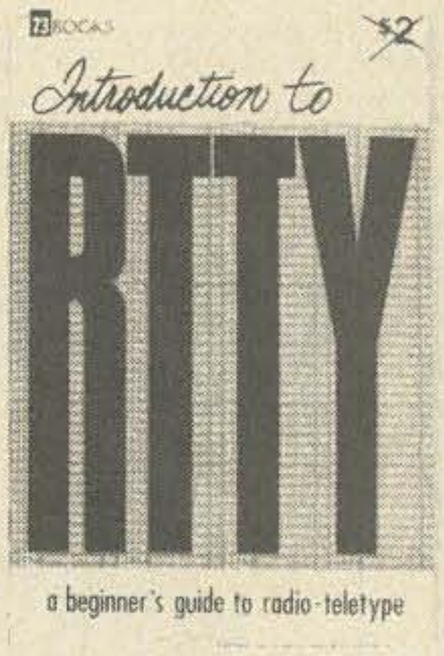

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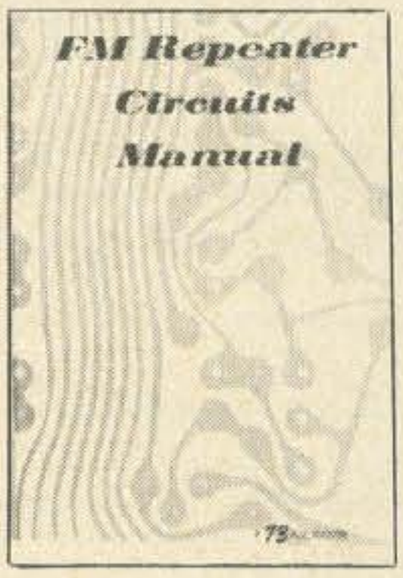

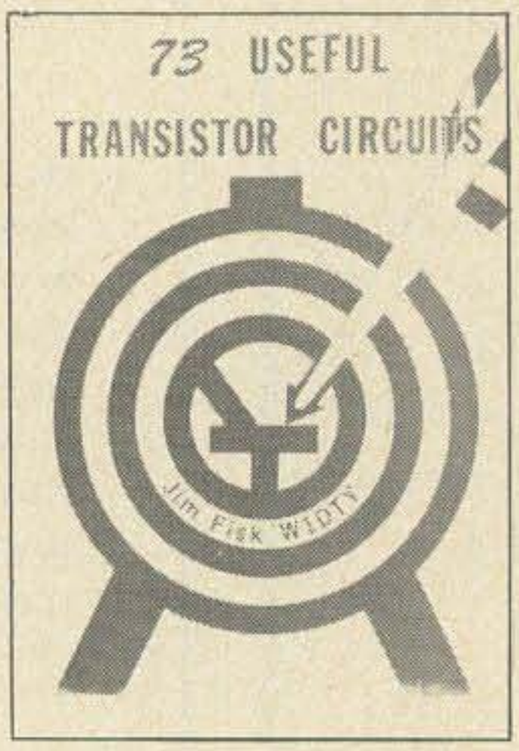

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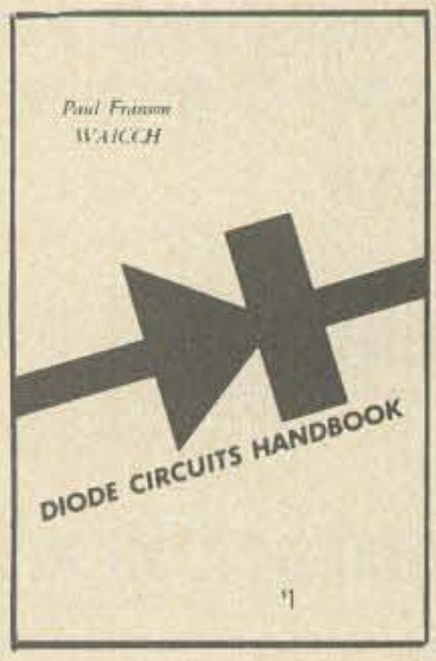

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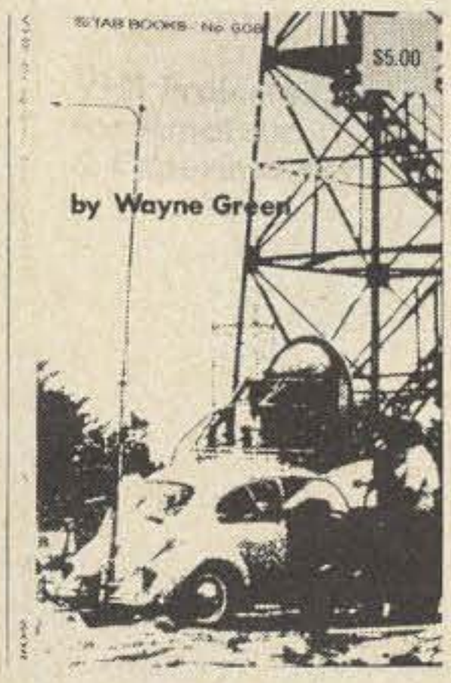

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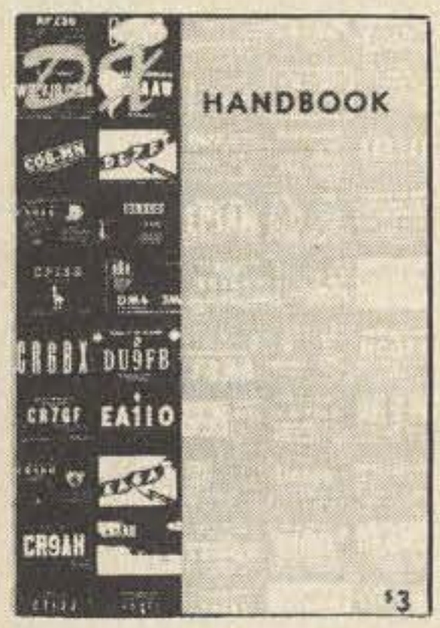

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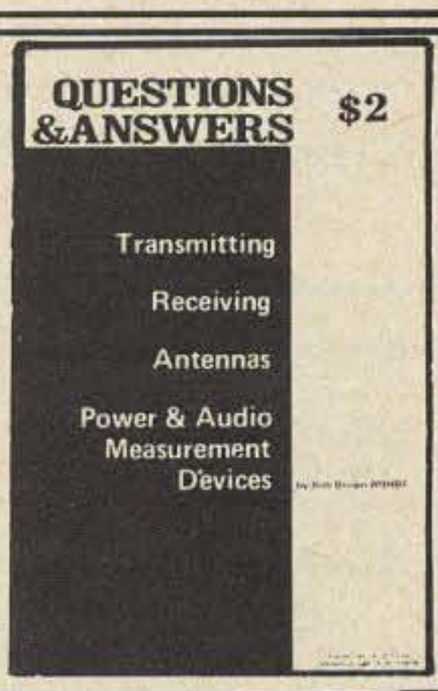

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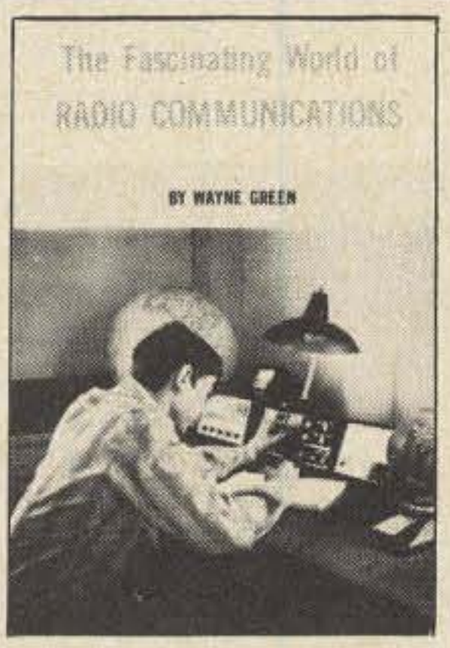

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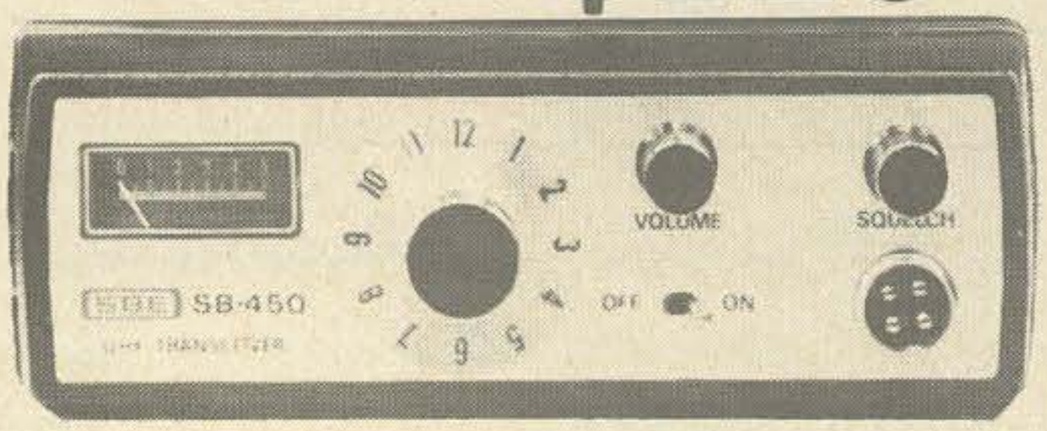

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CC-1 conv. console 39
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TR-4 Xcvr 389
TR-4/NB Xcvr 459
RV-4 remote VFO 69
TR-4C Xcvr 449
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PS-150-120 AC sup. 75
PS-150-12 DC sup. 49
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HW-22A 40m Xcvr 85
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AC-5 antenna tuner 6
210 AC supply 19
PM-3 Transceiver 49

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FTDX-401 Xcvr 449
FV-401 rem. VFO 75
FL-2100B Linear 249

12/31/74

All items subject to prior sale. Amateur Electronic Supply reserves the right to sell such items as power supplies with their matching equipment only, and not separately - depending upon our stock situation. To insure quality, our used gear is sent through our repair shops after we receive your order – so please allow for a possible slight delay (approximately 5 to 10 working days).

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Model	Reg.	Factory	NOW
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GTX-200	269	199	189
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New Life for the SX-111

Replacing the rf amplifier with a "hotter" tube, substituting a solid-state rectifier for the 5Y3 and complete realignment gives the SX-111 a new lease on life.

Toss the 5Y3 and substitute a silicon plug-in module from Poly-Paks. Or, if you have silicon rectifiers with peak reverse voltages of at least 1400V (GE-511), one can be installed between pins 4 and 8 and the other between pins 6 and 8 of the 5Y3 socket. Remove the 5V filament windings from pins 2 and 8. A 51Ω 2 watt surge resistor should be inserted in each leg of the HV secondary ahead of the diodes. Transient protection can be supplied by a GE-X14 thyrector or metal oxide varistor across the primary.

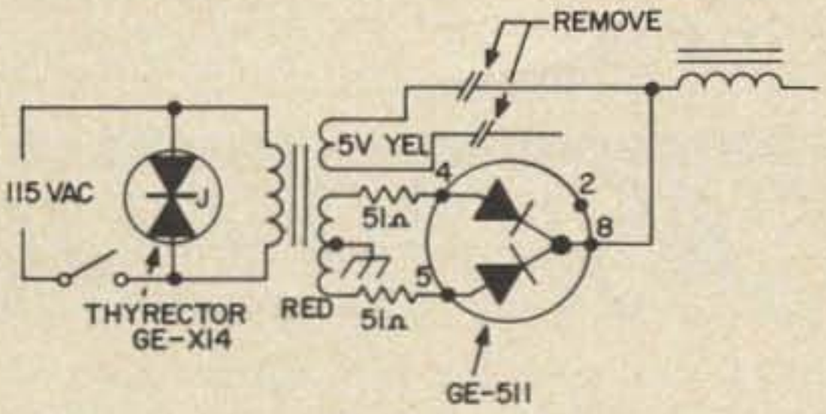

Fig. 1

Substituting a "hotter" 6EW6 rf amplifier for the 6DC6 improves transconductance from 5500 to 14,000μΩ. Bases are similar, so the tube can be simply plugged in. Change the cathode bias resistor from 180Ω to 56Ω at pin 2.

The plate and grid voltages are still well within the 300V maximums allowed for the 6EW6, so no further changes were made. Performance was comparable to the receiver portion of a TR4 in terms of sensitivity.

. . . W1HEO

W2NSD from page 3

other than the most relaxed rules they can make.

Of course there is no way I can counter every possible argument in a brief editorial, but it would be fun to get a large group at a convention and work over as many aspects of the situation as possible.

Docket 20282 seems to offer virtually nothing to anyone – except possibly a few Extra Class phone frequencies to the Advanced Class ops – and it takes away privileges wholesale. Two-thirds of the amateurs would be cut in power and just about everyone would have to go back to the books again to take more FCC exams – and ante up to the U.S. Treasury for each test.

> **I have a feeling that Walker has his heart set on making incentive licensing work even if it kills us . . .**

For my part, as publisher of 73, docket 20282 looks great. I'll be able to sell books and code cassettes for all those myriad of license grades – imagine eight different classes of license! Our Novice study guides are selling very well – as are the Novice study cassettes which have the theory plus Q&A on four one hour cassettes. The General Class Study Guide is doing fine – the Advanced Class Guide is selling well – and so is the Extra Class. Watch for my Communicator Class license guide and Experimenter Class license guides. I'll have to get busy on theory cassettes for Communicator, Experimenter, etc. . .

I have a feeling that Walker has his heart set on making incentive licensing work even if it kills us, so I don't hold out much hope for 20282 to get shot down, even if a lot of amateurs agree with me that it is a waste of time. Perhaps next year when he retires we'll do better and be able to get our rules to reflect the simple goal set out in 97.1c: To advance skills in both the communications and technical phases of the art.

OSCAR FEVER

One of the local Oscar fans was enthusing at a meeting of the Interstate Repeater Society (Geeze, how I hate the name of that club . . . dunno just why, just something about it that grates on me.) – anyway, this chap was saying that all you had to do was tune down to 145.95 when Oscar was passing over and you'd hear all sorts of interesting things being repeated from 432 MHz.

One afternoon a few days later I got to looking at the orbital chart in 73 and, after a fast calculation of GMT, decided this was the time to try it out. The only tunable receiver was my trusty Comcraft CTR-144 – the little rig I use to find secret repeaters and to fruitlessly tune the lower parts of the 144 MHz band listening for action. I put it on 145.95 with a counter and made myself present at schedule time. Nothing. Hmmm. I kept tuning up and down about 25 kHz and, outside of a small birdie generated by the Comcraft, nothing doing.

I had about given up, some four minutes later, when I began to hear all sorts of things coming through. I had the spotting switch on and was using the vfo as a bfo . . . first it was a W5 on CW . . . then a WA7 . . . then I began to hear several sideband stations. Tuning that vfo to demodulate sideband is not an exercise for the unsteady of hand. They were coming in from all over – W8, WØ, VE, even W2! I got so excited I ran through the

It would be gratifying to say that everyone came rushing in to hear the great wonders of satellite radio, but the cold hard fact is that I stirred up as much interest as an insurance salesman.

73 offices calling out the news . . . hey, come on and listen.

It would be gratifying to say that everyone came rushing in to hear the great wonders of satellite radio, but the cold hard fact is that I stirred up about as much interest as an insurance salesman. Oh well.

Once the satellite pass was over and the band had died again I got to ruminating about the incident. I knew that I would soon be getting on 432 on sideband . . . I didn't know how, but I knew I would. And I would be getting a good sideband/CW receiver system set up for 146 MHz too.

It was in 1948 that a similar thing happened to me. I'd been reading about six meters opening up and decided to give a listen. I dug out an old pre-war Meissner FM tuner . . . it tuned from 40-50 MHz . . . I'll bet not many of you remember when the broadcast FM band was down there . . . when we used to listen to Major Armstrong's station at Alpine, New Jersey. Well, I dusted that off and tuned up to the high end just about 50 MHz and hooked on a short indoor antenna . . . WOW! Fantastic. W6, W7, VE7, and all points in-between. And they were boiling through S-9 plus. The wideband FM tuner mixed them all together . . . I used it later to keep an ear on the band for openings.

Within a couple days I had a converter hooked on my SX-28A and a small transmitter, both of which I had thrown together in a flurry of midnight building. I worked everything and had a great time.

Oddly enough this early six meter work had a direct influence on my getting into ham publishing. It was along about 1950 that Perry Ferrell got involved with the Radio Amateur Scientific Observations (RASO) project to investigate six meter propagation and I was one of the amateurs who set up a beacon on 50.1 MHz. Perry eventually became editor of CQ Magazine and, knowing of my interest in RTTY, signed me on as RTTY editor.

Six meters was a lot different in 1950-1952. I was living in Brooklyn and I was the *only* active amateur on the band in Brooklyn! There were a couple chaps over in New Jersey, a few up north of the city, and now and then Ed Tilton would come on from up in Connecticut. Everyone was crystal controlled so I could tell instantly who was on the air just by measuring their frequency.

So here we are with another exciting development: Oscar 7. I'll have to get caught up on the state of the art in satellite communications – with data to know when the satellite will be available – a good uplink converter for my low band rig – a good antenna for it – a hot receiver for the downlink on 146 MHz – a cassette recorder to keep a record of the contacts. Watch out for me.

There are several ways of tuning in the 145.95 MHz Oscar 7 output – even with simple gear. One way would be with an FM receiver and a communications receiver tuned to the 10.7 MHz i-f output – that would enable you to copy the sideband and CW signals. A little converter is pretty easy to put together for the band, and you really don't have to go for DX sensitivity – or perhaps one of the excellent Vanguard converters.

Once you start listening you may find yourself hooked.

. . . Wayne

Sam Kelly W6JTT
12811 Owen Street
Garden Grove CA 92645

Try 160 CW With This Transmitter

Realizing the shortcomings of my surplus TCS transmitter on the 160 meter band, I decided that either major surgery was in order, or a new transmitter. Choosing the latter solution I quickly checked my budget and found it depleted as usual. Therefore, any new construction had to rely heavily on easily obtainable surplus components.

Basically the transmitter consists of a vfo that tunes from 3.25MHz to 3.45MHz, the output of which is heterodyned with a 5.25MHz crystal oscillator to produce a 1.8MHz to 2.0MHz output. Both oscillators are continuous running. Keying is accomplished by blocking the grid of the mixer and the final amplifier.

The vfo used was a surplus Collins 70-K1 which was found in a local surplus store for less than 10 dollars. Since these may not be readily available elsewhere, the circuit of an alternate vfo (which was tested) is included.

The final amplifier is a pair of 1625's operating in parallel into a pi section network. 1626's were chosen because of their abundance at about two bits each, plus the fact they are quite rugged.

The power supply uses a surplus receiver power transformer with a high voltage secondary of 340-0-340V. This is bridge rectified

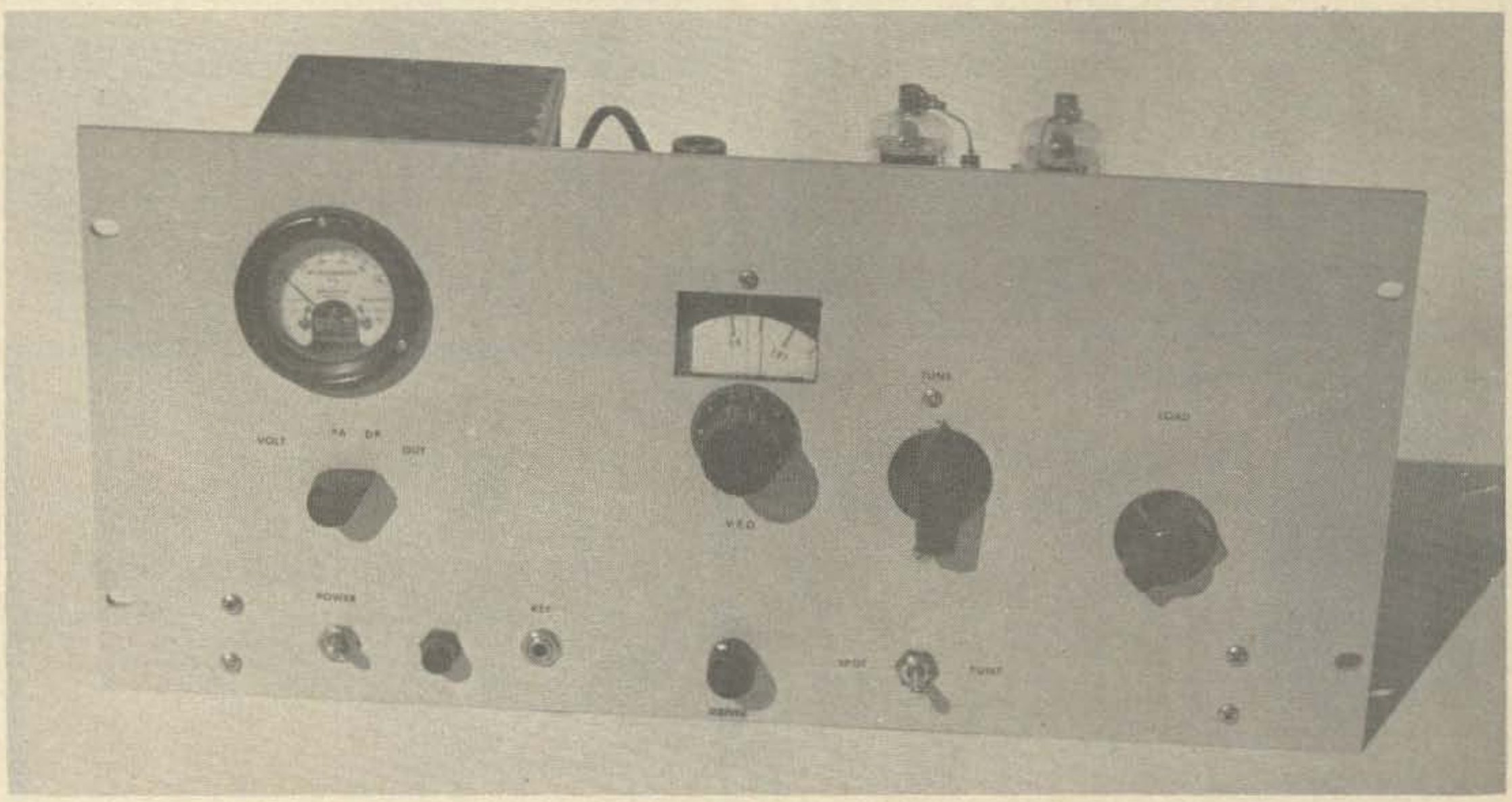

Fig. 1. Front view of the 160 meter heterodyne CW transmitter.

C-MOS

	1–9	10 up
4000AE	.48	.45
4001AE	.48	.40
4002AE	.48	.40
4004AE	5.85	5.85
4006AE	3.50	3.30
4007AE	.48	.42
4008AE	2.90	2.70
4009AE	.87	.86
4010AE	.55	.54
4011AE	.48	.45
4012AE	.48	.45
4013AE	.95	.85
4014AE	2.80	2.50
4015AE	2.80	2.50
4016AE	1.00	.90
4017AE	2.60	2.50
4018AE	2.80	2.60
4019AE	.95	.85
4020AE	2.80	2.60
4021AE	2.70	2.50
4022AE	2.70	2.50
4023AE	.48	.45
4024AE	1.80	1.60
4025AE	.48	.45
4026AE	8.40	7.90
4027AE	1.20	1.00
4028AE	2.20	2.00
4029AE	4.00	2.90
4030AE	1.00	.90
4033AE	3.40	2.90
4035AE	2.80	2.75
4040AE	2.80	2.60
4041AE	1.20	.90
4042AE	2.80	2.60
4043AE	2.80	2.60
4044AE	2.80	2.60
4047AE	3.10	3.00
4048AE	1.45	1.35
4049AE	1.10	.90
4050AE	1.10	.90
4051AE	3.35	2.90
4052AE	2.15	2.05
4053AE	2.90	2.80
4055AE	2.70	2.60
4056AE	3.45	3.41
4060AE	3.30	3.00
4066AE	1.80	1.60
4069AE	.80	.70
4071AE	.50	.45
4076AE	2.70	2.50
4081AE	.48	.42
4510AE	2.70	2.50
4516AE	2.90	2.80
4518AE	3.30	3.00
4520AE	3.30	3.00
4901AE	.48	.42

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XR205K **Only $28.00**

Here's a highly versatile lab instrument at a fraction of the cost of conventional unit. Kit includes two XR205 IC's, data & applications, PC board (etched & drilled, ready for assembly) and detailed instructions.

DUAL LOW NOISE OP AMP

LM331N:
V_{io} = 6mV
I_{ie} = 1000 nA
I_b = 2000 nA
Noise = 1.5dB
$2.20

DISPLAYS

OPCOA

SLA1	Red	2.25
SLA11	Green	3.50
SLA21	Yellow	3.50
SLA7	Red	1.60

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DL80	Red	6.00
DL81	Red	6.00
DL10	Red	6.00
DL10A	Red	4.00
DL101	Red	4.90
DL57	Red	9.90
DL61	Red	12.00
DL33	Red	4.00
DL44	Red	6.00
DL402	Red	4.00
DL701	Red	3.40
DL704	Red	2.25
DL707	Red	2.35
DL747	Red	2.50

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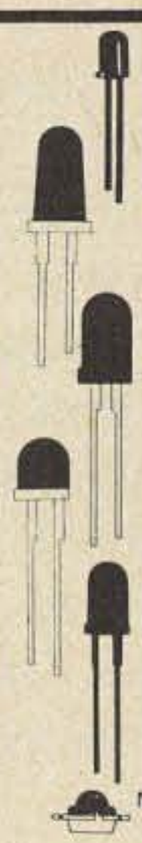
IL74	1.35
ILD74	1.75
ILQ74	3.40

LEDs



.125" dia.

209	Red	$.25
209	Yellow	.35
209	Green	.35

.160" dia.

216	Red	.25
216	Yellow	.30
216	Green	.30

.200" dia.

220	Red	.25
220	Yellow	.30
220	Green	.30

LOW PROFILE

226	Red	$.25
226	Yellow	.30
226	Green	.30
226	Orange	.30

5053	Red	.35
5053	Yellow	.40
5053	Green	.40
5053	Orange	.40

216 = MV5024
5053 = MV5053

MV50 Red $.30

7400N TTL

7400N	.16	7444N	1.05	7496N	.85	74161N	1.28
7401N	.23	7445N	1.04	74100N	1.45	74162N	1.50
7402N	.22	7446N	1.10	74104N	1.25	74163N	1.48
7403N	.22	7447N	1.10	74105N	.45	74164N	1.78
7404N	.21	7448N	1.10	74107N	.45	74165N	1.78
7405N	.21	7450N	.17	74109N	.92	74166N	1.54
7406N	.36	7451N	.53	74110N	.72	74170N	2.60
7407N	.45	7453N	.23	74111N	.92	74173N	1.55
7408N	.23	7454N	.26	74114N	.92	74174N	1.48
7409N	.23	7455N	.37	74115N	.92	74175N	1.80
7410N	.18	7460N	.25	74118N	1.51	74176N	1.54
7411N	.27	7462N	.37	74119N	1.80	74177N	1.54
7412N	.52	7464N	.37	74121N	.54	74180N	1.05
7413N	.72	7465N	.37	74122N	.51	74181N	3.49
7414N	2.25	7470N	.30	74123N	.90	74182N	.78
7415N	.37	7471N	.49	74125N	.64	74184N	2.86
7416N	.37	7472N	.33	74126N	.64	74185N	2.29
7417N	.37	7473N	.41	74128N	1.32	74188N	4.90
7420N	.18	7474N	.40	74132N	2.06	74190N	1.49
7421N	.60	7475N	.70	74136N	.92	74191N	1.49
7422N	.27	7476N	.45	74140N	2.50	74192N	1.45
7423N	.48	7478N	.55	74141N	1.19	74193N	1.29
7425N	.36	7480N	.60	74145N	1.12	74194N	1.35
7426N	.27	7481N	1.19	74147N	2.95	74195N	.89
7427N	.31	7482N	.98	74148N	2.49	74196N	2.38
7428N	.52	7483N	.98	74150N	.99	74197N	.88
7430N	.20	7484N	3.02	74151N	.84	74198N	2.09
7432N	.27	7485N	2.50	74152N	5.25	74199N	2.09
7433N	.62	7486N	.41	74153N	1.05	74200N	4.95
7437N	.41	7489N	2.50	74154N	1.48	74221N	1.75
7438N	.35	7490N	.70	74155N	1.08	74251N	1.75
7439N	1.05	7491N	1.15	74156N	1.18	74278N	2.95
7440N	.17	7492N	.84	74157N	1.18	74279N	1.10
7441N	.95	7493N	.71	74158N	1.44	74293N	.95
7442N	.95	7494N	1.29	74160N	1.50	74298N	2.55
7443N	.95	7495N	.85				

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1024-BIT N-Channel RAM

2601-1	11.40
2601-21	11.40
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2602-1B	8.00
2602-2B	8.00
MK4102P	11.40
7552-1CPE	8.00
7552-2CPE	8.00

74LS

74LS00	.58	74LS76	.92	9300PC	1.00
74LS01	.58	74LS78	.92	9301PC	1.20
74LS02	.58	74LS107	.92	9304PC	1.50
74LS03	.58	74LS109	.92	9306PC	6.90
74LS04	.63	74LS112	.92	9308PC	2.50
74LS05	.63	74LS113	.92	9309PC	1.60
74LS08	.58	74LS114	.92	9310PC	1.50
74LS09	.58	74LS138	2.38	9311PC	2.30
74LS10	.58	74LS139	2.38	9312PC	1.20
74LS11	.58	74LS151	2.10	9314PC	1.30
74LS15	.58	74LS153	2.38	9316PC	1.50
74LS20	.58	74LS157	2.10	9318PC	2.30
74LS21	.58	74LS158	2.40	9321PC	1.20
74LS22	.58	74LS160	2.70	9322PC	1.30
74LS27	.64	74LS161	2.70	9324PC	2.00
74LS30	.58	74LS170	5.92	9328PC	2.50
74LS32	.64	74LS174	3.02	9334PC	2.95
74LS51	.58	74LS175	2.90	9338PC	3.30
74LS54	.58	74LS181	3.72	9340PC	5.00
74LS55	.58	74LS251	2.55	9341PC	4.10
74LS73	.92	74LS253	3.05	9342PC	1.15
74LS74	.92	74LS260	.58	9360PC	1.75
				9366PC	1.75

9300 SERIES

1-AMP RECTIFIERS

	10	100	1000
1N4001	1.00	7.00	60.00
1N4002	1.10	8.00	70.00
1N4003	1.20	9.00	80.00
1N4004	1.30	10.00	90.00
1N4005	1.40	11.00	100.00
1N4006	1.50	12.00	110.00
1N4007	1.60	13.00	120.00

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LM567CM Mini-dip 2.10

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P1103 $6.20

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CY3635	ADC, 3 Digit BCD, Sect. Count, Low Cost	119.00

SCHOTTKY TTL

				74S158N	2.40
				74S160N	4.70
74S00N	.45	74S74N	1.30	74S161N	4.70
74S02N	.80	74S85N	6.10	74S174N	3.30
74S03N	.75	74S86N	2.70	74S175N	3.30
74S04N	.75	74S112N	2.20	74S181N	10.20
74S08N	.80	74S113N	1.50	74S189N	5.10
74S10N	.75	74S132N	3.60	74S194N	3.30
74S11N	.65	74S133N	.90	74S195N	3.30
74S20N	.80	74S138N	2.40	74S251N	2.40
74S30N	.80	74S139N	2.40	74S253N	2.40
74S32N	.80	74S140N	.90	74S257N	2.40
74S40N	.80	74S151N	2.40	74S258N	2.40
74S51N	.80	74S153N	2.40	74S260N	.90
74S64N	.80	74S157N	2.40	74S280N	5.70

AUDIO AMPS

Type	V	W	Ω	Price
LM352	6-15	1.15	8	1.60
LM354A	6-27	2.80	8	2.50
TAA611B12	6-15	1.15	8	1.60
TAA621A12	6-27	1.40	8	2.00
TBA641B11	6-18	2.20	4	3.00
TBA800	5-30	4.70	8	2.20
TBA810AS	4-20	2.50	4	3.00
TBA820	3-16	0.75	4	1.70
TCA830	5-20	2.00	4	2.20
TCA940	6-24	6.50	8	4.40

IC SOCKETS

SOLDER - TIN

8 pin DIL	.22
14 pin DIL	.26
16 pin DIL	.29
24 pin DIL	.75
28 pin DIL	1.10
36 pin DIL	1.70
40 pin DIL	1.90

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14 pin DIL	.40
16 pin DIL	.45

SOLDER - GOLD

14 pin DIL	.35
16 pin DIL	.40

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4 pin TO-5	.65
6 pin TO-5	.90
8 pin TO-5	1.10
10 pin TO-5	1.40

LINEAR ICs

H=TO5 N=DIP M=MINI-DIP D=CER-DIP K=TO3

LM114H	3.00	LM311H	1.70	LM711CN	.90
LM300H	1.20	LM311D	1.90	LM715CH	4.30
LM300N	1.20	LM311M	1.75	LM715CD	4.60
LM301AH	.90	LM311N	2.00	LM723CH	.90
LM301AM	.80	LM312H	2.70	LM723CN	.75
LM301AN	1.10	LM318H	2.60	LM725CH	5.00
LM301M	.90	LM324N	1.90	LM725CD	5.20
LM301H	.90	LM331N	2.20	LM733CH	1.40
LM302D	3.50	LM339N	3.20	LM733CD	3.50
LM302N	1.30	LM320-5K	2.90	LM733CN	1.30
LM302H	1.50	LM320-5T	2.50	LM741CH	.45
LM304H	1.50	LM320-12K	2.90	LM741CD	1.25
LM305H	1.05	LM320-12T	2.50	LM741CM	.44
LM305AH	1.05	LM340-05K	2.60	LM741CN	.70
LM305N	1.00	LM340-06K	2.60	LM747CH	1.70
LM306H	.95	LM340-08K	2.60	LM747CN	.90
LM307H	.75	LM340-12K	2.60	LM747CD	2.50
LM307M	.95	LM340-15K	2.60	LM748CM	.55
LM307N	1.50	LM340-18K	2.60	LM748CN	.55
LM308H	1.20	LM340-24K	2.60	LM777CH	2.15
LM308AH	5.00	LM555CM	.90	LM777CM	2.10
LM308D	2.00	LM556CN	1.30	LM3046CN	.95
LM308M	1.20	LM709CH	.45	LM3054CN	1.50
LM309H	1.75	LM709CN	.45	SG4501T	2.20
LM309K	1.95	LM710CH	.90	SG4501N	2.20
LM310H	1.60	LM710CN	.90	LM5000K	7.50
LM310M	1.80	LM711CH	.90		

75107

75107BN	2.60
75108BN	2.30
75109N	2.20
75110N	2.20
75115N	2.25
75138N	2.95
75150N	3.10
75154N	4.10
75208N	2.70
75234N	2.50
75450N	1.25
75451N	1.00
75452N	1.00
75453N	1.00

7520 SERIES SENSE AMPS

7520N	4.00
7521N	2.00
7522N	4.25
7523N	1.75
7524N	2.00
7525N	4.50

LOW POWER TTL

74L00N	.34
74L02N	.34
74L03N	.39
74L04N	.39
74L10N	.34
74L20N	.39
74L42N	1.62
74L51N	.34
74L73N	.74
74L74N	.89
74L90N	1.62
74L93N	1.74
74L95N	1.62

HIGH SPEED TTL

74H00N	.34	74H53N	.36
74H01N	.34	74H54N	.36
74H04N	.38	74H55N	.36
74H05N	.37	74H60N	.36
74H08N	.40	74H61N	.36
74H10N	.36	74H62N	.36
74H11N	.36	74H71N	.80
74H20N	.36	74H72N	.74
74H21N	.36	74H73N	.90
74H22N	.36	74H74N	.87
74H30N	.36	74H76N	.90
74H40N	.36	74H101N	.80
74H50N	.36	74H102N	.80
74H51N	.36	74H103N	1.10
74H52N	.36	74H106N	.95

2524V

Recirculating 512 Bit Dynamic Shift Register

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MM405H	23.00
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MM407H	6.50
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MM454F	18.00
MM506H	3.20
MM507H	3.20
MM550H	5.90
MM551H	5.60
MM555H	5.60

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P1101A1	8.50	P2102-2	6.00
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1403AH	8.00	2512K	5.50
1403AN	5.40	2521V	4.00
1404AH	8.00	2524V	3.90
1404AN	5.40	2525V	5.30
1405A	4.10	2533V	8.50
1506	4.00	3341PC	8.20
1507	4.00	MM5025N	20.00
1602	33.00	MM5026N	20.00
1702	33.00	MM5027N	20.00
C2102	8.00	MM5055N	5.50
P2102	6.00	MM5056N	5.50
C2102-1	8.00	MM5057N	5.50
P2102-1	6.00	MM5058N	5.50

BIPOLAR MEMORY

C3101	6.50
P3101	4.90
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P3101A	5.80
IM5501CDE	7.30
IM5501CPE	5.80
MM5560D	7.30
MM5560N	5.80
DM8599N	5.80
93403PC	5.80

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LM336K:	12V, 500mA 2.90
LM337K:	15V, 450mA 2.90

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BU204	3A	1300V	$4.14
BU205	3A	1500V	4.95
BU206	3A	1700V	5.94
BU207	6A	1300V	5.85
BU208	6A	1500V	6.93
BU209	6A	1700V	8.64

TRANSISTORS

2N173	2.15	2N3445	5.00	2N3957	1.60
2N512B	2.90	2N3563	.15	2N3971	1.00
2N677C	5.50	2N3565	.19	2N4045	1.95
2N697	.25	2N3567	.19	2N4228	.50
2N711	.50	2N3569	.17	2N4249	.18
2N918	.40	2N3642	.19	2N4303	.30
2N1136	1.50	2N3643	.14	2N4341	1.35
2N1377	1.50	2N3645	.15	2N4347	1.60
2N1483	1.20	2N3657	9.00	2N4348	2.00
2N1534	1.00	2N3684	1.25	2N4395	1.30
2N1540	1.10	2N3702	.18	2N4416	.90
2N1544	.90	2N3707	.17	2N4858	1.10
2N1924	1.30	2N3711	.18	2N4859	1.20
2N1934	9.40	2N3725	.36	2N4922	1.00
2N2102	.60	2N3731	2.00	2N5036	1.18
2N2219	.30	2N3771	2.20	2N5127	.16
2N2221	.25	2N3772	2.30	2N5198	4.30
2N2484	.25	2N3773	3.40	2N5306	.27
2N2713	.15	2N3789	3.00	2N5409	32.00
2N2906	.18	2N3819	.30	2N5453	5.40
2N2907	.20	2N3823	.70	2N5457	.40
2N2926	.15	2N3866	1.10	2N5458	.40
2N3053	.35	2N3905	.20	2N5778	.55
2N3055	.95	2N3906	.25	2N6027	.50
2N3202	16.00	2N3909	.80	2N6028	.65
2N3227	1.80	2N3955	2.70	2N6099	.85
2N3375	5.50	2N3955A	3.20	2N6101	.85
2N3442	2.20			2N6103	.90

COMPUTER INTERFACE

DM8820N	2.40
DM8820AN	6.90
DM8830N	2.40
DM8831N	5.20
DM8832N	6.00
N8T26B	4.40
9600PC	1.30
9601PC	1.20
9602PC	2.10
9614PC	2.30
9615PC	2.40
9616DC	5.00
9617PC	3.50
9620PC	4.00
9621PC	4.00

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XR1310 $3.90

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SPECIFICATION SHEETS: $.25 ea.

to produce about 940 Vdc at no load. A choke input filter from the center tap provides +300V for the other stages. A small 6.3V filament transformer is connected backwards across the 6.3V winding of the power transformer to provide bias for the mixer and final amplifier.

While the bias voltage could be keyed directly, I am partial to low voltage keying so I used surplus reed relays for keying, receiver muting and side tone keying. Antenna switching is done by a simple TR switch.

The top view of the transmitter is shown in Fig. 2. The vfo mixer sub assembly was built on a 4 x 6 x 2 inch chassis. The vfo shown is the surplus Collins 70K-1. It is highly desirable due to the extremely good linearity. It provides only 150kHz coverage, but this is adequate for most geographical locations. The alternate vfo circuit is shown in Fig. 4. A surplus link variable inductor from a Navy ATD transmitter tuning unit (3 – 9MHz) was modified by removing two turns from the rotable link. The remaining 2½ turns were then mechanically adjusted for maximum linearity. The final tuning range was 500kHz.

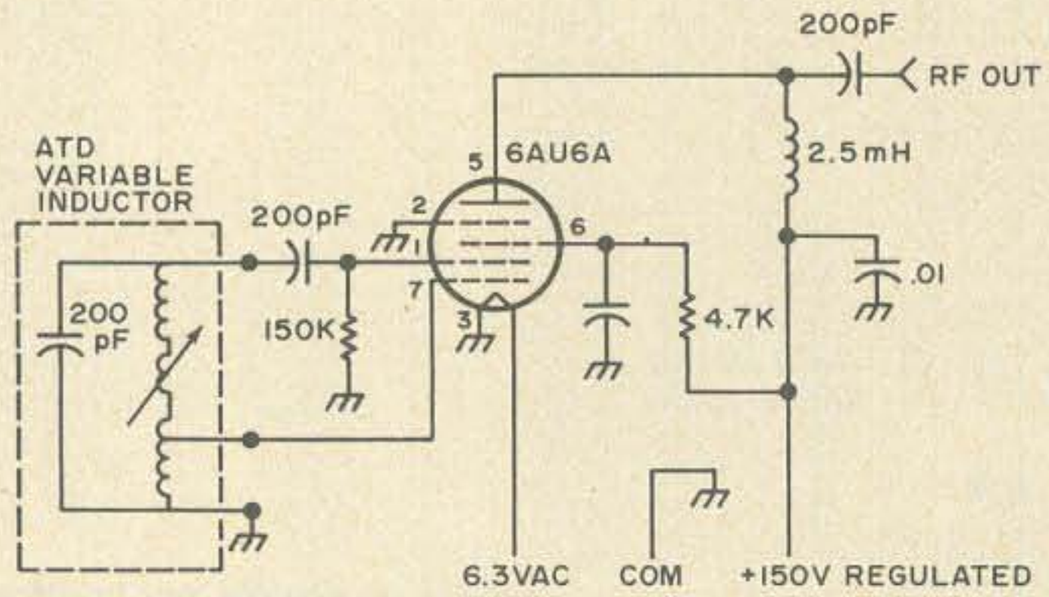


Fig. 4.

Transmitter construction was done in three stages. First the power supply stage (Fig. 5) followed by the vfo-mixer (Fig. 6) and then the driver – final amplifier (Fig. 7). Most components were mounted on simple tag strips. The sidetone oscillator, keying relays and meter multipliers are mounted on small pieces of fiberglass Vectorboard which are rigidly supported on standoff bushings.

Using the component values shown, the meter reads 1000V full scale (fs) in position 1, 500mA fs in position 2, 15mA fs in position 3 and relative amplitude in position

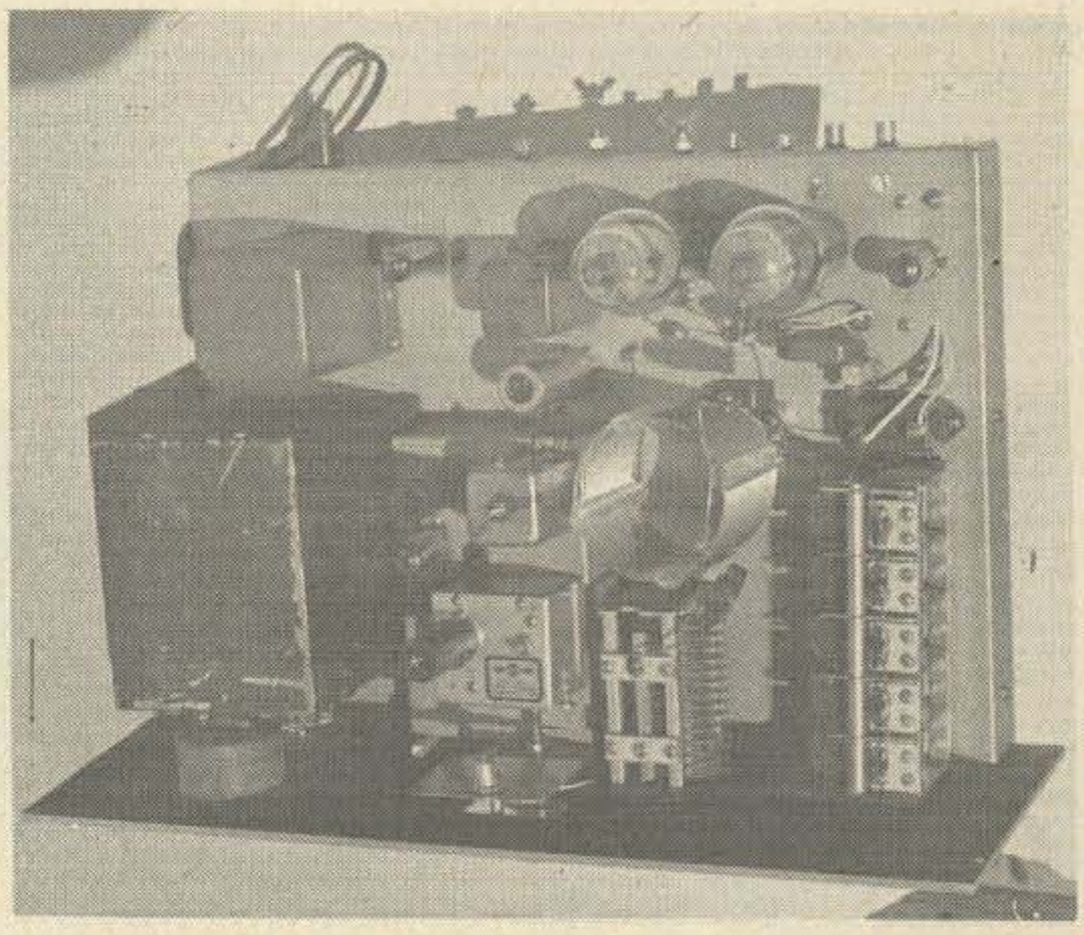


Fig. 2. Top view of transmitter with shielding removed.

4. The 10mΩ resistor was made up of three 3.3M 2W resistors.

A word of caution on selecting a meter switch! Avoid the low cost phenolic imports as they won't handle the voltage. I had one fail destroying the meter. I replaced it with a Centralab ceramic switch which has held up very well.

Filter capacitors are mounted on a heavy bracket under the chassis. A separate shield assembly is provided for the TR switch. A bottom plate and screen cage around the final tank assembly complete the shielding.

Alignment and check-out is simple. The vfo-mixer assembly is best aligned and calibrated using an oscilloscope and counter. However, satisfactory work can be done with a grid dip oscillator and either a LM or BC-221 frequency meter and a receiver. Adjust the slug in the mixer plate coil for a

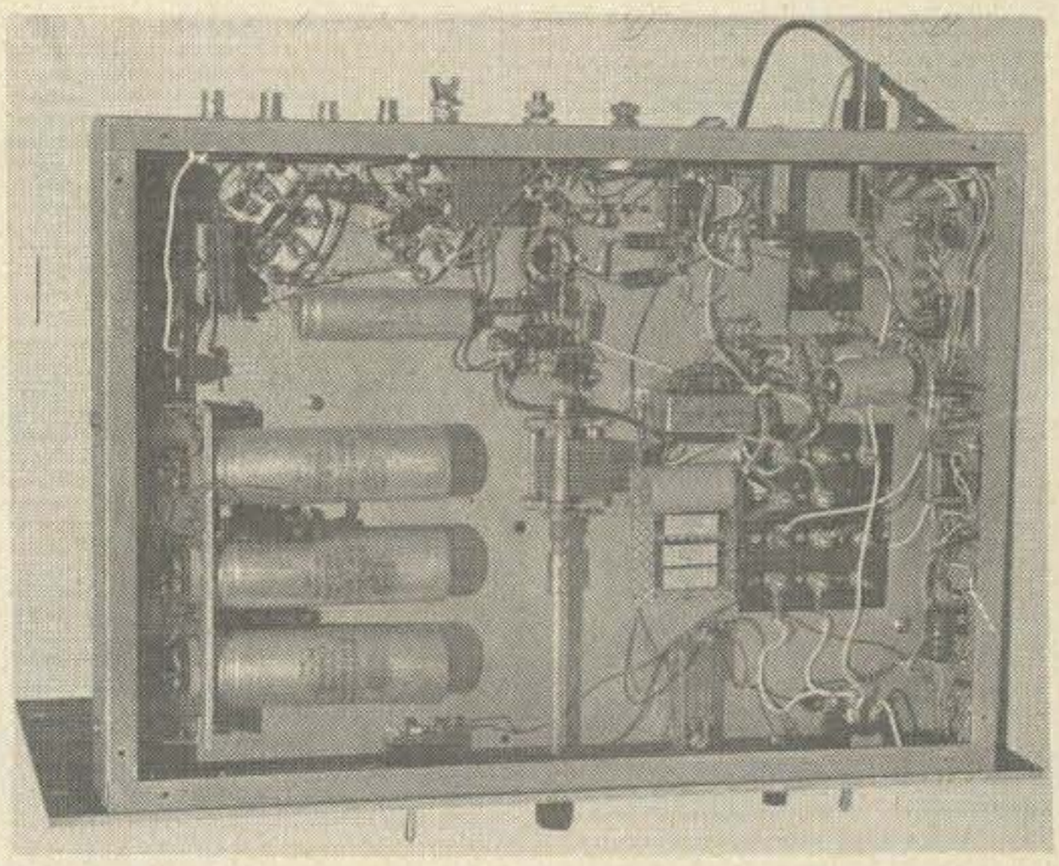
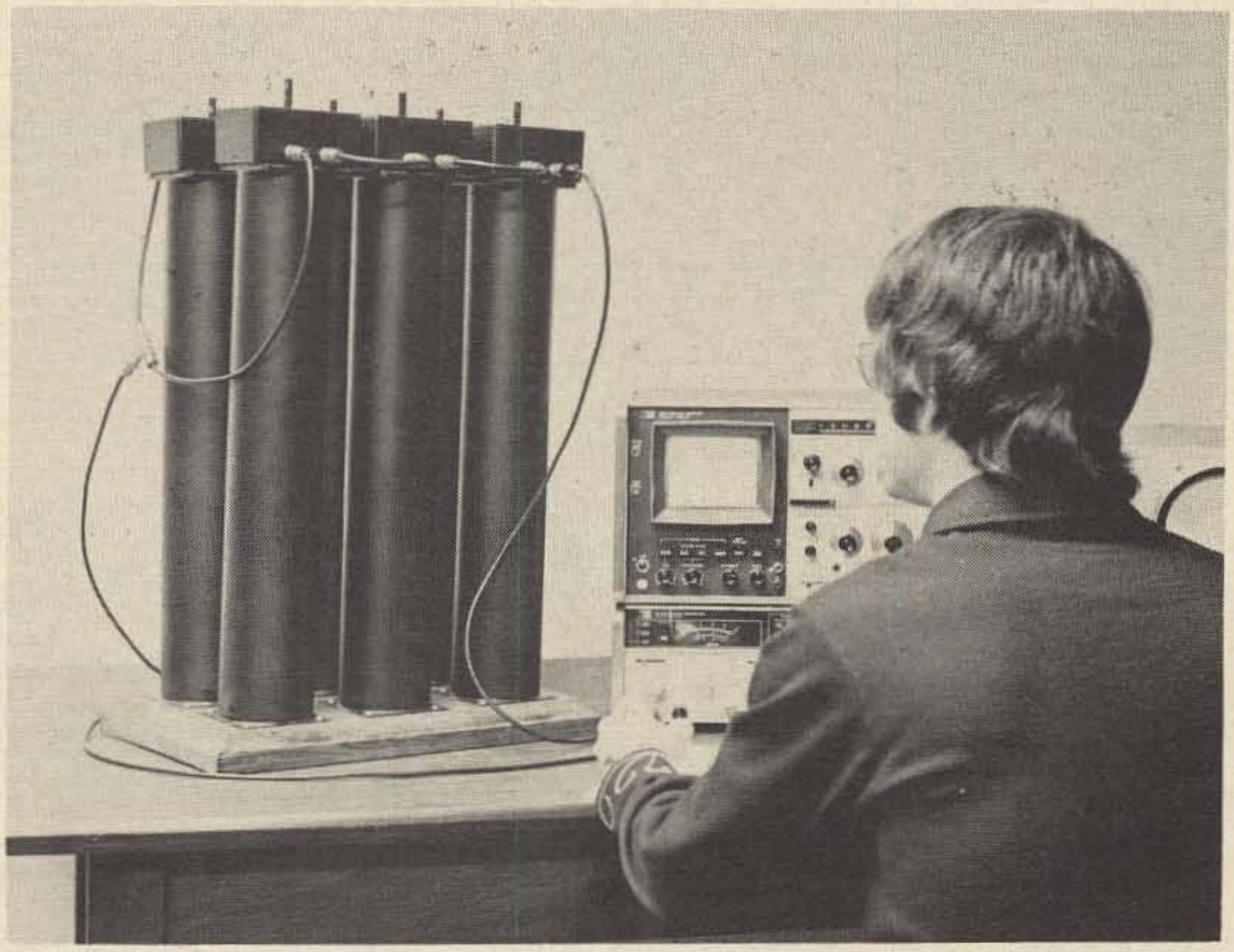


Fig. 3. Bottom view of the transmitter.

MEET



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maximum output at 1.9MHz, checking to insure that the output is really in the 160 meter band! The vfo dial can now be calibrated.

Next, the driver and final amplifier are aligned. Set the drive level control at minimum. Place the spot – tune switch in the tune position and adjust the drive level control (checking to see that the driver tuning control is adjusted for maximum grid drive) for plate current of 200mA with the power amplifier resonated into a 50 Ohm dummy load. Incidentally, power input can be reduced using the drive control to meet FCC regulations for the various geographical areas.

A note on the vfo dial construction is in order. While any vernier drive assembly can be used, it is difficult to beat the one shown for being cheap! The illuminated dial mechanism was made using a National Velvet Vernier planatary drive drom a scrap BC-375 tuning unit.

The dial itself was made from a piece of aluminum sheet cut out with a fly cutter. After spraying white, calibrations were applied using rub-on transfers. After the calibration was checked, the dial plate was given several coats of Krylon. The cursor was made by scribing a line on a small piece of lucite which was cemented into a panel cut-out with model airplane cement.

A black baffle was placed behind the dial plate. A 5/8 inch (standard) hole in the baffle accepts a standard push-in lamp

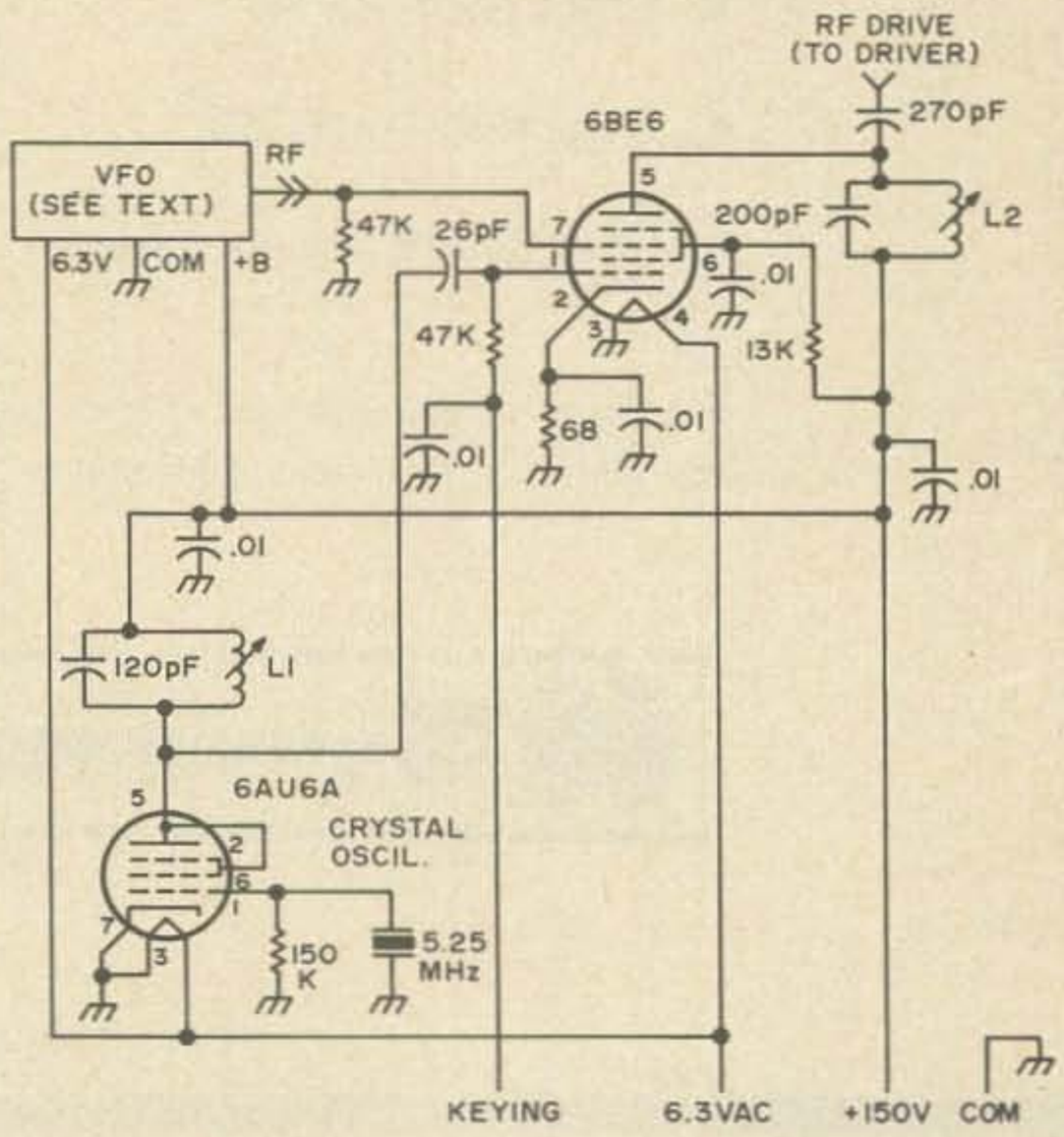

Fig. 6.

Z1 - 3 FERRITE BEADS ON 10 OHM RESISTOR LEAD.

Z2,Z3 - 5 TURNS NO. 18 WIRE SPACED ON A 100 OHM 1 WATT RESISTOR.

L3 - 47 TURNS NO. 28 ON 3/4 in. CERAMIC SLUG TUNED FORM.

L5 - PRIMARY = 20T NO. 24 ENAMELED ON 1/2 in. DIA SLUG TUNED FORM. SECONDARY = 3T NO. 24 WOUND OVER PRIMARY.

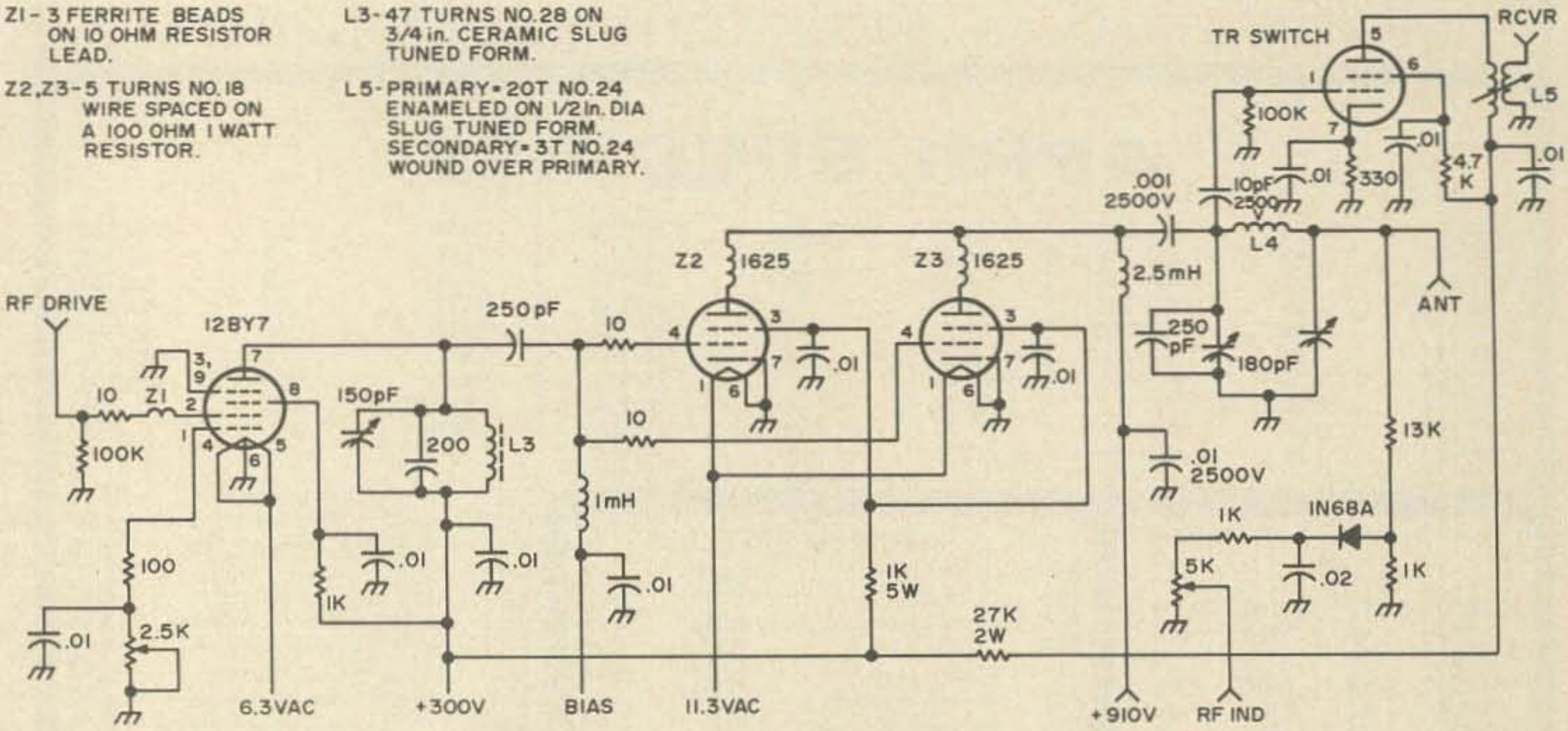

Fig. 7.

socket. The assembly was completed with a small skirted drive knob. The combination of the main dial calibration with skirt dial markings allows 1kHz readout.

Unless you are fortunate enough to have an antenna system that presents a 50 to 75 Ohm load at these frequencies, an antenna tuner will have to be used. At this QTH a simple rotary inductor from a BC-375 transmitter works well. Tuning is accomplished by tuning up the transmitter into the 50 Ohm dummy load then switching to the antenna. The variable inductor is then adjusted for maximum output power.

...W6JTT

H-113/U HEADSET 600 OHM SOFT PLASTIC EAR CUSHIONS 18" CORD W/PL-54 PLUG THAT FITS JK-26 JACK (SEE CD-307 EXTENSION CORD ELSEWHERE ON THIS PAGE WT: 3 LBS. USED-EX$3.95

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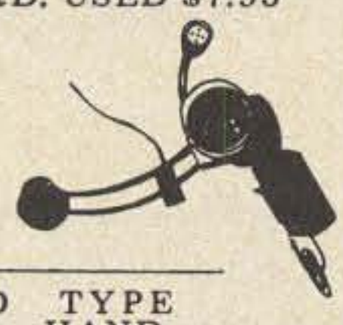

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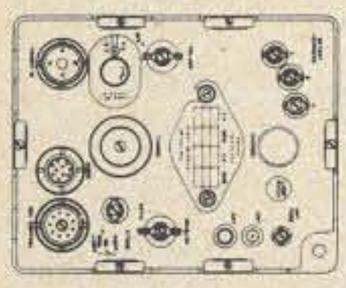
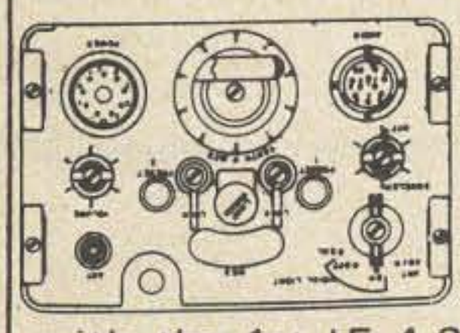
38 to 54 MHz RECEIVER



R-110 Receiver 38 to 54 MHz FM continuosly tuneable, variable squelch and audio, output impedance 600 Ohms. 4.3 MHz. I.F. with tubes 3/1U4, 2/1L4, 1A3, 2/3A5, 1S5, 2/3Q4, 2/6AK5 & OB2. Voltages req. 135 VDC @ 70 MA. and 12 volts @ 2 amps.

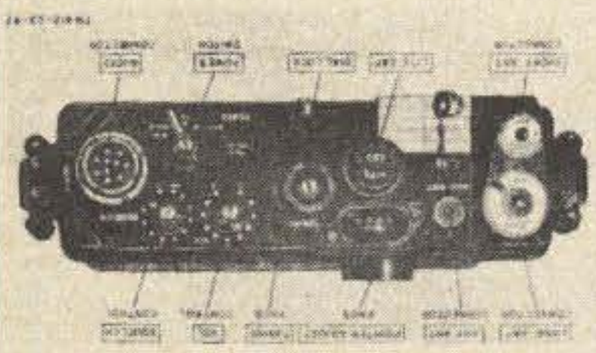
Size: 9x13x7½; WT: 32 LBS. Used $35.00.

RT-70 RECEIVER-TRANSMITTER



47 to 58.4 MHz FM voice communications. Features continuous tuning or two pre-set channels and push-to-talk transmission. The receiver circuit is the Dual Conversion type with the 1st IF 4.3 MHz and the 2nd IF 1.4MHz. With variable squelch control. 600 Ohm Audio Output Impedance. The transmitter circuit has a 500 MW Output and an Audio Input Imped. of 150 Ohms. Power required: 90 VDC @ 80 MA, 6.3 @ 360 MA and 6.3 @ 160 MA. With tubes: 6/1U4, 3/1L4, 2/1R5, 1S5, 1AE4, 4/3Q4, 3A5, and 3B4. Size 4¾x13x8 WT: 20 LBS. Used $20.00.

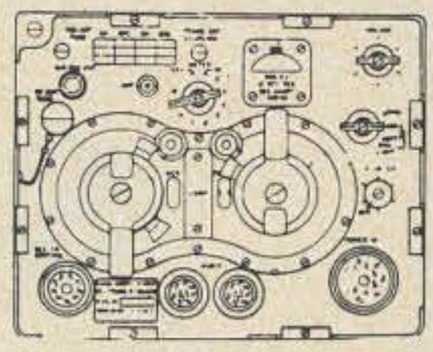
PRC - 10 RECEIVER - XMITTER



RT-176/PRC-10 Radio Receiver - Transmitter; portable unit operating from 38 to 54.9 MHz FM voice communications. The receiver section has an IF of 4.3 MHz and an audio output imped. of 600 Ohms. Transmitter output is 0.9 watts with a normal range of about five miles. Microphone input imped. 150 Ohms. Both Receiver and Transmitter sections are continuously tuneable. With controls for volume, tuning, squelch, pointer adjust and dial lock. Connector for external speaker. With tubes 9/5678, 2/5672, 3/5676, 1AD4 and 5A6. Power required; 135 VDC, 67 VDC and 1½ VDC. Less Battery case. Size: 9½x3x10½ WT; 9LBS. RT-176/PRC-10 Used $19.00.

All Prices FOB Wilkes Barre PA. Shipping charges collect. Send Money Order or Check.

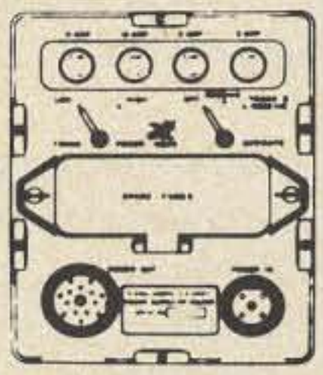
RECEIVER–TRANSMITTER



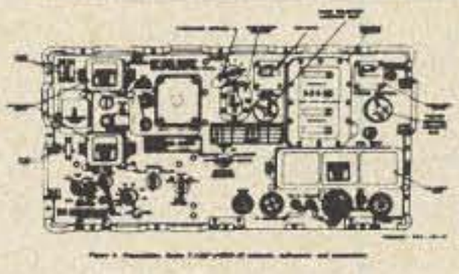
RT-68/GRC Receiver - Transmitter, 38 to 54.9 MHz range continuously tuneable or 100 KHz-step Detent channels or two preset channels. Receives and transmits both voice and 1600 Hz ringing FM signals. The overall communication range is from 10 to 15 miles. The receiver circuit is a Dual-Conversion superheterodyne type with the 1st IF variable from 4.45 to 5.45 MHz and the 2nd IF fixed at 1.4 MHz. The receiver has a variable squelch control and a 600 Ohm output impedance. The transmitter circuit uses a crystal-controlled oscillator and oscillator power amp and puts out 2 watts on low power voltage or 16 watts on high power voltages supplied from the power supply sold separately. The RT-68 also provides a meter and test switch to monitor transmitter power output filaments and the 90 volt input. With tubes 4/1U4, 2/1A3 2/1L4, 4/1R5, 2/1AE4, 1S5, 4/3Q4, 3/3A5, 2/3B4, 3A4, 6AK5 and 2E24. Size: 9x13x11¼ WT: 42 LBS. Used $40.00.

RT-66/GRC Receiver-Transmitter same as RT-68 above except 20-27.9 MHz range. Used $35.00.

RT-67/GRC Rec-Trans. Same as RT-68 except 27-38.9 MHz range. Reparable $35.00.

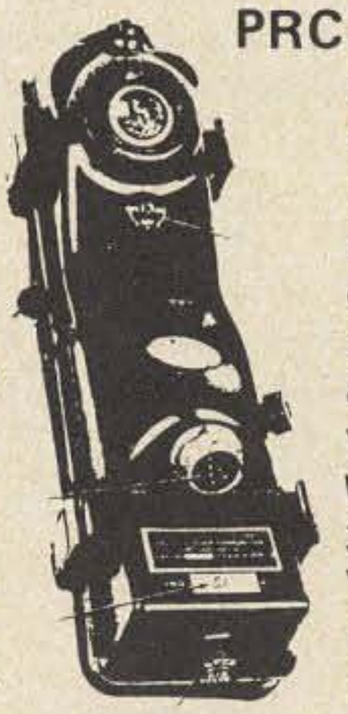


PP-112/GRC 24 Volt power supply for the RT-66, 67 and 68 series receiver-transmitters. This unit supplies all the necessary voltages for the receiver and transmitter circuits. Includes low and high power switch for the transmitter section. Size: 9x13x7¼ WT: 38 LBS. Used $20.00.



T195/GRC Transmitter 1.5 to 20 MHz 24 to 28VDC 100W output 10 Bands 8 Channels. CW, Voice, FSK. 20 tubes 122 LBS. Price used repairable, $50.00 ea.

PRC - 6 WALKIE - TALKIE



RT-196/PRC-6 Receiver-Transmitter F.M. 47 to 55.4 MHz, crystal controlled one preset channel, about 1 mile depending on terrain and conditions. Handheld unit has push to talk switch Mic., phone, fold down antenna, shoulder-strap etc. Also provisions for using H-33/PT Handset. With tubes 6/5678, 3/5672, 2/5676, 3B4, Power Req. 1.5, 45, and 90 VDC, usually supplied by BA-270 Battery (dry) not available. Size: 15x5x4½; WT: 5 LBS. Used $22.00.

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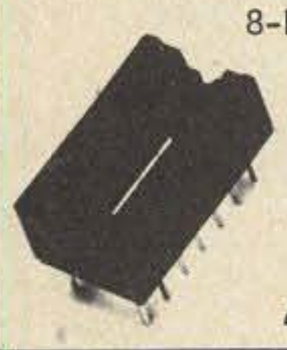

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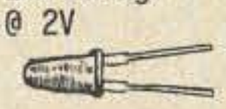

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7405	.30	74L72	.60
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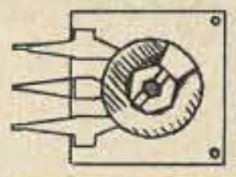

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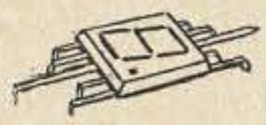

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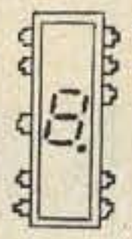

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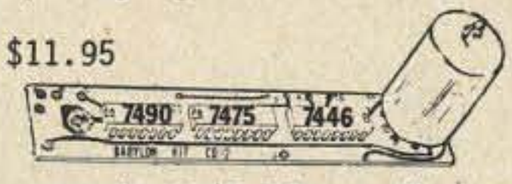

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710	Voltage comparator DIP	.75
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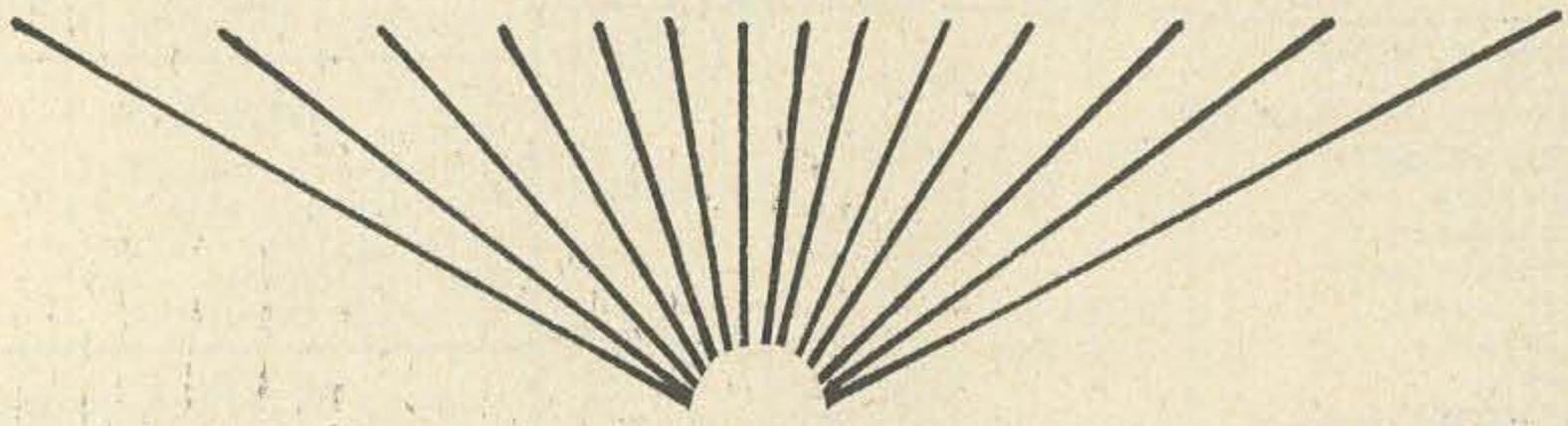
723	Precision voltage regulator DIP	1.00
741	Op amp TO-5/MINI DIP	.55
748	Op Amp TO-5	1.00
CA3018	2 Isolated transistors and a Darlington-connected transistor pair	1.00
CA3045	5 NPN transistor array	1.00
LM100	Positive DC regulator TO-5	1.00
LM105	Voltage regulator	1.25
LM302	Op Amp voltage follower TO-5	1.25
LM308	Op Amp TO-5	2.00
LM309H	5V 200 MA power supply TO-5	1.00
LM309K	5V 1A power supply module TO-3	2.00
LM311	Comparator ~~TO-5~~ MINI	1.75
LM370	AGC amplifier	2.00
LM380	2-Watt Audio Amp	1.75
LM1595	4-Quadrant multiplier	2.00
MC1536T	Op Amp	2.00

April Foolishness!

Advance special for 73 readers.



Calculator Kit

Easy to assemble calculator kit, includes case and all parts except batteries. 8 digit with overflow, floating point, memory, % display and blanking. Easy to assemble, goes together in less than an hour. $17.95 post paid.

Signatics 2533: 1,024 bit **STATIC SHIFT REGISTER** – for RTTY, slow to fast scan SSTV conversion or fast to slow scan SSTV conversion. In a MINI DIP package. Price – UNBELIEVEABLE $3.75.

SPRING SPECIAL: HOUSE NUMBERED PART: 256 bit, also **MOS STATIC MEMORY.** Same as 1101 or 2501. $1.00 each, 8/$7.95.

BLOCK BUSTER 4Kx8 MOS MEMORY. KIT INCLUDES 32 each 2102s – 2 each 7742 – 2 each 7404 – 1 each 7400. For Mark 8 computers, compatible with 8008 or 8080 processors. 32,000 bits. Requires single +5 volt power supply. Memory board from Solid State Music by special arrangement. 32,000 bits on a single board 5 ICs, 32 memory ICs ½ cent a bit. $163.84

GODBOUT

Box 2355 Oakland Airport
California 94614

GODBOUT

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT,
CA 94614

SUPER HAM SPECIAL — LM373 multimode if strip and COLLINS MECHANICAL FILTER. The LM373 is a complete if amp/detector for AM, FM or SSB. A single external filter connected between amplifier sections shapes bandpass from audio clear up to 30 MHz. Its first amp section is optimized to drive low impedance loads such as mechanical or ceramic filters. Includes self-contained detector/AGC. The COLLINS MECHANICAL FILTER is for 455 kHz, with a 10 kHz bandwidth. This filter is ideal for 2nd if in FM receivers. You can buy both the LM373 and the COLLINS FILTER, until MAY 1ST only, for $7.50.

INTRODUCTORY SPECIAL — We've just added the LM316 op amp to our linear repertoire. Similar to the 112 series, the 316 has a super beta darlington input, giving input bias currents that compare with premium fet types. Very high input impedance makes possible a host of applications beyond the capabilities of the usual op amp. We can introduce you to one for ONLY $2.50 UNTIL MAY 1ST ONLY.

12 VOLT 8 AMP POWER SUPPLY — Featured in the April 75 issue of 73. Includes adjustable output 11-14 volts, short protection, current limiting. Complete with all components and regulator PC board (yes, heat sink too). All you need is a chassis, line cord and $18.95 + shipping to get it happening.

±DUAL TRACKING VARIABLE REGULATED POWER SUPPLY — Perfect for breadboarding, this kit has proven to be very popular with experimenters. Up to 200 mA for both + and - sides, short protection, current limiting, and thermal overload protection. Do your lab a favor for $10.95 + shipping.

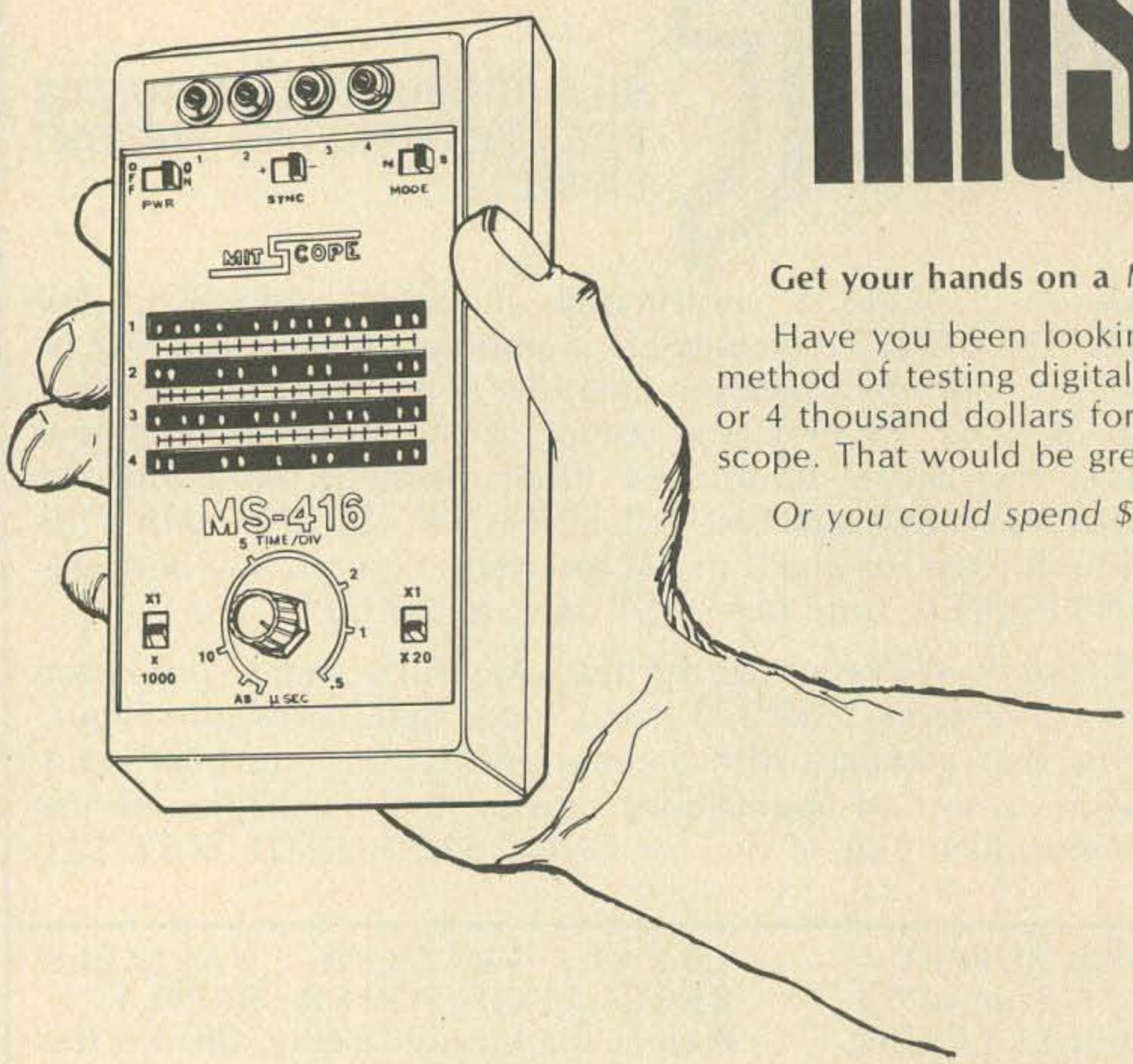
5 VOLT POWER SUPPLY KIT — Digital logic is intriguing more and more hams with its possibilities; for example, it has drastically simplified the scanner and repeater fields. Our supply, perfect for logic experiments, is thermally protected, short proof, and can deliver 1 amp at the fixed 5 volts out. **YOURS FOR $7.95 + SHIPPING.**

A LOT OF PEOPLE think of our kits when they think of GODBOUT ELECTRONICS, but we are happy to supply individual components . . . capacitors (we even have tantalum and polystyrene types), inductors, resistors (we don't sell onesies, but you can get 100 of any one type for $3.50), keyboards, trimpots . . . and our extensive line of semiconductors from diodes to the 8008 microcomputer on a chip. We've got TTL, CMOS, and linear ICs; readouts and LEDs, and also transistors, UHF fets, dual fets, and more . . . but send us your address and a stamp and we'll rush you our flyer listing parts and prices. Send for it! Be surprised.

FLASH! To make your life easier we've started a series of data sheets. Data on popular linear ICs now available, with CMOS data, complete linear data, and more coming up soon. Look at next month's ad for the details.

TERMS: Include 50¢ for orders under $10. Include postage on items where indicated; all other items shipped postpaid on orders over $10. California residents add sales tax. You may place a BankAmericard or Mastercharge order by calling (415) 357-7007; sorry, no COD orders.

mitScope



Get your hands on a MitScope!

Have you been looking for a convenient, inexpensive method of testing digital circuitry? You could shell out 3 or 4 thousand dollars for a four channel, storage oscilloscope. That would be great—if you can afford it.

Or you could spend $189.50 for a MitScope.

What's a MitScope?

A MitScope is a four channel, digital logic (DTL, TTL) oriented scope with full memory capability. Its time-base range (.5 microseconds to 200 milliseconds) will cover most digital circuit needs. Its four channels allow observation of extensive timing relationships.

In addition to the normal mode of operation, the MitScope can be switched into storage operation at any time during testing. This mode serves as an excellent pulse catcher for those elusive, one-time occuring pulses.

How does it work?

The MitScope signal is displayed on a four-line, sixteen-row LED matrix; one line for each channel. The information on the display is interpreted in much the same manner as that of an ordinary oscilloscope.

30 Day Trial Offer

To help convince you, MITS is making this special offer. Buy an assembled MitScope. If you aren't satisfied, return it within 30 days and we will refund your money (excluding postage and handling charge).

PRICE: $189.50 assembled. $127.50 kit.

Price includes nicad battery and charger, 4 probes and case.

MITS INC.®
"Creative Electronics"

Warranty: 90 days on parts and labor for assembled units.
90 days on parts for kits.

Prices and specifications subject to change without notice.

☐ Enclosed is a Check for $ _____
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3-75-73

RGS ELECTRONICS

SECOND ANNUAL APRIL FOLLY SALE!
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Offer applies
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(Take Sale Discount THEN Take Any Other Applicable Discounts.)

A POWER SUPPLY . . .

PS 5–1 5v 1a regulated power supply kit with p.c. board & instructions. Board measures 2" x 5", completed kit is 2" high. Transformer has internal r.f. shield. $8.00

CHEAP DISCRETE LEDs

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MV10 T0-18	$ .08
MV50 ribbon lead	.08
Large red lens	.20
Small red lens	.12
COLORED	
MV1 amber T0-18	$ .25
MV50 type, amber	.25
MV2 green T0-18	.30
MV5222 green	.30

ANOTHER POWER SUPPY . . .

PS 25–1 0 to 25v 1a lab type power supply with adjustable current limiting; remote sensing & remote programming for voltage & current. Insturctions included. All parts except chassis, meter(s), p.c. board. Kit of parts with schematics. $14.95
P.C. boards available, No. 007 $3.00 ea.

TTL

7400	$ .20	7485	$1.40
7401	.20	7486	.50
7402	.20	7489	2.90
7403	.20	7490	.80
7404	.25	7492	.80
7405	.25	7493	.80
7406	.45	7495	.90
7407	.45	7496	.85
7408	.25	74107	.50
7409	.25	74121	.60
7410	.20	74122	.60
7411	.30	74123	1.10
7413	.85	74125	.65
7416	.45	74126	.65
7417	.45	74141	1.25
7420	.20	74150	1.70
7430	.20	74151	1.00
7432	.30	74153	1.40
7437	.50	74154	1.70
7438	.50	74157	1.40
7440	.20	74161	1.50
7442	1.10	74163	1.70
7446	1.45	74164	2.00
7447	1.45	74165	2.00
7448	1.45	74166	1.75
7450	.20	74174	2.20
7451	.20	74175	2.20
7453	.20	74176	1.60
7454	.20	74177	1.35
7473	.45	74181	3.90
7474	.45	74192	1.50
7475	.80	74193	1.45
7476	.50	74195	1.00
7483	1.10		

SOME NEW TRANSISTORS . . .

				1-99	100+
N1	T0-92	NPN	Darlington	$ .35	.30
N2	T0-92	NPN	lo-noise, lo-level	.15	.10
N3	T0-92	NPN	medium purpose	.20	.15
N4	T0-92	NPN	2N3904 type	.15	.10
N5	T0-92	NPN	UHF	.20	.15
N6	T0-92	NPN	RF-IF	.15	.10
P2	T0-92	PNP	lo-level	.15	.10
P3	T0-92	PNP	medium power	.20	.15
P4	T0-92	PNP	2N3906 type	.15	.10
P7	T0-92	PNP	high-voltage	.25	.20
P8	T0-92	PNP	higher-voltage	.30	.25

AND SOME OLD TRANSISTORS . . .

	1-99	100+
2N2222 T0-18 NPN	$ .25	.20
2N2907 T0-18 PNP	.25	.20
NPN T0-92 general purpose	.08	.0595
PNP T0-92 general purpose	.08	.0595

Data on all transistors and JFETS is now in our flyer.

BRAND NEW ALUM. ELECTROLYTIC CAPS, RADIAL LEAD

	10wv	35wv	50wv
1mfd	$ .10	$ .12	$ .15
2mfd	.10	.12	
5mfd	.10	.12	
10mfd	.11	.13	.16
30mfd	.12	.20	.28
50mfd	.13		
100mfd	.15	.30	.45
200mfd	.20		.70
500mfd	.28	.75	
1000mfd	.50		

RGS ELECTRONICS

3650 Charles St., Suite K ■ Santa Clara, CA 95050 ■ (408) 247-0158

We sell many ICs and components not listed in this ad. Send a stamp for our free flyer. TERMS OF SALE: All orders prepaid; we pay postage. $1.00 handling charge on orders under $10.00. California residents please include sales tax. Please include name, address and zip code on all orders and flyer requests. Prices subject to change without notice.

DISCOUNTS: 10% OFF ORDERS OVER $25.00; 20% OFF ORDERS OVER $250.00.

DuPage FM

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ODDS and ENDS sale

HOME BREWERS TAKE NOTE OF THIS BARGAIN POWER SUPPLY SPECIAL:

MANUFACTURERS OVERRUN – BRAND NEW TRANSISTOR POWER SUPPLIES

These are brand new, in the original factory package. We cannot advertise the name, but you will recognize it immediately. The output voltages are changeable by changing a jumper.

Keyed outputs:	675 v @ 135 mA	400 v @ 150 mA	400 v @ 130 mA
	275 v @ 40 mA	275 v @ 40 mA	275 v @ 170 mA
Bias	-40 v @ 25 mA	-40 v @ 17 mA	-40 v @ 20 mA
Fixed outputs:	250 v @ 25 mA	275 v @ 27 mA	275 v @ 39 mA
	150 v @ 30 mA	150 v @ 30 mA	150 v @ 30 mA

Output connections are terminated in a multipin plug. Brand new with schematic, each $12.00.

New battery cables for above, includes "A" relay $3.00 each 5 for $12.00

New output cables for above. Connector mates with output connection on power supply. $4.50 each 5 for $20.00

TONE SIGNALING EQUIPMENT:

SECODE digital decoder. Made by Secode for RCA mobile units. Decodes pulsed 2805 cycle tone to activate any function you choose. Postpaid, each $10.00

SECODE: Model SD-30 call heads – Contains decoder and call indicator. 12 volt input. Most are brand new in original factory packages. Postpaid, each $35.00

BRAMCO – Two tone sequential encoders for mobile or base use. These are compatible with Motorola Quick-Call systems. Like new. Generates up to 80 tone combinations. Postpaid, each $95.00

BUY OF THE YEAR: RCA Scanning Control heads. Scans four channels, reverts to a selectible priority channel. Requires 12 volts dc and unfiltered audio from the discriminator. LED's indicate the channel being received. Schematic included. Only a few left for $50.00 each.

DU PAGE FM INC. P.O. Box 1 Lombard, Ill. 60148
(312) 627-3540

TERMS: All items sold as is. If not as represented return for exchange or refund (our option) shipping charged prepaid within 5 days of receipt. Illinois residents must add 5% sales tax. Personal checks must clear before shipment. All items sent shipping charges collect unless otherwise agreed. Accessories do not include crystals, relay or antennas.

TTL

7400*	6/$1.00	7488	4.00	CD4001	$ .55
7401	.23	7489*	2.25ea	CD4002	.55
7402	.23	7490*	.69ea	CD4007	1.25
7403	6/1.00	7491*	1.00	CD4009	1.40
7404	.25	7492	.95	CD4010	.60
7405	.24	7493	.95	CD4011	.55
7406	.50	7494	.97	CD4012	.55
7407	.50	7495	.95	CD4013	1.50
7408	.25	7496	.95	CD4016	1.40
7409	.25	74100	1.50	CD4017	2.75
7410*	6/1.00	74107	.47	CD4019	1.25
7411	.30	74121	.55	CD4020	1.50
7412	.40	74122	.47	CD4022	2.50
7413*	.75	74123	1.05	CD4023	.55
7416	.45	74125	.60	CD4025	.55
7417	.45	74126	.80	CD4027	1.25
7418	.25	74141	1.15	CD4030	.60
7420	.23	74145	1.15	CD4035	2.75
7421	.27	74150	.95	CD4049	1.25
7423	.32	75151	1.20	CD4050	1.25
7425	.27	74153	1.50	74C00	.45
7426	.31	74154	1.25	74C02	.45
7427	.32	74155	1.30	74C04	.70
7429	.40	74156	1.30	74C20	.65
7430	.33	74157	1.55	74C74	1.15
7432	.26	74160	1.65	74C160	3.25
7437	.45	74161	1.65	74C161	3.25
7438	.50	74163	2.50	74C107	1.50
7439	.50	74164	2.50	74C151	2.90
7440	.23	74165	2.50	74C154	3.50
7441	1.10	74166	1.75	74C163	3.25
7442	1.05	74170	3.00	74C164	3.50
7443	1.10	74173	1.75	74C173	2.90
7444	1.15	74174	1.85	74C195	3.00
7445	1.10	74175	1.85		
7446	1.25	74176	.85		
7447*	.89	74177	.85		
7448	1.25	74180*	1.00		
7450	.25	74181	3.75		
7451	.27	74182	1.00		
7453	.27	74184	2.30		
7454	.40	74185	2.30		
7459	.25	74187	7.00		
7460	.25	74190	1.50		
7470	.45	74191	1.50		
7472	.41	74192*	1.25		
7473*	.39	74193*	1.25		
7474	.47	74194	1.50		
7475*	.75	74195	1.05		
7476*	.40	74196	1.25		
7480	.50	74197	1.05		
7482	1.75	74198	2.25		
7483	1.15	74199	2.75		
7485*	1.10	74200	7.00		
7486	.47	74250	5.00		

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8008 Processor	$49.95	8080 Micro Processor	$249.95
1101 256 x 1 RAM	2.25	N8T97 HEX Inverter	2.95
2102 1024 RAM	7.95	1702 2048 EROM	29.95
5203 2048 EROM	19.95	8111 256 x 4 N Channel	11.95

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1UFD/16V	.14	.12	.11	100UFD/16V	.19	.15	.14
1UFD/50V	.15	.12	.11	100UFD/25V	.24	.18	.17
2.2UFD/50V	.14	.12	.11	100UFD/50V	.24	.18	.17
3.3UFD/25V	.14	.12	.11	220UFD/16V	.24	.18	.17
4.7UFD/25V	.14	.12	.11	220UFD/25V	.35	.25	.24
10UFD/16V	.14	.12	.11	470UFD/16V	.37	.30	.27
10UFD/25V	.14	.12	.11	470UFD/25V	.49	.39	.35
10UFD/50V	.14	.12	.11	1000UFD/16V	.49	.39	.35
22UFD/16V	.14	.12	.11	1000UFD/25V	.75	.60	.55
22UFD/25V	.15	.13	.12	2200UFD/16V	.75	.60	.55
47UFD/16V	.17	.14	.13	Axial or Radial Lead Type			

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.0047	mf.	6c	4c	3.5c	.047	mf.	6c	4c	3.5c
.01	mf.	5c	3.5c	3c	.1	mf.	12c		7.5c
.022	mf.	6c	4c	3.5c	100	pf	6c	4c	3.5c

TRANSISTORS

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2N2221A	4/$1	2N3053	2/$1	PN4250	4/$1
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2N2369	5/$1	2N3725A	2/$1	2N5129	.19
2N2369A	4/$1	2N3903	5/$1	2N5139	.19
2N2484	4/$1	2N3904	4/$1	C106B1-SCR	2/$1

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5001	$3.95	8 P	$ .22
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MM5311	5.95	18 P	.46
MM5312	5.95	24 P	.68
MM5313	5.95	28 P	.89
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LM304H	.79	LM1303N	.79
LM305H/N	.89	LM1304N	1.00
LM307H/N	.35	LM1307N	.79
LM308H/N	1.05	LM1310P	3.95
LM309K	1.25	LM1458N	.69
LM310H/N	1.19	LM1496N	.99
LM311H/N	.95	LM1556V	1.85
LM318N	1.69	CA3013	1.70
LM319N	1.19	CA3023	2.15
LM320K*	1.50	CA3035	2.25
LM324N	1.85	CA3039	1.35
LM339N	1.95	CA3046	1.15
LM340K	1.89	CA3059	2.46
LM340T	1.75	CA3060	2.80
LM370N	1.05	CA3065N	.75
LM373N	2.05	CA3080	.85
LM380-8	1.00	CA3083	1.60
LM380N	1.25	CA3086	.70
NE531T	3.00	CA3089	3.25
NE536T	3.00	CA3091	8.25
NE550N	.79	CA3123	1.85
NE555N	.75	CA3600	1.75
NE556N	1.85	LM3900	.55
NE560	2.50	LM3905	.65
NE561	2.50	LM7805	1.75
NE562	2.50	8038B	5.75
NE565H/N	2.00	LM9601	.55
NE566N	2.00	LM9602	.75
NE567H/N	2.00	75450	.49
LM703H/N	.43	75451	.39
LM709H/N	.29	75452	.39
LM710H/N	.29	75453	.39
LM711H/N	.29	75491	.79
LM723H/N	.55	75492	.89
LM733H/N	1.75	75494	.89
LM739N	1.29	75324N	1.75
LM565H	1.50	LM567H	1.50

1/4 W 5% CARBON COMP RESISTORS

5-25	30-95	100-495	500-995	1000 UP
.05	.04	.03	.0275	.025

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8263	$ 7.00
8267	4.00
2513*	11.00
2518	7.00
2519	4.00
2524*	3.95
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4024P*	2.25

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MAN-1	1.95
MAN-3	.95
MAN-4	1.95
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8000 Series

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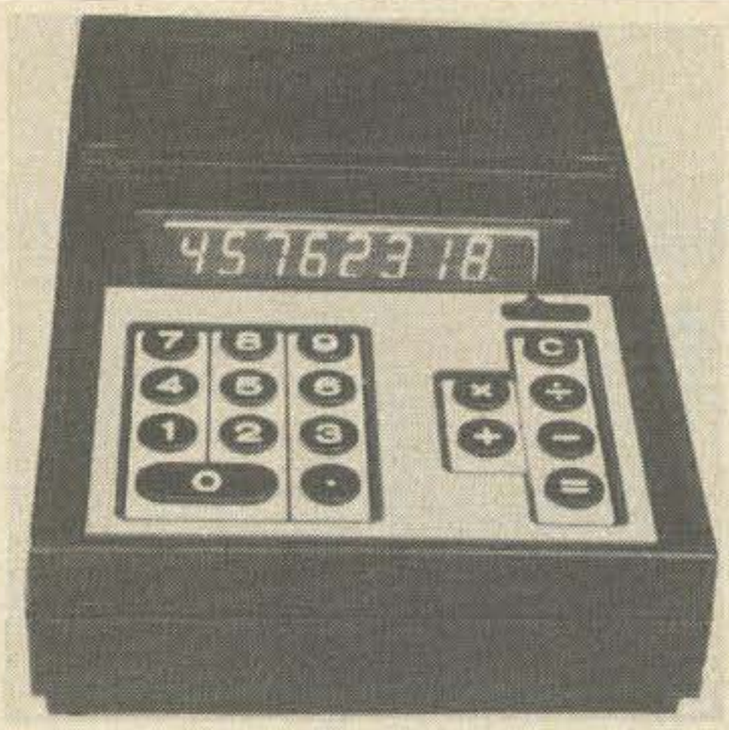
8123	1.50
8223 *	3.00
8263	7.00
8267	4.00
8280	.75
8281	.85
8288	1.15
8880	1.35



Desk top calculator by well known mfgr. These are rejects, 8 digit, 4 function, liquid crystal display. Fully assembled, some factory reject, some customer returns. Most are repaired in a few minutes. Sold "as is." Ship wt 3 lbs.
AC model $10 each 3 for **$26.50**
Battery portable model $11 each 3 for **$30.00**

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Solid state SQ 4 channel adapter, 2 amps built in. Decodes 4 channel or synthesizes 4 channel.
$25.00

LED READOUTS 5/$1.00!

The price is not a mistake. We have some hobby variety with some segments out. Ukinbuyem for as low as **5 for $1.00**

DUAL 16 BIT MEMORY

Dual 16 bit memory, serial MOS by Philco TO-5 case, brand new with 2 page specs.
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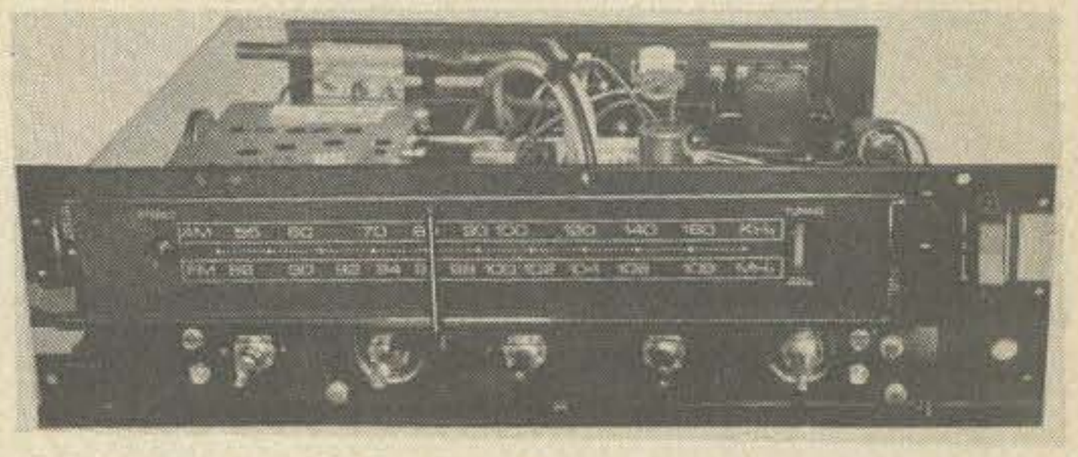

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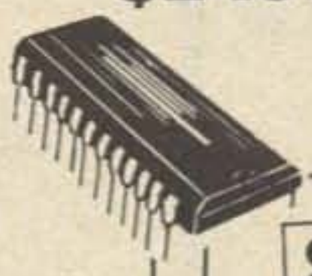

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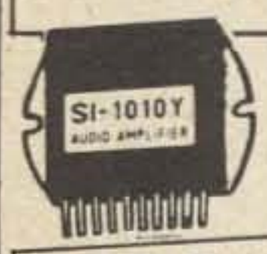

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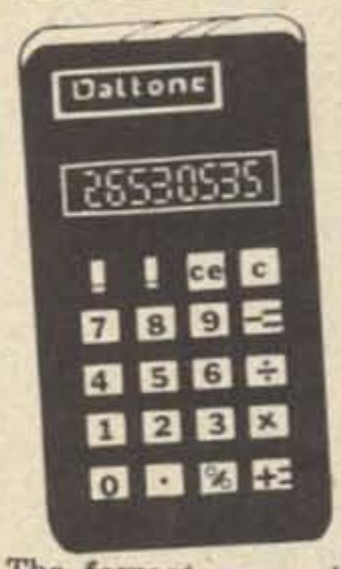

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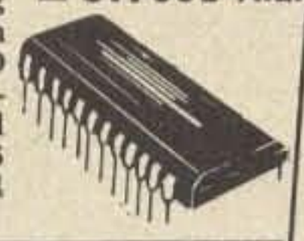

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ENGLAND	7	7	7	7	7	7	7	7	7	7A	14	7A
HAWAII	21	21 -	14	14	7A	7A	7	7	14	14	14	14A
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PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	7B	14
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RPT220	**NEW**—15 watt—220 MHz repeater	factory wired	**$595.95**
RPT432	**NEW**—10 watt—432 MHz repeater		**coming soon**

Repeaters are available in kit form—write for prices

SEE YOU AT DAYTON

ITEM	PART #	DESCRIPTION	PRICE	EXTENSION

NAME _____ TOTAL _____

ADDRESS _____ SHIPPING _____

CITY _____ NYS RESIDENTS-SALES TAX _____

STATE _____ ZIP _____ TOTAL ENCLOSED _____